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DURAPULSE GS30 DRIVE USER MANUAL

GS30_UMW

ORIGINAL INSTRUCTIONS

Automation Direct

Warnings and Trademarks

~ WARNING ~

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Warnings

Warning: Read this manual thoroughly before using DURApulse Series AC Motor Drives.

Warning: AC input power must be disconnected before performing any maintenance. Do not connect or disconnect wires or connectors while power is applied to the circuit. Maintenance must be performed only by a qualified technician.

Warning: There are highly sensitive MOS components on the printed circuit boards, and these components are especially sensitive to static electricity. To avoid damage to these components, do not touch these components or the circuit boards with metal objects or your bare hands.

Warning: A charge may still remain in the DC-link capacitor with hazardous voltages, even if the power has been turned off. To avoid personal injury, do not remove the cover of the AC drive until all "DISPLAY LED" lights on the digital keypad are off. Please note that there are live components exposed within the AC drive. Do not touch these live parts.

Warning: Ground the DURApulse AC Drive using the ground terminal. The grounding method must comply with the laws of the country where the AC drive is to be installed. Refer to "Basic Wiring Diagram" in Chapter 2.

Warning: The mounting enclosure of the AC drive must comply with EN50178. Live parts shall be arranged in enclosures or located behind barriers that meet at least the requirements of the Protective Type IP20. The top surface of the enclosures or barrier that is easily accessible shall meet at least the requirements of the Protective Type IP40. Users must provide this environment for DURApulse Series AC Drive.

Warning: The AC drive may be destroyed beyond repair if incorrect cables are connected to the input/output terminals. Never connect the AC drive output terminals T1, T2, and T3 directly to the AC main circuit power supply.

Three-phase DURApulse drives require a symmetrical 3-phase power source. Do not connect them to grounded, center-tapped delta transformers of the type typically used for lighting circuits.

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DURAPULSE

PLEASE INCLUDE THE MANUAL NUMBER AND THE MANUAL ISSUE, BOTH SHOWN BELOW, WHEN COMMUNICATING WITH TECHNICAL SUPPORT REGARDING THIS PUBLICATION.

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DURAPULSE

GS30 User Manual TOC

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Chapter 1: Getting Started

User Manual Overview

Overview of This Publication

The *DURApulse* GS30 Drive User Manual describes the installation, configuration, and methods of operation of the *DURApulse* GS30 Series AC Drive. Throughout this manual, please note:

- *GS30 refers to GS31 and GS33 models*

Who Should Read This Manual

This manual contains important information for those who will install, maintain, and/or operate any of the GS30 Series AC Drives.

Supplemental Publications

The National Electrical Manufacturers Association (NEMA) publishes many different documents that discuss standards for industrial control equipment. Global Engineering Documents handles the sale of NEMA documents. For more information, you can contact Global Engineering Documents at:

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Special Symbols

NOTE: When you see the "notepad" icon in the left-hand margin, the paragraph to its immediate right will be a special note.

WARNING: When you see the "exclamation mark" icon in the left-hand margin, the paragraph to its immediate right will be a warning. This information could prevent injury, loss of property, or even death (in extreme cases).

Purpose of AC Drives

AC drives are known by many different names: Adjustable Frequency Drives (AFD), Variable Frequency Drives (VFD), and Inverters. Drives are used primarily to vary the speed of three-phase AC induction motors, and they also provide non-emergency start and stop control, acceleration and deceleration, and overload protection. By gradually accelerating the motor, drives can reduce the amount of motor startup inrush current.

AC drives function by converting incoming AC power to DC, which is then synthesized back into three-phase output power. The voltage and frequency of this synthesized output power is directly varied by the drive, where the frequency determines the speed of the three phase AC induction motor.

Selecting the Proper Drive Rating

Determine Motor Full-Load Amperage (FLA)

Motor FLA is located on the nameplate of the motor.
NOTE: FLA of motors that have been rewound may be higher than stated.

Determine Motor Overload Requirements

Many applications experience temporary overload conditions due to starting requirements or impact loading. Most AC drives are designed to operate at 150% overload for 60 seconds. If the application requires an overload greater than 150% or longer than 60 seconds, the AC drive must be oversized.

NOTE: Applications that require replacement of existing motor starters with AC drives may require up to 600% overload.

Determine Application Type; Constant Torque or Variable Torque

This torque requirement has a direct effect on which drive to select. Variable Torque (VT) applications are generally easier to start and typically involve fans and pumps. Most other applications outside fans and pumps fall into the Constant Torque (CT) category (machine control, conveyors, etc.). If you are unsure of the application, assume Constant Torque. The specification, derating, and selection tables are generally split into Constant Torque and Variable Torque categories.

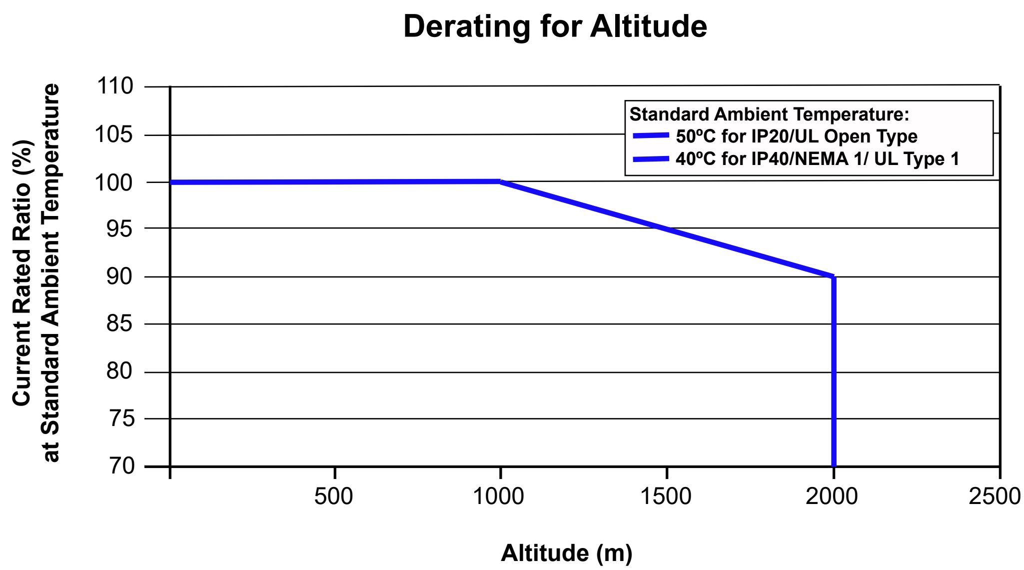
Installation Altitude

AC drives rely on air flow for cooling. As the altitude increases, the air becomes less dense. This drop in air density decreases the cooling properties of the air. Therefore, the AC drive must be oversized to compensate for the decrease in cooling. Most AC drives are designed to operate at 100% capacity at altitudes up to 1000 meters.

NOTE: For use above 1000m, the AC drive must be derated as described below.

Derate Output Current Based on Altitude Above 1000 Meters

- *If the AC drive is installed at an altitude of 0–1000m, follow normal operation restrictions.*
- *If installed at an altitude of 1000–2000m, decrease 1% of the rated current or lower 0.5°C of temperature for every 100m increase in altitude (1% or 0.9°F per 328ft).*
- *Maximum altitude for Corner Grounded is 2000m. If installation at an altitude higher than 2000m is required, please contact AutomationDirect.*



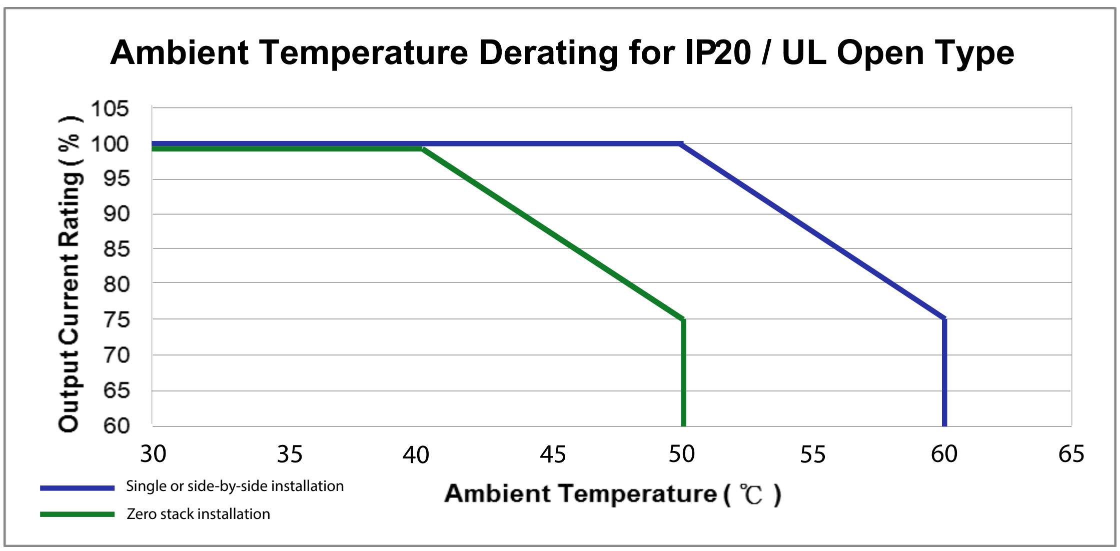
Determine Maximum Enclosure Internal Temperature

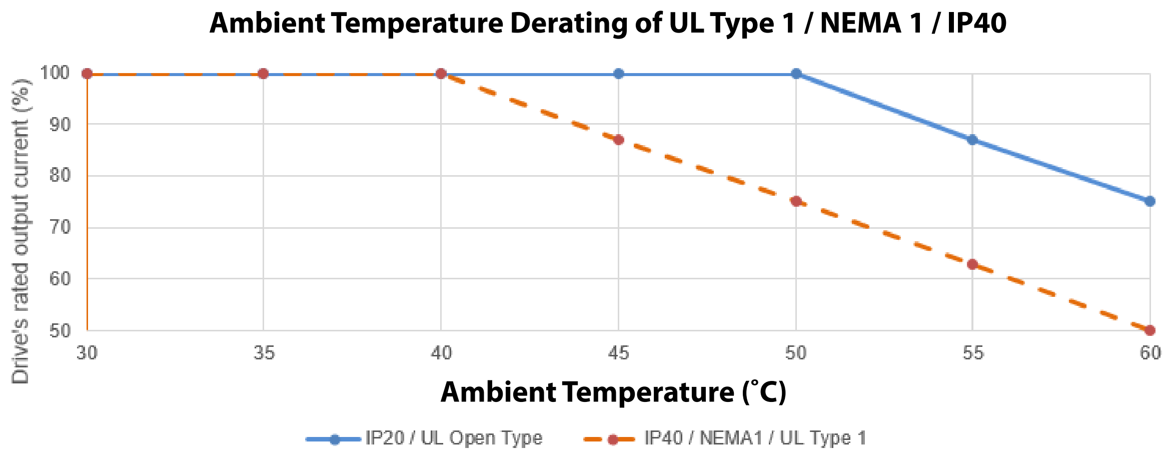
AC drives generate a significant amount of heat and may cause the internal temperature of an enclosure to exceed the rating of the AC drive, even when the ambient temperature is less than 104°F [40°C]. Enclosure ventilation and/or cooling may be required to maintain a maximum internal temperature of 104°F [40°C] or less. Ambient temperature measurements/calculations should be made for the maximum expected temperature. When permissible, flange mounting the AC drive (mounting with the drive heatsink in open ambient air) can greatly reduce heating in the enclosure.

For use above 104°F [40°C], the AC drive must be derated as described below.

Derate Output Current Based on Temperature Above 104°F [40°C]

Drive Derating by Temperature and Protection Level	
Protection Level	***Derating***
UL Open Type / IP20 *	If the AC motor drive operates at the rated current, the ambient temperature needs to be between -20 to 50°C. If the temperature is above 50°C, decrease 2.5% of the rated current for every 1°C increase in temperature. The maximum allowable temperature is 60°C.
UL Type 1 / NEMA 1 / IP40 *	When the AC motor drive is operating at the rated current, the ambient temperature must be between -20 to 40°C. When the temperature is over 40°C, for every increase by 1°C, decrease the rated current 2.5%. The maximum allowable temperature is 50°C.
** For more information about environmental ratings, refer to the "DURApulse GS30 AC Drive Environmental Information" on page 1–11 of this chapter.*	




Ambient Temperature Derating of UL Type 1 / NEMA 1 / IP40
Drive's rated output current (%)
100
90
80
70
60
50
30
35
40
45
50
55
60
Ambient Temperature (˚C)
IP20 / UL Open Type
IP40 / NEMA1 / UL Type 1

Derate Output Current Based on Carrier Frequency (if necessary)

Carrier Frequency Effects

AC Drives rectify the incoming 50 or 60Hz line power resulting in DC power at 0Hz. The resulting DC power is then pulse-width modulated and supplied to the motor by the drive's power electronics. IGBTs invert the DC power, simulating a sine wave at the desired frequency (that's what allows variable speed in AC induction motors). The speed at which the IGBTs are turned ON and OFF is called the Carrier Frequency. In AC drives, the Carrier Frequency can range from 2kHz to 15kHz. The Carrier Frequency can be adjusted in most AC Drives.

There are trade-offs between choosing High Carrier Frequencies and Low Carrier Frequencies.

Benefits of Higher Carrier Frequencies:

- *Better efficiency (lower harmonic losses) in the motor*
- *Lower audible noise*

Benefits of Lower Carrier Frequencies:

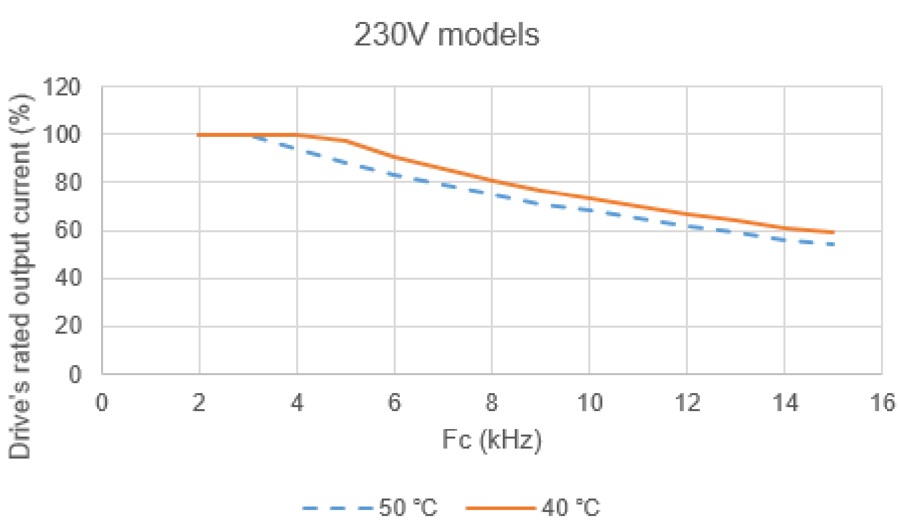
- *Better efficiency in the drive*
- *Lower EMI (electrical noise)*
- *Reduced reflective wave peak voltage*

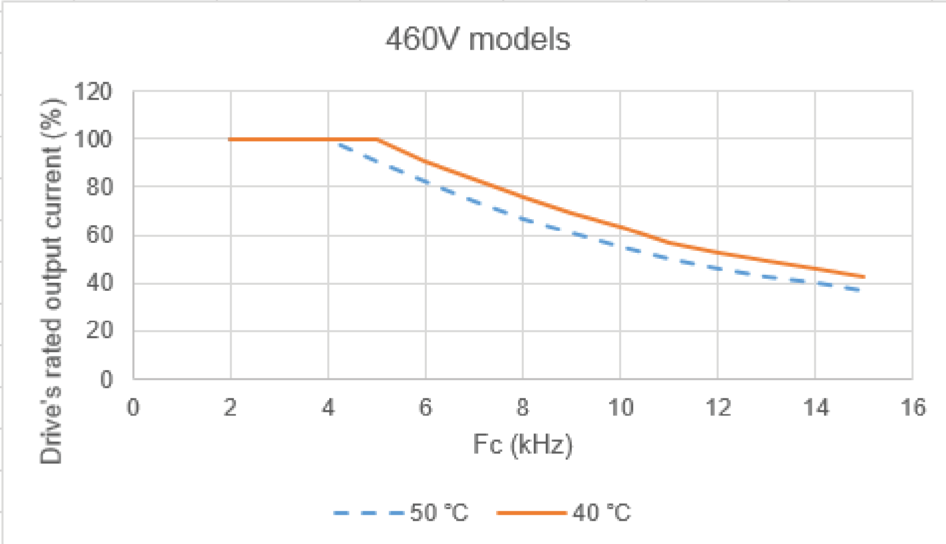
As a general rule, the Carrier Frequency should be set as low as possible without creating unacceptable audible noise in the motor. Smaller systems can have higher Carrier Frequencies, but larger drives (>20 or 30hp) should not have Carrier Frequencies set higher than 6kHz. Constant torque applications typically run around 2–4kHz.

GS30 Variable Torque Carrier Frequency Derating

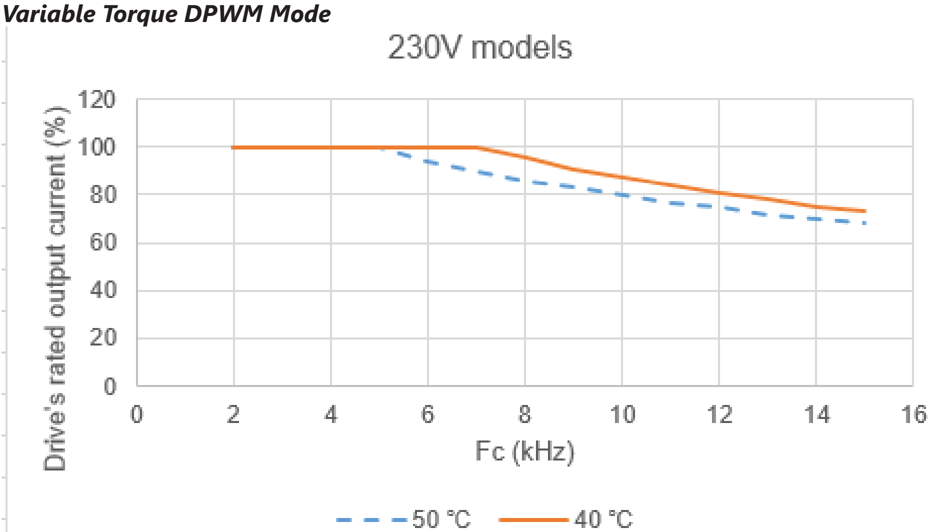
Note: Space Vector Pulse Width Modulation (SVPWM) and Two-Phase Pulse Width Modulation (DPWM) are determined by parameter P11.41. See Chapter 4 for details.

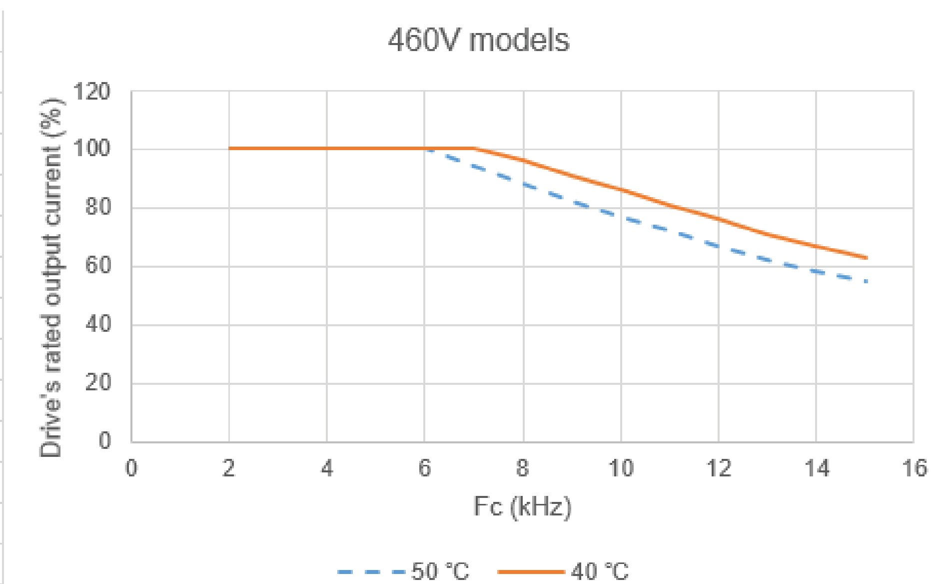
Variable Torque SVPWM Mode





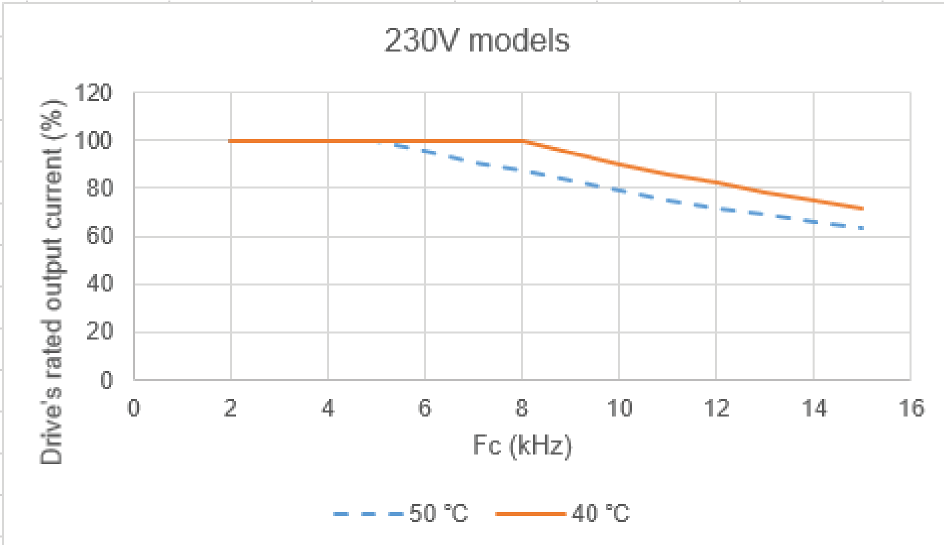
Variable Torque DPWM Mode

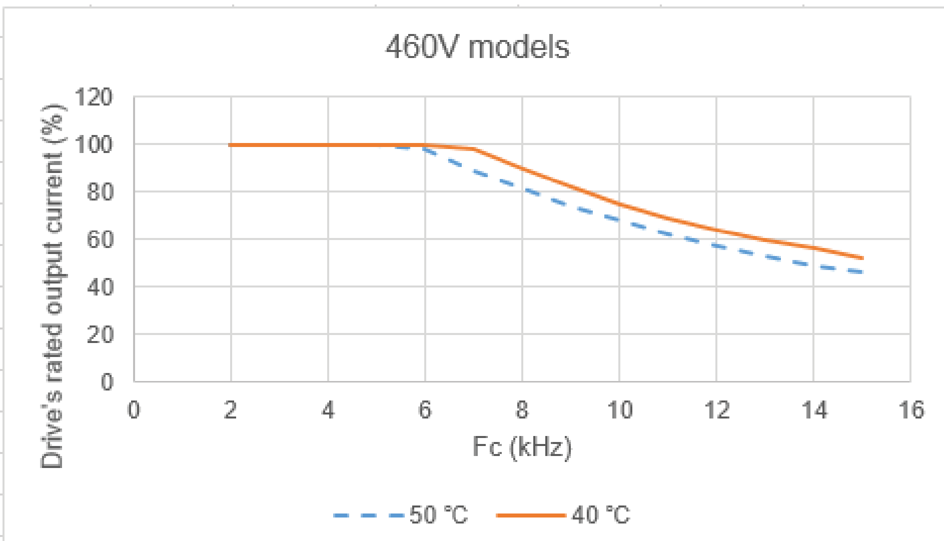




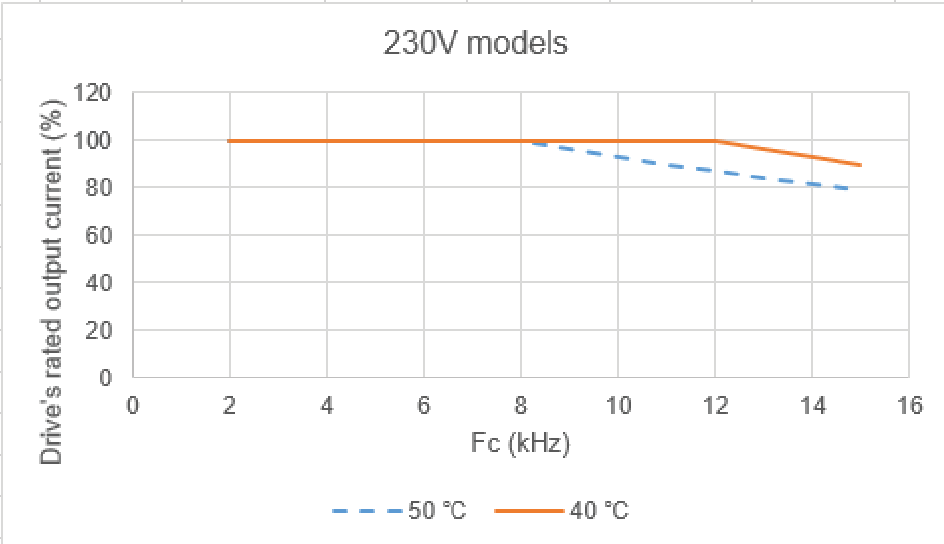
GS30 Constant Torque Carrier Frequency Derating

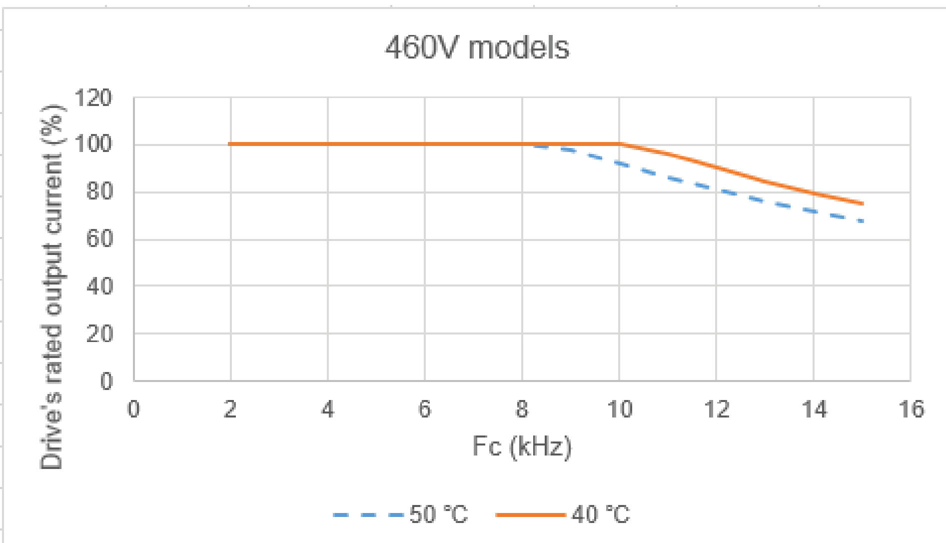
Constant Torque SVPWM Mode





Constant Torque DPWM Mode





DURApulse GS30 AC Drive Environmental Information

Storage and Transportation

AC drives should be kept in the shipping cartons or crates until they are installed. In order to retain the warranty coverage, they should be stored as described below if not to be installed and used within three months.

- *Store in a clean and dry location free from direct sunlight and corrosive fumes.*
- *Store within environmental conditions shown below in the “Environmental Conditions” table.*
- *DO NOT store in an area with rapid changes in temperature , to avoid condensation and frost.*
- *DO NOT place directly on the ground.*

If the drive is stored or is otherwise unused for more than a year, the drive’s internal DC link capacitors should be recharged before use. Otherwise, the capacitors may be damaged when the drive starts to operate. We recommend recharging the capacitors of any unused drive at least once per year. (Refer to Chapter 6, “Maintenance and Troubleshooting” for information about recharging DC link capacitors.)

GS30 Environmental Conditions

Environmental Conditions for GS30 AC Drives			
Condition	Operation	Storage	Transportation
Installation Location	IEC 60364-1/ IEC 60664-1 Pollution degree 2, Indoor use only.	n/a	n/a
Ambient Temperature	IP20/UL Open Type: -20 to 50°C (-20 to 60°C w/derating) [-4 to 122°F (-4 to 140°F w/derating)]	-40 to 85°C [-40 to 185°F]	-20 to 70°C [-4 to 158°F]
	Non-condensing, non-freezing		
Relative Humidity	90%, no water condensation	95%, no water condensation	
Air Pressure	86–106 kPa	70–106 kPA	
Pollution Level	IEC 60721-3-3, concentrate prohibited		
	Class 3C2; Class 3S2	Class 2C2; Class 2S2	Class 1C2; Class 1S2
Altitude	<1000 m (For altitudes > 1000 m, derate to use it.)		
Package Drop	n/a	ISTA procedure 1A (according to weight) IEC 60068-2-31	
Vibration	1.0 mm, peak to peak value range from 2–13.2 Hz; 0.7–1.0 G range from 13.2–55 Hz; 1.0 G range from 55–512 Hz. Compliance with IEC 60068-2-6	2.5 G peak, 5 Hz–2 kHz 0.015 inch maximum displacement	
Impact	15 G, 11 ms, compliance with IEC/EN60068-2-27	30G*	

**20G for Frame A-D option card installation kit.*

NOTE: DO NOT expose the GS30 AC Drive to harsh environments such as dust, direct sunlight, corrosive/flammable gases, humidity, liquid, or vibrations. The salts in the air must be less than 0.01 mg/cm² every year.

GS30 General Specifications

General Specifications for GS30 AC Drives		
Control Characteristics	Control Method	See GS30 Motor Control table (below)
	Applicable Motor	IM (Induction Motor), PM motor control (IPM and SPM)
	Speed Control Range[1]	See GS30 Motor Control table (below)
	Torque Limits	VT: 160% of output current, max CT: 180% of output current, max
	Max. Output Frequency	0.00–599.00 Hz
	Overload Capacity	VT: rated output current of 120% 60 sec. every 5 minutes, 150% 3 sec. every 30 seconds CT: rated output current of 150% 60 sec. every 5 minutes, 200% 3 sec. every 30 seconds
	Frequency Setting Signal	0–10 V / -10–10 V 4–20 mA / 0–10 V 1 channel pulse input (33 kHz), 1 channel pulse output (33 kHz)
	Digital Inputs	Seven (7) - 24VDC NPN or PNP, includes 1 frequency input 33kHz
	Digital Outputs	Three (3) - (2)-48VDC, (1) Relay-250VAC/30VDC
	Analog Inputs	Two (2) - (1) voltage, (1) selectable Voltage or Current
	Analog Outputs	One (1) - selectable voltage or current
	Frequency Output	One (1) - 30VDC, 33kHz
	Safe Torque Off	STO1 and STO2 inputs- 24VDC
	Main Functions	Multiple motor switching (a maximum of eight independent motor parameter settings), Fast start-up, Deceleration Energy Back (DEB) function, Wobble frequency function, Fast deceleration function, Master and Auxiliary frequency source selectable, Restart after momentary power loss, Speed tracking, Over-torque detection, Torque limit, 16-step speed (including the master speed), Accel./decel. time switch, S-curve accel./decel., three-wire operation control, JOG frequency, Frequency upper/lower limit settings, DC brake at start-up and stop, PID control, Built-in PLC (5000 steps), Positioning function, Tension control function, Built-in RS-485 (odbus) and CANopen.
	Application Macro	Built-in application parameter groups (selected by industry) and user-defined application parameter groups.
Protection Characteristics	Motor Protection	Over-current, Over-voltage, Over-heating, Phase loss, Overload.
	Stall Prevention	Stall prevention during acceleration, deceleration and running (independent settings).
Option Cards	Communication	GS30A-CM-EIP1, GS30A-CM-EIP2, GS30A-CM-ECAT, GS30A-CM-EIPKITP2
	Encoder	GS30A-FB-LD, GS30A-FB-OC
	Extension I/O	GS30A-06CDD, GS30A-2AD2DA, GS30A-02TRC, GS30A-03TRA
	24V Power	GS30-BPS
Agency Approvals[2]	UL, CE, RCM, TÜV (SIL 2), RoHS, REACH	

1: Control accuracy may vary depending on the environment, application conditions or different motors. For more information contact AutomationDirect.
2: See CE declaration on the GS30 support page at www.automationdirect.com

GS30 Motor Control (Applicable to All Models)					
	Motor Type	***Control Mode***		***Start Torque***	***Speed Control Range (Turndown/Accuracy)***
		Description	***Symbol***		
Motor Control	Induction Motor (IM)	Volts/Hz	IMVF	150% @ 3Hz	1:50
		Volts/Hz+encoder	IMVFPG		
		Sensorless vector	IMSVC		
		Field oriented control sensorless	IMFOC	200% @ 0.5 Hz	1:100
		Torque sensorless	IMTQC		±15%
		Field oriented control+encoder*	IMFOCPG	200% @ 0Hz	1:1000
		Torque+encoder*	IMTQCPG		±5%
	Permanent Magnet AC Motor (PM)	Sensorless vector	PMSVC	100% @ 1/20th motor frequency	1:20
		Field oriented control sensorless	PMSVC or IPM	150% @ 0Hz	1:100
		Field oriented control+encoder*	PMFOCPG	200% @ 0Hz	1:1000
		Torque+encoder*	PMTQCPG		±5%

** Encoder option card GS30A-DB-LD or GS30A-DB-OC is required.*

Efficiency Class

The EU Ecodesign regulation directive establishes a framework to set mandatory ecological requirements for energy-using and energy-related products. The IEC 61800-9-2 standard defines the efficiency classes for AC drives. The efficiency classes range (low to high) from IE0 to IE2. These classes apply to AC drives rated 100 to 1000 V and 0.12 to 1000 kW (1/6 to 1,340 HP).

Drive manufacturers must declare power losses in terms of percentage of rated apparent output power at eight different operating points, as well as standby losses. The International Efficiency (IE) level is given at the nominal point.

The power losses of GS30 drives shall not exceed the maximum power losses corresponding to the IE2 efficiency level. For specific power losses of each drive model, see the drive specification tables.

DURAPULSE GS30 AC Drive Specifications

230V Class – 1-Phase Model-Specific Specifications

GS30 230V Class Specifications; Frame Size A, B, C[1]							
Model Name: GS31-2xxx				***GS31-20P5***	***GS31-21P0***	***GS31-22P0***	***GS31-23P0***
Frame Size				***A***	***B***	***C***	***C***
Output Rating	***Max Motor Output***		***hp***	1/2	1	2	3
			kW	0.4	0.75	1.5	2.2
	CT	***Rated Output Capacity***	***kVA***	1.1	1.9	2.9	4.2
		Rated Output Current	***A***	2.8	5.0	7.5	11
		Carrier Frequency[3]	***kHz***	2–15 (default 4)			
	VT	***Rated Output Capacity***	***kVA***	1.2	2.0	3.2	4.8
		Rated Output Current	***A***	3.2	5.2	8.5	12.5
		Carrier Frequency[3]	***kHz***	2–15 (default 4)			
Input Rating[2]	***CT***	***Rated Input Current***	***A***	7.3	11.2	16.5	24.2
	VT	***Rated Input Current***	***A***	8.3	11.7	18.5	27.5
	Rated Voltage/Frequency			1-phase 200-240 VAC (-15% to +10%), 50/60 Hz			
	Operating Voltage Range (VAC)			170–265			
	Frequency Tolerance (Hz)			47–63			
IE2 Efficiency – Relative Power Loss (%)				3.5	2.8	2.7	2.5
SCCR Rating				100kA			
Weight (kg)				0.76	0.81	1.05	1.24
Cooling Method				Convective		Fan	
IP Rating				IP20			

1 - For use with three-phase motors only.
2 - Please refer to "Appendix A: Accessories" for input fusing information.
3 - The value of the carrier frequency is a factory default. Decrease the current value if you need to increase the carrier frequency. Refer to "Derate Output Current Based on Carrier Frequency (if necessary)" on page 1–7

230V Class – 3-Phase Model-Specific Specifications

GS30 230V Class Specifications; Frame Size A, B, C[1]								
Model Name: GS33-2xxx				**GS33-20P5**	**GS33-21P0**	**GS33-22P0**	**GS33-23P0**	**GS33-25P0**
Frame Size				**A**	**A**	**B**	**C**	**C**
Output Rating	**Max Motor Output**		**hp**	1/2	1	2	3	5
			kW	0.4	0.75	1.5	2.2	3.7
	CT	**Rated Output Capacity (3-phase [1-phase])**	**kVA**	1.9	1.9	2.9	4.2	6.5
		Rated Output Current (3-phase [1-phase])	**A**	5.0	5.0	7.5	11.0	17.0
		Carrier Frequency[3]	**kHz**	2–15 (default 4)				
	VT	**Rated Output Capacity**	**kVA**	1.2	2.0	3.0	4.8	7.4
		Rated Output Current	**A**	3.2	5.2	8.0	12.5	19.5
		Carrier Frequency[3]	**kHz**	2–15 (default 4)				
Input Rating[2]	**CT**	**Rated Input Current**	**A**	3.4	6.0	9.0	13.2	20.4
	VT	**Rated Input Current**	**A**	3.8	6.2	9.6	15.0	23.4
	Rated Voltage/Frequency			3-phase 200-240 VAC (-15% to +10%), 50/60 Hz				
	Operating Voltage Range (VAC)			170–265				
	Frequency Tolerance (Hz)			47–63				
IE2 Efficiency – Relative Power Loss (%)				3.5	3.0	2.6	2.5	2.3
SCCR Rating				100kA				
Weight (kg)				0.76	0.81	1.05	1.24	1.24
Cooling Method				Convective		Fan		
IP Rating				IP20				

1 - For use with three-phase motors only.

2 - If three-phase power source is non-symmerical, refer to "Circuit Connections – RFI Jumper" on page 2–15. Please refer to "Appendix A: Accessories" for input fusing information.

3 - The value of the carrier frequency is a factory default. Decrease the current value if you need to increase the carrier frequency. Refer to "Derate Output Current Based on Carrier Frequency (if necessary)" on page 1–7

230V Class – 3-Phase Model-Specific Specifications, continued

GS30 230V Class Specifications; Frame Size D, E, F[1]							
Model Name: GS33-2xxx				**GS33-27P5**	**GS33-2010**	**GS33-2015**	**GS33-2020**
Frame Size				**D**	**E**	**E**	**F**
Output Rating	**Max Motor Output**		**hp**	7.5	10	15	20
			kW	5.5	7.5	11	15
	CT	**Rated Output Capacity (3-phase [1-phase])**	**kVA**	9.5	12.6	18.7	24.8
		Rated Output Current (3-phase [1-phase])	**A**	25.0	33.0	49.0	65.0
		Carrier Frequency[3]	**kHz**	2–15 (default 4)			
	VT	**Rated Output Capacity**	**kVA**	10.3	13.7	19.4	26.3
		Rated Output Current	**A**	27.0	36.0	51.0	69.0
		Carrier Frequency[3]	**kHz**	2–15 (default 4)			
Input Rating[2]	**CT**	**Rated Input Current**	**A**	30.0	39.6	58.8	78.0
	VT	**Rated Input Current**	**A**	32.4	43.2	61.2	82.8
	Rated Voltage/Frequency			3-phase 200-240 VAC (-15% to +10%), 50/60 Hz			
	Operating Voltage Range (VAC)			170–265			
	Frequency Tolerance (Hz)			47–63			
IE2 Efficiency – Relative Power Loss (%)				2.4	2.4	2.3	2.1
SCCR Rating				100kA			
Weight (kg)				2.07	3.97	3.97	6.30
Cooling Method				Fan			
IP Rating				IP20			

1 - For use with three-phase motors only.
2 - If three-phase power source is non-symmerical, refer to "Circuit Connections – RFI Jumper" on page 2–15. Please refer to "Appendix A - Accessories" for input fusing information.
3 - The value of the carrier frequency is a factory default. Decrease the current value if you need to increase the carrier frequency. Refer to "Derate Output Current Based on Carrier Frequency (if necessary)" on page 1–7

230V Class – 3-Phase Model-Specific Specifications, continued

GS30 230V Class Specifications; Frame Size G, I[1]							
Model Name: GS33-2xxx				**GS33-2025**	**GS33-2030**	**GS33-2040**	**GS33-2050**
Frame Size				**G**	**G**	**I**	**I**
Output Rating	**Max Motor Output**		**hp**	25	30	40	50
			kW	18.5	22	30	37
	CT	**Rated Output Capacity (3-phase [1-phase])**	**kVA**	28.9	34.4	46.9	57.8
		Rated Output Current (3-phase [1-phase])	**A**	75	90	120	146
		Carrier Frequency[3]	**kHz**	2–15 (default 4)			
	VT	**Rated Output Capacity**	**kVA**	31.6	37.6	51.3	63.3
		Rated Output Current	**A**	81	102	134	160
		Carrier Frequency[3]	**kHz**	2–15 (default 4)			
Input Rating[2]	**CT**	**Rated Input Current**	**A**	77	92	117	143
	VT	**Rated Input Current**	**A**	85	103	126	151
	Rated Voltage/Frequency			3-phase 200-240 VAC (-15% to +10%), 50/60 Hz			
	Operating Voltage Range (VAC)			170–265			
	Frequency Tolerance (Hz)			47–63			
IE2 Efficiency – Relative Power Loss (%)				2.3	2.4	2.3	2.3
SCCR Rating				5kA			10kA
Weight (kg)				11.8	11.8	33	33.5
Cooling Method				Fan			
IP Rating				IP20			

1 - For use with three-phase motors only.
2 - If three-phase power source is non-symmerical, refer to “Circuit Connections – RFI Jumper” on page 2–15. Please refer to “Appendix A - Accessories” for input fusing information.
3 - The value of the carrier frequency is a factory default. Decrease the current value if you need to increase the carrier frequency. Refer to “Derate Output Current Based on Carrier Frequency (if necessary)” on page 1–7

460V Class – 3-Phase Model-Specific Specifications

GS30 460V Class Specifications; Frame Size A, B, C[1]								
Model Name: GS33-4xxx				GS33-40P5	GS33-41P0	GS33-42P0	GS33-43P0	GS33-45P0
Frame Size				A	A	B	C	C
Output Rating	Max Motor Output		hp	1/2	1	2	3	5
			kW	0.4	0.75	1.5	2.2	3.7
	CT	Rated Output Capacity	kVA	1.1	2.3	3.2	4.3	6.9
		Rated Output Current	A	1.5	3.0	4.2	5.7	9.0
		Carrier Frequency[3]	kHz	2–15 (default 4)				
	VT	Rated Output Capacity	kVA	1.4	2.5	3.5	5.0	8.0
		Rated Output Current	A	1.8	3.3	4.6	6.5	10.5
		Carrier Frequency[3]	kHz	2–15 (default 4)				
Input Rating[2]	CT	Rated Input Current	A	2.1	4.2	5.8	6.1	9.9
	VT	Rated Input Current	A	2.5	4.6	6.4	7.2	11.6
	Rated Voltage/Frequency			3-phase 380-480 VAC (-15% to +10%), 50/60 Hz				
	Operating Voltage Range (VAC)			323-528				
	Frequency Tolerance (Hz)			47–63				
IE2 Efficiency – Relative Power Loss (%)				4.4	2.8	2.4	2.3	3.1
SCCR Rating				100kA				
Weight (kg)				0.76	0.77	1.05	1.24	1.24
Cooling Method				Convective		Fan		
IP Rating				IP20				

1 - For use with three-phase motors only.

2 - If three-phase power source is non-symmerical, refer to "Circuit Connections – RFI Jumper" on page 2–15. Please refer to "Appendix A - Accessories" for input fusing information.

3 - The value of the carrier frequency is a factory default. Decrease the current value if you need to increase the carrier frequency. Refer to "Derate Output Current Based on Carrier Frequency (if necessary)" on page 1–7

460V Class – 3-Phase Model-Specific Specifications, continued

GS30 460V Class Specifications; Frame Size D, E, F[1]									
Model Name: GS33-4xxx				GS33-47P5	GS33-4010	GS33-4015	GS33-4020	GS33-4025	GS33-4030
Frame Size				D	D	E	E	F	F
Output Rating	Max Motor Output		hp	7.5	10	15	20	25	30
			kW	5.5	7.5	11	15	18.5	22
	CT	Rated Output Capacity	kVA	9.9	13.3	19.1	24.4	29	34.3
		Rated Output Current	A	13.0	17.5	25.0	32.0	38.0	45.0
		Carrier Frequency[3]	kHz	2–15 (default 4)					
	VT	Rated Output Capacity	kVA	11.1	15.1	21.3	27.4	31.6	37.3
		Rated Output Current	A	14.5	19.8	28.0	36.0	41.5	49.0
		Carrier Frequency[3]	kHz	2–15 (default 4)					
Input Rating[2]	CT	Rated Input Current	A	14.3	19.3	27.5	35.2	41.8	49.5
	VT	Rated Input Current	A	16.0	21.8	30.8	39.6	45.7	53.9
	Rated Voltage/Frequency			3-phase 380-480 VAC (-15% to +10%), 50/60 Hz					
	Operating Voltage Range (VAC)			323-528					
	Frequency Tolerance (Hz)			47–63					
IE2 Efficiency – Relative Power Loss (%)				2.0	1.9	1.7	1.6	1.5	1.4
SCCR Rating				100kA					
Weight (kg)				2.07	2.07	3.97	3.97	6.30	6.30
Cooling Method				Fan					
IP Rating				IP20					

1 - For use with three-phase motors only.

2 - If three-phase power source is non-symmerical, refer to "Circuit Connections – RFI Jumper" on page 2–15. Please refer to "Appendix A - Accessories" for input fusing information.

3 - The value of the carrier frequency is a factory default. Decrease the current value if you need to increase the carrier frequency. Refer to "Derate Output Current Based on Carrier Frequency (if necessary)" on page 1–7

460V Class – 3-Phase Model-Specific Specifications, continued

GS30 460V Class Specifications; Frame Size G, H, I[1]								
Model Name: GS33-4xxx				GS33-4040	GS33-4050	GS33-4060	GS33-4075	GS33-4100
Frame Size				G	H	H	I	I
Output Rating	Max Motor Output		hp	40	50	60	75	100
			kW	30	37	45	55	75
	CT	Rated Output Capacity	kVA	46.9	57.8	70.3	85.9	117.2
		Rated Output Current	A	60	75	91	112	150
		Carrier Frequency[3]	kHz	2–15 (default 4)				
	VT	Rated Output Capacity	kVA	51.3	63.3	76.9	94	128.2
		Rated Output Current	A	69	85	108	128	180
		Carrier Frequency[3]	kHz	2–15 (default 4)				
Input Rating[2]	CT	Rated Input Current	A	63	66	80	110	147
	VT	Rated Input Current	A	72.5	77	97	123	173
	Rated Voltage/Frequency			3-phase 380-480 VAC (-15% to +10%), 50/60 Hz				
	Operating Voltage Range (VAC)			323-528				
	Frequency Tolerance (Hz)			47–63				
IE2 Efficiency – Relative Power Loss (%)				1.4	2.0	1.8	1.7	1.7
SCCR Rating				5kA		10kA		
Weight (kg)				11.7	25.1	28.6	36	39
Cooling Method				Fan				
IP Rating				IP20				

1 - For use with three-phase motors only.

2 - If three-phase power source is non-symmerical, refer to “Circuit Connections – RFI Jumper” on page 2–15. Please refer to “Appendix A - Accessories” for input fusing information.

3 - The value of the carrier frequency is a factory default. Decrease the current value if you need to increase the carrier frequency. Refer to “Derate Output Current Based on Carrier Frequency (if necessary)” on page 1–7

Receiving and Inspection

Drive Package Contents

After receiving the GS30 AC Drive, please check the following:

1) Make sure that the package includes the GS30 AC Drive and the Quick-Start Guide that matches your product.
2) Please inspect the unit after unpacking to assure it was not damaged during shipment. Make sure that the part number printed on the package corresponds with the part number indicated on the nameplate.
3) Make sure that the part number indicated on the nameplate corresponds with the part number of your order.
4) Make sure that the voltage for the wiring lies within the range as indicated on the nameplate. Please install the GS30 AC Drive according to this manual.
5) Before applying the power, please make sure that all the devices, including power, motor, control board, and digital keypad are connected correctly.
6) When wiring the GS30 AC Drive, please make sure that the wiring of input terminals “R/L1, S/L2, T/L3” and output terminals “U/T1, V/T2, W/T3” are correct to prevent drive damage.
7) When power is applied, select the language and set parameter groups via the digital keypad. When executing a trial run, please begin with a low speed, and then gradually increase the speed until the desired speed is reached.

The GS30 AC Drive should be kept in the shipping carton before installation. In order to retain the warranty coverage, the GS30 AC Drive should be stored properly when it is not to be used for an extended period of time. Refer to the preceding “Environmental Information” section for proper storage conditions.

Model Number Explanation

GS33- 4 7P5

Applicable Motor Capacity*

0P5: 0.5hp	1P0: 1.0hp	2P0: 2.0hp	3P0: 3.0hp
5P0: 5.0hp	7P5: 7.5hp	010: 10hp	015: 15hp
020: 20hp	025: 25hp	030: 30hp	040: 40hp
050: 50hp	060: 60hp	075: 75hp	100: 100hp

*Not all capacities are available in each voltage.

Input Voltage
2: 230VAC
4: 460VAC

Phase
1: One-phase
3: Three-phase

Series Name

Nameplate Information

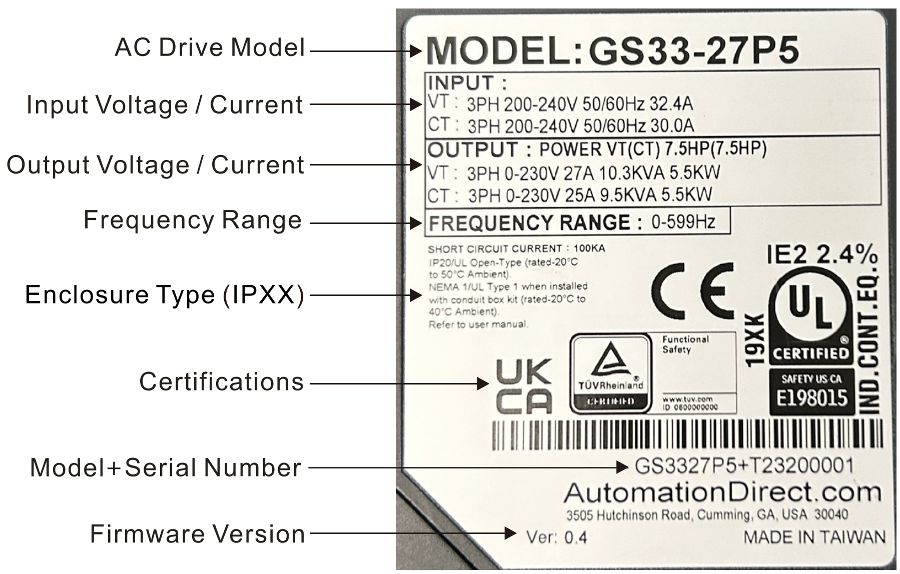


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Table of Contents

Drive Models by Frame Size

GS30 *DURApulse* Drive Models by Frame Size	
Frame	***Drive***
A	GS31-20P5, GS33-20P5, GS33-21P0, GS33-40P5, GS33-41P0
B	GS31-21P0, GS33-22P0, GS33-42P0
C	GS31-22P0, GS31-23P0, GS33-23P0, GS33-25P0, GS33-43P0, GS33-45P0
D	GS33-27P5, GS33-47P5, GS33-4010,
E	GS33-2010, GS33-2015, GS33-4015, GS33-4020
F	GS33-2020, GS33-4025, GS33-4030
G	GS33-2025 GS33-2030, GS33-4040
H	GS33-4050, GS33-4060
I	GS33-2040, GS33-2050, GS33-4075, GS33-4100

Installation

Install the AC drive in an enclosure that is specifically designed to house electrical and electronic control equipment. Provide proper spacing within the enclosure to allow the dissipation of heat produced by the drive and any other included electrical and electronic equipment. Ventilation or air conditioning may also be required, depending upon the application.

FAILURE TO OBSERVE THESE PRECAUTIONS MAY DAMAGE THE DRIVE AND VOID THE WARRANTY!

Improper installation of the AC drive will greatly reduce its life. Observe the following precautions when installing the drive:

- *Do not mount the AC drive near heat-radiating elements or in direct sunlight.*
- *Do not install the AC drive in a place subjected to high temperature, high humidity, excessive vibration, corrosive gases or liquids, or airborne dust or metallic particles.*
- *Install the AC drive in Pollution Degree 2 environments only.*
  Pollution Degree 2: Normally only non-conductive pollution occurs. Temporary conductivity caused by condensation is to be expected.
- *Install the AC drive in a cabinet. When installing one drive below another, use a metal separator between the drives to prevent mutual heating and to prevent the risk of fire.*
- *Mount the AC drive securely on a flat, rigid, non-flammable surface.*
- *Mount the AC drive vertically and do not restrict the air flow to the heat sink fins and fan(s) (if equipped).*
- *Prevent fiber particles, scraps of paper, shredded wood saw dust, metal particles, etc. from adhering to the heat sink.*

AC DRIVES GENERATE A LARGE AMOUNT OF HEAT WHICH MAY DAMAGE THEM. AUXILIARY COOLING METHODS ARE TYPICALLY REQUIRED IN ORDER NOT TO EXCEED MAXIMUM AMBIENT TEMPERATURES.

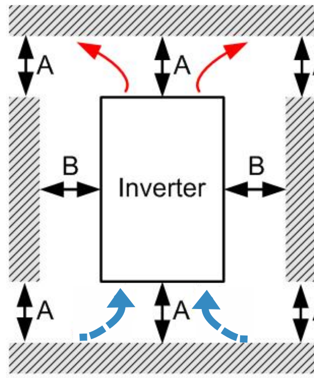
Minimum Clearances and Air Flow

Diagram Directional Arrows

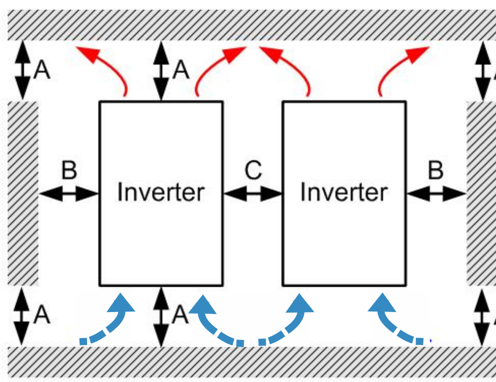
- *Air Inflow: Blue Arrow → →*
- *Air Outflow: Red Arrow → →*
- *Distance: Black Arrows ↔ ↔*

GS30 Series Minimum Clearance Distances

1) Single Drive Installation (Frames A–I)



2) Multiple Drives Side-By-Side



GS30 Minimum Mounting Clearances*

Installation Method	***Frame A-F***			***Frame G-I***			***Operation Temperature (°C)[°F]***	
	A	***B***	***C***	***A***	***B***	***C***	***Max (w/out derating)***	***Max (Derating)***
	(mm)[in]							
Single drive installation	50 [1.97]	30 [1.18]	–	100 [3.94]	50 [1.97]	–	50 [122]	60 [140]
Side-by-side horizontal installation	50 [1.97]	30 [1.18]	30 [1.18]	100 [3.94]	50 [1.97]	50 [1.97]	50 [122]	60 [140]
Zero stack installation	50 [1.97]	30 [1.18]	0	100 [3.94]	50 [1.97]	0	40 [104]	50 [122]

** The minimum mounting clearances stated in this table apply to GS30 drives. Failure to follow the minimum mounting clearances may cause the fan to malfunction and cause a heat dissipation problem.*

GS30 Airflow and Power Dissipation

GS30 Airflow and Power Dissipation						
Model Number	Frame Size	Airflow Rate for Cooling		Power Dissipation (Watts)		
		Flow Rate (cfm)	Flow Rate (m^3/hr)	Loss External (Heat sink)	Internal	Total
GS31-20P5	A	0.0	0.0	16.3	14.5	30.8
GS31-21P0	B	0.0	0.0	31.1	22.5	53.6
GS31-22P0	C	16.0	27.2	46.5	31.0	77.5
GS31-23P0				70.0	35	105
GS33-20P5	A	0.0	0.0	16.5	12.6	29.1
GS33-21P0		10.0	16.99	33.2	15.0	48.2
GS33-22P0	B			50.1	24.2	74.3
GS33-23P0	C	16.0	27.2	76.0	30.7	106.7
GS33-25P0				108.2	40.1	148.3
GS33-27P5	D	23.4	39.7	192.8	53.3	246.1
GS33-2010	E	53.7	91.2	244.5	79.6	324.1
GS33-2015				374.2	86.2	460.4
GS33-2020	F	67.9	115.2	492.0	198.2	690.2
GS33-2025	G	232.0	394.2	581.3	100.0	681.3
GS33-2030		266.0	451.9	732.5	107.0	839.5
GS33-2040	I	455.0	773.1	926.0	124.0	1050.0
GS33-2050		493.0	837.6	1144.9	132.0	1276.9
GS33-40P5	A	0.0	0.0	17.6	11.1	28.7
GS33-41P0		10.0	16.99	32.6	20.0	52.6
GS33-42P0	B			45.9	21.7	67.6
GS33-43P0	C	16.0	27.2	60.6	22.8	83.4
GS33-45P0				93.1	42	135.1
GS33-47P5	D	23,4	39.7	132.8	39.5	172.3
GS33-4010				164.7	55.8	220.5
GS33-4015	E	53.7	91.2	234.5	69.8	304.3
GS33-4020				319.8	74.3	394.1
GS33-4025	F	67.9	115.2	423.5	181.6	605.1
GS33-4030				501.1	200.3	701.4
GS33-4040	G	266.0	451.9	655.3	122.0	777.3
GS33-4050	H	322.0	547.1	896.8	135.0	1031.8
GS33-4060				1029.0	150.0	1179.0
GS33-4075	I	455.0	773.1	1219.9	165.0	1384.9
GS33-4100		493.0	837.6	1495.0	180.0	1675.0

- Published flow rates are the result of active cooling using fans, factory installed in the drive.
- Unpublished flow rates (0.0) are the result of passive cooling in drives without factory installed fans.
- The required airflow shown in the chart is for installing a single GS30 drive in a confined space.
- When installing multiple GS30 drives, the required air volume would be the required air volume for a single GS30 drive multiplied by the number of GS30 drives.

- When calculating power dissipation (Watt Loss), use the Total value. Heat dissipation shown in the chart is for installing a single GS30 drive in a confined space.
- When installing multiple drives, the volume of heat/power dissipation should be the heat/power dissipated by a single GS30 drive multiplied by the number of GS30 drives.
- Heat dissipation for each model is calculated by rated voltage, current and default carrier frequency.

Dimensions

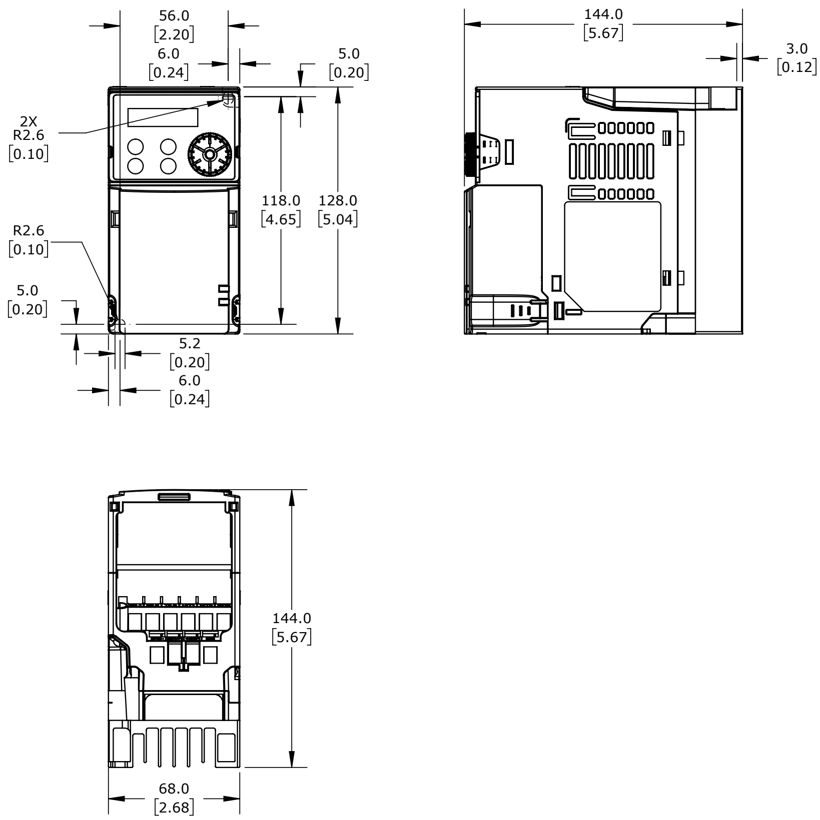
See our website for complete engineering drawings and 3D models.

GS30 DURAPULSE Frame Sizes by Drive Model				
230V			460V	
Drive	Frame		Drive	Frame
GS31-20P5	A2		GS33-40P5	A2
GS31-21P0	B2		GS33-41P0	A3
GS31-22P0	C1		GS33-42P0	B1
GS31-23P0	C1		GS33-43P0	C1
GS33-20P5	A2		GS33-45P0	C1
GS33-21P0	A3		GS33-47P5	D1
GS33-22P0	B1		GS33-4010	D1
GS33-23P0	C1		GS33-4015	E1
GS33-25P0	C1		GS33-4020	E1
GS33-27P5	D1		GS33-4025	F1
GS33-2010	E1		GS33-4030	F1
GS33-2015	E1		GS33-4040	G
GS33-2020	F1		GS33-4050	H
GS33-2025	G		GS33-4060	H
GS33-2030	G		GS33-4075	I
GS33-2040	I		GS33-4100	I
GS33-2050	I			

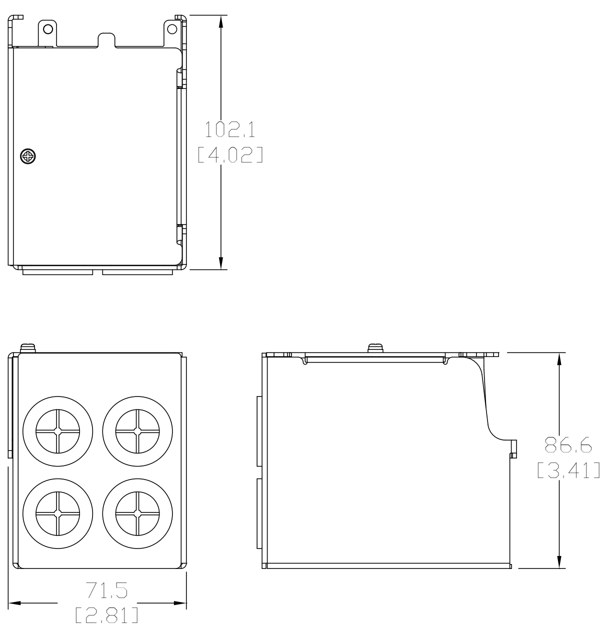
Dimensions (Units = mm [in])

See our website www.AutomationDirect.com for complete engineering drawings and 3D models.

GS30 Frame Size A



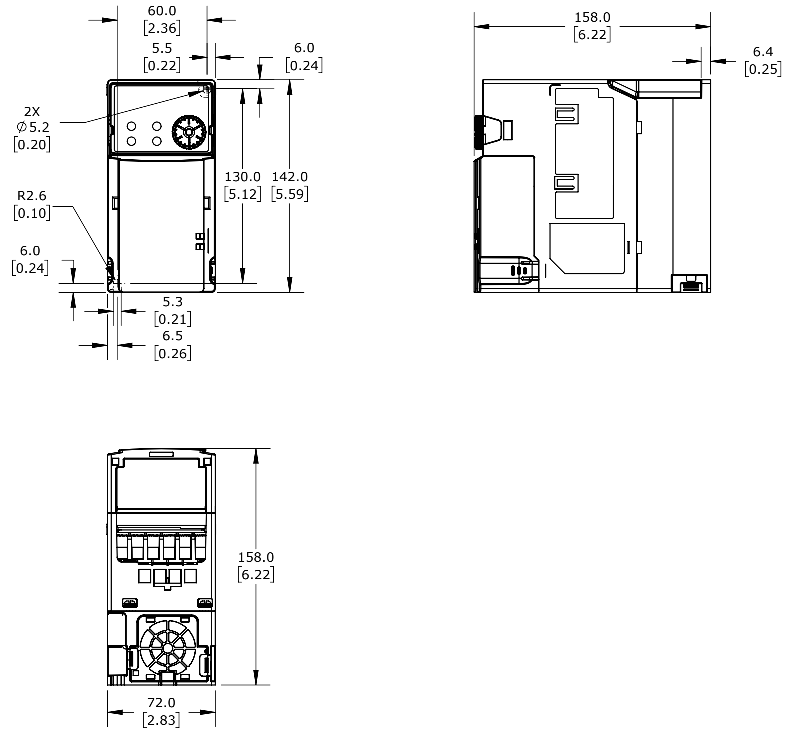
GS30 Frame Size A Conduit Box



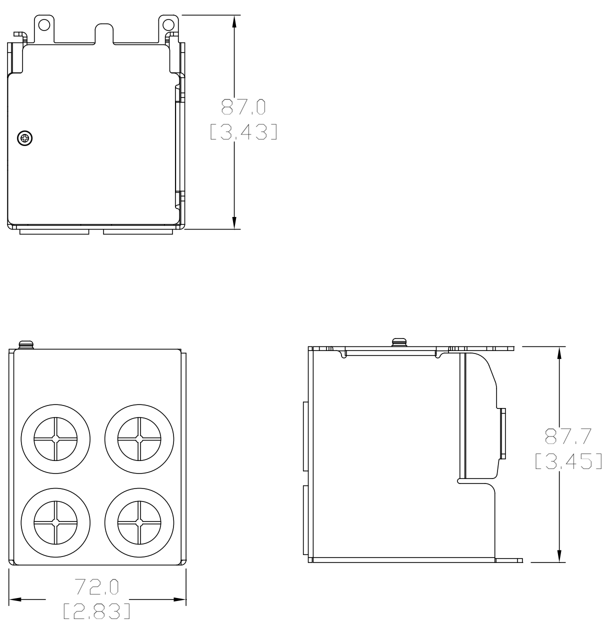
Dimensions (Units = mm [in])

See our website www.AutomationDirect.com for complete engineering drawings and 3D models.

GS30 Frame Size B



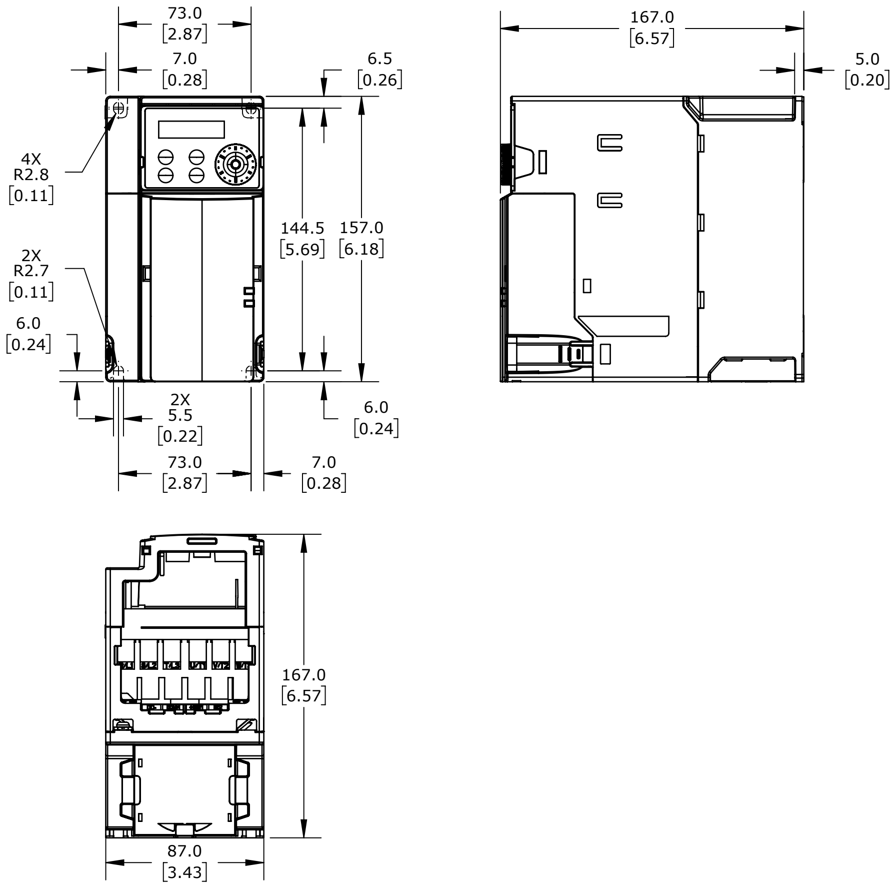
GS30 Frame Size B Conduit Box



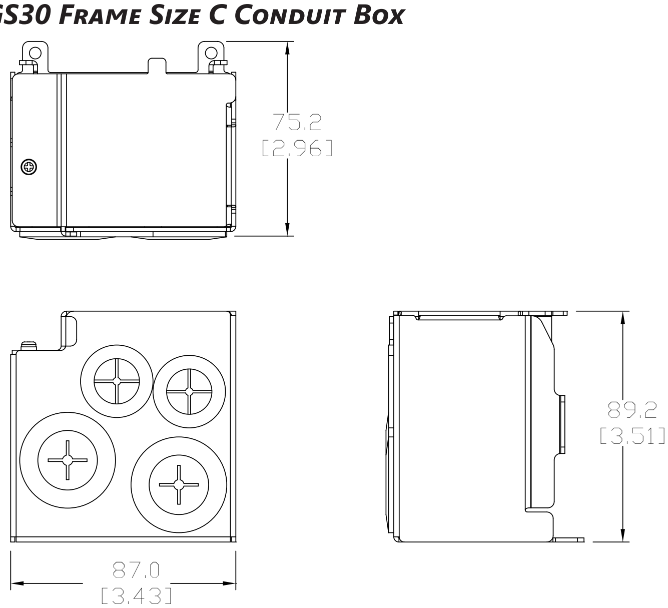
Dimensions (Units = mm [in])

See our website www.AutomationDirect.com for complete engineering drawings and 3D models.

GS30 Frame Size C



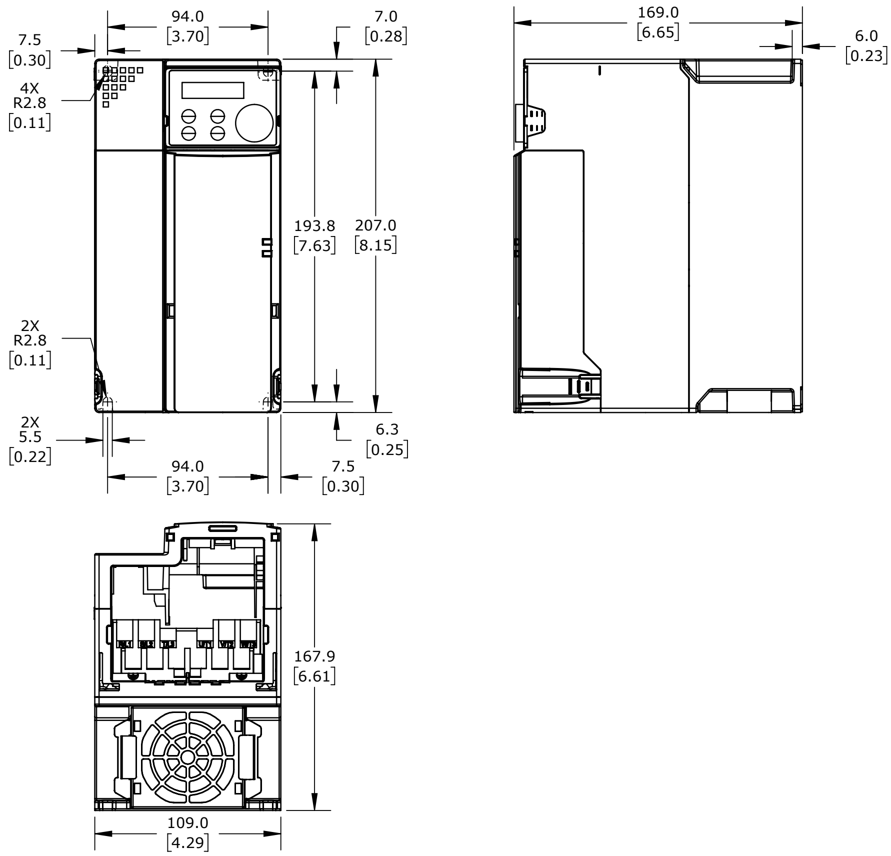
GS30 Frame Size C Conduit Box



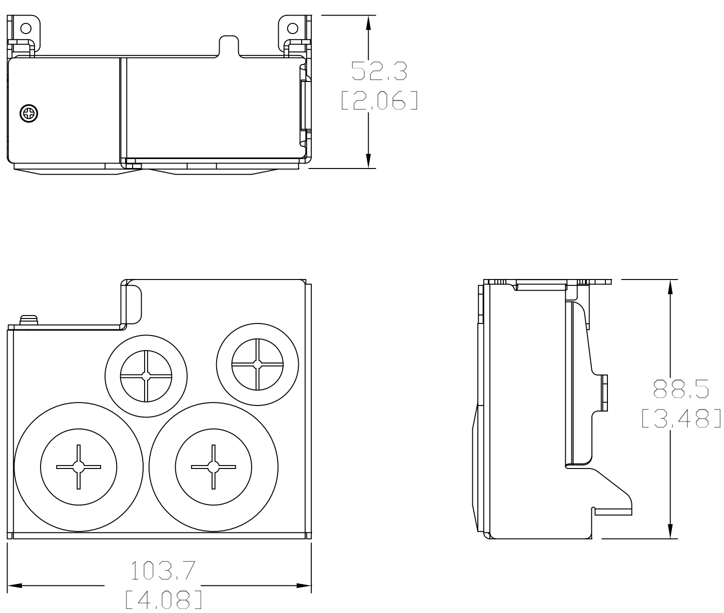
Dimensions (Units = mm [in])

See our website www.AutomationDirect.com for complete engineering drawings and 3D models.

GS30 Frame Size D



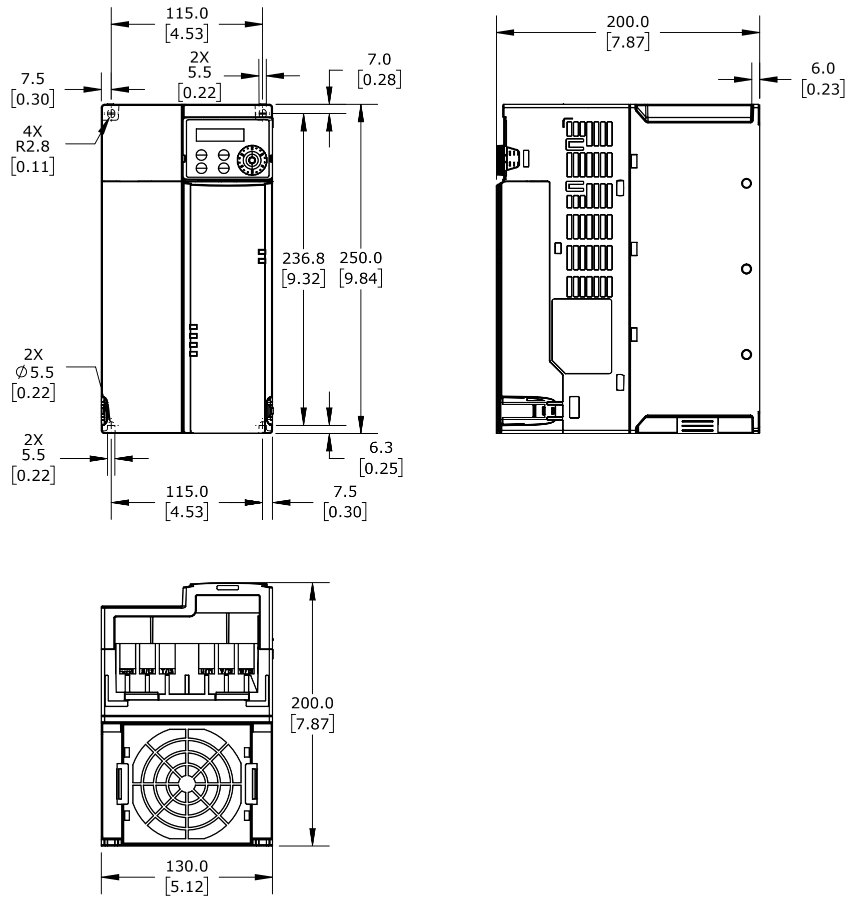
GS30 Frame Size D Conduit Box



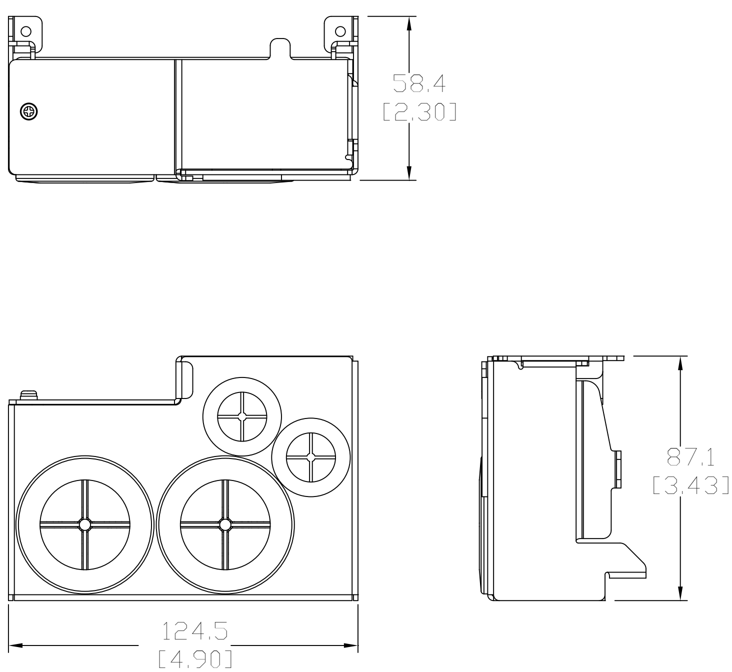
Dimensions (Units = mm [in])

See our website www.AutomationDirect.com for complete engineering drawings and 3D models.

GS30 Frame Size E



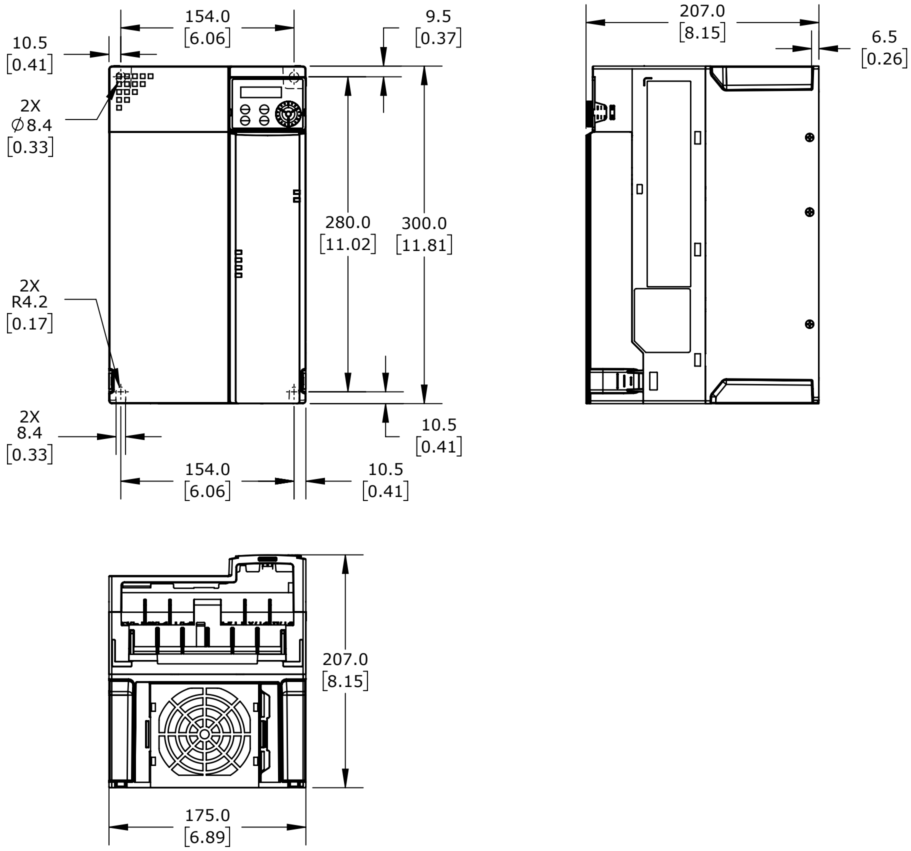
GS30 Frame Size E Conduit box



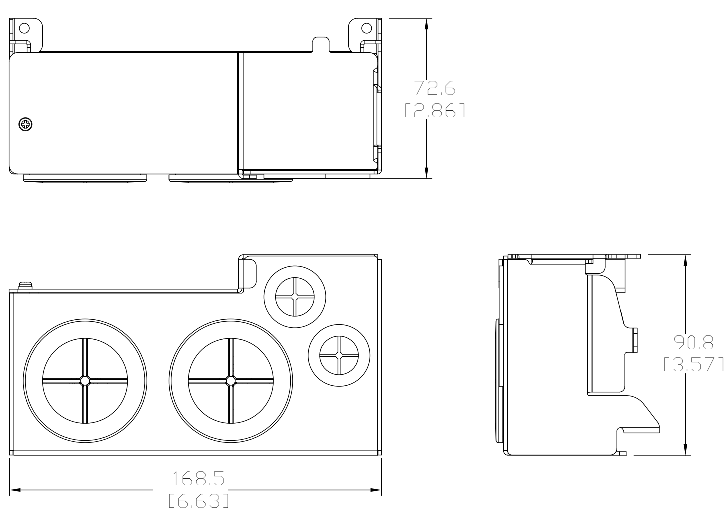
Dimensions (Units = mm [in])

See our website www.AutomationDirect.com for complete engineering drawings and 3D models.

GS30 Frame Size F



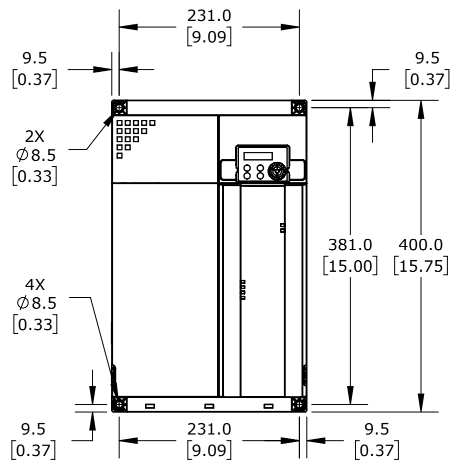
GS30 Frame Size F Conduit box

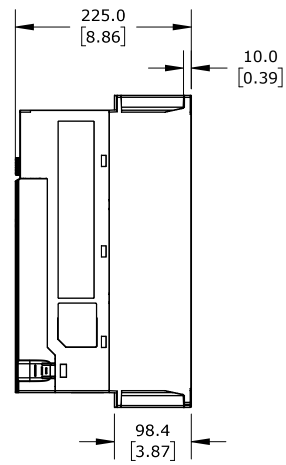


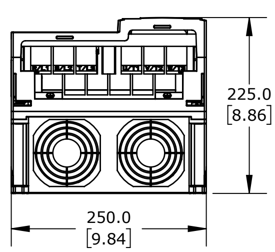
Dimensions (Units = mm [in])

See our website www.AutomationDirect.com for complete engineering drawings and 3D models.

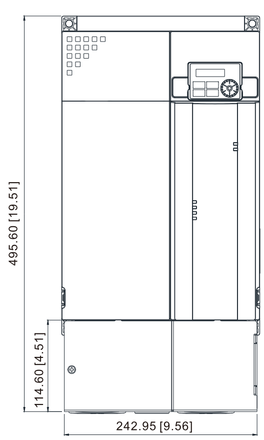
GS30 Frame Size G

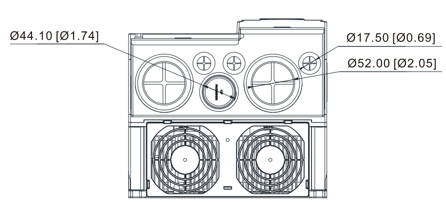






GS30 Frame Size G Conduit box

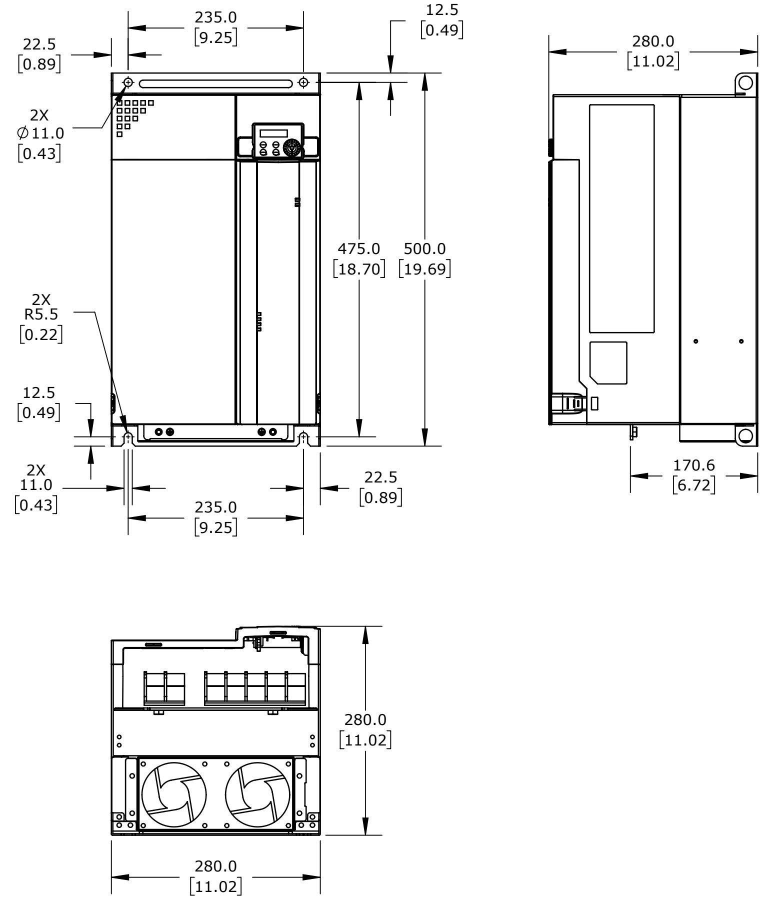




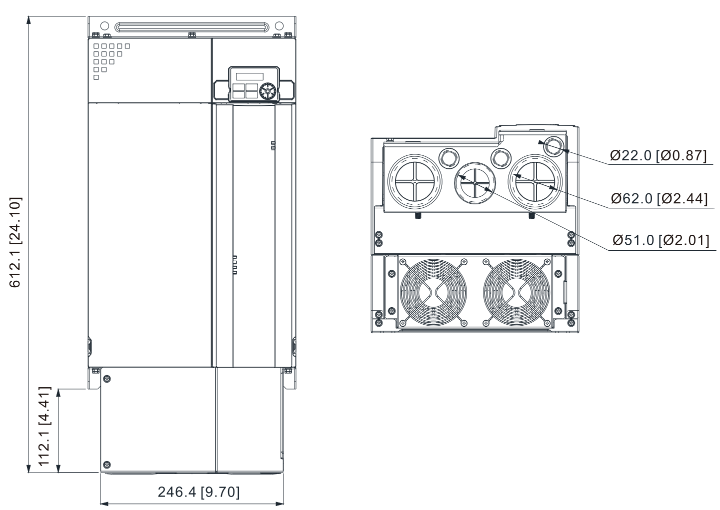
Dimensions (Units = mm [in])

See our website www.AutomationDirect.com for complete engineering drawings and 3D models.

GS30 Frame Size H



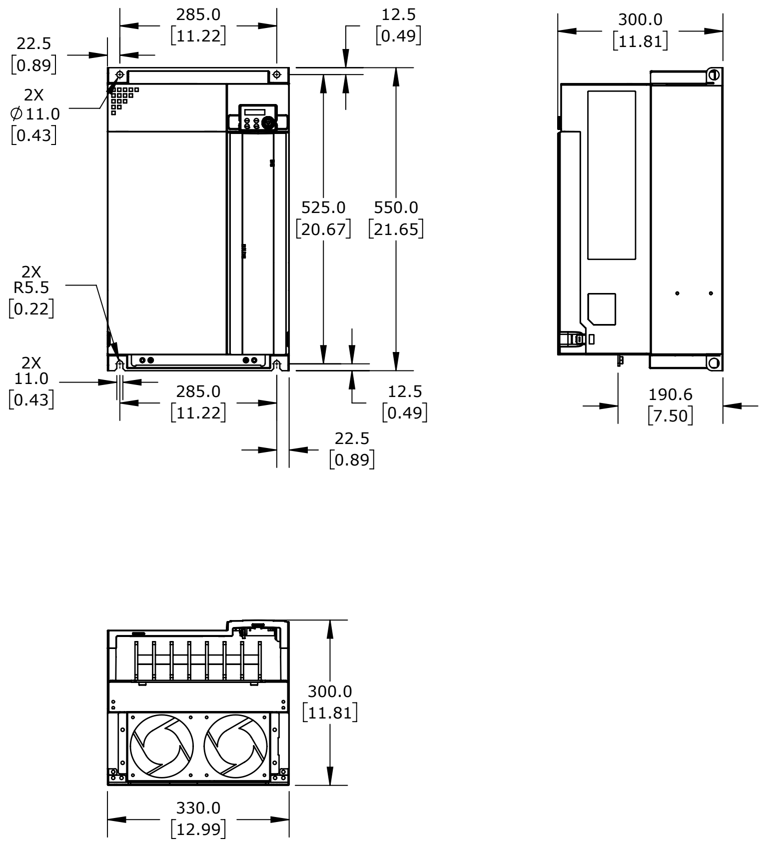
GS30 Frame Size H Conduit box



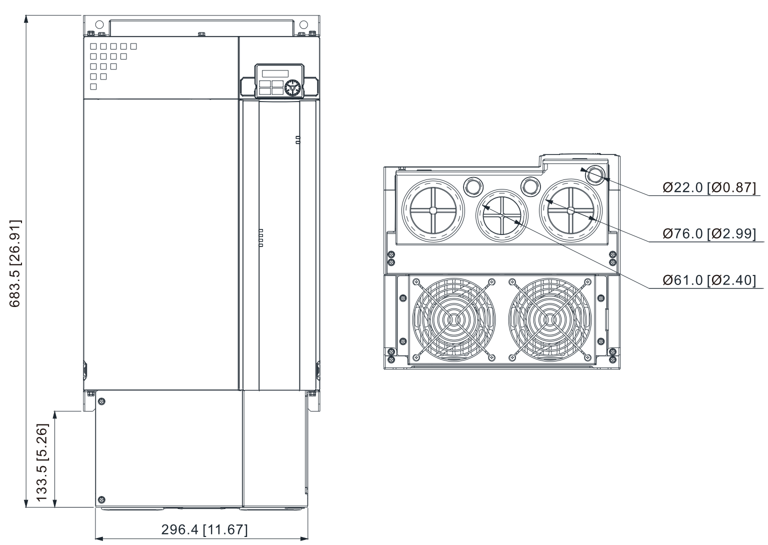
Dimensions (Units = mm [in])

See our website www.AutomationDirect.com for complete engineering drawings and 3D models.

GS30 Frame Size I



GS30 Frame Size I Conduit box



Circuit Connections – RFI Jumper

RFI Jumper: The GS30 drives may emit electrical noise. The drive contains Varistors / MOVs that are connected from phase to phase and from phase to ground to prevent the drive from unexpected stop or damage caused by mains surges or voltage spikes. Because the Varistors/ MOVs from phase to ground are connected to ground with the RFI jumper, removing the RFI jumper disables the protection.

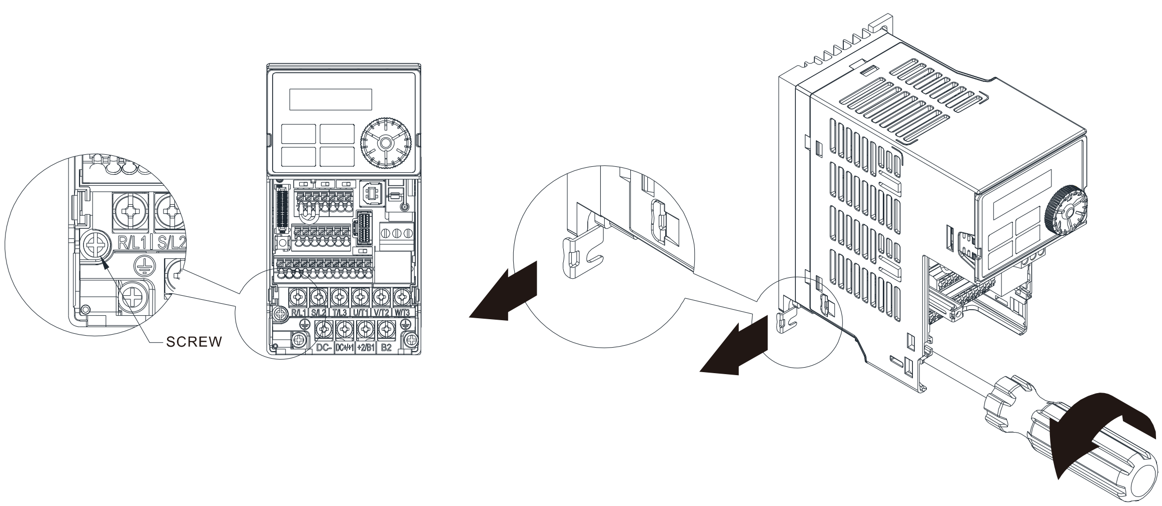
RFI Jumper Removal

The RFI jumper may need to be removed in some cases, such as situations in which the GS30 drive is powered from an Asymmetric Ground System (Corner Grounded TN System), as described on page 2–17.

GS30 Frames A~I

Screw Torque: 4–6 kg·cm [3.5–5.2 lb·in]

Loosen the screw indicated in the view below, and remove the RFI jumper. Tighten the screw to the specified torque after the RFI jumper is removed.



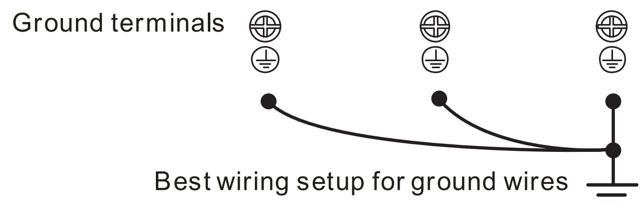
Isolating Main Power from Ground

WARNING: If the power distribution system supplying the GS30 drive is a floating-ground system (IT) or an asymmetric-ground system (TN), the RFI jumper MUST BE REMOVED.

If the power distribution system supplying the GS30 drive is a floating ground system (IT) or an asymmetric ground system (TN), the RFI jumper must be removed. Removing the RFI jumper disconnects the internal RFI filter capacitor between the drive's frame and circuits to avoid damaging those circuits and to reduce ground leakage current.

Important points regarding ground connection

- *To ensure the safety of personnel and proper operation, and to reduce electromagnetic radiation, the GS30 drive must be properly grounded during installation.*
- *The diameter of the cables must meet the size specified by applicable codes and regulations.*
- *The shield of shielded cables must be connected to the ground of the GS30 drive to meet safety regulations.*
- *The shield of shielded cables can be used as the ground for equipment only when the aforementioned points are met.*
- *When installing multiple GS30 drives, do not connect the grounds of the AC motor drive in series. Instead, use a single-point grounding scheme (as shown below) or provide individual grounding rods for each GS30 drive.*



Pay particular attention to the following WARNINGS:

WARNING: Do not remove the RFI jumper while power is applied to the GS30 drive.

WARNING: Removing the RFI jumper also disconnects the built-in EMC filter capacitors. Compliance with the EMC specifications is no longer guaranteed.

WARNING: The RFI jumper may not be removed if the main power is a symmetrically grounded power system.

WARNING: Warning: Do not remove the RFI jumper while conducting high voltage tests. When conducting a high voltage test to the entire facility, you must disconnect the mains power and the motor if the leakage current is too high.

Floating Ground System (IT Systems)

A floating ground system is also called an IT system, an ungrounded system, or a high impedance/ resistance grounding system (greater than 30Ω).

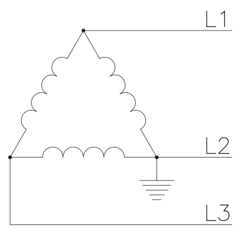
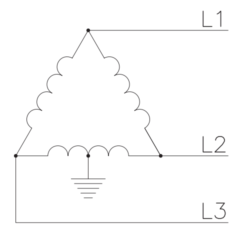
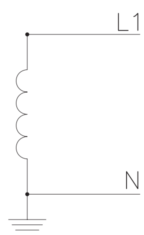
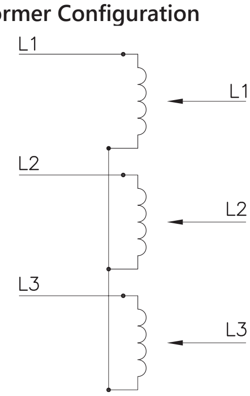
Disconnect the RFI Jumper

CAUTION: Do not install an external RFI/EMC filter! The EMC filter will pass through the RFI capacitor, thus connecting power input to ground. This is very dangerous and can easily damage the GS30 drive.

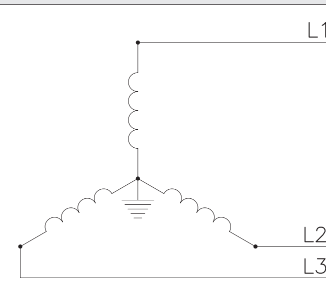
Asymmetric Ground System (Corner Grounded TN Systems)

CAUTION: Do not remove the RFI jumper while the input terminals of the GS30 drive carries power.

The RFI jumper must be removed in the following four situations. This is to prevent the system from grounding through the RFI capacitor, damaging the GS30 drive.

RFI Jumper Must Be Removed (Asymmetric Ground / Corner Grounded TN Systems)	
1) Grounding at a Corner of a Triangle Configuration 	2) Grounding at a Midpoint in a Polygonal Configuration 
3) Grounding at One End in a Single-Phase Configuration 	4) No Stable Neutral Grounding in a Three-Phase Autotransformer Configuration 

The RFI jumper should be left in place for a symmetrically grounded system.

RFI Jumper Left In Place (Symmetrical Ground System)	
Internal grounding through internal RFI filter which reduces electromagnetic radiation. In a situation with higher requirements for electromagnetic compatibility, and using a symmetrical grounding power system, an EMC filter can be installed. As a reference, the diagram on the right is a symmetrical grounding power system.	

Circuit Connections – Warnings and Notes

Danger!

Hazardous Voltage! Before making any connection to the AC drive, disconnect all power to the AC drive, and wait five minutes for DC bus capacitors to discharge.

Warning: Any electrical or mechanical modification to this equipment will void all warranties, may result in a safety hazard, and may void the UL and other listings.

Warning: Do not connect the AC input power to the T1, T2, and T3 output terminals. Doing this will damage the AC drive.

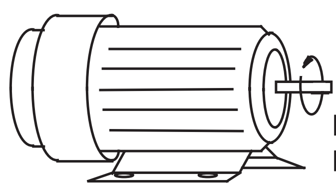
Warning: Do not connect single-phase power to a three-phase drive model.

Warning: Tighten all screws to the proper torque rating. See “Main Circuit Wiring” later in this chapter.

Wiring Notes: PLEASE READ PRIOR TO INSTALLATION.

1) During installation, follow all local electrical, construction, and safety codes for the country in which the AC drive is to be installed.
2) Refer to the “ GS30 Drive Specifications” in chapter 1 for voltage and current requirements.
3) Torque the screws of the main circuit terminals to prevent loosening due to vibration.
4) The addition of a magnetic contactor (MC) in the AC line power input wiring is recommended to turn off power quickly and reduce the possibility of malfunction if the protection function of the GS30 AC drive is activated. AutomationDirect recommends using a suppressor on the MC coil.
5) Do not use a power circuit contactor or disconnect switch for normal run/stop control of the GS30 AC drive and motor. This will reduce the operating life cycle of the AC drive. Cycling a power circuit switching device while the AC drive is in run mode should be done only in emergency situations.
6) Make sure the appropriate protective devices (circuit breaker or fuses) are connected between the power supply and AC drive.
7) Make sure that the leads are connected correctly and that the GS30 AC drive is properly grounded. Ground resistance should not exceed 0.1Ω.
8) Use ground leads that comply with AWG/MCM standards and keep them as short as possible.
9) Multiple GS30 AC drives can be installed in one location. All of the units should be grounded directly to a common ground terminal. The GS30 AC drive ground terminals may also be connected in parallel, as shown in the figure below.
Make sure there are no ground loops.

Correct Incorrect



Forward Running

10) When the GS30 AC drive output terminals T1, T2, and T3 are connected to the motor terminals T1, T2, and T3, respectively, the motor will rotate counterclockwise (as viewed from the shaft end of the motor) when a forward operation command is received. To reverse the direction of motor rotation, switch the connections of any of the two motor leads.
11) Make sure that the power source is capable of supplying the correct voltage and required current to the GS30 AC drive.
12) Do not attach or remove wiring when power is applied to the GS30 AC drive.
13) Do not inspect components until at least 5 minutes has passed from when the drive supply power was disconnected, to allow the drive capacitors to drain.
14) Do not access or remove any of the covers when the drive is powered.

15) Route the power, communication, and control wires separately, or at 90 degree angle to each other.
16) Ground both ends of the shield wire or conduit for the power wiring.
    a) If using a “VFD cable,” follow the manufacturer’s recommendation for grounding the cable shield.
    b) If using conduit, bond and ground conduit according to applicable electrical codes.
17) If a filter is required for reducing EMI (Electro Magnetic Interference), install it as close as possible to the GS30 AC drive input. EMI can also be reduced by lowering the Carrier Frequency. Please refer to the “Applied EMI/RFI Techniques” white paper at support.automationdirect.com.
18) If the GS30 AC drive is installed in a place where a load reactor is needed, install the reactor close to the T1, T2, and T3 side of GS30 AC drive. Do not use a Capacitor, L-C Filter (Inductance-Capacitance), or R-C Filter (Resistance-Capacitance).
19) When using a GFCI (Ground Fault Circuit Interrupt), select current sensor with sensitivity of 200mA or higher, and not less than 0.1-second operation time to avoid nuisance tripping.

Main Power Terminals

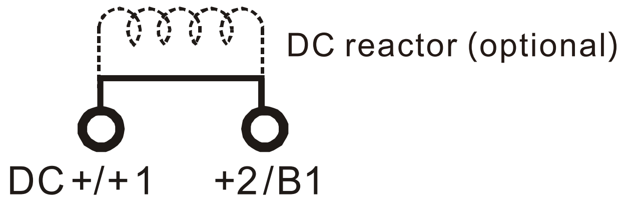
- *Do not supply any GS33-xxxx models with single-phase power.*
- *R/L1, S/L2, and T/L3 have no phase-sequence requirement; they can be wired in any order.*
- *Do NOT start/stop the GS30 AC drive by turning input power ON/OFF except in emergencies.*
- *Start/stop the GS30 AC drive using RUN/STOP commands via control terminals or the keypad. If you must start/stop the GS30 AC drive by turning power ON/OFF, it is recommended to do so only ONCE per hour.*

Output Terminals for Main Circuit

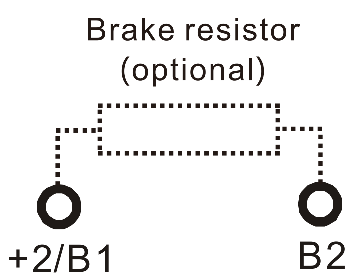
- *Do NOT connect phase-compensation capacitors or surge absorbers to the output terminals of the GS30 AC drive.*
- *Use a well-insulated motor rated for inverter operation.*

Terminals for Connecting DC Reactor, External Brake Resistor, and DC Circuit

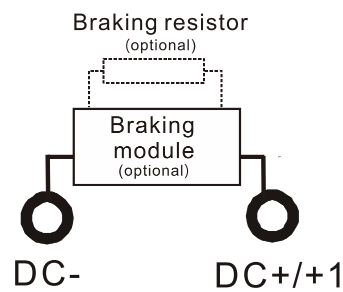
- *Terminals +1 and +2 are used to connect an optional DC reactor or choke to improve power factor. From the factory, these terminals are connected with a short-circuit jumper. Remove this jumper before connecting a DC reactor.*
- *Leave the jumper in place **IF** a DC reactor is not connected **AND** DC+/+1 and +2/B1 terminals are used for common DC bus or brake resistors. This will prevent the AC motor drive from losing power and damage to the terminals. If the jumper is missing due to wiring, refer to the recommended main circuit terminal wire to short-circuit the DC+/+1 and +2/B1 terminals.*



- *When the GS30 AC Drive is connected directly to a large-capacity power transformer (600kVA or above) or when a phase lead capacitor is switched, peak currents may occur in the power input circuit due to the load change. This can result in damage to the converter section of the drive. To avoid this damage install a line reactor at the GS30 input terminals, R/L1, S/L2, and T/L3. The installation of a line reactor will reduce current spikes and improve input power efficiency.*
- *Install an external brake resistor for applications that include frequent deceleration to stop, short deceleration time (such as high frequency operation and heavy load operation), too low braking torque, or increased braking torque.*



Frames A–G



Frames H–I

- *For GS30 drives, the external brake resistor should be connected to the B1 and B2 terminals for frame sizes A through G. On frames H & I, braking resistors must be connected to a dynamic braking unit and not directly to the drive. See diagram above for reference.*
- *If the terminals [+1], [+2], and [DC-] are not used, leave these three terminals open.*
- *To avoid personal injury and to prevent damage to the GS30 drive; DO NOT jumper DC- to DC+, DC- to +2/B1, DC- to B2. Connect braking resistors to B1 and B2 ONLY*
- *DC+ and DC- are connected for common DC bus, please refer to "Main Circuit Wiring Terminals" in this chapter for wiring terminal specification and wire gauge information.*
- *Please refer to the DURApulse Drives Dynamic Braking User Manual for more information on installing brake units.*
  (Available for free download at http://www.automationdirect.com/static/manuals/index.html.)

Motor Operation Precautions

1) When using the GS30 AC drive to operate a non-inverter rated 3-phase induction motor, notice that the energy loss is greater than for an inverter rated motor.
2) Avoid running a non-inverter rated induction motor at low speed. Doing so may cause the motor temperature to exceed the motor rating due to limited airflow produced by the motor's fan.
3) When the non-inverter rated motor operates at low speed, the output load must be decreased.
4) If **100% output torque** is desired at low speed, it is necessary to use an inverter rated motor.

Short Circuit Withstand (SCCR)

All *DURAPULSE* GS30 series drives are suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes.

Applicable Codes

All *DURAPULSE GS30* AC drives are Underwriters Laboratories, Inc. (UL) and Canadian Underwriters Laboratories (cUL) listed, and therefore comply with the requirements of the National Electrical Code (NEC) and the Canadian Electrical Code (CEC).

Installations intended to meet the UL and cUL requirements must follow the instructions provided in “Wiring Notes” as a minimum standard. Follow all local codes that exceed UL and cUL requirements. Refer to the technical data label affixed to the AC drive and the motor nameplate for electrical data.

The “Circuit Protection Devices” section in Appendix A lists the recommended fuse part number for each *DURAPULSE* part number. These fuses (or equivalent) must be used on all installations where compliance with UL standards is required.

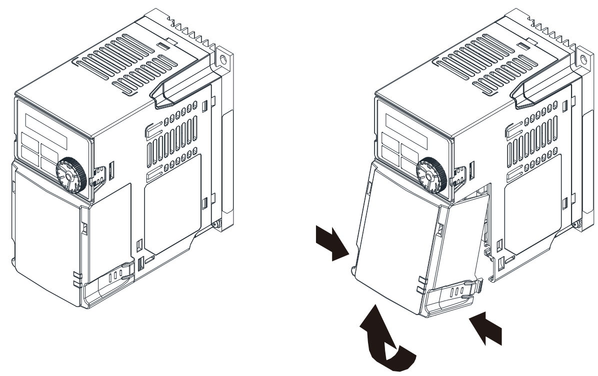
Wiring Terminal Access

Control Terminal Access

Remove the drive front cover to access and wire the multi-function input/output control terminals.

GS30 Drive Frames A ~ I

Press the tabs on both sides to remove the cover (Frame A example shown below).



Press the clip on both sides, and take out the front cover by rotating.

Main Circuit Wiring Terminals

Main Terminal Specifications

Main Circuit Terminals	
Terminal	***Description***
R/L1, S/L2	Input Power – 1-phase
R/L1, S/L2, T/L3	Input Power – 3-phase
U/T1, V/T2, W/T3	AC Motor Drive Output
+1, +2[1]	Connection for DC reactor/choke (remove jumper before installing a DC reactor/choke)
B1, B2	Braking Resistor Connection (Frames A–G)
DC+, DC-[1]	Common DC Bus
⏚	Ground

<table>
<tr><th colspan="8">GS30 Main Circuit Wiring Specifications</th></tr>
<tr><th rowspan="2">AC Drive Frame Size</th><th rowspan="2">AC Drive Model</th><th colspan="3">Main Circuit Terminals
R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC-, DC+/+1, +2/B1, B2</th><th colspan="3">Ground Terminals ⏚</th></tr>
<tr><th>Max Wire Gauge</th><th>Min Wire Gauge</th><th>Screw Size & Torque (±10%)</th><th>Max Wire Gauge</th><th>Min Wire Gauge</th><th>Screw Size & Torque (±10%)</th></tr>
<tr><td rowspan="5">A</td><td>GS31-20P5</td><td rowspan="5">2.5 mm^2
[14 AWG]</td><td rowspan="2">2.5 mm^2
[14 AWG]</td><td rowspan="5">M3.5
9 kg-cm
[7.8 in-lb]
[0.88 N·m]</td><td rowspan="5">2.5 mm^2
[14 AWG]</td><td rowspan="5">2.5 mm^2
[14 AWG]</td><td rowspan="5">M3.5
9 kg-cm
[7.8 in-lb]
[0.88 N·m]</td></tr>
<tr><td>GS33-21P0</td></tr>
<tr><td>GS33-20P5</td><td rowspan="2">0.75 mm^2
[18 AWG]</td></tr>
<tr><td>GS33-40P5</td></tr>
<tr><td>GS33-41P0</td><td>1.5 mm^2
[16 AWG]</td></tr>
<tr><td rowspan="3">B</td><td>GS31-21P0</td><td rowspan="3">4 mm^2
[12 AWG]</td><td rowspan="2">4 mm^2
[12 AWG]</td><td rowspan="3">M4
15 kg-cm
[13.0 in-lb]
[1.47 N·m]</td><td rowspan="2">4 mm^2
[12 AWG]</td><td rowspan="2">4 mm^2
[12 AWG]</td><td rowspan="3">M4
15 kg-cm
[13.0 in-lb]
[1.47 N·m]</td></tr>
<tr><td>GS33-22P0</td></tr>
<tr><td>GS33-42P0</td><td>2.5 mm^2
[14 AWG]</td><td>2.5 mm^2
[14 AWG]</td><td>2.5 mm^2
[14 AWG]</td></tr>
<tr><td rowspan="6">C</td><td>GS31-22P0</td><td rowspan="6">10 mm^2
[8 AWG]</td><td rowspan="3">10 mm^2
[8 AWG]</td><td rowspan="6">M4
20 kg-cm
[17.4 in-lb]
[1.96 N·m]</td><td rowspan="3">10 mm^2
[8 AWG]</td><td rowspan="3">10 mm^2
[8 AWG]</td><td rowspan="6">M4
20 kg-cm
[17.4 in-lb]
[1.96 N·m]</td></tr>
<tr><td>GS31-23P0</td></tr>
<tr><td>GS33-25P0</td></tr>
<tr><td>GS33-23P0</td><td>6 mm^2
[10 AWG]</td><td>6 mm^2
[10 AWG]</td><td>6 mm^2
[10 AWG]</td></tr>
<tr><td>GS33-43P0</td><td>2.5 mm^2
[14 AWG]</td><td>2.5 mm^2
[14 AWG]</td><td>2.5 mm^2
[14 AWG]</td></tr>
<tr><td>GS33-45P0</td><td>4 mm^2
[12 AWG]</td><td>4 mm^2
[12 AWG]</td><td>4 mm^2
[12 AWG]</td></tr>
<tr><td rowspan="3">D</td><td>GS33-27P5</td><td rowspan="3">10 mm^2
[8 AWG]</td><td rowspan="2">10 mm^2
[8 AWG]</td><td rowspan="3">M4
20 kg-cm
[17.4 in-lb]
[1.96 N·m]</td><td rowspan="2">10 mm^2
[8 AWG]</td><td rowspan="2">10 mm^2
[8 AWG]</td><td rowspan="3">M4
20 kg-cm
[17.4 in-lb]
[1.96 N·m]</td></tr>
<tr><td>GS33-4010</td></tr>
<tr><td>GS33-47P5</td><td>6 mm^2
[10 AWG]</td><td>6 mm^2
[10 AWG]</td><td>6 mm^2
[10 AWG]</td></tr>
<tr><td rowspan="4">E</td><td>GS33-2010</td><td rowspan="3">16 mm^2
[6 AWG]</td><td rowspan="3">16 mm^2
[6 AWG]</td><td rowspan="4">M5
25 kg-cm
[21.7 in-lb]
[2.45 N·m]</td><td rowspan="3">16 mm^2
[6 AWG]</td><td rowspan="4">16 mm^2
[6 AWG]</td><td rowspan="4">M5
25 kg-cm
[21.7 in-lb]
[2.45 N·m]</td></tr>
<tr><td>GS33-4015</td></tr>
<tr><td>GS33-4020</td></tr>
<tr><td>GS33-2015</td><td>25 mm^2
[4 AWG]</td><td>25 mm^2
[4 AWG]</td><td>25 mm^2
[4 AWG]</td></tr>
<tr><td rowspan="3">F</td><td>GS33-2020</td><td rowspan="3">35 mm^2
[2 AWG]</td><td rowspan="2">35 mm^2
[2 AWG]</td><td rowspan="3">M6
40 kg-cm
[34.7 in-lb]
[3.92 N·m]</td><td rowspan="2">35 mm^2
[2 AWG]</td><td rowspan="3">16 mm^2
[6 AWG]</td><td rowspan="3">M6
40 kg-cm
[34.7 in-lb]
[3.92 N·m]</td></tr>
<tr><td>GS33-4030</td></tr>
<tr><td>GS33-4025</td><td>25 mm^2
[4 AWG]</td><td>25 mm^2
[4 AWG]</td></tr>
<tr><td rowspan="3">G</td><td>GS33-2025</td><td rowspan="3">50 mm^2
[1/0 AWG]</td><td rowspan="3">35 mm^2
[2 AWG]</td><td rowspan="3">M8
80 kg-cm
[69.4 in-lb]
[7.84 N·m]</td><td rowspan="2">35 mm^2
[2 AWG]</td><td rowspan="3">16 mm^2
[6 AWG]</td><td rowspan="3">M8
80 kg-cm
[69.4 in-lb]
[7.84 N·m]</td></tr>
<tr><td>GS33-2030</td></tr>
<tr><td>GS33-4040</td><td>25 mm^2
[4 AWG]</td></tr>
</table>

** Wiring specifications for drives with optional conduit box*

(continued next page)

Main Circuit Wiring Specifications (continued)							
AC Drive Frame Size	***AC Drive Model***	***Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC-, DC+/+1, +2/B1, B2***			***Ground Terminals ⏚***		
		Max Wire Gauge	***Min Wire Gauge***	***Screw Size & Torque (±10%)***	***Max Wire Gauge***	***Min Wire Gauge***	***Screw Size & Torque (±10%)***
H	***GS33-4050***	95 mm^2 [3/0 AWG]	50 mm^2 [1/0 AWG]	M8 80 kg-cm [69.4 in-lb] [7.84 N·m]	95 mm^2 [3/0 AWG]	25 mm^2 [4 AWG]	M8 80 kg-cm [69.4 in-lb] [7.84 N·m]
	GS33-4060		95 mm^2 [3/0 AWG]			50 mm^2 [1/0 AWG]	
H*	***GS33-4050***	70 mm^2 [2/0 AWG]	50 mm^2 [1/0 AWG]	M8 80 kg-cm [69.4 in-lb] [7.84 N·m]	70 mm^2 [2/0 AWG]	25 mm^2 [4 AWG]	M8 80 kg-cm [69.4 in-lb] [7.84 N·m]
	GS33-4060		70 mm^2 [2/0 AWG]			35 mm^2 [2 AWG]	
I	***GS33-2040***	150 mm^2 [300MCM]	150 mm^2 [250MCM]	M8 80 kg-cm [69.4 in-lb] [7.84 N·m]	150 mm^2 [300MCM]	95 mm^2 [3/0 AWG]	M8 80 kg-cm [69.4 in-lb] [7.84 N·m]
	GS33-2050 ***GS33-4100***		150 mm^2 [300MCM]				
	GS33-4075		120 mm^2 [4/0 AWG]			70 mm^2 [2/0 AWG]	
I*	***GS33-2040***	120 mm^2 [4/0 AWG]	95 mm^2 [3/0 AWG]	M8 80 kg-cm [69.4 in-lb] [7.84 N·m]	150 mm^2 [300MCM]	95 mm^2 [3/0 AWG]	M8 80 kg-cm [69.4 in-lb] [7.84 N·m]
	GS33-2050 ***GS33-4100***		120 mm^2 [4/0 AWG]				
	GS33-4075		95 mm^2 [3/0 AWG]			70 mm^2 [2/0 AWG]	
** Wiring specifications for drives with optional conduit box*							

UL installations must use 600V, 75°C or 90°C wires. Use copper wire only.

Wiring Terminal Connector Dimensions – Main-Circuit Terminals

GS30 Drives, Frame Size A ~ I

NOTE: Heat shrink should comply with UL (600V, YDPU2).

Dimensions = mm

Power Terminal Wiring Connectors:

Heat Shrink Tubing:

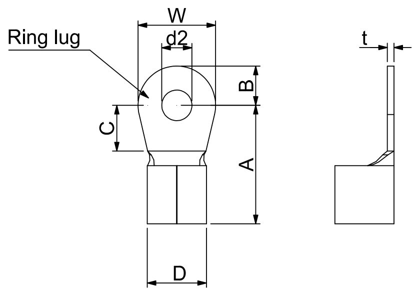


Figure 1.

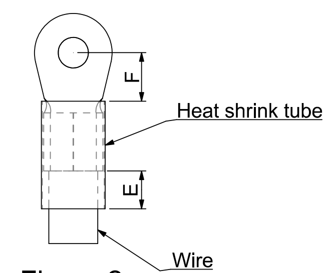
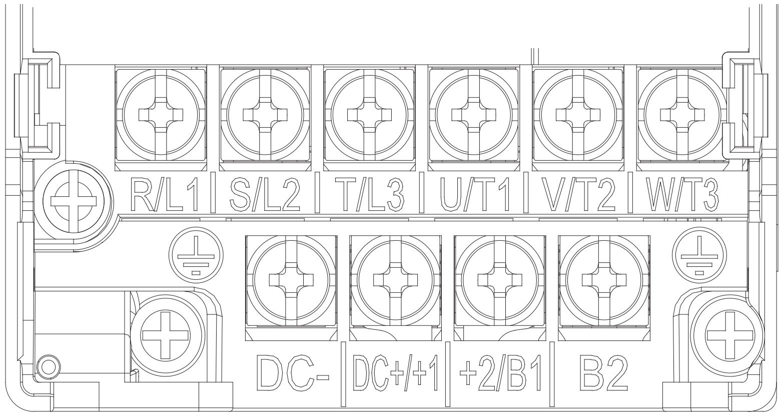


Figure 2.

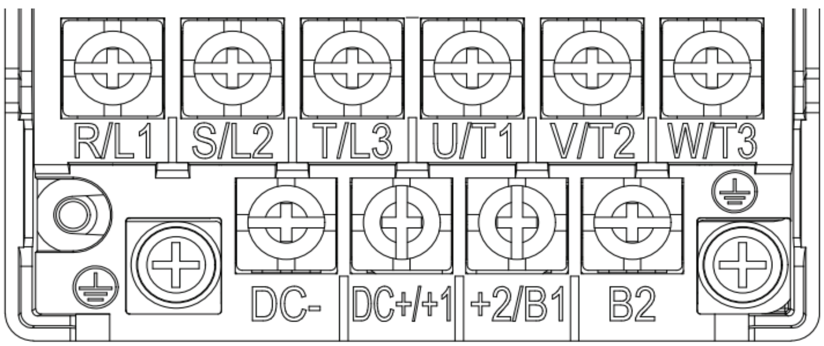
GS30 Ring Lug Dimensions (mm)											
Frame	AWG	Part Number (Manuf: K.S. Terminals)	A (Max)	B (Max)	C (Min)	D (Max)	d2 (Min)	E (Min)	F (Min)	W (Max)	t (Max)
A	18	RNBS 1.3.7	9.8	3.2	4.8	4.1	3.7	13.0	4.2	6.6	0.8
	16	RNBS 2-3.7									
	14	RNBS 2-3.7									
B	18	RNBS1-4	12.1	3.6	6.1	5.6	4.3	13.0	4.5	7.2	1
	16	RNBS1-4									
	14	RNBS2-4									
	12	RNBS5-4									
C	14	RNBS2-4	17.8	5.0	6.1	7.2	4.3	13.0	5.5	10.5	1.2
	12	RNBS5-4									
	10	RNBS5-4									
	8	RNBS8-4									
D	10	RNBS5-4	17.8	5.0	6.1	7.2	4.3	13.0	5.5	10.5	1.2
	8	RNBS8-4									
E	6	RNBS8-4	27.1	6.1	10.5	11.5	5.3	13.0	6.5	12.6	1.7
	4	RNBS14-5									
F	6	RNBS14-6	35.0	9.0	13.3	14.0	6.2	13.0	10.0	19.5	1.8
	4	RNBS22-6									
	2	RNBS38-6									
G	6	RNBS14-8	38.7	12.0	13.5	17.5	8.4	13.0	13.0	24.0	1.8
	4	RNB22-8									
	2	RNBS38-8									
	1/0	RNB60-8									
H	4	RNB22-8	40.0	11.0	10.0	23.0	8.3	13.0	14.0	24.0	4.5
	2	RNBS38-8									
	1	SQNBS60-8									
	1/0	SQNBS60-8									
	2/0	SQNBS80-8									
	3/0	SQNBS80-8									
I	1/0	RNB60-8	50.0	16.0	10.0	27.0	8.3	13.0	14.0	28.0	6.0
	2/0	RNB70-8									
	3/0	RNB80-8									
	4/0	SQNBS100-8									
	250MCM	SQNBS150-8									
	300MCM	SQNBS150-8									

Main Terminal Diagrams

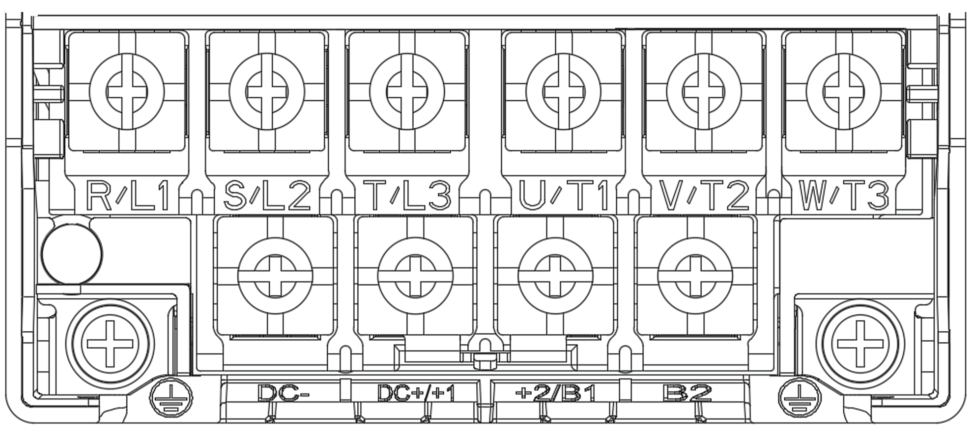
GS30 Frame Size A Main Terminals



GS30 Frame Size B Main Terminals

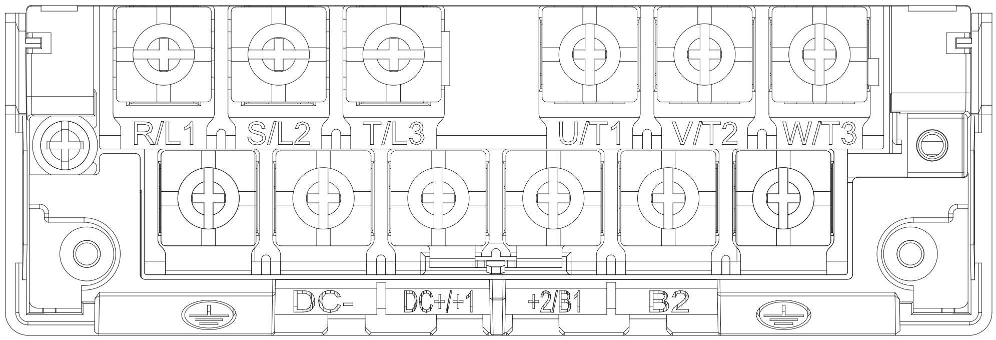


GS30 Frame Size C Main Terminals

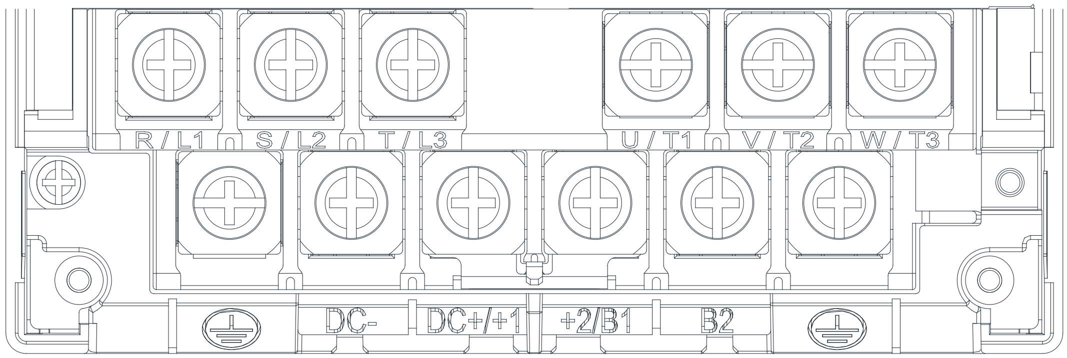


Main Terminal Diagrams (continued)

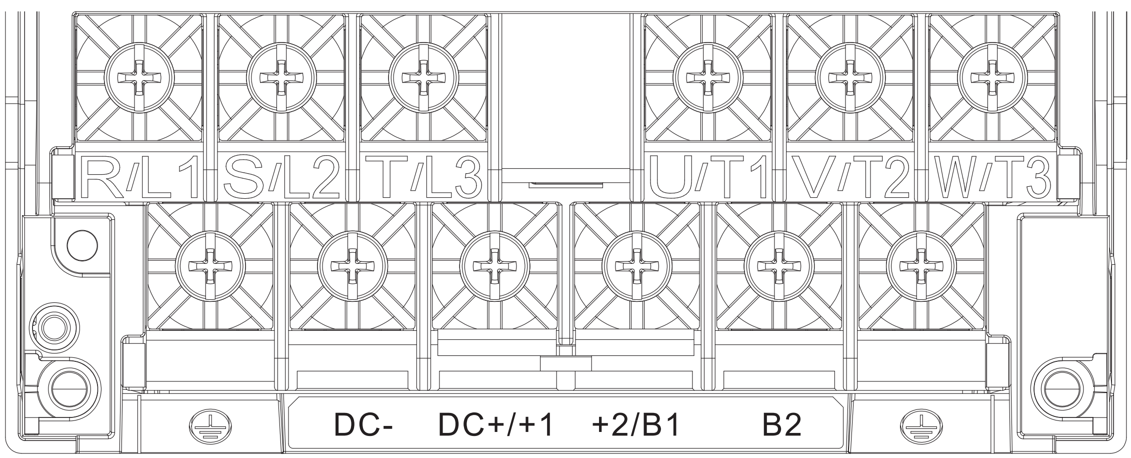
GS30 Frame Size D Main Terminals



GS30 Frame Size E Main Terminals

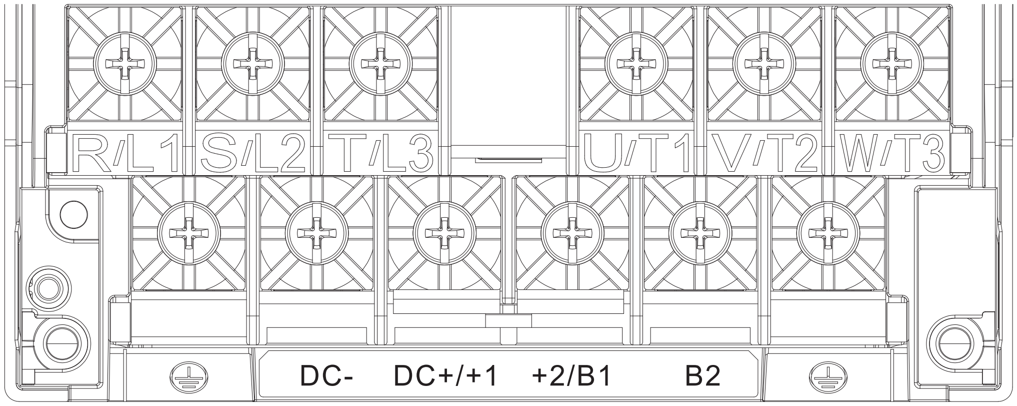


GS30 Frame Size F Main Terminals

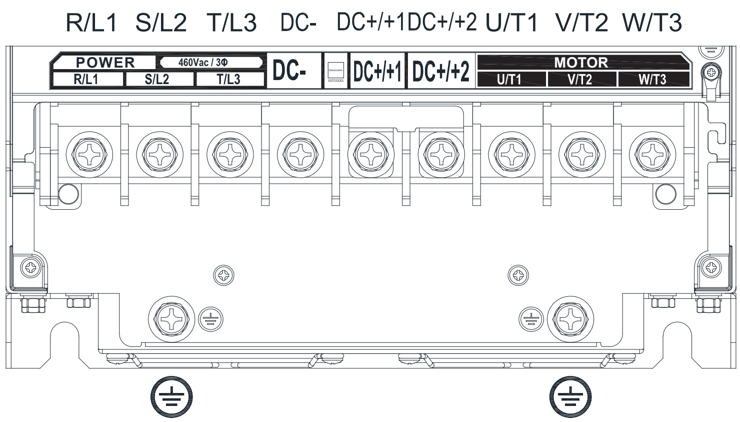


Main Terminal Diagrams (continued)

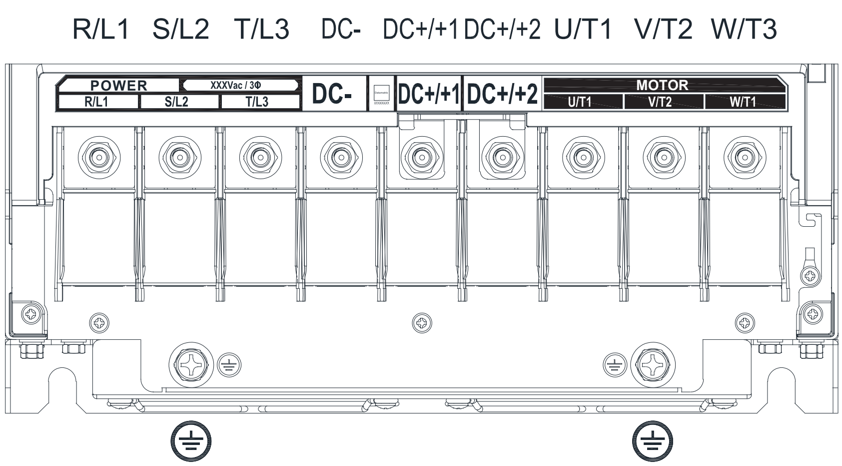
GS30 Frame Size G Main Terminals



GS30 Frame Size H Main Terminals

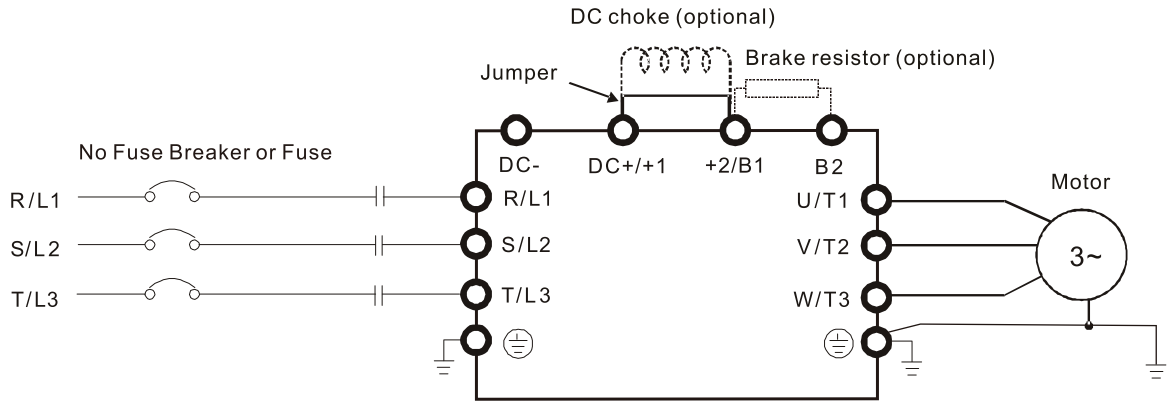


GS30 Frame Size I Main Terminals

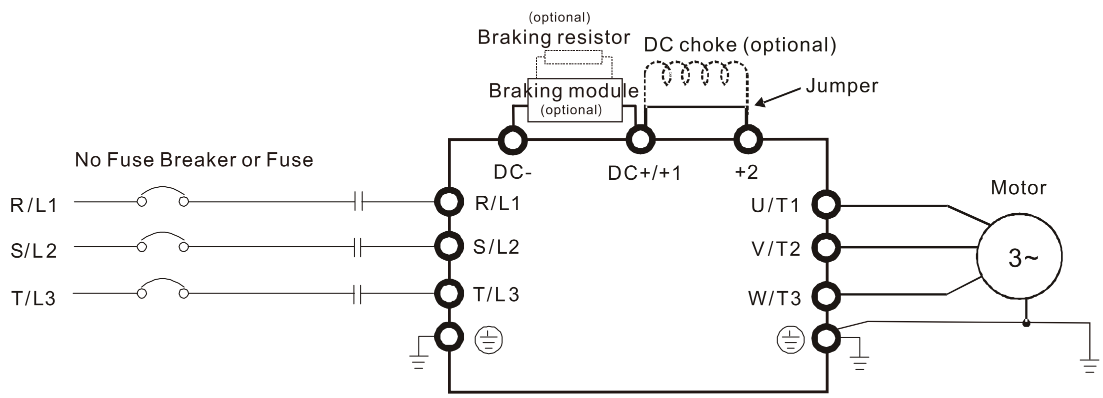


Main Circuit Wiring Diagrams

GS30 Frame Sizes A-G

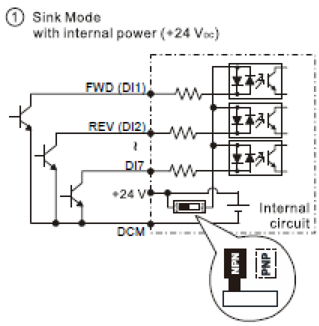
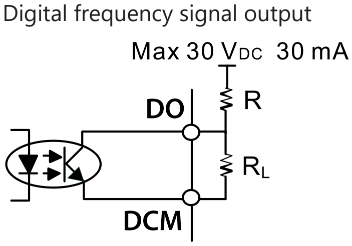
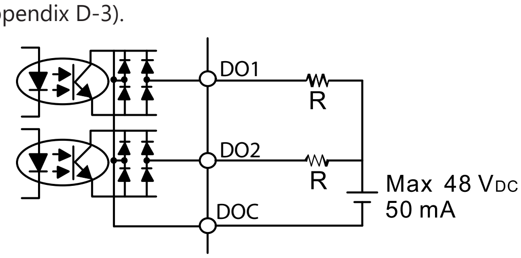


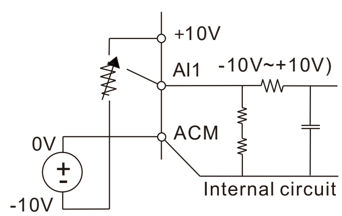
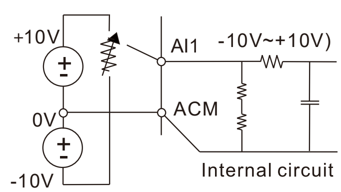
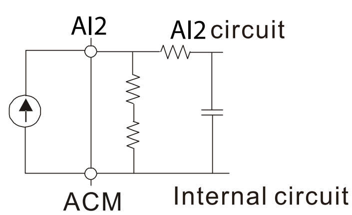
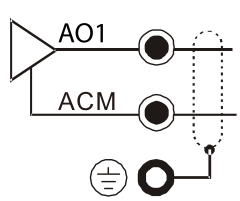
GS30 Frame Sizes H-I



Control Circuit Wiring Terminals

GS30 Control Terminal Specifications

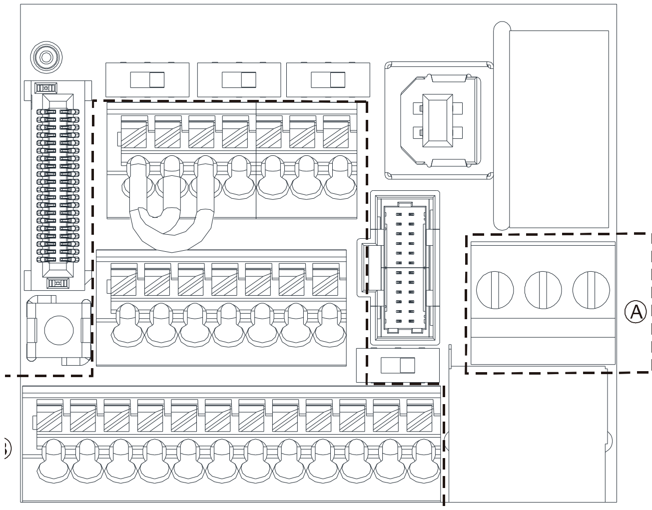
Control Circuit Terminals		
Terminal Symbol	***Terminal Function***	***Description***
+24V	Digital control signal common (Source)	+24V ± 10% 100 mA **Note:** When used in parallel, if the +24V terminal is used with a feedback sensor, unequal current may occur, and there will be a risk of failure.
FWD (DI1) REV (DI2) DI3 - DI7	Digital input 1–7  See page 2–35 for sinking/ sourcing wiring examples.	**<u>Source Mode:</u>** ON: activation current 3.3 mA ≥ 11 VDC OFF: cut-off voltage ≤ 5 VDC **<u>Sink Mode:</u>** ON: activation current 3.3 mA ≤ 13 VDC OFF: cut-off voltage ≥ 19 VDC DI7: Single pulse input, maximum input frequency=33kHz. Digital inputs can be configured by the user for many different functions. Refer to P02.01–P02.07 to program the digital inputs FWD (DI1), REV (DI2), DI3–DI7. • When P02.00=0, FWD (DI1) and REV (DI2) can be programmed. • When P02.00≠0, the functions of FWD (DI1) and REV (DI2) act according to P02.00 setting. • When P02.07=0, DI7 is pulse input terminal. • DI7 uses pulse input can be used as frequency command source or connect it to the encoder for motor closed-loop control. • DI7 motor closed-loop control only supports VFPG control mode.
DO	Digital frequency signal output 	DO uses pulse voltage as an output monitoring signal; Duty-cycle: 50 % Min. load impedance RL: 1 kΩ / 100 pF Max. current endurance: 30 mA Max. voltage: 30 VDC ± 1 % (when 30 VDC / 30 mA / RL=100 pF) Max. output frequency: 33 kHz Current-limiting resistor R: ≥ 1 KΩ Output load impedance RL Capacitive load ≤ 100 pF Resistive load ≥ 1 kΩ, resistance determines the output voltage value. DO-DCM voltage = external voltage * (RL/ (RL+R))
DCM	Digital control / Frequency signal common (Sink)	
DO1	Digital Output 1 (photo coupler)	The AC motor drive outputs various monitoring signals, such as drive in operation, frequency reached, and overload indication through a transistor (open collector). These can be wired as sinking or sourcing (see Appendix D-3). 
DO2	Digital Output 2 (photo coupler)	
DOC	Digital Output Common (photo coupler)	
(continued next page)		

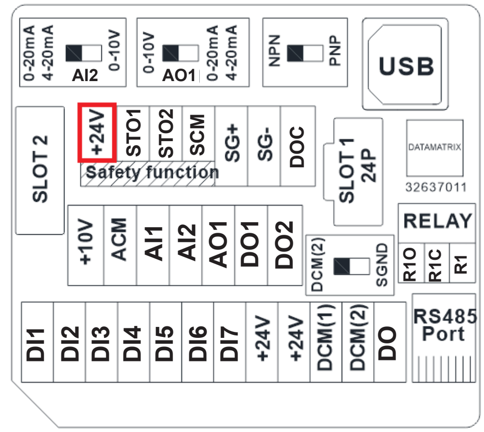
Control Circuit Terminals (continued)		
Terminal Symbol	**Terminal Function**	**Description**
R1O	Relay Output 1 (N.O.) a	**Resistive Load** • 3.0 A (NO), 3.0 A (NC) @ 250VAC • 5.0 A (NO), 3.0 A (NC) @ 30VDC **Inductive Load (COS 0.4)** • 1.2 A (NO), 1.2 A (NC) @ 250VAC • 2.0 A (NO), 1.2 A (NC) @ 30VDC To output different kinds of monitoring signals such as motor drive in operation, frequency reached, and overload indication.
R1C	Relay Output 1 (N.C.) b	
R1	Relay Output 1 Common	
+10V	Potentiometer power supply	Power supply for analog frequency setting: +10.5 ± 0.5 VDC / 20 mA
AI1	Analog voltage frequency command  	Circuit Impedance: 20kΩ Potentiometer Rating: 5kΩ (for full frequency range) Range: 0–10 V / -10–10 V = 0–Maximum Operation Frequency (P01.00) Mode switching by setting P03.00, P03.28 AI1 resolution=10 bits
AI2	Analog current frequency command 	Impedance: Current mode=250 Ω, Voltage mode=20 kΩ Range: 0–20 mA / 4–20 mA / 0–10 V = 0–Maximum Operation Frequency (P01.00) Mode switching by setting P03.01, P03.29 Switch: The AI2 default is 0–20 mA / 4–20 mA (current mode) AI2 resolution = 12 bits
AO1	Multi-function analog voltage output 	Switch: The AO1 default is 0–10 V (voltage mode). To switch to the current mode, two steps are required: 1) A dip switch must be configured (follow the instructions on the inner side of the front cover or see page 2–33. 2) Change P03.31 to 1 or 2 (see page 4–127). **Voltage mode** Range: 0–10 V (P03.31=0) corresponds to the maximum operating range of the control target Max. output current: 2 mA Max. Load: 5 kΩ **Current mode** Range: 0–20 mA (P03.31=1) / 4–20 mA (P03.31=2) corresponds to the maximum operating range of the control target, maximum load 500 Ω AO1 resolution=10 bits
ACM	Analog Signal Common	Analog signal common terminal

(continued next page)

<table>
<tr><th colspan="3">Control Circuit Terminals (continued)</th></tr>
<tr><th>Terminal Symbol</th><th>Terminal Function</th><th>Description</th></tr>
<tr><td>STO1, STO2</td><td colspan="2" rowspan="2">Default: STO1 / STO2 short-circuited to +24 V
Rated voltage: 24 VDC ± 10 %; maximum voltage: 30 VDC ±10 %
Rated current: 6.67 mA ± 10 %
<u>STO activation mode</u>
Input voltage level: 0 VDC < STO1-SCM or STO2-SCM < 5 VDC
STO response time ≤ 20 ms (STO1 / STO2 operates until the AC motor drive stops outputting current)
<u>STO cut-off mode</u>
Input voltage level: 11 VDC < STO1-SCM and STO2-SCM < 30 VDC
Power removal safety function per EN 954-1 and IEC / EN 61508
Note: Refer to Appendix E SAFE TORQUE OFF FUNCTION for details.</td></tr>
<tr><td>SCM</td></tr>
<tr><td>SG+</td><td colspan="2" rowspan="3">Modbus RS-485
Note: Refer to Chapter 4, parameter group 09 Communication Parameters for details.</td></tr>
<tr><td>SG-</td></tr>
<tr><td>SGND</td></tr>
<tr><td>RJ45</td><td>PIN 1, 2, 6: Reserved
PIN 3, 7: SGND
PIN 4: SG-
PIN 5: SG+
PIN 8: +10V supply GS4-KPD (provides GS4-KPD power)</td><td>The RJ45 port provides a serial communications connection. Max Baud Rate = 115.2 kbps</td></tr>
<tr><td>USB</td><td>Type B</td><td>Port for connecting the drive to GSoft2 and GSLogic for parameter, PLC, and firmware updates.</td></tr>
</table>

GS30 Control Terminal Block Diagram & Wiring Specifications

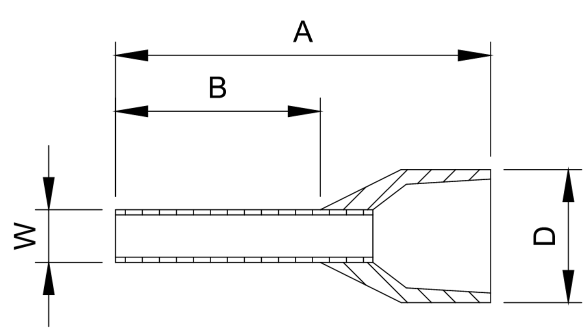




Wiring Specifications					
Terminal	***Wiring Type***	***Stripping Length (mm)***	***Maximum Wire Guage***	***Minimum Wire Gauge***	***Tightening Torque (kg·cm [lb·in])***
Relay	**Solid**	**6-7**	1.5 mm2 (16 AWG)	0.2 mm2 (24 AWG)	5 kg·cm (4.3 lb·in)
	Strand				
Control	**Solid**	**9**	0.75 mm2 (18 AWG)	0.2 mm2 (24 AWG)	n/a (spring terminals)
	Strand				
	Stranded with ferrules with plastic sleeves		0.5 mm2 (20 AWG)		

Recommended models or dimensions for ferrule terminals

Wire Gauge	*Manufacturer*	*Model Name*	*A (MAX)*	*B (MAX)*	*D (MAX)*	*W (MAX)*
0.25 mm2 [24 AWG]	PHOENIX CONTACT	AI 0,25- 8 YE	12.5	8	2.6	1.1
0.34 mm2 [22 AWG]	PHOENIX CONTACT	AI 0,34- 8 TQ	12.5	8	3.3	1.3
0.5 mm2 [20 AWG]	PHOENIX CONTACT	AI 0,5 - 8 WH	14	8	3.5	1.4
	Z+F	V30AE000006	14	8	2.6	1.15



Control Terminal Wiring Instructions

Digital Inputs

- *When using contacts or switches to control the digital inputs, use high-quality components to avoid contact bounce.*

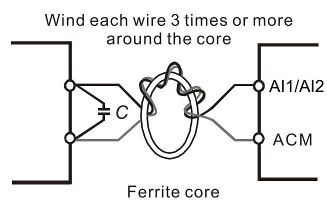
Wiring Multiple Drives Together – Digital Inputs

- *With drive Digital Inputs in SINKING mode: When connecting a single device to the Digital Inputs of multiple drives (Run, Stop, Reverse, etc.), the DCM (Digital Signal Common) terminals from each drive should be connected together. [DO NOT connect the different drive DCM terminals together if the drive DI are SOURCING.]*
- *With drive Digital Inputs in SOURCING mode (and the connected field devices are sinking): DO NOT connect the different drive DCM terminals together. [If the DCM terminals of multiple drives are connected together with the drive DI in sourcing mode, the inputs of some of the drives may inadvertently turn ON if another drive is powered OFF.]*
  Example: A switch is tied to Digital Input 1 of Drives A, B, C, and D. The Drive inputs are all set to Source current out to the field devices. If Drives A, B and C lose power, their Digital Inputs may sink enough current to inadvertently turn ON Digital Input 1 on Drive D.

WARNING: With drive Digital Inputs in SOURCING mode
DO NOT connect the different drive DCM terminals together.

Analog Inputs

- *Analog input signals are easily affected by external noise. Use shielded wiring and keep it as short as possible (<20m) with proper grounding. If the noise is inductive, connect the shield to terminal ACM.*
- *Use twisted-pair wire*
- *If the analog input signals are affected by noise from the AC motor drive, please connect a capacitor and ferrite core as indicated in the diagram at right.*
  (Wind each wire around the core 3 times or more.)



Control Terminal Wiring Instructions (continued)

Transistor Outputs (DO1, DO2, DOC)

- *Make sure digital outputs are connected with the correct polarity.*
- *When connecting a relay to digital outputs, connect a surge absorber across the coil of the relay.*

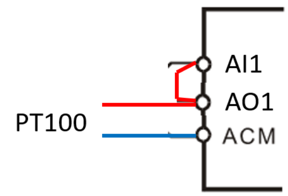
Analog Output

- *When setting dip switch AO1 ensure P03.31 AO1 0~20mA/4~20mA/0–10 V selection is set appropriately.*

PT100

PT100 RTD circuits should be wired and configured as follows:

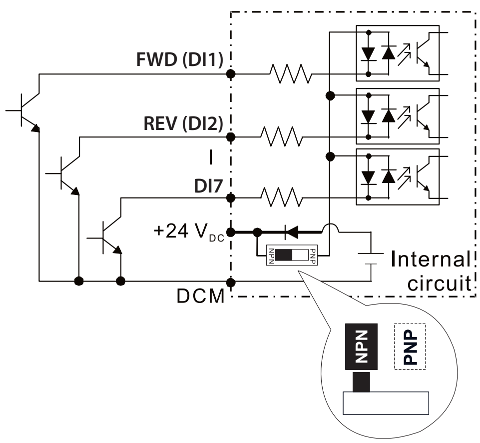
- *Set P03.00 = 11 (PT100 input)*
- *If using AI2, set dip switch to 0-10V, set P03.01=11, and P03.29=1.*



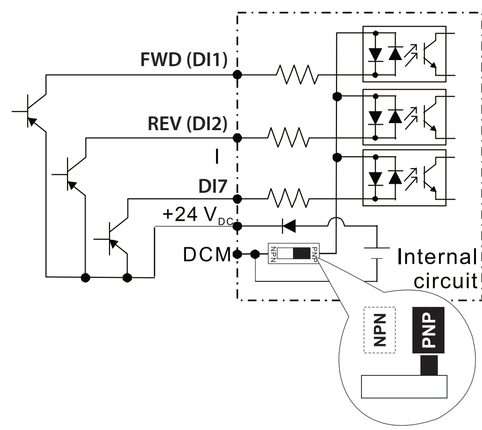
Control Circuit Wiring Diagrams

Digital Inputs

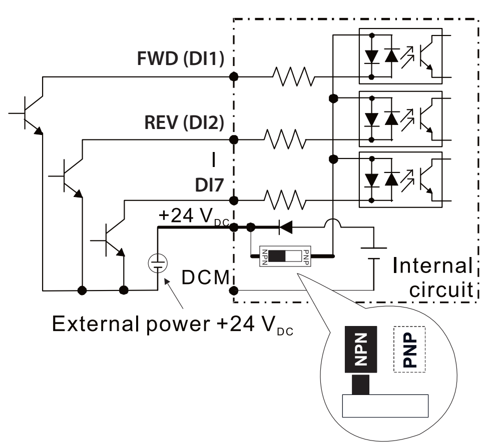
1 Sink Mode
with internal power (+24 VDC)



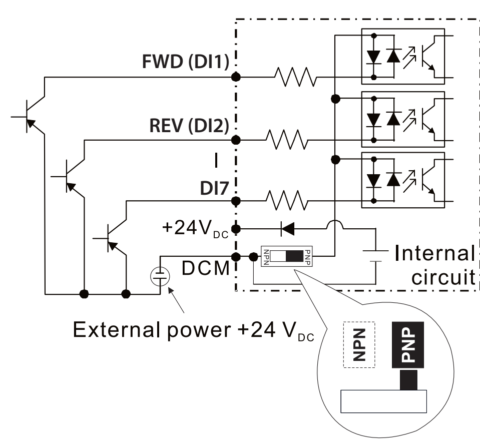
2 Source Mode
with internal power (+24 VDC)



3 Sink Mode
with external power

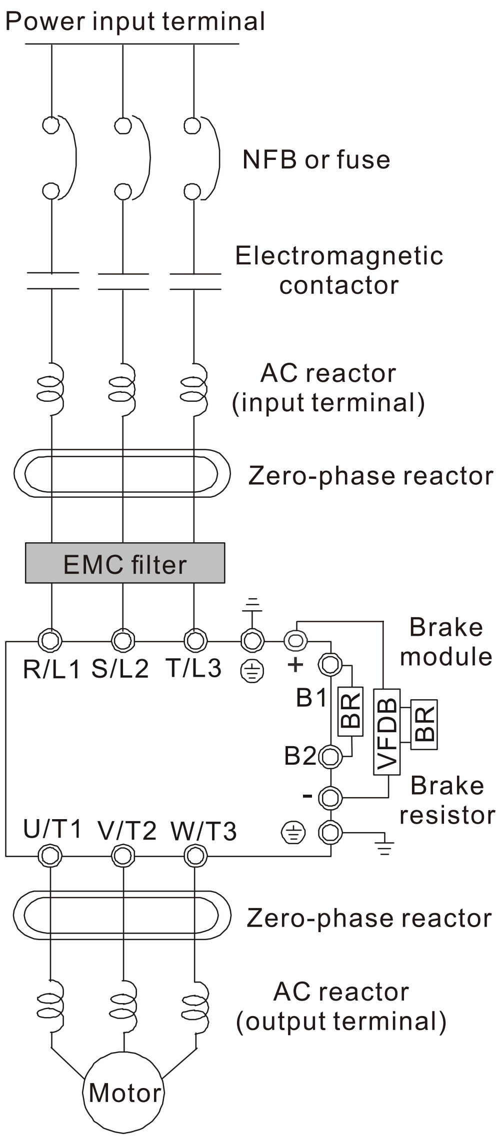


4 Source Mode
with external power



Control Circuit Wiring Diagrams (continued)

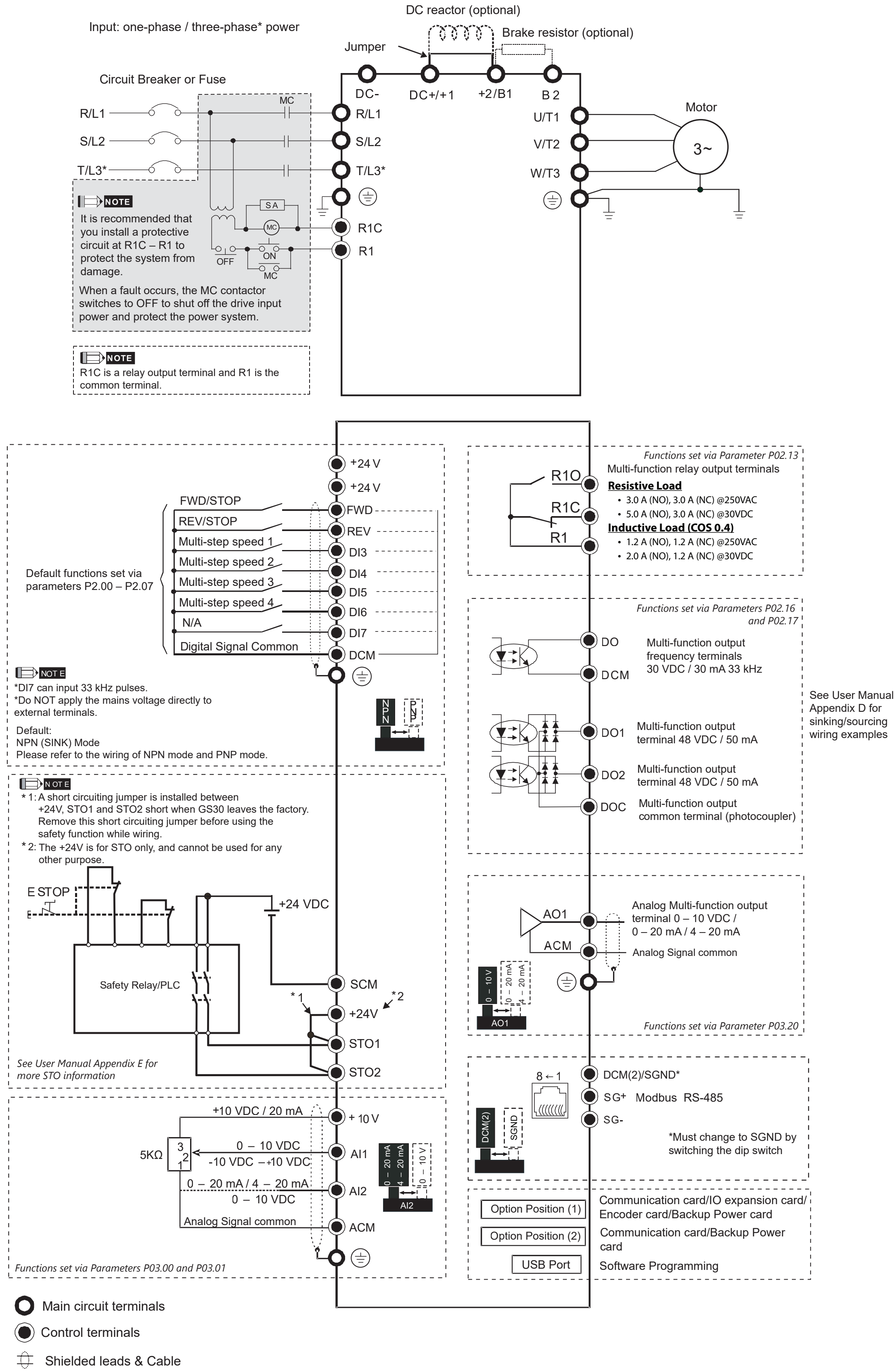
System Wiring Diagram



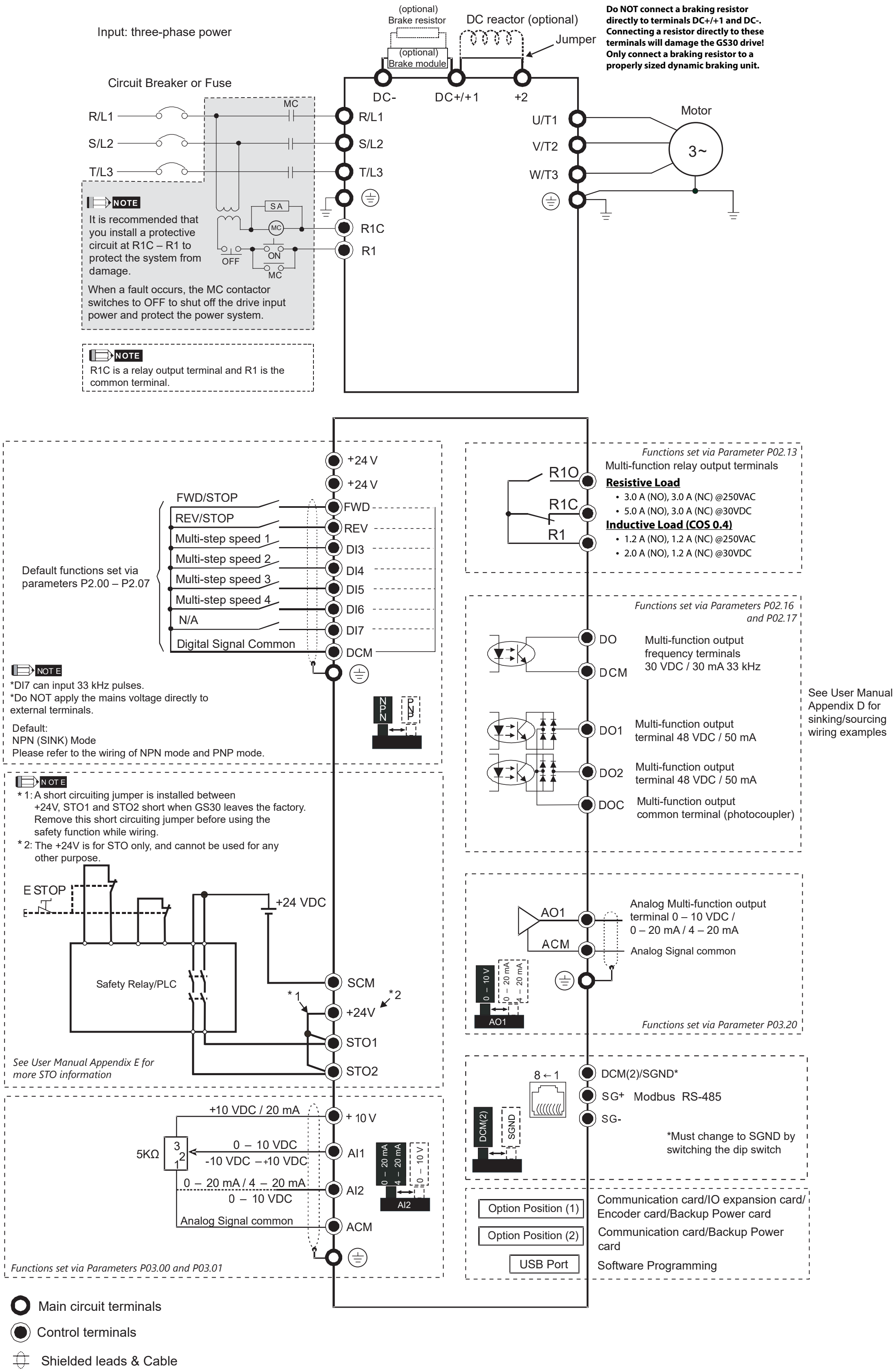
System Wiring Components	
Component	**Function**
Power input terminal	Supply power according to the rated power specifications indicated in the manual
NFB or fuse	There may be a large inrush current during power on. Select a suitable NFB (Non Fuse Breaker or Circuit Breaker) or Fuse.
Electromagnetic contactor	Switching the power ON/OFF on the primary side of the electromagnetic contactor can turn the drive ON/OFF, but frequent switching can cause machine failure. Do not switch ON/OFF more than once an hour. Do not use the electromagnetic contactor as the power switch for the drive; doing so shortens the life of the drive.
AC reactor (input terminal)	When the main power supply capacity is greater than 500 kVA, or when it switches into a phase capacitor, the instantaneous peak voltage and current generated may destroy the internal circuit of the drive. It is recommended that you install an input side AC reactor in the drive. This also improves the power factor and reduces power harmonics. The wiring distance should be within 10 meters of the drive.
Zero phase reactor	Used to reduce radiated interference, especially in environments with audio devices, and reduce input and output side interference. The effective range is AM band to 10 MHz.
EMC filter	Can be used to reduce electromagnetic interference.
Brake module and Brake resistor (BR)	Used to shorten the deceleration time of the motor.
AC reactor or Filter (output terminal)	The motor cable length affects the size of the reflected wave on the motor end. For motor distances greater than 100 feet, the VTF series dV/dT filter is recommended.

Control Circuit Wiring Diagrams (continued)

Full I/O Wiring Diagram (Frame A-G)



Full I/O Wiring Diagram (Frame H-I)



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Chapter 3: Keypad Operation and Quickstart

The DURApulse GS30 Digital Keypad

The GS30 drive comes with a digital keypad equipped with four buttons and a multi-function dial. You can use the keypad buttons and the dial to control the drive, set parameters, change drive modes, etc. For more detailed control options, you can use GSoft2 software by connecting to a computer via USB (see Chapter 7).

It is also possible to use the GS4-KPD with the GS30 for expanded keypad functionality. For more about using the GS4-KPD, please see “Optional Advanced Keypad” on page A–45.

GS30 Digital Keypad

Descriptions of Keypad Functions	
	**RUN Key** • Valid only when the source of operation command is the keypad. • RUN can be pressed even when drive is in process of stopping. • When in “LOCAL” mode, RUN is valid only when the source of operation command is from the keypad (drive default is Auto mode). Local mode can be set by changing P00.21 via the keypad, GS4-KPD, or software.
	**STOP/RESET Key** *This key has the highest processing priority in any situation.* • When the drive receives a STOP command, whether or not the drive is in operation or stop status, the drive will execute a "STOP" command. • The RESET key can be used to reset the drive after a fault occurs. For those faults that can't be reset by the RESET key, see the fault records after pressing MENU key for details. *NOTE: The ability to STOP the drive from the keypad is effective ONLY if the drive is configured to RUN and/or STOP from the keypad. Keypad STOP can be disabled by parameter 00.32, Digital Keypad STOP Function.*
	**MENU Key** Press MENU to return to the Main screen or cycle through the available menu options.
	**Left Shift Key** • Changes values and parameters
	**Digital Dial** The Digital Dial acts as both a potentiometer and a button. Rotate to select parameters or adjust values • Press to confirm selections (acts as ENTER key) The Digital Dial can also be set as the main frequency input. Set P00.20 or P00.30 to “0: Digital Keypad”.

Keypad Indicator LEDs

The left and right sides of the digital display contain a series of LEDs that light up to indicate certain drive functions.

Descriptions of LED Functions	
RUN	**Steady ON**: Drive is running. **Blinking**: Drive is stopping or in base block. **Steady OFF**: Drive is not running.
FWD	**Steady ON**: Drive is operating in Forward mode. **Blinking**: Drive is changing direction. **Steady OFF**: Drive is operating in Reverse mode.
REV	**Steady ON**: Drive is operating in Reverse mode. **Blinking**: Drive is changing direction. **Steady OFF**: Drive is operating in Forward mode.
STOP	**Steady ON**: Drive is stopped or in the process of stopping. **Blinking**: Drive is in standby (run but does not output). **Steady OFF**: Drive is not currently executing an operational (STOP) command. *NOTE: The ability to STOP the drive from the keypad is effective ONLY if the drive is configured to RUN and/or STOP from the keypad. Keypad STOP can be disabled by parameter 00.32, Digital Keypad STOP Function.*
PLC	**Steady ON**: PLC STOP (PLC 2) initiated. **Blinking**: PLC Run (PLC1) initiated. **Steady OFF**: No PLC functions implemented (PLC 0).

GS30 Keypad Operation

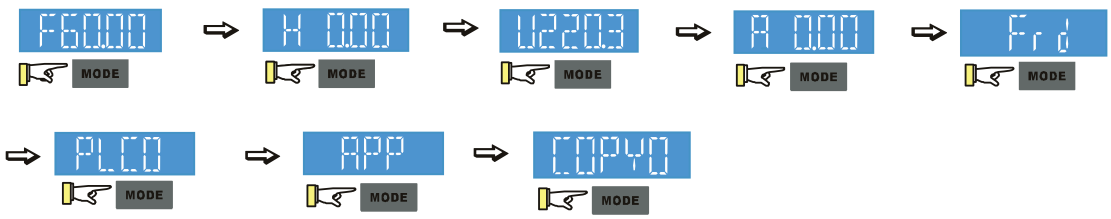
The following section details digital keypad operation for the GS30 series drives.

GS30 Keypad Function Examples

Instruction	*Press Key*	*Display Will Show*	
First screen to display after power up.	n/a	Displays the present frequency setting of the drive	
Press MENU once from startup.	MENU	Displays the actual output frequency of the drive	
Press MENU twice from startup.	MENU	Displays user defined output	
Press MENU three times from startup.	MENU	Displays output current	
Press MENU four times from startup. Displays Frd if the drive is currently configured for Forward operation. Scroll with the dial to change to rEv for Reverse. Press ENTER to confirm the change.	MENU, ENTER	Displays the Forward command if configured for Forward operation.	
		Displays the Reverse command if configured for Reverse operation.	
Press MENU five times from startup. Displays the current PLC setting. Scroll with the dial to change the PLC setting, then press ENTER to confirm.	MENU, ENTER	Displays the current PLC setting.	
Press MENU six times from startup. Used to Read/Write parameters between the drive and the local keypad. Scroll with the dial to select READ or WRITE, FILE Number and Save	MENU, ENTER	Parameter Read/Write function	
From the Frequency setting, Actual Frequency, User, Amps, or Frd/rEv screen, press ENTER to bring up the parameter number (Format XX.YY). Scroll with the dial to change the parameter number as needed, then press ENTER to alter the parameter value.	ENTER ENTER	Displays the parameter number	
From the parameter number screen, press ENTER to bring up the current value of the selected parameter. Scroll with the dial to adjust the value. Press ENTER again to confirm the choice.	ENTER ENTER	Displays the value of the selected parameter	
Once a desired parameter value has been set using the Dial, press ENTER to save the choice and display End message.	ENTER	End message. Displays when data has been accepted and stored	
Displays when an external fault is detected.	n/a	External fault message	
Displays when data is not accepted or the value exceeded	n/a	Error message.	

Main Page

When the drive first starts up, it will display the present frequency setting of the drive. To access the other main pages of the keypad, press the MENU button to cycle through the options.

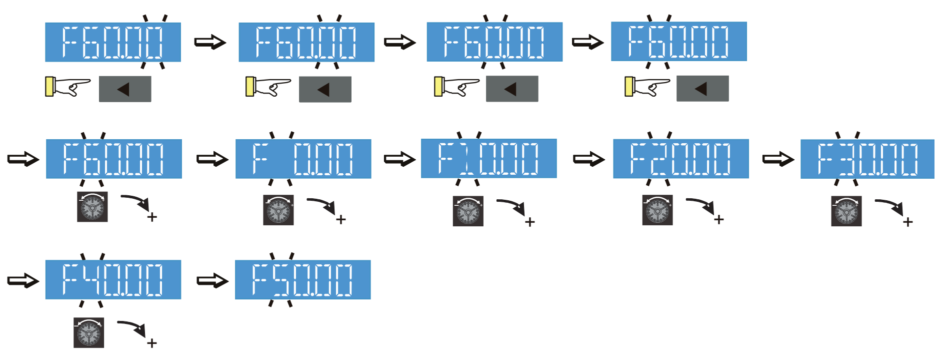


NOTE: In screen selection mode, press ENTER to set the parameters.

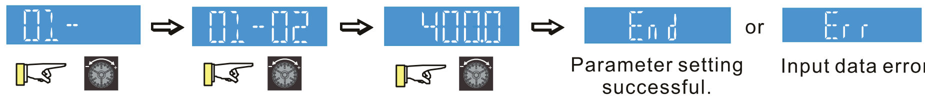
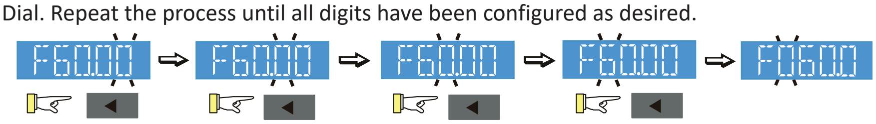
NOTE: APP only displays when parameter 13.00 does not equal 0.

Frequency Command Settings

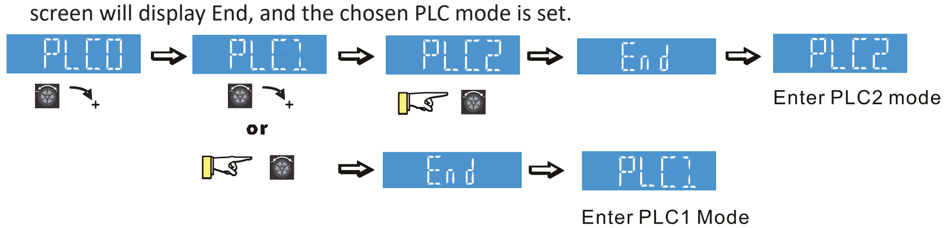
<table>
<tr><th colspan="2">Frequency Command Instructions</th></tr>
<tr><td>Change Frequency Setting</td><td>The default maximum frequency setting (parameter 01.00) is 60.00 Hz. The command frequency on the drive can not be set higher than the maximum frequency value. To set the command frequency value, follow the instructions below:

1) Press the MENU key until F60.00 is displayed (see “Parameter Settings” on page 3–6.).
2) Press the LEFT SHIFT button to select the digits you wish to change. Turn the Digital Dial to cycle through the values available.
3) Press and hold MENU until no digits are blinking.

Note: To change the value to something greater than 99.99, follow the steps above but press the LEFT SHIFT button until the left-most digit (normally blank) switches to a blinking 0. Then use the Digital Dial to change to the desired value. The maximum frequency value is 599.00. If a higher value is chosen, the parameter screen will display Err, followed by 599.00 (the maximum possible), then revert to the previous good value.</td></tr>
</table>

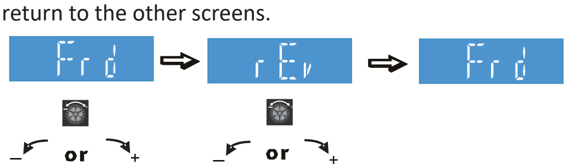
Parameter Settings

Parameter Setting Instructions	
Setting Parameters	1) Press MENU until the parameter screen appears (typically H 0.00). 2) Press the Digital Dial (ENTER) to switch to the parameter group, then turn the Digital Dial to select the desired group number. 3) Press the Digital Dial (ENTER) to switch to the parameter number, then turn the Digital Dial to select the desired number. 4) Press Digital Dial (ENTER) to switch to the parameter value, then turn the digital dial to cycle through the available options. 5) Press the Digital Dial (ENTER). If END displays, the parameter was successfully updated. If Err displays, the chosen configuration is not viable. 
Unsigned Parameter Settings	To set an unsigned parameter value, follow the steps for "Setting Parameters" above, until you reach the parameter value. Then: 1) Press and hold the LEFT SHIFT button until the last digit of the parameter value begins to blink. 2) Change the value by turning the Digital Dial. 3) Press the LEFT SHIFT button to move to the next digit, and change its value using the Digital Dial. Repeat the process until all digits have been configured as desired. 

PLC Settings

PLC Setting Instructions	
Setting the PLC Mode	The GS30 drive can be set to three PLC modes - PLC0 (Disable), PLC1 (Run), and PLC2 (Stop). To set the PLC mode, follow the steps below: 1) From the startup screen, press MENU until the keypad displays PLCx (where x=0, 1, or 2, depending on your current setting). 2) Turn the Digital Dial to select the desired PLC mode, then press the Digital Dial (ENTER). The screen will display End, and the chosen PLC mode is set. 

Setting Direction

Setting Direction Instructions	
Setting to Forward or Reverse Mode	The GS30 drive can be configured to run in forward (Frd) or reverse (rEv) mode. To set the drive direction: 1) From the startup screen, press the MENU button until Frd or rEv appears. 2) Use the Digital Dial to cycle through the options. The option is selected as soon as it displays. 3) Press MENU to return to the other screens. 

Application Settings

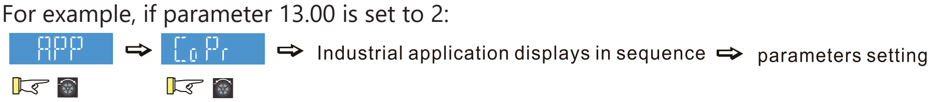
The APP setting can be used to provide a shortcut to application specific parameters for easier access through the keypad. The application selection page does not display unless parameter 13.00 is set to a value other than zero. By default, parameter 13.00 is set to 0.

<table>
<tr><th colspan="2">Application Settings Instructions</th></tr>
<tr><td>Enabling the APP keypad screen</td><td>To enable the APP keypad screen, set parameter 13.00 to a value other than 0. Use the instructions under “Parameter Settings” on page 3–6 to navigate to parameter 13.00 and set a value.

The following options are available:

<table>
<tr><th>Value</th><th>Keypad Display</th><th>Description</th></tr>
<tr><td>0</td><td>n/a</td><td>APP is off and does not display.</td></tr>
<tr><td>1</td><td>USEr</td><td>User-defined application.</td></tr>
<tr><td>2</td><td>CoPr</td><td>Compressor application</td></tr>
<tr><td>3</td><td>FAn</td><td>Fan application</td></tr>
<tr><td>4</td><td>PUNP</td><td>Pump application</td></tr>
<tr><td>5</td><td>CnYr</td><td>Conveyer application</td></tr>
<tr><td>6</td><td>CnC</td><td>Machine tool application</td></tr>
<tr><td>7</td><td>PAC</td><td>Packing application</td></tr>
<tr><td>8</td><td>tiLE</td><td>Textile application</td></tr>
</table></td></tr>
<tr><td>Using the APP setting</td><td>To verify the current APP setting of the drive, press the MENU button until APP appears, then press Digital Dial (ENTER) to display the current APP setting. If APP does not appear, parameter 13.00 is set to 0 and APP is disabled.

If APP is enabled, press Digital Dial (ENTER) again to access a list of application appropriate parameters. Use the Digital Dial to view parameter numbers. Press the Digital Dial (ENTER) to select a parameter, then modify per the standard parameter setting instructions.

For example, if parameter 13.00 is set to 2:

</td></tr>
</table>

Reference Table for Digital LED Character Display

The table below shows how characters display on the LED screen with the number or letter represented above it. This can helpful for characters such as "V" that do not display normally on the LED.

Number	0	1	2	3	4	5	6	7	8	9
16-segment display										
Alphabet	A	a	B	b	C	c	D	d	E	e
16-segment display		-								
Alphabet	F	f	G	g	H	h	I	i	J	j
16-segment display				-						
Alphabet	K	k	L	l	M	m	N	n	O	o
16-segment display		-		-		-				
Alphabet	P	p	Q	q	R	r	S	s	T	t
16-segment display		-						-		
Alphabet	U	u	V	v	W	w	X	x	Y	y
16-segment display								-		-
Alphabet	Z	z								
16-segment display		-								

Chapter 4

AC Drive Parameters

Table of Contents

Chapter 4: AC Drive Parameters

Introduction

This chapter covers all the parameters available for use with the GS30 series drives. The first section provides a summary of the parameters and some basic information. The second section provides detailed information about each parameter.

Video Tutorials

Video tutorials for the GS30 family of drives are located here:

- www.automationdirect.com/videos (random search)
- www.automationdirect.com/cookbook (organized by subject/topic)

DURApulse GS30 Parameter Summary

Drive Parameters Summary (P00.xx)

For detailed information about the P0.xx parameter group, please refer to page 4–61.

GS30 Parameters Summary – Drive Parameters (P00.xx)							
Parameter		***Range***	***Run[1] Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default[2]***	***User***
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P00.00	GS30 Model ID-Identity Code	303: 230 V, 1 Phase, 0.5 HP 304: 230 V, 1 Phase, 1 HP 305: 230 V, 1 Phase, 2 HP 306: 230 V, 1 Phase, 3 HP 203: 230 V, 3 Phase, 0.5 HP 204: 230 V, 3 Phase, 1 HP 205: 230 V, 3 Phase, 2 HP 206: 230 V, 3 Phase, 3 HP 207: 230 V, 3 Phase, 5 HP 208: 230 V, 3 Phase, 7.5 HP 209: 230 V, 3 Phase, 10 HP 210: 230 V, 3 Phase, 15 HP 211: 230 V, 3 Phase, 20 HP 212: 230 V, 3 Phase, 25 HP 213: 230 V, 3 Phase 30 HP 214: 230 V, 3 Phase 40 HP 215: 230 V, 3 Phase 50 HP 403: 460 V, 3 Phase, 0.5 HP 404: 460 V, 3 Phase, 1 HP 405: 460 V, 3 Phase, 2 HP 406: 460 V, 3 Phase, 3 HP 407: 460 V, 3 Phase, 5 HP 408: 460 V, 3 Phase, 7.5 HP 409: 460 V, 3 Phase, 10 HP 410: 460 V, 3 Phase, 15 HP 411: 460 V, 3 Phase, 20 HP 412: 460 V, 3 Phase, 25 HP 413: 460 V, 3 Phase, 30 HP 414: 460 V, 3 Phase, 40 HP 415: 460 V, 3 Phase, 50 HP 416: 460 V, 3 Phase, 60 HP 417: 460 V, 3 Phase, 75 HP 418: 460 V, 3 Phase, 100 HP	Read	0000	40001	–	
P00.01	Rated Current	Display by models	Read	0001	40002	–	
(table continued next page)							

GS30 Parameters Summary – Drive Parameters (P00.xx) – (continued)							
Parameter		***Range***	***Run Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default***	***User***
P00.02	Restore to Default	0: No function 1: Parameter Lock 3: Not used 4: Not used 5: Reset kWh Display to 0 6: Reset PLC 8: Disable Keypad Run 9: Reset all parameters to 50Hz defaults 10: Reset all parameters to 60Hz defaults 11: Reset all parameters to 50Hz defaults (retain user-defined parameter values P13.01~P13.50) 12: Reset all parameters to 60Hz defaults (retain user-defined parameter values P13.01~P13.50) 13: Not used ***Note:*** Reboot drive after resetting defaults.	R/W	0002	40003	0	
P00.03	Start-up display Selection	0: F – Freq Setpoint 1: H – Output Hz 2: U - User Display P00-04) 3: A – Output Amps	♦R/W	0003	40004	0	

(table continued next page)

GS30 Parameters Summary – Drive Parameters (P00.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P00.04	User Display	0: Output Amps (A) (unit: Amp) 1: Counter Value (c) (unit: CNT) 2: Output Frequency (H.) (unit: Hz) 3: DC Bus Voltage (v) (unit: Vdc) 4: Output Voltage (E) (unit: Vac) 5: Power Factor (n) (unit: deg) 6: Output Power (P) (unit: kW) 7: Actual RPM (r) (unit: rpm) 8: Est Output Torque (t) (unit: %) 9: Encoder (PG1) Pulses (G) (Pulses) 10: PID Feedback (b) (unit: %) 11: AI1 Analog Input Signal (1.) (unit: %) 12: AI2 Analog Input Signal (2.) (unit: %) 14: IGBT Temperature (i.) (unit: °C) 16: DI Input Status (ON / OFF) (i) 17: DO Output Status (ON / OFF) (o) 18: Multi-Speed Step (S) 19: CPU DI Input Status (d) 20: CPU DO Output Status (0.) 21: Encoder (PG1) counts (P.) (counts) 22: Pulse Cmd (PG2) frequency (S.) (Hz) 23: Pulse Cmd (PG2) Position (q.) (counts) 24: Position Error 25: Overload count (0.00–100.00%) (o.) (unit: %) 26: Ground fault GFF (G.) (unit: %) 27: DC bus voltage ripple (r.) (unit: VDC) 28: Display PLC register D1043 data (C) 29: PM Pole Section (t) (spd/trq) 30: Display the output of User-defined (U) 31: Display P00-05 user gain (K) 32: Encoder (PG1) Z Pulse Count (Z.) 33: Encoder (PG1) Pulses (q.) 35: Control mode display 36: Present operating carrier frequency of the drive (J.) (Unit: Hz) 38: Display the drive status (6.) 39: Display the drive's estimated output torque, positive and negative, using N•m as unit (t 0.0: positive torque; -0.0: negative torque) (C.) 40: Torque command (L.) (unit: %) 41: kWh display (J) (unit: kWh) 42: PID target value (h.) (unit: %) 43: PID compensation (o.) (unit: %) 44: PID output frequency (b.) (unit: Hz) 46: Auxiliary frequency value (U.) (unit: Hz) 47: Master frequency value (A) (unit: Hz) 48: Frequency value after addition and subtraction of master and auxiliary frequency (L.) (unit: Hz) 51: PMSVC torque offset 53: Reel Diameter 54: Line Speed 55: Tension Command 56: AI10 Analog Input Signal (4.)(unit:%) 57: AI11 Analog Input Signal (5.)(unit:%)	♦R/W	0004	40005	3	

(table continued next page)

GS30 Parameters Summary – Drive Parameters (P00.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P00.05	Coefficient Gain in Actual Output Frequency Display (H Page scale)	0.00–160.00	♦R/W	0005	40006	1.00	
P00.06	Firmware version	Read only	Read	0006	40007	~	
P00.07	Parameter protection password input	0–65535 0–4: the number of password attempts allowed	♦R/W	0007	40008	0	
P00.08	Parameter protection password setting	0–65535 0: No password protection or password entered correctly (P00-07) 1: Parameter has been set	♦R/W	0008	40009	0	
P00.10	Control Method	0: Velocity mode 1: Reserved 2: Torque mode	R/W	000A	40011	0	
P00.11	Speed (Velocity) Control mode	0: IMVF (V/F control) 1: IMVFPG (V/F control + encoder) 2: IM/PM SVC (IM or PM sensorless vector control) 3: IMFOCPG (IM FOC vector control + encdoer) 4: PMFOCPG (PM FOC vector control + encdoer) 5: IMFOC Sensorless (field-oriented sensorless vector control) 7: IPM sensorless (interior PM field-oriented sensorless vector control) **Note:** For option 2 (SVC), see P05.33 for induction motor (IM) or permanent magnent (PM) motor selection.	R/W	000B	40012	0	
P00.13	Torque control mode	0: IM TQCPG (IM torque control + encoder) 1: PM TQCPG (PM torque control + encoder) 2: IMTQC sensorless (IM sensorless torque control) 3: PM Torque Sensorless	R/W	000D	40014	0	
P00.16	Torque duty selection	0: Variable Torque (VT) 1: Constant Torque (CT)	R/W	0010	40017	1	
P00.17	Carrier frequency	Variable Torque: 2–15 kHz Constant Torque: 2–15 kHz Note: When P00-11=5 (IMFOC Sensorless), the maximum setting value for the carrier frequency is 10 kHz.	R/W	0011	40018	4	
P00.18	GS Series Number	30: GS30 series drive (GS31 or GS33)	Read	0012	40019	–	
P00.19	PLC command mask	bit 0: Control command is forced by PLC control bit 1: Frequency command is forced by PLC control bit 3: Torque command is forced by PLC control	Read	0013	40020	0	

(table continued next page)

GS30 Parameters Summary – Drive Parameters (P00.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P00.20	Master frequency command source (AUTO, REMOTE)	0: Digital keypad 1: RS-485 communication input 2: Analog input (Refer to P03.00) 3: External UP / DOWN terminal (digital input terminals) 4: Pulse Command (PG2) Reference w/o Direction (refer to P10.16 for pulse input config) 5: Pulse Command (PG2) Reference with Direction 8: Communication card 9: PID controller Note: HOA (Hand-Off-Auto) function is valid only when you use with digital input (DI) function setting 41/42 or 56 or with GS4-KPD (optional).	♦R/W	0014	40021	0	
P00.21	Operation command source (AUTO, REMOTE)	0: Digital keypad 1: External terminals 2: RS-485 communication input 5: Communication card Note: HOA (Hand-Off-Auto) function is valid only when you use with digital input (DI) function settings 41/42 or 56 or with GS4-KPD (optional)	♦R/W	0015	40022	0	
P00.22	Stop method	0: Ramp to stop 1: Coast to stop	♦R/W	0016	40023	0	
P00.23	Motor direction control	0: Enable forward / reverse 1: Disable reverse 2: Disable forward	♦R/W	0017	40024	0	
P00.24	Digital operator (keypad) frequency command memory	Read only	Read	0018	40025	60	

(table continued next page)

GS30 Parameters Summary – Drive Parameters (P00.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P00.25	User-defined characteristics (COEFF ATT)	bit 0–3: user-defined decimal places 0000h,0000b: no decimal place 0001h,0001b: one decimal place 0002h,0010b: two decimal places 0003h,0011b: three decimal places bit 4–15: user-defined unit 000xh: Hz 001xh: rpm 002xh: % 003xh: kg 004xh: m/s 005xh: kW 006xh: HP 007xh: ppm 008xh: 1/m 009xh: kg/s 00Axh: kg/m 00Bxh: kg/h 00Cxh: lb/s 00Dxh: lb/m 00Exh: lb/h 00Fxh: ft/s 010xh: ft/m 011xh: m 012xh: ft 013xh: degC 014xh: degF 015xh: mbar 016xh: bar 017xh: Pa 018xh: kPa 019xh: mWG 01Axh: inWG 01Bxh: ftWG 01Cxh: psi 01Dxh: atm 01Exh: L/s 01Fxh: L/m 020xh: L/h 021xh: m3/s 022xh: m3/h 023xh: GPM 024xh: CFM	♦R/W	0019	40026	0	
P00.26	User-defined maximum value (COEFF MAX)	0: Disable 0–65535 (when P00.25 is set to no decimal place) 0.0–6553.5 (when P00.25 is set to one decimal place) 0.00–655.35 (when P00.25 is set to two decimal places) 0.000–65.535 (when P00.25 is set to three decimal places)	RW	001A	40027	0	
P00.27	User-defined value (COEFF SET)	Read only	Read	001B	40028	0	
(table continued next page)							

GS30 Parameters Summary – Drive Parameters (P00.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P00.29	LOCAL / REMOTE selection	0: Standard HOA function 1: When switching between local and remote, the drive stops. 2: When switching between local and remote, the drive runs with REMOTE settings for frequency and operating status. 3: When switching between local and remote, the drive runs with LOCAL settings for frequency and operating status. 4: When switching between local and remote, the drive runs with LOCAL settings when switched to Local and runs with REMOTE settings when switched to Remote for frequency and operating status.	R/W	001D	40030	0	
P00.30	Master frequency command source (HAND, LOCAL)	0: Digital keypad 1: RS-485 communication input 2: External analog input (refer to P03.00) 3: External UP / DOWN terminal (digital input terminals) 4: Pulse Command (PG2) reference w/o direction command (refer to P10.16 for pulse input config) 5: Pulse Command (PG2) reference with direction command (refer to P10.16 for pulse input config) 7: Reserved 8: Communication card 9: PID controller Note: HOA (Hand-Off-Auto) function is valid only when you use with digital input (DI) function setting 41/42 or 56 or with GS4-KPD (optional).	♦R/W	001E	40031	0	
P00.31	Operation command source (HAND, LOCAL)	0: Digital keypad 1: External terminal 2: RS-485 communication input 5: Communication card Note: HOA (Hand-Off-Auto) function is valid only when you use with digital input (DI) function setting 41/42 or 56 or with GS4-KPD (optional).	♦R/W	001F	40032	0	
P00.32	Digital keypad STOP function	0: STOP key disabled 1: STOP key enabled	♦R/W	0020	40033	0	
P00.33	RPWM mode selection	0: Disabled 1: RPWM mode 1 2: RPWM mode 2 3: RPWM mode 3	R/W	0021	40034	0	
P00.34	RPWM range	0.0–4.0 kHz	♦R/W	0022	40035	0.0	
P00.35	Auxiliary frequency source	0: Disabled 1: Digital keypad 2: RS-485 communication input 3: Analog input 4: External UP / DOWN key input (digital input terminals) 5: Pulse Command (PG2) reference w/o direction command (refer to P10.16 for pulse input config) 8: Communication card	R/W	0023	40036	0	

(table continued next page)

GS30 Parameters Summary – Drive Parameters (P00.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P00.36	Master and auxiliary frequency command selection	0: Master + auxiliary frequency 1: Master - auxiliary frequency 2: Auxiliary - master frequency	R/W	0024	40037	0	
P00.47	Output phase order selection	0: Standard 1: Reverse the rotation direction	R/W	002F	40048	0	
P00.48	Display filter time (current)	0.001–65.535 sec.	♦R/W	0030	40049	0.100	
P00.49	Display filter time (keypad)	0.001–65.535 sec.	♦R/W	0031	40050	0.100	
P00.50	Date Code of Firmware version (date)	Read only	Read	0032	40051	0	

Basic Parameters Summary (P01.xx)

For detailed information about the P01.xx parameter group, please refer to page 4–90.

GS30 Parameters Summary – Basic Parameters (P01.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default[2]**	**User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P01.00	Maximum operation frequency	0.00–599.00 Hz	R/W	0100	40257	60.00 / 50.00	
P01.01	Motor 1 Fbase	0.00–599.00 Hz	R/W	0101	40258	60.00 / 50.00	
P01.02	Motor 1, Rated Voltage (Nameplate)	230V models: 0.0–255.0 V 460V models: 0.0–510.0 V	R/W	0102	40259	220.0 440.0	
P01.03	Motor 1, Mid-point frequency 1	0.00–599.00 Hz	R/W	0103	40260	3.00	
P01.04	Motor 1, Mid-point voltage 1	230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	0104	40261	11.0 22.0	
P01.05	Motor 1, Mid-point frequency 2	0.00–599.00 Hz	R/W	0105	40262	1.50	
P01.06	Motor 1, Mid-point voltage 2	230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	0106	40263	5.0 10.0	
P01.07	Motor 1, Minimum output frequency	0.00–599.00 Hz	R/W	0107	40264	0.50	
P01.08	Motor 1, Minimum output voltage	230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	0108	40265	1.0 2.0	
P01.09	Start-up frequency	0.00–599.00 Hz	R/W	0109	40266	0.50	
P01.10	Output frequency upper limit	0.00–599.00 Hz	♦R/W	010A	40267	599.00	
P01.11	Output frequency lower limit	0.00–599.00 Hz	♦R/W	010B	40268	0.00	
P01.12	Acceleration time 1	P01.45 = 0: 0.00–600.00 sec. P01.45 = 1: 0.0–6000.0 sec.	♦R/W	010C	40269	10.00 10.0	
P01.13	Deceleration time 1	P01.45 = 0: 0.00–600.00 sec. P01.45 = 1: 0.0–6000.0 sec.	♦R/W	010D	40270	10.00 10.0	
P01.14	Acceleration time 2	P01.45 = 0: 0.00–600.00 sec. P01.45 = 1: 0.0–6000.0 sec.	♦R/W	010E	40271	10.00 10.0	
P01.15	Deceleration time 2	P01.45 = 0: 0.00–600.00 sec. P01.45 = 1: 0.0–6000.0 sec.	♦R/W	010F	40272	10.00 10.0	
P01.16	Acceleration time 3	P01.45 = 0: 0.00–600.00 sec. P01.45 = 1: 0.0–6000.0 sec.	♦R/W	0110	40273	10.00 10.0	
P01.17	Deceleration time 3	P01.45 = 0: 0.00–600.00 sec. P01.45 = 1: 0.0–6000.0 sec.	♦R/W	0111	40274	10.00 10.0	
P01.18	Acceleration time 4	P01.45 = 0: 0.00–600.00 sec. P01.45 = 1: 0.0–6000.0 sec.	♦R/W	0112	40275	10.00 10.0	
P01.19	Deceleration time 4	P01.45 = 0: 0.00–600.00 sec. P01.45 = 1: 0.0–6000.0 sec.	♦R/W	0113	40276	10.00 10.0	
P01.20	JOG acceleration time	P01.45 = 0: 0.00–600.00 sec. P01.45 = 1: 0.0–6000.0 sec.	♦R/W	0114	40277	10.00 10.0	
P01.21	JOG deceleration time	P01.45 = 0: 0.00–600.00 sec. P01.45 = 1: 0.0–6000.0 sec.	♦R/W	0115	40278	10.00 10.0	
P01.22	JOG frequency	0.00–599.00 Hz	♦R/W	0116	40279	6.00	
P01.23	Acc/Dec ExchFreq Switch frequency between first and fourth Accel./Decel.	0.00–599.00 Hz	♦R/W	0117	40280	0.00	
P01.24	S-curve for acceleration begin time 1	P01.45 = 0: 0.00–25.00 sec. P01.45 = 1: 0.0–250.0 sec.	♦R/W	0118	40281	0.20 0.2	
(table continued next page)							

GS30 Parameters Summary – Basic Parameters (P01.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P01.25	S-curve for acceleration arrival time 2	P01.45 = 0: 0.00–25.00 sec. P01.45 = 1: 0.0–250.0 sec.	♦R/W	0119	40282	0.20 0.2	
P01.26	S-curve for deceleration begin time 1	P01.45 = 0: 0.00–25.00 sec. P01.45 = 1: 0.0–250.0 sec.	♦R/W	011A	40283	0.20 0.2	
P01.27	S-curve for deceleration arrival time 2	P01.45 = 0: 0.00–25.00 sec. P01.45 = 1: 0.0–250.0 sec.	♦R/W	011B	40284	0.20 0.2	
P01.28	Skip frequency 1 (upper limit)	0.00–599.00 Hz	R/W	011C	40285	0.00	
P01.29	Skip frequency 1 (lower limit)	0.00–599.00 Hz	R/W	011D	40286	0.00	
P01.30	Skip frequency 2 (upper limit)	0.00–599.00 Hz	R/W	011E	40287	0.00	
P01.31	Skip frequency 2 (lower limit)	0.00–599.00 Hz	R/W	011F	40288	0.00	
P01.32	Skip frequency 3 (upper limit)	0.00–599.00 Hz	R/W	0120	40289	0.00	
P01.33	Skip frequency 3 (lower limit)	0.00–599.00 Hz	R/W	0121	40290	0.00	
P01.34	Zero-speed mode	0: Standby 1: Zero-speed operation 2: Fmin (refer to P01.07 and P01.41)	R/W	0122	40291	0	
P01.35	Motor 2, Output frequency (Base frequency / Motor's rated frequency)	0.00–599.00 Hz	R/W	0123	40292	60.00 / 50.00	
P01.36	Motor 2, Output voltage (Base voltage / Motor's rated voltage)	230V models: 0.0–255.0 V 460V models: 0.0–510.0 V	R/W	0124	40293	220.0 440.0	
P01.37	Motor 2, Mid-point frequency	0.00–599.00 Hz	R/W	0125	40294	3.0	
P01.38	Motor 2, Mid-point voltage 1	230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	0126	40295	11.0 22.0	
P01.39	Motor 2, Mid-point frequency 2	0.00–599.00 Hz	R/W	0127	40296	1.50	
P01.40	Motor 2, Mid-point voltage 2	230V models: 0.0–240.0 V 460V models:0.0–480.0 V	♦R/W	0128	40297	5.0 10.0	
P01.41	Motor 2, Minimum output frequency	0.00–599.00 Hz	R/W	0129	40298	0.50	
P01.42	Motor 2, Minimum output voltage	230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	012A	40299	1.0 2.0	
P01.43	V/F curve selection	0: V/F curve determined by P01.00–P01.08 1: V/F curve to the power of 1.5 2: V/F curve to the power of 2	R/W	012B	40300	0	
P01.44	Auto-acceleration and auto-deceleration setting	0: Linear acceleration and deceleration 1: Auto-acceleration and linear deceleration 2: Linear acceleration and auto-deceleration 3: Auto-acceleration and auto-deceleration 4: Stall prevention by auto-acceleration and auto-deceleration (limited by P01.12 through P01.21)	♦R/W	012C	40301	0	

(table continued next page)

GS30 Parameters Summary – Basic Parameters (P01.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P01.45	Time unit for acceleration / deceleration and S-curve	0: Unit 0.01 sec. 1: Unit 0.1 sec.	R/W	012D	40302	0	
P01.49	Regenerative energy restriction control (decel method)	0: Disable 1: Over voltage energy restriction 2: Traction energy control (TEC)	R/W	0131	40306	0	
P01.52	Motor 2, Maximum operation frequency	0.00–599.00 Hz	R/W	0134	40309	60.00 / 50.00	
P01.53	Motor 3, Maximum operation frequency	0.00–599.00 Hz	R/W	0135	40310	60.00 / 50.00	
P01.54	Motor 3, Output frequency (Base frequency / Motor's rated frequency)	0.00–599.00 Hz	R/W	0136	40311	60.00 / 50.00	
P01.55	Motor 3, Output voltage (Base voltage / Motor's rated voltage)	230V models: 0.0–255.0 V 460V models: 0.0–510.0 V	R/W	0137	40312	220.0 440.0	
P01.56	Motor 3, Mid-point frequency 1	0.00–599.00 Hz	R/W	0138	40313	3.00	
P01.57	Motor 3, Mid-point voltage 1	230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	0139	40314	11.0 22.0	
P01.58	Motor 3, Mid-point frequency 2	0.00–599.00 Hz	R/W	013A	40315	1.50	
P01.59	Motor 3, Mid-point voltage 2	230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	013B	40316	5.0 10.0	
P01.60	Motor 3, Minimum output frequency	0.00–599.00 Hz	R/W	013C	40317	0.50	
P01.61	Motor 3, Minimum output voltage	230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	013D	40318	1.0 2.0	
P01.62	Motor 4, Maximum operation frequency	0.00–599.00 Hz	R/W	013E	40319	60.00 / 50.00	
P01.63	Motor 4, Output frequency (Base frequency / Motor's rated frequency)	0.00–599.00 Hz	R/W	013F	40320	60.00 / 50.00	
P01.64	Motor 4, Output voltage (Base voltage / Motor's rated voltage)	230V models: 0.0–255.0 V 460V models: 0.0–510.0 V	R/W	0140	40321	220.0 440.0	
P01.65	Motor 4, Mid-point frequency 1	0.00–599.00 Hz	R/W	0141	40322	3.00	
P01.66	Motor 4, Mid-point voltage 1	230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	0142	40323	11.0 22.0	
P01.67	Motor 4, Mid-point frequency 2	0.00–599.00 Hz	R/W	0143	40324	1.50	
P01.68	Motor 4, Mid-point voltage 2	230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	0144	40325	5.0 10.0	
P01.69	Motor 4, Minimum output frequency	0.00–599.00 Hz	R/W	0145	40326	0.50	
P01.70	Motor 4, Minimum output voltage	230V models: 0.0–240.0 V 460V models: 0.0–480.0 V	♦R/W	0146	40327	1.0 2.0	

Digital Input/Output Parameters Summary (P02.xx)

For detailed information about the P02.xx parameter group, please refer to page 4–101.

GS30 Parameters Summary – Digital Input/Output Parameters (P02.xx)							
Parameter		***Range***	***Run[1] Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default[2]***	***User***
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P02.00	Two-wire / three-wire operation control	Note: On the drive, DI1 is labeled FWD, and DI2 is labeled REV. 0: No function 1: Two-wire mode 1, power on for operation control (DI1: FWD/STOP, DI2: REV/STOP) 2: Two-wire mode 2, power on for operation control (DI1: RUN/STOP, DI2: REV/FWD) 3: Three-wire, power on for operation control (DI1: RUN, DI2: REV/FWD, DI3: STOP) 4: Two-wire mode 1, Quick Start (DI1: FWD/STOP, DI2: REV/STOP) 5: Two-wire mode 2, Quick Start (DI1: RUN/STOP, DI2: REV/FWD) 6: Three-wire, Quick Start (DI1: RUN, DI2: REV/FWD, DI3: STOP) **IMPORTANT** 1) In the QuickStart function, terminal output remains in ready status, and the drive responds to the start command immediately. 2) When using the Quick Start function, output terminals U, V, and W are powered immediately. To avoid electric shock hazard, do not touch the terminals or modify the motor wiring.	R/W	0200	40513	1	
(table continued next page)							

GS30 Parameters Summary – Digital Input/Output Parameters (P02.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P02.01	Multi-function input command 1 (FWD/DI1)	0: No function 1: Multi-step speed command 1 2: Multi-step speed command 2 3: Multi-step speed command 3 4: Multi-step speed command 4 5: Reset 6: JOG [by external control or GS4-KPD (optional)] 7: Acceleration / deceleration speed inhibit 8: 1st and 2nd acceleration / deceleration time selection 9: 3rd and 4th acceleration / deceleration time selection 10: External Fault (EF) Input (P07.20) 11: Base Block (B.B.) input from external source 12: Output stop 13: Cancel the setting of auto-acceleration / auto-deceleration time 15: Frequency command from AI1 16: Frequency command from AI2 18: Force to stop (P07.20) 19: Digital up command 20: Digital down command 21: PID function disabled 22: Clear the counter 23: Input the counter value (DI6) 24: FWD JOG command 25: REV JOG command 26: TQC / Field Oriented Control (FOC) mode selection 27: ASR1 / ASR2 selection 28: Emergency stop (EF1) 29: Signal confirmation for Y-connection 30: Signal confirmation for Δ-connection 31: High torque bias (P11.30) 32: Middle torque bias (P11.31) 33: Low torque bias (P11.32) 34: Reserved 35: Enable single-point positioning 36: Multi-position input 38: Disable writing EEPROM function 39: Torque command direction 40: Force coasting to stop 41: HAND switch 42: AUTO switch 43: Enable resolution selection (P02.48) 48: Mechanical gear ratio switch 49: Enable drive 50: Slave dEb action to execute	R/W	0201	40514	0	
(table continued next page)							

GS30 Parameters Summary – Digital Input/Output Parameters (P02.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P02.01 (cont'd)	Multi-function input command 1 (FWD/DI1) (continued)	51: Selection for PLC mode bit 0 52: Selection for PLC mode bit 1 56: Local / Remote selection 70: Force auxiliary frequency return to 0 71: Disable PID function, force PID output return to 0 72: Disable PID function, retain the output value before disabled 73: Force PID integral gain return to 0, disable integral 74: Reverse PID feedback 83: Multi-motor (IM) selection bit 0 84: Multi-motor (IM) selection bit 1 86: Enable initial reel diamter 87: Initial reel diameter 1 88: Initial reel diameter 2 89: PID integration reset 90: Stop calculating the reel diameter 91: Winding mode selection 92: Enable tension control 93: Pause tension PID function 94: Enable to auto switch the reel	R/W	0201	40514	0	
P02.02	Multi-function input command 2 (REV/DI2)	See P02.01 for values.	R/W	0202	40515	0	
P02.03	Multi-function input command 3 (DI3)	See P02.01 for values.	R/W	0203	40516	1	
P02.04	Multi-function input command 4 (DI4)	See P02.01 for values.	R/W	0204	40517	2	
P02.05	Multi-function input command 5 (DI5)	See P02.01 for values.	R/W	0205	40518	3	
P02.06	Multi-function input command 6 (DI6)	See P02.01 for values.	R/W	0206	40519	4	
P02.07	Multi-function input command 7 (DI7)	See P02.01 for values. For pulse input, use selection 0 - No function.	R/W	0207	40520	0	
P02.09	External Input key mode	0: By the acceleration / deceleration time 1: Constant speed (P02.10) 2: Pulse signal (P02.10) 3: Curve 4: Steps (P02.10)	♦R/W	0209	40522	0	
P02.10	Constant speed, acceleration / deceleration speed of the Dial	0.001–1.000 Hz/ms	♦R/W	020A	40523	0.001	
P02.11	Multi-function input response time	0.000–30.000 sec.	♦R/W	020B	40524	0.005	
P02.12	Multi-function input mode selection	0000h–FFFFh (0: N.O.; 1: N.C.)	♦R/W	020C	40525	0000	
(table continued next page)							

GS30 Parameters Summary – Digital Input/Output Parameters (P02.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P02.13	Multi-function output 1 (R1)	0: No function 1: Indication during RUN 2: Operation speed reached 3: Desired frequency reached 1 (P02.22) 4: Desired frequency reached 2 (P02.24) 5: Zero speed (Frequency command) 6: Zero speed including STOP (Frequency command) 7: Over-torque 1 (P06.06–06.08) 8: Over-torque 2 (P06.09–06.11) 9: Drive is ready 10: Low voltage warning (Lv) (P06.00) 11: Malfunction indication 13: Overheat warning (P06.15) 14: Software brake signal indicator (P07.00) 15: PID feedback error (P08.13, P08.14) 16: Slip error (oSL) 17: Count value reached, does not return to 0 (P02.20) 18: Count value reached, return to 0 (P02.19) 19: External interrupt B.B. input (Base Block) 20: Warning output 21: Over-voltage 22: Over-current stall prevention 23: Over-voltage stall prevention 24: Operation mode 25: Forward command 26: Reverse command 29: Output when frequency ≥ P02.34 30: Output when frequency < P02.34 31: Y-connection for the motor coil 32: Δ-connection for the motor coil 33: Zero speed (actual output frequency) 34: Zero speed including STOP (actual output frequency) 35: Fault option 1 (P06.23) 36: Fault option 2 (P06.24) 37: Fault option 3 (P06.25) 38: Fault option 4 (P06.26) 40: Speed reached (including STOP) 41: Multi-position 42: Crane function 43: Motor speed detection 44: Low current output (use with P06.71–06.73) 45: UVW output electromagnetic valve switch 46: Master dEb output	♦R/W	020D	40526	11	

(table continued next page)

GS30 Parameters Summary – Digital Input/Output Parameters (P02.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P02.13 (cont'd)	Multi-function output 1 (R1) (continued)	49: Homing action completed 51: Digital output control for serial modbus 52: Digital output control for communication card 66: SO output logic A 67: Analog input level reached 68: SO output logic B 69: Maximum reel diameter reached 70: Empty reel diameter reached 71: Broken belt detection 72: Tension PID feedback error 73: Over-torque 3 74: Over-torque 4 75: Forward running 76: Reverse running	♦R/W	020D	40526	11	
P02.16	Multi-function output 2 (DO1)	See P02.13 for values.	♦R/W	0210	40529	0	
P02.17	Multi-function output 3 (DO2)	See P02.13 for values.	♦R/W	0211	40530	0	
P02.18	Multi-function output direction	0000h–FFFFh (0: N.O.; 1: N.C.)	♦R/W	0212	40531	0000h	
P02.19	Maximum counting value reached (returns to 0)	0–65500	♦R/W	0213	40532	0	
P02.20	Middle counting value reached (does not return to 0)	0–65500	♦R/W	0214	40533	0	
P02.21	Digital output gain (DO)	1–55	♦R/W	0215	40534	1	
P02.22	Desired frequency reached 1	0.00–599.00 Hz	♦R/W	0216	40535	60.00 / 50.00	
P02.23	The pulse-width of the desired frequency reached 1	0.00–599.00 Hz	♦R/W	0217	40536	2.00	
P02.24	Desired frequency reached 2	0.00–599.00 Hz	♦R/W	0218	40537	60.00 / 50.00	
P02.25	The pulse-width of the desired frequency reached 2	0.00–599.00 Hz	♦R/W	0219	40538	2.00	
P02.26	Multifunction input of extension card (DI10)	See P02.01 for values.	R/W	021A	40539	0	
P02.27	Multifunction input of extension card (DI11)	See P02.01 for values.	R/W	021B	40540	0	
P02.28	Multifunction input of extension card (DI12)	See P02.01 for values.	R/W	021C	40541	0	
P02.34	Output frequency setting for digital output terminal	0.00–599.00 Hz	♦R/W	0222	40547	0.00	
P02.35	External operation control selection after fault reset and reboot	0: Disable 1: Drive runs if the RUN command remains after reset or reboot	♦R/W	0223	40548	0	
P02.36	Multifunction output of extension card (DI10)	See P02.13 for options.	R/W	0224	40549	0	

(table continued next page)

GS30 Parameters Summary – Digital Input/Output Parameters (P02.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P02.37	Multifunction output of extension card (DI11)	See P02.13 for options.	R/W	0225	40550	0	
P02.38	Multifunction ouput of extension card (DI12)	See P02.13 for options.	R/W	0226	40551	0	
P02.39	Reserved						
P02.47	Motor RPM zero-speed level	0–65535 rpm	♦R/W	022F	40560	0	
P02.48	Maximum frequency of resolution switch	0.01–599.00 Hz (use with DIx setting as 43)	♦R/W	0230	40561	60.00	
P02.49	Switch delay time of maximum output frequency	0.000–65.000 seconds	♦R/W	0231	40562	0.000	
P02.50	Display the status of multi-function input terminals DI1-DI7	Monitor the status of multi-function input terminals	Read	0232	40563	0	
P02.51	Display the status of multi-function output terminals R1, DO1, DO2	Monitor the status of digital output terminals	Read	0233	40564	0	
P02.52	Display the external multi-function input terminals DI1-DI7 used by PLC	Monitor which inputs are controlled by the PLC	Read	0234	40565	0	
P02.53	Display the external multi-function output terminals R1, DO1, DO2 used by PLC	Monitor which outputs are controlled by the PLC	Read	0235	40566	0	
P02.54	Display the frequency command executed by external terminal (EXT Speed REC)	0.00–599.00 Hz (Read only)	Read	0236	40567	0	
P02.58	Multi-function output terminal (function 42): brake frequency check point	0.00–599.00 Hz	♦R/W	023A	40571	0.00	
P02.70	I/O card type	1: GS30A-BPS (only when BPS card is in position 1) 10: GS30A-06CDD 11: GS30A-2AD2DA 12: GS30A-02TRC 13: GS30A-03TRA	Read	0246	40583	–	
P02.74	Internal/external multi-function input terminal selection	0000–FFFFh	R/W	024A	40587	0000h	
P02.75	Internal multi-function output terminal selection	0000–FFFFh	R/W	024B	40588	0000h	
P02.81	EF activates when the terminal count value reached	0: Terminal count value reached, no EF displays (continues to operate) 1: Terminal count value reached, EF activates	♦R/W	0251	40594	0	
P02.82	Initial Frequency com-mand (F) mode after stop	0: Use current Frequency command 1: Use zero Frequency Command 2: Use value in P02.83	♦R/W	0252	40595	0	

(table continued next page)

GS30 Parameters Summary – Digital Input/Output Parameters (P02.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P02.83	Initial Frequency com-mand (F) setting after stop	0.00–599.00 Hz	♦R/W	0253	40596	60.00	

Analog Input/Output Parameters Summary (P03.xx)

For detailed information about the P03.xx parameter group, please refer to page 4–121.

GS30 Parameters Summary – Analog Input/Output Parameters (P03.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address Hex**	**Modbus Address Dec**	**Settings Default[2]**	**Settings User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using using P00.02.							
P03.00	Analog input selection (AI1)	0: No function 1: Frequency command 2: Torque command (torque limit under speed mode) 3: Torque compensation command 4: PID target value 5: PID feedback signal 6: Thermistor (PTC) input value 7: Positive torque limit 8: Negative torque limit 9: Regenerative torque limit 10: Positive / negative torque limit 11: PT100 RTD input value 12: Auxiliary frequency input 13: PID compensation value 14: Tension PID feedback signal 15: Line speed 16: Reel diameter 17: Tension PID target value 18: Tension setting value 19: Zero-speed tensions 20: Tension taper	♦R/W	0300	40769	1	
P03.01	Analog input selection (AI2)		♦R/W	0301	40770	0	
P03.03	Analog input bias (AI1)	-100.0–100.0%	♦R/W	0302	40771	0	
P03.04	Analog input bias (AI2)	-100.0–100.0%	♦R/W	0303	40772	0	
P03.07	Positive / negative bias mode (AI1)	0: No bias 1: Lower than or equal to bias 2: Greater than or equal to bias 3: The absolute value of the bias voltage while serving as the center 4: Bias serves as the center	♦R/W	0304	40773	0	
P03.08	Positive / negative bias mode (AI2)		♦R/W	0308	40777	0	
P03.10	Analog input bias reverse method	0: Forward/reverse controlled by discrete input. 1: Forward/reverse by bias. Positive frequency = run in a forward direction; negative frequency = run in a reverse direction.	♦R/W	030A	40779	0	
P03.11	Analog input gain (AI1)	-100.0–100.0%	♦R/W	030B	40780	100.0	
P03.12	Analog input gain (AI2)	-100.0–100.0%	♦R/W	030C	40781	100.0	
P03.15	Analog input filter (LPF) time (AI1)	0.00–20.00 sec.	♦R/W	030F	40784	0.01	
P03.16	Analog input filter (LPF) time (AI2)	0.00–20.00 sec.	♦R/W	0310	40785	0.01	
P03.18	Analog input addition function	0: Disable (AI1, AI2) 1: Enable local analog inputs. Expansion cards not included.	♦R/W	0312	40787	0	
P03.19	Signal loss selection for analog input 4–20 mA	0: Disable 1: Continue operation at the last frequency 2: Decelerate to 0 Hz 3: Stop immediately and display "ACE"	R/W	0313	40788	0	

(table continued next page)

GS30 Parameters Summary – Analog Input/Output Parameters (P03.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P03.20	Multi-function output (AO1)	0: Output frequency (Hz) 1: Frequency command (Hz) 2: Motor speed (Hz) 3: Output current (rms) 4: Output voltage 5: DC bus voltage 6: Power factor 7: Power 8: Output torque 9: AI1% 10: AI2% 12: Iq current command 13: Iq feedback value 14: Id current command 15: Id feedback value 16: Vq-axis voltage command 17: Vd-axis voltage command 18: Torque command 19: Pulse Input (DI7) frequency command 21: RS-485 analog output 22: Communication card analog output 23: Fixed voltage output	♦R/W	0314	40789	0	
P03.21	Analog output gain (AO1)	0.0–500.0%	♦R/W	0315	40790	100.0	
P03.22	Analog output in REV direction (AO1)	0: Absolute value in output voltage 1: Reverse output 0 V; forward output 0–10 V 2: Reverse output 5–0 V; forward output 5–10 V	♦R/W	0316	40791	0	
P03.27	AO1 output bias	-100.00–100.00%	♦R/W	031B	40796	0.00	
P03.28	AI1 terminal input selection	0: 0–10 V (only P03.63–P03.68 are valid) 3: -10–10 V (only P03.63–P03.74 are valid)	♦R/W	031C	40797	0	
P03.29	AI2 terminal input selection	0: 4–20 mA 1: 0–10 V 2: 0–20 mA	♦R/W	031D	40798	0	
P03.30	PLC analog output terminal status	Monitor the status of the PLC analog output terminals bit 0: AO1 status	Read	031E	40799	0	
P03.31	AO1 output selection	0: 0–10 V output 1: 0–20 mA output 2: 4–20 mA output	♦R/W	031F	40800	0	
P03.32	AO1 output setting level	0.00–100.00%	♦R/W	0320	40801	0.00	
P03.35	AO1 output filter time	0.00–20.00 sec.	♦R/W	0323	40804	0.01	
P03.39	VR (keypad dial) input selection	Not used in GS30	♦R/W	0327	40808	1	
P03.44	Multi-function output (DO) by AI level source	0: AI1 1: AI2 3: AI10 4: AI11	♦R/W	032C	40813	0	
P03.45	AI upper level	-100–100%	♦R/W	032D	40814	50	
P03.46	AI lower level	-100–100%	♦R/W	032E	40815	10	
P03.47	AI1%	-100–100%	Read	032F	40816	0.00	
P03.48	AI2%	-100–100%	Read	0330	40817	0.00	

(table continued next page)

GS30 Parameters Summary – Analog Input/Output Parameters (P03.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P03.50	Analog input curve calculation selection	0: Normal curve 1: Three-point curve of AI1/AI10 2: Three-point curve of AI2/AI11 3: Three-point curve of all AI	♦R/W	0332	40819	0	
P03.57	AI2 lowest point	P03.29 = 1, 0.00–10.00 V P03.29 ≠ 1, 0.00–20.00 mA	♦R/W	0339	40826	4.00	
P03.58	AI2 lowest point percent	0.00–100.00%	♦R/W	033A	40827	0.00	
P03.59	AI2 mid-point	P03.29 = 1, 0.00–10.00 V P03.29 ≠ 1, 0.00–20.00 mA	♦R/W	033B	40828	12.00	
P03.60	AI2 mid-point percent	0.00–100.00%	♦R/W	033C	40829	50.00	
P03.61	AI2 highest point	P03.29 = 1, 0.00–10.00 V P03.29 ≠ 1, 0.00–20.00 mA	♦R/W	033D	40830	20.00	
P03.62	AI2 highest point percent	0.00–100.00%	♦R/W	033E	40831	100.00	
P03.63	AI1 voltage lowest point	0.00–10.00 V	♦R/W	033F	40832	0.00	
P03.64	AI1 lowest point percent	-100.00–100.00%	♦R/W	0340	40833	0.00	
P03.65	AI1 voltage mid-point	0.00–10.00 V	♦R/W	0341	40834	5.00	
P03.66	AI1 mid-point percent	-100.00–100.00%	♦R/W	0342	40835	50.00	
P03.67	AI1 voltage highest point	0.00–10.00 V	♦R/W	0343	40836	10.00	
P03.68	AI1 highest point percent	-100.00–100.00%	♦R/W	0344	40837	100.00	
P03.69	Negative AI1 voltage highest point	-10.00–0.00 V (valid when P03.28 sets as -10–10 V)	♦R/W	0345	40838	0.00	
P03.70	Negative AI1 highest point percent	-100.00–100.00% (valid when P03.28 sets as -10–10 V)	♦R/W	0346	40839	0.00	
P03.71	Negative AI1 voltage mid-point	-10.00–0.00 V (valid when P03.28 sets as -10–10 V)	♦R/W	0347	40840	-5.00	
P03.72	Negative AI1 mid-point percent	-100.00–100.00% (valid when P03.28 sets as -10–10 V)	♦R/W	0348	40841	-50.00	
P03.73	Negative AI1 voltage lowest point	-10.00–0.00 V (valid when P03.28 sets as -10–10 V)	♦R/W	0349	40842	-10.00	
P03.74	Negative AI1 lowest point percent	-100.00–100.00% (valid when P03.28 sets as -10–10 V)	♦R/W	034A	40843	-100.00	

Multi-Step Speed Parameters Summary (P04.xx)

For detailed information about the P04.xx parameter group, please refer to *page 4–154*.

GS30 Parameters Summary – Multi-Step Speed Parameters (P04.xx)							
Parameter		***Range***	***Run[1)] Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default[2)]***	***User***
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P04.00	1st step speed frequency	0.00–599.00 Hz	♦R/W	0400	41025	0.00	
P04.01	2nd step speed frequency	0.00–599.00 Hz	♦R/W	0401	41026	0.00	
P04.02	3rd step speed frequency	0.00–599.00 Hz	♦R/W	0402	41027	0.00	
P04.03	4th step speed frequency	0.00–599.00 Hz	♦R/W	0403	41028	0.00	
P04.04	5th step speed frequency	0.00–599.00 Hz	♦R/W	0404	41029	0.00	
P04.05	6th step speed frequency	0.00–599.00 Hz	♦R/W	0405	41030	0.00	
P04.06	7th step speed frequency	0.00–599.00 Hz	♦R/W	0406	41031	0.00	
P04.07	8th step speed frequency	0.00–599.00 Hz	♦R/W	0407	41032	0.00	
P04.08	9th step speed frequency	0.00–599.00 Hz	♦R/W	0408	41033	0.00	
P04.09	10th step speed frequency	0.00–599.00 Hz	♦R/W	0409	41034	0.00	
P04.10	11th step speed frequency	0.00–599.00 Hz	♦R/W	040A	41035	0.00	
P04.11	12th step speed frequency	0.00–599.00 Hz	♦R/W	040B	41036	0.00	
P04.12	13th step speed frequency	0.00–599.00 Hz	♦R/W	040C	41037	0.00	
P04.13	14th step speed frequency	0.00–599.00 Hz	♦R/W	040D	41038	0.00	
P04.14	15th step speed frequency	0.00–599.00 Hz	♦R/W	040E	41039	0.00	
P04.15	Reserved	–	–	040F	41040	–	
P04.16	Reserved	–	–	0410	41041	–	
P04.17	Reserved	–	–	0411	41042	–	
P04.18	Reserved	–	–	0412	41043	–	
P04.19	Reserved	–	–	0413	41044	–	
P04.20	Reserved	–	–	0414	41045	–	
P04.21	Reserved	–	–	0415	41046	–	
P04.22	Reserved	–	–	0416	41047	–	
P04.23	Reserved	–	–	0417	41048	–	
P04.24	Reserved	–	–	0418	41049	–	
P04.25	Reserved	–	–	0419	41050	–	
P04.26	Reserved	–	–	041A	41051	–	
P04.27	Reserved	–	–	041B	41052	–	
P04.28	Reserved	–	–	041C	41053	–	
P04.29	Reserved	–	–	041D	41054	–	
P04.30	Reserved	–	–	041E	41055	–	
P04.31	Reserved	–	–	041F	41056	–	
P04.32	Reserved	–	–	0420	41057	–	
P04.33	Reserved	–	–	0421	41058	–	
P04.34	Reserved	–	–	0422	41059	–	
P04.35	Reserved	–	–	0423	41060	–	
P04.36	Reserved	–	–	0424	41061	–	
P04.37	Reserved	–	–	0425	41062	–	
P04.38	Reserved	–	–	0426	41063	–	
P04.39	Reserved	–	–	0427	41064	–	
P04.40	Reserved	–	–	0428	41065	–	
P04.41	Reserved	–	–	0429	41066	–	
P04.42	Reserved	–	–	042A	41067	–	
P04.43	Reserved	–	–	042B	41068	–	
(table continued next page)							

GS30 Parameters Summary – Multi-Step Speed Parameters (P04.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P04.44	Reserved	–	–	042C	41069	–	
P04.50	PLC buffer 0	0–65535	♦R/W	0432	41075	0	
P04.51	PLC buffer 1	0–65535	♦R/W	0433	41076	0	
P04.52	PLC buffer 2	0–65535	♦R/W	0434	41077	0	
P04.53	PLC buffer 3	0–65535	♦R/W	0435	41078	0	
P04.54	PLC buffer 4	0–65535	♦R/W	0436	41079	0	
P04.55	PLC buffer 5	0–65535	♦R/W	0437	41080	0	
P04.56	PLC buffer 6	0–65535	♦R/W	0438	41081	0	
P04.57	PLC buffer 7	0–65535	♦R/W	0439	41082	0	
P04.58	PLC buffer 8	0–65535	♦R/W	043A	41083	0	
P04.59	PLC buffer 9	0–65535	♦R/W	043B	41084	0	
P04.60	PLC buffer 10	0–65535	♦R/W	043C	41085	0	
P04.61	PLC buffer 11	0–65535	♦R/W	043D	41086	0	
P04.62	PLC buffer 12	0–65535	♦R/W	043E	41087	0	
P04.63	PLC buffer 13	0–65535	♦R/W	043F	41088	0	
P04.64	PLC buffer 14	0–65535	♦R/W	0440	41089	0	
P04.65	PLC buffer 15	0–65535	♦R/W	0441	41090	0	
P04.66	PLC buffer 16	0–65535	♦R/W	0442	41091	0	
P04.67	PLC buffer 17	0–65535	♦R/W	0443	41092	0	
P04.68	PLC buffer 18	0–65535	♦R/W	0444	41093	0	
P04.69	PLC buffer 19	0–65535	♦R/W	0445	41094	0	

Motor Parameters Summary (P05.xx)

For detailed information about the P05.xx parameter group, please refer to page 4–156.

GS30 Parameters Summary – Motor Parameters (P05.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default[2]**	**User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P05.00	Motor parameter auto-tuning	0: No function 1: Dynamic test for induction motor (IM) 2: Static test for induction motor (IM) 4: Dynamic test for PM magnetic pole 5: Rotary tuning for PM motor 12: FOC sensorless inertia estimation (IM) 13: Static tune for PM motor	R/W	0500	41281	0	
P05.01	Induction Motor 1, Full-load amps	10–120% of the drive's rated current	R/W	0501	41282	Model dependent	
P05.02	Induction Motor 1, Rated power (kW)	0.00–655.35 kW	♦R/W	0502	41283	Model dependent	
P05.03	Induction Motor 1, Rated speed (rpm)	0–xxxxx rpm (set to value on motor nameplate)	♦R/W	0503	41284	1710	
P05.04	Induction Motor 1, Number of poles	2–20	R/W	0504	41285	4	
P05.05	Induction Motor 1, No-load amps	0.00–P05.01 default	R/W	0505	41286	Model dependent	
P05.06	Induction Motor 1, Stator resistance (Rs)	0.000–65.535 Ω	R/W	0506	41287	Model dependent	
P05.07	Induction Motor 1, Rotor resistance (Rr)	0.000–65.535 Ω	R/W	0507	41288	0.000	
P05.08	Induction Motor 1, Magnetizing inductance (Lm)	0.0–6553.5 mH	R/W	0508	41289	0.0	
P05.09	Induction Motor 1, Stator inductance (Lx)	0.0–6553.5 mH	R/W	0509	41290	0.0	
P05.13	Induction Motor 2, Full-load amps	10–120% of the drive's rated current	R/W	050D	41294	Model dependent	
P05.14	Induction Motor 2, Rated power (kW)	0.00–655.35 kW	♦R/W	050E	41295	Model dependent	
P05.15	Induction Motor 2, Rated speed (rpm)	0–xxxxx rpm (set to value on motor nameplate)	♦R/W	050F	41296	1710	
P05.16	Induction Motor 2, Number of poles	2–20	R/W	0510	41297	4	
P05.17	Induction Motor 2, No-load amps	0.00–P05.13 default	R/W	0511	41298	Model dependent	
P05.18	Induction Motor 2, Stator resistance (Rs)	0.000–65.535 Ω	R/W	0512	41299	Model dependent	
P05.19	Induction Motor 2, Rotor resistance (Rr)	0.000–65.535 Ω	R/W	0513	41300	0.000	
P05.20	Induction Motor 2, Magnetizing inductance (Lm)	0.0–6553.5 mH	R/W	0514	41301	0.0	
P05.21	Induction Motor 2, Stator inductance (Lx)	0.0–6553.5 mH	R/W	0515	41302	0.0	
(table continued next page)							

GS30 Parameters Summary – Motor Parameters (P05.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P05.22	Multi-motor (induction) selection	1: Motor 1 2: Motor 2 3: Motor 3 (VF or SVC control mode only) 4: Motor 4 (VF or SVC control mode only)	R/W	0516	41303	1	
P05.23	Frequency for Y-connection / Δ-connection switch for an induction motor	0.00–599.00 Hz	♦R/W	0517	41304	60.00	
P05.24	Y-connection /Δ-connection switch for an induction motor	0: Disable 1: Enable	R/W	0518	41305	0	
P05.25	Delay time for Y-connection /Δ-connection switch for an induction motor	0.000–60.000 sec.	♦R/W	0519	41306	0.200	
P05.26	Accumulated Watt-second for a motor (W-msec.)	Read only	Read	051A	41307	0	
P05.27	Accumulated Watt-second for a motor (W-sec.)	Read only	Read	051B	41308	0	
P05.28	Accumulated Watt-hour for a motor (W-hour)	Read only	Read	051C	41309	0	
P05.29	Accumulated Watt-hour for a motor (kW-hour)	Read only	Read	051D	41310	0	
P05.30	Accumulated Watt-hour for a motor (MW-hour)	Read only	Read	051E	41311	0	
P05.31	Accumulated motor operation time (Minutes)	0–1439	R/W	051F	41312	0	
P05.32	Accumulated motor operation time (days)	0–65535	R/W	0520	41313	0	
P05.33	Induction motor (IM) or permanent magnet synchronous AC motor (PM) selection	0: IM (Induction motor) 1: SPM (Surface permanent magnet synchronous AC motor) 2: IPM (Interior permanent magnet synchronous AC motor)	R/W	0521	41314	0	
P05.34	Full-load current for a permanent magnet synchronous AC motor	0–120% of the drive's rated current	R/W	0522	41315	Model dependent	
P05.35	Rated power for a permanent magnet synchronous AC motor	0.00–655.35 kW	R/W	0523	41316	Model dependent	
P05.36	Rated speed for a permanent magnet synchronous AC motor	0–65535 rpm	R/W	0524	41317	2000	
P05.37	Number of poles for a permanent magnet synchronous AC motor	0–65535	R/W	0525	41318	10	
P05.39	Stator resistance Rs for a permanent magnet synchronous AC motor	0.000–65.535 Ω	R/W	0527	41320	0.000	

(table continued next page)

GS30 Parameters Summary – Motor Parameters (P05.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P05.40	Permanent magnet synchronous AC motor Ld	0.00–655.35 mH	R/W	0528	41321	0.00	
P05.41	Permanent magnet synchronous AC motor Lq	0.00–655.35 mH	R/W	0529	41322	0.00	
P05.42	PG Offset Angle for a Permanent Magnet Synchronous Motor	0.00–655.35 mH	R/W	052A	41323	0	
P05.43	Ke parameter of a permanent magnet synchronous AC motor	0–65535 (Unit: V / krpm)	R/W	052B	41324	0	
P05.64	Induction Motor 3, Full-load amps	10–120% of the drive’s rated current	R/W	0540	41345	Model dependent	
P05.65	Induction Motor 3, Rated power (kW)	0.00–655.35 kW	♦R/W	0541	41346	Model dependent	
P05.66	Induction Motor 3, Rated speed (rpm)	0–xxxxx rpm (set to value on motor nameplate)	♦R/W	0542	41347	1710	
P05.67	Induction Motor 3, Number of poles	2–20	R/W	0543	41348	4	
P05.68	Induction Motor 3, No-load amps	0.00–P05.64 default	R/W	0544	41349	Model dependent	
P05.69	Induction Motor 3, Stator resistance (Rs)	0.000–65.535 Ω	R/W	0545	41350	Model dependent	
P05.70	Induction Motor 4, Full-load amps	10–120% of the drive’s rated current	R/W	0546	41351	Model dependent	
P05.71	Induction Motor 4, Rated power for (kW)	0.00–655.35 kW	♦R/W	0547	41352	Model dependent	
P05.72	Induction Motor 4, Rated speed (rpm)	0–xxxxx rpm (set to value on motor nameplate)	♦R/W	0548	41353	1710	
P05.73	Induction Motor 4, Number of poles	2–20	R/W	0549	41354	4	
P05.74	Induction Motor 4, No-load amps	0.00–P05.70 default	R/W	054A	41355	Model dependent	
P05.75	Induction Motor 4, Stator resistance (Rs)	0.000–65.535 Ω	R/W	054B	41356	Model dependent	

Protection Parameters Summary (P06.xx)

For detailed information about the P06.xx parameter group, please refer to page 4–165.

GS30 Parameters Summary – Protection Parameters (P06.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default[2]**	**User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P06.00	Low voltage level	230V models: 150.0–220.0 VDC 460V models: 300.0–440.0 VDC	♦R/W	0600	41537	180.0 360.0	
P06.01	Over-voltage stall prevention	0: Disable 230V models: 0.0–390.0 VDC 460V models: 0.0–900.0 VDC	♦R/W	0601	41538	380.0 760.0	
P06.02	Selection for over-voltage stall prevention	0: Traditional over-voltage stall prevention 1: Smart over-voltage stall prevention 2: Traditional over-voltage and smart over-current stall prevention 3: Smart over-voltage and smart over-current stall prevention	♦R/W	0602	41539	0	
P06.03	Over-current stall prevention during acceleration (OCA)	VT: 0–150% (100% corresponds to the rated current of the drive) CT: 0–200% (100% corresponds to the rated current of the drive)	♦R/W	0603	41540	120 180	
P06.04	Over-current stall prevention during operation (OCN)	VT: 0–150% (100% corresponds to the rated current of the drive) CT: 0–200% (100% corresponds to the rated current of the drive)	♦R/W	0604	41541	120 180	
P06.05	Acceleration / deceleration time selection for stall prevention at constant speed	0: By current acceleration / deceleration time 1: By the first acceleration / deceleration time 2: By the second acceleration / deceleration time 3: By the third acceleration / deceleration time 4: By the fourth acceleration / deceleration time 5: By Auto-acceleration / auto-deceleration	♦R/W	0605	41542	0	
P06.06	Over-torque detection selection (motor 1)	0: Disabled 1: Detect at speed and keep running 2: Detect at speed and stop 3: Detect at RUN and keep running 4: Detect at RUN and stop	♦R/W	0606	41543	0	
P06.07	Over-torque detection level (motor 1)	10–250% (100% corresponds to the rated current of the drive)	♦R/W	0607	41544	120	
P06.08	Over-torque detection time (motor 1)	0.1–60.0 sec.	♦R/W	0608	41545	0.1	
P06.09	Over-torque detection selection (motor 2)	0: Disabled 1: Detect at speed and keep running 2: Detect at speed and stop 3: Detect at RUN and keep running 4: Detect at RUN and stop	♦R/W	0609	41546	0	
(table continued next page)							

GS30 Parameters Summary – Protection Parameters (P06.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P06.10	Over-torque detection level (motor 2)	10–250% (100% corresponds to the rated current of the drive)	♦R/W	060A	41547	120	
P06.11	Over-torque detection time (motor 2)	0.1–60.0 sec.	♦R/W	060B	41548	0.1	
P06.12	Current limit	0–250% (100% corresponds to the rated current of the drive)	♦R/W	060C	41549	150	
P06.13	Electronic thermal relay selection 1 (motor 1)	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with fan on the shaft) 2: Disabled	♦R/W	060D	41550	1	
P06.14	Electronic thermal relay action time 1 (motor 1)	30.0–600.0 sec.	♦R/W	060E	41551	60.0	
P06.15	Temperature level overheat (OH) warning	0.0–110.0°C	♦R/W	060F	41552	Model dependent	
P06.16	Stall prevention limit level (Weak magnetic field current stall prevention level)	0–100% (refer to P06.03–P06.04)	♦R/W	0610	41553	100	

(table continued next page)

GS30 Parameters Summary – Protection Parameters (P06.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P06.17	Fault record 1	0: No fault record 1: Over-current during acceleration (ocA) 2: Over-current during deceleration (ocd) 3: Over-current during steady operation (ocn) 4: Ground fault (GFF) 5: IGBT short circuit between upper bridge and lower bridge (occ) 6: Over-current at stop (ocS) 7: Over-voltage during acceleration (ovA) 8: Over-voltage during deceleration (ovd) 9: Over-voltage during constant speed (ovn) 10: Over-voltage at stop (ovS) 11: Low-voltage during acceleration (LvA) 12: Low-voltage during deceleration (Lvd) 13: Low-voltage during constant speed (Lvn) 14: Low-voltage at stop (LvS) 15: Phase loss protection (orP) 16: IGBT overheating (oH1) 17: Heatsink overheating (oH2) 18: IGBT temperature detection failure (tH1o) 19: Capcitor hardware error (tH2o) 21: Over load (oL) 22: Electronic thermal relay 1 protection (EoL1) 23: Electronic thermal relay 2 protection (EoL2) 24: Motor PTC overheating (oH3) 26: Over torque 1 (ot1) 27: Over torque 2 (ot2) 28: Under current (uC) 29: Limit error (LiT) 31: EEPROM read error (cF2) 33: U-phase error (cd1) 34: V-phase error (cd2) 35: W-phase error (cd3) 36: cc (current clamp) hardware error (Hd0) 37: oc (over-current) hardware error (Hd1) 40: Auto-tuning error (AUE) 41: PID loss AI2 (AFE) 42: Encoder feedback error (PGF1) 43: Encoder feedback loss (PGF2) 44: Encoder feedback stall (PGF3) 45: Encoder slip error (PGF4) 48: AI2 loss (ACE) 49: External fault (EF) 50: Emergency stop (EF1) 51: External Base Block (bb) 52: Password is locked (Pcod)	Read	0611	41554	0	
(table continued next page)							

GS30 Parameters Summary – Protection Parameters (P06.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P06.17 (cont'd)	Fault record 1 (continued)	54: Illegal command (CE1) 55: Illegal data address (CE2) 56: Illegal data value (CE3) 57: Data is written to read-only address (CE4) 58: Modbus transmission time-out (CE10) 61: Y-connection / Δ-connection switch error (ydc) 62: Deceleration energy backup error (dEb) 63: Over slip error (oSL) 72: STO Loss (STL1) 76: STO (STo) 77: STO Loss 2 (STL2) 78: STO Loss 3 (STL3) 79: U-phase Over-current before run (Aoc) 80: V-phase Over-current before run (boc) 81: W-phase Over-current before run (coc) 82: Output phase loss U phase (oPL1) 83: Output phase loss V phase (oPL2) 84: Output phase loss W phase (oPL3) 87: Low frequency overload protection (oL3) 89: Rotor position detection error (roPd) 97: Ethernet Card Timeout (CD10) 111: InrCOM time-out error (ictE) 121: Internal communication error (CP20) 123: Internal communication error (CP22) 124: Internal communication error (CP30) 126: Internal communication error (CP32) 127: Internal communication error (CP33) 128: Over-torque 3 (ot3) 129: Over-torque 4 (ot4) 134: Internal communication error (EoL3) 135: Internal communication error (EoL4) 140: Oc hardware error (Hd6) 141: GFF occurs before run (b4GFF) 142: Auto-tune error 1 (DC test stage) (AuE1) 143: Auto-tune error 2 (High frequency test stage) (AuE2) 144: Auto-tune error 3 (Rotary test stage) (AuE3) 149: Auto-tune error 5 (Rotor resistance measure test stage) (AuE5)	Read	0611	41554	0	
P06.18	Fault record 2	See P06.17 for ranges.	Read	0612	41555	0	
P06.19	Fault record 3	See P06.17 for ranges.	Read	0613	41556	0	
P06.20	Fault record 4	See P06.17 for ranges.	Read	0614	41557	0	
P06.21	Fault record 5	See P06.17 for ranges.	Read	0615	41558	0	
P06.22	Fault record 6	See P06.17 for ranges.	Read	0616	41559	0	
P06.23	Fault output option 1	0–65535 (refer to bit table for fault code)	♦R/W	0617	41560	0	
P06.24	Fault output option 2	0–65535 (refer to bit table for fault code)	♦R/W	0618	41561	0	
P06.25	Fault output option 3	0–65535 (refer to bit table for fault code)	♦R/W	0619	41562	0	

(table continued next page)

GS30 Parameters Summary – Protection Parameters (P06.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P06.26	Fault output option 4	0–65535 (refer to bit table for fault code)	♦R/W	061A	41563	0	
P06.27	Electronic thermal relay selection 2 (motor 2)	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with fan on the shaft) 2: Disabled	♦R/W	061B	41564	1	
P06.28	Electronic thermal relay action time 2 (motor 2)	30.0–600.0 sec.	♦R/W	061C	41565	60.0	
P06.29	PTC detection selection	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	♦R/W	061D	41566	0	
P06.30	PTC level	0.0–100.0%	♦R/W	061E	41567	50.0	
P06.31	Frequency command at malfunction	0.00–599.00 Hz	Read	061F	41568	0	
P06.32	Output frequency at malfunction	0.00–599.00 Hz	Read	0620	41569	0	
P06.33	Output voltage at malfunction	0.0–6553.5 V	Read	0621	41570	0	
P06.34	DC bus voltage at malfunction	0.0–6553.5 V	Read	0622	41571	0	
P06.35	Output current at malfunction	0.00–655.35 Amp	Read	0623	41572	0	
P06.36	IGBT temperature at malfunction	-3276.7–3276.7°C	Read	0624	41573	0	
P06.38	Motor speed at malfunction	-32767–32767 rpm	Read	0626	41575	0	
P06.39	Torque command at malfunction	-32767–32767%	Read	0627	41576	0	
P06.40	Status of the digital input terminal at malfunction	0000h–FFFFh	Read	0628	41577	0	
P06.41	Status of the digital output terminal at malfunction	0000h–FFFFh	Read	0629	41578	0	
P06.42	Drive status at malfunction	0000h–FFFFh	Read	062A	41579	0	
P06.44	STO latch selection	0: STO latch 1: STO no latch	♦R/W	062C	41581	0	
P06.45	Output phase loss detection action (OPHL)	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	♦R/W	062D	41582	3	
P06.46	Detection time for output phase loss	0.000–65.535 sec.	♦R/W	062E	41583	0.500	
P06.47	Current detection level for output phase loss	0.00–100.00%	♦R/W	062F	41584	1.00	
P06.48	DC brake time for output phase loss	0.000–65.535 sec.	♦R/W	0630	41585	0.000	
P06.49	LvX auto-reset	0: Disable 1: Enable	R/W	0631	41586	0	
P06.53	Input phase loss detection action (OrP)	0: Fault and ramp to stop 1: Fault and coast to stop	♦R/W	0635	41590	0	

(table continued next page)

GS30 Parameters Summary – Protection Parameters (P06.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P06.55	Derating protection	0: Constant rated current and limit carrier frequency by load current and temperature 1: Constant carrier frequency and limit load current by setting carrier frequency 2: Constant rated current (same as setting 0), but close current limit	♦R/W	0637	41592	0	
P06.56	PT100 RTD voltage level 1	0.000–10.000 V	♦R/W	0638	41593	5.000	
P06.57	PT100 RTD voltage level 2	0.000–10.000 V	♦R/W	0639	41594	7.000	
P06.58	PT100 RTD level 1 frequency protection	0.00–599.00 Hz	♦R/W	063A	41595	0.00	
P06.59	PT100 RTD activation level 1 protection frequency delay time	0–6000 sec.	♦R/W	063B	41596	60	
P06.60	Software detection GFF current level	0.0–6553.5%	♦R/W	063C	41597	60.0	
P06.61	Software detection GFF filter time	0.00–655.35 sec.	♦R/W	063D	41598	0.10	
P06.63	Operation time of fault record 1 (Days)	0–65535 days	Read	063F	41600	0	
P06.64	Operation time of fault record 1 (Minutes)	0–1439 min.	Read	0640	41601	0	
P06.65	Operation time of fault record 2 (Days)	0–65535 days	Read	0641	41602	0	
P06.66	Operation time of fault record 2 (Minutes)	0–1439 min.	Read	0642	41603	0	
P06.67	Operation time of fault record 3 (Days)	0–65535 days	Read	0643	41604	0	
P06.68	Operation time of fault record 3 (Minutes)	0–1439 min.	Read	0644	41605	0	
P06.69	Operation time of fault record 4 (Days)	0–65535 days	Read	0645	41606	0	
P06.70	Operation time of fault record 4 (Minutes)	0–1439 min.	Read	0646	41607	0	
P06.71	Low current setting level	0.0–100.0%	♦R/W	0647	41608	0.0	
P06.72	Low current detection time	0.00–360.00 sec.	♦R/W	0648	41609	0.00	
P06.73	Low current action	0: No function 1: Fault and coast to stop 2: Fault and ramp to stop by the second deceleration time 3: Warn and continue operation	♦R/W	0649	41610	0	
P06.90	Operation time of fault record 5 (days)	0–65535 days	Read	065A	41627	0	
P06.91	Operation time of fault record 5 (Minutes)	0–1439 min.	Read	065B	41628	0	
P06.92	Operation time of fault record 6 (days)	0–65535 days	Read	065C	41629	0	

(table continued next page)

GS30 Parameters Summary – Protection Parameters (P06.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P06.93	Operation time of fault record 6 (Minutes)	0–1439 min.	Read	065D	41630	0	

Special Parameters Summary (P07.xx)

For detailed information about the P07.xx parameter group, please refer to *page 4–188*.

GS30 Parameters Summary – Special Parameters (P07.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default[2]**	**User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." *2) Parameters can be restored to their default values using P00.02.*							
P07.00	Software brake chopper threshold level	230V models: 350.0–450.0 VDC 460V models: 700.0–900.0 VDC	♦R/W	0000	41793	370.0 740.0	
P07.01	DC brake current level	0–100%	♦R/W	0701	41794	0	
P07.02	DC brake time at start-up	0.0–60.0 sec.	♦R/W	0702	41795	0.0	
P07.03	DC brake time at STOP	0.0–60.0 sec.	♦R/W	0703	41796	0.0	
P07.04	DC brake frequency at STOP	0.00–599.00 Hz	♦R/W	0704	41797	0.00	
P07.05	Voltage increasing gain	1–200%	♦R/W	0705	41798	100	
P07.06	Restart after momentary power loss	0: Stop operation 1: Speed tracking by the speed before the power loss 2: Speed tracking by the minimum output frequency	♦R/W	0706	41799	0	
P07.07	Allowed power loss duration	0.0–20.0 sec.	♦R/W	0707	41800	2.0	
P07.08	Base Block time	0.0–60.0 sec.	♦R/W	0708	41801	0.5	
P07.09	Current limit of speed tracking	20–200%	♦R/W	0709	41802	100	
P07.10	Restart after fault action	0: Stop operation 1: Speed tracking by current speed 2: Speed tracking by minimum output frequency	♦R/W	070A	41803	0	
P07.11	Number of times of restart after fault	0–10	♦R/W	070B	41804	0	
P07.12	Speed tracking during start-up	0: Disable 1: Speed tracking by the maximum output frequency 2: Speed tracking by the motor frequency at start-up 3: Speed tracking by the minimum output frequency	♦R/W	070C	41805	0	
P07.13	dEb function selection	0: Disable 1: dEb with auto-acceleration / auto-deceleration, the drive does not output the frequency after the power is restored. 2: dEb with auto-acceleration / auto-deceleration, the drive outputs the frequency after the power is restored. 3: dEb low-voltage control, then the drive's voltage increases to 350 VDC / 700 VDC and ramps to stop after low frequency 4: dEb high-voltage control of 350 VDC / 700 VDC, and the drive ramps to stop	♦R/W	070D	41806	0	
(table continued next page)							

GS30 Parameters Summary – Special Parameters (P07.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P07.15	Dwell time at acceleration	0.00–600.00 sec.	♦R/W	070F	41808	0.00	
P07.16	Dwell frequency at acceleration	0.00–599.00 Hz	♦R/W	0710	41809	0.00	
P07.17	Dwell time at deceleration	0.00–600.00 sec.	♦R/W	0711	41810	0.00	
P07.18	Dwell frequency at deceleration	0.00–599.00 Hz	♦R/W	0712	41811	0.00	
P07.19	Fan cooling control	0: Fan is always ON 1: Fan is OFF after the AC motor drive stops for one minute. 2: Fan is ON when the AC motor drive runs, fan is OFF when the AC motor drive stops. 3: Fan turns ON when temperature (IGBT) reaches approx 60°C.	♦R/W	0713	41812	3	
P07.20	Emergency stop (EF) & force to stop selection	0: Coast to stop 1: Stop by the first deceleration time 2: Stop by the second deceleration time 3: Stop by the third deceleration time 4: Stop by the fourth deceleration time 5: System deceleration 6: Automatic deceleration	♦R/W	0714	41813	0	
P07.21	Automatic energy-sAI1ng setting	0: Disable 1: Enable	♦R/W	0715	41814	0	
P07.22	Energy-sAI1ng gain	10–1000%	♦R/W	0716	41815	100	
P07.23	Automatic voltage regulation (AVR) function	0: Enable AVR 1: Disable AVR 2: Disable AVR during deceleration	♦R/W	0717	41816	0	
P07.24	Torque command filter time (V/F and SVC control mode)	0.001–10.000 sec.	♦R/W	0718	41817	0.050	
P07.25	Slip compensation filter time (V/F and SVC control mode)	0.001–10.000 sec.	♦R/W	0719	41818	0.100	
P07.26	Torque compensation gain (V/F and SVC control mode)	IM: 0–10 (when P05.33 = 0) PM: 0–5000 (when P05.33 = 1 or 2)	♦R/W	071A	41819	1	
P07.27	Slip compensation gain (V/F and SVC control mode)	0.00–10.00	♦R/W	071B	41820	0.00 (Default value is 1.00 in SVC mode)	
P07.29	Slip deviation level	0.0–100.0% 0: No detection	♦R/W	071D	41822	0	
P07.30	Over-slip deviation detection time	0.0–10.0 sec.	♦R/W	071E	41823	1.0	
P07.31	Over-slip deviation treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	♦R/W	071F	41824	0	
P07.32	Motor oscillation compensation factor	0–10000	♦R/W	0720	41825	1000	
P07.33	Auto-restart interval of fault	0.0–6000.0 sec.	♦R/W	0721	41826	60.0	
P07.38	PMSVC voltage feed forward gain	0.50–2.00	R/W	0726	41831	1.00	
P07.62	dEb gain (Kp)	0–65535	♦R/W	073E	41855	8000	

(table continued next page)

GS30 Parameters Summary – Special Parameters (P07.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P07.63	dEb gain (Ki)	0–65535	♦R/W	073F	41856	150	
P07.71	Torque compensation gain (motor 2)	IM: 0–10 (when P05.33 = 0) PM: 0–5000 (when P05.33 = 1 or 2)	♦R/W	0747	41864	1	
P07.72	Slip compensation gain (motor 2)	0.00–10.00	♦R/W	0748	41865	0.00 (Default value is 1.00 in SVC mode)	
P07.73	Torque compensation gain (motor 3)	IM: 0–10 (when P05.33 = 0) PM: 0–5000 (when P05.33 = 1 or 2)	♦R/W	0749	41866	1	
P07.74	Slip compensation gain (motor 3)	0.00–10.00	♦R/W	074A	41867	0.00 (Default value is 1.00 in SVC mode)	
P07.75	Torque compensation gain (motor 4)	IM: 0–10 (when P05.33 = 0) PM: 0–5000 (when P05.33 = 1 or 2)	♦R/W	074B	41868	1	
P07.76	Slip compensation gain (motor 4)	0.00–10.00	♦R/W	074C	41869	0.00 (Default value is 1.00 in SVC mode)	

High-Function PID Parameters Summary (P08.xx)

For detailed information about the P08.xx parameter group, please refer to *page 4–201*.

GS30 Parameters Summary – High-Function PID Parameters (P08.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address Hex**	**Modbus Address Dec**	**Settings Default[2]**	**Settings User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P08.00	Terminal selection of PID feedback	0: No function 1: Negative PID feedback: by analog input (P03.00, P03.01) 2: Negative PID feedback: by single-phase input (DI7), without direction (P10.16=5) 3: Negative PID feedback: by single-phase pulse input (DI7), with direction (P10.16) 4: Positive PID feedback: by analog input (P03.00, P03.01) 5: Positive PID feedback: by single-phase input (DI7), without direction (P10.16=5) 6: Positive PID feedback: by single-phase pulse input (DI7), with direction (P10.16) 7: Negative PID feedback: by communication protocols 8: Positive PID feedback: by communication protocols	♦R/W	0800	42049	0	
P08.01	Proportional gain (P)	0.0–1000.0 (When P08.23 bit 1=0) 0.00–100.00 (When P08.23 bit 1=1)	♦R/W	0801	42050	1.00	
P08.02	Integral time (I)	0.00–100.00 sec.	♦R/W	0802	42051	1.00	
P08.03	Differential time (D)	0.00–1.00 sec.	♦R/W	0803	42052	0.00	
P08.04	Upper limit of integral control	0.0–100.0%	♦R/W	0804	42053	100.0	
P08.05	PID output command limit (positive limit)	0.0–110.0%	♦R/W	0805	42054	100.0	
P08.06	PID feedback value by communication protocol	-200.00–200.00%	♦R/W	0806	42055	0.00	
P08.07	PID delay time	0.0–2.5 sec.	♦R/W	0807	42056	0.0	
P08.08	Feedback signal detection time	0.0–3600.0 sec.	♦R/W	0808	42057	0.0	
P08.09	Feedback signal fault treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: Warn and operate at last frequency	♦R/W	0809	42058	0	
P08.10	Sleep frequency	0.00–599.00 Hz	♦R/W	080A	42059	0.00	
P08.11	Wake-up frequency	0.00–599.00 Hz	♦R/W	080B	42060	0.00	
P08.12	Sleep time	0.0–6000.0 sec.	♦R/W	080C	42061	0.0	
P08.13	PID feedback signal error deviation level	1.0–50.0%	♦R/W	080D	42062	10.0	
P08.14	PID feedback signal error deviation detection time	0.1–300.0 sec.	♦R/W	080E	42063	5.0	
P08.15	PID feedback signal filter time	0.1–300.0 sec.	♦R/W	080F	42064	5.0	
P08.16	PID compensation selection	0: Parameter setting 1: Analog input	♦R/W	0810	42065	0	
(table continued next page)							

GS30 Parameters Summary – High-Function PID Parameters (P08.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P08.17	PID compensation	-100.0–100.0%	♦R/W	0811	42066	0	
P08.18	Sleep mode function setting	0: Refer to PID output command 1: Refer to PID feedback signal	R/W	0812	42067	0	
P08.19	Wake-up integral limit	0.0–200.0%	♦R/W	0813	42068	50.0	
P08.20	PID mode selection	0: Dependent ISA PID structure 1: Independent ISA PID structure	R/W	0814	42069	0	
P08.21	Enable PID to change the operation direction	0: Operation direction cannot be changed 1: Operation direction can be changed	R/W	0815	42070	0	
P08.22	Wake-up delay time	0.00–600.00 sec.	♦R/W	0816	42071	0.00	
P08.23	PID control flag	bit 0 = 1: PID running in reverse follows the setting for P00.23. bit 0 = 0: PID running in reverse refers to PID’s calculated value. bit 1 = 1: two decimal places for PID Kp bit 1 = 0: one decimal place for PID Kp	♦R/W	0817	42072	2	
P08.26	PID output command limit (reverse limit)	0.0–100.0%	♦R/W	081A	42075	100.0	
P08.27	Acceleration / deceleration time for PID command	0.00–655.35 sec.	♦R/W	081B	42076	0.00	
P08.29	Frequency base corresponding to 100.00% PID	0: PID control output 100.00% corresponding to maximum operation frequency (P01.00) 1: PID control output 100.00% corresponding to the input value of the auxiliary frequency	♦R/W	081D	42078	0	
P08.31	Proportional gain 2	0.0–1000.0 (when P08.23 setting bit1=0) 0.00–100.00 (when P08.23 setting bit1=1)	♦R/W	081F	42080	1.00	
P08.32	Integral time 2	0.00–100.00 sec.	♦R/W	0820	42081	1.00	
P08.33	Differential time 2	0.00–1.00 sec.	♦R/W	0821	42082	0.00	
P08.65	PID target value source	0: Frequency command (P00.20, P00.30) 1: P08.66 setting 2: RS-485 communication input 3: External analog input (refer to P03.00, P03.01) 6: Communication card	♦R/W	0841	42114	0	
P08.66	PID target value setting	-100.00–100.00%	♦R/W	0842	42115	50.00	
P08.67	Master and auxiliary reverse running cutoff frequency	0.0–100.0%	♦R/W	0843	42116	10.0	
P08.68	PID deviation limit	0.00–100.00%	♦R/W	0844	42117	0.00	
P08.69	Integral separation level	0.00–100.00%	♦R/W	0845	42118	0.00	
P08.70	Smart start-up level	0.00–100.00%	R/W	0846	42119	5.00	
P08.71	Smart start-up frequency command	0.00–599.00 Hz	♦R/W	0847	42120	0.00	
P08.72	Smart start-up acceleration time	0.00–600.00 sec.	♦R/W	0848	42121	3.00	
P08.75	PID2 parameter switch condition	0: No switching (refer to P08.01–P08.03) 1: Auto-switch based on the output frequency 2: Auto-switch based on the deviation	♦R/W	084B	42124	0	
P08.76	PID2 parameter switch deviation 1	0.00–P08.77%	♦R/W	084C	42125	10.00	

(table continued next page)

GS30 Parameters Summary – High-Function PID Parameters (P08.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P08.77	PID2 parameter switch deviation 2	P08.76–100.00%	♦R/W	084D	42126	40.00	
P08.78	Allowed reverse running time after start-up	0.0–6553.5 sec.	♦R/W	084E	42127	0.0	
P08.79	WireBreak detected upper level	0–100%	R/W	084F	42128	0	
P08.80	WireBreak detected lower level	0–100%	R/W	0850	42129	0	
P08.81	WireBreak detected Time	0.000–65.535 sec	R/W	0851	42130	0.000	
P08.82	WireBreak treatment	0: Warn and do not stop 1: Ramp to stop 2: Coast to stop 3: Warn, PID hold	R/W	0852	42131	0	

Communication Parameters Summary (P09.xx)

For detailed information about the P09.xx parameter group, please refer to page 4–217.

GS30 Parameters Summary – Communication Parameters (P09.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default[2]**	**User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P09.00	Communication address	1–254	♦R/W	0900	42305	1	
P09.01	COM1 transmission speed	4.8–115.2 Kbps	♦R/W	0901	42306	9.6	
P09.02	COM1 transmission fault treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning, no fault, and continue operation	♦R/W	0902	42307	3	
P09.03	COM1 time-out detection	0.0–100.0 sec.	♦R/W	0903	42308	0.0	
P09.04	COM1 communication protocol	1: 7, N, 2 (ASCII) 2: 7, E, 1 (ASCII) 3: 7, O, 1 (ASCII) 4: 7, E, 2 (ASCII) 5: 7, O, 2 (ASCII) 6: 8, N, 1 (ASCII) 7: 8, N, 2 (ASCII) 8: 8, E, 1 (ASCII) 9: 8, O, 1 (ASCII) 10: 8, E, 2 (ASCII) 11: 8, O, 2 (ASCII) 12: 8, N, 1 (RTU) 13: 8, N, 2 (RTU) 14: 8, E, 1 (RTU) 15: 8, O, 1 (RTU) 16: 8, E, 2 (RTU) 17: 8, O, 2 (RTU)	♦R/W	0904	42309	15	
P09.09	Communication response delay time	0.0–200.0 ms	♦R/W	0909	42314	2.0	
P09.10	Communication main frequency	0.00–599.00 Hz	R/W	090A	42315	60.00	
P09.11	Block transfer 1	0–65535	♦R/W	090B	42316	0	
P09.12	Block transfer 2	0–65535	♦R/W	090C	42317	0	
P09.13	Block transfer 3	0–65535	♦R/W	090D	42318	0	
P09.14	Block transfer 4	0–65535	♦R/W	090E	42319	0	
P09.15	Block transfer 5	0–65535	♦R/W	090F	42320	0	
P09.16	Block transfer 6	0–65535	♦R/W	0910	42321	0	
P09.17	Block transfer 7	0–65535	♦R/W	0911	42322	0	
P09.18	Block transfer 8	0–65535	♦R/W	0912	42323	0	
P09.19	Block transfer 9	0–65535	♦R/W	0913	42324	0	
P09.20	Block transfer 10	0–65535	♦R/W	0914	42325	0	
P09.21	Block transfer 11	0–65535	♦R/W	0915	42326	0	
P09.22	Block transfer 12	0–65535	♦R/W	0916	42327	0	
P09.23	Block transfer 13	0–65535	♦R/W	0917	42328	0	
P09.24	Block transfer 14	0–65535	♦R/W	0918	42329	0	
P09.25	Block transfer 15	0–65535	♦R/W	0919	42330	0	
P09.26	Block transfer 16	0–65535	♦R/W	091A	42331	0	
P09.30	Communication decoding method	0: Decoding method 1 (20xx method) 1: Decoding method 2 (60xx method)	R/W	091E	42335	0	

GS30 Parameters Summary – Communication Parameters (P09.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P09.31	Internal communication protocol	0: Modbus 485 -1 to -11: Reserved -12: Internal PLC control	R/W	091F	42336	0	
P09.33	PLC command force to 0	0–65535	♦R/W	0921	42338	0	
P09.35	PLC address	1–254	R/W	0923	42340	2	
P09.60	Communication card identification	0: No communication card 4: Modbus-TCP slave 5: EtherNet/IP slave 6: EtherCAT 10: Backup power supply **Note:** A reading of 4 or 5 is dependent on the setting of P09.74	Read	093C	42365	0	
P09.61	Firmware version of communication card	Read only (decimal representation/ display of hex value)	Read	093D	42366	0	
P09.62	Product code	Read only	Read	093E	42367	0	
P09.63	Error code	Read only	Read	093F	42368	0	
P09.74	Comms protocol select	0: Both protocols 1: EtherNet/IP 2: Modbus-TCP	♦R/W	094A	42379	0	
P09.75	Communication card IP configuration (Ethernet)	0: Static IP 1: Dynamic IP (DHCP)	♦R/W	094B	42380	0	
P09.76	Communication card IP address 1 (Ethernet)	0–255	♦R/W	094C	42381	0	
P09.77	Communication card IP address 2 (Ethernet)	0–255	♦R/W	094D	42382	0	
P09.78	Communication card IP address 3 (Ethernet)	0–255	♦R/W	094E	42383	0	
P09.79	Communication card IP address 4 (Ethernet)	0–255	♦R/W	094F	42384	0	
P09.80	Communication card address mask 1 (Ethernet)	0–255	♦R/W	0950	42385	0	
P09.81	Communication card address mask 2 (Ethernet)	0–255	♦R/W	0951	42386	0	
P09.82	Communication card address mask 3 (Ethernet)	0–255	♦R/W	0952	42387	0	
P09.83	Communication card address mask 4 (Ethernet)	0–255	♦R/W	0953	42388	0	
P09.84	Communication card gateway address 1 (Ethernet)	0–255	♦R/W	0954	42389	0	
P09.85	Communication card gateway address 2 (Ethernet)	0–255	♦R/W	0955	42390	0	
P09.86	Communication card gateway address 3 (Ethernet)	0–255	♦R/W	0956	42391	0	
P09.87	Communication card gateway address 4 (Ethernet)	0–255	♦R/W	0957	42392	0	
P09.88	Communication card password (low word) (Ethernet)	0–99	♦R/W	0958	42393	0	

GS30 Parameters Summary – Communication Parameters (P09.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P09.89	Communication card password (high word) (Ethernet)	0–99	♦R/W	0959	42394	0	
P09.90	Reset communication card (Ethernet)	0: Disable 1: Reset to defaults	♦R/W	095A	42395	0	
P09.91	Additional settings for the communication card (Ethernet)	bit 0: Enable IP filter bit 1: Enable internet parameters (1 bit) When the IP address is set, this bit is enabled. After updating the parameters for the communication card, this bit changes to disabled. bit 2: Enable login password (1 bit) When you enter the login password, this bit is enabled. After updating the communication card parameters, this bit changes to disabled.	♦R/W	095B	42396	0	
P09.92	Communication card status (Ethernet)	bit 0: Enable password When the communication card is set with a password, this bit is enabled. When the password is cleared, this bit is disabled.	R/W	095C	42397	0	
P09.93	Comm Card Time Out Action Selection	0: Warn and keep running 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning	♦R/W	095D	42398	3	
P09.94	Comm Card Time Out Detection Enable	0: Disabled 1: Enabled	♦R/W	095E	42399	1	
P09.95	Comm Card Time Out Duration Time	0.1–60.0 seconds	♦R/W	095F	42400	3.0	

Speed Feedback Control Parameters Summary (P10.xx)

For detailed information about the P10.xx parameter group, please refer to *page 4–234*.

GS30 Parameters Summary – Speed Feedback Control Parameters (P10.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default[2]**	**User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P10.00	Encoder (PG1) type selection	0: Disabled 1: Encoder option card 5: Pulse input (DI7)	R/W	0A00	42561	0	
P10.01	Encoder (PG1) pulses per revolution	1–20000	R/W	0AO1	42562	600	
P10.02	Encoder input type setting	0: Disable 1: Phase A and B are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees 2: Phase A and B are pulse inputs, forward direction if B-phase leads A-phase by 90 degrees 3: Phase A is a pulse input and phase B is a direction input (low input=reverse direction, high input=forward direction) 4: Phase A is a pulse input and Phase B is a direction input (low input=forward direction, high input=reverse direction) 5: Single-phase input (DI7)	R/W	0A02	42563	0	
P10.04	Electrical gear at load side A1 (Encoder PG1)	1–65535	♦R/W	0A04	42565	100	
P10.05	Electrical gear at motor side B1 (Encoder PG1)	1–65535	♦R/W	0A05	42566	100	
P10.06	Electrical gear at load side A2 (Encoder PG1)	1–65535	♦R/W	0A06	42567	100	
P10.07	Electrical gear at motor side B2 (Encoder PG1)	1–65535	♦R/W	0A07	42568	100	
P10.08	Encoder (PG1) feedback fault treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop	♦R/W	0A08	42569	2	
P10.09	Encoder (PG1) feedback fault detection time	0: Disabled 0.0–10.0 seconds	♦R/W	0A09	42570	1.0	
P10.10	Encoder (PG1) stall level	0: No function 0–120%	♦R/W	0A0A	42571	115	
P10.11	Encoder(PG1) stall detection time	0.0–2.0 sec.	♦R/W	0A0B	42572	0.1	
P10.12	Encoder (PG1) stall action	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop	♦R/W	0A0C	42573	2	
P10.13	Encoder (PG1) slip range	0: Disable 0–50%	♦R/W	0A0D	42574	50	
P10.14	Encoder(PG1) slip detection time	0.0–10.0 sec.	♦R/W	0A0E	42575	0.5	
P10.15	Encoder (PG1) stall and slip error action	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop	♦R/W	0A0F	42576	2	
(table continued next page)							

GS30 Parameters Summary – Speed Feedback Control Parameters (P10.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P10.16	Pulse Command (PG2) type setting	0: Disabled 1: Phases A and B are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees. 2: Phases A and B are pulse inputs, forward direction if B-phase leads A-phase by 90 degresas. 3: Phase A is a pulse input and phase B is a direction input (low input = reverse direction, high input = forward direction). 4: Phase A is a pulse input and phase B is a direction input (low input = forward direction, high input = reverse direction). 5: Single-phase input (DI7)	♦R/W	0A10	42577	0	
P10.17	Pulse Command (PG2) electrical gear A	1–65535	♦R/W	0A11	42578	100	
P10.18	Pulse Command (PG2) electrical gear B	1–65535	♦R/W	0A12	42579	100	
P10.19	Positioning for Encoder (PG1) position	-32767 to 32767 pulses	♦R/W	0A13	42580	0	
P10.20	Error range for Encoder (PG1) position	0–65535 pulses	♦R/W	0A14	42581	10	
P10.21	Pulse Command(PG2) low pass filter time	0.000–65.535 sec.	♦R/W	0A15	42582	0.100	
P10.24	FOC & TQC function control	0–65535	♦R/W	0A18	42585	0	
P10.25	FOC bandwidth for speed observer	20.0–100.0 Hz	♦R/W	0A19	42586	40.0	
P10.26	FOC minimum stator frequency	0.0–10.0% fN	♦R/W	0A1A	42587	2.0	
P10.27	FOC low pass filter time constant	1–1000 ms	♦R/W	0A1B	42588	50	
P10.28	FOC gain for excitation current rise time	33–100% Tr	♦R/W	0A1C	42589	100	
P10.29	Upper limit of frequency deviation	0.00–200.00 Hz	♦R/W	0A1D	42590	20.00	
P10.31	I/F mode, current command	0–150% rated current of the motor	♦R/W	0A1F	42592	40	
P10.32	PM sensorless speed estimator bandwidth	0.00–599.00 Hz	♦R/W	0A20	42593	5.00	
P10.34	PM sensorless speed estimator low-pass filter gain	0.00–655.35	♦R/W	0A22	42595	1.00	
P10.35	Active Magnetic Regulator (AMR) (Kp) gain	0.00–3.00	♦R/W	0A23	42596	1.00	
P10.36	Active Magnetic Regulator (AMR) (Ki) gain	0.00–3.00	♦R/W	0A24	42597	0.20	
P10.39	Frequency point to switch from I/F mode to PM sensorless mode	0.00–599.00 Hz	♦R/W	0A27	42600	20.00	
P10.40	Frequency point switch from PM sensorless mode to I/F mode	0.00–599.00 Hz	♦R/W	0A28	42601	20.00	
P10.42	Initial angle detection pulse value	0.0–3.0	♦R/W	0A2A	42603	1.0	

(table continued next page)

GS30 Parameters Summary – Speed Feedback Control Parameters (P10.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P10.43	Encoder option card version	0.00–655.35	Read	0A2B	42604	–	
P10.49	Zero voltage time during start-up	0.000–60.000 sec.	♦R/W	0A31	42610	0.000	
P10.51	Injection frequency	0–1200 Hz	♦R/W	0A33	42612	500	
P10.52	Injection magnitude	230V models: 100.0 V 460V models: 200.0 V Note: The setting range varies depending on the voltage.	♦R/W	0A34	42613	15.0 30.0	
P10.53	Angle detection method	0: Disabled 1: Force attracting the rotor to zero degrees 2: High frequency injection 3: Pulse injection	♦R/W	0A35	42614	0	

Advanced Parameters Summary (P11.xx)

For detailed information about the P11.xx parameter group, please refer to page 4–247.

GS30 Parameters Summary – Advanced Parameters (P11.xx)							
Parameter		Range	Run[1] Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default[2]	User
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P11.00	System control	bit 0: Auto-tuning for ASR bit 1: Inertia estimate (only in FOC Encoder mode) bit 2: Zero servo bit 3: Dead time compensation closed bit 7: Save or do not save the frequency	R/W	0B00	42817	0	
P11.01	Per-unit of system inertia	1–65535 (256 = 1 PU)	R/W	0B01	42818	256	
P11.02	ASR1/ASR2 switch frequency	5.00–599.00 Hz	♦R/W	0B02	42819	7.00	
P11.03	ASR1 low-speed bandwidth	1–40 Hz	Read	0B03	42820	0	
P11.04	ASR2 high-speed bandwidth	1–40 Hz	Read	0B04	42821	0	
P11.05	Zero-speed bandwidth	1–40 Hz	Read	0B05	42822	0	
P11.06	ASR1 (Kp) gain	0–40 Hz	♦R/W	0B06	42823	10	
P11.07	ASR1 (Ki) integral time	0.000–10.000 sec.	♦R/W	0B07	42824	0.100	
P11.08	ASR2 (Kp) gain	0–40 Hz	♦R/W	0B08	42825	10	
P11.09	ASR2 (Ki) integral time	0.000–10.000 sec.	♦R/W	0B09	42826	0.100	
P11.10	ASR Kp gain of zero speed	0–40 Hz	♦R/W	0B0A	42827	10	
P11.11	ASR (Ki) integral time of zero speed	0.000–10.000 sec.	♦R/W	0B0B	42828	0.100	
P11.12	Gain for ASR speed feed forward	0–200%	♦R/W	0B0C	42829	0	
P11.13	PDFF gain value	0–200%	♦R/W	0B0D	42830	30	
P11.14	ASR output low pass filter time	0.000–0.350 sec.	♦R/W	0B0E	42831	0.008	
P11.15	Notch filter depth	0–20 db	♦R/W	0B0F	42832	0	
P11.16	Notch filter frequency	0.00–200.00 Hz	♦R/W	0B10	42833	0.00	
P11.17	Forward motor torque limit	0–500%	♦R/W	0B11	42834	500	
P11.18	Forward regenerative torque limit	0–500%	♦R/W	0B12	42835	500	
P11.19	Reverse motor torque limit	0–500%	♦R/W	0B13	42836	500	
P11.20	Reverse regenerative torque limit	0–500%	♦R/W	0B14	42837	500	
P11.21	Flux weakening curve for motor 1 gain value	0–200%	♦R/W	0B15	42838	90	
P11.22	Flux weakening curve for motor 2 gain value	0–200%	♦R/W	0B16	42839	90	
P11.23	Flux weakening area speed response	0–150%	♦R/W	0B17	42840	65	
P11.24	APR gain	0.00–40.00 Hz (IM) / 0.00–100.00 Hz (PM)	♦R/W	0B18	42841	10.00	
P11.25	Gain value for the APR feed forward	0–100	♦R/W	0B19	42842	30	
P11.26	APR curve time	0.00–655.35 seconds	♦R/W	0B1A	42843	10.00	
P11.27	Maximum torque command	0–500%	♦R/W	0B1B	42844	100	

GS30 Parameters Summary – Advanced Parameters (P11.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P11.28	Torque offset source	0: Disable 1: Analog signal input 2: RS-485 communication (P11.29) 3: Controlled through external terminals (P11.30–P11.32)	♦R/W	0B1C	42845	0	
P11.29	Torque offset setting	-100.0–100.0%	♦R/W	0B1D	42846	0.0	
P11.30	High torque offset	-100.0–100.0%	♦R/W	0B1E	42847	30.0	
P11.31	Middle torque offset	-100.0–100.0%	♦R/W	0B1F	42848	20.0	
P11.32	Low torque offset	-100.0–100.0%	♦R/W	0B20	42849	10.0	
P11.33	Torque command source	0: Digital keypad 1: RS-485 communication (P11.34) 2: Analog signal input (P03.00) 5: Communication Card	♦R/W	0B21	42850	0	
P11.34	Torque command	-100.0–100.0%	♦R/W	0B22	42851	0.0	
P11.35	Torque command filter time	0.000–1.000 sec.	♦R/W	0B23	42852	0.000	
P11.36	Speed limit selection	0: Set by P11.37 (forward speed limit) and P11.38 (reverse speed limit) 1: Set by P00.20 and P11.37, P11.38 2: Set by P00.20 3: Line speed tension control	R/W	0B24	42853	0	
P11.37	Forward speed limit (Torque mode)	0–120%	♦R/W	0B25	42854	10	
P11.38	Reverse speed limit (Torque mode)	0–120%	♦R/W	0B26	42855	10	
P11.39	Zero torque command mode selection	0: Torque mode 1: Speed mode	R/W	0B27	42856	0	
P11.40	Reserved	-	-	-	-	-	
P11.41	PWM mode selection	0: Two-phase modulation mode 2: Space vector modulation mode	R/W	0B29	42858	2	
P11.42	System control flag	0000–FFFFh	♦R/W	0B2A	42859	0000	

Tension Control Parameters Summary (P12.xx)

For detailed information about the P12.xx parameter group, please refer to “Group 12.xx Details – Tension Control Parameters” on page 4–258.

GS30 Parameters Summary – Tension Control Parameters (P12.xx)							
Parameter		***Range***	***Run[1)]Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default[2)]***	***User***
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates “Read/Write.” Read indicates “Read-only.” 2) Parameters can be restored to their default values using P00.02.							
P12.00	Tension control selection	0: Disabled 1: Closed-loop tension, speed mode 2: Closed-loop linear speed, speed mode 3: Closed-loop tension, torque mode 4: Open-loop tension, torque mode	R/W	0C00	43073	0	
P12.01	Winding mode	0: Rewind 1: Unwind	R/W	0C01	43074	0	
P12.02	Mechanical gear A at load side	1–65535	R/W	0C02	43075	100	
P12.03	Mechanical gear B at motor side	1–65535	R/W	0C03	43076	100	
P12.04	PID target source	0: Set by parameter (P12.05) 1: Set by RS-485 2: Analog input	R/W	0C04	43077	0	
P12.05	PID target value	0.0–100.0%	♦R/W	0C05	43078	50.0	
P12.06	PID feedback source selection	0: Analog input 1: Pulse input	♦R/W	0C06	43079	0	
P12.07	Tension PID auto-tuning selection	0: Disabled 1: Reel diameter (P12.08–P12.09 corresponds to P12.29, P12.11–P12.12 corresponds to P12.28) 2: Frequency (P12.08–P12.09 corresponds to P01.07, P12.11–P12.12 corresponds to P01.00)	R/W	0C07	43080	0	
P12.08	Tension PID P gain 1	0.00–1000.0	R/W	0C08	43081	50.0	
P12.09	Tension PID I integral time 1	0.00–500.00 seconds	R/W	0C09	43082	1.00	
P12.11	Tension PID P gain 2	0.0–1000.0	R/W	0C0B	43084	50.0	
P12.12	Tension PID I integral time 2	0.00–500.00 seconds	R/W	0C0C	43085	1.00	
P12.14	Tension PID output status selection	0: PID output is positive 1: PID output is negative	R/W	0C0E	43087	0	
P12.15	Tension PID positive output limit	0.00–100.00%	R/W	0C0F	43088	20.00	
P12.16	Tension PID negative output limit	0.00–100.00%	R/W	0C10	43089	20.00	
P12.17	Tension PID feedback upper limit	0.0–100.0%	R/W	0C11	43090	100.0	
P12.18	Tension PID feedback lower limit	0.0–100.0%	R/W	0C12	43091	0.0	
P12.19	Linear speed input command source	0: Disabled 1: Analog input 2: RS-485 communication input 3: Encoder card 4: Reserved 5: Pulse input through DI6/DI7 terminal	R/W	0C13	43092	0	
P12.20	Maximum linear speed	0.0–6500.0 m/min	R/W	0C14	43093	1000.0	
P12.21	Minimum linear speed	0.0–6500.0 m/min	R/W	0C15	43094	0.0	
P12.22	Pulses per meter	0.0–6000.0 pulses/m	R/W	0C16	43095	0.0	

GS30 Parameters Summary – Tension Control Parameters (P12.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P12.23	Current linear speed	0.0–6500.0 m/min	♦R/W	0C17	43096	0.0	
P12.24	Linear speed low pass filter time	0.00–100.00 seconds	♦R/W	0C18	43097	0.10	
P12.25	Linear speed command acceleration time	0.00–655.35 seconds	♦R/W	0C19	43098	0.00	
P12.26	Linear speed comand deceleration time	0.00–655.35 seconds	♦R/W	0C1A	43099	0.00	
P12.27	Reel diameter source	0: Calculated via line speed 1: Calculated via analog input selection 2: Calculated via thickness integral, the encoder installed at reel side inputs by encoder card 3: Calculated via thickness integral, the encoder installed at motor side inputs by encoder card 4: Calculated via thickness integral, the encoder installed at reel side inputs by DI6/DI7 terminals 5: Calculated via thickness integral, the encoder installed at mode side inputs by DI6/DI7 terminals	R/W	0C1B	43100	0	
P12.28	Maximum reel diameter	1.0–6000.0 mm	R/W	0C1C	43101	6000.0	
P12.29	Empty reel diameter	1.0–6000.0 mm	R/W	0C1D	43102	100.0	
P12.30	Initial reel diameter source	0: RS-485 communication input (P12.31) 1: Analog input (P03.00–P03.01=d16)	R/W	0C1E	43103	0	
P12.31	Initial reel diameter 0	1.0–6000.0 mm	R/W	0C1F	43104	1.0	
P12.32	Initial reel diameter 1	1.0–6000.0 mm	R/W	0C20	43105	1.0	
P12.33	Initial reel diameter 2	1.0–6000.0 mm	R/W	0C21	43106	1.0	
P12.34	Pulses per revolution	1–60000 ppr	R/W	0C22	43107	1	
P12.35	Revolutions per layer	1–10000	R/W	0C23	43108	1	
P12.36	Material thickness	0.001–65.000 mm	R/W	0C24	43109	0.001	
P12.37	Reel diameter filter time	0.00–100.00 seconds	♦R/W	0C25	43110	1.00	
P12.38	Automatic reel diamter compensation	0: Disabled 1: Enabled	R/W	0C26	43111	0	
P12.39	Reel diameter calculation delay time	0.0–6553.5 seconds	♦R/W	0C27	43112	0.0	
P12.40	Current reel diameter	1.0–6000.0 mm	R/W	0C28	43113	1.0	
P12.41	Minimum output frequency for reel diameter calculation	0.00–599.00 Hz	♦R/W	0C29	43114	1.00	
P12.42	Pre-startup mode selection	0: Disabled 1: Pre-startup of rewind mind 2: Pre-startup of unwind mode	R/W	0C2A	43115	0	
P12.43	Switching level for pre-startup and PID enable	0.0–100.0% (according to P12.05)	R/W	0C2B	43116	15.0	
P12.44	Pre-startup frequency	0.00–599.00 Hz	R/W	0C2C	43117	2.00	
P12.45	Pre-startup acceleration time	0.01–600.0 seconds	♦R/W	0C2D	43118	3.00	
P12.46	Broken belt detection function	0: Disabled 1: Enabled	R/W	0C2E	43119	0	
P12.47	Minimum linear speed of broken belt detection	0.0–3000.0 m/min	R/W	0C2F	43120	0.0	
P12.48	Reel diameter error of broken belt detection	1.0–6000.0 mm	R/W	0C30	43121	100.0	
P12.49	Broken belt detection time	0.00–100.00 seconds	R/W	0C31	43122	1.0	

GS30 Parameters Summary – Tension Control Parameters (P12.xx) – (continued)							
Parameter		***Range***	***Run Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default***	***User***
P12.50	Tension PID feedback error level	0–100%	R/W	0C32	43123	100	
P12.51	Tension PID feedback error detection time	0.0–10.0 seconds	R/W	0C33	43124	0.5	
P12.52	Tension PID feedback error treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop	R/W	0C34	43125	0	
P12.53	PID output gain limit	0.0–200.0	R/W	0C35	43126	100.0	
P12.54	Tension command source selection	0: RS-485 communication input 1: Analog input	R/W	0C36	43127	0	
P12.55	Maximum tension value	0–65535 N	R/W	0C37	43128	0	
P12.56	Tension command setting value	0–65535 N	♦R/W	0C38	43129	0	
P12.57	Zero-speed tension setting source	0: Disabled 1: RS-485 communication input 2: Analog input	R/W	0C39	43130	0	
P12.58	Zero-speed tension setting value	0–65535 N	♦R/W	0C3A	43131	0	
P12.59	Zero-speed tension threshold (line speed)	0–100.00%	♦R/W	0C3B	43132	0	
P12.60	Dynamic friction torque compensation	0.0–100.0%	♦R/W	0C3C	43133	0.0	
P12.61	Material inertia compensation coefficient	0–30000	♦R/W	0C3D	43134	0	
P12.62	Acceleration inertia compensation gain	0.0–1000.0%	♦R/W	0C3E	43135	0.0	
P12.63	Inertia compensation filter time	0.00–100.00	♦R/W	0C3F	43136	5.00	
P12.64	Deceleration inertia compensation gain	0.0–1000.0%	♦R/W	0C40	43137	0.0	
P12.65	Tension taper curve selection	0: No taper 1: Curve taper 2: Linear taper 3: Multi-step curve taper 4: Multi-step linear taper	R/W	0C41	43138	0	
P12.66	Tension taper setting source	0: RS-485 communication input 1: Analog input	R/W	0C42	43139	0	
P12.67	Tension taper value	0–100%	♦R/W	0C43	43140	0	
P12.68	Tension taper curve compensation value	0–60000	R/W	0C44	43141	0	
P12.69	Multi-step taper reel diameter 1	10.0–6000.0	R/W	0C45	43142	6000.0	
P12.70	Multi-step taper reel diameter 2	10.0–6000.0	R/W	0C46	43143	6000.0	
P12.71	Multi-step taper value 1	0–100	♦R/W	0C47	43144	0	
P12.72	Multi-step taper value 2	0–100	♦R/W	0C48	43145	0	
P12.73	Pre-drive frequency gain	-50.0 to 50.0%	♦R/W	0C49	43146	0	
P12.74	Pre-drive acceleration time	0–65535	♦R/W	0C4A	43147	0	
P12.75	Pre-drive deceleration time	0–65535	♦R/W	0C4B	43148	0	
P12.76	Speed limit gain	0–65535	♦R/W	0C4C	43149	0	

GS30 Parameters Summary – Tension Control Parameters (P12.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P12.77	Tension control bits	bit 0: Closed loop tension speed mode, allowed changing operation direction bit 1: Start-up compensation (switching between zero-speed tension command and normal tension command) bit 2: Acceleration and deceleration compensation (P12.62 acceleration inertia compensation gain; P12.64 deceleration inertia compensation gain) bit 3: Reel diameter calculation by moving average method bit 5: PID output reverse limit selection bit 6: Material thickness range selection	♦R/W	0C4D	43150	0	

Macro / User Defined Macro Parameters Summary (P13.xx)

For detailed information about the P13.xx parameter group, please refer to *page 4–280*.

GS30 Parameters Summary – Macro / User-Defined Macro Parameters (P13.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default[2]**	**User**
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P13.00	Industry-specific parameter application	00: Disabled 01: User-defined parameter 02: Compressor 03: Fan 04: Pump 05: Conveyor 06: Machine tool 07: Packing 08: Textiles 10: Logistics 11: Tension PID 12: Tension PID + master / auxiliary frequency	R/W	0D0D	43329	00	
P13.01	User-defined parameter			0D01	43330		
P13.02	User-defined parameter			0D02	43331		
P13.03	User-defined parameter			0D03	43332		
P13.04	User-defined parameter			0D04	43333		
P13.05	User-defined parameter			0D05	43334		
P13.06	User-defined parameter			0D06	43335		
P13.07	User-defined parameter			0D07	43336		
P13.08	User-defined parameter			0D08	43337		
P13.09	User-defined parameter			0D09	43338		
P13.10	User-defined parameter			0D0A	43339		
P13.11	User-defined parameter			0D0B	43340		
P13.12	User-defined parameter			0D0C	43341		
P13.13	User-defined parameter			0D0D	43342		
P13.14	User-defined parameter			0D0E	43343		
P13.15	User-defined parameter			0D0F	43344		
P13.16	User-defined parameter			0D10	43345		
P13.17	User-defined parameter			0D11	43346		
P13.18	User-defined parameter			0D12	43347		
P13.19	User-defined parameter			0D13	43348		
P13.20	User-defined parameter			0D14	43349		
P13.21	User-defined parameter			0D15	43350		
P13.22	User-defined parameter			0D16	43351		
P13.23	User-defined parameter			0D17	43352		
P13.24	User-defined parameter			0D18	43353		
P13.25	User-defined parameter			0D19	43354		
P13.26	User-defined parameter			0D1A	43355		
P13.27	User-defined parameter			0D1B	43356		
P13.28	User-defined parameter			0D1C	43357		
P13.29	User-defined parameter			0D1D	43358		
P13.30	User-defined parameter			0D1E	43359		
P13.31	User-defined parameter			0D1F	43360		
P13.32	User-defined parameter			0D20	43361		
P13.33	User-defined parameter			0D21	43362		
P13.34	User-defined parameter			0D22	43363		

GS30 Parameters Summary – Macro / User-Defined Macro Parameters (P13.xx) – (continued)							
Parameter		**Range**	**Run* Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P13.35	User-defined parameter			0D23	43364		
P13.36	User-defined parameter			0D24	43365		
P13.37	User-defined parameter			0D25	43366		
P13.38	User-defined parameter			0D26	43367		
P13.39	User-defined parameter			0D27	43368		
P13.40	User-defined parameter			0D28	43369		
P13.41	User-defined parameter			0D29	43370		
P13.42	User-defined parameter			0D2A	43371		
P13.43	User-defined parameter			0D2B	43372		
P13.44	User-defined parameter			0D2C	43373		
P13.45	User-defined parameter			0D2D	43374		
P13.46	User-defined parameter			0D2E	43375		
P13.47	User-defined parameter			0D2F	43376		
P13.48	User-defined parameter			0D30	43377		
P13.49	User-defined parameter			0D31	43378		
P13.50	User-defined parameter			0D32	43379		

Protection Parameters (2) Summary (P14.xx)

For detailed information about the P14.xx parameter group, please refer to *page 4–293*.

GS30 Parameters Summary – Protection Parameters (2) (P14.xx)							
Parameter		***Range***	***Run[1] Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default[2]***	***User***
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/Write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P14.00	Extension card input terminal selection (AI10)	0: No function 1: Frequency command (this function can be the torque limit in torque control mode) 2: Torque command (torque limit in speed mode) 3: Torque compensation command 4: PID reference value 5: PID feedback signal 6: PTC thermistor input value 7: Positive torque limit 8: Negative torque limit 9: Regenerative torque limit 10: Positive/negative torque limit 11: PT100 thermistor input value 12: Aux frequency 13: PID compensation amount 14: Tension PID Fbk 15: Line speed 16: Reel diameter 17: Tension PID reference 18: Tension setting 19: Zero Speed Tension 20: Tension taper	♦R/W	0E0E	43585	0	
P14.01	Extension card input terminal selection (AI11)		♦R/W	0E01	43586	0	
P14.02	AI10 analog input bias	-100.0–100.0%	♦R/W	0E02	43587	0.0	
P14.03	AI11 analog input bias	-100.0–100.0%	♦R/W	0E03	43588	0.0	
P14.04	AI10 positive/ negative bias mode	0: No bias 1: Lower than or equal to bias 2: Higher than or equal to bias 3: The absolute value of the bias voltage while serving as the center 4: Bias serves as the center	♦R/W	0E04	43589	0	
P14.05	AI11 positive/ negative bias mode		♦R/W	0E05	43590	0	
P14.06	AI10 analog input gain	-500.0–500.0%	♦R/W	0E06	43591	100.0	
P14.07	AI11 analog input gain	-500.0–500.0%	♦R/W	0E07	43592	100.0	
P14.08	AI10 analog input filter time	0.00–20.00 seconds	♦R/W	0E08	43593	0.01	
P14.09	AI11 analog input filter time	0.00–20.00 seconds	♦R/W	0E09	43594	0.01	
P14.10	AI10 analog input 4–20mA signal loss selection	0: Disable 1: Run at the last frequency 2: Decelerate to 0Hz 3: Stop immediately and display "ACE"	R/W	0E0A	43595	0	
P14.11	AI211 analog input 4–20mA signal loss selection		R/W	0E0B	43596	0	

GS30 Parameters Summary – Protection Parameters (2) (P14.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P14.12	AO10 extension card output terminal selection	0: Output frequency (Hz) 1: Frequency command (Hz) 2: Motor speed (Hz) 3: Output current (RMS) 4: Output voltage 5: DC bus voltage 6: Power factor 7: Power 8: Output torque 9: AI1 percent 10: AI2 percent 12: Iq reference percent 13: Iq feedback percent 14: Id reference percent 15: Id feedback percent 16: Vq-axis voltage percent 17: Vd-axis voltage percent 18: Torque reference percent 19: Enc2 frequency percent 20: Reserved 21: RS-485 analog output 22: Communication card analog output 23: Fixed voltage	♦R/W	0E0C	43597	0	
P14.13	AO11 extenion card output terminal selection		♦R/W	0E0D	43598	0	
P14.14	AO10 analog output 1 gain	0.0–500.0%	♦R/W	0E0E	43599	100.0	
P14.15	AO11 analog output 1 gain	0.0–500.0%	♦R/W	0E0F	43600	100.0	
P14.16	AO10 analog output 1 in REV direction	0: Absolute value of output voltage 1: Reverse output < 0V, forward output > 0–10V 2: Reverse output < 5–0V, forward output > 5–10V	♦R/W	0E10	43601	0	
P14.17	AO11 analog output 1 in REV direction		♦R/W	0E11	43602	0	
P14.18	Extension card (AI10) input selection	0: 0–10V (AI10) 1: 0–20mA (AI10) 2: 4–20mA (AI10)	♦R/W	0E12	43603	0	
P14.19	Extension card (AI11) input selection	0: 0–10V (AI11) 1: 0–20mA (AI11) 2: 4–20mA (AI11)	♦R/W	0E13	43604	0	
P14.20	AO10 DC output setting level	0.00–100.00%	♦R/W	0E14	43605	0.00	
P14.21	AO11 DC output setting level	0.00–100.00%	♦R/W	0E15	43606	0.00	
P14.22	AO10 filter ouptut time	0.00–20.00 seconds	♦R/W	0E16	43607	0.01	
P14.23	AO11 filter output time	0.00–20.00 seconds	♦R/W	0E17	43608	0.01	
P14.24	AI10 extension card lowest point	P14.18=0: 0.00–10.00V P14.18≠0: 0.00–20.00mA or 4–20mA	♦R/W	0E18	43609	0.00	
P14.25	AI10 extension card proportional lowest percent	0.00–100.00%	♦R/W	0E19	43610	0.00	
P14.26	AI10 extension card mid-point	P14.18=0: 0.00–10.00V P14.18≠0: 0.00–20.00mA or 4–20mA	♦R/W	0E1A	43611	5.00	
P14.27	AI10 extension card proportional mid-percent	0.00–100.00%	♦R/W	0E1B	43612	50.00	
P14.28	AI10 extension card highest point	P14.18=0: 0.00–10.00V P14.18≠0: 0.00–20.00mA or 4–20mA	♦R/W	0E1C	43613	10.00	
P14.29	AI10 extension card proportional highest percent	0.00–100.00%	♦R/W	0E1D	43614	100.00	

GS30 Parameters Summary – Protection Parameters (2) (P14.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P14.30	AI11 extension card lowest point	P14.19=0: 0.00–10.00V P14.19≠0: 0.00–20.00mA or 4–20mA	♦R/W	0E1E	43615	0.00	
P14.31	AI11 extension card proportional lowest percent	0.00–100.00%	♦R/W	0E1F	43616	0.00	
P14.32	AI11 extension card mid-point	P14.19=0: 0.00–10.00V P14.19≠0: 0.00–20.00mA or 4–20mA	♦R/W	0E20	43617	5.00	
P14.33	AI11 extension card proportional mid-percent	0.00–100.00%	♦R/W	0E21	43618	50.00	
P14.34	AI11 extension card highest point	P14.19=0: 0.00–10.00V P14.19≠0: 0.00–20.00mA or 4–20mA	♦R/W	0E22	43619	10.00	
P14.35	AI11 extension card proportional highest percent	0.00–100.00%	♦R/W	0E23	43620	100.00	
P14.36	AO10 terminal analog signal mode	0: 0–10V (AI10) 1: 0–20mA (AI10) 2: 4–20mA (AI10)	♦R/W	0E24	43621	0	
P14.37	AO11 terminal analog signal mode	0: 0–10V (AI11) 1: 0–20mA (AI11) 2: 4–20mA (AI11)	♦R/W	0E25	43622	0	
P14.38	AO10 percent	-100.0–100.0%	Read	OE26	43623	0	
P14.39	AO11 percent	-100.0–100.0%	Read	OE27	43624	0	
P14.50	Output frequency at malfunction 2	0.00–599.00 Hz	Read	0E32	43635	0	
P14.51	DC bus voltage at malfunction 2	0.0–6553.5 V	Read	0E33	43636	0	
P14.52	Output current at malfunction 2	0.00–655.35 Amp	Read	0E34	43637	0	
P14.53	IGBT temperature at malfunction 2	-3276.7–3276.7°C	Read	0E35	43638	0	
P14.54	Output frequency at malfunction 3	0.00–599.00 Hz	Read	0E36	43639	0	
P14.55	DC bus voltage at malfunction 3	0.0–6553.5 V	Read	0E37	43640	0	
P14.56	Output current at malfunction 3	0.00–655.35 Amp	Read	0E38	43641	0	
P14.57	IGBT temperature at malfunction 3	-3276.7–3276.7°C	Read	0E39	43642	0	
P14.58	Output frequency at malfunction 4	0.00–599.00 Hz	Read	0E3A	43643	0	
P14.59	DC bus voltage at malfunction 4	0.0–6553.5 V	Read	0E3B	43644	0	
P14.60	Output current at malfunction 4	0.00–655.35 Amp	Read	0E3C	43645	0	
P14.61	IGBT temperature at malfunction 4	-3276.7–3276.7°C	Read	0E3D	43646	0	
P14.62	Output frequency at malfunction 5	0.00–599.00 Hz	Read	0E3E	43647	0	
P14.63	DC bus voltage at malfunction 5	0.0–6553.5 V	Read	0E3F	43648	0	
P14.64	Output current at malfunction 5	0.00–655.35 Amp	Read	0E40	43649	0	
P14.65	IGBT temperature at malfunction 5	-3276.7–3276.7°C	Read	0E41	43650	0	
P14.66	Output frequency at malfunction 6	0.00–599.00 Hz	Read	0E42	43651	0	
P14.67	DC bus voltage at malfunction 6	0.0–6553.5 V	Read	0E43	43652	0	

GS30 Parameters Summary – Protection Parameters (2) (P14.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P14.68	Output current at malfunction 6	0.00–655.35 Amp	Read	0E44	43653	0	
P14.69	IGBT temperature at malfunction 6	-3276.7–3276.7°C	Read	0E45	43654	0	
P14.70	Fault record 7	Refer to fault record P06.17–P06.22	Read	0E46	43655	0	
P14.71	Fault record 8		Read	0E47	43656	0	
P14.72	Fault record 9		Read	0E48	43657	0	
P14.73	Fault record 10		Read	0E49	43658	0	
P14.74	Over-torque detection selection (motor 3)	0: Disabled 1: Detect at speed and keep running 2: Detect at speed and stop 3: Detect at RUN and keep running 4: Detect at RUN and stop	♦R/W	0E4A	43659	0	
P14.75	Over-torque detection level (motor 3)	10–250% (100% corresponds to the rated current of the drive)	♦R/W	0E4B	43660	120	
P14.76	Over-torque detection time (motor 3)	0.1–60.0 sec.	♦R/W	0E4C	43661	0.1	
P14.77	Over-torque detection selection (motor 4)	0: Disabled 1: Detect at speed and keep running 2: Detect at speed and stop 3: Detect at RUN and keep running 4: Detect at RUN and stop	♦R/W	0E4D	43662	0	
P14.78	Over-torque detection level (motor 4)	10–250% (100% corresponds the rated current of the drive)	♦R/W	0E4E	43663	120	
P14.79	Over-torque detection time (motor 4)	0.1–60.0 sec.	♦R/W	0E4F	43664	0.1	
P14.80	Electronic thermal relay selection 3 (motor 3)	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with the fan on the shaft) 2: Disable	♦R/W	0E50	43665	1	
P14.81	Electronic thermal relay action time 3 (motor 3)	30.0–600.0 sec.	♦R/W	0E51	43666	60.0	
P14.82	Electronic thermal relay selection 4 (motor 4)	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with the fan on the shaft) 2: Disable	♦R/W	0E52	43667	1	
P14.83	Electronic thermal relay action time 4 (motor 4)	30.0–600.0 sec.	♦R/W	0E53	43668	60.0	

NOTE: For Command and Status addresses (2000h-2200h), refer to page 4-224.

DURApulse GS30 Parameter Details

Explanation of Parameter Details Format

		Type	Hex Addr	Dec Addr
Pxx.xx	**Descriptive Parameter Name**	♦R/W	xxxx	4xxxx
	Range/Units	Default		
	xx~xxx.xx	xx		

Where:

- *Pxx.xx* = Parameter number, followed by descriptive parameter name
- *Type* = Parameter type (♦R/W)
  - *♦ = Parameter can be set while drive is in run mode*
  - *R/W = Read/Write parameter*
  - *Read = Read-only; parameter can be read from, but not written to*
- *Hex Addr* = Hexadecimal parameter address
- *Dec Addr* = Modbus decimal parameter address
- *Range/Units* = Range of parameter settings, including units if applicable
- *Default* = Parameter default setting
  (Parameters can be restored to their default values using P00.02.)

Group P00.xx Details – Drive Parameters

		Type	Hex Addr	Dec Addr
P00.00	**GS30 Model ID**	Read	0000	40001
	Range/Units (Format: 16-bit unsigned)	*Default*		
	303: 230 V, 1 Phase, 0.5 HP 304: 230 V, 1 Phase, 1 HP 305: 230 V, 1 Phase, 2 HP 306: 230 V, 1 Phase, 3 HP 203: 230 V, 3 Phase, 0.5 HP 204: 230 V, 3 Phase, 1 HP 205: 230 V, 3 Phase, 2 HP 206: 230 V, 3 Phase, 3 HP 207: 230 V, 3 Phase, 5 HP 208: 230 V, 3 Phase, 7.5 HP 209: 230 V, 3 Phase, 10 HP 210: 230 V, 3 Phase, 15 HP 211: 230 V, 3 Phase, 20 HP 403: 460 V, 3 Phase, 0.5 HP 404: 460 V, 3 Phase, 1 HP 405: 460 V, 3 Phase, 2 HP 406: 460 V, 3 Phase, 3 HP 407: 460 V, 3 Phase, 5 HP 408: 460 V, 3 Phase, 7.5 HP 409: 460 V, 3 Phase, 10 HP 410: 460 V, 3 Phase, 15 HP 411: 460 V, 3 Phase, 20 HP 412: 460 V, 3 Phase, 25 HP 413: 460 V, 3 Phase, 30 HP 414: 460 V, 3 Phase, 40 HP 415: 460 V, 3 Phase, 50 HP 416: 460 V, 3 Phase, 60 HP 417: 460 V, 3 Phase, 75 HP 418: 460 V, 3 Phase, 100 HP	0		

P00.00 displays a code that corresponds to the voltage, phase, and horsepower rating of the GS30 drive.

		Type	Hex Addr	Dec Addr
P00.01	**GS30 Drive Rated Amps**	Read	0001	40002
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Display by models	0		

P00.01 displays rated current in amps for the drive. By default this displays the value for constant torque. Set P00.16=0 to display the variable torque rating instead.

		Type	Hex Addr	Dec Addr
P00.02	***Restore to Default***	R/W	0002	40003
	Range/Units (Format: 16-bit binary)	*Default*		
	0: No function 1: Parameter Lock 2: Reserved 5: Reset kWh Display to 0 6: Reset PLC 9: Reset all parameters to 50Hz defaults 10: Reset all parameters to 60Hz defaults 11: Reset all parameters to 50Hz defaults (retain user-defined parameter values P13.01~P13.50) 12: Reset all parameters to 60Hz defaults (retain user-defined parameter values P13.01~P13.50)	0		

P00.02 allows the resetting of various parameter sets and drive functions. PLC Mode must be set to 0-Disable to reset parameters. Cycle power to the drive after resetting to defaults.

NOTE: Parameter resets do not change the settings of the GS30A-CM-EIP1, EIP2, or GS30A-CM-ECAT cards.

Setting Explanations

- *P00.02=1, all parameters are set to read only except for P00.02, P00.07, and P00.08. P00.02 must be changed to 0 to change parameter settings.*
- *P00.02=5, returns the kWh displayed value to 0, even during drive operation. For example, P05.26 accumulated W-s will be set to zero.*
- *P00.02=6, clears the internal PLC program.*
- *P00.02=9, resets all parameters to default for base frequency of 50Hz.*
- *P00.02=10, resets all parameters to default for base frequency of 60Hz.*
- *P00.02=11, resets all parameters to default for base frequency of 50Hz, but keeps any user-defined parameter values (P13.01 through P13.50).*
- *P00.02=12, resets all parameters to default for base frequency of 60Hz, but keeps any user-defined parameter values (P13.01 through P13.50).*
- *If a password has been set using P00.08, you must unlock and clear the password (P00.07) before resetting parameters.*

NOTE: For settings 6, 9, 10, 11, and 12 you must reboot the drive after adjusting the setting to enable the change.

		Type	Hex Addr	Dec Addr
P00.03	***Start-up Display Selection***	♦R/W	0003	40004
	Range/Units (Format: 16-bit binary)	*Default*		
	0: F – Freq Setpoint 1: H – Output Hz 2: U - User Display (P00.04) 3: A – Output Amps	0		

P00.03 determines the start-up display page when the drive is powered on. The user-defined contents display according to the P00.04 settings.

		Type	Hex Addr	Dec Addr
P00.04	***User Display***	♦R/W	0004	40005
	Range/Units (Format: 16-bit binary)	*Default*		
		3		

Option Description	Keypad Display Symbol	Keypad Display Units
0: Output Amps	A	Amps
1: Counter Value	c	Decimal Number (CNT)
2: Output Frequency	H.	Hertz (Hz)
3: DC Bus Voltage	v	Volts (Vdc)
4: Output Voltage	E	Volts (Vac)
5: Power Factor	n	Degrees (deg)
6: Output Power	P	kw
7: Actual Motor Speed in RPM (Sensorless Estimate or Encoder Feedback actual)	r	rpm
8: Est Output Torque	t	%
9: Encoder (PG1) Feedback Pulses per Rev (option card)	G	Pulses (PLS)
10: PID Feedback	b	%
11: AI1 Analog Input Signal	1.	%
12: AI2 Analog Input Signal	2.	%
13. reserved		
14: IGBT Temperature	i.	°C
15 Reserved	c	°C
16: DI Input Status	i	hex
17: DO Output Status	o	hex
18: Multi-Speed Step	S	number
19: CPU DI Input Status	d	hex
20: CPU DO Output Status	0.	hex
21: Encoder (PG1) Position Counts (option card). 32 bit, 0 - 4.2x10^9	P.	Counts
22: Pulse Command (PG2) Frequency (option card)	S.	Hertz (Hz)
23: Pulse Command (PG2) Position Counts (option card). 16 bit, 0 - 65535	q.	Counts
24: Position Error	E.	
25: Overload count (0.00–100.00%)	o.	%
26: Ground fault GFF	G.	%
27: DC bus voltage ripple (r.) (unit: VDC)	r.	Volts (Vdc)
28: Display PLC register D1043 data (C)	C	Decimal Number
29: PM Pole Section	4.	
30: Display the output of User-defined (U)	U	(custom units)
31: Display P00-05 user gain (K)	K	
32: Encoder (PG1) Z-phase Counts (option card). 16 bit, 0 - 65535	Z.	Revolutions (rev)
33: Encoder (PG1) Feedback Pulses per Rev (Option card)	q	Pulses (PLS)
34. reserved		
35: Control mode display	t.	Speed or Torque (SPD or TRQ)
36: Present operating carrier frequency of the drive	J.	Hertz (Hz)
37. Reserved		
38: Display the drive status word (6.)	6.	hex
39: Display the drive's estimated output torque, positive and negative, (t 0.0: positive torque; -0.0: negative torque) (C.)	C.	Newton-Meters (Nt-m)
40: Torque command (L.) (unit: %)	L.	
41: kWh display (J) (unit: kWh)	J	KiloWatt-hours (KWH)
42: PID target value (h.) (unit: %)	h.	%
43: PID compensation (o.) (unit: %)	o.	%
44: PID output frequency (b.) (unit: Hz)	b.	Hertz (Hz)
45. Reserved		
46: Auxiliary frequency value	U.	Hertz
47: Master frequency value	A.	Hertz
48: Frequency value after addition and subtraction of master and auxiliary frequency (L.) (unit: Hz)	L.	
49. Reserved		
50. Reserved		
51: PMSVC torque offset	t.	
52. Reserved		
53: Reel Diameter	d	millimeters (mm)
54: Line Speed	L	(m/m)
55: Tension Command	T	(N)
56: AI10 Analog Input Signal	4.	%
57: AI11 Analog Input Signal	5.	%

P00.04 is used to configure the user display. This parameter will set the default display value. The digital dial on the keypad can be used to scroll through all display options.

Explanation 1:

It can also display negative values when setting analog input bias (P03.03 to P03.10).
Example: Assume that AI1 input voltage is 0V, P03.03 is 10.0%, P03.07 is 4 (bias serves as center).

Explanation 2:

Example: If DI1 and DI6 are ON, the following table shows the status of the terminals.
Normally opened contact (N.O.): (0: OFF, 1:ON)

Terminal	DI7	DI6	DI5	DI4	DI3	DI2	DI1
Status	0	1	0	0	0	0	1

- *The value is 0000 0000 0010 0001 in binary and 0021H in HEX. When P00.04 is set to 16 or 19, the User Defined Display on the keypad displays 0021h.*
- *Setting 16 is the ON/OFF status of digital input according to P02.12 setting, and setting 19 is the corresponding CPU pin ON/OFF status of the digital input.*
- *When DI1/DI2 default setting is two-wire/three-wire operation control (P02.00≠0) and DI3 is set to three-wire, it is not affected by P02.12.*
- *You can use setting 16 to monitor the digital input ON/OFF status, and then set 19 to check if the circuit is normal.*

Explanation 3:

Example: Assume that RY:P02.13 is set to 9 (Drive is ready). After the drive is powered on, if there is no other abnormal status, the contact is ON. The display status is shown below:
Normally opened contact (N.O.):

Terminal	D02	D01	R1
Status	0	0	1

- *If P00.04 is set to 17 or 20, it displays in hexadecimal "0001h" and the User Defined Display shows ON in the keypad.*
- *Setting 17 is the ON/OFF status of digital output according to P02.18 setting, and setting 20 is the corresponding CPU pin ON/OFF status of the digital output.*
- *You can use setting 17 to monitor the digital output ON/oFF status, and then set 20 to check if the circuit is normal.*

Explanation 4:

For setting 8, 100% represents the motor's rated torque.

Motor rated torque = (motor rated power x 60/2π) / motor rated speed

Explanation 5:

For setting 25, when the displayed value reaches 100.00%, the drive shows "oL" as an overload warning.

Explanation 6:

When set to 38, the bits are defined as follows:

- *Bit 0: The drive is running forward*
- *Bit 1: The drive is running backward*
- *Bit 2: The drive is ready*
- *Bit 3: Errors occured on the drive*
- *Bit 4: The drive is running*
- *Bit 5: Warnings occured on the drive*

When P10.01 is set to 1000 and P10.02 is set to 1 or 2, the displayed range for encoder feedback is between 0 and 4000.

When P10.01 is set to 1000 and P10.02 is set to 3, 4, or 5, the displayed range for encoder feedback is between 0 and 1000.

Explanation 7:

- *When P10.01 is set to 1000 and P10.02 is set to 1 or 2, the displayed range for Encoder (PG1) feedback is between 0–4000.*
- *When P10.01 is set to 1000 and P10.02 is set to 3, 4, or 5, the displayed range for Encoder (PG1) feedback is between 0–1000.*

		Type	Hex Addr	Dec Addr
P00.05	***Coefficient gain in actual output frequency***	R/W	0005	40006
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–160.00	1.00		

P00.05 is used to set the user-defined coefficient gain. Set P00.04=31 to display the calculation result on the screen (calculation = output frequency x P00.05).

		Type	Hex Addr	Dec Addr
P00.06	***Firmware Version***	Read	0006	40007
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Read only	0		

P00.06 displays the current firmware version of the drive. Also, check parameter 00.50 for FW date code. Minor updates may only increment a change in date code.

For latest firmware versions and release notes, visit the Gsoft2 software download page:

https://www.automationdirect.com/support/software-downloads?itemcode=GSoft2

		Type	Hex Addr	Dec Addr
P00.07	***Parameter Protection Password Input***	♦R/W	0007	40008
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535 0–4: the number of password attempts allowed	0		

P00.07 allows you to enter the password set via P00.08 to unlock parameter protection and make changes to parameters.

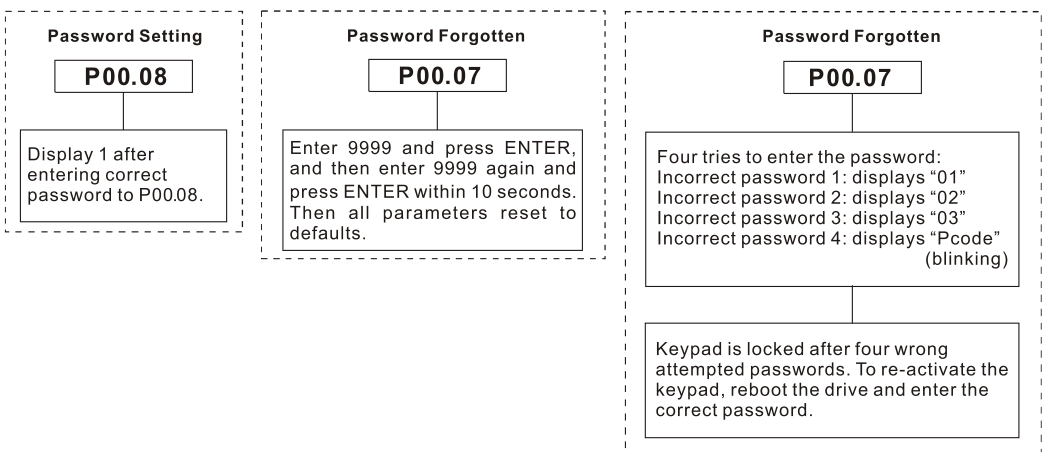
- *P00.07 and P00.08 are used to prevent personnel from accidentally changing parameter values.*
- *When password protection is on, all parameters will read 0 except for P00.08.*

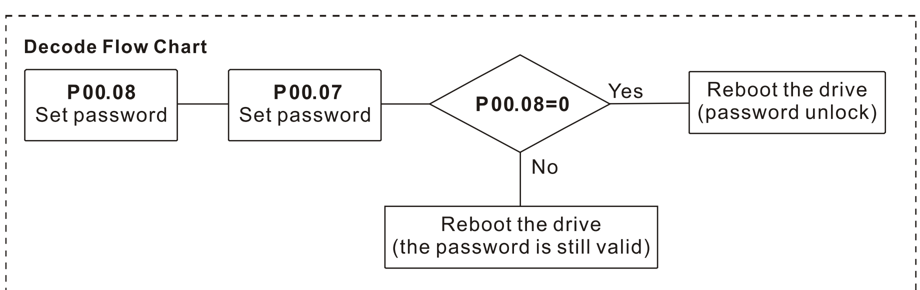
- *Incorrect passwords can be entered up to four times. Each time an incorrect password is entered, the keypad will display the number of incorrect attemps (01, 02, 03). When the final incorrect password is entered, the keypad will flash "Pcode" and the keypad will lock. To re-activate the keypad, reboot the drive and either enter the correct password or reset it.*
- *To reset a forgotten password, input 9999 and press ENTER, then input 9999 again and press ENTER again within 10 seconds. All settings will return to default.*

		Type	Hex Addr	Dec Addr
P00.08	***Parameter Protection Password Setting***	♦R/W	0008	40009
	Range/Units (Format: 16-bit unsigned)	Default		
	0–65535 0: No password protection or password entered correctly (P00.07) 1: Parameter has been set	0		

P00.08 allows you to set a password to protect parameter settings. If P00.08=1, password protection is active. If P00.08=0, password protection is disabled.

- *To change parameters once a password has been set, you must enter the correct password using P00.07 which temporarily deactivates parameter protection and sets P00.08=0. Once parameter changes are complete, reboot the drive and P00.08 will reset to 1.*
- *To permanently disable the password, manually change P00.08 to 0. Otherwise, password protection is always reactivated after you reboot the motor drive.*
- *The keypad copy function works only when the password protection is deactivated (temporarily or permanently), and the password set in P00.08 cannot be copied to the keypad. So when copying parameters from the keypad to the motor drive, set the password manually again in the motor drive to activate password protection.*





		Type	Hex Addr	Dec Addr
P00.10	***Control Method***	R/W	000A	40011
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Velocity mode 2: Torque mode	0		

P00.10 determines the control method of the GS30 drive.

- *If P00.10=0: Velocity Mode. Use Parameter P00.11 to set the specific velocity/speed control mode.*
- *If P00.10=2: Torque Mode. Use Parameter P00.13 to set the specific torque control mode.*

See Adjustments and Applications section on page 4–306 for further info on setting up control methods.

See the GS30 motor control table on page 1–12 for additional specifications on control methods.

		Type	Hex Addr	Dec Addr
P00.11	***Velocity Control Mode***	R/W	000B	40012
	Range/Units (Format: 16-bit binary)	Default		
	0: IMVF (V/F control) 1: IMVFPG (V/F control + encoder) 2: IM/PM SVC (IM or PM sensorless vector control) 3: IMFOCPG (IM FOC vector control + encdoer) 4: PMFOCPG (PM FOC vector control + encdoer) 5: IMFOC Sensorless (field-oriented sensorless vector control) 7: IPM sensorless (interior PM field-oriented sensorless vector control) **Note:** For option 2 (SVC), see P05.33 for induction motor (IM) or permanent magnent (PM) motor selection.	0		

P00.11 determines the velocity control mode of the GS30 drive.

P00.10 must be set to 0:Speed Control mode to enable this parameter.

Speed control abbreviations:

- *IM = Induction Motor*
- *PM = Permanent Magnet Motor*
- *SVC = Sensorless Vector Control*
- *VF = Volt/Frequency*
- *PG = Pulse Generator (encoder)*
- *FOC = Field Oriented Control*

Setting Explanations

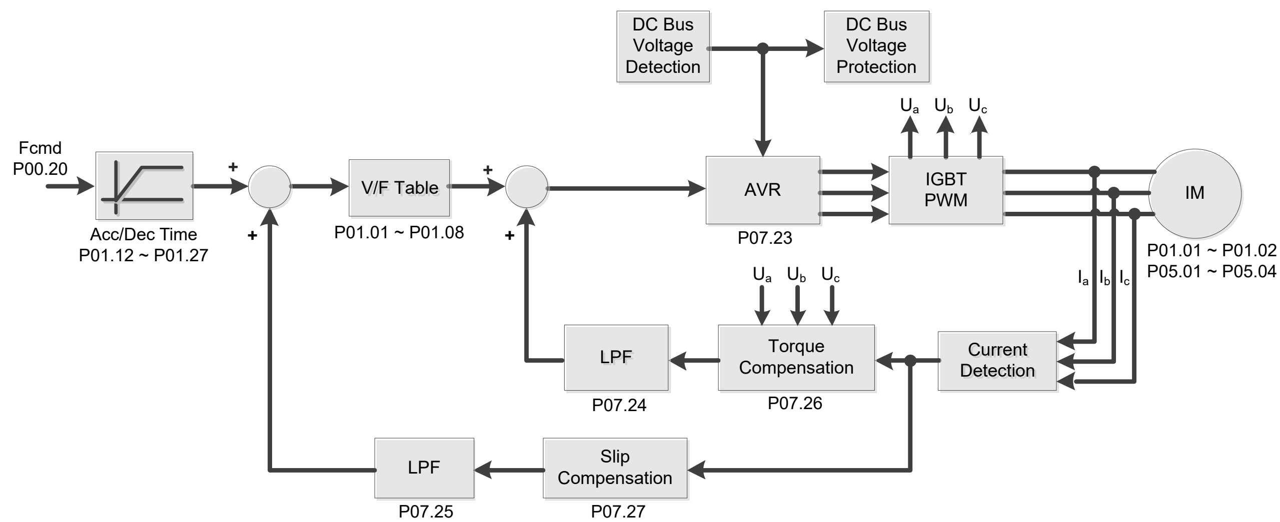
- *P00.11=0, drive is set to IM V/F control. You can configure the proportion of V/F as required and control multiple motors simultaneously.*
- *P00.11=1, drive is set to IM V/F control with encoder input. The encoder can be used for closed-loop speed control.*
- *P00.11=2, drive is set to IM/PM sensorless vector control. This auto-tunes motor parameters for optimal control. This is the only control mode that supports permanent magnet motors (IPM or SPM). Set P05.33=1 or 2 for PM motors.*
- *P00.11=3, drive is set to IM FOC vector control with encoder input. This allows you to both increase torque and increase the accuracy of velocity control (1:1000) with induction motors. Encoder option card is required.*
- *P00.11=4, drive is set to PM FOC vector control with encoder input. This allows you to both increase torque and increase the accuracy of velocity control (1:1000) with permanent magnet motors. Encoder option card is required.*
- *P00.11=5, drive is set to IM FOC sensorless: IM field-oriented sensorless vector control. Field oriented control (FOC) provides the most precise vector control algorithm for induction motors. This control method can separately control the motor's magnetic field and torque. When controlling the torque, the magnetic field won't be interfered and quick feedback from torque wresults in more stable operation. With optimized current control, the maximum torque can be reached with the minimum current. The motor's temperature will decrease and system efficiency will increase. FOC sensorless control is suitable for applications which require activation of torque at low frequency, quick feedback on speed chasing, and stable rotation speed and torque force.*
- *P00.11=7, drive is set to IPM sensorless. This allows interior PM field oriented sensorless vector control.*
- *See Adjustments and Applications section on page 4–306 for further info on setting up various speed modes.*

NOTE: If DI7 single-phase pulse input is used as speed feedback, the following settings must be used:
P00.11 speed control mode must be set to 1:IMVFPG only
P02.07 must be set to 0
P10.00 and P10.02 must be set to 5

Control Diagrams

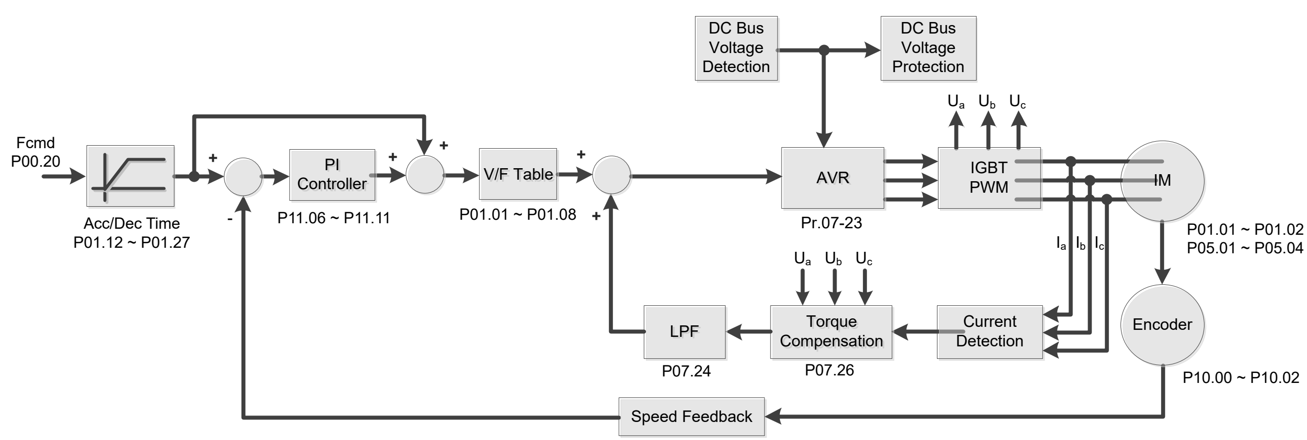
IM V/F Control (IMVF)

When P00.10=0 and P00.11 is set to 0:IMVF, the V/F control diagram is as shown here:



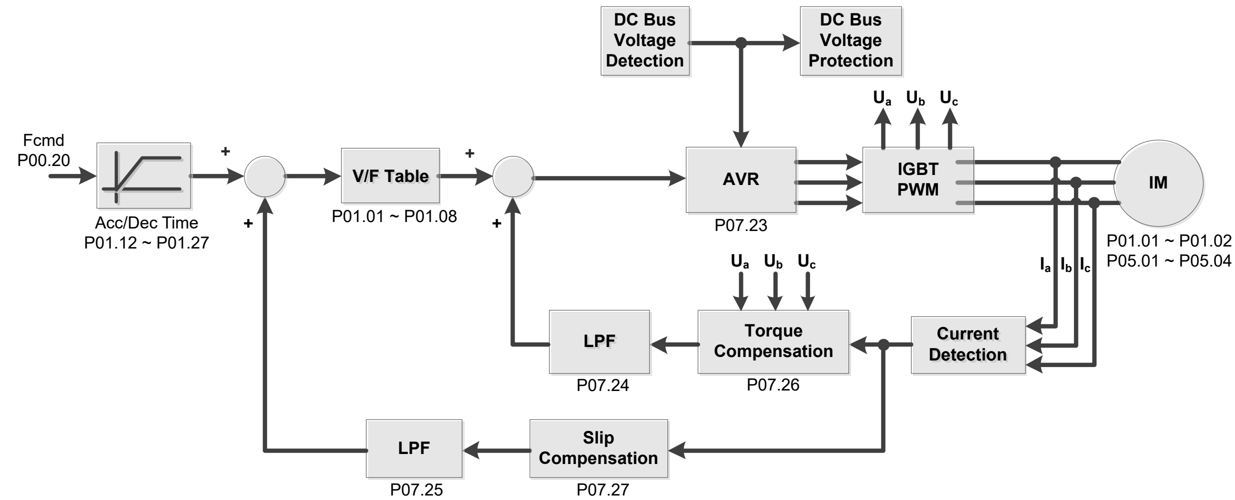
IM V/F control + encoder (IMVFPG)

When P00.10=0 and P00.11 is set to 1:IMVFPG, the V/F control + encoder diagram is as shown here:



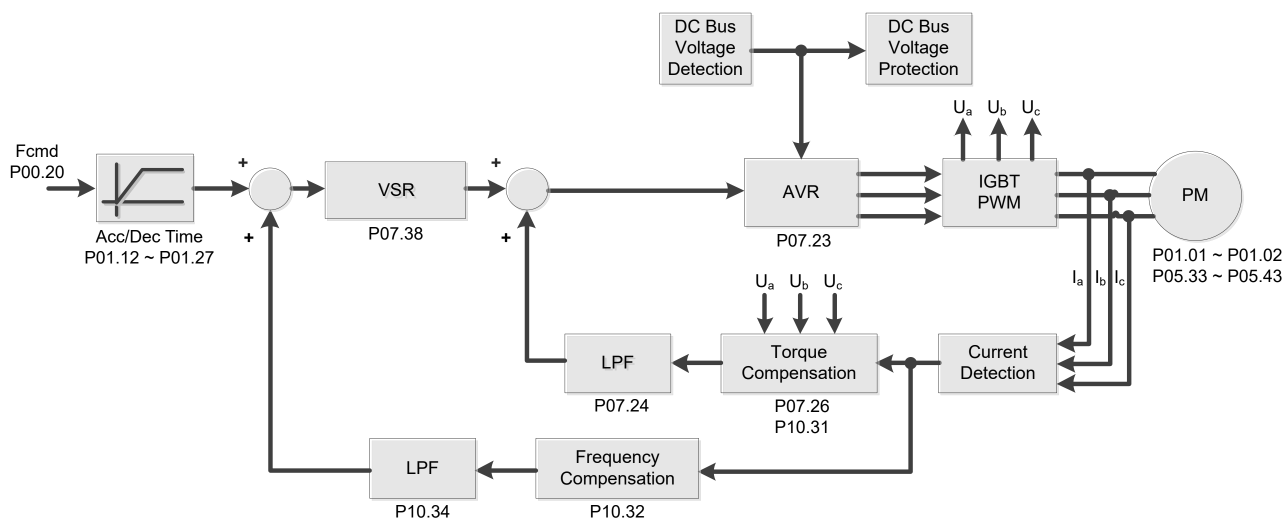
IM Sensorless Vector Control (IMSVC)

When P00.10=0 and P00.11 is set to 2:IM/PM SVC for an IM motor (P05.33=0), the sensorless vector control diagram is as shown here:



PM Sensorless Vector Control (PMSVC)

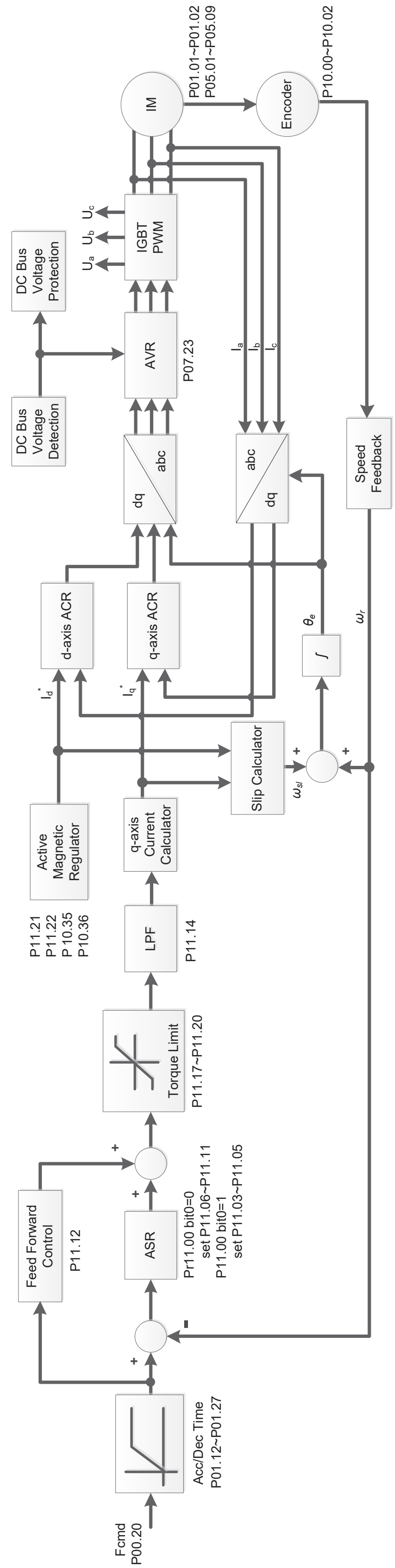
When P00.10=0 and P00.11 is set to 2:IM/PM SVC for a PM motor (P05.33=1 or 2), the sensorless vector control diagram is as shown here:



See Adjustments and Applications section on page 4–306 for further info on setting up this mode.

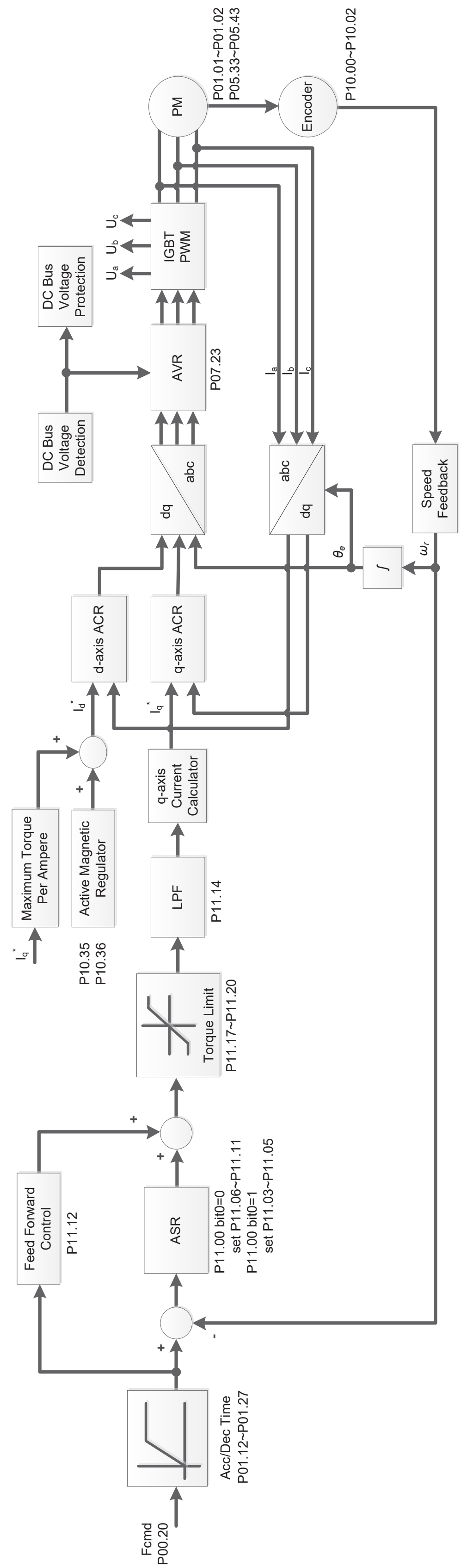
IMFOC Vector Control plus Encoder (IMFOCPG)

When P00.10=0 and P00.11 is set to 3, the IM FOCPG control diagram is as shown here:



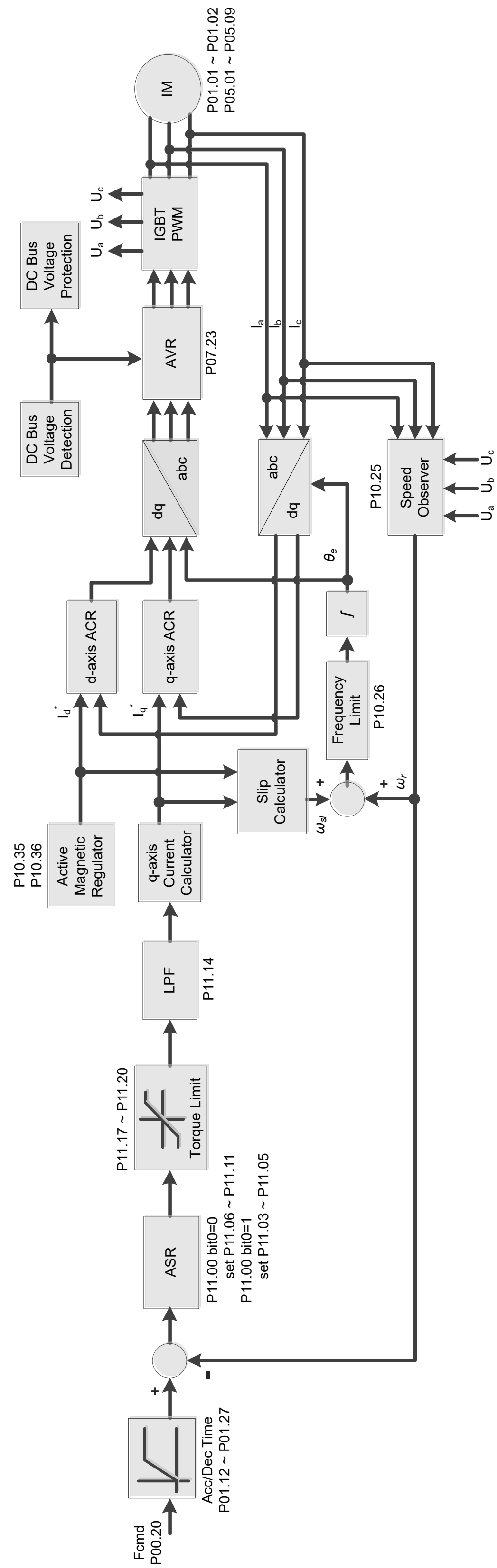
PMFOC Vector Control plus Encoder (PMFOCPG)

When P00.10=0 and P00.11 is set to 4, the PM FOCPG control diagram is as shown here:



IMFOC Sensorless

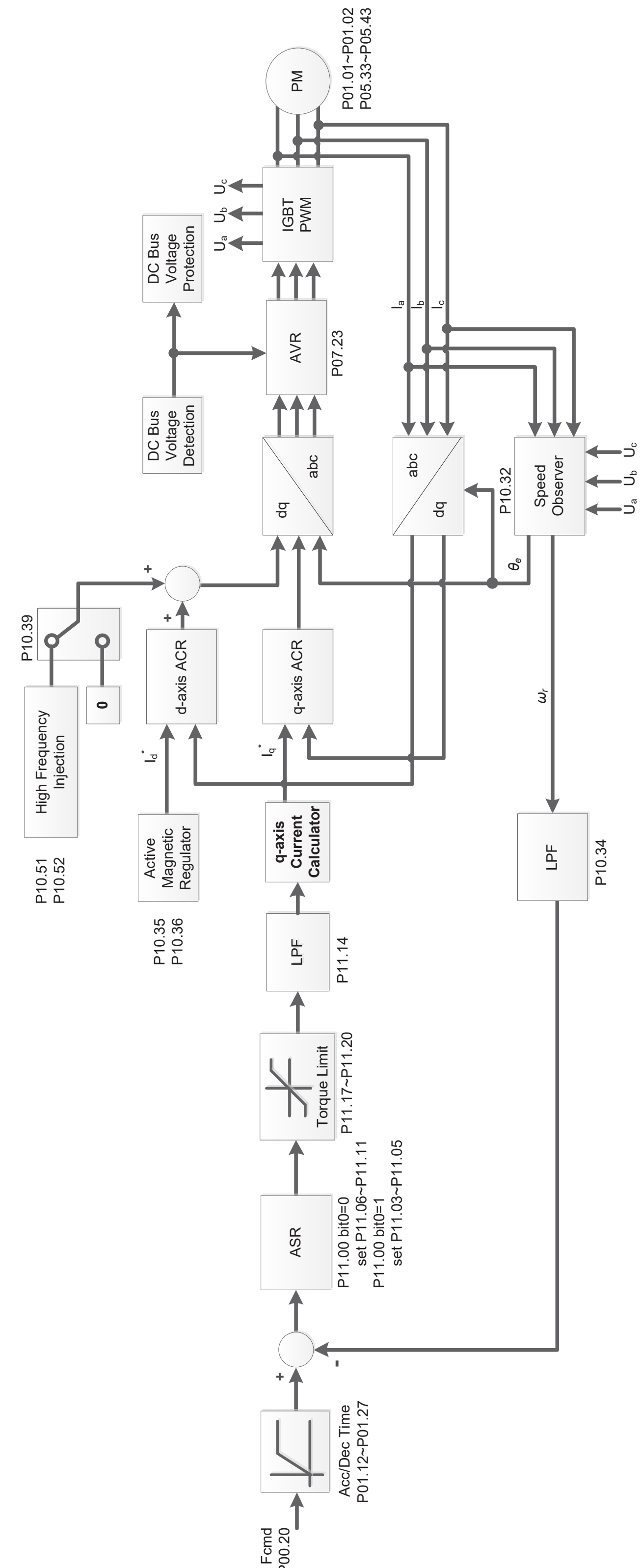
When P00.10=0 and P00.11 is set to 5:IMFOC Sensorless, the IMFOC sensorless control diagram is as shown here:



See Adjustments and Applications section on page 4–306 for further info on setting up this mode.

Interior PM Field-oriented Sensorless Vector Control (IPM Sensorless)

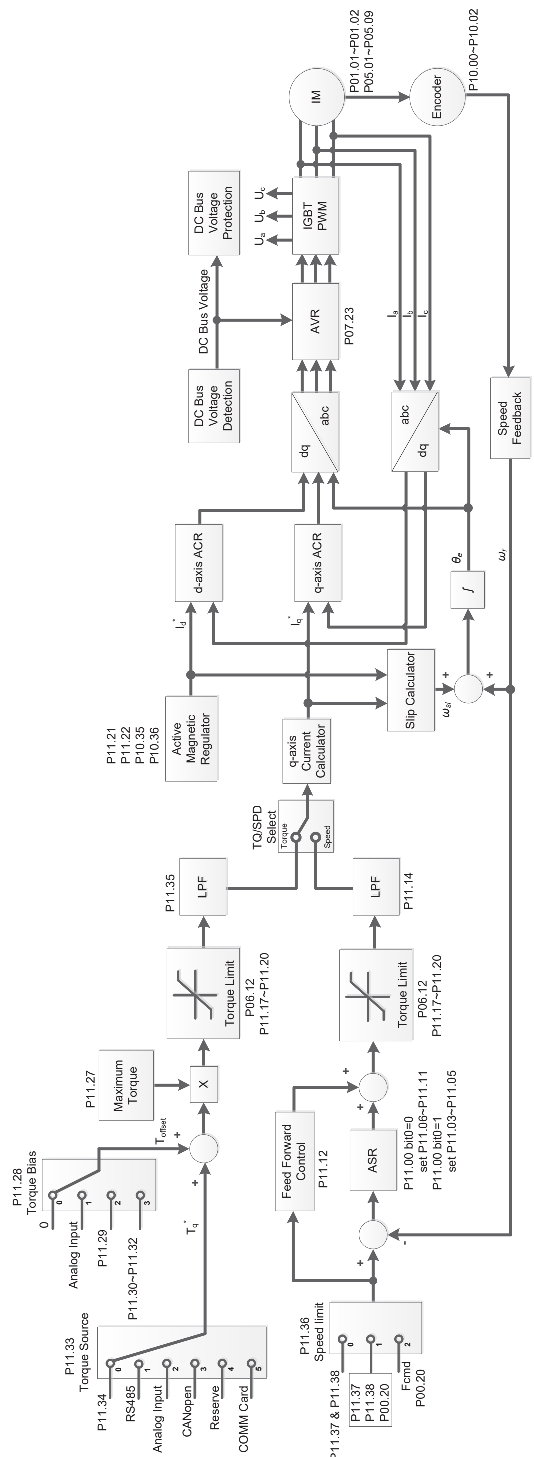
When P00.10=0 and P00.11 is set to 7, the IPM Sensorless control diagram is as shown here:



		Type	Hex Addr	Dec Addr
P00.13	***Torque Control Methods***	R/W	000D	40014
	Range/Units (Format: 16-bit binary)	*Default*		
	0: IM TQCPG (IM torque control + encoder) 1: PM TQCPG (PM torque control + encoder) 2: IMTQC sensorless (IM sensorless torque control) 3: PM Torque Sensorless	0		

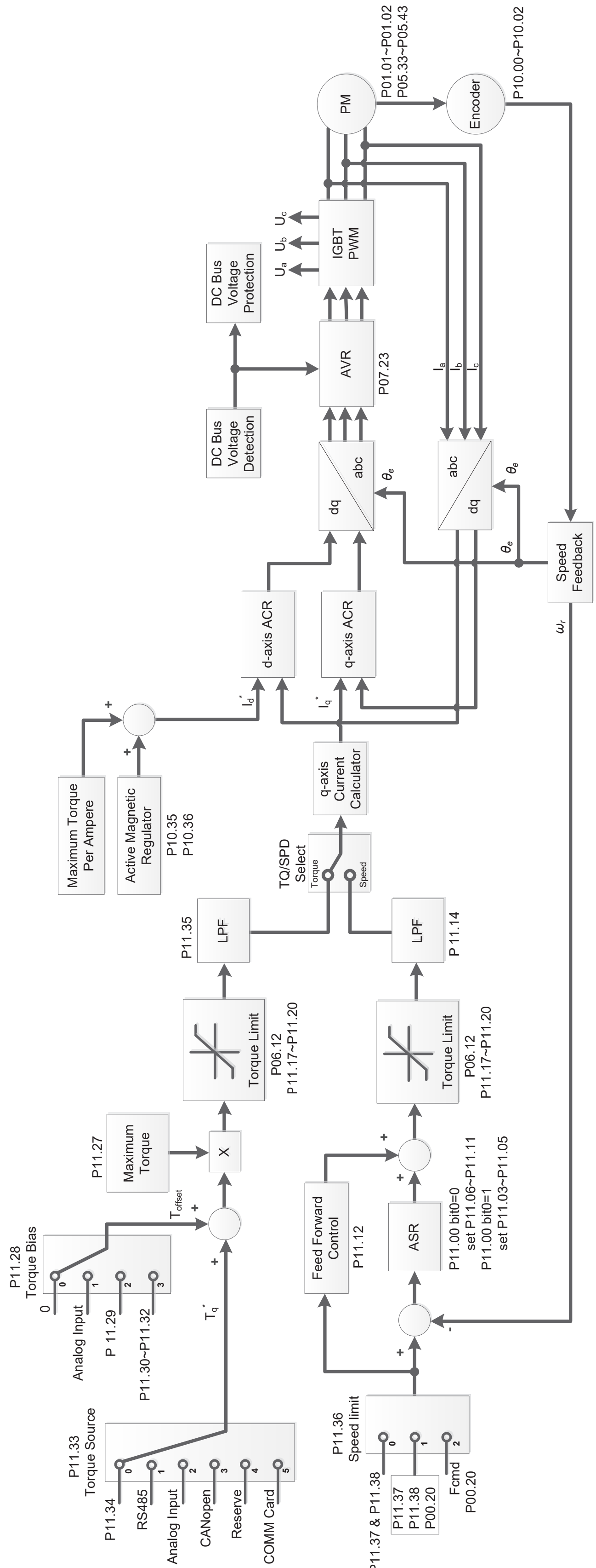
IM Torque Control plus Encoder (IM TQCPG)

When P00.13 is set to 0, the IM TQCPG control diagram is as shown here:



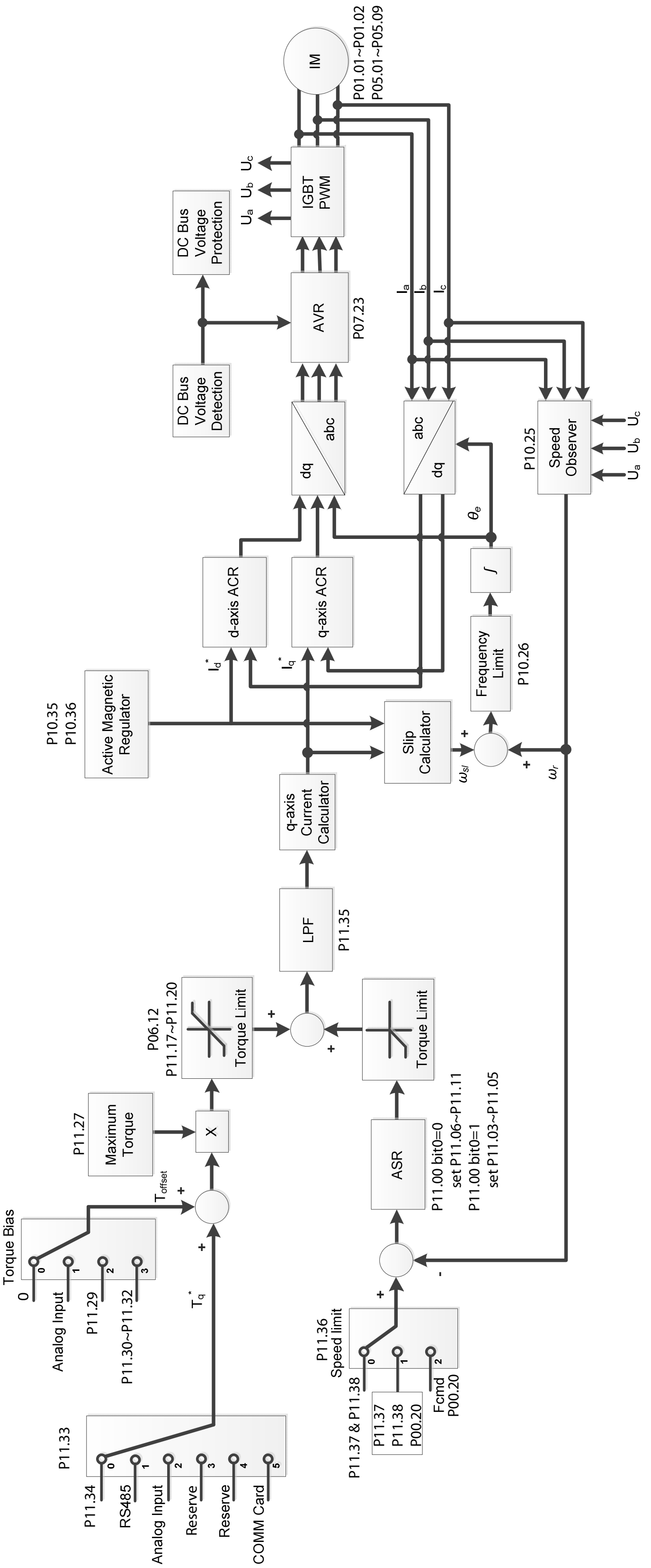
PM Torque Control plus Encoder (PM TQCPG)

When P00.13 is set to 1, the PM TQCPG control diagram is as shown here:



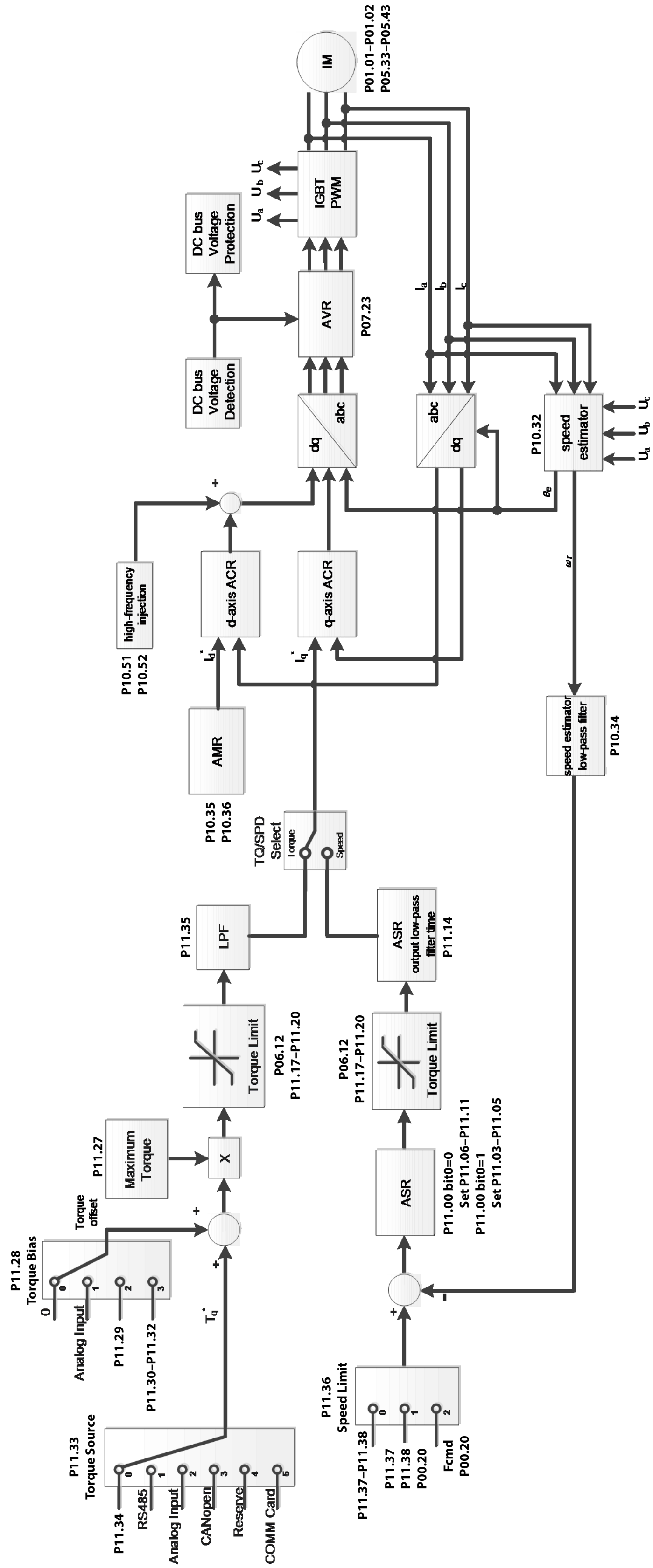
IM Sensorless Torque Control (IMTQC Sensorless)

When P00.13 is set to 2, the IMTQC Sensorless control diagram is as shown here:



PM Torque Sensorless

When P00.13 is set to 3, the PM Torque Sensorless control diagram is as shown here:



		Type	Hex Addr	Dec Addr
P00.16	***Torque Duty Selection***	R/W	0010	40017
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Variable Torque 1: Constant Torque	1		

P00.16 is used to configure the GS30 drive for variable torque or constant torque load.

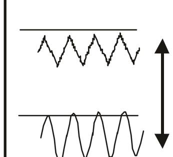
- *Variable Torque (VT): overload rated output current 150% in 3 seconds. (120%, 1 minute). Refer to P00.17 for the setting for the carrier frequency. Refer to Chapter 1 or P00.01 for the rated current.*
- *Constant Torque (CT): overload rated output current 200% in 3 seconds. (150%,1 minute) Refer to P00.17 for the setting for the carrier frequency. Refer to Chapter 1 or P00.01 for the rated current.*
- *P00.01 varies with the set value of P00.16. The default value and maximum of P06.03 and P06.04 also vary with the value of P00.16.*
- *In VT mode, the default setting of P06.03 and P06.04 is 120%, and the maximum is 150%.*
- *In CT mode, the default setting of P06.03 and P06.04 is 180%, and the maximum is 200%.*

		Type	Hex Addr	Dec Addr
P00.17	***Carrier Frequency***	R/W	0011	40018
	Range/Units (Format: 16-bit unsigned)	*Default*		
	VT: 2–15 kHz CT: 2–15 kHz Note: When P00.11=5 (IMFOC Sensorless), the maximum setting value for the carrier frequency is 10 kHz.	4		

P00.17 is used to set the PWM carrier frequency for the GS30 drive. Note that the maximum value is dependent on the horsepower and voltage ratings of the drive.

Model	*Range*
230V, 1/2–15 hp	2–15 kHz
230V, 20–30 hp	2–10 kHz
460V, 1/2–20 hp	2–15 kHz
460V, 25–40 hp	2–10 kHz

The table below shows that the PWM carrier frequency has significant influences on the electromagnetic noise, the AC motor drive heat dissipation, and the motor acoustic noise. Therefore, if the surrounding noise is greater than the motor noise, lower the carrier frequency to reduce the temperature rise. Although the motor has quiet operation in the higher carrier frequency, consider the entire wiring and interference.

Carrier Frequency	Acoustic Noise	Electromagnetic Noise or Leakage Current	Heat Dissipation	Current Wave
2 kHz	Significant	Minimal	Minimal	
8 kHz	↕	↕	↕	
15 kHz	Minimal	Significant	Significant	

When the carrier frequency is higher than the default, decrease the carrier frequency to protect the drive. Refer to P06.55 for the related setting and details.

		Type	Hex Addr	Dec Addr
P00.18	***GS Series Number***	Read	0012	40019
	Range/Units (Format: 16-bit binary)	*Default*		
	30: GS30 series drive (GS31 or GS33)	–		

GS drive series is a read only value that indicates that the drive is a GS31/GS33 hardware model.

		Type	Hex Addr	Dec Addr
P00.19	***PLC Command Mask***	Read	0013	40020
	Range/Units (Format: 16-bit binary)	*Default*		
	bit 0: Control command is forced by PLC control bit 1: Frequency command is forced by PLC control bit 3: Torque command is forced by PLC control	0		

P00.19 determines if the frequency command, control command or torque command is locked by PLC.

		Type	Hex Addr	Dec Addr
P00.20	***Master Frequency Command Source (AUTO, REMOTE)***	♦R/W	0014	40021
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Digital keypad 1: RS-485 communication input 2: Analog input (Refer to P03.00) 3: External UP / DOWN terminal (digital input terminals) 4: Pulse Command (PG2) Reference w/o direction (refer to P10.16 for pulse input config) 5: Pulse Command (PG2) Reference with direction 8: Communication card 9: PID controller Note: HOA (Hand-Off-Auto) function is valid only when you use with digital input (DI) function setting 41/42 or 56 or with GS4-KPD (optional).	0		

P00.20 determines the master frequency source in the “AUTO, REMOTE" mode. The default is AUTO mode.

- *You can switch the AUTO, REMOTE mode with the keypad GS4-KPD (optional) or the multi-function input terminal (DI) to set the master frequency source.*
- *The drive returns to AUTO or REMOTE mode whenever you cycle the power. If you use a multi-function input terminal to switch between HAND (LOCAL) and AUTO (REMOTE) mode, the highest priority is the multi-function input terminal.*
- *The pulse of P00.20=4 (Pulse input without direction command) is input by DI7 (pulse generator).*
- *If P00.20 is set to 9-PID, P08.65 will automatically set to 1. To change P00.20 from 9 to another value, P08.65 must be changed first (to a value other than 1). We recommend setting P08.65 to 1 first - this will automatically lock P00.20 to a value of 9.*

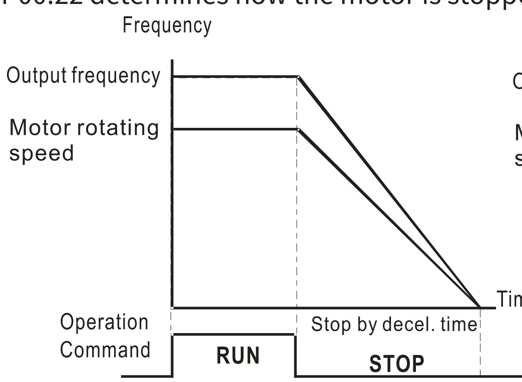
		Type	Hex Addr	Dec Addr
P00.21	***Operation Command Source (AUTO, REMOTE)***	♦R/W	0015	40022
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Digital keypad 1: External terminals 2: RS-485 communication input 3: No function 5: Communication card Note: HOA (Hand-Off-Auto) function is valid only when you use with DI function setting 41/42 or 56 or with GS4-KPD (optional)	0		

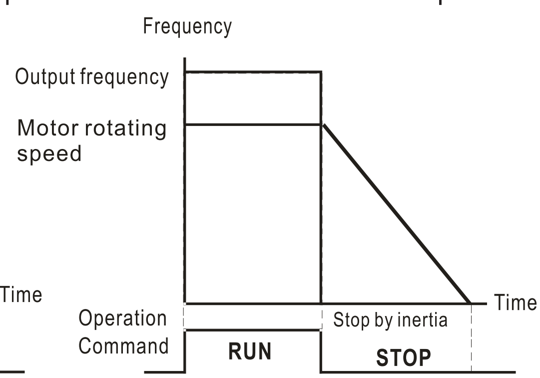
P00.21 determines the operation frequency source in the "AUTO, REMOTE" mode.

- *When Parameter 00.29 is in 0: HOA function, if the multi-function input terminal (DI) function setting 41 and 42 are OFF, the drive does not receive any operation command and JOG is invalid.*
- *The digital keypad is not capable of switching between AUTO and REMOTE. When P00.21=0, the ability to switch is essentially disabled.*

		Type	Hex Addr	Dec Addr
P00.22	***Stop Method***	♦R/W	0016	40023
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Ramp to stop 1: Coast to stop	0		

P00.22 determines how the motor is stopped when the drive receives the Stop command.





1) **Ramp to stop:** According to the set deceleration time, the AC motor drive decelerates to 0 Hz or the minimum output frequency (P01-07) and then stops.
2) **Coast to stop:** According to the load inertia, the AC motor drive stops output immediately, and the motor coasts to a stop.

Use "ramp to stop" for the safety of personnel or to prevent material from being wasted in applications where the motor must stop immediately after the drive stops. You must set the deceleration time accordingly.

If idling is allowed or the load inertia is large, use "coast to stop." For example, this is often used with blowers, punching machines, and pumps.

		Type	Hex Addr	Dec Addr
P00.23	***Motor Direction Control***	♦R/W	0017	40024
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Enable forward / reverse 1: Disable reverse 2: Disable forward	0		

P00.23 enables the motor to move in either forward or reverse, only forward, or only reverse. You can use it to prevent a motor from running in a direction that would cause injury or damage to the equipment, especially when only one running direction is allowed for the motor load.

		Type	Hex Addr	Dec Addr
P00.24	***Digital Operator (Keypad) Frequency Command Memory***	Read	0018	40025
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Read only	0		

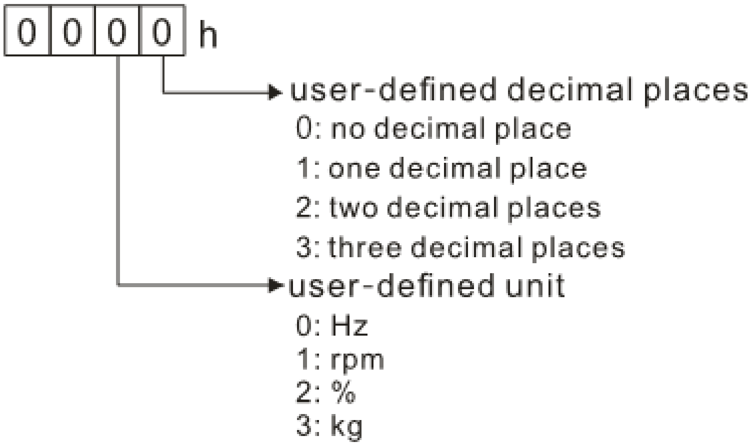
If the keypad is the frequency command source, P00.24 stores the current frequency command when Lv or fault occurs.

		Type	Hex Addr	Dec Addr
P00.25	***User-Defined Characteristics***	♦R/W	0019	40026
	Range/Units (Format: 16-bit binary)	*Default*		

bit 0–3: user-defined decimal places — Default: 0
0000h,0000b: no decimal place
0001h,0001b: one decimal place
0002h,0010b: two decimal places
0003h,0011b: three decimal places
bit 4–15: user-defined unit
000xh: Hz
001xh: rpm
002xh: %
003xh: kg
004xh: m/s
005xh: kW
006xh: HP
007xh: ppm
008xh: 1/m
009xh: kg/s
00Axh: kg/m
00Bxh: kg/h
00Cxh: lb/s
00Dxh: lb/m
00Exh: lb/h
00Fxh: ft/s
010xh: ft/m
011xh: m
012xh: ft
013xh: degC
014xh: degF
015xh: mbar
016xh: bar
017xh: Pa
018xh: kPa
019xh: mWG
01Axh: inWG
01Bxh: ftWG
01Cxh: psi
01Dxh: atm
01Exh: L/s
01Fxh: L/m
020xh: L/h
021xh: m3/s
022xh: m3/h
023xh: GPM
024xh: CFM
xxxxh: Hz

P00.25 configures the decimal places and units of displayed data.

- *bit 0–3:*
  The displayed units for the control frequency F page and user-defined (P00.04 = d10, PID feedback), and the displayed number of decimal places for P00.26 (supports up to three decimal places).
- *bit 4–15:*
  The displayed units for the control frequency F page, user-defined (P00.04 = d10, PID feedback) and P00.26.



- *You must convert the setting value to decimal when using the keypad to set parameters.*

Example:

Assume that the user-defined unit is **inWG** and user-defined decimal place is the **third** decimal point. According to the information above, the corresponding unit to inWG is **01Axh** (x is the set decimal point), and the corresponding unit to the third decimal place is **0003h**, then inWG and the third decimal point displayed in hexadecimal is **01A3h**. Converting 01A3h to decimal gives a value of **419**. Thus, set P00.25 = 419 to complete the setting.

		Type	*Hex Addr*	*Dec Addr*
P00.26	***Maximum User-Defined Value***	R/W	001A	40027
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Disable 0–65535 (when P00.25 is set to no decimal place) 0.0–6553.5 (when P00.25 is set to one decimal place) 0.00–655.35 (when P00.25 is set to two decimal places) 0.000–65.535 (when P00.25 is set to three decimal places)	0		

When P00.26 is NOT set to 0, the user-defined value is enabled. After selecting the displayed unit and number of decimal places with P00.25, the setting value of P00.26 corresponds to P01.00 (drive's maximum operating frequency).

Example:

When the frequency set in P01.00 = 60.00 Hz, the maximum user-defined value for P00.26 is 100.0%. This also means that P00.25 is set at 33 (0021h) to select % as the unit.

Set P00.25 before using P00.26. After you finish setting, when P00.26 is not 0, the displayed unit on the keypad shows correctly according to P00.25 settings.

		Type	*Hex Addr*	*Dec Addr*
P00.27	***User-Defined Value***	Read	001B	40028
	Range/Units (Format: 16-bit signed)	*Default*		
	Read only	0		

P00.27 displays the user-defined value when P00.26 is not set to 0.

The user-defined value is valid only when P00.20 (frequency source) is set to the digital keypad or to RS-485 communication.

		Type	Hex Addr	Dec Addr
P00.29	***LOCAL / REMOTE Selection***	R/W	001D	40030
	Range/Units (Format: 16-bit binary)	Default		
	0: Standard HOA function 1: When switching between local and remote, the drive stops. 2: When switching between local and remote, the drive runs with REMOTE settings for frequency and operating status. 3: When switching between local and remote, the drive runs with LOCAL settings for frequency and operating status. 4: When switching between local and remote, the drive runs with LOCAL settings when switched to Local and runs with REMOTE settings when switched to Remote for frequency and operating status.	0		

The default for P00.29 is 0, Standard HOA. Set the Local and Remote frequency and operation source with P00.20, P00.21 and P00.30, P00.31. The external terminal function (DI) = 56 for LOC / REM mode selection is disabled when P00.29=0.

- *If P00.29 is not set to 0, the top right corner of digital keypad GS4-KPD (optional) displays LOC or REM. Set the REMOTE and LOCAL frequency and operation source with P00.20, P00.21 and P00.30, P00.31. Set the multi-function input terminal (DI) = 56 to set the LOC / REM selection. The AUTO key on the GS4-KPD (optional) is the REMOTE function; the HAND key is the LOCAL function.*
- *If P00.29 is not set to 0, the AUTO / HAND keys are disabled. In this case, the external terminal (DI) setting = 56 (local / remote selection) has the highest command priority.*

		Type	Hex Addr	Dec Addr
P00.30	***Master Frequency Command Source (HAND, LOCAL)***	♦R/W	001E	40031
	Range/Units (Format: 16-bit binary)	Default		
	0: Digital keypad 1: RS-485 communication input 2: External analog input (refer to P03.00) 3: External UP / DOWN terminal (digital input terminals) 4: Pulse Command (PG2) Reference w/o direction command (refer to P10.16 for pulse input config) 5: Pulse Command (PG2) Reference with direction command (refer to P10.16 for pulse input config) 7: Reserved 8: Communication card 9: PID controller Note: HOA (Hand-Off-Auto) function is valid only when you use with digital input (DI) function setting 41/42 or 56 or with GS4-KPD (optional).	0		

P00.30 determines the master frequency source in the "HAND, LOCAL" mode.

- *You can switch the HAND, LOCAL mode with the keypad GS4-KPD (optional) or the multi-function input terminal (DI) to set the master frequency source.*
- *It returns to AUTO or REMOTE mode whenever you cycle the power. If you use a multi-function input terminal to switch between HAND (LOCAL) and AUTO (REMOTE) mode, the highest priority is the multi-function input terminal.*
- *The pulse of P00.20=4 (Pulse input without direction command) is input by DI7 (pulse generator).*
- *If P00.30 is set to 9-PID, P08.65 will automatically set to 1 and P00.20 will set to 9. To change P00.30 from 9 to another value, P08.65 must be changed first (to a value other than 1). Setting P00.30 to 9 only allows PID control frequency from P08.65 and P08.66 for both local and remote drive mode.*

		Type	Hex Addr	Dec Addr
P00.31	***Operation Command Source (HAND, LOCAL)***	♦R/W	001F	40032
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Digital keypad 1: External terminal 2: RS-485 communication input 3: No function 5: Communication card Note: HOA (Hand-Off-Auto) function is valid only when you use with DI function setting 41/42 or 56 or with GS4-KPD (optional).	0		

P00.31 determines the operation frequency source in the "HAND, LOCAL" mode.

In the HOA mode, if the multi-function input terminal (DI) function setting 41 and 42 are OFF, the drive does not receive any operation command and JOG is invalid

		Type	Hex Addr	Dec Addr
P00.32	***Digital Keypad STOP Function***	♦R/W	0020	40033
	Range/Units (Format: 16-bit binary)	*Default*		
	0: STOP key disabled 1: STOP key enabled	0		

P00.32 disables or enables the STOP key.

Valid when the operation command source is not the digital keypad (P00.21≠ 0). When P00.21=0, the STOP key on the digital keypad is not affected by this parameter.

		Type	Hex Addr	Dec Addr
P00.33	***RPWM Mode Selection***	R/W	0021	40034
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disabled 1: RPWM mode 1 2: RPWM mode 2 3: RPWM mode 3	0		

Control modes for P00.33:

Motor	***Induction Motor***				***Permanent Magnet Synchronous Motor (PM)***
Control Mode	VF	SVC	FOCPG	FOC	SVC
1: RPWM mode 1	✓	✓	✓	✓	✓
2: RPWM mode 2	✓	✓	✓	✓	✓
3: RPWM Mode 3	✓	✓	✓	✓	✓

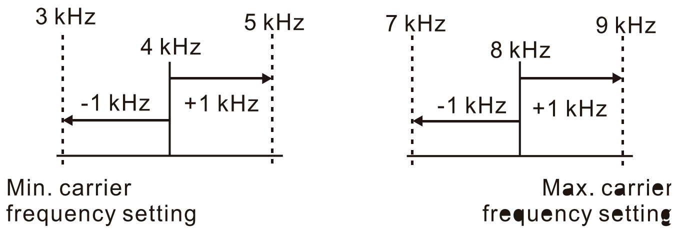
When the RPWM function is enabled, the drive randomly distributes the carrier frequency based on actual P00.17 carrier frequency settings.

- *The RPWM function can be applied to all control modes.*
- *Once the RPWM function is enabled, particularly high frequency audio noise is reduced, and the audio frequency produced by the running motor also changes (usually from higher to lower).*
- *Three RPWM modes are provided for different applications. Each mode corresponds to different frequency distribution, electromagnetic noise distribution, and audio frequency.*
- *The settings for P00.17 (Carrier Frequency) vary with enabling or disabling RPWM.*

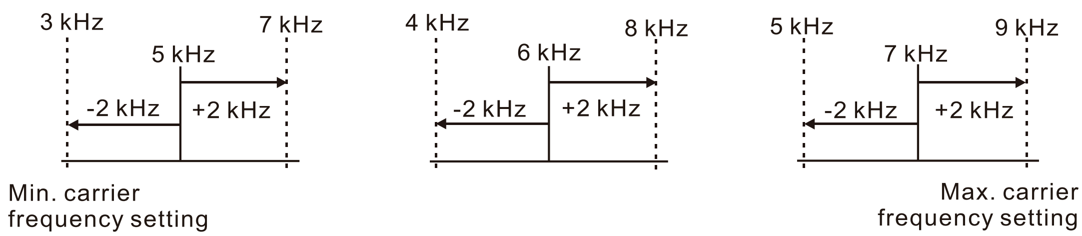
		Type	Hex Addr	Dec Addr
P00.34	***RPWM Range***	♦R/W	0022	40035
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–4.0 kHz	0.0		

When the RPWM function is enabled, the minimum carrier frequency setting for P00.17 is 3kHz, and the maximum is 9kHz.

- *P00.34 is valid only when the RPWM function is enabled (P00.33≠0).*
- *When the RPWM function is enabled and P00.17 is set to 4 or 8 kHz, the setting range for P00.34 is 0.0–2.0 kHz. When the maximum setting for P00.34 is 2.0 kHz (±1kHz) the carrier frequency fluctuation range is defined by the diagrams below:*



- *When the RPWM function is enabled and P00.17 is set to 5, 6, or 7 kHz, the setting range for P00.34 is 0.0–4.0 kHz. When the maximum setting for P00.34 is 4.0 kHz (±2kHz) the carrier frequency fluctuation range is defined by the diagrams below:*



Example:

When P00.17=4kHz, P00.33 is enabled (=1, 2, or 3) and P00.34=2.0kHz, then the carrier frequency outputs on the basis of 4kHz and the random frequency distribution tolerance is ±1kHz. The carrier frequency will randomly fluctuate from 3 to 5 kHz.

		Type	Hex Addr	Dec Addr
P00.35	***Auxiliary Frequency Source***	R/W	0023	40036
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disabled 1: Digital keypad 2: RS-485 communication input 3: Analog input 4: External UP / DOWN key input (digital input terminals) 5: Pulse Command (PG2) Reference w/o direction command (refer to P10.16 for pulse input config) 8: Communication card	0		

P00.35 determines the source for auxiliary frequency control.

		Type	Hex Addr	Dec Addr
P00.36	***Master and Auxiliary Frequency Command Selection***	♦R/W	0024	40037
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Master + auxiliary frequency 1: Master - auxiliary frequency 2: Auxiliary - master frequency	0		

P00.36 sets the master frequency source according to P00.20, and sets the auxiliary frequency source according to P00.35. This parameter determines the addition and subtraction of the master and auxiliary frequency.

- *When P00.36 = 0, 1, 2, the control command comes after adding or subtracting the master / auxiliary frequency and the acceleration and deceleration (including S-curve).*
- *If the value is negative after adding or subtracting the master / auxiliary frequency, P03.10 determines whether to change the running direction.*
- *If you set the master frequency source (P00.20 = 0) or the auxiliary frequency source (P00.35 = 1) using the keypad, the F page of the keypad displays the setting frequency that you can use to set the master frequency or the auxiliary frequency. If the master frequency source or the auxiliary frequency source is NOT set by the keypad (P00.20 ≠ 0 and P00.35 ≠ 1), the F page of the keypad displays the value after adding or subtracting the master / auxiliary frequency.*
- *When setting the master frequency source and auxiliary frequency source, P00.35 cannot be set to the same value as P00.20 or P00.30*

		Type	Hex Addr	Dec Addr
P00.47	***Output Phase Order Selection***	♦R/W	002F	40048
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Standard 1: Reverse the rotation direction	0		

This parameter can be used to change the rotation direction from forward to reverse or from reverse to forward without changing the wiring. The indicator light won't be changed.

When using this parameter with P00.23 (Control of Motor Direction), P00.23 has priority over P00.47. If P00.23 is set to only allow one direction of movement, P00.47 will not be able to reverse it.

		Type	Hex Addr	Dec Addr
P00.48	***Display Filter Time (Current)***	♦R/W	0030	40049
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.001–65.535 sec.	0.100		

P00.48 minimizes the current fluctuation displayed by the digital keypad.

		Type	Hex Addr	Dec Addr
P00.49	***Display Filter Time (User Display)***	♦R/W	0031	40050
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.001–65.535 sec.	0.100		

P00.49 minimizes the value fluctuation displayed by the digital keypad configurable user display. The filtering applies to P00.04 selections 0, 2, 4, 6, and 7 only. The default value of 0.100 disables the filtering.

		Type	Hex Addr	Dec Addr
P00.50	***Firmware Date Code***	Read	0032	40051
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Read only	0		

P00.50 displays the current drive firmware version by date.

Group P01.xx Details – Basic Parameters

		Type	Hex Addr	Dec Addr
P01.00	***Maximum Operation Frequency of Motor 1***	R/W	0100	40257
P01.52	***Maximum Operation Frequency of Motor 2***	R/W	0134	40309
P01.53	***Maximum Operation Frequency of Motor 3***	R/W	0135	40310
P01.62	***Maximum Operation Frequency of Motor 4***	R/W	013E	40319
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	60.00 / 50.00		

These parameters determine the AC motor drive's maximum operation frequency. All the AC motor drive frequency command sources (analog inputs 0–10 V, 4–20 mA, 0–20 mA, ±10 V) are scaled to correspond to the output frequency range.

		Type	Hex Addr	Dec Addr
P01.01	***Output Frequency of Motor 1 (Base frequency / Motor's rated frequency)***	R/W	0101	40258
P01.35	***Output Frequency of Motor 2 (Base frequency / Motor's rated frequency)***	R/W	0123	40292
P01.54	***Output Frequency of Motor 3 (Base frequency / Motor's rated frequency)***	R/W	0136	40311
P01.63	***Output Frequency of Motor 4 (Base frequency / Motor's rated frequency)***	R/W	013E	40319
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	60.00 / 50.00		

Set these parameters according to the motor's rated frequency on the motor nameplate. If the motor's rated frequency is 60Hz, set this parameter to 60. If the motor's rated frequency is 50Hz, set this parameter to 50.

		Type	Hex Addr	Dec Addr
P01.02	***Output Voltage of Motor 1 (Base voltage / Motor's rated voltage)***	R/W	0102	40259
P01.36	***Output Voltage of Motor 2 (Base voltage / Motor's rated voltage)***	R/W	0124	40293
P01.55	***Output Voltage of Motor 3 (Base voltage / Motor's rated voltage)***	R/W	0137	40312
P01.64	***Output Voltage of Motor 4 (Base voltage / Motor's rated voltage)***	R/W	0140	40321
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V models: 0.0–255.0 V	220.0		
	460V models: 0.0–510.0 V	440.0		

Set these parameters according to the rated voltage on the motor nameplate. If the motor's rated voltage is 220V, set this parameter to 220.0. If the motor's rated voltage is 200V, set this parameter to 200.0.

		Type	Hex Addr	Dec Addr
P01.03	***Mid-point Frequency 1 of Motor 1***	R/W	0103	40260
P01.37	***Mid-point Frequency 1 of Motor 2***	R/W	0125	40294
P01.56	***Mid-point Frequency 1 of Motor 3***	R/W	0138	40313
P01.65	***Mid-point Frequency 1 of Motor 4***	R/W	0141	40322
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	3.00		

		Type	Hex Addr	Dec Addr
P01.04	**Mid-point Voltage 1 of Motor 1**	♦R/W	0104	40261
P01.38	**Mid-point Voltage 1 of Motor 2**	♦R/W	0126	40295
P01.57	**Mid-point Voltage 1 of Motor 3**	♦R/W	0139	40314
P01.66	**Mid-point Voltage 1 of Motor 4**	♦R/W	0142	40323
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V models: 0.0–240.0 V	11.0		
	460V models: 0.0–480.0 V	22.0		

		Type	Hex Addr	Dec Addr
P01.05	**Mid-point Frequency 2 of Motor 1**	R/W	0105	40262
P01.39	**Mid-point Frequency 2 of Motor 2**	R/W	0127	40296
P01.58	**Mid-point Frequency 2 of Motor 3**	R/W	013A	40315
P01.67	**Mid-point Frequency 2 of Motor 4**	R/W	0143	40324
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	1.50		

		Type	Hex Addr	Dec Addr
P01.06	**Mid-point Voltage 2 of Motor 1**	♦R/W	0106	40263
P01.40	**Mid-point Voltage 2 of Motor 2**	♦R/W	0128	40297
P01.59	**Mid-point Voltage 2 of Motor 3**	♦R/W	013B	40316
P01.68	**Mid-point Voltage 2 of Motor 4**	♦R/W	0144	40325
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V models: 0.0–240.0 V	5.0		
	460V models: 0.0–480.0 V	10.0		

		Type	Hex Addr	Dec Addr
P01.07	**Minimum Output Frequency of Motor 1**	R/W	0107	40264
P01.41	**Minimum Output Frequency of Motor 2**	R/W	0129	40298
P01.60	**Minimum Output Frequency of Motor 3**	R/W	013C	40317
P01.69	**Minimum Output Frequency of Motor 4**	R/W	0145	40326
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	0.50		

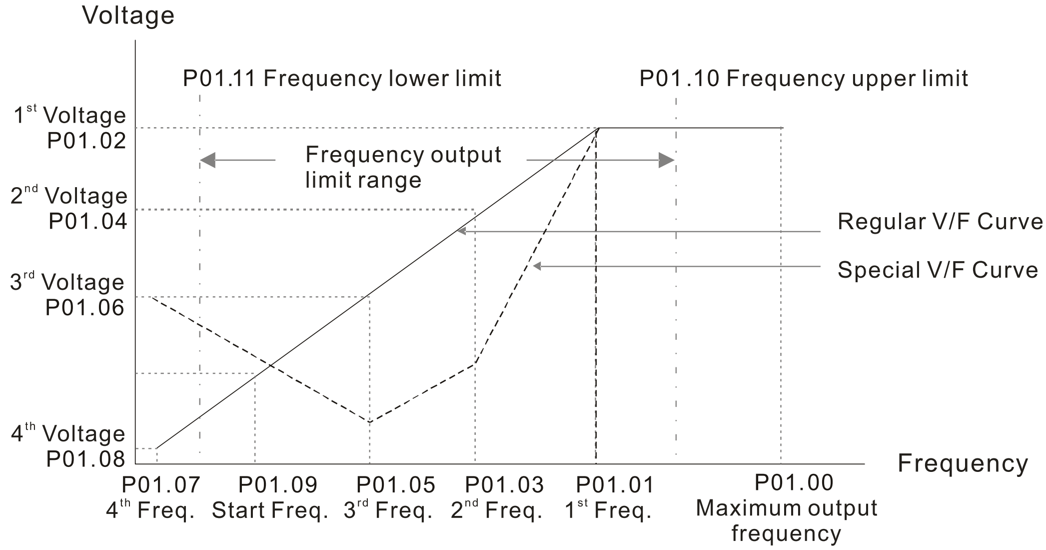
NOTE: P01.07 will set the V/F mode minimum frequency only. Use P01.11 to set the minimum frequency of the drive for any control mode.

		Type	Hex Addr	Dec Addr
P01.08	**Minimum Output Voltage of Motor 1**	♦R/W	0108	40265
P01.42	**Minimum Output Voltage of Motor 2**	♦R/W	012A	40299
P01.61	**Minimum Output Voltage of Motor 3**	♦R/W	013D	40318
P01.70	**Minimum Output Voltage of Motor 4**	♦R/W	0146	40327
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V models: 0.0–240.0 V	1.0		
	460V models: 0.0–480.0 V	2.0		

You usually set the V/F curve according to the motor's allowable loading characteristics. Pay special attention to the motor's heat dissipation, dynamic balance, and bearing lubrication when the loading characteristics exceed the loading limit of the motor.

There is no limit for the voltage setting, but a high voltage at a low frequency may cause motor damage, overheating, and trigger the stall prevention or the over-current protection; therefore, use low voltage at low frequency to prevent motor damage or drive error.

The diagram below shows the V/F curve for motor 1. You can use the same V/F curve for motor 2, motor 3, and motor 4. For multi-motor selections, refer to the multi-function input terminal (P02.01–P02.07) settings 83 and 84.

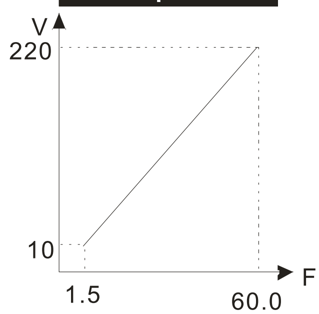


V/F Curve

Common settings for the V/F curve:

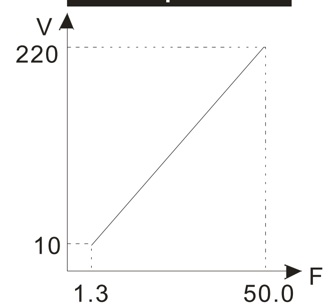
1) General purpose:

Motor spec. 60Hz



P	Setting
01.00	60.0
01.01	60.0
01.02	220.0
01.03 01.05	1.50
01.04 01.06	10.0
01.07	1.50
01.08	10.0

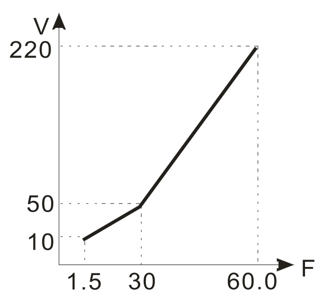
Motor spec. 50Hz



P	Setting
01.00	50.0
01.01	50.0
01.02	220.0
01.03 01.05	1.30
01.04 01.06	10.0
01.07	1.30
01.08	10.0

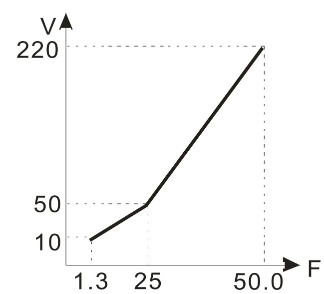
2) For fan and hydraulic machinery:

Motor spec. 60Hz



P	Setting
01.00	60.0
01.01	60.0
01.02	220.0
01.03 01.05	30.0
01.04 01.06	50.0
01.07	1.50
01.08	10.0

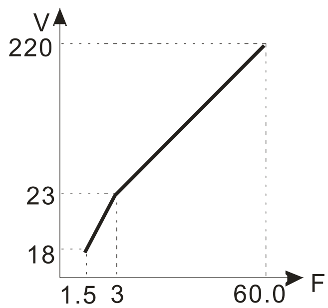
Motor spec. 50Hz



P	Setting
01.00	50.0
01.01	50.0
01.02	220.0
01.03 01.05	25.0
01.04 01.06	50.0
01.07	1.30
01.08	10.0

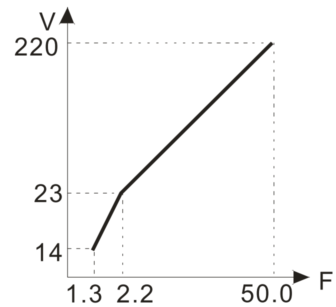
3) High starting torque:

Motor spec. 60Hz



P	Setting
01.00	60.0
01.01	60.0
01.02	220.0
01.03 01.05	3.00
01.04 01.06	23.0
01.07	1.50
01.08	18.0

Motor spec. 50Hz

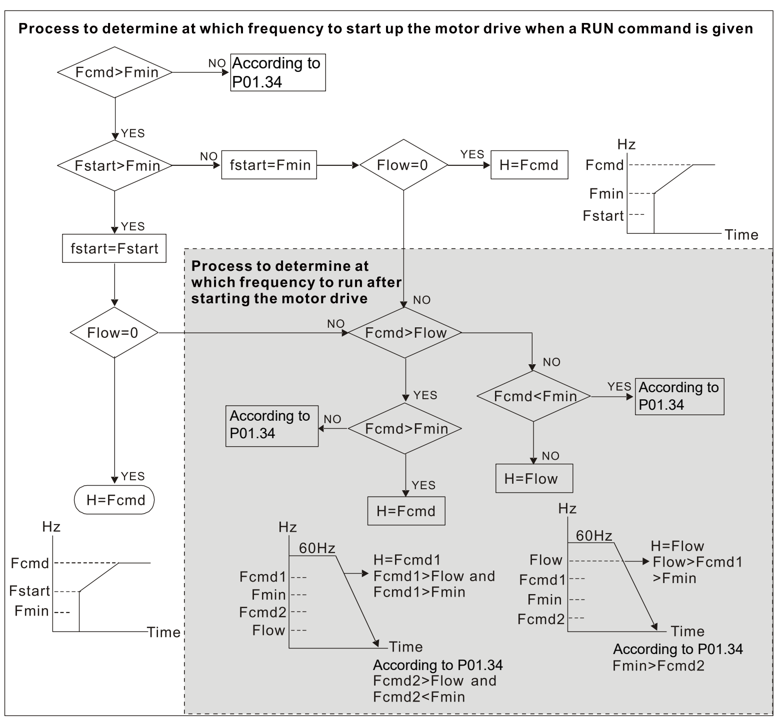


P	Setting
01.00	50.0
01.01	50.0
01.02	220.0
01.03 01.05	2.20
01.04 01.06	23.0
01.07	1.30
01.08	14.0

		Type	Hex Addr	Dec Addr
P01.09	***Start-up Frequency***	R/W	0109	40266
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	0.50		

P01.09 is used to set the starting frequency of the drive.

- *When the starting frequency (P01.09) is larger than the minimum output frequency (P01.11), the drive's frequency output starts when the starting frequency (P01.09) reaches the F command. Refer to the diagram below for details.*
- *Fcmd = frequency command;*
  Fstart = start-up frequency (P01.09);
  fstart = actual start-up frequency of the drive;
  Fmin = 4th output frequency setting (P01.07 / P01.41);
  Flow = output frequency lower limit (P01.11)
- *When Fcmd > Fmin and Fcmd < Fstart:*
  If Flow < Fcmd, the drive runs directly with Fcmd.
  If Flow ≥ Fcmd, the drive runs with Fcmd, and then rises to Flow according to acceleration time.
- *The drive's output frequency goes directly to 0 when decelerating to Fmin.*

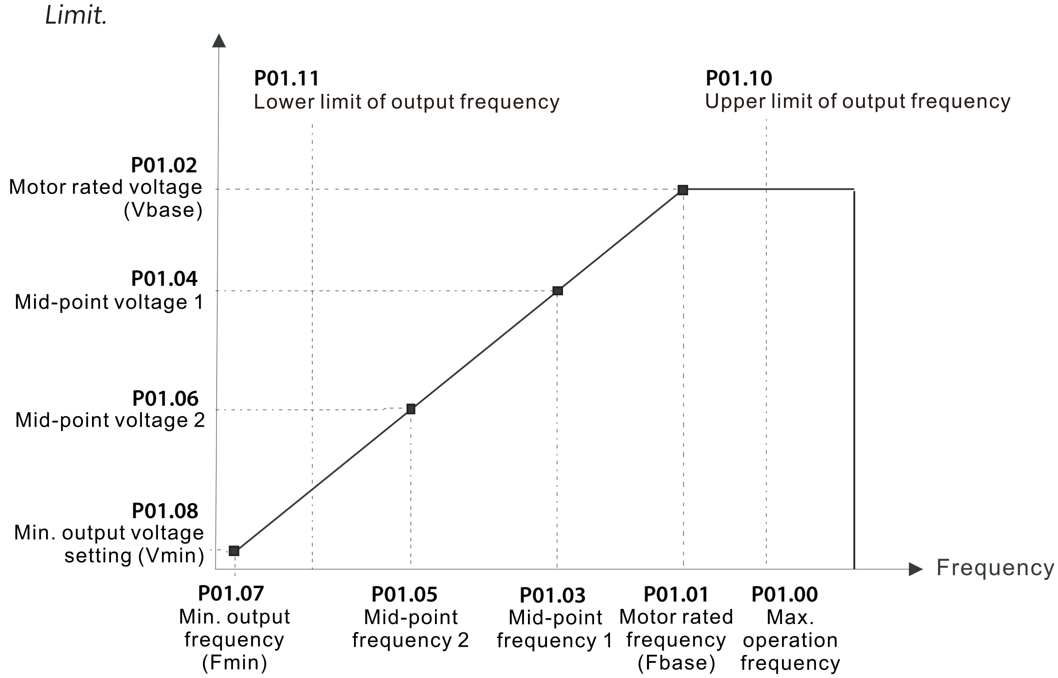


		Type	Hex Addr	Dec Addr
P01.10	***Output Frequency Upper Limit***	♦R/W	010A	40267
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	599.0		

		Type	Hex Addr	Dec Addr
P01.11	***Output Frequency Lower Limit***	♦R/W	010B	40268
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	0.00		

Use the upper and lower limit output frequency settings to limit the actual output frequency. If the output frequency setting is higher than the upper limit (P01.10), the drive runs with the upper limit frequency. If the output frequency setting is lower than the lower limit (P01.11) but higher than the minimum output frequency (P01.07), the drive runs with the lower limit frequency. Set the upper limit frequency > the lower limit frequency (P01.10 setting value must be > P01.11 setting value).

- *The upper output frequency limits the drive's maximum output frequency. If the frequency setting for the Frequency command is higher than P01.10, the drive runs with the P01.10 setting.*
- *If the PID feedback control is enabled for the drive, the drive's output frequency may exceed the Frequency command but is still limited by this setting.*
- *Related parameters: P01.00 Maximum Operation Frequency, P01.11 Output Frequency Lower Limit.*



- *The lower output frequency limits the drive's minimum output frequency. If the frequency setting for the Frequency command is lower than P01.11, the drive runs with the P01.11 setting.*
- *When the drive starts, it operates according to the V/F curve and accelerates from the minimum output frequency (P01.07) to the setting frequency. It is not limited by the lower output frequency settings.*
- *Use the output frequency upper and lower limit settings to prevent operator misuse, overheating caused by the motor's operating at a too low frequency, or mechanical wear due to a too high speed.*
- *If the output frequency upper limit setting is 50Hz and the frequency setting is 60Hz, the maximum output frequency is 50Hz.*
- *If the output frequency lower limit setting is 10Hz and the minimum output frequency setting (P01.07) is 1.5 Hz, then the drive operates at 10Hz when the Frequency command is higher than P01.07 but lower than 10Hz. If the Frequency command is lower than P01.07, the drive is in ready status without output.*

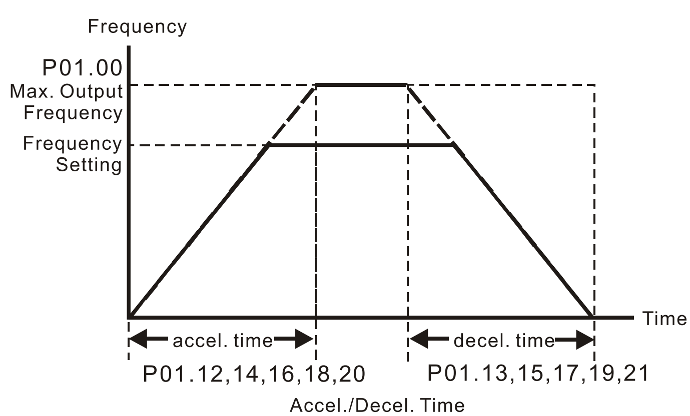
- *If the frequency output upper limit is 60Hz and the frequency setting is also 60Hz, only the Frequency command is limited at 60Hz. The actual output frequency may be higher than 60Hz if used for slip compensation.*

		Type	Hex Addr	Dec Addr
P01.12	***Acceleration Time 1***	♦R/W	010C	40269
P01.13	***Deceleration Time 1***	♦R/W	010D	40270
P01.14	***Acceleration Time 2***	♦R/W	010E	40271
P01.15	***Deceleration Time 2***	♦R/W	010F	40272
P01.16	***Acceleration Time 3***	♦R/W	0110	40273
P01.17	***Deceleration Time 3***	♦R/W	0111	40274
P01.18	***Acceleration Time 4***	♦R/W	0112	40275
P01.19	***Deceleration Time 4***	♦R/W	0113	40276
P01.20	***JOG Acceleration Time***	♦R/W	0114	40277
P01.21	***JOG Deceleration Time***	♦R/W	0115	40278

Range/Units (Format: 16-bit unsigned)	Default
P01.45 = 0: 0.00–600.00 sec. P01.45 = 1: 0.0–6000.0 sec.	10.00 / 10.0

The acceleration time determines the time required for the AC motor drive to ramp from 0.00 Hz to the maximum operation frequency (P01.00). The deceleration time determines the time required for the AC motor drive to decelerate from the maximum operation frequency (P01.00) down to 0.00 Hz.

- *The acceleration and deceleration time are invalid when using P01.44 Auto-acceleration and Auto-deceleration Setting.*
- *Select the Acceleration/Deceleration Time 1, 2, 3, 4 with the multi-function input terminal settings. The defaults are Acceleration Time 1 and Deceleration Time 1.*
- *With the enabled torque limits and stall prevention functions, the actual acceleration and deceleration time are longer than the above action time.*
- *Note that setting the acceleration and deceleration time too short may trigger the drive's protection function (P06.03 Over-current Stall Prevention during Acceleration or P06.01 Over-voltage Stall Prevention), and the actual acceleration and deceleration time are longer than this setting.*
- *Note that setting the acceleration time too short may cause motor damage or trigger drive protection due to over-current during the drive's acceleration.*
- *Note that setting the deceleration time too short may cause motor damage or trigger drive protection due to over-current during the drive's deceleration or over-voltage.*
- *Use suitable braking resistors (refer to Appendix A: Accessories) to decelerate in a short time and prevent over-voltage.*
- *When you enable P01.24–P01.27 (S-curve acceleration and deceleration begin and arrival time), the actual acceleration and deceleration time are longer than the setting.*



		Type	Hex Addr	Dec Addr
P01.22	***JOG Frequency***	♦R/W	0116	40279
Range/Units (Format: 16-bit unsigned)		*Default*		
0.00–599.00 Hz		6.00		

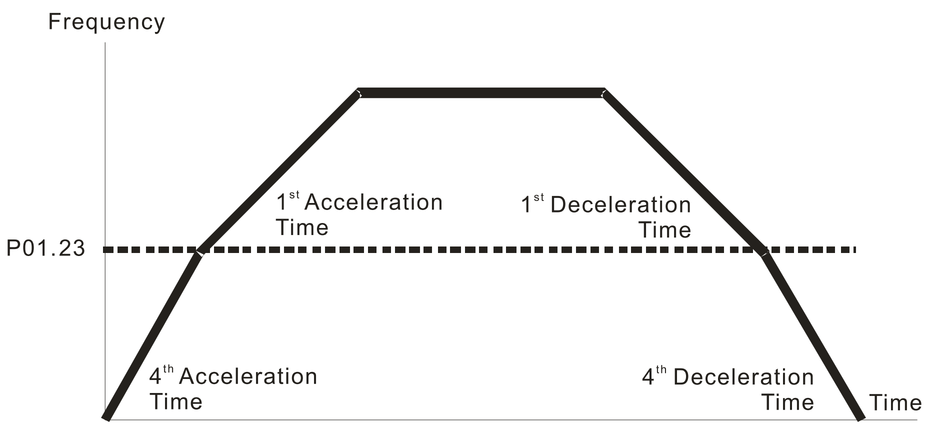
You can use both the external terminal JOG and F1 key on the optional keypad GS4-KPD (optional) to set the JOG function. When the JOG command is ON, the AC motor drive accelerates from 0 Hz to the JOG frequency (P01.22). When the JOG command is OFF, the AC motor drive decelerates from the JOG frequency to stop. The JOG acceleration and deceleration time (P01.20, P01.21) are the time to accelerate from 0.00 Hz to the JOG frequency (P01.22). You cannot execute the JOG command when the AC motor drive is running. When the JOG command is executing, other operation commands are invalid.

		Type	Hex Addr	Dec Addr
P01.23	***Switch Frequency between First and Fourth Accel./Decel.***	♦R/W	0117	40280
Range/Units (Format: 16-bit unsigned)		*Default*		
0.00–599.00 Hz		0.00		

This function does not require the external terminal switching function; it switches the acceleration and deceleration time automatically according to the P01.23 setting. If you set the external terminal, the external terminal has priority over P01.23.

When using this function, set the S-curve acceleration time to 0 if the fourth acceleration time is short.

1) If P01.12=10s, P 01.18=6s, then the acceleration time is 3s for 0–40 Hz and 5s for 40–80 Hz.
2) If P01.13=8s, P01.19=2s, then the deceleration time is 4s for 80–40 Hz and 1s for 40–0 Hz.

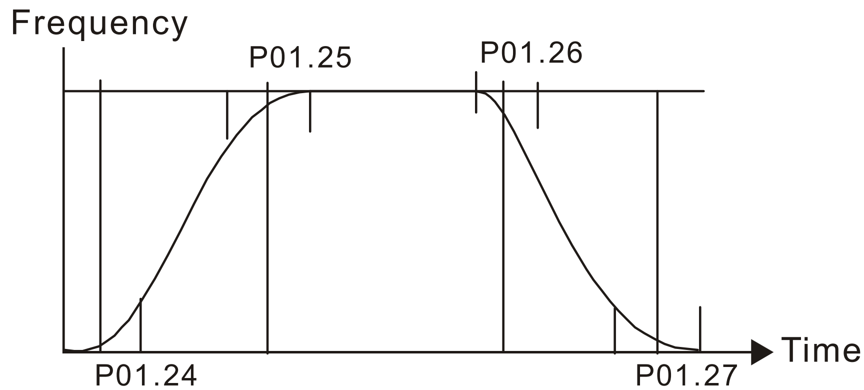


1st/4th Acceleration/Deceleration Frequency Switching

		Type	Hex Addr	Dec Addr
P01.24	***S-curve for Acceleration Begin Time 1***	♦R/W	0118	40281
P01.25	***S-curve for Acceleration Arrival Time 2***	♦R/W	0119	40282
P01.26	***S-curve for Deceleration Begin Time 1***	♦R/W	011A	40283
P01.27	***S-curve for Deceleration Arrival Time 2***	♦R/W	011B	40284
Range/Units (Format: 16-bit unsigned)		*Default*		
If P01.45 = 0: 0.00–25.00 sec.		0.20		
If P01.45 = 1: 0.0–250.0 sec.		0.2		

These parameters allow you to enable an S-curve. Using an S-curve gives the smoothest transition between speed changes. The acceleration and deceleration curve adjusts the acceleration and deceleration S-curve. When enabled, the drive produces a different acceleration and deceleration curve according to the acceleration and deceleration time.

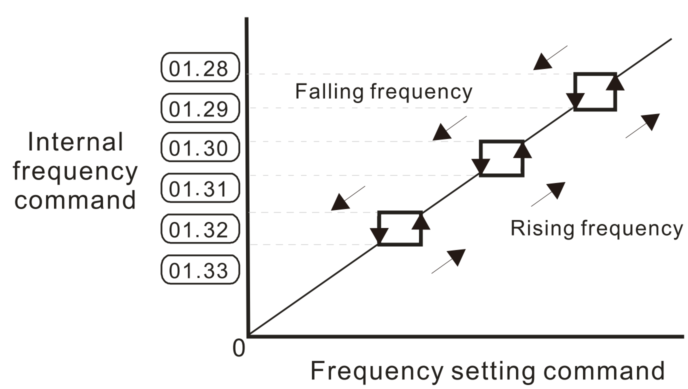
- *The S-curve function is invalid when you set the acceleration and deceleration time to 0.*
- *For P01.12, P01.14, P01.16, and P01.18:*
  When P01.1x ≥ P01.24 and P01.25, the actual acceleration time = P01.1x + (P01.24 + P01.25) / 2.
- *For P01.13, P01.15, P01.17, and P01.19:*
  When P01.1x ≥ P01.26 and P01.27, the actual deceleration time = P01.1x + (P01.26 + P01.27) / 2.



		Type	Hex Addr	Dec Addr
P01.28	***Skip Frequency 1 (Upper Limit)***	R/W	011C	40285
P01.29	***Skip Frequency 1 (Lower Limit)***	R/W	011D	40286
P01.30	***Skip Frequency 2 (Upper Limit)***	R/W	011E	40287
P01.31	***Skip Frequency 2 (Lower Limit)***	R/W	011F	40288
P01.32	***Skip Frequency 3 (Upper Limit)***	R/W	0120	40289
P01.33	***Skip Frequency 3 (Lower Limit)***	R/W	0121	40290
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	0.00		

These parameters set the AC motor drive's skip frequency. The drive's frequency setting skips these frequency ranges. However, the frequency output is continuous. There are no limits for these six parameters and you can combine them. P01.28 does not need to be greater than P01.29; P01.30 does not need to be greater than P01.31; P01.32 does not need to be greater than P01.33. You can set P01.28–01.33 as required. There is no size distinction among these six parameters.

- *These parameters set the skip frequency ranges for the AC motor drive. You can use this function to avoid frequencies that cause mechanical resonance. The skip frequencies are useful when a motor has resonance vibration at a specific frequency bandwidth. Skipping this frequency avoids the vibration. There are three frequency skip zones available.*
- *You can set the Frequency command (F) within the range of skip frequencies. Then the output frequency (H) is limited to the lower limit of skip frequency ranges.*
- *During acceleration and deceleration, the output frequency still passes through the skip frequency ranges.*

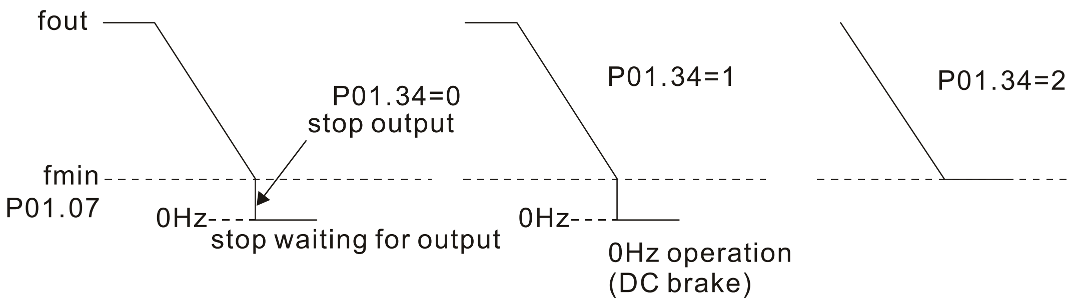


		Type	Hex Addr	Dec Addr
P01.34	***Zero-speed Mode***	R/W	0122	40291
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Output waiting 1: Zero-speed operation 2: Fmin (refer to P01.07 and P01.41)	0		

When the drive's Frequency command is lower than Fmin (P01.07 and P01.41), the drive operates according to this parameter.

- *0: the AC motor drive is in waiting mode without voltage output from terminals U, V, W.*
- *1: the drive executes the DC brake by Vmin (P01.08 and P01.42) in V/F, FOC sensorless, and SVC modes. And it executes zero-speed operation in VFPG mode.*
- *2: the AC motor drive runs using Fmin (P01.07 and P01.41) and Vmin (P01.08 and P01.42) in V/F, VFPG, SVC, and FOC sensorless modes.*

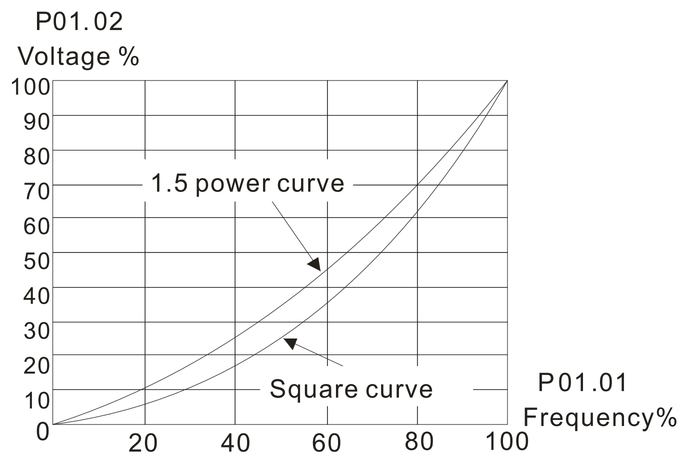
In V/F, VFPG, SVC and FOC sensorless modes:



		Type	Hex Addr	Dec Addr
P01.43	***V/F Curve Selection***	R/W	012B	40300
	Range/Units (Format: 16-bit binary)	*Default*		
	0: V/F curve determined by P.01.00–P01.08 1: V/F curve to the power of 1.5 2: V/F curve to the power of 2	0		

P01.43 is used to select the desired V/F curve for your application.

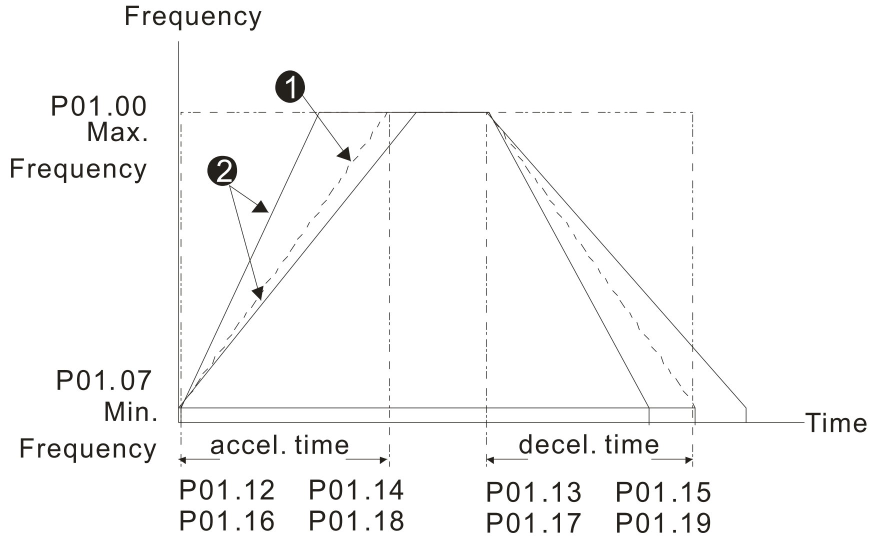
- *When setting to 0, refer to P01.01–01.08 for the motor 1 V/F curve. For motor 2, refer to P01.35–01.42. For motor 3, refer to P01.54–P01.61. For motor 4, refer to P01.35–P01.42.*
- *When setting to 1 or 2, the second and third voltage frequency settings (as shown in the V/F Curve diagram for P01.70) are invalid.*
- *If the load of the motor is a variable torque load (torque is in direct proportion to the rotating speed, such as the load of a fan or a pump), the load torque is low at low rotating speed. You can decrease the input voltage appropriately to make the magnetic field of the input current smaller and reduce flux loss and iron loss for the motor to increase efficiency.*
- *When you set the V/F curve to high power, it has lower torque at low frequency, and the drive is not suitable for rapid acceleration and deceleration. Do NOT use this parameter for rapid acceleration and deceleration.*



	Type	Hex Addr	Dec Addr
P01.44 ***Auto-acceleration and Auto-deceleration Setting***	♦R/W	012C	40301
Range/Units (Format: 16-bit binary)	*Default*		
0: Linear acceleration and deceleration 1: Auto-acceleration and linear deceleration 2: Linear acceleration and auto-deceleration 3: Auto-acceleration and auto-deceleration 4: Stall prevention by auto-acceleration and auto-deceleration (limited by P01.12 –P01.21)	0		

P01.44 is used to configure auto-acceleration and auto-decleration settings.

- *0 (linear acceleration and deceleration): the drive accelerates and decelerates according to the setting for P01.12–P01.19.*
- *1 or 2 (auto/linear acceleration and auto/linear deceleration): the drive auto-tunes the acceleration and deceleration to effectively reduce the mechanical vibration during the load start-up and stop and make the auto-tuning process easier. It does not stall during acceleration and does not need a braking resistor during deceleration to stop. It can also improve operation efficiency and save energy.*
- *3 (auto-acceleration and auto-deceleration–decelerating by the actual load): the drive auto-detects the load torque and automatically accelerates from the fastest acceleration time and smoothest start-up current to the setting frequency. During deceleration, the drive automatically determines the loaded regenerative energy to steadily and smoothly stop the motor in the fastest deceleration time.*
- *4 (stall prevention by auto-acceleration and deceleration–references the acceleration and deceleration time settings (P01.12 through P01.19). If the settings for acceleration and deceleration are too short, the actual acceleration and decleration times will be greater than the acceleration and deceleration time settings.*



Accel./Decel. Time

❶ When P01.44 is set to 0.

❷ When P01.44 is set to 3.

		Type	Hex Addr	Dec Addr
P01.45	***Time Unit for Acceleration and Deceleration and S-Curve***	R/W	012D	40302
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Unit 0.01 sec. 1: Unit 0.1 sec.	0		

		Type	Hex Addr	Dec Addr
P01.49	***Regenerative Energy Restriction Control Method***	R/W	0131	40306
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Over voltage energy restriction 2: Traction energy control (TEC)	0		

P01.49 is used to select the regenerative energy restriction control method.

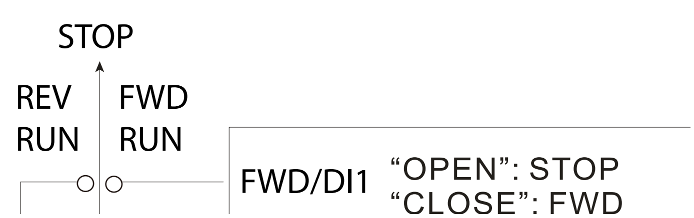
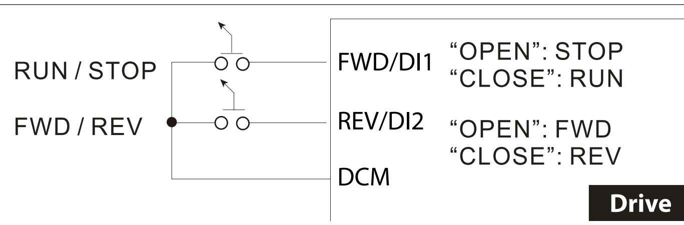
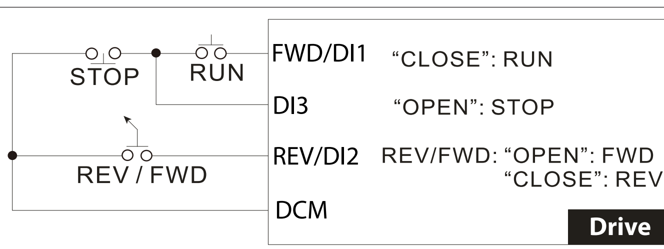
- *0: decelerate or stop in accordance with the original deceleration setting. The actual deceleration time of the motor is longer than the deceleration time setting because of the over-voltage stall prevention.*
- *1: during deceleration, the drive controls the motor according to the setting for P06.01 and the recovery voltage of the DC bus. The controller starts when the DC bus voltage reaches 95% of P06.01. When P06.01 is set to 0, the drive controls the motor according to the operating voltage and the recovery voltage of the DC bus. This method decelerates according to the setting for the deceleration time. The fastest actual deceleration time is not less than the deceleration time setting.*
- *2: during deceleration, the drive controls the motor according to the setting for P06.01 and the DC bus voltage. The controller starts when the DC bus voltage reaches 95% of P06.01, auto-tunes the output frequency and the output voltage to increase the consumption of the regenerative energy according to the drive's capability, and the deceleration time is the result of the drive's auto-tuning. Use this setting when over-voltage occurs due to unexpected deceleration time.*

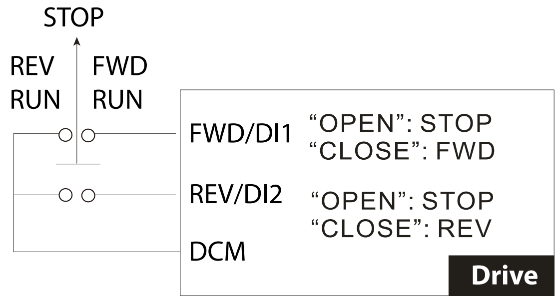
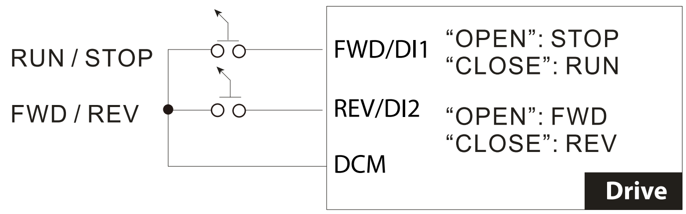
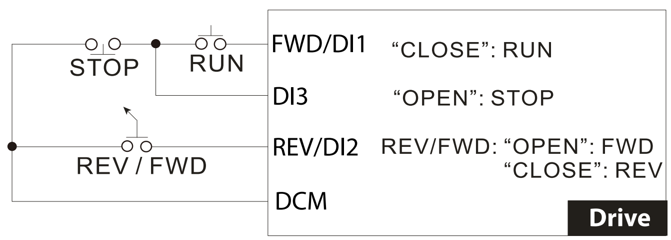
Group P02.xx Details – Digital Input/Output Parameters

		Type	Hex Addr	Dec Addr
P02.00	**Two-wire / Three-wire Operation Control**	R/W	0200	40513
	Range/Units (Format: 16-bit binary)	*Default*		
	0: No function 1: Two-wire mode 1, power on for operation control (DI1: FWD / STOP, DI2: REV / STOP) 2: Two-wire mode 2, power on for operation control (DI1: RUN / STOP, DI2: REV / FWD) 3: Three-wire, power on for operation control (DI1: RUN, DI2: REV / FWD, DI3: STOP) 4: Two-wire mode 1, Quick Start (DI1: FWD / STOP, DI2: REV / STOP) 5: Two-wire mode 2, Quick Start (DI1: RUN / STOP, DI2: REV / FWD) 6: Three-wire, Quick Start (DI1: RUN, DI2: REV / FWD, DI3: STOP)	1		

P02.00 is used to set the 2-wire or 3-wire operation control mode.

- *In the Quick Start function, the output remains ready for operation. The drive responds to the Start command immediately.*
- *When using Quick Start function, the output terminals UVW are with driving voltages in order to output and respond immediately if a Start command is given. Do NOT touch the terminals or modify the motor wiring to prevent electric shocks.*
- *This parameter sets the configuration of the external drive operation control and the Quick Start function. There are six different control modes listed in the following table.*

P02.00	***External Terminal Control Circuits***
Setting value: 1 Two-wire operation control FWD / STOP REV / STOP	
Setting value: 2 Two-wire operation control RUN / STOP FWD / REV	
Setting value: 3 Three-wire operation control	

P02.00	External Terminal Control Circuits
Setting value: 4 Two-wire operation control Quick Start	
Setting value: 5 Two-wire operation control Quick Start	
Setting value: 6 Three-wire operation control Quick Start	

		Type	Hex Addr	Dec Addr	Default
P02.01	***Multi-function input Command 1 (FWD/DI1)***	R/W	0201	40514	0
P02.02	***Multi-function input Command 2 (REV/DI2)***	R/W	0202	40515	0
P02.03	***Multi-function input Command 3 (DI3)***	R/W	0203	40516	1
P02.04	***Multi-function input Command 4 (DI4)***	R/W	0204	40517	2
P02.05	***Multi-function input Command 5 (DI5)***	R/W	0205	40518	3
P02.06	***Multi-function input Command 6 (DI6)***	R/W	0206	40519	4
P02.07	***Multi-function input Command 7 (DI7)***	R/W	0207	40520	0
P02.26	***Input Terminal of extension card (DI10)***	R/W	021A	40539	0
P02.27	***Input Terminal of extension card (DI11)***	R/W	021B	40540	0
P02.28	***Input Terminal of extension card (DI12)***	R/W	021C	40541	0

Range/Units (Format: 16-bit binary)

0: No function
1: Multi-step speed command 1
2: Multi-step speed command 2
3: Multi-step speed command 3
4: Multi-step speed command 4
5: Reset
6: JOG [by external control or GS4-KPD (optional)]
7: Acceleration / deceleration speed inhibit
8: 1st and 2nd acceleration / deceleration time selection
9: 3rd and 4th acceleration / deceleration time selection
10: External Fault (EF) Input (P07.20)
11: Base Block (B.B.) input from external source
12: Output stop
13: Cancel the setting of auto-acceleration / auto-deceleration time
15: Frequency command from AI1
16: Frequency command from AI2
18: Force to stop (P07.20)
19: Digital up command
20: Digital down command
21: PID function disabled
22: Clear the counter
23: Input the counter value (DI6)
24: FWD JOG command
25: REV JOG command
26: TQC / FOC mode selection
27: ASR1 / ASR2 selection
28: Emergency stop (EF1)
29: Signal confirmation for Y-connection
30: Signal confirmation for Δ-connection
31: High torque bias (P11.30)
32: Middle torque bias (P11.31)
33: Low torque bias (P11.32)
35: Enable single-point positioning
38: Disable writing EEPROM function
39: Torque command direction
40: Force coasting to stop
41: HAND switch
42: AUTO switch
43: Enable resolution selection (P02.48)
48: Mechanical gear ratio switch
49: Enable drive
50: Slave dEb action to execute
51: Selection for PLC mode bit 0
52: Selection for PLC mode bit 1
56: Local / Remote selection
70: Force auxiliary frequency return to 0
71: Disable PID function, force PID output return to 0
72: Disable PID function, retain the output value before disabled
73: Force PID integral gain return to 0, disable integral
74: Reverse PID feedback
83: Multi-motor (IM) selection bit 0
84: Multi-motor (IM) selection bit 1
86: Enable initial reel diameter
87: Initial reel diameter 1
88: Initial reel diameter 2
89: PID integration reset
90: Stop calculating the reel diameter
91: Winding mode selection
92: Enable tension control
93: Pause tension PID function
94: Enable to auto switch the reel

These parameters select the functions for each digital terminal.

- *When P02.00 = 0, you can set digital options with multi-function input terminals DI1, DI2.*
- *When P02.00 ≠ 0, the multi-function input terminals DI1, DI2 work in accordance with the setting values for P02.00.*

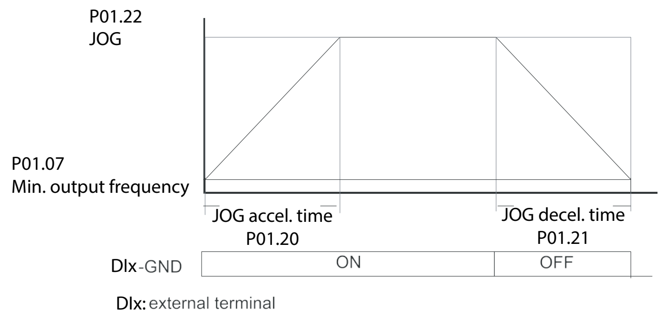
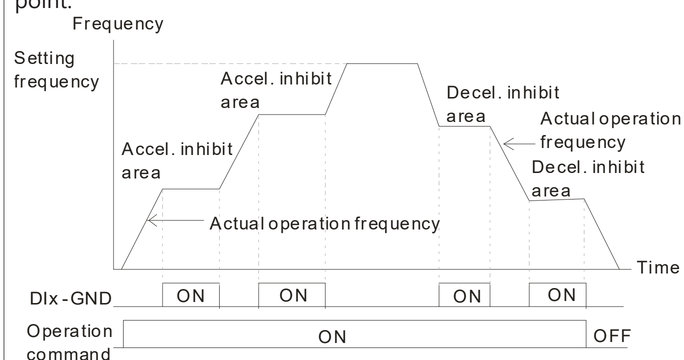
Example:

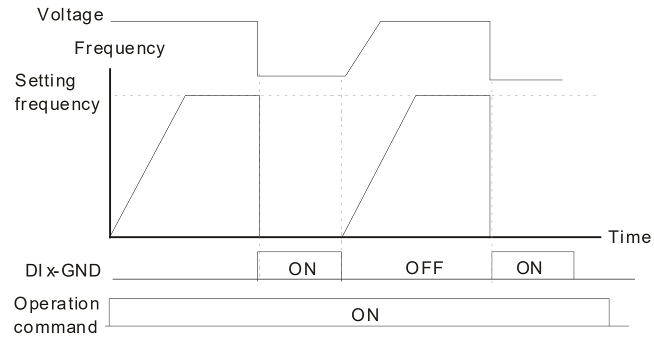
- *If P02.00 = 1: multi-function input terminal DI1 = FWD / STOP, DI2 = REV / STOP.*
- *If P02.00 = 2: multi-function input terminal DI1 = RUN / STOP, DI2 = FWD / REV.*
- *When multi-function input terminal DI7 = 0, DI7 is designated as a pulse input terminal.*
- *If P02.00 is set to three-wire operation control, terminal DI3 is for the STOP contact. The function set previously for this terminal is automatically invalid.*

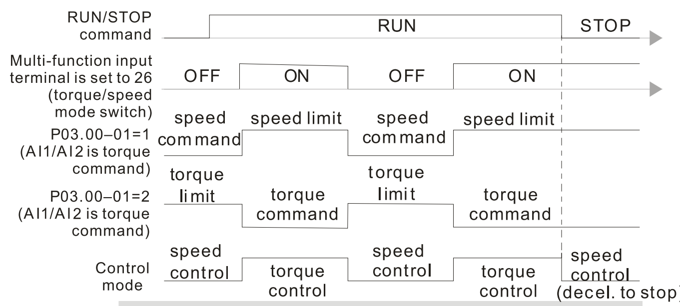
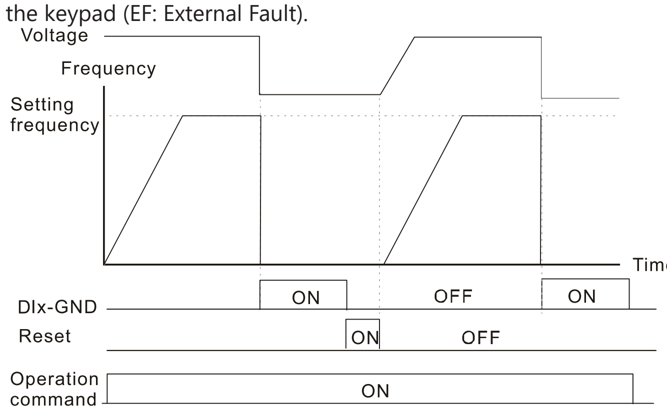
DI7 for Pulse Feedback:

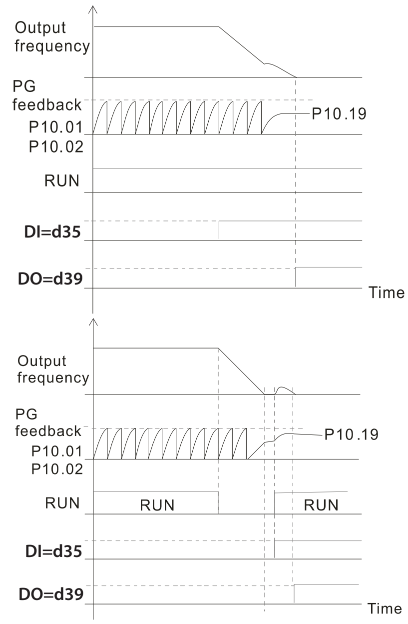
DI7 is set to "0" for pulse feedback. See Group 10 Parameter details for more information.

Summary of Function Settings

<table>
<tr><th>Setting</th><th>Function</th><th>Description</th></tr>
<tr><td>0</td><td>No function</td><td></td></tr>
<tr><td>1</td><td>Multi-step speed command 1</td><td rowspan="4">You can set 15 steps of speed or 15 positions with the digital status of these four terminals. You can use 16-steps of speed if you include the master speed when setting as 15 steps of speed (refer to Parameter Group 04 Multi-step Speed Parameters).</td></tr>
<tr><td>2</td><td>Multi-step speed command 2</td></tr>
<tr><td>3</td><td>Multi-step speed command 3</td></tr>
<tr><td>4</td><td>Multi-step speed command 4</td></tr>
<tr><td>5</td><td>Reset</td><td>Use this terminal to reset the drive after clearing a drive fault.</td></tr>
<tr><td>6</td><td>JOG operation
[by external control or GS4-KPD (optional)]</td><td>This function is valid when the source of the operation command is the external terminals.
The JOG operation executes when the drive stops completely. While running, you can still change the operation direction, and the STOP key on the keypad* and the STOP command from communications are valid. Once the external terminal receives the OFF command, the motor stops in the JOG deceleration time. Refer to P01.20–P01.22 for details.
*: This function is valid when P00.32 is set to 1.

</td></tr>
<tr><td>7</td><td>Acceleration / deceleration speed inhibit</td><td>When you enable this function, the drive stops acceleration or deceleration immediately. After you disable this function, the AC motor drive starts to accelerate or decelerate from the inhibit point.

</td></tr>
<tr><td>8</td><td>1st and 2nd acceleration / deceleration time selection</td><td rowspan="2">You can select the acceleration and deceleration time of the drive with this function, or from the digital status of the terminals; there are four acceleration and deceleration selections.
<table>
<tr><th rowspan="2">DI1
Option 8
(bit 0)</th><th rowspan="2">BI2
Option 9
(bit 1)</th><th rowspan="2">Acc/Dec Selection</th><th colspan="2">Related Parameters</th></tr>
<tr><th>Accel</th><th>Decel</th></tr>
<tr><td>0</td><td>0</td><td>Acc/Dec 1</td><td>01.12</td><td>01.13</td></tr>
<tr><td>1</td><td>0</td><td>Acc/Dec 2</td><td>01.14</td><td>01.15</td></tr>
<tr><td>0</td><td>1</td><td>Acc/Dec 3</td><td>01.16</td><td>01.17</td></tr>
<tr><td>1</td><td>1</td><td>Acc/Dec 4</td><td>01.18</td><td>01.19</td></tr>
</table></td></tr>
<tr><td>9</td><td>3rd and 4th acceleration / deceleration time selection</td></tr>
</table>

Setting	Function	Description
10	External Fault (EF) input (P07.20)	For external fault input. The drive decelerates according to the P07.20 setting, and the keypad shows "EF" (it shows the fault record when an external fault occurs). The drive will begin running again when the fault is cleared (terminal status restored) and RESET is pressed.
11	Base Block (B.B.) input from external	ON: the output of the drive stops immediately. The motor is in free run and the keypad displays the B.B. signal. Refer to P07.08 for details.
12	Output stop	ON: the output of the drive stops immediately, and the motor is in free run status. The drive is in output waiting status until the switch is turned to OFF, and then the drive restarts and runs to the current setting frequency. 
13	Cancel the setting of auto-acceleration / auto-deceleration time	Set P01.44 to one of the 01–04 setting modes before using this function. When this function is enabled, OFF is for auto mode and ON is for linear acceleration / deceleration.
15	Rotating speed command from AI1	ON: force the source of the drive's frequency to be AI1. If the rotating speed commands are set to AI1 and AI2 at the same time, the priority is AI1 > AI2.
16	Rotating speed command from AI2	ON: force the source of the drive's frequency to be AI2. If the rotating speed commands are set to AI1 and AI2 at the same time, the priority is AI1 > AI2.
18	Force to stop (P07.20)	ON: the drive ramps to a stop according to the P07.20 setting.
19	Digital up command	ON: the frequency of the drive increases or decreases by one unit. If this function remains ON continuously, the frequency increases or decreases according to P02.09 / P02.10. The Frequency command returns to zero when the drive stops and the displayed frequency is 0.00 Hz. If you select P11.00, bit 7 = 1, the frequency is not saved.
20	Digital down command	
21	PID function disabled	ON: the PID function is disabled.
22	Clear the counter	ON: the current counter value is cleared and displays 0. The drive counts up when this function is disabled.
23	Input the counter value (DI6)	ON: the counter value increases by one. Use the function with P02.19.
24	FWD JOG command	This function is valid when the source of the operation command is the external terminal. ON: the drive executes forward JOG. When executing the JOG command in torque mode, the drive automatically switches to speed mode. The drive returns to torque mode after the JOG command is complete.
25	REV JOG command	This function is valid when the source of the operation command is the external terminal. ON: the drive executes reverse JOG. When executing the JOG command in torque mode, the drive automatically switches to speed mode. The drive returns to torque mode after the JOG command is complete.

Setting	Function	Description
26	TQC / FOC mode selection	ON: TQC mode, OFF: FOC mode.  Switch timing for torque/speed control (P00.10=0 or 2, Multi-function input terminal is set to 26
27	ASR1 / ASR2 selection	ON: the speed is adjusted by the ASR 2 setting. OFF: the speed is adjusted by the ASR 1 setting. Refer to Pr.11-02 for details.
28	Emergency stop (EF1)	ON: the output of the drive stops immediately, displays “EF1” on the keypad, and the motor is in free run status. The drive remains stopped until the external fault is cleared after you press RESET on the keypad (EF: External Fault). 
29	Signal confirmation for Y-connection	When the control mode is V/F, ON: the drive operates by the first V/F.
30	Signal confirmation for Δ-connection	When the control mode is V/F, ON: the drive operates by the second V/F.
31	High torque bias	Refer to P11.30–P11.32 for details.
32	Middle torque bias	
33	Low torque bias	

<table>
<tr><th>Setting</th><th>Function</th><th>Description</th></tr>
<tr><td>35</td><td>Enable single-point positioning</td><td>ON: the AC motor drive executes internal single-point position control according to the setting for P10.19. This function is valid in FOCPG mode only.

</td></tr>
<tr><td>38</td><td>Disable writing EEPROM function (parameters memory disable)</td><td>ON: writing to EEPROM is disabled. Changed parameters are not saved after power off.</td></tr>
<tr><td>39</td><td>Torque command direction</td><td>For torque control (P00.10=2), when the torque command is AI1 or AI2, ON: negative torque.</td></tr>
<tr><td>40</td><td>Force coasting to stop</td><td>ON: during operation, the motor coasts to stop.</td></tr>
<tr><td>41</td><td>HAND switch</td><td rowspan="2">1) When the DI terminal switches to OFF, it executes a STOP command. Therefore, if the DI terminal switches to OFF during operation, the drive stops.
2) Use the optional keypad GS4-KPD to switch between HAND and AUTO. The drive stops first, and then switches to HAND or AUTO status.
3) The optional digital keypad GS4-KPD displays the current status of the drive (HAND / OFF / AUTO).
<table><tr><th></th><th>bit 1</th><th>bit 0</th></tr><tr><td>OFF</td><td>0</td><td>0</td></tr><tr><td>AUTO</td><td>0</td><td>1</td></tr><tr><td>HAND</td><td>1</td><td>0</td></tr><tr><td>OFF</td><td>1</td><td>1</td></tr></table></td></tr>
<tr><td>42</td><td>AUTO switch</td></tr>
<tr><td>43</td><td>Enable resolution selection (P02.48)</td><td>Refer to P02.48 for details.</td></tr>
<tr><td>44</td><td colspan="2">Reserved</td></tr>
<tr><td>45</td><td colspan="2">Reserved</td></tr>
<tr><td>46</td><td colspan="2">Reserved</td></tr>
<tr><td>48</td><td>Mechanical gear ratio switch</td><td>ON: the Encoder (PG1) mechanical gear ratio switches to the second group. Refer to P10.04–P10.07 for details.</td></tr>
<tr><td>49</td><td>Enable drive</td><td>When the drive is enabled, the RUN command is valid.
When the drive is disabled, the RUN command is invalid.
When the drive is operating, the motor coasts to stop.
This function varies with a Multifunction Output DO1 or DO2 = 45.</td></tr>
</table>

<table>
<tr><th>Setting</th><th>Function</th><th>Description</th></tr>
<tr><td>50</td><td>Slave dEb action to execute</td><td>Enter the message setting in this parameter when the master triggers dEb. This ensures that the slave also triggers dEb, then the master and slave stop simultaneously.</td></tr>
<tr><td>51</td><td>Selection for PLC mode (bit 0)</td><td rowspan="2"><table><tr><th>PLC Status</th><th>bit 1</th><th>bit 0</th></tr><tr><td>Disable PLC function (PLC 0)</td><td>0</td><td>0</td></tr><tr><td>Trigger PLC to operate (PLC 1)</td><td>0</td><td>1</td></tr><tr><td>Trigger PLC to stop (PLC 2)</td><td>1</td><td>0</td></tr><tr><td>No function</td><td>1</td><td>1</td></tr></table></td></tr>
<tr><td>52</td><td>Selection for PLC mode (bit 1)</td></tr>
<tr><td>56</td><td>Local / Remote selection</td><td>Use P00.29 to select LOCAL / REMOTE mode. When P00.29 is not set to 0, the optional digital keypad GS4-KPD displays LOC / REM status. (Refer to P00.29 for details).<table><tr><th></th><th>bit 0</th></tr><tr><td>REM</td><td>0</td></tr><tr><td>LOC</td><td>1</td></tr></table></td></tr>
<tr><td>70</td><td>Force auxiliary frequency return to 0</td><td>Forces the auxiliary frequency return to 0 when using this function. PID keeps operating if PID is the master frequency. When P00.35 ≠ 0, the master and auxiliary frequencies are enabled, and then selecting this function with the terminal effectively forces the auxiliary frequency return to 0.</td></tr>
<tr><td>71</td><td>Disable PID function, force PID output return to 0</td><td>When the master and auxiliary frequencies are enabled and when using the PID function, ON: PID does not operate, returns the integral value to 0, and forces the PID output return to 0.</td></tr>
<tr><td>72</td><td>Disable PID function, retain the output value before disabled</td><td>When the master and auxiliary frequencies are enabled, and the PID function is enabled, ON: PID does not operate, and its output value remains the same as the value before it was disabled.</td></tr>
<tr><td>73</td><td>Force PID integral gain return to 0, disable integral</td><td>ON: PID continues to operate, disables the integral control, and returns the integral value to 0.</td></tr>
<tr><td>74</td><td>Reverse PID feedback</td><td>ON: PID negative feedback becomes positive feedback, or PID positive feedback becomes negative feedback.</td></tr>
<tr><td>82</td><td>OOB loading balance detection</td><td>You can use the OOB (Out Of Balance Detection) function with a PLC program in a washing machine system type application. ON: Parameter P07.48 is calculated according to P07.46 (OOB Sampling Time) and P07.47 (Number of OOB Sampling Times). The PLC or the host controller should be set up to read this parameter and determine the motor's speed according to this Δθ value (P07.48).</td></tr>
<tr><td>83</td><td>Multi-motor (IM) selection bit 0</td><td rowspan="2">ON: parameters can be changed.
Example: DI1 = 83, DI2 = 84<table><tr><th rowspan="2">DI1</th><th rowspan="2">DI2</th><th rowspan="2">Motor Selection</th><th colspan="2">Related Motor Parameter</th></tr><tr><td>Max Operation Frequency</td><td>V/F Curve Parameters</td></tr><tr><td>OFF</td><td>OFF</td><td>Motor 1</td><td>P01.00</td><td>P01.01–P01.08</td></tr><tr><td>ON</td><td>OFF</td><td>Motor 2</td><td>P01.52</td><td>P01.35–P01.42</td></tr><tr><td>OFF</td><td>ON</td><td>Motor 3</td><td>P01.53</td><td>P01.54–P01.61</td></tr><tr><td>ON</td><td>ON</td><td>Motor 4</td><td>P01.62</td><td>P01.63–P01.70</td></tr></table></td></tr>
<tr><td>84</td><td>Multi-motor (IM) selection bit 1</td></tr>
<tr><td>86</td><td>Enable initial reel diameter</td><td rowspan="3"><table><tr><th>DIx=88</th><th>DIx=87</th><th>DIx=86</th></tr><tr><td>OFF</td><td>OFF</td><td>ON: the setting value of P12.31 will be written into P12.40.</td></tr><tr><td>OFF</td><td>ON</td><td>ON: the setting value of P12.32 will be written into P12.40.</td></tr><tr><td>ON</td><td>OFF</td><td>ON: the setting value of P12.33 will be written into P12.40.</td></tr><tr><td>ON</td><td>ON</td><td>ON: the setting value of P12.40 will be reset to the default.</td></tr></table></td></tr>
<tr><td>87</td><td>Initial reel diameter 1</td></tr>
<tr><td>88</td><td>Initial reel diameter 2</td></tr>
</table>

Setting	Function	Description
89	PID integration reset	ON: the integral items in PID return to zero
90	Stop calculating the reel diameter	ON: stop calculating the reel diameter
91	Winding mode selection	ON: rewind mode; OFF: unwind mode
92	Enable tension control	ON: the output of tension PID equals zero
93	Puase tension PID function	ON: PID keeps the present output until the status changes to be OFF and re-starts to calculate tension PID.
94	Enable to auto switch the reel	ON: the drive automatically calculates output frequency according to the linear speed and the reel diameter have been detected to match their linear speed.

		Type	Hex Addr	Dec Addr
P02.09	***External UP / DOWN Key Mode***	♦R/W	0209	40522

Range/Units (Format: 16-bit binary) — *Default*: 0

0: UP / DOWN by the acceleration / deceleration time
1: UP / DOWN constant speed (P02.10)
2: Pulse signal (P02.10)
3: External terminals UP / DOWN key mode

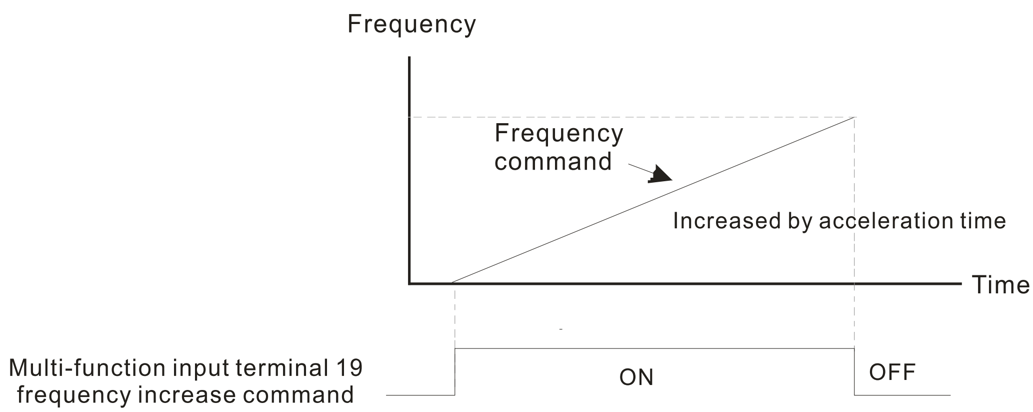
		Type	Hex Addr	Dec Addr
P02.10	***Constant Speed, Acceleration / Deceleration Speed of the UP / DOWN Key***	♦R/W	020A	40523

Range/Units (Format: 16-bit unsigned) — *Default*: 0.001

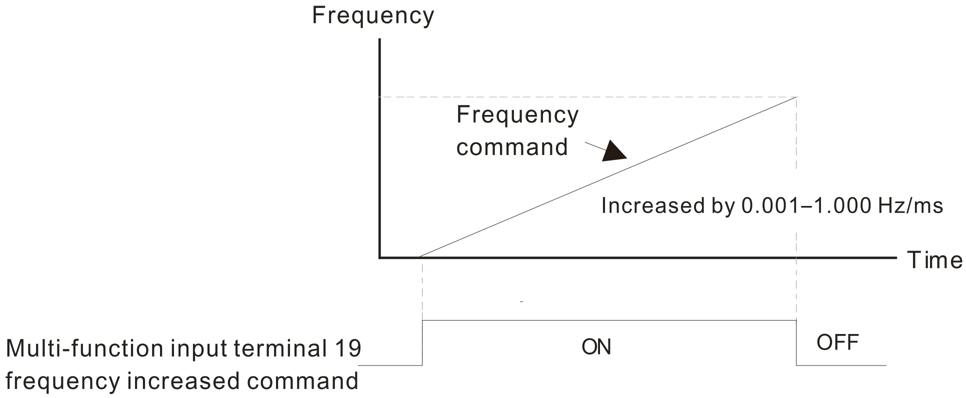
0.001–1.000 Hz / ms

These parameters are used when the multi-function input terminals are set to 19, 20 (Digital UP / DOWN command). The frequency increases or decreases according to P02.09 and P02.10.

- *When P11.00 bit 7 = 1, the frequency is not saved. The Frequency command returns to zero when the drive stops, and the displayed frequency is 0.00 Hz. At this time, increasing or decreasing the Frequency command (F) by using the UP or DOWN key is valid only when the drive is running.*
- *When P02.09 is set to 0, the increasing or decreasing Frequency command (F) operates according to the setting for acceleration or deceleration time (refer to P01.12–P01.19).*



- *When P02.09 is set to 1, the increasing or decreasing Frequency command (F) operates according to the setting of P02.10 (0.001–1.000 Hz/ms).*



		Type	Hex Addr	Dec Addr
P02.11	***Multi-function Input Response Time***	♦R/W	020B	40524
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–30.000 sec.	0.005		

Use P02.11 to set the response time of the digital input terminals DI1–DI7.

This function is to delay and confirm the digital input terminal signal. The time for delay is also the time for confirmation. The confirmation prevents interference that could cause error in the input to the digital terminals. It delays the response time though confirmation to improve accuracy.

		Type	Hex Addr	Dec Addr
P02.12	***Multi-function Input Mode Selection***	♦R/W	020C	40525
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0000h–FFFFh (0: N.O.; 1: N.C.)	0000		

The parameter value will be displayed/entered in decimal format on the drive keypad or in GSoft2. If using the GS4-KPD, the value will be displayed/entered in hexadecimal format. This parameter sets the status of the multi-function input signal (0: normally open, 1: normally closed) and it is not affected by the status of SINK / SOURCE.

- *bit 0–bit 6 correspond to DI1–DI7.*
- *The default for bit 0 (DI1) is FWD terminal, and the default for bit 1 (DI2) is REV terminal. You cannot use this parameter to change the input mode when P02.00 ≠ 0.*
- *You can change the terminal ON / OFF status through communications.*
- *For example: DI3 is set to 1 (multi-step speed command 1) and DI4 is set to 2 (multi-step speed command 2). Then the forward + second step speed command = 1001 (binary) = 9 (decimal). As long as P02.12 = 9 is set through communications, there is no need to wire any multi-function terminal to run forward with the second step speed.*

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
			DI12	DI11	DI10				DI7	DI6	DI5	DI4	DI3	DI2	DI1

- *Use P11.42 bit 1 to select whether FWD / REV terminal is controlled by P02.12 bit 0 and bit 1.*

NOTE: These options also apply when the DI is controlled by the internal PLC, Comms, or the keypad.

		Type	Hex Addr	Dec Addr	Default
P02.13	***Multi-function Output 1 (R1)***	♦R/W	020D	40526	11
P02.16	***Multi-function Output 2 (DO1)***	♦R/W	0210	40529	0
P02.17	***Multi-function Output 3 (DO2)***	♦R/W	0211	40530	0
P02.36	***Multi-function Output of Extension Card (DO10)***	♦R/W	0224	40549	0
P02.37	***Multi-function Output of Extension Card (DO11)***	♦R/W	0225	40550	0
P02.38	***Multi-function Output of Extension Card (DO12)***	♦R/W	0226	40551	0

Range/Units (Format: 16-bit binary)

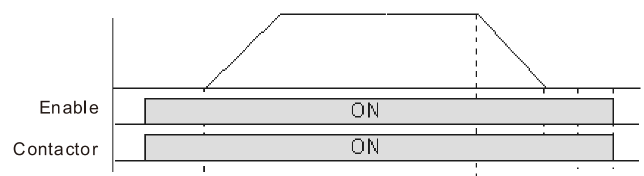
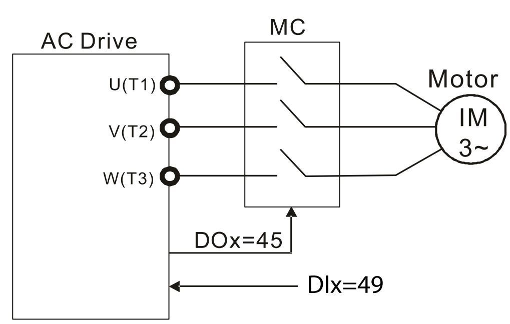
0: No function
1: Indication during RUN
2: Operation speed reached
3: Desired frequency reached 1 (P02.22)
4: Desired frequency reached 2 (P02.24)
5: Zero speed (Frequency command)
6: Zero speed including STOP (Frequency command)
7: Over-torque 1 (P06.06–06.08)
8: Over-torque 2 (P06.09–06.11)
9: Drive is ready
10: Low voltage warning (Lv) (P06.00)
11: Malfunction indication
13: Overheat warning (P06.15)
14: Software brake signal indicator (P07.00)
15: PID feedback error (P08.13, P08.14)
16: Slip error (oSL)
17: Count value reached, does not return to 0 (P02.20)
18: Count value reached, return to 0 (P02.19)
19: External interrupt B.B. input (Base Block)
20: Warning output
21: Over-voltage
22: Over-current stall prevention
23: Over-voltage stall prevention
24: Operation mode
25: Forward command
26: Reverse command
29: Output when frequency ≥ P02.34
30: Output when frequency < P02.34
31: Y-connection for the motor coil
32: Δ-connection for the motor coil
33: Zero speed (actual output frequency)
34: Zero speed including STOP (actual output frequency)
35: Error output selection 1 (P06.23)
36: Error output selection 2 (P06.24)
37: Error output selection 3 (P06.25)
38: Error output selection 4 (P06.26)
40: Speed reached (including STOP)
42: Crane function
43: Motor speed detection
44: Low current output (use with P06.71–06.73)
45: UVW output electromagnetic valve switch
46: Master dEb output
51: Digital output control for serial modbus
52: Digital output control for communication card
53: Fire mode indication
66: SO output logic A
67: Analog input level reached
68: SO output logic B
73: Over-torque 3
74: Over-torque 4
75: Forward RUN status
76: Reverse RUN status

Use these parameters to set the function of multi-function terminals.

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
								DI12 RY12	DI11 RY11 RY11	DI10 RY10 RY10	DI2	DI1			RLY1

Summary of Function Settings

Setting	Function	Description
0	No Function	Output terminal with no function
1	Indication during RUN	Activates when the drive is not in STOP.
2	Operation speed reached	Activates when output frequency of drive reaches to the setting frequency.
3	Desired frequency reached 1 (P02.22)	Activates when the desired frequency (P02.22) is reached.
4	Desired frequency reached 2 (P02.24)	Activates when the desired frequency (P02.24) is reached.
5	Zero speed (Frequency command)	Activates when Frequency command = 0. (the drive must be in RUN status)
6	Zero speed including STOP (Frequency command)	Activates when Frequency command = 0 or stopped.
7	Over-torque 1	Activates when the drive detects over-torque. P06.07 sets the over-torque detection level (motor 1), and P06.08 sets the over-torque detection time (motor 1). Refer to P06.06–P06.08.
8	Over-torque 2	Activates when the drive detects over-torque. P06.10 sets the over-torque detection level (motor 2), and P06.11 sets the over-torque detection time (motor 2). Refer to P06.09–P06.11.
9	Drive is ready	Activates when the drive is ON with no error detected.
10	Low voltage warning (Lv)	Activates when the DC bus voltage is too low. (refer to P06.00 Low Voltage Level)
11	Malfunction indication	Activates when fault occurs (except Lv stop).
13	Overheat warning	Activates when IGBT or heat sink overheats to prevent the drive from shutting down due to overheating. (refer to P06.15)
14	Software brake signal indication	Activates when the soft brake function is ON. (refer to P07.00).
15	PID feedback error (P08.13, P08.14)	Activates when the PID feedback signal error is detected.
16	Slip error (oSL)	Activates when the slip error is detected.
17	Count value reached, does not return to 0 (P02.20)	When the drive executes external counter, this contact activates if the count value is equal to the setting value for P02.20. This contact deactivates when the setting value for P02.20 > P02.19.
18	Count value reached, returns to 0 (P02.19)	When the drive executes the external counter, this contact activates if the count value is equal to the setting value for P02.19.
19	External interrupt B.B. input (Base Block)	Activates when external interrupt (B.B.) stop output occurs in the drive.
20	Warning output	Activates when a warning is detected.
21	Over-voltage	Activates when over-voltage is detected.
22	Over-current stall prevention	Activates when the over-current stall prevention is detected.
23	Over-voltage stall prevention	Activates when over-voltage stall prevention is detected.
24	Operation mode	Activates when the source of operation command is not controlled by the digital keypad (P00.21 ≠ 0).
25	Forward command	Activates when the operation direction is forward.
26	Reverse command	Activates when the operation direction is reverse.
29	Output when frequency ≥ P02.34	Activates when frequency is ≥ P02.34 (actual output H ≥ P02.34).

Setting	Function	Description
30	Output when frequency < P02.34	Activates when frequency is < P02.34 (actual output H < P02.34).
31	Y-connection for the motor coil	Activates when P05.24 = 1, the frequency output is lower than P05.23 minus 2 Hz and the time is longer than P05.25.
32	Δ-connection for the motor coil	Activates when P05.24 = 1, the frequency output is higher than P05.23 plus 2 Hz and the time is longer than P05.25.
33	Zero speed (actual output frequency)	Activates when the actual output frequency is 0 (the drive is in RUN mode).
34	Zero speed including stop (actual output frequency)	Activates when the actual output frequency is 0 or stopped.
35	Error output selection 1 (P06.23)	Activates when P06.23 is ON.
36	Error output selection 2 (P06.24)	Activates when P06.24 is ON.
37	Error output selection 3 (P06.25)	Activates when P06.25 is ON.
38	Error output selection 4 (P06.26)	Activates when P06.26 is ON.
40	Speed reached (including Stop)	Activates when the drive's output frequency reaches the setting frequency or stopped.
42	Crane function	Use this function with P02.34 and P02.58. Refer to P02.34 and P02.58 for details and application examples.
43	Actual motor speed detection	Activates when using the DI7 as pulse input signal and motor actual speed is less than P02.47.
44	Low current output	Use this function with P06.71–P06.73.
45	UVW output electromagnetic valve switch	Use this function with any multifunction input = 49 (drive enabled) and multifunction output = 45 (electromagnetic valve enabled), and then the electromagnetic valve is ON or OFF according to the status of the drive.  
46	Master dEb output	When dEb rises at the master, DO1 or DO2 sends a dEb signal to the slave. Output the message when the master triggers dEb. This ensures that the slave also triggers dEb. Then the slave follows the deceleration time of the master to stop simultaneously with the master.

<table>
<tr><th>Setting</th><th>Function</th><th>Description</th></tr>
<tr><td>51</td><td>Digital output control for serial modbus</td><td rowspan="2">Control the digital outputs through communications(51= Serial Modbus, 52 = GS30A-CM-EIPx).
Use Register 2640 to set the Output value.
<table>
<tr><th>Physical terminal</th><th>Parameter Setting</th><th>Attribute</th><th>Corresponding index</th></tr>
<tr><td>R1</td><td>P02.13 = 51 or 52</td><td>RW</td><td>bit 0 of 0x2640</td></tr>
<tr><td>DO1</td><td>P02.16 = 51 or 52</td><td>RW</td><td>bit 3 of 0x2640</td></tr>
<tr><td>DO2</td><td>P02.17 = 51 or 52</td><td>RW</td><td>bit 4 of 0x2640</td></tr>
</table></td></tr>
<tr><td>52</td><td>Digital output control for communication card</td></tr>
<tr><td>53</td><td>Fire mode indication</td><td>Activates when DI setting 58 or 59 is enabled.</td></tr>
<tr><td>66</td><td>SO output logic A</td><td rowspan="2">
<table>
<tr><th rowspan="2">Status of the drive</th><th colspan="2">Status of the safety output</th></tr>
<tr><th>Status A (DOx = 66)</th><th>Status B (DOx = 68)</th></tr>
<tr><td>Normal</td><td>0</td><td>1</td></tr>
<tr><td>STO</td><td>1</td><td>0</td></tr>
<tr><td>STL1–STL3</td><td>1</td><td>0</td></tr>
</table></td></tr>
<tr><td>68</td><td>SO output logic B</td></tr>
<tr><td>67</td><td>Analog input level reached</td><td>The multi-function output terminals operate when the analog input level is between the high level and the low level.
P03.44: Select one of the analog input channels (AI1, AI2) to be compared.
P03.45: The high level for the analog input, default is 50%.
P03.46: The low level for the analog input, default is 10%.
If analog input > P03.45, the multi-function output terminal operates. If analog input < P03.46, the multi-function output terminal stops output.</td></tr>
<tr><td>73</td><td>Over-torque 3</td><td>Activates when over-torque is detected. P14.75 sets the over-torque detection level. P14.76 sets the over-torque detection time (refer to P14.74–P14.76).</td></tr>
<tr><td>74</td><td>Over-torque 4</td><td>Activates when over-torque is detected. P14.78 sets the over-torque detection level. P14.79 sets the over-torque detection time (refer to P14.77–P14.79).</td></tr>
<tr><td>75</td><td>Forward RUN status</td><td>When the drive runs FWD, the output terminal for forward running is closed; when the drive stops, the output terminal for forward running is open.</td></tr>
<tr><td>76</td><td>Reverse RUN status</td><td>When the drive runs REV, the output terminal for reverse running is closed; when the drive stops, the output terminal for reverse running is open.</td></tr>
</table>

		Type	Hex Addr	Dec Addr
P02.18	***Multi-function Output Direction***	♦R/W	0212	40531
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0000h–FFFFh (0:N.O.; 1:N.C.)	0000h		

The parameter value will be displayed/entered in decimal format on the drive keypad or in GSoft2. If using the GS4-KPD, the value will be displayed/entered in hexadecimal format. This parameter is set by a bit. If the bit is 1, the corresponding multi-function output acts in an opposite way.

Example:

Assume P02.13 = 1. If the output is positive, and the bit is set to 0, then the Relay is ON when the drive runs and is OFF when the drive stops. Conversely, if the output is negative, and the bit is set to 1, then the Relay is OFF when the drive runs and is ON when the drive stops.

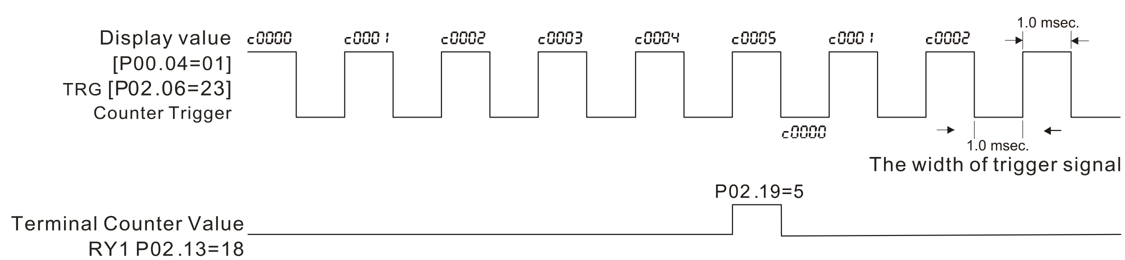
Index	***bit12***	***bit11***	***bit10***	***bit9***	***bit8***	***bit7***	***bit6***	***bit5***	***bit4***	***bit3***	***bit2***	***bit1***	***bit0***
1							DI7	DI6	DI5	DI4	DI3	DI2	DI1
2	DI12	DI11	DI10										

NOTE: Use this parameter to set digital outputs ON/OFF with remote communications.

		Type	Hex Addr	Dec Addr
P02.19	***Terminal Counting Value Reached (returns to 0)***	♦R/W	0213	40532
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65500	0		

The counting function is enabled when P02.19≠0.

- *You can set the input point for the counter using the multifunction input terminal DI6 as a trigger terminal (set P02.06 to 23). When counting is completed, the specified multi-function output terminal is activated (P02.13, P02.16, or P02.17 is set to 18).*
- *The timing diagram below shows that when counting to 5, R1 activates and displays 0.*

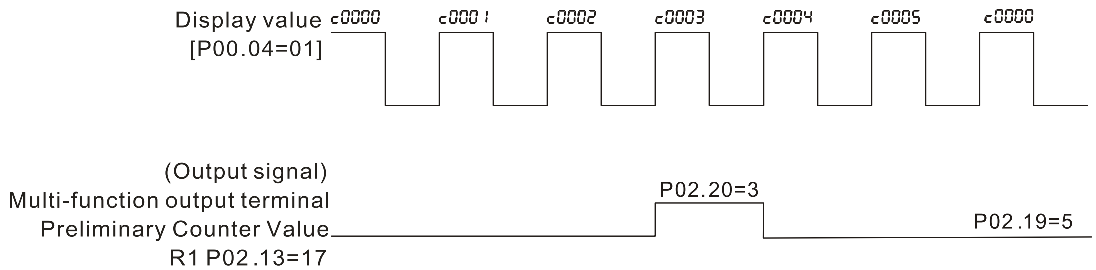


The timing diagram of
the external counting terminals and the counting value reached

		Type	Hex Addr	Dec Addr
P02.20	***Preliminary Counting Value Reached (does not return to 0)***	♦R/W	0214	40533
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65500	0		

Use this parameter in conjuction with P02.19.

- *When the count value counts from 1 to reach this value, the corresponding multi-function output terminal is activated (P02.13, P02.16, or P02.17 is set to 17) and keeps counting to the last count value.*
- *Use this parameter as the end of counting to make the drive run from the low speed to stop.*
- *The timing diagram is R1 activates when the count value is three, and the display returns to zero when counts to five:*



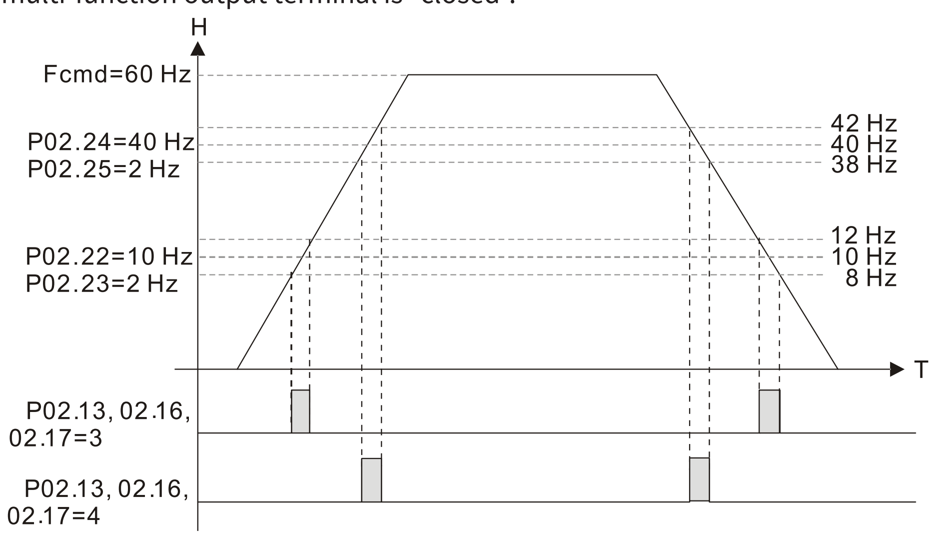
The timing diagram of
the external counting terminals and the counting value reached

		Type	Hex Addr	Dec Addr
P02.21	***Digital Output Gain (DO)***	♦R/W	0215	40534
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1–55	1		

P02.21 sets the signal for the digital output terminals (DO-DCM) and the digital frequency output (pulse, work period=50 %). The output pulse per second = output frequency X P02.21.

		Type	Hex Addr	Dec Addr	Default
P02.22	***Desired Frequency Reached 1***	♦R/W	0216	40535	60.00/50.00
P02.23	***The Width of the Desired Frequency Reached 1***	♦R/W	0217	40536	2.00
P02.24	***Desired Frequency Reached 2***	♦R/W	0218	40537	60.00/50.00
P02.25	***The Width of the Desired Frequency Reached 2***	♦R/W	0219	40538	2.00
	Range/Units (Format: 16-bit unsigned)				
	0.00–599.00 Hz				

Use these parameters to close multi-function output terminals when the specified conditions are met. Once the output speed (frequency) reaches the desired speed (frequency), if the corresponding multi-function output terminal is set to 3 or 4 (P02.13, P02.16, and P02.17), this multi-function output terminal is “closed”.



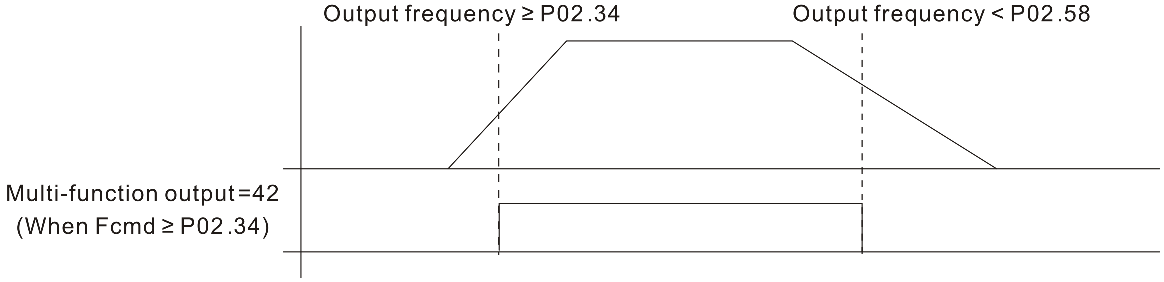
Use these parameters to close multi-function output terminals when the specified conditions are met. Once the output speed (frequency) reaches the desired speed (frequency), if the corresponding multi-function output terminal is set to 3 or 4 (P02.13, P02.16, and P02.17), this multi-function output terminal is “closed”.

		Type	Hex Addr	Dec Addr
P02.34	***Output Frequency Setting for Multi-function Output Terminal***	♦R/W	0222	40547
P02.58	***Multi-function Output Terminal (Function 42): Brake Frequency Check Point***	♦R/W	023A	40571
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	0.00		

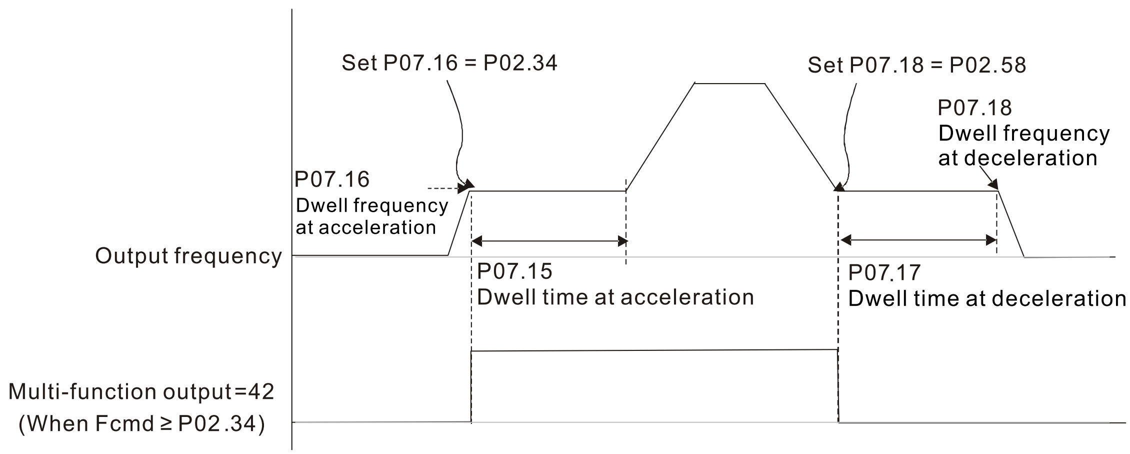
Use P02.34 with P02.58 for the crane function. Configure multifunction outputs P02.14, P02.16, and/or P02.17 with a terminal setting of 42: Crane function.

- *When the output frequency (H) is lower than the setting for P02.58, multi-function output terminal setting 42 stops after the command breaks off.*
- *P02.58 must be lower than P02.34 when using multifunction output terminal setting=42.*

Crane application example:



It is recommended that you use this with the Dwell acceleration/deceleration function as shown in the following diagram.



		Type	Hex Addr	Dec Addr
P02.35	***External Operation Control Selection after Reset and Reboot***	♦R/W	0223	40548
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable	0		
	1: Drive runs if the RUN command remains after reset or reboot.			

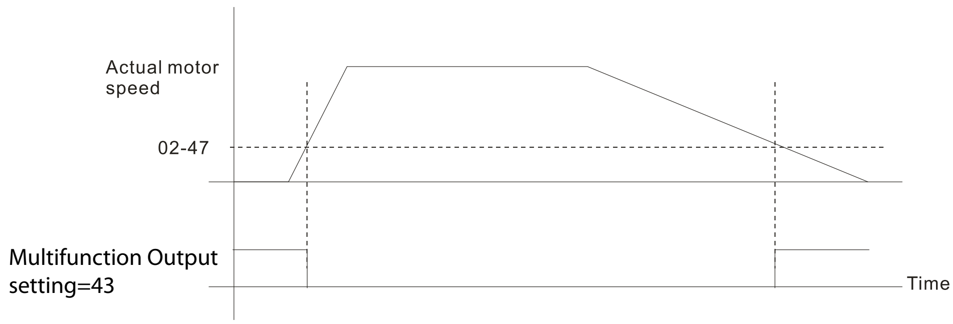
P02.35 allows the drive to resume running after a reset or reboot if an external control is still commanding it to RUN.

Setting value 1:

- *Situation 1: After the drive is powered up and the external terminal for RUN stays ON, the drive runs.*
- *Situation 2: After clearing a detected fault and while the external terminal for RUN stays ON, you can run the drive by pressing the RESET key.*

		Type	Hex Addr	Dec Addr
P02.47	***Motor Zero-speed Level***	♦R/W	022F	40560
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535 rpm	0		

Use this parameter with multifunction output=43 and set P10.00=5. Use this parameter to set the motor's speed level to zero-speed. When the actual speed is lower than this setting, the corresponding multi-function output terminal setting 43 is ON, as shown in the diagram below.



		Type	Hex Addr	Dec Addr
P02.50	***Display the Status of Multi-function Input Terminal***	Read	0232	40563
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Monitor the status of the Multi-function Input Terminal	0		

P02.50 displays the status of the multi-function input terminals. Use the diagram below to interpret the display. The value will display in decimal on the keypad and must be converted to binary.

bit15	***bit14***	***bit13***	***bit12***	***bit11***	***bit10***	***bit9***	***bit8***	***bit7***	***bit6***	***bit5***	***bit4***	***bit3***	***bit2***	***bit1***	***bit0***
			DI12	DI11	DI10				DI7	DI6	DI5	DI4	DI3	DI2	DI1

		Type	Hex Addr	Dec Addr
P02.51	***Display the Status of Multi-function Output Terminal***	Read	0233	40564
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Monitor the status of the Multi-function Ouput Terminal	0		

P02.51 displays the status of the multi-function output terminals. Use the diagram below to interpret the display. The value will display in decimal on the keypad and must be converted to binary.

bit15	***bit14***	***bit13***	***bit12***	***bit11***	***bit10***	***bit9***	***bit8***	***bit7***	***bit6***	***bit5***	***bit4***	***bit3***	***bit2***	***bit1***	***bit0***
								DI12 RY12	DI11 RY11 RY11	DI10 RY10 RY10	DI2	DI1			RLY1

		Type	Hex Addr	Dec Addr
P02.52	***Display the External Multi-function Input Terminals Used by PLC***	Read	0234	40565
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Monitor which inputs are controlled by the PLC	0		

P02.52 displays the mask status of the PLC input terminals. These values indicate if the input is controlled by the PLC or drive. Use the diagram below to interpret the display. The value will display in decimal on the keypad and must be converted to binary.

bit15	***bit14***	***bit13***	***bit12***	***bit11***	***bit10***	***bit9***	***bit8***	***bit7***	***bit6***	***bit5***	***bit4***	***bit3***	***bit2***	***bit1***	***bit0***
			DI12	DI11	DI10				DI7	DI6	DI5	DI4	DI3	DI2	DI1

		Type	*Hex Addr*	*Dec Addr*
P02.53	***Display the External Multi-function Output Terminals Used by PLC***	Read	0235	40566
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Monitor which outputs are controlled by the PLC	0		

P02.53 displays the mask status of the PLC output terminals. These values indicate if the output is controlled by the PLC or Drive. Use the diagram below to interpret the display. The value will display in decimal on the keypad and must be converted to binary.

bit15	***bit14***	***bit13***	***bit12***	***bit11***	***bit10***	***bit9***	***bit8***	***bit7***	***bit6***	***bit5***	***bit4***	***bit3***	***bit2***	***bit1***	***bit0***
								DI12 RY12	DI11 RY11 RY11	DI10 RY10 RY10	DI2	DI1			RLY1

		Type	*Hex Addr*	*Dec Addr*
P02.54	***Display the Frequency Command Executed by External Terminal***	Read	0236	40567
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz (Read only)	0		

When you set the source of the Frequency command as the external terminal, if LV or Fault occurs, the external terminal Frequency command is saved in this parameter.

		Type	*Hex Addr*	*Dec Addr*
P02.70	***I/O Card Type***	Read	0246	40583
	Range/Units (Format: 16-bit binary)	*Default*		
	1: GS30A-BPS (when in position 1 only) 10: GS30A-06CDD 11: GS30A-2AD2DA 12: GS30A-02TRC 13: GS30A-03TRA	–		

		Type	*Hex Addr*	*Dec Addr*
P02.74	***Internal/external Multi-function Input Terminal Source Selection***	♦R/W	024A	40587
	Range/Units (Format: 16-bit binary)	*Default*		
	0000-FFFFh	0000h		

Use P02.74 to select whether the DI will activate from a wire to the DI, or from the PLC/Comms/Keypad. When set to Internal - The DI is controlled from the internal PLC, external communication such as from a P3000 or the drives Keypad. It will not change state even if there is a wire connected to the DI.

Setting Method:

Convert the binary 12-bit number to hexadecimal number for input. For example, if the DI1, DI3, and DI4 are triggered by virtual terminals, then P02.74=34h.

bit15	***bit14***	***bit13***	***bit12***	***bit11***	***bit10***	***bit9***	***bit8***	***bit7***	***bit6***	***bit5***	***bit4***	***bit3***	***bit2***	***bit1***	***bit0***
			DI12	DI11	DI10				DI7	DI6	DI5	DI4	DI3	DI2	DI1

		Type	Hex Addr	Dec Addr
P02.75	***Internal Multi-function Input Terminal Selection***	♦R/W	024B	40588
	Range/Units (Format: 16-bit binary)	*Default*		
	0000-FFFFh	0000h		

Sets the DI internal state from either the drive PLC, Comms card, or the keypad.

The Local/Remote options on the digital keypad have the lowest priority. When the PLC controls the DI, the DI can still be triggered through virtual terminals.

- *P02.74 and P02.75 can both be changed during RUN, but doing so is not recommended.*
- *P02.74 and P02.75 settings are saved after powering off.*
- *You can choose N.O. (P02.12 bit=0) or N.C. (P02.12 bit=1) through the P02.12 DI mode to trigger the virtual terminals.*

Example:

Set P02.75=34h to activate DI1, DI3, and DI4.

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
			DI12	DI11	DI10				DI7	DI6	DI5	DI4	DI3	DI2	DI1

		Type	Hex Addr	Dec Addr
P02.81	***EF Activates when the Terminal Count Value Reached***	♦R/W	0251	40594
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Terminal count value reached, no EF displays (continues to operate) 1: Terminal count value reached, EF activates	0		

		Type	Hex Addr	Dec Addr
P02.82	***Initial Frequency Command (F) Mode after Stop***	♦R/W	0252	40595
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Use current Frequency command 1: Use zero Frequency command 2: Refer to P02.83 to set up	0		

		Type	Hex Addr	Dec Addr
P02.83	***Initial Frequency Command (F) Setting after Stop***	♦R/W	0253	40596
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	60.00		

Group P03.xx Details – Analog Input/Output Parameters

		Type	Hex Addr	Dec Addr	Default
P03.00	**Analog Input Selection (AI1)**	♦R/W	0300	40769	1
P03.01	**Analog Input Selection (AI2)**	♦R/W	0301	40770	0

Range/Units (Format: 16-bit binary)

0: No function
1: Frequency command
2: Torque command (torque limit under speed mode)
3: Torque compensation command
4: PID target value
5: PID feedback signal
6: Thermistor (PTC) input value
7: Positive torque limit
8: Negative torque limit
9: Regenerative torque limit
10: Positive / negative torque limit
11: PT100 RTD input value
12: Auxiliary frequency input
13: PID compensation value

When using the analog analog input as the PID reference target, you must set P00.20 to 2 (external analog input).

- *Setting method 1: P03.00–P03.01 set 1 as PID reference target input.*
- *Setting method 2: P03.00–P03.01 set 4 as PID reference target input.*

If both setting value 1 and 4 are input, the AI1 input has highest priority to become the PID reference target input value.

- *When you use analog input as the PID compensation value, you must set P08.16 to 1 (source of PID compensation value is analog input). You can see the compensation value with P08.17.*
- *When using the Frequency command, the corresponding value for 0–10 V / 4–20 mA is 0–maximum operation frequency (P01.00).*
- *When using the torque command, the corresponding value for 0–10 V / 4–20 mA is 0–maximum output torque (P11.27).*
- *When using torque compensation, the corresponding value for 0–10 V / 4–20 mA is 0–the motor's rated torque.*
- *If the settings for P03.00–P03.01 are the same, the AI1 input has priority over the AI2 input.*
- *For use of Selection 2 as Torque limit , a multifunction input must be set to value 26 (TQC/FOC mode selection) to toggle between Torque command and Torque limit mode.*

		Type	Hex Addr	Dec Addr
P03.03	**Analog Input Bias (AI1)**	♦R/W	0302	40771

Range/Units (Format: 16-bit signed) — Default

-100.0–100.0 % — 0

P03.03 sets the corresponding AI1 voltage for the external analog input. P03.50 must be set to zero for this parameter to be active. See analog input examples at the end of this section for further explanation of bias/gain settings.

		Type	Hex Addr	Dec Addr
P03.04	**Analog Input Bias (AI2)**	♦R/W	0303	40772

Range/Units (Format: 16-bit signed) — Default

-100.0–100.0 % — 0

P03.04 sets the corresponding AI2 voltage for the external analog input. P03.50 must be set to zero for this parameter to be active. See analog input examples at the end of this section for further explanation of bias/gain settings.

		Type	Hex Addr	Dec Addr
P03.07	***Positive / Negative Bias Mode (AI1)***	♦R/W	0304	40773
P03.08	***Positive / Negative Bias Mode (AI2)***	♦R/W	0308	40777
	Range/Units (Format: 16-bit binary)	*Default*		
	0: No bias 1: Lower than or equal to bias 3: The absolute value of the bias voltage while serving as the center 4: Bias serves as the center	0		

Using negative bias to set the frequency greatly reduces noise interference. In a noisy environment, do NOT use signals less than 1V to set the drive's operation frequency. P03.50 must be set to zero for these parameters to be active. See analog input examples at the end of this section for further explanation of bias/gain settings.

		Type	Hex Addr	Dec Addr
P03.10	***Reverse Setting when Analog Signal Input is Negative Frequency***	♦R/W	030A	40779
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Negative frequency input is not allowed. The digital keypad or external terminal controls the forward and reverse direction. 1: Negative frequency input is allowed. Positive frequency = run in a forward direction; negative frequency = run in a reverse direction. The digital keypad or external terminal control cannot change the running direction.	0		

Use this parameter only for AI1 or AI2 analog input.

Requirements for negative frequency (reverse running):

1) P03.10 = 1
2) P03.07/P03.08 Bias mode = 4: Bias serves as the center
3) P03.11/P03.12 analog input gain < 0 (negative); this makes the input frequency negative. When using the analog input addition function (P03.18=1), if the analog signal is negative after the addition, you can set this parameter to allow or not allow the reverse running. The result after adding depends on the "Requirements for negative frequency (reverse running)".

P03.50 must be set to zero for this parameter to be active.

See analog input examples at the end of this section for further explanation of bias/gain settings.

		Type	Hex Addr	Dec Addr
P03.11	***Analog Input Gain (AI1)***	♦R/W	030B	40780
P03.12	***Analog Input Gain (AI2)***	♦R/W	030C	40781
	Range/Units (Format: 16-bit signed)	*Default*		
	-500.0–500.0 %	100.0		

P03.03–P03.12 are used when the Frequency command source is the analog voltage or current signal. P03.50 must be set to zero for these parameters to be active.

See analog input examples at the end of this section for further explanation of bias/gain settings.

		Type	Hex Addr	Dec Addr
P03.15	***Analog Input Filter Time (AI1)***	♦R/W	030F	40784
P03.16	***Analog Input Filter Time (AI2)***	♦R/W	0310	40785
	Range/Units (Format: 16-bit signed)	*Default*		
	0.00–20.00 sec.	0.01		

Analog signals, such as those entering AI2 and AI2, are commonly affected by interference that affects the stability of the analog control. Use the Input Noise Filter to create a more stable system.

- *When the time constant setting is too large, the control is stable but the control response is slow.*
- *When the time constant setting is too small, the control response is faster but the control may be unstable.*
- *For optimal setting, adjust the setting based on the control stability or the control response.*

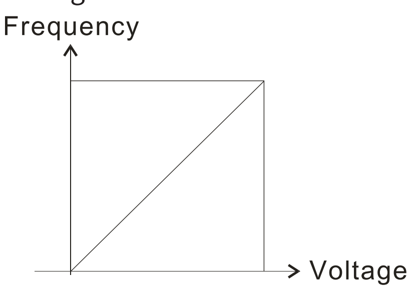
		Type	Hex Addr	Dec Addr
P03.18	***Analog Input Addition Function***	♦R/W	0312	40787
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable (AI1, AI2) 1: Enable	0		

Enables the analog input addition function when P03.18=1:

Example:

P03.00 = P03.01 = 1, Frequency command = AI1 + AI2

When P03.18=0 and the analog input selection settings (P03.00 and P03.01) are the same, AI1 has priority over AI2. For example, when P03.00 and P03.01 are both set to 1 (Frequency command), the drive ignores the setting value from AI2 but executes the Frequency command according to the setting value from AI1.



$$\text{F command} = [(\text{ay} \pm \text{bias}) * \text{gain}] * \frac{\text{Fmax (P01.00)}}{\text{10V or 16mA or 20mA}}$$

F command: the corresponding frequency for 10V or 20mA
ay: 0–10 V, 4–20 mA, 0–20 mA
bias: P03.03, P03.04
gain: P03.11, P03.12

		Type	Hex Addr	Dec Addr
P03.19	***Signal Loss Selection for the Analog Input 4–20 mA***	R/W	0313	40788
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Continue operation at the last frequency 2: Decelerate to 0Hz 3: Stop immediately and display "ACE"	0		

Determines the treatment when the 4–20 mA signal is lost (AI2 (P03.29 = 0)).

- *When P03.29 ≠ 0, the voltage input to AI2 terminal is 0–10 V or 0–20 mA, and P03.19 is invalid.*
- *When the setting is 1 or 2, the keypad displays the warning code "ANL". It keeps blinking until the AI2 signal is recovered.*
- *When the drive stops, the condition that causes the warning does not exist , so the warning automatically disappears.*

		Type	*Hex Addr*	*Dec Addr*
P03.20	***Multi-function Output (AO1)***	♦R/W	0314	40789

Range/Units (Format: 16-bit binary) — *Default*
0–23 — 0

Summary of Function Settings

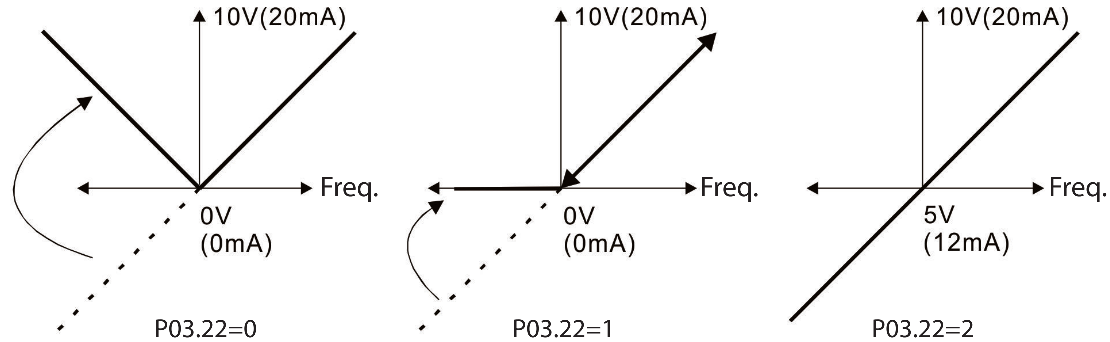
Setting	Function	Description
0	Output frequency (Hz)	Maximum frequency P01.00 is processed as 100 %.
1	Frequency command (Hz)	Maximum frequency P01.00 is processed as 100 %.
2	Motor speed (Hz)	Maximum frequency P01.00 is processed as 100 %.
3	Output current (rms)	(2.5 X drive rated current) is processed as 100 %.
4	Output voltage	(2 X motor rated voltage) is processed as 100 %.
5	DC bus voltage	230V series: 450V = 100 % 460V series: 900V = 100 %
6	Power factor	-1.000–1.000 = 100 %
7	Power	(2 X drive rated power) is processed as 100 %.
8	Output torque	Full-load torque = 100 %
9	AI1	0–10 V = 0–100 %
10	AI2	4–20 mA = 0–100 %
12	Iq current command	(2.5 X drive rated current) is processed as 100 %.
13	Iq feedback value	(2.5 X drive rated current) is processed as 100 %.
14	Id current command	(2.5 X drive rated current) is processed as 100 %.
15	Id feedback value	(2.5 X rated current) is processed as 100 %.
16	Vq-axis voltage command	230V series: 250V = 100 % 460V series: 500V = 100 %
17	Vd-axis voltage command	230V series: 250V = 100 % 460V series: 500V = 100 %
18	Torque command	Motor rated torque = 100%
19	PG2 frequency command	Maximum operation frequency (Pr.01-00) is processed as 100 %.
21	RS-485 analog output	For RS-485 (Modbus) control analog output Terminal / Address: AO1 — 26A0H AO10 — 26AAH AO11 — 26ABH
22	Communication card analog output	For communication analog output (GS30A-CM-EIPx)) Terminal / Address: AO1 — 26A0H AO10 — 26AAH AO11 — 26ABH
23	Constant voltage output	P03.32 controls the voltage output level. 0–100 % of P03.32 corresponds to 0–10 V for AO1.

		Type	*Hex Addr*	*Dec Addr*
P03.21	***Analog Output Gain (AO1)***	♦R/W	0315	40790

Range/Units (Format: 16-bit unsigned) — *Default*
0.0–500.0 % — 100.0

P03.21 adjusts the voltage level output to the analog meter from the analog signal (P03.20) output terminal AO1 of the drive. See P03.27 for equation.

		Type	Hex Addr	Dec Addr
P03.22	***Analog Output in REV Direction (AO1)***	♦R/W	0316	40791
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Absolute value in output voltage 1: Reverse output 0 V; forward output 0–10 V 2: Reverse output 5-0 V; forward output 5–10 V	0		



		Type	Hex Addr	Dec Addr
P03.27	***AO1 Output Bias***	♦R/W	031B	40796
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.00–100.00 %	0.00		

This parameter sets the corresponding voltage of the analog output.

Example 1:

AO1 0–10 V is set to the output frequency, the output equation is:

$$10\text{ V x } \left(\frac{\text{Output Frequency}}{\text{P01.00}} \right) \text{ x P03.21 + 10 V x P03.27}$$

Example 2:

AO1 0–20 mA is set to the output frequency, the output equation is:

$$20\text{ mA x } \left(\frac{\text{Output Frequency}}{\text{P01.00}} \right) \text{ x P03.21 + 20 mA x P03.27}$$

Example 3:

AO1 4–20 mA is set to the output frequency, the output equation is:

$$4\text{ mA + 16 mA x } \left(\frac{\text{Output Frequency}}{\text{P01.00}} \right) \text{ x P03.21 + 16 mA x P03.27}$$

		Type	Hex Addr	Dec Addr
P03.28	***AI1 Terminal Input Selection***	♦R/W	031C	40797
	Range/Units (Format: 16-bit binary)	*Default*		
	0: 0–10 V (P03.63–P03.68 is valid) 3: -10–10 V (P03.69–P03.74 are valid)	0		

		Type	Hex Addr	Dec Addr
P03.29	***AI2 Terminal Input Selection***	♦R/W	031D	40798
	Range/Units (Format: 16-bit binary)	*Default*		
	0: 4–20 mA 1: 0–10 V 2: 0–20 mA	0		

When you change the input mode, verify that the external terminal switch (AI2) position is correct.

		Type	Hex Addr	Dec Addr
P03.30	***PLC Analog Output Terminal Status***	Read	031E	40799
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Monitor the status of the PLC analog output terminals bit 1: AO1 bit 2: AO10 bit 3: AO11	Read only		

bit3	bit2	bit1	bit0
AO11	AO10	AO1	Reserved

Example:

When P03.30 displays 000Ah (hex) (that is, the value is 10 (decimal) and 1010 (binary)), it means that AO1 and AO11 are used by PLC.

bit3	bit2	bit1	bit0
1	0	1	0

		Type	Hex Addr	Dec Addr
P03.31	***AO1 Output Selection***	♦R/W	031F	40800
	Range/Units (Format: 16-bit binary)	Default		
	0: 0–10 V output 1: 0–20 mA output 2: 4–20 mA output	0		

		Type	Hex Addr	Dec Addr
P03.32	***AO1 DC Output Setting Level***	♦R/W	0320	40801
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–100.00 %	0.0		

		Type	Hex Addr	Dec Addr
P03.35	***AO1 Output Filter Time***	♦R/W	0323	40804
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–20.00 sec.	0		

		Type	Hex Addr	Dec Addr
P03.39	***VR Input Selection***	♦R/W	0327	40808
	Range/Units (Format: 16-bit binary)	Default		
	0: Disable 1: Frequency command	1		

Not used in GS30.

		Type	Hex Addr	Dec Addr
P03.44	***Multi-function Output (DOx) by AI Level Source***	♦R/W	032C	40813
	Range/Units (Format: 16-bit binary)	Default		
	0: AI1 1: AI2 2: AI10 3: AI11	0		

		Type	Hex Addr	Dec Addr
P03.45	***DOx - AI Upper Level***	♦R/W	032D	40814
	Range/Units (Format: 16-bit signed)	Default		
	-100–100 %	50		

		Type	Hex Addr	Dec Addr
P03.46	***DOx - AI Lower Level***	♦R/W	032E	40815
	Range/Units (Format: 16-bit signed)	Default		
	-100–100 %	10		

Use parameters P03.44–P03.46 with multi-function output setting 67: (analog input level reached) on P02.13, P02.16, and P02.17. The digital output is active when the AI input level is higher than P03.45. The digital output is disabled when the AI input is lower than P03.46.

When setting levels, P03.45 DOx-AI upper level must be higher than P03.46 DOx-AI lower level.

		Type	Hex Addr	Dec Addr
P03.50	***Analog Input Curve Selection***	♦R/W	0332	40819
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Normal curve 1: Three-point curve of AI1 (and AI10 extension) 2: Three-point curve of AI2 (and AI11 extension) 3: Three-point curve of AI1 & AI2 (AI10 & AI11)	0		

This parameter determines use of the gain/bias settings or the three point curve settings to adjust the frequency output command.

- *P03.50=0: Normal Curve*
  AI1/AI2: Enables Gain/Bias parameters P03.03, P03.04, P03.07, P03.10, P03.11, and P03.12.
  AI10/AI11: Enables Gain/Bias parameters P14.02 - P14.07. Proportional parameters are not used.
- *P03.50=1:*
  AI1: Enables Parameters P03.63–P03.68. (if P03.28= 0). Enables Parameters P03.63–P03.74 (if P03.28=3)
  AI2: Keeps Gain/Bias parameters.
  AI10: Enables Parameter P14.24-P14.29.
  AI11: Keeps Gain/Bias parameters.
- *P03.50=2:*
  AI2: Enables parameters P03.57–P03.62. AI1: Uses Gain/Bias
  AI11: Enables parameters P14.30-P14.35
  AI10: Uses Gain/Bias
- *P03.50=3:*
  AI1 & AI2: Enables all proportional parameters P03.57–P03.74.
  AI10 & AI11: Enables all proportional parameters P14.24 - P14.35.
  Gain/Bias is not used.

When 3-point curve mode is selected, P03.10 must be set to 1. Forward/Reverse action is determined by the frequency polarity in the proportional parameters.

For a -10V to 10V signal in AI1, parameters P03.62 - P03.68 are used for the 0-10V signal and Parameters P03.69 to P03.74 are used for the -10-0V signal. This is effectively a 6 point curve.

NOTE: For -10V to 10V signal, parameters P03.62 - P03.68 are used to set the 0 to +10V portion of the signal.

		Type	Hex Addr	Dec Addr
P03.57	***AI2 Lowest Point***	♦R/W	0339	40826
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P03.29 = 1, 0.00–10.00 V P03.29 ≠ 1, 0.00–20.00 mA	4.00		

When the input current falls below this parameter, the action defined in P03.19 will initiate.

		Type	Hex Addr	Dec Addr
P03.58	***AI2 Proportional Lowest Point***	♦R/W	033A	40827
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00 %	0.00		

		Type	Hex Addr	Dec Addr
P03.59	***AI2 Mid-point***	♦R/W	033B	40828
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P03.29 = 1, 0.00–10.00 V P03.29 ≠ 1, 0.00–20.00 mA	12.00		

		Type	Hex Addr	Dec Addr
P03.60	***AI2 Proportional Mid-point***	♦R/W	033C	40829
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00 %	50.00		

		Type	Hex Addr	Dec Addr
P03.61	***AI2 Highest Point***	♦R/W	033D	40830
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P03.29 = 1, 0.00–10.00 V P03.29 ≠ 1, 0.00–20.00 mA	20.00		

		Type	Hex Addr	Dec Addr
P03.62	***AI2 Proportional Highest Point***	♦R/W	033E	40831
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00 %	100.00		

When P03.29 = 1, the AI2 setting is 0–10 V and the unit is voltage (V).

When P03.29 ≠ 1, the AI2 setting is 0–20 mA or 4–20 mA and the unit is current (mA).

- *When you set the analog input AI2 to the Frequency command, 100% corresponds to Fmax (P01.00 Maximum Operation Frequency).*
- *The requirement for the low, mid, and high point parameters (P03.57, P03.59 and P03.61) is P03.57 < P03.59 < P03.61. The values for three proportional points (P03.58, P03.60 and P03.62) have no limits. There is a linear calculation between two points.*
- *The output percentage becomes 0% when the AI2 input value is lower than the lowest point setting.*

Example:

If P03.57 = 2mA; P03.58 = 10%, then the output becomes 0% when the AI2 input is ≤ 2mA.

Once the AI2 input goes above 2mA, the drive's output frequency starts at 10%.

		Type	Hex Addr	Dec Addr
P03.63	***AI1 Voltage Lowest Point***	♦R/W	033F	40832
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–10.00 V	0.00		

		Type	Hex Addr	Dec Addr
P03.64	***AI1 Proportional Lowest Point***	♦R/W	0340	40833
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.00–100.00 %	0.00		

		Type	Hex Addr	Dec Addr
P03.65	***AI1 Voltage Mid-point***	♦R/W	0341	40834
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–10.00 V	5.00		

		Type	Hex Addr	Dec Addr
P03.66	***AI1 Proportional Mid-point***	♦R/W	0342	40835
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.00–100.00 %	50.00		

		Type	Hex Addr	Dec Addr
P03.67	***AI1 Highest Point***	♦R/W	0343	40836
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–10.00 V	10.00		

		Type	Hex Addr	Dec Addr
P03.68	***AI1 Proportional Highest Point***	♦R/W	0344	40837
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.00–100.00 %	100.00		

When you set the positive voltage AI1 to the Frequency command, 100% corresponds to Fmax (P01.00 Maximum Operation Frequency) and the motor runs in the forward direction.

- *The requirement for the low, mid, and high point parameters (P03.63, P03.65, and P03.67) is P03.63 < P03.65 < P03.67. The values for three proportional points (P03.64, P03.66 and P03.68) have no limits. There is a linear calculation between two points.*
- *The output percentage becomes 0 % when the positive voltage AI1 input value is lower than the lowest point setting.*

Example:

If P03.63 = 1V; P03.64 = 10%, then the output becomes 0% when the AI1 input is ≤ 1V.

Once the AI1 input increases above 1V, the drive output frequency will start at 10%.

		Type	Hex Addr	Dec Addr
P03.69	***Negative AI1 Voltage Highest Point***	♦R/W	0345	40838
	Range/Units (Format: 16-bit signed)	*Default*		
	-10.00–0.00 V (valid when P03.28 set as -10–10 V)	0.00		

		Type	Hex Addr	Dec Addr
P03.70	***Negative AI1 Proportional Highest Point***	♦R/W	0346	40839
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.00–100.00 % (valid when P03.28 set as -10–10 V)	0.00		

		Type	Hex Addr	Dec Addr
P03.71	***Negative AI1 Voltage Mid-point***	♦R/W	0347	40840
	Range/Units (Format: 16-bit signed)	*Default*		
	-10.00–0.00 V (valid when P03.28 set as -10–10 V)	-5.00		

		Type	Hex Addr	Dec Addr
P03.72	***Negative AI1 Proportional Mid-point***	♦R/W	0348	40841
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.00–100.00 % (valid when P03.28 set as -10–10 V)	-50.00		

		Type	Hex Addr	Dec Addr
P03.73	***Negative AI1 Lowest Point***	♦R/W	0349	40842
	Range/Units (Format: 16-bit signed)	*Default*		
	-10.00–0.00 V (valid when P03.28 set as -10–10 V)	-10.00		

		Type	Hex Addr	Dec Addr
P03.74	***Negative AI1 Proportional Lowest Point***	♦R/W	034A	40843
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.00–100.00 % (valid when P03.28 set as -10–10 V)	-100.00		

When you set the negative voltage AI1 to the Frequency command, -100% corresponds to Fmax (P01.00 Maximum Operation Frequency) and the motor runs in the reverse direction.

- *The requirement for the low, mid, and high point parameters (P03.69, P03.71, and P03.73) is P03.69 < P03.71 < P03.73, the values for three proportional points (P03.70, P03.72, and P03.74) have no limits. There is a linear calculation between two points.*
- *The output percentage becomes 0% when the negative voltage AI1 input value is lower than the lowest point setting.*

Example:

If P03.69 = -1V; P03.70 = 10%, then the output becomes 0% when the AI1 input is ≥ -1V.

If the AI1 input swings between -1V and -1.1 V, drive's output frequency oscillates between 0% and 10%.

NOTE: For -10V to 10V signal, parameters P03.69 - P03.74 are used to set the 0 to -10V signal.

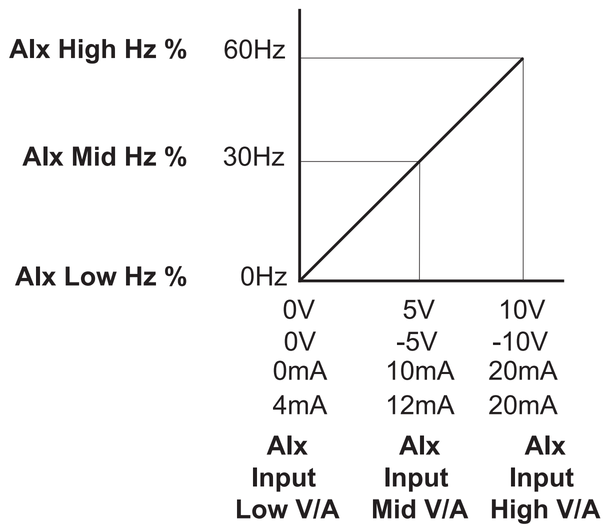
Analog Input Parameter Examples

Refer to the following equations and examples for changing the ratio of the analog input signal relative to the output frequency of the drive.

There are 2 methods of changing the ratio: Three point curve or Bias/Gain. Either method can be used and is largely a matter of user preference.

Three Point Curve (P03.50 ≠ 0):

The Three Point Curve parameters are used to set the low, mid, and high input signals corresponding to a low, mid, and high proportional output value. This method eliminates the need for using any mathematic equations by the user. A curve slope will be calculated automatically between the low and mid point values, and the mid and high point values. See “Analog Input Parameter Example 11: Forward and Reverse Operation with -10V to +10V Input” on page 4–153 for Three point curve using a -10 to 10V input signal.



Analog Input	AI1	AI2
Polarity	0–10 V	Positive (+)
Curve Selection	P03.50 = 1 or 3	P03.50 = 2 or 3
Low V/A	P03.63	P03.57
Low Hz Percent	P03.64	P03.58
Mid V/A	P03.65	P03.59
Mid Hz Percent	P03.66	P03.60
High V/A	P03.67	P03.61
High Hz Percent	P03.68	P03.62

Bias/Gain (P03.50 = 0: Normal Curve, default):

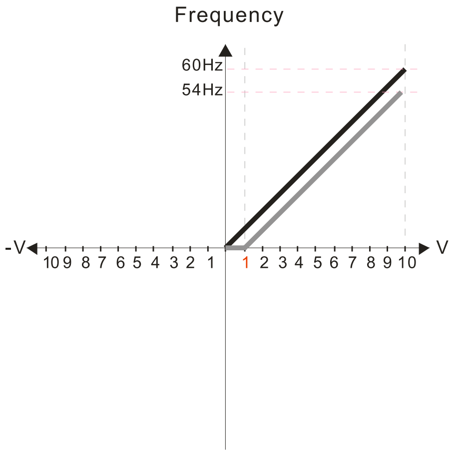
The Normal Curve setting utilizes 4 different parameters to modify the output frequency of the drive. The bias/gain parameters work in accordance with the Pos/Neg bias mode and reverse setting parameter. Use diagrams 1 - 32 to understand the frequency outputs that will result from these parameter settings.

Analog Input	AI1	AI2
Bias Parameter	P03.03	P03.04
Pos/Neg Bias Parameter	P03.07	P03.08
Gain Parameter	P03.11	P03.12
Reverse Setting Parameter	P03.10	
Curve Parameter	P03.50	
Drive Max Output Freq	P01.00	

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 1:



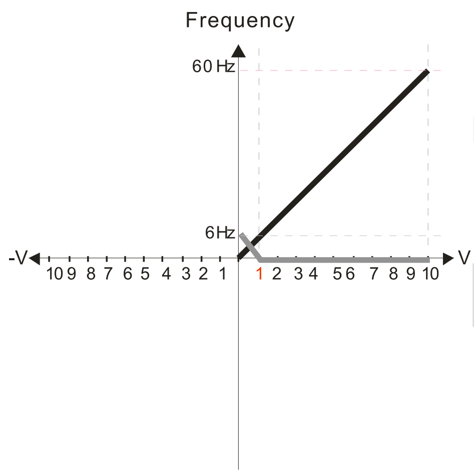
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Bias and Gain Example 2:



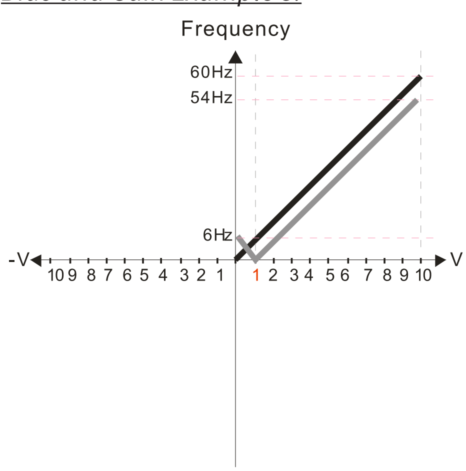
P03.03=10%
P03.07– P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Bias and Gain Example 3:



P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

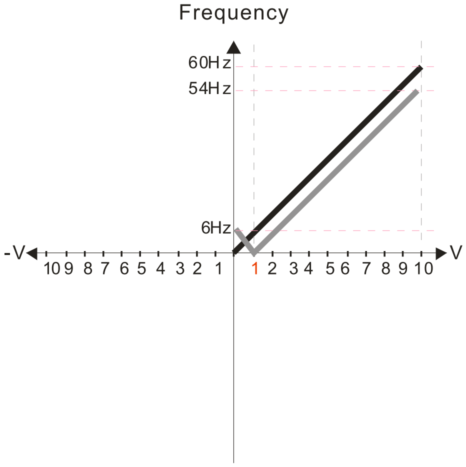
0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Frequency output at default bias/gain settings
Manipulated frequency output based on listed parameter values

Bias and Gain Example 4:



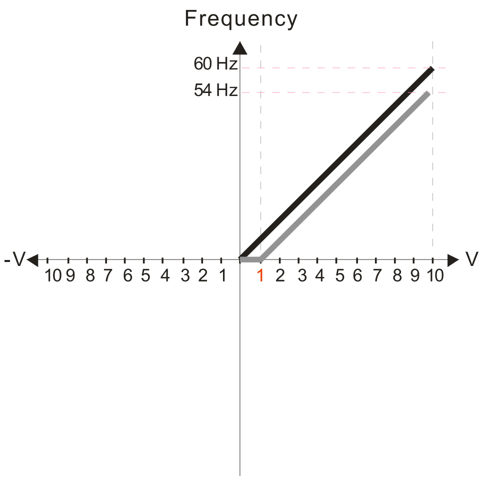
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Bias and Gain Example 5:



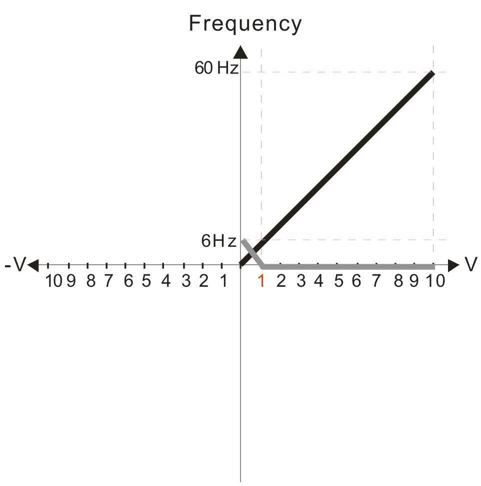
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Bias and Gain Example 6:



P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

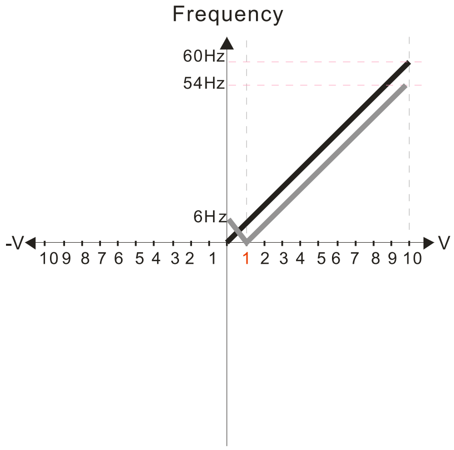
P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 7:



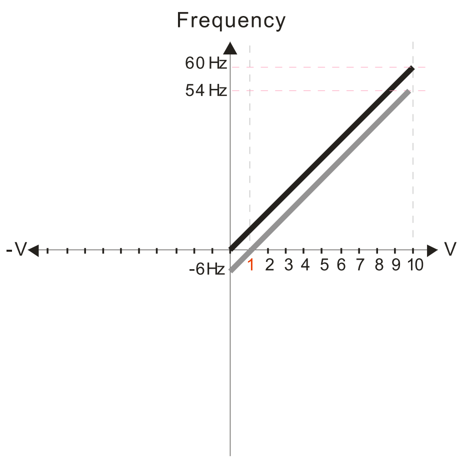
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Bias and Gain Example 8:



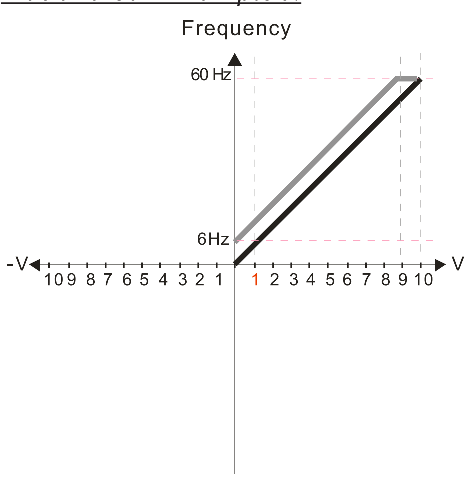
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Bias and Gain Example 9:



P03.03=-10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

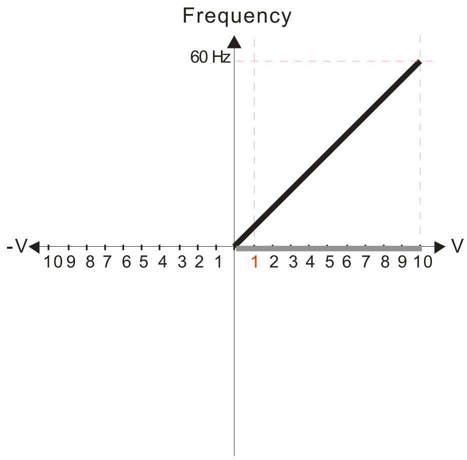
P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 10:



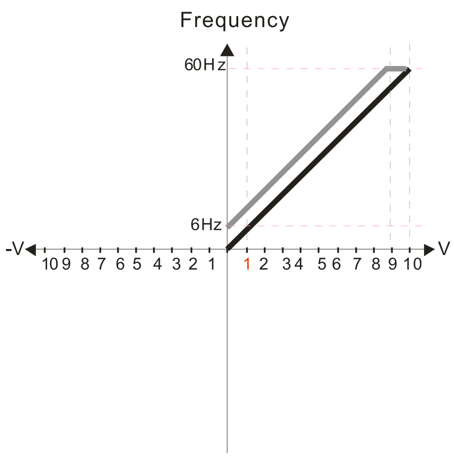
P03.03=-10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Bias and Gain Example 11:



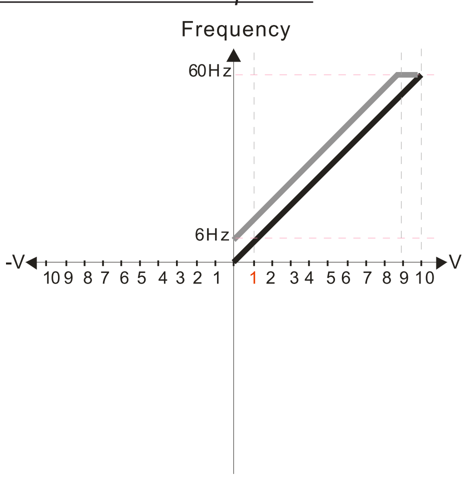
P03.03=-10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Bias and Gain Example 12:



P03.03=-10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

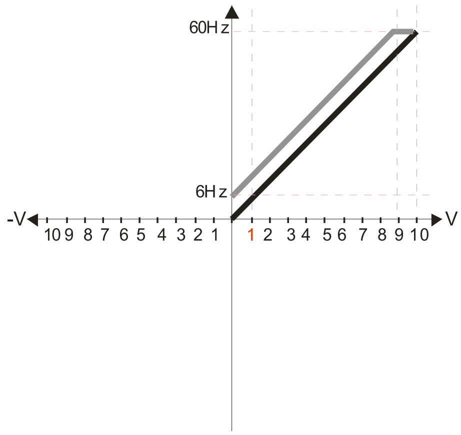
P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 13:



P03.03=-10%

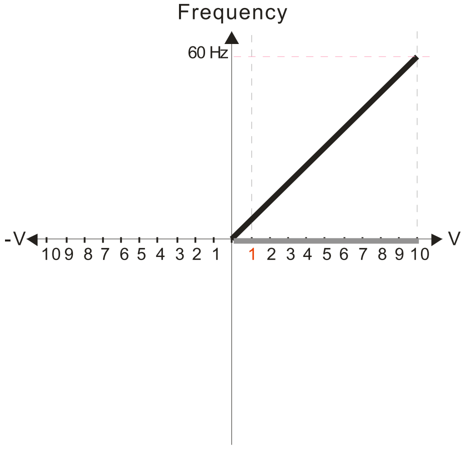
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Bias and Gain Example 14:



P03.03=-10%

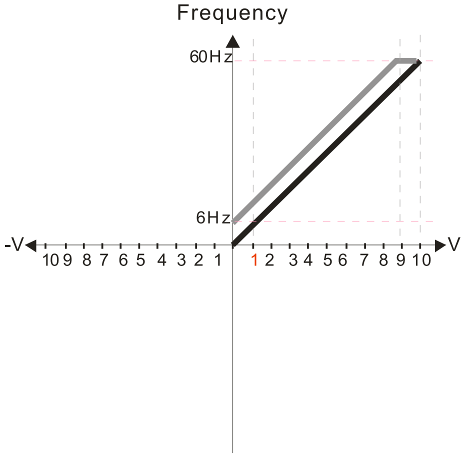
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Bias and Gain Example 15:



P03.03=-10%

P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

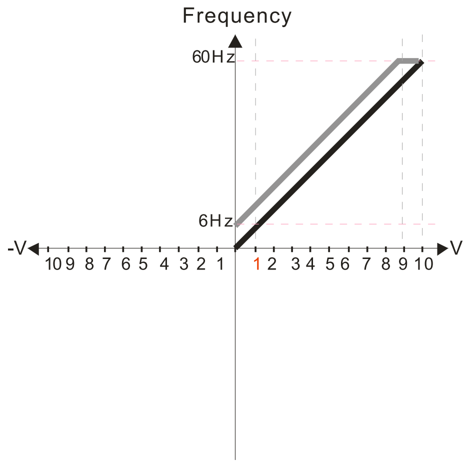
P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 16:



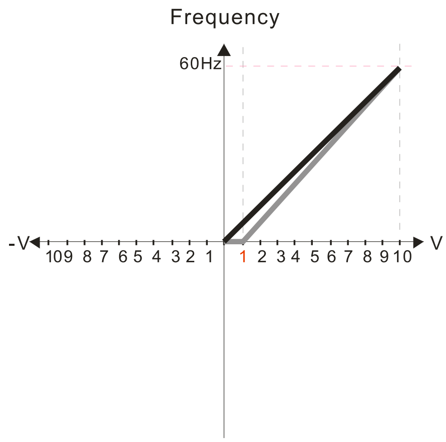
P03.03=-10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 100%

Bias and Gain Example 17:



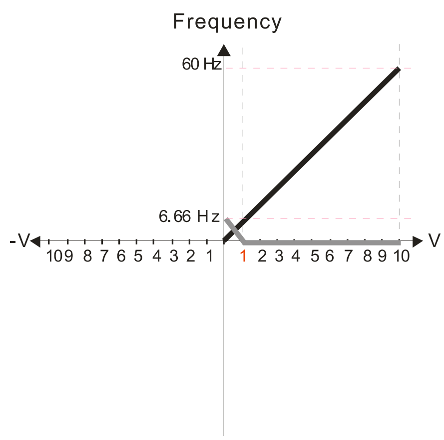
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 111.1%
10/9 = 111.1%

Bias and Gain Example 18:



P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

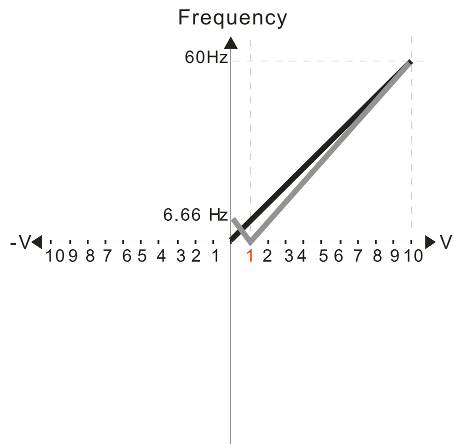
P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 111.1%
10/9 = 111.1%

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 19:



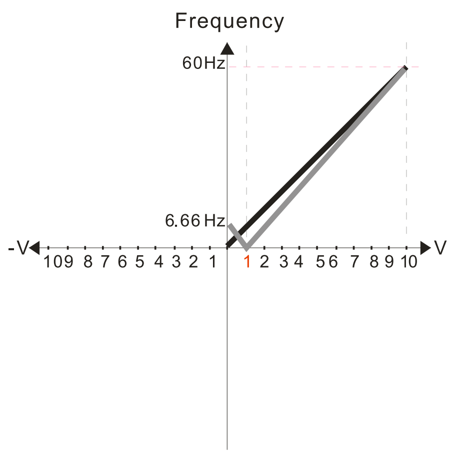
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 111.1%
10/9 = 111.1%

Bias and Gain Example 20:



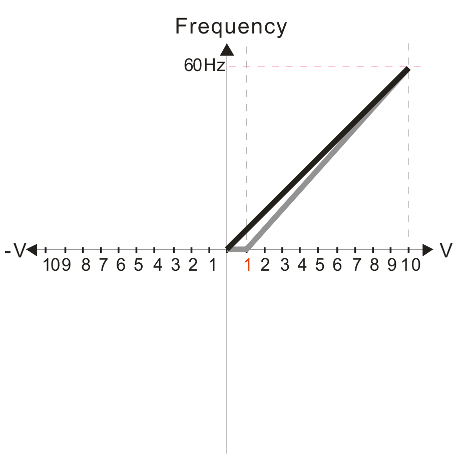
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 111.1%
10/9 = 111.1%

Bias and Gain Example 21:



P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

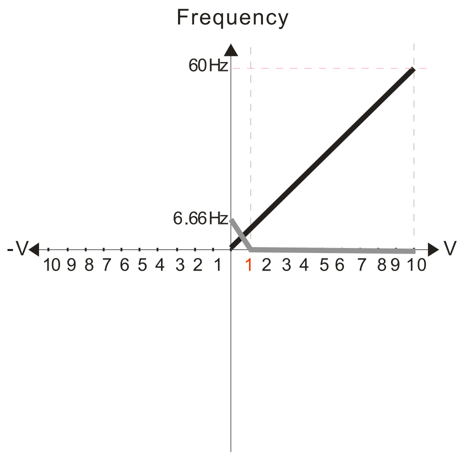
P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 111.1%
10/9 = 111.1%

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 22:



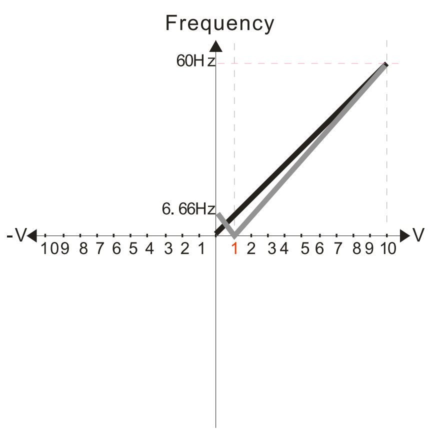
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 111.1%
10/9 = 111.1%

Bias and Gain Example 23:



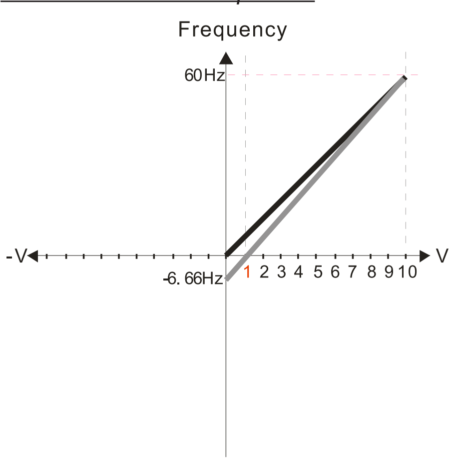
P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 111.1%
10/9 = 111.1%

Bias and Gain Example 24:



P03.03=10%
P03.07–P03.08 (Positive/Negative Bias Mode)

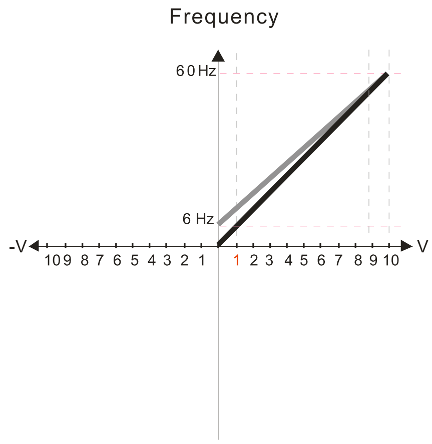
0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

P03.11 Analog input Gain (AI1) = 111.1%
10/9 = 111.1%

Frequency output at default bias/gain settings
Manipulated frequency output based on listed parameter values

Bias and Gain Example 25:



P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

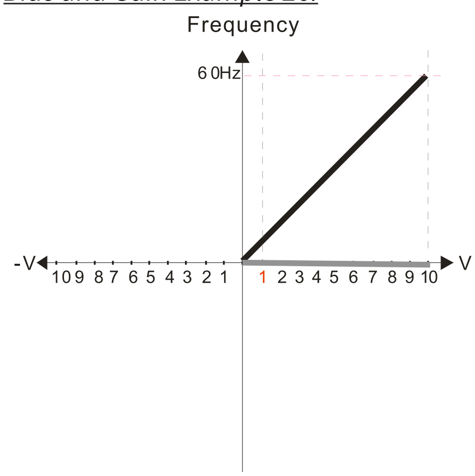
Calculate the bias:

$$\frac{60-6\text{Hz}}{10\text{V}} = \frac{6-0\text{ Hz}}{(0-\text{XV})} \quad \text{XV} = \frac{100}{-9} = -1.11\text{V} \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\,\%$$

Calculate the gain:

$$\text{P03.11} = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\%$$

Bias and Gain Example 26:

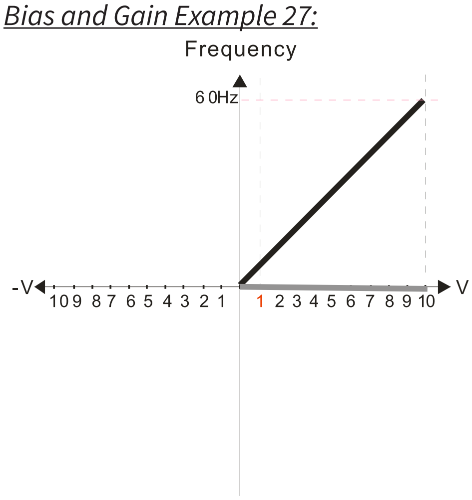


P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Bias and Gain Example 27:



P03.07–P03.08 (Positive/Negative Bias Mode)

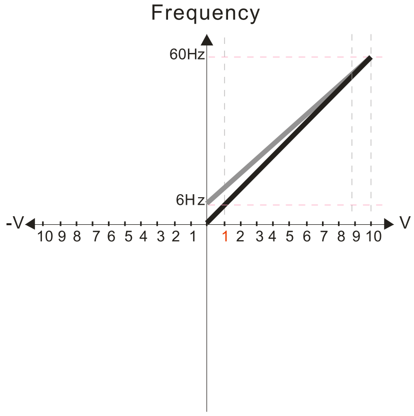
0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 28:



P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

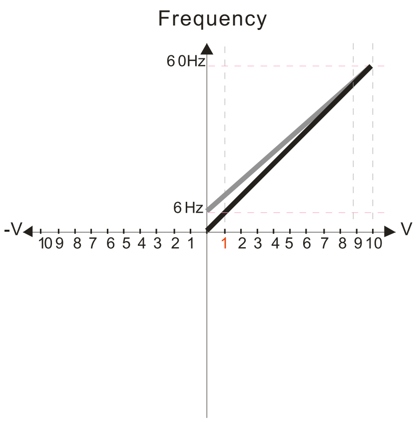
Calculate the bias:

$$\frac{60\text{-}6\text{Hz}}{10\text{V}} = \frac{6\text{-}0\text{ Hz}}{(0\text{-XV})} \quad XV = \frac{100}{-9} = -1.11\text{V} \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\%$$

Calculate the gain:

$$P03.11 = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\%$$

Bias and Gain Example 29:



P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Calculate the bias:

$$\frac{60\text{-}6\text{Hz}}{10\text{V}} = \frac{6\text{-}0\text{ Hz}}{(0\text{-XV})} \quad XV = \frac{100}{-9} = -1.11\text{V} \quad \therefore 03\text{-}03 = \frac{-1.11}{10} \times 100\% = -11.1\%$$

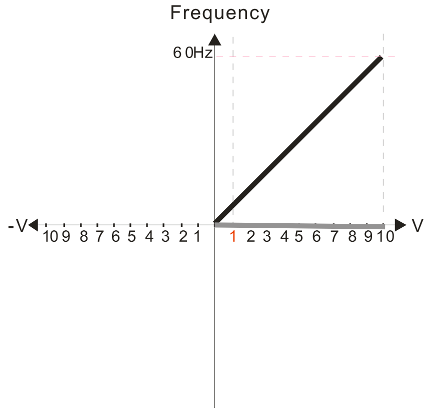
Calculate the gain:

$$P03.11 = \frac{10\text{V}}{11.1\text{V}} \times 100\% = 90.0\%$$

Frequency output at default bias/gain settings

Manipulated frequency output based on listed parameter values

Bias and Gain Example 30:

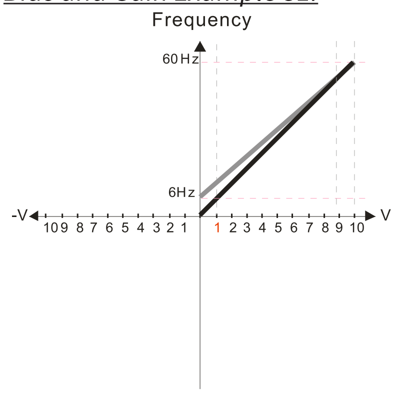


P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Bias and Gain Example 31:



P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

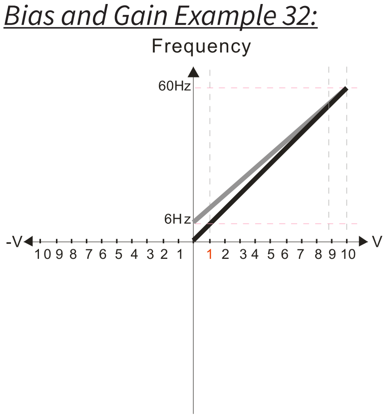
Calculate the bias:

$$\frac{60-6Hz}{10V} = \frac{6-0Hz}{(0-XV)} \quad XV = \frac{100}{-9} = -1.11V \quad \therefore 03.03 = \frac{-1.11}{10} \times 100\% = -11.1\%$$

Calculate the gain:

$$P03.11 = \frac{10V}{11.1V} \times 100\% = 90.0\%$$

Bias and Gain Example 32:



P03.07–P03.08 (Positive/Negative Bias Mode)

0: No bias
1: Lower than or equal bias
2: Greater than or equal to bias
3: The absolute value of the bias voltage while serving as the center
4: Bias serves as the center

P03.10 (Analog Frequency Command for Reverse Run)
0: Negative frequency is not valid. Forward and reverse run is controlled by digital keyboard or external terminals.
1: Negative frequency is valid. Positive frequency = forward run; negative frequency = reverse run. Direction can not be switched by digital keypad or external terminal control.

Calculate the bias:

$$\frac{60-6Hz}{10V} = \frac{6-0Hz}{(0-XV)} \quad XV = \frac{100}{-9} = -1.11V \quad \therefore 03.03 = \frac{-1.11}{10} \times 100\% = -11.1\%$$

Calculate the gain:

$$P03.11 = \frac{10V}{11.1V} \times 100\% = 90.0\%$$

Analog Input Parameter Example 1: Standard Operation

This example illustrates the default operation of the drive. The example is given to further illustrate the use of the analog calculations. The full range of the analog input signal corresponds to the full forward frequency range of the AC drive.

- *Minimum Frequency Reference = 0Hz*
- *Maximum Frequency Reference = 60Hz*

For AI1, AI2, AI10, and AI11: ***P03.50 (Analog Input Curve) must be set to zero (Normal Curve) to enable bias and gain calculations.***

Calculations

A) **Drive Maximum Output Frequency** = P01.00 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Bias %** = 0%

Analog Input (AIx)	*AI1*	*AI2*	*AI10*	*AI11*
Bias Parameter	P03.03	P03.04	P14.02	P14.03

C) **Analog Gain %** = [(60Hz - 0Hz) / 60Hz] x 100 = 100%

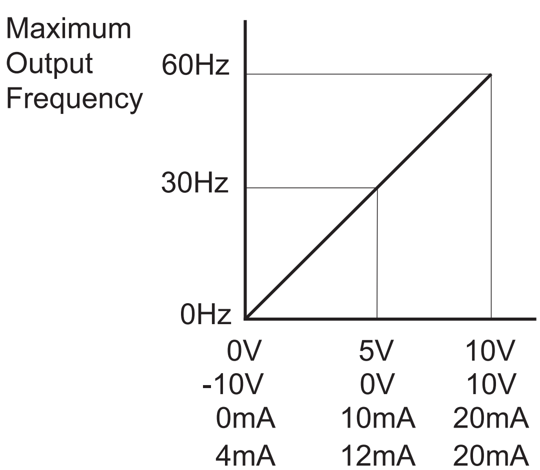
Analog Input	*AI1*	*AI2*	*AI10*	*AI11*
Gain Parameter	P03.11	P03.12	P14.06	P14.07

D) **Mid-point Frequency** = [(60Hz - 0Hz) / 2] + 0Hz = 30Hz

Parameter Settings

Analog Input	*AI1 or*	*AI2 or*	*AI10 or*	*AI11*	*Parameter Settings*
Bias Parameter	P03.03	P03.04	P14.02	P14.03	0.0%
Pos/Neg Bias Parameter	P03.07	P03.08	P14.04	P14.05	0: No Bias
Gain Parameter	P03.11	P03.12	P14.06	P14.07	100.0%
Reverse Setting Parameter	P03.10				0: No Neg Freq
Curve Parameter	P03.50				0
Drive Max Output Freq	P01.00				60Hz

Results



Analog Input Parameter Example 2:
Standard Operation with Increased Maximum Output Frequency

This example illustrates how to run the motor faster than its base speed. For this purpose, the only required parameter change is P01.00, Drive Maximum Output Frequency. (Motors produce reduced output torque when running above their base speed.)

The analog input adjustment parameters can remain defaulted, as determined by the analog input calculations shown below. The increased Drive Maximum Output Frequency can be obtained regardless of whether the Source of Frequency Command (P03.00 or P03.01) is an analog input or one of the other sources, such as the keypad, RS-485 communication interface, jog, or multi-speed settings.

- *Minimum Frequency Reference = 0Hz*
- *Maximum Frequency Reference = 70Hz*
- *Motor Maximum Output Speed = 2042 rpm*

*For AI1, AI2, AI10, and AI11: **P03.50 (Analog Input Curve) must be set to zero (Normal Curve) to enable bias and gain calculations.***

Calculations

A) **Drive Maximum Output Frequency** = P01.00 = (2042 rpm / 1750 rpm) x 60Hz = 70Hz

B) **Analog Bias %** = 0%

Analog Input (AIx)	***AI1***	***AI2***	***AI10***	***AI11***
Bias Parameter	P03.03	P03.04	P14.02	P14.03

C) **Analog Gain %** = [(70Hz – 0Hz) / 70Hz] x 100 = 100% = AIx Input Gain

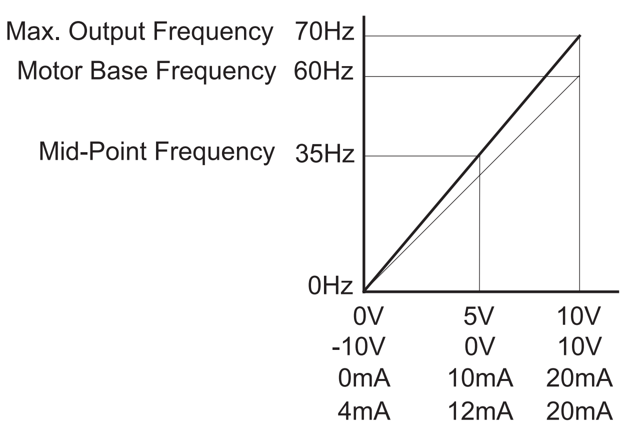
Analog Input	***AI1***	***AI2***	***AI10***	***AI11***
Gain Parameter	P03.11	P03.12	P14.06	P14.07

D) **Mid-point Frequency** = [(70Hz – 0Hz) / 2] + 0Hz = 35Hz

Parameter Settings

Analog Input	***AI1 or***	***AI2 or***	***AI10 or***	***AI11***	***Parameter Settings***
Bias Parameter	P03.03	P03.04	P14.02	P14.03	0.0%
Pos/Neg Bias Parameter	P03.07	P03.08	P14.04	P14.05	0: No Bias
Gain Parameter	P03.11	P03.12	P14.06	P14.07	100.0%
Reverse Setting Parameter	P03.10				0: No Neg Freq
Curve Parameter	P03.50				0
Drive Max Output Freq	P01.00				70Hz

Results



Analog Input Parameter Example 3: Positive Offset

In this example, the Analog Input will have a positive offset while still using the full scale of the potentiometer or other analog signal device. When the analog signal is at its lowest value (-10V, 0V, 0mA, or 4mA), the set-point frequency will be at 10Hz. When analog signal is at its maximum value (10V or 20mA), the set-point frequency will be 60Hz. This example will use the three point curve method.

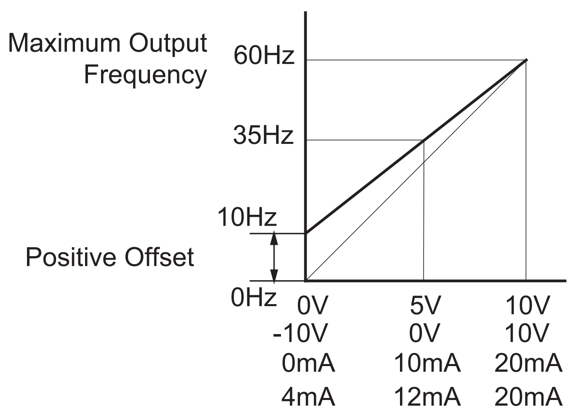
- *Minimum Frequency Reference @0V = 10Hz (10/60=16%)*
- *Mid-point Frequency Reference @5V = 35Hz (35/60=58%)*
- *Maximum Frequency Reference @10V = 60Hz (60/60=100%)*

For AI1, AI2, AI10, and AI1: ***P03.50 (Analog Input Curve) must be set to 1, 2, or 3 to enable three point curve calculations.***

Parameter Settings

Analog Input	***AI1***	***AI2***	***AI10***	***AI11***	***Parameter Settings***
Polarity	0–10 V	Positive (+)	Positive (+)	Positive (+)	
Curve Selection	P03.50 = 1 or 3	P03.50 = 2 or 3	P03.50 = 2 or 3	P03.50 = 2 or 3	1, 2, or 3
Term Input Selection	P03.28=0	P03.29=0,1,2	P14.18	P14.19	0, 1, or 2
Low V/A	P03.63	P03.57	P14.24	P14.30	0V
Low Hz Percent	P03.64	P03.58	P14.25	P14.31	16%
Mid V/A	P03.65	P03.59	P14.26	P14.32	5V
Mid Hz Percent	P03.66	P03.60	P14.27	P14.33	58%
High V/A	P03.67	P03.61	P14.28	P14.34	10V
High Hz Percent	P03.68	P03.62	P14.29	P14.35	100%

Results



Analog Input Parameter Example 4: Forward and Reverse Operation

In this example, the potentiometer (or other analog signal device) is programmed to run a motor full-speed in both forward and reverse directions. The frequency reference will be 0Hz when the potentiometer is positioned at mid-point of its scale. This example will be shown using the three point curve parameters.

Utilize negative frequency percentage values in the proportional settings for reverse motion. Use positive percentage values for forward motion.

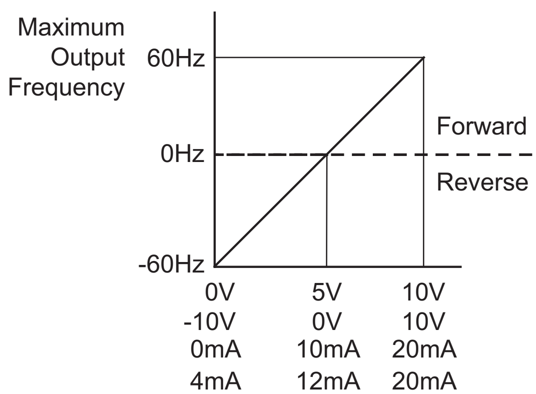
- *Minimum Frequency Reference @0V = -60Hz (-100%)(reverse)*
- *Mid-point Frequency Reference @5V = 0Hz (0%)*
- *Maximum Frequency Reference @10V = 60Hz (100%)*

For AI1, AI2, AI10, and AI11: ***P03.50 (Analog Input Curve) must be set to 1, 2, or 3 to enable three point curve parameters.***

Parameter Settings

Analog Input	***AI1***	***AI2***	***AI10***	***AI11***	***Parameter Settings***
Polarity	0–10 V	Positive (+)	Positive (+)	Positive (+)	
Curve Selection	P03.50 = 1 or 3	P03.50 = 2 or 3	P03.50 = 2 or 3	P03.50 = 2 or 3	1, 2, or 3
Term Input Selection	P03.28=0	P03.29=0,1,2	P14.18	P14.19	0, 1, or 2
Positive/Negative Bias	P03.07=4	P03.08=4	P14.04=4	P14.05=4	4
Reverse Setting	P03.10=1	P03.10=1	P03.10=1	P03.10=1	1
Low V/A	P03.63	P03.57	P14.24	P14.30	0V
Low Hz Percent	P03.64	P03.58	P14.25	P14.31	-100%
Mid V/A	P03.65	P03.59	P14.26	P14.32	5V
Mid Hz Percent	P03.66	P03.60	P14.27	P14.33	0%
High V/A	P03.67	P03.61	P14.28	P14.34	10V
High Hz Percent	P03.68	P03.62	P14.29	P14.35	100%

Results



Analog Input Parameter Example 5: Forward Run/Reverse Jog

This example shows an application in which the drive runs full-speed forward and jogs in reverse. The full scale of the potentiometer (or other analog signal device) will be used.

Use negative frequency percentage values in the proportional settings for reverse motion. Use positive percentage values for forward motion.

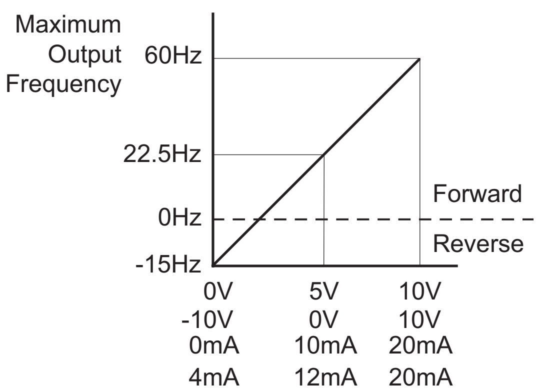
- *Minimum Frequency Reference @0V = -15Hz (-15/60 = -25%)(reverse)*
- *Mid-Point Frequency Reference @5V = 22.5 Hz (22.5/60 = 37.5%)*
- *Maximum Frequency Reference @10V = 60Hz (60/60 = 100%)*

For AI1, AI2, AI10, and AI11: ***P03.50 (Analog Input Curve) must be set to 1, 2, or 3 to enable three point curve parameters.***

Parameter Settings

Analog Input	***AI1***	***AI2***	***AI10***	***AI11***	***Parameter Settings***
Polarity	0–10 V	Positive (+)	Positive (+)	Positive (+)	
Curve Selection	P03.50 = 1 or 3	P03.50 = 2 or 3	P03.50 = 2 or 3	P03.50 = 2 or 3	1, 2, or 3
Term Input Selection	P03.28=0	P03.29=0,1,2	P14.18	P14.19	0, 1, or 2
Low V/A	P03.63	P03.57	P14.24	P14.30	0V
Low Hz Percent	P03.64	P03.58	P14.25	P14.31	-25%
Mid V/A	P03.65	P03.59	P14.26	P14.32	5V
Mid Hz Percent	P03.66	P03.60	P14.27	P14.33	37.5%
High V/A	P03.67	P03.61	P14.28	P14.34	10V
High Hz Percent	P03.68	P03.62	P14.29	P14.35	100%

Results



Analog Input Parameter Example 6: Reduced Analog Gain

This example shows how to limit the Maximum Frequency Reference by reducing the Analog Input Gain. When the Analog Input is at its maximum value (10V or 20mA), the set-point frequency will be 50Hz. However, this reduced maximum frequency applies only to an Analog Input Source of Frequncy Command. The Maximum Output Frequency can still can still go to 60Hz if controlled from the Keypad, RS-485 interface, Jog Command, or Multi-Speed settings. For this example, the only required parameter change is P03.11 or P03.12, Gain parameter.

- *Minimum Frequency Reference = 0Hz*
- *Maximum Frequency Reference = 50Hz*

For AI1, AI2, AI10, and AI11: ***P03.50 (Analog Input Curve) must be set to zero (Normal Curve) to enable bias and gain calculations.***

Calculations

A) **Drive Maximum Output Frequency** = P01.00 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Bias %** = 0%

Analog Input (AIx)	*AI1*	*AI2*	*AI10*	*AI11*
Bias Parameter	P03.03	P03.04	P14.02	P14.03

C) **Analog Gain %** = [(50Hz – 0Hz) / 60Hz] x 100 = 83.3% = AIx Input Gain

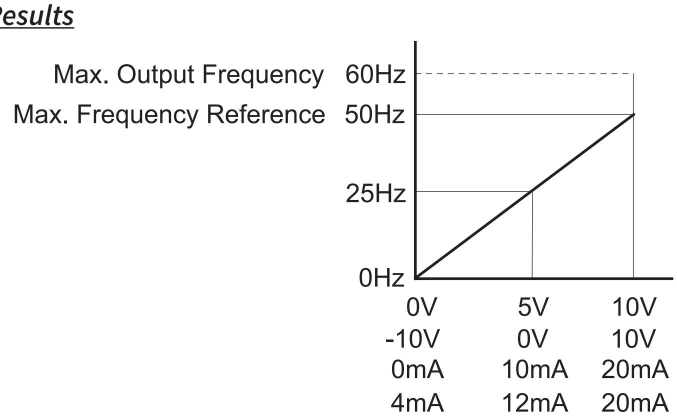
Analog Input	*AI1*	*AI2*	*AI10*	*AI11*
Gain Parameter	P03.11	P03.12	P14.06	P14.07

D) **Mid-point Frequency** = [(50Hz – 0Hz) / 2] + 0Hz = 25Hz

Parameter Settings

Analog Input	*AI1 or*	*AI2 or*	*AI10 or*	*AI11*	*Parameter Settings*
Polarity	Positive (+)	Positive (+)	Positive (+)	Positive (+)	
Bias Parameter	P03.03	P03.04	P14.02	P14.03	0.0%
Pos/Neg Bias Parameter	P03.07	P03.08	P14.04	P14.05	0: No Bias
Gain Parameter	P03.11	P03.12	P14.06	P14.07	83.3%
Reverse Setting Parameter	P03.10				0: No Neg Freq
Curve Parameter	P03.50				0

Results



Analog Input Parameter Example 7: Positive Offset with Reduced Analog Gain

This example illustrates how to provide a positive offset of the Analog Input, while using the full scale of the potentiometer or other analog device. At the same time, the Maximum Frequency Reference is limited by reducing the Analog Input Gain.

When the analog signal is at its lowest value, the set-point frequency will be at 11.5Hz. When the analog signal is at its maximum value, the set-point frequency will be 39.6Hz.

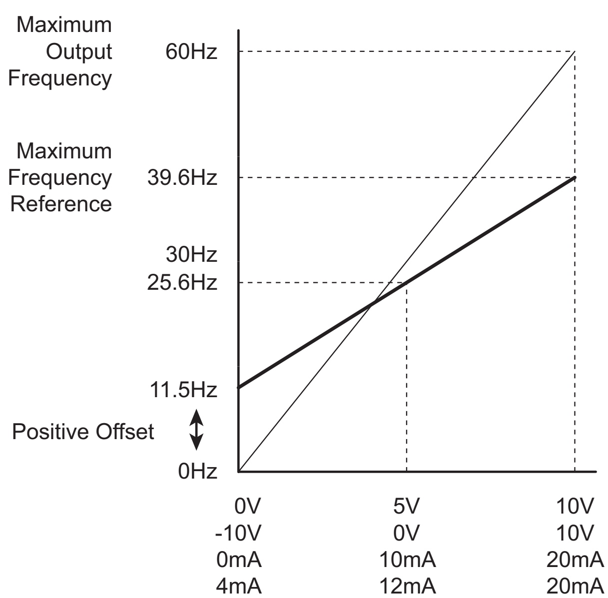
- *Minimum Frequency Reference @0V = 11.5 Hz (11.5/60 = 19%)*
- *Mid-point Frequency Reference @5V = 22.5 Hz (22.5/60 = 37.5%)*
- *Maximum Frequency Reference @10V = 39.6 Hz (39.6/60 = 66%)*

For AI1, AI2, AI10, and AI11: ***P03.50 (Analog Input Curve) must be set to 1, 2, or 3 to enable three point curve parameters.***

Parameter Settings

Analog Input	AI1	AI2	AI10	AI11	Parameter Settings
Polarity	0–10 V	Positive (+)	Positive (+)	Positive (+)	
Curve Selection	P03.50 = 1 or 3	P03.50 = 2 or 3	P03.50 = 2 or 3	P03.50 = 2 or 3	1, 2, or 3
Term Input Selection	P03.28=0	P03.29=0,1,2	P14.18	P14.19	0, 1, or 2
Low V/A	P03.63	P03.57	P14.24	P14.30	0V
Low Hz Percent	P03.64	P03.58	P14.25	P14.31	19%
Mid V/A	P03.65	P03.59	P14.26	P14.32	5V
Mid Hz Percent	P03.66	P03.60	P14.27	P14.33	37.5%
High V/A	P03.67	P03.61	P14.28	P14.34	10V
High Hz Percent	P03.68	P03.62	P14.29	P14.35	66%

Results



Analog Input Parameter Example 8: Zero Volts Out at Low V_{IN}

This example gives 0Hz output through the first 0V~2.5V of Analog Input. The rest of the 2.5V~10V corresponds to 0~45 Hz. This example will use the three point curve method.

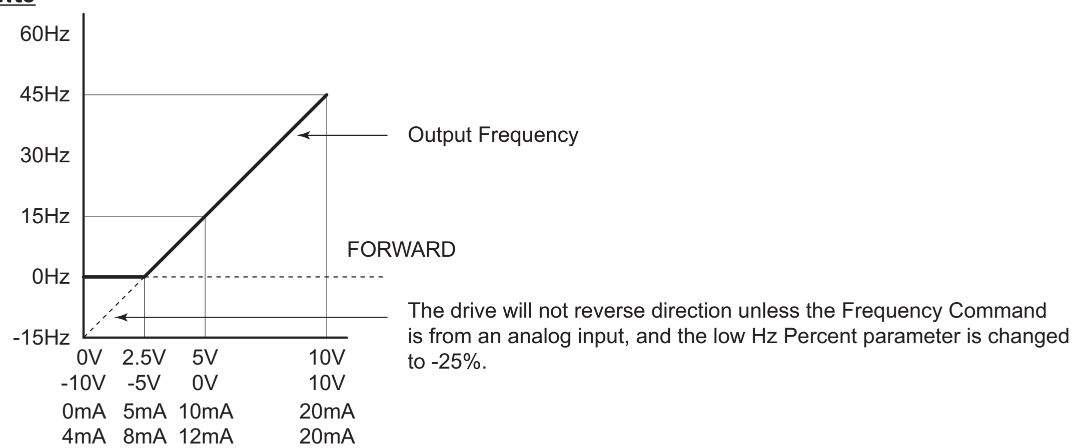
- *Minimum Frequency Reference @0V = 0Hz (0/60 = 0%)*
- *Mid-point Frequency Reference @5V = 0Hz (0/60 = 0%)*
- *Maximum Frequency Reference @10V = 45Hz (45/60 = 75%)*

For AI1, AI2, AI10, and AI11: ***P03.50 (Analog Input Curve) must be set to 1, 2, or 3 to enable three point curve parameters.***

Parameter Settings

Analog Input	**AI1**	**AI2**	**AI10**	**AI11**	**Parameter Settings**
Polarity	0–10 V	Positive (+)	Positive (+)	Positive (+)	
Curve Selection	P03.50 = 1 or 3	P03.50 = 2 or 3	P03.50 = 2 or 3	P03.50 = 2 or 3	1, 2, or 3
Term Input Selection	P03.28=0	P03.29=0,1,2	P14.18	P14.19	0, 1, or 2
Low V/A Input	P03.63	P03.57	P14.24	P14.30	0V
Low Hz Percent	P03.64	P03.58	P14.25	P14.31	0%
Mid V/A Input	P03.65	P03.59	P14.26	P14.32	2.5V
Mid Hz Percent	P03.66	P03.60	P14.27	P14.33	0%
High V/A Input	P03.67	P03.61	P14.28	P14.34	10V
High Hz Percent	P03.68	P03.62	P14.29	P14.35	75%

Results



Analog Input Parameter Example 9: Inverse Analog Speed Reference

This example illustrates the use of an inverse analog speed reference to the drive. The minimum analog reference value corresponds to the full forward output frequency of the drive. In this example, only the Pos/Neg Bias Parameter must be changed from default.

- *Minimum Frequency Reference = 60Hz*
  (drive output frequency at the minimum analog input reference, 0V)
- *Maximum Frequency Reference = 0Hz*
  (drive output frequency at the maximum analog input reference, 10V)

For AI1, AI2, AI10, and AI11: ***P03.50 (Analog Input Curve) must be set to zero (Normal Curve) to enable bias and gain calculations.***

Calculations (see *page 4–132* for formulas)

A) **Drive Maximum Output Frequency** = P01.00 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Bias %** = 100%

Analog Input (AIx)	***AI1***	***AI2***
Bias Parameter	P03.03	P03.04

C) **Analog Gain %** = [(0Hz - 60Hz) / 60Hz] x 100 = -100%

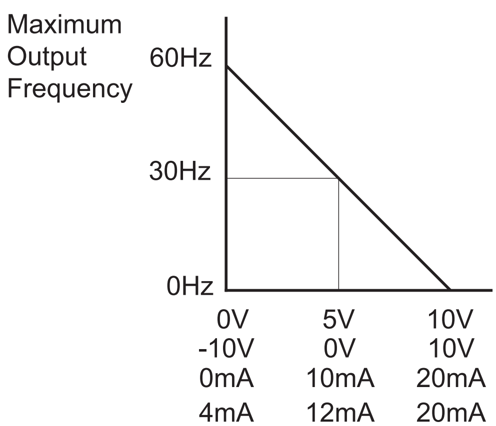
Analog Input	***AI1***	***AI2***
Gain Parameter	P03.11	P03.12

D) **Mid-point Frequency** = [(60Hz - 0Hz) / 2] + 0Hz = 30Hz

Parameter Settings

Analog Input	***AI1 or***	***AI2 or***	***AI10 or***	***AI11***	***Parameter Settings***
Polarity	Positive (+)	Positive (+)	Positive (+)	Positive (+)	
Bias Parameter	P03.03	P03.04	P14.02	P14.03	100.0%
Pos/Neg Bias Parameter	P03.07	P03.08	P14.04	P14.05	2: Greater than or equal to
Gain Parameter	P03.11	P03.12	P14.06	P14.07	100.0%
Reverse Setting Parameter	P03.10				0: No Neg Freq
Curve Parameter	P03.50				0
Drive Max Output Freq	P01.00				60Hz

Results



Analog Input Parameter Example 10: Forward and Reverse Operation with -10V to +10V Input

In this example, the potentiometer (or other analog signal device) is programmed to run a motor full-speed in both forward and reverse directions using a -10V to +10V analog input. The frequency reference will be 0Hz when the potentiometer is positioned at mid-point of its scale (0V). When using -10V to +10V the three point curve method is used. This requires using parameters P03.62 – P03.68 for 0 to +10V scaling and P03.69 – P03.74 for 0 to -10V scaling. This is effectively a six point curve.

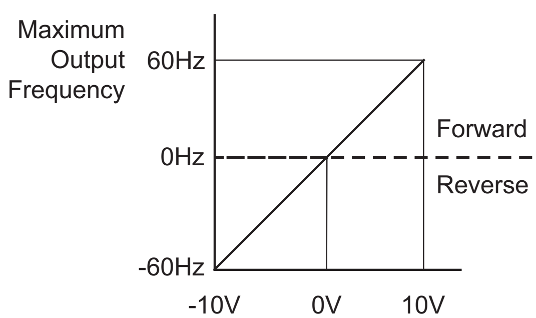
- *Minimum Frequency Reference @-10V = -60Hz (-60/60 = -100%)(reverse)*
- *Mid-point Frequency Reference @-5V = -30Hz (-30/60 = -50%)(reverse)*
- *Maximum Frequency Reference @0V = 0Hz (0/60 = 0%)*
- *Minimum Frequency Reference @0V = 0Hz (0/60 = 0%)*
- *Mid-point Frequency Reference @5V = 30Hz (30/60 = 50%)*
- *Maximum Frequency Reference @10V = 60Hz (60/60 = 100%)*

For AI1, AI2, AI10, and AI11: ***P03.50 (Analog Input Curve) must be set to 1, 2, or 3 to enable three point curve parameters.***

Parameter Settings

Analog Input	***AI1***	***Parameter Settings***
Polarity	-10V to +10V	
Curve Selection	P3.50	1 or 3
Term Input Select	P3.28	3
Low Point Input Value	03.63	0
Low Proportional % Out	03.64	0
Middle Point Input Value	03.65	5
Middle Proportional % Out	03.66	-50%
High Point Input Value	03.67	10
High Proportional % Out	03.68	100%
High Point Input Value	03.69	0
High Proportional % Out	03.70	0
Middle Point Input Value	03.71	-5
Middle Proportional % Out	03.72	-50%
Low Point Input Value	03.73	-10
Low Proportional % Out	03.74	-100%

Results



Group P04.xx Details – Multi-Step Speed Parameters

		Type	Hex Addr	Dec Addr
P04.00	***1st Step Speed Frequency***	♦R/W	0400	41025
P04.01	***2nd Step Speed Frequency***	♦R/W	0401	41026
P04.02	***3rd Step Speed Frequency***	♦R/W	0402	41027
P04.03	***4th Step Speed Frequency***	♦R/W	0403	41028
P04.04	***5th Step Speed Frequency***	♦R/W	0404	41029
P04.05	***6th Step Speed Frequency***	♦R/W	0405	41030
P04.06	***7th Step Speed Frequency***	♦R/W	0406	41031
P04.07	***8th Step Speed Frequency***	♦R/W	0407	41032
P04.08	***9th Step Speed Frequency***	♦R/W	0408	41033
P04.09	***10th Step Speed Frequency***	♦R/W	0409	41034
P04.10	***11th Step Speed Frequency***	♦R/W	040A	41035
P04.11	***12th Step Speed Frequency***	♦R/W	040B	41036
P04.12	***13th Step Speed Frequency***	♦R/W	040C	41037
P04.13	***14th Step Speed Frequency***	♦R/W	040D	41038
P04.14	***15th Step Speed Frequency***	♦R/W	040E	41039

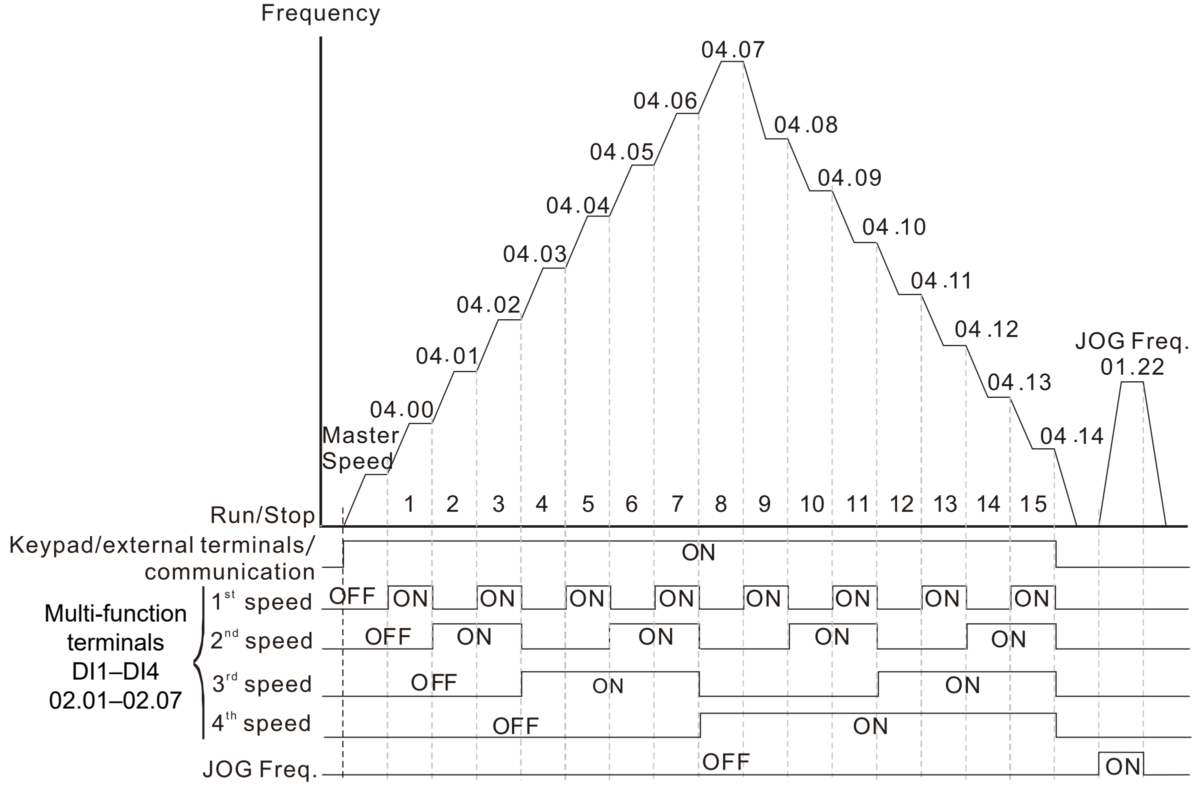
Range/Units (Format: 16-bit unsigned)	*Default*
0.00–599.00 Hz	0.00

Use the multi-function input terminals (refer to settings 1–4 of P02.01–P02.07 Multi-function Input Command) to select the multi-step speed command (the maximum is 15th step speed). P04.00 to P04.14 sets the multi-step speed (frequency) as shown in the following diagram.

- *The external terminal/digital keypad/communication controls the RUN and STOP commands with P00.21.*
- *You can set each multi-step speed between 0.00–599.00 Hz during operation.*
- *Explanation for the timing diagram of the multi-step speed and external terminals.*
  The related parameter settings are:
  a) P04.00–P04.14: sets the 1st–15th multi-step speed (to set the frequency of each step speed).
  b) P02.01–P02.07: sets the multi-function input terminals (multi-step speed command 1–4).

Related parameters:

- *P01.22 JOG frequency setting*
- *P02.01 multi-function input command 1 (DI1)*
- *P02.02 multi-function input command 2 (DI2)*
- *P02.03 multi-function input command 3 (DI3)*
- *P02.04 multi-function input command 4 (DI4)*



Speed Selection through External Terminals

		Type	Hex Addr	Dec Addr
P04.50	***PLC Buffer 0***	♦R/W	0432	41075
P04.51	***PLC Buffer 1***	♦R/W	0433	41076
P04.52	***PLC Buffer 2***	♦R/W	0434	41077
P04.53	***PLC Buffer 3***	♦R/W	0435	41078
P04.54	***PLC Buffer 4***	♦R/W	0436	41079
P04.55	***PLC Buffer 5***	♦R/W	0437	41080
P04.56	***PLC Buffer 6***	♦R/W	0438	41081
P04.57	***PLC Buffer 7***	♦R/W	0439	41082
P04.58	***PLC Buffer 8***	♦R/W	043A	41083
P04.59	***PLC Buffer 9***	♦R/W	043B	41084
P04.60	***PLC Buffer 10***	♦R/W	043C	41085
P04.61	***PLC Buffer 11***	♦R/W	043D	41086
P04.62	***PLC Buffer 12***	♦R/W	043E	41087
P04.63	***PLC Buffer 13***	♦R/W	043F	41088
P04.64	***PLC Buffer 14***	♦R/W	0440	41089
P04.65	***PLC Buffer 15***	♦R/W	0441	41090
P04.66	***PLC Buffer 16***	♦R/W	0442	41091
P04.67	***PLC Buffer 17***	♦R/W	0443	41092
P04.68	***PLC Buffer 18***	♦R/W	0444	41093
P04.69	***PLC Buffer 19***	♦R/W	0445	41094

Range/Units (Format: 16-bit unsigned)	Default
0–65535	0

You can combine the PLC buffer with the built-in PLC function for a variety of applications.

Group P05.xx Details – Motor Parameters

In this parameter group, the following are abbreviations for different types of motors:

- *IM: Induction motor*
- *PM: Permanent magnet synchronous AC motor*
- *IPM: Interior permanent magnet synchronous AC motor*
- *SPM: Surface permanent magnet synchronous AC motor*

		Type	Hex Addr	Dec Addr
P05.00	***Motor Parameter Auto-tuning***	R/W	0000	41281
	Range/Units (Format: 16-bit binary)	*Default*		
	0: No function 1: Dynamic test for induction motor (IM) 2: Static test for induction motor (IM) 4: Dynamic test for PM magnetic pole 5: Rotary tuning for PM motor 12: FOC sensorless inertia estimation (IM) 13: Static tune for PM motor	0		

Setting 1 can be used for P00.10=2 Torque mode and P00.11=5 FOC sensorless mode only.

Drive motion will occur during these tests.

When auto tuning is in process, “TUN” will display on the drive keypad.

For PM motors, tune motor with no load connected. P05.00=5 provides more accurate calculation of the Ke parameter (P05.43) based on actual motor rotation. When P05.00=13, the Ke parameter is calculated based on the motor power, current and rotor speed.

See Adjustment and Applications section for detailed tuning procedures.

		Type	Hex Addr	Dec Addr
P05.01	***Full-load Current for Induction Motor 1 (A)***	Read	0501	41282
	Range/Units (Format: 16-bit unsigned)	*Default*		
	10–120 % of the drive’s rated current	Model dependent		

Sets this value according to the rated current of the motor as indicated on the motor nameplate. The default is 90% of the drive’s rated current.

Example:

The rated current for a 7.5 hp (5.5 kW) motor is 25A. The default is 22.5 A.

The setting range is 2.5–30 A (25 × 10% = 2.5 A and 25 × 120% = 30A).

		Type	Hex Addr	Dec Addr
P05.02	***Rated Power for Induction Motor 1 (kW)***	♦R/W	0502	41283
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 kW	Model dependent		

P05.02 sets the rated power for motor 1. The default is the drive’s power value.

		Type	Hex Addr	Dec Addr
P05.03	***Rated Speed for Induction Motor 1 (rpm)***	♦R/W	0503	41284
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–xxxxx rpm (Depending on the motor’s number of poles) 1710 (60Hz 4 poles); 1410 (50Hz 4 poles)	Dependent on the motor’s number of poles		

P05.03 sets the rated speed for the motor as indicated on the motor nameplate.

This parameter works in conjunction with the Number of Poles and Hertz. Set up P01.01 and P05.04 before setting up P05.03 to ensure that the motor operates normally.

		Type	Hex Addr	Dec Addr
P05.04	***Number of Poles for Induction Motor 1***	R/W	0504	41285
	Range/Units (Format: 16-bit unsigned)	*Default*		
	2–20	4		

P05.04 sets the number of poles for the motor (must be an even number).

		Type	Hex Addr	Dec Addr
P05.05	***No-load Current for Induction Motor 1 (Amps)***	R/W	0505	41286
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–P05.01 default	Model dependent		

The default is 40% of the motor's rated current.

		Type	Hex Addr	Dec Addr
P05.06	***Stator Resistance (Rs) for Induction Motor 1***	R/W	0506	41287
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 Ω	Model dependent		

		Type	Hex Addr	Dec Addr
P05.07	***Rotor Resistance (Rr) for Induction Motor 1***	R/W	0507	41288
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 Ω	0.000		

		Type	Hex Addr	Dec Addr
P05.08	***Magnetizing Inductance (Lm) for Induction Motor 1***	R/W	0508	41289
P05.09	***Stator Inductance (Lx) for Induction Motor 1***	R/W	0509	41290
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5 mH	0.0		

		Type	Hex Addr	Dec Addr
P05.13	***Full-load Current for Induction Motor 2 (A)***	R/W	050D	41294
	Range/Units (Format: 16-bit unsigned)	*Default*		
	10–120 % of the drive's rated current	Model dependent		

Set P05.13 according to the rated current of the motor as indicated on the motor nameplate. The default is 90% of the drive's rated current.

Example:

The rated current for a 7.5 hp (5.5 kW) motor is 25A. The default is 22.5 A.

The setting range is 2.5–30 A (25 × 10 % = 2.5 A and 25 × 120 % = 30A).

		Type	Hex Addr	Dec Addr
P05.14	***Rated Power for Induction Motor 2 (kW)***	♦R/W	050E	41295
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 kW	Model dependent		

P05.14 sets the rated power for motor 2. The default is the drive's power value.

		Type	Hex Addr	Dec Addr
P05.15	***Rated Speed for Induction Motor 2 (rpm)***	♦R/W	050F	41296
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–xxxxx rpm (Depending on the motor's number of poles) 1710 (60Hz 4 poles); 1410 (50Hz 4 poles)	Dependent on the motor's number of poles		

P05.15 sets the rated speed for the motor as indicated on the motor nameplate.

This parameter works in conjunction with the Number of Poles and Hertz. Set up P01.35 and P05.16 before setting up P05.15 to ensure that the motor operates normally.

		Type	Hex Addr	Dec Addr
P05.16	***Number of Poles for Induction Motor 2***	R/W	0510	41297
	Range/Units (Format: 16-bit unsigned)	*Default*		
	2–20	4		

P05.16 sets the number of poles for the motor (must be an even number).

Check P05.15 for accuracy after changing this value.

		Type	Hex Addr	Dec Addr
P05.17	***No-load Current for Induction Motor 2 (Amps)***	R/W	0511	41298
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–P05.13 default	Model dependent		

The default is 40% of the motor's rated current.

		Type	Hex Addr	Dec Addr
P05.18	***Stator Resistance (Rs) for Induction Motor 2***	R/W	0512	41299
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 Ω	Model dependent		

		Type	Hex Addr	Dec Addr
P05.19	***Rotor Resistance (Rr) for Induction Motor 2***	R/W	0513	41300
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 Ω	0.000		

		Type	Hex Addr	Dec Addr
P05.20	***Magnetizing Inductance (Lm) for Induction Motor 2***	R/W	0514	41301
P05.21	***Stator Inductance (Lx) for Induction Motor 2***	R/W	0515	41302
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5 mH	0.0		

		Type	Hex Addr	Dec Addr
P05.22	***Multi-motor (Induction) Selection***	R/W	0516	41303
	Range/Units (Format: 16-bit binary)	*Default*		
	1: Motor 1 2: Motor 2 3: Motor 3 (VF or SVC control mode only) 4: Motor 4 (VF or SVC control mode only)	1		

P05.22 sets the motor operated by the AC motor drive. Multi-motor selection only supports single control mode. For example, when you set motor 1 as SVC control mode, the control mode of motors 2–4 are also set as SVC

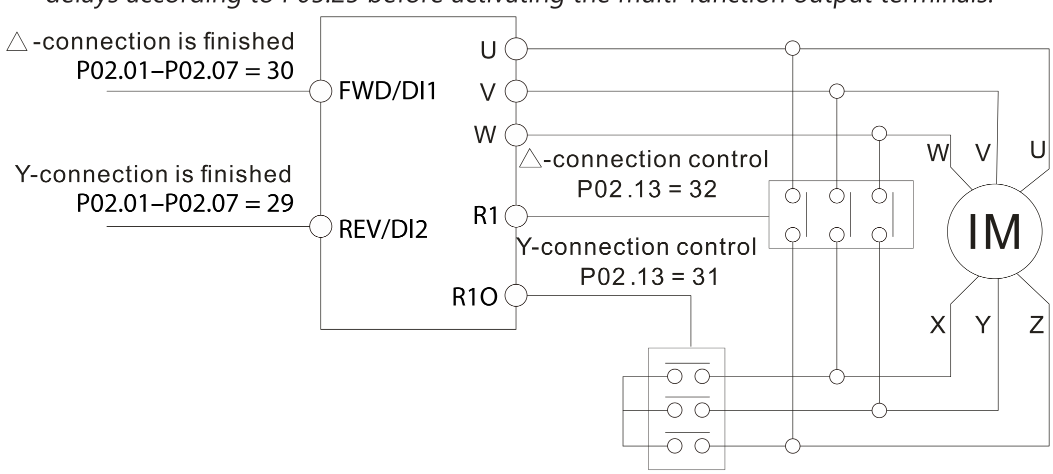
		Type	Hex Addr	Dec Addr
P05.23	***Frequency for Y-connection /Δ-connection Switch for an Induction Motor***	♦R/W	0517	41304
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	60.00		

		Type	Hex Addr	Dec Addr
P05.24	***Y-connection /Δ-connection Switch for an Induction Motor***	R/W	0518	41305
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Enable	0		

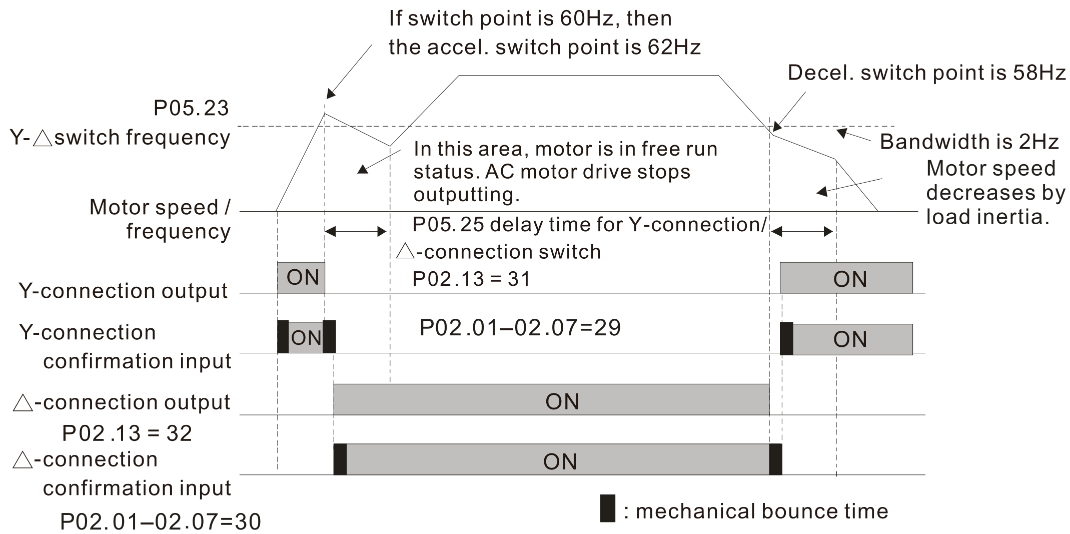
		Type	Hex Addr	Dec Addr
P05.25	***Delay Time for Y-connection/Δ-connection Switch for an Induction Motor***	♦R/W	0519	41306
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–60.000 sec.	0.200		

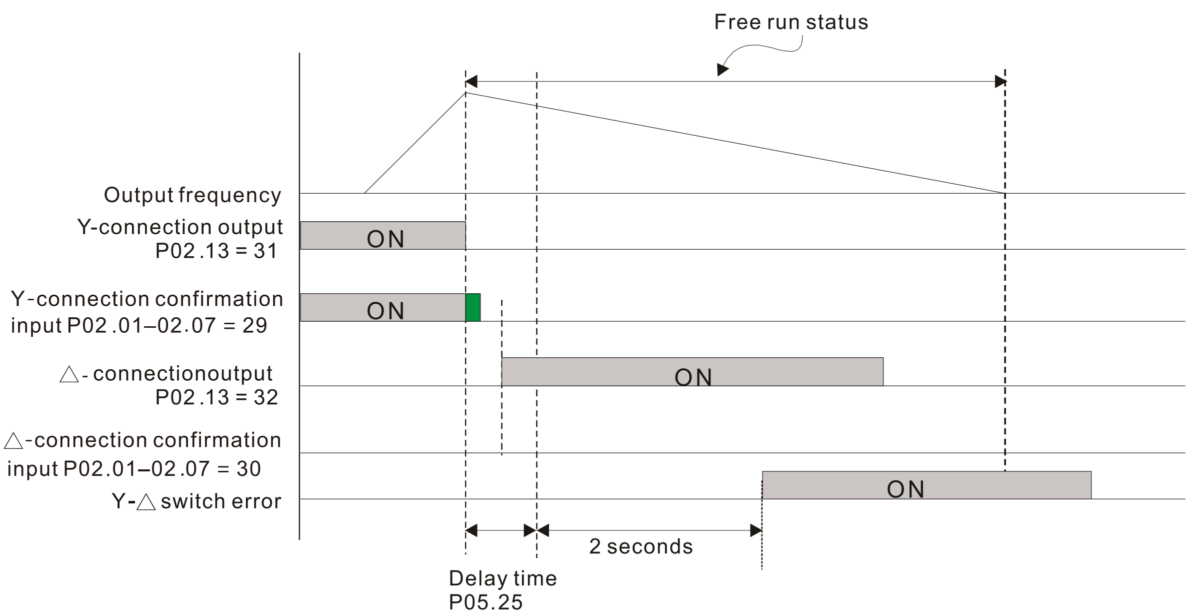
You can apply P05.23–P05.25 in wide range motors, and the motor coil executes the Y-connection/Δ-connection switch as required. The wide range motors are related to the motor design. In general, the motor has higher torque with low speed Y-connection and has higher speed with high speed Δ-connection.

- *P05.24 enables and disables the switch of Y-connection/Δ-connection.*
- *When you set P05.24 to 1, the drive uses the P05.23 setting and current motor frequency, and switches the current motor to Y-connection or Δ-connection. You can switch the relevant motor parameter settings simultaneously.*
- *P05.25 sets the switch delay time of Y-connection/Δ-connection.*
- *When the output frequency reaches the Y-connection/Δ-connection switch frequency, the drive delays according to P05.25 before activating the multi-function output terminals.*



Y- △connection switch: can be used for wide range motor
Y -connection for low speed: higher torque can be used for rigid tapping
△-connection for high speed: higher speed can be used for high-speed drilling





		Type	Hex Addr	Dec Addr
P05.26	***Accumulated Watt-second for a Motor (W-msec.)***	Read	051A	41307
P05.27	***Accumulated Watt-second for a Motor (W-sec. or joule)***	Read	051B	41308
P05.28	***Accumulated Watt-hour for a Motor (W-hour)***	Read	051C	41309
P05.29	***Accumulated Watt-hour for a Motor (kW-hour)***	Read	051D	41310
P05.30	***Accumulated Watt-hour for a Motor (MW-hour)***	Read	051E	41311
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Read only	0		

Parameters P05.26–P05.30 record the amount of power the motors consume. The accumulation begins when the drive is activated and the record is saved when the drive stops or turns OFF. The amount of consumed watts continues to accumulate when the drive is activated again. To clear the accumulation, set P00.02 to 5 to return the accumulation record to 0.

- *The accumulated total watts of the motor per second = P05.27 x 65536 + P05.26.*
  Example: When P05.26 = 2548.1 and P05.27 = 15.2, the accumulated total watts of the motor per second = 15.2 x 65536 + 2548.1 = 996147.2 + 2548.1 = 998695.3*

- *The accumulated total kilowatts of the motor per hour = P05.30 x 65536 + P05.29.*
  Example: When P05.29 = 3361.4 and P05.30 = 11.2, the accumulated total kilowatts of the motor per hour = 11.2 x 65536 + 3361.4 = 734003.2 + 3361.4 = 737364.6

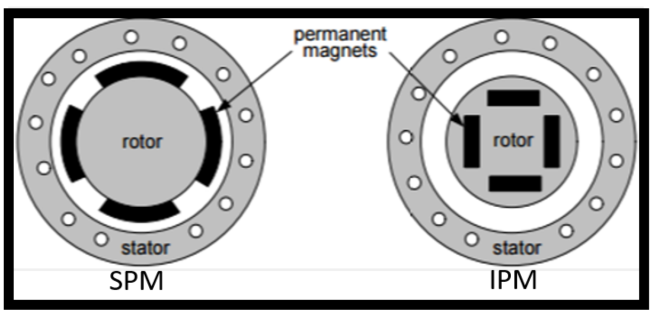
		Type	Hex Addr	Dec Addr
P05.31	***Accumulated Motor Operation Time (minutes)***	R/W	051F	41312
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–1439	0		

		Type	Hex Addr	Dec Addr
P05.32	***Accumulated Motor Operation Time (days)***	R/W	0520	41313
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535	0		

Use P05.31 and P05.32 to record the motor operation time. To clear the operation time, set P05.31 and P05.32 to 0. An operation time shorter than 60 seconds is not recorded.

		Type	Hex Addr	Dec Addr
P05.33	***Induction Motor (IM) or Permanent Magnet Synchronous AC Motor Selection***	R/W	0521	41314
	Range/Units (Format: 16-bit binary)	*Default*		
	0: IM (Induction motor) 1: SPM (Surface permanent magnet synchronous AC motor) 2: IPM (Interior permanent magnet synchronous AC motor)	0		

On SPM motors, magnets are mounted on the exterior of the rotor shaft. On IPM motors, magnets are mounted inside of the rotor shaft.



		Type	Hex Addr	Dec Addr
P05.34	***Full-load Current for a Permanent Magnet Synchronous AC Motor***	R/W	0522	41315
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–120% of the drive's rated current	Model dependent		

		Type	Hex Addr	Dec Addr
P05.35	***Rated Power for a Permanent Magnet Synchronous AC Motor***	R/W	0523	41316
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 kW	Model dependent		

Sets the rated power for the permanent magnet synchronous AC motor. The default is the drive's power value.

		Type	Hex Addr	Dec Addr
P05.36	***Rated Speed for a Permanent Magnet Synchronous AC Motor***	R/W	0524	41317
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535 rpm	2000		

		Type	Hex Addr	Dec Addr
P05.37	***Number of Poles for a Permanent Magnet Synchronous AC Motor***	R/W	0525	41318
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535	10		

		Type	Hex Addr	Dec Addr
P05.39	***Stator Resistance for a Permanent Magnet Synchronous AC Motor***	R/W	0527	41320
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 Ω	0.000		

		Type	Hex Addr	Dec Addr
P05.40	***Permanent Magnet Synchronous AC Motor Ld***	R/W	0528	41321
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 mH	0.00		

		Type	Hex Addr	Dec Addr
P05.41	***Permanent Magnet Synchronous AC Motor Lq***	R/W	0529	41322
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 mH	0.00		

		Type	Hex Addr	Dec Addr
P05.42	***PG Offset Angle for a Permanent Magnet Synchronous MOtor***	R/W	052A	41323
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–360.0º	0.0		

When P05.00=4, the drive detects the offset angle and writes it into P05.42.

		Type	Hex Addr	Dec Addr
P05.43	***Ke parameter of a Permanent Magnet Synchronous AC Motor***	R/W	052B	41324
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535 V / krpm	0		

		Type	Hex Addr	Dec Addr
P05.64	***Full-load Current for Induction Motor 3 (A)***	R/W	0540	41345
	Range/Units (Format: 16-bit unsigned)	*Default*		
	10–120% of the drive's rated current	Model dependent		

Set this value according to the rated current of the motor as indicated on the motor nameplate. The default is 90% of the drive's rated current.

Example:

The rated current for a 7.5 hp (5.5 kW) motor is 25A. The default is 22.5 A.

The setting range is 2.5–30 A (25 × 10 % = 2.5 A and 25 × 120 % = 30A).

		Type	Hex Addr	Dec Addr
P05.65	***Rated Power for Induction Motor 3 (kW)***	♦R/W	0541	41346
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 kW	Model dependent		

P05.65 sets the rated power for motor 3. The default is the drive's power value.

		Type	Hex Addr	Dec Addr
P05.66	***Rated Speed for Induction Motor 3 (rpm)***	♦R/W	0542	41347
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–xxxxx rpm (Depending on the motor's number of poles) 1710 (60Hz 4 poles); 1410 (50Hz 4 poles)	Dependent on the motor's number of poles		

P05.66 sets the rated speed for the motor as indicated on the motor nameplate.

		Type	Hex Addr	Dec Addr
P05.67	***Number of Poles for Induction Motor 3***	R/W	0543	41348
	Range/Units (Format: 16-bit unsigned)	*Default*		
	2–20	4		

P05.67 sets the number of poles for the motor (must be an even number).

Set up P01.54 and P05.66 before setting up P05.67 to ensure that the motor operates normally.

		Type	Hex Addr	Dec Addr
P05.68	***No-load Current for Induction Motor 3 (Amps)***	R/W	0544	41349
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–P05.64 default	Model dependent		

The default is 40% of the motor's rated current.

		Type	Hex Addr	Dec Addr
P05.69	***Stator Resistance (Rs) for Induction Motor 3***	R/W	0545	41350
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 Ω	Model dependent		

		Type	Hex Addr	Dec Addr
P05.70	***Full-load Current for Induction Motor 4 (Amps)***	R/W	0546	41351
	Range/Units (Format: 16-bit unsigned)	*Default*		
	10–120% of the drive's rated current	Model dependent		

Set this value according to the rated current of the motor as indicated on the motor nameplate. The default is 90% of the drive's rated current.

Example:

The rated current for a 7.5 hp (5.5 kW) motor is 25A. The default is 22.5 A.

The setting range is 2.5–30 A (25 × 10% = 2.5 A and 25 × 120% = 30A).

		Type	Hex Addr	Dec Addr
P05.71	***Rated Power for Induction Motor 4 (kW)***	♦R/W	0547	41352
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 kW	Model dependent		

P05.71 sets the rated power for motor 4. The default is the drive's power value.

		Type	Hex Addr	Dec Addr
P05.72	***Rated Speed for Induction Motor 4 (rpm)***	♦R/W	0548	41353
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–xxxxx rpm (Depending on the motor's number of poles) 1710 (60Hz 4 poles); 1410 (50Hz 4 poles)	Dependent on the motor's number of poles		

P05.72 sets the rated speed for the motor as indicated on the motor nameplate.

		Type	Hex Addr	Dec Addr
P05.73	***Number of Poles for Induction Motor 4***	R/W	0549	41354
	Range/Units (Format: 16-bit unsigned)	*Default*		
	2–20	4		

P05.73 sets the number of poles for the motor (must be an even number).
Set up P01.63 and P05.72 before setting up P05.73 to make sure the motor operates normally.

		Type	Hex Addr	Dec Addr
P05.74	***No-load Current for Induction Motor 4 (Amps)***	R/W	054A	41355
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–P05.70 default	Model dependent		

The default is 40% of the motor's rated current.

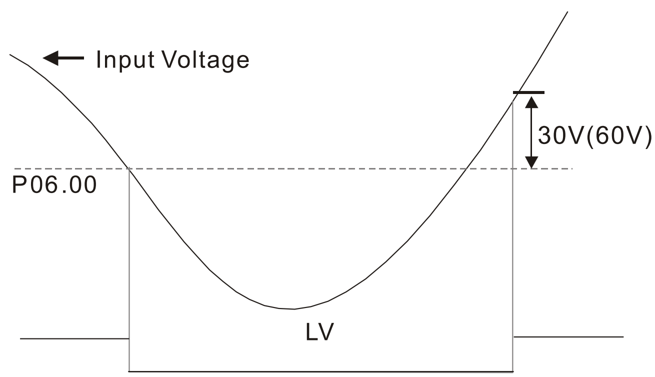
		Type	Hex Addr	Dec Addr
P05.75	***Stator Resistance (Rs) for Induction Motor 4***	R/W	054B	41356
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 Ω	Model dependent		

Group P06.xx Details – Protection Parameters

		Type	Hex Addr	Dec Addr
P06.00	**Low Voltage Level**	♦R/W	0600	41537
	Range/Units (Format: 16-bit unsigned)	Default		
	230V series: 150.0–220.0 VDC	180.0		
	460V series: 300.0–440.0 VDC	360.0		

P06.00 sets the Low Voltage (LV) level. When the DC bus voltage is lower than P06.00 an LV fault is triggered.

- *If the LV fault is triggered during operation, the drive stops output and the motor coasts to a stop. There are three LV faults, LvA (LV during acceleration), Lvd (LV during deceleration), and Lvn (LV in constant speed) that are triggered according to the status of acceleration or deceleration. You must press RESET to clear the LV fault. The drive automatically restarts if set to restart after momentary power loss (refer to P07.06 Restart after Momentary Power Loss and P07.07 Allowed Power Loss Duration for details).*
- *If the LV fault is triggered when the drive is in STOP status, the drive displays LvS (LV during stop), which is not recorded, and the drive restarts automatically when the input voltage is higher than the LV level +30V (230V series) or +60V (460V series).*



		Type	Hex Addr	Dec Addr
P06.01	**Over-voltage Stall Prevention**	♦R/W	0601	41538
	Range/Units (Format: 16-bit unsigned)	Default		
	0: Disabled			
	230V: 0.0–390.0 VDC	380.0		
	460V: 0.0–900.0 VDC	760.0		

Set P06.01 to 0.0 to disable the over-voltage stall prevention function (connected with braking unit or braking resistor). Use this setting when braking units or braking resistors are connected to the drive.

Set P06.01 to a value > 0.0 to enable the over-voltage stall prevention. This setting refers to the power supply system and loading. If the setting is too low, then over-voltage stall prevention is easily activated, which may increase deceleration time.

Related parameters:

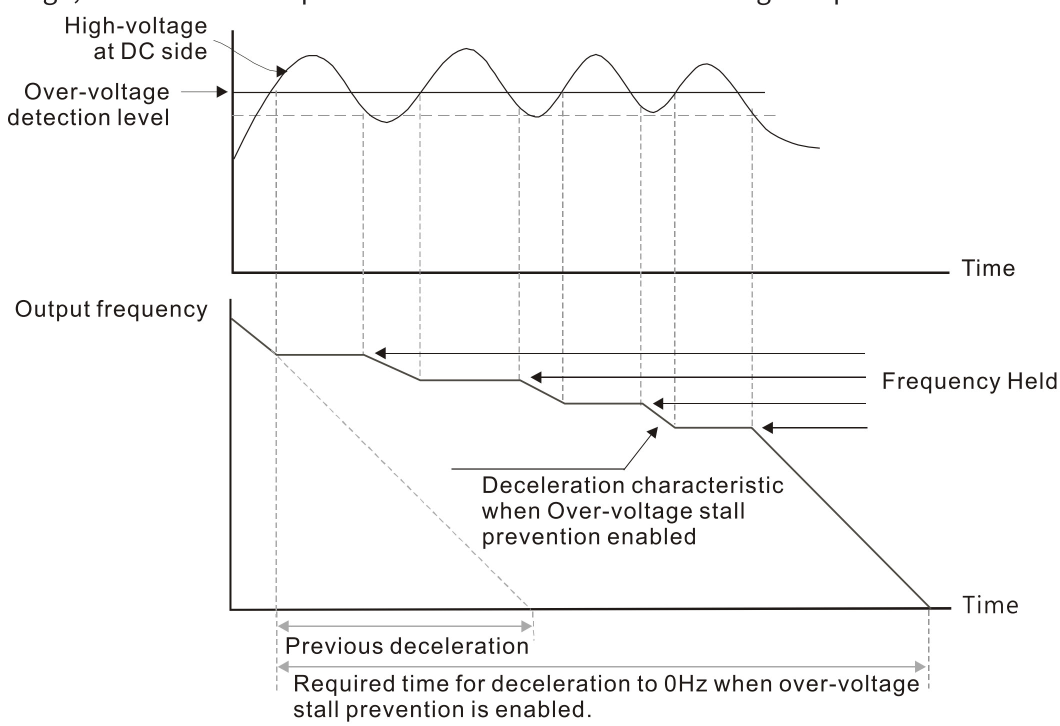
P01.13, P01.15, P01.17, P01.19 Deceleration Time 1–4, P02.13 Multi-function Output 1 (R1), P02.16–P02.17 Multi-function Output (DO1, DO2), and P06.02 Selection for Over-voltage Stall Prevention.

		Type	Hex Addr	Dec Addr
P06.02	***Selection for Over-voltage Stall Prevention***	♦R/W	0602	41539
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Traditional over-voltage stall prevention	0		
	1: Smart over-voltage stall prevention			
	2: Traditional over-voltage and smart over-current stall prevention			
	3: Smart over-voltage and smart over-current stall prevention			

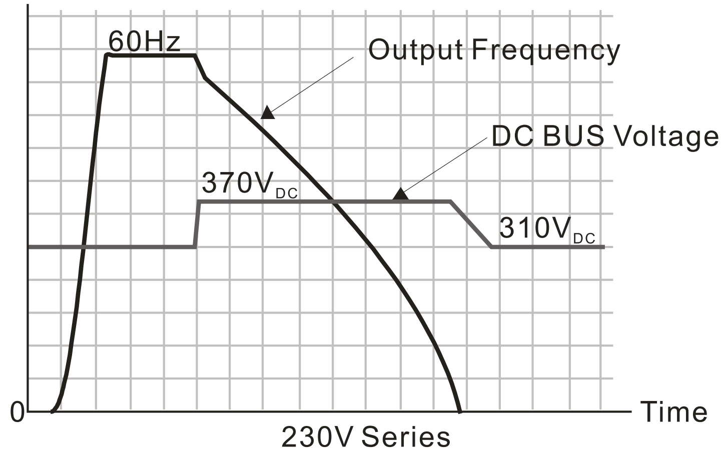
Use this function when you are unsure about the load inertia. When stopping under normal load, the over-voltage does not occur during deceleration and meet the deceleration time setting.

If an over-voltage occurs during deceleration to STOP due to a regenerative inertial load increase, then the AC motor drive extends the deceleration time automatically until the drive stops.

When P06.02 is set to 0, and during deceleration the motor exceeds the synchronous speed due to high load inertia (the motor becomes an electrical generator), then the DC bus voltage may exceed its maximum allowable value due to motor regeneration, or drive deceleration time being set too short. When traditional over-voltage stall prevention is enabled, if the DC bus voltage detected is too high, then the drive stops deceleration until the DC bus voltage drops below the setting value.



When P06.02 is set to 1 (smart over-voltage stall prevention), during deceleration the drive maintains the DC bus voltage preventing drive OV.



When you enable the over-voltage stall prevention, the drive's deceleration time is longer than the setting. If you encounter any problem with the deceleration time, refer to the following guides for troubleshooting.

1) Increase the deceleration time to a proper value.
2) Install a braking resistor (refer to Accessories appendix for details) to dissipate the electrical energy that is generated from the motor.

Related parameters:

P01.13, P01.15, P01.17, P01.19 Deceleration Time 1–4, P02.13 Multi-function Output 1 (Relay 1), P02.16–P02.17 Multi-function Output (DO1, DO2), and P06.01 Over-voltage Stall Prevention.

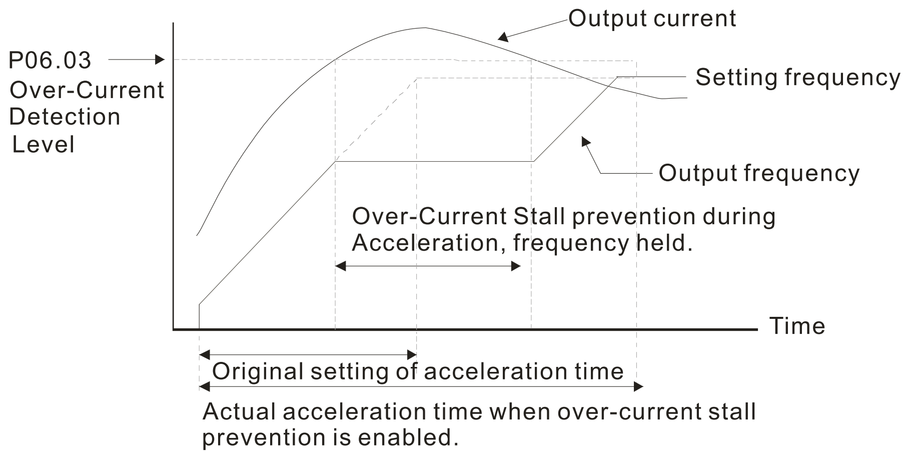
		Type	Hex Addr	Dec Addr
P06.03	***Over-current Stall Prevention during Acceleration***	♦R/W	0603	41540
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Variable Torque (VT): 0–150% (100% corresponds to the rated current of the drive)	120		
	Constant Torque (CT): 0–200% (100% corresponds to the rated current of the drive)	180		

In constant torque mode (P00.16=1), if the DC voltage is higher than 700VDC (460V series) or 350VDC (230 series), the maximum value for P06.03 is 185%.

- *If the motor load is too large or the drive's acceleration time is too short, the output current of the drive may be too high during acceleration, and it may cause motor damage or trigger the drive's protection functions (OL or OC). Use this parameter to prevent these situations.*
- *During acceleration, the output current of the drive may increase abruptly and exceed the setting value of P06.03. In this case, the drive stops accelerating and keeps the output frequency constant, and then continues to accelerate until the output current decreases.*
- *When you enable the over-current stall prevention, the drive's acceleration time is longer than the setting.*
- *When the over-current stall prevention occurs because the motor capacity is too small or operates in the default, decrease the P06.03 setting value.*
- *If you encounter any problem with the acceleration time, refer to the following guides for troubleshooting.*
  a) Increase the deceleration time to a proper value.
  b) Set P01.44 Auto-Acceleration and Auto-Deceleration Setting to 1, 3 or 4 (auto-acceleration)

Related parameters:

P01.12, P01.14, P01.16, P01.18 (Acceleration Time 1–4), P01.44. Auto-Acceleration and Auto-Deceleration Setting, P02.13 Multi-function Output 1 (Relay 1), P02.16–P02.17 Multi-function Output (DO1, DO2).



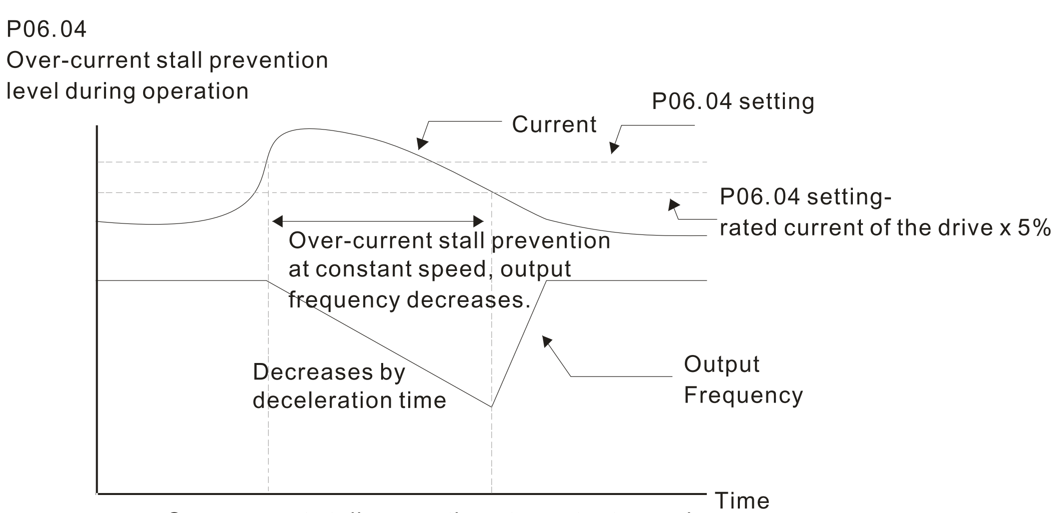
		Type	Hex Addr	Dec Addr
P06.04	***Over-current Stall Prevention during Operation***	♦R/W	0604	41541

Range/Units (Format: 16-bit unsigned) — *Default*: 120 / 180

Variable Torque (VT): 0–150%
(100% corresponds to the rated current of the drive)
Constant Torque (CT): 0–200%
(100% corresponds to the rated current of the drive)

In constant torque mode (P00.16=1), if the DC voltage is higher than 700VDC (460V series) or 350VDC (230 series), the maximum value for P06.04 is 185%.

- *This is a protection for the drive and decreases output frequency automatically when the motor overloads abruptly during constant motor operation.*
- *If the output current exceeds the setting value for P06.04 when the drive is operating, the drive decelerates according to the P06.05 setting to prevent the motor from stalling. If the output current is lower than the setting value for P06.04, the drive accelerates (according to P06.05) to the setting frequency.*



Over-current stall prevention at constant speed

		Type	Hex Addr	Dec Addr
P06.05	***Acceleration/Deceleration Time Selection for Stall Prevention at Constant Speed***	♦R/W	0605	41542

Range/Units (Format: 16-bit binary) — *Default*: 0

0: By current acceleration / deceleration time
1: By the first acceleration / deceleration time
2: By the second acceleration / deceleration time
3: By the third acceleration / deceleration time
4: By the fourth acceleration / deceleration time
5: By auto-acceleration / auto-deceleration

P06.05 sets the acceleration / deceleration time selection when stall prevention occurs at constant speed.

		Type	Hex Addr	Dec Addr
P06.06	***Over-torque Detection Selection (Motor 1)***	♦R/W	0606	41543
P06.09	***Over-torque Detection Selection (Motor 2)***	♦R/W	0609	41546

Range/Units (Format: 16-bit binary) — *Default*: 0

0: No function
1: Continue operation after over-torque detection during constant speed operation
2: Stop after over-torque detection during constant speed operation
3: Continue operation after over-torque detection during RUN
4: Stop after over-torque detection during RUN

When you set P06.06 and P06.09 to 1 or 3, a warning message displays but there is no error record.

When you set P06.06 and P06.09 to 2 or 4, an error message displays and there is an error record.

		Type	Hex Addr	Dec Addr
P06.07	***Over-torque Detection Level (Motor 1)***	♦R/W	0607	41544
P06.10	***Over-torque Detection Level (Motor 2)***	♦R/W	060A	41547

Range/Units (Format: 16-bit unsigned) — *Default*: 120

10–250% (100% corresponds to the rated current of the drive)

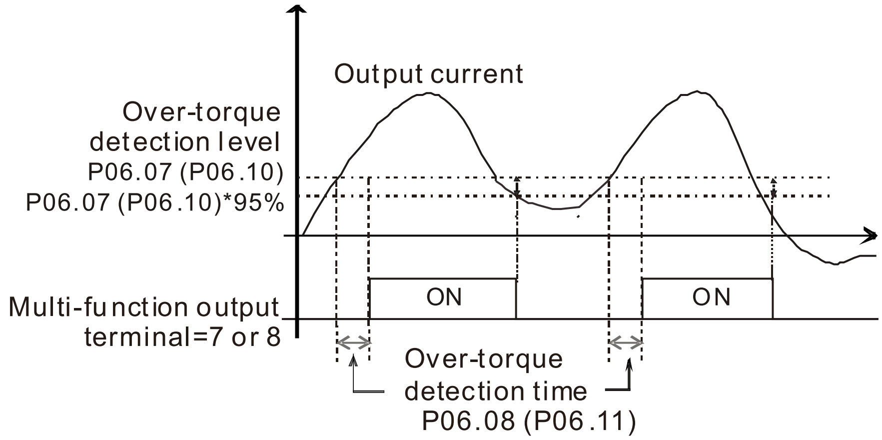
		Type	Hex Addr	Dec Addr
P06.08	***Over-torque Detection Time (Motor 1)***	♦R/W	0608	41545
P06.11	***Over-torque Detection Time (Motor 2)***	♦R/W	060B	41548

Range/Units (Format: 16-bit unsigned) — *Default*: 0.1

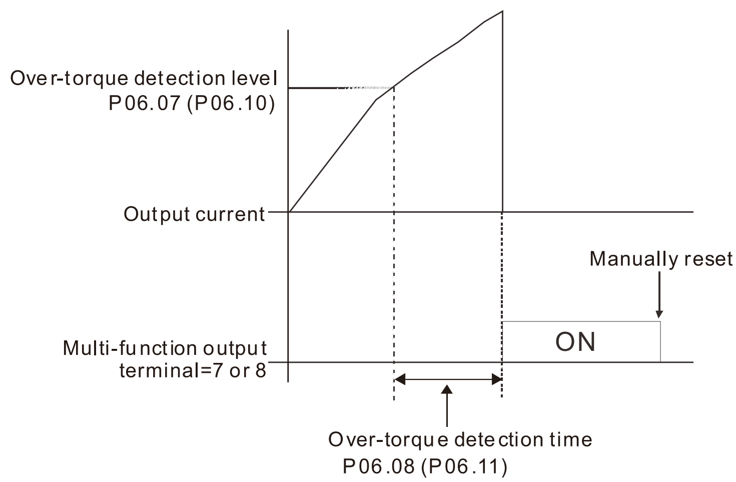
0.1–60.0 sec.

When the output current exceeds the over-torque detection level (P06.07 or P06.10) and also exceeds the over-torque detection time (P06.08 or P06.11), the over-torque detection follows the setting of P06.06 and P06.09.

- *When you set P06.06 or P06.09 to 1 or 3, an ot1 / ot2 warning displays while the drive keeps running after over-torque detection. The warning remains on until the output current is smaller than 5% of the over-torque detection level.*



- *When you set P06.06 or P06.09 to 2 or 4, an ot1 / ot2 warning displays and the drive stops running after over-torque detection. The drive does not run until you manually reset it.*



		Type	Hex Addr	Dec Addr
P06.12	***Current Limit***	♦R/W	060C	41549
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–250% (100% corresponds to the rated current of the drive)	150		

This parameter limits the current output of the drive in all control modes.

		Type	Hex Addr	Dec Addr
P06.13	***Electronic Thermal Relay Selection 1 (Motor 1)***	♦R/W	060D	41550
P06.27	***Electronic Thermal Relay Selection 2 (Motor 2)***	♦R/W	061B	41564
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Inverter motor (with external forced cooling) 1: Standard motor (motor with fan on the shaft) 2: Disable	1		

These parameters prevent self-cooled motors from overheating under low speed. Use an electronic thermal relay to limit the drive's output power. A value of 1 or 2 is recommended for most applications to better protect the motor.

- *Setting the parameter to 0 is suitable for an inverter motor (motor fan using an independent power supply). For this kind of motor, there is no significant correlation between cooling capacity and motor speed. Therefore, the action of electronic thermal relays remains stable in low speed to ensure the load capability of the motor in low speed.*

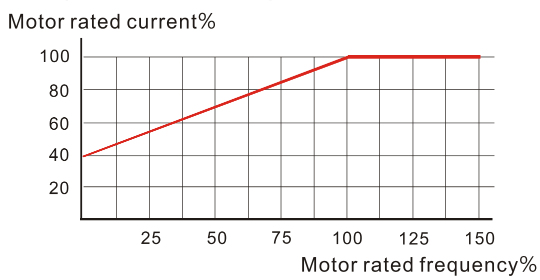
- *Setting the parameter to 1 is suitable for standard motor (motor fan is fixed on the rotor shaft). For this kind of motor, the cooling capacity is lower in low speed; therefore, the action of an electronic thermal relay reduces the action time to ensure the life of motor.*
- *When the power is cycled frequently, the electronic thermal relay protection is reset when the power is switched OFF; therefore, even setting the parameter to 0 or 1 may not protect the motor well. If there are several motors connected to one drive, install an electronic thermal relay in each motor.*

		Type	Hex Addr	Dec Addr
P06.14	***Electronic Thermal Relay Action Time 1 (Motor 1)***	♦R/W	060E	41551
P06.28	***Electronic Thermal Relay Action Time 2 (Motor 2)***	♦R/W	061C	41565
	Range/Units (Format: 16-bit unsigned)	*Default*		
	30.0–600.0 sec.	60.0		

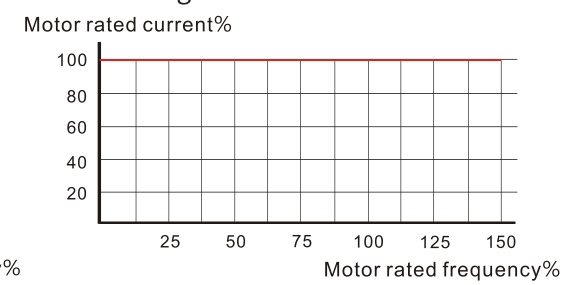
The electronic thermal relay amperage threshold is based on 150% of the parameter value in "Full Load Current for Induction Motor X" (P5.01 for motor 1, P5.13 for motor 2).

Set Parameter 06.14 or 06.28 for the amount of time the motor exceeds this threshold. Proper setup will prevent motor damage due to overheating. When it reaches the setting, the drive displays "EoL3 / EoL4", and the motor coasts to stop.

Use this parameter to set the action time of the electronic thermal relay. It works based on the I2t characteristic curve of electronic thermal relay, the output frequency and current of the drive, and the operation time to prevent the motor from overheating.



Motor cooling curve with shaft-fixed fan

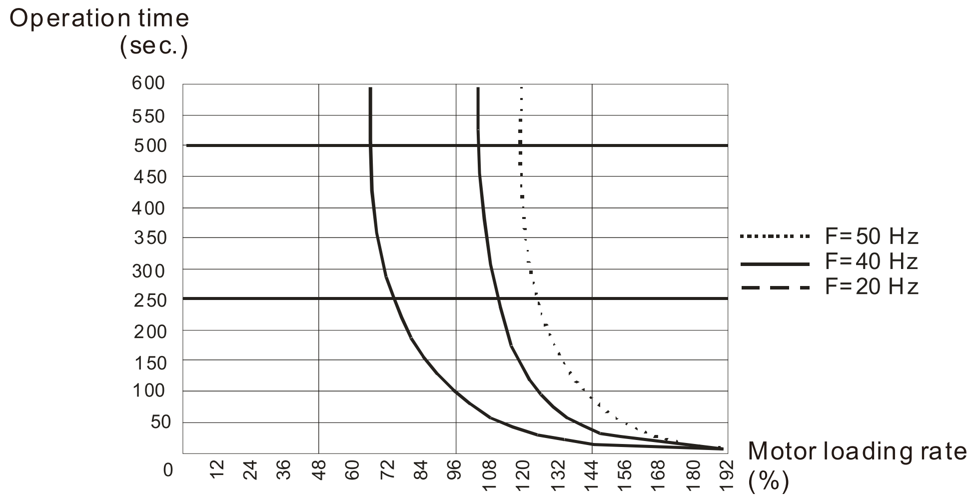


Motor cooling curve with independent fan

The action of the electronic thermal relay depends on the settings for P06.13 and P06.27.

1) P06.13 or P06.27 is set to 0 (using inverter motor):
   When the output current of the drive is higher than 150% of the motor rated current (refer to the motor rated current % corresponded to the motor rated frequency in the motor cooling curve with independent fan), the drive starts to count the time. The electronic thermal relay acts when the accumulated time exceeds P06.14 or P06.28.

2) P06.13 or P06.27 is set to 1 (using standard motor):
When the output current of the drive is higher than 150% of the motor rated current (refer to the motor rated current % corresponded to the motor rated frequency in the motor cooling curve with shaft-fixed fan), the drive starts to count the time. The electronic thermal relay acts when the accumulated time exceeds P06.14 or P06.28.
The actual electronic thermal relay action time adjusts according to the drive output current (shown as the motor loading rate %). The action time is short when the current is high, and the action time is long when the current is low. Refer to the following diagram.



	Type	Hex Addr	Dec Addr
P06.15 ***Temperature Level Overheat (OH) Warning***	♦R/W	060F	41552
Range/Units (Format: 16-bit unsigned)	*Default*		
0.0–110.0°C	Model dependent		

P06.15 sets the drive's internal IGBT overheat warning level. When the temperature is higher than P06.15 setting, the oH1 fault displays and the warning remains but it does not affect the drive operation.

- *Use this parameter to check the motor overheat in advance in order to take precautionary measures to decrease the temperature and maintain the motor's normal operation.*
- *If you set the temperature 5ºC higher than the maximum setting value for P06.15, IGBT overheating occurs and the drive stops. Refer to oH1 fault descriptions for details.*

	Type	Hex Addr	Dec Addr
P06.16 ***Stall Prevention Limit Level (Weak Magnetic Field Current Stall Prevention Level)***	♦R/W	0610	41553
Range/Units (Format: 16-bit unsigned)	*Default*		
0–100% (Refer to P06.03–P06.04)	100		

P06.16 only works in VF, VFPG, and SVC control mode.

Sets the over-current stall prevention level when the motor's operation frequency is larger than P01.01 (base frequency).

Example:

When P06.03 = 150%, P06.04 = 100% and P06.16 = 80%.

- *The over-current stall prevention level during acceleration:*
  *P06.03 * P06.16 = 150 x 80% = 120%.*
- *The over-current stall prevention level during operation:*
  *P06.04 * P06.16 = 100 x 80% = 80%.*

		Type	Hex Addr	Dec Addr
P06.17	**Fault Record 1**	Read	0611	41554
P06.18	**Fault Record 2**	Read	0612	41555
P06.19	**Fault Record 3**	Read	0613	41556
P06.20	**Fault Record 4**	Read	0614	41557
P06.21	**Fault Record 5**	Read	0615	41558
P06.22	**Fault Record 6**	Read	0616	41559

Range/Units (Format: 16-bit binary) — *Default*: 0

0: No fault record
1: Over-current during acceleration (ocA)
2: Over-current during deceleration (ocd)
3: Over-current during steady operation (ocn)
4: Ground fault (GFF)
6: Over-current at stop (ocS)
7: Over-voltage during acceleration (ovA)
8: Over-voltage during deceleration (ovd)
9: Over-voltage during constant speed (ovn)
10: Over-voltage at stop (ovS)
11: Low-voltage during acceleration (LvA)
12: Low-voltage during deceleration (Lvd)
13: Low-voltage during constant speed (Lvn)
14: Low-voltage at stop (LvS)
15: Phase loss protection (orP)
16: IGBT overheating (oH1)
18: IGBT temperature detection failure (tH1o)
21: Over load (oL)
22: Electronic thermal relay 1 protection (EoL1)
23: Electronic thermal relay 2 protection (EoL2)
24: Motor PTC overheating (oH3)
26: Over torque 1 (ot1)
27: Over torque 2 (ot2)
28: Under current (uC)
31: EEPROM read error (cF2)
33: U-phase error (cd1)
34: V-phase error (cd2)
35: W-phase error (cd3)
36: cc (current clamp) hardware error (Hd0)
37: oc (over-current) hardware error (Hd1)
40: Auto-tuning error (AUE)
41: PID loss AI2 (AFE)
43: Encoder feedback loss (PGF2)
44: Encoder feedback stall (PGF3)
45: Encoder slip error (PGF4)
48: AI2 loss (ACE)
49: External fault (EF)
50: Emergency stop (EF1)
51: External base block (bb)
52: Password is locked (Pcod)
54: Illegal command (CE1)
55: Illegal data address (CE2)
56: Illegal data value (CE3)
57: Data is written to read-only address (CE4)

58: Modbus transmission time-out (CE10)
61: Y-connection / Δ-connection switch error (ydc)
62: Deceleration energy backup error (dEb)
63: Over slip error (oSL)
72: STO Loss (STL1)
76: STO (STo)
77: STO Loss 2 (STL2)
78: STO Loss 3 (STL3)
79: U-phase over-current before run (Aoc)
80: V-phase over-current before run (boc)
81: W-phase over-current before run (coc)
82: Output phase loss U phase (oPL1)
83: Output phase loss V phase (oPL2)
84: Output phase loss W phase (oPL3)
87: Low frequency overload protection (oL3)
89: Rotor position detection error (roPd)
97: Ethernet Card Timeout (CD10)
111: InrCOM time-out error (ictE)
121: Internal communication error (CP20)
123: Internal communication error (CP22)
124: Internal communication error (CP30)
126: Internal communication error (CP32)
127: Internal communication error (CP33)
128: Over-torque 3 (ot3)
129: Over-torque 4 (ot4)
134: Internal communication error (EoL3)
135: Internal communication error (EoL4)
140: Oc hardware error (Hd6)
141: GFF occurs before run (b4GFF)
142: Auto-tune error 1 (DC test stage) (AuE1)
143: Auto-tune error 2 (High frequency test stage) (AuE2)
144: Auto-tune error 3 (Rotary test stage) (AuE3)
149: Auto-tune error 5 (Rotor resistance measure test stage) (AuE5)

These parameters record when the fault occurs and forces a stop.

- *When low-voltage at stop fault (LvS) occurs, the fault is not recorded. When low-voltage during operation faults (LvA, Lvd, Lvn) occur, the faults are recorded.*
- *When dEb function is valid and enabled, the drive executes dEb and records fault code 62 to P06.17–P06.22 and P14.70–P14.73 simultaneously.*

		Type	Hex Addr	Dec Addr
P06.23	**Fault Output Option 1**	♦R/W	0617	41560
P06.24	**Fault Output Option 2**	♦R/W	0618	41561
P06.25	**Fault Output Option 3**	♦R/W	0619	41562
P06.26	**Fault Output Option 4**	♦R/W	061A	41563

Range/Units (Format: 16-bit unsigned) — Default

0–65535 (refer to bit table for fault code) — 0

Use these parameters with multi-function output terminal (set P06.23–P06.26 to 35–38) for the specific requirement. When a fault occurs, the corresponding terminals are activated. Convert the binary value to a decimal value before you enter the value for P06.23–P06.26.

Fault Code Table

Fault Code	bit 0 current	bit 1 Volt.	bit 2 OL	bit 3 SYS	bit 4 FBK	bit 5 EXI	bit 6 CE
0: No fault record							
1: Over-current during acceleration (ocA)	●						
2: Over-current during deceleration (ocd)	●						
3: Over-current during steady operation (ocn)	●						
4: Ground fault (GFF)	●						
6: Over-current at stop (ocS)	●						
7: Over-voltage during acceleration (ovA)		●					
8: Over-voltage during deceleration (ovd)		●					
9: Over-voltage during constant speed (ovn)		●					
10: Over-voltage at stop (ovS)		●					
11: Low-voltage during acceleration (LvA)		●					
12: Low-voltage during deceleration (Lvd)		●					
13: Low-voltage during constant speed (Lvn)		●					
14: Low-voltage at stop (LvS)		●					
15: Phase loss protection (orP)		●					
16: IGBT over-heat (oH1)			●				
18: IGBT temperature detection failure (tH1o)			●				
21: Drive over-load (oL)			●				
22: Electronics thermal relay 1 protection (EoL1)			●				
23: Electronics thermal relay 2 protection (EoL2)			●				
24: Motor PTC overheating (oH3)			●				
26: Over torque 1 (ot1)			●				
27: Over torque 2 (ot2)			●				
28: Under current (uC)	●						
31: EEPROM read error (cF2)				●			
33: U-phase error (cd1)				●			
34: V-phase error (cd2)				●			
35: W-phase error (cd3)				●			
36: cc (current clamp) hardware error (Hd0)				●			
37: oc (over-current) hardware error (Hd1)				●			
40: Auto-tuning error (AUE)				●			
41: PID loss AI2 (AFE)					●		
43: Encoder feedback loss (PGF2)					●		
44: Encoder feedback stall (PGF3)					●		
45: Encoder slip error (PGF4)					●		

Fault Code	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6
	current	Volt.	OL	SYS	FBK	EXI	CE
48: AI2 loss (ACE)					●		
49: External fault (EF)						●	
50: Emergency stop (EF1)						●	
51: External base block (bb)						●	
52: Password is locked (Pcod)				●			
54: Illegal command (CE1)							●
55: Illegal data address (CE2)							●
56: Illegal data value (CE3)							●
57: Data is written to read-only address (CE4)							●
58: Modbus transmission time-out (CE10)							●
61: Y-connection / Δ-connection switch error (ydc)						●	
62: Deceleration energy backup error (dEb)		●					
63: Over slip error (oSL)						●	
72: STO Loss (STL1)				●			
76: STO (STo)				●			
77: STO Loss 2 (STL2)				●			
78: STO Loss 3 (STL3)				●			
79: U-phase over-current before run (Aoc)	●						
80: V-phase over-current before run (boc)	●						
81: W-phase over-current before run (coc)	●						
82: U-phase output phase loss (oPL1)	●						
83: V-phase output phase loss (oPL2)	●						
84: W-phase output phase loss (oPL3)	●						
87: Low frequency overload protection (oL3)			●				
89: Rotor position detection error (roPd)					●		
97: Ethernet Card Timeout (CD10)							●
111: InrCOM time-out error (ictE)							●
121: Internal communication error (CP20)							●
123: Internal communication error (CP22)							●
124: Internal communication error (CP30)							●
126: Internal communication error (CP32)							●
127: Internal communication error (CP33)				●			
128: Over-torque 3 (ot3)			●				
129: Over-torque 4 (ot4)			●				
134: Electronics thermal relay 3 protection (EoL3)			●				
135: Electronics thermal relay 4 protection (EoL4)			●				
140: Oc hardware error (Hd6)				●			
141: GFF occurs before run (b4GFF)				●			
142: Auto-tuning error 1 (no feedback current error) (AUE1)				●			
143: Auto-tuning error 2 (motor phase loss error) (AUE2)				●			
144: Auto-tuning error 3 (no-load current I0 measuring error) (AUE3)				●			
149: Auto-tuning error 5 (rotor resistance measuring error) (AuE5)				●			

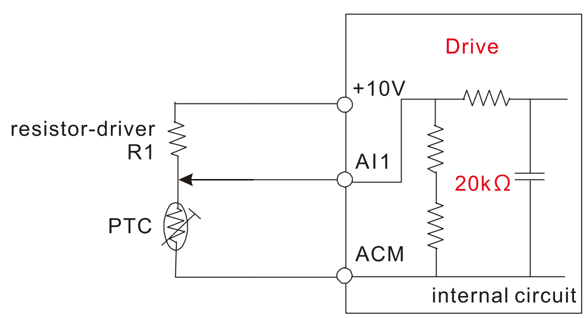
		Type	Hex Addr	Dec Addr
P06.29	***PTC Detection Selection***	♦R/W	061D	41566
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	0		

P06.29 sets the operation mode of a drive after detecting PTC (Positive Temperature Coefficient).

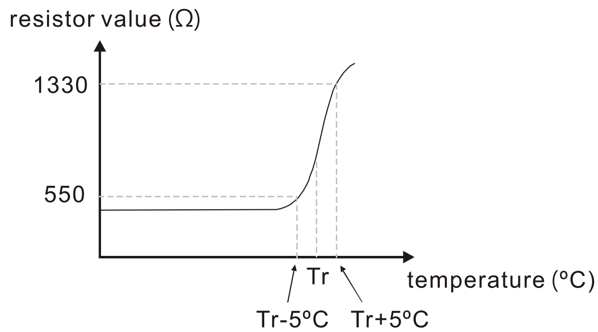
		Type	Hex Addr	Dec Addr
P06.30	***PTC Level***	♦R/W	061E	41567
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–100.0%	50.0		

P06.30 sets AI1 / AI2 analog input function P03.00–03.01 to 6 [thermistor (PTC) input value)].

- *Use this parameter to set the PTC level; 100% PTC level corresponds to the maximum analog input value.*
- *When using the AI1 terminal, you must set P03.28 to 0 and switch AI2 voltage to 0–10 V. At this time, the AI1 input impedance is 20 KΩ.*
- *When the temperature rises to the set protection level, the motor responds according to the settings for P06.29 and displays warning "oH3" (if P06.29 = 1–3). When the temperature is lower than the set protection level, you can press RESET key to clear the fault.*
- *The PTC uses the AI1-input and is connected through divider resistance as shown below:*
    a) The voltage between +10V to ACM: lies within 10–11V.
    b) The impedance for AI1 is around 20K Ω. Recommended value for divider resistance is 1K–10K Ω.
    c) Please contact your motor dealer for the curve of temperature and resistance value for PTC. Protection level (P06.30) = V+10 * (RPTC//20K) / [R1+(RPTC//20K)]
        i) V+10: voltage between +10V-ACM actual value
        ii) RPTC: motor PTC overheat protection level;
        iii) 20K Ω: the AI1 input impedance;
        iv) R1: divider resistance (recommended value: 1–10k Ω)



Take the standard PTC thermistor as an example: if the protection level is 1330 Ω, the actual voltage between +10V-ACM is 10.5 V and divider resistance R1 is 4.4k Ω.



Refer to the following calculation when P06.30 is set to 23% and motor temperature overheating protection level is 1330Ω:

1330//20000 = (1330*20000) / (1330+20000) = 1247.07

10.5 * 1247.07 / (4400+1247.07) = 2.32 (V) = 2.3 (V)

P06.30 = 2.3 / 10 V * % = 23%

		Type	*Hex Addr*	*Dec Addr*
P06.31	***Frequency Command at Malfunction***	Read	061F	41568
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	0		

When a malfunction occurs, check the current Frequency command. If it happens again, it overwrites the previous record

		Type	*Hex Addr*	*Dec Addr*
P06.32	***Output Frequency at Malfunction***	Read	0620	41569
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	0		

When a malfunction occurs, check the current output frequency. If it happens again, it overwrites the previous record.

		Type	*Hex Addr*	*Dec Addr*
P06.33	***Output Voltage at Malfunction***	Read	0621	41570
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5 V	0		

When a malfunction occurs, check the current output voltage. If it happens again, it overwrites the previous record.

		Type	*Hex Addr*	*Dec Addr*
P06.34	***DC bus Voltage at Malfunction***	Read	0622	41571
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5 V	0		

When a malfunction occurs, check the current DC bus voltage. If it happens again, it overwrites the previous record.

		Type	Hex Addr	Dec Addr
P06.35	***Output Current at Malfunction***	Read	0623	41572
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 Amp	0		

When a malfunction occurs, check the current output current. If it happens again, it overwrites the previous record.

		Type	Hex Addr	Dec Addr
P06.36	***IGBT Temperature at Malfunction***	Read	0624	41573
	Range/Units (Format: 16-bit signed)	*Default*		
	-3276.7–3276.7 °C	0		

When a malfunction occurs, check the current IGBT temperature. If it happens again, it overwrites the previous record.

		Type	Hex Addr	Dec Addr
P06.38	***Motor Speed at Malfunction***	Read	0626	41575
	Range/Units (Format: 16-bit signed)	*Default*		
	-32767–32767 rpm	0		

When a malfunction occurs, check the current motor speed in rpm. If it happens again, it overwrites the previous record.

		Type	Hex Addr	Dec Addr
P06.39	***Torque Command at Malfunction***	Read	0627	41576
	Range/Units (Format: 16-bit signed)	*Default*		
	-32767–32767%	0		

When a malfunction occurs, check the current torque command. If it happens again, it overwrites the previous record.

		Type	Hex Addr	Dec Addr
P06.40	***Status of the Multi-function Input Terminal at Malfunction***	Read	0628	41577
P06.41	***Status of the Multi-function Output Terminal at Malfunction***	Read	0629	41578
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0000h–FFFFh	0		

When a malfunction occurs, check the current status of the multi-function input/output terminals. If it happens again, it overwrites the previous record.

		Type	Hex Addr	Dec Addr
P06.42	***Drive Status at Malfunction***	Read	062A	41579
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0000h–FFFFh	0		

When a malfunction occurs, check the current drive status (communication address 2101H). If it happens again, it overwrites the previous record.

		Type	Hex Addr	Dec Addr
P06.44	***STO Latch Selection***	♦R/W	062C	41581
	Range/Units (Format: 16-bit binary)	*Default*		
	0: STO Latch 1: STO No Latch	0		

Use P06.44 to select STO latch.

- *P06.44 = 0: STO Alarm Latch. After you clear the cause of the STO Alarm, use a Reset command to clear the STO Alarm.*
- *P06.44 = 1: STO Alarm no Latch. After you clear the cause of the STO Alarm, the STO Alarm clears automatically.*

All of the STL1–STL3 errors are "Alarm Latch" mode (in STL1–STL3 mode, the P06.44 function is not available).

		Type	Hex Addr	Dec Addr
P06.45	***Output Phase Loss Detection Action (OPHL)***	♦R/W	062D	41582
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	3		

The OPHL protection is enabled when P06.45 is not set to 3.

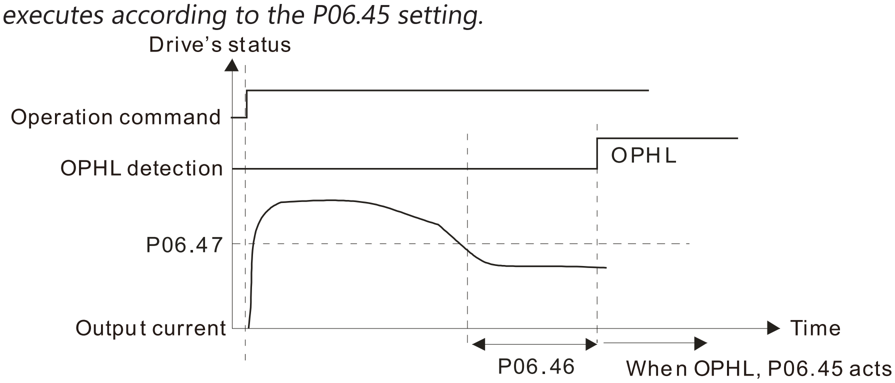
		Type	Hex Addr	Dec Addr
P06.46	***Detection Time for Output Phase Loss***	♦R/W	062E	41583
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 sec.	0.500		

		Type	Hex Addr	Dec Addr
P06.47	***Current Detection Level for Output Phase Loss***	♦R/W	062F	41584
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00%	1.00		

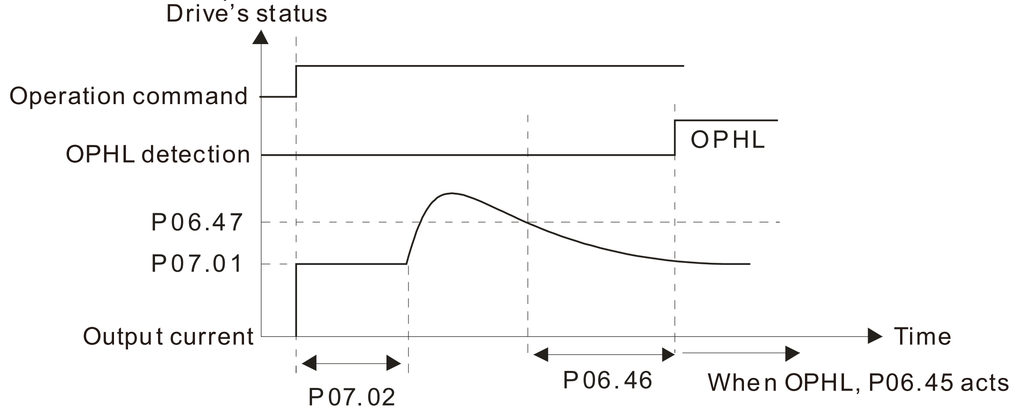
		Type	Hex Addr	Dec Addr
P06.48	***DC Brake Time for Output Phase Loss***	♦R/W	0630	41585
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–65.535 sec.	0.000		

Setting P06.48 to 0 disables the OPHL detection function before operation.

- *Status 1:*
  The drive is in operation
  When any phase is less than the P06.47 setting, and exceeds the P06.46 setting time, the drive executes according to the P06.45 setting.

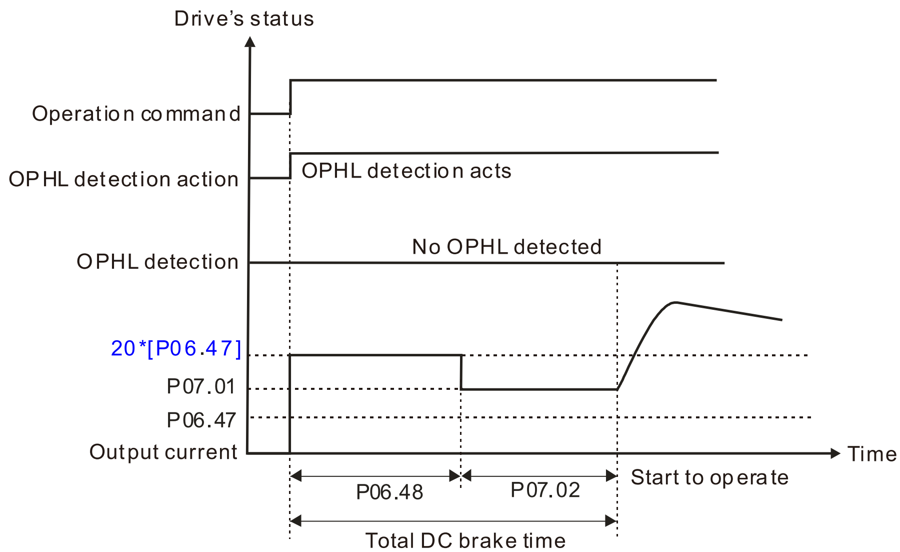


- *Status 2:*
  The drive is in STOP; P06.48 = 0; P07.02 ≠ 0
  After the drive starts, the DC brake operates according to P07.01 and P07.02. During this period, OPHL detection is not active. After the DC brake action is completed, the drive starts to run, and enables the OPHL protection as mentioned above for status 1.

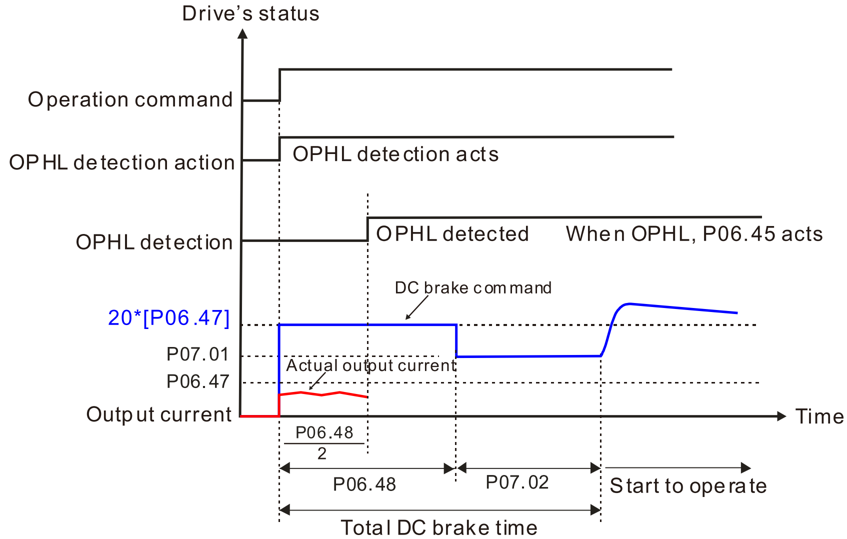


- *Status 3:*
  The drive is in STOP; P06.48 ≠ 0; P07.02 ≠ 0
  When the drive starts, it executes P06.48 first, and then executes P07.02 (DC brake). The DC brake current level in this state includes two parts: one is 20 times the P06.47 setting value in P06.48 setting time; the other is the P07.01 setting value in P07.02 setting time. The total DC brake time T = P06.48 + P07.02. In this period, if an OPHL occurs within the time for P06.48, the drive executes the P06.45 setting after the drive starts counting for half the time of P06.48.

Status 3-1: P06.48≠0, P07.02≠0 (No OPHL detected before operation)

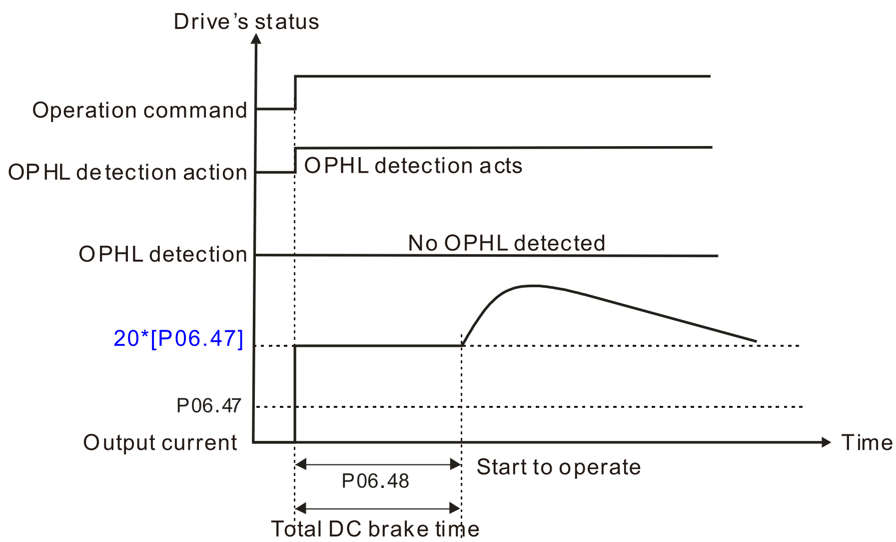


Status 3-2: P06.48≠0, P07.02≠0 (OPHL detected before operation)

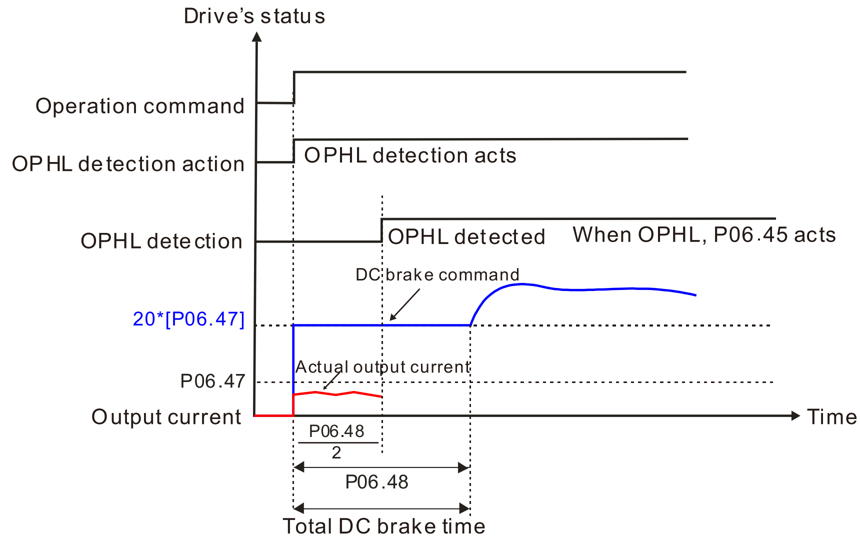


- *Status 4:*
  The drive is in STOP; P06.48 ≠ 0; P07.02=0
  When the drive starts, it executes P06.48 as the DC brake. The DC brake current level is 20 times the P06.47 setting value. In this period, if an OPHL occurs within the time for P06.48, the drive executes the P06.45 setting after the drive starts counting for half the time of P06.48.

Status 4-1: P06.48≠0, P07.02=0 (No OPHL detected before operation)



Status 4-2: P06.48≠0, P07.02=0 (OPHL detected before operation)



		Type	Hex Addr	Dec Addr
P06.49	***LvX Auto-reset***	R/W	0631	41586
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Enable	0		

In the event of any low voltage fault on the DC bus (LvS, LvN, LvA, LvD faults), this parameter will automatically reset the drive if enabled.

		Type	Hex Addr	Dec Addr
P06.53	***Input Phase Loss Detection Action (OrP)***	♦R/W	0635	41590
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Fault and ramp to stop 1: Fault and coast to stop	0		

The drive executes the input phase loss protection according to P06.53.

		Type	Hex Addr	Dec Addr
P06.55	***Derating Protection***	♦R/W	0637	41592
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Constant rated current and limit carrier frequency by load current and temperature 1: Constant carrier frequency and limit load current by setting carrier frequency 2: Constant rated current (same as setting 0), but close current limit	0		

Allowable maximum output frequency and the minimum carrier frequency limit in control mode:

For VF, SVC, VFPG modes:

When the maximum output frequency is 599 Hz, the minimum carrier frequency is 6k.

Setting 0:

- *When the operating point is greater than the derating curve (when the operating carrier frequency is greater than the rated carrier frequency), the rated current is constant, and carrier frequency (Fc) output by the drive decreases automatically according to the ambient temperature, overload output current and overload time. If overloads are not frequent, and the concern is only about the carrier frequency operating with the rated current for a long time, and changes to the carrier frequency due to short overload are acceptable, set to 0.*
- *Refer to Derating for Ambient Temperature, Altitude and Carrier Frequency for the carrier frequency derating level.*
- *Take GS33-45P0 in normal load as an example: ambient temperature 50°C, UL open-type, and independent installation. When the carrier frequency is set to 10kHz, it corresponds to 55% of the rated output current. In the same condition for ambient temperature 40°C, it corresponds to 75% of rated output current. When the output current is higher than this value, it automatically decreases the carrier frequency according to the ambient temperature, output current and overload time. At this time, the overload capacity of the drive is 150% of the rated current.*

Setting 1:

- *When the operating point exceeds the derating curve 1, the carrier frequency is the setting value. Select this mode if the change of carrier frequency and motor noise caused by ambient temperature and frequent overload are not allowed. (Refer to P00.17.)*
- *Refer to Derating for Ambient Temperature, Altitude and Carrier Frequency for the rated current derating level. Take GS33-45P0 in variable torque as an example. If you need to maintain the carrier frequency at 10kHz, decrease the rated current to 55%. The OL protection executes when the current is 120% * 55% = 66% for one minute; therefore, you must operate using the values within the derating curve to keep the carrier frequency constant.*

Setting 2:

- *The protection method and action are the same as setting value 0, but it disables the current limit when output current is the derating ratio ×120% (default value) in variable torque and when the output current is the derating ratio ×180% (default value) in constant torque. The advantage is that it provides a higher starting output current when the carrier frequency setting is higher than the default. However, the carrier frequency derates easily when it overloads.*
  *Example: when P06.55 = 0 or 1, over-current stall prevention level = Ratio * P06.03. When P06.55 = 2, the over-current stall prevention level = P06.03.*

Use this parameter with P00.16 and P00.17.

The ambient temperature also affects the derating. Refer to Derating Curve for Ambient Temperature and Altitude.

Example:

Take *GS33-45P0* in variable torque with ambient temperature 50°C, UL open-type, and independent installation. When the carrier frequency is set to 10kHz, it corresponds to 55% of the rated output current. If used for ambient temperature 60°C, it corresponds to 55% * 75% of the rated output current.

		Type	*Hex Addr*	*Dec Addr*
P06.56	***PT100 RTD Voltage Level 1***	♦R/W	0638	41593
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–10.000 V	5.000		

		Type	*Hex Addr*	*Dec Addr*
P06.57	***PT100 RTD Voltage Level 2***	♦R/W	0639	41594
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–10.000 V	7.000		

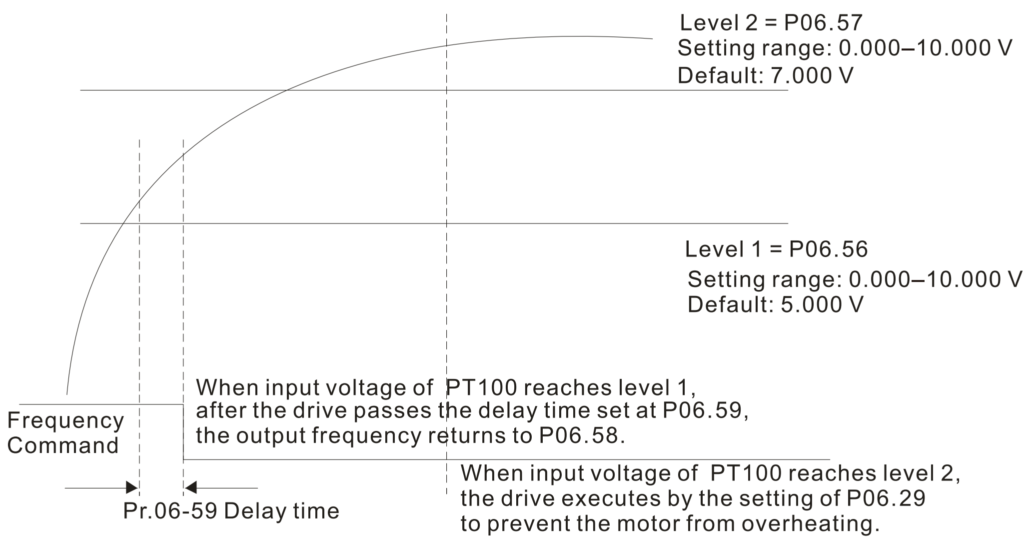
Condition settings: PT100 RTD voltage level P06.57 > P06.56.

		Type	Hex Addr	Dec Addr
P06.58	***PT100 RTD Level 1 Frequency Protection***	♦R/W	063A	41595
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–599.00 Hz	0.00		

		Type	Hex Addr	Dec Addr
P06.59	***PT100 RTD Activation Level 1 Protection Frequency Delay Time***	♦R/W	063B	41596
	Range/Units (Format: 16-bit binary)	Default		
	0–6000 sec.	60		

PT100 RTD operation instructions:

1) Use voltage type analog input (AI1, AI2 voltage 0–10 V) and select PT100 RTD mode.
2) Select one of the voltage type analog inputs below:
   (a) P03.00 =11, (b) P03.01 = 11 and P03.29 = 1
3) When selecting P03.01 = 11 and P03.29 = 1, you must switch AO1 to 0–10 V.
4) The AO1 outputs constant voltage or current, then P03.20 = 23. You must switch ACM to 0–20 mA, and set AO1 output level to 45% (Pr.03-32 = 45%) of 20 mA = 9 mA.
5) Use P03.32 to adjust the constant voltage or constant current of the AO1 output; the setting range is 0.00–100.00%.
6) There are two types of action levels for PT100 RTD. The diagram below shows the PT100 RTD protection action.



When P06.58 = 0.00 Hz, PT100 RTD function is disabled.

Case:

When using PT100 RTD, if the motor temperature is higher than 135°C (275°F), the drive starts to count the delay time for auto-deceleration (P06.59). The drive decreases the motor frequency to the setting for P06.58 when it reaches the delay time count value. The drive operates at the frequency set for P.06.58 until the motor temperature is lower than 135°C (275°F). If the motor temperature is higher than 150°C (302°F), the drive automatically decelerates to STOP and displays the warning “oH3”.

Set up process:

1) Switch AO1 to 0–20 mA on the control board dip switch.
2) Wiring:
   Connect external terminal AO1 to “+”
   Connect external terminal ACM to “-“
   Connect AO1 and AI1 to “short circuit”

3) P03.00 = 11, P03.20 = 23, P03.32 = 45% (9 mA)
4) Refer to the PT100 RTD temperature and resistance comparison table
   Temperature = 135°C, resistance = 151.71 Ω, input current: 9 mA, voltage: about 1.37 VDC
   Temperature = 150°C, resistance = 157.33 Ω, input current: 9 mA, voltage: about 1.42 VDC
5) When the PT100 RTD temperature > 135°C, the drive decelerates to the specified operation frequency automatically. Then, P06.56 = 1.37 V and P06.58 = 10Hz. (When P06.58 = 0, it disables the specified operation frequency.)
6) When PT100 RTD temperature > 150°C, the drive outputs a fault, decelerates to STOP, and displays the warning "oH3". Then, P06.57 = 1.42 V and P06.29 = 1 (fault and ramp to stop).

		Type	Hex Addr	Dec Addr
P06.60	***Software Detection GFF Current Level***	♦R/W	063C	41597
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5%	60.0		

		Type	Hex Addr	Dec Addr
P06.61	***Software Detection GFF Filter Time***	♦R/W	063D	41598
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 sec.	0.10		

When the drive detects that the unbalanced three-phase output current is higher than the setting for P06.60, GFF protection activates. The drive then stops output.

		Type	Hex Addr	Dec Addr
P06.63	***Operation Time of Fault Record 1 (Day)***	Read	063F	41600
P06.65	***Operation Time of Fault Record 2 (Day)***	Read	0641	41602
P06.67	***Operation Time of Fault Record 3 (Day)***	Read	0643	41604
P06.69	***Operation Time of Fault Record 4 (Day)***	Read	0645	41606
P06.90	***Operation Time of Fault Record 5 (Day)***	Read	065A	41627
P06.92	***Operation Time of Fault Record 6 (Day)***	Read	065C	41629
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535 days	0		

		Type	Hex Addr	Dec Addr
P06.64	***Operation Time of Fault Record 1 (Min.)***	Read	0640	41601
P06.66	***Operation Time of Fault Record 2 (Min.)***	Read	0642	41603
P06.68	***Operation Time of Fault Record 3 (Min.)***	Read	0644	41605
P06.70	***Operation Time of Fault Record 4 (Min.)***	Read	0646	41607
P06.91	***Operation Time of Fault Record 5 (Min.)***	Read	065B	41628
P06.93	***Operation Time of Fault Record 6 (Min.)***	Read	065D	41630
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–1439 min.			

If there is any malfunction when the drive operates, P06.17–P06.22 records the malfunctions, and P06.63–P06.70 records the operation time for four sequential malfunctions. Check if there is any problem with the drive according to the interval of the recorded fault.

Example:

The first error: ocA occurs after motor drive operates for 1000 minutes.

The second error: ocd occurs after another 1000 minutes.

The third error: ocn occurs after another 1000 minutes.

The fourth error: ocA occurs after another 1000 minutes.

The fifth error: ocd occurs after another 1000 minutes.

The sixth error: ocn occurs after another 1000 minutes.

Then, P06.17–P06.22 and P06.63–P06.70 are recorded as follows:

Parameter	1st fault	2nd fault	3rd fault	4th fault	5th fault	6th fault
Pr.06-17	ocA	ocd	ocn	ocA	ocd	ocn
Pr.06-18	0	ocA	ocd	ocn	ocA	ocd
Pr.06-19	0	0	ocA	ocd	ocn	ocA
Pr.06-20	0	0	0	ocA	ocd	ocn
Pr.06-21	0	0	0	0	ocA	ocd
Pr.06-22	0	0	0	0	0	ocA
Pr.06-63	1000	560	120	1120	680	240
Pr.06-64	0	1	2	2	3	4
Pr.06-65	0	1000	560	120	1120	680
Pr.06-66	0	0	1	2	2	3
Pr.06-67	0	0	1000	560	120	1120
Pr.06-68	0	0	0	1	2	2
Pr.06-69	0	0	0	1000	560	120
Pr.06-70	0	0	0	0	1	2

By examining the time record, you can see that the last fault (P06.17) happened after the drive ran for four days and 240 minutes.

		Type	*Hex Addr*	*Dec Addr*
P06.71	***Low Current Setting Level***	♦R/W	0647	41608
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–100.0%	0.0		

		Type	*Hex Addr*	*Dec Addr*
P06.72	***Low Current Detection Time***	♦R/W	0648	41609
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–360.00 sec.	0.00		

		Type	*Hex Addr*	*Dec Addr*
P06.73	***Low Current Action***	♦R/W	0649	41610
	Range/Units (Format: 16-bit binary)	*Default*		
	0 : No function	0		

1 : Fault and coast to stop
2 : Fault and ramp to stop by the second deceleration time
3 : Warn and continue operation

The drive operates according to the setting for P06.73 when the output current is lower than the setting for P06.71 and when the time of the low current exceeds the detection time for P06.72. Use this parameter with the external multi-function output terminal setting 44 (low current output).

The low current detection function does not execute when drive is in sleep or standby status.

Group P07.xx Details – Special Parameters

		Type	Hex Addr	Dec Addr
P07.00	***Software Brake Chopper Action Level***	♦R/W	0000	41793
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V models: 350.0–450.0 VDC	370.0		
	460V models: 700.0–900.0 VDC	740.0		

P07.00 sets the DC bus voltage at which the brake chopper is activated. Choose a suitable braking resistor to achieve the optimal deceleration performance. 230V 40 to 50 HP and 460V 50 to 100 HP drives will require the use of an external dynamic braking unit (DBU). Refer to the Accessories chapter for information about braking resistors.

		Type	Hex Addr	Dec Addr
P07.01	***DC Brake Current Level***	♦R/W	0701	41794
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–100%	0		

P07.01 sets the level of the DC brake current output to the motor at start-up and stop. When setting the DC brake current, the rated current (P00.01) is 100%. It is recommended that you start with a low DC brake current level and then increase until you reach the proper holding torque. However, the DC brake current cannot exceed the motor's rated current to prevent the motor from burnout. Therefore, DO NOT use the DC brake for mechanical retention, otherwise injury or accident may occur.

		Type	Hex Addr	Dec Addr
P07.02	***DC Brake Time at Start-up***	♦R/W	0702	41795
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–60.0 sec	0.0		

The motor may continue rotating due to external forces or the inertia of the motor itself. If you use the drive with the motor rotating, it may cause motor damage or trigger drive protection due to over-current. This parameter outputs DC current, generating torque to force the motor stop to get a stable start before motor operation. This parameter determines the duration of the DC brake current output to the motor when the drive starts up. Set this parameter to 0.0 to disable the DC brake at start-up.

		Type	Hex Addr	Dec Addr
P07.03	***DC Brake Time at STOP***	♦R/W	0703	41796
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–60.0 sec	0.0		

The motor may continue rotating after the drive stops output due to external forces or the inertia of the motor itself. This parameter outputs DC current, generating torque to force the motor stop after the drive stops output to make sure that the motor stops.

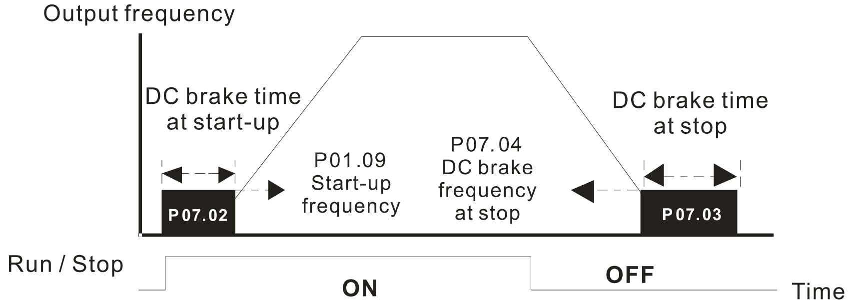
This parameter determines the duration of the DC Brake current output to the motor when braking. To enable the DC brake at STOP, you must set P00.22 (Stop Method) to 0 (ramp to stop). Set this parameter to 0.0 to disable the DC brake at stop.

Related parameters:

P00.22 Stop Method, P07.04 DC Brake Frequency at Start-up

		Type	Hex Addr	Dec Addr
P07.04	***DC Brake Frequency at STOP***	♦R/W	0704	41797
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 0 Hz	0.00		

Determines the start frequency of the DC brake before the drive ramps to stop. When this setting is less than P01.09 (Start-up Frequency), the start frequency for the DC brake begins at the minimum frequency.



DC Brake Output Timing Diagram

- *Use the DC brake before running the motor when the load is movable at stop, such as with fans and pumps. The motor is in free running status and in unknown rotation direction before the drive starts up. Execute the DC brake before you start the motor.*
- *Use the DC Brake at STOP when you need to brake the motor quickly or to control the positioning, such as with cranes or cutting machines.*

		Type	Hex Addr	Dec Addr
P07.05	***Voltage Increasing Gain***	♦R/W	0705	41798
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1–200%	100		

When using speed tracking, adjust P07.05 to slow down the increasing voltage gain if there are errors such as oL or oc; however, the speed tracking time will be longer.

		Type	Hex Addr	Dec Addr
P07.06	***Restart after Momentary Power Loss***	♦R/W	0706	41799
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Stop operation 1: Speed tracking by the speed before the power loss 2: Speed tracking by the minimum output frequency	0		

P07.06 determines the operation mode when the drive restarts from a momentary power loss.

The power system connected to the drive may power off momentarily for many reasons. This function allows the drive to keep outputting voltages after the drive is repowered and does not cause the drive to stop.

1) Frequency tracking begins before momentary power loss and accelerates to the master Frequency command after the drive output frequency and motor rotator speed are synchronous. Use this setting when there is a lot of inertia with little resistance on the motor load. For example, in equipment with a large inertia flywheel, there is NO need to wait until the flywheel stops completely after a restart to execute the operation command; therefore, it saves time.
2) Frequency tracking starts from the minimum output frequency and accelerates to the master Frequency command after the drive output frequency and motor rotator speed are synchronous. Use this setting when there is little inertia and large resistance.

In Encoder control mode, the AC motor drive executes the speed tracking function automatically according to the encoder speed when this setting is NOT set to 0.

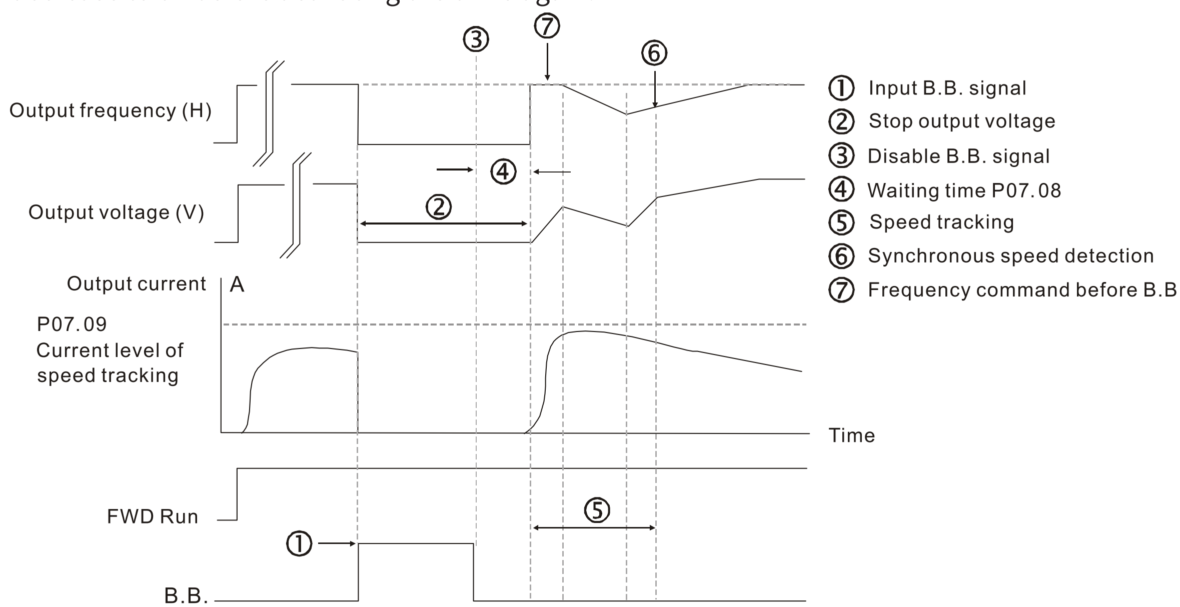
		Type	*Hex Addr*	*Dec Addr*
P07.07	***Allowed Power Loss Duration***	♦R/W	0707	41800
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–20.0 sec.	2.0		

Determines the maximum time of allowable power loss. If the duration of a power loss exceeds this parameter setting, the AC motor drive stops output after the power recovers.

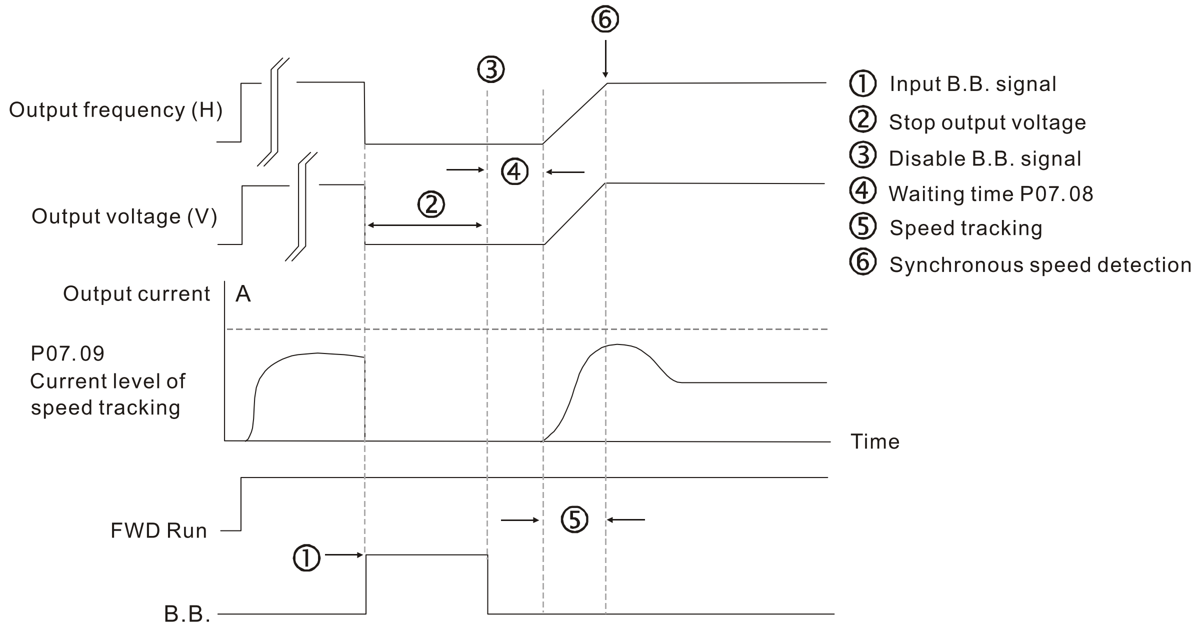
P07.06 is valid when the maximum allowable power loss time is ≤ 20 seconds and the AC motor drive displays “LU”. If the AC motor drive is powered off due to overload, even if the maximum allowable power loss time is ≤ 20 seconds, P07.06 is invalid after the power recovers.

		Type	*Hex Addr*	*Dec Addr*
P07.08	***Base Block Time***	♦R/W	0708	41801
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–60.0 sec.	0.5		

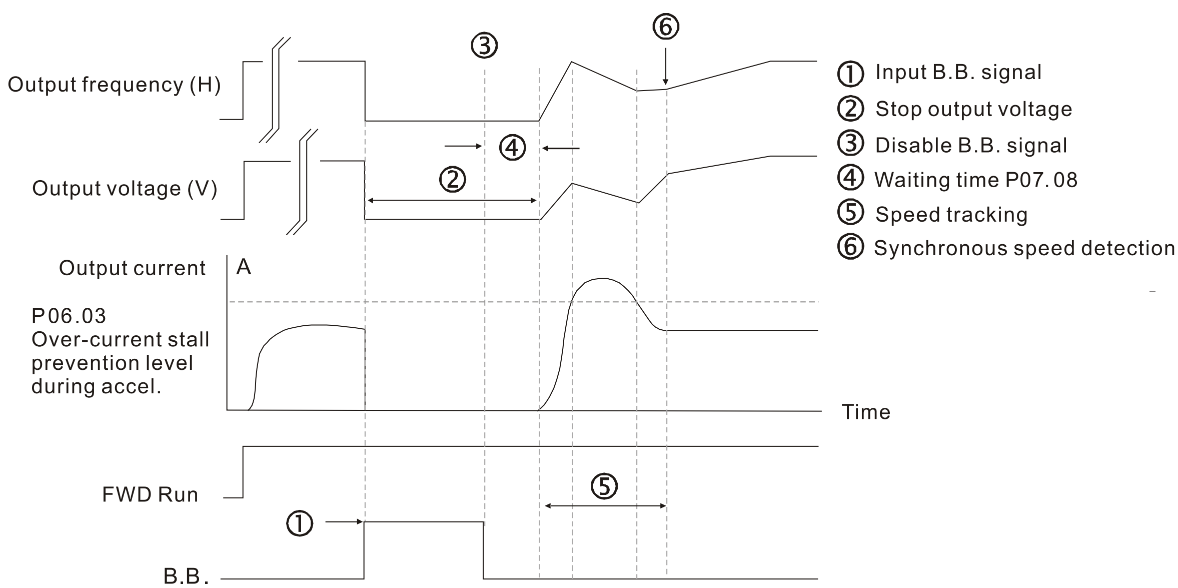
When momentary power loss is detected, the AC motor drive blocks its output and then waits for a specified period of time (determined by P07.08, called Base Block Time) before resuming operation. Set this parameter to the time that allows the residual voltage at the output side to decrease to 0V before activating the drive again.



B.B. Speed tracking: from last output frequency



B.B. Speed tracking: from minimum output frequency



Over-current stall prevention

		Type	Hex Addr	Dec Addr
P07.09	***Current Limit of Speed Tracking***	♦R/W	0709	41802
	Range/Units (Format: 16-bit unsigned)	*Default*		
	20–200%	100		

The AC motor drive executes speed tracking only when the output current is greater than the value set in P07.09.

The maximum current for speed tracking affects the synchronous time. The larger the parameter setting, the faster the synchronization occurs. However, if the parameter setting is too large, the overload protection function may be activated.

		Type	Hex Addr	Dec Addr
P07.10	***Restart after Fault Action***	♦R/W	070A	41803
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Stop operation 1: Speed tracking by current speed 2: Speed tracking by minimum output frequency	0		

In encoder control mode, the AC motor drive executes the speed tracking function automatically according to the encoder speed when this setting is NOT set to 0.

Faults include: bb, oc, ov, occ. To restart after oc, ov, occ, you can NOT set P07.11 to 0.

		Type	Hex Addr	Dec Addr
P07.11	***Number of Times of Restart after Fault***	♦R/W	070B	41804
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–10	0		

After fault (allowed fault: oc, ov, occ) occurs, the AC motor drive can reset and restart automatically up to 10 times. If P07.11 is set to 0, the drive resets or restarts automatically after faults occur. The drive starts according to the P07.10 setting after restarting after fault.

If the number of faults exceeds the P07.11 setting, the drive does not reset and restart until you press “RESET” manually and execute the operation command again.

		Type	Hex Addr	Dec Addr
P07.12	***Speed Tracking during Start-up***	♦R/W	070C	41805
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Speed tracking by the maximum output frequency 2: Speed tracking by the motor frequency at start-up 3: Speed tracking by the minimum output frequency	0		

Speed tracking is suitable for punch presses, fans, and other large inertia loads. For example, a punch press usually has a large inertia flywheel, and the general stop method is coast to stop. If it needs to be restarted again, the flywheel may take 2–5 minutes or longer to stop. This parameter setting allows you to start the flywheel operating again without waiting until the flywheel stops completely.

In Encoder control mode, the AC motor drive executes the speed tracking function automatically according to the encoder speed when this setting is NOT set to 0.

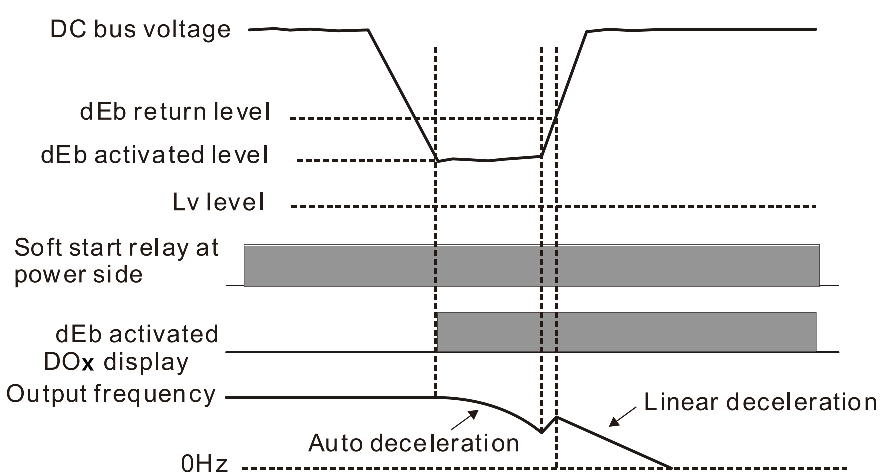
		Type	Hex Addr	Dec Addr
P07.13	***dEb Function Selection***	♦R/W	070D	41806
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: dEb with auto-acceleration / auto-deceleration, the drive does not output the frequency after the power is restored. 2: dEb with auto-acceleration / auto-deceleration, the drive outputs the frequency after the power is restored. 3: dEb low-voltage control, then the drive’s voltage increases to 350 VDC / 700 VDC and ramps to stop after low frequency 4: dEb high-voltage control of 350 VDC / 700 VDC, and the drive ramps to stop	0		

- *dEb (Deceleration Energy Backup) lets the motor decelerate to stop when momentary power loss occurs. When the power loss is instantaneous, use this function to let the motor decelerate to zero speed. If the power recovers at this time, the drive restarts the motor after the dEb return time.*
- *Lv return level: Default value depends on the drive power model.*
  a) Models for frame A, B, C, D = P06.00 + 60V (460V series) / 30V (230V series)
  b) Models for frame E and above = P06.00 + 40V (230V series)
- *Lv level: Default is P06.00.*
- *During dEb operation, other protection, such as ryF, ov, oc, occ, and EF may interrupt it, and these error codes are recorded.*
- *The STOP (RESET) command does not work during the dEb auto-deceleration, and the drive continues decelerating to stop. To make the drive coast to stop immediately, use another function (EF) instead.*
- *The B.B. function does not work when executing dEb. The B.B. function is enabled after the dEb function finishes.*
- *Even though the Lv warning does not display during dEb operation, if the DC bus voltage is lower than the Lv level, DOx = 10 (Low voltage warning) still operates.*
- *The following explains the dEb action:*
  When the DC bus voltage drops below the dEb setting level, the dEb function starts to work (soft start relay remains closed), and the drive executes auto-deceleration.

Situation 1:

Momentary power loss, or too low and unstable power voltage, or power supply sliding down because of sudden heavy load. P07.13 = 1 and power recovers.

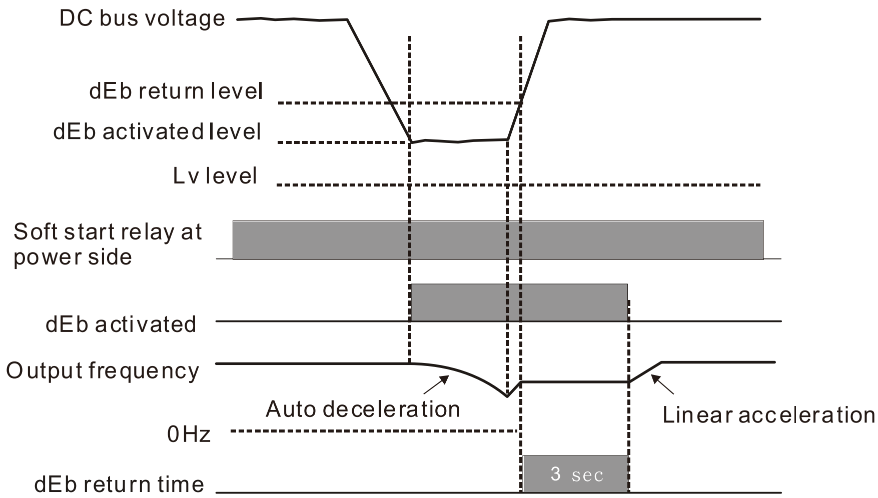
When the power recovers and DC bus voltage exceeds the dEb return level, the drive linearly decelerates to 0Hz and stops. The keypad displays the “dEb” warning until you manually reset it, so you can see the reason for the stop.



Situation 2:

Momentary power loss, or too low and unstable power voltage, or power supply sliding down because of sudden heavy load. P07.13 = 2 and power recovers.

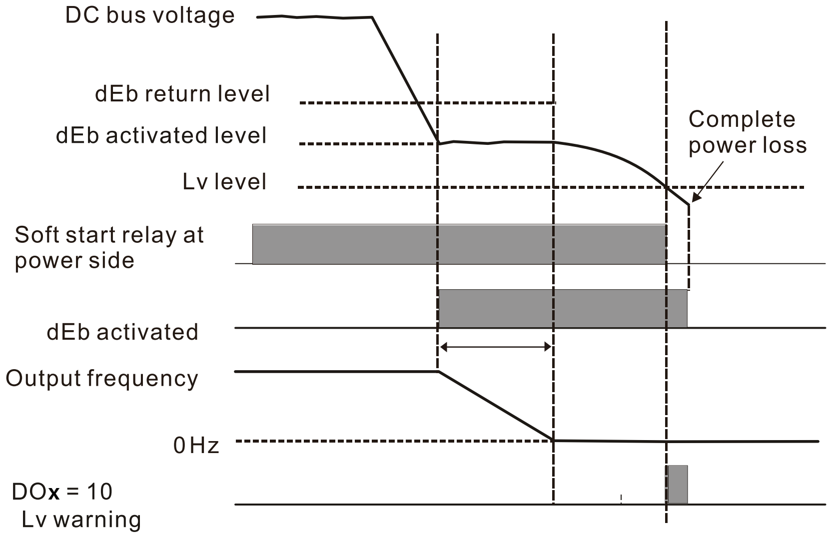
During the dEb deceleration (includes 0Hz run), if the power recovers to a voltage higher than dEb return level, the drive maintains the frequency for three seconds and then accelerates again. The “dEb” warning on the keypad is automatically cleared.



Situation 3:

Unexpected power shut down or power loss. P07.13 = 1 and power does not recover.

The keypad displays the “dEb” warning and the drive stops after decelerating to the lowest operating frequency. When the DC bus voltage is lower than the Lv level, the drive disconnects the soft start relay until the power completely runs out.



Situation 4:

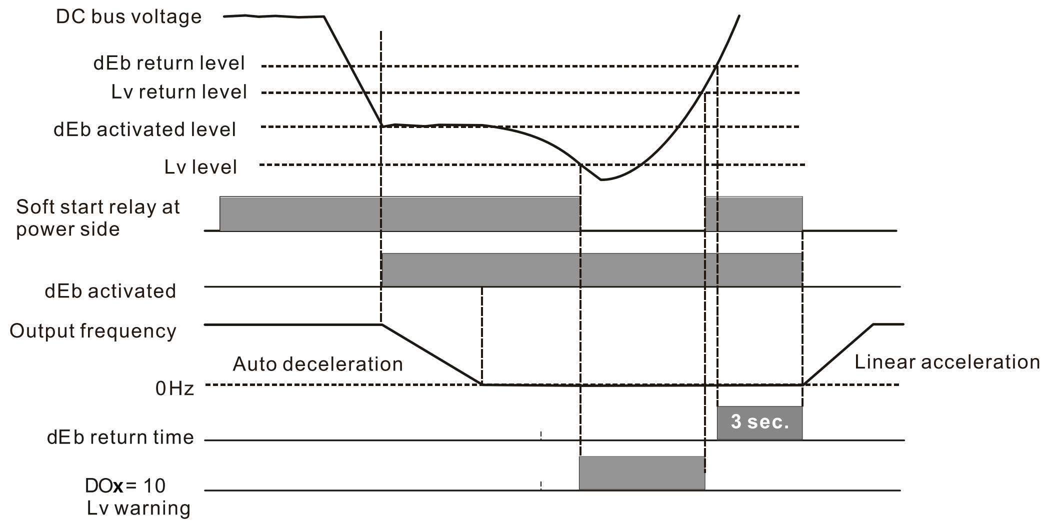
Unexpected power shut down or power loss. P07.13 = 2 and power does not recover.

The drive decelerates to 0Hz. The DC bus voltage continues to decrease until the voltage is lower than the Lv level, and then the drive disconnects the soft start relay. The keypad displays “dEb” warning until the drive completely runs out of power.

Situation 5:

P07.13 = 2 and power recovers after the DC bus voltage is lower than the Lv level.

The drive decelerates to 0Hz. The DC bus voltage continues to decrease until the voltage is lower than the Lv level, and then the drive disconnects the soft start relay. The soft start relay closes again after the power recovers and the DC bus voltage is higher than the Lv return level. When the DC bus voltage is higher than the dEb return level, the drive maintains the frequency for three seconds and starts to accelerate linearly. The “dEb” warning on the keypad is automatically cleared.

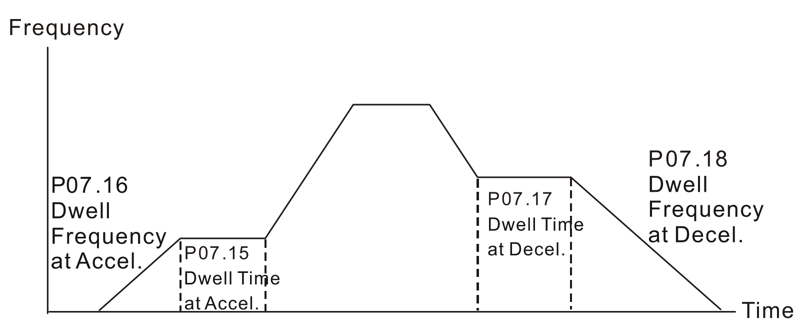


		Type	Hex Addr	Dec Addr
P07.15	***Dwell Time at Acceleration***	♦R/W	070F	41808
P07.17	***Dwell Time at Deceleration***	♦R/W	0711	41810
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–600.00 sec	0.00		

		Type	Hex Addr	Dec Addr
P07.16	***Dwell Frequency at Acceleration***	♦R/W	0710	41809
P07.18	***Dwell Frequency at Deceleration***	♦R/W	0712	41811
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	0.00		

In constant torque situations, the Dwell temporarily maintains stable output frequency. Use this parameter for cranes, elevators, and so on.

For constant torque applications, use P07.15–P07.18 to avoid OV or OC protection.



Dwell at accel./decel.

		Type	Hex Addr	Dec Addr
P07.19	***Fan Cooling Control***	♦R/W	0713	41812
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Fan is always ON 1: Fan is OFF after the AC motor drive stops for one minute. 2: Fan is ON when the AC motor drive runs; fan is OFF when the AC motor drive stops 3: Fan turns ON when the temperature (IGBT) reaches around 60°C.	3		

Use P07.19 to control the fan.

- *P07.19 = 0: Fan runs immediately when the drive power is turned ON.*
- *P07.19 = 1: Fan runs when the AC motor drive runs. One minute after the AC motor drive stops, the fan is OFF.*
- *P07.19 = 2: Fan runs when the AC motor drive runs and stops immediately when the AC motor drive stops.*
- *P07.19 = 3: When temperature of the IGBT or capAI2tors is higher than 60°C, the fan runs. When both the temperature of the IGBT and capAI2tors are lower than 40°C, the fan stops.*

		Type	Hex Addr	Dec Addr
P07.20	***Emergency Stop (EF) & Force to Stop Selection***	♦R/W	0714	41813
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Coast to stop 1: Stop by the first deceleration time 2: Stop by the second deceleration time 3: Stop by the third deceleration time 4: Stop by the fourth deceleration time 5: System deceleration 6: Automatic deceleration	0		

When the multi-function input terminal setting is set to 10 (EF input) or 18 (force to stop) and the terminal contact is ON, the drive stops according to the setting of this parameter.

- *When P07.20 = 5 (system deceleration), the EF deceleration behAI1or will follow P01.44 setting. If P01.44=0 or 1 & P07.20=5. when EF is ON, the deceleration will be Linear. If P01.44=2 or 3 & P07.20=5, when EF is ON, the deceleration will be Auto deceleration.*
- *When P07.20 = 6 (auto deceleration), the drive automatically determines the loaded regenerative energy to steadily and smoothly stop the motor in the fastest deceleration time.*

		Type	Hex Addr	Dec Addr
P07.21	***Automatic Energy-sAI1ng Setting***	♦R/W	0715	41814
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Enable	0		

When energy-sAI1ng is enabled, the motor acceleration/deceleration operates with full voltage. During constant speed operation, it automatically calculates the best voltage value according to the load power. This function is not suitable for fluctuating loads or loads which are nearly full during operation.

When the output frequency is constant (that is, constant operation), the output voltage decreases automatically as the load decreases. Therefore, the drive operates with minimum multiplication of voltage and current (electric power) to reach the energy-sAI1ng.

		Type	Hex Addr	Dec Addr
P07.22	***Energy-sAI1ng Gain***	♦R/W	0716	41815
	Range/Units (Format: 16-bit unsigned)	*Default*		
	10–1000%	100		

When P07.21 is set to 1, use this parameter to adjust the energy-sAI1ng gain. The default is 100%. If the result is not satisfactory, adjust it by decreasing the setting value. If the motor oscillates, then increase the setting value.

In certain applications such as high speed spindles, the temperature rise in the motor is a major concern. When the motor is not in working state, reduce the motor current to a lower level. Reduce this parameter setting to meet this requirement.

		Type	Hex Addr	Dec Addr
P07.23	***Automatic Voltage Regulation (AVR) Function***	♦R/W	0717	41816
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Enable AVR 1: Disable AVR 2: Disable AVR during deceleration	0		

The rated voltage of a 220V motor is usually 200VAC, 60Hz / 50Hz, and the input voltage of the AC motor drive may vary from 180–264 VAC, 50Hz / 60Hz. Therefore, when the AC motor drive is used without the AVR function, the output voltage is the same as the input voltage. When the motor runs at the voltage exceeding 12–20% of the rated voltage, it causes higher temperatures, damaged insulation, and unstable torque output, which result in shortened motor lifetime.

The AVR function automatically regulates the output voltage of the AC motor drive to the motor's rated voltage when the input voltage exceeds the motor's rated voltage. For example, if the V/F curve is set at 200VAC, 50Hz and the input voltage is at 200–264 VAC, then the drive automatically reduces the output voltage to the motor to a maximum of 200VAC, 50Hz. If the input voltage is at 180–200 VAC, the output voltage to motor is in direct proportion to the input voltage.

- *P07.23 = 0: When the AVR function is enabled, the drive calculates the output voltage according to the actual DC bus voltage. The output voltage does NOT change when the DC bus voltage changes.*
- *P07.23 = 1: When the AVR function is disabled, the drive calculates the output voltage according to the actual DC bus voltage. The output voltage changes with the DC bus voltage, and may cause insufficient current, over-current or oscillation.*
- *P07.23 = 2: The drive disables the AVR function only during deceleration to stop, and at this time, you can accelerate the braking to achieve the same result.*

When the motor ramps to stop, disable the AVR function to shorten the deceleration time. Then, use with the auto-acceleration and auto-deceleration functions to make the motor's deceleration faster and more stable.

AVR applies to all control modes (P00.10/P00.11). Refer to page 4–68 for function block diagrams of AVR in the drive control loop.

		Type	Hex Addr	Dec Addr
P07.24	***Torque Command Filter Time (V/F and SVC Control Mode)***	♦R/W	0718	41817
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.001–10.000 sec.	0.050		

When the time constant setting is too large, the control is stable but the control response is slow. When the time constant setting is too small, the control response is faster but the control may be unstable. For optimal setting, adjust the setting based on the control stability or the control response.

		Type	Hex Addr	Dec Addr
P07.25	**Slip Compensation Filter Time (V/F and IMSVC Control Mode)**	♦R/W	0719	41818
	Range/Units (Format: 16-bit unsigned)	Default		
	0.001–10.000 sec.	0.100		

Change the compensation response time with P07.24 and P07.25.

If you set P07.24 and P07.25 to 10 seconds, the compensation response time is the slowest; however, the system may be unstable if you set the time too short.

P07.25 is only used for V/F mode (P00.11=0) and IM-SVC mode (P00.11=2). See function block diagram under P00.11 on page 4–68.

		Type	Hex Addr	Dec Addr
P07.26	**Torque Compensation Gain (Motor 1)**	♦R/W	071A	41819
P07.71	**Torque Compensation Gain (Motor 2)**	♦R/W	0747	41864
P07.73	**Torque Compensation Gain (Motor 3)**	♦R/W	0749	41866
P07.75	**Torque Compensation Gain (Motor 4)**	♦R/W	074B	41868
	Range/Units (Format: 16-bit unsigned)	Default		
	IM: 0–10 (when P05.33=0) PM: 0–5000 (when P05.33=1 or 2)	1		

These parameters apply to P00.11 V/F and SVC control modes.

With a large motor load, a part of the drive output voltage is absorbed by the stator winding resistor; therefore, the air gap magnetic field is insufficient. This causes insufficient voltage at motor induction and results in excessive output current but insufficient output torque. Auto-torque compensation can automatically adjust the output voltage according to the load and keep the air gap magnetic fields stable to get the optimal operation.

In the V/F control, the voltage decreases in direct proportion with decreasing frequency. The torque decreases at low speed because of a decreasing AC resistor and an unchanged DC resistor. The auto-torque compensation function increases the output voltage at low frequency to get a higher starting torque.

When the compensation gain is set too high, it may cause motor over-flux and result in a too great an output current from the drive, motor overheating or trigger the drive's protection function.

See function block diagrams under P00.11 on page 4–68.

		Type	Hex Addr	Dec Addr
P07.27	**Slip Compensation Gain (Motor 1)**	♦R/W	071B	41820
P07.72	**Slip Compensation Gain (Motor 2)**	♦R/W	0748	41865
P07.74	**Slip Compensation Gain (Motor 3)**	♦R/W	074A	41867
P07.76	**Slip Compensation Gain (Motor 4)**	♦R/W	074C	41869
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–10.00	0.00 (1 in SVC mode)		

These parameters apply to P00.11 V/F and SVC control modes.

The induction motor needs constant slip to produce electromagnetic torque. It can be ignored at higher motor speeds, such as rated speed or 2–3% of slip.

However, during the drive operation, the slip and the synchronous frequency are in reverse proportion to produce the same electromagnetic torque. The slip is larger with the reduction of the synchronous frequency. Moreover, the motor may stop when the synchronous frequency decreases to a specific value. Therefore, the slip seriously affects the motor speed accuracy at low speed.

In another situation, when you use an induction motor with the drive, the slip increases when the load increases. It also affects the motor speed accuracy.

Use this parameter to set the compensation frequency, and reduce the slip to maintain the synchronous speed when the motor runs at the rated current in order to improve the accuracy of the drive. When the drive output current is higher than P05.05 (No-load Current for Induction Motor 1 (A)), the drive compensates the frequency according to this parameter.

This parameter is set to 1.00 automatically when P00.11 (Speed Control Mode) is changed from V/F mode to vector mode. Otherwise, it is automatically set to 0.00. Apply the slip compensation after load and acceleration. Increase the compensation value from small to large gradually; add the output frequency to the [motor rated slip x P07.27 (Slip Compensation Gain)] when the motor is at the rated load. If the actual speed ratio is slower than expected, increase the parameter setting value; otherwise, decrease the setting value.

See function block diagrams under P00.11 on page 4–68.

		Type	Hex Addr	Dec Addr
P07.29	***Slip Deviation Level***	♦R/W	071D	41822
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–100.0% 0: No detection	0		

		Type	Hex Addr	Dec Addr
P07.30	***Over-slip Deviation Detection Time***	♦R/W	071E	41823
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–10.0 sec.	1.0		

		Type	Hex Addr	Dec Addr
P07.31	***Over-slip Deviation Treatment***	♦R/W	071F	41824
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	0		

P07.29–P07.31 set the allowable slip level/time and the over-slip treatment when the drive is running.

		Type	Hex Addr	Dec Addr
P07.32	***Motor Oscillation Compensation Factor***	♦R/W	0720	41825
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–10000	1000		

If there are current wave motions which cause severe motor oscillation in some specific area, setting P07.32 can effectively improve this situation. (When running with high frequency or PG, set this parameter to 0. When the current wave motion occurs in low frequency and high power, increase the value for P07.32.)

		Type	Hex Addr	Dec Addr
P07.33	***Auto-restart Interval of Fault***	♦R/W	0721	41826
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6000.0 sec.	60.0		

When a reset/restart occurs after a fault, the drive uses P07.33 as a timer and starts counting the number of faults within this time period. Within this period, if the number of faults does not exceed the setting for P07.11, the counting clears and starts from 0 when the next fault occurs.

		Type	Hex Addr	Dec Addr
P07.38	***PMSVC Voltage Feed Forward Gain***	R/W	0726	41831
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.50–2.00	1.00		

		Type	Hex Addr	Dec Addr
P07.62	***dEb Gain (Kp)***	♦R/W	073E	41855
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535	8000		

		Type	Hex Addr	Dec Addr
P07.63	***dEb Gain (Ki)***	♦R/W	073F	41856
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535	150		

These parameters set the PI gain of DC bus voltage controller when the dEb function activates.

If the DC bus voltage drops too fast, or the speed oscillation occurs during deceleration after the dEb function activates, adjust P07.62 and P07.63. Increase the Kp setting to quicken the control response, but oscillation may occur if the setting is too large. Use Ki parameter to decrease the steady-state error to zero, and increase the setting to quicken the response speed.

Group P08.xx Details – High-function PID Parameters

		Type	Hex Addr	Dec Addr
P08.00	**Terminal Selection of PID Feedback**	♦R/W	0800	42049
	Range/Units (Format: 16-bit binary)	Default		
	0: No function 1: Negative PID feedback: by analog input (P03.00, P03.01) 2: Negative PID feedback: by singlephase input (DI7), without direction (P10.16=5) 3: Negative PID feedback: by singlephase pulse input (DI7), with direction (P10.16) 4: Positive PID feedback: by analog input (P03.00, P03.01) 5: Positive PID feedback: by singlephase input (DI7), without direction (P10.16=5) 6: Positive PID feedback: by single-phase pulse input (DI7), with direction (P10.16) 7: Negative PID feedback: by communication protocols 8: Positive PID feedback: by communication protocols	0		

Negative feedback:

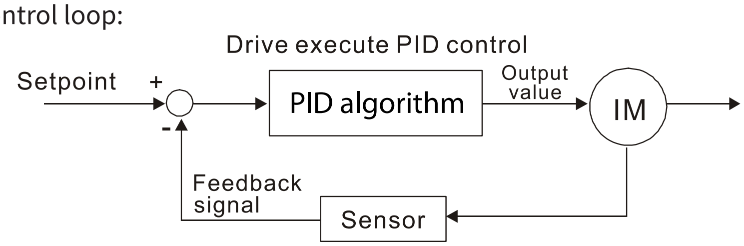
Error = + Target value (set point) – Feedback. Use negative feedback when the detection value increases if the output frequency increases.

Positive feedback:

Error = Target value (set point)+ Feedback. Use positive feedback when the detection value decreases if the output frequency increases.

When P08.00 ≠ 7 or ≠ 8, the input value is disabled. The setting value does not remain when the drive is powered off.

1) Common applications for PID control:
   a) Flow control: Use a flow sensor to feedback the flow data and perform accurate flow control.
   b) Pressure control: Use a pressure sensor to feedback the pressure data and perform precise pressure control.
   c) Air volume control: Use an air volume sensor to feedback the air volume data to achieve excellent air volume regulation.
   d) Temperature control: Use a thermocouple or thermistor to feedback temperature data for comfortable temperature control.
   e) Speed control: Use a speed sensor to feedback motor shaft speed or input another machine speed as a target value for synchronous control.
2) PID control loop:

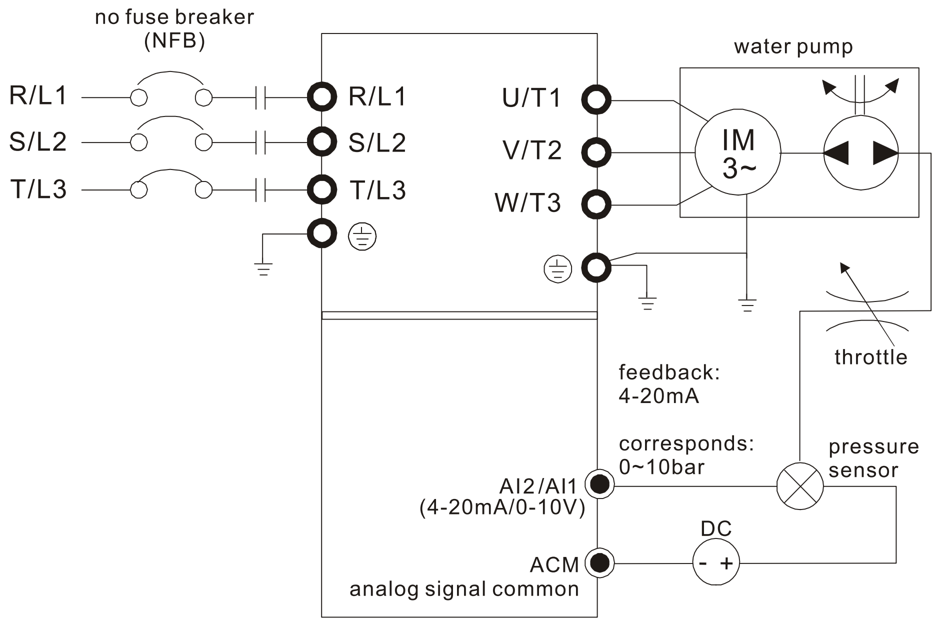


3) Concept of PID control:
   a) Proportional gain (P): The output is proportional to input. With only a proportional gain control, there is always a steady-state error.

b) Integral time (I): The controller output is proportional to the integral of the controller input. When an automatic control system is in a steady state and a steady-state error occurs, the system is called a System with Steady-state Error. To eliminate the steady-state error, add an “integral part” to the controller. The integral time controls the relation between the integral part and the error. The integral part increases over time even if the error is small. It gradually increases the controller output to eliminate the error until it is zero. This stabilizes the system without a steady-state error by using proportional gain control and integral time control.

c) Differential control (D): The controller output is proportional to the differential of the controller input. During elimination of the error, oscillation or instability may occur. Use the differential control to suppress these effects by acting before the error. That is, when the error is near 0, the differential control should be 0. Use proportional gain (P) and differential control (D) to improve the system state during PID adjustment.

4) Using PID control in a constant pressure pump feedback application:
Set the application’s constant pressure value (bar) to be the set point of PID control. The pressure sensor sends the actual value as the PID feedback value. After comparing the PID set point and PID feedback, an error displays. The PID controller calculates the output by using proportional gain (P), integral time (I) and differential time (D) to control the pump. It controls the drive to use a different pump speed and achieves constant pressure control by using a 4–20 mA signal corresponding to 0–10 bar as feedback to the drive.



- *P00.04 = 10 (display PID feedback (b) (%))*
- *P01.12 Acceleration Time is set according to actual conditions.*
- *P01.13 Deceleration Time is set according to actual conditions.*
- *P00.21 = 0, operate through the digital keypad*
- *P00.20 = 0, the digital keypad controls the set point.*
- *P08.00 = 1 (negative PID feedback from analog input)*
- *AI2 analog input P03.01 = 5, PID feedback signal.*
- *P08.01-P08.03 is set according to actual conditions.*
- *If there is no oscillation in the system, increase P08.01 (Proportional Gain (P))*
- *If there is no oscillation in the system, decrease P08.02 (Integral Time (I))*
- *If there is no oscillation in the system, increase P08.03 (Differential Time (D))*
- *Refer to P08.00–P08.21 for PID parameter settings.*

		Type	Hex Addr	Dec Addr
P08.01	**Proportional Gain (P)**	♦R/W	0801	42050
	Range/Units (Format: 16-bit unsigned)	Default		
	0.0–1000.0 (When P08.23 bit 1 = 0) 0.00–100.00 (When P08.23 bit 1 = 1)	1.00		

Sets the proportional gain to determine the deviation response speed. The higher the proportional gain, the faster the response speed. Eliminates the system deviation; usually used to decrease the deviation and get faster response speed. If you set the value too high, overshoot occurs and it may cause system oscillation and instability.

When P08.01 = 1.0: Kp gain is 100%; if the setting is 0.5, Kp gain is 50%.

If you set the other two gains (I and D) to zero, proportional control is the only effective parameter.

		Type	Hex Addr	Dec Addr
P08.02	**Integral Time (I)**	♦R/W	0802	42051
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–100.00 sec.	1.00		

Use the integral controller to eliminate deviation during stable system operation. The integral control does not stop working until the deviation is zero. The integral is affected by the integral time. The smaller the integral time, the stronger the integral action. It is helpful to reduce overshoot and oscillation for a stable system. Accordingly, the speed to lower the steady-state deviation decreases. Integral control is often used with the other two controls for the PI controller or PID controller.

Sets the integral time of the I controller. When the integral time is long, there is a small I controller gain, with slower response and slow external control. When the integral time is short, there is a large I controller gain, with faster response and rapid external control.

- *When the integral time is too short, it may cause overshoot or oscillation for the output frequency and system.*
- *Set Integral Time to 0.00 to disable the I controller.*

		Type	Hex Addr	Dec Addr
P08.03	**Differential Time (D)**	♦R/W	0803	42052
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–1.00 sec.	0.00		

Use the differential controller to show the system deviation change, as well as to preview the change in the deviation. You can use the differential controller to eliminate the deviation in order to improve the system state. Using a suitable differential time can reduce overshoot and shorten adjustment time; however, the differential operation increases noise interference. Note that a too large differential causes more noise interference. In addition, the differential shows the change and the differential output is 0 when there is no change. Note that you cannot use the differential control independently. You must use it with the other two controllers for the PD controller or PID controller.

Sets the D controller gain to determine the deviation change response. Using a suitable differential time reduces the P and I controllers overshoot to decrease the oscillation for a stable system. A differential time that is too long may cause system oscillation.

The differential controller acts on the change in the deviation and cannot reduce interference. Do not use this function when there is significant interference.

		Type	Hex Addr	Dec Addr
P08.04	***Upper Limit of Integral Control***	♦R/W	0804	42053
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–100.0%	100.0		

P08.04 defines an upper bound for the integral gain (I) and therefore limits the master frequency.

The formula is: Integral upper bound = Maximum Operation Frequency (P01.00) x (P08.04%).

An excessive integral value causes a slow response due to sudden load changes and may cause motor stall or machine damage. If so, decrease it to a proper value.

		Type	Hex Addr	Dec Addr
P08.05	***PID Output Command Limit (Positive Limit)***	♦R/W	0805	42054
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–110.0%	100.0		

P08.05 defines the percentage of the output frequency limit during the PID control. The formula is Output Frequency Limit = Maximum Operation Frequency (P01.00) × P08.05%.

		Type	Hex Addr	Dec Addr
P08.06	***PID Feedback Value by Communication Protocol***	♦R/W	0806	42055
	Range/Units (Format: 16-bit signed)	*Default*		
	-200.00–200.00%	0.00		

Use communications to set the PID feedback value when the PID feedback input is set to communications (P08.00 = 7 or 8).

		Type	Hex Addr	Dec Addr
P08.07	***PID Delay Time***	♦R/W	0807	42056
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–2.5 sec.	0.0		

P08.07 determines the primary low pass filter time when in PID control. Setting a large time constant may slow down the drive’s response speed.

PID control output frequency is filtered with a primary low pass function. This function can filter a mix of frequencies. A long primary low pass time means the filter degree is high and a short primary low pass time means the filter degree is low.

Inappropriate delay time setting may cause system oscillation.

		Type	Hex Addr	Dec Addr
P08.08	***Feedback Signal Detection Time***	♦R/W	0808	42057
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–3600.0 sec.	0.0		

Valid only when the feedback signal is AI2 (4–20 mA).

P08.08 sets the detection time for abnormal PID signal feedback. You can also use it when the system feedback signal response is extremely slow. (Setting the detection time to 0.0 disables the detection function.)

		Type	Hex Addr	Dec Addr
P08.09	***Feedback Signal Fault Treatment***	♦R/W	0809	42058

Range/Units (Format: 16-bit binary) — *Default*: 0

0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: Warn and operate at last frequency

Valid only when the feedback signal is AI2 (4–20 mA).

Sets the treatments when the PID feedback signal is abnormal.

		Type	Hex Addr	Dec Addr
P08.10	***Sleep Frequency***	♦R/W	080A	42059

Range/Units (Format: 16-bit unsigned) — *Default*: 0.00

0.00–599.00 Hz (P08.18=0)
0.00–200.00% (P08.18=1)

P08.10 determines the sleep frequency, and if the sleep time and the wake-up frequency are enabled or disabled.

- *P08.10 = 0: Disabled*
- *P08.10 ≠ 0: Enabled*

		Type	Hex Addr	Dec Addr
P08.11	***Wake-up Frequency***	♦R/W	080B	42060

Range/Units (Format: 16-bit unsigned) — *Default*: 0.00

0.00–599.00 Hz (P08.18=0)
0.00–200.00% (P08.18=1)

When P08.18=0, the unit for P08.10 and that for P08.11 switch to frequency. The settings are between 0.00–599.00 Hz.

When P08.18=1, the unit for P08.10 and that for P08.11 switch to percentage. The settings are between 0.00–200.00%.

- *The percentage is based on the current setpoint value, not the maximum value. For example, if the maximum value is 100kg, and the current setpoint value is 30kg, then if P08.11=40%, the value is 12kg.*
- *P08.10 uses the same logic for calculation.*

		Type	Hex Addr	Dec Addr
P08.12	***Sleep Time***	♦R/W	080C	42061

Range/Units (Format: 16-bit unsigned) — *Default*: 0.0

0.0–6000.0 sec.

When the Frequency command is smaller than the sleep frequency and less than the sleep time, the Frequency command is equal to the sleep frequency. However, the Frequency command remains at 0.00 Hz until the Frequency command becomes equal to or larger than the wake-up frequency.

		Type	Hex Addr	Dec Addr
P08.13	***PID Feedback Signal Error Deviation Level***	♦R/W	080D	42062

Range/Units (Format: 16-bit unsigned) — *Default*: 10.0

1.0–50.0%

		Type	Hex Addr	Dec Addr
P08.14	***PID Feedback Signal Error Deviation Detection Time***	♦R/W	080E	42063
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.1–300.0 sec.	5.0		

When the PID control function is normal, it should calculate the value within a period of time that is close to the target value.

Refer to the PID control diagram for details. When executing PID feedback control, if |PID reference target value - detection value| > P08.13 PID Feedback Signal Error Deviation Level and time exceeds P08.14 setting, it is regarded as a PID control fault, and the multi-function output terminal setting 15 (PID feedback error) activates.

		Type	Hex Addr	Dec Addr
P08.15	***PID Feedback Signal Filter Time***	♦R/W	080F	42064
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.1–300.0 sec.	5.0		

		Type	Hex Addr	Dec Addr
P08.16	***PID Compensation Selection***	♦R/W	0810	42065
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Parameter setting 1: Analog input	0		

When P08.16=0: the setting for P08.17 determines the PID compensation value.

		Type	Hex Addr	Dec Addr
P08.17	***PID Compensation***	♦R/W	0811	42066
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.0–100.0%	0		

The PID compensation value = maximum PID target value × P08.17.

Example:

If the maximum operation frequency P01.00 = 60Hz, and P08.17 = 10.0%, the PID compensation value increases the output frequency 6.00 Hz (60.00 Hz × 100.00% × 10.0% = 6.00 Hz).

		Type	Hex Addr	Dec Addr
P08.18	***Sleep Mode Function Setting***	R/W	0812	42067
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Refer to PID output command 1: Refer to PID feedback signal	0		

P08.18 determines the setting type for P08.10 and P08.11.

- *P08.18 = 0: The unit for P08.10 and P08.11 switch to frequency. The settings are between 0.00–599.00 Hz.*
- *P08.18 = 1: The unit for P08.10 and P08.11 switch to percentage. The settings are between 0.00–200.00%.*

		Type	Hex Addr	Dec Addr
P08.19	***Wake-up Integral Limit***	♦R/W	0813	42068
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–200.0%	50.0		

P08.19 reduces the reaction time from sleep to wake-up.

Defines the wake-up integral frequency limit = (P01.00 × P08.19%)

		Type	Hex Addr	Dec Addr
P08.20	***PID Mode Selection***	R/W	0814	42069
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Dependent ISA PID structure	0		
	1: Independent/Parallel PID structure			

- *P08.20 = 0: Use Dependent (ISA) PID control structure (Kp, Kp*Ki, Kp*Kd).*
- *P08.20 = 1: Use Independent/Parallel PID control structure. The proportional gain, integral gain, and differential gain are independent (Kp, Ki, Kd). You can customize the P, I, and D value to fit your application.*

PI Control:

Controlled only by the P action, so the deviation cannot be entirely eliminated. In general, to eliminate residual deviations, use the P + I controls. When you use the PI control, it eliminates the deviation caused by the targeted value changes and the constant external interferences. However, if the I action is too powerful, it delays the response when there is rapid variation. You can use the P action by itself to control the loading system with the integral components.

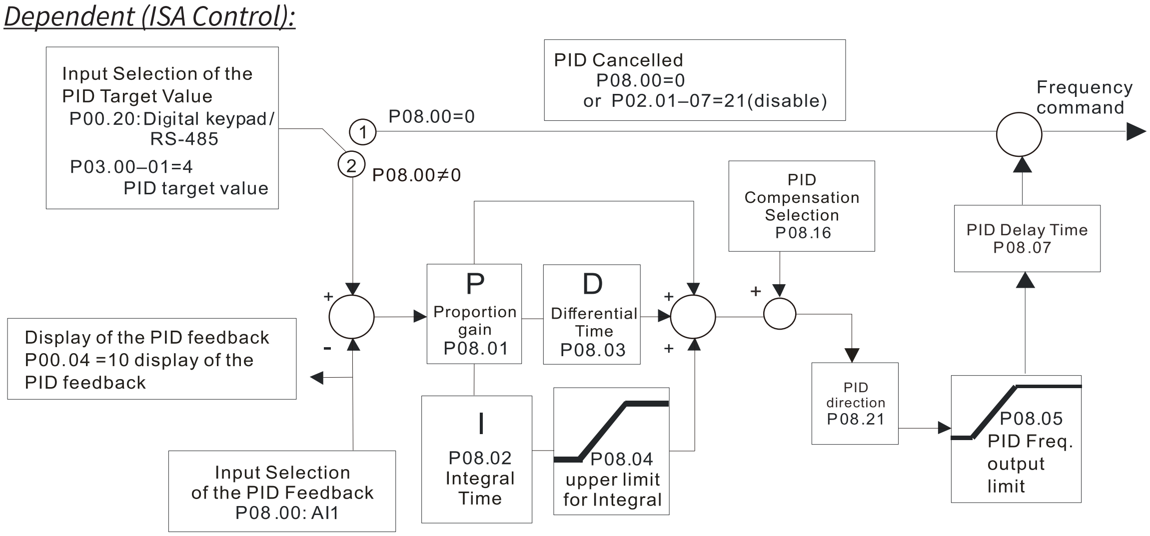
PD Control:

When deviation occurs, the system immediately generates an operation load that is greater than the load generated only by the D action to restrain the deviation increment. If the deviation is small, the effectiveness of the P action decreases as well. The control objects include applications with integral component loads, which are controlled by the P action only. Sometimes, if the integral component is functioning, the whole system may oscillate. In this case, use the PD control to reduce the P action's oscillation and stabilize the system. In other words, this control is useful with no brake function's loading over the processes.

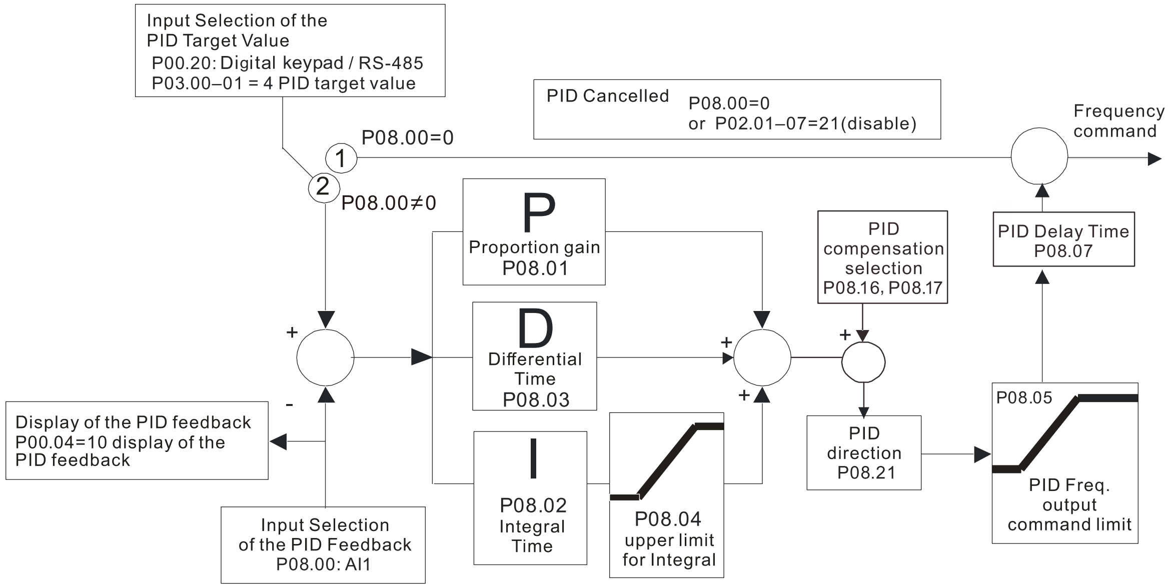
PID Control:

Use the I action to eliminate the deviation and the D action to reduce oscillation; then combine this with the P action for the PID control. Use the PID method for a control process with no deviations, high accuracy, and a stable system.

Dependent (ISA Control):



Independent (Parallel) control:



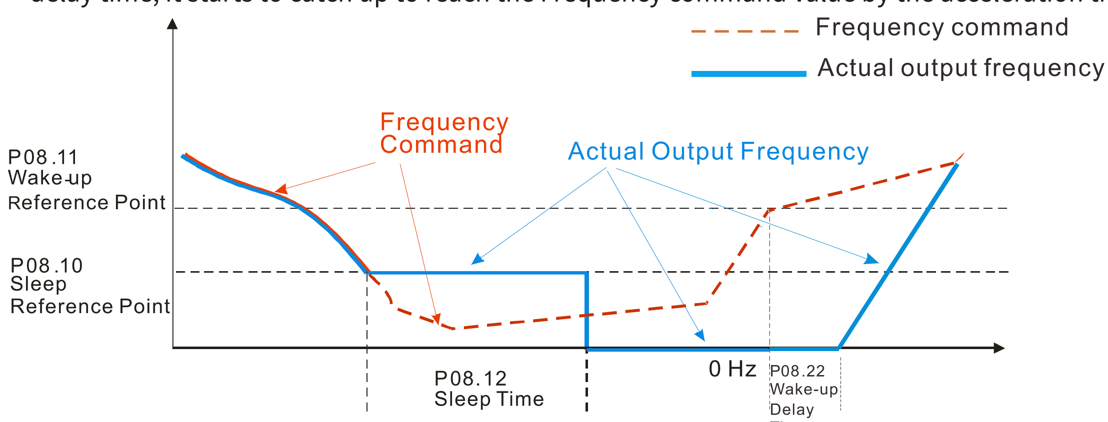
		Type	Hex Addr	Dec Addr
P08.21	***Enable PID to Change the Operation Direction***	R/W	0815	42070
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Operation direction cannot be changed 1: Operation direction can be changed	0		

		Type	Hex Addr	Dec Addr
P08.22	***Wake-up Delay Time***	♦R/W	0816	42071
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–600.00 sec.	0.00		

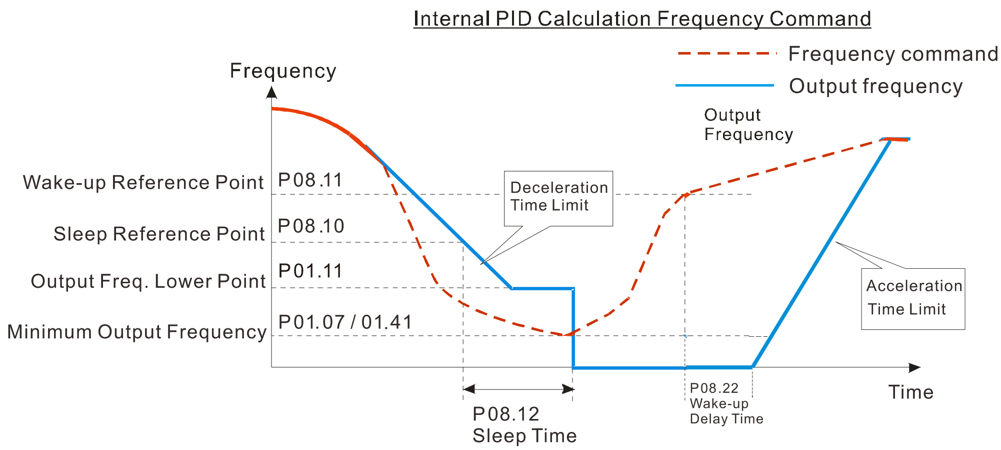
Refer to P08.18 and the diagrams in P08.23 for more information.

There are three scenarios for the sleep and wake-up frequency.

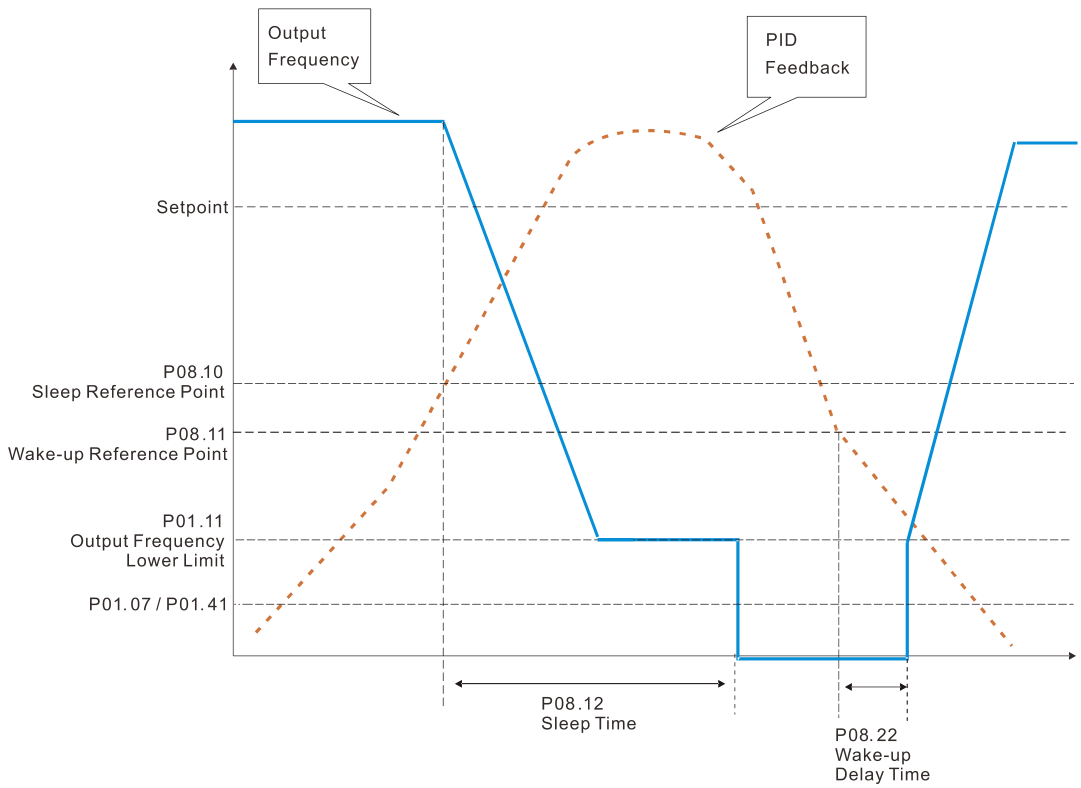
1) Frequency Command (PID is not in use, P08.00 = 0. Works only in V/F mode)
When the output frequency ≤ the sleep frequency and the drive reaches the preset sleep time, then the drive is in sleep mode (0Hz). When the Frequency command reaches the wake-up frequency, the drive starts to count the wake-up delay time. When the drive reaches the wake-up delay time, it starts to catch up to reach the Frequency command value by the acceleration time.



2) Internal PID Calculation Frequency Command (PID is in use, P08.00 ≠ 0 and P08.18=0.)
When the PID calculation Frequency command reaches the sleep frequency, the drive starts to count the sleep time and the output frequency starts to decrease. If the drive exceeds the preset sleep time, then the drive is in sleep mode (0Hz). If the drive does not reach the preset sleep time, it remains at the lower frequency limit (if there is a preset lower limit.), or it remains at the minimum output frequency set for P01.07 and waits until it reaches the sleep time before going into sleep mode (0Hz). When the PID calculated Frequency command reaches the wake-up frequency, the drive starts to count the wake-up delay time. Once it reaches the wake-up delay time, the drive starts to catch up to reach the PID Frequency command value by the acceleration time.



3) PID Feedback Value Percentage (PID is in use, P08.00 ≠ 0 and P08.18 = 1)
When the PID feedback value reaches the sleep level percentage, the drive starts to count the sleep time and the output frequency starts to decrease. If the drive exceeds the preset sleep time, then the drive is in sleep mode (0Hz). If the drive does not reach preset the sleep time, it remains at the lower frequency limit (if there is a preset of lower limit.), or it remains at the minimum output frequency set for P01.07 and waits until it reaches the sleep time before going into sleep mode (0Hz).
When the PID feedback value reaches the wake-up percentage, the drive starts to count the wake-up delay time. Once it reaches the wake-up delay time, the drive starts to catch up to reach the PID Frequency command value by the acceleration time.



		Type	*Hex Addr*	*Dec Addr*
P08.23	***PID Control Flag***	♦R/W	0817	42072

Range/Units (Format: 16-bit binary) — *Default*: 2

bit 0 = 1, PID running in reverse follows the setting for P00.23.
bit 0 = 0, PID running in reverse refers to PID's calculated value.
bit 1 = 1, two decimal places for PID Kp
bit 1 = 0, one decimal place for PID Kp

P08.23 sets the PID control flag.

- *P08.23 bit 0 = 1: PID running in reverse function is valid only when P08.21=1.*
- *P08.23 bit 0 = 0: If the PID calculated value is positive, the direction is forward. If the PID calculated value is negative, the direction is reverse.*

When the bit1 setting changes, the Kp gain does not change. For example: Kp = 6. When P08.23 bit1 = 0, Kp = 6.0; when P08.23 bit1 = 1, Kp = 6.00.

		Type	*Hex Addr*	*Dec Addr*
P08.26	***PID Output Command Limit (Reverse Limit)***	♦R/W	081A	42075

Range/Units (Format: 16-bit unsigned) — *Default*: 100.0

0.0–100.0%

When PID enables the reverse direction, the PID output is a negative value, and the PID output value is limited by the setting for P08.26. Use this function with P08.21.

		Type	Hex Addr	Dec Addr
P08.27	**Acceleration / Deceleration Time for PID Command**	♦R/W	081B	42076
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–655.35 sec.	0.00		

When P08.27 = 0.00 seconds: Disables the PID acceleration/deceleration command, and the target value is equal to the PID command.

When P08.27 ≠ 0.00 seconds: Enables the PID acceleration/deceleration command. For PID acceleration and deceleration, when the PID target value changes, the command value increment/decrement is executed according to this parameter.

Example:

If we set P08.27 to 10.00 seconds, when PID target value changes from 0% to 100%, it takes 10 seconds for the PID command to change from 0% to 100%. In a similar way, when PID target value changes from 100% to 0%, it takes 10 seconds for the PID command to change from 100% to 0%.

		Type	Hex Addr	Dec Addr
P08.29	**Frequency Base Corresponding to 100.00% PID**	R/W	081D	42078
	Range/Units (Format: 16-bit binary)	Default		
	0: PID control output 100.00% corresponding to maximum operation frequency (P01.00) 1: PID control output 100.00% corresponding to the input value of the auxiliary frequency	0		

Valid only when you enable the master and auxiliary frequency functions.

When P08.29 = 0, PID control outputs 100.00% corresponding to the maximum operation frequency. When P08.29 = 1, PID control outputs 100.00% corresponding to the auxiliary frequency. (The PID output frequency changes when the auxiliary frequency command changes.)

		Type	Hex Addr	Dec Addr
P08.31	**Proportional gain 2**	♦R/W	081F	42080
	Range/Units (Format: 16-bit unsigned)	Default		
	0.0–1000.0 (when P08.23 setting bit 1=0) 0.00–100.00 (when P08.23 setting bit 1=1)	1.00		

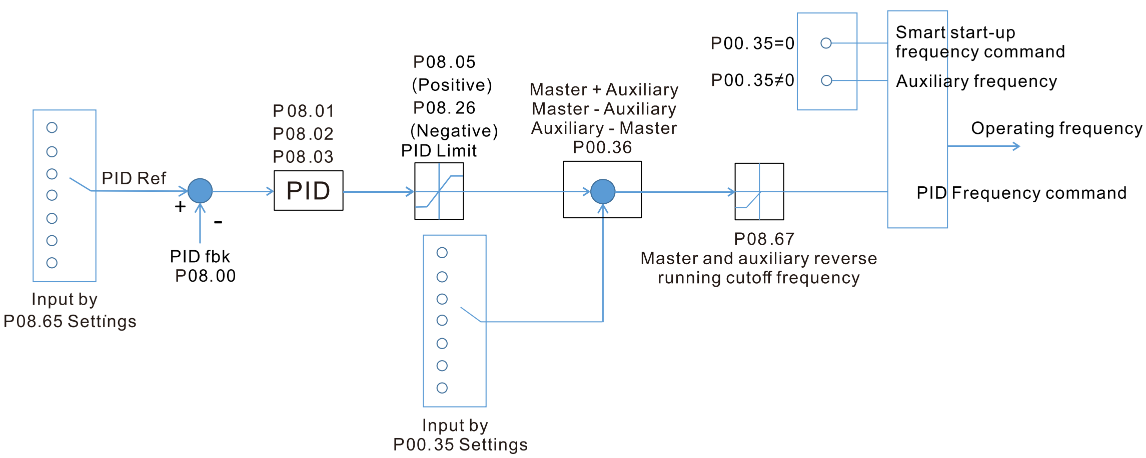
		Type	Hex Addr	Dec Addr
P08.32	**Integral time 2**	♦R/W	0820	42081
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–100.00 sec.	1.00		

		Type	Hex Addr	Dec Addr
P08.33	**Differential time 2**	♦R/W	0821	42082
	Range/Units (Format: 16-bit binary)	Default		
	0.00–1.00 sec.	0.00		

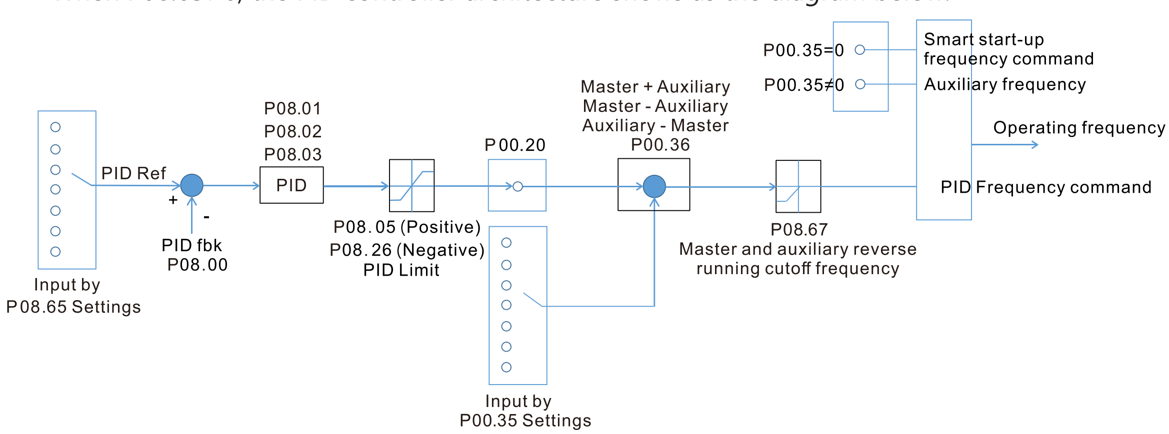
		Type	Hex Addr	Dec Addr
P08.65	***PID Target Value Source***	♦R/W	0841	42114
	Range/Units (Format: 16-bit binary)	Default		
	0: Frequency command (P00.20, P00.30) 1: P08.66 setting 2: RS-485 communication input 3: External analog input (refer to P03.00, P03.01) 6: Communication card 7: By the digital dial on the keypad	0		

P08.65 selects the target value source for the PID controller.

- *When P08.65=0, the maximum operating frequency P01.00 is 60Hz, the error is 100%, and P08.01=1.00, then the output frequency is "1" times the P01.00 maximum operating frequency. Therefore, the output frequency = 60 * 100% * 1=60Hz.*
  *Calculation formula: Output frequency=Fmax (P01.00) * error% ((PID reference value (P00.20 / P00.30) – PID feedback (P08.00)) * P08.01.*
- *When P08.65≠0, the internal calculation of the proportional gain reduces by 100 times, that is, when P01.00 Fmax=60Hz, error=100%, P08.01=1.00, then the output frequency is "0.01" times the P01.00 Fmax. Therefore, the output frequency=60 * 100% * 0.01=0.6 Hz.*
  *Calculation formula: Output frequency=Fmax (P01.00) * error% ((PID reference value (P08.66) – PID feedback value (P08.00)) * P08.01 * 0.01.*
- *When P08.65=0, the PID controller architecture shows as the diagram below:*



- *When P08.65≠0, the PID controller architecture shows as the diagram below:*



- *When P08.65 is not set to 0, P00.20 is automatically set to 9.*
- *When P08.65 is set to 1, set the PID command through P08.66; when P08.65 is not set to 1, P08.66 displays the PID command.*
- *When P08.65 is set to 2, 4, and 6, the corresponding communication address is C2003H.*

		Type	Hex Addr	Dec Addr
P08.66	***PID Target Value Setting***	♦R/W	0842	42115
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.00–100.00%	50.00		

The target value setting of the PID controller (P08.66) is a relative value.

		Type	Hex Addr	Dec Addr
P08.67	***Master and Auxiliary Reverse Running Cutoff Frequency***	♦R/W	0843	42116
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–100.0%	10.0		

100% corresponds to P01.00 the maximum operation frequency

In some cases, it is only possible for the PID to control the set point and the feedback to the same status when the PID output frequency is negative (the motor runs in reverse). However, an excessively high reverse frequency is not allowed in some cases, and P08.67 is used to determine the upper limit of the reverse frequency

		Type	Hex Addr	Dec Addr
P08.68	***PID Deviation Limit***	♦R/W	0844	42117
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00%	0.00		

When P08.68 is not set to 0, the PID deviation limit function is enabled.

When PID deviation ≤ PID deviation limit, PID stops adjusting, which means the PID output frequency maintains the value at last status. This function is effective for some closed-loop control applications.

		Type	Hex Addr	Dec Addr
P08.69	***Integral Separation Level***	♦R/W	0845	42118
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00%	0.00		

P08.69 reduces overshoot when overshoot occurs in the PID feedback at start-up.

- *When P08.69 is not set to 0, the integral separation function is enabled.*
- *The benchmark for the integral separation level is the PID error%.*
- *The integral separation function activates only once at start-up.*

When PID deviation ≥ P08.69, the integral effect is cancelled to avoid the increasing system overshoot due to the integral effect. When PID deviation is smaller than P08.69, the integral effect is activated to eliminate the steady-state error.

		Type	Hex Addr	Dec Addr
P08.70	***Smart Start-up Level***	R/W	0846	42119
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00%	5.00		

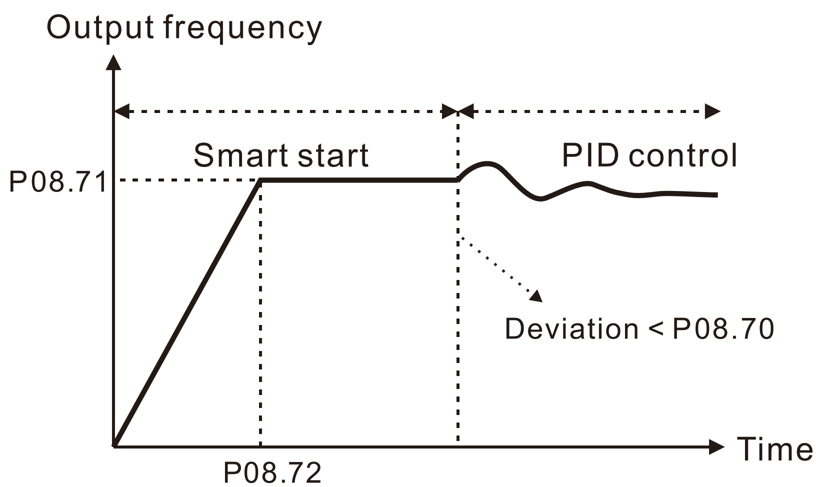
		Type	Hex Addr	Dec Addr
P08.71	***Smart Start-up Frequency Command***	♦R/W	0847	42120
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	0.00		

		Type	Hex Addr	Dec Addr
P08.72	***Smart Start-up Acceleration Time***	♦R/W	0848	42121
	Range/Units (Format: 16-bit unsigned)	*Default*		
		3.00		

When P08.71 is not set to 0, the smart start-up function is enabled.

- *The benchmark for the smart start-up level is the percentage of PID deviation.*
- *Use the smart start-up function to reduce overshoot when overshoot occurs in the PID feedback at start-up. The smart start-up activates only once at start-up.*

When the smart start-up function is enabled, it starts with the P08.71 frequency and P08.72 acceleration time (P08.72 acceleration time is the time that it accelerates to P08.71). When the PID deviation is smaller than P08.70, it switches to the normal PID control (the smart start-up frequency is filled into the PID integral when switching to PID control to avoid discontinuous frequency).



		Type	Hex Addr	Dec Addr
P08.75	***PID2 Parameter Switch Condition***	♦R/W	084B	42124
	Range/Units (Format: 16-bit binary)	*Default*		
	0: No switching (refer to P08.01–P08.03) 1: Auto-switch based on the output frequency 2: Auto-switch based on the deviation	0		

		Type	Hex Addr	Dec Addr
P08.76	***PID2 Parameter Switch Deviation 1***	♦R/W	084C	42125
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–P08.77%	10.00		

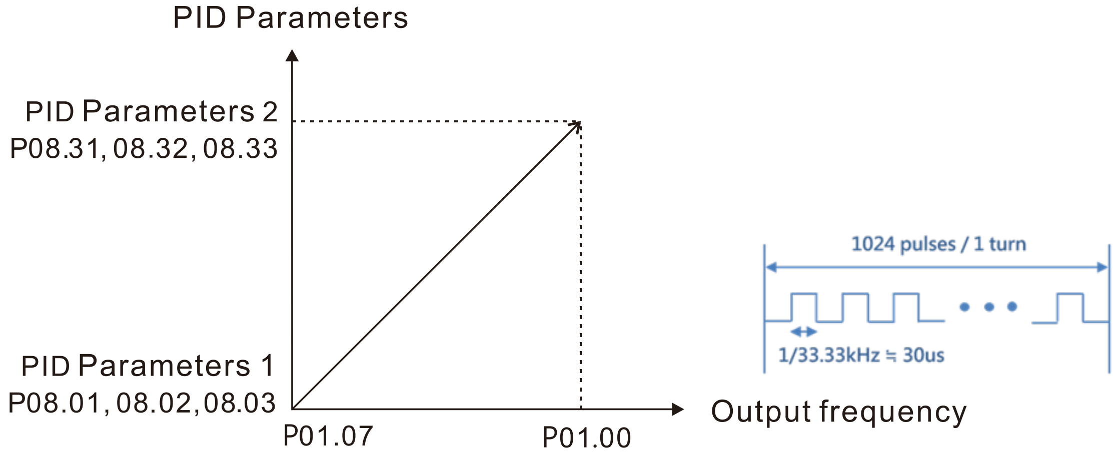
		Type	Hex Addr	Dec Addr
P08.77	***PID2 Parameter Switch Deviation 2***	♦R/W	084D	42126
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P08.76–100.00%	40.00		

A set of PID parameters cannot meet the requirements of the entire running process in some applications. Use P08.75 to switch to the second set of PID parameters P08.31–P08.33. The setting method for P08.31–P08.33 is the same as that for P08.01–P08.03.

The two sets of PID parameters switch automatically according to the frequency and deviation.

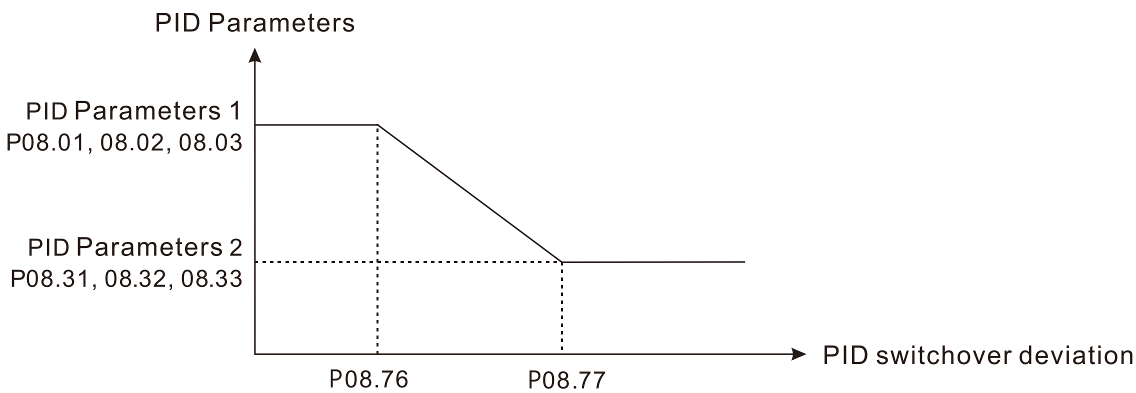
Switch according to the output frequency:

When the output frequency is between P01.07 and P01.00, the PID parameter is the linear interpolation value between the two PID parameter groups.



Switch according to the deviation:

- *When the deviation absolute value between the set point and feedback is smaller than P08.76 (PID2 Parameter Switch Deviation 1), the first group PID parameters are used.*
- *When the deviation absolute value between the set point and feedback is larger than P08.77 (PID2 Parameter Switch Deviation 2), the second group PID parameters are used.*
- *When the deviation absolute value between the set point and feedback is between P08.76 and P08.77, the PID parameter is the linear interpolation value between the two PID parameter groups.*



		Type	Hex Addr	Dec Addr
P08.78	***Allowed Reverse Running Time after Start-up***	♦R/W	084E	42127
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5 sec.	0.0		

When P08.78 is not set to 0, the allowed reverse running time after start-up is enabled.

When it is set to 1 second, the PID control is not allowed to change the running direction within 0–1 seconds of starting time (P08.21=0), and is allowed to change after 1 second of starting time (P08.21=1).

		Type	Hex Addr	Dec Addr
P08.79	***WireBreak Detected Upper Level***	R/W	084F	42128
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–100%	0		

		Type	Hex Addr	Dec Addr
P08.80	**WireBreak Detected Lower Level**	R/W	0850	42129
	Range/Units (Format: 16-bit unsigned)	Default		
	0–100%	0		

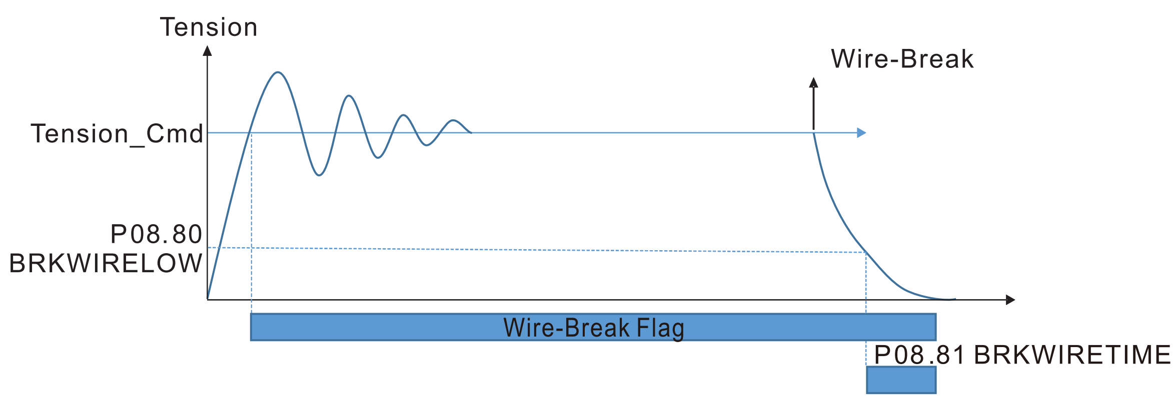
		Type	Hex Addr	Dec Addr
P08.81	**WireBreak Detected Time**	R/W	0851	42130
	Range/Units (Format: 16-bit unsigned)	Default		
	0.000–65.535 sec.	0.000		

		Type	Hex Addr	Dec Addr
P08.82	**WireBreak Treatment**	R/W	0852	42131
	Range/Units (Format: 16-bit unsigned)	Default		
	0: Warn and do not stop 1: Ramp to stop 2: Coast to stop 3: Warn, PID hold	0		

Since the tension control may be activated during unwinding, there must be a mechanism to determine the material cutoff after rewind.

As shown in the figure below, when the tension feedback is below the setting in P08.80 for the time value in P08.81, a wire break condition is set. Similarly, if the tension feedback is greater that the setting in P08.79 for the time value in P08.81, a wire break condition is set.

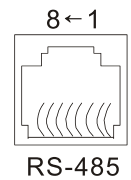
In either case, the drive will respond according to the setting in P08.82.



Group P09.xx Details – Communication Parameters

When connecting the drive to an RS-485 network, the diagram on the right shows the built-in RS-485 communication port pin definitions.

To connect your drive to a PC USB port with GSoft2 software, utilize the GS30 USB Type B port. The USB port does not require configuration of the COM1 parameters.



Modbus RS-485
Pin 1, 2, 6: Reserved
Pin 3, 7: SGND
Pin 4: SG-
Pin 5: SG+
Pin 8: +10VS

		Type	*Hex Addr*	*Dec Addr*
P09.00	***COM1 Communication Address***	♦R/W	0900	42305
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1–254	1		

P09.00 sets the communication address for the drive if the AC motor drive is controlled through RS-485 serial communication. The communication address for each AC drive must be unique.

		Type	*Hex Addr*	*Dec Addr*
P09.01	***COM1 Transmission Speed***	♦R/W	0901	42306
	Range/Units (Format: 16-bit unsigned)	*Default*		
	4.8–115.2 Kbps	9.6		

P09.01 sets the transmission speed of the RS-485 port of the drive.

Options are 4.8 Kbps, 9.6 Kbps, 19.2 Kbps, 38.4 Kbps, 57.6 Kbps, or 115.2 Kbps; otherwise, the transmission speed is set to the default 9.6 Kbps.

For optional GS4-KPD remote keypad, value must be set to 19.2.

		Type	*Hex Addr*	*Dec Addr*
P09.02	***COM1 Transmission Fault Treatment***	♦R/W	0902	42307
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning, no fault, and continue operation	3		

P09.02 determines the treatment when an error is detected that the host controller does not continuously transmit data to the AC motor drive during Modbus communication. The detection time is based on the P09.03 setting.

When a transmission error occurs (for example, the error code CE10 displays), the error remains even if the transmission status returns to normal, and is not cleared automatically. In this case, set a reset command (Reset) to clear the error.

		Type	*Hex Addr*	*Dec Addr*
P09.03	***COM1 Time-out Detection***	♦R/W	0903	42308
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–100.0 sec.	0.0		

P09.03 sets the communication time-out value.

		Type	Hex Addr	Dec Addr
P09.04	***COM1 Communication Protocol***	♦R/W	0904	42309
	Range/Units (Format: 16-bit binary)	*Default*		

1: 7, N, 2 (ASCII)
2: 7, E, 1 (ASCII)
3: 7, O, 1 (ASCII)
4: 7, E, 2 (ASCII)
5: 7, O, 2 (ASCII)
6: 8, N, 1 (ASCII)
7: 8, N, 2 (ASCII)
8: 8, E, 1 (ASCII)
9: 8, O, 1 (ASCII)
10: 8, E, 2 (ASCII)
11: 8, O, 2 (ASCII)
12: 8, N, 1 (RTU)
13: 8, N, 2 (RTU)
14: 8, E, 1 (RTU)
15: 8, O, 1 (RTU)
16: 8, E, 2 (RTU)
17: 8, O, 2 (RTU)

Default: 15

Control by RS-485 Network

When using the RS-485 serial communication interface, you must specify each drive's communication address in P09.00. The RS-485 network master then implements control using the drives' individual addresses.

Modbus ASCII (American Standard Code for Information Interchange): Each byte of data is the combination of two ASCII characters. For example, one byte of data: 64 Hex, shown as '64' in ASCII, consists of '6' (36Hex) and '4' (34Hex).

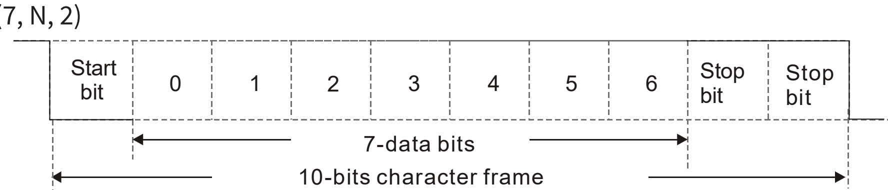
1) Code Description
The communication protocol is in hexadecimal, ASCII: "0" … "9", "A" … "F", every hexadecimal value represents an ASCII code. The following table shows some examples.

Character	***'0'***	***'1'***	***'2'***	***'3'***	***'4'***	***'5'***	***'6'***	***'7'***
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

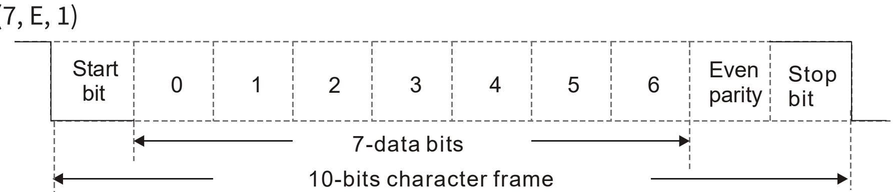
Character	***'8'***	***'9'***	***'A'***	***'B'***	***'C'***	***'D'***	***'E'***	***'F'***
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

2) Data Format
10-bit character frame (For ASCII):

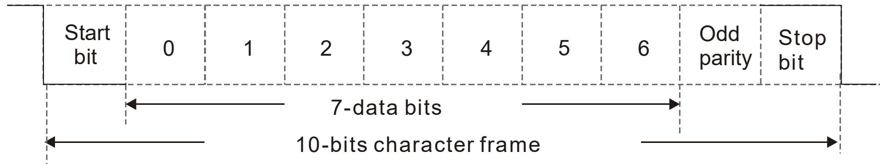
a) (7, N, 2)



b) (7, E, 1)

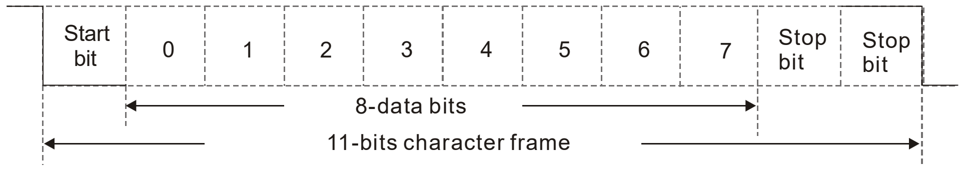


c) (7, O, 1)

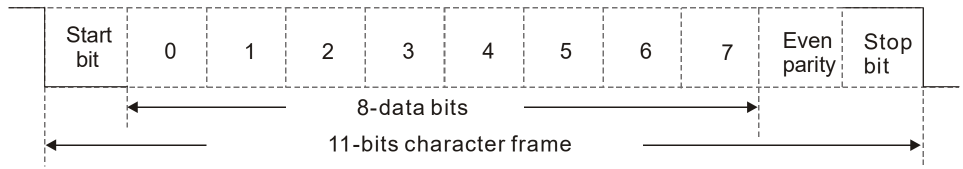


11-bit character frame (For RTU):

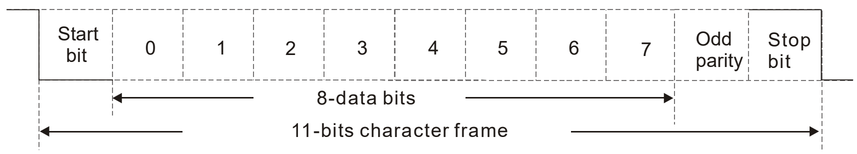
a) (8, N, 2)



b) (8, E, 1)



c) (8, O, 1)



3) Communication Protocol

a) Communication Data Frame

ASCII mode:

STX	Start character = ' : ' (3AH)
Address High	Communication address: one 8-bit address consists of 2 ASCII codes
Address Low	
Function High	Command code: one 8-bit command consists of 2 ASCII codes
Function Low	
DATA (n-1)	Contents of data: n x 8-bit data consists of 2n ASCII codes n ≤ 16, maximum of 32 ASCII codes (20 sets of data)
....	
DATA 0	
LRC Check High	LRC checksum: one 8-bit checksum consists of 2 ASCII codes
LRC Check Low	
END High	End characters: END High = CR (0DH), END Low = LF (0AH)
END Low	

RTU mode:

START	Defined by a silent interval of larger than/equal to 10ms
Address	Communication address: 8-bit binary address
Function	Command code: 8-bit binary command
DATA (n-1)	Contents of data: n × 8-bit data, n ≤ 16
....	
DATA 0	
CRC Check Low	CRC checksum: one 16-bit CRC checksum consists of 2 8-bit binary characters
CRC Check High	
END	Defined by a silent interval of larger than/equal to 10ms

b) Communication Address (Address)

- *00H: Broadcast to all AC motor drives*
- *01H: AC motor drive at address 01*
- *0FH: AC motor drive at address 15*
- *10H: AC motor drive at address 16*
- *FEH: AC motor drive at address 254*

c) Function (Function code) and DATA (Data characters)

i) 03H: Read data from a register
Example: Reading two continuous data from register address 2102H. AMD address is 01H.
ASCII Mode:

Command Message	
STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Starting register	'2'
	'1'
	'0'
	'2'
Number of register (count by word)	'0'
	'0'
	'0'
	'2'
LRC Check	'D'
	'7'
END	CR
	LF

Response Message	
STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Number of register (count by byte)	'0'
	'4'
Content of starting register 2102H	'1'
	'7'
	'7'
	'0'
Content of register 2103H	'0'
	'0'
	'0'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

RTU Mode:

Command Message	
Address	01H
Function	03H
Starting data register	21H
	02H
Number of register (count by world)	00H
	02H
CRC Check Low	6FH
CRC Check High	F7H

Response Message	
Address	01H
Function	03H
Number of register (count by byte)	04H
Content of register address 2102H	17H
	70H
Content of register address 2103H	00H
	00H
CRC Check Low	FEH
CRC Check High	5CH

ii) 06H: Single write, write single data to a register
Example: Writing data 6000 (1770H) to register 0100H. AMD address is 01H.
ASCII Mode:

Command Message	
STX	':'
Address	'0'
	'1'
Function	'0'
	'6'
Target register	'0'
	'1'
	'0'
	'0'
Register content	'1'
	'7'
	'7'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

Response Message	
STX	':'
Address	'0'
	'1'
Function	'0'
	'6'
Target register	'0'
	'1'
	'0'
	'0'
Register content	'1'
	'7'
	'7'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

RTU Mode:

Command Message	
Address	01H
Function	06H
Target register	01H
	00H
Register content	17H
	70H
CRC Check Low CRC Check High	86H
	22H

Response Message	
Address	01H
Function	06H
Target register	01H
	00H
Register content	17H
	70H
CRC Check Low CRC Check High	86H
	22H

iii) 10H: Write multiple registers (can write at most 20 sets of data simultaneously).
Example: Set the multi-step speed of an AC motor drive (address is 01H):
P04.00 = 50.00 (1388H), P04.01 = 40.00 (0FA0H)
ASCII Mode:

Command Message	
STX	':'
ADR 1 ADR 0	'0'
	'1'
CMD 1	'1'
CMD 0	'0'
Target register	'0'
	'5'
	'0'
	'0'
Number of register (count by word)	'0'
	'0'
	'0'
	'2'
Number of register (count by Byte)	'0'
	'4'
The first data content	'1'
	'3'
	'8'
	'8'
The second data content	'0'
	'F'
	'A'
	'0'
LRC Check	'9'
	'A'
END	CR
	LF

Response Message	
STX	':'
ADR 1 ADR 0	'0'
	'1'
CMD 1	'1'
CMD 0	'0'
Target register	'0'
	'5'
	'0'
	'0'
Number of register (count by word)	'0'
	'0'
	'0'
	'2'
LRC Check	'E'
	'8'
END	CR
	LF

RTU Mode:

Command Message	
ADR	01H
CMD	10H
Target register	05H
	00H
Number of register (count by word)	00H
	02H
Quantity of data (byte)	04
The first data content	13H
	88H
The second data content	0FH
	A0H
CRC Check Low	'9'
CRC Check High	'A'

Response Message	
ADR	01H
CMD 1	10H
Target register	05H
	00H
Number of register (count by word)	00H
	02H
CRC Check Low	41H
CRC Check High	04H

d) Checksum

i) ASCII mode (LRC Check):

LRC (Longitudinal Redundancy Check) is calculated by summing up the values of the bytes from ADR1 to the last data character then calculating the hexadecimal representation of the 2's-complement negation of the sum.

For example, as shown in the above Section 3.3.(1),

01H + 03H + 21H + 02H + 00H + 02H = 29H, the 2's-complement negation of 29H is D7H.

ii) RTU mode (CRC Check):

CRC (Cyclical Redundancy Check) is calculated by the following steps:

- ***Step 1:*** *Load a 16-bit register (called CRC register) with FFFFH.*
- ***Step 2:*** *Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16-bit CRC register, and put the result in the CRC register.*
- ***Step 3:*** *Examine the LSB of CRC register.*
- ***Step 4:*** *If the LSB of CRC register is 0, shift the CRC register one bit to the right, fill MSB with zero, then repeat step 3. If the LSB of CRC register is 1, shift the CRC register one bit to the right, fill MSB with zero, Exclusive OR the CRC register with the polynomial value A001H, then repeat step 3.*
- ***Step 5:*** *Repeat step 3 and 4 until you perform eight shifts. This processes a complete 8-bit byte.*
- **Step 6:** Repeat step 2 through 5 for the next 8-bit byte of the command message. Continue doing this until all bytes are processed. The final contents of the CRC register are the CRC value. When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, that is, the lower order byte is transmitted first.

The following is an example of CRC generation using C language.

- *The function takes two arguments:*
  Unsigned char data ← a pointer to the message buffer*
  Unsigned char length ← the quantity of bytes in the message buffer
- *The function returns the CRC value as a type of unsigned integer.*

Unsigned int crc_chk(unsigned char* data, unsigned char length)

```
{
  int j;
  unsigned int reg_crc=0Xffff;
  while(length--){
        reg_crc ^= *data++;
        for(j=0;j<8;j++){
              if(reg_crc & 0x01){  /* LSB(b0)=1 */
                    reg_crc=(reg_crc>>1) ^ 0Xa001;
              }else{
                    reg_crc=reg_crc >>1;
              }
        }
  }
  return reg_crc;              // return register CRC
}
```

4) Address list

Content	Function		Hex	Dec	Octal
AC motor drive parameters	GG is the parameter group, nn is the parameter number; for example, the address of P04.10 is 040AH.		GGnn (ex. 040A)	xxxxx (41035)	yyyyy (2012)
Command write only	bit 1–0	00B: No function	2000	48193	20000
		01B: Stop			
		10B: Run			
		11B: JOG + RUN			
	bit 3–2	Reserved			
	bit 5–4	00B: No function			
		01B: FWD			
		10B: REV			
		11B: Change direction			
	bit 7–6	00B: 1st accel. / decel.			
		01B: 2nd accel. / decel.			
		10B: 3rd accel. / decel.			
		11B: 4th accel. / decel.			
	bit 11–8	000B: Master speed			
		0001B: 1st step speed frequency			
		0010B: 2nd step speed frequency			
		0011B: 3rd step speed frequency			
		0100B: 4th step speed frequency			
		0101B: 5th step speed frequency			
		0110B: 6th step speed frequency			
		0111B: 7th step speed frequency			
		1000B: 8th step speed frequency			
		1001B: 9th step speed frequency			
		1010B: 10th step speed frequency			
		1011B: 11th step speed frequency			
		1100B: 12th step speed frequency			
		1101B: 13th step speed frequency			
		1110B: 14th step speed frequency			
		1111B: 15th step speed frequency			
	bit 12	1: Enable bit 06–11 function			
	bit 14–13	00B: No function			
		01B: No function			
		10B: No function			
		11B: No function			
	bit 15	Reserved			
	Frequency command (XXX.XX Hz)		2001	48194	20001
	bit 0	1: E.F. (External Fault) ON	2002	48195	20002
	bit 1	1: Reset command			
	bit 2	1: B.B. ON			
	bit 4–3	Reserved			
	bit 5	Reserved			
	bit 15–6	Reserved			
Status monitor read only	High byte: Warning code / Low Byte: Fault code		2100	48449	20400

Content	Function		Hex	Dec	Octal
Status monitor read only (continued)	bit 1–0	AC motor drive operation status 00B: The drive stops 01B: The drive is decelerating 10B: The drive is in standby status 11B: The drive is operating	2101	48450	20401
	bit 2	1: JOG command			
	bit 4–3	Operation direction 00B: FWD running 01B: From REV running to FWD running 10B: From FWD running to REV running 11B: REV running			
	bit 8	1: Master frequency controlled by the communication interface			
	bit 9	1: Master frequency controlled by the analog / external terminal signal			
	bit 10	1: Operation command controlled by the communication interface			
	bit 11	1: Parameter locked			
	bit 12	1: Enable to copy parameters from keypad			
	bit 15–13	Reserved			
	Frequency command (XXX.XX Hz)		2102	48451	20402
	Output frequency (XXX.XX Hz)		2103	48452	20403
	Display the drive's output current (XX.XX A). When the current is higher than 655.35, it automatically shifts one decimal place as (XXX.X A). Refer to the high byte of 211F for information on the decimal places.		2104	48453	20404
	DC bus voltage (XXX.X V)		2105	48454	20405
	Output voltage (XXX.X V)		2106	48455	20406
	Current step for the multi-step speed operation		2107	48456	20407
	Max Torque Output (N·m)		2108	48457	20410
	Digital Input Counter value		2109	48458	20411
	Output power factor angle (XXX.X)		210A	48459	20412
	Output torque (XXX.X %)		210B	48460	20413
	Actual motor speed (XXXXX rpm)		210C	48461	20414
	Encoder Feedback		210D	48462	20415
	DI7 Pulse Input Count		210E	48463	20416
	Power output (X.XXX kW)		210F	48464	20417
	Multi-function display (P00.04)		2116	48471	20426
	Maximum Operation Frequency (P01.00) or Maximum User-defined Value (P00.26) When P00.26 is 0, this value is equal to P01.00 setting When P00.26 is not 0, and the command source is keypad, this value = P00.24 * P00.26 / P01.00. When P00.26 is not 0, and the command source is 485, this value = P09.10 * P00.26 / P01.00.		211B	48476	20433
	High byte: the decimal place of current value (display)		211F	48480	20437
	Display the drive's output current (XX.XX A). When the current is higher than 655.35, it automatically shifts one decimal place as (XXX.X A). Refer to the high byte of 211F for information on the decimal places.		2200	48705	21000
	Counter value		2201	48706	21001
	Actual output frequency (XXXXX Hz)		2202	48707	21002
	DC bus voltage (XXX.X V)		2203	48708	21003

Content	Function	Hex	Dec	Octal
Status monitor read only (continued)	Output voltage (XXX.X V)	2204	48709	21004
	Power factor angle (XXX.X)	2205	48710	21005
	Display the output power of U, V, W (XXXX.X kW)	2206	48711	21006
	Display the motor speed estimated by the drive or encoder feedback (XXXXX rpm)	2207	48712	21007
	Display the positive / negative output torque estimated by the drive (+0.0: positive torque; -0.0: negative torque) (XXX.X%)	2208	48713	21010
	Reserved	2209	48714	21011
	Display the PID feedback value after enabling PID function (XXX.XX%)	220A	48715	21012
	Display the AI1 analog input terminal signal, 0–10 V corresponds to 0.00–100.00% (see Explanation 1 in Pr.00-04)	220B	48716	21013
	Display the AI2 analog input terminal signal, 4–20 mA / 0–10 V corresponds to 0.00–100.00% (2.) (see Explanation 2 in P00.04)	220C	48717	21014
	Reserved	220D	48718	21015
	IGBT temperature of the power module (XXX.X °C)	220E	48719	21016
	Reserved	220F	48720	21017
	The digital input status (ON / OFF), refer to P02.12 (see Explanation 2 in P00.04)	2210	48721	21020
	The digital output status (ON / OFF), refer to P02.18 (see Explanation 3 in P00.04)	2211	48722	21021
	Current step for the multi-step speed operation	2212	48723	21022
	The corresponding CPU digital input pin status (d.) (see Explanation 3 in P00.04)	2213	48724	21023
	The corresponding CPU digital output pin status (O.) (see Explanation 4 in P00.04)	2214	48725	21024
	Encoder Feedback	2215	48726	21025
	DI7 Pulse input frequency (XXX.XX Hz)	2216	48727	21026
	DI7 Pulse Input Count	2217	48728	21027
	Reserved	2218	48729	21030
	Counter value of overload (XXX.XX %)	2219	48730	21031
	GFF (XXX.XX %)	221A	48731	21032
	DC bus voltage ripples (XXX.X V)	221B	48732	21033
	PLC register D1043 data	221C	48733	21034
	Magnetic field area of the synchronous motor	221D	48734	21035
	User page displays the value in physical measure	221E	48735	21036
	Output value of P00.05 (XXX.XX Hz)	221F	48736	21037
	Reserved	2220	48737	21040
	Reserved	2221	48738	21041
	Reserved	2222	48739	21042
	Control mode of the drive 0: speed mode 1: torque mode	2223	48740	21043
	Carrier frequency of the drive (XX kHZ)	2224	48741	21044
	Reserved	2225	48742	21045

Content	Function		Hex	Dec	Octal
Status monitor read only (continued)	Drive status		2226	48743	21046
	bit 1–0	00b: No direction			
		01b: Forward			
		10b: Reverse			
	bit 3–2	01b: Drive ready			
		10b: Error			
	bit 4	0b: Motor drive does not output			
		1b: Motor drive outputs			
	bit 5	0b: No warning			
		1b: Warning			
	Drive’s estimated output torque (positive or negative direction) (XXXX N•m)		2227	48744	21047
	Reserved		2228	48745	21050
	KWH display (XXXX.X)		2229	48746	21051
	Reserved		222A	48747	21052
	Reserved		222B	48748	21053
	Reserved		222C	48749	21054
	Reserved		222D	48750	21055
	PID target value (XXX.XX %)		222E	48751	21056
	PID offset (XXX.XX %)		222F	48752	21057
	PID output frequency (XXX.XX Hz)		2230	48753	21060
	Reserved		2231	48754	21061
	Display the auxiliary frequency		2232	48755	21062
	Display the master frequency		2233	48756	21063
	Display the frequency after adding and subtracting of the master and auxiliary frequencies.		2234	48757	21064

5) Exception response:
When the drive is using the communication connection, if an error occurs, the drive responds to the error code and sets the highest bit (bit 7) of the command code to 1 (function code AND 80H) then responds to the control system to signal that an error occurred.
If the keypad displays “CE-XX” as a warning message, “XX” is the error code at that time. Refer to the table of error codes for communication error for reference.
Example:

ASCII Mode	
STX	‘:’
Address	‘0’
	‘1’
Function	‘8’
	‘6’
Exception code	‘0’
	‘2’
LRC Check	‘7’
	‘7’
END	CR
	LF

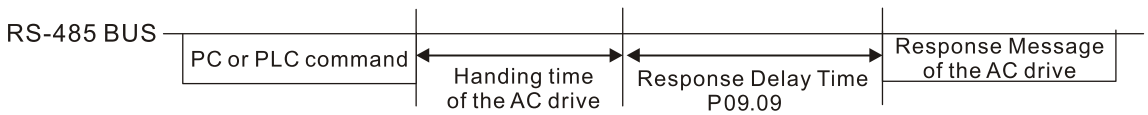
RTU Mode	
Address	01H
Function	86H
Exception code	02H
CRC Check Low	C3H
CRC Check High	A1H

The following table describes the exception code.

Exception Code	Description
1	Function code is not supported or unrecognized.
2	Address is not supported or unrecognized.
3	Data is not correct or unrecognized.
4	Failure to execute this function code

		Type	Hex Addr	Dec Addr
P09.09	**Communication Response Delay Time**	♦R/W	0909	42314
	Range/Units (Format: 16-bit unsigned)	Default		
	0.0–200.0 ms	2.0		

If the host controller does not finish the transmitting/receiving process, you can use this parameter to set the response delay time after the AC motor drive receives communication command as shown in the following picture.



		Type	Hex Addr	Dec Addr
P09.10	**Communication Main Frequency**	R/W	090A	42315
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–599.00 Hz	60.00		

When you set P00.20 to 1 (RS-485 communication input), the AC motor drive saves the last Frequency command into P09.10 when there is abnormal power off or momentary power loss. When power is restored, the AC motor drive operates with the frequency in P09.10 if there is no new Frequency command input. When a Frequency command of 485 changes (the Frequency command source must be set as Modbus), this parameter also changes.

		Type	Hex Addr	Dec Addr
P09.11	**Block Transfer 1**	♦R/W	090B	42316
P09.12	**Block Transfer 2**	♦R/W	090C	42317
P09.13	**Block Transfer 3**	♦R/W	090D	42318
P09.14	**Block Transfer 4**	♦R/W	090E	42319
P09.15	**Block Transfer 5**	♦R/W	090F	42320
P09.16	**Block Transfer 6**	♦R/W	0910	42321
P09.17	**Block Transfer 7**	♦R/W	0911	42322
P09.18	**Block Transfer 8**	♦R/W	0912	42323
P09.19	**Block Transfer 9**	♦R/W	0913	42324
P09.20	**Block Transfer 10**	♦R/W	0914	42325
P09.21	**Block Transfer 11**	♦R/W	0915	42326
P09.22	**Block Transfer 12**	♦R/W	0916	42327
P09.23	**Block Transfer 13**	♦R/W	0917	42328
P09.24	**Block Transfer 14**	♦R/W	0918	42329
P09.25	**Block Transfer 15**	♦R/W	0919	42330
P09.26	**Block Transfer 16**	♦R/W	091A	42331

Range/Units (Format: 16-bit unsigned) — *Default*

0–65535 — 0

This is a group of block transfer parameters that is available for communications use in the drive (P09.11–P09.26). Using communication code 03H, you can store the parameters (P09.11–P09.26) that you want to read.

		Type	Hex Addr	Dec Addr
P09.30	**Communication Decoding Method**	R/W	091E	42335

Range/Units (Format: 16-bit binary) — *Default*

0: Decoding method 1 (20xx) — 0

1: Decoding method 2 (60xx)

Source of Operation Control	Decoding Method 1	Decoding Method 2
Digital Keypad	Digital keypad controls the drive action regardless of decoding method 1 or 2.	
External Terminal	External terminal controls the drive action regardless of decoding method 1 or 2.	
RS-485	Refer to address: 2000h–20FFh	Refer to address: 2000h–20FFh
Communication Card	Refer to address: 2000h–20FFh	Not supported - for future use
PLC	PLC command controls the drive action regardless of decoding method 1 or 2.	

EtherCAT card only supports decoding method 2 (60xx).

		Type	Hex Addr	Dec Addr
P09.31	***Internal Communication Protocol***	R/W	091F	42336
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Modbus 485 -12: Internal PLC control	0		

When set to internal PLC control, refer to “Modbus Remote I/O Control Applications (use MODRW)” on page D–19.

		Type	Hex Addr	Dec Addr
P09.33	***PLC Command Force to 0***	♦R/W	0921	42338
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535	0		

P09.33 defines whether the Frequency command or the Speed command must be cleared to zero or not before the PLC starts the next scan.

bit	Description
bit 0	Before PLC scan, set the PLC target frequency = 0
bit 1	Before PLC scan, set the PLC target torque = 0
bit 2	Before PLC scan, set the speed limit of torque mode = 0

		Type	Hex Addr	Dec Addr
P09.35	***PLC Address***	R/W	0923	42340
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1–254	2		

The PLC address is required for modbus communications to the PLC. Ensure this address remains different from P09.01, or any other nodes on the modbus network. See Chapter 5 for more information.

		Type	Hex Addr	Dec Addr
P09.60	***Communication Card Identification***	Read	093C	42365
	Range/Units (Format: 16-bit binary)	*Default*		
	0: No communication card 4: Modbus-TCP slave 5: EtherNet/IP slave 6: EtherCAT 10: Backup power supply Note: A reading of 4 or 5 is dependent on the setting of P09.74	0		

If P09.74 = 2, GS30A-CM-EIPx comm card will identify as 4: Modbus TCP slave.

If P09.74 ≠ 2, GS30A-CM-EIPx comm card will identify as 5:EtherNet/IP slave.

		Type	Hex Addr	Dec Addr
P09.61	***Firmware Version of Communication Card***	Read	093D	42366
P09.62	***Product Code***	Read	093E	42367
P09.63	***Error code***	Read	093F	42368
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Read only. P09.61 is displayed in shifted decimal format of the hex value. **Example:** A value of 258 in this parameter converts to 102 in hex format, which corresponds to a FW version of 1.02.	0		

		Type	Hex Addr	Dec Addr
P09.74	**Comms Protocol Select**	♦R/W	094A	42379
	Range/Units (Format: 16-bit unsigned)	Default		
	0: Both protocols (Modbus TCP & EtherNet/IP) 1: EtherNet/IP 2: Modbus-TCP	0		

P09.74 defines the master protocol of the communication card and allows the user to define proper actions in the event of communication timeouts.

If P09.74 = 0 or 1: EtherNet/IP, in a timeout situation (defined by P09.93 – P09.95), only the EtherNet/IP connection (Implicit OR Explicit) will trigger the timeout, not Modbus TCP.

A 'timeout situation' is defined by 5 different possibilities:

1) A TCP RST or FIN message from the Master in EtherNet/IP Explicit (no EtherNet/IP Implicit).
2) A Forward Close message in EtherNet/IP Implicit.
3) No data message received in the time duration specified in Pr09-95 on EtherNet/IP Explicit.
4) No data message received in the time duration specified in RPI timeout EtherNet/IP Implicit.
5) Physical connection loss (no link available on Ethernet interface).

If P09.74 = 2: Modbus TCP, in a timeout situation (defined by P09.93 – P09.95), only the Modbus TCP connection will trigger the timeout, not EtherNet/IP Explicit (Implicit won't be allowed in this case).

A 'timeout situation' is defined by 3 different possibilities:

1) A TCP RST or FIN message from the Master in Modbus TCP
2) No data message received in the time duration specified in Pr09-95 on Modbus TCP
3) Physical connection loss (no Link Good on Ethernet interface).

		Type	Hex Addr	Dec Addr
P09.75	**Communication Card IP Configuration (for GS30A-CM-EIPx)**	♦R/W	094B	42380
	Range/Units (Format: 16-bit binary)	Default		
	0: Static IP 1: Dynamic IP (DHCP)	0		

When P09.75=0: Set the IP address manually.

When P09.75=1: IP address is dynamically set by the host controller.

		Type	Hex Addr	Dec Addr
P09.76	**Communication Card IP Address 1 (for GS30A-CM-EIPx)**	♦R/W	094C	42381
P09.77	**Communication Card IP Address 2 (for GS30A-CM-EIPx)**	♦R/W	094D	42382
P09.78	**Communication Card IP Address 3 (for GS30A-CM-EIPx)**	♦R/W	094E	42383
P09.79	**Communication Card IP Address 4 (for GS30A-CM-EIPx)**	♦R/W	094F	42384
	Range/Units (Format: 16-bit unsigned)	Default		
	0–255	0		

Use P09.76–P09.79 with a communication card.

		Type	Hex Addr	Dec Addr
P09.80	***Communication Card Address Mask 1 (for GS30A-CM-EIPx)***	♦R/W	0950	42385
P09.81	***Communication Card Address Mask 2 (for GS30A-CM-EIPx)***	♦R/W	0951	42386
P09.82	***Communication Card Address Mask 3 (for GS30A-CM-EIPx)***	♦R/W	0952	42387
P09.83	***Communication Card Address Mask 4 (for GS30A-CM-EIPx)***	♦R/W	0953	42388
P09.84	***Communication Card Gateway Address 1 (for GS30A-CM-EIPx)***	♦R/W	0954	42389
P09.85	***Communication Card Gateway Address 2 (for GS30A-CM-EIPx)***	♦R/W	0955	42390
P09.86	***Communication Card Gateway Address 3 (for GS30A-CM-EIPx)***	♦R/W	0956	42391
P09.87	***Communication Card Gateway Address 4 (for GS30A-CM-EIPx)***	♦R/W	0957	42392

Range/Units (Format: 16-bit unsigned) — *Default*

0–255 — 0

		Type	Hex Addr	Dec Addr
P09.88	***Communication Card Password (Low Word)(for GS30A-CM-EIPx)***	♦R/W	0958	42393
P09.89	***Communication Card Password (High Word)(for GS30A-CM-EIPx)***	♦R/W	0959	42394

Range/Units (Format: 16-bit unsigned) — *Default*

0–99 — 0

		Type	Hex Addr	Dec Addr
P09.90	***Reset Communication Card (for GS30A-CM-EIPx)***	♦R/W	095A	42395

Range/Units (Format: 16-bit binary) — *Default*

0: Disable — 0
1: Reset to defaults

		Type	Hex Addr	Dec Addr
P09.91	***Additional Settings for the Communication Card (for GS30A-CM-EIPx)***	♦R/W	095B	42396

Range/Units (Format: 16-bit binary) — *Default*

bit 0: Enable IP filter — 0

bit 1: Enable Internet parameters (1 bit)

When the IP address is set, this bit is enabled. After updating the parameters for the communication card, this bit changes to disabled.

bit 2: Enable login password (1 bit)

When you enter the login password, this bit is enabled. After updating the communication card parameters, this bit changes to disabled.

		Type	Hex Addr	Dec Addr
P09.92	***Communication Card Status (for GS30A-CM-EIPx)***	R/W	095C	42397

Range/Units (Format: 16-bit binary) — *Default*

bit 0: Enable password — 0

When the communication card is set with a password, this bit is enabled. When the password is cleared, this bit is disabled.

		Type	Hex Addr	Dec Addr
P09.93	***Comm Card Time Out Action Selection***	♦R/W	095D	42398
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn and keep running 1. Warn and ramp stop 2. Warn and coast stop 3. No warning	3		

		Type	Hex Addr	Dec Addr
P09.94	***Comm Card Time Out Detection Enable***	♦R/W	095E	42399
	Range/Units (Format: 16-bit binary)	*Default*		
	0. Disabled 1. Enabled	1		

		Type	Hex Addr	Dec Addr
P09.95	***Comm Card Time Out Duration Time***	♦R/W	095F	42400
	Range/Units (Format: 16-bit binary)	*Default*		
	0.1–60.0 seconds	3.0		

Group P10.xx Details – Speed Feedback Control Parameters

In this parameter group the following abbreviations are used:

- *ASR - Adjust Speed Regulator*
- *AMR - Active Magnetic Regulator*
- *PG1 - Encoder Input*
- *PG2 - Pulse Command*

Parameters P10.00 - P10.21 are used for setting up an Encoder(PG1) or Pulse command (PG2) signal into the GS30 drive.

For motor control methods xxFOCPG, xxFOCPG,or xxTQCPG, the GS30A-FB-LD or -OC encoder option card is required.

The DI7 multifunction input will accept a pulse generator signal with a maximum frequency of 33kHz. This signal can be configured as an encoder feedback device from a motor (encoder, PG1) or as a speed pulse command signal to the drive (PG2) from another device.

DI7 uses pulse time to calculate the motor frequency. The Encoder PPR (pulse per revolution) and Motor RPM will affect the operating frequency range. Normal encoder PPR values are 512, 1024, 2048, etc. To calculate the operating frequency of an application, use this formula:

(Max Motor RPM x Encoder PPR) / 60 seconds = Pulses/Sec

Choose an encoder PPR value that will generate less than 33,000 pulses/sec for use with the DI7 input. For encoder closed loop control modes, either the GS30A-FB-LD or GS30A-FB-OC encoder option cards will accept up to 300kHz.

NOTE: For GS30, VF+PG is only single-phase input and will not know if it's REV or FWD.

The following table summarizes the parameter configuration for an Encoder(PG1) or Pulse Command (PG2) application with either the Encoder option card or DI7 input. See the detailed parameter descriptions for more information. When the setting for P10.00, P10.01, and P10.02 are changed, cycle drive power.

Encoder PG1 Setup

Parameter	Encoder Option Cards GS30A-FB-LD GS30A-FB-OC	DI7 Input	Description
	Parameter Setting		
P00.04	9- Pulses 21- Counts 32- Z revs	7- rpm	Monitor feedback on keypad display (optional)
P00.11	3,4	1	Speed Control Mode
P00.13	0,1	n/a	Torque Control Mode
P02.07	n/a	0	DI7 input config
P10.00	1	5	Selects Pulse Input for use (PG1 and PG2)
P10.01	1–20,000		Defines Pulses per revolution of device (PG1 or PG2)
P10.0.2	1–4	5	Encoder(PG1) input type
P10.03	1–255		Encoder (PG1) Scale Factor
P10.04	1–65535		Electrical Gearing Load Side A1 (Encoder PG1), Default
P10.05	1–65535		Electrical Gearing Motor Side B1 (Encoder PG1), Default
P10.06	1–65535		Electrical Gearing Load Side A2 (Encoder PG1) DIx selectable
P10.07	1–65535		Electrical Gearing Motor Side B2 (Encoder PG1), DIx selectable
P10.10	0–1.20		Encoder(PG1) Stall Level
P10.11	0–2.0 sec		Encoder(PG1) Stall Time
P10.1.2	0, 1, or .2		Encoder(PG1) Stall Action
P10.13	0–50		Encoder(PG1) Slip Range
P10.14	0–10 sec		Encoder(PG1) Slip 0etection 7iPe
P10.15	0, 1, or .2		Encoder(PG1) Stall and Slip Error Action
P10.19	-32767 to 32767		Encoder (PG1) Internal position mode
P10.20	1–65535		Encoder (PG1) Error range

Pulse Command (PG2) Setup

Parameter	Encoder Option Cards GS30A-FB-LD GS30A-FB-OC	DI7 Input	Description
	Pulse Cmd (PG2)		
P00.04	" 22- Freq 23- Counts"	n/a	Monitor feedback on keypad display (optional)
P00.11	any	any	Speed Control Mode
P00.20	4	4	Use for Drive command, Auto Mode Only
P00.30	4	4	Use for Drive command, Manual Mode Only
P02.07	n/a	0	DI7 input config
P03.20			Analog Output to send encoder signal to another device (optional)
P10.00	1	5	Selects Pulse Input for use (PG1 and PG2)
P10.01	1–20,000		Defines Pulses per revolution of device (PG1 or PG2)
P10.16	1–4	5	Set Pulse Command (PG2) Input Type
P10.17	1–65535	1–65535	Pulse Command (PG2) Electrical Gear A
P10.18	1–65535	1–65535	Pulse Command (PG2) Electrical Gear B
P10.21	0–65.5 sec	0–65.5 sec	Pulse Command (PG2) Low pass filter time

		Type	Hex Addr	Dec Addr
P10.00	***Pulse Type Selection (Encoder PG1 or Pulse Command PG2)***	R/W	0A00	42561
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disabled 1: Encoder option card 5: Pulse input (DI7)	0		

When set to 1: Encoder option card, either GS30A-FB-LD or -OC card must be installed in drive position 1.

When you use DI7 single-phase pulse input (Encoder Pulse), you must use it with P10.00=5 and P00.20=4, P02.07=0, and P10.16=5.

When you use DI6 and DI7 two-phase pulse input function, you must use them with P00.20=4, P10.00=0, and P10.16=1–4.

When you use DI7 single-phase pulse input as speed feedback, you must use it with P10.00 =5 and P10.02 = 5. The drive calculates the DI7 single-phase pulse input speed when the control modes are VF, VFPG, SVC, IM / PM FOC Sensorless, or IM / PM TQC.

When you use DI6 and DI7 two-phase pulse input as speed feedback, you must use them with P10.00 = 5 and P10.02 = 1–4. The drive calculates the DI6 and DI7 two-phase pulse input speed when the control modes are VF, VFPG, SVC, IM / PM FOC Sensorless, or IM / PM TQC.

When using DI6 and DI7 as pulse inputs, the maximum resolution of each input is 16.5kHz.

		Type	Hex Addr	Dec Addr
P10.01	***Pulses per Revolution (Encoder PG1 or Pulse Cmd PG2)***	R/W	0AO1	42562
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1–20000	600		

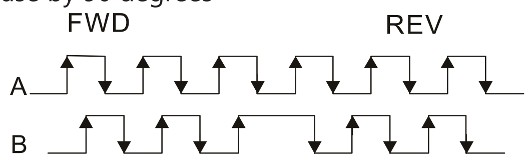
P10.01 sets the pulses per revolution (PPR) for either Encoder (PG1) or Pulse Command (PG2) device from the Encoder option card or the DI7 input, respectively. Determine the pulses per revolution from the feedback device and enter the value in this parameter. The A/B phase cycle generates the pulse number.

- *This setting is also the encoder resolution. The speed control has greater precision with higher resolution.*
- *If you set this parameter incorrectly, it may cause motor stall, drive over-current, or a magnetic pole origin detection error for the PM motor in closed-loop control. When using the PM motor, you must perform the magnetic pole origin detection (P05.00 = 13) again if you modify the content of this parameter.*

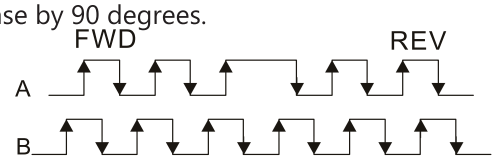
		Type	Hex Addr	Dec Addr
P10.02	***Encoder (PG1) Input Type Setting***	R/W	0A02	42563
	Range/Units (Format: 16-bit binary)	*Default*		

0: Disable — Default: 0

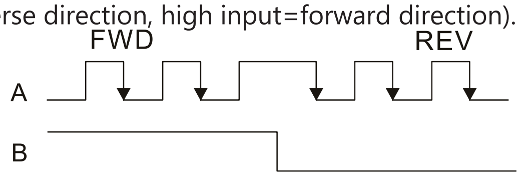
1: Phase A and B are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees



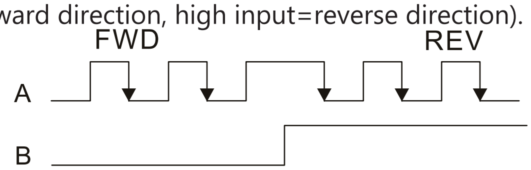
2: Phase A and B are pulse inputs, foward direction if B-phase leads A-phase by 90 degrees.



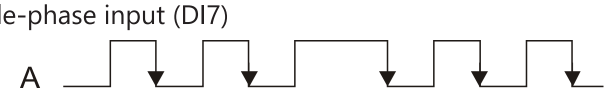
3: Phase A is a pulse input and phase B is a direction input (low input=reverse direction, high input=forward direction).



4: Phase A is a pulse input and phase B is a direction input (low input=forward direction, high input=reverse direction).



5: Single-phase input (DI7)



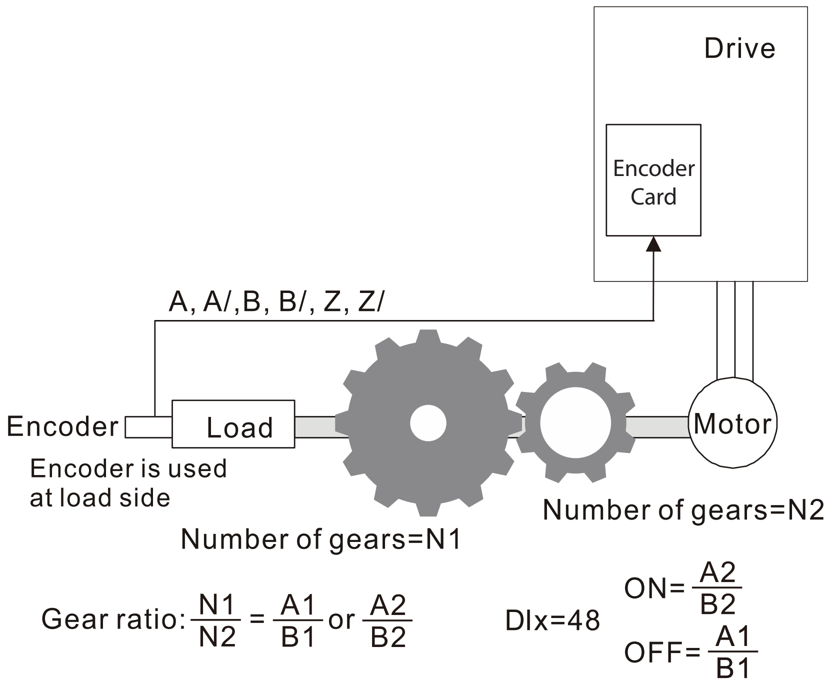
NOTE: *When the GS30 inputs the A / B phase pulse, you must connect the DI6* terminal to the A-phase pulse, and the DI7 terminal to the B-phase pulse. When the GS30 uses single-phase input, it disables the DI6 function and prohibits any signal connection. In this case, the maximum resolution of each input is 16.5 kHz.

Velocity control: PG2 acts according to the setting for P10.01 (PG1 ppr), and will not be affected by PG1 pulse (single-phase pulse or A / B phase pulse). When the setting for P10.00, P10.01 and P10.02 are changed, cycle the power of the motor drive.

1) The speed formula is (input ppr) / (PG1 ppr), when PG1 ppt = 2500, PG2 is single-phase pulse, and the input pps is 1000 (1000 pulse per second), the speed should be (1000 / 2500) = 0.40 Hz.
2) The same pps inputs of A / B phase pulse or single-phase pulse input should get the same frequency command.

		Type	Hex Addr	Dec Addr
P10.04	**Electrical Gear at Load Side A1 (Encoder PG1)**	♦R/W	0A04	42565
P10.05	**Electrical Gear at Motor Side B1 (Encoder PG1)**	♦R/W	0A05	42566
P10.06	**Electrical Gear at Load Side A2 (Encoder PG1)**	♦R/W	0A06	42567
P10.07	**Electrical Gear at Motor Side B2 (Encoder PG1)**	♦R/W	0A07	42568
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1–65535	100		

For the encoder card only. Use P10.04–P10.07 with the multi-function input terminal setting 48 to switch to P10.04– P10.05 or P10.06–P10.07, as shown in the diagram below.



A1 = Electrical Gear A1 at Load Side (P10.04)

B1 = Electrical Gear B1 at Motor Side (P10.05)

A2 = Electrical Gear A2 at Load Side (P10.06)

B2 = Electrical Gear B2 at Motor Side (P10.07)

		Type	Hex Addr	Dec Addr
P10.08	**Encoder (PG1) Feedback Fault Treatment**	♦R/W	0A08	42569
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop	2		

		Type	Hex Addr	Dec Addr
P10.09	**Encoder (PG1) Feedback Fault Detection Time**	♦R/W	0A09	42570
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–10.0 seconds (0=disabled)	1.0		

When there is an encoder loss, an encoder signal error, a pulse signal setting error or a signal error, if the duration exceeds the detection time for the encoder feedback fault (P10.09), the encoder signal error occurs. Refer to P10.08 for encoder feedback fault treatment.

When the speed controller signal is abnormal, if time exceeds the detection time for the encoder feedback fault (P10.09), the feedback fault occurs. Refer to P10.08 for the encoder feedback fault treatment.

		Type	Hex Addr	Dec Addr
P10.10	***Encoder (PG1) Stall Level***	♦R/W	0A0A	42571
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–120% (0: Disable)	115		

P10.10 determines the maximum encoder feedback signal allowed before a fault occurs; the maximum operation frequency P01.00 = 100%.

		Type	Hex Addr	Dec Addr
P10.11	***Encoder (PG1) Stall Detection Time***	♦R/W	0A0B	42572
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–2.0 sec.	0.1		

		Type	Hex Addr	Dec Addr
P10.12	***Encoder (PG1) Stall Action***	♦R/W	0A0C	42573
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop	2		

When the drive output frequency exceeds the encoder stall level (P10.10), the drive starts to count the time. When the error time exceeds the encoder stall detection time (P10.11), the drive implements the encoder stall action.

		Type	Hex Addr	Dec Addr
P10.13	***Encoder (PG1) Slip Range***	♦R/W	0A0D	42574
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–50% (0: Disable)	50		

		Type	Hex Addr	Dec Addr
P10.14	***Encoder (PG1) Slip Detection Time***	♦R/W	0A0E	42575
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–10.0 sec.	0.5		

		Type	Hex Addr	Dec Addr
P10.15	***Encoder (PG1) Stall and Slip Error Action***	♦R/W	0A0F	42576
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop	2		

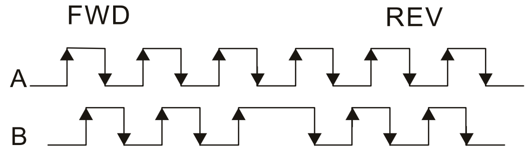
P10.15 acts on the settings for P10.13–P10.14:

When the value of (rotation speed – motor frequency) exceeds the P10.13 setting, and the detection time exceeds P10.14; the drive starts to count the time. If the detection time exceeds P10.14, the encoder feedback signal error occurs.

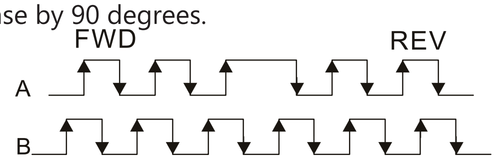
		Type	Hex Addr	Dec Addr
P10.16	***Pulse Command Input Type Setting (PG2)***	♦R/W	0A10	42577
	Range/Units (Format: 16-bit binary)	Default		

0: Disable (Default: 0)

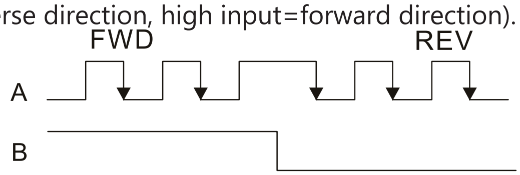
1: Phase A and B are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees



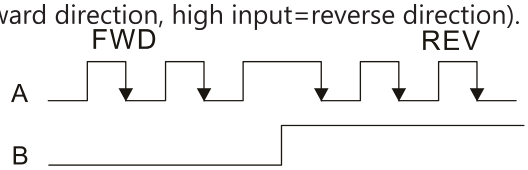
2: Phase A and B are pulse inputs, foward direction if B-phase leads A-phase by 90 degrees.



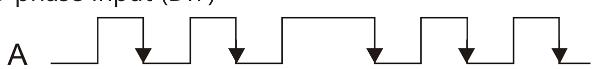
3: Phase A is a pulse input and phase B is a direction input (low input=reverse direction, high input=forward direction).



4: Phase A is a pulse input and phase B is a direction input (low input=forward direction, high input=reverse direction).



5: Single-phase input (DI7)



When this setting is different from the P10.02 setting and the source of the Frequency command is pulse input (P00.20=5), it causes a four-times frequency problem.

Example:

Assume that P10.01=1024, P10.02=1, P10.16=3, P00.20=5, DI=37 and ON, then the pulse needed to rotate the motor one revolution is 4096 (1024*4), with a four-times frequency problem.

- *Assume that P10.01=1024, P10.02=1, P10.16=1, P00.20=5, DI=37 and ON, the pulse needed to rotate the motor one revolution is 1024 (1024*1), without four-times frequency problem.*

When using two-phase pulse input, you must set pulse direction to DI6, and enter the pulses to DI7.

When using single-phase pulse input, DI6 is invalid, you must enter the pulses to DI7 and forbid connecting to any signals.

When P10.16=5, you cannot set P10.02 as 5 (single-phase input, DI7) to execute closed-loop control.

The setting steps when using the DI7 single-phase pulse input as the frequency command:

1) Set P00.20=4: Pulse inputs without direction command
2) Set P10.00 = 0: Disabled
3) Set P10.01 for motor pulse per revolution (ppr)
4) Set P10.16 =5: Single-phase pulse input
5) Set P00.04 = 22 to check if the pulse input frequency is right.

		Type	Hex Addr	Dec Addr
P10.17	***Pulse Command (PG2) Electrical Gear A***	♦R/W	0A11	42578
P10.18	***Pulse Command (PG2) Electrical Gear B***	♦R/W	0A12	42579
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1–65535	100		

For Encoder Option card PG2 input or DI7 input. Rotation speed = pulse frequency / encoder pulses (P10.01) * electrical gear A / electrical gear B.

		Type	Hex Addr	Dec Addr
P10.19	***Positioning for Encoder (PG1) Position***	♦R/W	0A13	42580
	Range/Units (Format: 16-bit binary)	*Default*		
	-32767 to 32767 pulses	0		

Determines the internal position in the position mode.

Use this with the multi-function input terminal setting = 35 (enable single-point position control).

When set to 0, it is the Z-phase position of the encoder.

		Type	Hex Addr	Dec Addr
P10.20	***Error Range for Encoder (PG1) Position Reached***	♦R/W	0A14	42581
	Range/Units (Format: 16-bit binary)	*Default*		
	0–65535 pulses	10		

P10.20 determines the range for the internal positioning position reached.

Example:

When you set the position for P10.19 (Positioning for Encoder Position) to 1000 and P10.20 to 10, it reaches the position if the position is between 990-1010 after positioning.

		Type	Hex Addr	Dec Addr
P10.21	***Pulse Command (PG2) Speed Command Low Pass Filter Time***	♦R/W	0A15	42582
	Range/Units (Format: 16-bit binary)	*Default*		
	0.000–65.535 sec.	0.100		

For Encoder Option Card PG2 input or DI7 input, when you set P00.20 to 4, the system treats the pulse command as a Frequency command. Use this parameter to suppress the speed command jump.

Parameters P10.24 - P10.53 are for configuring the speed and torque control loop characteristics. These parameters are only applicable to certain speed control modes (P00.11). See function block diagrams under P00.11 on page 4–68 for a visual representation of how the parameters interact.

		Type	*Hex Addr*	*Dec Addr*
P10.24	***FOC Function Control***	♦R/W	0A18	42585
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–65535	0		

FOC (Field Oriented Control) is the highest accuracy speed control mode of the drive, set by P00.11=5: IMFOC sensorless mode. This parameter configures the optional settings of FOC.

bit	Description
0	ASR controller under torque control. 0: use PI as ASR; 1: use P as ASR
1–10	N/A
11	Activates the DC brake when executing the zero torque command. 0: ON; 1: OFF
12	FOC sensorless mode with crossing zero means the speed goes from negative to positive or positive to negative (forward to reverse direction or reverse to forward direction). 0: determined by the stator frequency; 1: determined by the speed command
13	N/A
14	N/A
15	Direction control in open-loop torque 0: Switch ON direction control; 1: Switch OFF direction control

Only bit = 0 is used for closed-loop; other bits are used for open-loop.

Set the bits as needed in binary format. Then convert to decimal for parameter entry on drive keypad, or Hex for parameter entry on optional GS4-KPD.

This parameter is only active when P00.11=5: IMFOC sensorless mode. See function block diagrams under P00.11 on page 4–68.

		Type	*Hex Addr*	*Dec Addr*
P10.25	***FOC Bandwidth for Speed Observer***	♦R/W	0A19	42586
	Range/Units (Format: 16-bit unsigned)	*Default*		
	20.0–100.0 Hz	40.0		

Setting the speed observer to a higher bandwidth could shorten the speed response time but creates greater noise interference during the speed observation.

This parameter is only active when P00.11=5: IMFOC Sensorless mode. See Function diagram under P00.11 on page 4–68.

		Type	*Hex Addr*	*Dec Addr*
P10.26	***FOC Minimum Stator Frequency***	♦R/W	0A1A	42587
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–10.0% fN	2.0		

P10.26 sets the stator frequency lower limit in operation status. This setting ensures the stability and accuracy of observer and avoids interferences from voltage, current and motor parameters. fN is the motor rated frequency.

This parameter is only active when P00.11=5: IMFOC Sensorless mode. See Function diagram under P00.11 on page 4–68.

		Type	Hex Addr	Dec Addr
P10.27	***FOC Low Pass Filter Time Constant***	♦R/W	0A1B	42588
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1–1000 ms	50		

P10.27 sets the low pass filter time constant of a flux observer at start-up. If you cannot activate the motor during high speed operation, lower the setting for this parameter.

		Type	Hex Addr	Dec Addr
P10.28	***FOC Gain for Excitation Current Rise Time***	♦R/W	0A1C	42589
	Range/Units (Format: 16-bit unsigned)	*Default*		
	33–100% Tr	100		

P10.28 sets the drive's excitation current rise time when it activates in open-loop torque mode. When the drive's activation time is too long in torque mode, adjust this parameter to a shorter time value. Tr is the rotor time constant.

		Type	Hex Addr	Dec Addr
P10.29	***Upper Limit of Frequency Deviation***	♦R/W	0A1D	42590
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–200.00 Hz	20.00		

P10.29 limits the maximum frequency deviation.

This parameter is only applicable when P00.11=IMVFPG, using input DI7 as the encoder.

If you set this parameter too high, an abnormal feedback malfunction occurs.

If the application needs a higher setting for P10.29, note that a higher setting results in larger motor slip, which causes a PG Error (PGF3, PGF4). In this case, you can set P10.10 and P10.13 to 0 to disable PGF3 and PGF4 detection, but you must make sure the DI7 wiring and application are correct; otherwise, it may lose the instant PG protection. Setting P10.29 too high is not commonly done.

		Type	Hex Addr	Dec Addr
P10.31	***I/F Mode, Current Command***	♦R/W	0A1F	42592
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–150% rated current of the motor	40		

P10.31 is only applicable to PM motors with P00.11= 2: PMSVC. See Function diagram under P00.11 on page 4–68.

P10.31 sets the current command for the drive in the low speed area (low speed area: Frequency command < P10.39). When the motor stalls on heavy duty start-up or forward/reverse with load, increase the parameter value. If the inrush current is too high and causes oc stall, then decrease the parameter value.

		Type	Hex Addr	Dec Addr
P10.32	***PM Sensorless Speed Estimator Bandwidth***	♦R/W	0A20	42593
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–600.00 Hz	5.00		

P10.32 is only applicable to PM motors with P00.11= 2: PMSVC. See Function diagram under P00.11 on page 4–68.

P10.32 sets the speed estimator bandwidth. Adjust the parameter to influence the stability and the accuracy of the motor speed.

If there is low frequency vibration (the waveform is similar to a sine wave) during the process, then increase the bandwidth. If there is high frequency vibration (the waveform shows extreme vibration and is like a spur), then decrease the bandwidth.

		Type	Hex Addr	Dec Addr
P10.34	***PM Sensorless Speed Estimator Low-pass Filter Gain***	♦R/W	0A22	42595
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35	1.00		

P10.34 is only applicable to PM motors with P00.11= 2: PMSVC. See Function diagram under P00.11 on page 4–68.

P10.34 influences the response speed of the speed estimator.

If there is low frequency vibration (the waveform is similar to a sine wave) during the process, then increase the gain. If there is high frequency vibration (the waveform shows extreme vibration and is like a spur), then decrease the gain.

		Type	Hex Addr	Dec Addr
P10.35	***AMR (Kp) Gain***	♦R/W	0A23	42596
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–3.00	1.00		

		Type	Hex Addr	Dec Addr
P10.36	***AMR (Ki) Gain***	♦R/W	0A24	42597
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–3.00	0.20		

The AMR parameters P10.35 and P10.36 are only active when P00.11= 5: IMFOC Sensorless mode. See Function diagram under P00.11 on page 4–68.

Active Magnetic Regulator (AMR) Kp/Ki, affects the response of magnetic regulation in the low magnetic area.

If entering the low magnetic area and the input voltage (or DC BUS) plummets (e.g. an unstable power net causes instant insufficient voltage, or a sudden load that makes DC BUS drop), which causes the ACR diverge and oc, then increase the gain. If the Id value of a spur creates large noise in high-frequency output current, decrease the gain to reduce noise. Decreasing the gain will slow down the response.

		Type	Hex Addr	Dec Addr
P10.39	***Frequency Point to Switch from I/F Mode to PM Sensorless Mode***	♦R/W	0A27	42600
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	20.00		

P10.39 sets the frequency for the switch point from low frequency to high frequency. This parameter is only applicable to PM motors with P00.11=2: PMSVC.

Due to the weak back-EMF in the low frequency area, PM sensorless mode cannot estimate the accurate speed and position of the rotor. Thus, using I/F mode control is more suitable. In the medium-to-high frequency area, PM sensorless can accurately estimate the back-EMF, stabilizes and controls the motor with lower current.

If the switch point is too low and PM sensorless mode operates at a too low frequency, the motor does not generate enough back-EMF to let the speed estimator measure the right position and speed of the rotor, and causes stall and oc when running at the switch point frequency.

If the switch point is too high, the drive easily runs in the frequency area of the I/F mode for a long time, which generates a larger current and will not save energy. (If the current for P10.31 is too high, the high switch point makes the drive continue to output with the setting value for P10.31.)

		Type	Hex Addr	Dec Addr
P10.40	***Frequency Point to Switch from PM Sensorless to I/F Mode***	♦R/W	0A28	42601
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	20.00		

P10.40 sets the switch point from high frequency to low frequency.

Due to the weak back-EMF in the low frequency area, PM sensorless mode cannot estimate the accurate speed and position of the rotor. Thus, using I/F mode control is more suitable. In the medium-to-high frequency area, PM sensorless can accurately estimate the back-EMF, stabilizes and control the motor with lower current.

If the switch point is too low and PM sensorless mode operates at a too low frequency, the motor does not generate enough back-EMF to let the speed estimator measure the rotor right position and speed, and causes stall and oc when running at the switch point frequency.

If the switch point is too high, the drive easily runs in the frequency area of the I/F mode for a long time, which generates a larger current and cannot save energy. (If the current value for P10.31 is too high, the high switch point makes the drive continue to output with the setting value for P10.31).

		Type	Hex Addr	Dec Addr
P10.42	***Initial Angle Detection Pulse Value***	♦R/W	0A2A	42603
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–3.0	1.0		

P10.42 is only applicable to SPM motors with P00.11=2:PMSVC. See Function diagram under P00.11 on page 4–68.

P10.42 is only active when P10.53=3:Pulse Injection.

The angle detection is fixed to 3: Use the pulse injection method to start. The parameter influences the value of the pulse during the angle detection. The larger the pulse, the higher the accuracy of rotor's position. A larger pulse might cause oc.

Increase the parameter when the running direction and the command are opposite during start-up. If oc occurs at start-up, then decrease the parameter.

Refer to Adjustment & Application for detailed motor adjustment procedure.

		Type	Hex Addr	Dec Addr
P10.43	***Encoder Card Version***	Read	0A2B	42604
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35	Read only		

Corresponding version reference:

- *GS30A-FB-LD/OC 11.XX*

		Type	Hex Addr	Dec Addr
P10.49	***Zero Voltage Time during Start-up***	♦R/W	0A31	42610
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–60.000 sec.	0.000		

P10.49 is valid only when the setting of P07.12 (Speed Tracking during Start-up) = 0.

When the motor is in static state at start-up, this increases the accuracy when estimating angles. In order to put the motor in static state, set the drive three-phase output to the motor to 0V. The P10.49 setting time is the length of time for three-phase output at 0 V.

It is possible that even when you apply this parameter, the motor cannot go in to the static state because of inertia or some external force. If the motor does not go into a complete static state in 0.2 seconds, increase this setting value appropriately.

If P10.49 is set too high, the start-up time is longer. If it is too low, then the braking performance is weak.

		Type	Hex Addr	Dec Addr
P10.51	***Injection Frequency***	♦R/W	0A33	42612
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–1200 Hz	500		

P10.51 is a high frequency injection command in PM SVC control mode, and usually you do not need to adjust it. But if a motor's rated frequency (for example, 400Hz) is too close to the frequency setting for this parameter (that is, the default of 500Hz), it affects the accuracy of the angle detection. Refer to the setting for P01.01 before you adjust this parameter.

- *If the setting value for P00.17 is lower than P10.51*10, then increase the frequency of the carrier frequency.*
- *P10.51 is valid only when P10.53 = 2.*

		Type	Hex Addr	Dec Addr
P10.52	***Injection Magnitude***	♦R/W	0A34	42613
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V series: 100.0 V	15.0		
	460V series: 200.0 V	30.0		
	Note: The setting range varies depending on the voltage.			

P10.52 is the magnitude command for the high frequency injection signal in PM SVC control mode. Increasing the parameter can increase the accuracy of the angle estimation, but the electromagnetic noise might be louder if the setting value is too high.

- *The system uses this parameter when the motor's parameter is "Auto". This parameter influences the angle estimation accuracy.*
- *When the ratio of the salient pole (Lq / Ld) is lower, increase P10.52 to make the angle detection accurate.*
- *P10.52 is valid only when P10.53 = 2.*

		Type	Hex Addr	Dec Addr
P10.53	***Angle Detection Method***	♦R/W	0A35	42614
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disabled	0		
	1: Force attracting the rotor to zero degrees			
	2: High frequency injection			
	3: Pulse injection			

Set P10.53 = 2 for IPM; set to 3 for SPM. If these settings cause problems, then set the parameter to 1.

Group P11.xx Details – Advanced Parameters

In this parameter group the following abbreviations are used:

- *ASR - Adjustable Speed Regulation. ASR parameters are for tuning the zero, low and high speed ranges of the drive when in IMFOC sensorless vector speed control mode (P00.11=5) or IMVFPG (P00.11=1) speed control mode.*

Parameters P11.00 – P11.16 are used to configure the Adjust Speed Regulator.

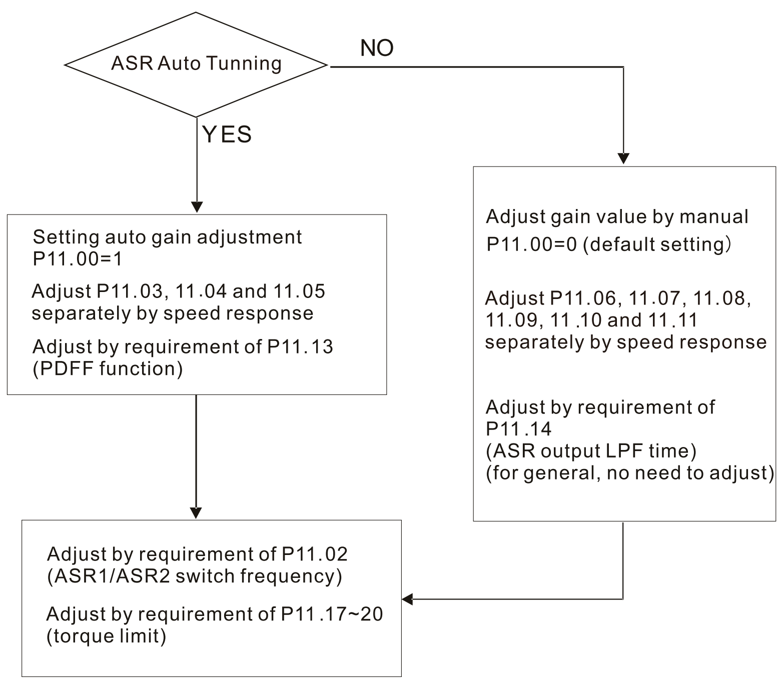
Parameters P11.17 – P11.38 are used to configure Torque control parameters.

		Type	Hex Addr	Dec Addr
P11.00	***Adjust Speed Regulator (ASR) System Control***	R/W	0B00	42817
	Range/Units (Format: 16-bit binary)	*Default*		

bit 0: Auto-tuning for ASR — Default: 0
bit 1: Inertia estimate (only in FOCPG mode)
bit 2: Zero servo
bit 3: Dead time compensation closed
bit 7: Save or do not save the frequency

bit 0

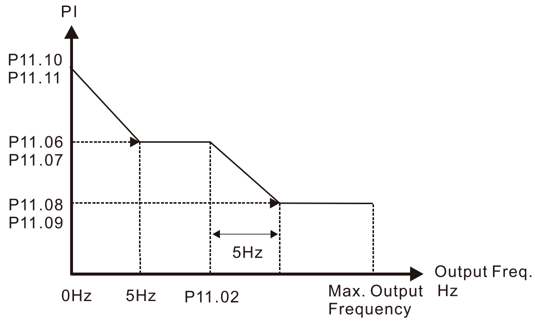
- *When bit 0 = 0: Manual adjustment for ASR gain, P11.06–P11.11 are valid and P11.03–P11.05 are invalid.*
- *When bit 0 = 1: Auto-adjustment for ASR gain, the system automatically generates an ASR setting, P11.06–P11.11 are invalid and P11.03–P11.05 are valid.*



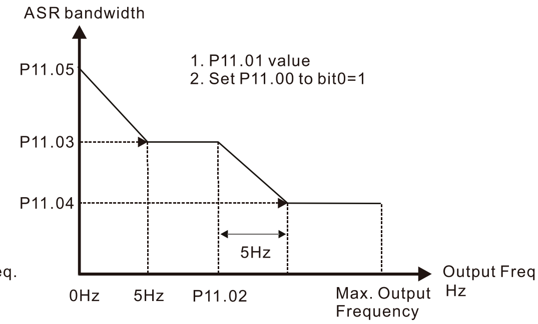
When the drive needs to keep a certain torque at zero-speed, or it needs a steady frequency output at extreme low speed, increase P11.05 zero-speed bandwidth appropriately. When the speed is in high-speed area, if the output current trembles seriously and makes the drive vibrate, then decrease the high-speed bandwidth.

For example:

Manual gain	[P11.10, P11.11] > [P11.06, P11.07] > [P11.08, P11.09]
Auto gain	P11.05 = 15Hz, P11.03 = 10 Hz, P11.04 = 8 Hz



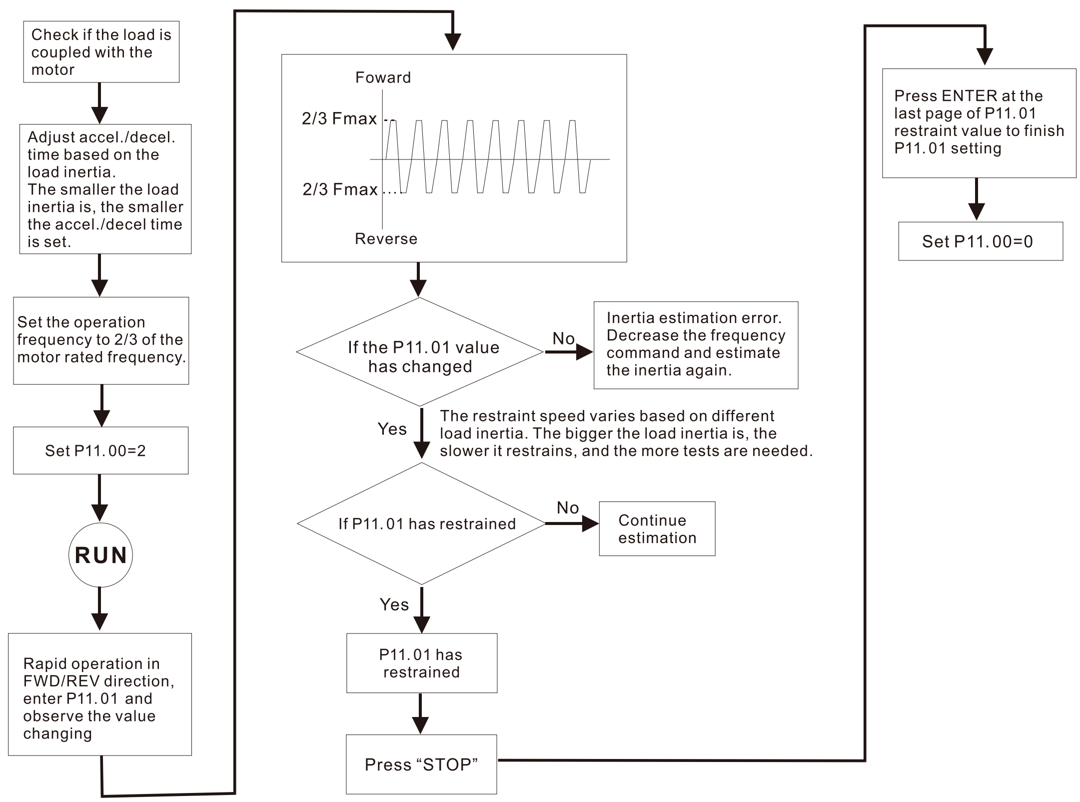
ASR adjustment- manual gain



ASR adjustment- auto gain

bit 1

- *When bit1 = 0: no function.*
- *When bit1 = 1: Inertia estimation function is enabled. The bit1 setting would not activate the estimation process, set P05.00=12 to begin FOC / TQC Sensorless inertia estimating.*



bit 2

- *When bit2 = 0: no function.*
- *When bit2 = 1: when frequency command is less than Fmin (P01.07), it will use the zero-servo function as position control.*

bit 7

- *When bit7 = 0: Save the frequency before power is OFF. When power is ON again, the save frequency is displayed.*
- *When bit7 = 1: Do not save the frequency before power is OFF. When power is ON again, 0.00 Hz is the displayed frequency.*

		Type	Hex Addr	Dec Addr
P11.01	***ASR Per-Unit of System Inertia***	R/W	0B01	42818
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1–65535 (256 = 1 PU)	256		

To get the system inertia per unit from P11.01, you need to set P11.00 to bit1 = 1 and execute continuous forward / reverse running. See Adjustments and Applications section.

When P11.01 = 256, it is 1PU. So if you use a 2HP motor, the 2HP motor inertia is 0.00043 kg-cm2 according to the table below. If P11.01 = 10000 after tuning, the system inertia is (10000 / 256) x 0.00043 kg-cm^2.

Perform the operation test with load based on the inertia after tuning. Run the motor in acceleration, deceleration, and steady speed and observe the values. If values between speed feedback and speed command are close, steady-state error is small and overshoot is less, then this inertia is a better one.

If the Iq current command from ASR has a high-frequency glitch, then decrease the setting. If the response time of sudden loading is too slow, then increase the setting.

When using torque mode as the control mode, perform the tuning with speed mode first to see if the tuned inertia can work normally. After verifying with speed mode, change the control mode to torque mode.

The following table shows the base value for the induction motor system inertia (Unit: kg-m^2)

Power	Setting
1 HP	0.00023
2 HP	0.00043
3 HP	0.00083
5 HP	0.00148
7.5 HP	0.0026

Power	Setting
10 HP	0.00358
15 HP	0.00743
20 HP	0.00953
25 HP	0.01428
30 HP	0.01765

		Type	Hex Addr	Dec Addr
P11.02	***ASR1 / ASR2 Switch Frequency***	♦R/W	0B02	42819
	Range/Units (Format: 16-bit unsigned)	*Default*		
	5.00–599.00 Hz	7.00		

P11.02 sets the low-speed and high-speed ASR switching point in the FOC area. Provides flexibility to meet two needs: in the high-speed region of the estimator switch point it has a high response, and in the low-speed region of the estimator switch point it has a lower response. The recommended switching point is higher than P10.39.

A low setting does not cover P10.39. If the setting is too high, high-speed range is too narrow.

		Type	Hex Addr	Dec Addr
P11.03	***ASR1 Low-speed Bandwidth***	♦R/W	0B03	42820
P11.04	***ASR2 High-speed Bandwidth***	♦R/W	0B04	42821
P11.05	***Zero-speed Bandwidth***	♦R/W	0B05	42822
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1–40 Hz	10		

After estimating the inertia and setting P11.00 bit 0 = 1 (auto-tuning), you can adjust P11.03, P11.04 and P11.05 separately by speed response. The larger the setting value, the faster the response. P11.02 is the switch frequency between the low-speed/high-speed bandwidth.

		Type	Hex Addr	Dec Addr
P11.06	***ASR 1 Gain***	♦R/W	0B06	42823
P11.08	***ASR2 Gain***	♦R/W	0B08	42825
P11.10	***ASR Gain of Zero Speed***	♦R/W	0B0A	42827
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–40 Hz	10		

Enabled when P11.00 Bit 0 = 0.

		Type	Hex Addr	Dec Addr
P11.07	***ASR 1 Integral Time***	♦R/W	0B07	42824
P11.09	***ASR2 Integral Time***	♦R/W	0B09	42826
P11.11	***ASR Integral Time of Zero Speed***	♦R/W	0B0B	42828
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–10.000 sec.	0.100		

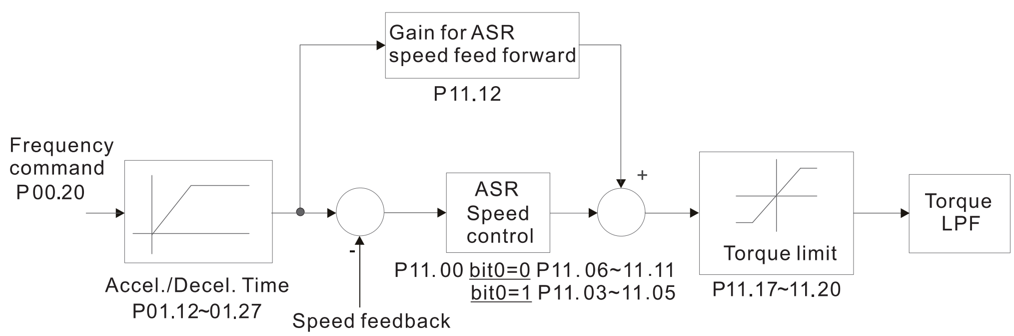
Enabled when P11.00 Bit 0 = 0.

		Type	Hex Addr	Dec Addr
P11.12	***Gain for ASR Speed Feed Forward***	♦R/W	0B0C	42829
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–200%	0		

This function enables when P11.00 bit 0 = 1.

Increase the setting for P11.12 to reduce the command tracking difference and improve the speed response. Use this function for speed tracking applications.

Set P11.01 correctly to improve the speed response.



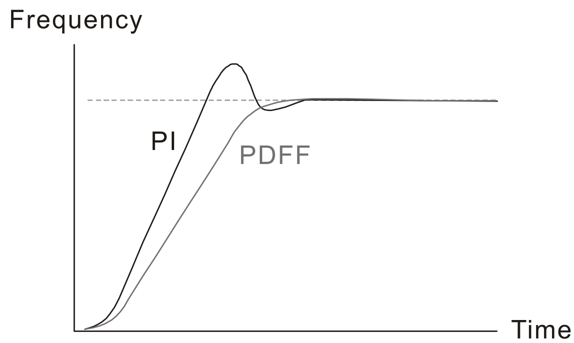
		Type	Hex Addr	Dec Addr
P11.13	***PDFF Gain Value***	♦R/W	0B0D	42830
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–200%	30		

P11.13 is invalid when P05.24 = 1. This parameter is valid only when P11.00 bit0 = 1.

After you estimate and set P11.00 bit0=1 (auto-tuning), use P11.13 to reduce overshoot. However, a shift of the curve may occur earlier. In this case, you can set P11.13=0 first, and then increase the setting value to "a condition with best acceleration and without overshoot" when the acceleration time meets your application but overshoot occurs.

- *Increasing P11.13 improves the overshoot of speed tracking, but an excessive value may reduce the transient response.*
- *Increasing P11.13 enhances the system stiffness in high-speed steady state and reduces the speed transient fluctuation at a sudden loading.*

Set P11.01 system inertia correctly to improve speed response.



		Type	Hex Addr	Dec Addr
P11.14	***ASR Output Low Pass Filter Time***	♦R/W	0B0E	42831
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000–0.350 sec.	0.008		

P11.14 sets the ASR command filter time.

		Type	Hex Addr	Dec Addr
P11.15	***Notch Filter Depth***	♦R/W	0B0F	42832
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–20 db	0		

		Type	Hex Addr	Dec Addr
P11.16	***Notch Filter Frequency***	♦R/W	0B10	42833
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–200.00 Hz	0.00		

P11.16 sets the resonance frequency of the mechanical system. Adjust it to a smaller value to suppress the mechanical system resonance.

- *A larger value improves resonance suppression function.*
- *The notch filter frequency is the mechanical frequency resonance.*

		Type	Hex Addr	Dec Addr
P11.17	***Forward Motor Torque Limit***	♦R/W	0B11	42834
P11.18	***Forward Regenerative Torque Limit***	♦R/W	0B12	42835
P11.19	***Reverse Motor Torque Limit***	♦R/W	0B13	42836
P11.20	***Reverse Regenerative Torque Limit***	♦R/W	0B14	42837
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–500%	500		

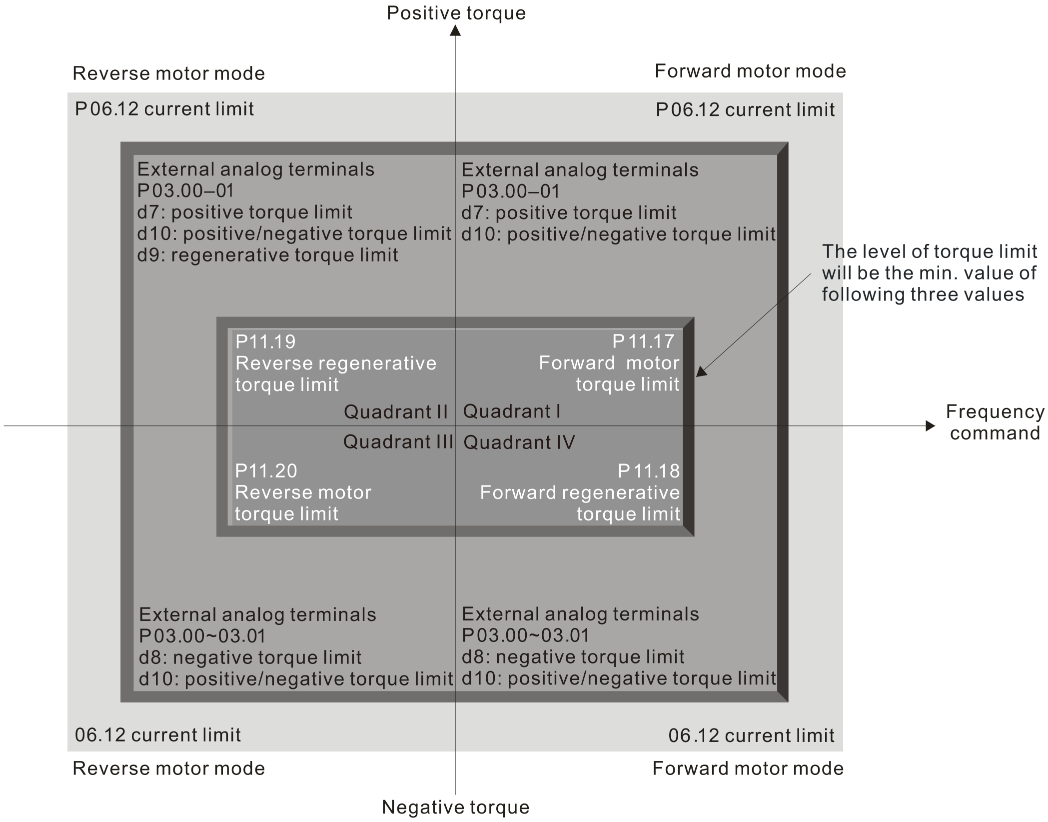
FOC Encoder & FOC Sensorless mode:

The motor rated current = 100%. The settings value for P11.17–11.20 is compared with P03.00 = 7, 8, 9, 10. The minimum value of the comparison result is the torque limit. The diagram on the next page illustrates the torque limit.

TQCPG and TQC Sensorless mode:

The function of P11.17–11.20 is the same as FOC; however, in this case, the torque limit and the torque command executes the output torque limit at the same time. Therefore, the minimum value between P11.17–11.20 and P06.12 becomes the current output torque limit.

Refer to P11.34 for calculation equation for the motor rated torque.



All control modes are based on 100% of the motor rated current except:

- *IM: VF, VF Encoder, SVC*
- *PM: PMSVC*

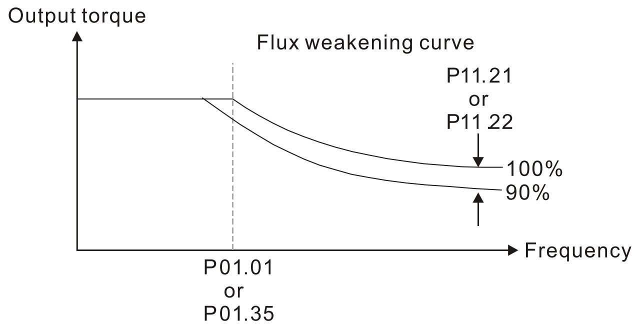
Note: P11.21-P11.38 are for configuring Torque control mode (P00.10=2). See Function block diagram under P00.13 on page 4-68 and Adjustments and Applications section.

		Type	Hex Addr	Dec Addr
P11.21	***Flux Weakening Curve for Motor 1 Gain Value***	♦R/W	0B15	42838
P11.22	***Flux Weakening Curve for Motor 2 Gain Value***	♦R/W	0B16	42839
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–200%	90		

P11.21 and P11.22 adjust the output voltage for the flux weakening curve.

For the spindle application, use this adjustment method:

1) Run the motor to the highest frequency.
2) Observe the output voltage.
3) Adjust P11.21 (motor 1) or P11.22 (motor 2) setting to make the output voltage reach the motor rated voltage. The larger the setting value, the greater the output voltage.



		Type	Hex Addr	Dec Addr
P11.23	***Flux Weakening Area Speed Response***	♦R/W	0B17	42840
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–150%	65		

P11.23 controls the speed in the flux weakening area. The larger the value, the faster the acceleration/deceleration. In normal condition, you do not need to adjust this parameter.

		Type	Hex Addr	Dec Addr
P11.24	***APR Gain***	♦R/W	0B18	42841
	Range/Units (Format: 16-bit unsigned)	*Default*		
	IM: 0.00–40.00 Hz PM: 0.00–100.00 Hz	10.00		

Sets the Kp gain of the internal position (DIx = 35).

The pulse-train position command (DIx = 37) controls Kp gain, and this can adjust the value of P11.05 directly. The larger the setting value of P11.05, the smaller the static error.

		Type	Hex Addr	Dec Addr
P11.25	***Gain Value for the APR Feed Forward***	♦R/W	0B19	42842
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–100	30		

This parameter is valid to the internal position (DIx = 35) and position control pulse command (DIx = 37). A larger value set can shorten the pulse-train tracking error, but it may easily cause overshoot.

		Type	Hex Addr	Dec Addr
P11.26	***APR Curve Time***	♦R/W	0B1A	42843
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 seconds	3.00		

This is valid when the multi-function input terminal is set to 35 (ON). The larger the setting value, the longer the positioning time.

		Type	Hex Addr	Dec Addr
P11.27	***Maximum Torque Command***	♦R/W	0B1B	42844
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–500%	100		

P11.27 determines the upper limit of the torque command (motor rated torque is 100%).

Calculation equation for the motor rated torque:

Motor rated torque: $T(N.M)=\dfrac{P(W)}{\omega(rad/s)}$

Where:
P (W) value = P05.02

ω (rad / s) value = $\dfrac{P5.03\times 2\pi}{60}=rad/s$

		Type	*Hex Addr*	*Dec Addr*
P11.28	***Torque Offset Source***	♦R/W	0B1C	42845
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Analog signal input 2: RS-485 communication (Pr.11-29) 3: Controlled through external terminals (by Pr.11-30–Pr.11-32)	0		

P11.28 specifies the torque offset source.

When set to 3, the torque offset sources are P11.30, P11.31 or P11.32 according to the multi-function input terminal settings 31, 32 or 33.

Normally open (N.O.) contact:

- *ON = contact closed*
- *OFF = contact open*

P11.32	***P11.31***	***P11.30***	***Torque Offset***
DIx = 33 (Low)	***DIx = 32 (Mid)***	***DIx = 31 (High)***	
OFF	OFF	OFF	None
OFF	OFF	ON	P11.30
OFF	ON	OFF	P11.31
OFF	ON	ON	P11.30 + P11.31
ON	OFF	OFF	P11.32
ON	OFF	ON	P11.30 + P11.32
ON	ON	OFF	P11.31 + P11.32
ON	ON	ON	P11.30 + P11.31 + P11.32

		Type	*Hex Addr*	*Dec Addr*
P11.29	***Torque Offset Setting***	♦R/W	0B1D	42846
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.0–100.0 %	0.0		

P11.29 determines the torque offset command. The motor rated torque is 100%.

The calculation equation for the motor rated torque:

Motor rated torque: $T(N.M)=\dfrac{P(W)}{\omega(rad/s)}$

P (W) value = P05.02, ω (rad / s) value = P05.03; $\dfrac{P5.03\times 2\pi}{60}=rad/s$

		Type	Hex Addr	Dec Addr
P11.30	**High Torque Offset**	♦R/W	0B1E	42847
P11.31	**Middle Torque Offset**	♦R/W	0B1F	42848
P11.32	**Low Torque Offset**	♦R/W	0B20	42849

Range/Units (Format: 16-bit signed)	Default
-100.0–100.0 %	High: 30.0 Middle: 20.0 Low: 10.0

When P11.28 is set to 3, the torque offset sources are P11.30, P11.31 or P11.32 according to the multi-function input terminals settings 31, 32 or 33. The motor rated torque is 100%.

The calculation equation for the motor rated torque:

Motor rated torque: $T(N.M) = \dfrac{P(W)}{\omega(rad/s)}$

P (W) value = P05.02, ω (rad / s) value = P05.03; $\dfrac{P5.03 \times 2\pi}{60} = rad/s$

		Type	Hex Addr	Dec Addr
P11.33	**Torque Command Source**	♦R/W	0B21	42850

Range/Units (Format: 16-bit unsigned)	Default
0: Digital keypad 1: RS-485 communication (P11.34) 2: Analog signal input (P03.00) 5: Communication Card	0

When P11.33 is set to 0 or 1, you can set the torque command in P11.34.

When P11.33 is set to 2 or 5, P11.34 only displays the torque command.

		Type	Hex Addr	Dec Addr
P11.34	**Torque Command**	♦R/W	0B22	42851

Range/Units (Format: 16-bit signed)	Default
-100.0–100.0%	0.0

This parameter sets the torque command. When P11.27 is 250% and P11.34 is 100%, the actual torque command = 250 × 100% = 250% of the motor rated torque.

The drive saves the settings before power is OFF.

		Type	Hex Addr	Dec Addr
P11.35	**Torque Command Filter Time**	♦R/W	0B23	42852

Range/Units (Format: 16-bit unsigned)	Default
0.000–1.000 sec.	0.000

When the P11.35 setting is too long, the control is stable but the control response is delayed. When the setting is too short, the response is quick but the control may be unstable. Adjust the setting according to your control and response situation.

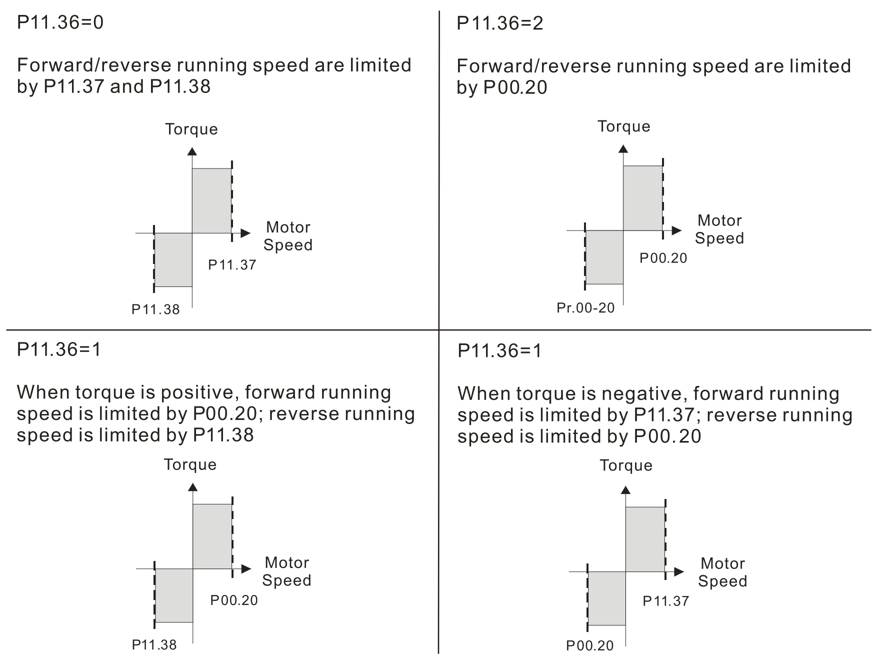
		Type	Hex Addr	Dec Addr
P11.36	***Speed Limit Selection***	R/W	0B24	42853
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Set by P11.37 (Forward Speed Limit) and P11.38 (Reverse Speed Limit) 1: Set by P00.20 (Master Frequency Command (AUTO, REMOTE) Source) and P11.37, P11.38 2: Set by P00.20 (Master Frequency Command (AUTO, REMOTE) Source) 3: Line speed tension control	0		

Speed limit function: when you use torque control mode, if the torque command is greater than the load, the motor accelerates until the motor speed equals the speed limit. At this time, it switches to speed control mode to stop acceleration.

When P11.36 = 1:

- *When the torque command is positive, the forward speed limit is P00.20 and the reverse speed limit is P11.38. When the torque command is negative, the forward speed limit is P11.37 and the reverse speed limit is P00.20.*
- *Example:*
  In an unwinding application, if the torque command direction is different from the motor operating direction, the load drives the motor. In this case, the speed limit must be P11.37 or P11.38. Only in normal applications where the motor drives the load and the torque command is in the same direction as the speed limit can you set the speed limit according to P00.20.

In torque control mode, the F page of keypad displays the present speed limit value. For details on the keypad display, refer to the LED Function Description in Section 7-14 Digital Keypad (optional).



		Type	Hex Addr	Dec Addr
P11.37	***Forward Speed Limit (Torque Mode)***	♦R/W	0B25	42854
P11.38	***Reverse Speed Limit (Torque Mode)***	♦R/W	0B26	42855
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0–120%	10		

P11.37 and P11.38 limit the speed for forward and reverse running in torque mode (P01.00 Maximum Operation Frequency = 100%).

		Type	Hex Addr	Dec Addr
P11.39	**Zero Torque Command Mode Selection**	R/W	0B27	42856
	Range/Units (Format: 16-bit binary)	Default		
	0: Torque mode 1: Speed mode	0		

P11.39 is only valid in IM TQCPG and PM TQCPG, and it defines the mode when the speed limit is 0% or 0 Hz.

When you set P11.39 to 0, and speed limit is 0% or 0 Hz, the motor generates an excitation current, and the torque command P11.34 limits the torque.

When you set P11.39 to 1, and speed limit is 0% or 0 Hz, the AC motor drive can generate output torque through the speed controller (the torque limit is P06.12), and the control mode changes from TQC + Encoder to FOC + Encoder mode. The motor has a holding torque. If the speed command is not 0, the drive automatically changes it to 0.

		Type	Hex Addr	Dec Addr
P11.41	**PWM Mode Selection**	R/W	0B29	42858
	Range/Units (Format: 16-bit binary)	Default		
	0: Two-phase modulation mode 2: Space vector modulation mode	2		

Two-phase modulation mode: effectively reduces the drive power component losses and provides better performance in long wiring applications.

Space vector modulation mode: effectively reduces the power loss and electromagnetic noise of the motor.

		Type	Hex Addr	Dec Addr
P11.42	**System Control Flag**	R/W	0B2A	42859
	Range/Units (Format: 16-bit unsigned)	Default		
	0000–FFFFh	0000		

bit No.	Function	Description
0	Reserved	
1	FWD / REV action control	0: FWD / REV cannot be controlled by Pr.02-12 bit 0 & 1. 1: FWD / REV can be controlled by Pr.02-12 bit 0 & 1.

Group 12.xx Details – Tension Control Parameters

		Type	Hex Addr	Dec Addr
P12.00	***Tension Control Selection***	R/W	0C00	43073
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Disabled 1: Closed-loop tension, speed mode 2: Closed-loop linear speed, speed mode 3: Closed-loop tension, torque mode 4: Open-loop tension, torque mode	0		

The table below shows the control modes applicable to each setting value:

Setting value	Control Mode			
	VF	SVC	FOC	TQC
0: Disabled				
1: Closed-loop tension, speed mode	✓	✓	✓	
2: Closed-loop linear speed, speed mode	✓	✓	✓	
3: Closed-loop tension, torque mode				✓
4: Open-loop tension, torque mode				✓

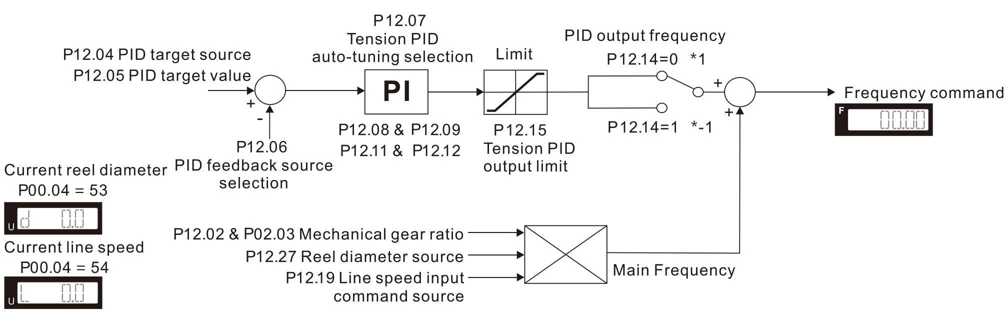
See the instructions below for setting each value:

P12.00=1, Closed-loop tension, speed mode

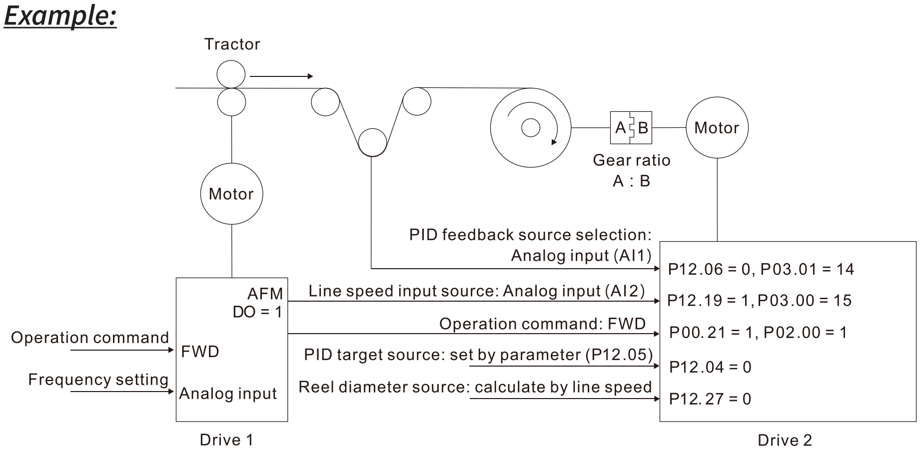
The calculation of the main frequency in tension control:

$$f(Hz) = \frac{V}{\pi D} \cdot \frac{A}{B}$$

V: Linear speed (m/min.)
D: Reel diameter (m)
A/B: Mechanical gear ratio

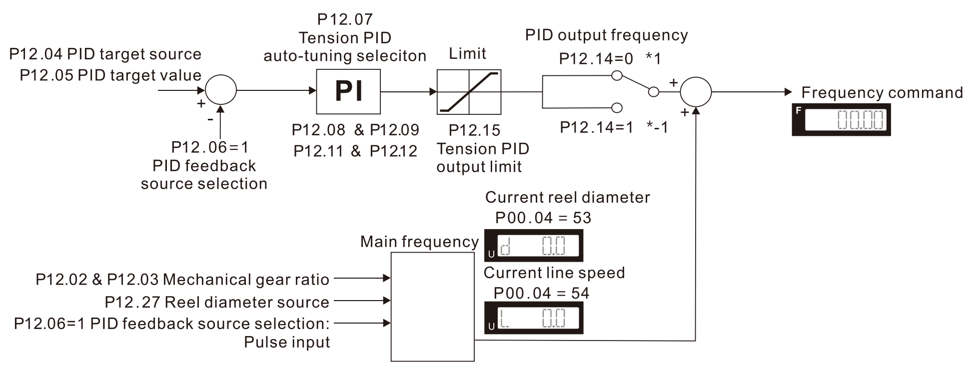


Example:

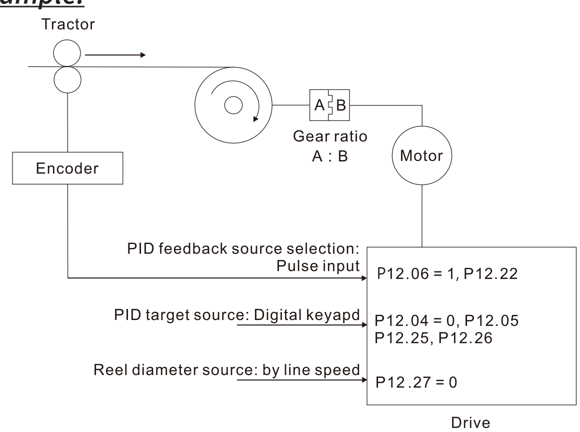


Summary of Parameters - Tension Closed-loop, Speed Mode				
	Parameter	**Parameter Name**	**Setting**	**Note**
Tractor (Drive 1)	P00.20	Master frequency command source (AUTO, REMOTE)	2	Inputs from external analog (refer to P03.00)
	P00.21	Operation command source (AUTO, REMOTE)	1	Operates by using external terminals
	P02.16	Digital Output 2 (DO1)	1	Indication during RUN
	P03.20	AFM multi-function output	0	Output frequency (Hz)
Winder Machine Drive 2)	P00.21	Operation command cource (AUTO, REMOTE)	1	Operates by using external terminals
	P03.00	AI1 analog input selection	15	Linear speed
	P03.01	AI2 analog input selection	14	Tension PID feedback signal
	P12.00	Tension control selection	1	Closed-loop tension, speed mode
	P12.02	Mechanical gear A at load side	100	Depends on working condition
	P12.03	Mechanical gear B at motor side	100	Depends on working condition
	P12.04	PID target source	0	Set by parameter (P12.05)
	P12.05	PID target value	50	Depends on working condition
	P12.06	PID feedback source selection	0	Analog input
	P12.19	Linear speed input command source	1	Analog input
	P12.27	Reel diameter source	0	Calculated via linear speed

P12.00=2, Closed-loop linear speed, speed mode



Example:

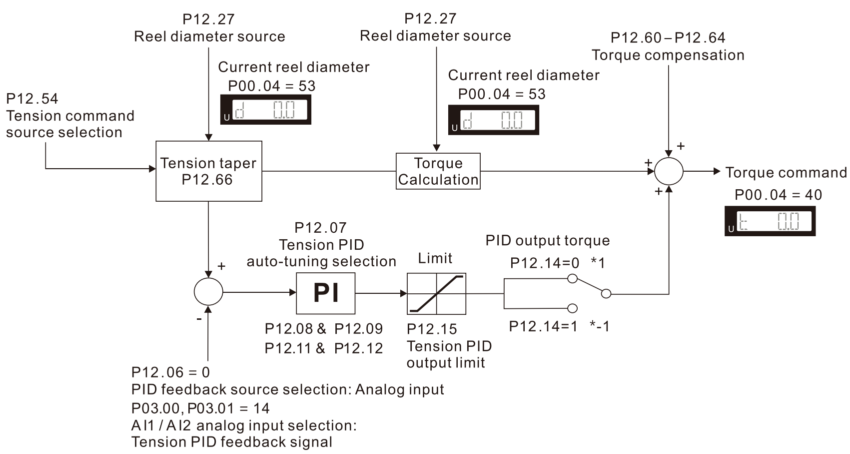


Summary of Parameters - Closed-loop Linear Speed, Speed Mode			
Parameter	**Parameter Name**	**Setting**	**Note**
P10.00	Encoder type selection	5	Pulse input
P10.16	Pulse input type setting	1	Phases A and B are pulse inputs, forward direction if A-phase leads B-phse by 90 degrees
P12.00	Tension control selection	2	Closed-loop linear speed, speed mode
P12.02	Mechanical gear A at load side	100	Depends on working condition
P12.03	Mechanical gear B at motor side	100	Depends on working condition
P12.04	PID target source	0	Set by parameter (P12.05)
P12.05	PID target value	50	Depends on working condition
P12.06	PID feedback source selection	1	Pulse input
P12.22	Pulses per meter	500	Depends on working condition
P12.25	Linear speed command acceleration time	10	Depends on working condition
P12.26	Linear speed command deceleration time	10	Depends on working condition
P12.27	Reel diameter source	0	Calculated via linear speed

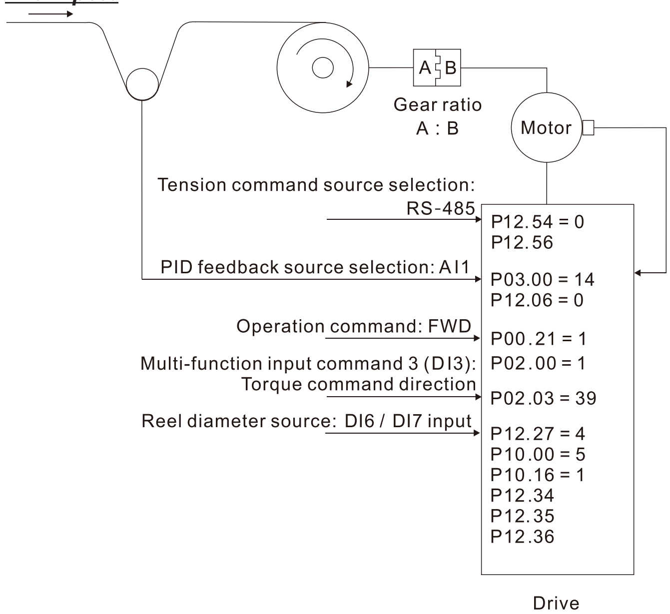
P12.00=3, Closed-loop tension, torque mode

$$\text{Torque (N} - \text{m)} = \frac{F \cdot D}{2}$$

F: Tension (N)
D: Reel diameter (m)

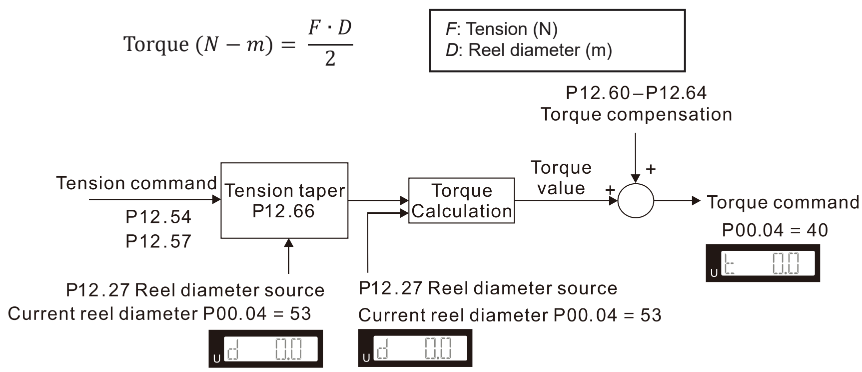


Example:

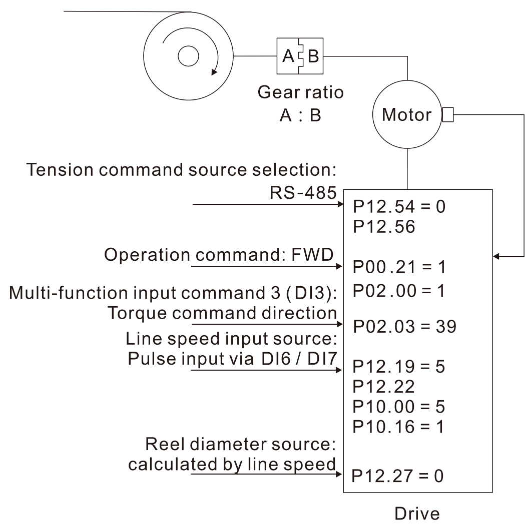


Summary of Parameters - Tension Closed-loop, Torque Mode			
Parameter	***Parameter Name***	***Setting***	***Note***
P00.21	Operation command source (AUTO, REMOTE)	1	Operates by using external terminals
P02.03	Multi-function input command (DI3)	39	Torque command direction
P03.00	AI1 analog input selection	14	Tension PID feedback signal
P10.00	Encoder type selection	5	Pulse input
P10.16	Pulse input type setting	1	Phases A and B are pulse inputs, forward direction if A-phase leads B-phse by 90 degrees
P12.00	Tension control selection	3	Tension closed-loop, torque mode
P12.02	Mechanical gear A at load side	100	Depends on working condition
P12.03	Mechanical gear B at motor side	100	Depends on working condition
P12.06	PID feedback source selection	0	Analog input
P12.27	Reel diameter source	4	Calculated via thickness itegral, the encoder installed at reel side inputs by DI6/DI7
P12.34	Pulses per revolution	1000	Depends on working condition
P12.35	Revolutions per layer	10	Depends on working condition
P12.36	Material thickness	0.01	Depends on working condition
P12.54	Tension command source selection	0	RS-485 communication input
P12.56	Tension command setting value	100	Depends on working condition

P12.00=4, Open-loop tension, torque mode



Example:

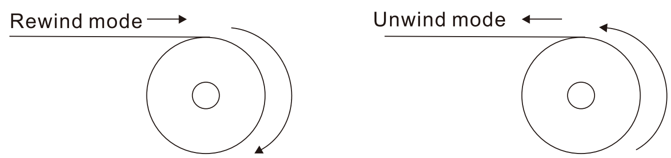


Summary of Parameters - Open-loop Tension, Torque Mode			
Parameter	**Parameter Name**	**Setting**	**Note**
P00.21	Operation command source (AUTO, REMOTE)	1	Operates by using external terminals
P02.03	Multi-function input command (DI3)	39	Torque command direction
P10.00	Encoder type selection	5	Pulse input
P10.16	Pulse input type setting	1	Phases A and B are pulse inputs, forward direction if A-phase leads B-phse by 90 degrees
P12.00	Tension control selection	4	Open-loop tension, torque mode
P12.02	Mechanical gear A at load side	100	Depends on working condition
P12.03	Mechanical gear B at motor side	100	Depends on working condition
P12.19	Linear speed input command source	5	Pulse input through DI6/DI7 terminal
P12.22	Pulses per meter	1000	Depends on working condition
P12.27	Reel diameter source	0	Calculated via linear speed
P12.54	Tension command source selection	0	RS-485 communication input
P12.56	Tension command setting value	100	Depends on working condition

		Type	Hex Addr	Dec Addr
P12.01	***Winding Mode***	R/W	0C01	43074
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Rewind 1: Unwind	0		

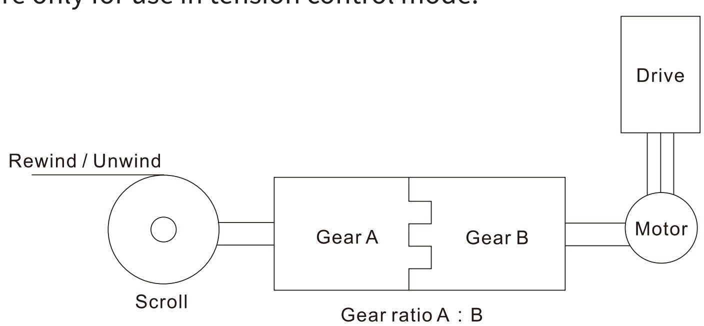
When P12.01=1, the tension taper function is invalid.

When using rewind mode, the reel diameter (D) increases gradually; when using unwind mode, the reel diameter (D) decreases gradually. See the figure below:



		Type	Hex Addr	Dec Addr
P12.02	***Mechanical Gear A at Load Side***	R/W	0C02	43075
P12.03	***Mechanical Gear B at Motor Side***	R/W	0C03	43076
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1–65535	100		

P12.02 and P12.03 are only for use in tension control mode.



		Type	Hex Addr	Dec Addr
P12.04	***PID Target Source***	R/W	0C04	43077
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Set by parameter (P12.05) 1: Set by RS-485 2: Analog input	0		

This parameter is valid when P12.00=1 or 2.

- *When P12.04=0, you can adjust PID target value (P12.05) via keypad.*
- *When P12.04=1, you can adjust PID target value (P12.05) via communication.*
- *When P12.04=2, analog input is set to be tension PID target value (P03.00, P03.01=d7) and the tension target value will only display in P12.05.*

		Type	Hex Addr	Dec Addr
P12.05	***PID Target Value***	♦R/W	0C05	43078
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–100.0%	50.0		

This parameter is valid when P12.00=1 or 2.

When using closed-loop linear speed and speed mode (P12.00=2), P03.00 and P03.01 are set to 15 (linear speed) as the linear speed PID command. For other tension modes, P03.00 and P03.01 are set to 15 (linear speed) as the actual linear speed.

Then setting range 0.0–100.0% corresponds to the tension feedback 0–10V / 0 to maximum linear speed (P12.20).

Example:

- *In tension mode, when P12.00=1 (closed-loop tension, speed mode), setting P03.00 and P03.01 to 17 corresponds to the tension feedback 0–10V.*
- *In tension mode, when P12.00=2 (closed-loop linear speed, speed mode) setting P03.00 and P03.01 to 15 corresponds to 0 to maximum linear speed (P12.07).*

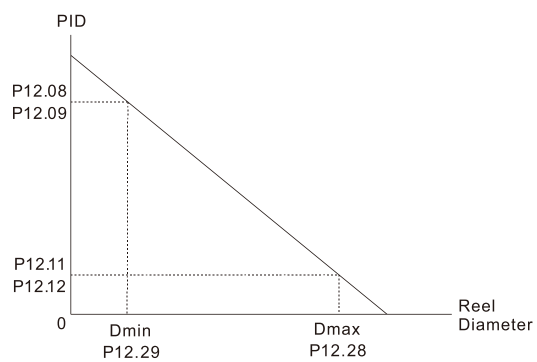
		Type	Hex Addr	Dec Addr
P12.06	***PID Feedback Source Selection***	♦R/W	0C06	43079
	Range/Units (Format: 16-bit binary)	Default		
	0: Analog input 1: Pulse input	0		

When P12.06=0, P03.00 and P03.01 must be set to d14 (tension PID feedback signal).

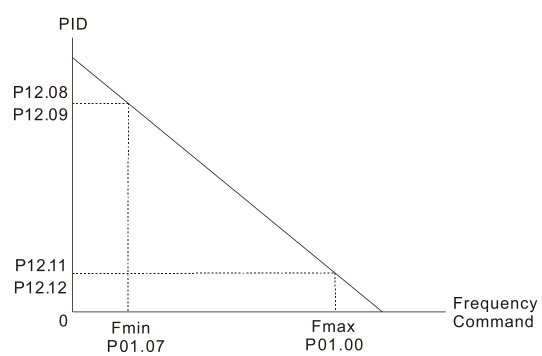
When P12.06=1, pulses per meter must be set in P12.22.

		Type	Hex Addr	Dec Addr
P12.07	***Tension PID Auto-tuning Selection***	R/W	0C07	43080
	Range/Units (Format: 16-bit binary)	Default		
	0: Disabled 1: Reel diameter (P12.08–P12.09 corresponds to P12.29; P12.11–P12.12 corresponds to P12.28) 2: Frequency (P12.08–P12.09 corresponds to P01.07; P12.11–P12.12 corresponds to P01.00)	0		

When P12.07=1:



When P12.07=2:



		Type	Hex Addr	Dec Addr
P12.08	***Tension PID P Gain 1***	R/W	0C08	43081
P12.11	***Tension PID P Gain 2***	R/W	0C0B	43084

Range/Units (Format: 16-bit binary) — *Default*

0.00–1000.0 — 50.0

		Type	Hex Addr	Dec Addr
P12.09	***Tension PID Integral Time 1***	R/W	0C09	43082
P12.12	***Tension PID Integral Time 2***	R/W	0C0C	43085

Range/Units (Format: 16-bit binary) — *Default*

0.00–500.0 seconds — 1.00

		Type	Hex Addr	Dec Addr
P12.14	***Tension PID Output Status Selection***	R/W	0C0E	43087

Range/Units (Format: 16-bit binary) — *Default*

0: PID output is positive — 0
1: PID output is negative

Use the table below to determine the correct setting for your application.

Tension feedback:

Action	Loose ← 0–100% → Tight	Tight ← 0–100% → Loose
Rewind	Positive output	Negative output
Unwind	Negative output	Positive output

		Type	Hex Addr	Dec Addr
P12.15	***Tension PID Positive Output Limit***	R/W	0C0F	43088

Range/Units (Format: 16-bit binary) — *Default*

0.00–100.00% — 20.00

The output limit range = P12.15 x P01.00.

		Type	Hex Addr	Dec Addr
P12.16	***Tension PID Negative Output Limit***	R/W	0C10	43089

Range/Units (Format: 16-bit binary) — *Default*

0.00–100.00% — 20.00

P12.16 determines the percentage of output command limit in PID control. The negative output limit range = Tension PID negative output limit x P01.00.

		Type	Hex Addr	Dec Addr
P12.17	***Tension PID Feedback Upper Limit***	R/W	0C11	43090

Range/Units (Format: 16-bit binary) — *Default*

0.00–100.00% — 100.00

P12.17 is valid when P12.00=1 or 3.

		Type	Hex Addr	Dec Addr
P12.18	***Tension PID Feedback Lower Limit***	R/W	0C12	43091

Range/Units (Format: 16-bit binary) — *Default*

0.00–100.00% — 0.0

P12.18 is valid when P12.00=1 or 3.

		Type	Hex Addr	Dec Addr
P12.19	***Linear Speed Input Command Source***	R/W	0C13	43092
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disabled 1: Analog input 2: RS-485 communication input 3: Encoder card 4: Reserved 5: Pulse input through DI6/DI7 terminal	0		

This parameter is invalid when P12.00=2.

- *When P12.19 is not 2, the current linear speed saved in P12.23 by analog or pulse command is used. When P12.19=2, the current linear speed in P12.23 can be changed using communication.*
- *When P12.19=1, sets analog input to be linear speed (P03.00, P03.01 = d15)*
- *When P12.19=3, connects pulse signals to the input of the encoder card (inputs pulse command), then sets encoder type through P10.16.*
- *When P12.19=3 or 5, you must set the pulses per meter in P12.22.*

		Type	Hex Addr	Dec Addr
P12.20	***Maximum Linear Speed***	R/W	0C14	43093
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–6500.0 m/min	1000.0		

In closed-loop tension and open-loop tension modes, the maximum linear speed is the reel linear speed of the tractor that corresponds to the maximum frequency of the drive.

When P12.00=2, P12.20 sets maximum linear speed.

		Type	Hex Addr	Dec Addr
P12.21	***Minimum Linear Speed***	R/W	0C15	43094
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–6500.0 m/min	0.0		

If the linear speed is lower than the value set in P12.21, the drive stops calculating the reel diameter and keeps the current reel diameter.

		Type	Hex Addr	Dec Addr
P12.22	***Pulses per Meter***	R/W	0C16	43095
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–6000.0 pulses/m	0.0		

When P12.06=1, P12.22 must be configured.

If the command source of the linear speed input is the pulses input from an encoder or the pulses input by terminal DI6/DI7 (P12.19=3 or 5), then P12.22 must be configured.

		Type	Hex Addr	Dec Addr
P12.23	***Current Linear Speed***	♦R/W	0C17	43096
	Range/Units (Format: 16-bit binary)	Default		
	0.00–100.00%	20.00		

The linear speed of closed-loop linear speed and speed mode refer to P12.06. The range to display in this parameter is based on P12.20 and P12.21.

When P12.19=1, 3, or 5, the current linear speed saved in P12.23 by analog or pulse command is used. This parameter is read only if P12.19 does not equal 2.

When P12.19=2, the set value of the current linear speed can be changed using communication.

		Type	Hex Addr	Dec Addr
P12.24	***Linear Speed Low Pass Filter Time***	♦R/W	0C18	43097
	Range/Units (Format: 16-bit binary)	Default		
	0.00–100.00 seconds	0.10		

P12.24 is valid when the command source of the linear speed input is the pulses input from the encoder card or the pulses input by terminal DI6/DI7 (P12.19=3 or 5).

Adjust this parameter to reduce vibration caused by linear speed.

		Type	Hex Addr	Dec Addr
P12.25	***Linear Speed Command Acceleration Time***	♦R/W	0C19	43098
	Range/Units (Format: 16-bit binary)	Default		
	0.00–655.35 seconds	0.00		

P12.25 is valid when using closed-loop linear speed and speed mode (P12.00=2).

		Type	Hex Addr	Dec Addr
P12.26	***Linear Speed Command Deceleration Time***	♦R/W	0C1A	43099
	Range/Units (Format: 16-bit binary)	Default		
	0.00–655.35 seconds	0.00		

P12.26 is valid when using closed-loop linear speed and speed mode (P12.00=2).

		Type	Hex Addr	Dec Addr
P12.27	***Reel Diameter Source***	R/W	0C1B	43100
	Range/Units (Format: 16-bit binary)	Default		
	0: Calculated via line speed. 1: Calculated via analog input selection. 2: Calculated via thickness integral, the encoder installed at reel side inputs by encoder card. 3: Calculated via thickness integral, the encoder installed at motor side inputs by encoder card. 4: Calculated via thickness itegral, the encoder installed at reel side inputs by DI6/DI7 terminals. 5 Calculated via thickness integral, the encoder installed at mode side inputs by DI6/DI7 terminals.	0		

When P12.27=1, AI1/AI2 analog inputs are set to be reel diameter (P03.00, P03.01 = d16), and 10V corresponds to the maximum reel diameter (P12.28).

When P12.27=2, reel diameter is read from the encoder on the reel axle. When pulse signals connect to the input of the encoder card (inputs pulse command), the encoder type (P10.00), pulse input type (P10.16), pulse per revolution (P12.34), revolutions per layer (P12.35), and material thickness (P12.36) are all set and used to calculate the reel diameter.

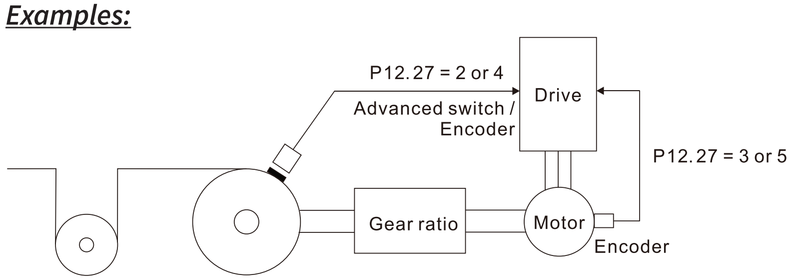
When P12.27=3, reel diameter can be determined by doing a back calculation of the motor, encoder, and gear ratio. When pulse signals connect to the input of the encoder card (pulse feedback), the gear ratio (P12.02, P12.03), the encoder type (P10.00), encoder pulses per revolution (P10.01), revolutions per layer (P12.35), and material thickness (P12.36) are all set and used to calculate the reel diameter.

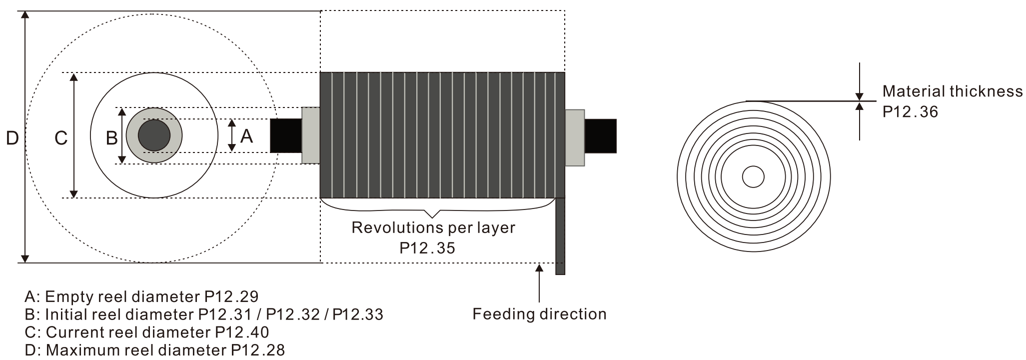
- *When P12.27=2 or 3, an encoder card is required.*
- *When P12.27=5, DI6 and DI7 are supported.*
- *When P12.27=5, P10.16 must be set to 5. If rewing/unwind mode is being changed during the operation process, you must also set P12.01.*

Refer to the table below for the related settings when the reel diameter source is calculated via thickness integral.

Position	Pulse Signal	Signal Interface	Parameter Settings	Related Parameters	Note
Motor axle	Encoder	PG1	P10.00=1	P12.27=3 P12.02, P12.03, P12.35, P12.36	The settings of P10.01 and P10.02 are depending on the working condition.
		PG2	P10.00=1 P10.16=1,2	P12.27=3 P12.02, P12.03, P12.34, P12.35, P12.36	N/A
		DI6/DI7	P10.00=5 P10.16=1,2	P12.27=5 P12.02, P12.03, P12.34, P12.35, P12.36	Uses two-phase input by DI6/DI7 and considers the direction.
	Advanced switch	DI7	P10.00=5 P10.16=5	P12.27=5 P12.02, P12.03, P12.34, P12.35, P12.36	N/A
Rewind axle	Encoder	PG2	P10.00=1	P12.27=2 P12.34, P12.35, P12.36	The setting of P10.16 is depending on the working condition.
		DI6/DI7	P10.00=1 P10.16=1,2	P12.27=4 P12.34, P12.35, P12.36	Uses two-phase input by DI6/DI7 and considers the direction.
	Advanced switch	DI7	P10.00=5 P10.16=5	P12.27=4 P12.34, P12.35, P12.36	N/A

Examples:





		Type	Hex Addr	Dec Addr
P12.28	***Maximum Reel Diameter***	R/W	0C1C	43101
	Range/Units (Format: 16-bit binary)	*Default*		
	1.0–6000.0 mm	6000.0		

		Type	Hex Addr	Dec Addr
P12.29	***Empty Reel Diameter***	R/W	0C1D	43102
	Range/Units (Format: 16-bit binary)	*Default*		
	1.0–6000.0 mm	100.0		

		Type	Hex Addr	Dec Addr
P12.30	***Initial Reel Diameter Source***	R/W	0C1E	43103
	Range/Units (Format: 16-bit binary)	*Default*		
	0: RS-485 communication input (P12.31) 1: Analog input (P03.00, P03.01 = d16)	0		

When P12.30=1, 10V corresponds to the maximum reel diameter (P12.28).

		Type	Hex Addr	Dec Addr
P12.31	***Initial Reel Diameter 0***	R/W	0C1F	43104
	Range/Units (Format: 16-bit binary)	*Default*		
	1.0–6000.0 mm	1.0		

P12.31 defines the reel diameter at startup. For the rewind zone, it’s the diameter of the reel axle. For the unwind zone, it’s the diameter of the reel.

When P12.30=1, this parameter is read only.

		Type	Hex Addr	Dec Addr
P12.32	***Initial Reel Diameter 1***	R/W	0C20	43105
P12.33	***Initial Reel Diameter 2***	R/W	0C21	43106
	Range/Units (Format: 16-bit binary)	*Default*		
	1.00–6000.0 mm	1.0		

If you choose more than one type of reel diameter, you can set P12.30=0 (using RS-485 communication input).

Example:

To plan HMI pages or use text panel (TP series of PLC products), you can change the setting of P12.31 using communication.

When the AC motor drive is at a tandsill and in tension control mode, you can set three sections of intial reel diameter (P12.31–P12.33) by using multi-function terminals 87 and 88. After finishing the setting of DI=87 and DI=88, executes the function of DI=86. See below:

DIx=88	DIx=87	DIx=86
OFF	OFF	ON: the setting value of P12.31 will be written into P12.40
OFF	ON	ON: the setting value of P12.32 will be written into P12.40
ON	OFF	ON: the setting value of P12.33 will be written into P12.40
ON	ON	ON: the setting value of P12.40 will reset to default.

		Type	Hex Addr	Dec Addr
P12.34	***Pulses per Revolution***	R/W	0C22	43107
	Range/Units (Format: 16-bit binary)	*Default*		
	1–60000 ppr	1		

When P12.27=2 or 4, you must cofigure P12.34 to set the pulses per revolution of the reel.

		Type	Hex Addr	Dec Addr
P12.35	***Revolutions per Layer***	R/W	0C23	43108
	Range/Units (Format: 16-bit binary)	*Default*		
	1–10000	1		

		Type	Hex Addr	Dec Addr
P12.36	***Material Thickness***	R/W	0C24	43109
	Range/Units (Format: 16-bit binary)	*Default*		
	0.001–65.000 mm	0.001		

Sets the thickness of the material to wind.

		Type	Hex Addr	Dec Addr
P12.37	***Reel Diameter Filter Time***	♦R/W	0C25	43110
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–100.00 seconds	1.00		

P12.37 reduces the instability of the reel diameter source (P12.27).

		Type	Hex Addr	Dec Addr
P12.38	**Automatic Reel Diameter Compensation**	R/W	0C26	43111

Range/Units (Format: 16-bit binary) — Default: 0

0: Disabled
1: Enabled

P12.38 is only valid when P12.00=1 and P12.19≠0. If the mechanical gear ratio or the linear speed is not accurate enough, you can use this parameter to compensate the reel diameter.

		Type	Hex Addr	Dec Addr
P12.39	**Reel Diameter Calculation Delay Time**	♦R/W	0C27	43112

Range/Units (Format: 16-bit binary) — Default: 0.0

0.0–6553.5 seconds

Starts to calculate the reel diameter after canceling the pre-startup and delaying time set in this parameter.
Set P12.39 to delay the time to calculate the reel diameter and prevent inaccurate reel diameter or instability in a short time after the pre-startup stops.

		Type	Hex Addr	Dec Addr
P12.40	**Current Reel Diameter**	R/W	0C28	43113

Range/Units (Format: 16-bit binary) — Default: 1.0

1.0–6000.0 mm

When the drive is not in STOP status, this parameter is read only.

		Type	Hex Addr	Dec Addr
P12.41	**Minimum Output Frequency for Reel Diameter Calculation**	♦R/W	0C29	43114

Range/Units (Format: 16-bit binary) — Default: 1.00

0.00–599.00 Hz

		Type	Hex Addr	Dec Addr
P12.42	**Pre-startup Mode Selection**	R/W	0C2A	43115

Range/Units (Format: 16-bit binary) — Default: 0

0: Disabled
1: Pre-startup of rewind mode
2: Pre-startup of unwind mode

When P12.42=2, the output frequency limit is P08.67.

		Type	Hex Addr	Dec Addr
P12.43	**Switching Level for Pre-startup and PID Enable**	R/W	0C2B	43116

Range/Units (Format: 16-bit binary) — Default: 15.0

0.0–100.0% (according to P12.05)

Example:

The tension feedback value is 0–100% that the lower value has loose tension and the larger value has tight tension. If P12.05=50%, P12.43=10%, then the range to pre-startup is 0–40%.

		Type	Hex Addr	Dec Addr
P12.44	**Pre-startup Frequency**	R/W	0C2C	43117
	Range/Units (Format: 16-bit binary)	Default		
	0.00–599.00 Hz	2.00		

		Type	Hex Addr	Dec Addr
P12.45	**Pre-startup Acceleration Time**	♦R/W	0C2D	43118
	Range/Units (Format: 16-bit binary)	Default		
	0.01–600.0 seconds	3.00		

You can set P12.42=1 when activating the tension function to prevent the loose rewinding/unwinding material or the value exceeds the setting range of P12.45 from causing the tension convergent time to be too long.

Example:

Adjust the value of P12.44 and P12.45 to make the tension feedback be in the setting range of P12.43 and PID control is effective.

When P12.42=2, in unwind mode the motor is allowed to run in reverse to tightly roll the material automatically.

		Type	Hex Addr	Dec Addr
P12.46	**Broken Belt Detection Function**	R/W	0C2E	43119
	Range/Units (Format: 16-bit binary)	Default		
	0: Disabled 1: Enabled	0		

When P12.21≠0 and P12.27=0, P12.46 is valid.

		Type	Hex Addr	Dec Addr
P12.47	**Minimum Linear Speed of Broken Belt Detection**	R/W	0C2F	43120
	Range/Units (Format: 16-bit binary)	Default		
	0.0–3000.0 m/min	0.0		

		Type	Hex Addr	Dec Addr
P12.48	**Reel Diameter Error of Broken Belt Detection**	R/W	0C30	43121
	Range/Units (Format: 16-bit binary)	Default		
	1.0–6000.0 mm	100.0		

		Type	Hex Addr	Dec Addr
P12.49	**Broken Belt Detection Time**	R/W	0C31	43122
	Range/Units (Format: 16-bit binary)	Default		
	0.00–100.00 seconds	1.00		

The broken belt occurs when the linear speed is higher than P12.47, the change of the reel diameter exceeds P12.48, and over the time setting in P12.49. When broken belt detection is enabled, if broken belt occurs, the drive shows “dEb” and ramps to stop. At the same time, you can also set MO to be 46 as the indication of broken belt.

		Type	Hex Addr	Dec Addr
P12.50	**Tension PID Feedback Error Level**	R/W	0C32	43123
	Range/Units (Format: 16-bit binary)	Default		
	0–100%	100		

		Type	Hex Addr	Dec Addr
P12.51	**Tension PID Feedback Error Detection Time**	R/W	0C33	43124
	Range/Units (Format: 16-bit binary)	Default		
	0.0–10.0 seconds	0.5		

		Type	Hex Addr	Dec Addr
P12.52	**Tension PID Feedback Error Treatment**	R/W	0C33	43125
	Range/Units (Format: 16-bit binary)	Default		
	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop	0		

If the difference between the tension PID target value and the tension PID feedback value exceeds the tension PID feedback error level (P12.50), and the error time exceeds the tension PID feedback error detection time (P12.51), then the PID feedback error is abnormal. “tdEv” displays on the keypad, the treatment refers to the setting in P12.52.

		Type	Hex Addr	Dec Addr
P12.53	**PID Output Gain Limit**	R/W	0C34	43126
	Range/Units (Format: 16-bit binary)	Default		
	0.0–200.0	100.0		

		Type	Hex Addr	Dec Addr
P12.54	**Tension Command Source Selection**	R/W	0C36	43127
	Range/Units (Format: 16-bit binary)	Default		
	0: RS-485 communication input 1: Analog input	0		

P12.54 is valid when P12.00=3 or 4.

- *When P12.54=0, you can use the digital keypad, HMI page planning, or text panel to change the tension command setting value of P12.56 by using communication.*
- *When P12.54=1, the setting for AI1/AI2 analog input selection have to be tension setting value (P03.00, P03.01 = d18) and P12.56 only can display the value (read only).*

		Type	Hex Addr	Dec Addr
P12.55	**Maximum Tension Value**	R/W	0C37	43128
	Range/Units (Format: 16-bit binary)	Default		
	0–65535 N	0		

P12.55 is valid when P12.00=3 or 4.

		Type	Hex Addr	Dec Addr
P12.56	***Tension Command Setting Value***	♦R/W	0C38	43129
	Range/Units (Format: 16-bit binary)	*Default*		
	0–65535 N	0		

P12.56 is valid when P12.00=3 or 4.

When P12.54=1, P12.56 is read only. Analog input 10V corresponds to P12.55.

		Type	Hex Addr	Dec Addr
P12.57	***Zero-speed Tension Setting Source***	R/W	0C39	43130
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disabled 1: RS-485 communication input 2: Analog input	0		

P12.57 is valid when P12.00=3 or 4.

- *When P12.57=1, you can use digital keypad, HMI page planning, or text panel to change the zero-speed tension setting value (P12.58) by using communication.*
- *When P12.57=2, the setting for AI1/AI2 analog input selection has to be zero-speed tension (P03.00, P03.01 = d19), and P12.58 only can display the value (read only).*

Zero-speed parameters are used for overcoming static friction.

		Type	Hex Addr	Dec Addr
P12.58	***Zero-speed Tension Setting Value***	♦R/W	0C3A	43131
	Range/Units (Format: 16-bit binary)	*Default*		
	0–65535 N	0		

P12.58 is valid when P12.00=3 or 4.

When P12.57=2, P12.58 is read only. Analog input 10V corresponds to P12.55.

		Type	Hex Addr	Dec Addr
P12.59	***Zero-speed Tension Threshold (line speed)***	♦R/W	0C3B	43132
	Range/Units (Format: 16-bit binary)	*Default*		
	0–100.00%	0		

P12.59 is valid when P12.00=3 or 4.

When linear speed is lower than the avlue set in P12.59, the tension value is P12.58 and reaches the static friction tension compensation.

		Type	Hex Addr	Dec Addr
P12.60	***Dynamic Friction Torque Compensation***	♦R/W	0C3C	43133
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–100.0%	0.0		

P12.60 is valid when P12.00=3 or 4.

- *A setting of 100% corresponds to the motor rated torque. This is mainly for the compensation of dynamic friction.*
- *Executes inertia estimation in speed mode to get the compensation coefficient of the friction torque. Users can adjust the value by different control effects.*

This parameter is used for overcoming dynamic friction.

		Type	Hex Addr	Dec Addr
P12.61	***Material Inertia Compensation Coefficient***	♦R/W	0C3D	43134
	Range/Units (Format: 16-bit binary)	*Default*		
	0–30000	0		

P12.61 is valid when P12.00=3 or 4.

Compensation coefficient of material inertia=material density x material width (unit of density=kg/m^3, unit of width=m). The material inertia of reel changes along with the reel diameter.

		Type	Hex Addr	Dec Addr
P12.62	***Acceleration Inertia Compensation Gain***	♦R/W	0C3E	43135
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–1000.0%	0.0		

P12.62 is valid when P12.00=3 or 4.

This parameter is used for compensating extra torque of the moment of inertia of mechanism when the system is accelerating.

		Type	Hex Addr	Dec Addr
P12.63	***Inertia Compensation Filter Time***	♦R/W	0C3F	43136
	Range/Units (Format: 16-bit binary)	*Default*		
	0.00–100.00	5.00		

P12.63 is valid when P12.00=3 or 4.

		Type	Hex Addr	Dec Addr
P12.64	***Deceleration Inertia Compensation Gain***	♦R/W	0C40	43137
	Range/Units (Format: 16-bit binary)	*Default*		
	0.0–1000.0%	0.0		

P12.64 is valid when P12.00=3 or 4.

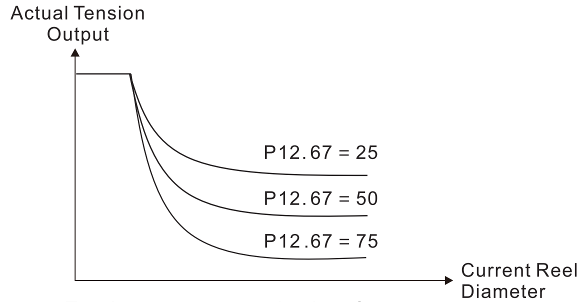
This parameter is used for compensating extra torque of the moment of inertia of mechansim when the system is decelerating.

		Type	Hex Addr	Dec Addr
P12.65	***Tension Taper Curve Selection***	R/W	0C41	43138
	Range/Units (Format: 16-bit binary)	*Default*		
	0: No taper 1: Curve taper 2: Linear taper 3: Multi-step curve taper 4: Multi-step linear taper	0		

P12.65 is valid when P12.01=1.

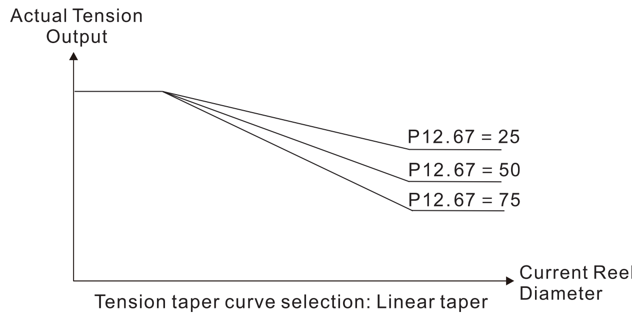
In some situations, users request that tension decreases along with the increasing reel diameter to ensure the material is smootly rewound. To meet the goal, you can set the tension taper related parameters.

- *When P12.65=1, the curve is generated by P12.67 and the curve can be fine tuned by P12.68.*



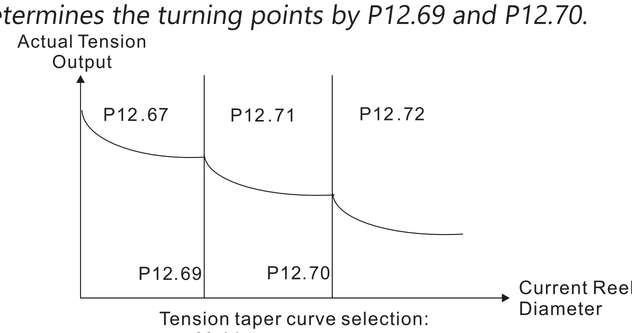
Tension taper curve selection: Curve taper
P12.65 = 1

- *When P12.65=2, the linear taper is generated by P12.67.*



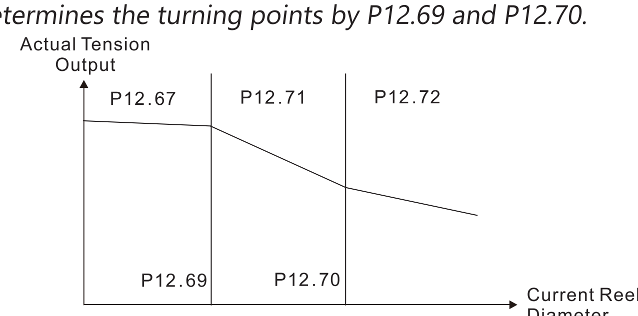
Tension taper curve selection: Linear taper
P12.65 = 2

- *When P12.65=3, determines the taper of multi-curves by P12.67, P12.71, and P12.72; and determines the turning points by P12.69 and P12.70.*



Tension taper curve selection:
Multi-step curve taper
P12.65 = 3

- *When P12.65=4, determines the multi-step linear taper by P12.67, P12.71, and P12.72; and determines the turning points by P12.69 and P12.70.*



Tension taper curve selection:
Multi-step linear taper
P12.65 = 4

		Type	Hex Addr	Dec Addr
P12.66	***Tension Taper Setting Source***	R/W	0C42	43139
	Range/Units (Format: 16-bit binary)	*Default*		
	0: RS-485 communication input 1: Analog input	0		

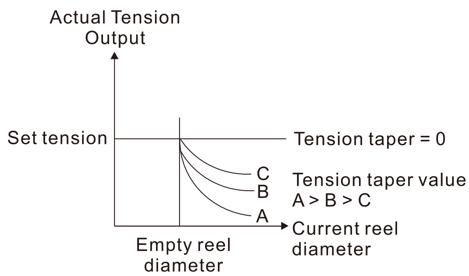
P12.66=0, you can use digital keypad, HMI page planning, or text panel to change the tension taper value (P12.67) by using communication.

When P12.66=1, P03.00 and P03.01 = d20 (tension taper), and P12.67 only can display the value (read only).

		Type	Hex Addr	Dec Addr
P12.67	***Tension Taper Value***	♦R/W	0C43	43140
	Range/Units (Format: 16-bit binary)	*Default*		
	0–100%	0		

During the process of rewind, sometimes the tension needs to decrease along with the increasing reel diameter to ensure that the material is rewound successfully.

The diagram below shows the unwind control:



		Type	Hex Addr	Dec Addr
P12.68	***Tension Taper Curve Compensation Value***	R/W	0C44	43141
	Range/Units (Format: 16-bit binary)	*Default*		
	0–60000	0		

		Type	Hex Addr	Dec Addr
P12.69	***Multi-step Taper Reel Diameter 1***	R/W	0C45	43142
P12.70	***Multi-step Taper Reel Diameter 2***	R/W	0C46	43143
	Range/Units (Format: 16-bit binary)	*Default*		
	10.0–6000.0	6000.0		

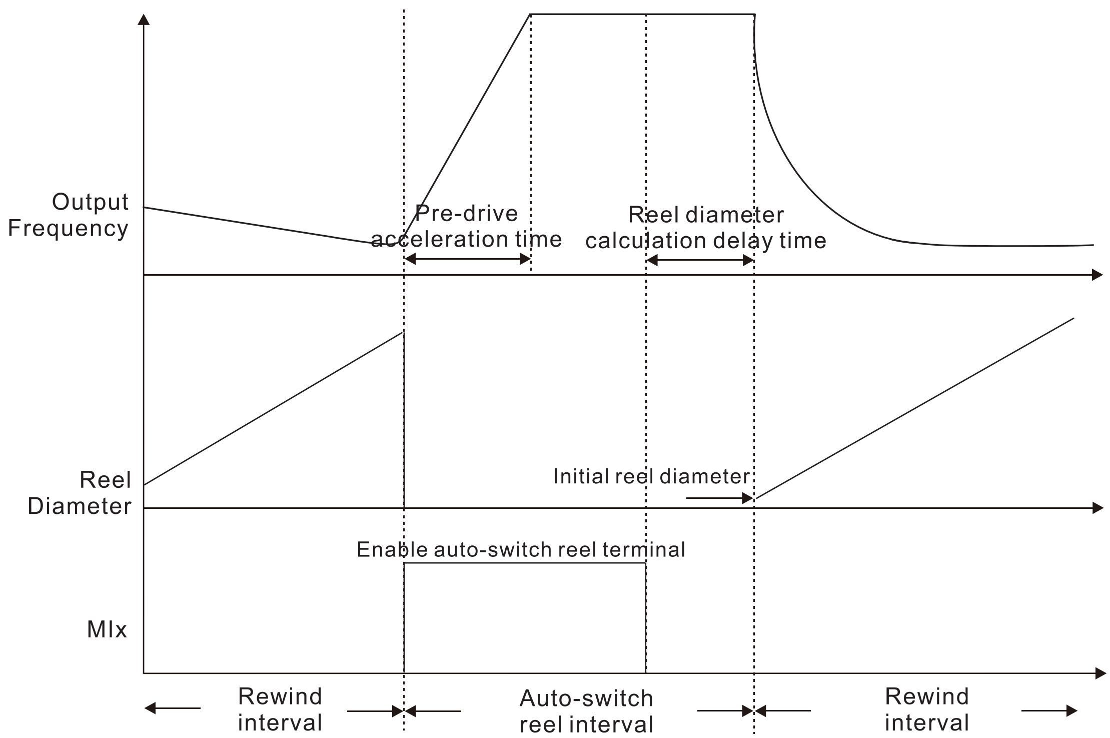
		Type	Hex Addr	Dec Addr
P12.71	***Multi-step Taper Value 1***	♦R/W	0C47	43144
P12.72	***Multi-step Taper Value 2***	♦R/W	0C48	43145
	Range/Units (Format: 16-bit binary)	*Default*		
	0–100	0		

		Type	Hex Addr	Dec Addr
P12.73	***Pre-drive Frequency Gain***	♦R/W	0C49	43146
	Range/Units (Format: 16-bit binary)	*Default*		
	-50.0 to 50.0%	0		

When switching the reel during operation, the pre-drive function rotates the rewind axle/unwind axle in advance, and makes the linear speed of the rotation and the material the same to prevent issues. When pre-drive terminal is valid, the drive automatically calculates output frequency according to the linear speed and the reel diameter that have been detected to match their linear speed.

		Type	Hex Addr	Dec Addr
P12.74	***Pre-drive Accleration Time***	♦R/W	0C4A	43147
	Range/Units (Format: 16-bit binary)	*Default*		
	0–65535	0		

		Type	Hex Addr	Dec Addr
P12.75	***Pre-drive Deceleration Time***	♦R/W	0C4B	43148
	Range/Units (Format: 16-bit binary)	*Default*		
	0–65535	0		



		Type	Hex Addr	Dec Addr
P12.76	***Speed Limit Gain***	♦R/W	0C4C	43149
	Range/Units (Format: 16-bit binary)	*Default*		
	0–65535	0		

In tension mode, when using the analog quantity of linear speed signal as the speed limit (sets P11.36=3), you can use this parameter to adjust the value of the speed limit.

		Type	Hex Addr	Dec Addr
P12.77	**Tension Control Bits**	♦R/W	0C4D	43150

Range/Units (Format: 16-bit binary) — Default: 0

bit 0: Closed loop tension speed mode, allowed changing operation direction
bit 1: Start-up compensation (switching between zero-speed tension command and normal tension command)
bit 2: Acceleration and deceleration compensation (P12.62 acceleration inertia compensation gain; P12.64 deceleration inertia compensation gain)
bit 3: Reel diameter calculation by moving average method bit 5: PID output reverse limit selection
bit 6: Material thickness range selection

Tension Related Analog Input Functions:

	Setting Value	Function Name
P03.00 P03.01	14	Tension PID feedback signal
	15	Line speed
	16	Reel diameter
	17	Tension PID target value
	18	Tension setting value
	19	Zero-speed tension
	20	Tension taper
P00.04	53	Display the current reel diameter under the tension control (d) (unit: mm)
	54	Display the current line speed under the tension control (L) (unit: m/minute)
	55	Display the current tension setting value under the tension control (T) (unit: N)

Group P13.xx Details – Macro / User Defined Parameters

		Type	Hex Addr	Dec Addr
P13.00	***Industry-specific Parameter Application***	R/W	0D0D	43329
	Range/Units (Format: 16-bit binary)	*Default*		

00: Disabled — Default: 00
01: User-defined parameter
02: Compressor
03: Fan
04: Pump
05: Conveyor
06: Machine tool
07: Packing
08: Textiles
10: Logistics
11: Tension PID
12: Tension PID + master / auxiliary frequency

NOTE: : After you select the macro, some of the default values adjust automatically according to the application selection. If P13.00 is set to a macro selection, the drive must be set back to defaults (P00.02 =10) to revert all parameters to the original parameter settings.

P13.00=02: Compressor

The following table lists the relevant compressor setting application parameters.

Parameter	Parameter Name	Settings
P00.11	Speed control mode	0 (IMVF control mode)
P00.16	Load selection	0 (Normal load)
P00.17	Carrier frequency	Default setting
P00.20	Master frequency command source (AUTO, REMOTE)	2 (External analog input)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P00.22	Stop method	0 (Ramp to stop)
P0023	Motor direction control	1 (Disable reverse)
P01.00	Maximum operation frequency	Default setting
P01.01	Output frequency of motor 1 (Base frequency / Motor's rated frequency)	Default setting
P01.02	Output voltage of motor 1 (Base voltage / Motor's rated voltage)	Default setting
P01.03	Mid-point frequency 1 of motor 1	Default setting
P01.04	Mid-point voltage 1 of motor 1	Default setting
P01.05	Mid-point frequency 2 of motor 1	Default setting
P01.06	Mid-point voltage 2 of motor 1	Default setting
P01.07	Minimum output frequency of motor 1	Default setting
P01.08	Minimum output voltage of motor 1	Default setting
P01.11	Output frequency lower limit	20 (Hz)
P01.12	Acceleration time 1	20 (sec.)
P01.13	Deceleration time 1	20 (sec.)
P03.00	Analog input selection (AI1)	0 (No function)
P03.01	Analog input selection (AI2)	1 (Frequency command)
P05.01	Full-load current for induction motor 1 (A)	Default setting
P05.03	Rated speed for induction motor 1 (rpm)	Default setting
P05.04	Number of poles for induction motor 1	Default setting

P13.00=03: Fan

The following table lists the relevant fan setting application parameters.

Parameter	Parameter Name	Settings
P00.11	Speed control mode	0 (IMVF)
P00.16	Load selection	0 (Normal load)
P00.17	Carrier frequency	Default setting
P00.20	Master frequency command source (AUTO, REMOTE)	2 (External analog input)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P00.22	Stop method	1 (Coast to stop)
P00.23	Motor direction control	1 (Disable reverse)
P00.30	Master frequency command source (HAND, LOCAL)	0 (Digital keypad)
P00.31	Operation command source (HAND, LOCAL)	0 (Digital keypad)
P01.00	Maximum operation frequency	Default setting
P01.01	Output frequency of motor 1 (Base frequency / Motor's rated frequency)	Default setting
P01.02	Output voltage of motor 1 (Base voltage / Motor's rated voltage)	Default setting
P01.03	Mid-point frequency 1 of motor 1	Default setting
P01.04	Mid-point voltage 1 of motor 1	Default setting
P01.05	Mid-point frequency 2 of motor 1	Default setting
P01.06	Mid-point voltage 2 of motor 1	Default setting
P01.07	Minimum output frequency of motor 1	Default setting
P01.08	Minimum output voltage of motor 1	Default setting
P01.10	Output frequency upper limit	50 (Hz)
P01.11	Output frequency lower limit	35 (Hz)
P01.12	Acceleration time 1	15 (sec.)
P01.13	Deceleration time 1	15 (sec.)
P01.43	V/F curve selection	2 (V/F curve to the power of 2)
P02.05	Multi-function input command 5 (DI5)	16 (Rotating speed command from AI2)
P02.16	Multi-function output 2 (DO1)	11 (Malfunction indication)
P02.17	Multi-function output 3 (DO2)	1 (Indication during RUN)
P03.00	Analog input selection (AI1)	1 (Frequency command)
P03.01	Analog input selection (AI2)	1 (Frequency command)
P03.28	AI1 terminal input selection	0 (0–10 V)
P03.29	AI2 terminal input selection	1 (0–10 V)
P03.31	AO1 output selection	0 (0–10 V)
P03.50	Analog input curve selection	1 (three-point curve of AI1)
P07.06	Restart after momentary power loss	2 (Speed tracking by the minimum output freqeuncy)
P07.11	Number of times of restart after fault	5 (times)
P07.33	Auto-restart interval of fault	60 (sec.)

P13.00=04: Pump

The following table lists the relevant pump setting application parameters.

Parameter	Parameter Name	Settings
P00.11	Speed control mode	0 (IMVF)
P00.16	Load selection	0 (Normal load)
P00.20	Master frequency command source (AUTO, REMOTE)	2 (External analog input)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P00.23	Motor direction control	1 (Disable reverse)
P01.00	Maximum operation frequency	Default setting
P01.01	Output frequency of motor 1 (Base frequency / Motor's rated frequency)	Default setting
P01.02	Output voltage of motor 1 (Base voltage / Motor's rated voltage)	Default setting
P01.03	Mid-point frequency 1 of motor 1	Default setting
P01.04	Mid-point voltage 1 of motor 1	Default setting
P01.05	Mid-point frequency 2 of motor 1	Default setting
P01.06	Mid-point voltage 2 of motor 1	Default setting
P01.07	Minimum output frequency of motor 1	Default setting
P01.08	Minimum output voltage of motor 1	Default setting
P01.10	Output frequency upper limit	50 (Hz)
P01.11	Output frequency lower limit	35 (Hz)
P01.12	Acceleration time 1	15 (sec.)
P01.13	Deceleration time 1	15 (sec.)
P01.43	V/F curve selection	2 (V/F curve to the power of 2)
P07.06	Restart after momentary power loss	2 (Speed tracking by the minimum output frequency)
P07.11	Number of times of restart after fault	5 (times)
P07.33	Auto-restart interval of fault	60 (sec.)

P13.00=05: Conveyor

The following table lists the relevant conveyor setting application parameters.

Parameter	Parameter Name	Settings
P00.11	Speed control mode	0 (IMVF)
P00.16	Load selection	0 (Normal load)
P00.20	Master frequency command source (AUTO, REMOTE)	2 (External analog input)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P01.00	Maximum operation frequency	Default setting
P01.01	Output frequency of motor 1 (Base frequency / Motor's rated frequency)	Default setting
P01.02	Output voltage of motor 1 (Base voltage / Motor's rated voltage)	Default setting
P01.03	Mid-point frequency 1 of motor 1	Default setting
P01.04	Mid-point voltage 1 of motor 1	Default setting
P01.05	Mid-point frequency 2 of motor 1	Default setting
P01.06	Mid-point voltage 2 of motor 1	Default setting
P01.07	Minimum output frequency of motor 1	Default setting
P01.08	Minimum output voltage of motor 1	Default setting

Parameter	Parameter Name	Settings
P01.12	Acceleration time 1	10 (sec.)
P01.13	Deceleration time 1	10 (sec.)

P13.00=06: Machine Tool

The following table lists the relevant machine tool setting application parameters.

Parameter	Parameter Name	Settings
P00.11	Speed control mode	0 (IMVF)
P00.17	Carrier frequency	Default setting
P00.20	Master frequency command source (AUTO, REMOTE)	2 (External analog input)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P01.00	Maximum operation frequency	Default setting
P01.01	Output frequency of motor 1 (Base frequency / Motor's rated frequency)	Default setting
P01.02	Output voltage of motor 1 (Base voltage / Motor's rated voltage)	Default setting
P01.03	Mid-point frequency 1 of motor 1	0
P01.04	Mid-point voltage 1 of motor 1	0
P01.05	Mid-point frequency 2 of motor 1	0
P01.06	Mid-point voltage 2 of motor 1	0
P01.07	Minimum output frequency of motor 1	Default setting
P01.08	Minimum output voltage of motor 1	Default setting
P01.12	Acceleration time 1	5 (sec.)
P01.13	Deceleration time 1	5 (sec.)
P01.24	S-curve for acceleration begin time 1	0
P01.25	S-curve for acceleration arrival time 2	0
P01.26	S-curve for deceleration begin time 1	0
P01.27	S-curve for deceleration arrival time 2	0
P02.03	Multi-function input command 3 (DI3)	1 (Multi-step speed command 1)
P02.04	Multi-function input command 4 (DI4)	2 (Multi-step speed command 2)
P02.13	Multi-function output 1 (R1)	11 (Malfunction indication)
P02.16	Multi-function output 2 (DO1)	1 (Indication during RUN)
P02.17	Multi-function output 3 (DO2)	2 (Operation speed reached)
P03.00	Analog input selection (AI1)	1 (Frequency command)
P06.01	Over-voltage stall prevention	0 (Disabled)
P06.03	Over-current stall prevention during acceleration	0 (Disabled)
P06.04	Over-current stall prevention during operation	0 (Disabled)
P06.05	Acceleration / deceleration time selection for stall prevention at constant speed	0 (By current acceleration / deceleration time)
P07.01	DC brake current level	20 (%)
P07.03	DC brake time at STOP	0.3 (sec.)
P07.04	DC brake frequency at STOP	0 (Hz)
P07.23	Automatic voltage regulation (AVR) function	1 (Disable AVR)

P13.00=07: Packing

The following table lists the relevant compressor setting application parameters.

Parameter	Parameter Name	Settings
P00.11	Speed control mode	0 (IMVF)
P00.20	Master frequency command source (AUTO, REMOTE)	0 (Digital keypad)
P00.21	Operation command source (AUTO, REMOTE)	2 (RS-485 communication input)
P02.00	Two-wire / three-wire operation control	1 (two-wire mode 1, power on for operation control (M1: FWD / STOP, M2: REV / STOP))
P01.00	Maximum operation frequency	Default setting
P01.01	Output frequency of motor 1 (Base frequency / Motor's rated frequency)	Default setting
P01.02	Output voltage of motor 1 (Base voltage / Motor's rated voltage)	Default setting
P01.03	Mid-point frequency 1 of motor 1	Default setting
P01.04	Mid-point voltage 1 of motor 1	Default setting
P01.05	Mid-point frequency 2 of motor 1	Default setting
P01.06	Mid-point voltage 2 of motor 1	Default setting
P01.07	Minimum output frequency of motor 1	Default setting
P01.08	Minimum output voltage of motor 1	Default setting
P01.12	Acceleration time 1	10 (sec.)
P01.13	Deceleration time 1	10 (sec.)
P01.24	S-curve for acceleration begin time 1	Default setting
P01.25	S-curve for acceleration arrival time 2	Default setting
P01.26	S-curve for deceleration begin time 1	Default setting
P01.27	S-curve for deceleration arrival time 2	Default setting
P03.00	Analog input selection (AI1)	1 (Frequency command)
P03.28	AI1 terminal input selection	Default setting

P13.00=08: Textiles

The following table lists the relevant textile setting application parameters.

Parameter	Parameter Name	Settings
P00.11	Speed control mode	0 (IMVF)
P00.20	Master frequency command source (AUTO, REMOTE)	1 (RS-485 communication input)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P01.00	Maximum operation frequency	Default setting
P01.01	Output frequency of motor 1 (Base frequency / Motor's rated frequency)	Default setting
P01.02	Output voltage of motor 1 (Base voltage / Motor's rated voltage)	Default setting
P01.03	Mid-point frequency 1 of motor 1	Default setting
P01.04	Mid-point voltage 1 of motor 1	Default setting
P01.05	Mid-point frequency 2 of motor 1	Default setting
P01.06	Mid-point voltage 2 of motor 1	Default setting
P01.07	Minimum output frequency of motor 1	Default setting
P01.08	Minimum output voltage of motor 1	Default setting
P01.12	Acceleration time 1	10 (sec.)
P01.13	Deceleration time 1	10 (sec.)

Parameter	Parameter Name	Settings
P01.24	S-curve for acceleration begin time 1	0.2 (sec.)
P01.25	S-curve for acceleration arrival time 2	0.2 (sec.)
P01.26	S-curve for deceleration begin time 1	0.2 (sec.)
P01.27	S-curve for deceleration arrival time 2	0.2 (sec.)
P06.03	Over-current stall prevention during acceleration	180 (%)
P06.04	Over-current stall prevention during operation	180 (%)
P06.07	Over-torque detection level (motor 1)	200 (%)
P07.19	Fan cooling control	2 (Fan is ON when the AC motor drive runs; fan is OFF when the AC motor drive stops)

P13.00=10: Logistics

The following table lists the relevant logistics setting application parameters.

Parameter	Parameter Name	Settings
P00.20	Master frequency command source (AUTO, REMOTE)	7 (Digital keypad VR/potentiometer dial)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P01.00	Maximum operation frequency	Default setting
P01.01	Output frequency of motor 1 (Base frequency / Motor's rated frequency)	Default setting
P01.02	Output voltage of motor 1 (Base voltage / Motor's rated voltage)	400.0
P01.04	Mid-point voltage 1 of motor 1	20.0
P01.06	Mid-point voltage 2 of motor 1	20.0
P01.08	Minimum output voltage of motor 1	20.0
P01.03	Mid-point frequency 1 of motor 1	1.50
P01.07	Minimum output frequency of motor 1	1.50
P01.12	Acceleration time 1	3 (sec.)
P01.13	Deceleration time 1	3 (sec.)
P01.24	S-curve for acceleration begin time 1	0.00
P01.25	S-curve for acceleration arrival time 2	0.00
P01.26	S-curve for deceleration begin time 1	0.00
P01.27	S-curve for deceleration arrival time 2	0.00
P06.03	Over-current stall prevention during acceleration	200
P06.04	Over-current stall prevention during operation	200
P06.05	Acceleration / deceleration time selection for stall prevention at constant speed	2: By the second acceleration / deceleration time
P07.23	Automatic voltage regulation (AVR) function	1: Disable AVR
P07.26	Torque compensation gain	0

P13.00=11: PID

The following table lists the relevant PID setting application parameters.

Parameter	Parameter Name	Settings
P00.20	Master frequency command source (AUTO, REMOTE)	9 (PID controller)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P01.00	Maximum operation frequency	Default setting
P01.12	Acceleration time 1	3 (sec.)
P01.13	Deceleration time 1	3 (sec.)
P03.00	Analog input selection (AI1)	5 (PID feedback signal)
P03.50	Analog input curve selection	1: Three-point curve of AI1
P03.63	AI1 voltage lowest point	0.00
P03.65	AI1 voltage mid-point	9.99
P03.66	AI1 proportional mid-point	100%
P08.00	Terminal selection of PID feedback	1: Negative PID feedback: by analog input (P03.00, P03.01)
P08.01	Proportional gain (P)	10
P08.02	Integral time (I)	1
P08.20	PID mode selection	1: Parallel connection
P08.21	Enable PID to change the operation direction	0: Operation direction cannot be changed
P08.65	PID target value source	1: P08.66 setting
P08.66	PID target value setting	50%

P13.00=12: Tension PID + Master/Aux Frequency

The following table lists the relevant tension PID setting application parameters.

Parameter	Parameter Name	Settings
P00.20	Master frequency command source (AUTO, REMOTE)	9 (PID controller)
P00.21	Operation command source (AUTO, REMOTE)	1 (External terminals)
P01.00	Maximum operation frequency	Default setting
P01.12	Acceleration time 1	3 (sec.)
P01.13	Deceleration time 1	3 (sec.)
P00.35	Auxiliary frequency source	3: Analog input
P03.00	Analog input selection (AI1)	5 (PID feedback signal)
P03.01	Analog input selection (AI2)	12: Auxiliary frequency input
P03.10	Reverse setting when analog signal input is negative frequency	0: Negative frequency input is not allowed. The digital keypad or external terminal controls the forward and reverse direction.
P03.12	Analog input gain (AI2)	100.0%
P03.29	AI2 terminal input selection	1: 0–10 V
P03.50	Analog input curve selection	1: Three-point curve of AI1
P03.63	AI1 voltage lowest point	0.00
P03.65	AI1 voltage mid-point	9.99
P03.66	AI1 proportional mid-point	100%
P08.00	Terminal selection of PID feedback	1: Negative PID feedback: by analog input (P03.00, P03.01)
P08.01	Proportional gain (P)	10
P08.02	Integral time (I)	1
P08.20	PID mode selection	1: Parallel connection

Parameter	Parameter Name	Settings
P08.21	Enable PID to change the operation direction	0: Operation direction cannot be changed
P08.65	PID target value source	1: P08.66 setting
P08.66	PID target value setting	50%
P08.67	Master and auxiliary reverse running cutoff frequency	10%

P13.00=1, User-defined Parameters

Parameters 13.01 through 13.50 are blank for your use. You can record any user defined parameter settings here if you wish.

	Type	Hex Addr	Dec Addr
P13.01	♦R/W	0D01	43330
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.02	♦R/W	0D02	43331
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.03	♦R/W	0D03	43332
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.04	♦R/W	0D04	43333
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.05	♦R/W	0D05	43334
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.06	♦R/W	0D06	43335
Range/Units (Format: 16-bit unsigned)	*Default*		

	Type	Hex Addr	Dec Addr
P13.07	♦R/W	0D07	43336
Range/Units (Format: 16-bit unsigned)	*Default*		

		Type	Hex Addr	Dec Addr
P13.08		♦R/W	0D08	43337
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.09		♦R/W	0D09	43338
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.10		♦R/W	0D0A	43339
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.11		♦R/W	0D0B	43340
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.12		♦R/W	0D0C	43341
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.13		♦R/W	0D0D	43342
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.14		♦R/W	0D0E	43343
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.15		♦R/W	0D0F	43344
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.16		♦R/W	0D10	43345
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.17		♦R/W	0D11	43346
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.18		♦R/W	0D12	43347
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.19		♦R/W	0D13	43348
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.20		♦R/W	0D14	43349
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.21		♦R/W	0D15	43350
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.22		♦R/W	0D16	43351
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.23		♦R/W	0D17	43352
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.24		♦R/W	0D18	43353
	Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.25		♦R/W	0D19	43354
	Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.26	♦R/W	0D1A	43355
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.27	♦R/W	0D1B	43356
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.28	♦R/W	0D1C	43357
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.29	♦R/W	0D1D	43358
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.30	♦R/W	0D1E	43359
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.31	♦R/W	0D1F	43360
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.32	♦R/W	0D20	43361
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.33	♦R/W	0D21	43362
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.34	♦R/W	0D22	43363
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.35	♦R/W	0D23	43364
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.36	♦R/W	0D24	43365
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.37	♦R/W	0D25	43366
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.38	♦R/W	0D26	43367
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.39	♦R/W	0D27	43368
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.40	♦R/W	0D28	43369
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.41	♦R/W	0D29	43370
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.42	♦R/W	0D2A	43371
Range/Units (Format: 16-bit unsigned)	Default		

	Type	Hex Addr	Dec Addr
P13.43	♦R/W	0D2B	43372
Range/Units (Format: 16-bit unsigned)	Default		

		Type	Hex Addr	Dec Addr
P13.44		♦R/W	0D2C	43373
	Range/Units (Format: 16-bit unsigned)	*Default*		

		Type	Hex Addr	Dec Addr
P13.45		♦R/W	0D2D	43374
	Range/Units (Format: 16-bit unsigned)	*Default*		

		Type	Hex Addr	Dec Addr
P13.46		♦R/W	0D2E	43375
	Range/Units (Format: 16-bit unsigned)	*Default*		

		Type	Hex Addr	Dec Addr
P13.47		♦R/W	0D2F	43376
	Range/Units (Format: 16-bit unsigned)	*Default*		

		Type	Hex Addr	Dec Addr
P13.48		♦R/W	0D30	43377
	Range/Units (Format: 16-bit unsigned)	*Default*		

		Type	Hex Addr	Dec Addr
P13.49		♦R/W	0D31	43378
	Range/Units (Format: 16-bit unsigned)	*Default*		

		Type	Hex Addr	Dec Addr
P13.50		♦R/W	0D32	43379
	Range/Units (Format: 16-bit unsigned)	*Default*		

Group P14.xx Details – Protection Parameters (2)

		Type	Hex Addr	Dec Addr
P14.00	***Extension Card Input Terminal Selection (AI10)***	♦R/W	0E0E	43585
P14.01	***Extension Card Input Terminal Selection (AI11)***	♦R/W	0E01	43586

Range/Units (Format: 16-bit unsigned) — *Default*: 0

0: No function
1: Frequency command (this function can be the torque limit in torque control mode)
2: Torque command (torque limit in speed mode)
3: Torque compensation command
4: PID reference value
5: PID feedback signal
6: PTC thermistor input value
7: Positive torque limit
8: Negative torque limit
9: Regenerative torque limit
10: Positive/negative torque limit
11: PT100 thermistor input value
12: Aux frequency
13: PID compensation amount
14: Tension PID Fbk
15: Line speed
16: Reel diameter
17: Tension PID reference
18: Tension setting
19: Zero Speed Tension
20: Tension taper

When P14.00 or P14.01 = 1: This function can be the torque limit in torque control mode.

When you use analog input as PID reference target input, you must set Pr.00-20 to 2 (external analog input).

- *Setting method 1: Pr.14-00–14-01 set 1 as frequency command.*
- *Setting method 2: Pr.14-00–14-01 set 4 as PID reference target input.*
- *If the setting value 1 and setting value 4 exist at the same time, AI10 input has highest priority to become the PID reference target input value.*

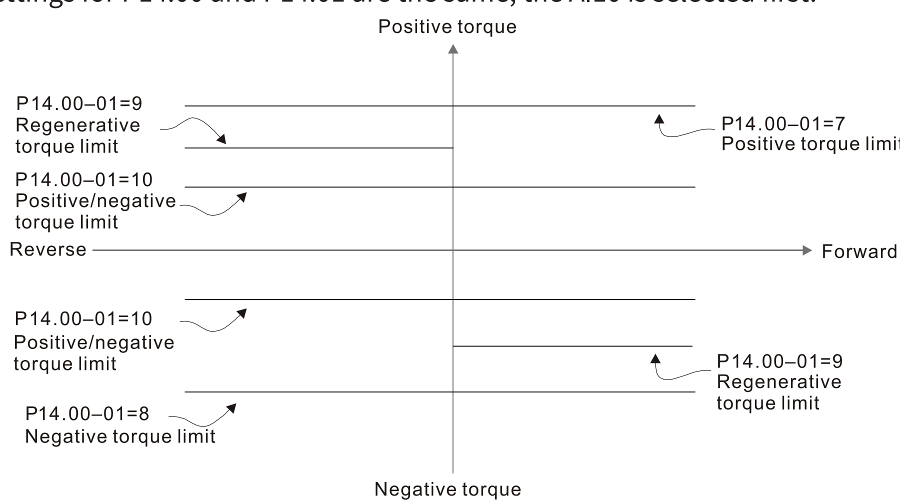
When you use analog input as the PID compensation value, you must set P08.16 to 1 (Source of PID compensation value is analog input). You can see the compensation value with P08.17.

When you use the frequency command, the corresponding value for 0– ± 10 V / 4–20 mA is 0–maximum operation frequency (P01.00).

When you use the torque command, the corresponding value for 0– ± 10 V / 4–20 mA is 0–maximum output torque (P11.27).

When you use torque compensation, the corresponding value for 0– ± 10 V / 4–20 mA is 0–rated torque.

When the settings for P14.00 and P14.01 are the same, the AI10 is selected first.



		Type	Hex Addr	Dec Addr
P14.02	***AI10 Analog Input Bias***	♦R/W	0E02	43587
	Range/Units (Format: 16-bit unsigned)	*Default*		
	-100.0 to 100.0%	0.0		

Sets the corresponding AI10 voltage for the external analog input to 0.

		Type	Hex Addr	Dec Addr
P14.03	***AI11 Analog Input Bias***	♦R/W	0E03	43588
	Range/Units (Format: 16-bit unsigned)	*Default*		
	-100.0 to 100.0%	0.0		

Sets the corresponding AI11 current for the external analog input to 0.

		Type	Hex Addr	Dec Addr
P14.04	***AI10 Analog Input Bias***	♦R/W	0E04	43589
P14.05	***AI11 Analog Input Bias***	♦R/W	0E05	43590
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: No bias 1: Lower than or equal to bias 2: Greater than or equal to bias 3: The absolute value of the bias voltage while serving as the center 4: Bias serves as the center	0		

In a noisy environment, use negative bias to provide a noise margin. Do NOT use less than 1V to set the operation frequency.

See the bias gain diagrams under “Analog Input Parameter Examples” on page 4–132. The black line is voltage-frequency curve with no bias; gray line is voltage-frequency curve with bias.

		Type	Hex Addr	Dec Addr
P14.06	***AI10 Analog Input Gain***	♦R/W	0E06	43591
P14.07	***AI11 Analog Input Gain***	♦R/W	0E07	43592
	Range/Units (Format: 16-bit unsigned)	*Default*		
	-500.0 to 500.0%	100.0		

Use P14.06–14.07 when the source of the frequency command is the analog voltage / current signal.

		Type	Hex Addr	Dec Addr
P14.08	***AI10 Analog Input Filter Time***	♦R/W	0E08	43593
P14.09	***AI11 Analog Input Filter Time***	♦R/W	0E09	43594
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–20.00 seconds	0.01		

The analog signals enter via the control terminals AI1 and AI2 commonly cause interference. This might affect the stability of the analog control, use these input delays to filter a noisy analog signal.

When the setting for the time constant is too large, the control is stable but the control response is slow. When the setting for time constant is too small, the control response is faster but the control may be unstable. For optimal setting, adjust the setting according to the control stability or the control response.

		Type	Hex Addr	Dec Addr
P14.10	***AI10 Analog Input 4–20 mA Signal Loss Selection***	R/W	0E0A	43595
P14.11	***AI11 Analog Input 4–20 mA Signal Loss Selection***	R/W	0E0B	43596

Range/Units (Format: 16-bit unsigned) — *Default*: 0

0: Disable
1: Continue operation at the last frequency
2: Decelerate to 0Hz
3: Stop immediately and display "ACE"

Determines the treatment when the 4–20 mA signal is lost (P14.18 =2, P14.19 = 2).

When P14.18 or P14.19 = 0, the voltage input is 0–10 V; when P14.18 or P14.19 = 0, the voltage input is 0–20 mA. At this moment, P14.10 and 14.11 are invalid.

When set to 1 or 2: Displays the warning code "ANL" on the keypad. It continues blinking until the lost ACI signal is recovered.

When the drive stops, the warning condition does not continue to exist, so the warning disappears.

		Type	Hex Addr	Dec Addr
P14.12	***AO10 Extension Card Output Terminal Selection***	♦R/W	0E0C	43597
P14.13	***AO11 Extension Card Output Terminal Selection***	♦R/W	0E0D	43598

Range/Units (Format: 16-bit unsigned) — *Default*: 0

0–23

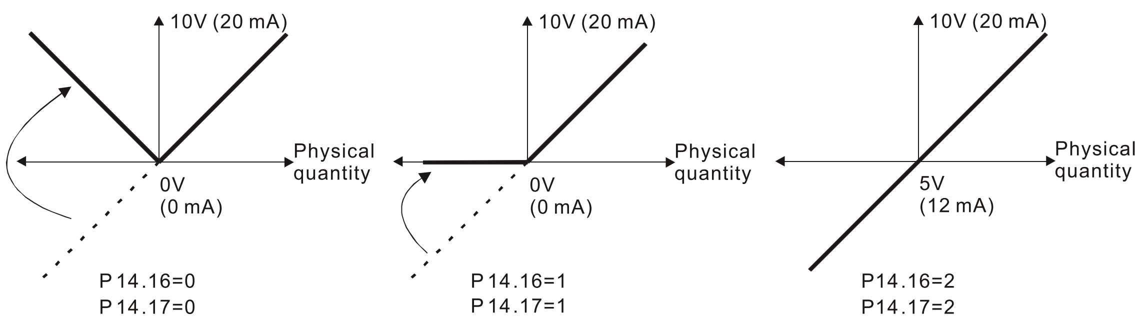
Function Chart

<table>
<tr><th>Settings</th><th>Functions</th><th>Descriptions</th></tr>
<tr><td>0</td><td>Output frequency (Hz)</td><td>Maximum frequency P01.00 is processed as 100%.</td></tr>
<tr><td>1</td><td>Frequency command (Hz)</td><td>Maximum frequency P01.00 is processed as 100%.</td></tr>
<tr><td>2</td><td>Motor speed (Hz)</td><td>Maximum frequency P01.00 is processed as 100%.</td></tr>
<tr><td>3</td><td>Output current (rms)</td><td>(2.5 x rated current) is processed as 100%.</td></tr>
<tr><td>4</td><td>Output voltage</td><td>(2 x rated voltage) is processed as 100%.</td></tr>
<tr><td>5</td><td>DC bus voltage</td><td>450V (900V) = 100%</td></tr>
<tr><td>6</td><td>Power factor</td><td>-1.000–1.000 = 100%</td></tr>
<tr><td>7</td><td>Power</td><td>(2 x rated power) is processed as 100%.</td></tr>
<tr><td>8</td><td>Output torque</td><td>Full load torque = 100%</td></tr>
<tr><td>9</td><td>AI1</td><td>0–10 V = 0–100%</td></tr>
<tr><td>10</td><td>AI2</td><td>4–20 mA = 0–100%</td></tr>
<tr><td>12</td><td>Iq current command</td><td>(2.5 x rated current) is processed as 100%.</td></tr>
<tr><td>13</td><td>Iq feedback value</td><td>(2.5 x rated current) is processed as 100%.</td></tr>
<tr><td>14</td><td>Id current command</td><td>(2.5 x rated current) is processed as 100%.</td></tr>
<tr><td>15</td><td>Id feedback value</td><td>(2.5 x rated current) is processed as 100%.</td></tr>
<tr><td>16</td><td>Vq-axis voltage command</td><td>250V (500V) = 100%</td></tr>
<tr><td>17</td><td>Vd-axis voltage command</td><td>250V (500V) = 100%</td></tr>
<tr><td>18</td><td>Torque command</td><td>Rated current of motor = 100%</td></tr>
<tr><td>19</td><td>Encoder frequency command</td><td>Maximum frequency P01.00 is processed as 100%.</td></tr>
<tr><td>21</td><td>RS-485 analog output</td><td>For RS-485 (Modbus) analog output:
<table>
<tr><th>Terminal</th><th>Corresponding Address</th></tr>
<tr><td>AO1</td><td>26A0H</td></tr>
<tr><td>AO10</td><td>26AAH</td></tr>
<tr><td>AO11</td><td>26ABH</td></tr>
</table></td></tr>
<tr><td>22</td><td>Communication card analog output</td><td>For Communication analog output:
<table>
<tr><th>Terminal</th><th>Corresponding Address</th></tr>
<tr><td>AO1</td><td>26A0H</td></tr>
<tr><td>AO10</td><td>26AAH</td></tr>
<tr><td>AO11</td><td>26ABH</td></tr>
</table></td></tr>
<tr><td>23</td><td>Constant voltage output</td><td>P03.32 controls the voltage output level.
0–100% of P03.32 corresponds to 0–10 V of AFM.</td></tr>
</table>

		Type	Hex Addr	Dec Addr
P14.14	***AO10 Analog Output 1 Gain***	♦R/W	0E0E	43599
P14.15	***AO11 Analog Output 1 Gain***	♦R/W	0E0F	43600
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–500.0%	100.0		

Adjusts the voltage level outputted to the analog meter from the analog signal (P14.12, P14.13) output terminal AFM of the drive.

		Type	Hex Addr	Dec Addr
P14.16	***AO10 Analog Output 1 in REV Direction***	♦R/W	0E10	43601
P14.17	***AO11 Analog Output 1 in REV Direction***	♦R/W	0E11	43602
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Absolute value of output voltage 1: Reverse output 0V; forward output 0–10 V 2: Reverse output 5–0 V; forward output 5–10 V	0		



Selections for the analog output direction

		Type	Hex Addr	Dec Addr
P14.18	***Extension Card (AI10) Input Selection***	♦R/W	0E12	43603
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: 0–10 V 1: 0–20 mA 2: 4–20 mA	0		

When you change the input mode, verify that the switch position of external terminal (AI10) is correct.

		Type	Hex Addr	Dec Addr
P14.19	***Extension Card (AI11) Input Selection***	♦R/W	0E13	43604
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: 0–10 V 1: 0–20 mA 2: 4–20 mA	0		

When you change the input mode, verify that the switch position of external terminal (AI11) is correct.

		Type	Hex Addr	Dec Addr
P14.20	***AO10 DC Output Setting Level***	♦R/W	0E14	43605
P14.21	***AO11 DC Output Setting Level***	♦R/W	0E15	43606
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.0%	0.00		

		Type	Hex Addr	Dec Addr
P14.22	***AO10 Filter Output Time***	♦R/W	0E16	43607
P14.23	***AO11 Filter Output TIme***	♦R/W	0E17	43608
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–20.00 seconds	0.01		

		Type	Hex Addr	Dec Addr
P14.24	***AI10 Extension Card Lowest Point***	♦R/W	0E18	43609
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P14.18=0, 0.00–10.00 V P14.18≠0, 0.00–20.00 mA or 4–20 mA	0.00		

NOTE: : Parameters P14.24 through P14.29 require P03.50=1 or 3.

		Type	Hex Addr	Dec Addr
P14.25	***AI10 Extension Card Proportional Lowest Point***	♦R/W	0E19	43610
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00%	0.00		

		Type	Hex Addr	Dec Addr
P14.26	***AI10 Extension Card Mid-point***	♦R/W	0E1A	43611
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P14.18=0, 0.00–10.00 V P14.18≠0, 0.00–20.00 mA or 4–20 mA	5.00		

		Type	Hex Addr	Dec Addr
P14.27	***AI10 Extension Card Proportional Mid-point***	♦R/W	0E1B	43612
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00%	50.00		

		Type	Hex Addr	Dec Addr
P14.28	***AI10 Extension Card Highest Point***	♦R/W	0E1C	43613
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P14.18=0, 0.00–10.00 V P14.18≠0, 0.00–20.00 mA or 4–20 mA	10.00		

		Type	Hex Addr	Dec Addr
P14.29	***AI10 Extension Card Proportional Highest Point***	♦R/W	0E1D	43614
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–100.00%	100.00		

When P14.18 = 0, the voltage type is 0–10 V analog input and the unit is in voltage (V). When P14.18≠0, the current type is 0–20 mA or 4–20 mA and the unit is in current (mA).

When you set the analog input AI10 to the Frequency command, 100% corresponds to Fmax (P01.00 Maximum Operation Frequency).

The requirement for these three parameters (P14.24, P14.26 and P14.28) is P14.24 < P14.26 < P14.28. The corresponding percentage is unlimited. There is a linear calculation between two points.

The output % becomes 0% when the AI10 input value is lower than lowest point setting.

Example:

If P14.24 = 2mA and P14.25 = 10%, then the output becomes 0% when the value is ≤ 2mA. If the AI10 input swings between 2mA and 2.1 mA, the drive's output frequency oscillates between 0% and 10%.

		Type	Hex Addr	Dec Addr
P14.30	***AI11 Extension Card Lowest Point***	♦R/W	0E1E	43615
	Range/Units (Format: 16-bit unsigned)	Default		
	P14.19=0, 0.00–10.00 V P14.19≠0, 0.00–20.00 mA or 4–20 mA	0.00		

NOTE: : Parameters P14.30 through P14.35 require P03.50=2 or 3.

		Type	Hex Addr	Dec Addr
P14.31	***AI11 Extension Card Proportional Lowest Point***	♦R/W	0E1F	43616
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–100.00%	0.00		

		Type	Hex Addr	Dec Addr
P14.32	***AI11 Extension Card Mid-point***	♦R/W	0E20	43617
	Range/Units (Format: 16-bit unsigned)	Default		
	P14.19=0, 0.00–10.00 V P14.19≠0, 0.00–20.00 mA or 4–20 mA	5.00		

		Type	Hex Addr	Dec Addr
P14.33	***AI11 Extension Card Proportional Mid-point***	♦R/W	0E21	43618
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00–100.00%	50.00		

		Type	Hex Addr	Dec Addr
P14.34	***AI11 Extension Card Highest Point***	♦R/W	0E22	43619
	Range/Units (Format: 16-bit unsigned)	Default		
	P14.19=0, 0.00–10.00 V P14.19≠0, 0.00–20.00 mA or 4–20 mA	10.00		

		Type	Hex Addr	Dec Addr
P14.35	***AI11 Extension Card Proportional Highest Point***	♦R/W	0E23	43620
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–100.00%	100.00		

When P14.19 = 0, the voltage type is 0–10 V analog input and the unit is in voltage (V). When P14.19 ≠ 0, the current type is 0–20 mA or 4–20 mA and the unit is in current (mA).

When you set the analog input AI11 to the Frequency command, 100% corresponds to Fmax (P01.00 Maximum Operation Frequency).

The requirement for these three parameters (P14.30, P14.32 and P14.34) is P14.30 < P14.32 < P14.34. The corresponding percentage is unlimited. There is a linear calculation between two points.

The output % becomes 0% when the AI11 input value is lower than lowest point setting.

For example:

If P14.30 = 2 mA and P14.31 = 10%, then the output becomes 0% when the value is ≤ 2mA. If the AI11 input swings between 2mA and 2.1 mA, the drive's output frequency oscillates between 0% and 10%.

		Type	Hex Addr	Dec Addr
P14.36	***AO10 Terminal Analog Signal Mode***	♦R/W	0E24	43621
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Analog voltage signal 0.00–10.00 V 1: Analog current signal 0.0–20.0 mA 2: Analog current signal 4.0–20.0 mA	0		

		Type	Hex Addr	Dec Addr
P14.37	***AO11 Terminal Analog Signal Mode***	♦R/W	0E25	43622
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Analog voltage signal 0.00–10.00 V 1: Analog current signal 0.0–20.0 mA 2: Analog current signal 4.0–20.0 mA	0		

		Type	Hex Addr	Dec Addr
P14.50	***Output Frequency at Malfunction 2***	Read	0E32	43635
P14.54	***Output Frequency at Malfunction 3***	Read	0E36	43639
P14.58	***Output Frequency at Malfunction 4***	Read	0E3A	43643
P14.62	***Output Frequency at Malfunction 5***	Read	0E3E	43647
P15.66	***Output Frequency at Malfunction 6***	Read	0E42	43651
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–599.00 Hz	0		

When an error occurs, you can check the output frequency for the malfunction. If the error happens again, this parameter overwrites the previous record.

		Type	Hex Addr	Dec Addr
P14.51	***DC bus Voltage at Malfunction 2***	Read	0E33	43636
P14.55	***DC bus Voltage at Malfunction 3***	Read	0E37	43640
P14.59	***DC bus Voltage at Malfunction 4***	Read	0E3B	43644
P14.63	***DC bus Voltage at Malfunction 5***	Read	0E3F	43648
P14.67	***DC bus Voltage at Malfunction 6***	Read	0E43	43652
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0–6553.5 V	0		

When an error occurs, you can check the DC bus voltage for the malfunction. If the error happens again, this parameter overwrites the previous record.

		Type	Hex Addr	Dec Addr
P14.52	***Output Current at Malfunction 2***	Read	0E34	43637
P14.56	***Output Current at Malfunction 3***	Read	0E38	43641
P14.60	***Output Current at Malfunction 4***	Read	0E3C	43645
P14.64	***Output Current at Malfunction 5***	Read	0E40	43649
P14.68	***Output Current at Malfunction 6***	Read	0E44	43653
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00–655.35 Amps	0		

When an error occurs, you can check the output current for the malfunction. If the error happens again, this parameter overwrites the previous record.

		Type	Hex Addr	Dec Addr
P14.53	***IGBT Temperature at Malfunction 2***	Read	0E35	43638
P14.57	***IGBT Temperature at Malfunction 3***	Read	0E39	43642
P14.61	***IGBT Temperature at Malfunction 4***	Read	0E3D	43646
P14.65	***IGBT Temperature at Malfunction 5***	Read	0E41	43650
P14.69	***IGBT Temperature at Malfunction 6***	Read	0E45	43654
	Range/Units (Format: 16-bit signed)	*Default*		
	-3276.7–3276.7 °C	0		

When an error occurs, you can check the IGBT temperature for the malfunction. If the error happens again, this parameter overwrites the previous record.

		Type	Hex Addr	Dec Addr
P14.70	**Fault Record 7**	Read	0E46	43655
P14.71	**Fault Record 8**	Read	0E47	43656
P14.72	**Fault Record 9**	Read	0E48	43657
P14.73	**Fault Record 10**	Read	0E49	43658

Range/Units (Format: 16-bit unsigned) — *Default*

Settings — Default: 0

0: No fault record
1: Over-current during acceleration (ocA)
2: Over-current during deceleration (ocd)
3: Over-current during steady operation (ocn)
4: Ground fault (GFF)
6: Over-current at STOP (ocS)
7: Over-voltage during acceleration (ovA)
8: Over-voltage during deceleration (ovd)
9: Over-voltage during constant speed (ovn)
10: Over-voltage at stop (ovS)
11: Low-voltage during acceleration (LvA)
12: Low-voltage during deceleration (Lvd)
13: Low-voltage during constant speed (Lvn)
14: Low-voltage at stop (LvS)
15: Phase loss protection (orP)
16: IGBT overheating (oH1)
18: IGBT temperature detection failure (tH1o)
21: Over load (oL)
22: Electronics thermal relay 1 protection (EoL1)
23: Electronics thermal relay 2 protection (EoL2)
24: Motor PTC overheating (oH3)
26: Over-torque 1 (ot1)
27: Over-torque 2 (ot2)
28: Under current (uC)
31: EEPROM read error (cF2)
33: U-phase error (cd1)
34: V-phase error (cd2)
35: W-phase error (cd3)
36: cc (current clamp) hardware error (Hd0)
37: oc (over-current) hardware error (Hd1)
40: Auto-tuning error (AUE)
41: PID loss AI2 (AFE)
43: Encoder feedback loss (PGF2)
44: Encoder feedback stall (PGF3)
45: Encoder slip error (PGF4)
48: AI2 loss (ACE)
49: External fault (EF)
50: Emergency stop (EF1)
51: External Base Block (bb)
52: Password is locked (Pcod)
54: Illegal command (CE1)
55: Illegal data address (CE2)
56: Illegal data value (CE3)
57: Data is written to read-only address (CE4)
58: Modbus transmission time-out (CE10)
61: Y-connection / Δ-connection switch error (ydc)

62: Deceleration energy backup error (dEb)
63: Over slip error (oSL)
72: STO Loss (STL1)
76: STO (STo)
77: STO Loss 2 (STL2)
78: STO Loss 3 (STL3)
79: U-phase over-current before run (Aoc)
80: V-phase over-current before run (boc)
81: W-phase over-current before run (coc)
82: Output phase loss U phase (oPL1)
83: Output phase loss V phase (oPL2)
84: Output phase loss W phase (oPL3)
87: Low frequency overload protection (oL3)
89: Rotor position detection error (roPd)
97: Ethernet Card Timeout (CD10)
111: InrCOM time-out error (ictE)
121: Internal communication error (CP20)
123: Internal communication error (CP22)
124: Internal communication error (CP30)
126: Internal communication error (CP32)
127: Internal communication error (CP33)
128: Over-torque 3 (ot3)
129: Over-torque 4 (ot4)
134: Internal communication error (EoL3)
135: Internal communication error (EoL4)
140: Oc hardware error (Hd6)
141: GFF occurs before run (b4GFF)
142: Auto-tune error 1 (DC test stage) (AuE1)
143: Auto-tune error 2 (High frequency test stage) (AuE2)
144: Auto-tune error 3 (Rotary test stage) (AuE3)
149: Auto-tune error 5 (Rotor resistance measure test stage) (AuE5)

The parameters record when the fault occurs and forces a stop.

- *When low-voltage at stop fault (LvS) occurs, the fault is not recorded. When low-voltage during operation faults (LvA, Lvd, Lvn) occur, the faults are recorded.*
- *When the dEb function is valid and enabled, the drive executes dEb and records fault code 62 to P06.17–P06.22 and P14.70–P14.73 simultaneously.*

		Type	Hex Addr	Dec Addr
P14.74	**Over-torque Detection Selection (Motor 3)**	♦R/W	0E4A	43659
P14.77	**Over-torque Detection Selection (Motor 4)**	♦R/W	0E4D	43662
	Range/Units (Format: 16-bit binary)	*Default*		
	0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	0		

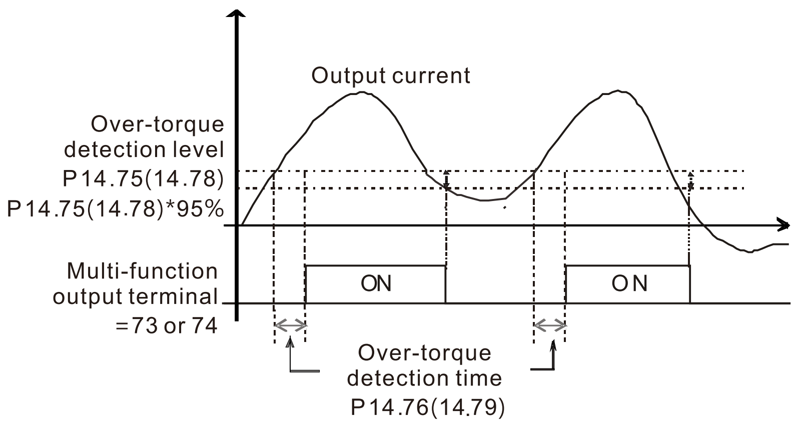
When you set P14.74 and P14.77 to 1 or 3, a warning message displays but there is no error record.
When you set P14.74 and P14.77 to 2 or 4, an error message displays and there is an error record.

		Type	Hex Addr	Dec Addr
P14.75	***Over-torque Detection Level (Motor 3)***	♦R/W	0E4B	43660
P14.78	***Over-torque Detection Level (Motor 4)***	♦R/W	0E4E	43663
	Range/Units (Format: 16-bit unsigned)	*Default*		
	10–250% (100% corresponds to the rated current of the drive)	120		

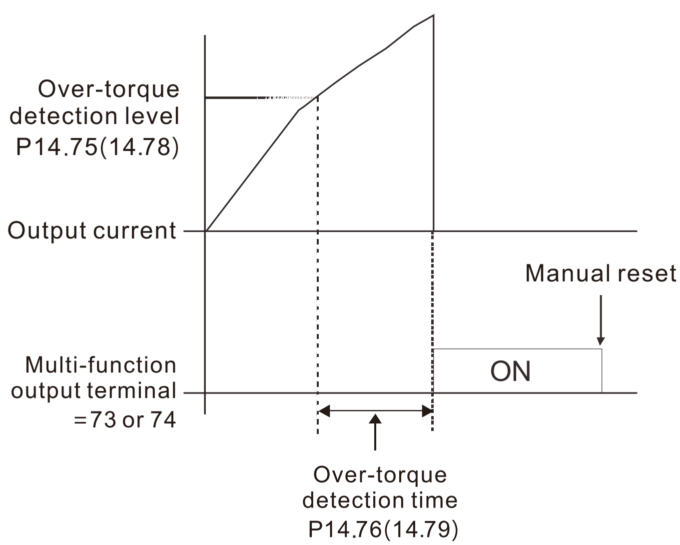
		Type	Hex Addr	Dec Addr
P14.76	***Over-torque Detection Time (Motor 3)***	♦R/W	0E4C	43661
P14.79	***Over-torque Detection Time (Motor 4)***	♦R/W	0E4F	43664
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.1–60.0 sec.	0.1		

When the output current exceeds the over-torque detection level (P14.75 or P14.78) and also exceeds the over-torque detection time (P14.76 or P14.79), the over-torque detection follows the setting of P14.74 or P14.77.

When you set P14.74 or P14.77 to 1 or 3, an ot3/ot4 warning displays while the drive keeps running after over-torque detection. The warning remains on until the output current is smaller than 5% of the over-torque detection level.



When you set P14.74 or P14.77 to 2 or 4, an ot3/ot4 warning displays and the drive stops running after over-torque detection. The drive does not run until you manually reset it.



		Type	Hex Addr	Dec Addr
P14.80	***Electronic Thermal Relay Selection 3 (Motor 3)***	♦R/W	0E50	43665
P14.82	***Electronic Thermal Relay Selection 4 (Motor 4)***	♦R/W	0E52	43667

Range/Units (Format: 16-bit binary) — *Default*: 1

0: Inverter motor (with external forced cooling)
1: Standard motor (motor with the fan on the shaft)
2: Disable

These parameters prevent self-cooled motors from overheating under low speed. Use an electronic thermal relay to limit the drive's output power.

- *Setting the parameter to 0 is suitable for an inverter motor (motor fan using an independent power supply). For this kind of motor, there is no significant correlation between cooling capacity and motor speed. Therefore, the action of electronic thermal relays remains stable in low speed to ensure the load capability of the motor in low speed.*
- *Setting the parameter to 1 is suitable for standard motor (motor fan is fixed on the rotor shaft). For this kind of motor, the cooling capacity is lower in low speed; therefore, the action of an electronic thermal relay reduces the action time to ensure the life of motor.*

When the power is cycled frequently, if the power is switched OFF, the electronic thermal relay protection is reset; therefore, even setting the parameter to 0 or 1 may not protect the motor well. If there are several motors connected to one drive, install an electronic thermal relay in each motor.

		Type	Hex Addr	Dec Addr
P14.81	***Electronic Thermal Relay Action Time 3 (Motor 3)***	♦R/W	0E51	43666
P14.83	***Electronic Thermal Relay Action Time 4 (Motor 4)***	♦R/W	0E53	43668

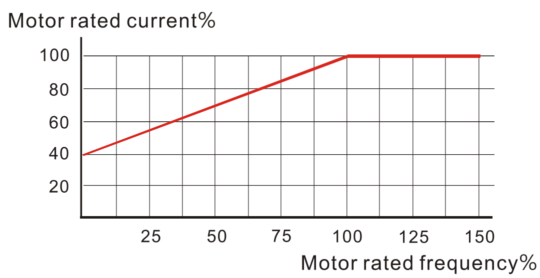
Range/Units (Format: 16-bit unsigned) — *Default*: 60.0

30.0–600.0 sec.

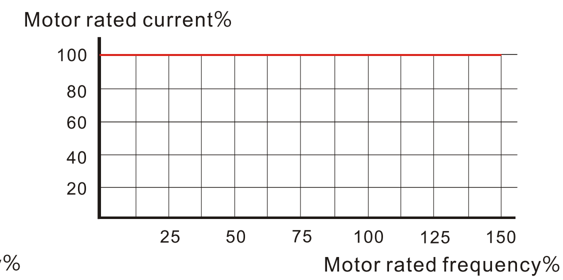
The electronic thermal relay amperage threshold is based on 150% of the parameter value in "Full Load Current for Induction Motor X" (P05.64 for motor 1, P05.70 for motor 2).

Set Parameter P14.81 or P14.83 for the amount of time the motor exceeds this threshold. Proper setup will prevent motor damage due to overheating. When it reaches the setting, the drive displays "EoL3 / EoL4", and the motor coasts to stop.

Use this parameter to set the action time of the electronic thermal relay. It works based on the I2t characteristic curve of electronic thermal relay, the output frequency and current of the drive, and the operation time to prevent the motor from overheating.



Motor cooling curve with shaft-fixed fan



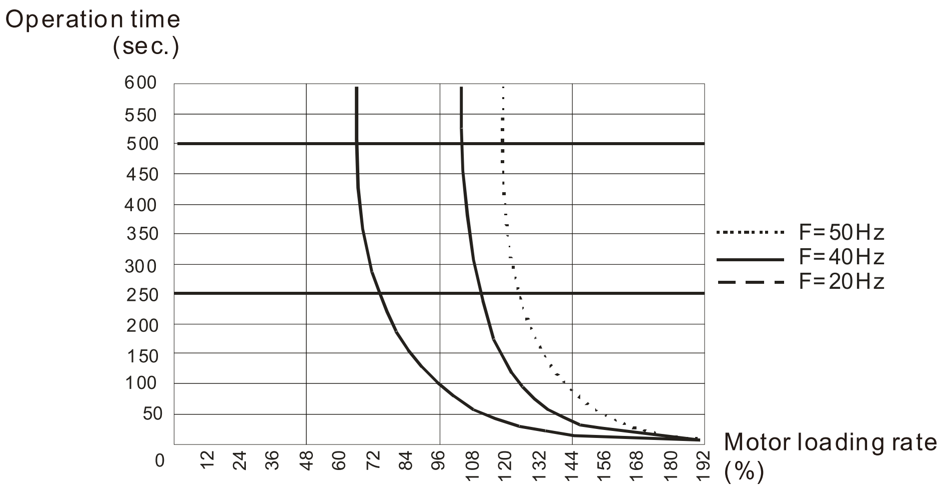
Motor cooling curve with independent fan

The action of the electronic thermal relay depends on the settings for P14.80 and P14.82:

1) P14.80 or P14.82 is set to 0 (using inverter motor):
When the output current of the drive is higher than 150% of the motor rated current (refer to the motor rated current % corresponded to the motor rated frequency in the motor cooling curve with independent fan), the drive starts to count the time. The electronic thermal relay acts when the accumulated time exceeds P14.81 or P14.83.

2) P14.80 or P14.82 is set to 1 (using standard motor):
   When the output current of the drive is higher than 150% of the motor rated current (refer to the motor rated current % corresponded to the motor rated frequency in the motor cooling curve with shaft-fixed fan), the drive starts to count the time. The electronic thermal relay acts when the accumulated time exceeds P14.81 or P14.83.

The actual electronic thermal relay action time adjusts according to the drive output current (shown as the motor loading rate %). The action time is short when the current is high, and the action time is long when the current is low. Refer to the following diagram.



Adjustments and Applications

This section provides step-by-step information on how to optimize the advanced speed and torque control modes of the GS30 drive. These setup guides are not used for the basic speed control modes of V/F and IMVFPG (P00.11=0 or 1). These procedures are not required for advanced speed control, but will ensure your drive and motor perform at the highest level.

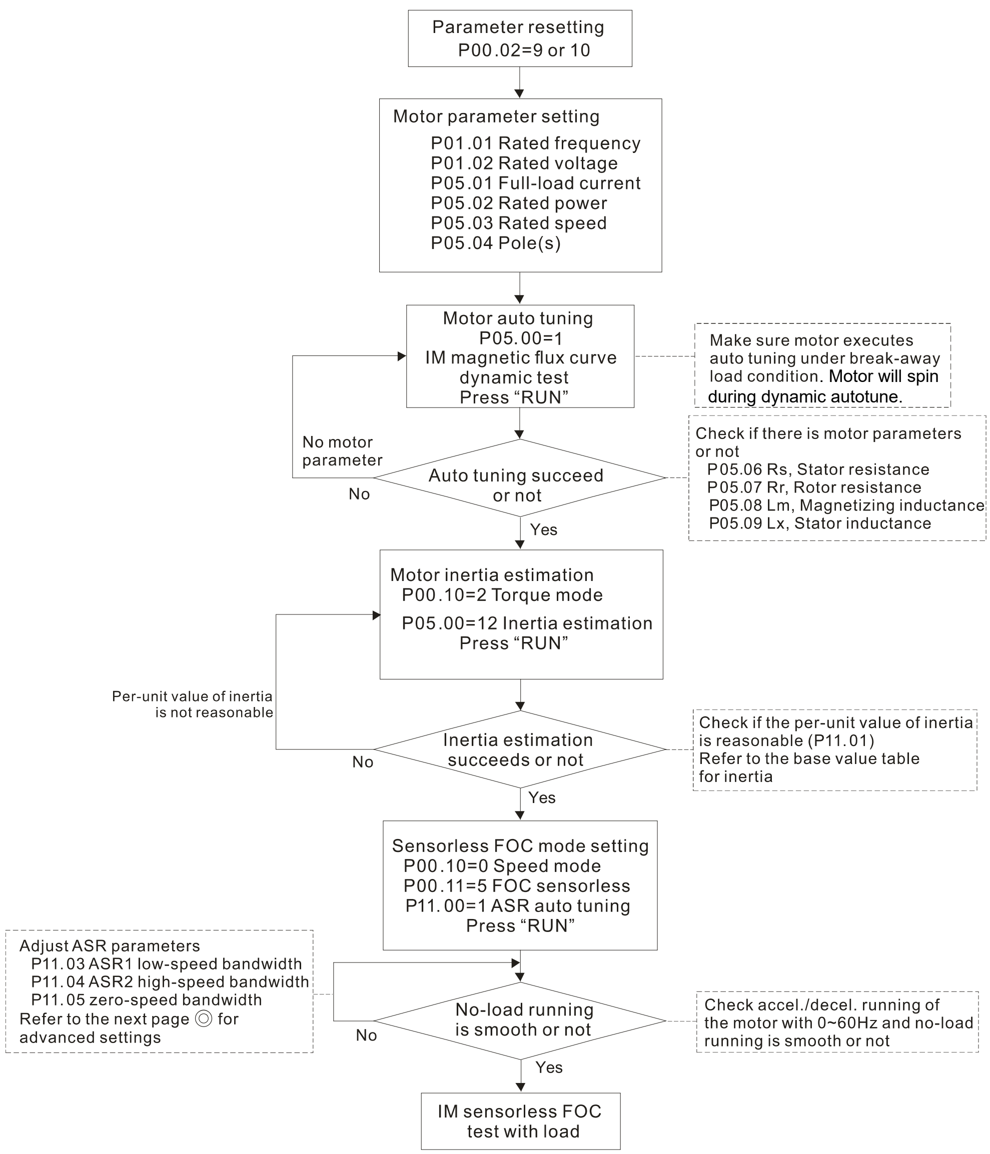
The following adjustment procedures can be found in this section:

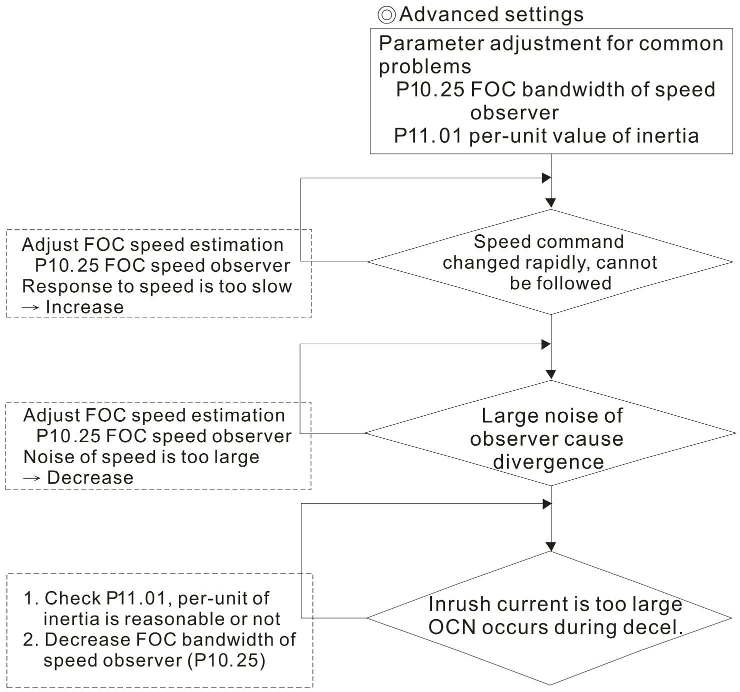
1) IMFOC field oriented control mode with induction motor (P00.11=5)
2) IMTQC sensorless torque mode with induction motor (P00.13=2)
3) PMSVC sensorless vector mode with permanent magnet motor (P00.11=2)
4) PMFOCPG - Field-Oriented Control with PMAC motor with encoder (P00.11=4)
5) IPM SVC Sensorless Field-Oriented Control with interior PMAC motor (P00.11=7)

IMFOC Field oriented control Mode with Induction Motor (IM) Adjustment Procedure

When P00.10=0, P00.11=5.

Flow Chart





FOC control diagram

Please see the function block diagrams under P00.11 on page 4–68.

Adjustment Procedure

1) Parameter reset to default, P00.02=10 or 9
(To avoid other parameters that are not related affecting the motor control).
2) Set up the following motor parameters according to the nameplate on the motor:
   - *P01.01, Output Frequency of Motor 1*
   - *P01.02, Output Voltage of Motor 1*
   - *P05.01, Full-load Current for Indunction Motor 1*
   - *P05.02, Rated Power for Induction Motor 1*
   - *P05.03, Rated Speed for Induction Motor 1*
   - *P05.04, Number of Poles for Induction Motor 1*
3) Press RUN to start auto-tuning of IM magnetic flux curve dynamic test for P05.00=1 or 6 (motor is running). Make sure the motor executes auto-tuning under break-away load condition, motor will spin during dynamic autotune. Check if there are motor parameters after auto-tuning.
   - *P05.06, Stator Resistance (Rs) for Induction Motor 1*
   - *P05.07, Rotor Resistance (Rr) for Induction Motor 1*
   - *P05.08, Magnetizing Inductance (Lm) for Induction Motor 1*
   - *P05.09, Stator Inductance (Lx) for Induction Motor 1*
4) Execute estimation of the motor inertia (optional). Press "RUN" to start the estimation after finishing the settings for the parameters mentioned below.
   - *P00.10=2: Torque mode*
   - *P05.00=12: FOC sensorless inertia estimation (motor is running)*

   After inertia estimation is finished, check if the estimated value for P11.01 is reasonable, refer to the base value table below (unit = kg•cm2):

Power	Setting
1HP	2.3
2HP	4.3
3HP	8.3
5HP	14.8
7.5HP	26.0
10HP	35.8
12HP	54.8
15HP	74.3
20HP	95.3

Power	Setting
25HP	142.8
30HP	176.5
40HP	202.5
50HP	355.5
60HP	410.8
75HP	494.8
100HP	1056.5
125HP	1275.3
150HP	1900.0

Power	Setting
175HP	2150.0
250HP	2800.0
300HP	3550.0
375HP	5139.0
425HP	5981.0
475HP	7053.0
600HP	9643.0
650HP	10734.0
750HP	13000.0

5) Execute IM sensorless FOC mode and set up the following parameters:
   - *P00.10=0, set as speed mode*
   - *P00.11=5, set as FOC sensorless mode*
   - *P11.00 bit0=1, use ASR gain auto-tuning*

   Press RUN and start the test with no load. Accelerate the motor to the rated speed, then decelerate to stop and check if the motor runs smoothly.

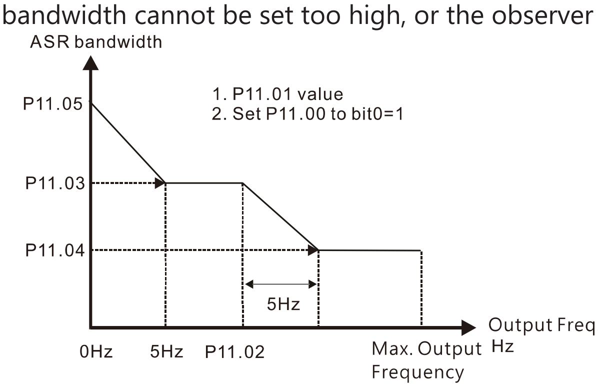
   a) If the motor runs smoothly, then the setting for IM Sensorless FOC is complete.

   b) If the motor does not run smoothly, or fails to start at low frequency, refer to the following steps for adjustment.

6) Select auto-tuning gain (P11.00 bit0=1) and adjust ASR parameters according to the speed response.
   - *P11.00 bit0=1, use auto-tuning for ASR.*
   - *P11.03, ASR1 low-speed bandwidth. When the acceleration of low-speed cannot follow the acceleration command, increase the low-speed bandwidth.*
   - *P11.04, ASR2 high-speed bandwidth. When the acceleration in high speed causes vibration or cannot follow the acceleration command, increase high-speed bandwidth.*
   - *P11.05, Zero-speed bandwidth. If the response of start-up is slow or incapable, increase zero-speed bandwidth.*

   The bigger the setting value for ASR bandwidth, the faster the response.

   The low speed bandwidth cannot be set too high, or the observer will diverge.



ASR adjustment- auto gain

7) Adjust the setting of FOC speed observer and per-unit value of inertia (common problems).

   a) P10.25: Set up FOC bandwidth of speed observer.
   - *Situation 1: Speed command changes rapidly, but speed response cannot follow. Speed response is too slow, increase the setting value.*
   - *Situation 2: The noise of the observer is too large, and causes the operation to diverge. Speed noise is too large, decrease the setting value.*

   b) P11.01: Set up per unit of system inertia.

- *Situation 1: The inrush current is too high at startup and causes an oc error.*
- *Situation 2: An ocn error occurs during RUN or STOP and the motor runs randomly.*
  - *Check P11.01 and determine whether the JM per-unit of system inertia is too large.*
  - *Decrease P10.25 FOC bandwidth for speed observer, or P11.05 zero-speed bandwidth.*

IMTQC Sensorless Torque Mode with Induction Motor (IM) Adjustment Procedure

When P00.10=2, P00.13=2.

Adjustment Procedure

1) Set P00.02=9 (50Hz) or 10 (60Hz) to go back to factory setting.
2) Set the following parameters based on the nameplate values of the IM motor you are using:
   - *P01.00, Induction Motor Max Frequency (Hz)*
   - *P01.01, Induction Motor Rated Frequency (Hz)*
   - *P01.02, Induction Motor Rated Voltage (V)*
   - *P05.01, Induction Motor Rated Current (A)*
   - *P05.02, Induction Motor Rated Power (kW)*
   - *P05.03, Induction Motor Rated Speed (RPM)*
   - *P05.04, Induction Motor Pole Numbers*
3) Set P05.00=1, named IM flux curve dynamic tuning and press the RUN key to get parameters P05.05 to P05.09 and weak flux parameters for sensorless.
   Please note that the motor will run in P05.00=1: Auto-tuning method.
4) Check the following parameters after IM flux curve dynamic tuning:
   - *P05.05, IM No-load Current*
   - *P05.06, IM Stator Resistance*
   - *P05.07, IM Rotor Resistance*
   - *P05.08, IM Lm*
   - *P05.09, IM Lx*
5) Set P05.00=12 to begin IM motor inertia auto-tuning.
   - *Set P00.10=2, Torque mode*
   - *Set P05.00=12, press RUN key to operate inertia estimation.*
   - *Repeat to set P05.00=12 for operating inertia estimation until P11.01 is stable.*
6) Enable automatic ASR bandwidth adjustment.
   - *Set P11.00=1 to enable automatic ASR bandwidth adjustment. This allows P11.03 to P11.05 to make real ASR PI changes automatically based on the situation. This is more flexible for practical commissioning.*
   - *If P11.00=0, ASR bandwidth is not automatically adjusted and only P11.06 to P11.11 will be enabled. The ASR bandwidth will not adjust while running.*
7) The following additional parameters may help fine tune the performance of your motor – adjust as needed:
   - *P10.24, bit0, ASR control at TQC sensorless*
   - *P10.24, bit11, DC brake when executing zero torque command*
   - *P10.24, bit15, Direction limitation at TQC sensorless*
   - *P10.25, FOC bandwidth of speed observer (Hz). Setting this value higher can decrease the speed response time, but will creat emore noise interference.*
   - *P10.26, FOC minimum stator frequency. Set the minimum stator frequency in case the frequency command or limitation is too low.*
   - *P10.27, FOC low-pass filter time constance (ms). If the motor can't be activated during high-speed operation, decrease the value of P10.27.*
   - *P10.28, FOC gain of excitation current rise time (ms). If the drive's action time is too long in torque mode, decrease the value of P10.28.*
   - *P11.33, Source of torque command.*
   - *P11.34, Torque command.*
   - *P11.36, Speed limit selection.*

TQC Sensorless Mode FAQ

1) Q: Can we use GS30 TQC sensorless mode to work smoothly in any situation?

   A: It is dependent on load. GS30 TQC sensorless works smoothly at 3Hz and 10% torque, the minimum requirements. However, with a light load the GS30 can work smoothly even below 3Hz.

2) Q: What is the essence of the P10.26 function?

   A: P10.26 is for minimum stator frequency. So if P10.26=10 and P01.00=50Hz, the minimum stator frequency is P01.00 x P10.26 / 100 = 5Hz. When your frequency limitation is less than 5Hz, the output frequency will be at least 5Hz. Do not set P10.26 too high or too low as drive internal calculations have one stable range for successful operation. Typically it's best to use the default settings for P10.26 through P10.28.

3) Q: Why does the motor run when the speed limit is zero and the torque command is not zero?

   A: GS30 TQC sensorless can't calculate accurately when the motor is working at very low speed. If the speed lmit is zero, the motor will still run at about 3Hz due to internal drive calculations. Set P01.34=1 to use DC brake mode and the motor will be held when the speed limit is zero and torque command is not zero. However, the motor will run if the speed limit is above 3Hz to ensure smooth operation.

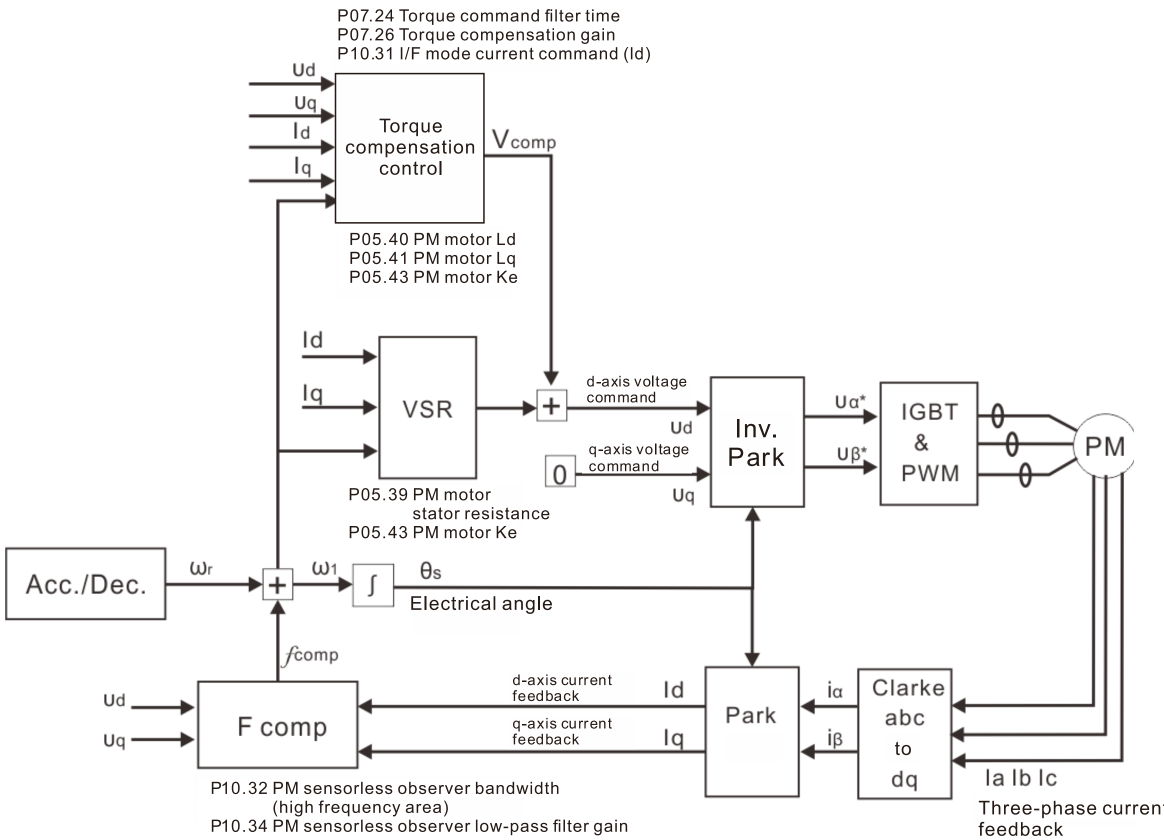
4) Q: How do I use the DC brake function when the torque command is zero?

   A: When the torque command is zero, the motor should not output torque. However, in some special applications, even if the torque command is zero the motor needs to output zero speed torque to avoid load falling. In these instances, we can set bit11 of P10.24=0 (default) to enable the DC brake when the torque command is zero, but DC brake torque size is fixed by firmware and can't be adjusted. If bit11 of P10.24=1, no DC output will occur when torque command is zero and the GS30 will output one frequency based on P10.26.

PMSVC Sensorless Vector mode with permanent magnet motor adjustment procedure

When P00.11 Speed Control Mode = 2 SVC (P05.33 = 1 or 2)

PMSVC control diagram



NOTE: In the diagram, "PM motor" means "permanent magnet synchronous AC motor".

NOTE: Once PMSVC adjustment procedure is complete, cycle power to the GS30 drive.

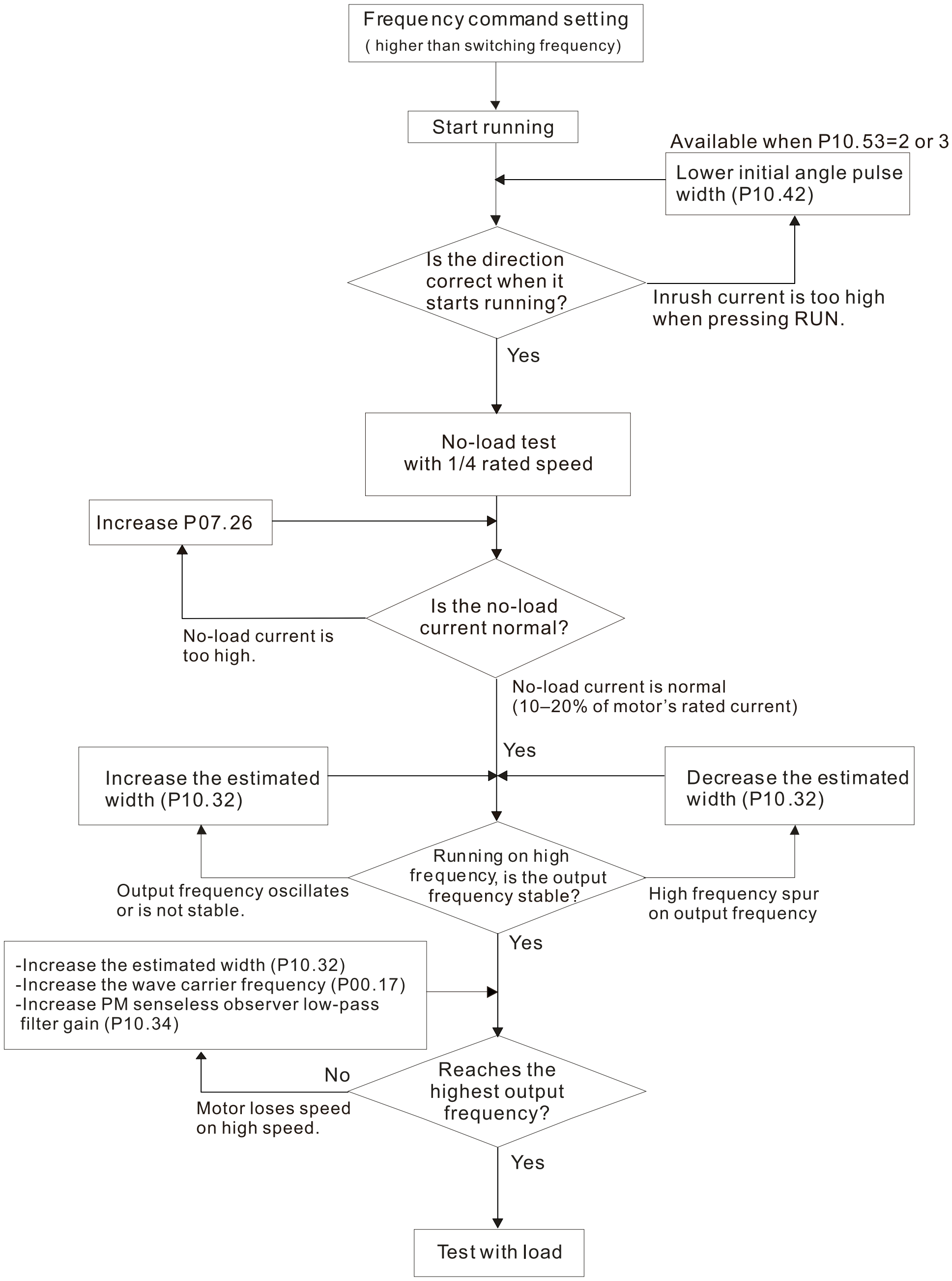
Adjustment procedure

1) Select PM synchronous AC motor control.
   P05.33 Induction Motor (IM) or Permanent Magnet (PM) Synchronous AC Motor Selection =1 (SPM) or 2 (IPM)
2) Set up motor parameters according to the motor's nameplate.
   - *P01.01: Rated frequency*
   - *P01.02: Rated voltage*
   - *P05.34: Rated current*
   - *P05.35: Rated Power*
   - *P05.36: Rated speed*
   - *P05.37: Number of poles for the motor*
3) Execute PM synchronous AC motor auto-tuning (static).
   a) Set P05.00 Motor Parameter Auto-tuning =13 (High frequency stall test for PM synchronous AC motor) and press RUN.

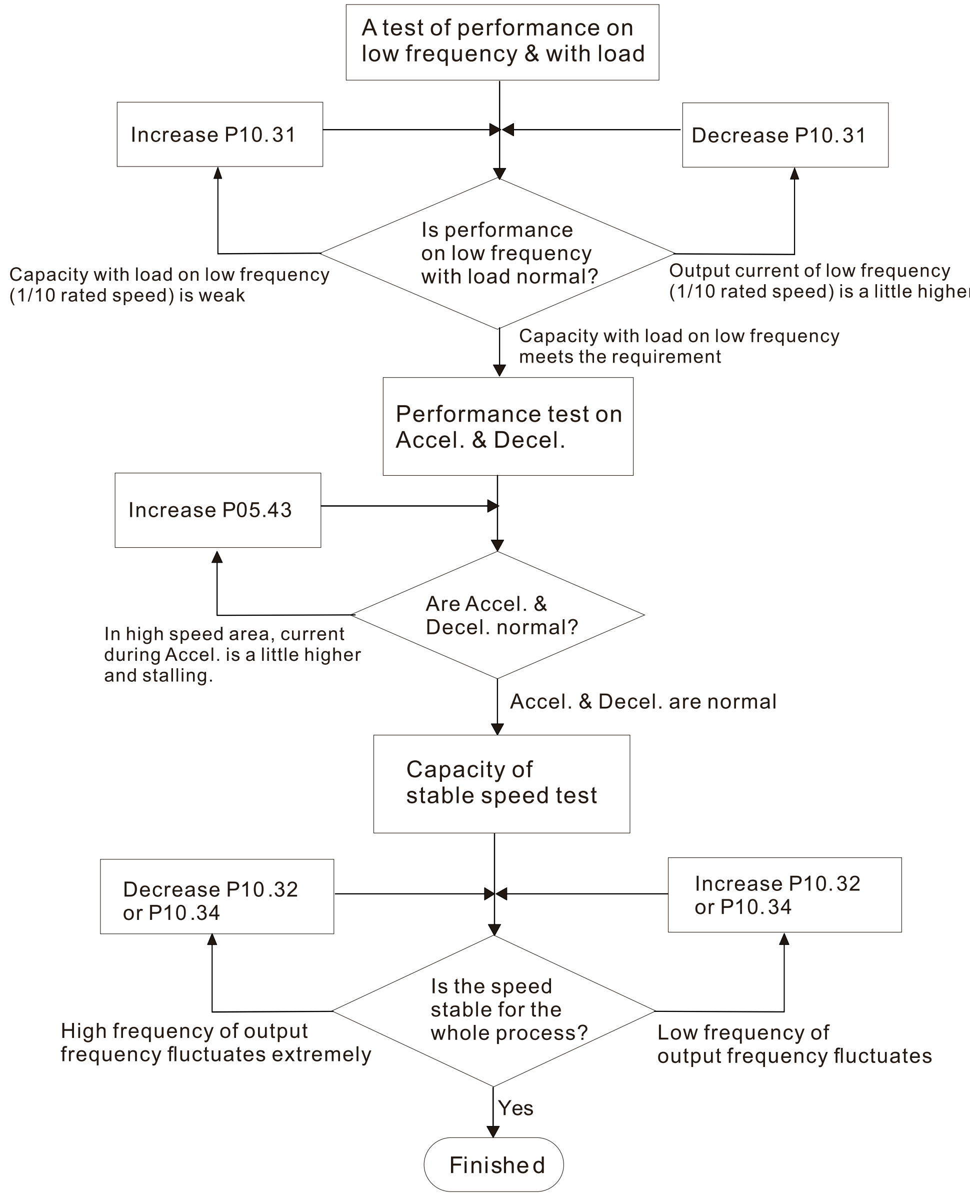
b) When you finish tuning, the following parameters are available:
- *P05.39: Stator resistance*
- *P05.40: Permanent magnet synchronous AC motor Ld*
- *P05.41: Permanent magnet synchronous AC motor lq*
- *P05.43: (V / 1000 rpm), the Ke parameter of PM synchronous AC motor (you can calculate this automatically according to power, current, and speed of the motor).*

4) Set the speed control mode: P00.10 Control Mode = 0, P00.11 Speed Control Mode = 2 SVC.
5) Cycle the power after you finish tuning.
6) The ratio of the PMSVC control mode is 1:20.
7) When the PMSVC control mode is under 1/20th of the rated speed, the load bearing capacity is 100% of the motor rated torque.
8) PMSVC control mode is not applicable to zero speed control.
9) The start-up load and the load bearing capacity of the forward/reverse running in PMSVC control mode equal to 100% of the motor rated torque.

10) Adjustment flow chart when starting WITHOUT load:



11) Adjustment flow chart when starting WITH load:



12) Set up the related parameters for speed estimators.

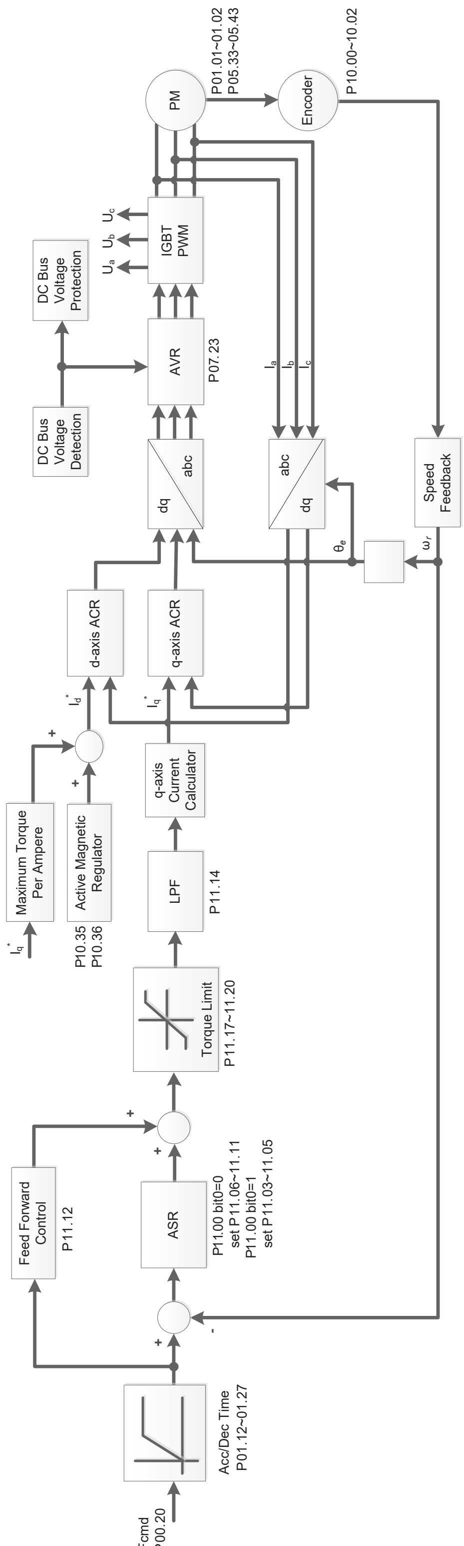
- *P10.31, I/F Mode, Current Command*
- *P10.32, PM FOC Sensorless Speed Estimator Bandwidth*
- *P10.34, PM Sensorless Speed Estimator Low-pass Filter Gain*
- *P10.39, Frequency Point to Switch from I/F Mode to PM Sensorless Mode*
- *P10.42, Initial Angle Detection Pulse Value*
- *P10.49, Zero Voltage Time during Start-up*
- *P10.51, Injection Frequency*
- *P10.52, Injection Magnitude*
- *P10.53, Angle Detection Method*
- *P07.26, Torque Compensation Gain*

13) After PMSVC setup is complete, cycle power to the GS30 drive.

PMFOCPG - Field-Oriented Control with PMAC motor with encoder

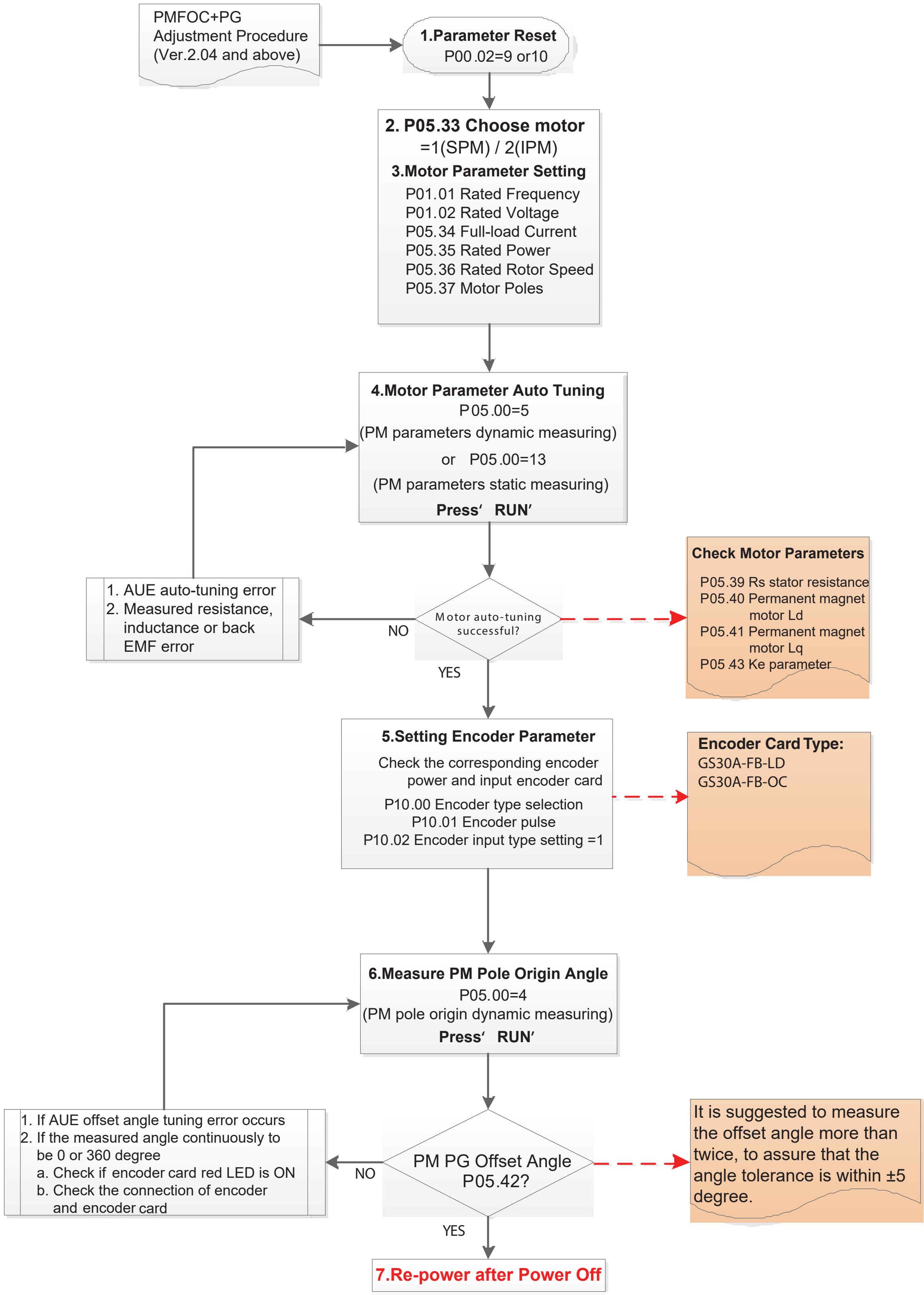
When P00.11=4.

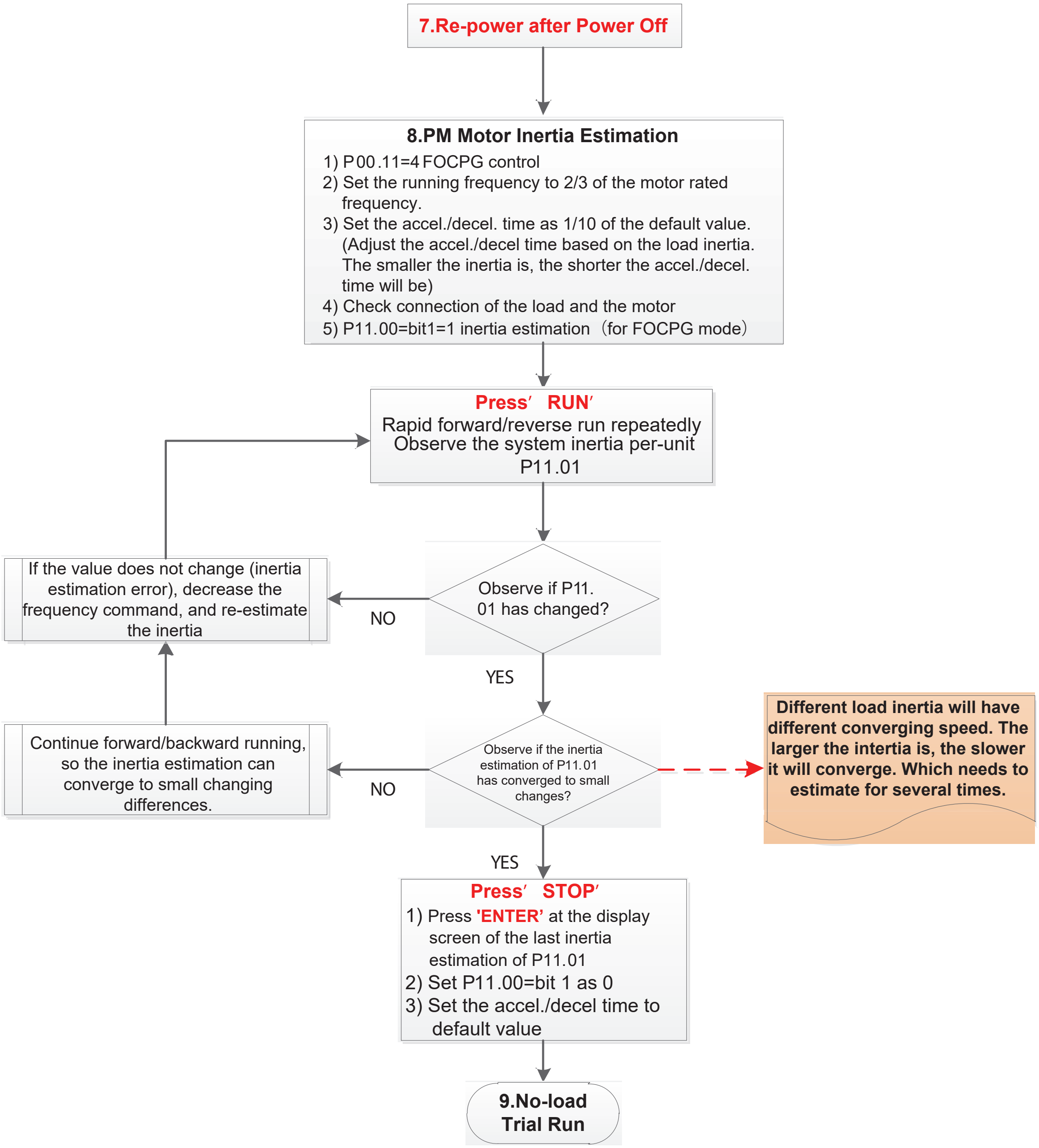
PMFOCPG Control Diagram



Adjustment Procedure

The number marked on the flowchart corresponds to the step number of the procedure.





1) Parameter reset:
   Reset P00.02=9 (50Hz) or 10 (60Hz) to the default value.
2) Select IPM motor type:
   P05.33=1 (SPM) or 2 (IPM)
3) Motor nameplate parameter setting:

Parameter	***Description***
P01.01	Rated frequency (Hz)
P01.02	Rated voltage (VAC)
P05.34	Rated current (A)
P05.35	Rated power (kW)
P05.36	Rated rotor speed (rpm)
P05.37	Number of poles for the motor (poles)

4) PM parameter auto-tuning:
Set P05.00=5 (rolling auto-tuning for PM, with no load) or 13 (static auto-tuning for PM) and press the RUN key to finish motor auto-tuning. You will get the following parameters:

Parameter	**Description**
P05.39	Stator resistance for a permanent magnet motor (Ω)
P05.40	Permanent magnet motor Ld (mH)
P05.41	Permanent magnet motor Lq (mH)
P05.43	Ke parameter of a permanent magnet motor (V_{phase}, rms/krpm) When P05.00=5, the Ke parameter is measured based on the actual motor rotation. When P05.00=13, the Ke parameter is automatically calculated based on the motor power, current, and rotor speed.

If an auto-tuning error (AUE) occurs, refer to “Troubleshooting” on page 6–8.

AUE Error (code)	**Description**
AUE (40)	Auto-tuning error
AUE1 (142)	Auto-tuning error 1 (No feedback current error)
AUE2 (143)	Auto-tuning error 2 (motor phase loss error)
AUE3 (144)	Auto-tuning error 3 (no-load current I_0 measuring error)
AUE4 (148)	Auto-tuning error 4 (leakage inductance Lsigma measuring error

5) Set encoder parameter:
Check the encoder power and input type, make sure it is used with correct encoder (PG) card.

Encoder (PG) Card Type	
GS30A-FB-LD	GS30A-FB-OC

Related parameters:
-P10.00: Encoder type selection
-P10.01: Encoder pulses per revolution
-P10.02: Encoder input type setting=1 (A-phase and B-phase are pulse inputs, forward direction if A-phase leads B-phase by 90 degrees)

6) Measure the initial magnetic pole angle of PM:
Set P05.00=4 (dynamic test for PM magnetic pole). Press RUN key to proceed the PM magnetic pole measurement, and to get the offset angle.
If offset angle tuning error occurs or if the measured angle continues to be 0 or 360 degrees, then:

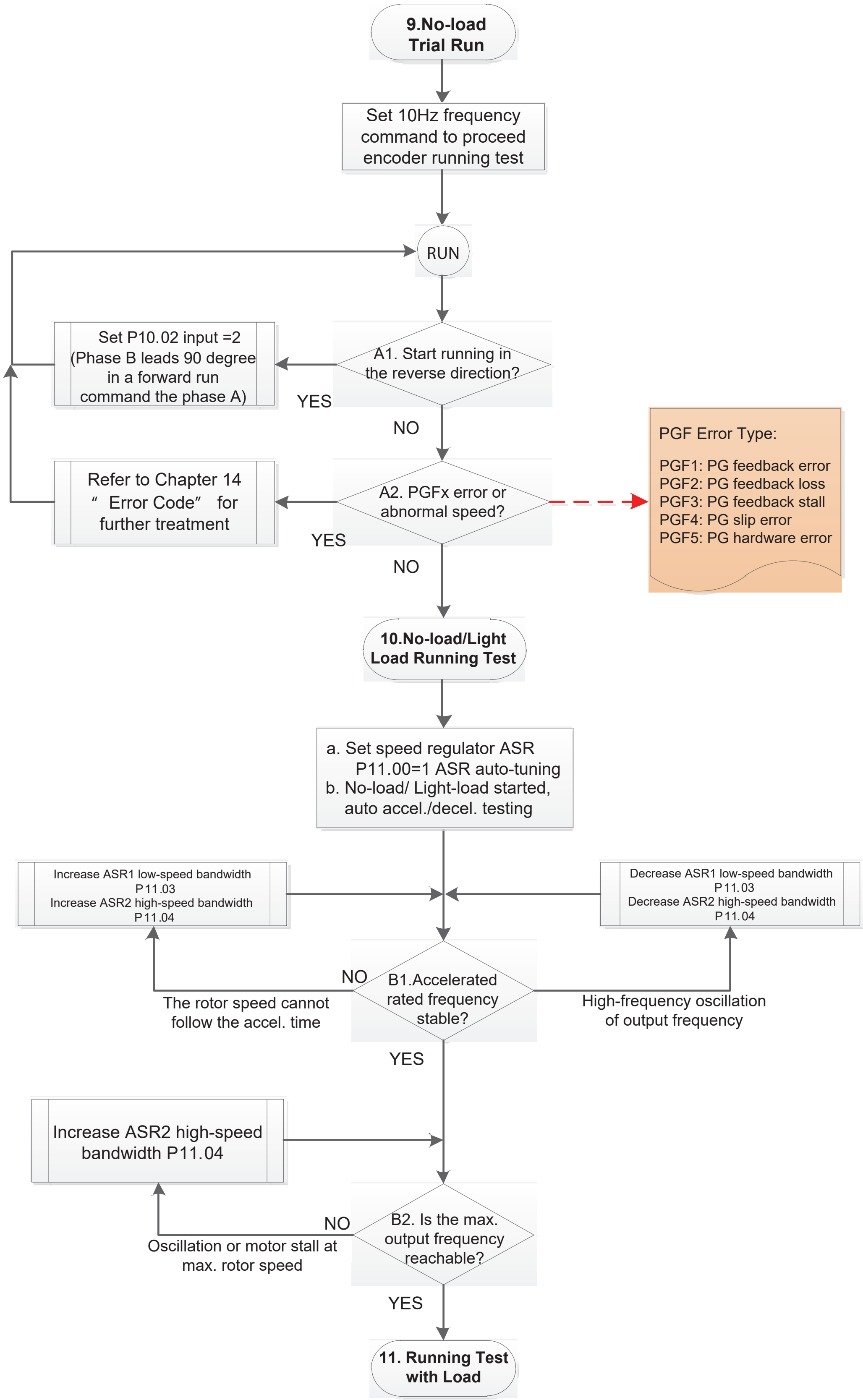
Step	**Action**
A	Check if encoder option card red LED is ON.
B	Check the connection of encoder and encoder option card.
Note 1: Measure the offset angle more than twice to ensure the angle tolerance is within ±5 degrees. *Note 2: Verify that the encoder and the encoder option card are connected in the right order.*	

7) Cycle system power.

8) Execute inertia estimation for PM.

Step	Action
1	Set P00.11=4, PM FOCPG control.
2	Set the operation frequency command to 2/3 of the motor's rated frequency.
3	Set the accleration/deceleratoin time (P01.12, P01.13) to 1/10 of the default time. Adjust the acceleration/deceleration time according to the load inertia. The smaller the load inertia, the shorter the accleration/deceleration time is set.
4	Check of the load and the motor is connected.
5	Set P11.00 bit1=1, inertia estimate (only in FOCPG mode).
Press RUN	Press RUN key to proceed the inertia. Quickly run the motor in forward and reverse direction repeatedly, and observe the interia estimated value of P11.01 for the keypad. • If the system inertial estimated value of P11.01 does not change (=default 256),then the inertia estimation is wrong. Reduce the frequency command and estimate the inertia again. • If the system inertia estimated value of P11.01 is still significantly different from the estimated value of FWD/REV operation, continue the estimation in forward reverse operating direction to restrain the estimated inertia to a small difference.
Press STOP	Press STOP key to obtain the estimated inertia value: 1) Press ENTER to confirm the input value at the displayed page of the last estimated inertia value of P11.01. 2) Set P11.01 bit1=0, return the control mode to speed mode. 3) Set the acceleration/deceleration time (P01.12, P01.13) back to the default value.

PM FOCPG Adjustment Flowchart for Operation without Load/with Light Load



Adjustment for Operation with No Load/Light Load

9) No-load trial run:
Set the frequency command to 10 Hz to proceed the encoder running test:

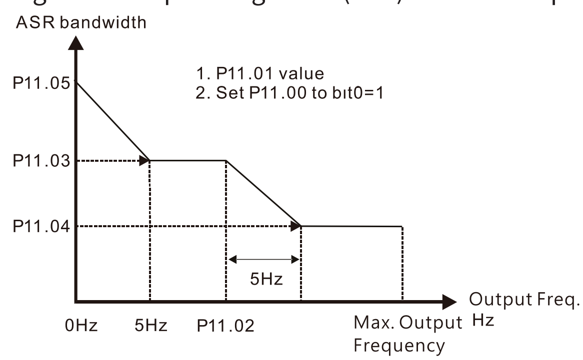
Step	Action
A1	If the motor starts in a reverse direction, set the encoder input type P10.02=2 (A-phase and B-phase are pulse inputs, forward direction if B-phase leads A-phase by 90 degrees).
A2	Observe if a PGFx error is displayed on the keypad, or the motor runs in an abnormal speed. If the PGFx error is displayed or the motor runs in an abnormal speed, refer to "Troubleshooting" on page 6–8 or the following table for PGFx error type and further treatment.

PGF Error (Code)	Description	Solution
PGF1 (42)	Encoder feedback error	Check parameter setting of P10.00–P10.02.
PGF2 (43)	Encoder feedback loss	Check the wiring of encoder and encoder option card.
PGF3 (44)	Encoder feedback stall	Check the wiring of encoder and encoder option card.
PGF4 (45)	Encoder slip error	Check the pulse setting of P10.01. Check the wiring of encoder and encoder option card.
PGF5 (65)	Encoder hardware error	Check if the encoder option card is installed to the correct slot position. Check the setting parameter of the encoder.

10) No-load / light load running test:

Step	Action
a	Set the speed regulator (ASR) as P11.00=1, and set the ASR gain as auto-tuning.
b	Start the motor with no load / light load and proceed acceleration / deceleration test.
B1	Accelerate to the rated frequency and observe if the motor runs stably. • If the output rotor speed cannot follow the acceleration time, increase P11.04 (ASR2 high-speed bandwidth) or P11.03 (ASR1 low-speed bandwidth). • If a high-frequency oscillation occurs in the output frequency, decrease P11.04 (ASR2 high-speed bandwidth) or P11.03 (ASR1 low-speed bandwidth).
B2	Accelerate the motor to the maximum frequency and observe if it runs stably. • If an oscillation occurs or motor stalls at maximum rotor speed during operation, increase P11.04 (ASR2 high-speed bandwidth).

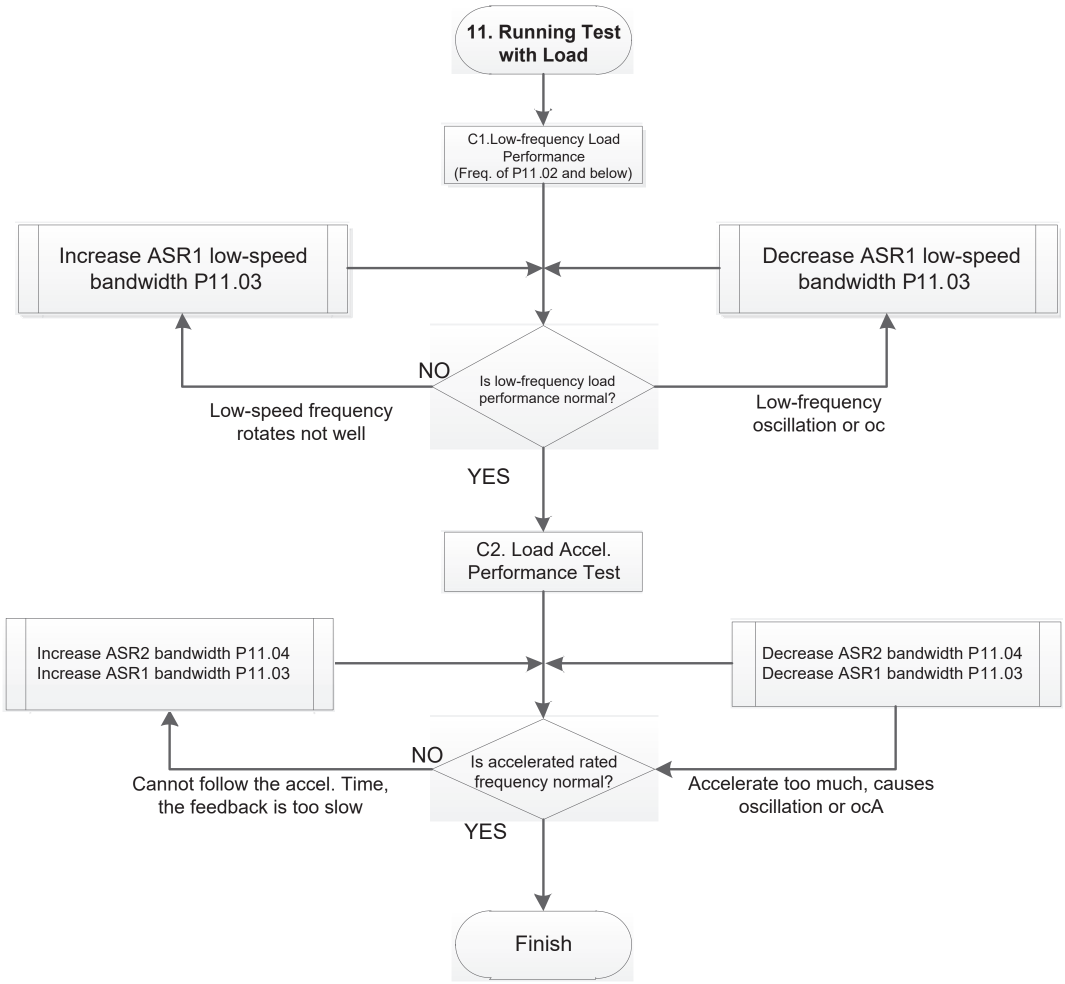
Setting curve of speed regulator (ASR) and related parameter:



ASR adjustment- auto gain

Parameter	Description	Default
P11.00	System control	0
P11.01	Per unit of system inertia	256
P11.02	ASR1/ASR2 switch frequency (for best results set switch frequenc higher than P10.39)	7.00 Hz
P11.03	ASR1 low-speed bandwidth	10Hz
P11.04	ASR2 high-speed bandwidth	10Hz
P11.05	ASR zero-speed bandwidth	10Hz

PM FOCPG Adjustment Flowchart for Operation Starts with Load



Adjustment for Operation with Load

11) Running test with load:

Step	Action
C1	Low-frequency load performance, when the drive operates under ASR1 / ASR2 switch frequency (P11.02): a) If the low-speed frequency cannot start-up with load or the rotor speed is not smooth, increase P11.03 (ASR1 low-speed bandwidth), or increase P11.01 (Per-unit system inertia). b) If an oscillation or over current (oc) error occurs at low-speed frequency, decrease P11.03 (ASR1 low-speed bandwidth) or decrease P11.01 (Per-unit system inertia).
C2	With-load accelerating performance testing in heavy-load status, accelerate the motor to the rated rotor speed according to the acceleration time. • If the motor rotor speed cannot follow the acceleration time, and the response is too slow, increase P11.04 (ASR2 high-speed bandwidth) and P11.03 (ASR1 low-speed bandwidth); if the response speed is still not enough, increase 10% of the per-unit system inertia for P11.01 each time. • If an excessive acceleration causes an oscillation or ocA error, decrease P11.04 (ASR2 high-speed bandwidth) and P11.03 (ASR1 low-speed bandwidth).

PM FOCPG Adjustment Parameters

For the full list of parameters and details, refer to “DURApulse GS30 Parameter Details” on page 4–60.

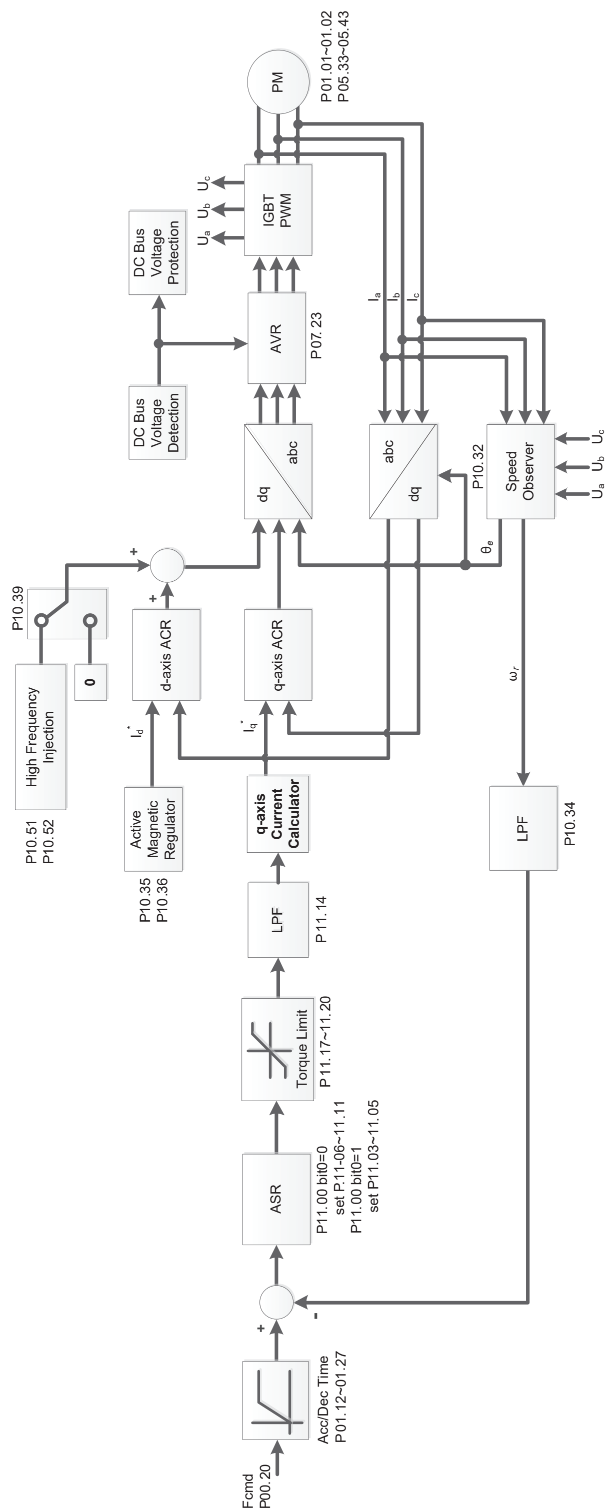
Parameter	Description	Unit	Default	Setting Range
Encoder Setting Parameters				
P10.00	Encoder type selection	N/A	0	0–5
P10.01	Encoder pulses per revolution	ppr	600	1–20000
P10.02	Encoder input type setting	N/A	0	0–5
Motor Performance Control Parameters				
P11.00	System control	bit	0	0–8
P11.01	Per unit of system inertia	N/A	256	1–65535
P11.02	ASR1/ASR2 switch frequency	Hz	7	5.00–599
P11.03	ASR1 low-speed bandwidth	Hz	10	1–100 (PM) 1–40 (IM)
P11.04	ASR2 high-speed bandwidth	Hz	10	1–100 (PM) 1–40 (IM)
P11.05	Zero-speed bandwidth	Hz	10	1–100 (PM) 1–40 (IM)

IPM SVC Sensorless Field-Oriented Control with interior PMAC motor

When P00.11=7.

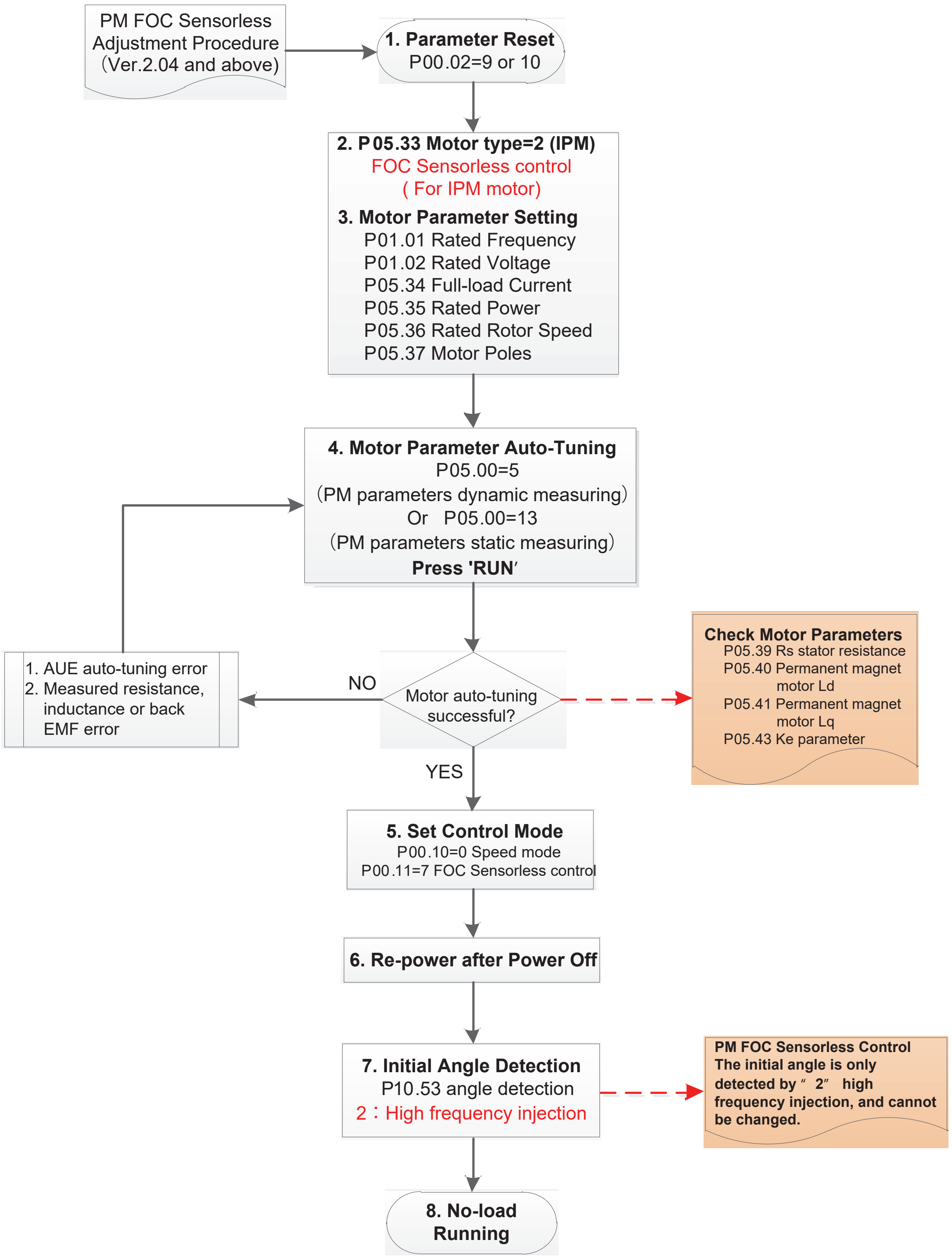
PM Sensorless FOC control is the control method dedicated for IPM, it uses the high salient pole characteristic (Lq > Ld) of IPM to detect the positions of NS magnetic poles. By doing this, it calculates the motor's rotor position at low-speed frequency.

IPM SVC Control Diagram



Adjustment Procedure

The number marked on the flowchart corresponds to the step number of the procedure.



Basic Motor Parameters Adjustment

1) Parameter reset:
   Reset P00.02=9 (50Hz) or 10 (60Hz) to the default value.
2) Select IPM motor type:
   P05.33= 2 (IPM)
3) Motor nameplate parameter setting:

Parameter	Description
P01.01	Rated frequency (Hz)
P01.02	Rated voltage (VAC)
P05.33	PM motor type (IPM or SPM)
P05.34	Rated current (A)
P05.35	Rated power (kW)
P05.36	Rated rotor speed (rpm)
P05.37	Number of poles for the motor (poles)

4) PM parameter auto-tuning:
   Set P05.00=5 (rolling auto-tuning for PM, with no load) or 13 (static auto-tuning for PM) and press the RUN key to finish motor auto-tuning. You will get the following parameters:

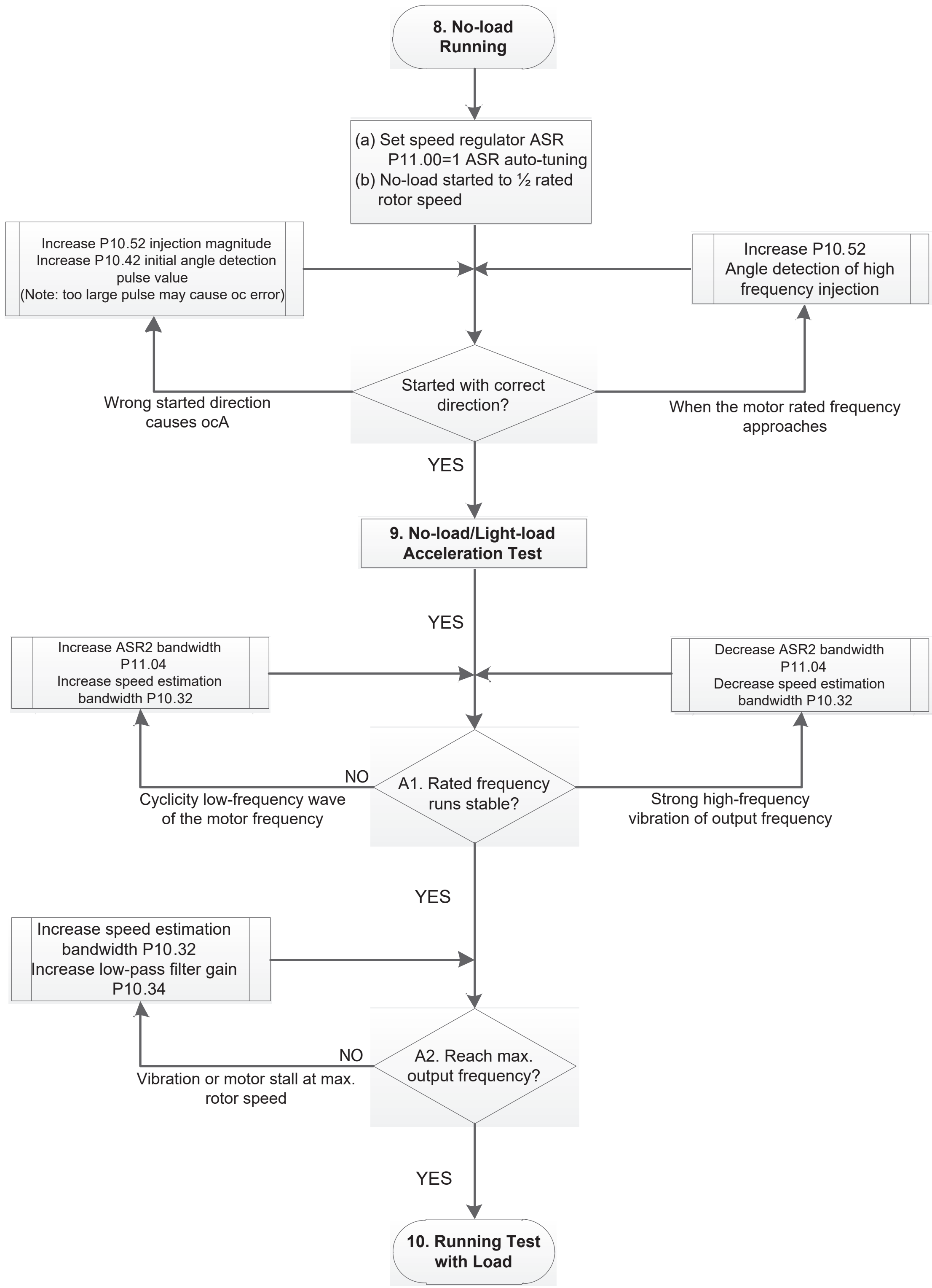
Parameter	Description
P05.39	Stator resistance for a permanent magnet motor (Ω)
P05.40	Permanent magnet motor Ld (mH)
P05.41	Permanent magnet motor Lq (mH)
P05.43	Ke parameter of a permanent magnet motor (V_{phase}, rms/krpm) When P05.00=5, the Ke parameter is measured based on the actual motor rotation. When P05.00=13, the Ke parameter is automatically calculated based on the motor power, current, and rotor speed.

If an auto-tuning error (AUE) occurs, refer to “Troubleshooting” on page 6–8.

AUE Error (code)	Description
AUE (40)	Auto-tuning error
AUE1 (142)	Auto-tuning error 1 (No feedback current error)
AUE2 (143)	Auto-tuning error 2 (motor phase loss error)
AUE3 (144)	Auto-tuning error 3 (no-load current I_0 measuring error)
AUE4 (148)	Auto-tuning error 4 (leakage inductance Lsigma measuring error

5) Set control mode:
   - Control mode for the drive: P00.10=0 (Speed Mode)
   - Control mode for the motor: P00.11=7 (Interior PM FOC Sensorless)
6) After auto-tuning, cycle system power.
7) Measure the initial magnetic pole angle of PM.
   When P00.11=7 (PM FOC Sensorless Mode) the initial magnetic pole angle detection method is high frequency injection.

IPM Sensorless Adjustment Flowchart for Operation without Load/with Light Load



Adjustment for Operation with No Load/Light Load

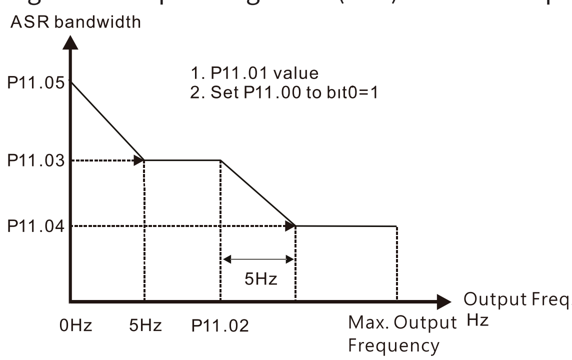
8) Start the motor with no load:

Step	Action
(a)	Set P11.00=1, Auto-tuning for ASR and APR
(b)	Start the motor without load, and operate the motor to 1/2 of rated rotor speed a. If the start direction is wrong, starting rotation is not smooth (ocA) or the motor salient ratio (Lq / Ld) is low, increase P10.52 (injection magnitude) and P10.42 (initial angel detection pulse value) to improve the accuracy of the angle detection. b. If P10.51 (injection frequency) is close to the rated motor frequency (P01.01), then increase P10.51 to avoid the angle detection difference caused by motor rated frequency.

9) Acceleration test with No-load / light load:

Step	Action
A1	Accelerate to rated frequency and observe if the motor operates stably. a. If the motor output rotor speed presents periodic low-frequency wave, increase P11.04 (ASR2 high-speed bandwidth), or increase P10.32 (PM FOC sensorless speed estimator bandwidth). b. If the output frequency reflects high-frequency vibration, decrease P11.04 or decrease P10.32.
A2	Accelerate the motor to the maximum frequency, and observe if it operates stably. If the motor stalls when accelerating to the maximum rotor speed, increase P10.32 (PM FOC sensoress speed estimator bandwidth) and P10.34 (PM sensorless speed estimator low-pass filter gain).

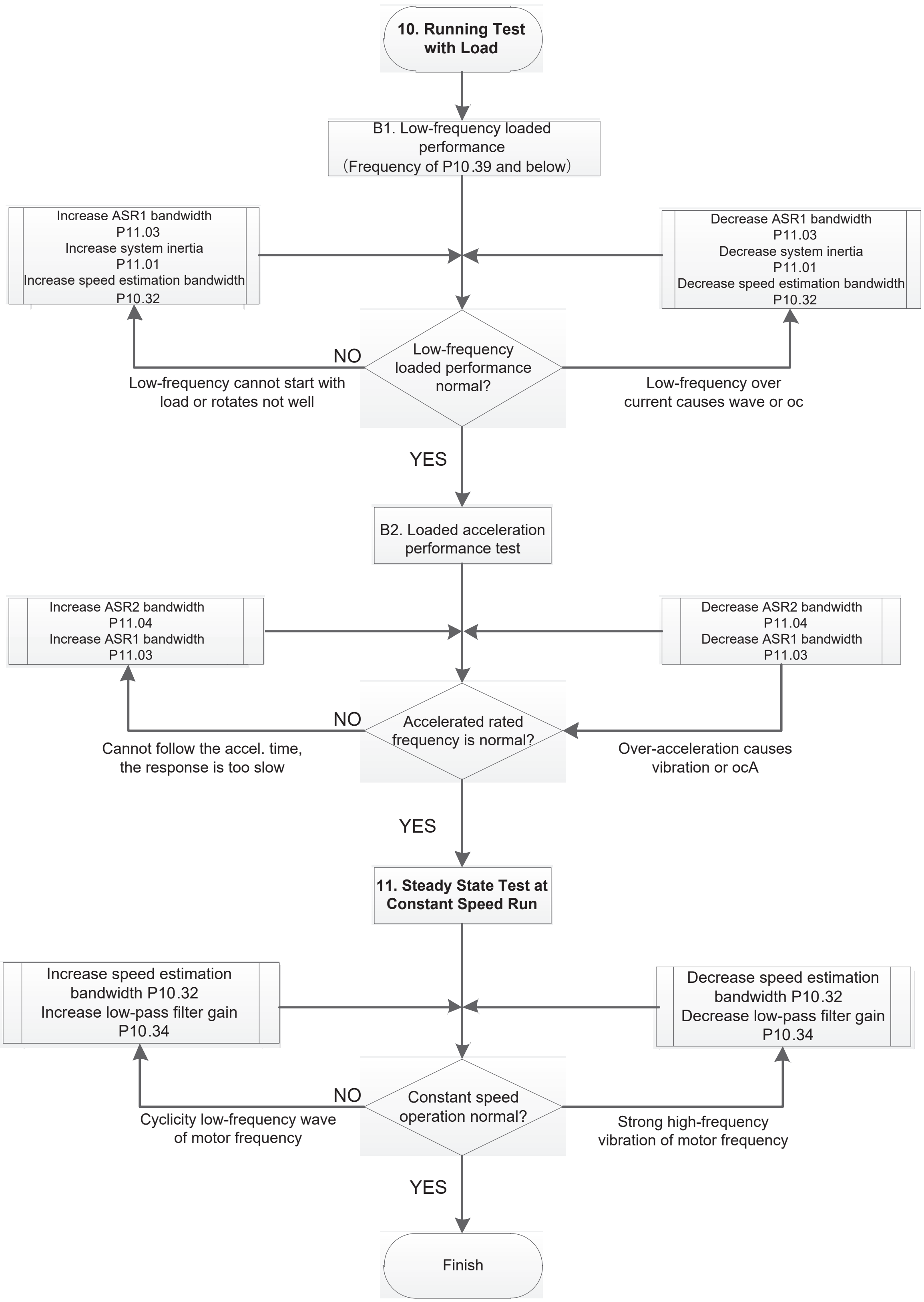
Setting curve of speed regulator (ASR) and related parameter:



ASR adjustment- auto gain

Parameter	Description	Default
P11.00	System control	0
P11.01	Per unit of system inertia	256
P11.02	ASR1/ASR2 switch frequency (for best results set switch frequenc higher than P10.39)	7.00 Hz
P11.03	ASR1 low-speed bandwidth	10Hz
P11.04	ASR2 high-speed bandwidth	10Hz
P11.05	ASR zero-speed bandwidth	10Hz

IPM Sensorless Adjustment Flowchart for Operation Starts with Load



Adjustment for Operation with Load

10) Load operating test:

Step	Action
B1	Low-frequency loading performance, when the switch frequency is below Pr.10-39: a. When the low-frequency cannot start the motor with load, or the rotor speed is not smooth, increase P11.03 (ASR1 low-speed bandwidth) or P11.01 (per-unit of system inertia); if the above adjustment cannot meet the requirement, then increase P10.32 (PM FOC sensorless speed estimator bandwidth). b. When frequency outputs, low-frequency operating current is large or an oc error occurs, decrease P11.03 and P11.01; or decrease P10.32.
B2	Acceleration performance test under heavy-load status, accelerate the motor to rated rotor speed according to the acceleration time: a. If the motor cannot follow the acceleration time, and the response is too slow, increase P11.04 (ASR2 high-speed bandwidth) and P11.03 (ASR1 low-speed bandwidth). b. If an excessive acceleration causes vibration or ocA error, decrease P11.04 and P11.03.

11) Stability test at constant speed operation: if the motor operates stably at constance speed.

Step	Action
a	If the motor output rotor speed presents periodic low-frequency wave, increase P10.34 (PM sensorless speed estimator low-pass filter gain), or increase P10.32 (PM FOC sensorless speed estimator bandwidth).
b	If the output frequency reflects high-frequency vibration, decrease P10.34 or decrease P10.32.

IPM Sensorless Adjustment Parameters

For the full list of parameters and details, refer to “DURApulse GS30 Parameter Details” on page 4–60.

Parameter	Description	Unit	Default	Setting Range
P10.32	PM FOC sensorless speed estimator bandwidth	Hz	5.00	0.00–600
P10.34	PM sensorless speed estimator bandwidth	N/A	1.00	0.00–655.35
P10.35	AMR (Kp) gain	N/A	1.00	0.00–3.00
P10.36	AMR (Ki) gain	N/A	0.20	0.00–3.00
P10.39	Frequency point to switch from I/F mode to PM sensorless mode	Hz	20.00	0.00–599
P10.40	Frequency point to switch from PM sensorless mode to V/F mode	Hz	20.00	0.00–599
P10.42	Initial angle detection pulse value	N/A	1.0	0.0–3.0
Initial Angle Estimating Parameters				
P10.51	Injection frequency (for IPM)	Hz	500	0–1200
P10.52	Injection magnitude (for IPM)	V	15.0 / 30.0	0.0–200.0
P10.53	PM initial rotor position detection method	N/A	0	0–3
Motor Performance Control Parameters				
P11.00	System control	bit	0	0–8
P11.01	Per unit of system inertia	N/A	256	1–65535
P11.02	ASR1/ASR2 switch frequency	Hz	7	5.00–599
P11.03	ASR1 low-speed bandwidth	Hz	10	1–100 (PM) 1–40 (IM)
P11.04	ASR2 high-speed bandwidth	Hz	10	1–100 (PM) 1–40 (IM)
P11.05	Zero-speed bandwidth	Hz	10	1–100 (PM) 1–40 (IM)

Torque Calculation and Torque Parameter Setup Reference

Drive Motor Torque Calculation

Torque reference scaling is based on the motor rated torque, set by the Group 5 parameters. The Torque calculated value can be viewed in P00.04 = 39 while the drive is running. The value will be similar to the rated nameplate motor torque.

See an example for Motor Y360 below:

Calculation equation for the motor rated torque:

Motor rated torque: $T(N.M) = \frac{P(W)}{\omega(rad/s)}$

Where:

P (W) value = P05.02

ω (rad / s) value = $\frac{P5.03 \times 2\pi}{60} = rad/s$

1) Set the motor nameplate data in the Group 5 parameters. See example for Marathon Motor Y360 below:

MOTOR NAMEPLATE DATA

Motor	Torque	Current	Power	Speed
Part No	N-m	Amps	kW	RPM
Y360	1.5	1.8	0.37	1725

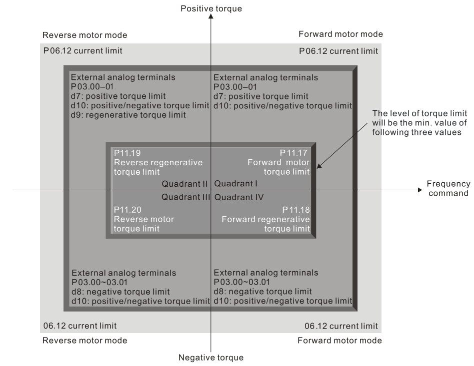
SET MOTOR PARAMETERS

Parameter	Description	Parameter Value
P05.01	IM1, FLA	1.8
P05.02	IM1 Power (kW)	0.37
P05.03	IM1 Speed (rpm)	1725

$$T\,(N\cdot m) = \frac{P5.02 \times 1000}{\left(\frac{P5.03 \times 2 \times 3.14}{60}\right)} = \frac{0.37 \times 1000}{\left(\frac{1725 \times 2 \times 3.14}{60}\right)} = 2.0$$

2) Set P11.27, Max Torque Command, to scale the upper limit of the torque command. The value can be 0–500%.
   - P11.27 = 100% . . . this corresponds to the 2 N·m result from the step above.

GS30 Drive - Torque Limit in Speed Mode Detailed Explanation



Torque limit is controlled in 2 ways:

1) Parameter control: P11.17–P11.20.

   P11.17 ***Forward Motor Torque Limit***
   P11.18 ***Forward Regenerative Torque Limit***
   P11.19 ***Reverse Motor Torque Limit***
   P11.20 ***Reverse Regenerative Torque Limit***
   Range/Units (Format: 16-bit unsigned)
   0–500%

2) Analog input control: P03.00 or P03.01 = 7, 8, 9, or 10.

P03.00	Analog input selection (AI1)	0: No function 1: Frequency command 2: Torque command (torque limit under speed mode) 3: Torque compensation command 4: PID target value 5: PID feedback signal 6: Thermistor (PTC) input value
P03.01	Analog input selection (AI2)	7: Positive torque limit 8: Negative torque limit 9: Regenerative torque limit 10: Positive / negative torque limit 11: PT100 thermistor input value 12: Auxiliary frequency input 13: PID compensation value

These settings are based on MOTOR RATED TORQUE = 100%. The settings for P11.17–P11.20 compare with the P03.00 = 7, 8, 9, 10 in the torque limit block. The minimum value of the comparison result is the torque limit.

NOTE: The total drive current limit is governed by P06.12. This parameter is to protect the drive (0 -250% of Drive Rated Current). If either P11.17-20 or Analog input torque limit exceeds P06.12, the speed of the drive will be reduced until the current is under this limit.

P06.12 is the only current/torque limit available for V/F, VFPG, IMSVC or PMSVC modes (P00.11 = 0, 1,2).

P06.12	Current limit	0–250% (100% corresponds to the rated current of the drive)

Speed Mode with Torque Limits via Analog Input

While in Speed mode and controlling torque limits via an analog input, use the following parameter configuration.

NOTE: Only P00.11=5 IMFOC speed mode can be used with torque limits.

Set parameters as follows:

1) Set Control Modes:

Parameter	Parameter Description	Parameter Value
P00.10	Control Method	0 (Speed)
P00.11	Speed (Velocity) Control Mode	5 (IMFOC)

2) Set up motor values for calculation of proper torque:

Parameter	Parameter Description	Parameter Value
P05.01	Induction Motor 1, Full-load amps	10-120% drive current
P05.02	Induction Motor 1, Rated power (kW)	Set based on motor. This is used to calculate Torque Cmd value
P05.03	Induction Motor 1, Rated speed (rpm)	Set based on motor. This is used to calculate Torque Cmd value

3) Tune Motor:

Parameter	Parameter Description	Parameter Value
P05.00	1	Press Run and allow Auto-Tune

4) Set up User display to monitor the torque of the drive. This is optional but will help you see what the drive is doing to limit the torque:

Parameter	Parameter Description	Parameter Value
P00.04	User Display	8 = % Torque or 39 = Torque Netwon - Meters

5) Set up Analog Input command signal:

Parameter	Parameter Description	Parameter Value
P03.00 or P03.01	Analog input selection	**7–10 - Torque limits** When using this selection, the corresponding value for 0–10 V / 4–20 mA is 0 – maximum output torque (P11.27).

6) Set up the maximum torque value for the torque command:

Parameter	Parameter Description	Parameter Value
P11.27	Maximum Torque Command	0-500% (of Motor Rated Torque)

7) Set up the torque limits for the torque command:

Parameter	Parameter Description	Parameter Value
P11.17	Forward motor torque limit	500%
P11.18	Forward regenerative torque limit	500%
P11.19	Reverse motor torque limit	500%
P11.20	Reverse regenerative torque limit	500%

8) Ensure the drive current limit will not interfere with torque command limits:

Parameter	Parameter Description	Parameter Value
P06.12	Current limit	0-250% drive current. Ensure this value is set above the motor torque requirements or it will prevent full torque to the motor

GS30 Drive Quick Reference- Alternating between Torque and Speed Mode

The drive allows alternating between Torque and Speed mode via a digital input. ***A multifunction input must be set to 26 for the use of P03.00 / P03.01 = 2*** as the torque limit function.

Set parameters according to the steps below to use analog input control of torque and frequency while in this mode.

1) Set Control Modes:

Parameter	Parameter Description	Parameter Value
P00.10	Control Method	0 (Speed) or 2 (Torque)
P00.11	Speed (Velocity) Control Mode	5 (IMFOC)

2) Set up motor values for calculation of proper torque:

Parameter	Parameter Description	Parameter Value
P05.01	Induction Motor 1, Full-load amps	10-120% drive current
P05.02	Induction Motor 1, Rated power (kW)	Set based on motor. This is used to calculate Torque Cmd value
P05.03	Induction Motor 1, Rated speed (rpm)	Set based on motor. This is used to calculate Torque Cmd value

3) Tune Motor:

Parameter	Parameter Description	Parameter Value
P05.00	1	Press Run and allow Auto-Tune

4) Set up User display to monitor the torque of the drive. This is optional but will help you see what the drive is doing to limit the torque:

Parameter	Parameter Description	Parameter Value
P00.04	User Display	8 = % Torque or 39 = Torque Netwon - Meters

5) Set up one digital input selection of control mode:

Parameter	Parameter Description	Parameter Value
P02.01–P02.07	Digital input config	26 (DIx=1 TQC Torque mode, DIx=0 IMFOC Speed Mode) **NOTE:** If P00.10 = 0....when Speed mode is enabled (Dix=0), the torque limit will be held at the last value used while in torque mode. If P00.10=2, when Speed mode is enabled (Dix=0), the torque limit follows the value of the configured analog input in real time.

6) Set up Analog Input command signal:

Parameter	Parameter Description	Parameter Value
P03.00 or P03.01	Analog input selection	**2 - Torque command (torque limit under speed mode)** When using this selection, the corresponding value for 0–10 V / 4–20 mA is 0–maximum output torque (P11.27). When DIx=1: AI functions as Torque Commmand. When DIx=0: AI functions as Torque Limit. Speed command is determined by P00.20.

7) Set up the Analog input as the torque command source:

Parameter	Parameter Description	Parameter Value
P11.33	Torque command source	2 – Analog Signal Input

8) Set up the maximum torque value for the torque command:

Parameter	Parameter Description	Parameter Value
P11.27	Maximum Torque Command	0-500% (of Motor Rated Torque)

9) Set up the torque limits for the torque command:

Parameter	Parameter Description	Parameter Value
P11.17	Forward motor torque limit	500%
P11.18	Forward regenerative torque limit	500%
P11.19	Reverse motor torque limit	500%
P11.20	Reverse regenerative torque limit	500%

10) Ensure the drive current limit will not interfere with torque command limits:

Parameter	Parameter Description	Parameter Value
P06.12	Current limit	0-250% drive current. Ensure this value is set above the motor torque requirements or it will prevent full torque to the motor

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Table of Contents

Chapter 5: Serial Communications

Communications Parameters Summary

A summary of the GS30 AC drives Communications Parameters is listed below. Refer to "Parameters" Chapter 4 for a complete listing of all GS30 AC drives parameters, including details and Modbus addresses.

For GS30A-CM-ENETIP communication card parameters and information, please see Appendix B.

Summary – Serial Communication Parameters

GS30 Parameters Summary – Communication Parameters (P09.xx)							
Parameter		***Range***	***Run[1]) Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default[2])***	***User***
1) ♦ in the Run-Read/Write column indicates that the parameter can be set during RUN mode. R/W indicates "Read/write." Read indicates "Read-only." 2) Parameters can be restored to their default values using P00.02.							
P09.00	Communication address	1–254	♦R/W	0900	42305	1	
P09.01	COM1 transmission speed	4.8–115.2 Kbps	♦R/W	0901	42306	9.6	
P09.02	COM1 transmission fault treatment	0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning, no fault, and continue operation	♦R/W	0902	42307	3	
P09.03	COM1 time-out detection	0.0–100.0 sec.	♦R/W	0903	42308	0.0	
P09.04	COM1 communication protocol	1: 7, N, 2 (ASCII) 2: 7, E, 1 (ASCII) 3: 7, O, 1 (ASCII) 4: 7, E, 2 (ASCII) 5: 7, O, 2 (ASCII) 6: 8, N, 1 (ASCII) 7: 8, N, 2 (ASCII) 8: 8, E, 1 (ASCII) 9: 8, O, 1 (ASCII) 10: 8, E, 2 (ASCII) 11: 8, O, 2 (ASCII) 12: 8, N, 1 (RTU) 13: 8, N, 2 (RTU) 14: 8, E, 1 (RTU) 15: 8, O, 1 (RTU) 16: 8, E, 2 (RTU) 17: 8, O, 2 (RTU)	♦R/W	0904	42309	15	
P09.09	Communication response delay time	0.0–200.0 ms	♦R/W	0909	42314	2.0	
P09.10	Communication main frequency	0.00–599.00 Hz	R/W	090A	42315	60.00	
P09.11	Block transfer 1	0–65535	♦R/W	090B	42316	0	
P09.12	Block transfer 2	0–65535	♦R/W	090C	42317	0	
P09.13	Block transfer 3	0–65535	♦R/W	090D	42318	0	
P09.14	Block transfer 4	0–65535	♦R/W	090E	42319	0	
P09.15	Block transfer 5	0–65535	♦R/W	090F	42320	0	
P09.16	Block transfer 6	0–65535	♦R/W	0910	42321	0	
P09.17	Block transfer 7	0–65535	♦R/W	0911	42322	0	
P09.18	Block transfer 8	0–65535	♦R/W	0912	42323	0	
P09.19	Block transfer 9	0–65535	♦R/W	0913	42324	0	
P09.20	Block transfer 10	0–65535	♦R/W	0914	42325	0	
P09.21	Block transfer 11	0–65535	♦R/W	0915	42326	0	

GS30 Parameters Summary - Serial Communication Parameters (P09.xx) - (continued)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default[2]**	**User**
P09.22	Block transfer 12	0–65535	♦R/W	0916	42327	0	
P09.23	Block transfer 13	0–65535	♦R/W	0917	42328	0	
P09.24	Block transfer 14	0–65535	♦R/W	0918	42329	0	
P09.25	Block transfer 15	0–65535	♦R/W	0919	42330	0	
P09.26	Block transfer 16	0–65535	♦R/W	091A	42331	0	
P09.30	Communication decoding method	0: Decoding method 1 1: Decoding method 2	R/W	091E	42335	1	
P09.33	PLC command force to 0	0–65535	♦R/W	0921	42338	0	
P09.35	PLC address	1–254	R/W	0923	42340	2	
P09.60	Communication card identification	0: No communication card 4: Modbus-TCP slave 5: EtherNet/IP slave 10: Backup power supply	Read	093C	42365	0	
P09.61	Firmware version of communication card	Read only	Read	093D	42366	0	
P09.62	Product code	Read only	Read	093E	42367	0	
P09.63	Error code	Read only	Read	093F	42368	0	
P09.74	Set Comm Master Protocol	0: Ethernet IP and Modbus TCP both 1: Ethernet IP 2: Modbus TCP	♦R/W	094A	42379	1	
P09.75	Communication card IP configuration (Ethernet)	0: Static IP 1: Dynamic IP (DHCP)	♦R/W	094B	42380	0	
P09.76	Communication card IP address 1 (Ethernet)	0–255	♦R/W	094C	42381	0	
P09.77	Communication card IP address 2 (Ethernet)	0–255	♦R/W	094D	42382	0	
P09.78	Communication card IP address 3 (Ethernet)	0–255	♦R/W	094E	42383	0	
P09.79	Communication card IP address 4 (Ethernet)	0–255	♦R/W	094F	42384	0	
P09.80	Communication card address mask 1 (Ethernet)	0–255	♦R/W	0950	42385	0	
P09.81	Communication card address mask 2 (Ethernet)	0–255	♦R/W	0951	42386	0	
P09.82	Communication card address mask 3 (Ethernet)	0–255	♦R/W	0952	42387	0	
P09.83	Communication card address mask 4 (Ethernet)	0–255	♦R/W	0953	42388	0	
P09.84	Communication card gateway address 1 (Ethernet)	0–255	♦R/W	0954	42389	0	
P09.85	Communication card gateway address 2 (Ethernet)	0–255	♦R/W	0955	42390	0	
P09.86	Communication card gateway address 3 (Ethernet)	0–255	♦R/W	0956	42391	0	
P09.87	Communication card gateway address 4 (Ethernet)	0–255	♦R/W	0957	42392	0	

GS30 Parameters Summary - Serial Communication Parameters (P09.xx) - (continued)							
Parameter		Range	Run1) Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default2)	User
P09.88	Communication card password (low word) (Ethernet)	0–99	♦R/W	0958	42393	0	
P09.89	Communication card password (high word) (Ethernet)	0–99	♦R/W	0959	42394	0	
P09.90	Reset communication card (Ethernet)	0: Disable 1: Reset to defaults	♦R/W	095A	42395	0	
P09.91	Additional settings for the communication card (Ethernet)	bit 0: Enable IP filter bit 1: Enable internet parameters (1 bit) When the IP address is set, this bit is enabled. After updating the parameters for the communication card, this bit changes to disabled. bit 2: Enable login password (1 bit) When you enter the login password, this bit is enabled. After updating the communication card parameters, this bit changes to disabled.	♦R/W	095B	42396	0	
P09.92	Communication card status (Ethernet)	bit 0: Enable password When the communication card is set with a password, this bit is enabled. When the password is cleared, this bit is disabled.	R/W	095C	42397	0	
P09.93	ENETIP Comm Card Fault Select	0: Warn & Continue Operation 1: Warn & Ramp to Stop 2: Warn & Coast to Stop 3: No Warning & Continue Operation	♦R/W	095D	42398	3	
P09.94	ENETIP Comm Card Time Out Detection	0: Disable 1: Enable	♦R/W	095E	42399	1	
P09.95	ENETIP Comm Card Time Out Duration	0.1 to 100.0 seconds	♦R/W	095F	42400	3.0	

Block Transfer Explanation

Block Transfer allows Parameters from many different Parameter Groups to be consolidated into one (or fewer) Modbus communication messages. This can greatly simplify PLC programming and reduce network traffic.

The Block Transfer parameters are P09.11 through P09.26. To use these parameters, enter the value of another parameter you wish to read or write through the keypad or GSoft2 configuration software. The parameter values must be converted by adding the upper byte value to the lower byte value, convert the sum to hex, then convert the hex to decimal.

Example:

Parameter P02.22. 0200 + 16 (hex of 22) = 0x0216 = result is 534. 534 is what would be entered in the Block Transfer parameter to read or write parameter P02.22.

Examples of Block Transfer are below:

1) Block transfer 1 (P09.11) = 0000 (AC Motor drive identity code). A Modbus read of P09.11 results in a value of 104. In this case, the drive is model # GS21-11P0 and corresponds to the value 104 in Parameter P00.00.
2) Block transfer 2 (P09.12) = 0006 (Firmware version). A Modbus read of P09.12 results in a value of 100. This is the firmware version of the GS30 drive.
3) Block transfer 3 (P09.13) = 8448 (decimal value of 0x2100 Status Monitor 1). A Modbus read of P09.13 returns the current status of Status Monitor 1.

4) Block transfer 4 (P09.14) = 8449 (decimal value of 0x2101 Status Monitor 2). A Modbus read of P09.14 returns the current status of Status Monitor 2.
5) Block transfer 5 (P09.15) = 8451 (decimal value of 0x2103 Output Frequency). A Modbus read of P09.15 returns the current running frequency of the GS30.
6) Block transfer 6 (P09.16) = 0268 (Acceleration time 1 is parameter P01.12. 12 = 0x0c. 0100 + 0c = 0x010C = 0268 decimal). A Modbus write to P09.16 will set the Acceleration time 1 value.
7) Block transfer 7 (P09.17) = 0269 (Deceleration time 1 is parameter P01.13. 13 = 0x0d. 0100 + 0d = 0x010d = 0269 decimal). A Modbus write to P09.17 will set the Deceleration time 1 value.
8) Block transfer 8 (P09.18) = 8192 (Control Word 1 (Run, Stop, etc…) is 0x2000 = 8192). A Modbus write to P09.18 will control the Run/Stop of the drive along with other items.
9) Block transfer 9 (P09.19) = 8193 (Control Word 2 (Frequency Command) is 0x2001 = 8193). A Modbus write to P09.19 will control the commanded Frequency of the drive.

Accessing all of the registers above would typically take about 6 Modbus messages but by blocking them together in the Block Transfer parameters, we can access everything with 1 read and 1 write.

Serial Modbus Status Addresses

The *DURAPULSE* GS30 AC drive has status memory addresses that are used to monitor the AC drive.

Status Addresses (Read Only)

GS30 Addresses						
Description		***Range***		***Modbus Address***		
				Hex	***Dec***	***Octal***
Status Monitor 1 Read Only	Fault Codes	0: No fault record 1: Over-current during acceleration (ocA) 2: Over-current during deceleration (ocd) 3: Over-current during steady operation (ocn) 4: Ground fault (GFF) 6: Over-current at stop (ocS) 7: Over-voltage during acceleration (ovA) 8: Over-voltage during deceleration (ovd) 9: Over-voltage during constant speed (ovn) 10: Over-voltage at stop (ovS) 11: Low-voltage during acceleration (LvA) 12: Low-voltage during deceleration (Lvd) 13: Low-voltage during constant speed (Lvn) 14: Low-voltage at stop (LvS) 15: Phase loss protection (orP) 16: IGBT overheating (oH1) 18: IGBT temperature detection failure (tH1o) 21: Over load (oL) 22: Electronic thermal relay 1 protection (EoL1) 23: Electronic thermal relay 2 protection (EoL2) 24: Motor PTC overheating (oH3) 26: Over torque 1 (ot1) 27: Over torque 2 (ot2) 28: Under current (uC) 31: EEPROM read error (cF2) 33: U-phase error (cd1) 34: V-phase error (cd2) 35: W-phase error (cd3) 36: cc (current clamp) hardware error (Hd0) 37: oc (over-current) hardware error (Hd1) 40: Auto-tuning error (AUE) 41: PID loss AI2 (AFE) 43: PG feedback loss (PGF2) 44: PG feedback stall (PGF3) 45: PG slip error (PGF4) 48: AI2 loss (ACE) 49: External fault (EF) 50: Emergency stop (EF1) 51: External base block (bb) 52: Password is locked (Pcod) 54: Illegal command (CE1) 55: Illegal data address (CE2)	56: Illegal data value (CE3) 57: Data is written to read-only address (CE4) 58: Modbus transmission time-out (CE10) 61: Y-connection / Δ-connection switch error (ydc) 62: Deceleration energy backup error (dEb) 63: Over slip error (oSL) 72: STO Loss (STL1) 76: STO (STo) 77: STO Loss 2 (STL2) 78: STO Loss 3 (STL3) 79: U-phase over-current before run (Aoc) 80: V-phase over-current before run (boc) 81: W-phase over-current before run (coc) 82: Output phase loss U phase (oPL1) 83: Output phase loss V phase (oPL2) 84: Output phase loss W phase (oPL3) 87: Low frequency overload protection (oL3) 89: Rotor position detection error (roPd) 97: Ethernet Card Timeout (CD10) 111: InrCOM time-out error (ictE) 121: Internal communication error (CP20) 123: Internal communication error (CP22) 124: Internal communication error (CP30) 126: Internal communication error (CP32) 127: Internal communication error (CP33) 128: Over-torque 3 (ot3) 129: Over-torque 4 (ot4) 134: Internal communication error (EoL3) 135: Internal communication error (EoL4) 140: Oc hardware error (Hd6) 141: GFF occurs before run (b4GFF) 142: Auto-tune error 1 (DC test stage) (AuE1) 143: Auto-tune error 2 (High frequency test stage) (AuE2) 144: Auto-tune error 3 (Rotary test stage) (AuE3) 149: Auto-tune error 5 (Rotor resistance measure test stage) (AuE5)	0611	41554	3021
Note: *Status Monitor 1 corresponds to P06.17 Fault Record 1.*						

GS30 Addresses (continued)					
Description	**Range**		**Modbus Address**		
			Hex	**Dec**	**Octal**
Status monitor read only	High byte: Warning code / Low Byte: Error code		2100	48449	20400
	bit 1–0	AC motor drive operation status 00B: The drive stops 01B: The drive is decelerating 10B: The drive is in standby status 11B: The drive is operating	2101	48450	20401
	bit 2	1: JOG command			
	bit 4–3	Operation direction 00B: FWD running 01B: From REV running to FWD running 10B: From FWD running to REV running 11B: REV running			
	bit 8	1: Master frequency controlled by the communication interface			
	bit 9	1: Master frequency controlled by the analog / external terminal signal			
	bit 10	1: Operation command controlled by the communication interface			
	bit 11	1: Parameter locked			
	bit 12	1: Enable to copy parameters from keypad			
	bit 15–13	Reserved			
	Frequency command (XXX.XX Hz)		2102	48451	20402
	Output frequency (XXX.XX Hz)		2103	48452	20403
	Display the drive’s output current (XX.XX A). When the current is higher than 655.35, it automatically shifts one decimal place as (XXX.X A). Refer to the high byte of 211F for information on the decimal places.		2104	48453	20404
	DC bus voltage (XXX.X V)		2105	48454	20405
	Output voltage (XXX.X V)		2106	48455	20406
	Current step for the multi-step speed operation		2107	48456	20407
	Reserved		2108	48457	20410
	Counter value		2109	48458	20411
	Output power factor angle (XXX.X)		210A	48459	20412
	Output torque (XXX.X %)		210B	48460	20413
	Actual motor speed (XXXXX rpm)		210C	48461	20414

GS30 Addresses (continued)					
Description	Range		Modbus Address		
			Hex	Dec	Octal
Command write only	bit 1–0	00B: No function	2000	48193	20000
		01B: Stop			
		10B: Run			
		11B: JOG + RUN			
	bit 3–2	Reserved			
	bit 5–4	00B: No function			
		01B: FWD			
		10B: REV			
		11B: Change direction			
	bit 7–6	00B: 1st accel. / decel.			
		01B: 2nd accel. / decel.			
		10B: 3rd accel. / decel.			
		11B: 4th accel. / decel.			
	bit 11–8	000B: Master speed			
		0001B: 1st step speed frequency			
		0010B: 2nd step speed frequency			
		0011B: 3rd step speed frequency			
		0100B: 4th step speed frequency			
		0101B: 5th step speed frequency			
		0110B: 6th step speed frequency			
		0111B: 7th step speed frequency			
		1000B: 8th step speed frequency			
		1001B: 9th step speed frequency			
		1010B: 10th step speed frequency			
		1011B: 11th step speed frequency			
		1100B: 12th step speed frequency			
		1101B: 13th step speed frequency			
		1110B: 14th step speed frequency			
		1111B: 15th step speed frequency			
	bit 12	1: Enable bit 06–11 function			
	bit 14–13	00B: No function			
		01B: Operated by the digital keypad			
		10B: Operated by Pr.00-21 setting			
		11B: Change the operation source			
	bit 15	Reserved			
	Frequency command (XXX.XX Hz)		2001	48194	20001
	bit 0	1: E.F. (External Fault) ON	2002	48195	20002
	bit 1	1: Reset command			
	bit 2	1: B.B. ON			
	bit 4–3	Reserved			
	bit 5	1: Enable fire mode			
	bit 15–6	Reserved			

Serial Communications Overview

The GS30 RJ-45 Serial Comm Port will accommodate an RS-485 connection, through which the drive can be controlled by a remote master device on an RS-485 network spanning up to 1200 meters (4000 feet) of cable. RS-232 signals can be converted to RS-485 by using a separate converter.

The GS30 AC drive communication address is specified in P9.00, and the remote master device can control each AC drive according to its individual communication address.

The GS30 AC drive can be configured to communicate using either Modbus RTU or ASCII. The desired protocol is selected in parameter P09.04, COM1 Protocol. (The GS30 drive cannot use both protocols simultaneously.)

- *Standard Modbus protocol using ASCII or RTU transmission modes.*
  Parameter P09.04, Communication Protocol, is used to select the desired mode, number of data bits, parity, and number of stop bits. The mode and serial parameters must be the same for all devices on a Modbus network.

DURApulse GS30 drives have a provision for shutting down control or power to the inverter in the event of a communications time out. This feature can be set up through parameters P09.02 (COM1 transmission fault treatment) and P09.03 (COM1 time-out detection).

Ethernet connectivity for EtherNet/IP or Modbus TCP communication is possible with an optional communication card # GS30A-CM-EIP1 or GS30A-CM-EIP2.
Refer to “Appendix B: Optional I/O and Communication Cards” for details.

Serial Communications Connectivity

This section contains information regarding wiring connections to the GS30 RS-485 serial communication ports. For information regarding serial connections to AutomationDirect PLCs, please refer to Appendix D of this user manual, or to the applicable PLC user manual.

Minimum AC Drive Parameter Settings For Serial Communication

The following parameters need to be set as shown in order to communicate properly:

Minimum Parameter Settings (for Communication to ADC PLC)		
Parameter Setting	***Description***	***Setting Value Explanation***
P00.21 = 02	1st Source of Operation Command [Remote]	02: RS-485 communication input
P00.31 = 02	2nd Source of Operation Command [Local]	02: RS-485 communication input, Keypad STOP is Enabled (P00.32)
P02.01~P02.07 = 56	Multifunction Inputs (DI1-DI7) Definition	56: Local/Remote selection
P00.20 = 1	1st Source of Frequency Command [Remote]	1: RS-485 communication input
P00.30 = 1	2nd Source of Frequency Command [Local]	1: RS-485 communication input
P09.00 = 1~254	Communication Address	01~254 Drive Comm Address
P09.01 = 4.8~115.2	Transmission Speed	4.8–115.2 Kbps
P09.04 = 1 to 17	COM1 Protocol	1: 7, N, 2 (ASCII) 2: 7, E, 1 (ASCII) 3: 7, O, 1 (ASCII) 4: 7, E, 2 (ASCII) 5: 7, O, 2 (ASCII) 6: 8, N, 1 (ASCII) 7: 8, N, 2 (ASCII) 8: 8, E, 1 (ASCII) 9: 8, O, 1 (ASCII) 10: 8, E, 2 (ASCII) 11: 8, O, 2 (ASCII) 12: 8, N, 1 (RTU) 13: 8, N, 2 (RTU) 14: 8, E, 1 (RTU) 15: 8, O, 1 (RTU) 16: 8, E, 2 (RTU) 17: 8, O, 2 (RTU)

This list of parameter settings is the minimum required to communicate with an AutomationDirect PLC. There may be other parameters that need to be set to meet the needs of your particular application.

Common Third-Party Modbus RTU Masters

- *KEPSERVER EX 5.0 from www.kepware.com*
- *Modbus Poll from www.modbustools.com*

AutomationDirect PLCs as Modbus Master

Serial Modbus-capable AutomationDirect PLCs can communicate with the GS30 drive (for GS30 Ethernet and Modbus TCP connectivity and control, refer to the GS30A-CM-EIP1/EIP2 Communication card information in Appendix B).

Serial Modbus control is easier to accomplish from a PLC that has a built-in RS-485 port and supports dedicated Modbus messaging. [RS-232-only PLCs will require an RS-232–RS-485 converter (FA-ISOCON); and older PLCs may require programming to construct the Modbus strings.] We recommend PLCs with built-in RS-485 ports and dedicated Modbus serial commands: CLICK (with RS-485 ports), Productivity 1000/2000/3000, BRX/Do-more, DirectLogic (DL06, D2-260, or D2-262). Other PLC-Drive connectivity is possible: Please refer to the “Typical ADC PLC to GS30 Serial Connectivity Matrix” below.

Typical ADC PLC to GS30 Serial Communications Connectivity

Typical ADC PLC to GS30 Serial Communications Connectivity Matrix*						
Recommended PLC Connectivity			**Communication**	**Direct Cable**	**GS30**	
PLC	**Port #**	**Port Type**			**Port Type**	**Port #**
CLICK	3	3 screw terminals	RS-485	Q8304-1 cable	RJ45 or SG+ SG- SGND	RJ45
D2-260	2	HD15	RS-485	D2-DSCBL-2		
D2-262	2	HD15	RS-485	D2-DSCBL-2		
DL06	2	HD15	RS-485	D2-DSCBL-2		
BRX/Do-more	RS-485	3 screw terminals	RS-485	Q8304-1 cable		
Do-more H2-DM1	RS-232	RJ12	RS-232 to RS-485	FA-ISOCON with Q8304-1 cable		
P1-550	RS-485	4 screw terminals	RS-485	Q8304-1 cable		
P2-550	RS-485	3 screw terminals	RS-485	Q8304-1 cable		
P3-530	RS-485	3 screw terminals	RS-485	Q8304-1 cable		
P3-550	RS-485	3 screw terminals	RS-485	Q8304-1 cable		
P3-550E	RS-485	3 screw terminals	RS-485	Q8304-1 cable		
Other PLC Connectivity			–	–		
D2-250-1	2	HD15	RS-485	D2-DSCBL-2		
D4-450/D4-454	1	DB25	RS-232 to RS-485	FA-ISOCON with Q8304-1 cable		
DL05	2	RJ12	RS-232 to RS-485	FA-ISOCON with Q8304-1 cable		
DL06 + DCM	2	HD15	RS-485	D2-DSCBL-2		
Do-more H2-DM1 + H2-SERIO-4	3	5 screw terminals	RS-485	Q8304-1 cable		
Do-more T1H-DM1	RS-232	RJ12	RS-232 to RS-485	FA-ISOCON with Q8304-1 cable		
P2-SCM	4	4 screw terminals	RS-485	Q8304-1 cable		
P3-SCM	4	4 screw terminals	RS-485	Q8304-1 cable		

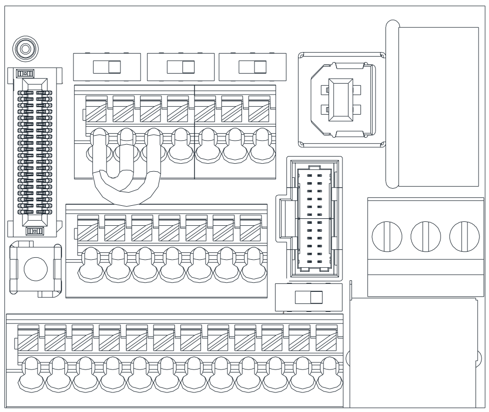
** Ethernet connectivity for EtherNet/IP or Modbus TCP communication is possible with optional communication cards # GS30A-CM-EIP1 or EIP2. Refer to "Appendix B: Optional I/O and Communication Cards" for details.*

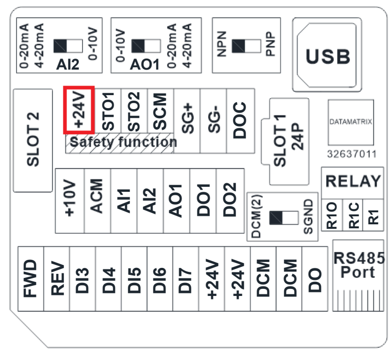
Connecting Communication Cables

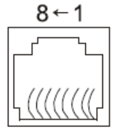
A 120 ohm external terminating resistor is required for the drive end. An external termination resistor may be required on the other end of RS-485 network; especially on long runs. Select resistors that match the impedance of the cable (between 100Ω and 500Ω).

The *DURAPULSE* GS30 serial communication port is an RS-485 input. Please note that terminals SG+ and SG- are shared with the RJ45 connector. That means the user can use standard RJ45 patch cables or industrial RS-485 cabling to access the comm port. GS30 to GS30 serial connections can be accomplished with standard Ethernet patch cables (do not use cross-over cables). RS-232 signals can be converted to RS-485 by using a separate converter (see the FA-ISOCON drawings on page 5–12).

DURAPulse GS30 RS-485 Serial Comm Ports







Modbus RS-485
Pin 1, 2, 6: Reserved
Pin 3, 7: SGND
Pin 4: SG-
Pin 5: SG+
Pin 8: +10VS

Note: If using both Modbus connection points (Terminal block and RS-485 Port), ensure you have the same ground reference. Non-equivalent grounding, or grounding from different references, can introduce noise issues that interfere with communications.

Recommended RS-485 cable: Belden 9842, AutomationDirect Q8304-1 series, or equivalent.

Note: When using hardwire terminations for RS-485, you must connect the common wire to the right-hand DCM terminal and set the DIP switch to SGND.

RS-232C to RS-485 Conversion

An RS-485 network cable can span up to 1200 meters (4000 feet). However, many AutomationDirect PLCs have only RS-232C communication ports, and require an FA-ISOCON (RS-232C to RS-422/485 network adapter) in order to make an RS-485 connection.

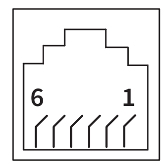
If an FA-ISOCON module is used, set the module dipswitches as required. Refer to the FA-ISOCON manual for more detailed information.

FA-ISOCON Switch Settings:

- *S21–S23: OFF, ON, ON (19200 baud)*
- *S24–S27: OFF (Automatic Network Transmit Enable)*
- *Terminate: ON (end of run term resistors)*
- *Bias (2): ON (end of run bias resistors)*
- *1/2 DPX (2): ON (RS-485 TXD/RXD jumpers)*

Helpful Hint: Some applications require that the FA-ISOCON baud rate is set faster than the drive/network baud rate.

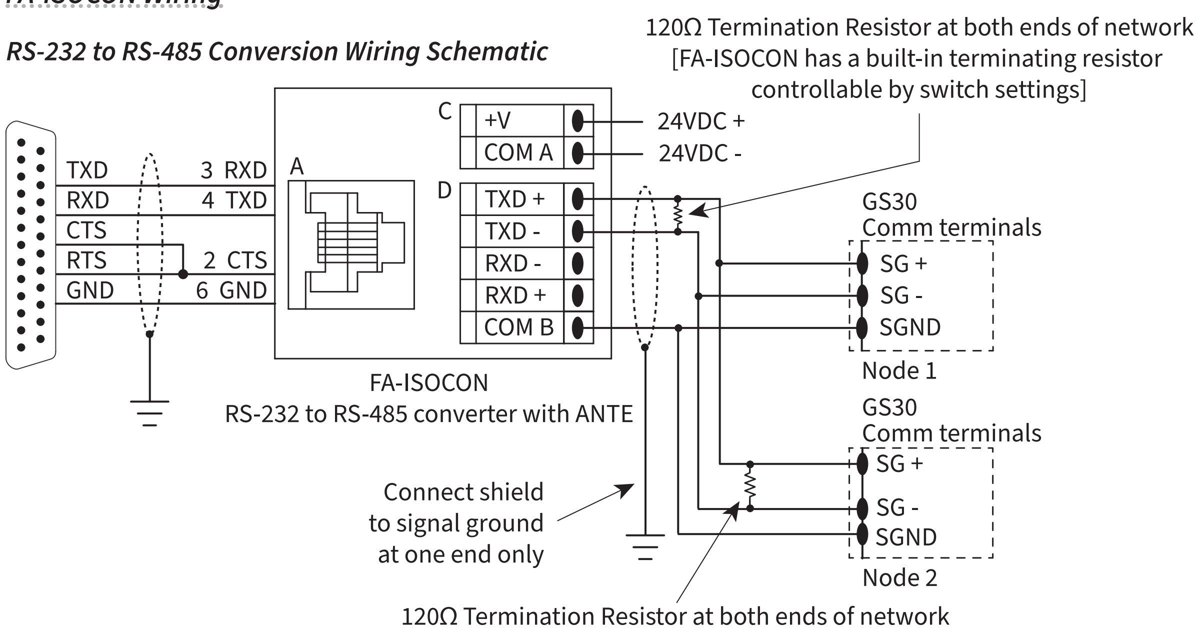
FA-ISOCON RJ-12 Serial Comm Port A
RS-232 Input Port



1: Signal Ground
2: CTS (input)
3: RXD (input)
4: TXD (output)
5: +5VDC in
6: Signal Ground

FA-ISOCON Wiring

RS-232 to RS-485 Conversion Wiring Schematic



Note: When using hardwire terminations for RS-485, you must connect the common wire to the right-hand DCM terminal and set the DIP switch to SGND.

For information regarding configuration of AutomationDirect PLCs or other PLCs, please refer to Appendix D of this user manual, or to the applicable PLC user manual for your application.

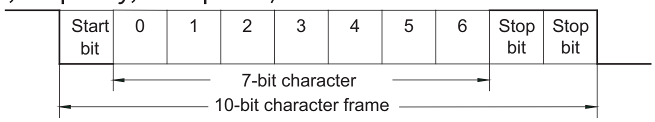
Detailed Serial Modbus Communication Information

The GS30 drive follows the standard Modbus RTU and Modbus ASCII protocols. The following pages provide some brief information on this but if your device does not support these protocols natively and you are required to develop this framework on your own, consult the more detailed documentation at http://www.modbus.org.

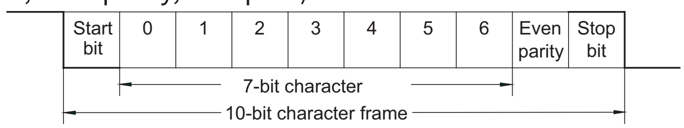
Data Format

ASCII Mode: 10-bit character frame (For 7-bit character):

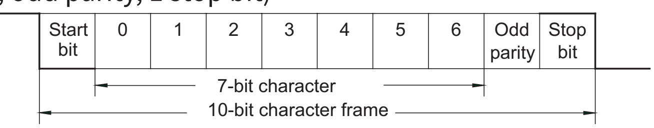
P09.04 = 01 (7 data bits, no parity, 2 stop bits)



P09.04 = 02 (7 data bits, even parity, 1 stop bit)

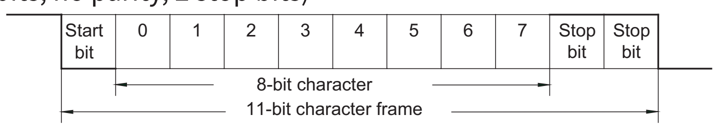


P09.04 = 03 (7 data bits, odd parity, 1 stop bit)

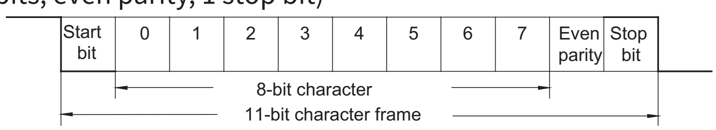


RTU Mode: 11-bit character frame (For 8-bit character):

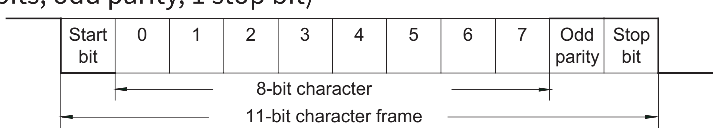
P09.04 = 13 (8 data bits, no parity, 2 stop bits)



P09.04 = 14 (8 data bits, even parity, 1 stop bit)



P09.04 = 15 (8 data bits, odd parity, 1 stop bit)



Communication Protocol

ASCII Mode:

STX	Start Character: (3AH)
ADR 1	Communication Address: 8-bit address consists of 2 ASCII codes
ADR 0	
CMD 1	
CMD 0	
DATA (n-1)	Contents of data: n x 8-bit data consists of 2n ASCII codes. n ≤ 25 maximum of 50 ASCII codes
....	
DATA 0	
LRC CHK 1	LRC check sum: 8-bit check sum consists of 2 ASCII codes
LRC CHK 0	
END 1	END characters: END 1 = CR (0DH); END 0 = LF (0AH)
END 0	

RTU Mode:

START	A silent interval of more than 10 ms
ADR	Communication Address: 8-bit address
CMD	Command Code: 8-bit command
DATA (n-1)	Contents of data: n x 8-bit data, n ≤ 25
....	
DATA 0	
CRC CHK Low	CRC check sum: 16-bit check sum consists of 2 8-bit characters
CRC CHK High	
END	A silent interval of more than 10 ms

ADR (Communication Address)

Valid communication addresses are in the range of 0 to 254. A communication address equal to 0 means broadcast to all AC drives, in which case the drives will not acknowledge any message from the master device.

For example, communication to AC drive with address 16 decimal:

- *ASCII mode: (ADR 1, ADR 0)='1','0' => '1'=31H, '0'=30H*
- *RTU mode: (ADR)=10H*

CMD (Command Code) and DATA (Data Characters)

The format of data characters depends on the command code. The available command codes are described as followed: Command code: 03H, read N words. The maximum value of N is 12. For example, reading continuous 2 words from starting address 2102H of the AC drive with address 01H.

ASCII mode:

Command Message	
STX	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'3'
Starting data address	'2'
	'1'
	'0'
	'2'
Number of data (Count by word)	'0'
	'0'
	'0'
	'2'
LRC CHK 1	'D'
LRC CHK 0	'7'
END 1	CR
END 0	LF

Response Message	
STX ':'	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'3'
Number of data (Count by byte)	'0'
	'4'
Content of starting data address 2102H	'1'
	'7'
	'7'
	'0'
Content data address 2103H	'0'
	'0'
	'0'
	'0'
LRC CHK 1	'7'
LRC CHK 0	'1'
END 1	CR
END 0	LF

RTU mode:

Command Message	
ADR	01H
CMD	03H
Starting data address	21H
	02H
Number of data (Count by word)	00H
	02H
CRC CHK Low	6FH
CRC CHK High	F7H

Response Message	
ADR	01H
CMD	03H
Number of data (Count by byte)	04H
	'0'
Content of data address 2102H	17H
	70H
Content of data address 2103H	00H
	02H
CRC CHK Low	FEH
CRC CHK High	5CH

Command code: 06H, write 1 word

For example, writing 6000(1770H) to address 0100H of the AC drive with address 01H.

ASCII mode:

Command Message			***Response Message***	
STX	':'		STX ':'	':'
ADR 1	'0'		ADR 1	'0'
ADR 0	'1'		ADR 0	'1'
CMD 1	'0'		CMD 1	'0'
CMD 0	'6'		CMD 0	'6'
Data Address	'0'		Data Address	'0'
	'1'			'1'
	'0'			'0'
	'0'			'0'
	'1'		Data Content	'1'
	'7'			'7'
	'7'			'7'
	'0'			'0'
LRC CHK 1	'7'		LRC CHK 1	'7'
LRC CHK 0	'1'		LRC CHK 0	'1'
END 1	CR		END 1	CR
END 0	LF		END 0	LF

RTU mode:

This is an example of using function code 16 for writing to multiple registers.

Command Message			***Response Message***	
ADR	01H		ADR	01H
CMD	10H		CMD	10H
Starting data address	20H		Starting data address	20H
	00H			00H
Number of registers	00H		Number of data (Count by word)	00H
	02H			02H
Byte count	04H		CRC CHK Low	4AH
Content of data address 2000H	00H		CRC CHK High	08H
	02H			
Content of data address 2001H	02H			
	58H			
CRC CHK Low	CBH			
CRC CHK High	34H			

NOTE Concerning 2100h: When GS30 drive is setup with reference RS-485 (P00.20 = 1 & drive in Remote/Auto) -OR- (P00.30 = 1 & drive in Local/Hand) -AND- Reference > P01.00 Drive Max Out Freq, the GS30 drive goes up to Max Out Freq and remains there until Max Out Freq is modified or a lower Freq Ref or a Stop Command is sent to the drive.

CHK (check sum)

ASCII Mode:

LRC (Longitudinal Redundancy Check) is calculated by summing up module 256, the values of the bytes from ADR1 to last data character, then calculating the hexadecimal representation of the 2's-complement negation of the sum.

For example, reading 1 word from address 0401h of the AC drive with address 01h.

Command Message	
STX	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'3'
Starting data address	'0'
	'4'
	'0'
	'1'
Number of data (Count by word)	'0'
	'0'
	'0'
	'1'
LRC CHK 1	'F'
LRC CHK 0	'6'
END 1	CR
END 0	LF

01h+03h+04h+01h+00h+01h=0Ah;
the 2's complement negation of 0Ah is F6h.

RTU Mode:

Response Message	
ADR	01h
CMD	03h
Starting data address	21h
	02h
Number of data (Count by word)	00h
	02h
CRC CHK Low	6Fh
CRC CHK High	F7h

CRC (Cyclical Redundancy Check) is calculated by the following steps:

10) Load a 16-bit register (called CRC register) with FFFFh.
11) Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.
12) Shift the CRC register one bit to the right with MSB zero filling. Extract and examine the LSB.
13) If the LSB of CRC register is 0, repeat step 3; else Exclusive or the CRC register with the polynomial value A001h.
14) Repeat step 3 and 4 until eight shifts have been performed. When this is done, a complete 8-bit byte will have been processed.
15) Repeat steps 2 to 5 for the next 8-bit byte of the command message.

Continue doing this until all bytes have been processed. The final contents of the CRC register are the CRC value.

When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, i.e. the lower order byte will be transmitted first.

The following is an example of CRC generation using C language. The function takes two arguments:

```
Unsigned char* data ← a pointer to the message buffer
Unsigned char length ← the quantity of bytes in the message buffer
    The function returns the CRC value as a type of unsigned integer.
        Unsigned int crc_chk(unsigned char* data, unsigned char length){
            int j;
            unsigned int reg_crc=0xFFFF;
            while(length--){
                        reg_crc ^= *data++;
                        for(j=0;j<8;j++){
                            if(reg_crc & 0x01){  /* LSB(b0)=1 */
                                reg_crc=(reg_crc>>1) ^ 0xA001;
                        }else{
                                reg_crc=reg_crc >>1;
                        }
                    }
                }
            return reg_crc;
        }
```

RTU mode is preferred. Limited support is available to ASCII users.

6

Table of Contents

Chapter 6: Maintenance and Troubleshooting

Maintenance and Inspections

Modern AC drives are based on solid state electronics technology, including ICs, resistors, capacitors, transistors, cooling fans, relays, etc. These components have a limited life under normal operation. Preventive maintenance is required to operate the GS30 drive in its optimal condition, and to ensure a long life. We recommend that a qualified technician perform a regular inspection of the GS30 drive. Some items should be checked once a month, and some items should be checked yearly.

NOTE: All inspections should be accomplished with Safety in mind with due and required caution. Some of these Inspection items may require the Drive to be powered down, while others may require power to be applied. Proper safety precautions including the use of PPE is required. Please review cautionary statements in each section.

Monthly Inspection

Check the following items at least once a month.

1) *Make sure the motors are operating as expected.*
2) *Make sure the drive installation environment is normal.*
3) *Make sure the enclosure and drive cooling systems are operating as expected.*
4) *Check for irregular vibrations or sounds during operation.*
5) *Make sure the motors are not overheating during operation.*
6) *Check the input voltage to the* GS30 *drive and make sure the voltage is within the operating range.*

Annual Inspection

Check the following items once annually.

1) *Check the torque of the GS30 power and control terminal screws and tighten if necessary. They may loosen due to vibration or changing temperatures.*
2) *Make sure the conductors and insulators are not corroded or damaged.*
3) *Check the resistance of cable insulation with a megohmmeter.*
4) *Clean off any dust and dirt with a vacuum cleaner. Pay special attention to cleaning the ventilation ports and PCBs. Always keep these areas clean. Accumulation of dust and dirt in these areas can cause unforeseen failures.*
5) *Recharge the capacitors of any drive that is in storage or is otherwise unused.*

Recharge Capacitors (for drives not in service)

Recharge the DC link before using any drive that has not been operated within a year:

1) *Disconnect the motor from the drive.*
2) *Apply input power to the drive for 2 hours.*

If the drive is stored or is otherwise unused for more than a year, the drive's internal DC link capacitors should be recharged before use. Otherwise, the capacitors may be damaged when the drive starts to operate. We recommend recharging the capacitors of any unused drive at least once per year.

Disconnect AC power and ensure that the internal capacitors have fully discharged before inspecting the GS30 drive! Wait at least FIVE minutes after all display lamps have turned off.

CAUTION

- ☑ Wait 5 seconds after a fault has been cleared before performing reset via keypad or input terminal.
- ☑ When the power is off after 5 minutes for ≤ 30hp models and 10 minutes for ≥ 40hp models, please confirm that the capacitors have fully discharged by measuring the voltage between + and -. The voltage between + and - should be less than 25VDC.
- ☑ Only qualified personnel can install, wire and maintain drives. Please take off any metal objects, such as watches and rings, before operation. And only insulated tools are allowed.
- ☑ Never reassemble internal components or wiring.
- ☑ Make sure that installation environment complies with regulations without abnormal noise, vibration and smell.

Recommended Inspection Schedules

Before the check-up, always turn off the AC input power and remove the cover. Wait at least 10 minutes after all display lamps have gone out, and then confirm that the capacitors have fully discharged by measuring the voltage between DC+ and DC-. The voltage between DC+ and DC-should be less than 25VDC.

Ambient environment

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
Check the ambient temperature, humidity, vibration and see if there are any dust, gas, oil or water drops	Visual inspection and measurement with equipment with standard specification	○		
If there are any dangerous objects	Visual inspection	○		

Voltage

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
Check if the voltage of main circuit and control circuit is correct	Measure with multimeter with standard specification	○		

Digital Keypad Display

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
Is the display clear for reading	Visual inspection	○		
Any missing characters	Visual inspection	○		

Mechanical parts

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there is any abnormal sound or vibration	Visual and audible inspection		○	
If there are any loose screws	Tighten the screws		○	
If any part is deformed or damaged	Visual inspection		○	
If there is any color change due to overheating	Visual inspection		○	
If there is any dust or dirt	Visual inspection		○	

Recommended Inspection Schedules (continued)

Main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there are any loose or missing screws	Tighten or replace the screw	○		
If any drive or wiring insulation is deformed, cracked, damaged or has changed color due to overheating or aging	Visual inspection **NOTE: Ignore any color change of copper plate**		○	
If there is any dust or dirt	Visual inspection		○	

Terminals and wiring of main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If the terminal color or the placement has changed due to overheating	Visual inspection		○	
If the wiring insulation is damaged or there has been a color change	Visual inspection		○	
If there is any damage	Visual inspection	○		

DC capacity of main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there is any liquid leaking, color change, crack or deformation	Visual inspection	○		
If the capacitor safety vent is bulging or inflated.	Visual inspection	○		
Measure static capacity when required (if drive overloads/faults during normal operation)	Measure with multimeter with standard specification	○		

Recommended Inspection Schedules (continued)

Resistor of main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there is any peculiar smell or insulation cracks due to overheating	Visual inspection, smell	○		
If there is any disconnection or discoloration	Visual inspection	○		
If the connection is damaged	Measure with a multimeter with standard specifications	○		

Transformer and reactor of main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there is any abnormal vibration or peculiar smell	Visual, audible inspection and smell	○		

Magnetic contactor and relay of main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there are any loose screws	Visual and audible inspection	○		
If the contact works correctly	Visual inspection	○		

Printed circuit board and connector of main circuit

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there are any loose screws and connectors	Tighten the screws and press the connectors firmly in place		○	
If there is any peculiar smell and/or color change	Visual and smell inspection		○	
If there is any crack, damage, deformation or corrosion	Visual inspection		○	
If there is any liquid leakage or deformation in capacity	Visual inspection		○	

Recommended Inspection Schedules (continued)

Cooling fan of cooling system

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there is any abnormal sound or vibration	Visual, audible inspection and turn the fan with hand (turn off the power before operation) to see if it rotates smoothly		○	
If there is any loose screw	Tighten the screw		○	
If there is any color change due to overheating	Change the fan		○	

Ventilation channel of cooling system

Check Items	Methods and Criteria	Maintenance Period		
		Daily	Half Year	One Year
If there is any obstruction in the heat sink, air intake or air outlet	Visual inspection		○	

Please use a clean lint free cloth for cleaning and use a dust cleaner to remove dust when necessary.

Troubleshooting

Warning Codes

The GS30 drive has a comprehensive diagnostic system that includes several different warning codes. The most common warning codes can be read on the digital keypad display.

For communication errors, "Upper unit" is referring to the Master controller of the serial network. Always ensure the communication settings of the drive (P09.01 and P09.04) match those of the master controller and network.

Warning Codes					
Display on GS30 Keypad	**ID No.**	**Warning Name and Description**	**Action and Reset**		**Corrective Action**
n/a	0	No error	n/a	n/a	n/a
CE1	1	Communication error 1 (CE1) RS-485 Modbus illegal function code.	Action Level	When the function code is 03, 06, 10, and 63	1) Check if the communication command is correct 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	"Warning" occurs when P09.02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct function code.	
			Reset condition	Immediately reset	
			Record	N/A	
CE2	2	Communication error 2 (CE2) RS-485 Modbus illegal data address	Action Level	When the input data address is incorrect	1) Check if the communication command is correct. 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	"Warning" occurs when P09.02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct data address.	
			Reset condition	Immediately reset	
			Record	N/A	
CE3	3	Communication error 3 (CE3) RS-485 Modbus illegal data value	Action Level	When the length of communication data is too long	1) Check if the communication command is correct. 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	"Warning" occurs when P09.02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct communication data value.	
			Reset condition	Immediately reset	
			Record	N/A	

(continued next page)

Warning Codes (continued)					
Display on GS30 Keypad	***ID No.***	***Warning Name and Description***	***Action and Reset***		***Corrective Action***
CE4	4	Communication error 4 (CE4) RS-485 Modbus data is written to read-only address	Action Level	When the data is written to read-only address	1) Check if the communication command is correct 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	"Warning" occurs when P09.02=0 and the motor drive keeps running. The drive resets automatically when receiving the correct written address of communication data.	
			Reset condition	Immediately reset	
			Record	N/A	
CE10	5	Communication error 10 (CE10) RS-485 Modbus transmission time-out	Action Level	When the communication time exceeds the detection time of P09.03 communication time-out	1) Check if the upper unit transmits the communication command within the setting time for P09.03. 2) Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
			Action Time	P09.03	
			Warning setting parameter	N/A	
			Reset method	"Warning" occurs when P09.02=0 and the motor drive keeps running. The drive resets automatically when receiving the next communication packet.	
			Reset condition	Immediately reset	
			Record	N/A	
SE1	7	Save error 1 (SE1) Keypad COPY error 1: Keypad copy time-out	Action Level	"SE1" warning occurs when the GS4-KPD optional keypad does not transmit the COPY command to the drive, and does not transmit any data to the drive again in 10 ms at the time you copy the parameters to the drive.	SE1: The causes of error are mostly communication problems between the keypad and control board. Potential causes include communication signal interference and the unacceptable communication command to the Slave. Check if the error occurs randomly, or only occurs when copying certain parameters (the error displays on the upper right corner of the copy page). If you cannot clear the error, please contact AutomationDirect Technical Support.
			Action Time	10 ms	
			Warning setting parameter	N/A	
			Reset method	Manual reset (or cycle power)	
			Reset condition	Immediately reset	
			Record	N/A	
SE2	8	Save error 2 (SE2) Keypad COPY error 2: parameter writing error	Action Level	"SE2" warning occurs when writing the parameters incorrectly at the time you copy parameters to the drive. For example, you copy the new firmware version with added parameters to the drive with old firmware version.	SE2: In this stage, the copied data has been transmitted to the Slave. The Slave compares and processes the copied data, and then saves the data to the Data ROM. During the process, the data error (should be attribution error) may occur, or the data cannot be saved to EEPROM. At this time, the warning occurs. Check the status of Data ROM and remove the error causes first. If you cannot clear the error, please contact AutomationDirect Technical Support.
			Action Time	N/A	
			Warning setting parameter	N/A	
			Reset method	Manual reset (or cycle power)	
			Reset condition	Immediately reset	
			Record	N/A	

(continued next page)

<table>
<tr><th colspan="6">Warning Codes (continued)</th></tr>
<tr><th>Display on GS30 Keypad</th><th>ID No.</th><th>Warning Name and Description</th><th colspan="2">Action and Reset</th><th>Corrective Action</th></tr>
<tr><td rowspan="6">oH1</td><td rowspan="6">9</td><td rowspan="6">IGBT over-heating warning (oH1)

The AC motor drive detects IGBT overheating and exceeds the protection level of oH1 warning. (When P06.15 is higher than the IGBT overheating protection level, the drive shows oH1 error without displaying oH1 warning.)</td><td>Action Level</td><td>P06.15</td><td rowspan="6">1) Check the ambient temperature.
2) Regularly inspect the ventilation hole of the control cabinet.
3) Change the installed location if there are heating objects, such as braking resistors, in the surroundings.
4) Install/add cooling fan or air conditioner to lower the temperature inside the cabinet.
5) Check for and remove obstructions or replace the cooling fan.
6) Increase ventilation space of the drive.
7) Decrease loading.
8) Decrease the carrier wave.
9) Replace the drive with higher capacity model.</td></tr>
<tr><td>Action Time</td><td>“oH1” warning occurs when IGBT temperature is higher than P06.15 setting value.</td></tr>
<tr><td>Warning setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Auto-reset</td></tr>
<tr><td>Reset condition</td><td>The drive auto-resets when IGBT temperature is lower than oH1 warning level minus (–) 5°C</td></tr>
<tr><td>Record</td><td>N/A</td></tr>
<tr><td rowspan="6">PId</td><td rowspan="6">11</td><td rowspan="6">PID feedback error (PID)

PID feedback loss (warning for analog feedback signal; works only when PID enables)</td><td>Action Level</td><td>When the analog input is lower than 4 mA (only detects analog input 4–20 mA)</td><td rowspan="6">1) Check the PID feedback wiring and tighten the terminals.
2) Replace the cable.
3) Replace the feedback device.
4) If the PID error still occurs after checking all the wiring, contact AutomationDirect Technical Support.</td></tr>
<tr><td>Action Time</td><td>P08.08</td></tr>
<tr><td>Warning setting parameter</td><td>P08.09 setting is:
0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: Warn and operate at last frequency</td></tr>
<tr><td>Reset method</td><td>1) Auto: “Warning” occurs when P08.09=0 or 3. The “Warning” automatically clears when the feedback signal is larger than 4 mA.
2) Manual: “Error” occurs when P08.09=1 or 2. You must reset manually.</td></tr>
<tr><td>Reset condition</td><td>Immediately reset</td></tr>
<tr><td>Record</td><td>Records when P08.09=1 or 2 (“Error”).
Does not record when P08.09=3 (“Warning”).</td></tr>
<tr><td colspan="6">(continued next page)</td></tr>
</table>

Warning Codes (continued)					
Display on GS30 Keypad	**ID No.**	**Warning Name and Description**	**Action and Reset**		**Corrective Action**
AnL	12	AI2 analog signal loss (AnL) Analog input current loss (including all analog 4–20 mA signals)	Action Level	When the analog input is lower than 4 mA (only detects analog input 4–20 mA)	1) Check the AI2 wiring and tighten the terminals. 2) Replace the cable. 3) Replace the external device. 4) If the AnL error still occurs after checking all the wiring, contact AutomationDirect Technical Support.
			Action Time	Immediately act	
			Warning setting parameter	P03.19 setting is: 0: Disable 1: Continue operation at the last frequency (warning, keypad displays ANL) 2: Decelerate to 0 Hz (warning, keypad displays ANL) 3: Stop immediately and display "ACE"	
			Reset method	1) Auto: "Warning" occurs when P03.19=1 or 2. The "Warning" automatically clears when the feedback signal is larger than 4 mA. 2) Manual: "Error" occurs when P03.19=3. You must reset manually.	
			Reset condition	Immediately reset	
			Record	Does not record when P03.19=1 or 2 ("Warning").	
uC	13	Under current (uC) Low current	Action Level	P06.71	1) Check for a broken motor cable, then exclude the connection issue of the motor and its load. 2) Verify low current protection settings. If needed, set the proper settings for P06.71, P06.72 and P06.73. 3) Check the loading status and make sure the loading matches the motor capacity.
			Action Time	P06.72	
			Warning setting parameter	P06.73 setting is: 0: No function 1: Fault and coast to stop 2: Fault and ramp to stop by the 2nd deceleration time 3: Warn and continue operation	
			Reset method	1) Auto: "Warning" occurs when P06.73=3. The "Warning" automatically clears when the output current is larger than (P06.71+0.1 A). 2) Manual: "Error" occurs when P06.73=1 or 2. You must reset manually.	
			Reset condition	Immediately reset	
			Record	Does not record when P06.73=3 and uC displays ("Warning").	
oSPd	17	Over speed warning (oSPd) Over speed warning	Action Level	The encoder feedback speed > P10.10	1) Verify setting of P10.25. Decrease value if needed. 2) Verify bandwidth setting for ASR speed control and increase the bandwidth setting if needed. 3) Reset motor parameter and run parameter tuning. 4) Verify the wiring of the control circuit, and the wiring/grounding of the main circuit to prevent interference.
			Action Time	P10.11	
			Warning setting parameter	P10.12=0 0: Warn and continue operation	
			Reset method	"Warning" automatically clears when the drive stops	
			Reset condition	"Warning" automatically clears when the drive stops	
			Record	N/A	

(continued next page)

<table>
<tr><th colspan="6">Warning Codes (continued)</th></tr>
<tr><th>Display on GS30 Keypad</th><th>ID No.</th><th>Warning Name and Description</th><th colspan="2">Action and Reset</th><th>Corrective Action</th></tr>
<tr><td rowspan="6">dAuE</td><td rowspan="6">18</td><td rowspan="6">Deviation Warning
(dAvE)

Over speed deviation warning</td><td>Action Level</td><td>P10.13</td><td rowspan="6">1) Verify parameter setting for slip error and reset value for P10.13 and P10.14 if needed.
2) Reset ASR parameters and set proper accel./ decel. time.
3) Verify motor status and remove any causes if the motor is locked.
4) Check status of the mechanical brake and verify the action timing of the system if the brake is not released.
5) Verify torque limit and adjust parameters P06.12 and P11.17-P11.20 as needed.
6) Verify the wiring of the control circuit, and the wiring/grounding of the main circuit to prevent interference.</td></tr>
<tr><td>Action Time</td><td>P10.14</td></tr>
<tr><td>Warning setting parameter</td><td>P10.15 Encoder Stall and Slip Error Action =0
0: Warn and continue operation</td></tr>
<tr><td>Reset method</td><td>“Warning” automatically clears when the drive stops</td></tr>
<tr><td>Reset condition</td><td>After the drive stops</td></tr>
<tr><td>Record</td><td>N/A</td></tr>
<tr><td rowspan="6">PHL</td><td rowspan="6">19</td><td rowspan="6">Phase loss
(PHL)

Input phase loss warning</td><td>Action Level</td><td>One of the phases outputs less than P06.47</td><td rowspan="6">1) Verify the wiring of the main circuit.
2) Verify a single-phase power input is not being used on a three-phase model. Use the model with voltage that matches the power.
3) If the power of main circuit works well, check if the MC of the main circuit is broken. Cycle the power after verifying the power is normal. If PHL still occurs, contact AutomationDirect Technical Support.
4) Tighten the terminal screws with the torque listed in the user manual.
5) Verify the input cable is not broken. Make sure the wiring is correct. Replace the broken part of the cable if needed.
6) Verify the three-phase power is not unbalanced.</td></tr>
<tr><td>Action Time</td><td>P06.46</td></tr>
<tr><td>Warning setting parameter</td><td>P06.45 Output Phase Loss Detection Action (OPHL) =0
0: Warn and continue operation</td></tr>
<tr><td>Reset method</td><td>“Warning” automatically clears when the drive stops</td></tr>
<tr><td>Reset condition</td><td>After the drive stops</td></tr>
<tr><td>Record</td><td>N/A</td></tr>
<tr><td colspan="6">(continued next page)</td></tr>
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<tr><th colspan="6">Warning Codes (continued)</th></tr>
<tr><th>Display on GS30 Keypad</th><th>ID No.</th><th>Warning Name and Description</th><th colspan="2">Action and Reset</th><th>Corrective Action</th></tr>
<tr><td rowspan="6">ot1</td><td rowspan="6">20</td><td rowspan="6">Over-torque 1 (ot1)

Over-torque 1 warning</td><td>Action Level</td><td>P06.07</td><td rowspan="6">1) Configure the settings for P06.07 and P06.08 again.
2) Check for mechanical error and remove the causes of malfunction.
3) Verify load and decrease the loading or replace with a motor with larger capacity if load is too high.
4) Verify accel/decel time and increase the setting values for P01.12–P01.19 (accel./ decel. time) if work cycle is too short.
5) Verify V/F voltage and adjust the V/F curve (Motor 1, P01.01–P01.08), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
6) Replace motor with a larger capacity motor.
7) Check for overload during low-speed operation and decrease the loading during low-speed operation or increase the motor capacity.
8) Verify torque compensation and adjust P07.26 torque compensation gain until the output current decreases and the motor does not stall.
9) Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for P07.09 speed tracking.</td></tr>
<tr><td>Action Time</td><td>P06.08</td></tr>
<tr><td>Warning setting parameter</td><td>P06.06 Over-torque Detection Selection (Motor 1) =1 or 3
0: No function
1: Continue operation after over-torque detection during constant speed operation
2: Stop after over-torque detection during constant speed operation
3: Continue operation after over-torque detection during RUN
4: Stop after over-torque detection during RUN</td></tr>
<tr><td>Reset method</td><td>When the output current < P06.07, the ot1 warning automatically clears</td></tr>
<tr><td>Reset condition</td><td>When the output current < P06.07, the ot1 warning automatically clears</td></tr>
<tr><td>Record</td><td>N/A</td></tr>
<tr><td colspan="6">(continued next page)</td></tr>
</table>

Warning Codes (continued)					
Display on GS30 Keypad	***ID No.***	***Warning Name and Description***	***Action and Reset***		***Corrective Action***
ot2	21	Over-torque (ot2) Over-torque 2 warning	Action Level	P06.10	1) Configure the settings for P06.10 and P06.11 again. 2) Check for mechanical error and remove the causes of malfunction. 3) Verify load and decrease the loading or replace with a motor with larger capacity if load is too high. 4) Verify accel/decel time and increase the setting values for P01.12–P01.19 (accel./ decel. time) if work cycle is too short. 5) Verify V/F voltage and adjust the V/F curve (Motor 2, P01.35–P01.42), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed). 6) Replace motor with a larger capacity motor. 7) Check for overload during low-speed operation and decrease the loading during low-speed operation or increase the motor capacity. 8) Verify torque compensation and adjust P07.71 torque compensation gain until the output current decreases and the motor does not stall. 9) Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for P07.09 speed tracking.
			Action Time	P06.11	
			Warning setting parameter	P06.09 Over-torque Detection Selection (Motor 2) =1 or 3 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	
			Reset method	When the output current < P06.10, the ot2 warning automatically clears	
			Reset condition	When the output current < P06.10, the ot2 warning automatically clears	
			Record	N/A	

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Warning Codes (continued)					
Display on GS30 Keypad	***ID No.***	***Warning Name and Description***	***Action and Reset***		***Corrective Action***
oH3	22_1	Motor over-heating (oH3) PTC Motor overheating warning. The AC motor drive detects the temperature inside the motor is too high	Action Level	P03.00=6 (PTC), PTC input level > P06.30 PTC level (default=50%)	1) Check if motor is locked and clear the motor lock status. 2) Verify load and decrease the loading or replace with a motor with larger capacity if load is too high. 3) Verify ambient temperature and change the installed location if there are heating devices in the surroundings, or install/add cooling fan or air conditioner to lower the ambient temperature. 4) Check the cooling system and ensure it's working normally. 5) Verify the motor fan is working and replace the fan if needed. 6) Verify duration of low speed operation. Decrease low-speed operation time. Change to dedicated motor for the drive. Increase the motor capacity. 7) Verify accel/decel time and increase setting values for P01.12–P01.19 (accel./ decel. time) if working cycle is too short. 8) Verify V/F voltage and adjust settings for P01.01–P01.08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed). 9) Verify the motor rated current matches the motor nameplate and configure the correct rated current value of the motor if needed. 10) Check the connection between PTC thermistor and the heat protection. 11) Verify stall prevention setting and set the stall prevention to the proper value if needed. 12) Check for unbalanced three-phase motor impedance. Replace the motor if needed. 13) Verify harmonics and reduce harmonics if too high.
			Action Time	Immediately act	
			Warning setting parameter	Error treatment: P06.29 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning When P06.29=0 and when the temperature is ≤ P06.30 level, the oH3 warning automatically clears. When P06.29=0 ("Warning"), it automatically resets.	
			Reset method	When P06.29=0, oH3 displays as "Warning". When the temperature is ≤ P06.30 level, the oH3 warning automatically clears.	
			Reset condition	When the temperature is ≤ P06.30 level, the oH3 warning automatically clears.	
			Record	N/A	
oSL	24	Over slip warning (oSL) Over slip warning. By using the maximum slip (P10.29) as the base, when the drive outputs at constant speed, and the F>H or F<H exceeds P07.29 level and P.07.30 setting time, 100% P07.29 = P10.29.	Action Level	When the drive outputs at constant speed, and F>H or F<H exceeds the P07.29 level	1) Check the motor parameter. 2) Verify load and decrease the loading if needed. 3) Verify the parameter settings for oSL protection (P07.29, P07.30, and P10.29) are correctly set.
			Action Time	P07.30	
			Warning setting parameter	P07.31=0 Warning 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	
			Reset method	When P07.31=0 and when the drive outputs at constant speed, and F>H or F<H no longer exceeds the P07.29 level, the oSL warning automatically clears.	
			Reset condition	N/A	
			Record	N/A	

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Warning Codes (continued)					
Display on GS30 Keypad	**ID No.**	**Warning Name and Description**	**Action and Reset**		**Corrective Action**
tUn	25	Auto tuning (tUn) Parameter auto-tuning is processing. When running auto-tuning, the keypad displays “tUn”.	Action Level	When running P05.00 motor parameter auto-tuning, the keypad displays “tUn”.	When the auto-tuning is finished, the warning automatically clears.
			Action Time	N/A	
			Warning setting parameter	N/A	
			Reset method	When auto-tuning is finished and no error occurs, the warning automatically clears.	
			Reset condition	When auto-tuning is finished and no error occurs.	
			Record	N/A	
oPHL	28	Output phase loss (oPHL) Output phase loss of the drive	Action Level	P06.47	1) Check for unbalanced three-phase motor impedance and replace the motor if needed. 2) Check the cable and replace if needed. 3) Ensure a three-phase motor is being used. 4) Check if the control board cable is loose. If yes, reconnect the cable and run the drive to test. If the error still occurs, contact AutomationDirect Technical Support. 5) Check if the three-phase current is balanced with a current clamp meter. If the current is balanced and the oPHL error still shows on the display, contact AutomationDirect Technical Support. 6) Verify the drive’s capacity matches or exceeds the motor’s.
			Action Time	N/A	
			Warning setting parameter	P06.45 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning	
			Reset method	If P06.45 is set to 0, the oPHL warning automatically clears after the drive stops.	
			Reset condition	N/A	
			Record	N/A	
SE3	30	Copy model error 3 (SE3) Keypad COPY error 3: copy model error	Action Level	“SE3” warning occurs when different drive identity codes are found during copying parameters.	It is mainly to prevent parameter copies between different HP/models.
			Action Time	Immediately act when the error is detected	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	N/A	
			Record	N/A	

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<table>
<tr><th colspan="6">Warning Codes (continued)</th></tr>
<tr><th>Display on GS30 Keypad</th><th>ID No.</th><th>Warning Name and Description</th><th colspan="2">Action and Reset</th><th>Corrective Action</th></tr>
<tr><td rowspan="6">ot3</td><td rowspan="6">31</td><td rowspan="6">Over-torque (ot3)

Over-torque 3 warning</td><td>Action Level</td><td>P14.75</td><td rowspan="6">1) Configure the settings for P14.75 and P14.76 again.
2) Check for mechanical error and remove the causes of malfunction.
3) Verify load and decrease the loading or replace with a motor with larger capacity if load is too high.
4) Verify accel/decel time and increase the setting values for P01.12–P01.19 (accel./ decel. time) if work cycle is too short.
5) Verify V/F voltage and adjust the V/F curve (Motor 3, P01.54–P01.61), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed).
6) Replace motor with a larger capacity motor.
7) Check for overload during low-speed operation and decrease the loading during low-speed operation or increase the motor capacity.
8) Verify torque compensation and adjust P07.73 torque compensation gain until the output current decreases and the motor does not stall.
9) Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for P07.09 speed tracking.</td></tr>
<tr><td>Action Time</td><td>P14.76</td></tr>
<tr><td>Warning setting parameter</td><td>P14.74 Over-torque Detection Selection (Motor 3) =1 or 3
0: No function
1: Continue operation after over-torque detection during constant speed operation
2: Stop after over-torque detection during constant speed operation
3: Continue operation after over-torque detection during RUN
4: Stop after over-torque detection during RUN</td></tr>
<tr><td>Reset method</td><td>When the output current < P14.75, the ot3 warning automatically clears</td></tr>
<tr><td>Reset condition</td><td>When the output current < P14.75, the ot3 warning automatically clears</td></tr>
<tr><td>Record</td><td>N/A</td></tr>
<tr><td colspan="6">(continued next page)</td></tr>
</table>

Warning Codes (continued)

Display on GS30 Keypad	ID No.	Warning Name and Description	Action and Reset		Corrective Action
ot4	32	Over-torque (ot4) Over-torque 4 warning	Action Level	P14.78	1) Configure the settings for P14.78 and P14.79 again. 2) Check for mechanical error and remove the causes of malfunction. 3) Verify load and decrease the loading or replace with a motor with larger capacity if load is too high. 4) Verify accel/decel time and increase the setting values for P01.12–P01.19 (accel./ decel. time) if work cycle is too short. 5) Verify V/F voltage and adjust the V/F curve (Motor 3, P01.63–P01.70), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed). 6) Replace motor with a larger capacity motor. 7) Check for overload during low-speed operation and decrease the loading during low-speed operation or increase the motor capacity. 8) Verify torque compensation and adjust P07.75 torque compensation gain until the output current decreases and the motor does not stall. 9) Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for P07.09 speed tracking.
			Action Time	P14.79	
			Warning setting parameter	P14.77 Over-torque Detection Selection (Motor 4) =1 or 3 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN	
			Reset method	When the output current < P14.78, the ot4 warning automatically clears	
			Reset condition	When the output current < P14.79, the ot4 warning automatically clears	
			Record	N/A	
PLod	50	PLC opposite defect (PLod) PLC download error warning	Action Level	During PLC downloading, the program source code detects incorrect address (e.g. the address exceeds the range), then the PLod warning occurs.	Verify the data number used when downloading the PLC program and use the correct data number.
			Action Time	Immediately act when the fault is detected	
			Warning setting parameter	N/A	
			Reset method	Check if the program is correct and download the program again. If the fault does not exist, the warning automatically clears.	
			Reset condition	N/A	
			Record	N/A	
PLSv	51	PLC save memory error (PLSv) Data error during PLC operation	Action Level	The program detects incorrect written address (e.g. the address exceeds the range) during PLC operation, then the PLSv warning occurs.	Make sure the written address is correct and download the program again.
			Action Time	Immediately act when the fault is detected	
			Warning setting parameter	N/A	
			Reset method	Check if the program is correct and download the program again. If the fault does not exist, the warning automatically clears.	
			Reset condition	N/A	
			Record	N/A	

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Warning Codes (continued)					
Display on GS30 Keypad	**ID No.**	**Warning Name and Description**	**Action and Reset**		**Corrective Action**
PLdA	52	Data defect (PLdA) Data error during PLC operation	Action Level	The program detects incorrect written address when translating the program source code (e.g. the address exceeds the range) during PLC downloading, then PLdA warning occurs.	Check if the upper unit transmits the correct command.
			Action Time	Immediately act when the fault is detected	
			Warning setting parameter	N/A	
			Reset method	Check if the program is correct and download the program again. If the fault does not exist, the warning automatically clears.	
			Reset condition	N/A	
			Record	N/A	
PLFn	53	Function defect (PLFn) PLC download function code error	Action Level	The program detects incorrect command (unsupported command) during PLC downloading, then PLFn warning occurs.	Check the drive firmware and if not the latest version, download and install the latest version from the ADC support website
			Action Time	Immediately act when the fault is detected	
			Warning setting parameter	N/A	
			Reset method	Check if the program is correct and download the program again. If the fault does not exist, the warning automatically clears.	
			Reset condition	N/A	
			Record	N/A	
PLor	54	PLC buffer overflow (PLor) PLC register overflow	Action Level	When PLC runs the last command and the command exceeds the maximum capacity of the program, then PLor warning occurs.	Follow the steps below to reset the PLC software: 1) Disable PLC 2) Reset the PLC program (P00.02=6) 3) Enable PLC 4) Re-download the PLC program
			Action Time	Immediately act when the fault is detected	
			Warning setting parameter	N/A	
			Reset method	Check if the program is correct and download the program again. If the fault does not exist, the warning automatically clears.	
			Reset condition	N/A	
			Record	N/A	

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Warning Codes (continued)					
Display on GS30 Keypad	**ID No.**	**Warning Name and Description**	**Action and Reset**		**Corrective Action**
PLFF	55	Function defect (PLFF) Function code error during PLC operation	Action Level	The program detects incorrect command (unsupported command) during PLC operation, then PLFF warning occurs.	When starting the PLC function and there is no program in the PLC, the PLFF warning occurs. This is a normal warning, please download the program.
			Action Time	Immediately act when the fault is detected	
			Warning setting parameter	NA	
			Reset method	Check if the program is correct and download the program again. If the fault does not exist, the warning automatically clears.	
			Reset condition	N/A	
			Record	N/A	
PLSn	56	Checksum error (PLSn) PLC checksum error	Action Level	PLC checksum error is detected after the drive is powered on, then PLSn warning occurs.	Follow the steps below to reset the PLC software: 1) Disable PLC 2) Reset the PLC program (P00.02=6) 3) Enable PLC 4) Re-download the PLC program
			Action Time	Immediately act when the fault is detected	
			Warning setting parameter	NA	
			Reset method	Check if the program is correct and download the program again. If the fault does not exist, the warning automatically clears.	
			Reset condition	N/A	
			Record	N/A	
PLEd	57	No end command (PLEd) PLC end command is missing	Action Level	The “End” command is missing. Until the last command is executed, the PLEd warning occurs.	Follow the steps below to reset the PLC software: 1) Disable PLC 2) Reset the PLC program (P00.02=6) 3) Enable PLC 4) Re-download the PLC program
			Action Time	Immediately act when the fault is detected	
			Warning setting parameter	NA	
			Reset method	Check if the program is correct and download the program again. If the fault does not exist, the warning automatically clears.	
			Reset condition	N/A	
			Record	N/A	
PLCr	58	PLC MCR error (PLCr) PLC MCR command error	Action Level	The MC command is detected during PLC operation, but there is no corresponding MCR command, then the PLCr warning occurs.	The MC command cannot be used continuously for 9 times. Check and reset the program, then re-download the program.
			Action Time	Immediately act when the fault is detected	
			Warning setting parameter	NA	
			Reset method	Check if the program is correct and download the program again. If the fault does not exist, the warning automatically clears.	
			Reset condition	N/A	
			Record	N/A	

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Warning Codes (continued)					
Display on GS30 Keypad	**ID No.**	**Warning Name and Description**	**Action and Reset**		**Corrective Action**
PLdF	59	PLC download fail (PLdF) PLC download failure	Action Level	PLC download failure due to momentary power loss during download. After the power is again present, the PLdF warning occurs.	Check for programming errors, if they exist, correct and download the program again.
			Action Time	Immediately act when the fault is detected	
			Warning setting parameter	NA	
			Reset method	Check for programming errors, if they exist, correct and download the program again. If the fault does not exist, the warning automatically clears.	
			Reset condition	N/A	
			Record	N/A	
PLSF	60	PLC scan time fail (PLSF) PLC scan time exceeds the maximum allowable time	Action Level	When the PLC scan time exceeds the maximum allowable time (400 ms), the PLSF warning occurs.	Check for Source Code errors, if they exist, correct and download the program again.
			Action Time	Immediately act when the fault is detected	
			Warning setting parameter	NA	
			Reset method	Check for programming errors, if they exist, correct and download the program again. If the fault does not exist, the warning automatically clears.	
			Reset condition	N/A	
			Record	N/A	
EC id	70	ExCOM ID fail (ECid) Duplicate MAC ID error Node address setting error	Action Level	Duplicate setting of MAC ID, Node address setting error	1) If setting address exceeds the range (0–63), check the address setting of the communication card (P09.70). 2) If the speed setting exceeds the range, standard: 0–2, non-standard: 0–7. 3) If the address is duplicated with other nodes on the bus, reset the address.
			Action Time	N/A	
			Warning setting parameter	N/A	
			Reset method	Correct the setting and cycle the power.	
			Reset condition	N/A	
			Record	N/A	
ECLv	71	ExCom power loss (ECLv) Low voltage of the communication card	Action Level	The 5V power that the drive provides to the communication card is too low	1) Make sure the communication card is well inserted and not loose. 2) Use the same communication card with another GS30 drive to check if the ECLv warning still occurs. If yes, replace with a new communication card; if not, replace the drive. 3) Use another communication card to test if the ECLv warning still occurs on the same drive. If not, replace the card; if yes, replace the drive.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Cycle the power	
			Reset condition	N/A	
			Record	N/A	
ECtt	72	ExCom test mode (ECtt) The communication card is in the test mode	Action Level	The communication card is in the test mode	Cycle the power
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Cycle the power and enter the normal mode	
			Reset condition	N/A	
			Record	N/A	

(continued next page)

Warning Codes (continued)					
Display on GS30 Keypad	**ID No.**	**Warning Name and Description**	**Action and Reset**		**Corrective Action**
ECbF	73	ExCom Bus off (ECbF) The communication card detects too many errors in the BUS, then enters the bus-off status and stops communicationg.	Action Level	When the drive detects bus-off (for DeviceNet)	1) Check for poor cable connection and re-connec the cable 2) Cable may be bad, replace entire cable.
			Action Time	Immediately acts	
			Warning setting parameter	N/A	
			Reset method	Cycle the power	
			Reset condition	N/A	
			Record	N/A	
ECnP	74	ExCom no power (ECnP) There is no power supply on the DeviceNet	Action Level	There is no power supply on the DeviceNet	Check if the cable and power is normal. If yes, return device to AutomationDirect.
			Action Time	Immediately acts	
			Warning setting parameter	N/A	
			Reset method	Re-power	
			Reset condition	N/A	
			Record	N/A	
ECFF	75	ExCom factory defect (ECFF) Factory default setting error	Action Level	Factory default setting error	Use GSoft2 to download a new parameter set into the drive.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Cycle the power	
			Reset condition	N/A	
			Record	N/A	
EC iF	76	ExCom inner error (ECiF) Serious internal error	Action Level	Internal memory saving error	1) Verify the wiring of the control circuit, and the wiring/grounding of the main circuit to prevent interference. 2) Cycle the power. 3) Reset to the default value and check if the error still exists. If yes, replace the communication card.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Cycle the power	
			Reset condition	N/A	
			Record	N/A	
ECPP	78	ExCom parameter data error (ECPP) Profibus parameter data error	Action Level	N/A	The GSD file is incorrect - get the correct GSD file from the software.
			Action Time	N/A	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Immediately reset	
			Record	N/A	
ECP i	79	ExCom configuration data error (ECPi) Profibus configuration data error	Action Level	N/A	The GSD file is incorrect - get the correct GSD file from the software.
			Action Time	N/A	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Immediately reset	
			Record	N/A	
ECEF	80	Ethernet link fail (ECEF) The Ethernet cable is not connected	Action Level	Hardware detection	1) Re-connect the cable 2) Replace the cable
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	N/A	
			Record	N/A	
ECto	81	Communication time-out (ECto) Communication time-out for communication card and the upper limit	Action Level	N/A	1) Check the connection of the communication cable and re-connect if needed. 2) Check communication of upper unit
			Action Time	N/A	
			Warning setting parameter	N/A	
			Reset method	N/A	
			Reset condition	CMC-EC01: auto resets when the communication with the upper unit is back to normal.	
			Record	N/A	

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Warning Codes (continued)					
Display on GS30 Keypad	***ID No.***	***Warning Name and Description***	***Action and Reset***		***Corrective Action***
ECCS	82	Checksum error (ECCS) Checksum error for the communication card and the drive	Action Level	Software detection	Verify the wiring of the control circuit, and the wiring/grounding of the main circuit to prevent interference.
			Action Time	N/A	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Immediately reset	
			Record	N/A	
ECrF	83	Return defect (ECrF) Communication card returns to the default setting	Action Level	Communication card returns to the default setting	No actions required.
			Action Time	N/A	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Immediately reset	
			Record	N/A	
ECo0	84	Modbus TCP over (ECo0) Modbus TCP exceeds the maximum communication value	Action Level	Hardware detection	1) Verify the Master communication value does not exceed the allowable number of communication cards. If it does, decrease the Master communication value. 2) Check if the connection is occupied due to not disconnecting the Modbus TCP while the upper unit is connected without communicating. If it is, revise the program of the upper unit to disconnect the connection while the communication is not used for a long time. 3) Check if a new Modbus TCP connection is built whenever the upper unit is connected to the communication card. If so, revise the program of the upper unit to use the same Modbus TCP connection when connecting to the same communication card.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Immediately reset	
			Record	N/A	
ECo1	85	EtherNet/IP over (ECo1) EtherNet/IP exceeds the maximum communication value	Action Level	Hardware detection	1) Verify the Master communication value does not exceed the allowable number of communication cards. If it does, decrease the Master communication value. 2) Check if the connection is occupied due to not disconnecting the Modbus TCP while the upper unit is connected without communicating. If it is, revise the program of the upper unit to disconnect the connection while the communication is not used for a long time. 3) Check if a new Modbus TCP connection is built whenever the upper unit is connected to the communication card. If so, revise the program of the upper unit to use the same Modbus TCP connection when connecting to the same communication card.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Immediately reset	
			Record	N/A	
ECiP	86	IP fail (ECiP) IP setting error	Action Level	Software detection	1) Reset IP 2) Contact MIS to check if DHCP Server works normally
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Immediately reset	
			Record	N/A	

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Warning Codes (continued)					
Display on GS30 Keypad	***ID No.***	***Warning Name and Description***	***Action and Reset***		***Corrective Action***
EC3F	87	Mail fail (EC3F) Mail warning. Alarm mail will be sent when the communication card establishes alarm conditions	Action Level	Communication card establishes alarm conditions	No action.
			Action Time	Immediately acts	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Immediately resets	
			Record	N/A	
ECbY	88	ExCom busy (ECbY) Communication card busy: too many packets are received	Action Level	Software detection	Decrease communication packets
			Action Time	N/A	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	N/A	
			Record	N/A	
ECCb	89	ExCom card break (ECCb) Communication card break off warning	Action Level	Communication card break off	Re-install the communication card
			Action Time	N/A	
			Warning setting parameter	N/A	
			Reset method	Auto-resets after the communication card is re-installed	
			Reset condition	Immediately reset	
			Record	N/A	
CPLP	90	Copy PLC: password error (CPLP) Copy PLC password error. When PLC copy is processing and the PLC password is incorrect, the CPLP warning occurs.	Action Level	PLC password is incorrect	Reset and enter the correct PLC password
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Directly reset	
			Record	N/A	
CPL0	91	Copy PLC: Read mode error (CPL0) Copy PLC read mode error	Action Level	Incorrect process when copying the PLC read mode	Cycle the power and copy the PLC read mode again
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Directly reset	
			Record	N/A	
CPL1	92	Copy PLC: Write mode (CPL1) Copy PLC write mode error	Action Level	Incorrect process when copying the PLC write mode	Cycle the power and copy the PLC write mode again
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Directly reset	
			Record	N/A	
CPLv	93	Copy PLC: version error (CPLv) Copy PLC version error. When a non-GS30 built-in PLC is copied to the GS30 drive, the CPLv warning occurs.	Action Level	Software detection	Check if the copied PLC program is for GS30. If not, use the correct GS30 PLC program.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Directly reset	
			Record	N/A	
CPLS	94	Copy PLC: size error (CPLS) Copy PLC capacity error	Action Level	Software detection	Check if the copied PLC program is for GS30. Use the correct capacity for the GS30 PLC program.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Directly reset	
			Record	N/A	

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Warning Codes (continued)					
Display on GS30 Keypad	***ID No.***	***Warning Name and Description***	***Action and Reset***		***Corrective Action***
CPLF	95	Copy PLC: PLC function (CPLF) Copy PLC function must be executed when PLC is disabled.	Action Level	Software detection	Disable the PLC function first, and then run the PLC copy function again.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Directly reset	
			Record	N/A	
CPLt	96	Copy PLC: time-out (CPLt) Copy PLC time-out	Action Level	Software detection	The GS30-KPD cannot be removed during the PLC copy process
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Manual reset	
			Reset condition	Directly reset	
			Record	N/A	
ictn	101	InrCOM time-out (ictn) Internal communication time-out	Action Level	When P09.31= (-1) – (-10) (no -9) and the internal communication between Master and Slave is abnormal, the ictn warning occurs.	1) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 2) Check if the setting for P09.04 is the same as the setting for the upper unit 3) Check the cable and replace it if necessary.
			Action Time	Immediately act	
			Warning setting parameter	N/A	
			Reset method	Auto-reset	
			Reset condition	The warning automatically clears when the communication is back to normal condition	
			Record	N/A	

Fault Codes

The GS30 drive has a comprehensive fault diagnostic system that include a variety of fault messages. When a fault is detected, the GS30 drive will shut down in order to protect internal components. The following faults are displayed as shown on the GS30 digital keypad display.

For communication errors, “Upper unit” is referring to the Master controller of the serial network. Always ensure the communication settings of the drive (P09.01 and P09.04) match those of the master controller and network.

Gaps in the fault ID numbers below are set aside as “reserved” faults for possible future use. Should your GS30 drive repeatedly display a reserved fault, please note the fault ID number and contact AutomationDirect technical support.

Fault Codes

Display on GS30 Keypad	ID No.	Fault Name and Description	Action, Reset, and Corrective Action	
ocA	1	Over-current during acceleration (ocA) Output current exceeds three times of the rated current during acceleration. When ocA occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocA error.	Action Level	300% of the rated current
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Check acceleration time. If too short: a) Increase the acceleration time b) Increase the acceleration time of S-curve c) Set auto-acceleration and auto-deceleration parameter (P01.44) d) Set over-current stall prevention function (P06.03) e) Replace the drive with a larger capacity model. 2) Check the motor cable and remove causes of any short circuits, or replace the cable before turning on the power. 3) Check the motor insulation value with megger. Replace the motor if the insulation is poor. 4) Check if the output current during the whole working process exceeds the AC motor drive’s rated current. If yes, replace the AC motor drive with a larger capacity model. 5) Reduce the load or increase the capacity of AC motor drive. 6) Check the motor capacity (the rated current on the motor’s nameplate should ≤ the rated current of the drive). 7) Check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage. 8) Adjust the V/F curve setting and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage. 9) Adjust the torque compensation (refer to P07.26 torque compensation gain) until the output current reduces and the motor does not stall. 10) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference. 11) Enable speed tracking during start-up of P07.12. 12) Correct the parameter settings for speed tracking. a) Start the speed tracking function. b) Adjust the maximum current for P07.09 speed tracking. 13) Check the settings for P00.11 control mode: a) For IM, P00.11=0, 1, 2, 5 b) For PM, P00.11=2 14) Increase the AC motor drive’s capacity. 15) Install AC reactor(s) on the output side (U/V/W).

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Fault Codes (continued)				
Display on GS30 Keypad	ID No.	Fault Name and Description	Action, Reset, and Corrective Action	
ocA	1	ocA (continued)	Corrective Actions (cont'd)	16) In the case of hardware failure, the ocA occurs due to the short circuit or ground fault at the output side of the drive. a) Check for possible short circuits between terminals with the electric meter: b) B1 corresponds to U, V and W; DC- corresponds to U, V and W; corresponds to U, V and W. c) If short circuit occurs, contact AutomationDirect Technical Support. 17) Check the stall prevention setting and set the stall prevention to the proper value.
ocd	2	Over-current during deceleration (ocd) Output current exceeds three times of the rated current during deceleration. When ocd occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocd error.	Action Level	300% of the rated current
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Check if the deceleration time is too short. If so: a) Increase the deceleration time b) Increase the deceleration time of S-curve c) Set auto-acceleration and auto-deceleration parameter (P01.44) d) Set over-current stall prevention function (P06.03) e) Replace the drive with a larger capacity model 2) Check if the mechanical brake of the motor activates too early. 3) Check the motor cable and remove causes of any short circuits, or replace the cable before turning on the power. 4) Check the motor insulation value with megger. Replace the motor if the insulation is poor. 5) Check if the output current during the whole working process exceeds the AC motor drive's rated current. If yes, replace the AC motor drive with a larger capacity model. 6) Check the impulsive change of the load and reduce the load or increase the capacity of AC motor drive as needed. 7) Verify the motor capacity, the rated current on the motor's nameplate should ≤ the rated current of the drive. 8) If using an ON/OFF controller at the (U/V/W) drive output, check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage. 9) Adjust the V/F curve settings and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage. 10) Adjust the P07.26 torque compensation gain until the output current reduces and the motor does not stall. 11) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference. 12) Check the length of the motor cable. If it is too long, increase the AC motor drive's capacity or install AC reactor(s) on the output side (U/V/W). 13) In the case of a hardware error, the ocd occurs due to the short circuit or ground fault at the output side of the drive. a) Check for possible short circuits between terminals with the electric meter: b) B1 corresponds to U, V and W; DC- corresponds to U, V and W; corresponds to U, V and W. c) If short circuits occurs, contact AutomationDirect Technical Support. 14) Verify the stall prevention setting and set the stall prevention to the proper value.

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<table>
<tr><th colspan="5">Fault Codes (continued)</th></tr>
<tr><th>Display on GS30 Keypad</th><th>ID No.</th><th>Fault Name and Description</th><th colspan="2">Action, Reset, and Corrective Action</th></tr>
<tr><td rowspan="7">ocn</td><td rowspan="7">3</td><td rowspan="7">Over-current during steady operation (ocn)

Output current exceeds three times of the rated current during constant speed.
When ocn occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ocn error.</td><td>Action Level</td><td>300% of the rated current</td></tr>
<tr><td>Action Time</td><td>Immediately act</td></tr>
<tr><td>Fault setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Manual reset</td></tr>
<tr><td>Reset condition</td><td>Reset in five seconds after the fault is cleared</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td>Corrective Actions</td><td>1) Check the motor cable and remove causes of any short circuits, or replace the cable before turning on the power.
2) Check for possible shaft lock, burnout or aging insulation of the motor.
a) Check the motor insulation value with megger. Replace the motor if the insulation is poor.
3) Check for impulsive change of the load, and reduce the load or increase the capacity of AC motor drive.
4) Check motor capacity (the rated current on the motor’s nameplate should ≤ the rated current of the drive)
5) If using an ON/OFF controller at the drive output, check the action timing of the contactor and make sure it is not turned ON/OFF when the drive outputs the voltage.
6) Adjust the V/F curve settings and frequency/voltage. When the fault occurs, and the frequency voltage is too high, reduce the voltage.
7) Adjust P07.26 torque compensation gain until the output current reduces and the motor does not stall.
8) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference.
9) Check the length of the motor cable. If too long:
a) Increase the AC motor drive’s capacity.
b) Install AC reactor(s) on the output side (U/V/W).
10) In the case of hardware failure, the ocn may occur due to a short circuit or ground fault at the output side of the drive.
a) Check for possible short circuit between terminals with the electric meter:
b) B1 corresponds to U, V and W; DC- corresponds to U, V, and W; corresponds to U, V, and W.
c) If short circuits occurs, contact AutomationDirect Technical Support.</td></tr>
<tr><td rowspan="7">GFF</td><td rowspan="7">4</td><td rowspan="7">Ground fault (GFF)

When the drive detects grounding short circuit on the output terminals (U/V/W), the drive closes the gate of the output immediately, the motor runs freely, and the display shows a GFF error.</td><td>Action Level</td><td>N/A</td></tr>
<tr><td>Action Time</td><td>N/A</td></tr>
<tr><td>Fault setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Manual reset</td></tr>
<tr><td>Reset condition</td><td>Reset in five seconds after the fault is cleared</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td>Corrective Actions</td><td>1) Check for motor burnout or aging insulation.
a) Check the motor insulation value with megger.
b) Replace the motor if the insulation is poor.
2) Check the cable for short circuits and replace the cable if needed.
3) If the motor cable length exceeds 100 m, decrease the setting value for the carrier frequency and take remedies to reduce stray capacitance.
4) Verify the grounding and wiring of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance.
5) Cycle the power after checking the status of motor, cable, and cable length. If GFF still exists, contact AutomationDirect Technical Support.
6) Refer to the corrective actions for ocn.
7) Refer to the corrective actions for ocA.
8) Refer to the corrective actions for ocd.</td></tr>
<tr><td colspan="5">(continued next page)</td></tr>
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Fault Codes (continued)				
Display on GS30 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
ocC	5	IGBT short circuit between upper bridge and lower bridge (occ) Short-circuit is detected between upper bridge and lower bridge of the IGBT module	Action Level	Hardware protection
			Action Time	Act immediately
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Rest in 5 seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Check the motor wiring. 2) Cycle the power. If occ still occurs, return to AutomationDirect.
ocS	6	Over-current at stop (ocS) Over-current or hardware failure in current detection at stop. Cycle the power after ocS occurs. If the hardware failure occurs, the display shows cd1, cd2 or cd3.	Action Level	300% of the rated current
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference. 2) Check if other error codes such as cd1–cd3 occur after cycling the power. If yes, return to the factory for repair.
ovA	7	Over-voltage during acceleration (ovA) DC bus over-voltage during acceleration. When ovA occurs, the drive closes the gate of the output, the motor runs freely, and the display shows an ovA error.	Action Level	230V series: 410VDC 460V series: 820VDC
			Action Time	Immediately act when the DC bus voltage is higher than the level
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset only when the DC bus voltage is lower than 90% of the over-voltage level
			Record	Yes
			Corrective Actions	1) Check acceleration. If too slow: a) Decrease the acceleration time b) Use a braking unit or DC bus c) Replace the drive with a larger capacity model. 2) Check the setting for stall prevention level. If the value is lower than no-load current, adjust it to be higher than no-load current. 3) Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes. 4) If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor. 5) Check for regenerative voltage of motor inertia. If regenerative voltage is being generated: a) Use over-voltage stall prevention function (P06.01) b) Use auto-acceleration and auto-deceleration setting (P01.44) c) Use a braking unit or DC bus 6) Check if the over-voltage Fault occurs after acceleration stops, which indicates acceleration time is too short. Do the following: a) Increase the acceleration time b) Set P06.01 over-voltage stall prevention c) Increase the setting value for P01.25 S-curve acceleration arrival time 2 7) The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is a ground fault on the motor cable, wiring box, or its internal terminals. 8) If using a braking resistor or brake unit, check the wiring. 9) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference.

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Fault Codes (continued)				
Display on GS30 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
oud	8	Over-voltage during deceleration (ovd) DC bus over-voltage during deceleration. When ovd occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ovd error.	Action Level	230V series: 410VDC 460V series: 820VDC
			Action Time	Immediately act when the DC bus voltage is higher than the level
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset only when the DC bus voltage is lower than 90% of the over-voltage level
			Record	Yes
			Corrective Actions	1) Deceleration time may be too short, resulting in too much regenerative energy. a) Increase the setting value of P01.13, P01.15, P01.17 and P01.19 (deceleration time) b) Connect a braking resistor, braking unit or DC bus on the drive. c) Reduce the braking frequency. d) Replace the drive with a larger capacity model. e) Use S-curve acceleration/deceleration. f) Use over-voltage stall prevention (P06.01). g) Use auto-acceleration and auto-deceleration (P01.44). h) Adjust the braking level (P07.01 or the bolt position of the braking unit). 2) Verify that the setting for stall prevention level is larger than no-load current 3) Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes. 4) If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor. 5) The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box, or its internal terminals. 6) If using a braking resistor or braking unit, check the wiring. 7) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference.
oun	9	Over-voltage during constant speed (ovn) DC bus over-voltage at constant speed. When ovn occurs, the drive closes the gate of the output immediately, the motor runs freely, and the display shows an ovn error.	Action Level	230V series: 410VDC 460V series: 820VDC
			Action Time	Immediately act when the DC bus voltage is higher than the level
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset only when the DC bus voltage is lower than 90% of the over-voltage level
			Record	Yes
			Corrective Actions	1) Check for impulsive change of the load, then do the following: a) Connect a brake resistor, braking unit or DC bus to the drive. b) Reduce the load. c) Replace the drive with a larger capacity model. d) Adjust the braking level (P07.01 or bolt position of the brake unit). 2) Verify the stall prevention level setting is higher than no-load current. 3) Check for regenerative voltage, then enable over-voltage stall prevention function (P06.01) or use a braking unit or DC bus 4) Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes. 5) If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor. 6) The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box, or its internal terminals. 7) If using a braking resistor or braking unit, check the wiring. 8) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference.

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Fault Codes (continued)				
Display on GS30 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
ouS	10	Over-voltage at stop (ovS) Over-voltage at stop	Action Level	230V series: 410VDC 460V series: 820VDC
			Action Time	Immediately act when the DC bus voltage is higher than the level
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset only when the DC bus voltage is lower than 90% of the over-voltage level
			Record	Yes
			Corrective Actions	1) Check if the input voltage is within the rated AC motor drive input voltage range, and check for possible voltage spikes. 2) If the phase-in capacitor or active power supply unit acts in the same power system, the input voltage may surge abnormally in a short time. In this case, install an AC reactor. 3) The ground short circuit current charges the capacitor in the main circuit through the power. Check if there is ground fault on the motor cable, wiring box, or its internal terminals. 4) If using a braking resistor or braking unit, check the wiring. 5) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference. 6) Check if other error codes such as cd1–cd3 occur after cycling the power. If yes, contact AutomationDirect Technical Support.
LuA	11	Low-voltage during acceleration (LvA) DC bus voltage is lower than P06.00 setting value during acceleration	Action Level	P06.00 230V series = 180VDC 460V series = 360VDC
			Action Time	Immediately act when the DC bus voltage is lower than P06.00
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset when the DC bus voltage is higher than P06.00 + 30 V
			Record	Yes
			Corrective Actions	1) Improve power supply condition. 2) Adjust voltage to the power range of the drive 3) Check the power system and increase the capacity of power equipment if needed. 4) The load may be too heavy. If so: a) Reduce the load. b) Increase the drive capacity. c) Increase the acceleration time. 5) Check the DC bus and install DC reactor(s). 6) Check for a short circuit plate or DC reactor installed between terminal +1 and +2. Connect short circuit plate or DC reactor between terminal +1 and +2. 7) If the error still exists, contact AutomationDirect Technical Support.
Lud	12	Low-voltage during deceleration (Lvd) DC bus voltage is lower than P06.00 setting value during deceleration	Action Level	P06.00 230V series = 180VDC 460V series = 360VDC
			Action Time	Immediately act when the DC bus voltage is lower than P06.00
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset when the DC bus voltage is higher than P06.00 + 30 V
			Record	Yes
			Corrective Actions	1) Improve power supply condition. 2) Adjust voltage to the power range of the drive 3) Check the power system and increase the capacity of power equipment if needed. 4) The fault may be triggered by sudden load. If so: a) Reduce the load. b) Increase the drive capacity. 5) Check the DC bus and install DC reactor(s).

(continued next page)

Fault Codes (continued)				
Display on GS30 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
Lvn	13	Low-voltage at constant speed (Lvn) DC bus voltage is lower than P06.00 setting value at constant speed	Action Level	P06.00 230V series = 180VDC 460V series = 360VDC
			Action Time	Immediately act when the DC bus voltage is lower than P06.00
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset when the DC bus voltage is higher than P06.00 + 30 V
			Record	Yes
			Corrective Actions	1) Improve power supply condition. 2) Adjust voltage to the power range of the drive 3) Check the power system and increase the capacity of power equipment if needed. 4) The fault may be triggered by sudden load. If so: a) Reduce the load. b) Increase the drive capacity. 5) Check the DC bus and install DC reactor(s).
LvS	14	Low-voltage at stop (LvS) DC bus voltage is lower than P06.00 setting value at stop or a hardware failure in voltage detection had occurred.	Action Level	P06.00 230V series = 180VDC 460V series = 360VDC
			Action Time	Immediately act when the DC bus voltage is lower than P06.00
			Fault setting parameter	N/A
			Reset method	Manual / Auto: 230V series: Lv level + 30VDC + 500ms 460V series: Lv level + 60VDC + 500ms
			Reset condition	500 ms
			Record	Yes
			Corrective Actions	1) Improve power supply condition. 2) Check if the power specification matches the drive. 3) Adjust voltage to the power range of the drive. 4) Cycle the power after checking the power. If LvS error still exists, return to the factory for repair. 5) Check the power system. 6) Increase the capacity of power equipment. 7) Install DC reactor(s).
orP	15	Phase loss protection (orP) Phase loss of power input	Action Level	When DC bus ripple is higher than the protection level, and the output current exceeds 50% of the rated current, the drive starts counting. When the counting value reaches the upper limit, an orP error occurs.
			Action Time	The action time varies with different output current.
			Fault setting parameter	P06.53
			Reset method	Manual reset
			Reset condition	Immediately reset when DC bus is higher than P07.00
			Record	Yes
			Corrective Actions	1) Verify the wiring of the main circuit power is installed correctly. 2) Check that a single-phase power supply is not being used with a three-phase model. Choose the model whose power matches the voltage. 3) Power voltage changes can trigger this fault. If the main circuit power works normally, verify the main circuit. Cycle the power after checking the power, if orP error still exists, contact AutomationDirect Technical Support. 4) Check for loose terminal wiring, tighten the terminal screws according to the torque described in the user manual. 5) Verify the input cable is undamaged and replace if needed. 6) Check for unbalanced three-phase input power.

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Fault Codes (continued)				
Display on GS30 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
oH1	16	IGBT overheating (oH1) IGBT temperature exceeds the protection level. Protection level is model default of P06.15 + 5°C	Action Level	Depending on the model power, model default of P06.15 +5°C. When the setting for P06.15 is higher than the oH1 level, oH1 error occurs instead of oH1 warning. An IGBT overheating error occurs, and the drive stops.
			Action Time	Immediately when limit is reached.
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset only when IGBT temperature is lower than oH1 error level minus (-) 10°C
			Record	Yes
			Corrective Actions	1) Check the ambient temperature. 2) Regularly inspect the ventilation hole of the control cabinet. 3) Change the installed location if there are heating objects, such as braking resistors, in the surroundings. 4) Install/add cooling fan or air conditioner to lower the temperature inside the cabinet. 5) Check for and remove obstructions or replace the cooling fan. 6) Increase ventilation space of the drive. 7) Decrease loading. 8) Decrease the carrier wave. 9) Replace the drive with higher capacity model.
oH2	17	Over-heat key components (oH2) The drive has detected the key components are overheating	Action Level	Refer to the overheat setpoint for each model.
			Action Time	The oH2 fault occurs when the temperature sensor of key components detects the temperature is higher than the protection level for 100ms.
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	The drive auto-resets when the temperature sensor of key components detects the temperature is lower than oH2 error level by 10ºC
			Record	Yes
			Corrective Actions	1) Check the ambient temperature. 2) Regularly inspect the ventilation hole of the control cabinet. 3) Change the installed location if there are heating objects, such as braking resistors, in the surroundings. 4) Install/add cooling fan or air conditioner to lower the temperature inside the cabinet. 5) Check for and remove obstructions or replace the cooling fan. 6) Increase ventilation space of the drive. 7) Decrease loading. 8) Decrease the carrier wave. 9) Replace the drive with higher capacity model. 10) Install reactor(s). 11) Reduce load changes.
tH1o	18	IGBT temperature detection failure (tH1o) IGBT hardware failure in temperature detection	Action Level	NTC broken or wiring failure
			Action Time	When the IGBT temperature is higher than the protection level, and detection time exceeds 100 ms, the tH1o protection activates.
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	Wait for 10 minutes, and then cycle the power. Check if tH1o protection still exists. If yes, contact AutomationDirect Technical Support.
tH2o	19	Capacitor hardware fault (tH2o) Hardware failure in capacitor temperature detection	Action Level	NTC broken or wiring failure
			Action Time	When the IGBT temperature is higher than the protection level, and detection time exceeds 100 ms, the tH2o protection activates.
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	Wait for 10 minutes, and then cycle the power. Check if tH2o protection still exists. If yes, contact AutomationDirect Technical Support.

(continued next page)

Fault Codes (continued)				
Display on GS30 Keypad	ID No.	Fault Name and Description	Action, Reset, and Corrective Action	
oL	21	Over load (oL) The AC motor drive detects excessive drive output current. Overload capacity: • Variable Torque (VT): Sustains for one minute when the drive outputs 120% of the drive's rated output current. Sustains for three seconds when the drive outputs 150% of the drive's rated output current. • Constant Torque (CT): Sustains for one minute when the drive outputs 150% of the drive's rated output current. Sustains for three seconds when the drive outputs 200% of the drive's rated output current.	Action Level	Based on overload curve and derating curve.
			Action Time	When the load is higher than the protection level and exceeds allowable time, the oL protection activates.
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Reduce the load. 2) Increase the setting value for P01.12–P01.19 (accel./decel. time) 3) Adjust the settings for P01.01–P01.08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of P01.43. 4) Replace the drive with a larger capacity model. 5) If the oL only occurs during low-speed operations: a) Reduce the load during low-speed operation. b) Increase the drive capacity. c) Decrease the carrier frequency of P00.17. 6) Adjust P07.26 Torque Compensation Gain until the output current reduces and the motor does not stall. 7) Verify stall prevention is set to the proper value. 8) Check the status of three-phase motor and verify the cable is not broken or screws are loose. 9) Verify the parameter settings for speed tracking. a) Start the speed tracking function. b) Adjust the maximum current for P07.09 speed tracking.
EoL1	22	Electronics thermal relay 1 protection (EoL1) Electronics thermal relay 1 protection. The drive coasts to stop once it activates.	Action Level	Start counting when the output current > 150% of the motor 1 rated current
			Action Time	P06.14 (If the output current is larger than 105% of the motor 1 rated current again within 60 sec., the counting time reduces and is less than P06.14)
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Reduce the load. 2) Increase the setting value for P01.12–P01.19 (accel./decel. time) 3) Adjust the settings for P01.01–P01.08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of P01.43. 4) If the EoL1 only occurs during low-speed operations: a) Replaced the drive with a dedicated VFD model. b) Increase the motor capacity. 5) If using a VFD dedicated motor, verify P06.13=1: Standard motor (motor with fan on the shaft). 6) Verify motor rated current and reset if needed. 7) Verify motor rated frequency and reset if needed. 8) If using one drive to run multiple motors, set P06.13=2: Disable, and install thermal relay on each motor. 9) Set stall prevention to the proper value. 10) Adjust P07.26 torque compensation gain until the current reduces and the motor does not stall. 11) Check the status of the fan, or replace the fan. 12) Replace the motor.
(continued next page)				

<table>
<tr><th colspan="5">Fault Codes (continued)</th></tr>
<tr><th>Display on GS30 Keypad</th><th>ID No.</th><th>Fault Name and Description</th><th colspan="2">Action, Reset, and Corrective Action</th></tr>
<tr><td rowspan="7">EoL2</td><td rowspan="7">23</td><td rowspan="7">Electronic thermal relay 2 protection (EoL2)

Electronic thermal relay 2 protection. The drive coasts to stop once it activates.</td><td>Action Level</td><td>Start counting when the output current > 150% of the motor 2 rated current</td></tr>
<tr><td>Action Time</td><td>P06.28 (If the output current is larger than 105% of the motor 2 rated current again within 60 sec., the counting time reduces and is less than P06.28)</td></tr>
<tr><td>Fault setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Manual reset</td></tr>
<tr><td>Reset condition</td><td>Reset in five seconds after the fault is cleared</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td>Corrective Actions</td><td>1) Reduce the load.
2) Increase the setting value for P01.12–P01.19 (accel./decel. time)
3) Adjust the settings for P01.35–P01.42 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of P01.43.
4) If the EoL2 only occurs during low-speed operations:
a) Replaced the drive with a dedicated VFD model.
b) Increase the motor capacity.
5) If using a VFD dedicated motor, verify P06.27=1: Standard motor (motor with fan on the shaft).
6) Verify motor rated current and reset if needed.
7) Verify motor rated frequency and reset if needed.
8) If using one drive to run multiple motors, set P06.27=2: Disable, and install thermal relay on each motor.
9) Set stall prevention to the proper value.
10) Adjust P07.71 torque compensation gain until the current reduces and the motor does not stall.
11) Check the status of the fan, or replace the fan.
12) Replace the motor.</td></tr>
<tr><td colspan="5">(continued next page)</td></tr>
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Fault Codes (continued)				
Display on GS30 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
oH3	24_1	Motor overheating (oH3) PTC Motor overheating (PTC) (P03.00–P03.01=6 PTC), when PTC input > P06.30, the fault treatment acts according to P06.29.	Action Level	PTC input value > P06.30 setting (Default = 50%)
			Action Time	Immediately act
			Fault setting parameter	P06.29 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
			Reset method	When P06.29=0, oH3 is a “Warning”. The “Warning” is automatically cleared. When P06.29=1 or 2, oH3 is a “Fault”. You must reset manually.
			Reset condition	Immediately reset
			Record	When P06.29=1 or 2, oH3 is a “Fault”, and the fault is recorded.
			Corrective Actions	1) Check if motor is locked and remove the motor shaft lock. 2) Verify load and decrease the loading or replace motor with a higher capacity model if load is too high. 3) Verify ambient temperature and change the installation location if there are heating devices in the surroundings, or install/add cooling fan or air conditioner to lower the ambient temperature. 4) Check the cooling system and ensure it’s working normally. 5) Verify the motor fan is working and replace the fan if needed. 6) Verify duration of low speed operation. a) Decrease low-speed operation time. b) Change to dedicated motor for the drive. c) Increase the motor capacity. 7) Verify accel/decel time and increase setting values for P01.12–P01.19 (accel./ decel. time) if working cycle is too short. 8) Verify V/F voltage and adjust settings for P01.01–P01.08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed). 9) Verify the motor rated current matches the motor nameplate and configure the correct rated current value of the motor if needed. 10) Check the connection between PTC thermistor and the heat protection. 11) Verify stall prevention is set correctly and adjust the value if needed. 12) Check for unbalanced three-phase motor impedance. Replace the motor if needed. 13) Verify harmonics and reduce harmonics if too high.

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Fault Codes (continued)				
Display on GS30 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
oH3	24_2	Motor overheating (oH3) PT100 RTD Motor overheating (PT100) (P03.00–P03.01=11 PT100). When PT100 input > P06.57 (default = 7V), the fault treatment acts according to P06.29.	Action Level	PT100 RTD input value > P06.57 setting (default = 7V)
			Action Time	Immediately act
			Fault setting parameter	P06.29 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
			Reset method	When P06.29=0 and the temperature < P06.56, oH3 is automatically cleared. When P06.29=1 or 2, oH3 is a "Fault". You must reset manually.
			Reset condition	Immediately reset
			Record	When P06.29=1 or 2, oH3 is a "Fault", and the fault is recorded.
			Corrective Actions	1) Check if motor is locked and remove the motor shaft lock. 2) Verify load and decrease the loading or replace motor with a higher capacity model if load is too high. 3) Verify ambient temperature and change the installation location if there are heating devices in the surroundings, or install/add cooling fan or air conditioner to lower the ambient temperature. 4) Check the cooling system and ensure it's working normally. 5) Verify the motor fan is working and replace the fan if needed. 6) Verify duration of low speed operation. a) Decrease low-speed operation time. b) Change to dedicated motor for the drive. c) Increase the motor capacity. 7) Verify accel/decel time and increase setting values for P01.12–P01.19 (accel./ decel. time) if working cycle is too short. 8) Verify V/F voltage and adjust settings for P01.01–P01.08 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed). 9) Verify the motor rated current matches the motor nameplate and configure the correct rated current value of the motor if needed. 10) Check the connection of PT100 RTD. 11) Verify stall prevention is set correctly and adjust the value if needed. 12) Check for unbalanced three-phase motor impedance. Replace the motor if needed. 13) Verify harmonics and reduce harmonics if too high.
ot1	26	Over torque 1 (ot1) When the output current exceeds the over-torque detection level (P06.07) and exceeds over-torque detection time (P06.08), and when P06.06 or P06.09 is set to 2 or 4, the ot1 error displays.	Action Level	P06.07
			Action Time	P06.08
			Fault setting parameter	P06.06 setting is: 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN
			Reset method	When P06.06=1 or 3, ot1 is a "Warning". The warning is automatically cleared when the output current < (Pr.06-07 – 5%) When P06.06=2 or 4, ot1 is a "Fault". You must reset manually.
			Reset condition	Immediately reset
			Record	When P06.06=2 or 4, ot1 is a "Fault", and the fault is recorded.
			Corrective Actions	1) Verify the settings for P06.07 and P06.08. 2) Check for mechanical failure and remove any causes of malfunction. 3) Reduce the load or replace the motor with a higher capacity model. 4) Increase the setting values for P01.12–P01.19 (accel./decel. time) 5) Adjust the V/F curve (Motor 1, P01.01–P01.08), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). 6) If error occurs during low-speed operation: a) Decrease low-speed operation time. b) Increase the motor capacity. 7) Adjust P07.26 torque compensation gain until the current reduces and the motor does not stall. 8) Very speed tracking settings and correct the parameter settings as needed. a) Start the speed tracking function. b) Adjust the maximum current for P07.09 speed tracking.

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Fault Codes (continued)				
Display on GS30 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
ot2	27	Over torque 2 (ot2) When the output current exceeds the over-torque detection level (P06.10) and exceeds over-torque detection time (P06.11), and when P06.09 is set to 2 or 4, the ot2 error displays.	Action Level	P06.10
			Action Time	P06.11
			Fault setting parameter	P06.09 setting is: 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN
			Reset method	When P06.09=1 or 3, ot2 is a “Warning”. The warning is automatically cleared when the output current < (P06.10 – 5%). When P06.09=2 or 4, ot2 is a “Fault”. You must reset manually.
			Reset condition	Immediately reset
			Record	When P06.09=2 or 4, ot2 is a “Fault”, and the fault is recorded.
			Corrective Actions	1) Verify the settings for P06.10 and P06.11. 2) Check for mechanical failure and remove any causes of malfunction. 3) Reduce the load or replace the motor with a higher capacity model. 4) Increase the setting values for P01.12–P01.19 (accel./decel. time) 5) Adjust the V/F curve (Motor 1, P01.35–P01.42), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). 6) If error occurs during low-speed operation: a) Decrease low-speed operation time. b) Increase the motor capacity. 7) Adjust P07.71 torque compensation gain until the current reduces and the motor does not stall. 8) Very speed tracking settings and correct the parameter settings as needed. a) Start the speed tracking function. b) Adjust the maximum current for P07.09 speed tracking.
uC	28	Under current (uC) Low current detection	Action Level	P06.71
			Action Time	P06.72
			Fault setting parameter	P06.73 setting is: 0: No function 1: Fault and coast to stop 2: Fault and ramp to stop by the 2nd deceleration time 3: Warn and continue operation
			Reset method	When P06.73=3, uC is a “Warning”. The warning is automatically cleared when the output current > (P06.71+0.1A). When P06.73=1 or 2, uC is a “Fault”. You must reset manually.
			Reset condition	Immediately reset
			Record	When P06.71=1 or 2, uC is a “Fault”, and the fault is recorded.
			Corrective Actions	1) Confirm the motor cable is connected properly. 2) Verify settings of P06.71, P06.72, and P06.73 and set to correct values if needed. 3) Check if the load is too low and whether the motor capacity matches the load.
Lit	29	Limit error (LiT) This code occurs when the motor drive is running under speed mode (not IMFOCPG/PMFOCPG) and the negative running limit or the positive running limit of the DIx terminals is enabled.	Action Level	When under the speed mode (not FOCPG), negative running limit or positive running limit is enabled.
			Action Time	Immediately acts.
			Fault setting parameter	N/A
			Reset method	Move the motor away from the limit position and press the STOP/RESET button on the keypad (manual reset).
			Reset condition	Immediately resets.
			Record	Yes
			Corrective Actions	1) Set the limit ON/OFF switch to the correct position. 2) Set P00.04=16 (digital input status ON/OFF) to verify if the DIx terminals work properly. 3) Reduce deceleration time. Adjust setting value of DC brake to current level (P07.01 or the insert position on the brake unit).

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Fault Codes (continued)				
Display on GS30 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
cF2	31	EEPROM read error (cF2) Internal EEPROM cannot be read	Action Level	Firmware internal detection
			Action Time	cF2 acts immediately when the drive detects the fault
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Press "RESET" key or reset the parameter to the default setting. If cF2 still occurs, contact AutomationDirect Technical Support. 2) Cycle the power, if cF2 error still occurs, contact AutomationDirect Technical Support.
cd1	33	U-phase error (cd1) U-phase current detection error when power is ON	Action Level	Hardware detection
			Action Time	cd1 acts immediately when the drive detects the fault
			Fault setting parameter	N/A
			Reset method	Power-off
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Cycle the power, if cd1 error still occurs, contact AutomationDirect Technical Support.
cd2	34	V-phase error (cd2) V-phase current detection error when power ON	Action Level	Hardware detection
			Action Time	cd2 acts immediately when the drive detects the fault
			Warning setting parameter	N/A
			Reset method	Power-off
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Cycle the power, if cd2 error still occurs, contact AutomationDirect Technical Support.
cd3	35	W-phase error (cd3) W-phase current detection error when power ON	Action Level	Hardware detection
			Action Time	cd3 acts immediately when the drive detects the fault
			Warning setting parameter	N/A
			Reset method	Power-off
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Cycle the power, if cd3 error still occurs, contact AutomationDirect Technical Support.
Hd0	36	cc hardware error (Hd0) cc (current clamp) hardware protection error when power is ON	Action Level	Hardware detection
			Action Time	Hd0 acts immediately when the drive detects the fault
			Fault setting parameter	N/A
			Reset method	Power-off
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Cycle the power, if Hd0 error still occurs, contact AutomationDirect Technical Support.
Hd1	37	oc hardware error (Hd1) oc hardware protection error when power is ON	Action Level	Hardware detection
			Action Time	Hd1 acts immediately when the drive detects the fault
			Fault setting parameter	N/A
			Reset method	Power-off
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Cycle the power, if Hd1 error still occurs, contact AutomationDirect Technical Support.

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<table>
<tr><th colspan="5">Fault Codes (continued)</th></tr>
<tr><th>Display on GS30 Keypad</th><th>ID No.</th><th>Fault Name and Description</th><th colspan="2">Action, Reset, and Corrective Action</th></tr>
<tr><td rowspan="7">AUE</td><td rowspan="7">40</td><td rowspan="7">Auto-tuning error (AUE)

Motor auto-tuning error</td><td>Action Level</td><td>Hardware detection</td></tr>
<tr><td>Action Time</td><td>Immediately act</td></tr>
<tr><td>Fault setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Manual reset</td></tr>
<tr><td>Reset condition</td><td>Immediately reset</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td>Corrective Actions</td><td>1) This error can occur if you press the STOP key during auto-tuning. Re-execute auto-tuning.
2) Check motor capacity and related parameters.
a) Set the correct parameters P01.01–P01.02.
b) Set P01.00 larger than the motor rated frequency.
3) Check the motor wiring.
4) Check for motor shaft lock and remove cause of lock if needed.
5) Check for electromagnetic contactor at output (U/V/W) and make sure the electromagnetic valve is OFF.
6) Verify load. If too heavy:
a) Reduce the load.
b) Replace the motor with a larger capacity model.
7) Check if accel/decel time is too short, then increase the setting values for P01.12–P01.19 (accel./decel. time) if needed.</td></tr>
<tr><td rowspan="7">AFE</td><td rowspan="7">41</td><td rowspan="7">PID loss AI2 (AFE)

PID feedback loss (analog feedback signal is only valid when the PID function is enabled)</td><td>Action Level</td><td>When the analog input < 4 mA (only detects 4–20 mA analog input)</td></tr>
<tr><td>Action Time</td><td>P08.08</td></tr>
<tr><td>Fault setting parameter</td><td>P08.09 setting is:
0: Warn and continue operation
1: Fault and ramp to stop
2: Fault and coast to stop
3: Warn and operate at last frequency</td></tr>
<tr><td>Reset method</td><td>When P08.09=3 or 4, AFE is a “Warning”. When the feedback signal is > 4 mA, the “Warning” is automatically cleared.
When P08.09=1 or 2, AFE is a “Fault”. You must reset manually.</td></tr>
<tr><td>Reset condition</td><td>Immediately reset</td></tr>
<tr><td>Record</td><td>When P08.09=1 or 2, AFE is a “Fault”, and the fault is recorded; when P08.09=3 or 4, AFE is a “Warning”, and the warning is not recorded.</td></tr>
<tr><td>Corrective Actions</td><td>1) Check the PID feedback cable and tighten the terminal. Replace the cable with a new one if needed.
2) Check for feedback device failure and replace the device with a new one.
3) Check all the wiring. If AFE fault still exists, contact AutomationDirect Technical Support.</td></tr>
<tr><td rowspan="7">PGF1</td><td rowspan="7">42</td><td rowspan="7">PG feedback error (PGF1)

The motor runs in a reverse direction to the frequency command direction</td><td>Action Level</td><td>Software detection</td></tr>
<tr><td>Action Time</td><td>P10.09</td></tr>
<tr><td>Fault setting parameter</td><td>P10.08
0: Warn and keep operation
1: Fault and ramp to stop
2: Fault and coast to stop</td></tr>
<tr><td>Reset method</td><td>Manual reset</td></tr>
<tr><td>Reset condition</td><td>Immediately resets</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td>Corrective Actions</td><td>1) Check and reset encoder parameter (P10.02) if incorrect.
2) Check encoder wiring and rewire if necessary.
3) Check the PG card or encoder, replace if failed.
4) Verify wiring of the control circuit and wiring/grounding of the main circuit to prevent interference.</td></tr>
<tr><td rowspan="7">PGF2</td><td rowspan="7">43</td><td rowspan="7">PG feedback loss (PGF2)

P10.00 and P10.02 is not set in the PG control mode. When press “RUN” key, PGF2 fault occurs.</td><td>Action Level</td><td>Software detection</td></tr>
<tr><td>Action Time</td><td>Immediately act</td></tr>
<tr><td>Fault setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Manual reset</td></tr>
<tr><td>Reset condition</td><td>Immediately reset</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td>Corrective Actions</td><td>1) Reset encoder parameters (P10.00 and P10.02)
2) Verify correct control mode is selected (P00.11=1).</td></tr>
<tr><td colspan="5">(continued next page)</td></tr>
</table>

Display on GS30 Keypad	ID No.	Fault Name and Description	Action, Reset, and Corrective Action	
PGF3	44	PG feedback stall (PGF3) Under PG mode, when the motor frequency exceeds the encoder observer stall level (P10.10) and starts to count, the fault time is longer than the detection time of encoder observer stall (P10.11), then PGF3 fault occurs.	Action Level	P10.10
			Action Time	P10.11
			Fault setting parameter	P10.12 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Reset encoder parameter (P10.01) 2) Value for P01.00 may be too low, set a higher value. 3) Reset ASR parameters. Verify accel/decel times and reset if needed. 4) Reset PG feedback stall values, P10.10 and P10.11.
PGF4	45	PG slip error (PGF4) Under PG mode, when the motor frequency exceeds encoder observer slip range (P10.13) and starts to count, the fault time is longer than the detection time of encoder observer slip (P10.14), PGF4 fault occurs.	Action Level	P10.13
			Action Time	P10.14
			Fault setting parameter	P10.15 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop
			Reset method	Auto: When P10.15=0, PGF4 is a "Warning". When the deviation between the output frequency and motor frequency is smaller than the encoder observer slip range, the warning is automatically cleared. Manual: When P10.15=1 or 2, PGF4 is a "Fault" and you must reset manaully.
			Reset condition	Immediately reset
			Record	When P10.15=1 or 2, PGF4 is a "Fault" and the fault is recorded.
			Corrective Actions	1) Reset PG feedback parameters (P10.13 and P10.14) 2) Reset ASR parameters. Verify accel/decel times and reset if needed. 3) Reset encoder parameters (P0.01). 4) Verify torque limit and set new values if needed (P06.12, P11.17-P11.20) 5) Check for and resolve any causes of motor shaft lock. 6) Check the mechanical brake has released correctly and verify the timing of the system.
ACE	48	AI2 loss (ACE) Analog input loss (including all the 4–20 mA analog signal)	Action Level	When the analog input is < 4 mA (only detects 4–20 mA analog input)
			Action Time	Immediately act
			Fault setting parameter	P03.19 setting is: 0: Disable 1: Continue operation at the last frequency (warning, ANL is displayed on the keypad) 2: Decelerate to stop (warning, ANL is displayed on the keypad) 3: Stop immediately and display ACE
			Reset method	When P03.19=1 or 2, ACE is a "Warning". When analog input signal is > 4 mA, the warning is automatically cleared. When P03.19=3, ACE is a "Fault". You must reset manually.
			Reset condition	Immediately reset
			Record	When P03.19=3, ACE is a "Fault", and the fault is recorded.
			Corrective Actions	1) Check the AI2 feedback cable and tighten the terminal. Replace the cable with a new one if needed. 2) Check for external device failure and replace the device with a new one. 3) Check all the wiring. If ACE fault still exists, contact AutomationDirect Technical Support.

Fault Codes (continued)

(continued next page)

Fault Codes (continued)

Display on GS30 Keypad	ID No.	Fault Name and Description	Action, Reset, and Corrective Action	
EF	49	External fault (EF) External fault. When the drive decelerates based on the setting of P07.20, the EF fault displays on the keypad.	Action Level	DIx=10: External fault (EF) and the DI terminal is ON
			Action Time	Immediately act
			Fault setting parameter	P07.20 setting is: 0: Coast to stop 1: Stop by the 1st deceleration time 2: Stop by the 2nd deceleration time 3: Stop by the 3rd deceleration time 4: Stop by the 4th deceleration time 5: System deceleration 6: Automatic deceleration (P01.46)
			Reset method	Manual reset
			Reset condition	Manual reset only after the external fault is cleared (terminal status is recovered)
			Record	Yes
			Corrective Actions	Press RESET key after the fault is cleared.
EF1	50	Emergency stop (EF1) When the contact of DIx=EF1 is ON, the output stops immediately and displays EF1 on the keypad. The motor is in free running.	Action Level	DIx=28: Emergency Stop (EF1) and the DI terminal is ON
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Manual reset only after the external fault is cleared (terminal status is recovered)
			Record	Yes
			Corrective Actions	Verify if the system is back to normal condition, and then press “RESET” key to go back to the default.
bb	51	External base block (bb) When the contact of DIx=bb is ON, the output stops immediately and displays bb on the keypad. The motor is in free running.	Action Level	DIx=11: Base Block (BB) and the DI terminal is ON
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	The display “bb” is automatically cleared after the fault is cleared.
			Reset condition	N/A
			Record	No
			Corrective Actions	Verify if the system is back to normal condition, and then press “RESET” key to go back to the default.
Pcod	52	Password is locked (Pcod) Entering the wrong password three consecutive times through P00.07	Action Level	Entering the wrong password three consecutive times
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Power-off
			Record	Yes
			Corrective Actions	1) Input the correct password after rebooting the motor drive. 2) If you forget the password, do the following steps: a) Step 1: Input 9999 and press ENTER. b) Step 2: Repeat step 1. Input 9999 and press ENTER. (You need to finish step 1 and step 2 within 10 seconds. If you don’t finish the two steps in 10 seconds, try again.) 3) The parameter settings return to the default when the “Input 9999” process is finished.
CE1	54	Illegal command (CE1) Communication command is illegal	Action Level	When the function code is not 03, 06, 10, or 63.
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	No
			Corrective Actions	1) Check if the communication command is correct. 2) Verify the wiring and grounding of the communication circuit. It is recommended to separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.

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Fault Codes (continued)

Display on GS30 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
CE2	55	Illegal data address (CE2) Data address is illegal	Action Level	When the data address is correct.
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	No
			Corrective Actions	1) Check if the communication command from the upper limit is correct. 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
CE3	56	Illegal data value (CE3) Data value is illegal	Action Level	When the data length is too long
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	No
			Corrective Actions	1) Check if the communication command from the upper limit is correct. 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
CE4	57	Data is written to read-only address (CE4) Data is written to read-only address	Action Level	When the data is written to read-only address.
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	No
			Corrective Actions	1) Check if the communication command from the upper limit is correct. 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.
CE10	58	Modbus transmission time-out (CE10) Modbus transmission time-out occurs	Action Level	When the communication time exceeds the detection time for P09.03 communication time-out.
			Action Time	P09.03
			Fault setting parameter	P09.02 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning, no fault, and continue operation
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Check if the upper unit transmits the communication command within the setting time for P09.03. 2) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 3) Check if the setting for P09.04 is the same as the setting for the upper unit. 4) Check the cable and replace it if necessary.

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Fault Codes (continued)				
Display on GS30 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
Ydc	61	Y-connection / Δ-connection switch error (ydc) An error occurs when Y-Δ switches	Action Level	1) ydc occurs when the confirmation signals of Y-connection and Δ-connection are conducted at the same time. 2) If any of confirmation signals is not conducted within P05.25, ydc occurs.
			Action Time	P05.25
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Can be reset only when the confirmation signal of Y-connection is conducted if it is Y-connection, or when the confirmation signal of Δ-connection is conducted if it is Δ-connection.
			Record	Yes
			Corrective Actions	1) Check if the electromagnetic valve works normally during switch. If not, replace it. 2) Check if related parameters are all set up and set correctly. 3) Check the wiring of the Y-Δ switch function.
dEb	62	Deceleration energy backup error (dEb) When P07.13 is not 0, and the power is suddenly off, causing the DC bus voltage lower than the dEb action level, the dEb function acts and the motor ramps to stop. Then dEb displays on the keypad.	Action Level	When P07.13 is not 0, and the DC bus voltage is lower than the level of dEb.
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	When P07.13=2 (dEb with auto-acceleration / auto-deceleration, the drive outputs the frequency after the power is restored): dEb is automatically cleared. When P07.13=1 (dEb with auto-acceleration / auto-deceleration, the drive does not output the frequency after the power is restored): The drive stops when dEb acts and the rotation speed becomes 0 Hz, then the drive can be reset manually.
			Reset condition	Auto: The fault is automatically cleared. Manual: When the drive decelerates to 0 Hz.
			Record	Yes
			Corrective Actions	1) Check that the power system is not unstable or off. 2) If another large load operates in the same power system: a) Replace power system with a larger capacity model. b) Ensure the large load system is on a different power system.
oSL	63	Over slip error (oSL) On the basis of the maximum slip limit set via P10.29, the speed deviation is abnormal. When the motor drive outputs at constant speed, F>H or F<H exceeds the level set via P07.29, and it exceeds the time set via P07.30, oSL shows. oSL occurs in induction motors only.	Action Level	P07.29 100% of P07.29 = the maximum limit of the slip frequency (P10.29)
			Action Time	P07.30
			Fault setting parameter	P07.31 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
			Reset method	P07.31=0 is a warning. When the motor drive outputs at constant speed, and F>H or F<H does not exceed the level set via P07.29 anymore, oSL warning will be cleared automatically. When P07.31=1 or 2, oSL is an error, and it needs to reset manually.
			Reset condition	Immediately reset
			Record	P07.31=1 or 2, oSL is “Fault”, and the fault is recorded.
			Corrective Actions	1) Verify the group 5 motor parameters. 2) Decrease the load 3) Check the setting of oSL protection function related parameters P07.29, P07.30, and P10.29
SrL 1	72	STO Loss 1 (STL1) STO1–SCM1 internal loop detection error	Action Level	Hardware detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Hardware failure, and cannot reset. Cycle the power.
			Reset condition	N/A
			Record	Yes
			Corrective Actions	1) Verify the STO1 and SCM1 short circuit lines are connected. Re-connect the short circuit line if needed. Ensure all wiring is correct. 2) Verify the connections at the drive control terminals. 3) If issue still persists, contact AutomationDirect Technical Support.
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Fault Codes (continued)

Display on GS30 Keypad	ID No.	Fault Name and Description	Action, Reset, and Corrective Action	
STo	76	STO (STo) Safety Torque Off function active	Action Level	Hardware detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	When P06.44=1 and after STo error is cleared, it automatically resets. When P06.44=0 and after STo error is cleared, reset it manually.
			Reset condition	Reset only after STo error is cleared.
			Record	Yes
			Corrective Actions	1) Reset the STO1/SCM1 and STO2/SCM2 switch (ON) and cycle the power. 2) Verify the connections at the drive control terminals. 3) If issue still persists, contact AutomationDirect Technical Support.
STL2	77	STO Loss 2 (STL2) STO2–SCM2 internal loop detection error	Action Level	Hardware detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Hardware failure, and cannot reset. Cycle the power.
			Reset condition	N/A
			Record	Yes
			Corrective Actions	1) Verify the STO2 and SCM2 short circuit lines are connected. Re-connect the short circuit line if needed. Ensure all wiring is correct. 2) Verify the connections at the drive control terminals. 3) If the issue persists, contact AutomationDirect Technical Support.
STL3	78	STO Loss 3 (STL3) STO1–SCM1 and STO2–SCM2 internal loop detection error	Action Level	Hardware detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Hardware failure, and cannot reset. Cycle the power.
			Reset condition	N/A
			Record	Yes
			Corrective Actions	1) Verify the STO1 and SCM1 or STO2 and SCM2 short circuit lines are connected. Re-connect the short circuit line if needed. Ensure all wiring is correct. 2) Verify the connections at the drive control terminals. 3) If the issue persists, contact AutomationDirect Technical Support.
Aoc	79	U-phase over-current before run (Aoc) U-phase short circuit detected when the output wiring detection is performed before the drive runs.	Action Level	300% of the rated current
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault clears
			Record	Yes
			Corrective Actions	1) Check if the motor's internal wiring and the UVW wiring of the drive output terminal are correct. 2) Check the motor cable and remove causes of any short circuits, or replace the cable before turning on the power. 3) Check the motor insulation value with megger. Replace the motor if the insulation is poor. 4) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference. 5) Check the length of the motor cable. If it's too long: a) Increase the AC motor drive's capacity. b) Install AC reactor(s) on the output side (U/V/W). 6) The Aoc may occur due to a short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with an electric meter: a) B1 corresponds to U, V and W; DC- corresponds to U, V and W; corresponds to U, V and W. b) If short circuit occurs, contact AutomationDirect Technical Support.

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<table>
<tr><th colspan="5">Fault Codes (continued)</th></tr>
<tr><th>Display on GS30 Keypad</th><th>ID No.</th><th>Fault Name and Description</th><th colspan="2">Action, Reset, and Corrective Action</th></tr>
<tr><td rowspan="7">boc</td><td rowspan="7">80</td><td rowspan="7">V-phase over-current before run (boc)

V-phase short circuit detected when the output wiring detection is performed before the drive runs.</td><td>Action Level</td><td>300% of the rated current</td></tr>
<tr><td>Action Time</td><td>Immediately act</td></tr>
<tr><td>Fault setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Manual reset</td></tr>
<tr><td>Reset condition</td><td>Reset in five seconds after the fault clears</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td>Corrective Actions</td><td>1) Check if the motor’s internal wiring and the UVW wiring of the drive output terminal are correct.
2) Check the motor cable and remove causes of any short circuits, or replace the cable before turning on the power.
3) Check the motor insulation value with megger. Replace the motor if the insulation is poor.
4) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference.
5) Check the length of the motor cable. If it’s too long:
a) Increase the AC motor drive’s capacity.
b) Install AC reactor(s) on the output side (U/V/W).
6) The Aoc may occur due to a short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with an electric meter:
a) B1 corresponds to U, V and W; DC- corresponds to U, V and W; corresponds to U, V and W.
b) If short circuit occurs, contact AutomationDirect Technical Support.</td></tr>
<tr><td rowspan="7">coc</td><td rowspan="7">81</td><td rowspan="7">W-phase over-current before run (coc)

W-phase short circuit detected when the output wiring detection is performed before the drive runs.</td><td>Action Level</td><td>300% of the rated current</td></tr>
<tr><td>Action Time</td><td>Immediately act</td></tr>
<tr><td>Fault setting parameter</td><td>N/A</td></tr>
<tr><td>Reset method</td><td>Manual reset</td></tr>
<tr><td>Reset condition</td><td>Reset in five seconds after the fault clears</td></tr>
<tr><td>Record</td><td>Yes</td></tr>
<tr><td>Corrective Actions</td><td>1) Check if the motor’s internal wiring and the UVW wiring of the drive output terminal are correct.
2) Check the motor cable and remove causes of any short circuits, or replace the cable before turning on the power.
3) Check the motor insulation value with megger. Replace the motor if the insulation is poor.
4) Verify the wiring of the control circuit and the wiring/grounding of the main circuit to prevent interference.
5) Check the length of the motor cable. If it’s too long:
a) Increase the AC motor drive’s capacity.
b) Install AC reactor(s) on the output side (U/V/W).
6) The Aoc may occur due to a short circuit or ground fault at the output side of the drive. Check for possible short circuits between terminals with an electric meter:
a) B1 corresponds to U, V and W; DC- corresponds to U, V and W; corresponds to U, V and W.
b) If short circuit occurs, contact AutomationDirect Technical Support.</td></tr>
<tr><td colspan="5">(continued next page)</td></tr>
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Fault Codes (continued)				
Display on GS30 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
oPL1	82	Output phase loss U phase (oPL1) U phase output phase loss	Action Level	P06.47
			Action Time	P06.46 P06.48: Use the setting value of P06.48 first. If DC braking function activates, use that of P06.46.
			Fault setting parameter	P06.45 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	P06.45=1 or 2 is "Fault", and the fault is recorded.
			Corrective Actions	1) Check for unbalanced three-phase motor impedance. If unbalanced, replace the motor. 2) Verify motor is wired correctly. Check the cable condition and replace the cable if necessary. 3) Ensure a single-phase motor is not being used with a three-phase drive 4) Check the flat cable of the control board. Re-do the wiring and test again if the flat cable is loose. If the fault still exists, contact AutomationDirect Technical Support. 5) Verify that the three-phase current is balanced with a current clamp meter. If it is balanced and the oPL1 fault still exists, contact AutomationDirect Technical Support. 6) Make sure the capacity of the drive and motor match each other.
oPL2	83	Output phase loss V phase (oPL2) V phase output phase loss	Action Level	P06.47
			Action Time	P06.46 P06.48: Use the setting value of P06.48 first. If DC braking function activates, use that of P06.46.
			Fault setting parameter	P06.45 setting is: 0: Warn and keep operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	When P06.45=1 or 2, oPL2 is a "Fault", and the fault is recorded.
			Corrective Actions	1) Check for unbalanced three-phase motor impedance. If unbalanced, replace the motor. 2) Verify motor is wired correctly. Check the cable condition and replace the cable if necessary. 3) Ensure a single-phase motor is not being used with a three-phase drive 4) Check the flat cable of the control board. Re-do the wiring and test again if the flat cable is loose. If the fault still exists, contact AutomationDirect Technical Support. 5) Verify that the three-phase current is balanced with a current clamp meter. If it is balanced and the oPL2 fault still exists, contact AutomationDirect Technical Support. 6) Make sure the capacity of the drive and motor match each other.

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Fault Codes (continued)

Display on GS30 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
oPL3	84	Output phase loss W phase (oPL3) W phase output phase loss	Action Level	P06.47
			Action Time	P06.46 P06.48: Use the setting value of P06.48 first. If DC braking function activates, use that of P06.46.
			Fault setting parameter	P06.45 setting is: 0: Warn and continue operation 1: Fault and ramp to stop 2: Fault and coast to stop 3: No warning
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	When P06.45=1 or 2, oPL3 is a “Fault”, and the fault is recorded.
			Corrective Actions	1) Check for unbalanced three-phase motor impedance. If unbalanced, replace the motor. 2) Verify motor is wired correctly. Check the cable condition and replace the cable if necessary. 3) Ensure a single-phase motor is not being used with a three-phase drive 4) Check the flat cable of the control board. Re-do the wiring and test again if the flat cable is loose. If the fault still exists, contact AutomationDirect Technical Support. 5) Verify that the three-phase current is balanced with a current clamp meter. If it is balanced and the oPL3 fault still exists, contact AutomationDirect Technical Support. 6) Make sure the capacity of the drive and motor match each other.
oL3	87	Low frequency overload protection (oL3) Low frequency and high current protection	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Enhance the heat dissipation capacity for the cabinet. 2) Lower the carrier frequency (P00.17). 3) Decrease the voltage settings that correspond to frequency below 15 Hz in the V/F curve. 4) Set P00.11=0 (V/F, general control mode). 5) Replace the drive with a higher power model.
roPd	89	Rotor position detection error (roPd) Rotor position detection error protection	Action Level	Reset the software
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Check the motor cable for damage and replace if needed. 2) Check the motor coil, if damaged replace the motor. 3) IGBT may be broken. If so, contact AutomationDirect Technical Support. 4) Cycle the power. If roPd still occurs during operation, contact AutomationDirect Technical Support.
Cd10	97	Ethernet Card Timeout (CD10) Ethernet communication has not been received from the external controller (within the Ethernet Timeout window).	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediate reset
			Record	Yes
			Corrective Actions	1) Initiate Ethernet communications from the master controller again. 2) Disable checking for Ethernet Timeout in P9.94.

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Fault Codes (continued)				
Display on GS30 Keypad	**ID No.**	**Fault Name and Description**	**Action, Reset, and Corrective Action**	
ictE	111	InrCOM time-out error (ictE) Internal communication overtime error	Action Level	P09.31=-1 – -10 (there is no -9), when the internal communication between Slave and Master is abnormal, ictE fault occurs.
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Automatically reset after the internal communication is normal
			Reset condition	N/A
			Record	Yes
			Corrective Actions	1) Verify the wiring and grounding of the communication circuit. Separate the communication circuit from the main circuit, or wire in 90 degree for effective anti-interference performance. 2) Verify the setting for P09.04 is the same as the setting for the upper unit. 3) Check the cable and replace it if necessary.
CP20	121	Internal communication error (CP20) Internal communication time-out	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	N/A
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Contact AutomationDirect Technical Support.
CP22	123	Internal communication error (CP22) Abnormal internal communication	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	N/A
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Contact AutomationDirect Technical Support.
CP30	124	Internal communication error (CP30) Abnormal internal communication	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	N/A
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Contact AutomationDirect Technical Support.
CP32	126	Internal communication error (CP32) Abnormal internal communication	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	N/A
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Contact AutomationDirect Technical Support.
CP33	127	Internal communication error (CP33) Abnormal internal communication	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	N/A
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Contact AutomationDirect Technical Support.

(continued next page)

Fault Codes (continued)

Display on GS30 Keypad	ID No.	Fault Name and Description	Action, Reset, and Corrective Action	
ot3	128	Over-torque 3 (ot3) When the output current exceeds the over-torque detection level (P14.75) and exceeds over-torque detection time (P14.76), and when P14.74 is set to 2 or 4, the ot3 error displays.	Action Level	P14.75
			Action Time	P14.76
			Fault setting parameter	P14.74 setting is: 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN
			Reset method	When P14.74=1 or 3, ot3 is a “Warning”. The warning is automatically cleared when the output current < P14.75. When P14.74=2 or 4, ot3 is a “Fault”. You must reset manually.
			Reset condition	Immediately reset
			Record	P14.74=2 or 4, ot3 is a “Fault”, and the fault is recorded.
			Corrective Actions	1) Configure the settings for P14.75 and P14.76 again. 2) Check for mechanical error and remove the causes of malfunction. 3) Verify load and decrease the loading or replace with a motor with larger capacity if load is too high. 4) Verify accel/decel time and increase the setting values for P01.12–P01.19 (accel./ decel. time) if work cycle is too short. 5) Verify V/F voltage and adjust the V/F curve (Motor 3, P01.54–P01.61), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed). 6) Replace motor with a larger capacity motor. 7) Check for overload during low-speed operation and decrease the loading during low-speed operation or increase the motor capacity. 8) Verify torque compensation and adjust P07.73 torque compensation gain until the output current decreases and the motor does not stall. 9) Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for P07.09 speed tracking.
ot4	129	Over-torque 4 (ot4) When the output current exceeds the over-torque detection level (P14.78) and exceeds over-torque detection time (P14.79), and when P14.77 is set to 2 or 4, the ot4 error displays.	Action Level	P14.78
			Action Time	P14.79
			Fault setting parameter	P14.77 setting is: 0: No function 1: Continue operation after over-torque detection during constant speed operation 2: Stop after over-torque detection during constant speed operation 3: Continue operation after over-torque detection during RUN 4: Stop after over-torque detection during RUN
			Reset method	When P14.77=1 or 3, ot3 is a “Warning”. The warning is automatically cleared when the output current < P14.75. When P14.77=2 or 4, ot3 is a “Fault”. You must reset manually.
			Reset condition	Immediately reset
			Record	P14.77=2 or 4, ot3 is a “Fault”, and the fault is recorded.
			Corrective Actions	1) Configure the settings for P14.78 and P14.79 again. 2) Check for mechanical error and remove the causes of malfunction. 3) Verify load and decrease the loading or replace with a motor with larger capacity if load is too high. 4) Verify accel/decel time and increase the setting values for P01.12–P01.19 (accel./ decel. time) if work cycle is too short. 5) Verify V/F voltage and adjust the V/F curve (Motor 3, P01.63–P01.70), especially the setting value for the mid-point voltage (if the mid-point voltage is set too small, the load capacity decreases at low-speed). 6) Replace motor with a larger capacity motor. 7) Check for overload during low-speed operation and decrease the loading during low-speed operation or increase the motor capacity. 8) Verify torque compensation and adjust P07.75 torque compensation gain until the output current decreases and the motor does not stall. 9) Correct the parameter settings for speed tracking. Start the speed tracking function. Adjust the maximum current for P07.09 speed tracking.

(continued next page)

Fault Codes (continued)				
Display on GS30 Keypad	ID No.	Fault Name and Description	Action, Reset, and Corrective Action	
EoL3	134	Internal communication error (EoL3) Electronic thermal relay 3 protection. The drive coasts to stop once it activates.	Action Level	Start counting when output current > 150% of the motor 3 rated current.
			Action Time	P14.81 (If the output current is larger than 105% of the motor 3 rated current again within 60 sec., the counting time reduces and is less than P14.81)
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Reduce the load. 2) Increase the setting value for P01.12–P01.19 (accel./decel. time) 3) Adjust the settings for P01.54–P01.61 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of P01.43. 4) If the EoL3 only occurs during low-speed operations: a) Replaced the drive with a dedicated VFD model. b) Increase the motor capacity. 5) If using a VFD dedicated motor, verify P14.80=1: Standard motor (motor with fan on the shaft). 6) Verify motor rated current and reset if needed. 7) Verify motor rated frequency and reset if needed. 8) If using one drive to run multiple motors, set P14.80=2: Disable, and install thermal relay on each motor. 9) Set stall prevention to the proper value. 10) Adjust P07.73 torque compensation gain until the current reduces and the motor does not stall. 11) Check the status of the fan, or replace the fan. 12) Replace the motor.
EoL4	135	Internal communication error (EoL4) Electronic thermal relay 4 protection. The drive coasts to stop once it activates.	Action Level	Start counting when the output current > 150% of the motor 4 rated current.
			Action Time	P14.83 (If the output current is larger than 105% of motor 4 rated current again within 60 sec., the counting time reduces and is less than P14.83)
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Reduce the load. 2) Increase the setting value for P01.12–P01.19 (accel./decel. time) 3) Adjust the settings for P01.62–P01.70 (V/F curve), especially the setting value for the mid-point voltage (if the mid-point voltage is set too low, the load capacity decreases at low speed). Refer to the V/F curve selection of P01.43. 4) If the EoL4 only occurs during low-speed operations: a) Replaced the drive with a dedicated VFD model. b) Increase the motor capacity. 5) If using a VFD dedicated motor, verify P14.82=1: Standard motor (motor with fan on the shaft). 6) Verify motor rated current and reset if needed. 7) Verify motor rated frequency and reset if needed. 8) If using one drive to run multiple motors, set P14.82=2: Disable, and install thermal relay on each motor. 9) Set stall prevention to the proper value. 10) Adjust P07.75 torque compensation gain until the current reduces and the motor does not stall. 11) Check the status of the fan, or replace the fan. 12) Replace the motor.

(continued next page)

Fault Codes (continued)				
Display on GS30 Keypad	***ID No.***	***Fault Name and Description***	***Action, Reset, and Corrective Action***	
Hd6	140	oc hardware error (Hd6) GFF hardware protection error when power is ON.	Action Level	Hardware detection
			Action Time	Immediately act when the fault is detected
			Fault setting parameter	N/A
			Reset method	Power-off
			Reset condition	N/A
			Record	Yes
			Corrective Actions	Cycle the power. If Hd6 still exists, contact AutomationDirect Technical Support.
b4GFF	141	GFF occurs before run (b4GFF) The ground short circuit detected when the output wiring detection is performed before the drive runs.	Action Level	250% of the rated current
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Reset in five seconds after the fault is cleared
			Record	Yes
			Corrective Actions	1) Check if the motor’s internal wiring and the UVW wiring of the drive output terminal are correct. 2) Check the motor cable and remove causes of any short circuits, or replace the cable before turning on the power. 3) Check the motor insulation value with megger. Replace the motor if the insulation is poor.
AuE1	142	Auto-tune error 1 (AuE1) No feedback current error when the motor parameter automatically detects	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Verify the motor is wired correctly. 2) If a contactor is used as an open state on the output side of the drive (U/V/W), check if the contactor coil is closed.
AuE2	143	Auto-tune error 2 (AuE2) Motor phase loss error when the motor parameter automatically detects	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Verify that the motor is wired correctly and no wires are broken. 2) Confirm that the motor works normally outside of auto-tuning. 3) If an electromagnetic contactor is used as an open state on the output side of the drive (U/V/W), verify that the three phases of the electromagnetic valve are all closed.
AuE3	144	Auto-tune error 3 (AuE3) No load current I_0 measurement error when the motor parameter automatically detects	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Check the settings for P05.01 / P05.13 / P05.34. 2) Confirm that the motor works normally outside of auto-tuning.
AuE5	149	Auto-tune error 5 (AuE5) The rotor resistance measuring error when the motor parameter automatically detects	Action Level	Software detection
			Action Time	Immediately act
			Fault setting parameter	N/A
			Reset method	Manual reset
			Reset condition	Immediately reset
			Record	Yes
			Corrective Actions	1) Verify that the motor is wired correctly and no wires are broken. 2) Confirm that the motor works normally outside of auto-tuning. Possibly test with standard across-the-line starter.

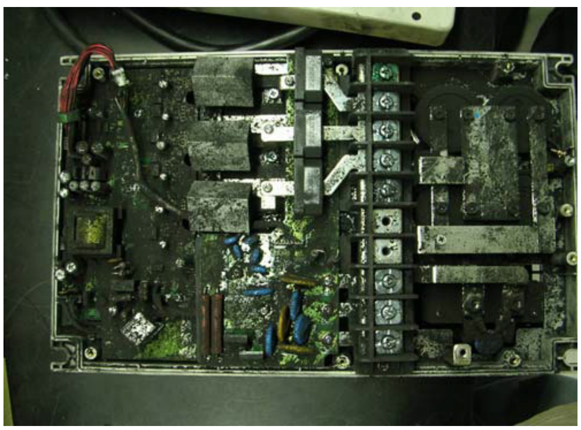
Typical AC Drive Problems and Solutions

Grease and Dirt Problems

In those industries where grease and dirt are common. Please be aware of the possible damage that grease, oil, and dirt, may cause to your GS30 drive:

1) *Electronic components that silt up with greasy oil may cause the drive to burn out or even explode.*
2) *Most greasy dirt contains corrosive substances that may damage the drive.*

Solution:
Install the GS30 drive in a suitable enclosure to protect it from grease and dirt. Clean and remove grease and dirt regularly to prevent damage of the drive.

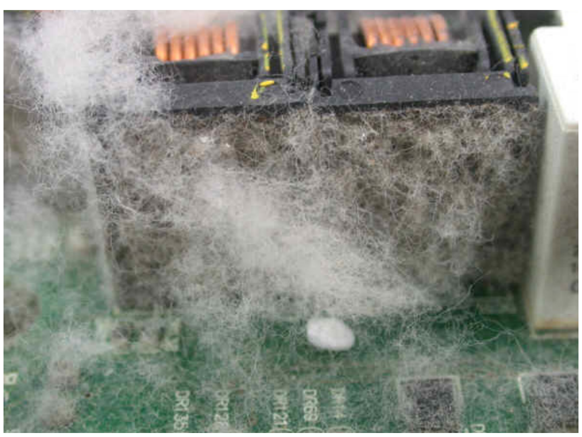


Fiber Dust Problem

Problems related to fiber dust are typical in the textile industry. Please be aware of the possible damage that fiber dust may cause to your GS30 drive:

1) *Fiber dust that accumulates or adheres to the fans will result in poor ventilation and cause overheating problems.*
2) *Textile plant environments with high humidity levels may experience GS30 drive failure or damage as a result of wet fiber dust adhering to components within the drive.*

Solution:
Install the GS30 drive in a suitable enclosure to protect it from fiber dust. Clean and remove fiber dust regularly to prevent damage to the drive.

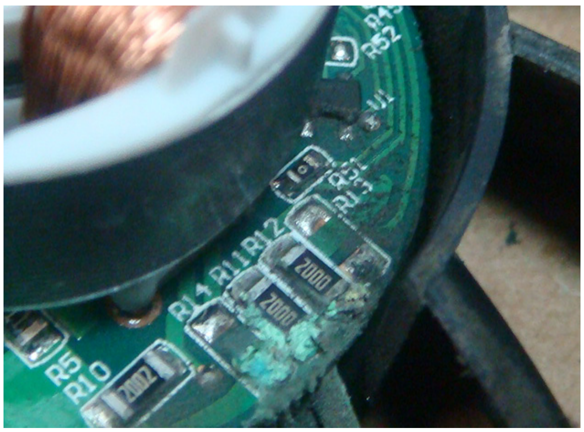


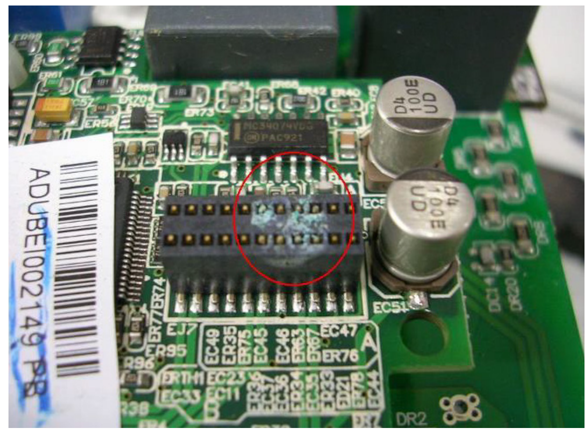
Corrosion Problem

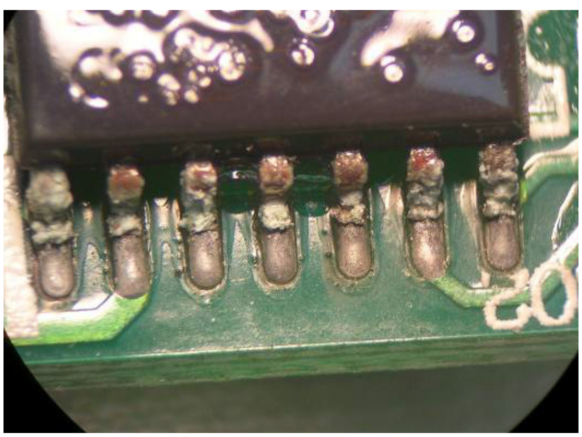
Corrosion problems may occur if any fluids or liquid in vapor form flows into the GS30 drive. Please be aware of the damage that corrosion may cause to your drive.

- *Corrosion of internal components may cause the GS30 drive to malfunction and possibly explode.*

Solution:
Install the GS30 drive in a suitable enclosure to protect it from fluids. Clean the drive regularly to prevent corrosion.





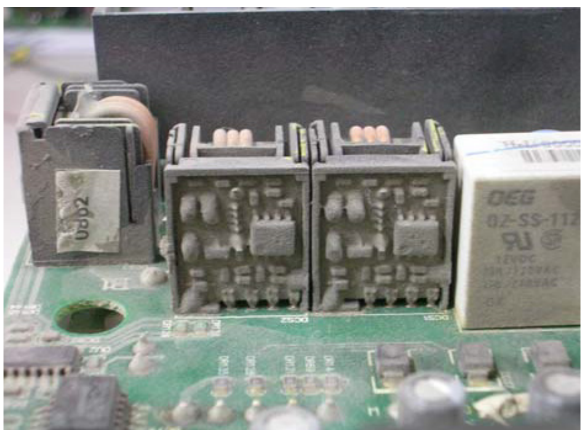


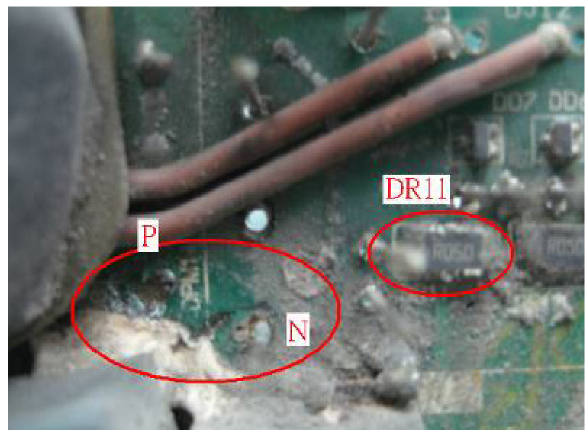
Industrial Dust Problem

Serious industrial dust pollution frequently occurs in stone processing plants, flour mills, cement plants, and so on. Please be particularly aware of any metal dust, filings or if metalized vapor is present as these may cause damage to your drives:

1) *Dust accumulating on electronic components may cause overheating problems and shorten the service life of the drive.*
2) *Conductive dust may damage the circuit board and may cause the drive to explode.*

Solution:
Install the GS30 drive in a suitable enclosure and protect it from dust. Clean the cabinet and ventilation filter regularly for good ventilation.



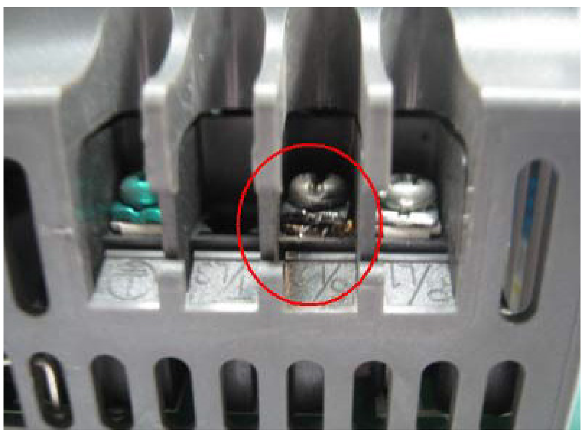


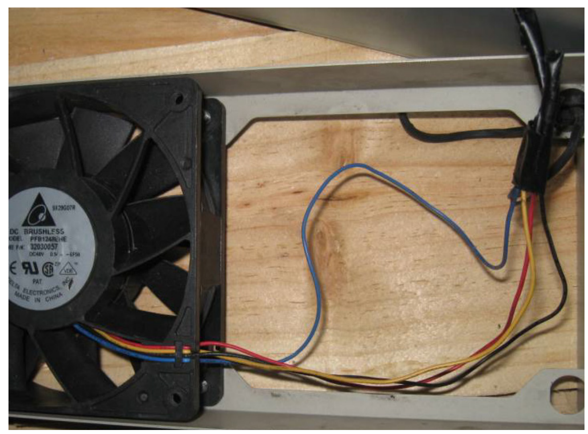
Wiring and Installation Problem

When wiring the GS30 drive, the most common problems are connection to the wrong terminal or poor wiring practice. Please be aware of the possible damage that poor wiring practice may cause to your GS30 drive:

1) *Screw terminals where the wire is not fully inserted or the terminal screw is not adequately tightened may result in sparking or high temperature due to a high resistance connection.*
2) *If circuit boards in the GS30 drive have been modified, components on the affected boards may have been damaged.*

Solution:
Inspect all power and control terminal connections in the GS30 drive to ensure adequate wire insertion. Do not attempt to disassemble or repair control boards in the GS30 drive.



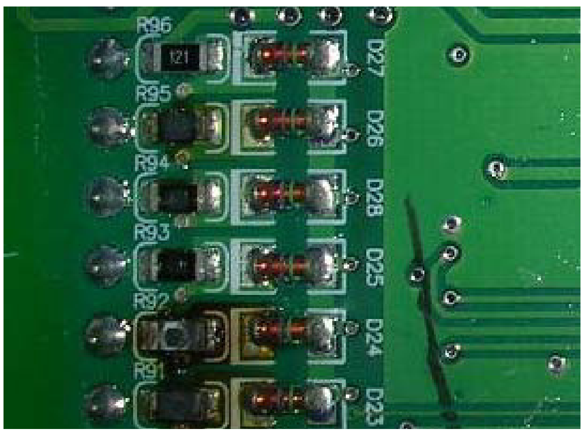


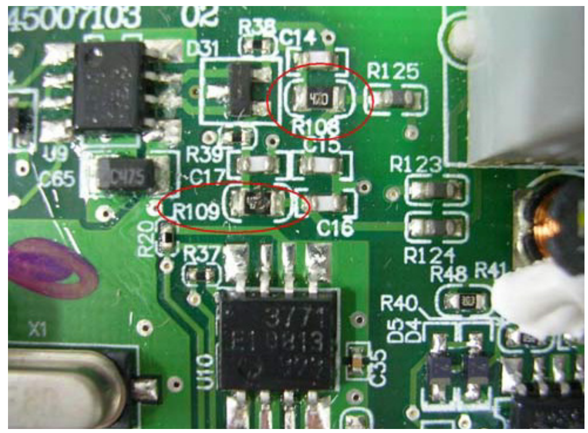
Digital Input/Output Terminal Problems

Problems with digital I/O are usually the result of improper termination, or failure to segregate control wiring from power wiring. This may result in errant signals due to induced voltage, capacitive coupling or electrical noise. Incorrect voltage levels applied to the digital I/O terminals can damage the I/O circuitry of the drive.

- *Input/Output circuit may burn out when the terminal usage exceeds its limit.*

Solution:
Refer to the user manual for multi-function input output terminals usage and follow the specified voltage and current. DO NOT exceed the specification limits.





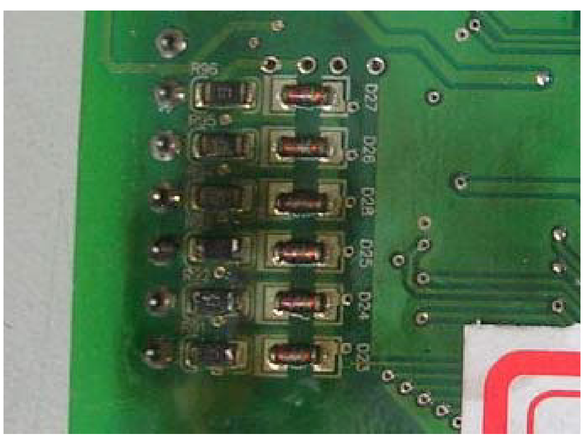


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Table of Contents

Chapter 7: GSoft2 – Getting Started

GS30 Drive Configuration Software

GSoft2 is the configuration software for the Automation Direct DURAPulse family of drives. It is designed to allow you to connect a personal computer to the drive, and perform a variety of functions:

- *Create new drive configurations*
- *Upload/download drive configurations*
- *Edit drive configurations*
- *Archive/store multiple drive configurations on your PC*
- *Trend drive operation parameters*
- *Tune the drive PID loop*
- *View real time key operating parameters*
- *Start/Stop drive and switch directions, provided drive is set up for remote operation*
- *View drive faults*

GSoft2 includes an integral help file with software instructions. GSoft2 can be downloaded for free or purchased on USB card from AutomationDirect.com (search for GSoft2). Use version 3.0.x.x or higher with GS30.

System Requirements

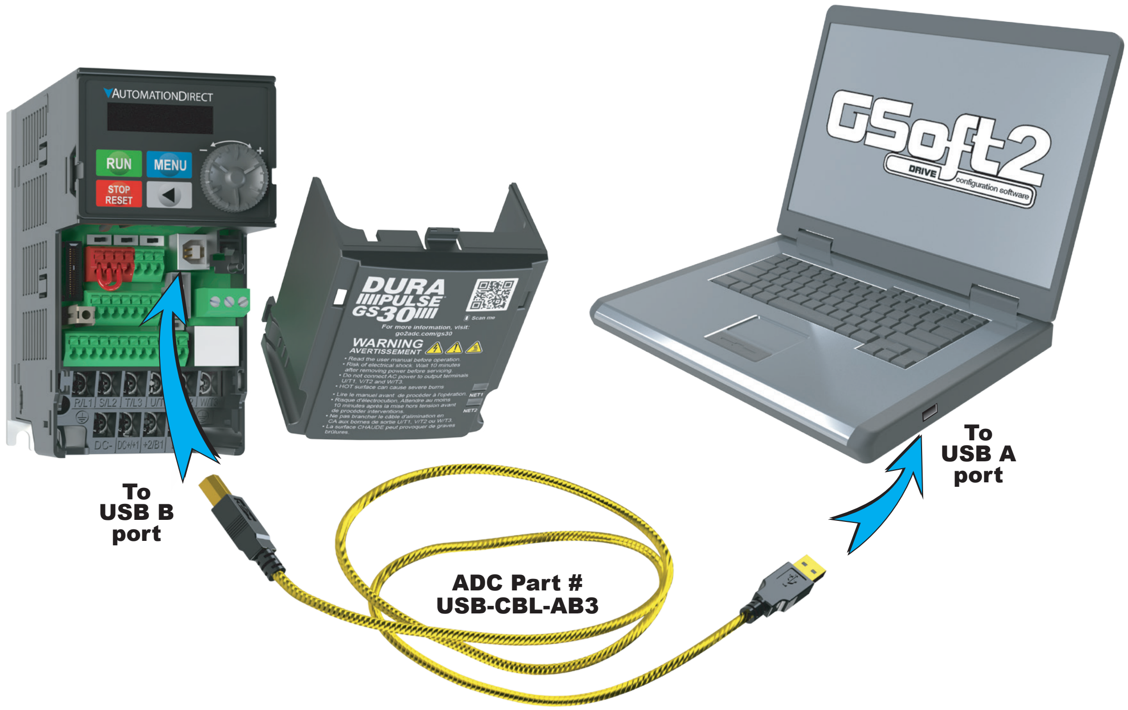
GSoft2 will run on PCs that meet the following requirements:

- *Windows OS: 8: 32 & 64 bit, 8.1: 32 & 64 bit, 10: 64 bit, 11*
- *Browser such as Edge or Chrome (for HTML help support)*
- *32 Mb of available memory*
- *10 Mb hard drive space*
- *Available USB port (for USB Type A or C to USB Type B cable)*

Installation Guide

System Requirement Configuration

Verify the GS30 drive connection to a PC/Laptop computer by connecting the PC's USB type A port to the GS30 drive's USB type B connector. The GS30 RS485 port is for connecting to an RS485 network only and can not be used to connect to GSoft2. See Chapter 5 for further information on GS30 drive communications.

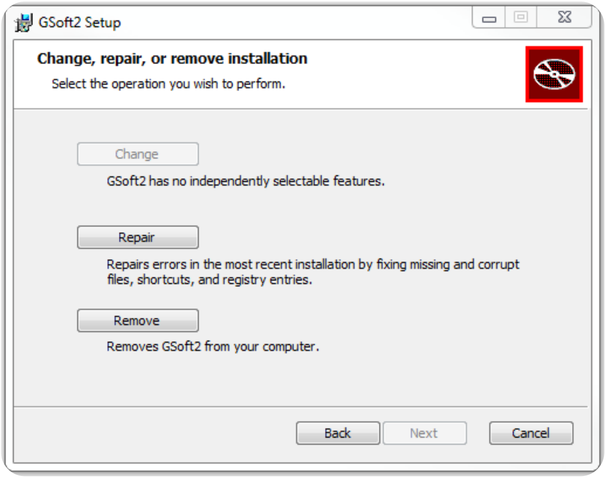


Software Installation

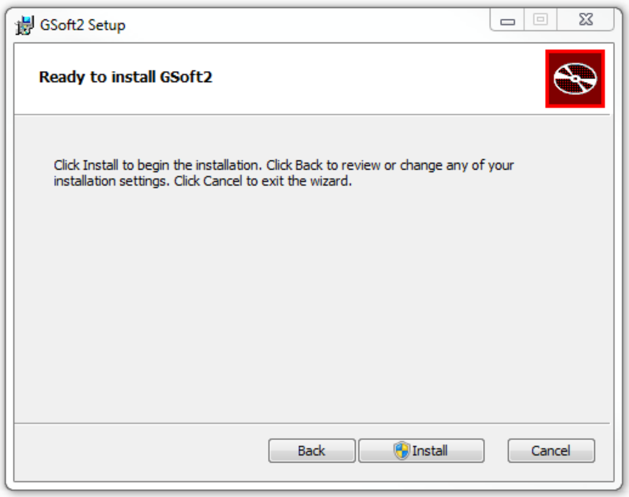
Step 1: Download the installation file from AutomationDirect.com or place the GSoft2 USB into your PC. If Autoplay is not enabled, doubleclick Setup.msi to start the installation process.

Step 2: Proceed with installation. At the welcome dialogue box select NEXT to continue installation process.

Step 3: If GSoft2 was previously installed then the Change, repair, or remove installation window allows you to effect changes to your installation, repair corrupt files or fix other issues with the current installation. Should you choose the GSoft2 file can be removed as well.



Step 4: If this is a new installation, click "Install" to continue the installation process. Follow the prompts to complete software installation.

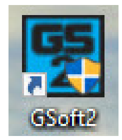


Opening GSoft2 Software Program

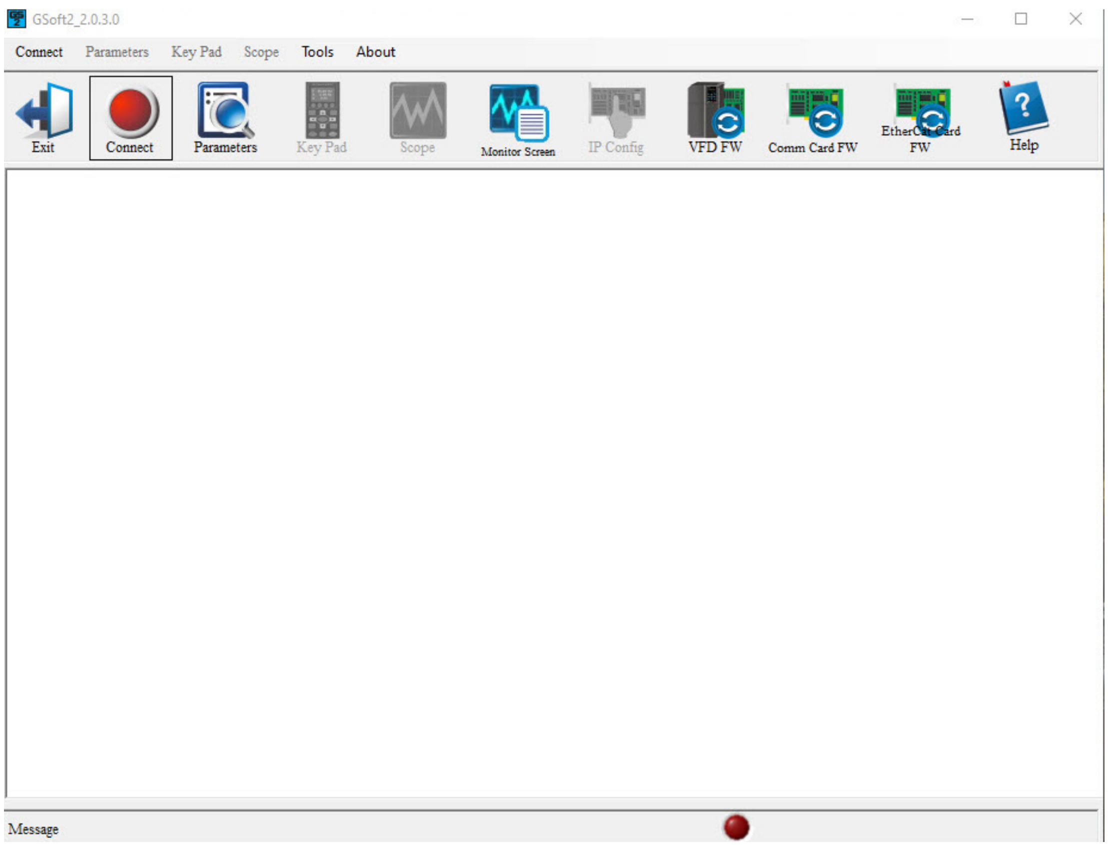
GSoft2 includes an integral help file with software instructions.

GSoft2 offers the user a PC based software configuration tool for creating and editing a GS30 Drive configuration. The configuration tool provides access to GS30 Drive parameters in a table format. Each parameter can be adjusted for your specific drive application. Once the selected parameters have been changed, the file can be downloaded to the GS30 Drive as well as saved to your project folder for future use on other drives. Once created and saved, subsequent editing is done using the GSoft2 software.

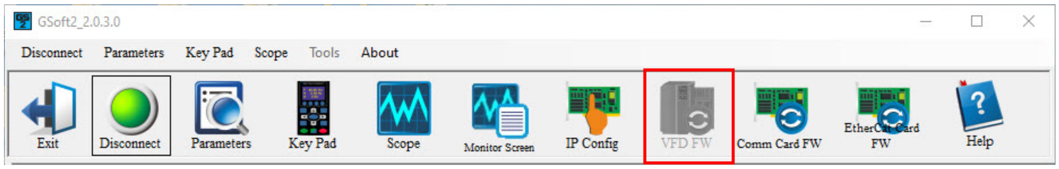
Double click the GSoft2 shortcut to open the program; OR click in the search box in the lower left corner of Desktop and type GSoft2.



GSoft2 Graphic User Interface (GUI) will open. You will notice that only one menu command is in bold (Connect), while the others are grayed out. Some icons on the toolbar are initially grayed out as well. At this point, the GUI includes seven Icons that are available as shown in the screencap. "Connect" is bold as shown upper left.

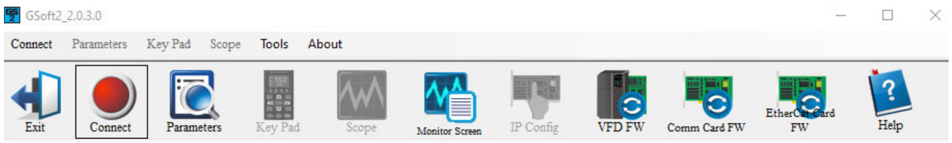


Icons within the red rectangles below will be grayed out after successfully connecting to the drive. Menu Bar commands will now appear in bold text (available).

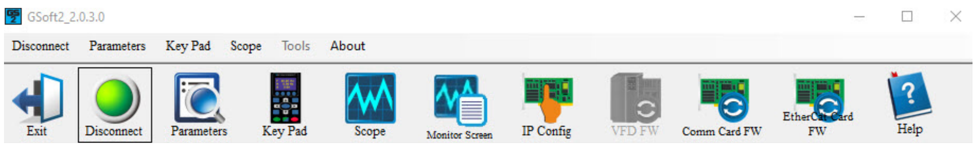


Software Functions

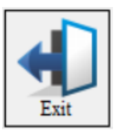
Icon Appearance Before Connecting to Drive



Icon Appearance After Connecting to Drive



Icon Functions

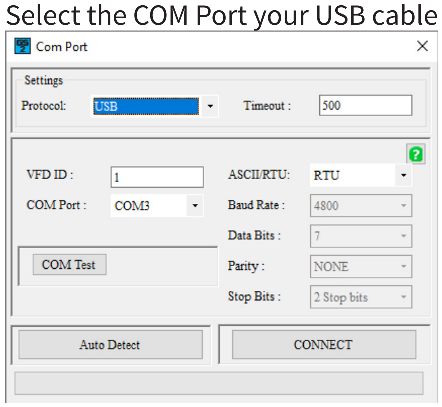


EXIT: Shuts down the GSoft2 software. (A pop-up "Are you sure" window will appear).

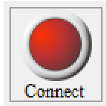
CONNECT: Opens Com Port dialog box (Same as “Connect” on the menu bar). This allows you to configure the settings to establish serial communication to your drive. If several COM ports are installed on your PC, you will need to go to Device Manager to determine which COM port is the correct one.
For GS30 it is not necessary to modify the communication settings (ASCII/RTU, Baud Rate, Data bits, etc.) for the drive when using USB (USB settings are hard-coded) or Ethernet connections. For RS485 connections, the AutoDetect feature will set the Baud, Data, Parity, and Stop bits.

To Connect via USB

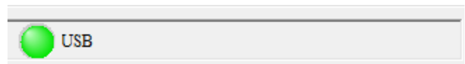
1) Select **USB** from the drop-down menu.
2) Verify that RTU is showing in the ASCII/RTI window selector.
3) Verify the VFD ID is correct. Default value on all drives is 1.
4) Select the COM Port your USB cable is connected to.



5) Click the **Connect** button.

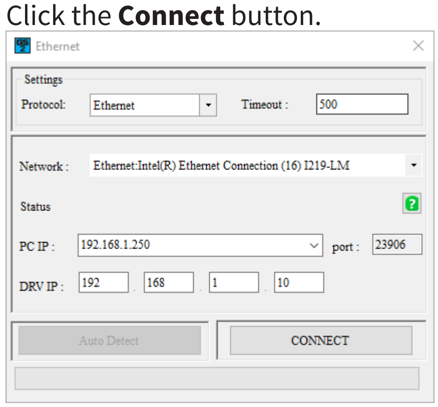


6) When connected, the button will turn green and there will be an indicator in the lower right-hand corner of the screen.

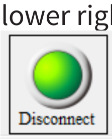


To Connect via Ethernet

1) Select **Ethernet** from the drop-down menu.
2) In the Network box, select the Ethernet card your cable is plugged in to.
3) Verify your PC and the Drives IP addresses are correct. All Ethernet cards are default addressed 192.168.1.10.
4) Click the **Connect** button.

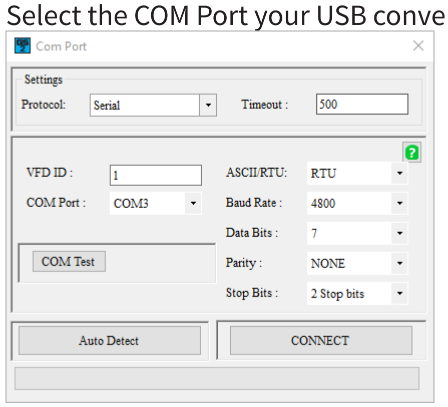


5) When connected, the button will turn green and there will be an indicator in the lower right-hand corner of the screen.

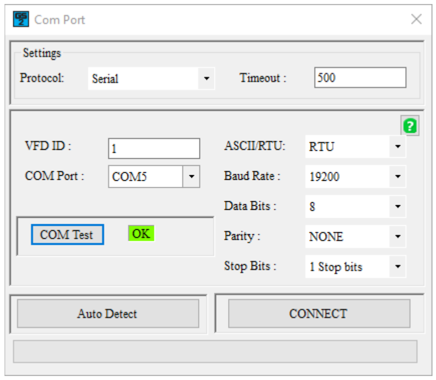


To Connect via RS485

1) Select **Serial** from the drop-down menu.
2) Verify the VFD ID is correct. Default value on all drives is 1.
3) Select the COM Port your USB converter is connected to.

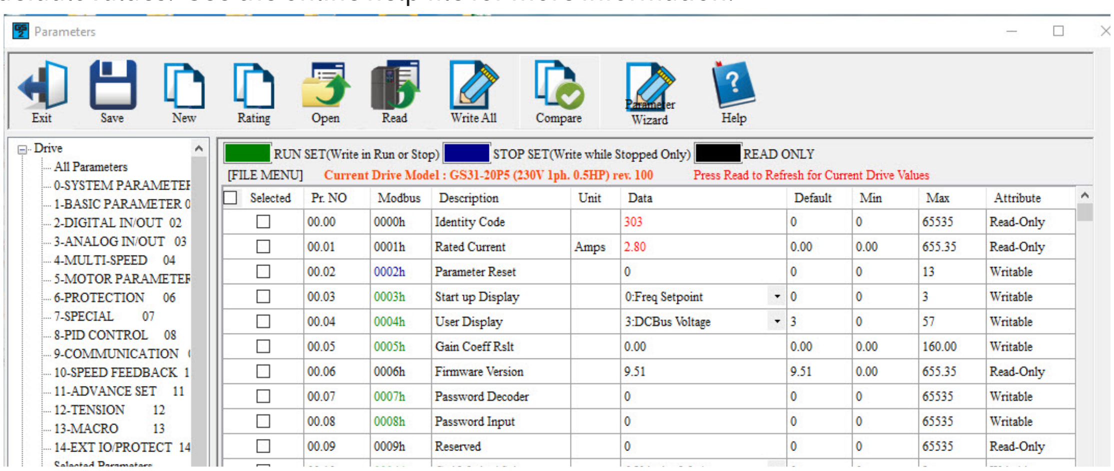


4) Click **AutoDetect**.
5) After AutoDetect is complete, click COM Test to verify settings (a green **OK** should appear). If Red Fault appears, then double check your connections at the PC and the drive.
6) Click the **Connect** button.



7) When connected, the button will turn green and there will be an indicator in the lower right-hand corner of the screen.

PARAMETERS: Opens GSoft2 drive parameters table. The Parameters screen allows the user to upload and download entire configurations to and from the drive. Individual parameters can be changed "live" as well. There is also the ability to Open and Save files on the PC's hard drive, and the ability to Compare parameter information to a drive's default values. See the online help file for more information.

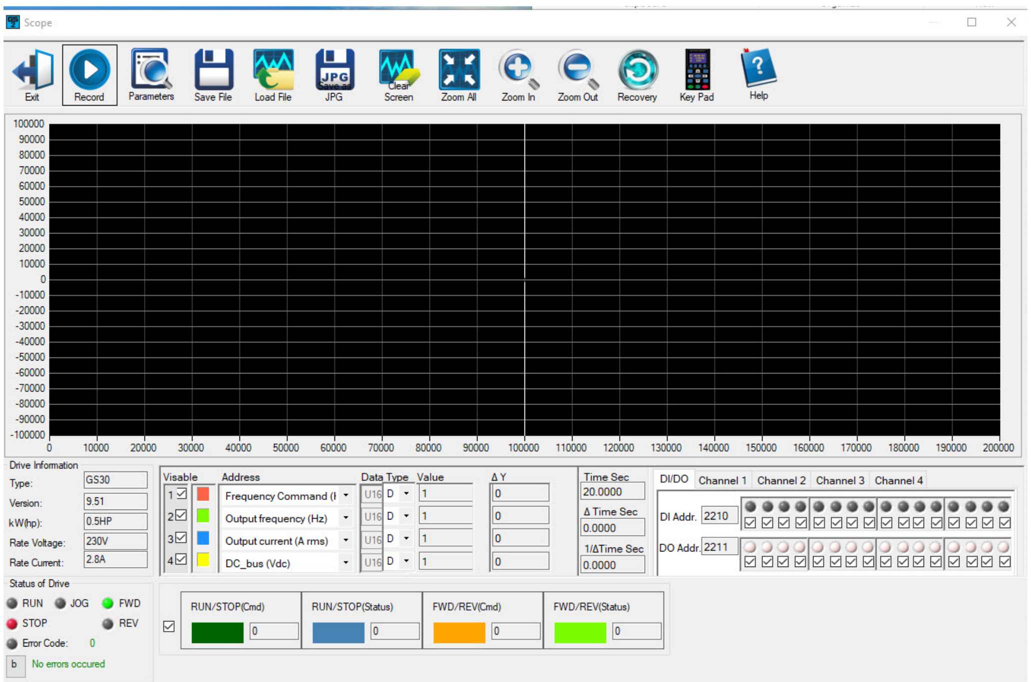


KEYPAD: Opens an advanced software keypad for use with your drive. Several buttons will be grayed-out (ESC, MENU, and several other keys are non-functional).

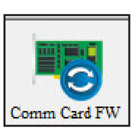
Operational Instructions:

To enable the Jog (F1), RUN, FWD/REV, and STOP/RESET buttons and to allow changes to the drive's speed, please see the GSoft2 online help file (must set P00.20/P00.21 (remote) and P00.30/P00.31 (local) for the drive to accept commands from RS485).

SCOPE: Opens a functional graphic interface for testing and viewing selected drive parameter data values (See the GSoft2 online helpfile for further detailed description).

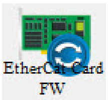


IP Config: Allows manual configuration of an optional Ethernet card's IP address. GSoft2 uses the serial USB connection to communicate to the GS30 Drive ethernet communication card. Gsoft2 does not communicate via ethernet.

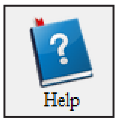


Comm Card FW: Use when upgrading firmware to any newer GS4 Network card with J2 jumper or any GS30 Ethernet comm card. Please read the important *"Firmware Upgrade Notes" on* *page 7–12*. See the GSoft2 Helpfile for details on how to upgrade communication card firmware.

VFD FW: Use when upgrading GS drive firmware. Icon is "grayed out" and not accessible after drive connection has been initiated. Press "Disconnect" to resume functionality.
Please read the important *"Firmware Upgrade Notes" on page 7–12*. See the GSoft2 Helpfile for details on how to upgrade firmware.
NOTE: 500mA is required from the USB port of the sending PC. If unsure of the available current supplied by the PC, please use a powered USB hub.



EtherCAT Card FW: Use when upgrading EtherCAT card firmware. Icon is active regardless of drive connection status. Please read the important *"Firmware Upgrade Notes" on page 7–12*. See the GSoft2 Helpfile for details on how to upgrade firmware.



Help: Use the icon to show the help file which provides detailed instructions on all features and detailed procedures.

Tools Menu

The following options can be accessed through the Tools menu rather than an icon on the toolbar.

- *GS4 Legacy Comm Card: Access this option through the Tools drop down menu. Use this feature when upgrading the GS4 Legacy ethernet communication cards (no J2 jumper is on the card). Icon is "grayed out" and not accessible after drive connection has been initiated. Press "Disconnect" to resume functionality. This is not used with GS30.*
- *GS4 KEYPAD FW: Use when upgrading KEYPAD firmware. Icon is "grayed out" and not accessible after drive connection has been initiated. Press "Disconnect" to resume functionality.*
  Please read the important "Firmware Upgrade Notes" below.
  See the GSoft2 Helpfile for details on how to upgrade keypad firmware.

Firmware Upgrade Notes

When upgrading drive firmware, the drive should be disconnected from all power sources (incoming AC power and control-level DC power). Power is required for EIP and EtherCAT card firmware updates.

All unnecessary USB peripherals should be disconnected from the host PC; Especially any USB to serial converters (USB-485M, USB-RS232, etc.) (drivers may conflict with the USB FW upgrade driver).

The host PC must be connected to the upgrade port of the GS30 via a standard USB A-to-B cable (USB-CBL-AB6 or similar).

Once the PC is connected to the GS30, the drive will be recognized as a USB serial device COM port. Open Device Manager to determine which port number has been assigned.

Follow the software's instructions to upgrade the GS30 firmware. More detailed firmware upgrade instructions are available in the GSoft2 online help file.

GSoft2 Help File Note

To get the most use out of GSoft2 for the GS30 AC Drive and to learn what powerful features and tools exist within GSoft2, we highly recommend that you use the internally available Help File. There are a couple of ways to access this Help File within the GSoft2 software:

• Help The easiest way to access the Help File information is to click the Help (Help File) icon in the far right of the Toolbox above the viewing pain.

• Alternately, you can access specific topics within the Help File by clicking "?" marks within the GSoft2 software. Those links bring up specific Help File information applicable to the particular GSoft2 topic.

Various data that exists within the User Manual also exists within the Help File, e.g., explanations of "how to" accomplish various tasks. Other information is found only within the Help File, such as more detailed information for using GSoft2 and for upgrading the GS30 drive firmware. The help File also contains detailed information concerning the GS30 AC drive parameters and information for understanding and using the PID process.

Make use of the Help File, and the Help File will live up to its name.

8

Table of Contents

Chapter 8: GSLogic Introduction

Purpose of This Chapter

This chapter is intended as an overview and quick-start guide to get your first GS30 GSLogic PLC program quickly up and running.

For More Detailed Information

For further explanation of the GS30 PLC user interface, instruction set, and PLC implementation, please refer to the GSLogic Help File. The Help File can be accessed under the “Help” menu or anywhere you see the “?” symbol. Help on all of the following is located in the GSLogic Help file:

- *Full descriptions of the user interface, menu items, windows, and toolbars*
- *Basics of the GS30 PLC*
- *Special Function registers*
- *All GS30 PLC instructions*
- *Memory addressing and data types*
- *Using the digital and analog I/O*
- *Communication with the PLC and MODBUS addresses*

GSLogic Introduction

GSLogic is the PLC programming software for the built in GSLogic PLCs included on specified AutomationDirect Durapulse series of AC drives. This software can be used on any Durapulse drive series that includes the built-in GSLogic PLC: currently GS4, GS20/20X, and GS30. The software is designed to enable you to perform a variety of PLC programming functions. Windows editing functions like cut, copy, paste, multiple windows, etc., are supported. GSLogic also provides for register editing, settings, file reading, saving, online monitoring settings, and other convenience functions, such as:

- *Upload/download of PLC program files to the on board PLC*
- *Editing of PLC programs*
- *Archive/store multiple PLC programs on your PC or on the GS4-KPD drive keypad*
- *Control PLC PID loops (FPID instructions)*
- *View in real time all PLC registers*
- *Print PLC program files*

GSLogic includes an integral help file that includes software instructions, how to use GSLogic, and how to use the GS30 PLC.

GS30 PLC Summary

Introduction

The GS30 drive includes a built-in PLC. Programmed in ladder logic, the GS30 PLC provides a comprehensive set of basic and application-specific instructions. This chapter is intended to provide an overview of the GS30 PLC, and to help you get started using it. For those unfamiliar with the onboard PLC, the Help File included with GSLogic includes all the detailed information needed to use the PLC.

The PLC functionality can be accessed over communications by external PLCs (over serial Modbus) or the drive (using built-in PLC instructions). The purpose and scope of the onboard PLC is to provide the user with solutions that a simple PLC can provide. The GS30 PLC is perfectly suited for simple PLC applications, where digital and analog I/O requirements are small. For applications with complex PLC programming or large I/O requirements, please consider Click, Productivity, or Do-More/BRX. All of these PLCs can be easily integrated with the GS30 drive or the internal PLC. The optional GS4-KPD keypad of the GS30 is capable of storing multiple PLC programs (PLC must be disabled to perform a keypad copy).

There are *two methods* for communicating with the GS30 PLC. The *first method* is to use the *WPR* (write to parameters) *and RPR* (read parameters) *instructions* available in the PLC's library. These two instructions can read from or write to any GS30 AC drive parameter in the same physical drive, but not to other GS30 drives. The *second method* is to use *Modbus RTU*. The PLC is a Serial Modbus slave only. A Modbus RTU master can communicate with the PLC via serial only; the GS30 Modbus TCP/EtherNet/IP communication card cannot address the PLC. If the Modbus TCP/EtherNet/IP card is the desired method of communication, then parameters P09.11~P09.26 (PLC Buffers) can be used. Simply write the needed information from the PLC into the drive's PLC buffer parameters using the WPR instruction. The Modbus TCP/EtherNet/IP card can then read the VFD parameters.

For more detailed serial communication parameter information, refer to Chapter 5: Serial Communications. For more detailed Modbus TCP/EtherNet/IP communication card parameter information, refer to Appendix B.

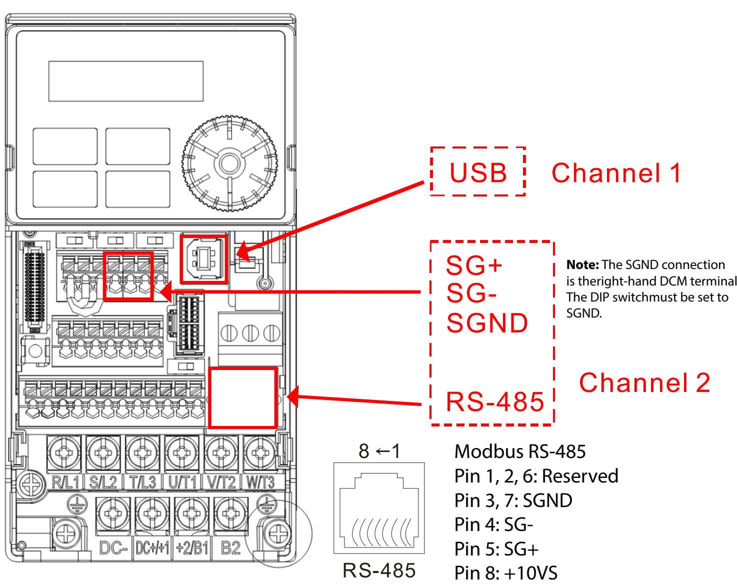
CAUTION: IF THE PLC IS IN CONTROL OF SPECIFIC INPUTS AND OUTPUTS, ONCE THE PLC IS DISABLED THE BEHAVIOR OF THE INPUTS AND OUTPUTS ARE NOW CONTROLLED BY P02.01–P02.07 / P02.13–P02.17. IT IS GOOD PRACTICE TO SET THE I/O THAT IS USED IN THE PLC TO "NO FUNCTION," SO WHEN THE PLC IS DISABLED THERE IS NOT SUDDEN OR UNEXPECTED MOTION.

Notes on Using GSLogic, the GS30 PLC, and the GS30 Drive

1) The GS30 PLC default node address is 2. The PLC node address can be changed in parameter P09.35, but this address cannot be the same as the GS30 drive node address of P09.00, which has a default node of 1. If multiple GS30 drives and PLCs will be connected to a third-party Modbus Master, *be sure to avoid duplicate node numbers*.
2) The GS30 drive provides one RJ45 port and one set of terminals (SG+ & SG-) for serial RS-485 communications, internally wired in parallel, that can either be used to connect to RS485 networks. The GS30 drive provides one Type B Serial port that can be used to connect to a PC and download PLC programs using GSLogic (see figure below).

   Channel 1 (Type B USB Serial for PC communication only) has a fixed communications format, and can only be used to connect the drive with GSlogic software on a PC. Ensure GSlogic Communication serial RTU/ASCII setting match the Drive Parameter P09.04 setting. All other settings are hard coded for this channel.

   Channel 2 is the serial interface to Modbus-capable PLCs, HMIs, and PCs for programming and reading/writing data. Channel 2 can be accessed via the built-in RJ45 connector (ideal for connecting multiple drives together with standard RJ45 cables) or via the SG+, SG-, and SGND terminals. The SGND terminal is the right-hand DCM terminal and the DIP switch above it must be set to SGND. Channel 2 has a default communications setting of 9600, 8, O, 1 Modbus RTU (one RJ45 port and one set of terminals for RS-485). If communication settings in P09.01 and P09.04 are changed, this also changes the PLC comm settings. The Drive node and PLC node will always have the same serial baud rate and protocol. The communication settings are the same for the PLC and Drive communications, programming, and configurations. P09.01 and P09.04 are used to set up the serial communication rate and protocol.

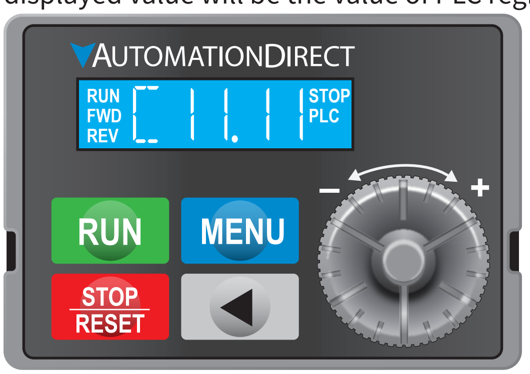


Note: If using both Modbus connection points (Terminal block and RS-485 Port), ensure you have the same ground reference. Non-equivalent grounding, or grounding from different references, can introduce noise issues that interfere with communications.

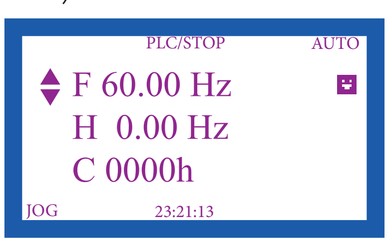
4) A client can simultaneously access data from the GS30 drive and the internal PLC. This is performed by using the two node numbers. For instance, if the GS30 drive node is 1 and the internal PLC node is 2, then the client command will be: 01 (node) 03 (read) 0400 (address) 0001 (1 data item), indicating that it must read the data from the GS30 drive parameter P04.00. Or the client will select the PLC: 02 (node) 02 (read) 0800 (address) 0001 (1 data item), indicating that it must read the data from the internal PLC which is the address to internal bit M0.
5) The PLC program will be disabled from running when uploading/downloading programs.
6) Please note when using WPR (Write to Drive Parameters) commands, values may be modified up to a maximum of 10^6 times. More than this number of writes will result in a memory write error. The calculation of modifications is based on whether the entered value has been changed. If the entered value is left unchanged, the modification count will not increase. But if the entered value is different from before, the modification count will increase by one.
The parameters in the following table are exceptions, and can be written to an unlimited number of times. The FREQ instruction is also an exception to this.

Parameter	Description
P00.10	Control Mode (Speed or Torque)
P00.11	(Speed) Control Mode
P00.27	User-defined value
P01.12~P1.19	1st~4th Acc/Dec Time
P02.12	Multi-Function Input Contact Selection
P02.18	Multi-Function Output Contact Selection
P04.50–P04.69	PLC buffer 1~20
P08.04	Upper Limit for Integral Time
P08.05	PID Output Frequency Limit
P10.17	Electronic gear A
P10.18	Electronic gear B
P11.34	Torque command

7) When parameter P00.04 is set to 28 (User Display = PLC D1043 Value), the GS30 keypad displayed value will be the value of PLC register D1043.



Optional Digital Keypad GS4-KPD Can Display 0~FFFF (hex). (See the 3rd line in the figure below)



8) In the PLC Run and PLC Stop modes, the parameter P00.02 cannot be set to 9 or 10 (cannot be reset to factory defaults). PLC must be in Disable mode (PLC0) for this. A power cycle is needed after resetting to defaults.
9) The PLC memory will be cleared and the program erased from the PLC when parameter P00.02 is set to 6. The PLC must be in Disable mode before resetting the PLC.
10) When the PLC controls the GS30 drive operation, control commands will be entirely controlled by the PLC, and will _not_ be affected by the setting of parameter P00.21 or P00.31.
11) When the PLC controls the GS30 drive frequency commands, the commanded frequency will _not_ be affected by parameter P00.20, P00.30, or the P00.29 Hand ON/OFF configuration.
12) The use of certain registers will disable the drive's control of the drive output frequency. The instructions and registers that transfer control of the drive output to the PLC are: FREQ, M1040, M1025, M1026, and M1027. See P00.19 or P09.33 for details about what the PLC controls.
13) GS30 PLC is limited to 5,000 Steps. Steps in the PLC program are not directly proportional to rungs. See GSLogic Help inside the GSLogic software for additional information.
14) When the PLC controls the drive operation, if the keypad STOP (P00.32) setting is valid, this triggers an FStP error and causes the drive to stop.
15) The corresponding drive parameter Multi-Function Inputs and Outputs will be disabled when the PLC ladder program contains external terminal usage X and Y registers. (*See GS30 AC Drive to PLC Input/Output Cross Reference tables, page 8–9*).
16) Several parameters in the GS30 drive are directly related to the GS30 PLC operation, monitoring, or control.

GS30 AC Drive Parameters Related to GS30 PLC	
Parameter/Setting Number	***Parameter/Setting Description***
P02.01~P02.07 = 51	Multi-Function Inputs = PLC Mode Select bit 0
P02.01~P02.07 = 52	Multi-Function Inputs = PLC Mode Select bit 1
P02.52	PLC Digital Input Mask
P02.53	PLC Digital Output Mask
P03.30	PLC Analog Output Mask
P00.04 = 28	User Display = PLC D1043 Value (displayed only in hexadecimal)
P09.11~P09.26	PLC Buffers
P09.01 = 9.6	Modbus Baud Rate = 9.6k
P09.04 = 13	Modbus Protocol = 8,N,2 (RTU)
P00.02 = 6	Parameter Reset = Reset PLC (clear PLC)
P00.19	PLC Command Mask
P09.35 = 2	PLC Address = 2 (Cannot be the same as the address of the drive (P9.00))
P09.33	PLC Frequency Command Force to 0

Getting Started

The GS30 automatically switches to PLC mode when the external multi-function input terminals (DI1–DI7) are in PLC Mode selection bit 0 (51) or PLC Mode selection bit1 (52), and the terminal contact is closed or open. In this case, keypad switching is invalid. The corresponding actions are listed below:

PLC mode		PLC Mode selection bit1 (52)	PLC Mode selection bit0 (51)
Using GS4-KPD (optional)	Using GS30 Keypad		
Disable	PLC 0	OFF	OFF
PLC Run	PLC 1	OFF	ON
PLC Stop	PLC 2	ON	OFF
Maintain previous state	Maintain previous state	ON	ON

- *When the PLC screen from the keypad is set to PLC0 (or "Disable" on GS4-KPD), the built-in PLC is disabled and you cannot use GSLogic to connect to it.*
- *When the PLC screen from the keypad is set to PLC1 (or "PLC Run" on GS4-KPD), the built-in PLC is enabled and you can use GSLogic to connect to it through Modbus.*
- *When the PLC screen from the keypad is set to PLC2 (or "PLC Stop" on GS4-KPD), the built-in PLC is enabled and you can use GSLogic to connect to it. However, the programs in the built-in PLC do not work.*
- *When the built-in PLC is enabled (PLC1 or PLC2), you can switch between PLC Run or PLC Stop through GSLogic.*
- *The external terminal control method is the same as shown in the table above.*

NOTE: When the input/output terminals (DI1-DI7, R1, and DO) are included in the PLC program, these input/output terminals are used only by the PLC. For example, when the PLC program controls Y0 during PLC operation (PLC1 or PLC2), the corresponding output terminal relay (R1) operates according to the program. At this time, the multifunctional input/output terminal setting has no effect. Because these terminal functions are already being used by the PLC, you can determine the DI/DO/AO in use by the PLC by looking at P02.52, P02.53, and P03.30.

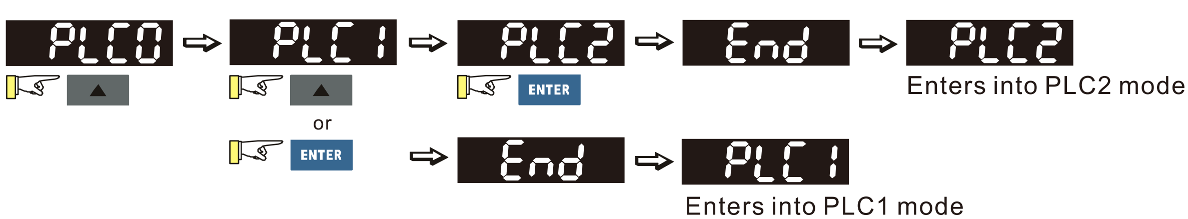
NOTE: When the PLC program uses special register D1040, the corresponding AO contact AO1 is occupied.

NOTE: P03.30 monitors the action state of the PLC function analog output terminals; bit 0 corresponds to the AO1 action state.

Connect to PLC

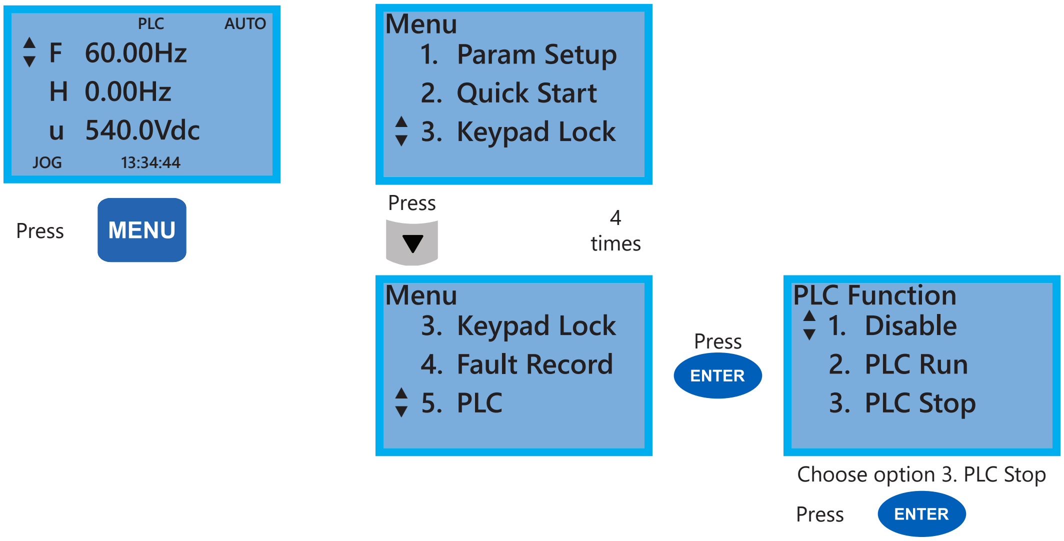
Start operation of PLC functions in accordance with the following steps from the GS30 drive keypad.

1) Press the MENU button on the keypad until PLC0 appears.
2) Press the UP arrow key to navigate to PLC1 or PLC2 as desired.
3) Press ENTER to start the selected PLC mode.



If using the optional GS4-KPD, follow the four steps below instead:

1) Using the Menu key on the GS30 digital keypad, select 5: PLC, press Enter key (see figure below).
The PLC can be connected to only when in Run or Stop modes. When it is in Disable mode the communications to the PLC will be terminated.

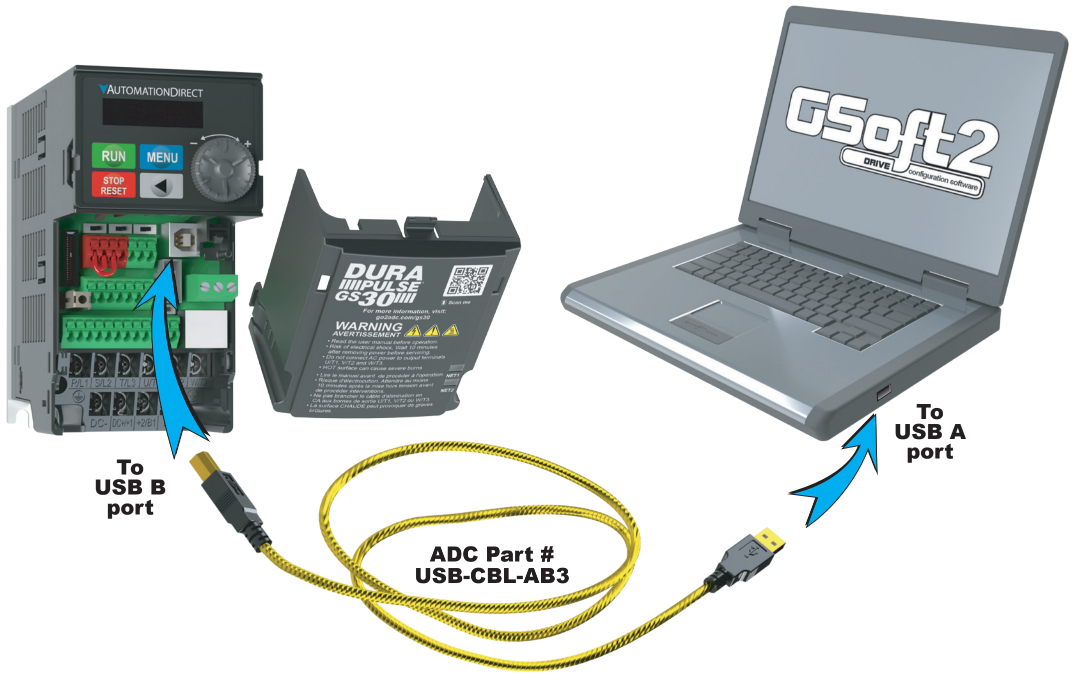


PLC functions are as shown in the lower right menu of the figure above; options 2 or 3 will enable the PLC communication connection. Choose 3 (stop) for now, or if you do not know what the PLC might do if placed into Run mode.

1: PLC0 - Disable: No function
2: PLC1 - PLC Run: Enable PLC functions
3: PLC2 - PLC Stop: Stop PLC functions

Important: When the PLC is Disabled, the PLC Modbus RTU node does not exist, and no communications to the PLC can occur. The PLC must be in Run or Stop for GSLogic or a Modbus device to be able to connect.

2) Wiring: Connect the GS30 drive USB serial communication interface port to a PC USB port. Then you are ready to install and connect to GSLogic software.



Controlling Drive IO with the PLC

When the external Multi-Functional Input terminals (DI1 to DI7, P02.01 to P02.07) are set to function 51 or 52 (PLC Mode select bit0 or bit1), the digital inputs have priority and the keypad will not be able to change PLC modes.

PLC Mode	*Select Bit1 (52)*	*Select Bit0 (51)*
PLC0 - Disable	OFF	OFF
PLC1 - PLC Run	OFF	ON
PLC2 - PLC Stop	ON	OFF
Maintain Previous State	ON	ON

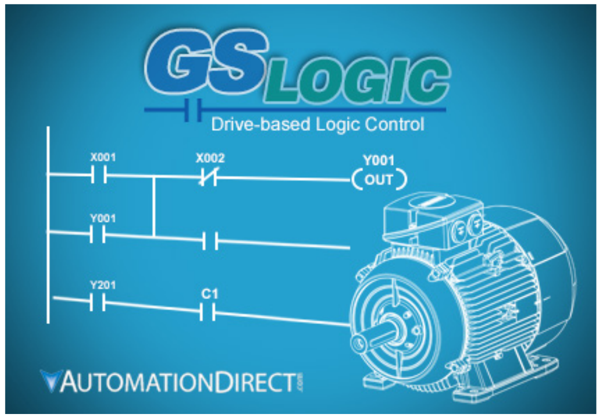
GS30 AC Drive to PLC *Input* Cross Reference			
GS30 Digital Input	*PLC Address*	*GS30 Analog Input*	*PLC Address*
FWD (DI1)	X0	AI1	D1028
REV (DI2)	X1	AI2	D1029
DI3	X2	AI10	D1031
DI4	X3	AI11	D1032
DI5	X4	–	
DI6	X5		
DI7	X6		
DI10	X12		
DI11	X13		
DI12	X14		

GS30 AC Drive to PLC *Output* Cross Reference			
GS30 Digital Output	*PLC Address*	*GS30 Analog Output*	*PLC Address*
R1-R1C-R1O	Y0	AO1	D1040
DO1	Y3	AO10	D1041
DO2	Y4	AO11	D1042

NOTE 1: When X and Y addresses for the input and output terminals are included in the PLC program, these input/output terminals will only be used by the PLC. The DI and DO multifunction assignments are configured by parameters P02.01~P02.07 and will be overridden. As an example, when the PLC program controls Y0 during PLC operation, the corresponding output terminal relay (R1) will operate in accordance with the program. At this time, the Multi-Function Output terminal setting P02.13 will be ineffective because these terminal functions are already being used by the PLC.

NOTE 2: When the PLC uses the special registers D1040, the corresponding Analog Output AO1 will only be used by the PLC overriding the multifunction configuration. The AO multifunction assignments, when they are drive controlled, are configured by parameter P03.20.

Installation of GSLogic Programming Software



System Requirements

GSLogic Windows-based programming software environment. Please check the following requirements when choosing your PC configuration:

- *Windows OS: 7: 32 & 64 bit, 8: 32 & 64 bit, 8.1: 32 & 64 bit, 10: 64 bit*
- *300MB free hard-disk space*
- *RAM: Windows 7 or higher*
  - *with GUI version 2.0.0.x or higher, RAM = 2GB memory (4GB recommended)*
  - *with GUI version 1.10 or lower, RAM = 512MB free RAM (1GB recommended)*
- *USB Port for project transfer to GS30*

About Getting Started

If you are familiar with Programmable Logic Controllers in general, then following the simple steps in this chapter may be all you require to start being productive using a GS30 PLC system. After you have completed the steps, your GS30 controller will be running the ladder logic project that you programmed.

Technical Support

We strive to make our manuals the best in the industry. We rely on your feedback to let us know if we are reaching our goal. The feedback section of the Help File can be used to send a comment to Technical Support. If you cannot find the solution to your particular application, or if for any reason you need technical assistance, please call us at:

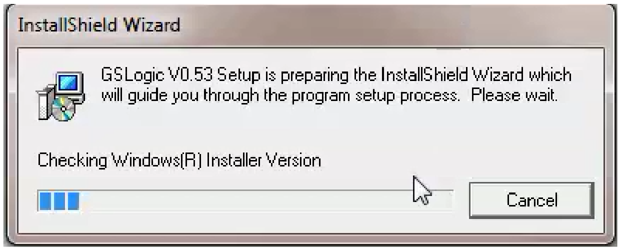
1–770–844–4200

Our technical support group will work with you to answer your questions. They are available Monday through Friday from 9:00 A.M. to 6:00 P.M. Eastern Time. We also encourage you to visit our web site where you can find information about our company and specific technical information about a wide array of our products.

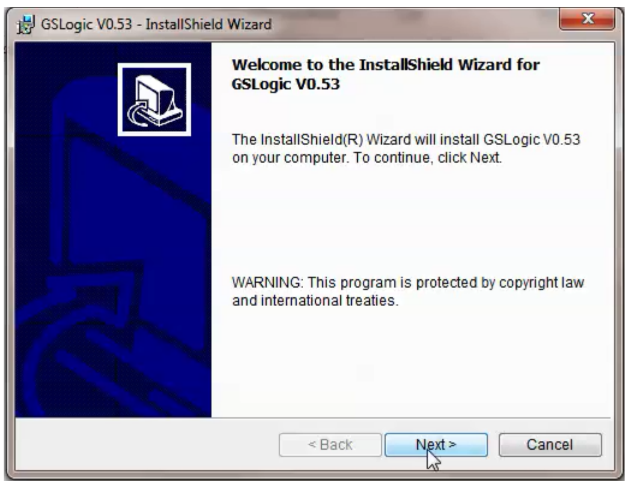
https://www.automationdirect.com

Installing GSLogic Programming Software

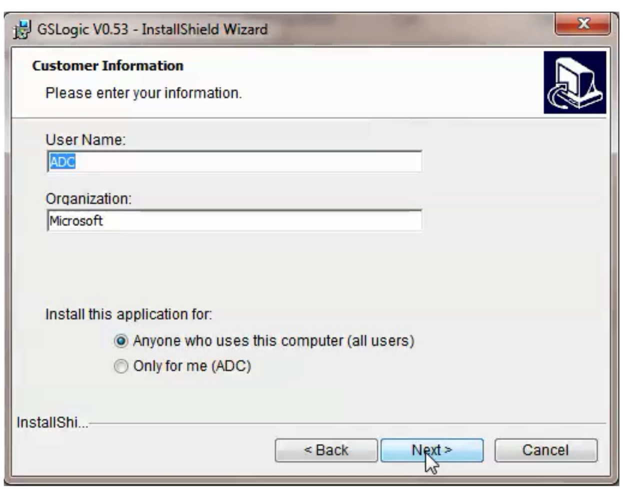
1) Download the latest version of the GSLogic Software, (See ADC's website for GSLogic editing software: www.automationdirect.com/pn/gslogic). Or, if the GSLogic USB drive is available, insert it into your PC USB port. Open the GSLogic setup.exe file.
2) The "InstallShield Wizard" popup (shown below) will appear briefly while the software is checking for previous installs.



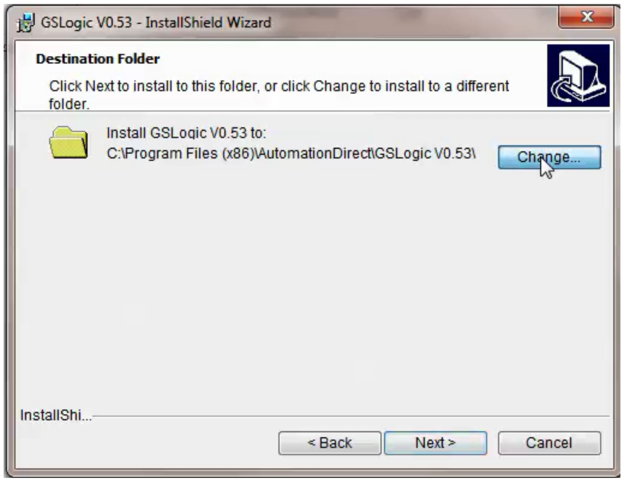
3) The Welcome popup will appear, allowing you to choose to proceed or not. Click the "Next" button to install.



4) The "Customer Information" window will open next. Enter a User Name and Organization name, then click "Next."

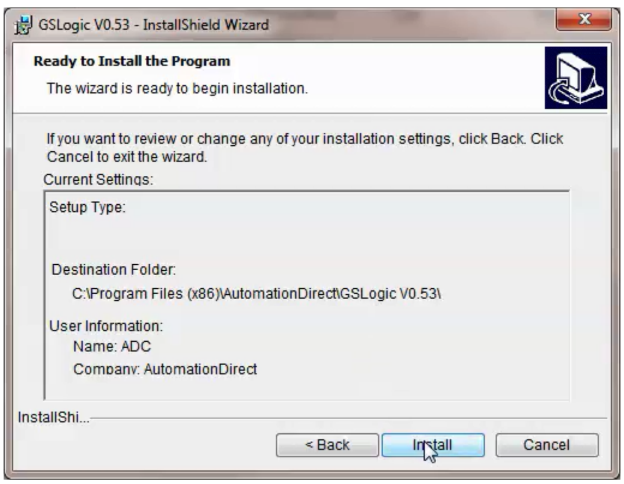


5) The Destination Folder popup will appear, showing the default path to the destination file; click "Next" to continue. Should you want to change to another destination, Click "Change" and another dialog box will appear, allowing entry of a new file path.

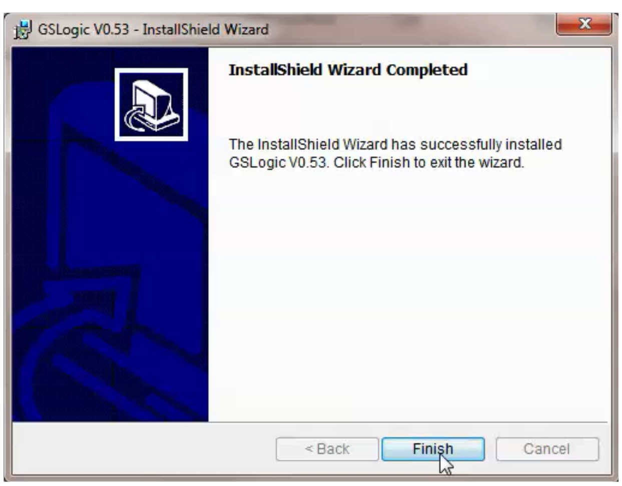


The default installation folder is:
C:\Program Files (x86)\
AutomationDirect\GSLogic Vx.xx

6) Once you have selected the install folder (default or new path), the "Destination Folder" window will appear. Click "Next" to continue the installation process. Click "Install" when ready to install the software.



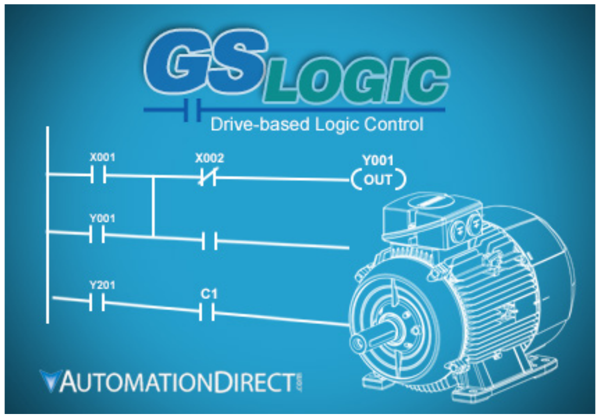
7) The Installation is now complete. Click "Finish." Double-click on the GSLogic icon or navigate to the AutomationDirect folder in the start menu to open the GSLogic programming environment.



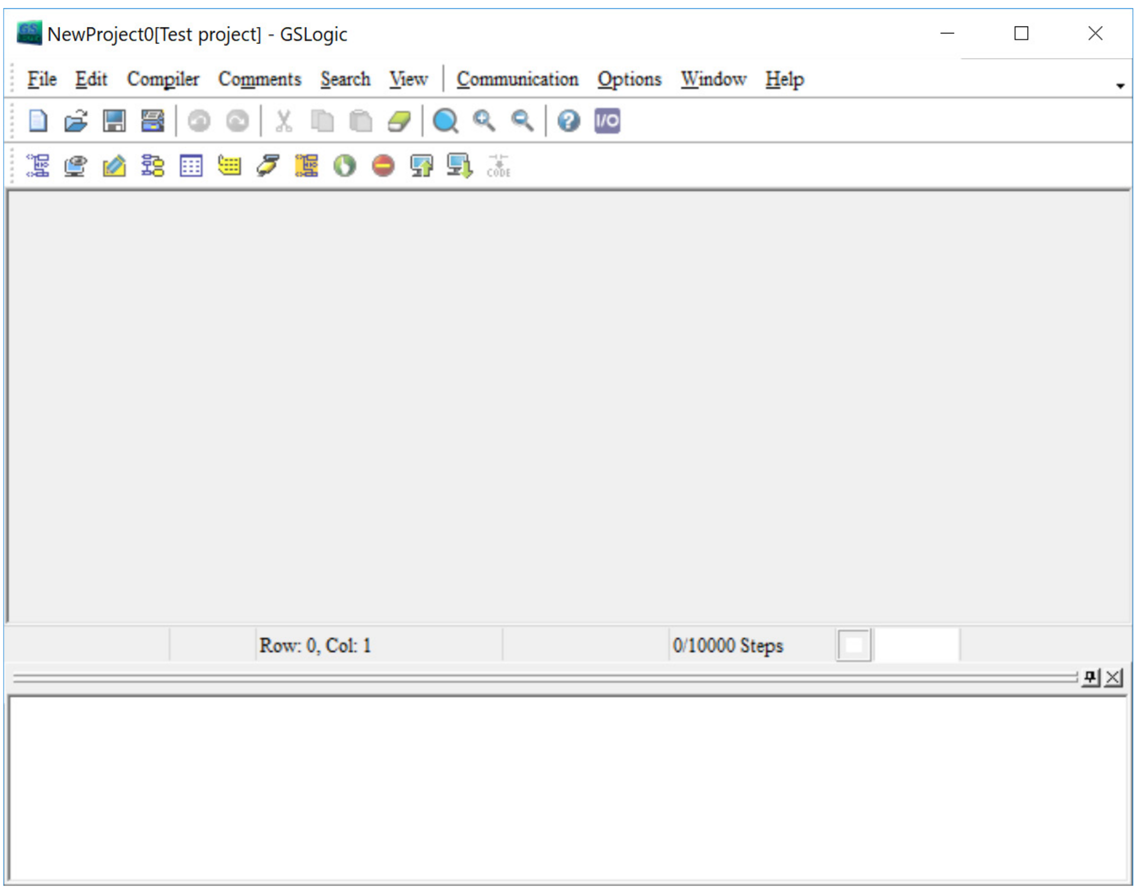
Program Writing

Connecting GSLogic PC to GS30 PLC

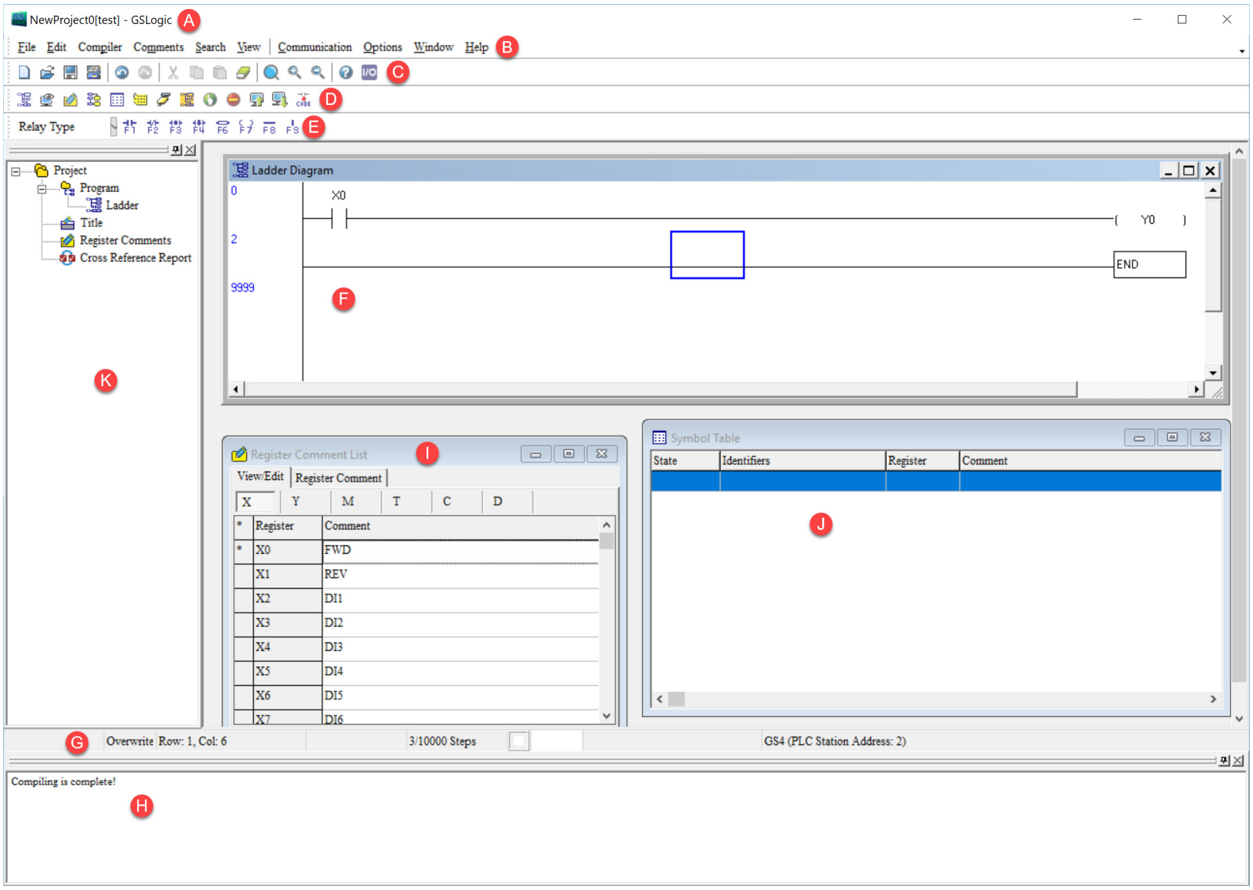
In order to connect to the PLC with GSLogic, the PLC must be enabled by either selecting PLC1 or PLC2 on the GS30 keypad, or PLC Run or PLC Stop in the optional GS4-KPD keypad. Also, no other Modbus master can be connected to the GS30 drive; *this includes GSOFT2*.



When running GSLogic for the first time, before a “New file” has been used, only the “File (F),” View (V),” “Communications (C),” “Options (O),” and “Help (H)” functions will appear on the function toolbar.



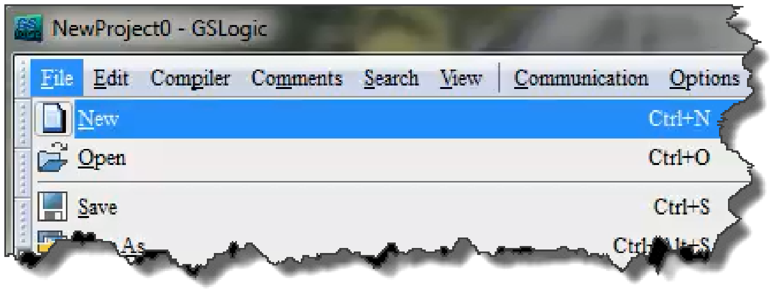
After running GSLogic for the second time, the last file edited will open and be displayed in the editing window.



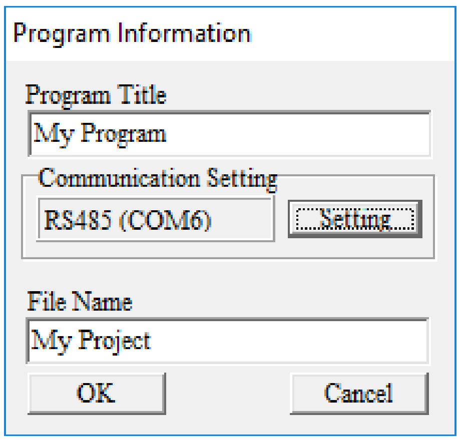
Following is a brief description of the various areas in the GSLogic editing software window shown above.

Symbol	***Name***	***Description***
A	Project Title Toolbar	Project File Name and Project Title shown here (File Name [Project Title])
B	Menu Toolbar	Individual drop-down menu options
C	Standard Editing Toolbar	Contains standard Windows application features
D	PLC Quick Access Toolbar	Allows easy access to the most commonly used GSLogic tasks
E	Ladder Editing Toolbar	Provides quick access to the most common devices used in creating ladder code
F	Ladder Diagram Window	Where the program ladder code is entered and edited
G	Status Toolbar	Displays messages regarding PLC and program status
H	Output Window	Shows compiling status and error messages
I & J	Auxiliary Window	The Symbol Table and Register Comment List Window are shown in order to demonstrate how multiple windows can be placed in the workspace.
K	Reveals or hides the Project Workspace Window	From here, you can open the Ladder Diagram window, change the project title and description, Register Comments, and view the Cross Reference table.

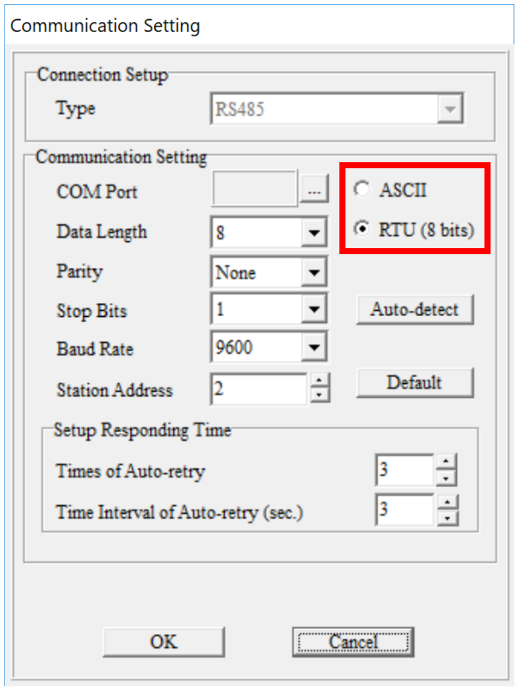
Click the “NEW FILE” icon on the toolbar to open a new file (Ctrl+N).
You can also use “File (F)”=>New file (N) (Ctrl+N).



The “Program Information” window will appear after opening a new file.
Enter the Program Title and File Name. These will appear at the top of the project window.



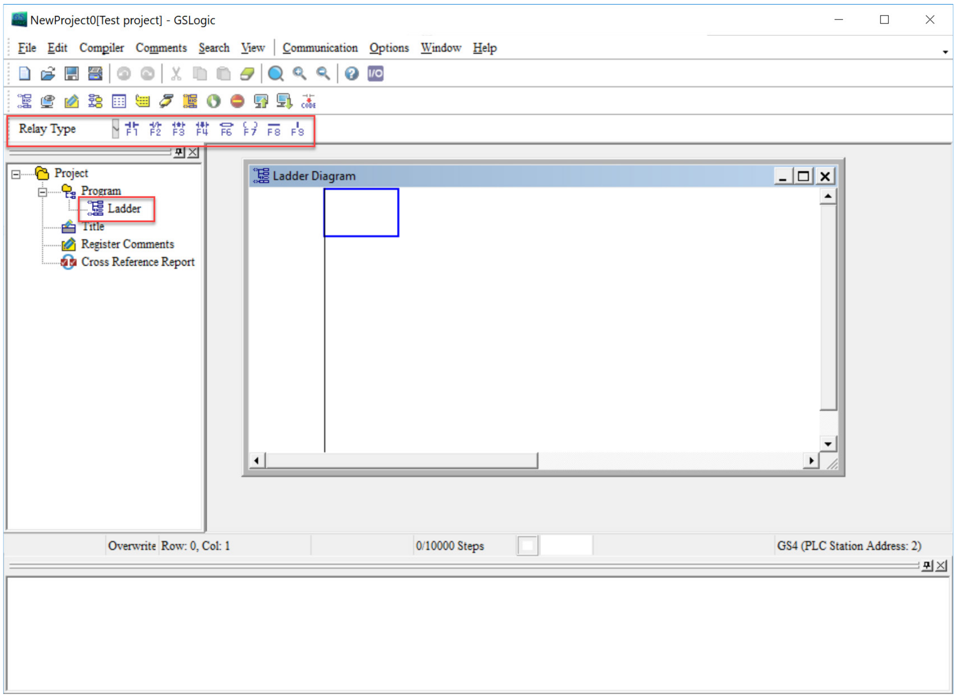
Select "Setting" to choose the communication settings to be used. To adjust communication settings on an existing project, go to the Communication menu and select "Communication Settings." Choose the correct COM Port and ASCII/RTU setting. Only the GSLogic communication settings selection for ASCII or RTU must be the same as the Drive's ASCII/RTU setting found in P09.04. All other settings on this window can be left at default. These values are hard coded in the GS30 drive to communicate with GSLogic.



Communication Setting: Perform settings in accordance with the desired communications method. The Default Station Address for the PLC is 2. (The Modbus station address must be different from the GS30 Drive's station address. The Drive's default address =1.)

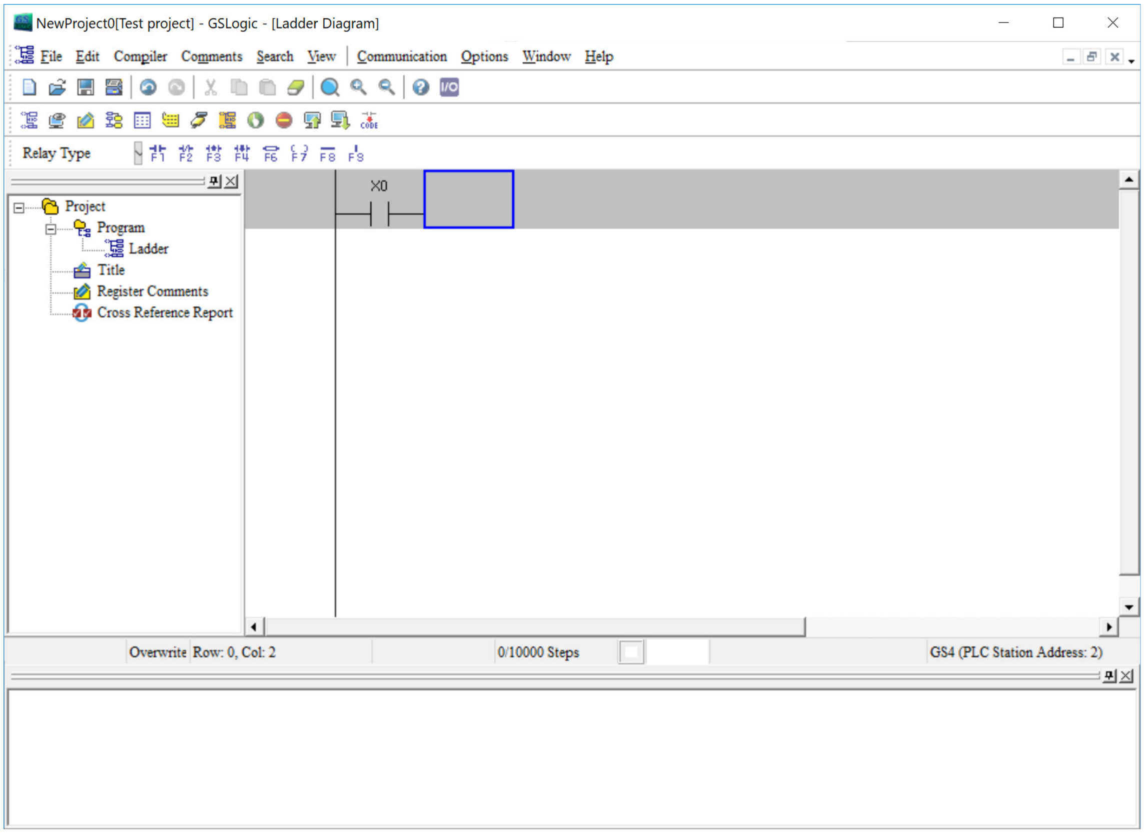
Click "OK" after completing settings to return to program editing in ladder diagram mode.

In ladder diagram mode, you can perform program editing using the buttons on the Ladder Diagram Toolbar.

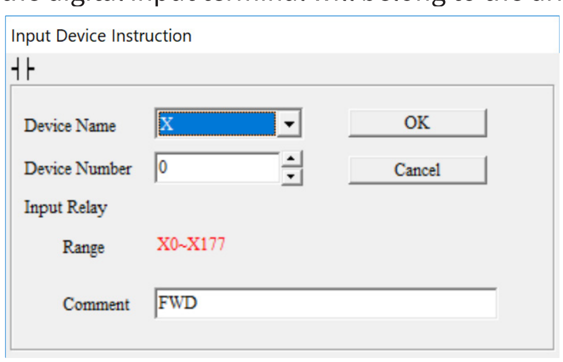


Basic Ladder Program Example

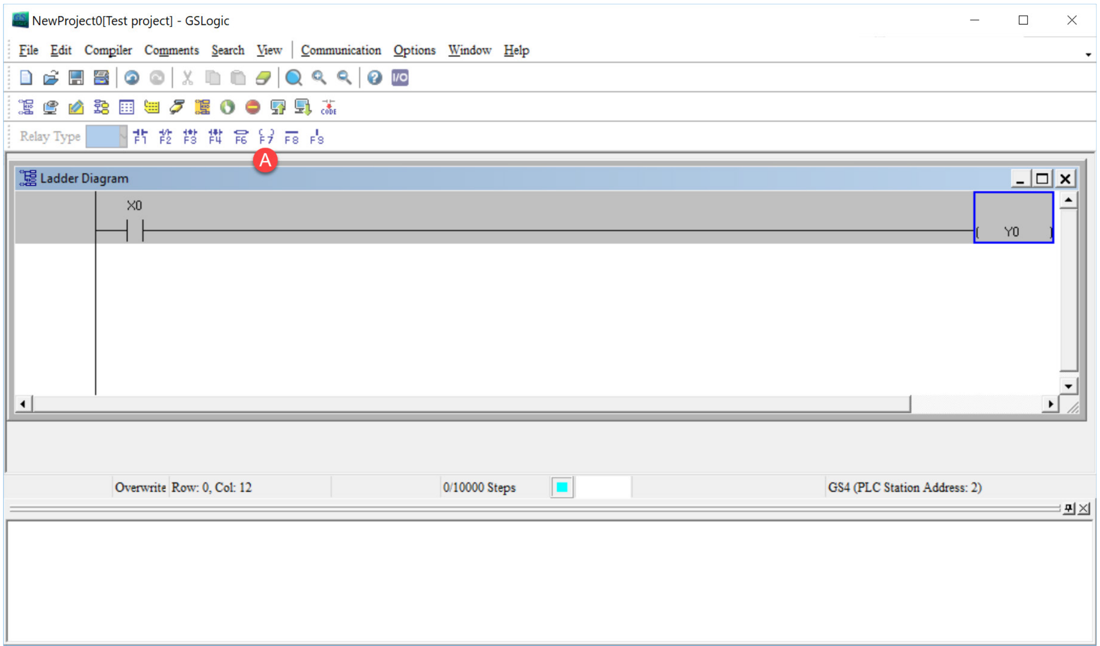
1) With the cursor in the ladder diagram editor window, select a "Normally Open" contact icon from the Ladder Editing Tool Bar, or use keyboard function key (F1) operation.



2) The Input Device Instruction dialog box will appear. Select the device name (such as "M" or "X"), the device number (such as "10" or "0"), and input comments (such as "Enable Pushbutton") can be selected; click the OK button when finished. X0 is a digital input which is tied to the FWD terminal of the drive. Any preconfigured behavior of the terminal is void now that the input is being used in the PLC code. Once the PLC is in Disable Mode, the control of the digital input terminal will belong to the drive again.



3) Click on the output coil icon (a) or press function key F7. In the Input Device Instruction dialog box choose device name (such as "M"), device number (such as "0"), and input comments (such as "Enable Light"). Click the OK button when finished.

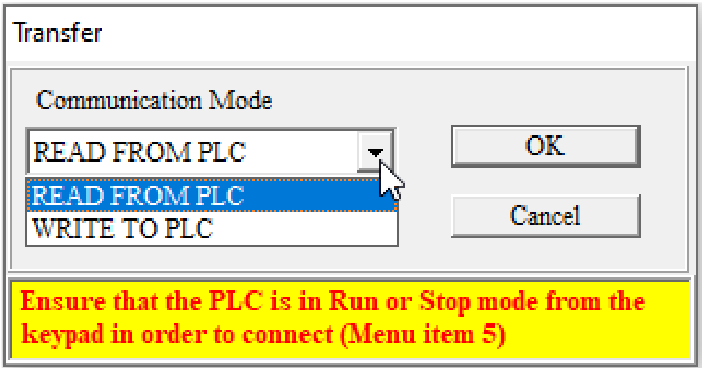


4) While the cursor edit box is on the next row, double-click in the cursor box to bring up the Input Instruction text box (or press F6 to invoke the Instruction List dialogue box). Type in "End" and click OK to add the end instruction rung to the ladder program. This signals the end of the ladder program.

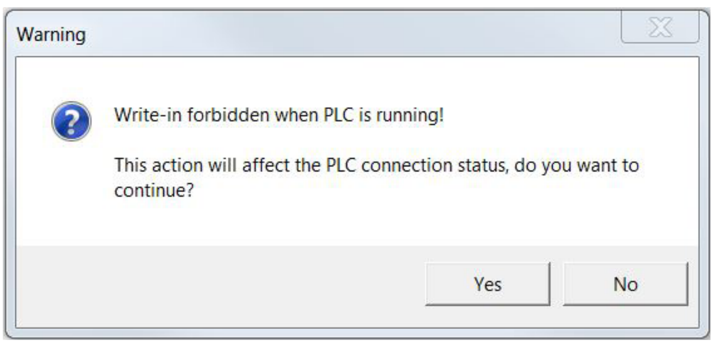
5) Click on the compile (CODE) icon on the tools ribbon. After compiling, the number of steps will appear on the left side of the editor window. The PLC can only accept 2,000 steps.
<u>Note</u>:
Steps in the PLC program are not proportionally related to rungs. One rung of code with a single contact and a single coil would have two steps for that one rung. A rung with one contact and the FREQ instruction would have eight steps.

Program Download

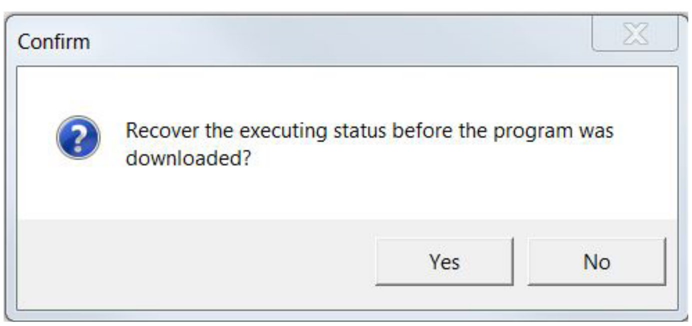
Be sure the PLC is NOT in Disabled mode (PLC0) on the GS30 keypad. After creating and compiling a program using GSLogic, select the Write to PLC icon on the tool ribbon () . When the Transfer Setup window appears, make sure that the Communication Mode is set to "Write to PLC," which will download the program to the PLC. GSLogic will perform program download with the GS30 drive PLC in the communications format specified in previously set up communications settings dialog box.



If the PLC is in Run mode, a warning will appear asking if you want to continue. Press Yes if you want to proceed with the download.



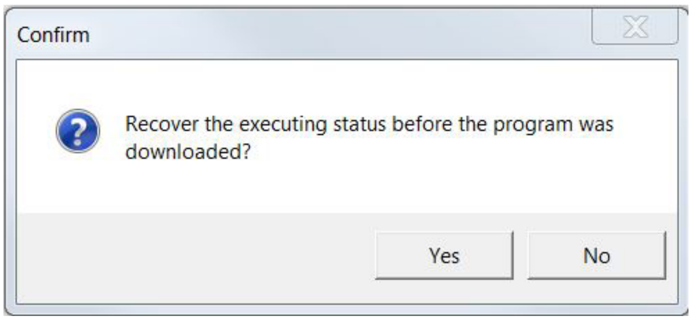
After the program has downloaded, GSLogic will ask you to confirm that you want to put the PLC back in the previous run/stop state it was in before the download. Click Yes if you would like to recover this state.

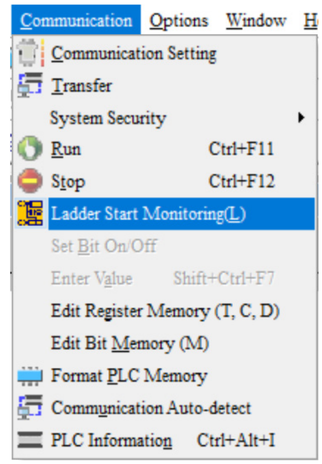


If the PLC is in Run mode, then the ladder code is now running on the GS30 PLC.

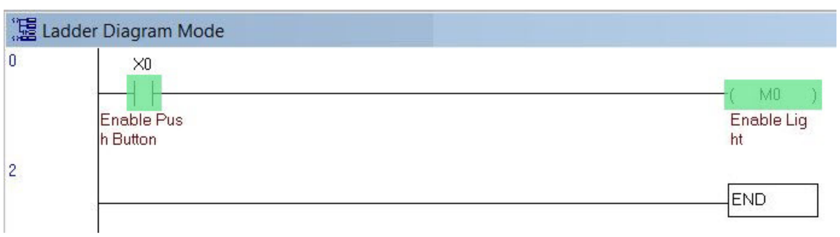
Program Monitoring

Press the Online Mode icon ( ) to go online with the PLC and the current ladder code, and confirm the PLC is in Run Mode at the bottom of the screen. While confirming that the PLC is in the Run Mode after downloading a program, click on the Ladder Start Monitoring icon ( ) in the Communication menu drop-down, or on the tools ribbon (see figures below).

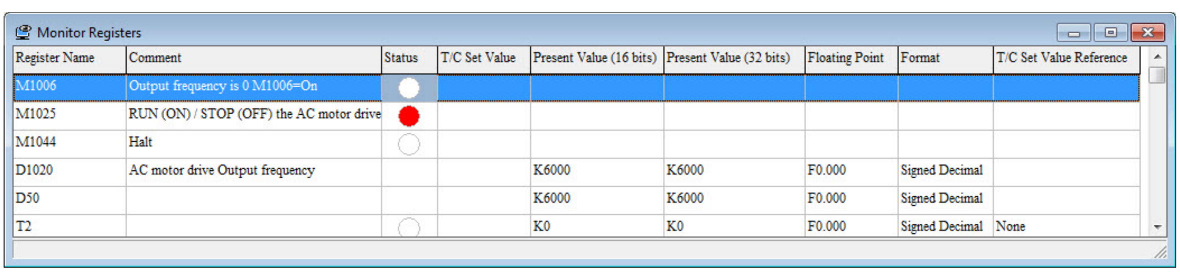




If you select the Ladder Start Monitoring icon, a live view of the ladder diagram can be viewed similar to the image below. A contact, coil, or instruction highlighted in *green* indicates that it is *conducting* if it is a *contact*, and it is *activated* if it is a *coil or instruction*.



Press the Edit Monitored Registers icon ( ) to monitor and edit values live in the PLC code. In order to monitor a specific register either double click or right click on a row in the window and type in the register you wish to monitor. To change the value of the register right click on the row and enter the desired value.


Monitor Registers

Register Name	Comment	Status	T/C Set Value	Present Value (16 bits)	Present Value (32 bits)	Floating Point	Format	T/C Set Value Reference
M1006	Output frequency is 0 M1006=On							
M1025	RUN (ON) / STOP (OFF) the AC motor drive							
M1044	Halt							
D1020	AC motor drive Output frequency			K6000	K6000	F0.000	Signed Decimal	
D50				K6000	K6000	F0.000	Signed Decimal	
T2				K0	K0	F0.000	Signed Decimal	None

This chapter is designed to be an overview and quick-start guide to get you quickly up and running your first PLC program. For more details and further explanation of the user interface, instruction set, and implementing the PLC, please refer to the GSLogic Help File. This Help File can be accessed under the "Help" menu or anywhere you see the "?" symbol.

Help on all of the following is located in the GSLogic Help file: Full description of the user interface, menu items, windows, and tool bars; Basics of the PLC; Special Function registers; Full set of PLC Instructions; Memory locations and data types; Using the digital and analog I/O; Communication with the PLC and MODBUS addresses.

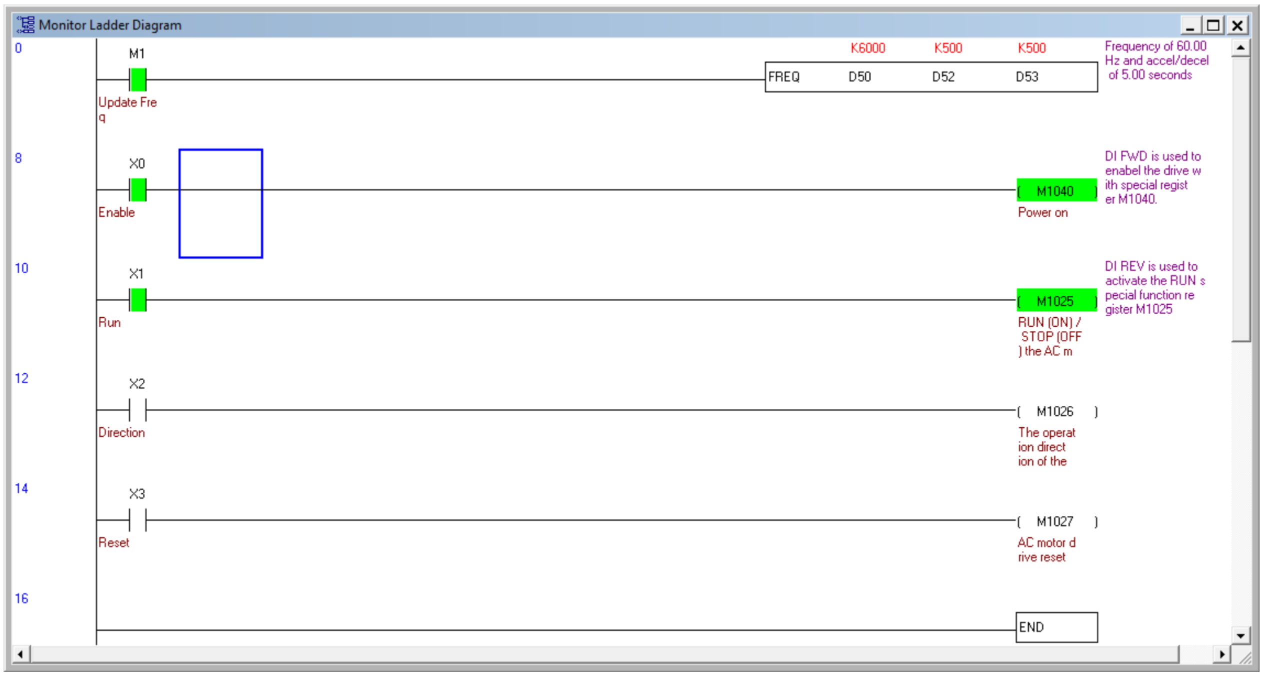
GS30 GSLogic Program Examples

Ex 1: GS30 Drive Control from GS30 PLC

Below is an example in which the drive PLC has control of the drive run, stop, direction, reset, and speed controls. Example GSlogic programs can be downloaded here:

https://cdn.automationdirect.com/static/support/sampleprg/drv/GSLogic%20Sample%20Programs.zip

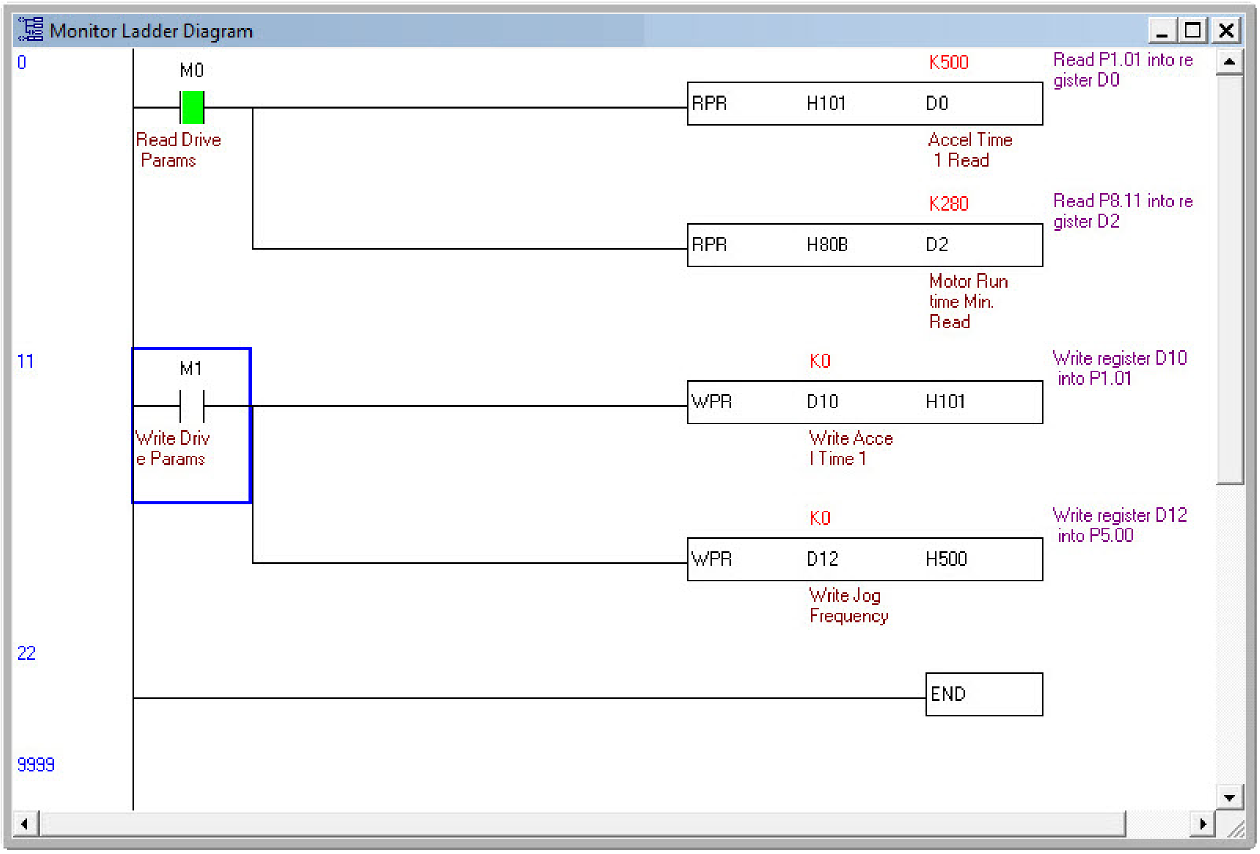
- *Rung 1: When bit M1 is on the FREQ instruction will write the values in D50, D52, and D53 to the drive. This instruction will not cause the drive to run on its own. M1 can be turned on either via Modbus or through GSLogic. The values of D50, D52, and D53 are populated using GSLogic by modifying the register.*
- *Rung 2: X0 (Digital input FWD) will turn on the output relay and allow power to the output of the drive.*
- *Rung 3: X1 (Digital input REV) will tell the drive to run at profile assigned in the FREQ command in rung 1.*
- *Rung 4: X2 (Digital input 3) will change the direction of rotation of the motor.*
- *Rung 5: X3 (Digital input 4) will reset any resettable faults in the drive, if they occur.*



Ex 2: Drive Intercommunications

Below is an example of using the PLC to read and write to the VFD parameters using the RPR and WPR instructions. The WPR (Write Parameter) follows the same rules as when entering new values through the keypad. Even when using the WPR instruction, a Stop-Mode-Only writable parameter can still be written to only when the drive output is stopped.

The comments on the right side of each rung describes what each RPR and WPR does in the following example.



A

Table of Contents

Appendix A: Accessories

Fuses/Circuit Breakers

Protection devices are essential to prevent damage to your GS30 drive and application equipment. Please use the fuse specification chart below to select fuses that are applicable to your GS30 drive. Only use UL-certified fuses which comply with your local regulations.

Fuse Specification Chart GS30 *DURApulse* Drives									
Drive Model	***HP***	***Input Power***			***Input Fuse***			***Circuit Breaker***	
		Ø	***Volts***	***GS30 Input Amps***	***Fuse Amps***	***Fast Acting Class T***	***Edison Class J****	***Size***	***Note***
GS31-20P5	1/2	1	230	8.3	15	TJN15	JHL15	20	GCB100S-3FF20LL
GS31-21P0	1			11.3	20	TJN20	JHL20	30	GCB100S-3FF30LL
GS31-22P0	2			18.5	35	TJN35	JHL35	45	GCB100S-3FF40LL
GS31-23P0	3			27.5	50	TJN50	JHL50	70	GCB100S-3FF70LL
GS33-20P5	1/2	3		3.8	15	TJN15	JHL15	15	GCB100S-3FF15LL
GS33-21P0	1			6	20	TJN20	JHL20	16	GCB100S-3FF15LL
GS33-22P0	2			9.6	35	TJN35	JHL35	25	GCB100S-3FF25LL
GS33-23P0	3			15	50	TJN50	JHL50	40	GCB100S-3FF40LL
GS33-25P0	5			23.4	80	TJN80	JHL80	60	GCB100S-3FF60LL
GS33-27P5	7 1/2			32.4	60	TJN60	JHL60	63	GCB100S-3FF60LL
GS33-2010	10			43.2	80	TJN80	JHL80	90	GCB100S-3FF90LL
GS33-2015	15			61.2	110	TJN110	JHL110	125	GCB150S-3FF125LL
GS33-2020	20			82.8	150	TJN150	JHL150	160	BW250JAGU- 3P160SB
GS33-2025	25			85.0	170	TJN175	JHL175	175	GCB250S-3FF175LL
GS33-2030	40			103.0	206	TJN200	JHL200	200	GCB250S-3FF200LL
GS33-2040	40			126.0	252	TJN250	JHL250	225	GCB250S-3FF225LL
GS33-2050	50			151.0	302	TJN300	JHL300	300	GCB400S-3FF300LL
GS33-40P5	1/2		460	2	10	TJS10	JHL10	15	GCB100S-3FF15LL
GS33-41P0	1			3.3	15	TJS15	JHL15	15	GCB100S-3FF15LL
GS33-42P0	2			5.1	20	TJS20	JHL20	15	GCB100S-3FF15LL
GS33-43P0	3			7.2	25	TJS25	JHL25	20	GCB100S-3FF20LL
GS33-45P0	5			11.6	45	TJS45	JHL45	30	GCB100S-3FF30LL
GS33-47P5	7 1/2			17.3	35	TJS35	JHL35	32	GCB100S-3FF30LL
GS33-4010	10			22.6	45	TJS45	JHL45	45	GCB100S-3FF40LL
GS33-4015	15			30.8	60	TJS60	JHL60	60	GCB100S-3FF60LL
GS33-4020	20			39.6	80	TJS80	JHL80	80	GCB100S-3FF80LL
GS33-4025	25			45.7	90	TJS90	JHL90	90	GCB100S-3FF90LL
GS33-4030	30			53.9	110	TJS110	JHL110	100	GCB100S-3FF100LL
GS33-4040	40			72.5	150	TJN150	JHL150	125	GCB150S-3FF125LL
GS33-4050	50			77.0	160	TJN175	JHL175	150	GCB150S-3FF150LL
GS33-4060	60			97.0	200	TJN200	JHL200	175	GCB250S-3FF175LL
GS33-4075	75			123.0	250	TJN250	JHL250	225	GCB250S-3FF225LL
GS33-4100	100			173.0	350	TJN350	JHL350	300	GCB400S-3FF300LL

** High-speed Class J.*
Note: JHL fuses can be used with GS and DURApulse drives in non-UL applications. Fuse the drive according to NEC guidelines (NEC Article 430). For UL applications, GS, and DURApulse drives require Class T fuses.

Recommended Fuse Specifications for the DC Side of Common DC Bus

These fuses are applicable only when connecting input power directly to the DC bus with terminals DC+ and DC-.

- *The fuse current specifications in table below are based on overloading. If there is no possibility of overloading during use then fuses with a lower rating than the table below are allowed. The DC-side current calculation method described below can be used to calculate a suitable fuse rating for drive with DC current. Special cases such as overload or emergency stop must be considered however.*
- *For the DC-side fuse, please select a DC fuse or refer to the DC voltage specifications from the fuse parameters. The DC voltage rating must be higher than the operating voltage.*
- *Fuse selection should take into account operating class (e.g. High-speed or general purpose) and overloading.*
  a) If the drive is subject to overloading and high-speed fuses are used: Due to the speed of response the chosen fuse should be rated double that of the calculated maximum instantaneous DC current.
  b) If the drive is subject to overloading and normal fuses are used: Fuse selection should be based on the calculated maximum instantaneous current during overloading.
  c) If drive is not subject to overloading: Select fuses with a current rating close to that of the calculated DC current.
- *UL-listed fuse suitable for short-circuit protection of inputs. "In the United States, branch circuits must comply with the US National Electrical Code (NEC) and its local directives." Please select a UL-listed fuse to comply with local regulations.*
- *"In Canada, branch circuits must comply with the Canadian Electrical Code and its local directives." Please select a UL-listed fuse to comply with local regulations.*

GS30 - DC Bus Fusing			
Requirement	***Drive Model***	***230V Drives***	***460V Drives***
DC Bus Voltage Level	all models	350	700
DC Bus Fuse Voltage Rating	all models	690	1250
	0P5 (1/2HP)	10	10
	1P0 (1HP)	16	10
	2P0 (2HP)	25	16
	3P0 (3HP)	40	20
	5P0 (5HP)	63	30
	7P5 (7.5HP)	80	40
	010 (10HP)	100	55
	015 (15HP)	160	80
	020 (20HP)	200	100
	025 (25HP)	-	125
	030 (30HP)	-	160

DC Side Current Calculation

Different motors and loads will produce different DC current values. When the motor power and efficiency parameters are known, use the following formula to calculate the DC current:

$$I_{dc} = P_{motor} / (1.35 * V_{Line} * \eta_{motor})$$

Where

- V_{Line}=*Output voltage*
- η_{motor}=*motor efficiency*
- P_{motor}=*Motor power*

If the input DC voltage, output load, and output power factor are known then the following formulation can be used as well:

$$I_{dc} = (V_{line}*\sqrt{3}*Io*\cos\theta / 0.95) / VDC$$

For example:

V_{line}=220V, motor power factor $\cos\theta$=0.8, drive efficiency 0.95 (generally 0.94~0.98), output current Io=11A, VDC=360V

$$I_{dc} = (220V*\sqrt{3}*11*0.8 / 0.95) / 360$$
$$I_{dc} = 9.8A$$

Standard Footprint EMC Filter and Zero Phase Reactor

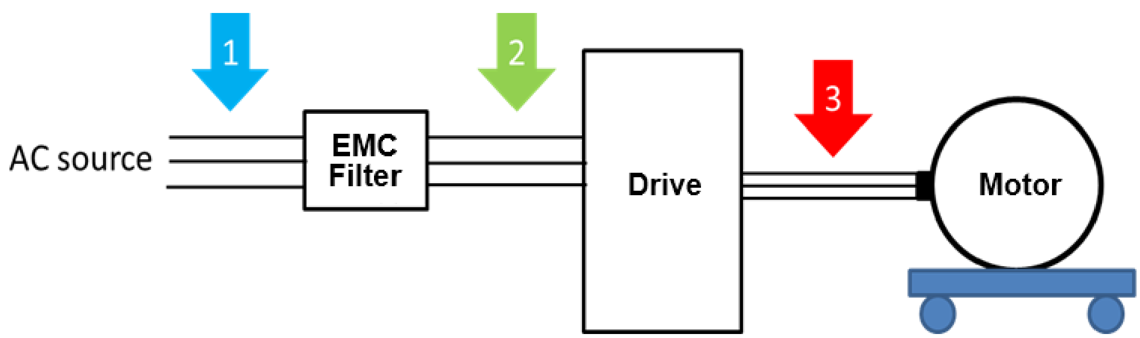
Use EMC filters to enhance the EMC performance for the environment and machines and to comply with EMC regulations, further reducing EMC problems. If you purchase a motor drive without a built-in EMC filter, we recommend that you select an EMC filter as shown below. GS30 drives will mount on top of these footprint filters for Frames A–D. For some motor drive models, you need to work with zero phase reactors to be compliant with EMC regulations. Refer to the table and figure below for the recommended model, setting method, and maximum motor cable length of the EMC filter and zero phase reactor.

GS30 EMC Filter and Zero Phase Reactor												
Frame	***Drive Model***	***Input Current (A)***	***Footprint Filter** Model #***	***Filter Dimensions***	***Recom-mended Zero Phase Reactor***	***Conducted Emission***				***Radiated Emission***		
						C1-motor cable length-30m			C2-motor cable length-100m	C2-motor cable length-100m		
						Zero Phase Reactor Position*						
						1	***2***	***3***	***n/a***	***1***	***2***	***3***
A	***GS31-20P5***	6.7	EMF11AM21A	PDF	RF008X00A		✓	✓	N/A		✓	✓
	GS33-20P5	3.8	EMF10AM23A	PDF			✓	✓			✓	✓
	GS33-21P0	6	EMF10AM23A				✓	✓			✓	✓
	GS33-40P5	2.5	EMF6A0M43A	PDF				✓				✓
	GS33-41P0	4.2	EMF6A0M43A					✓				✓
B	***GS31-21P0***	10.5	EMF11AM21A	PDF			✓	✓			✓	✓
	GS33-22P0	9.6	EMF10AM23A	PDF			✓	✓			✓	✓
	GS33-42P0	6.4	EMF6A0M43A	PDF				✓				✓
C	***GS31-22P0***	17.9	EMF27AM21B	PDF				✓				✓
	GS31-23P0	26.3	EMF27AM21B					✓				✓
	GS33-23P0	15	EMF24AM23B	PDF			✓	✓			✓	✓
	GS33-25P0	23.4	EMF24AM23B				✓	✓			✓	✓
	GS33-43P0	7.2	EMF12AM43B	PDF								
	GS33-45P0	11.6	EMF12AM43B				✓	✓			✓	✓
D	***GS33-27P5***	32.4	EMF33AM23B	PDF		✓	✓			✓	✓	
	GS33-47P5	17.3	EMF23AM43B	PDF		✓	✓	✓		✓	✓	✓
	GS33-4010	22.6	EMF23AM43B			✓	✓	✓		✓	✓	✓
E	***GS33-2010***	43.2	B84143D0050R127	PDF			✓	✓			✓	✓
	GS33-2015	61.2	B84143D0075R127	PDF			✓	✓			✓	✓
	GS33-4015	30.8	B84143D0050R127	PDF								
	GS33-4020	39.6	B84143D0050R127				✓	✓			✓	✓
F	***GS33-2020***	82.8	B84143D0090R127	PDF			✓	✓			✓	✓
	GS33-4025	45.7	B84143D0050R127	PDF			✓	✓			✓	✓
	GS33-4030	53.9	B84143D0075R127	PDF			✓	✓			✓	✓
Continued on next page												
Note: It is not necessary to add a zero phase reactor for passing the C2 conducted emission test.												
** See diagram on the next page for installation positions.*												
*** The B8 series filters are not footprint filters, they must be mounted separately.*												

GS30 EMC Filter and Zero Phase Reactor																	
Frame	***Drive Model***	***Input Current (A)***	***Footprint Filter** Model #***	***Filter Dimensions***	***Recom-mended Zero Phase Reactor***	***Conducted Emission***									***Radiated Emission***		
						C1-motor cable length-10m			C2-motor cable length-20m			C3-motor cable length 100m			C2-motor cable length-100m		
						Zero Phase Reactor Position*											
						1	***2***	***3***	***1***	***2***	***3***	***1***	***2***	***3***	***1***	***2***	***3***
G	***GS33-2025***	85	B84143A0120R105	PDF	RF008X00A		✓	✓			✓					✓	✓
	GS33-2030	103	B84143A0120R105				✓	✓			✓					✓	✓
	GS33-4040	72.5	B84143A0120R105			✓		✓			✓						
H	***GS33-4050***	77	B84143D0150R127	PDF	RF002X00A**	✓		✓			✓					✓	✓
	GS33-4060	97	B84143D0150R127			✓		✓			✓					✓	✓
I	***GS33-2040***	126	B84143D0200R127	PDF		✓	✓	✓								✓	✓
	GS33-2050	151	B84143D0200R127			✓	✓									✓	✓
	GS33-4075	123	B84143D0200R127				✓										
	GS33-4100	173	B84143D0200R127				✓										

Note: It is not necessary to add a zero phase reactor for passing the C2 conducted emission test.
** See diagram below for installation positions.*
*** The B8 series filters are not footprint filters, they must be mounted separately.*

Zero phase reactor installation position diagram:



1: Install at the cable between the power supply and the EMC filter.
2: Install at the cable between the EMC filter and the drive.
3: Install at the cable between the drive and the motor.

Example of drive installed with footprint filter

High Performance EMI Input Filters

The optional accessories listed in this chapter are available for use with the GS30 drive. Selection of these accessories is application specific and may improve drive performance. Additional information regarding filter installation and operation is available in the AutomationDirect white paper, "Applied EMI/RFI Techniques Overview."

EMI Filters Selection

Model	Description	EMI Filter*	
		Roxburgh Filters Chassis 1ph	Roxburgh Filters C2 Rated
GS31-20P5	230V 1ph 0.5 hp	RES90F10	MIF10
GS31-21P0	230V 1ph 1.0 hp	RES90F16	MIF16
GS31-22P0	230V 1ph 2.0 hp	RES90S20	MIF23
GS31-23P0	230V 1ph 3.0 hp	RES90S30	MIF330B
GS33-20P5	230V 3ph 0.5 hp	-	KMF306A
GS33-21P0	230V 3ph 1.0 hp	-	KMF306A
GS33-22P0	230V 3ph 2.0 hp	-	KMF318A
GS33-23P0	230V 3ph 3.0 hp	-	KMF318A
GS33-25P0	230V 3ph 5.0 hp	-	KMF325A
GS33-27P5	230V 3ph 7.5 hp	-	KMF336A
GS33-2010	230V 3ph 10hp	-	KMF350A
GS33-2015	230V 3ph 15hp	-	KMF370A
GS33-2020	230V 3ph 20hp	-	KMF3100A
GS33-2025	230V 3ph 25hp	-	KMF3100A
GS33-2030	230V 3ph 30hp	-	KMF3100A
GS33-2040	230V 3ph 40hp	-	MIF3150
GS33-2050	230V 3ph 50hp	-	MIF3150
GS33-40P5	460V 3ph 0.5 hp	-	KMF306A
GS33-41P0	460V 3ph 1.0 hp	-	KMF306A
GS33-42P0	460V 3ph 2.0 hp	-	KMF306A
GS33-43P0	460V 3ph 3.0 hp	-	KMF310A
GS33-45P0	460V 3ph 5.0 hp	-	KMF318A
GS33-47P5	460V 3ph 7.5 hp	-	KMF318A
GS33-4010	460V 3ph 10hp	-	KMF325A
GS33-4015	460V 3ph 15hp	-	KMF336A
GS33-4020	460V 3ph 20hp	-	KMF350A
GS33-4025	460V 3ph 25hp	-	KMF350A
GS33-4030	460V 3ph 30hp	-	KMF370A
GS33-4040	460V 3ph 40hp	-	KMF370A
GS33-4050	460V 3ph 50hp	-	KMF370A
GS33-4060	460V 3ph 60hp	-	KMF3100A
GS33-4075	460V 3ph 75hp	-	MIF3150
GS33-4100	460V 3ph 100hp	-	MIF3150

** All specs for the EMI filters can be found at www.automationdirect.com or by clicking the following links: -KMF Series Filters*
-MIF Series Filters
-RES90 Series Filters

EMI Filter Installation

Electrical equipment like the GS30 drive, will generate electrical noise when in operation and may interfere with the normal operation of peripheral equipment. The use of an EMI filter will mitigate this type of power supply interference. Other measures may be required for reduction or mitigation of radiated emissions. Roxburgh EMI filters have been tested with the GS30 family of drives and are recommended for the mitigation of interference and the highest performance When the GS30 drive and Roxburgh EMI filter are installed and wired according to the user manual, the installation will conform to the following rules:

- *EN61000-6-4*
- *EN61800-3: 1996*
- *EN55011 (1991) Class A Group 1 (1st Environment, restricted distribution)*

General precaution

1) *Install the EMI filter and GS30 drive on the same subpanel or metal plate.*
2) *Install the EMI filter as close as possible to the GS30 drive.*
3) *Keep wiring between the EMI filter and GS30 drive as short as possible.*
4) *The subpanel or metal plate used to support the EMI filter and GS30 drive should be well grounded (minimal resistance to ground is typically less then 1Ω).*
5) *To insure that the EMI filter and GS30 drive are adequately grounded, insure that both are securely attached to the subpanel or plate.*

Choose suitable motor cable and precautions

Proper installation and the the choice of good motor cable will positively affect the performance of the filter. When selecting motor cable, please observe the following precautions.

1) *Cable shielding (double shielding is best).*
2) *Ground the shield on both ends of the motor cable. Maintain minimum length and employ strong mechanical connection to ground.*
3) *Remove paint on the metal saddle, subpanel or plate to insure good contact to ground.*

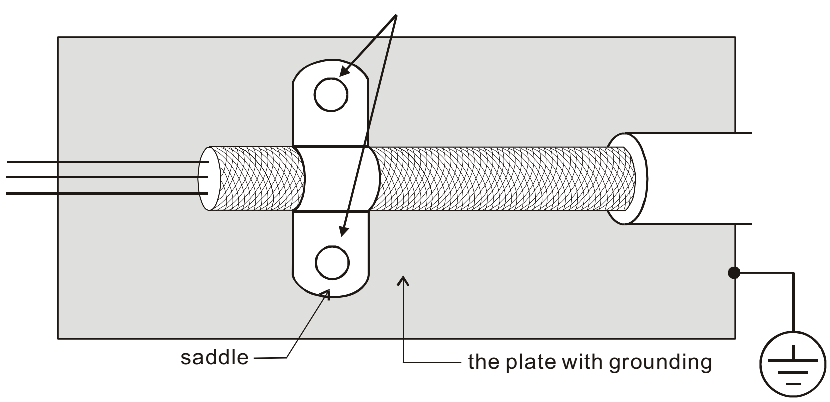


Figure 1

EMI Filter Installation (continued)

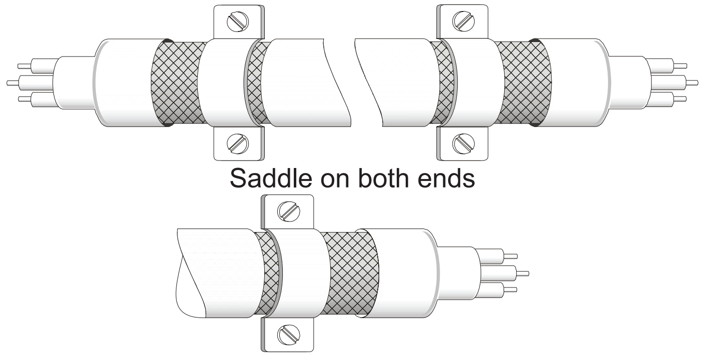


Figure 2

Reflective Wave Phenomenon

The inverter section of a PWM drive like the GS30 does not produce sinusoidal output voltage wave forms. Rather, the output voltage produced is a continuous train of width modulated pulses, sent to the motor terminals via the motor cable.

Peak pulse voltage at the GS30 drive is equal to the drive DC bus voltage and contains steep rise and fall times, the result of the IGBT switching device used in the drive inverter section.

Peak pulse voltage at the motor terminals may exceed the drive DC bus voltage and is dependent on the dynamics of the drive output voltage rise time, cable transmission line characteristics, cable length and motor impedance.

The voltage pulse train at the motor terminals experiences momentary transient over voltage as the IGBT transistors switch. The result being voltage levels at the motor terminals double that of the drive bus voltage.

Over voltage of this type has the potential to stress the motor insulation, damaging the motor.

Recommended Motor Cable Length

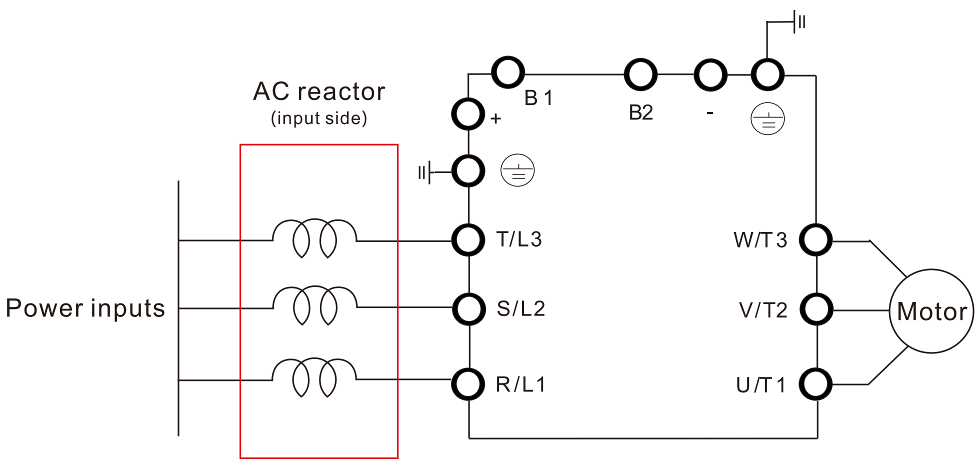
1) Never connect phase lead capacitors or surge absorbers to the output terminals of the drive.
2) As cable length increases, capacitance between cables will increase and may result in leakage current and over current faults with the possibility of damage to the GS30 drive.
3) If more than one motor is connected to the drive, the total cable length is the sum of the cable lengths from the GS30 drive to each motor.
4) Should an overload relay malfunction occur, lower the GS30 drive carrier frequency (P2.10) or install an output reactor.
5) When operating an AC motor with a PWM drive like the GS30, the motor may experience reflective wave as described above. To prevent this situation, please observe the recommendations below:
   a) Use a motor with enhanced insulation. (1000V, 1200V, 1600V, higher is better)
   b) Connect an output reactor (optional) to the output terminals of the drive.
   c) Keep motor cable length as short as possible. (65ft, 20m, or less)
   d) Where motor cable lengths will exceed 65ft (20m), refer to "Maximum Recommended Cable Length - GS30" on page A–16.

Line Reactors / Voltage Time Filters

Line Reactor

Installing an AC reactor on the input side of an AC motor drive can increase line impedance, improve the power factor, reduce input current, increase system capacity, and reduce interference generated from the motor drive. It also reduces momentary voltage surges or abnormal current spikes from the mains power, further protecting the drive. For example, when the main power capacity is higher than 500 kVA, or when using a phase-compensation capacitor, momentary voltage and current spikes may damage the AC motor drive's internal circuit. An AC reactor on the input side of the AC motor drive protects it by suppressing surges.

Install an AC input reactor in series between the main power and the three input phases R S T, as shown in the figure below:

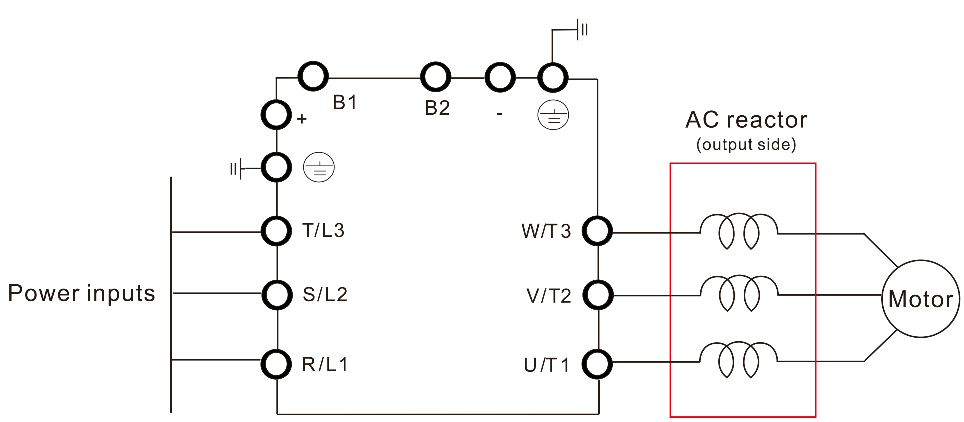


Load Reactor/Voltage Time Filter

When using drives in long wiring output application, ground fault (GFF), over-current (OC) and motor over-voltage (OV) often occur. GFF and OC cause errors due to the drive's self-protective mechanism; over-voltage damages motor insulation.

The excessive length of the output wires makes the grounded stray capacitance too large, increases the three-phase output common mode current, and the reflected wave of the long wires makes the motor dv / dt and the motor terminal voltage too high. Thus, installing a reactor on the drive's output side can increase the high-frequency impedance to reduce the dv / dt and terminal voltage to protect the motor. For distances greater than 100 feet, a dV/dT filter (VTF Series) is recommended for best performance.

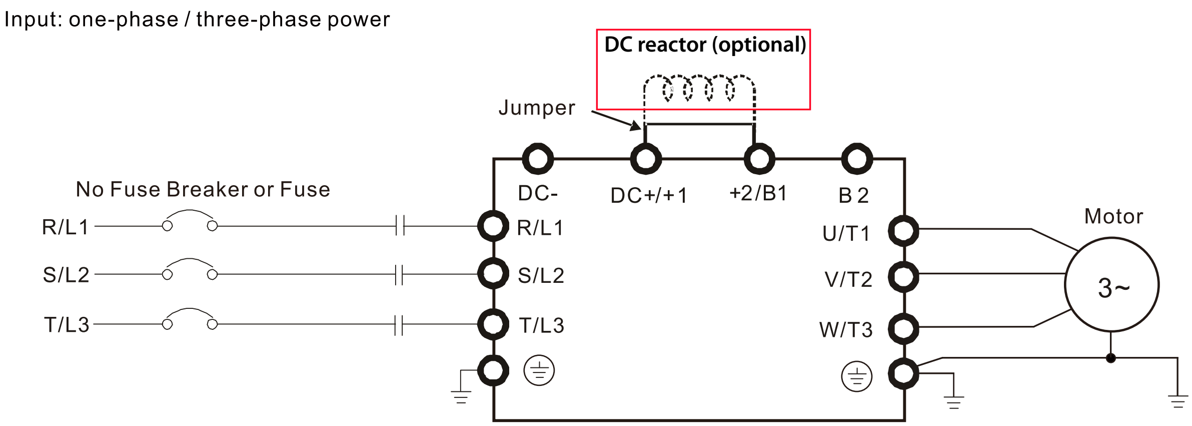
Install an AC output reactor or voltage time filter in series between the three output phases U V W and the motor, as shown in the figure below:



DC Reactor

A DC reactor can also increase line impedance, improve the power factor, reduce input current, increase system power, and reduce interference generated from the motor drive. A DC reactor stabilizes the DC bus voltage. Compared with an AC input reactor, a DC reactor is in smaller size, lower price, and lower voltage drop (lower power dissipation).

Install a DC reactor between terminals +1 and +2. Remove the jumper, as shown in the figure below, before installing a DC reactor.



When the GS30 drive is connected directly to a large-capacity power transformer (600kVA or above) or when a power correction capacitor is switched on, excessive peak currents may occur in the input power circuit resulting in damage to the GS30 drive.

To avoid this, install a line reactor in series with the GS30 drive on the input side. The installation of a line reactor will reduce input current peaks and improve the output power efficiency.

Line (load) reactors installed on the output side protect the motor insulation against AC drive short circuits and IGBT reflective wave damage, and also allow the motor to run cooler by "smoothing" the motor current waveform. They are recommended for operating "non-inverter-duty" motors, and for any motors where the length of wiring between the AC drive and motor is less than or equal to 100 feet. For AC drive-to-motor wiring distances over 100 feet, use of the VTF series output filter is recommended.

Line/Load Reactors Selection Charts

GS30 Line/Load Reactor, AC Output Filter, & DC Reactor Selections							
GS30 Model	**CT Output Amps (rms)**	**Saturation Amps (rms)**	**Motor HP**	**Line Reactor (LR2)****	**Load Reactor (LR2)****	**AC Output Filter (VTF)****	**DC Reactor Delta P/N***
GS31-20P5	2.8	5.6	1/2	LR2-20P5-1PH	LR2-20P5	VTF-246-CFG	DR008D0366
GS31-21P0	4.8	9.6	1	LR-23P0	LR2-21P0	VTF-24-FH	DR011D0266
GS31-22P0	7.5	15	2	LR2-22P0-1PH	LR-22P0	VTF-246-HKL	DR017D0172
GS31-23P0	11	22	3	LR-27P5	LR-25P0	VTF-24-JL	DR025D0117
GS33-20P5	2.8	5.6	1/2	LR2-20P5	LR2-20P5	VTF-246-DGH	DR005D0585
GS33-21P0	4.8	9.6	1	LR2-20P7	LR2-20P7	VTF-24-FH	DR005D0585
GS33-22P0	7.5	15	2	LR-22P0	LR-22P0	VTF-246-HKL	DR008D0366
GS33-23P0	11	22	3	LR-25P0	LR-25P0	VTF-24-JL	DR011D0266
GS33-25P0	17	34	5	LR-27P5	LR-25P0	VTF-46-LM	DR017D0172
GS33-27P5	25	50	7 1/2	LR-2010	LR-2010	VTF-46-NP	DR025D0117
GS33-2010	33	66	10	LR-2015	LR-2010	VTF-246-LPQ	DR033DP851
GS33-2015	46	92	15	LR-2020	LR-2015	VTF-246-NRS	DR049DP574
GS33-2020	65	130	20	LR-2030	LR-2020	VTF-246-PSU	DR065DP432
GS33-2025	75	140	25	LR-2030	LR-2025	VTF-246-PSU	DR090DP325
GS33-2030	90	180	30	LR-2030	LR-2030	VTF-246-RUV	n/a
GS33-2040	120	240	40	LR-2040	LR-2040	VTF-246-RUV	n/a
GS33-2050	146	292	50	LR-2050	LR-2050	n/a	n/a
GS33-40P5	1.5	3	1/2	LR2-40P5	LR2-40P5	VTF-46-DE	DR003D1870
GS33-41P0	2.7	5.4	1	LR2-41P0	LR2-41P0	VTF-246-CFG	DR003D1870
GS33-42P0	4.2	8.4	2	LR2-43P0	LR2-42P0	VTF-24-FH	DR004D1403
GS33-43P0	5.5	11	3	LR2-45P0	LR2-43P0	VTF-24-FH	DR006D0935
GS33-45P0	9	18	5	LR2-47P5	LR2-45P0	VTF-246-HKL	DR009D0623
GS33-47P5	13	26	7 1/2	LR-4010	LR2-47P5	VTF-24-JL	DR012D0467
GS33-4010	17	34	10	LR-4015	LR-4010	VTF-24-JL	DR018D0311
GS33-4015	25	50	15	LR-4015	LR-4015	VTF-246-LPQ	DR024D0233
GS33-4020	32	64	20	LR-4020	LR-4020	VTF-246-LPQ	DR032D0175
GS33-4025	38	76	25	LR-4030	LR-4025	VTF-246-MQR	DR038D0147
GS33-4030	45	90	30	LR-4040	LR-4030	VTF-246-NRS	DR045D0124
GS33-4040	60	120	40	LR-4050	LR-4040	VTF-246-NRS	DR060DP935
GS33-4050	75	150	50	LR-4050	LR-4050	VTF-246-PSU	n/a
GS33-4060	91	182	60	LR-4060	LR-4060	VTF-246-PSU	n/a
GS33-4075	112	224	75	LR-4100	LR-4075	VTF-246-RUV	n/a
GS33-4100	150	300	100	LR-4100	LR-4100	VTF-246-SVW	n/a

** Not available at AutomationDirect.com*

*** Reactor sizing is based on rated HP NEMA motor load, not drive output amp load. Size the reactor based on the motor nameplate current. All specs for the LR2 and VTF can be found at www.automationdirect.com or by clicking the following links::*

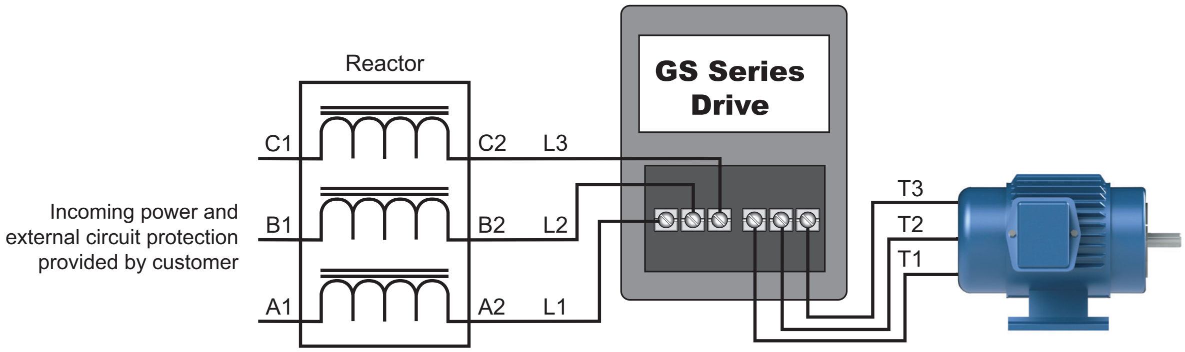
-*LR2 Line Reactors*

-*VTF Output Filters*

Line Reactor Applications and Wiring Connections

Input Side of AC Drive

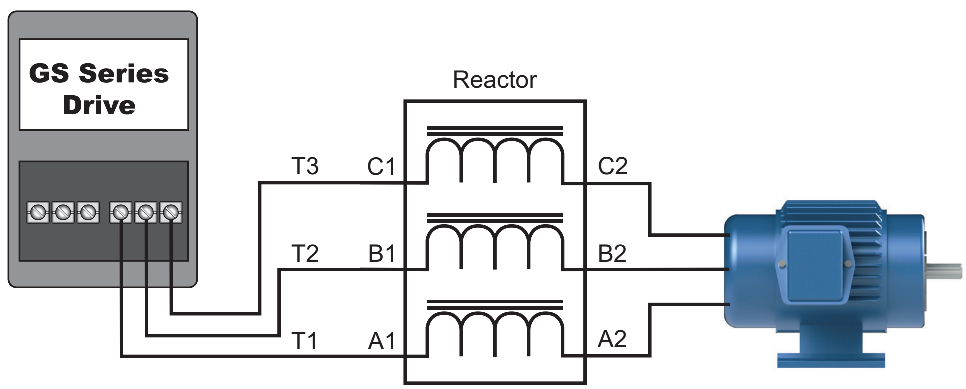
When installed on the input side of the GS30 drive, a line reactor will reduce line notching, current peaks, voltage spikes and surges from the incoming line, as well as reduce the available short circuit current. A line reactor will also reduce harmonic distortion from the GS30 drive onto the line. The line reactor is installed in front of the GS30 drive as shown.



Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS30 drive.

Output Side of AC Drive

When installed on the output side of the GS30 drive, line (load) reactors help to protect the GS30 drive from short circuits at the load. Voltage and current waveforms from the GS30 drive are enhanced, reducing motor overheating and noise emissions.

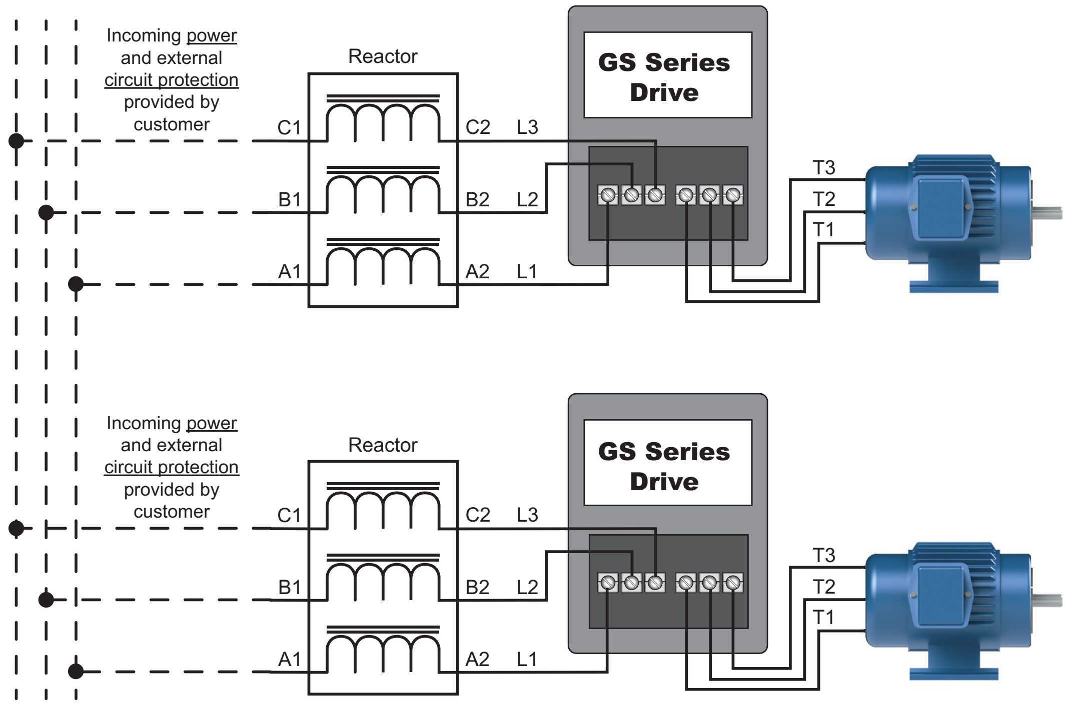


Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS30 drive.

Single phase line reactors should NOT be installed on the output side of an AC Drive. Use only three-phase reactors on drive outputs, and only for three-phase motors.

Multiple AC Drives

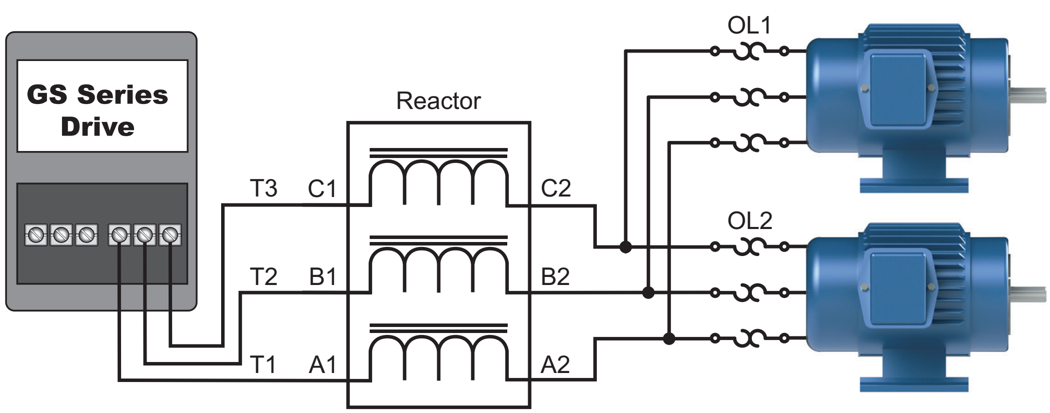
Individual line reactors are recommended when installing multiple GS30 drives on the same power line. Individual line reactors eliminate cross-talk between multiple GS30 drives and provide isolated protection for each GS30 drive for its own specific load.



Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS30 drive.

Multiple Motors

A single output (load) reactor can be used with multiple motors on the same GS30 drive, but only if the motors operate simultaneously. Size the reactor based upon the total horsepower of all the motors, and select a reactor with a current rating greater than the sum of the motor full-load currents. Overload relays are required for use in multi-motor applications.

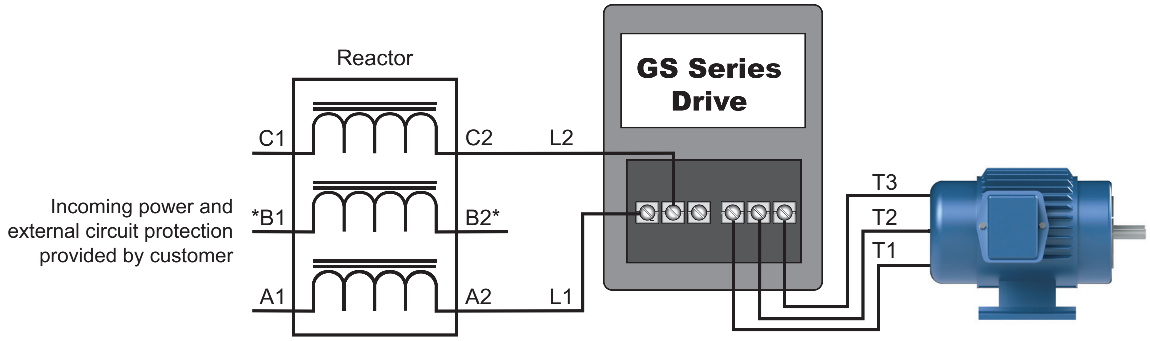


Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS30 drive.

A single reactor should be used with multiple motors ONLY when the motors will operate simultaneously from a single AC drive. OVERLOAD RELAYS are required for use in multiple motor applications.

Single-Phase Applications

Some three-phase line reactors are listed for use with single-phase input power. Follow the connection diagram shown below. Make sure that terminals B1 and B2, if present, are properly insulated before any connections are made. If a 3-phase reactor is used on the line side of a single-phase input drive application, ensure that the actual single-phase current does not exceed the Line Reactor's current rating (example: a 3-phase, 5hp Line Reactor and 3-phase 5hp drive will not handle enough current to power a 5hp motor on a single-phase supply - both the drive and the Line Reactor will have to be upsized).



*LR series 1-phase reactors do not include a B-phase winding. For LR2 series reactors on single phase drive inputs, use terminals A and C. B is left unconnected.

Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS30 drive.

Ensure that you properly insulate terminals B1 and B2 before making any connections to single-phase power.

Recommended Cable Length

Motor Leakage Current

If the cable length is too long, the stray capacitance between cables increases and may cause leakage current. This activates over-current protection, increases leakage current, or may affect the current display. In the worst case, it may damage the AC motor drive. If more than one motor is connected to one AC motor drive, the total wiring length should be the sum of the wiring length from AC motor drive to each motor.

For the 460V series AC motor drive, when you install an overload thermal relay between the drive and the motor to protect the motor from overheating, the connecting cable must be shorter than 50m; however, an overload thermal relay malfunction may still occur. To prevent the malfunction, install an output reactor (optional) to the drive or lower the carrier frequency setting (see P00.17 Carrier Frequency).

Motor Surge Voltage

When a motor is driven by a PWM-type AC drive, the motor terminals experience surge voltages (dv/dt) due to power transistor conversion of the drive. For very long motor cable (especially for the 460V series), surge voltages (dv/dt) may damage the motor insulation and bearing. To prevent this, follow these rules:

A) Use a motor with enhanced insulation.
B) Reduce the cable length between the AC drive and motor to suggested values.
C) Connect an output reactor (optional) to the output terminals of the AC drive.

Refer to the following tables for the suggested motor shielded cable length. For drive models < 480V, use a motor with a rated voltage ≤ 500 VAC and an insulation level ≥ 1.35 kVp-p in accordance with IEC 60034-17.

Maximum Recommended Cable Length - GS30							
GS30 Model	***Input Power***		***VT Rated Current (Arms)***	***Without Output AC Reactor (meters)***		***With Output AC Reactor (meters)***	
	Ø	***Volts***		***Shielded Cable***	***Unshielded Cable***	***Shielded Cable***	***Unshielded Cable***
GS31-20P5	1	230	3.2	50	75	75	115
GS31-21P0			5				
GS31-22P0			8.5				
GS31-23P0			12.5				
GS33-20P5	3		3.2				
GS33-21P0			5				
GS33-22P0			8				
GS33-23P0			12.5				
GS33-25P0			19.5				
GS33-27P5			27				
GS33-2010			36	100	150	150	225
GS33-2015			51				
GS33-2020			69				
GS33-2025			81				
GS33-2030			102				
GS33-2040			134				
GS33-2050			160				
GS33-40P5		460	1.8	35	50	50	90
GS33-41P0			3				
GS33-42P0			4.6				
GS33-43P0			6.5	50	75	75	115
GS33-45P0			10.5				
GS33-47P5			15.7				
GS33-4010			20.5	100	150	150	225
GS33-4015			28				
GS33-4020			36				
GS33-4025			41.5				
GS33-4030			49				
GS33-4040			69				
GS33-4050			85				
GS33-4060			108				
GS33-4075			128				
GS33-4100			180				

Dynamic Braking

Dynamic braking resistors dissipate the regeneration energy of AC motors when they are being controlled to a stop faster than a coasting stop. Most general purpose and heavy-duty AC drives have the braking circuit built-in. All GS30 drives have this feature. Drives 230V 40/50 hp and 460V 50hp+require a separate dynamic braking unit. To utilize dynamic braking:

1) Wire the appropriate braking resistor to terminals B1/B2 (refer to page page 2–20)
2) Set parameter P07.00 Software Brake Chopper Action Level for the application. When the DC bus voltage rises above this setpoint, the dynamic braking circuit will activate.

To avoid possible injury, please refer to Chapter 2 of this manual for correct wiring of the resistors and DBUs.

Drive Unit Dynamic Braking Specifications

GS30 AC Drive Dynamic Braking Specifications									
Drive V Rating	Motor Power (hp)	Motor Power (kW)	Drive Model	Dynamic Braking Unit Qty.	Dynamic Braking Unit Part #	Drive Braking Circuit B1/B2 Min Resistor Value (Ω)	Drive Braking Circuit B1/B2 Max Total Brake Current (A)	Drive Braking Circuit B1/B2 Peak Power (kW)	Compatible Brake Resistors* (125% Torque, 10% Duty Cycle)
230V	0.5	0.4	GS31-20P5	–	n/a	95.0	4	1.5	Click here
	1	0.75	GS31-21P0			63.3	6	2.3	
	2	1.5	GS31-22P0			47.5	8	3.0	
	3	2.2	GS31-23P0			38.0	10	3.8	
	0.5	0.4	GS33-20P5			95.0	4	1.5	
	1	0.75	GS33-21P0			63.3	6	2.3	
	2	1.5	GS33-22P0			47.5	8	3.0	
	3	2.2	GS33-23P0			38.0	10	3.8	
	5	3.7	GS33-25P0			19.0	20	7.6	
	7.5	5.5	GS33-27P5			16.5	23	8.7	
	10	7.5	GS33-2010			14.6	26	9.9	
	15	11	GS33-2015			12.6	29	11.0	
	20	15	GS33-2020			8.3	46	17.5	
	25	18.5	GS33-2025			8.3	46	17.5	
	30	22	GS33-2030			5.8	66	25.1	
	40	30	GS33-2040	2	GS-1DBU	4.8	79	30.1	
	50	57	GS33-2050	2	GS-2DBU	3.2	119	45.1	
460V	0.5	0.4	GS33-40P5	–	n/a	380.0	2	1.5	
	1	0.75	GS33-41P0			190.0	4	3.0	
	2	1.5	GS33-42P0			126.7	6	4.6	
	3	2.2	GS33-43P0			108.6	7	5.3	
	5	3.7	GS33-45P0			84.4	9	6.8	
	7.5	5.5	GS33-47P5			50.7	15	11.4	
	10	7.5	GS33-4010			40.0	19	14.4	
	15	11	GS33-4015			33.0	23	17.5	
	20	15	GS33-4020			26.2	29	22.0	
	25	18	GS33-4025			26.2	29	22.0	
	30	22	GS33-4030			23.0	33	25.1	
	40	30	GS33-4040			15.2	50	38.0	
	50	37	GS33-4050	1	GS-4DBU	12.7	60	45.5	
	60	45	GS33-4060	1	GS-4DBU	12.7	60	45.5	
	75	55	GS33-4075	2	GS-3DBU	9.5	80	60.8	
	100	75	GS33-4100	2	GS-4DBU	6.3	121	91.7	

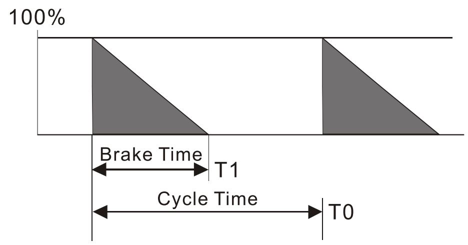
* 10% Duty Cycle with maximum ON (braking) time for 10 seconds.

For a full list of all brake resistors compatible with GS30 drives, please see the GS30 series braking technical specification: https://cdn.automationdirect.com/static/specs/gs30braking.pdf.

Please refer to DURApulse Dynamic Braking User Manual for detailed information on DBU installation and wiring. You can download it from the AutomationDirect online store here.

Choosing and Installing a Braking Resistor

1) Select the resistance value, power and brake usage (ED %).
Definition for Brake Usage ED%:



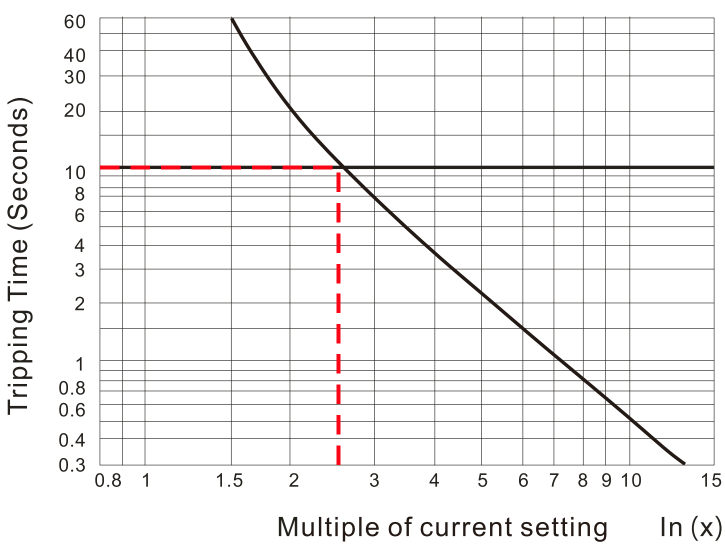
ED% = T1 / T0 x 100(%)

Explanation:
Brake usage ED (%) is the amount of time needed for the brake unit and brake resistor to dissipate heat generated by braking. When the brake resistor heats up, the resistance increases with temperature, and braking torque decreases accordingly.

For safety, install a thermal overload relay (O.L) between the brake unit and the brake resistor in conjunction with the magnetic contactor (MC) before the drive for additional protection. The thermal overload relay protects the brake resistor from damage due to frequent or continuous braking. Under such circumstances, turn off the power to prevent damage to the brake resistor and drive.

Note: Never use the thermal overload relay to disconnect the brake resistor.

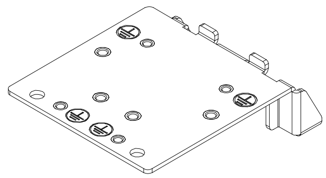
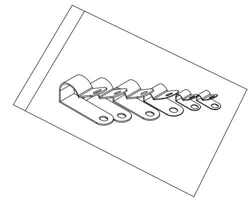
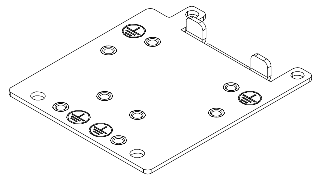
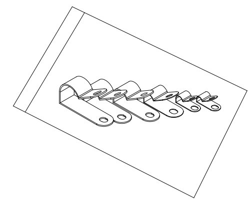
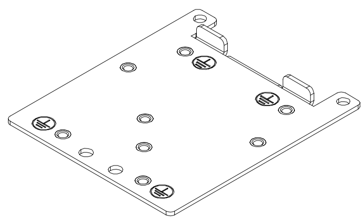
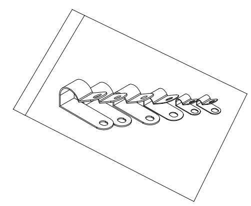
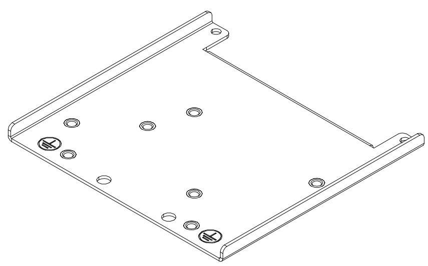
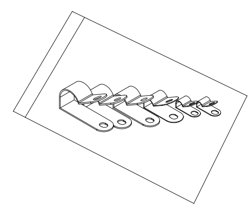
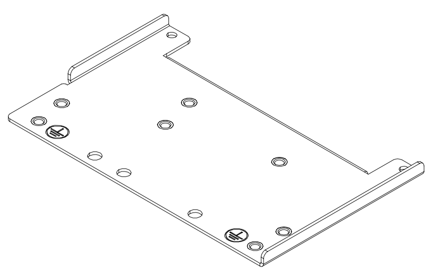
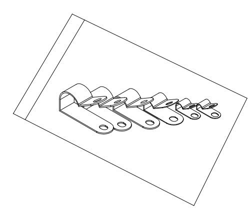
2) Any damage to the drive or other equipment caused by using brake resistors and brake modules that are not provided by AutomationDirect voids the warranty.
3) Consider environmental safety factors when installing the brake resistors. If you use the minimum resistance value, consult AutomationDirect for the power calculation.
4) Refer to the ADC Dynamic Braking unit User Manual for more detail on braking resistors (https://cdn.automationdirect.com/static/manuals/gs3dbm/gs-db_ump.pdf)
5) The selection tables are for 10% duty cycle. If the AC motor drive requires frequent braking, increase the Watts by two to three times.
6) Thermal Overload Relay (TOR):
Thermal overload relay selection is based on its overload capacity. A standard braking capacity of the GS30 is 10% ED (Tripping time=10 s). As shown in the figure below, a 460V, 1kw GS30 required the thermal relay to take 260% overload capacity for 10 seconds (hot starting) and the braking current is 24A. In this case, select a thermal overload relay rated at 10A (10 * 260% = 26 A > 24 A). The property of each thermal relay may vary among different manufacturers. Carefully read the specification before using it.

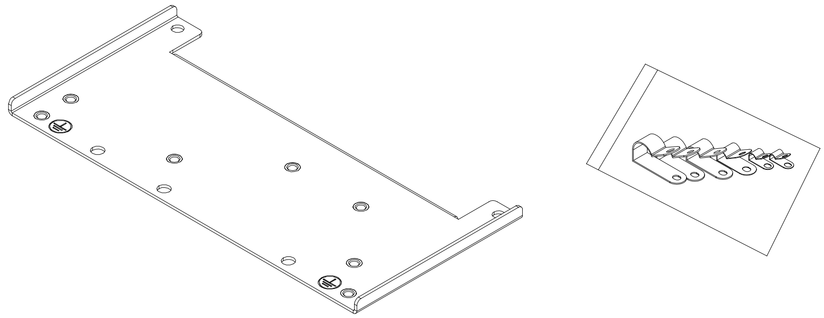
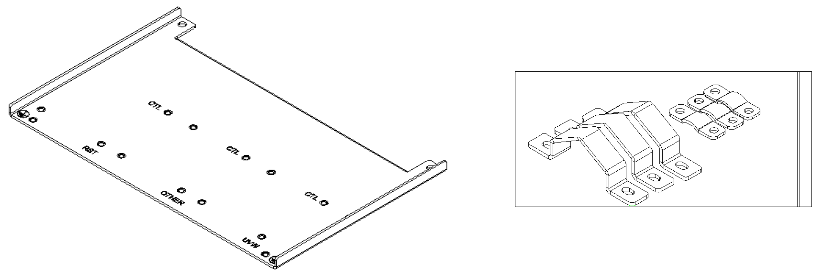
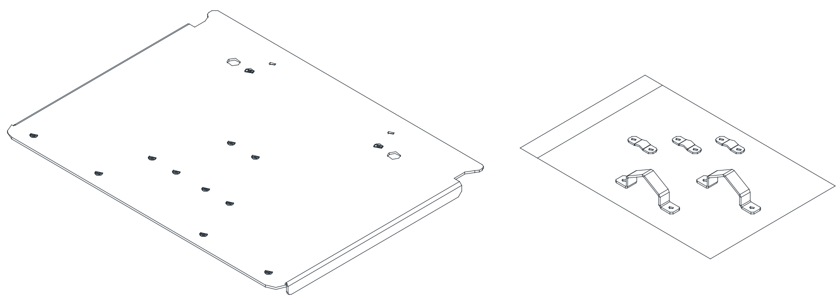
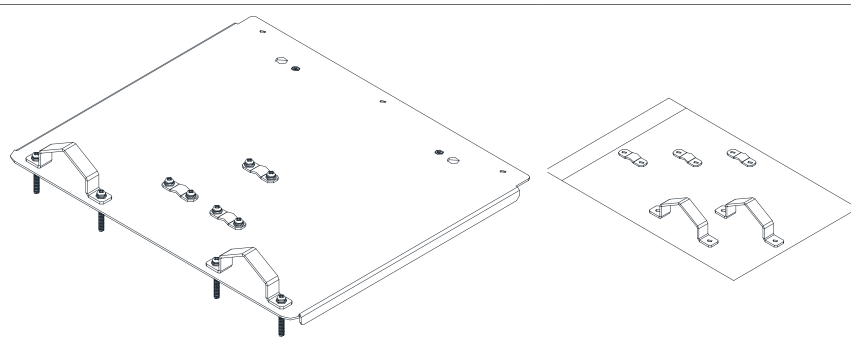


EMC Shield & Earthing Plates

GS30 EMC Shield Plates

EMC shield plates are available for use with shielded cable and your GS30 drive (some parts shared with GS20). Find the frame type from the specification tables of your GS30 and reference the table below:

GS30 EMC Shield Plate Selection			
Frame	**EMC Shield Plate Model**	**Reference Drawing**	
A	GS20A-ESP-A		
B	GS20A-ESP-B		
C	GS20A-ESP-C		
D	GS20A-ESP-D		
E	GS20A-ESP-E		

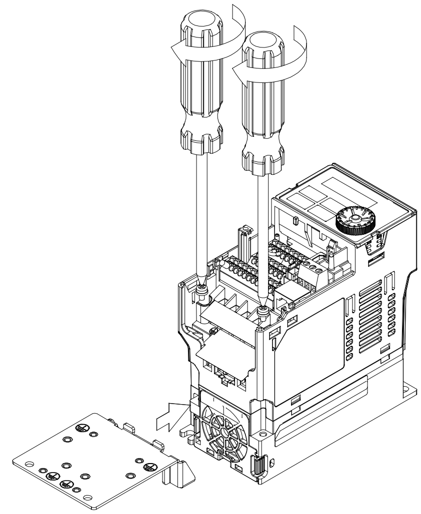
GS30 EMC Shield Plate Selection		
Frame	***EMC Shield Plate Model***	***Reference Drawing***
F	GS20A-ESP-F	
G	GS30A-ESP-G	
H	GS30A-ESP-H	
I	GS30A-ESP-I	

EMC Shield Plate Installation

The steps below show how to install the EMC shield plate on a GS30 drive. The diagram examples use an A frame model.

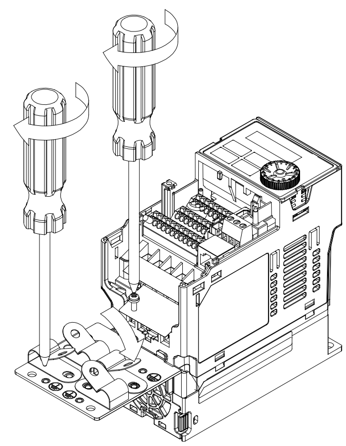
1) Attach the shield plate to the GS30 drive as shown in the diagram to the right.
Torque the screws per the table below:

Frame	Screw	Torque
A	M3.5	6–8 kg-cm (5.2–6.9 lb-in.) [0.59–0.78 N•m]
B	M4	6–8 kg-cm (5.2–6.9 lb-in.) [0.59–0.78 N•m]
C	M4	6–8 kg-cm (5.2–6.9 lb-in.) [0.59–0.78 N•m]
D	M3	4–6 kg-cm (3.5–5.2 lb-in.) [0.39–0.59 N•m]
E	M3	4–6 kg-cm (3.5–5.2 lb-in.) [0.39–0.59 N•m]
F	M4	6–8 kg-cm (5.2–6.9 lb-in.) [0.59–0.78 N•m]
G	M5	10–12 kg-cm (8.7–10.4 lb-in.) [0.98–1.18 N•m]
H	M4x2	14–16 kg-cm (12.1–13.9 lb-in.) [1.38–1.56 N•m]
	M8x2	75–85 kg-cm (65.0–73.7 lb-in.) [7.35–8.33 N•m]
I	M4x3	14–16 kg-cm (12.1–13.9 lb-in.) [1.38–1.56 N•m]
	M8x2	175–185 kg-cm (151.9–160.6 lb-in.) [17.16–18.14 N•m]



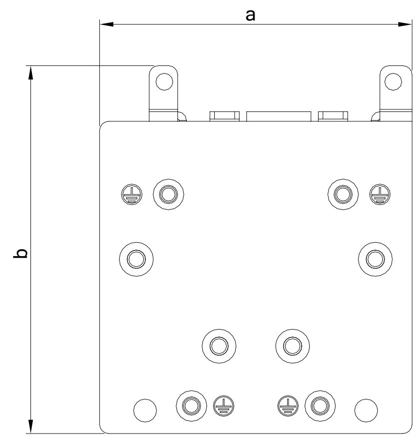
2) Select an R-clip suitable for the wire gauge used and then fix the R-clip to the shield plate as shown in the diagram to the right.
Torque the R-clip screws per the table below:

Screw	Torque
M4	6–8 kg-cm (5.2–6.9 lb-in.) [0.59–0.78 N•m]



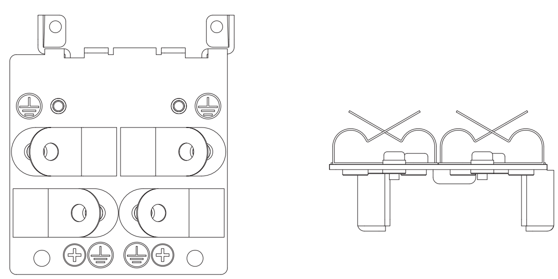
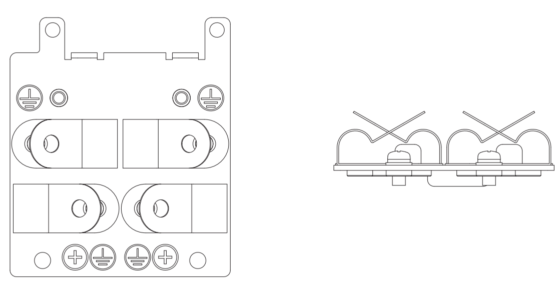
EMC Shield Plate Dimensions

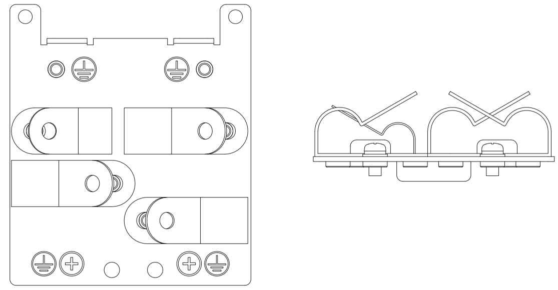
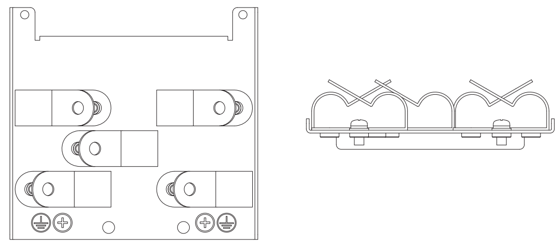
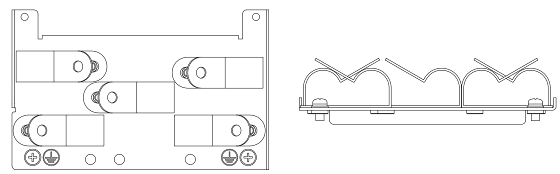
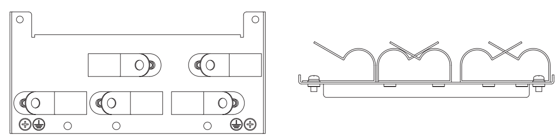
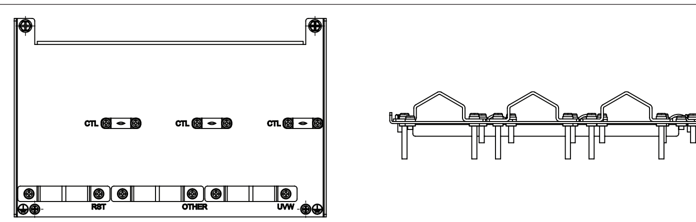
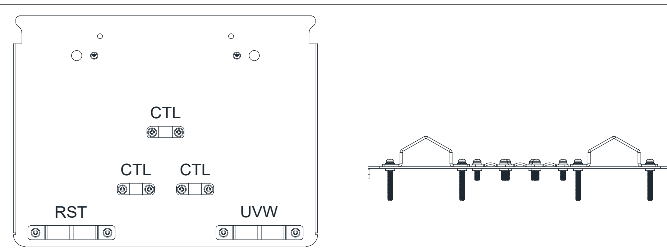
EMC Shield Plate Dimensions		
Model	**Dimensions mm [inch]**	
	a	**b**
GS20-ESP-A	69.3 [2.73]	80.0 [3.15]
GS20-ESP-B	67.7 [2.67]	79.7 [3.14]
GS20-ESP-C	78.0 [3.07]	91.0 [3.58]
GS20-ESP-D	103.4 [4.07]	97.0 [3.82]
GS20-ESP-E	124.3 [4.89]	77.4 [3.05]
GS20-ESP-F	168.0 [6.61]	80.0 [3.15]
GS30-ESP-G	243.5 [9.59]	154.9 [6.10]
GS30-ESP-H	262.0 [10.31]	201.9 [7.95]
GS30-ESP-I	304.0 [11.97]	260.7 [10.26]

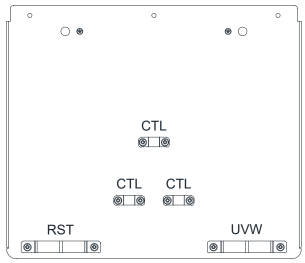
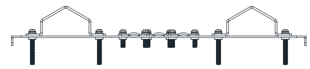


Recommended Wiring Method

The diagrams below show the recommended R-clip configuration for wiring shielded cable to each frame type/EMC shield plate model.

EMC Shield Plate Wiring Methods		
Frame	**EMC Shield Plate Model**	**Reference Drawing**
A	GS20A-ESP-A	
B	GS20A-ESP-B	

EMC Shield Plate Wiring Methods		
Frame	***EMC Shield Plate Model***	***Reference Drawing***
C	GS20A-ESP-C	
D	GS20A-ESP-D	
E	GS20A-ESP-E	
F	GS20A-ESP-F	
G	GS30A-ESP-G	
H	GS30A-ESP-H	

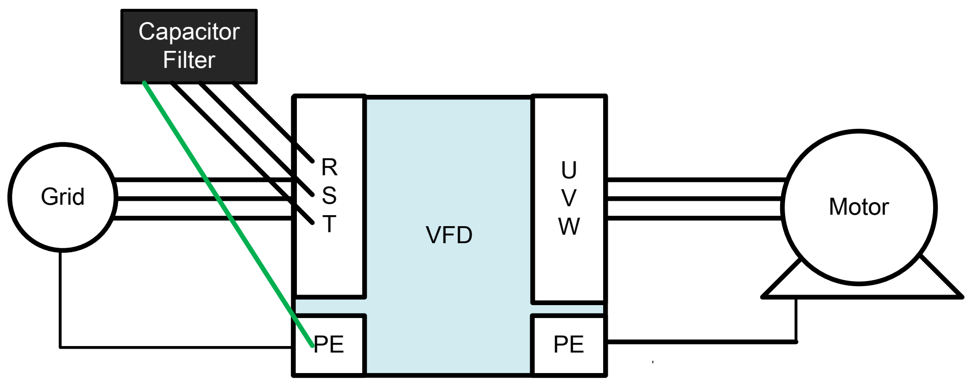
EMC Shield Plate Wiring Methods		
Frame	***EMC Shield Plate Model***	***Reference Drawing***
I	GS30A-ESP-I	 

Capacitive Filter (GS20A-CAPF)

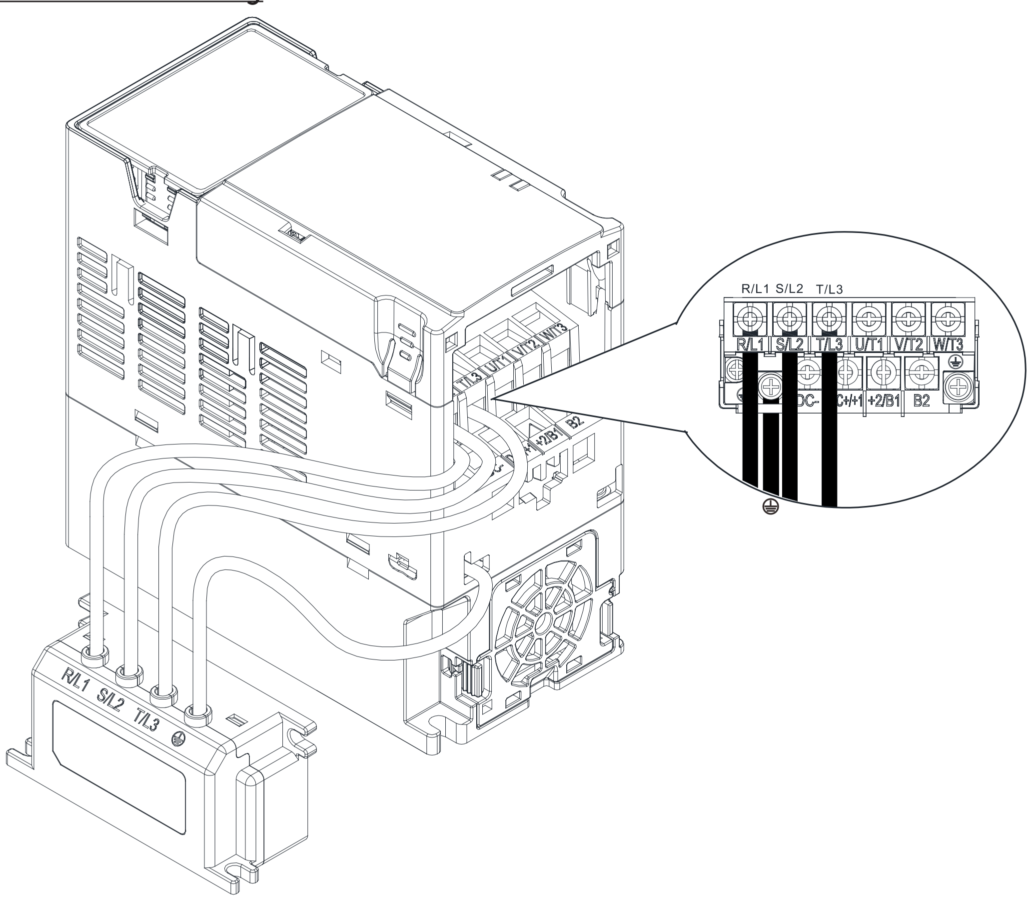
The GS20A-CAPF capacitive filter supports basic filtering and noise interference reduction for models 460V and below.

GS20A-CAPF Specifications			
Model	***Applicable Voltage***	***Temperature Range***	***Capacitance***
GS20A-CAPF	110–480 VAC	-40–85°C	Cx: 1uF ± 20% Cy: 0.1uF ± 20%

Installation diagram:

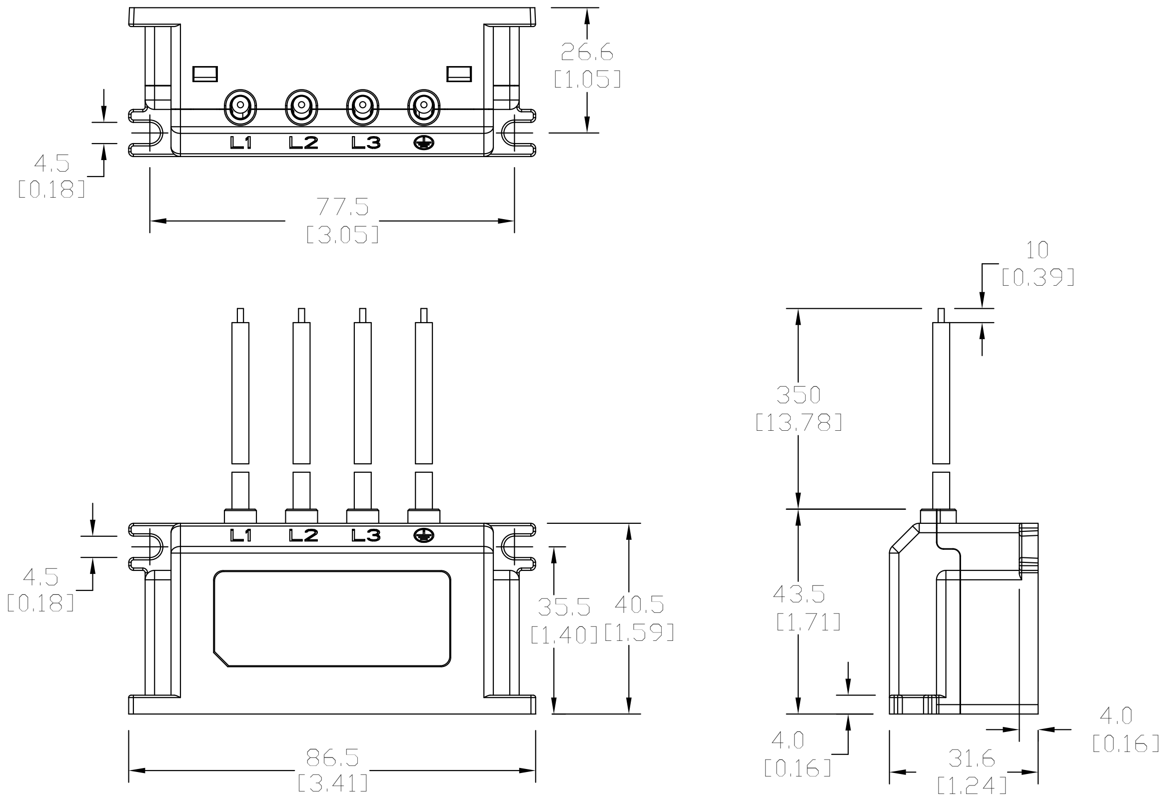


Filter and Drive Wiring



GS20A-CAPF Dimensions

Units = mm [inch]



Conduit Box

NEMA 1 / UL Type 1 compliant conduit boxes are available for all frame sizes (A–F).

Conduit Box Dimensions

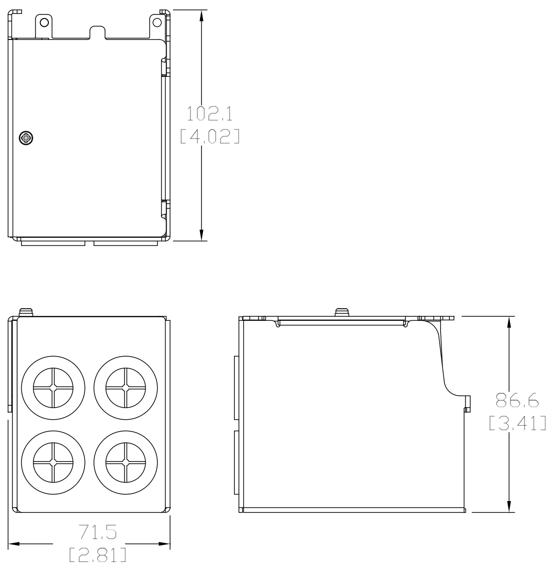
Units = mm [inch]

Frame A1, A2, A3

Applicable models

GS31-20P5, GS33-20P5, GS33-21P0, GS33-40P5, GS33-41P0

Conduit Box GS30-N1A

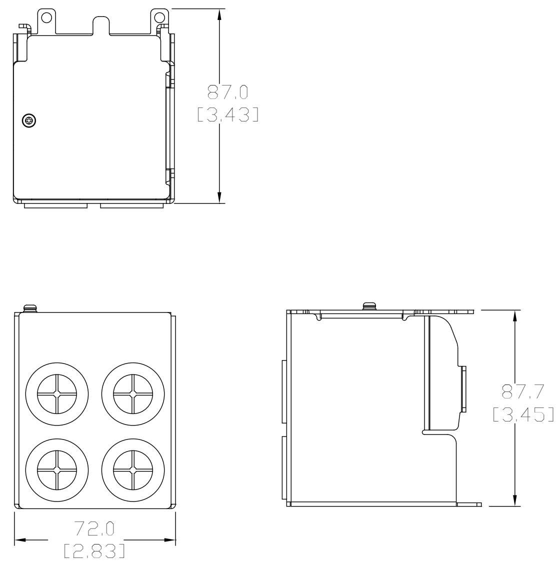


Frame B1, B2

Applicable models

GS31-21P0, GS33-22P0, GS33-42P0

Conduit Box GS30-N1B

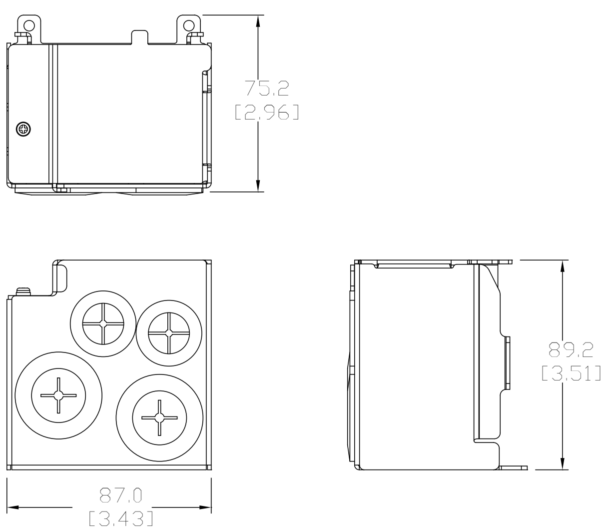


Frame C

Applicable models

GS31-22P0, GS33-23P0, GS33-25P0, GS33-43P0, GS33-45P0

Conduit Box GS30-N1C

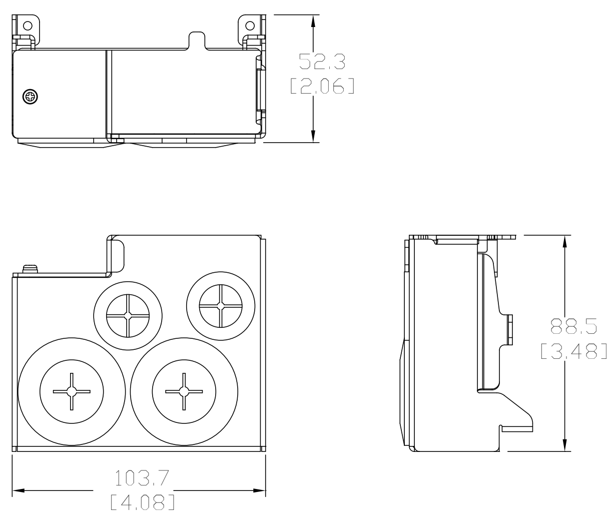


Frame D

Applicable models

GS33-27P5, GS33-47P5, GS33-4010

Conduit Box GS30-N1D



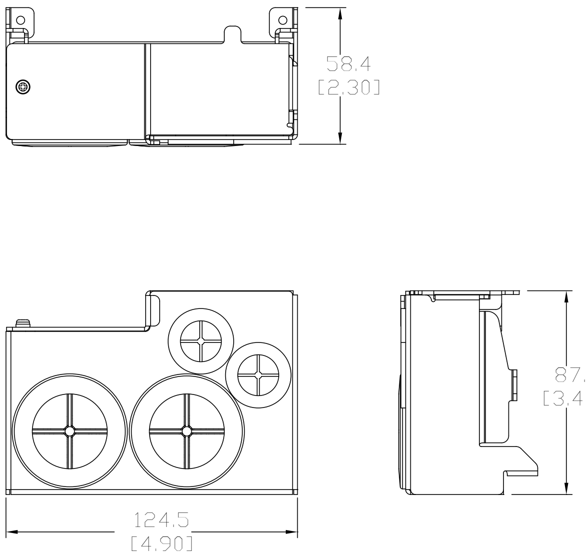
Units = mm [inch]

Frame E

Applicable models

GS33-2010, GS33-2015, GS33-4015, GS33-4020

Conduit Box GS30-N1E

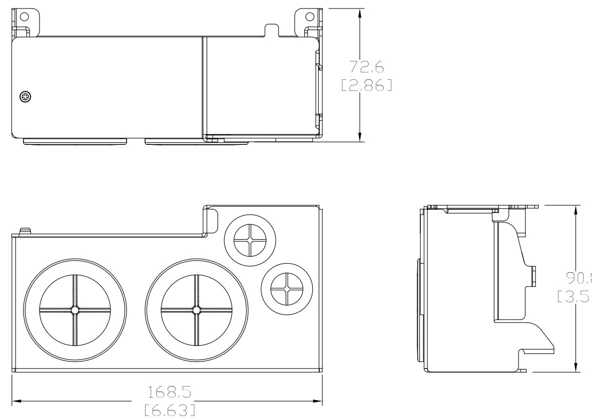


Frame F

Applicable models

GS33-2020, GS33-4025, GS33-4030

Conduit Box GS30-N1F

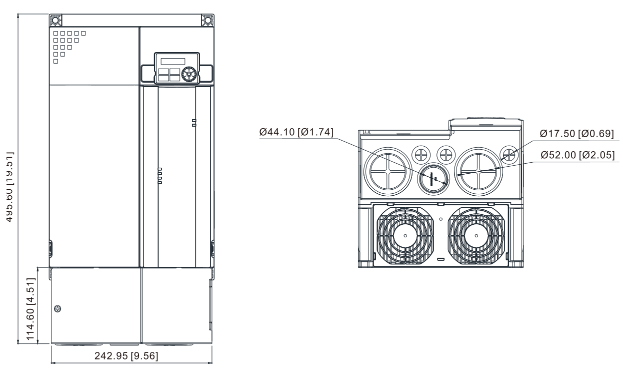


Frame G

Applicable models

GS33-2025, GS33-2030, GS33-4040

Conduit Box GS30-N1G

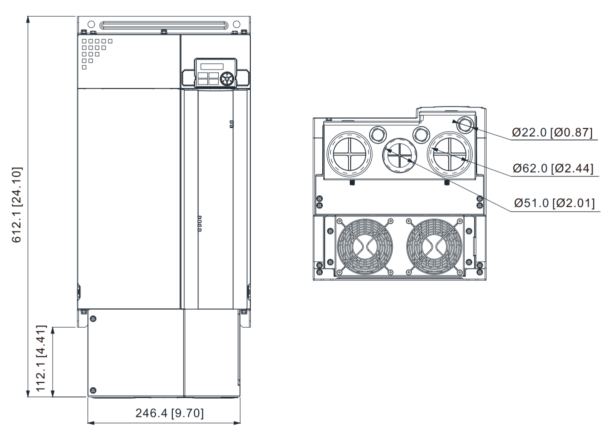


Frame H

Applicable models

GS33-4050, GS33-4060

Conduit Box GS30-N1H



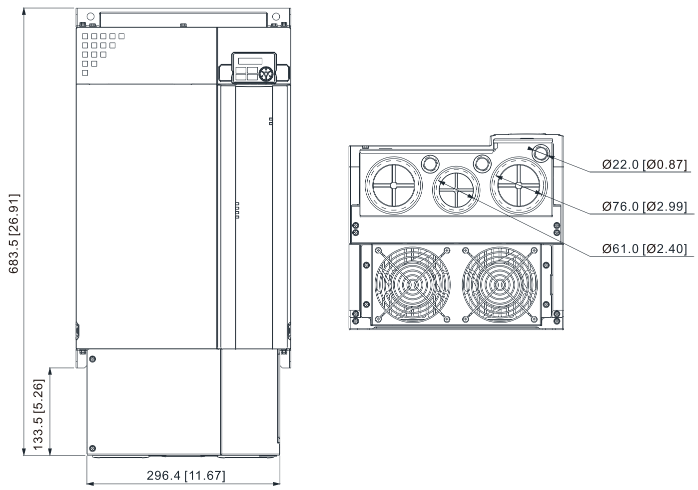
Units = mm [inch]

Frame I

Applicable models

GS33-2040, GS33-2050, GS33-4075, GS33-4100

Conduit Box GS30-N1I



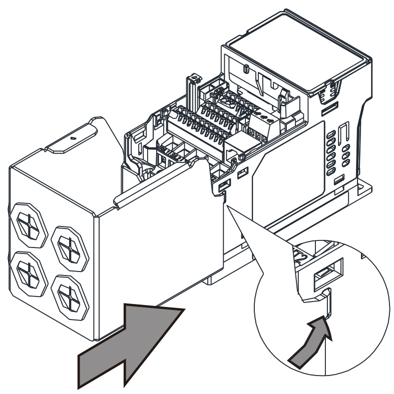
Conduit Box Installation

Follow the steps below to install a conduit box to your GS30 drive. The first set of instructions are for Frame A drives, the second set of instructions is for Frame B–I drives.

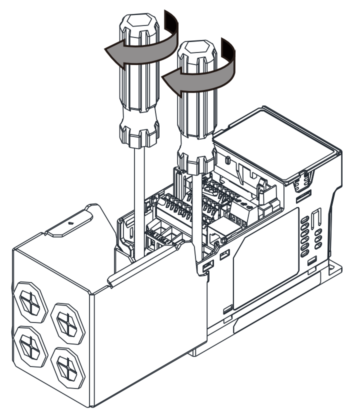
Recommended Screw Size and Torque Value	
Screw	***Torque***
M3	4–6 kg-cm (3.5–5.2 lb-in.) [0.39–0.59 N•m]
M3.5	4–6 kg-cm (3.5–5.2 lb-in.) [0.39–0.59 N•m]
M4	6–8 kg-cm (5.2–6.9 lb-in.) [0.59–0.78 N•m]

__Frame A Conduit Box Installation:__

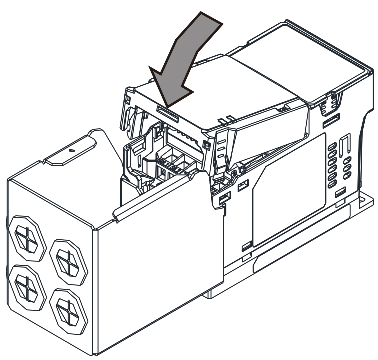
1)



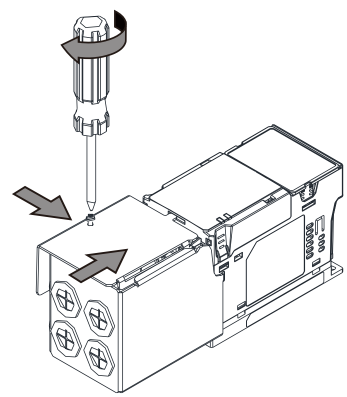
2)



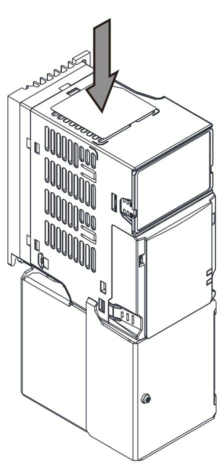
3)



4)

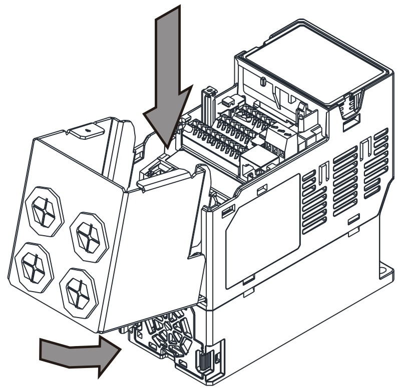


5)

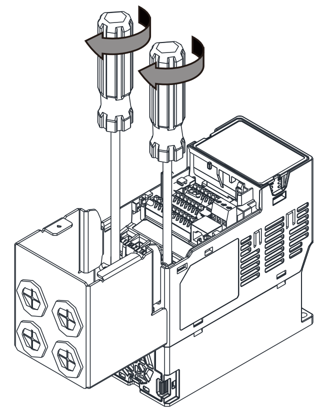


Frame B–I Conduit Box Installation:

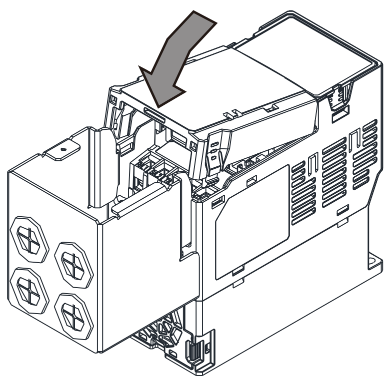
1)



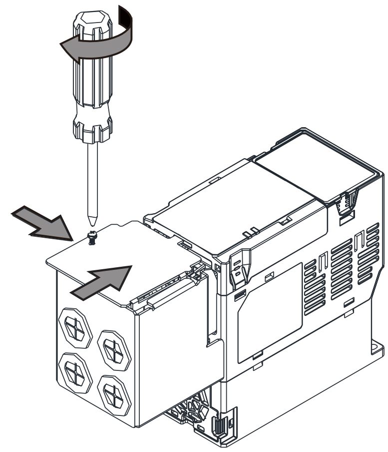
2)



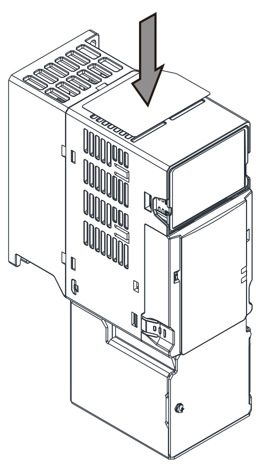
3)



4)

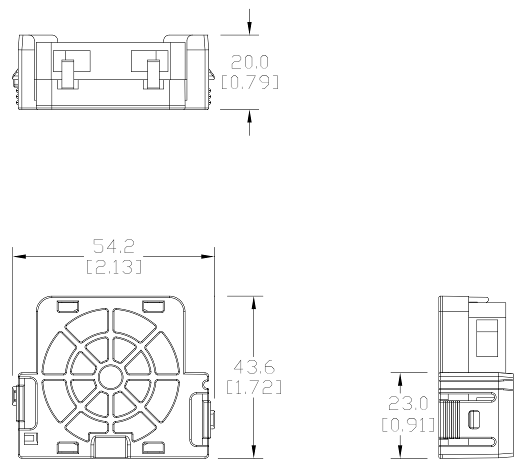
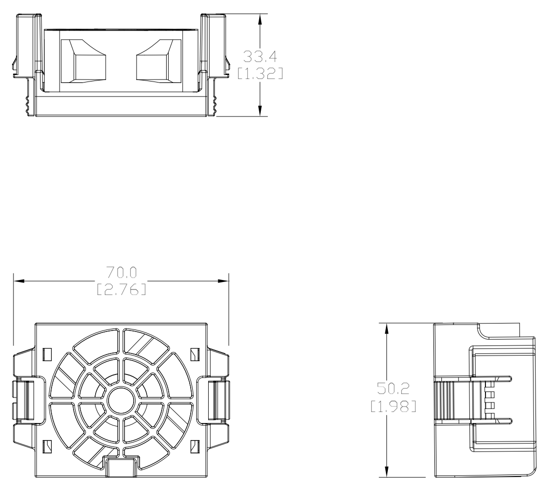
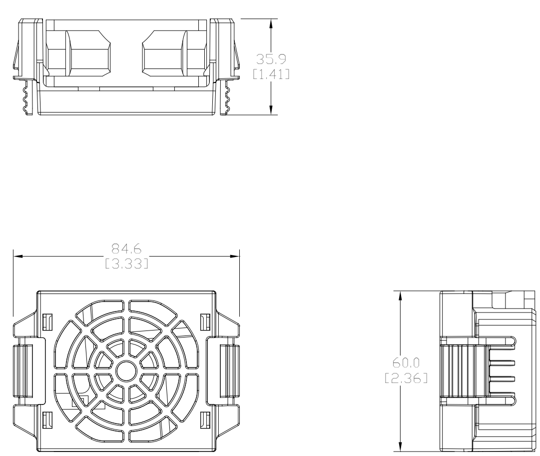


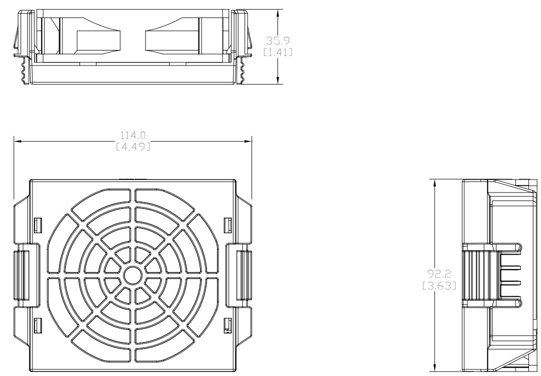
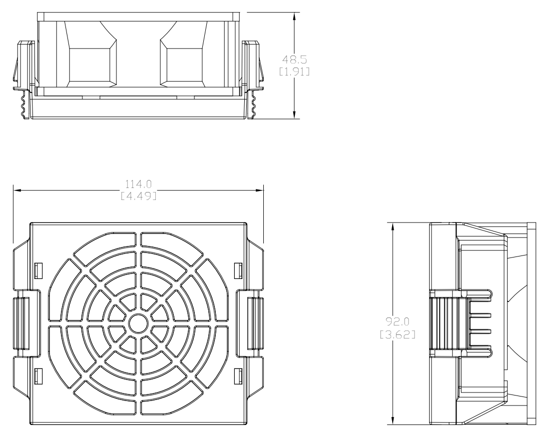
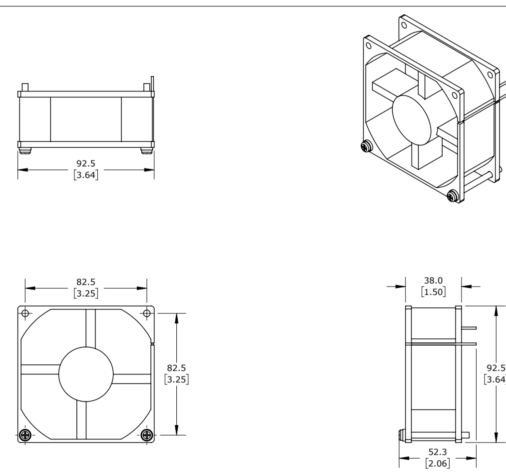
5)

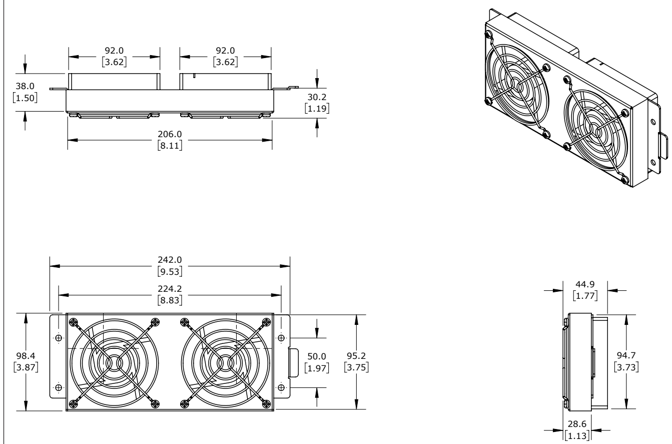
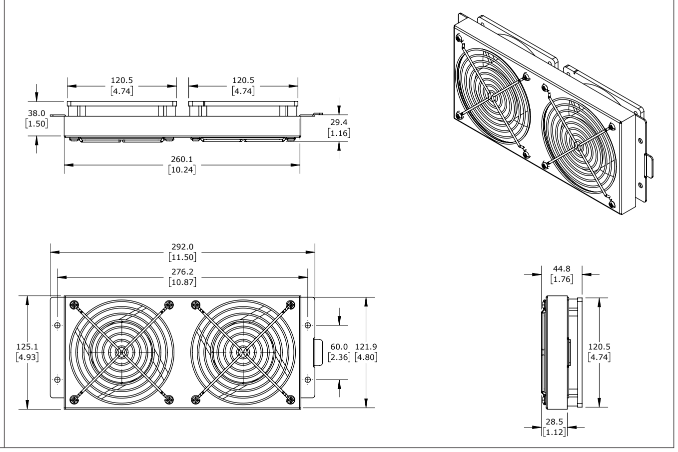


Replacement Fan Kit

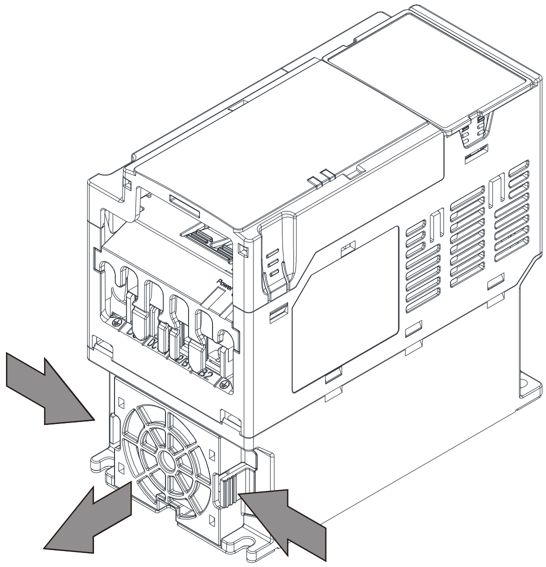
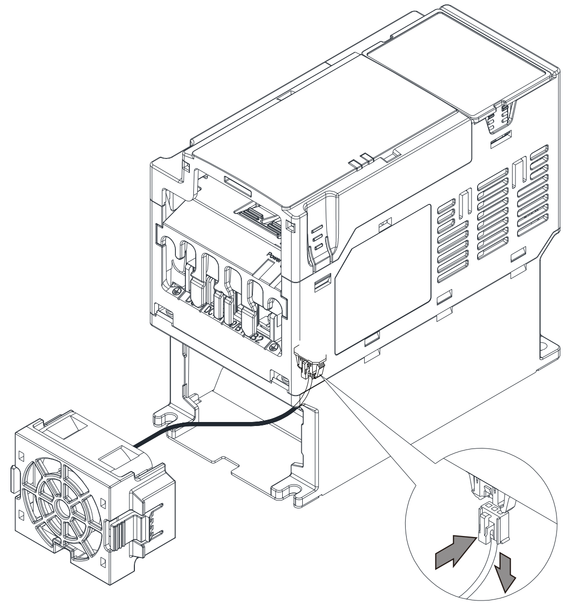
Most GS30 drives come equipped with a fan that can be replaced if needed. Many of the GS30 models share parts with the GS20. Use the table below to select the right fan for your drive, then remove and replace the existing fan.

GS30 Fan Kit Selector			
Frame	***Drive Series***	***Fan Kit Model***	***Reference Drawing (units = mm [inch])***
A	GS30	n/a	
B	GS30	GS20A-FAN-B	
C	GS30	GS20A-FAN-C	
D	GS30	GS20A-FAN-D	

GS30 Fan Kit Selector (continued)			
Frame	***Drive Series***	***Fan Kit Model***	***Reference Drawing (units = mm [inch])***
E	GS30	GS20A-FAN-E	
F	GS30	GS20A-FAN-F	
G	GS30	GS30A-FAN-G	

GS30 Fan Kit Selector (continued)			
Frame	***Drive Series***	***Fan Kit Model***	***Reference Drawing (units = mm [inch])***
H	GS30	GS30A-FAN-H	
I	GS30	GS30A-FAN-I	

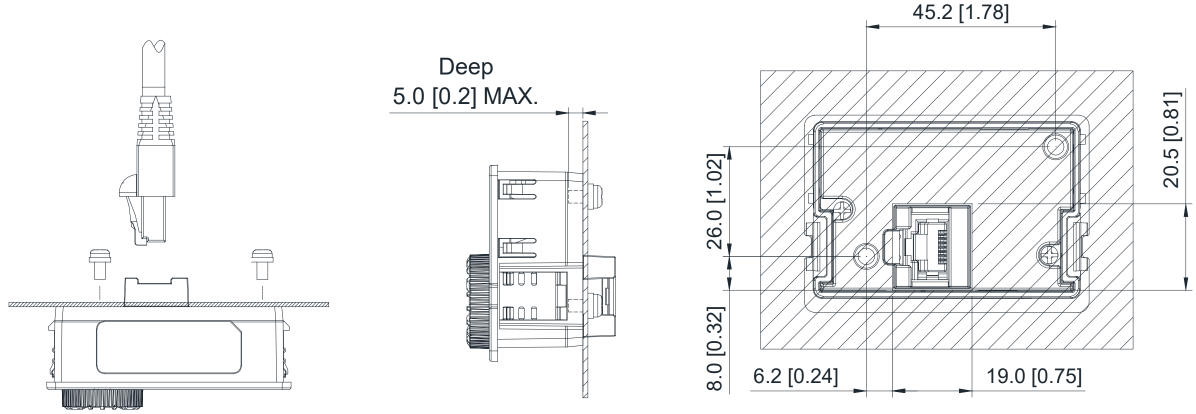
GS30 Series Fan Removal

1) As shown in the figure below, press the tabs on both sides of the fan to remove it.	2) Disconnect the power cable while removing the fan.
	

Remote Keypad Mounting

The GS30 keypad can detach from the drive and be mounted remotely. Use an extension cable and screws to create a remote access keypad for the drive. The keypad can be mounted either directly on a plate, or embedded in a plate. Use the reference material below to mount and connect your GS30 keypad.

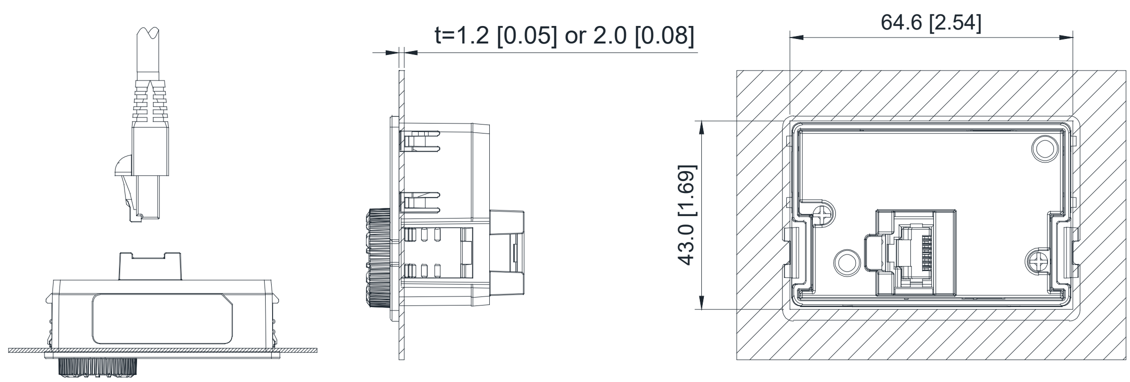
Direct Mounting on a Plate



Screw	Torque
M3	8–9 kg-cm (6.94–7.81 lb-in.) [0.78–0.88 N•m]

Embedded Mounting in a Plate

Plate Thickness (mm[inch]) = 1.2 [0.05] or 2.0 [0.08]



Available Extension Cables

Any standard Ethernet cable up to 5 meters (16.4 feet) in length.

DIN Rail Mounting

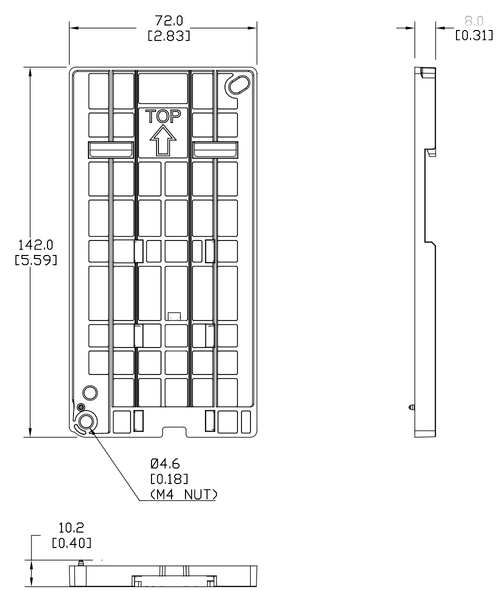
Frame A, B, and C GS30 drives can be DIN rail mounted using a DIN rail mounting kit. One kit is used for A and B frame drives, while a second kit is used for C frame drives.

GS30 DIN Rail Mounting Compatibility		
Drive Model	***Frame***	***Mounting Plate***
GS31-20P5	A2	GS20A-DR-AB
GS33-20P5	A2	
GS33-40P5	A2	
GS33-21P0	A3	
GS33-41P0	A3	
GS33-22P0	B1	
GS33-42P0	B1	
GS31-21P0	B2	
GS31-22P0	C1	GS20A-DR-C
GS33-23P0	C1	
GS33-25P0	C1	
GS33-43P0	C1	
GS33-45P0	C1	

GS20A-DR-AB

Used with Frame A and B GS30 drives.

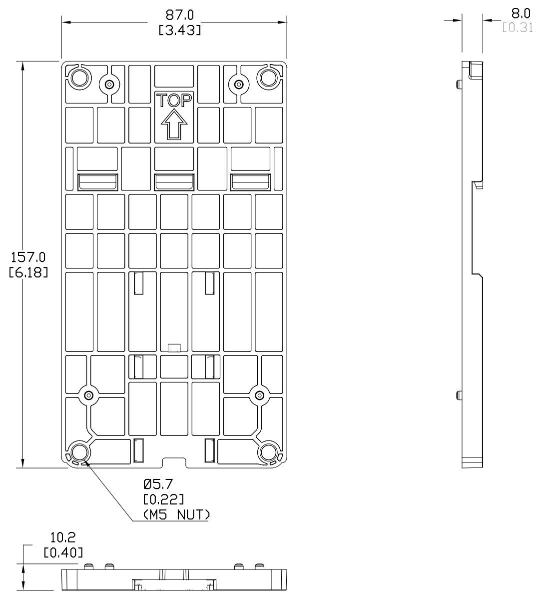
Screw	*Torque*
M4 x 2	8–10 kg-cm (6.9–8.7 lb-in.) [0.78–0.98 N•m]



GS20A-DR-C

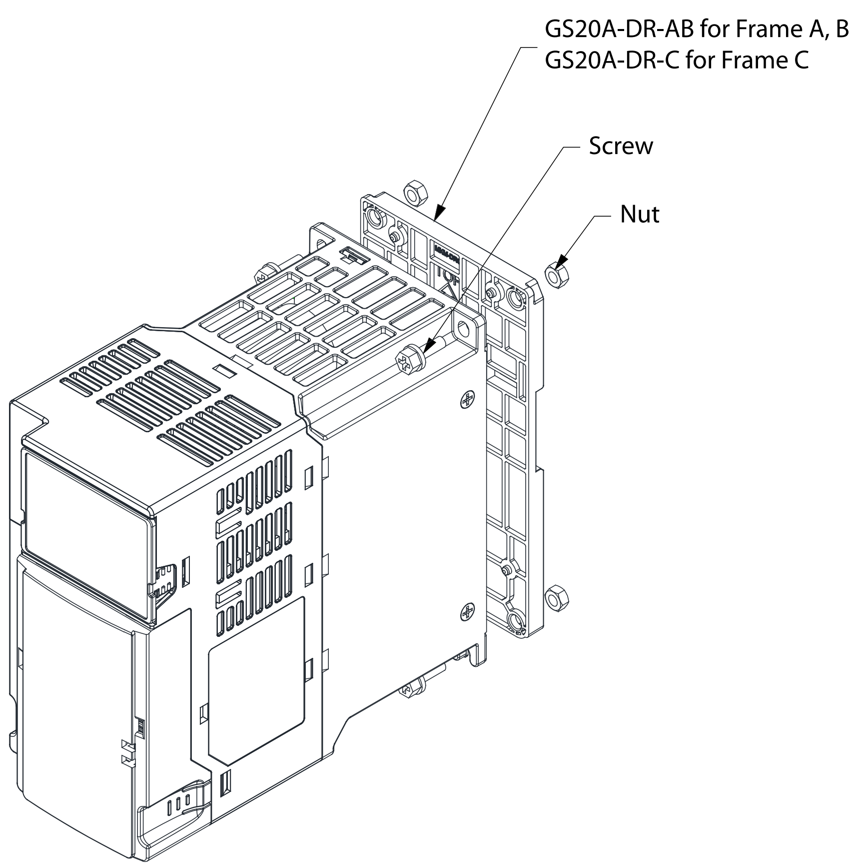
Used with Frame C GS30 drives.

Screw	Torque
M5 x 4	10–12 kg-cm (8.7–10.4 lb-in.) [0.98–1.18 N•m]



GS30 DIN Rail Installation

Attach the GS30 drive to the DIN rail kit mounting bracket as shown below. The diagram is for a Frame C drive, for Frame A or B, use one screw at the top and one at the bottom.



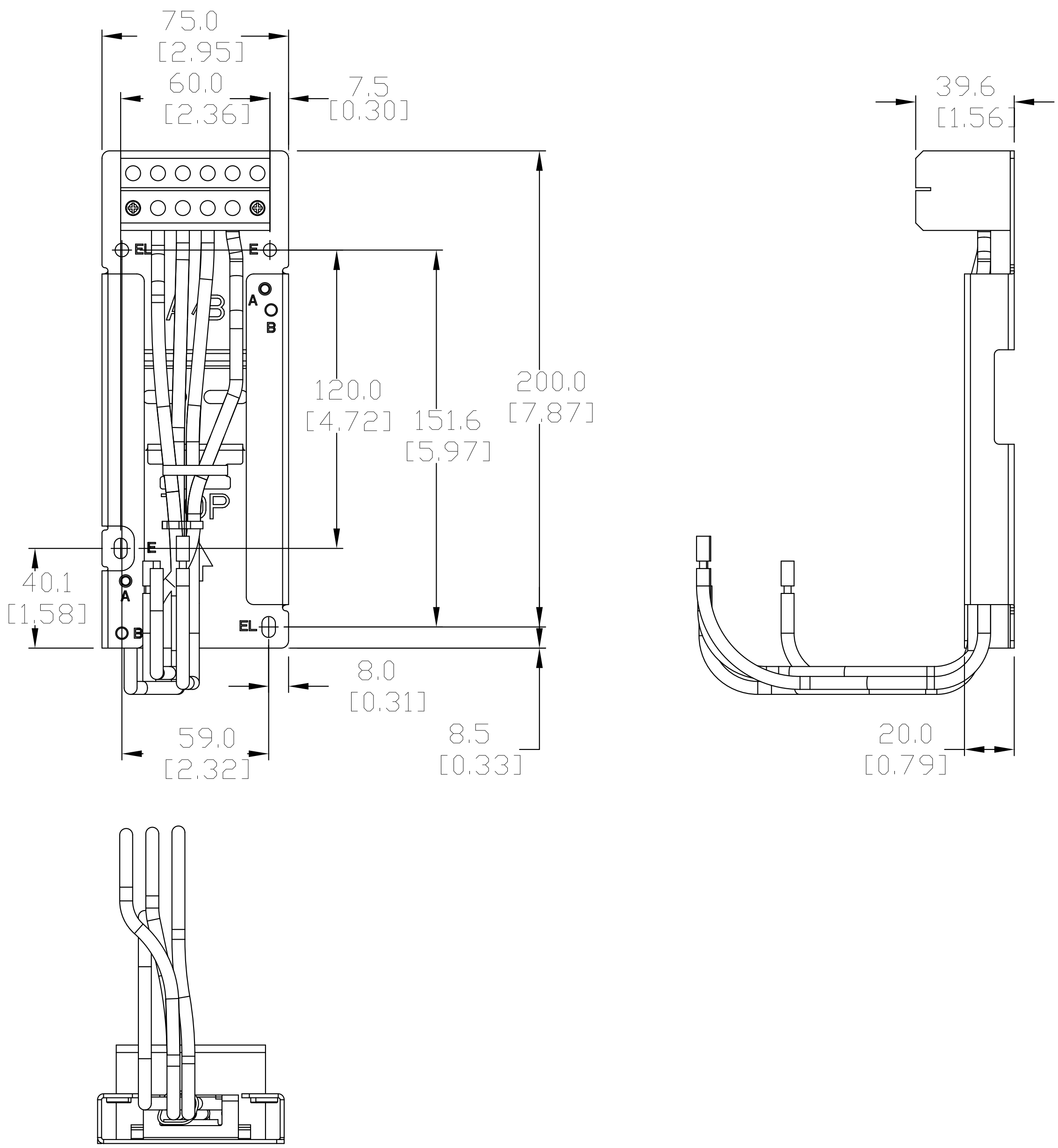
Mounting Adapter Plate

The mounting adapter plate can be used to change the wiring method for the GS30 series and provides flexibility for installation. This accessory changes the wiring method from the “bottom-mains input/ bottom-motor output" to the “top-mains input/bottom-motor output" for GS30. Use the table below to select the correct mounting plate for your drive.

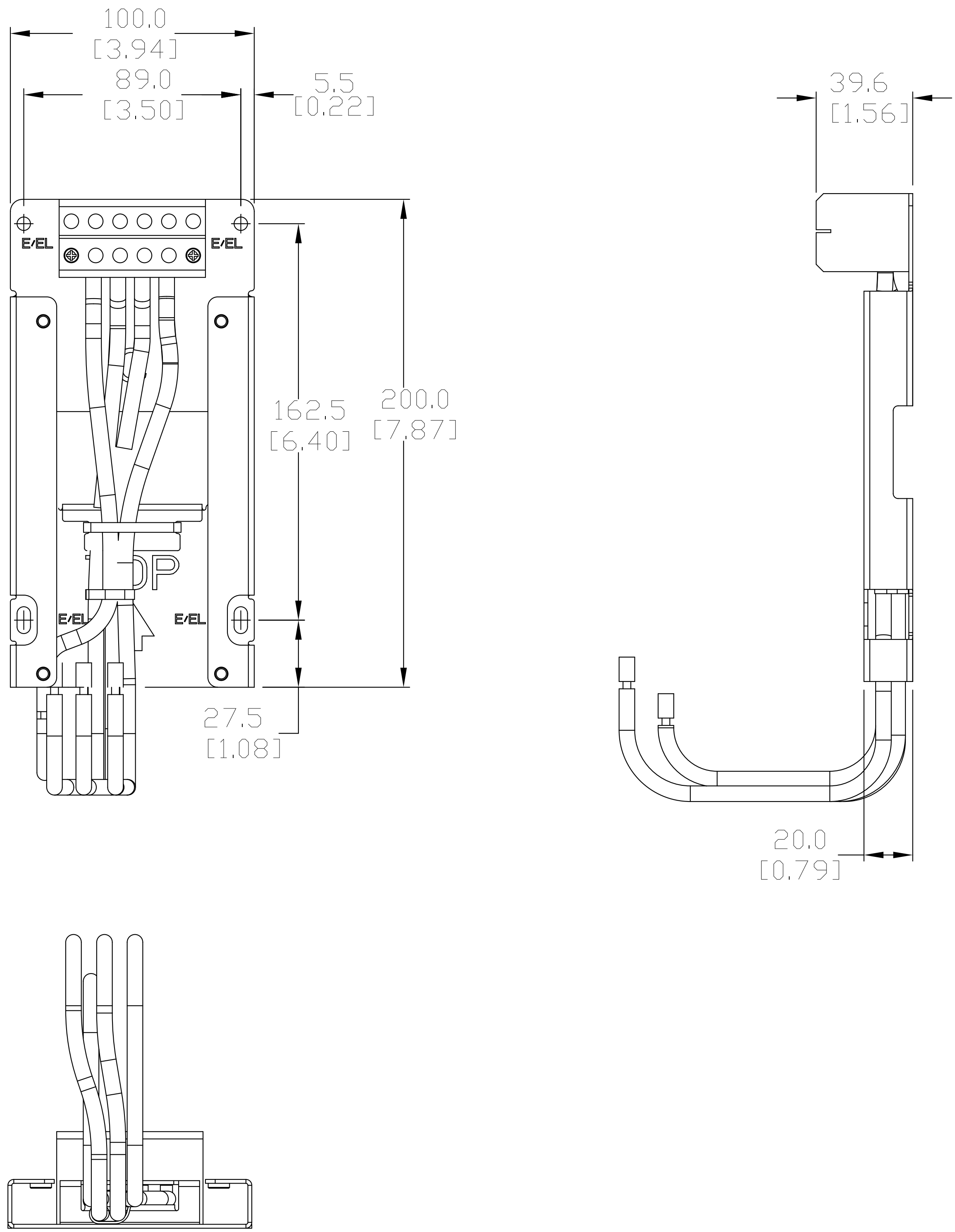
GS30 Mounting Adapter Compatibility		
Drive Model	***Frame***	***Mounting Plate***
GS31-20P5	A2	GS20A-MP-AB
GS33-20P5	A2	
GS33-40P5	A2	
GS33-21P0	A3	
GS33-41P0	A3	
GS33-22P0	B1	
GS33-42P0	B1	
GS31-21P0	B2	
GS31-22P0	C1	GS20A-MP-C
GS33-23P0	C1	
GS33-25P0	C1	
GS33-43P0	C1	
GS33-45P0	C1	

Mounting Adapter Plate Dimensions

GS20A-MP-AB



GS20A-MP-C

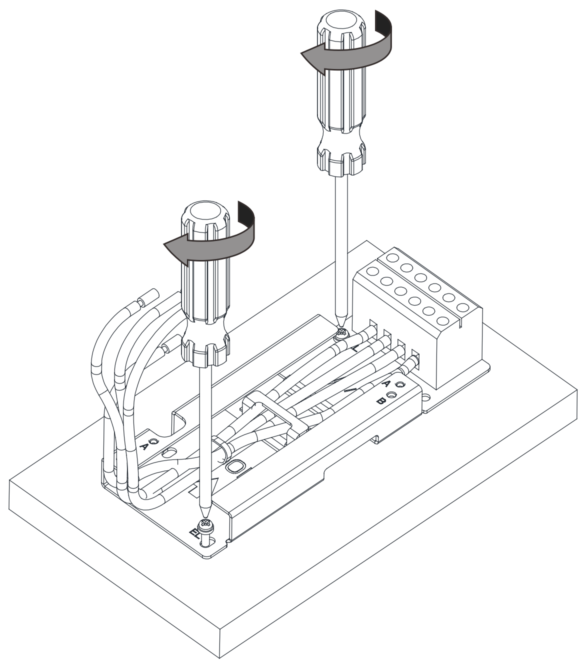

100.0
[3.94]
89.0
[3.50]
5.5
[0.22]
39.6
[1.56]
E/EL
E/EL
E/EL
E/EL
162.5
[6.40]
200.0
[7.87]
27.5
[1.08]
20.0
[0.79]

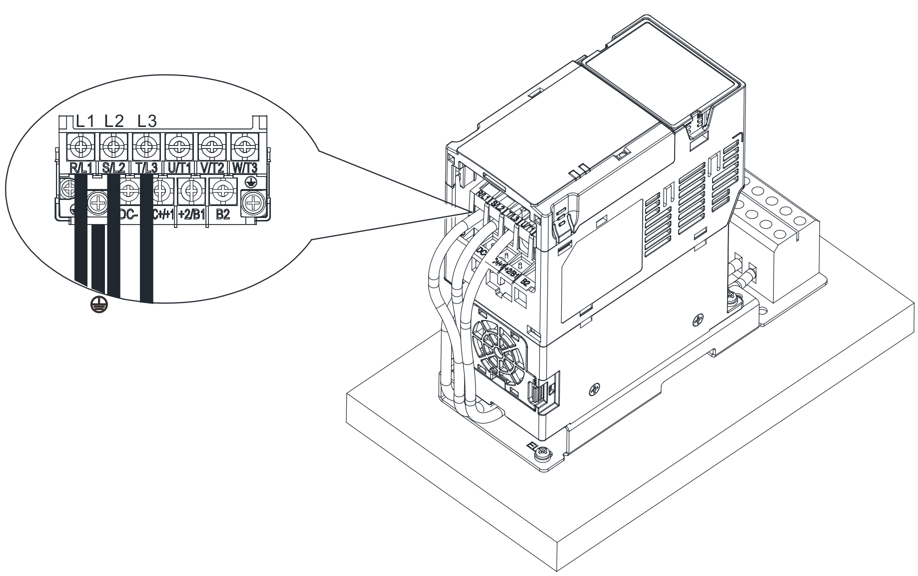
Mounting Adapter Plate Installation

Use the diagrams below and on the following page to install the mounting adapter plate and reroute the wiring.

GS20A-MP-AB

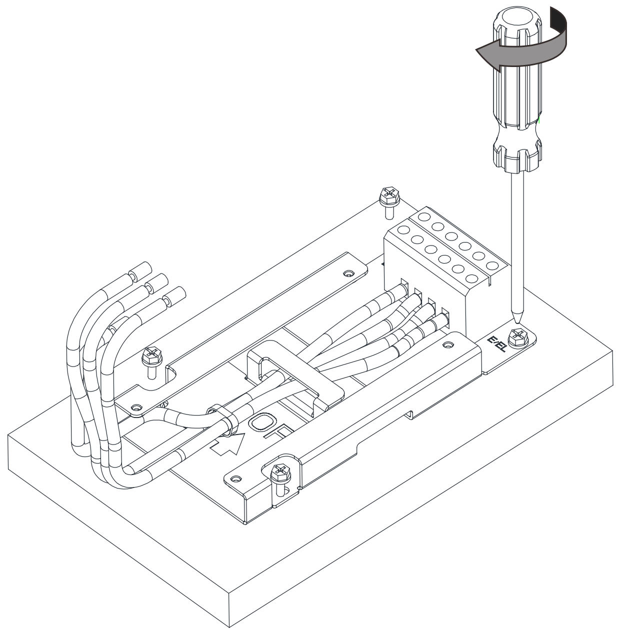
GS20A-MP-AB Screw Size and Torque Value	
Screw	***Torque***
M4	14–16 kg-cm (12.4–13.9 lb-in.) [1.37–1.57 N•m]
M5	16–20 kg-cm (13.9–17.4 lb-in.) [1.57–1.96 N•m]

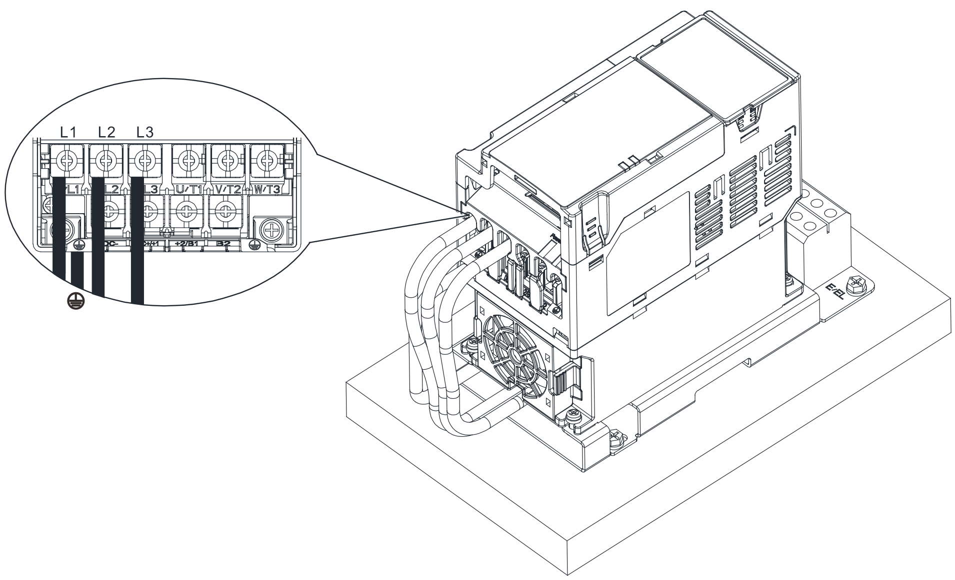




GS20A-MP-C

GS20A-MP-C Screw Size and Torque Value	
Screw	***Torque***
M4	14–16 kg-cm (12.4–13.9 lb-in.) [1.37–1.57 N•m]
M5	16–20 kg-cm (13.9–17.4 lb-in.) [1.57–1.96 N•m]





Optional Advanced Keypad

GS4-KPD

The GS4-KPD can be used with GS30 drives and offers a more advanced interface with additional features. The keypad can be installed flat on the surface any control panel (with or without bezel GS4-BZL). The front cover is IP56 rated.

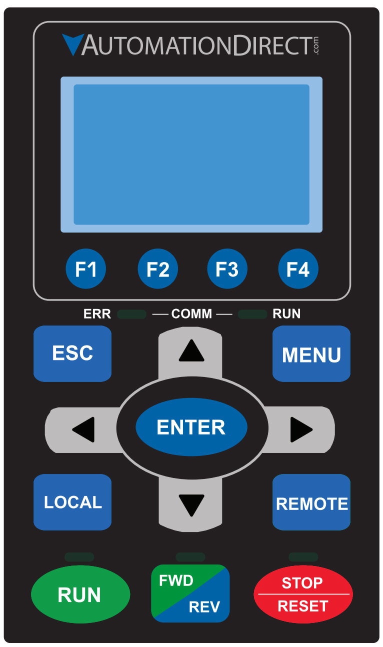
The maximum RJ45 extension lead is 5m (16ft). The keypad communication connection to the drive when mounted remotely can be accomplished by using a standard RJ45 CAT5e straight through patch cable. No other wiring is required. The small RJ45 plastic connector that comes standard with each GS4-KPD kit is not used with GS30.

The communication protocol for GS4-KPD is RTU 19200, 8, N, 2. Therefore, you must set GS30 communication parameters so as to connect with the digital keypad GS4-KPD. The setting steps are as follows:

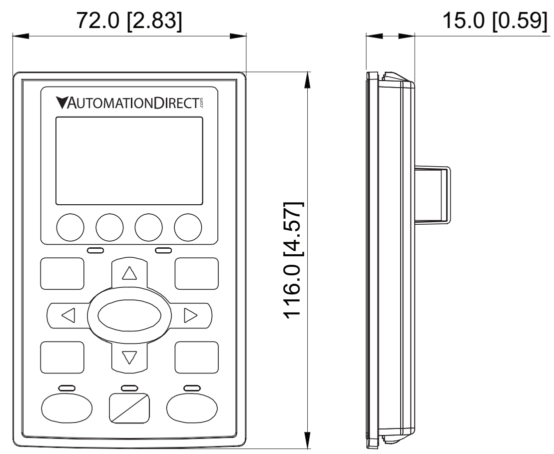
1) Set P09.00 communication address = 1
2) Set P09.01 COM1 transmission speed (Baud rate) = 19.2 Kbps
3) Set P09.04 COM1 communication protocol = 13: 8N2 (RTU)

To control the GS30 drive motion and speed with the keypad, the setting steps are as follows:

1) Frequency control - Parameter P00.20 and/or P00.30 to 1:RS-485 input
2) Operation control- Parameter P00.21 and/or P00.31 to 2: RS-485 input.

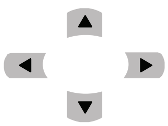


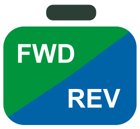
RJ45 Connector (included, not used)



Dimensions mm [in]

Descriptions of Keypad Functions	
	**RUN Key** 1) It is only valid when the source of operation command is from the advanced keypad via RS-485. 2) It can operate the AC motor drive by the function setting and the RUN LED will be ON. 3) RUN can be pressed even when drive is in process of stopping. 4) When enabling "LOCAL" mode, it is only valid when the source of operation command is from the advanced keypad via RS-485.
	**STOP/RESET Key** *This key has the highest processing priority in any situation.* 1) When it receives STOP command, whether or not the AC drive is in operation or stop status, the AC motor drive will execute a "STOP" command. 2) The RESET key can be used to reset the drive after the fault occurs. For those faults that can't be reset by the RESET key, see the fault records after pressing MENU key for details.
Continued on next page.	

Descriptions of Keypad Functions (*continued*)	
FWD REV	**Operation Direction Key** 1) This key only controls the operation direction and does NOT activate the drive. FWD: forward. REV: reverse. 2) Refer to the LED descriptions for more details.
ENTER	**ENTER Key** Press ENTER and go to the next menu level. If it is the last level, then press ENTER to execute the command.
ESC	**ESC Key** The ESC key function serves to leave the current menu and return to the last menu. It also functions as a return key while in the sub-menu.
MENU	**MENU Key** Press MENU to return to the main menu. Menu Content: 1) Param Setup 2) Quick Start 3) Keypad Lock 4) Fault Record 5) PLC 6) Copy Param 7) Copy PLC 8) Displ Setup 9) Time Setup 10) Language 11) Start-up
	**Direction: Left/Right/Up/Down** 1) In the numeric value setting mode, it is used to move the cursor and change the numeric value. 2) In the menu/text selection mode, it is used for item selection.
F1 F2 F3 F4	**Function Keys** 1) F1 is JOG function 2) The F2, F3, F4 keys are reserved for future use.
LOCAL	**LOCAL Key** 1) This key is executed by the parameter settings of the source of Local frequency and Local operation. The factory settings of both source of Local frequency and Local operation are the digital keypad. 2) Pressing the LOCAL key with the drive stopped will switch the operation and frequency to the LOCAL source. Pressing the LOCAL key with the drive running will stop the drive, with "AHSP" warning displayed and when stopped, will switch the operation and frequency source to the LOCAL source. 3) The selected mode, LOCAL or REMOTE, will be displayed on the GS4-KPD. 4) When P00.29=0 then LOCAL correlates to HAND mode. The Digital Input Definition must not be set to 56 (LOC/REM Switch). *Refer to P00.29 for more detail and other options on how the drive behaves when switching between LOCAL and REMOTE.*
REMOTE	**REMOTE Key** 1) This key is executed by the parameter settings of the source of Remote frequency and Remote operation. The digital keypad is the the factory default source for both Remote frequency and Remote operation. 2) Pressing the REMOTE key with the drive stopped will switch the operation and frequency to the REMOTE source. Pressing the REMOTE key with the drive running will stop the drive, with “AHSP” warning displayed and when stopped, will switch the operation and frequency source to the REMOTE source. 3) The selected mode, LOCAL or REMOTE, will be displayed on the GS4-KPD. 4) When P00.29=0 then LOCAL correlates to HAND mode. The Digital Input definition must not be set to 56 (LOC/REM Switch). *Refer to P00.29 for more detail and other options on how the drive behaves when switching between LOCAL and REMOTE.*

Descriptions of LED Functions	
	**Steady ON**: Operation indicator of the AC motor drive, including DC brake, zero speed, standby, restart after fault and speed search. **Blinking**: Drive is decelerating to stop or in the status of base block. **Steady OFF**: Drive is not currently executing an operational (RUN) command.
	**Steady ON**: Stop indicator of the AC motor drive. **Blinking**: Drive is in the standby status. **Steady OFF**: Drive is not currently executing an operational (STOP) command.
	**Operation Direction LED** 1) Green light is on, the drive is running forward or will run forward when given a run command. 2) Red light is on, the drive is running backwards or will run backwards when given a run command. 3) Alternating green/red light: the drive is changing direction.
	**ERR_COMM_RUN** Descriptions reserved for future use.

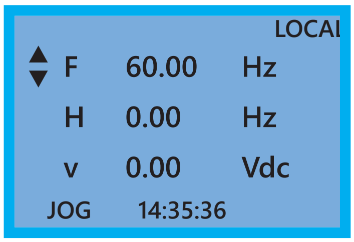
GS30 Display Screens for GS4-KPD

Start-Up Display

At power up, the Start-up Page displays the *DURAPULSE*, GS30 logo. This page is replaced by the Status Page in 3 seconds.

Pressing the UP Arrow while the Start-up Page is displayed will show the current keypad firmware.

Status Page



Drive status:
Press the LOCAL key to allow local control of the drive.
Press the REMOTE key to allow remote control of the drive.
Pressing the Up and Down Direction keys allow the user to scroll through the Status Page items.
F X.xx Hz (actual GS30 command frequency)
H X.xx Hz (actual GS30 output frequency)
U XXX.x User defined value (in this example P00.04 = 3 DC bus voltage*
A X.xx Amp (output amperage)
JOG and time:
JOG appears above the F1 key and is the function assigned to that key.
The internal clock is displayed, center bottom.

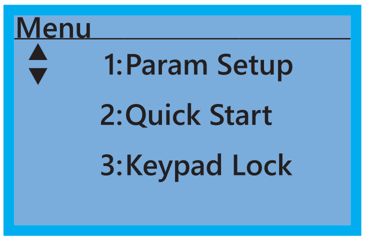
NOTE: When Power is applied, the keypad will display the startup Page followed by the Status Page. The Status Page displays the GS30 default settings F/H/U/A. While the order F/H/U/A is always fixed, P00.03 can be used to set which value appears on the top row at power-up. The UP and DOWN Arrows will scroll through the display options.

NOTE: If an “Err” appears on the keypad after pressing <Enter> in any menu or parameter, then the action did not take affect. The keypad will report back “End” if the action was performed correctly. Ex: writing a value out of range to a parameter will cause a “Err” message.

** NOTE: Refer to Parameter P00.04 in Chapter 4, AC Drive Parameters for a complete list of the values that can be displayed on line 3 of the keypad display. The value in P00.04 is the value that will be shown when the drive powers up. By scrolling to the User Defined row, the Left and Right Direction keys can be used to display any of the other selections available.*

NOTE: The GS4-KPD is connected to the GS30 by the RJ45 communications port with a standard ethernet cable. The following communications settings must be used: P09.01=19.2 (kBps) and P09.04=13 (8N2 RTU).

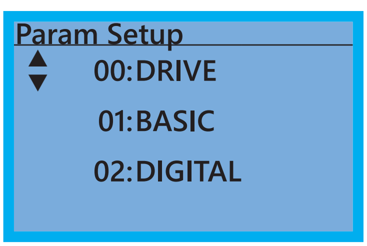
Menu Page



Press the Menu button from any page to access the Menu Page. Use the Up and Down Direction keys to scroll through the Menu content. Press the Enter key to open the selected Menu content item.

1: Param Setup - Parameter Setup:
   Set up the individual drive parameters.
2: Quick Start - This function not available for GS30.
3: Keypad Lock:
   Lock the Keypad.
4: Fault Record:
   Display fault information for the drive.
5: PLC:
   Run the current PLC program.
6: Copy Param - Copy Parameters:
   Save drive parameters to the keypad or drive.
7: Copy PLC:
   Copy a previously saved PLC program to the keypad or drive.
8: Displ Setup:
   Adjust contrast and backlight settings for the display.
9: Time Setup:
   Set the time.
10: Language:
   Set the display language.
11: Start-up:
   Set the Start-up Page display.

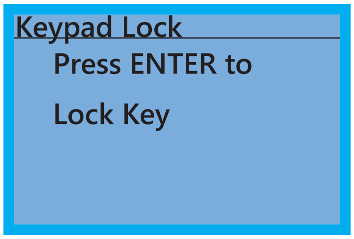
Param Setup - Parameter Setup Page



See the individual parameter summary tables in *Chapter 4 - AC Drive Parameters* for specific parameter explanations and settings.

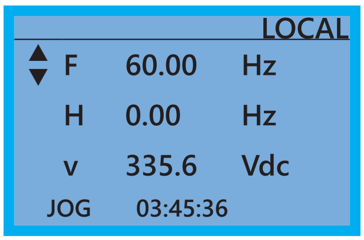
00: DRIVE
01: BASIC
02: DIGITAL
03: ANALOG
04: SPEED
05: MOTOR
06: PROTECT
07: SPECIAL
08: PID
09: COMMUNICATION
10: FEEDBACK
11: ADVANCED
13: USER
14: PROTECT(2)

Keypad Lock - Keypad Lock Page

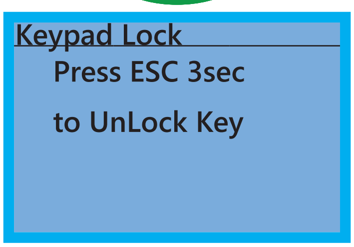


Keypad Lock is used to lock the keypad from unintentional activation during operation.

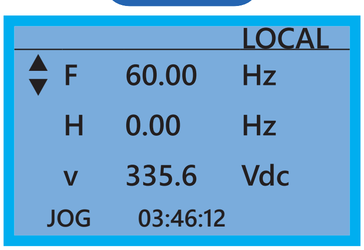
Press the Enter key to lock the keypad.



The Status Page will again display.

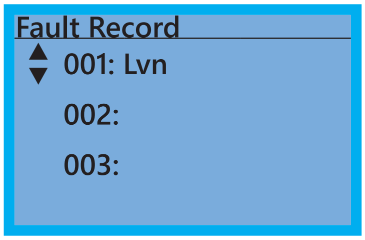


Pressing ANY key will display the message Press ESC to UnLock Key.



Press and hold the ESC key for 3 seconds to unlock the keypad. The display will return to the Status Page.

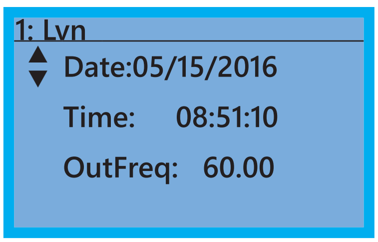
Fault Record - Fault Record Page



GS30 drive faults are stored from 1: to 20:. Refer to *Chapter 6: Maintenance and Troubleshooting* for a complete list of fault messages that may appear. Use the Up and Down Direction keys to scroll through the list.

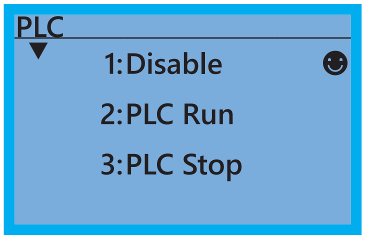
1:
2:
3:
▲
▼
18:
19:
20:

Press the Enter key to display information about the drive status when the fault occurred.



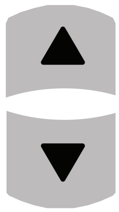
Date: 00/00/0000
Time: 00:00:00
OutFreq: 0.00
OutAmp: 0.00
OutVolt 0.0
DCBus: 0.0

PLC - PLC Function Page



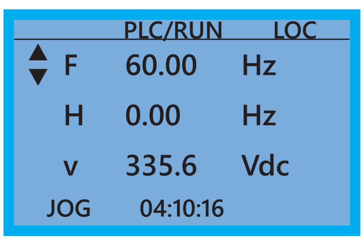
PLC Function is used to Enable/Disable and Run/Stop the internal PLC. The active selection is marked by a smiley face character on the far right of the display.

WARNING: On a power cycle the PLC Run/Stop state will be determined by the last state the keypad was placed in, or by the configured digital inputs. If the state was changed via GSLogic, that Run/Stop state may not be true on a power cycle.



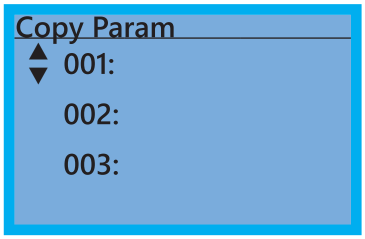
Use the Up and Down Direction keys to select Disable, PLC Run or PLC Stop.

Press the Enter key to confirm the selection.



Selecting PLC Run will activate the GS30 internal PLC. The keypad status Page will display PLC/RUN at the top, center of the display. If PLC Stop is selected, the PLC program will stop and the Status Page will display PLC/STOP at the top center of the page. Selecting Disable will disable the GS30 internal PLC and return control to the drive. Selecting PLC Run or PLC Stop also can determine whether the physical I/O are controlled by the Drive or are controlled by the PLC. See Chapter 8 for more information on the integrated PLC and GSLogic software.

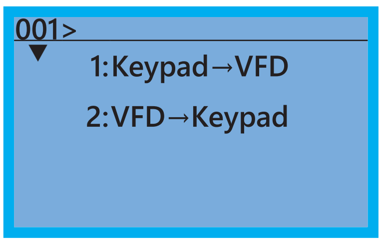
Copy Param - Copy Parameters Page (Keypad Copy)



Copy Parameters is used to save up to four drive configurations into the keypad. The keypad can then download any of these configurations into the drive, or it can be moved to a different drive and download the parameter settings of the original drive. Use the Up and Down Direction keys to scroll through the four available copy parameter locations. If a field is blank, then no copy has been made to that location.

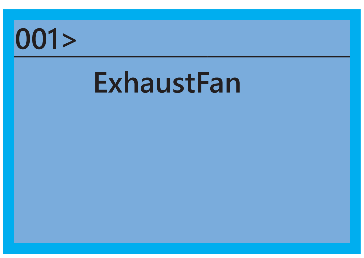
001: ExhaustFan
002: IntakeFan1
003: Filename02
004:

Press the Enter key to select the desired location for writing the current parameter settings.



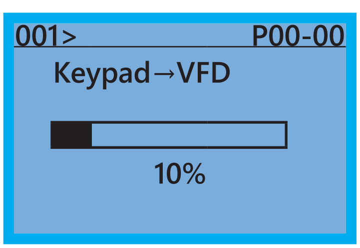
Use the Up and Down Direction keys to select Keypad→VFD to copy the current parameter settings from the keypad to the drive or VFD→Keypad to write the current parameter settings from the drive to the keypad. Press the Enter key.

VFD→ Keypad



After VFD→Keypad is selected, the keypad will prompt you for a filename to save the existing configuration into. Use the Left/Right Arrows to scroll from character to character and the Up/Down Arrows to change the alphanumeric character. Pressing Enter will begin the transfer of parameters from the drive into the keypad.

Keypad→ VFD

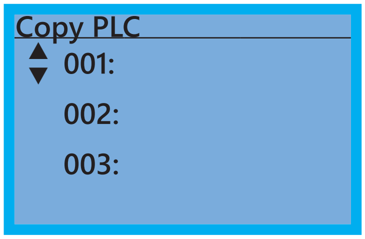


When Keypad→VFD is selected, the keypad will begin the transfer of the preselected file parameters from the keypad into the drive.

As shown in the example to the left, “001” is the file to be transferred.

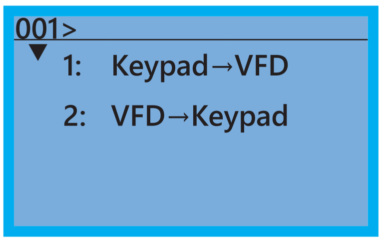
Pressing F4 while in the Copy Param menu will prompt you to Delete All 4 saved programs (“Press ENTER to clear”).

Copy PLC - Copy PLC Page



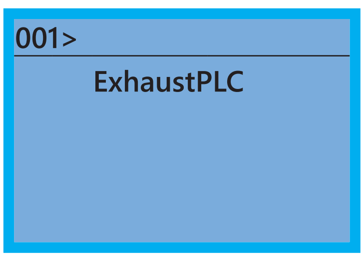
Copy PLC is used to copy previously saved PLC program from the keypad to the drive or from the drive to the keypad. Use the Up and Down Direction keys to scroll through the four available Copy PLC locations. If the field is blank, then no copies have been made. The keypad can store both the parameters and the PLC program at the same time.

Press the Enter key to select the desired location for writing the current program.



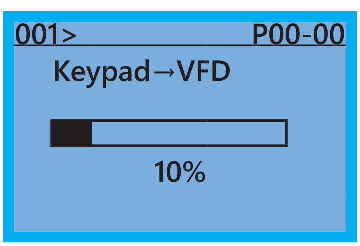
Use the Up and Down Direction keys to select Keypad→VFD to copy the previously saved PLC settings from the keypad to the drive or VFD→Keypad to write the current PLC program from the drive to the keypad.

VFD→ Keypad



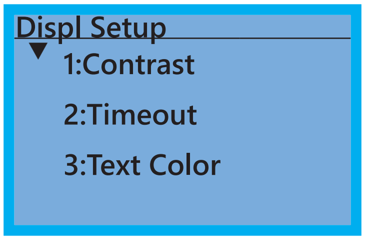
When VFD→Keypad is selected, the keypad will prompt you for a filename to save the existing configuration into. Use the Left/Right arrows to scroll from character to character and the Up/Down arrows to change the alphanumeric character. Pressing Enter will begin the transfer of PLC program from the drive into the keypad.

Keypad→ VFD



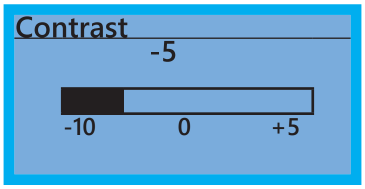
When Keypad→VFD is selected, the keypad will begin the transfer of PLC program from the keypad into the drive.

Displ Setup - Display Setup Page

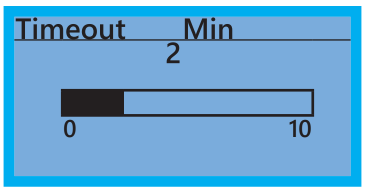


The Display Setup Page allows the user to adjust the Contrast, Backlight time and Text Color of the display.

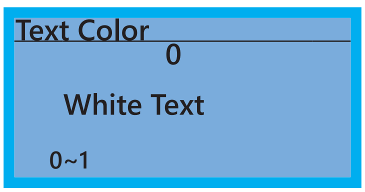
1: Contrast
2: Timeout
3: Text Color



Use the Up and Down direction arrows to adjust the Contrast to the desired setting.
The range of adjustment is from -20 to +20.
The default value is 0.
Entering a value of 0 will keep the backlight ON all the time.

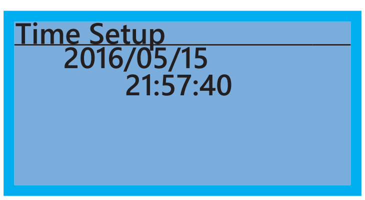


Use the Up and Down direction arrows to adjust the time when the display backlight turns off. The range of adjustment is from 0 to 10 minutes. The default value is 5 minutes.



Use the Up and Down direction arrows to select from white text or blue text for the display.

Time Setup - Time Setup Page

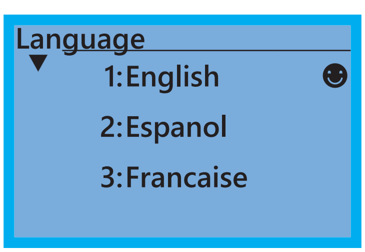


The Time Setup Page allows the user to change the date and time. The date format is Year/Month/Day. Time is displayed in 24-hour clock format and is displayed as Hours:Minutes:Seconds. Use the Right and Left Arrow keys to move the cursor to the desired location and use the Up and Down Arrow keys to adjust the setting.

After adjusting the time, move the cursor to the Seconds entry before pressing the Enter Key.

The real time clock (RTC) is maintained in the keypad. A capacitor is used to provide power for the RTC during power loss. The capacitor can maintain power for the RTC for 7 days with no drive power applied.

Language - Language Page



The Language Page sets the language shown on the display. Select from English, Spanish or French. The translation applies to the keypad menu structure only. The Detailed parameter settings will remain in English.

Start-up - Start-up Page

Start-up
▼ 1:Default1 ☻
2:Default2

The Start-up Page allows the user to select from two different screens that display during initial start-up. Default1 setting displays the GS30 logo screen, Default2 setting displays “Initializing, Please Wait.”

Keypad Fault Codes

Following are the fault codes and descriptions for the GS4-KPD. To reset the fault codes press the Enter and Reset buttons simultaneously. These faults indicate either a communication error between the keypad and the drive or a keypad failure. To correct: 1) Inspect and clean the RJ45 connectors on the back of the keypad and the RJ45 connector leading into the drive. 2) Replace the cable and/or RJ45 M-M adapter with a standard Ethernet patch cable. 3) If the RJ45 connections are OK, replace the keypad.

① LOCAL
Fault
② FrEr
③ kpdFlash Read Er

① Display error signal

② Abbreviated error code
The code is displayed as shown on GS4-KPD

③ Display error description

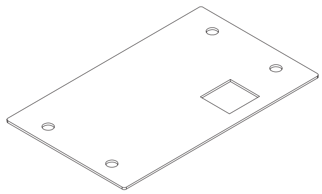
ID No.	Description	Corrective Actions
LOCAL Fault FrEr kpdFlash Read Er	Keypad flash memory read error.	An error has occurred on keypad’s flash memory. 1. Press RESET on the keypad to clear the error. 2. Verify what kind of error has occurred on keypad’s flash memory. 3. Shut down the system, wait 10 minutes and power up the system. If the error remains contact technical support.
LOCAL Fault FSEr kpdFlash Save Er	Keypad flash memory save error.	An error has occurred on keypad’s flash memory. 1. Press RESET on the keypad to clear the error. 2. Verify what kind of error has occurred on keypad’s flash memory. 3. Shut down the system, wait 10 minutes and power up the system. If the error remains contact technical support.
LOCAL Fault FPEr kpdFlash Pr Er	Keypad flash memory parameter error.	Errors occurred on factory setting parameters possibly caused by firmware update. 1. Press RESET on the keypad to clear the error. 2. Verify if there is a problem on the FLASH IC. 3. Shut down the system, wait 10 minutes and power up the system. If the error remains contact technical support.
LOCAL Fault VFDr Read VFD Info Er	Keypad flash memory when read AC data error.	Keypad can’t read data from drive. 1. Verify if the keypad is properly connected to the drive with the RJ45 connector. 2. Press RESET on the keypad to clear the error. 3. Shut down the system, wait 10 minutes and power up the system. If the error remains contact technical support.
LOCAL Fault ERR88 Type Mismatch	Keypad/Drive parameter file mismatch.	There has been an attempt to copy an incorrect file between the keypad and the drive. Ensure that there is a valid file in the keypad (if attempting Keypad → VFD transfer).

Keypad Panel Mounting Kit GS4-BZL

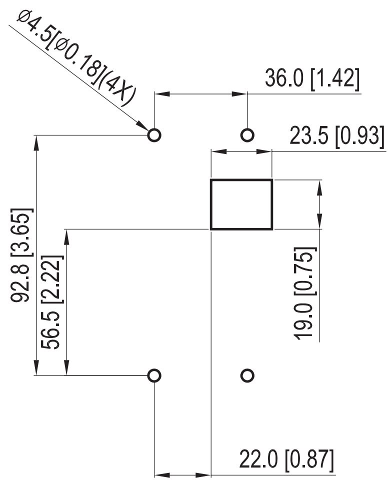
This panel mounting kit can be used for wall mounting or embedded mounting of the GS4-KPD.

Wall Mounting

Accessory 1



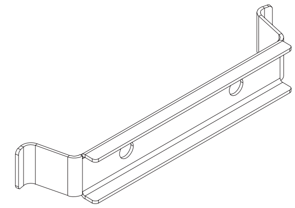
Screws: (4) M4*p 0.7 *L8mm
Torque: 10-12 kg·cm (8.7-10.4lb-in.)



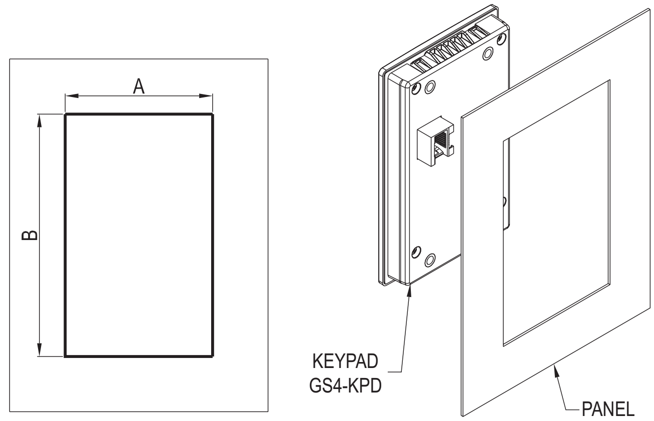
Panel cutout dimensions mm [in]

Embedded Mounting

Accessory 2



Screws: (4) M4*p 0.7 *L8mm
Torque: 10-12 kg·cm (8.7-10.4 lb·in)



Normal cutout dimension

Panel Thickness	1.2 mm	1.6 mm	2.0 mm
A	66.4 [2.614]		
B	110.2 [4.339]	111.3 [4.382]	112.5 [4.429]

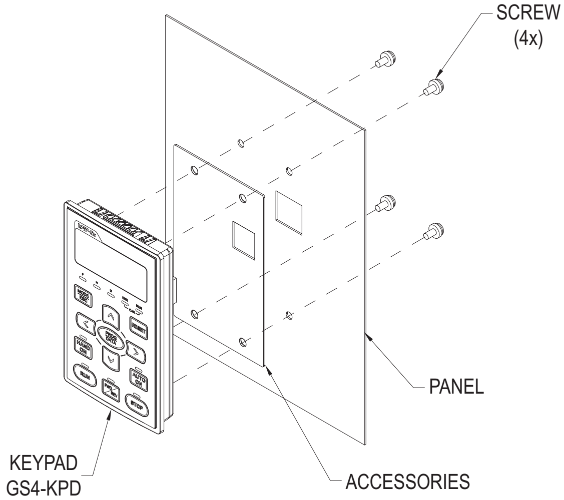
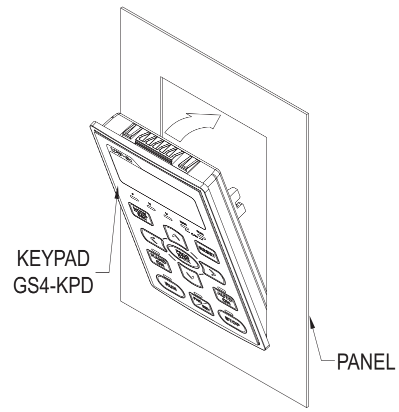
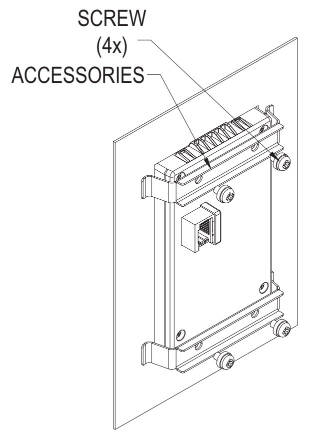
* Deviation: ± 0.15 mm / ± 0.0059 in

Cutout dimension (Waterproof level: IP56)

Panel Thickness	1.2 mm	1.6 mm	2.0 mm
A	66.4 [2.614]		
B	110.8 [4.362]		

* Deviation: ± 0.15 mm / ± 0.0059 in

Continued on next page.

Wall Mounting	Embedded Mounting
	 

Optional I/O and Communication Cards

Appendix

B

Table of Contents

Introduction

GS30 drives have a variety of option cards that can be used to expand the functionality of the drive.

Communication Cards:

- *GS30A-CM-EIP1: Provides EtherNet/IP and Modbus TCP communications with 1 Ethernet port.*
- *GS30A-CM-EIP2: Provides EtherNet/IP and Modbus TCP communications with 2 Ethernet ports.*
- *GS30A-CM-ECAT: Provides EtherCAT communications.*

I/O Cards:

- *GS30A-06CDD: Provides 3-point sinking/sourcing inputs/outputs*
- *GS30A-2AD2DA: Provides 2-channel current/voltage inputs/outputs*
- *GS30A-02TRC: Provides 240VAC/30VDC (2) Form B (SPDT) relays*
- *GS30A-03TRA: Provides 250VAC/30VDC (3) Form A (SPST) relays*
- *GS30A-FB-LD: Provides line driver (differential) encoder input. Pulse Command and Pulse output*
- *GS30A-FB-OC: Provides NPN open collector and PNP open collector encoder input, Pulse Command and Pulse output*

Misc. Cards:

- *GS30A-BPS: Provides backup power supply.*

One I/O and one communication card be installed at the same time. The BPS card can be installed with either an I/O card OR a communication card.

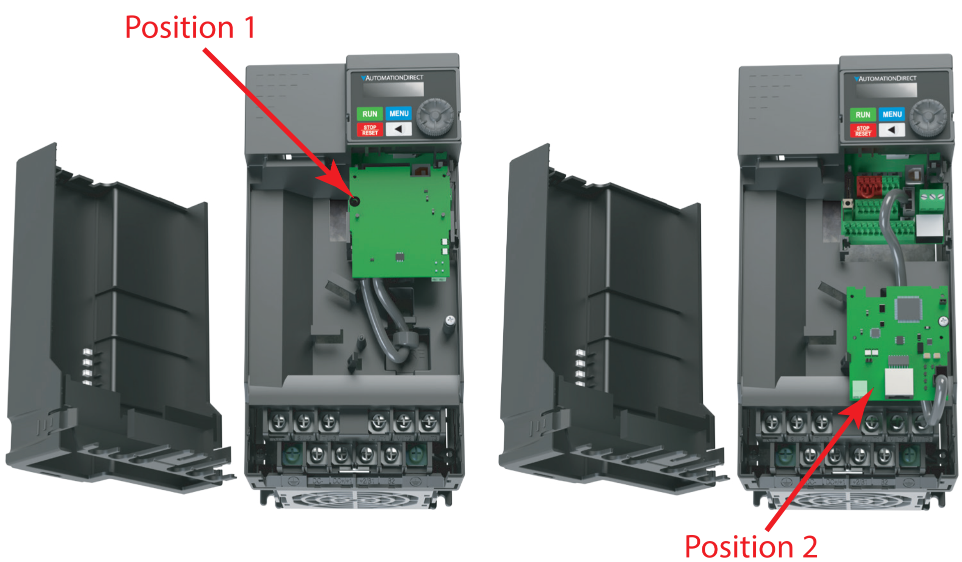
Option Card Installation

The option cards in this chapter are optional accessories. Select the applicable option cards for your GS30 drive, or contact AutomationDirect for suggestions. The option cards can significantly improve the functionality of the drive. To prevent damage to the GS30 drive during installation, remove the digital keypad and the cover before wiring.

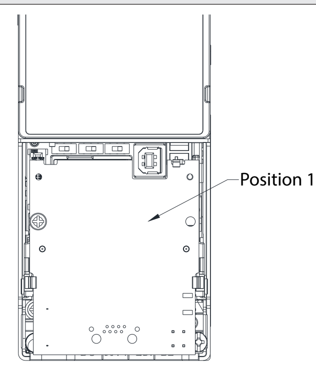
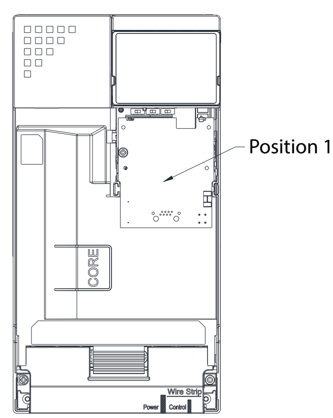
Option Card Locations

The GS30 drive supports installation of up to two option cards at a time. I/O cards must be installed in position 1. The GS30A-CM-EIP1/EIP2 communication cards and the GS30A-BPS can be installed in position 1 or position 2. The GS30A-CM-ECAT card must be installed in position 2 to comply with ECAT standards. This means you can have one comm card and one I/O card installed, or the GS30A-BPS and either a comm card or an I/O card.

Mounting Positions for Frames A-D



Mounting Positions for Frames E-I

GS30 Optional I/O and Communication Cards			
Part Number	***Description***	***Position***	***Reference Diagram***
GS30A-BPS	GS30 series backup power supply module.	1 or 2	 ***Card Installed in Position 1 of GS30 Frame A-D***
GS30A-CM-EIP1	GS30 series communication module, EtherNet/IP and ModbusTCP, 1 port, (1) Ethernet (RJ45) port.	1 or 2	
GS30A-CM-EIP2	GS30 series communication module, EtherNet/IP and Modbus TCP, 2 ports, (2) Ethernet (RJ45) port(s).	1 or 2	
GS30A-ECAT	GS30 series communication module, EtherCAT CoE protocol, 2 ports, (2) Ethernet (RJ45) port(s).	2	
GS30A-06CDD	GS30 series discrete combo module, Input: 3-point, 24 VDC, sinking/sourcing selectable, Output: 3-point, 48 VDC, sinking/sourcing selectable, 30mA/point, 50mA resistive output current.	1	
GS30A-2AD2DA	GS30 series analog combo module, Input: 2-channel, current/voltage, 0-20 mA and 4-20 mA, 0-10 VDC, Output: 2-channel, current/voltage, 0-20 mA and 4-20 mA, 0-10 VDC	1	 ***Card Installed in Position 1 of GS30 Frame E-F***
GS30A-02TRC	GS30 series relay output module, 240 VAC/30 VDC, (2) Form B (SPDT) relays, 1 isolated common(s), 1 point(s) per common. Screw terminal blocks included.	1	
GS30A-03TRA	GS30 series relay output module, 250 VAC/30 VDC, (3) Form A (SPST) relays, 1 isolated common(s), 1 point(s) per common. Screw terminal blocks included	1	
GS30A-FB-LD	GS30 series encoder module, line driver (differential) encoder input. For use with GS30 series AC drives. Supports 1-phase and 2-phase input	1	
GS30A-FB-OC	GS30 series encoder module, NPN open collector and PNP open collector encoder input. For use with GS30 series AC drives. Supports 1-phase and 2-phase input	1	

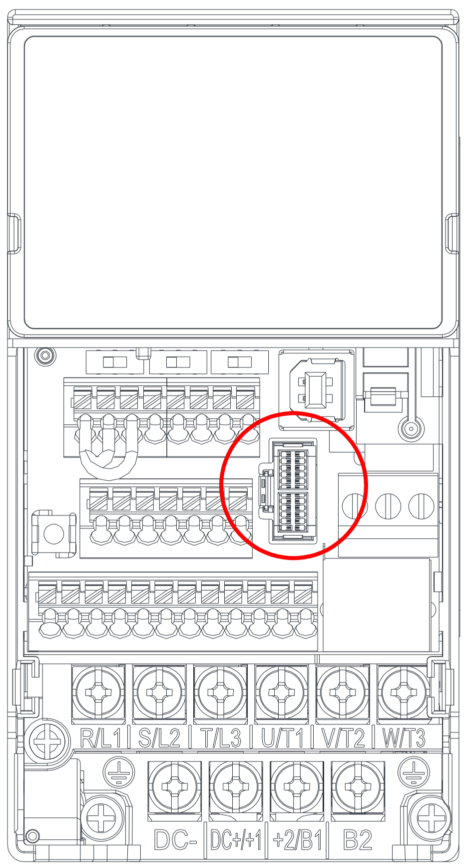
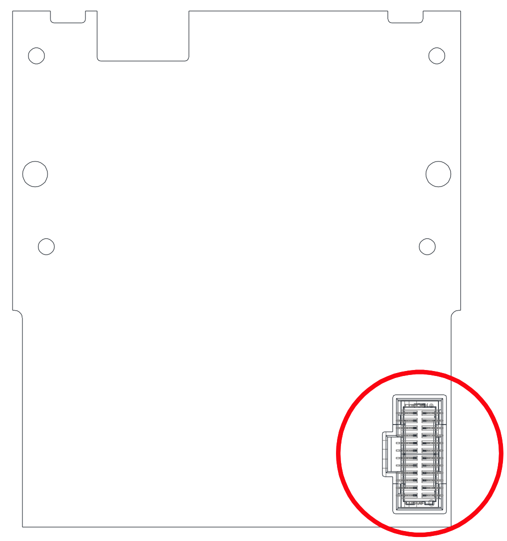
Removing the Card Slot Cover

WARNING: AC input power must be disconnected before performing any maintenance. Do not connect or disconnect wires or connectors while power is applied to the circuit. Maintenance must be performed only by a qualified technician.

WARNING: A charge may still remain in the DC-link capacitor with hazardous voltages, even if the power has been turned off. To avoid personal injury, do not remove the cover of the AC drive until all "DISPLAY LED" lights on the digital keypad are off. Please note that there are live components exposed within the AC drive. Do not touch these live parts.

NOTE: To prevent damage during installation, remove the digital keypad and cover before option card installation. See "Chapter 2: Installation and Wiring" for instructions.

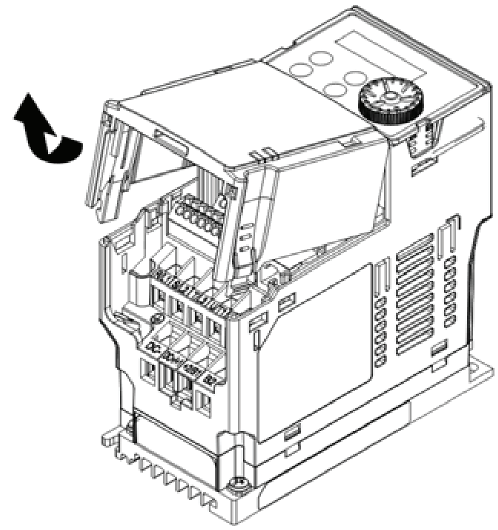
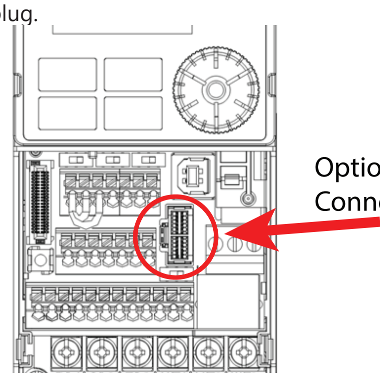
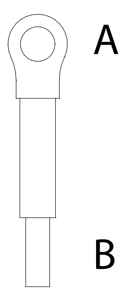
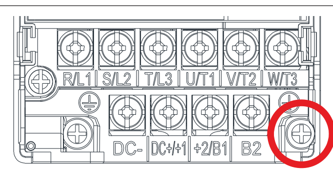
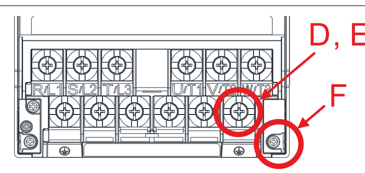
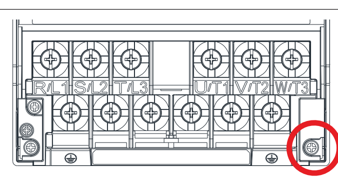
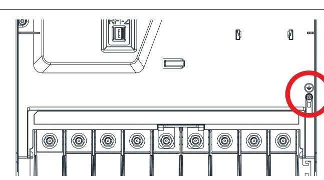
Option Card Wiring

<table>
<tr><th colspan="2">GS30 Card Wiring</th></tr>
<tr><th>GS30 Control Board Connector</th><th>Option Card Connector</th></tr>
<tr><td>
</td><td></td></tr>
</table>

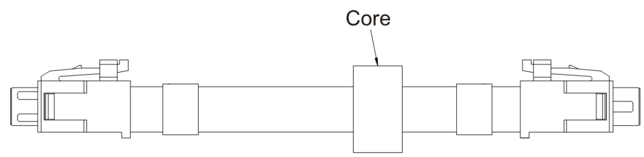
WARNING: Please read the descriptions on the connecting cables and install carefully. Using incorrect cables can damage the option card or the drive.

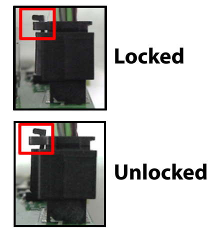
Install the Communication Card in Position 1

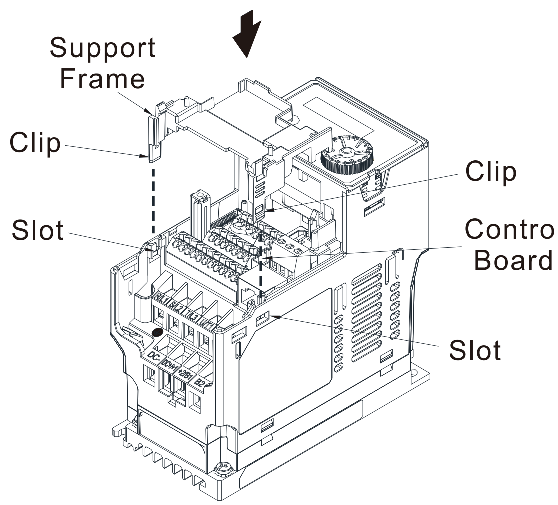
Installation method: Back-mount the option card by connecting flat cables to the control board.

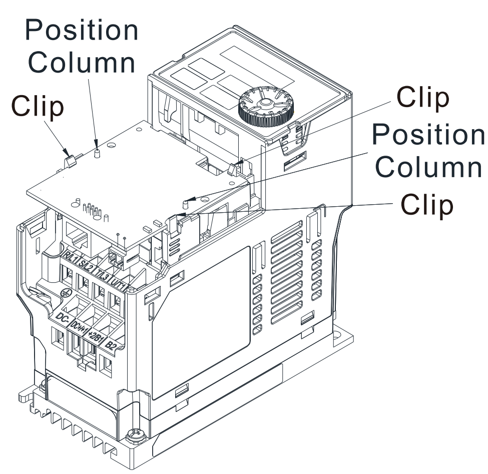
<table>
<tr><th colspan="5">GS30 Communication Card Installation Steps (Position 1)</th></tr>
<tr><th>Step</th><th colspan="4">Description</th></tr>
<tr><td>1</td><td colspan="4">Turn off the drive power and remove the front cover.
</td></tr>
<tr><td>2</td><td colspan="4">Remove the plug terminal cover from the drive control board. A small screwdriver can be used to pry the cover from the plug.

</td></tr>
<tr><td rowspan="5">3</td><td colspan="4">The communication card must be grounded before wiring. A ground terminal wire is included with the card. The A side of the ground terminal connects to the PE on the drive as indicated by the red circles below. The B side of the ground terminal connects to the green terminal block labeled PE on the option card. Connect the wire then plug the terminal block back into the option card. Note, for E-I frames, snip the "A" ring of the ground terminal wire to fit the connector around the ground screw.</td></tr>
<tr><th>Ground Terminal Wire</th><th>Frame A–C</th><th colspan="2">Frame D–F</th></tr>
<tr><td rowspan="3">
</td><td>
</td><td colspan="2">
</td></tr>
<tr><th>Frame G</th><th colspan="2">Frame H–I</th></tr>
<tr><td>
</td><td colspan="2"></td></tr>
</table>

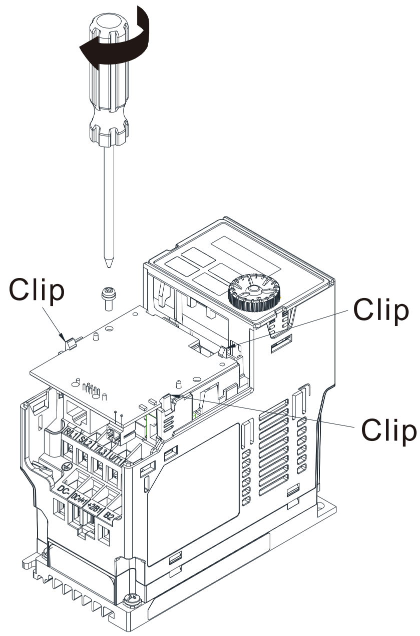
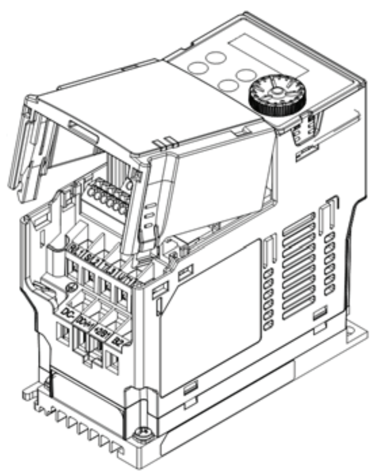
<table>
<tr><th colspan="2">GS30 Communication Card Installation Steps (Position 1)(continued)</th></tr>
<tr><th>Step</th><th>Description</th></tr>
<tr><td>4</td><td>Plug each end of the control board connector cable included with the option card into the appropriate slot on the card and the drive. Apply enough pressure to ensure the connector is properly locked in place.




</td></tr>
<tr><td>5</td><td>Aim the two clips at the two slots on the drive, and then press downward to have the two clips engage the slots.

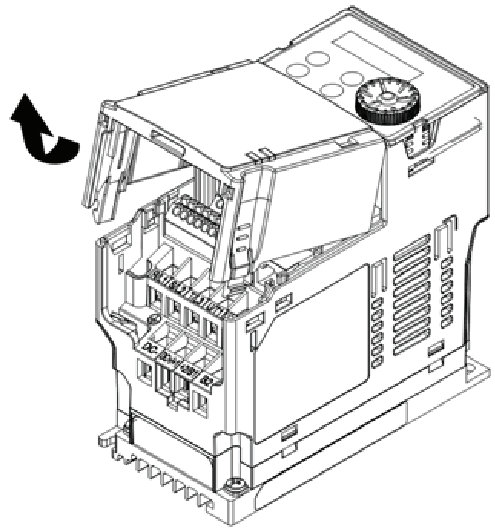
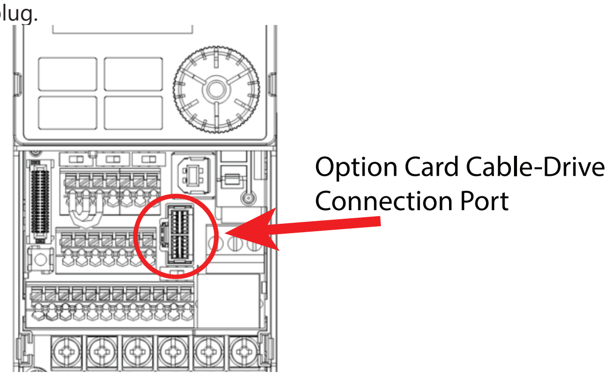
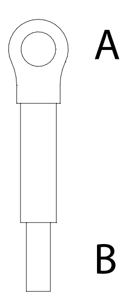
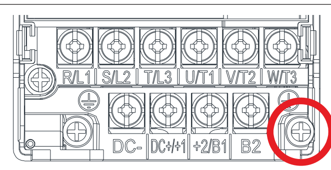
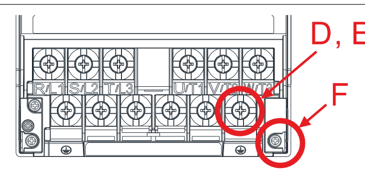
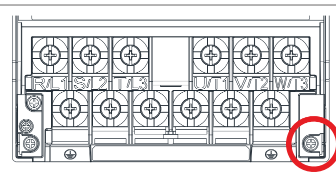
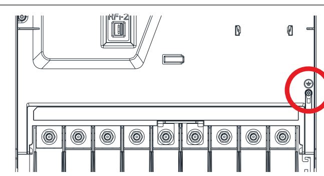

</td></tr>
<tr><td>6</td><td>With the terminal block and connector of the option card facing downward, aim the two holes of the option card to the position column and press downward so that the three clips engage the option card.


</td></tr>
</table>

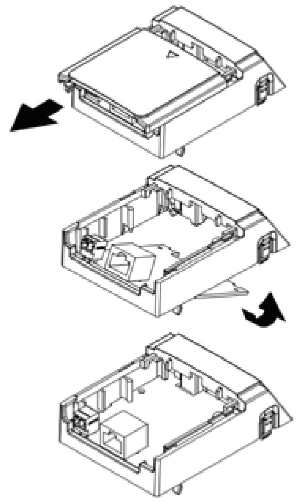
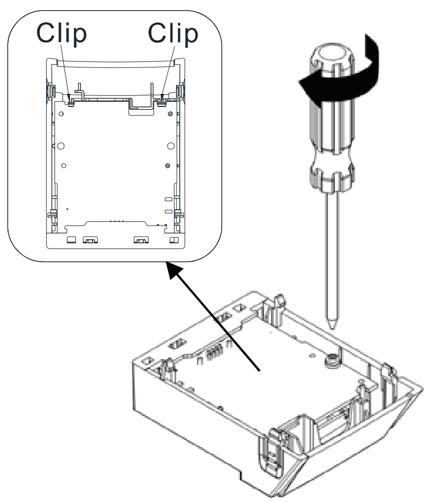
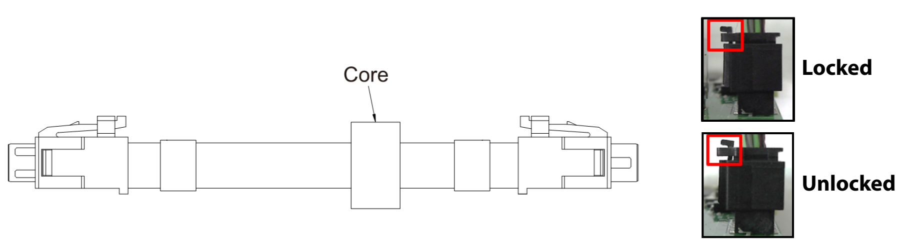
GS30 Communication Card Installation Steps (Position 1)(continued)	
Step	**Description**
7	Fasten the screw to fix the option card firmly in place and torque approximately 4-6 kg-cm (3.5-5.2 in-lb)(0.39-0.59 N·m). 
8	Replace the GS30 drive front cover. Installation is complete. 

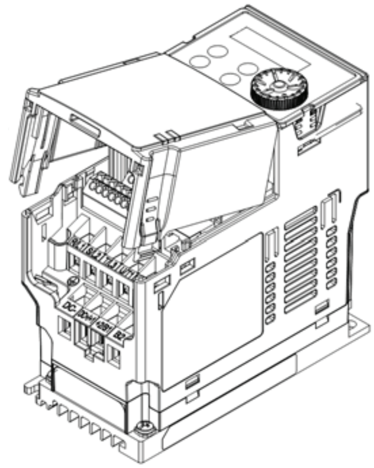
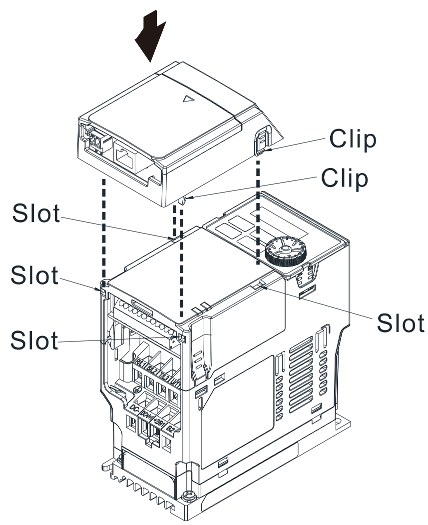
Install the Communication Card in Position 2

Installation method: Back-mount the option card by connecting flat cables to the control board.

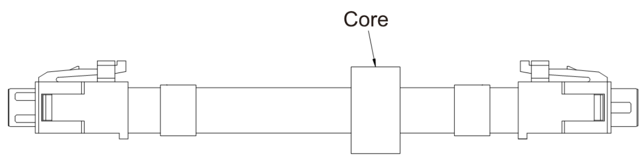
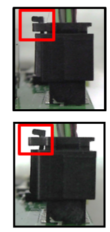
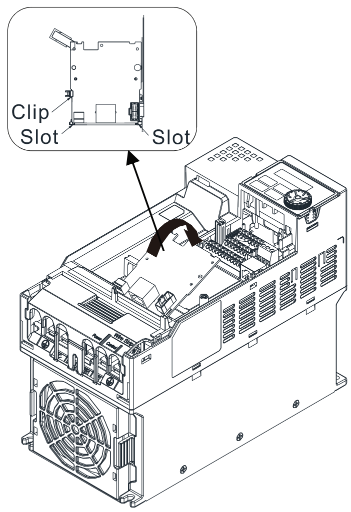
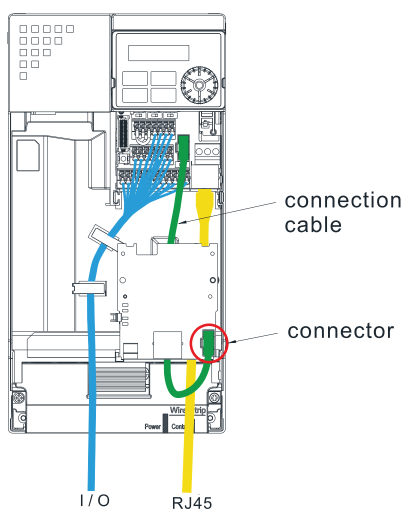
<table>
<tr><th colspan="4">GS30 Communication or BPS Card Installation Steps (Position 2)</th></tr>
<tr><th>Step</th><th colspan="3">Description</th></tr>
<tr><td>1</td><td colspan="3">Turn off the power of the drive, and then remove the front cover.
</td></tr>
<tr><td>2</td><td colspan="3">Remove the plug terminal cover from the drive control board. A small screwdriver can be used to pry the cover from the plug.

</td></tr>
<tr><td rowspan="5">3</td><td colspan="3">The communication card must be grounded before wiring. A ground terminal wire is included with the card. The A side of the ground terminal connects to the PE on the drive as indicated by the red circles below. The B side of the ground terminal connects to the green terminal block labeled PE on the option card. Connect the wire then plug the terminal block back into the option card. Note, for E-I frames, snip the "A" ring of the ground terminal wire to fit the connector around the ground screw.</td></tr>
<tr><th>Ground Terminal Wire</th><th>Frame A–C</th><th>Frame D–F</th></tr>
<tr><td rowspan="3">
</td><td>
</td><td>
</td></tr>
<tr><th>Frame G</th><th>Frame H–I</th></tr>
<tr><td>
</td><td></td></tr>
</table>

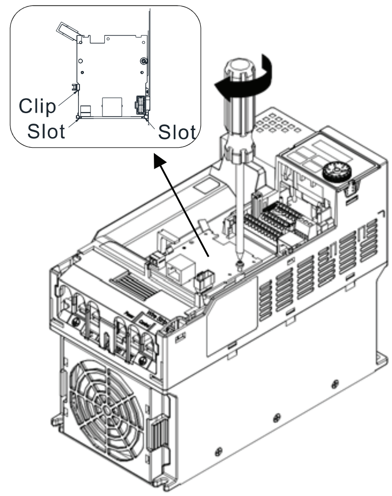
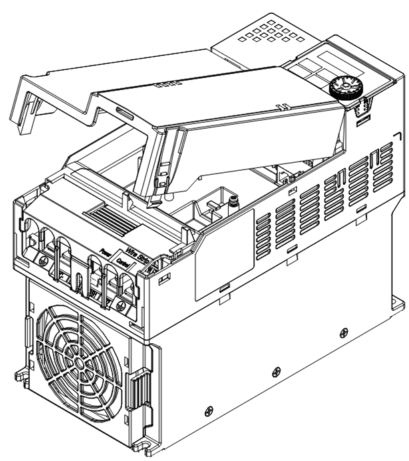
Final Installation Steps for Frame A-D:

GS30 Communication or BPS Card Installation Steps (Position 2)	
Step	**Description**
4	Detach the upper cover of the external mounting cover and place the communication card in the box with the terminal block and connector facing up and snap into place. 
5	Flip the external mounting cover over and ensure the two clips are fully engaged. Then fasten the screws as shown below (torque screws to 4-6 kg•cm/3.5-5.2 lb-in/ 0.39-0.59 N•m). 
6	Plug each end of the control board connector cable included with the option card into the appropriate slot on the card and the drive. Apply enough pressure to ensure the connector is properly locked in place. 

GS30 Communication or BPS Card Installation Steps (Position 2)(Continued)	
Step	**Description**
7	Replace the GS30 drive front cover. 
8	Line up the four clips on the back of the installation box with the four slots on the front of the GS30 drive. Press downward to engage the clips. Installation is complete 

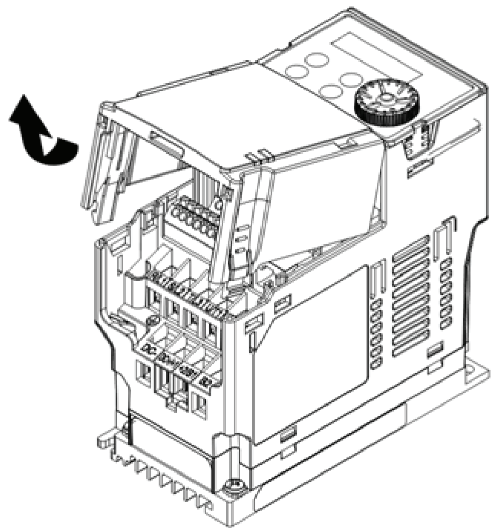
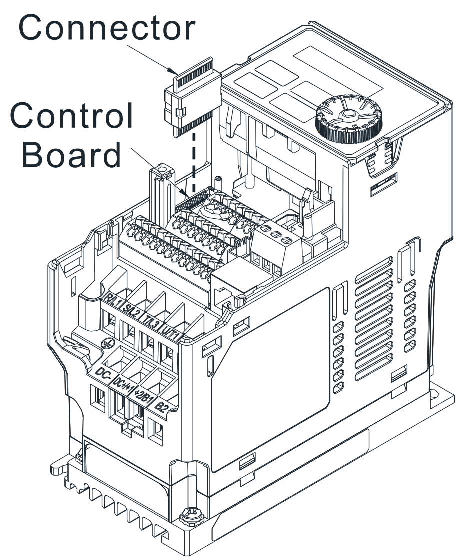
Final Installation Steps for Frame E-I:

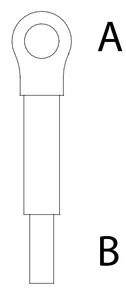
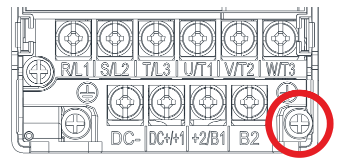
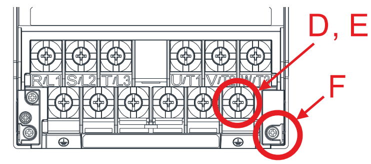
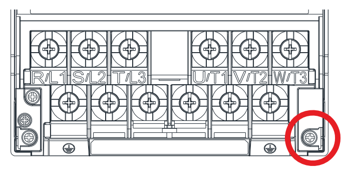
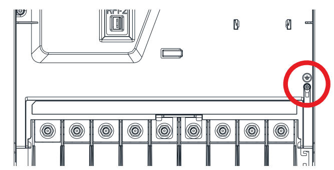
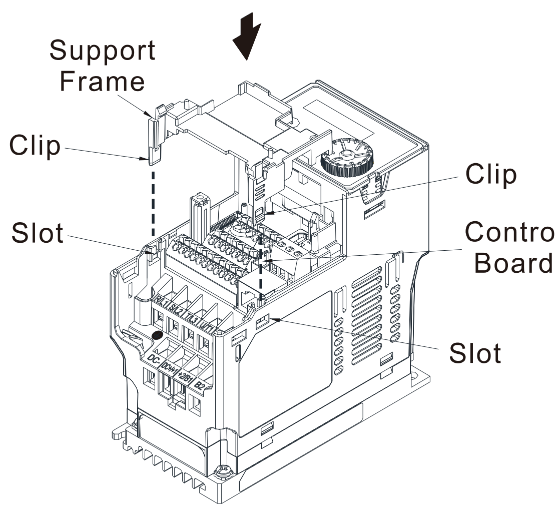
GS30 Communication or BPS Card Installation Steps (Position 2)	
Step	**Description**
4	Plug each end of the control board connector cable included with the option card into the appropriate slot on the card and the drive. Apply enough pressure to ensure the connector is properly locked in place.  
5	Place the communication card with terminal block and connector facing up in the position 2 slot of the drive. Make sure to run the connector cable under the card, not over it. 
6	Before securing the card in place, make sure all cables are running around or under the communication card (see below). 

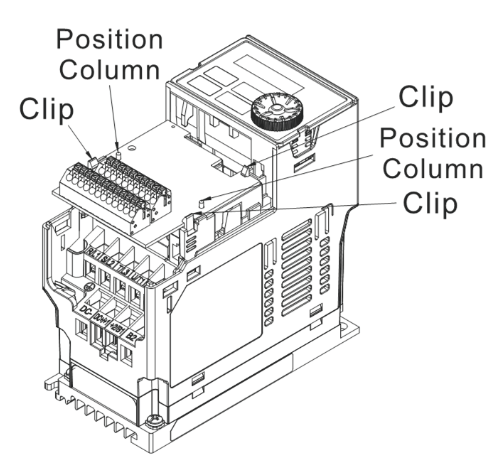
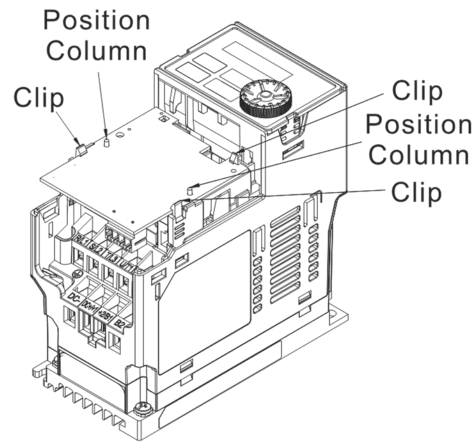
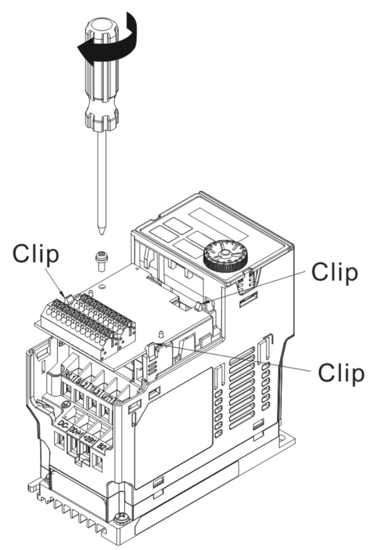
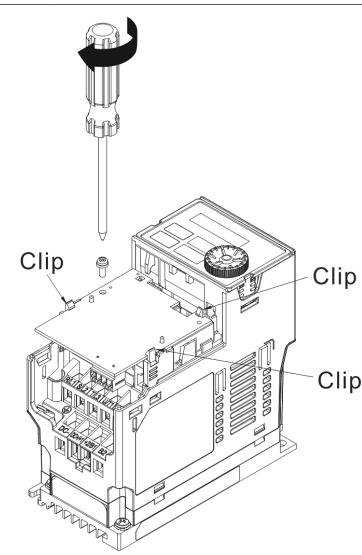
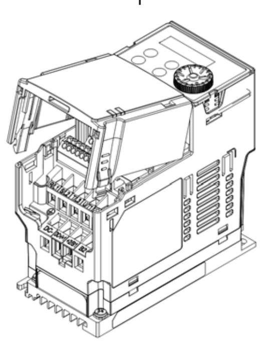
GS30 Communication or BPS Card Installation Steps (Position 2)(Continued)	
Step	**Description**
7	Press downward to engage the clips, then fasten the screws as shown (torque screws to 4-6 kg•cm/3.5-5.2 lb-in/ 0.39-0.59 N•m). 
8	Replace the GS30 drive front cover. Installation is complete. 

Install the I/O, Encoder, or BPS Card in Position 1

Installation method: Back-mount the option card by connecting a card connector to the control board.

GS30 I/O Card Installation Steps (Position 1)	
Step	***Description***
1	Turn off the drive power and remove the front cover. 
2	Mount the card connector to the drive control board. 

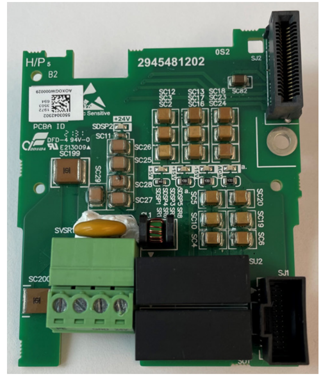
<table>
<tr><th colspan="4">GS30 I/O Card Installation Steps (Position 1)(continued)</th></tr>
<tr><th>Step</th><th colspan="3">Description</th></tr>
<tr><td rowspan="5">3</td><td colspan="3">The encoder and BPS cards must be grounded before wiring. A ground terminal wire is included with the card. The A side of the ground terminal connects to the PE on the drive as indicated by the red circles below. The B side of the ground terminal connects to the green terminal block labeled PE on the option card. Connect the wire then plug the terminal block back into the option card. Note, for E-I frames, snip the “A” ring of the ground terminal wire to fit the connector around the ground screw.</td></tr>
<tr><td>Ground Terminal Wire</td><td>Frame A–C</td><td>Frame D–F</td></tr>
<tr><td rowspan="3">
</td><td>
</td><td>
</td></tr>
<tr><td>Frame G</td><td>Frame H–I</td></tr>
<tr><td>
</td><td></td></tr>
<tr><td>4</td><td colspan="3">Aim the two clips at the two slots on the drive, and then press downward to have the two clips engage the slots.

</td></tr>
</table>

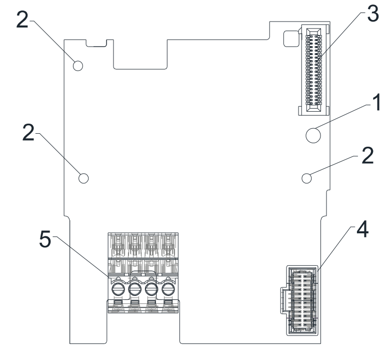
<table>
<tr><th colspan="3">GS30 I/O Card Installation Steps (Position 1)(continued)</th></tr>
<tr><th>Step</th><th colspan="2">Description</th></tr>
<tr><td rowspan="3">5</td><td colspan="2">With the terminal block and connector of the option card facing downward, aim the two holes of the option card to the position column and press downward so that the three clips engage the option card.</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Encoder and I/O cards, terminals up</td><td>BPS card, terminals down</td></tr>
<tr><td rowspan="3">6</td><td colspan="2">Fasten the screw to fix the option card firmly in place and torque approximately 4-6 kg-cm (3.5-5.2 in-lb)(0.39-0.59 N·m).</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Encoder and I/O cards</td><td>BPS card</td></tr>
<tr><td>7</td><td colspan="2">Replace the GS30 drive front cover. Installation is complete.
</td></tr>
</table>

GS30A-BPS

The GS30A-BPS is a backup power supply for GS30 series AC drives that can be installed in Position 1 or Position 2 as needed.

A backup power supply card allows external 24VDC to be connected to the drive, which keeps communications and some I/O of the drive active during main power downs. This is especially useful if frequent operator lockouts turn line power off to the drive. Network communications will remain active during power downs.





GS30A-BPS

GS30A-BPS Overview			
Drawing Item	***Description***	***Wiring Info***	***Screw Torque***
1	Screw fixing hole	Wire gauge: 0.25–0.5 mm^2 [24–20 AWG] Stripping length: 7–8 mm	Screw torque: 2 kg-cm / [1.7 lb-in.] / [0.2 N•m]
2	Positioning hole		
3	AC drive connection port		
4	AC drive connection port		
5	+24 V terminal block		

Features

- *Provides external power supply for the controls circuitry.*
- *Supports 24 VDC input.*
- *Supports parameter reading and writing and status monitoring of the drive.*

Specifications

If the GS30 drive is running solely on power provided by the GS30A-BPS, GS30 communication works normally along with the following functions:

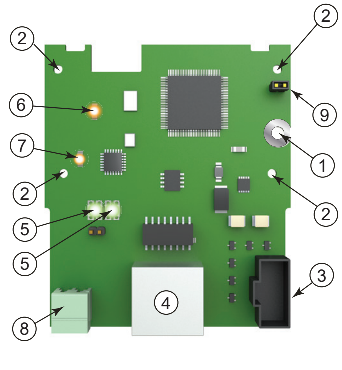
- *Parameter reading and writing*
- *Keypad display*
- *Keys on the keyboard panel (except the RUN key)*
- *Analog input with +10 V terminal supply power*
- *Multi-function inputs (FWD/DI1, REV/DI2, DI3–DI7) with +24V terminal or external power supply*
- *Relay output*
- *Pulse sequence frequency command*

The following functions are not supported when running on backup power only:

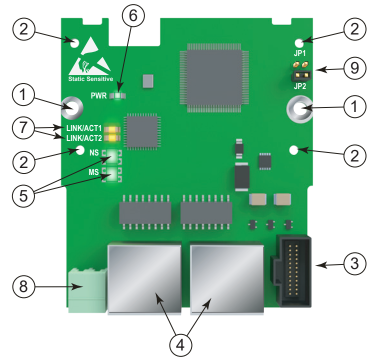
- *DO digital frequency signal output*
- *AO1 multi-function analog voltage output*
- *PLC functions*

GS30A-CM-EIP1 and GS30A-CM-EIP2

The GS30A-CM-EIP1 and GS30A-CM-EIP2 are communication cards for GS30 series AC drives that enable Modbus TCP and EtherNet/IP communications. The GS30A-CM-EIP1 is a single port card while GS30A-CM-EIP2 is a dual-port card. Either card can be installed in Position 1 or Position 2.



GS30-CM-EIP1



GS30-CM-EIP2

GS30A-CM-EIP1 Overview			
Drawing Item	***Description***	***Wiring Info***	***Screw Torque***
1	Screw fixing hole	Wire gauge: 0.25–0.5 mm^2 [24–20 AWG] Stripping length: 7–8 mm	Screw torque: 2 kg-cm / [1.7 lb-in.] / [0.2 N•m]
2	Positioning hole		
3	AC drive connection port		
4	Communication port		
5	Indicator lights; NET1 (NS), NET2 (MS)		
6	Power indicator		
7	Link indicator		
8	Ground terminal block		
9	Jumper		

GS30A-CM-EIP2 Overview			
Drawing Item	***Description***	***Wiring Info***	***Screw Torque***
1	Screw fixing hole	Wire gauge: 0.25–0.5 mm^2 [24–20 AWG] Stripping length: 7–8 mm	Screw torque: 2 kg-cm / [1.7 lb-in.] / [0.2 N•m]
2	Positioning hole		
3	AC drive connection port		
4	Communication ports: Port 1, Port 2		
5	Indicator lights; NS, MS		
6	Power indicator		
7	Link indicator: ACT1 (Port 1), ACT2 (Port 2)		
8	Ground terminal block		
9	Jumper		

Features

- *Supports Modbus TCP and EtherNet/IP protocol*
- *32/32 words read/write parameters correspondence*
- *User-defined corresponding parameters*
- *MDI / MDI-X auto-detect*

Specifications

GS30A-CM-EIPx Specifications	
Network Interface	
Interface	RJ45 with Auto MDI/MDIX
Number of ports	GS30A-CM-EIP1: 1 port GS30A-CM-EIP2: 2 ports
Transmission method	IEEE 802.3, IEEE 802.3u
Transmission cable	Category 5e shielding 100MHz
Transmission speed	10/100 Mbps Auto-Detect
Network protocol	ICMP, IP, TCP, UDP, DHCP, Modbus over TCP/IP, EtherNet/IP, BOOTP
Electrical	
Power supply voltage	15VDC (supplied by the AC drive)
Insulation voltage	500VDC
Power consumption	0.8W
Physical	
Weight	GS30-CM-EIP1: 25g GS30-CM-EIP2: 30g
Environment	
Noise immunity	ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Test (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)
Operation / storage	Operation: -10°C~50°C [14°F~122°F] (temperature), 90% (humidity) Storage: -25°C~70°C [-13°F~158°F] (temperature), 95% (humidity)
Vibration / shock immunity	International standard: IEC 61800-5-1, IEC 60068-2-6/IEC 61800-5-1, IEC 60068-2-27

Connecting Comm Card to PC

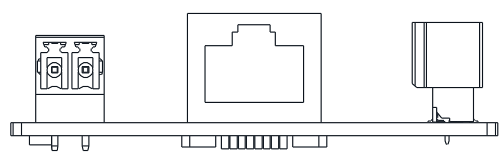
To connect the GS30A-CM-EIPx to the network:

1) Turn off the power of the drive.

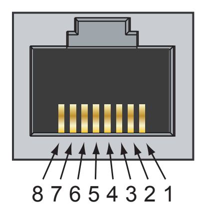
2) Open the front cover of the drive.

3) Connect the CAT-5e network cable to the RJ45 port of the GS30A-CM-EIPx (as shown in the right figure).

Note: the GS30A-CM-EIP2 has 2 ports but steps are the same.



PIN Description for GS30A-CM-EIPx					
PIN	**Signal**	**Description**	**PIN**	**Signal**	**Description**
1	TX+	Transmit Data +	**5**	–	N/C
2	TX–	Transmit Data –	**6**	RX –	Receive Data –
3	RX+	Receive Data +	**7**	–	N/C
4	–	N/C	**8**	–	N/C



GS30A-CM-EIPx LED Indicators and Troubleshooting

There are four LED indicators on the GS30A-CM-EIP1 and GS30A-CM-EIP2 cards. The POWER LED displays the status of the power supply, and the LINK LED displays the communication status with the network. If any of these conditions exist and the cause cannot be determined, power down the drive, remove the comm card and reinstall it. Re-seating the card may eliminate certain problems.

GS30A-CM-EIPx LED Indicators				
LED	***Status***		***Indication***	***How to correct it?***
POWER	Amber/ Green*	On	Power supply in normal status	None
		Off	No power supply	Re-seat comm card connection and verify drive power
LINK	Amber	On	Network is connected	None
		Off	No network connection	Verify network cable is connected
NET1 (NS) (network status)	Off	Off	The device is powered off, or is powered on but with no IP address configured	Re-seat comm card connection cable and verify drive power. Enter IP address in device
	Green	Flashes	Network in operation, sending/receiving network packet.	None
		On	IP address is configured, at least one CIP connection is established, and an Exclusive Owner connection has not timed out.	None
	Red	Flashes	Connection timeout- An IP address is configured, and an Exclusive Owner connection for which this device is the target has timed out.	Verify that the Originator is attempting commumication with the target. Verify operation of network cabling and switches.
		On	Major Fault- Duplicate IP detected	Ensure no other device on the network has the same IP address
	Red/ Green	Flashes	Self-Test, device is performing power up testing.	Device is performing power up testing.
NET2 (MS) (module status)	Off	Off	The device is powered off, or is powered on but with no IP address configured	Re-seat comm card connection cable and verify drive power
	Green	Flashes	Device in Standby, has not been configured	None
		On	Device Operational	None
	Red	Flashes	Major Recoverable Fault	An incorrect or inconsistent configuration. Update configuration settings.
		On	Major Unrecoverable Fault	Cycle power on the drive, reseat cables. If error doesn't clear, contact ADC Technical support
	Red/ Green	Flashes	Self-Test, device is performing power up testing.	None
** Applies to dual port model only (GS30A-CM-EIP2)*				

NOTE: If the communication card is not recognized by the drive (P09.60=0), try the following:
1) Ensure cable connector is in locked position on the card.
2) Ensure the J2 Jumper is removed from the card and then cycle power to the drive.

GS30A-CM-EIPx LED Troubleshooting		
Abnormality	***Cause***	***How to correct it?***
POWER LED off	AC drive not powered	Check if AC drive is powered, and if the power supply is normal.
	GS30A-CM-EIPx not connected to the AC drive	Make sure GS30A-CM-EIPx is connected to the AC drive.
MS or NS LED off	GS30A-CM-EIPx not connected to the network	Make sure the network cable is correctly connected to the network.
	Poor contact to RJ-45 connector	Make sure the RJ-45 connector is connected to the Ethernet port.
Cannot ping communication card IP address on the network	The GS30A-CM-EIPx is not connected to the network.	Ensure that the GS30A-CM-EIPx is correctly connected to the network. Ensure Jumper J2 is not left in place on the EIP card after a FW update.
	The PC and the GS30A-CM-EIPx are in different networks and blocked by network firewall.	Search by IP or set up relevant settings using the AC drive keypad.
Cannot open GS30A-CM-EIPx setup page	The GS30A-CM-EIPx is not connected to the network.	Ensure that the GS30A-CM-EIPx is correctly connected to the network.
	Incorrect communication setting in GSoft2.	Ensure that the communication setting in GSoft2 is set to Ethernet.
	The PC and the GS30A-CM-EIPx are in different networks and blocked by network firewall.	Use the drive keypad to set the ethernet card address.

GS30A-CM-EIPx Error Codes		
ID	***Code***	***Definition***
71	ECLv	5V power that drive provides to the Comm card is too low
72	ECtt	Communication card is in test mode
75	ECFF	Incorrect default setting
76	ECiF	Serious internal error
80	ECEF	Ethernet connection error. Ensure ethernet cable is plugged in and ethernet switch is powered (if used).
81	ECto	Communication timeout between GS30A-CM-EIPx and GS30
82	ECCS	Checksum error in the communication between GS30A-CM-EIPx and GS30
83	ECrF	Reset GS30A-CM-EIPx to default setting
84	ECo0	Exceeds max. number of communications in Modbus TCP
85	ECo1	Exceeds max. number of communications ini EtherNet/IP
86	ECiP	IP error: Default Gateway address must match subnet of IP address or be set to 0.0.0.0
87	EC3F	reserved
88	ECbY	GS30 is busy.
89	ECCb	ExCom card break

GS30A-CM-EIPx IP Address and Network Configuration

Ethernet communication cards must have their own unique IP address. While the card addresses can be set for DHCP (IP address is set and can be changed by the network), we recommend using static IP addresses. That way, the IP address of the drive will stay fixed. Either method requires the IP addresses (and subnet masks) of the communication cards to be compatible with any other devices that want to connect to the drive. For an easy subnet mask calculator, please visit www.subnet-calculator.com.

NOTE: If at any point the communication card configuration becomes problematic, the communication card can always be reset to factory defaults by entering a "1" into P09.90 Com Card Factory Reset.

The following **example** will set the IP addresses of the PC and drive. **Your actual addresses may need to be different, depending on your local network.**

Set the IP address of the GS30 Drive

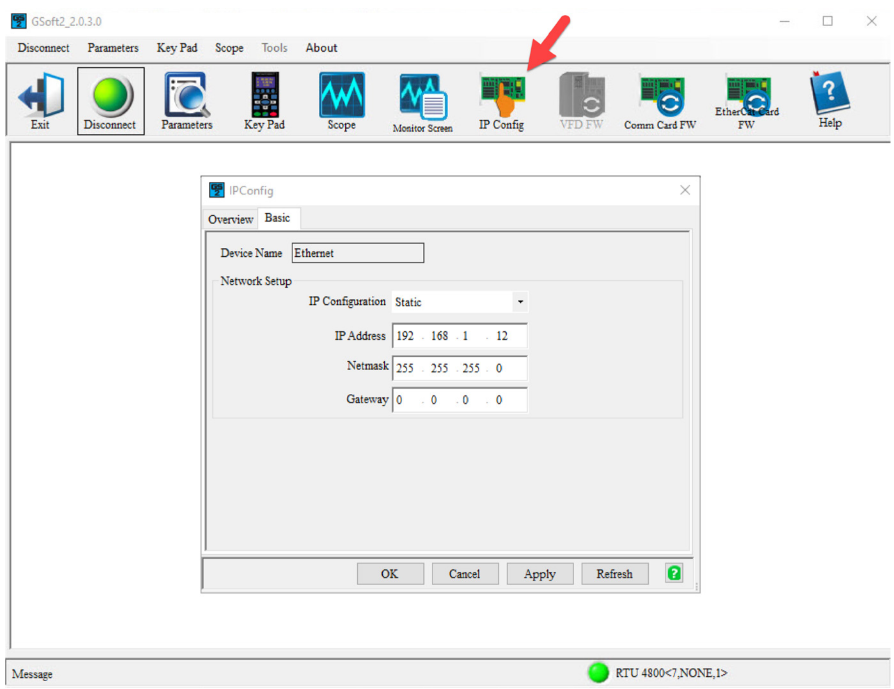
Set the IP address of the drive through GSoft2 software or by the drive keypad.

NOTE: Changing an Ethernet communication parameter in the drive does not immediately affect the communication card; there is a second set of registers in the comm card. Entering a value of 2 in parameter P09.91 causes the drive to push the P09 communication parameters to the card. Bits in P09.91 reset themselves automatically.

GSoft2 method

Connect to the drive thru the Type B serial port. Once connected, the "IP Config button" will become active. Click on it. The Overview tab that pops up shows the current drive configuration. Click on the Basic tab to edit the IP address. Enter the following:

IP Configuration = Static
IP Address = 192.168.1.10
Subnet Mask = 255.255.255.0
Gateway = 0.0.0.0 (or same as IP address 1st three octets; ex: 192.168.1.1)
Press Apply for the changes to take effect. (This effectively sets bit 1 in P09.91)



Keypad method

Enter the following parameter data in the drive keypad:

GS30 IP Configuration		
Parameter	**Set Value**	**Explanation**
P09.75	0	Set the IP to "Static"
P09.76	192	IP address 1
P09.77	168	IP address 2
P09.78	1	IP address 3
P09.79	10	IP address 4
P09.80	255	Subnet Mask 1
P09.81	255	Subnet Mask 2
P09.82	255	Subnet Mask 3
P09.83	0	Subnet Mask 4
P09.84	192	Gateway Address 1
P09.85	168	Gateway Address 2
P09.86	1	Gateway Address 3
P09.87	1	Gateway Address 4

Enter a "2" into P09.91 (sets bit 1 = 1) and press "Enter" to transfer the network parameters to the comm card. P09.91 will save the parameters to the card and will then reset P09.91 to zero.

GS30A-CM-EIPx Common Parameters

When the GS30 drive is connected via Ethernet, please use the communication parameters in the table below to configure the drive. The master will be able to read/write the frequency word and control word for the GS30 drive after the communication parameters are set up.

GS30 Communication Parameters			
Parameter	**Function**	**Set Value (Dec)**	**Explanation**
P00.20	Source of frequency command setting	8	The frequency command is controlled by communication card.
P00.21	Source of operation command setting	5	The operation command is controlled by communication card.
P09.30	Communication decoding method	0	Set decoding method
P09.74	Set Comm Master Protocol	1	Set master
P09.75	IP setting	0	Static IP(0) / Dynamic distribution IP(1)
P09.76	IP address -1	192	IP address 192.168.1.5
P09.77	IP address -2	168	IP address 192.168.1.5
P09.78	IP address -3	1	IP address 192.168.1.5
P09.79	IP address -4	5	IP address 192.168.1.5
P09.80	Netmask -1	255	Netmask 255.255.255.0
P09.81	Netmask -2	255	Netmask 255.255.255.0
P09.82	Netmask -3	255	Netmask 255.255.255.0
P09.83	Netmask -4	0	Netmask 255.255.255.0
P09.84	Default gateway -1	192	Default gateway 192.168.1.1
P09.85	Default gateway -2	168	Default gateway 192.168.1.1
P09.86	Default gateway -3	1	Default gateway 192.168.1.1
P09.87	Default gateway -4	1	Default gateway 192.168.1.1
P09.93	EIP Comm Card Fault Select	3	Set communication timeout settings
P09.94	EIP Comm Card Time Out Detection	1	Set communication timeout settings
P09.95	EIP Comm Card Time Out Duration	3.0	Set communication timeout settings

Communication Card Special Function Parameters	
Parameter	***Explanation***
P09.90	Communication Card Factory Reset, 1 = Reset to factory defaults
P09.91	Communication Card Set, 2 = Write parameters to card

After changing any of the P09.xx communication card parameters, enter a “2” into P09.91 (Bit1 = 1). This will write any parameter changes from the drive into the communication card.

NOTE: The external controller’s RPI must be set greater than 10ms.

Modbus TCP or EtherNet/IP Protocol Selection

The GS30A-CM-EIPx card can communicate via Modbus TCP or EtherNet/IP protocols.

P09.74 defines the master protocol of the communication card and allows the user to define proper actions in the event of communication timeouts.

If P09.74 = 1: EtherNet/IP, in a timeout situation (defined by P09.93 – P09.95), only the EtherNet/IP connection (Implicit OR Explicit) will trigger the timeout, not Modbus TCP. A ‘timeout situation’ is defined by 5 different possibilities:

1) A TCP RST or FIN message from the Master in EtherNet/IP Explicit (no EtherNet/IP Implicit).
2) A Forward Close message in EtherNet/IP Implicit.
3) No data message received in the time duration specified in Pr09-95 on EtherNet/IP Explicit.
4) No data message received in the time duration specified in RPI timeout EtherNet/IP Implicit.
5) Physical connection loss (no link available on Ethernet interface).

If P09.74 = 2: Modbus TCP, in a timeout situation (defined by P09.93 – P09.95), only the Modbus TCP connection will trigger the timeout, not EtherNet/IP Explicit (Implicit won’t be allowed in this case). A ‘timeout situation’ is defined by 3 different possibilities:

1) 1) A TCP RST or FIN message from the Master in Modbus TCP
2) 2) No data message received in the time duration specified in Pr09-95 on Modbus TCP
3) 3) Physical connection loss (no Link Good on Ethernet interface).

If P09.74 = 0: Ethernet/IP and Modbus TCP both on, a loss in either will cause a timeout.

Modbus TCP Protocol Configuration

GS30A-CM-EIPx Control Words – Modbus Addressing

Modbus TCP Protocol Parameter Address Definitions			
Modbus Address		**Definition**	
Decimal	**Hex**		
48193	2000	bit 0~1	00: No function
			01: Stop
			10: Run
			11: Enable JOG
		bit 2~3	reserved
		bit 4~5	00B: No function
			01B: Forward command
			10B: Reverse command
			11B: no function
		bit 6~7	00B: 1st accel. / decel.
			01B: 2nd accel. / decel.
			10B: 3rd accel. / decel.
			11B: 4th accel. / decel.
		bit 8~11	000B: Master speed
			0001B: 1st step speed frequency
			0010B: 2nd step speed frequency
			0011B: 3rd step speed frequency
			0100B: 4th step speed frequency
			0101B: 5th step speed frequency
			0110B: 6th step speed frequency
			0111B: 7th step speed frequency
			1000B: 8th step speed frequency
			1001B: 9th step speed frequency
			1010B: 10th step speed frequency
			1011B: 11th step speed frequency
			1100B: 12th step speed frequency
			1101B: 13th step speed frequency
			1110B: 14th step speed frequency
			1111B: 15th step speed frequency
		bit 12	1: Enable bit 06-11 function. Must =1 to use above bits
		bit 13~14	00B: No function
			01B: No function
			10B: No function
			11B: No function
		bit 15	Reserved
48194	2001*	Frequency Command / PID Setpoint	6000 = 60.00Hz
48195	2002	bit 0	1: E.F. = ON (Trigger an External Fault)
		bit 1	1: Reset command
		bit 2	1: External interruption (B.B) = ON
		bit 3~5	reserved
***Note concerning 2001h: If the Frequency Command (via RS485, Ethernet, Keypad, analog, etc.) is set higher than P01.00 Max Frequency Output, the drive will limit the actual output to P01.00.*			

GS30A-CM-EIPx Status Words – Modbus Addressing

Modbus TCP Protocol Parameter Address Definitions			
Address		**Definition**	
Modbus Decimal	**Modbus Hex**		
Status Monitor 1 – Warning Codes			
48449	2100	bit 0–7	Fault Code*
		bit 8–15	Warning Code*
		* Refer to Chapter 6: Maintenance and Troubleshooting for code definitions.	
Status Monitor 2 – Status of GS30 AC Drive			
48450	2101	bit 0~1	00: Stop
			01: Decel during stop
			10: Standby
			11: Run
		bit 2	1: JOG active
		bit 3~4	00: Forward
			01: Transition from Reverse to Forward
			10: Transition from Forward to Reverse
			11: Reverse
		bit 5~7	reserved
		bit 8	1: Main Frequency comes from Communication Interface
		bit 9	1: Main Frequency comes from Analog/External Terminal signal input
		bit 10	1: The Command is operated by Communication Interface (keypad)
		bit 11	1: Parameters have been Locked
		bit 12	Running Status [0 = Drive Stopped; 1 = Drive Running (including Standby)]
		bit 13~15	reserved
48451	2102	Frequency Command (F) / PID Setpoint	
48452	2103	Output Frequency (H)	
48453	2104	Output Current (A)	
48454	2105	DC Bus Voltage (U)	
48455	2106	Output Voltage (E)	
48456	2107	Multi Speed or PID Inputs current Step Number	
48457	2108	Max Output Torque (N·m)	
48458	2109	Digital Input Counter Value	
48459	210A	Power Factor Angle (cos Θ)	
48460	210B	Output torque (XXX.X%)	
48461	210C	Actual Motor Speed in rpm (Sensorless Estimate or Encoder Feedback actual)	
48462	210D	Encoder (PG1) feedback counts (option card), 16-bit, 0–65,535	
48463	210E	Pulse Command (PG2) pulses per rev (option card)	
48464	210F	Power Output in kW	
48471	2116	Multi-function display P00.04	
48476	211B	Maximum Operation Frequency P01.00 or Maximum User- defined Value P00.26 When P00.26 is 0, this value is equal to P01.00 setting. When P00.26 is not 0, and the command source is keypad, this value = P00.24 * P00.26 / P01.00. When P00.26 is not 0, and the command source is 485, this value = P09.10 * P00.26 / P01.00.	
48480	211F	High byte: the decimal place of current value display	
48705	2200	Display the drive's output current XX.XX. When the current is higher than 655.35, it automatically shifts one decimal place as XXX.X. Refer to the high byte of 211F for information on the decimal places.	
48706	2201	Counter value	
48707	2202	Actual output frequency XXXXX Hz	
48708	2203	DC bus voltage XXX.X V	
48709	2204	Output voltage XXX.X V	
Continued on next page			

Communication Protocol Parameter Address Definitions (continued)		
Address		
Modbus Decimal	Modbus Hex	Definition
48710	2205	Power factor angle XXX.X
48711	2206	Display the output power of U, V, W XXXX.X kW
48712	2207	Actual Motor Speed in rpm (Sensorless Estimate or Encoder Feedback actual)
48713	2208	Display the positive / negative output torque estimated by the drive +0.0: positive torque; -0.0: negative torque XXX.X%
48714	2209	Encoder (PG1) Feedback Pulses per Rev (option card)*
48715	220A	Display the P ID feedback value after enabling ID function XXX.XX%
48716	220B	Display the AI1 analog input terminal signal, 0-10 V corresponds to 0.00-100.00% see Explanation 1 in P00.04
48717	220C	Display the AI2 analog input terminal signal, 4-20 m / 0-10 V corresponds to 0.00-100.00% 2. See Explanation 2 in P00.04,
48718	220D	Reserved
48719	220E	IGBT temperature of the power module XXX.X °C
48720	220F	Reserved
48721	2210	The digital input status ON / OFF , refer to P02.12. See Explanation 2 in P00.04.
48722	2211	The digital output status ON / OFF , refer to P02.18. See Explanation 3 in P00.04.
48723	2212	Current step for the multi-step speed operation
48724	2213	The corresponding PLC digital input pin status. See Explanation 3 in P00.04
48725	2214	The corresponding PLC digital output pin status. See Explanation 4 in P00.04
48726	2215	Encoder (PG1) Position Counts (option card),16-bit, 0–65,535
48727	2216	Pulse Command (PG2) Frequency (option card) XXX.XX Hz
48728	2217	Pulse Command (PG2) Position Counts (option card) 16-bit, 0–65,535
48729	2218	Reserved
48730	2219	Counter value of overload XXX.XX %
48731	221A	GFF XXX.XX %
48732	221B	DC bus voltage ripples XXX.X V
48733	221C	PLC register D1043 data
48734	221D	Magnetic field area of the synchronous motor
48735	221E	User page displays the value in physical measure
48736	221F	Output value of P00.05 XXX.XX Hz
48737	2220	Reserved
48738	2221	Reserved
48739	2222	Reserved
48740	2223	Control mode of the drive, 0: speed mode 1: torque mode
48741	2224	Carrier frequency of the drive XX kHZ
48742	2225	Reserved
*When P10.01 is set to 1000 and P10.02 is set to 1, 2, the displayed range for PG feedback is between 0–4000. When P10.01 is set to 1000 and P10.02 is set to 3, 4, 5, the displayed range for PG feedback is between 0–1000.		
Continued on next page		

Communication Protocol Parameter Address Definitions (continued)			
Address		Definition	
Modbus Decimal	Modbus Hex		
48743	2226	bit 1~0	Drive status
			00b: No direction
			01b: Forward
			10b: Reverse
		bit 3~2	01b: Drive ready
			10b: Error
		bit 4	0b: Drive does not output
			1b: Drive outputs
		bit 5	0b: No warning
			1b: Warning
48744	2227	Drive's estimated output torque positive or negative direction XXXX N•m	
48745	2228	Reserved	
48746	2229	KWH display XXXX.X	
48747	222A	Encoder (PG1) Position Counts 32-bit register, Low Word (option card) ,16-bit, 0–65,535	
48748	222B	Encoder (PG1) Position Counts 32-bit register, High Word (option card),16-bit, 0–65,535	
48749	222C	Reserved	
48750	222D	Reserved	
48751	222E	PID target value XXX.XX %	
48752	222F	PID offset XXX.XX %	
48753	2230	PID output frequency XXX.XX Hz	
48754	2231	Reserved	
48755	2232	Display the auxiliary frequency	
48756	2233	Display the master frequency	
48757	2234	Display the frequency after adding and subtracting of the master and auxiliary frequencies.	

Modbus TCP Communication

GS30A-CM-EIPx Modbus Function Codes	
Code	**Definition**
0x03	Read register(s) from GS30
0x06	Write single register to GS30
0x10	Write multiple data registers to GS30

EtherNet/IP Protocol

GS30A-CM-EIPx EtherNet/IP I/O Messaging (Implicit Messaging)

- *Trigger type: Cyclic*
- *Transport class: 1*
- *Application connection type: Exclusive owner*

Parameter	O→T		T→O	
Data size		Fixed		Fixed
Connection type	Point-to-Point		Mulitcast, Point to Point	

GS30A-CM-EIPx EtherNet/IP Communication Parameter

- *Input buffer register: In Assembly Instance = 101, Data Type = 16 bits, Size = 16*
- *Output buffer register: Out Assembly Instance = 100, Data Type = 16 bits, Size = 3*
- *Configuration: Instance = 102, Data Type = 8 bits, Size = 0*

GS30A-CM-EIPx EtherNet/IP CIP Command Status Code

Status Code	Status	Definition
0x00	**Success**	Requested service is successfully executed.
0x01	**Connection failure**	Connected service fails.
0x04	**Path segment error**	Node in the program cannot identify the definition or syntax of a path segment. When this error takes place, the execution of program will be terminated.
0x05	**Path destination unknown**	The path is related to object type, but the node in the program does not cover or cannot identify the type or structure of the object. When this error takes place, the execution of program will be terminated.
0x08	**Service not supported**	The object does not support required service or has not yet defined the service.
0x0E	**Attribute not settable**	Receives request to modify unchangeable attribute
0x13	**Not enough data**	Receives insufficient data and therefore cannot execute command
0x14	**Attribute not supported**	Does not support requested attribute
0x 5	**Too much data**	The received data exceeds what the command execution requires.
0x20	**Invalid parameter**	The requested parameter is invalid, indicating that the parameter does not fit the definition of the requirement, or the requirement has been defined in "Application Object Specification".
0x26	**Path size invalid**	The size of the path transmitting requested service cannot afford the request to the object or cover too much route data.

GS30A-CM-EIPx EtherNet/IP Error Code for Monitor Request

Status Code	Extended Status Code	Definition
0x00	–	The execution of service is successful.
0x01	0x0100	The connection is in progress or the connection is re-opened. The code will be sent back when the source is trying to establish a connection to the target but the target has already been connected.
0x01	0x0103	Does not support the combination of this transmission type and trigger. The target does not support the defined combination of transmission type and trigger. The router will not teminate the connection, only the target end has to send back this extended status code.
0x01	0x0106	Clash of control right A connection takes the control, blocking the establishment of other connections. When this device occupies the connection in this way, only one connection will be allowed to control this device.
0x01	0x0107	Cannot find the corresponding target to connect
0x01	0x0108	Invalid network connection parameter When the application program in the target does not support the defined connection type, connection level, or there are too many users, the extended status code will be sent back. Only the node on target has to send back the extended status code.
0x01	0x0109	Invalid setting of the size of the on-line data exchange zone This device does not support the setting of the current data exchange zone. The setting can be too big or too small.
0x01	0x0111	RPI setting not supported
0x01	0x0112	RPI Value(s) Not Acceptable. Module requires an RPI of 10ms or greater.
0x01	0x0113	The number of connections exceeds the maximum. No further connections are able to connect to this device.
0x01	0x0114	The company ID does not match product code. The product code or company ID marked in the electronic key logic section does not match the record in the target device.
0x01	0x0115	Inconsistent product type The product type marked in the electronic key logic section does not match the record in the target device.
0x01	0x0116	Inconsistent version The primary and secondary revised versions marked in the electronic key logic section do not match the record in the target device.
0x01	0x0315	Invalid section exists in the path. The type or value of a section in the path is invalid. When the device cannot interpret the path, it will respond with this extended status code. Cause of this error: Unidentifiable path type, unexpected section type or other problems existing in the path.

GS30A-CM-EIPx EtherNet/IP Communication Protocol Parameter Address Definitions

EtherNet/IP Communication Protocol Parameter Address Definitions				
Class Code (Parameter Content)	**Instance**	**Address**	**Definition**	
Class 4 (Commands to GS30)	Instance 100 (0x64)	0	bit 0~1	00: no function
				01: Stop
				10: Run
				11: Enable JOG
			bit 2~3	reserved
			bit 4~5	00: no function
				01: Forward command
				10: Reverse command
				11: no function
			bit 6~7	00B: 1st accel. / decel.
				01B: 2nd accel. / decel.
				10B: 3rd accel. / decel.
				11B: 4th accel. / decel.
			bit 8~11	0000B: Master speed
				0001B: 1st step speed frequency
				0010B: 2nd step speed frequency
				0011B: 3rd step speed frequency
				0100B: 4th step speed frequency
				0101B: 5th step speed frequency
				0110B: 6th step speed frequency
				0111B: 7th step speed frequency
				1000B: 8th step speed frequency
				1001B: 9th step speed frequency
				1010B: 10th step speed frequency
				1011B: 11th step speed frequency
				1100B: 12th step speed frequency
				1101B: 13th step speed frequency
				1110B: 14th step speed frequency
				1111B: 15th step speed frequency
			bit 12	1: Enable bit 06-11 function. Must =1 to use above bits
			bit 13~14	00B: No function
				01B: No function
				10B: No function
				11B: No function
			bit 15	Reserved
		1	Frequency command (6000 = 60.00Hz)	
		2	bit 0	1: E.F. = ON (trigger an External Fault)
			bit 1	1: Reset command
			bit 2	1: External interruption (B.B) = ON
			bit 3~15	reserved

Continued on next page

Communication Protocol Parameter Address Definitions (continued)				
Class Code (Parameter Content)	**Instance**	**Address**	**Definition**	
Class 4 (Monitor GS30 status)	Instance 101 (0x65)	0	bit 0–7	Fault Code*
			bit 8–15	Warning Code*
			*Refer to Chatper 6: Maintenance and Troubleshooting for code definitions.	
		1	bit 0~1	00: Stop
				01: Decel during Stop
				10: Standby
				11: Run
			bit 2	1: JOG active
			bit 3~4	00: Forward
				01: Transition from Reverse to Forward
				10: Transition from Forward to Reverse
				11: Reverse
			bit 5~7	reserved
			bit 8	1: Main frequency comes from communication interface
			bit 9	1: Main frequency comes from analog/external terminal signal input
			bit 10	1: The command is operated by communication interface (keypad)
			bit 11	1: Parameters have been locked
			bit 12	Running status 0: Drive stopped 1: Drive running (including standby)
			bit 13~15	reserved
		2	Frequency command (F) / PID Setpoint (6000 = 60.00Hz)	
		3	Output frequency (H) (6000 = 60.00Hz)	
		4	Output current (A)	
		5	DC bus voltage (U)	
		6	Output voltage (E)	
		7	Multi-speed or PID Inputs current Step Number	
		8	Max Output Torque (N·m)	
		9	Digital Input counter value	
		10	Power Factor angle (cosθ)	
		11	Output torque (XXX.X%)	
		12	Actual Motor Speed in rpm (Sensorless Estimate or Encoder Feedback actual)	
		13	Encoder (PG1) Feedback Counts (option card), 16-bit, 0–65,535	
		14	Pulse Command (PG2) Position Counts (option card), 16-bit, 0–65,535	
		15	Power Output (kW)	

EtherNet/IP Communication Protocol Parameter Address Definitions – Class 300			
Class Code (Parameter Content)	***Instance***	***Attribute***	***Definition***
Explicit Class 0x300 (Montior GS30 Status)	Instance 33 (0x21)	0x16	Multi-function display P00.04
		0x1B	Maximum Operation Frequency P01.00 or Maximum User-defined Value P00.26 When P00.26 is 0, this value is equal to P01.00 setting. When P00.26 is not 0, and the command source is keypad, this value = P00.24 * P00.26 / P01.00. When P00.26 is not 0, and the command source is 485, this value = P09.10 * P00.26 / P01.00.
		0x1F	High byte: the decimal place of current value display
	Instance 34 (0x22)	0x00	Display the drive's output current XX.XX. When the current is higher than 655.35, it automatically shifts one decimal place as XXX.X. Refer to the high byte of 211F for information on the decimal places.
		0x01	Counter value
		0x02	Actual output frequency XXXXX Hz
		0x03	DC bus voltage XXX.X V
		0x04	Output voltage XXX.X V
		0x05	Power factor angle XXX.X
		0x06	Display the output power of U, V, W XXXX.X kW
		0x07	Display the motor speed estimated by the drive or encoder feedback XXXXX rpm
		0x08	Display the positive / negative output torque estimated by the drive +0.0: positive torque; -0.0: negative torque XXX.X%
		0x09	Reserved
		0x0A	Display the P ID feedback value after enabling ID function XXX.XX%
		0x0B	Display the AI1 analog input terminal signal, 0-10 V corresponds to 0.00-100.00% see Explanation 1 in P00.04
		0x0C	Display the AI2 analog input terminal signal, 4-20 m / 0-10 V corresponds to 0.00-100.00%. See Explanation 2 in P00.04.
		0x0D	Reserved
		0x0E	IGBT temperature of the power module XXX.X °C
		0x0F	Reserved
		0x10	The digital input status ON / OFF , refer to P02.12. See Explanation 2 in P00.04
		0x11	The digital output status ON / OFF , refer to P02.18. See Explanation 3 in P00.04.
		0x12	Current step for the multi-step speed operation
		0x13	The corresponding PLC digital input pin status. See Explanation 3 in P00.04.
		0x14	The corresponding PLC digital output pin status. See Explanation 4 in P00.04.
		0x15	Reserved
		0x16	Pulse input frequency XXX.XX Hz
		0x17	Reserved
		0x18	Reserved
		0x19	Counter value of overload XXX.XX %
		0x1A	GFF XXX.XX %
		0x1B	DC bus voltage ripples XXX.X V
		0x1C	PLC register D1043 data
		0x1D	Magnetic field area of the synchronous motor
		0x1E	User page displays the value in physical measure
		0x1F	Output value of P00.05 XXX.XX Hz
		0x20	Reserved
		0x21	Reserved
		0x22	Reserved
		0x23	Control mode of the drive, 0: speed mode 1: torque mode
		0x24	Carrier frequency of the drive XX kHZ
		0x25	Reserved

Continued on next page

EtherNet/IP Communication Protocol Parameter Address Definitions – Class 300 (continued)				
Class Code (Parameter Content)	***Instance***	***Attribute***	***Definition***	
Explicit Class 0x300 (Montior GS30 Status)	Instance 34 (0x22)	0x26		Drive status
			bit 1~0	00b: No direction
				01b: Forward
				10b: Reverse
			bit 3~2	01b: Drive ready
				10b: Error
			bit 4	0b: Drive does not output
				1b: Drive outputs
			bit 5	0b: No warning
				1b: Warning
		0x27	Drive's estimated output torque positive or negative direction XXXX N•m	
		0x28	Reserved	
		0x29	KWH display XXXX.X	
		0x2A	Reserved	
		0x2B	Reserved	
		0x2C	Reserved	
		0x2D	Reserved	
		0x2E	PID target value XXX.XX %	
		0x2F	PID offset XXX.XX %	
		0x30	PID output frequency XXX.XX Hz	
		0x31	Reserved	
		0x32	Display the auxiliary frequency	
		0x33	Display the master frequency	
		0x34	Display the frequency after adding and subtracting of the master and auxiliary frequencies.	

GS30A-CM-EIPx Explicit Messaging

EtherNet/IP Services and Objects

EtherNet/IP Objects Supported		
Object	**Class Code**	**Definition**
Identity Object	0x01	For device identity
Message Router Object	0x02	For message route
Assembly Object	0x04	For assembly
Connection Manager Object	0x06	For connection management
TCP/IP Interface Object	0xF5	For TCP/IP interface
Ethernet Link Object	0xF6	For Ethernet connection
BR Object	0x64	For basic control registers
AL Object	0x65	For alarm registers
AC Drive (VFD) Data Object	0x300	For any VFD parameter

EtherNet/IP Data Formats Supported	
Data Format	**Explanation**
BYTE	8-bit string
WORD	16-bit string
DWORD	32-bit string
STRING[n]	String composed of n bytes
SHORT_STRING	String combined from bytes (1 byte length indicator, 1 byte characters)
USINT	8-bit unsigned integer
UINT	16-bit unsigned integer
UDINT	32-bit unsigned integer

Identity Object (Class Code: 0x01)

Instance Code: 0x01

Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description of Attribute
0x01	Get	Vendor ID	UINT	660
0x02	Get	Device Type	UINT	Communications Adapter 12
0x03	Get	Product Code	UINT	Model code: 0x0104
0x04	Get	Revision	STRUCT of: USINT, USINT	Firmware version Major revision Minor revision
0x05	Get	Status	WORD	Summary status of devices.
0x06	Get	Serial Number	UDINT	32-bit serial number of device
0x07	Get	Product Name	SHORT_STRING	GS30A-CM-EIP1/EIP2

Common Services

Service Code	Implemented for		Service Name	Description of Service
	Class	Instance		
0x05		✓	Reset	Resets device settings
0x0E		✓	Get Single Attribute	Sends back attribute of designated object

Message Router Object (Class Code: 0x02)

Instance Code: 0x01

Instance Attributes: None

Common Services

Service Code	Implemented for		Service Name	Description of service
	Class	Instance		
0x0E		✓	Get Single Attribute	Sends back attribute of designated object

Assembly Object (Class Code: 0x04)

Instance Code

Instance	Description
0x64	Corresponds to output buffer register
0x65	Corresponds to input buffer register
0x66	Corresponds to setup object

Instance Attributes

Attribute ID	Access Rule	Name	Data type	Description of attribute
0x03	Get / Set	Data	ARRAY of BYTE	Instance Code = 0x64 (Get/Set) Others Get only

Common Services

Service Code	Implemented for		Service Name	Description of service
	Class	Instance		
0x0E		✓	Get Single Attribute	Sends back attribute of designated object
0x10		✓	Set Single Attribute	Modifies attribute

Connection Manager Object (Class Code: 0x06)

Instance Code: 0x01

Instance Attributes: None

Services

Service Code	Implemented for		Service Name	Description of service
	Class	Instance		
0x4E		✓	Forward Close	Shuts down the connection
0x54		✓	Forward Open	Establishes the connection, max. 511 bytes per transmission.

TCP/IP Interface Object (Class Code: 0xF5)

Instance Code: 0x01

Instance Attributes

Attribute ID	Access Rule	Name	Data type	Description of attribute
0x01	Get	Status	DWORD	Interface status
0x02	Get	Configuration Capability	DWORD	Interface capability flags
0x03	Get / Set	Configuration Control	DWORD	Interface control flags
0x04	Get	Path Size, Path	STRUCT of: UINT, Padded EPATH	Path size Path
0x05	Get / Set	Interface Configuration	STRUCT of: UDINT, UDINT, UDINT, UDINT, UDINT, STRING	IP Address Network Mask Gateway Address Name Server Name Server 2 Domain Name
0x06	Get / Set	Host Name	STRING	Host name

Status Instance Attribute

Bits	Name	Description
0~3	Interface Configuration Status	0 = The Interface Configuration attribute has not been configured. 1 = The Interface Configuration attribute contains valid configuration obtained from BOOTP, DHCP or non-volatile storage. 2 = The IP address member of the Interface Configuration attribute contains valid configuration, obtained from hardware settings (e.g.: pushwheel, thumbwheel, etc.) 3-15 = reserved for future use.

Configuration Capability Attribute

Bits	Name	Description
2	DHCP Client	1 (TRUE) shall indicate the device is capable of obtaining its network configuration via DHCP.
4	Configuration Settable	1 (TRUE) shall indicate the Interface Configuration attribute is settable.

Configuration Control Attribute

Bits	Name	Description
0~3	Startup Configuration	0 = The device shall use the interface configuration values previously stored in non-volatile memory. 1 = The device shall obtain its interface configuration values via BOOTP. 2 = The device shall obtain its interface configuration values via DHCP upon start-up. 3-15 = reserved for future use.

Common Services

Service Code	Implemented for Class	Implemented for Instance	Service Name	Description of service
0x0E		✓	Get Single Attribute	Sends back attribute of designated object
0x10		✓	Set Single Attribute	Modifies attribute

Ethernet Link Object (Class Code: 0xF6)

Instance Code: 0x01

Instance Attributes

Attribute ID	Access Rule	Name	Data type	Description of attribute
0x01	Get	Interface Speed	UDINT	Interface speed currently in use Speed in Mbps (e.g., 0, 10, 100, 1000, etc.)
0x02	Get	Interface Flags	DWORD	Interface status flags
0x03	Get	Physical Address	USINT[6]	MAC address

Interface Flags

Bits	Name	Description
0	Link Status	0 indicates an inactive link; 1 indicates an active link.
1	Half/Full Duplex	0 indicates the interface is running half duplex; 1 indicates full duplex.
2-4	Negotiation Status	Indicates the status of link auto-negotiation 0 = Auto-negotiation in progress. 1 = Auto-negotiation and speed detection failed. Using default values for speed and duplex. defaults are 10Mbps and half duplex. 2 = Auto negotiation failed but detected speed. default is half duplex. 3 = Successfully negotiated speed and duplex. 4 = Auto-negotiation not attempted. Forced speed and duplex.

Services

Service Code	Implemented for		Service Name	Description of service
	Class	Instance		
0x0E		✓	Get Single Attribute	Sends back attribute of designated object

GS30A-CM-EIPx EtherNet/IP Basic Registers

GS30A-CM-EIPx Basic Registers			
BR#	**Read / Write**	**Content**	**Explanation**
#0	R	Model name	Set up by the system; read only. The model code of GS30A-CM-EIPx=0204H
#1	R	Firmware version	Displaying the current firmware version in hex, e.g. 0100H indicates the firmware version V1.00.
#2	R	Release date of the version	Displaying the data in decimal form. 10,000s digit and 1,000s digit are for "month"; 100s digit and 10s digit are for "day". For 1 digit: 0 = morning; 1 = afternoon.
#6	R	GS30 Drive station number	1 – 254
#11	R/W	Modbus Timeout	Pre-defined setting: 50 (ms)
#13	R/W	Keep Alive Time	Pre-defined setting: 30 (s)

BR#0 - Model Name: Model code for GS30A-CM-EIPx is 0x0104. Read the model code to confirm connection with GS30A-CM-EIPx.

BR#1 - Firmware Version: The firmware version of GS30A-CM-EIPx displayed in hexadecimal. Example: 0100h indicates version V1.00.

BR#2 - Release Date of the Version: The date is displayed in decimal form. 10,000s digit and 1,000s digit are for "month;" 100s digit and 10 digit are for "day." For 1s digit: 0 = morning; 1 = afternoon.10
Example: 12191 indicates that the version was released the afternoon of December 19.

BR#6 - GS30 Drive Station Number: Station number of the GS30 series drive. Range 1~254.

BR#11 - Modbus Communication Timeout: Sets the communication timeout (ms) for Modbus TCP.

BR#13 - Modbus TCP Keep Alive Time: Range 5~65,535 seconds. If the connection idle time exceeds the keep alive time, GS30A-CM-EIPx will cut the idling connection.

BR Object (Class Code: 0x64)

Instance Code

Instance	Description
0x01	Corresponds to BR0: Model name
0x02	Corresponds to BR1: Firmware version
0x03	Corresponds to BR2: Release date of the version
0x07	Corresponds to BR6: GS30 station No.
0x0C	Corresponds to BR11: MODBUS communication timeout
0x0E	Corresponds to BR13: Network keep alive time (TCP/IP)

Instance Attributes

Attribute ID	Access Rule	Name	Data type	Description of attribute
0x03	Get / Set	Data	UINT	Refer to 4.2 for corresponding value Instance Code = 0x0E Get/Set Others Get Only

Common Services

Service Code	Implemented for		Service Name	Description of service
	Class	Instance		
0x0E		✓	Get Single Attribute	Sends back attribute of designated object
0x10		✓	Set Single Attribute	Modifies attribute

GS30A-CM-EIPx EtherNet/IP Alarm Register

<table>
<tr><th colspan="5">GS30A-CM-EIPx EtherNet/IP Alarm Register
(Alarm Modbus Address Base – 0x0200, 40513)</th></tr>
<tr><th>AL#</th><th>Bit in each AL</th><th>Read / Write</th><th>Function</th><th>Explanation</th></tr>
<tr><td rowspan="5">#0~#15</td><td>bit 15</td><td>R</td><td>Function enabling flag</td><td>bit 15 = 1 → Function enabled
bit 15 = 0 → Function disabled</td></tr>
<tr><td>bit 4~bit 14</td><td>R</td><td colspan="2">reserved</td></tr>
<tr><td>bit 2~bit 3</td><td>R</td><td>Type of triggered event</td><td><table><tr><th></th><th>bit 3</th><th>bit 2</th></tr><tr><td>reserved</td><td>0</td><td>0</td></tr><tr><td>reserved</td><td>0</td><td>1</td></tr><tr><td>reserved</td><td>1</td><td>0</td></tr><tr><td>reserved</td><td>1</td><td>1</td></tr></table></td></tr>
<tr><td>bit 1</td><td>R</td><td>Status of trigger</td><td>bit 1 = 1 → Not yet triggered
bit 1 = 0 → Already triggered</td></tr>
<tr><td>bit 0</td><td>R</td><td>Type of trigger</td><td>bit 0 = 1 → Triggered by software
bit 0 = 0 → Triggered by hardware</td></tr>
</table>

AL Object (Class Code: 0x65)

Instance Code

Instance	Description
0x01~0x10	Corresponds to AL0~AL15: Alarm register

Instance Attributes

Attribute ID	Access Rule	Name	Data type	Description of attribute
0x03	Get	Data	UINT	Refer to 4.3 for corresponding value

Common Services

Service Code	Implemented for		Service Name	Description of service
	Class	Instance		
0x0E		✓	Get Single Attribute	Sends back attribute of designated object

AC Drive (VFD) Data Object (Class Code: 0x300)

Class Attributes & Instance Attributes

- *Object Class = 0x300*
- *Instance = Parameter Group*
- *Attribute = Parameter Member*

Instance & Attributes					
Instance	Attributes	Access Rule	Name	Data Type	Description of Attribute
0x20	0x00~0x02	Get / Set	VFD Command	UINT	VFD Command Data
0x21	0x00~0x1F	Get	VFD Status	UINT	VFD Status Data
0x22	0x00~0x34	Get	VFD Status	UINT	VFD Status Data

Services

Instance & Attributes				
Service Code	Implemented for		Service Name	Description of Service
	Class	Instance		
0x0E	✓	✓	Get_Attribute_Single	Returns the attributes of a designated element
0x10	✓	✓	Set_Attribute_Single	Gets the attributes of a designated element

EtherNet/IP Communication Card Register Settings

The EtherNet/IP interface of the GS30 AC Drive supports the drive's various modes of control. The communication protocol provides support for two packet types for data exchange:

- *Explicit Message*
- *Implicit Message*

Explicit Message-based Data Exchange:

The host controller directly assigns values to the GS30 Drive. Therefore it is necessary for the EIP communication card to allocate a corresponding address for the Object Class.

Currently, the address of the Object Class occupied by the GS30 Drive is 0x300.

The regular correspondence between parameter addresses and explicit messages is as follows:

EIP Communication Data Format

Object Class	+	*Instance*	+	*Attribute*
0x300	+	Parameter Group #	+	Parameter Member #

For example:

If we wish to write a command for parameter P01.01 (to set Acceleration Time 1), proceed as follows:

Explicit Message Format to Write to P1.01

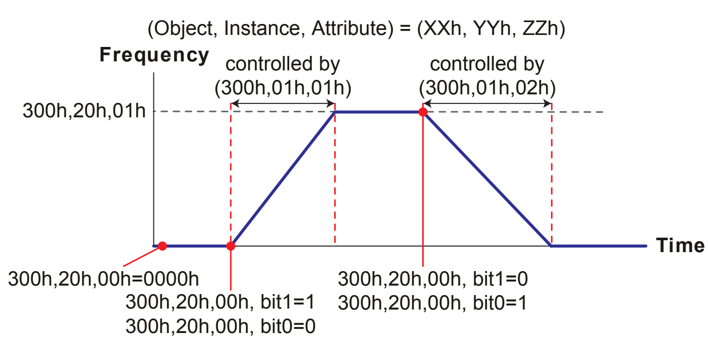
	Object Class	+	*Instance*	+	*Attribute*
=	0x300	+	Parameter Group #	+	Parameter Member #
=	0x300	+	1 [0x01]	+	1 [0x01]
=	0x300	+	0x01	+	0x01

Using Speed Mode as a Control Method

1) Setting the Target Frequency:
Set (Object, Instance, Attribute) = (300h, 20h, 01h);
Unit = Hz, with a decimal precision at the hundredths position;
Example: 1000 represents 10.00.

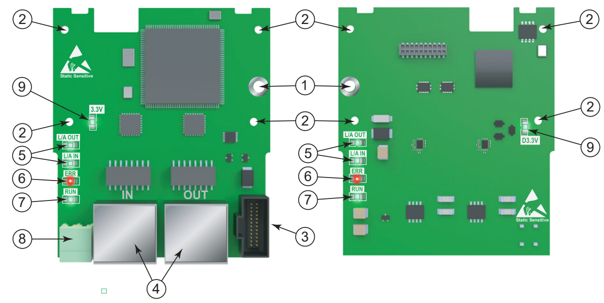
2) Operation:
Setting (Object, Instance, Attribute) = (300h, 20h, 00h) = 0002h indicates Run;
Setting (Object, Instance, Attribute) = (300h, 20h, 00h) = 0001h indicates Stop.

3) Acceleration/Deceleration time Operations:
If the first accel/decel section is used as the basis,
the accel time is set to (Object, Instance, Attribute) = (300h, 01h, 01h),
and the decel time is set to (Object, Instance, Attribute) = (300h, 01h, 02h),
with unit = seconds and a decimal precision at the tenths position.
Example: 100 represent 10.0 seconds.



GS30A-CM-ECAT

The GS30A-CM-ECAT option module uses an EtherCAT based industrial ethernet network with the CoE (CANOpen over EtherCAT) protocol. The GS30A-CM-ECAT comes equipped with two RJ45 Ethernet ports. It should be installed in Position 2 using the included mounting kit.



GS30A-CM-ECAT

GS30A-CM-ECAT Overview			
Drawing Item	***Description***	***Wiring Info***	***Screw Torque***
1	Screw fixing hole	Wire gauge: 0.25–0.5 mm² [24–20 AWG] Stripping length: 7–8 mm	Screw torque: 2 kg-cm / [1.7 lb-in.] / [0.2 N•m]
2	Positioning hole		
3	AC drive connection port		
4	Communication ports		
5	Indicator lights: L/A OUT, L/A IN		
6	Error indicator		
7	Run indicator		
8	Ground terminal block		
9	Power indicator		

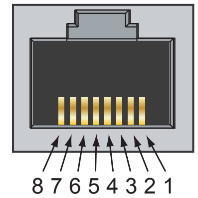
Features

- *Supports speed mode*
- *Supports standard CANopen CiA 402 decoding (CoE)*
- *Supports reading and writing parameters*
- *Supports stop during disconnection*

Specifications

GS30A-CM-ECAT Specifications	
Network Interface	
Interface	RJ45
Number of ports	2 ports
Transmission method	IEEE 802.3, IEEE 802.3u
Transmission cable	Category 5e shielding 100MHz
Transmission speed	100 Mbp
Electrical	
Power supply voltage	15VDC (supplied by the AC drive)
Insulation voltage	500VDC
Power consumption	0.8W
Physical	
Weight	27g
Environment	
Noise immunity	ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Test (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)
Operation / storage	Operation: -10°C~50°C [14°F~122°F] (temperature), 90% (humidity) Storage: -25°C~70°C [-13°F~158°F] (temperature), 95% (humidity)
Vibration / shock immunity	International standard: IEC 61800-5-1, IEC 60068-2-6/IEC 61800-5-1, IEC 60068-2-27

PIN Description for GS30A-CM-ECAT					
PIN	**Signal**	**Description**	**PIN**	**Signal**	**Description**
1	TX+	Transmit Data +	**5**	–	N/C
2	TX–	Transmit Data –	**6**	RX –	Receive Data –
3	RX+	Receive Data +	**7**	–	N/C
4	–	N/C	**8**	–	N/C



Common Parameters

When the GS30 drive is connected via EtherCAT, please use the communication parameters in the table below to configure the drive. The master will be able to read/write the frequency word and control word for the GS30 drive after the communication parameters are set up.

GS30 Communication Parameters			
Parameter	**Function**	**Set Value (Dec)**	**Explanation**
P09.00	COM1 communication address	-	Use to set the EtherCAT node address.
P00.20	Source of frequency command setting	8	The frequency command is controlled by communication card.
P00.21	Source of operation command setting	5	The operation command is controlled by communication card.
P09.30	Communication decoding method	1	Set decoding method. EtherCAT only supports decoding method 2 (60xx).
P09.60	Comm card identification	6	When the drive connects with GS30-CM-ECAT the value displayed is 6 (EtherCAT Slave).

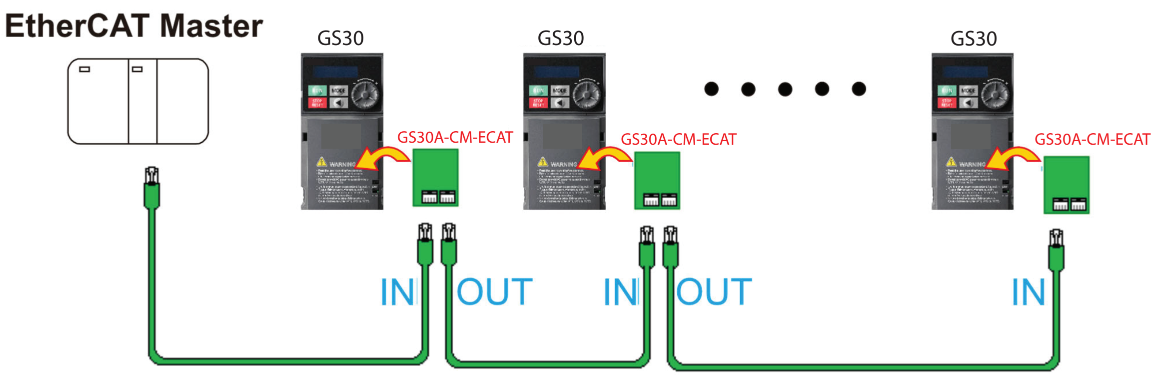
LED Indicators and Troubleshooting

There are four LED indicators on the GS30A-CM-ECAT card. The POWER LED displays the status of the power supply, and the LINK LED displays the communication status with the network. If any of these conditions exist and the cause cannot be determined, power down the drive, remove the comm card and reinstall it. Re-seating the card may eliminate certain problems.

GS30A-CM-ECAT LED Indicators			
LED	**Status**		**Indication**
RUN	Green	ON	Normal operation
		Flashes	Pre-operation (the light stays ON for 200ms and then goes OFF for 200s, alternating)
		OFF	No power supply
ERROR	Red	Flashes	Basic configuration error (the light stays ON for 200ms and then goes OFF for 200ms, alternating)
			Status switching error (the light stays ON for 200ms then goes OFF for 1000ms, alternating)
			Time out (the light statys ON for 200ms twice, then goes OFF for 200ms, alternating)
		OFF	No errors
LINK-IN	Green	ON	Network connection normal
		Flashes	Network in operation
		OFF	No network connection
LINK-OUT	Green	ON	Network connection normal
		Flashes	Network in operation
		OFF	No network connection

EtherCAT Connection Setup

Packet delivery when using EtherCAT communications is directional, so careful setup of cable connections is important. When front-mounting the communication card, the delivery direction for GS30A-CM-ECAT is from left (IN) to right (OUT). Each port is labeled on the circuit board as "IN" or "OUT". The diagram below shows the correct wiring for front-mounting GS30A-CM-ECAT.



After assembling the hardware, supply power to the drive. P09.60 should now display "EtherCAT" with a value of 6. If not, make sure your GS30 drive has firmware version 1.02 or later and that the communication card is correctly connected.

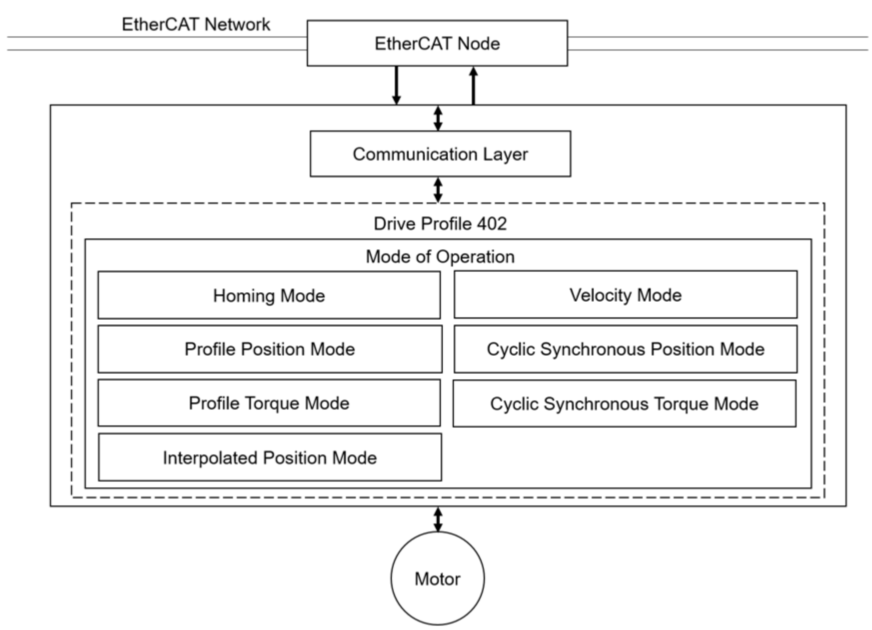
Introduction to EtherCAT

Protocol

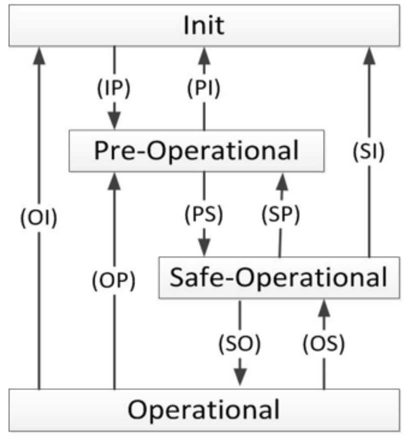
EtherCAT (Ethernet for Control Automation Technology) was created by the German company Beckhoff based on the Ethernet communication protocol which is applicable on the industrial automation and industrial open, real-time, on-site fieldbus technology. The EtherCAT Technology Group (ETG) currently supports and promotes future development of this technology.

The Ethernet structure of a drive is shown in the image below.

1) Communication layer: This protocol covers communication objects such as PDO, SDO, Sync and Emergency Objects. It also covers related communication object dictionary.
2) DS402 is the motion control layer (Drives and motion control device profile) It defines the action of different motions and the parameter setting of the objects when



EtherCAT State Machine



State Description

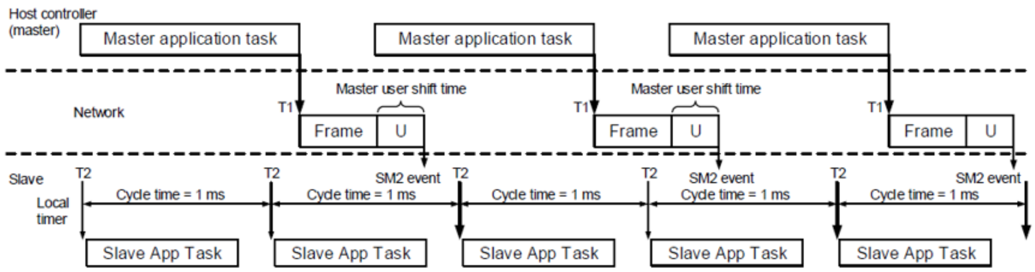
State Descriptions	
State	***Description***
Init	The drive successfully finishes initializing after power-on, and no error occurs. There are no communications for the application layer.
Pre-Operational	Can use mailbox communication for the current status.
Safe-Operational	Can read PDO input data (TxPDO). Cannot receive PDO output data (RxPDO)
Operational	Executes cyclic I/O communications. Can process PDO output data (RxPDO).
State Switch Command	***Description***
IP	Starts mailbox communication.
PI	Interrupts mailbox communication.
PS	Starts updating input data (TxPDO).
SP	Stops updating input data (TxPDO).
SO	Starts updating output data (RxPDO)
OS	Stops updating output data (RxPDO)
OP	Stops updating input/output data.
SI	Stops updating input data and mailbox communication.
OI	Stops all input/output data update and mailbox communication.

System Setup

Free Run Mode (Asynchronous)

The GS30 drive currently only supports Free Run mode (Asynchronous) operation.

In Free Run mode the master and slave stations run asynchronously. Each station has an individual clock that calculates the time. In other words, the clocks of the master and slave are not synchronized. The command and feedback transmissions between the master and slave are based on a sequential order instead of a precise time synchronization. For example, the master sends a PDO at time T1, and the slave receives the PDO at T2 after the SM2 event.



PDO mapping configuration

The following tables show the default PDO mapping configuration of the EtherCAT drive for data exchange. This is also defined in the XML file of the EtherCAT slave. You can modify the PDO mapping configuration according to the requirements.

RxPDO Mapping

First group of RxPDO mapping in VL Mode.

RxPDO (0x1600)	Controlword (0x6040)	vl target velocity (0x6042)	Mode of Operation (0x6060)
	Max Torque (0x6072)	Max Motor Speed (0x6080)	

TxPDO Mapping

First group of TxPDO mapping.

TxPDO (0x1A00)	Statusword (0x6041)	Mode of Operation Display (0x6061)	Position Actual Value (0x6064)
	Velocity Actual Value (0x606C)	Torque Actual Value (0x6077)	Error Code (0x603F)

Set PDO Mapping

The settings are as follows:

1) Disable the PDO configuration: set OD 1C12 sub 0 to 0 (RxPDO) and OD 1C13 sub 0 to 0 (TxPDO).
2) Disable the PDO mapping setting: set OD 1600 sub 0 to 0 (RxPDO) and OD 1A01 sub 0 to 0 (TxPDO).
3) Set the contents and number of RxPDO mappings: set OD 1600 to 1603 sub 1 to sub 8 (RxPDO) for the content and set OD 1600 to 1603 sub 0 (RxPDO) for the number of RxPDO mappings.
   Take the OD 1601 as an example:

Mapping parameter setting for RxPDO	*Data*	*Description*
OD 1601 sub1	6040h	Controlword, 16-bit
OD 1601 sub2	6060h	Modes of operation, 8-bit
OD 1601 sub3	6072h	Max torque, 32-bit
OD 1601 sub4	607Ah	Target torque, 32-bit
OD 1601 sub5	6080h	Max motor speed, 32-bit
OD 1601 sub0	5	Set 5 fort the number of RxPDO mappings

4) Set the contents and number of TxPDO mappings: set OD 1A00 to1A03 sub 1 to sub 8 (TxPDO) for the content and set OD 1A00 to 1A03 sub 0 (TxPDO) for the number of TxPDO mappings. Take the OD 1A00 below as an example:

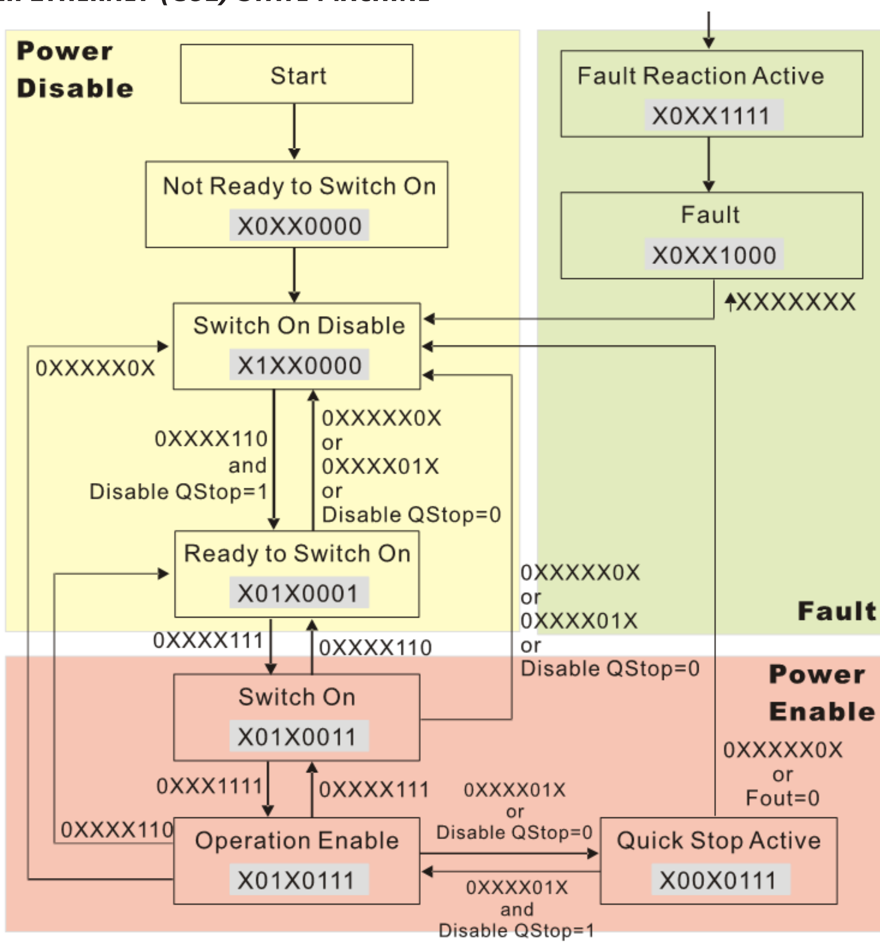
Mapping parameter setting for TxPDO	*Data*	*Description*
OD 1A00 sub1	6041h	Statusword, 16-bit
OD 1A00 sub2	6061h	Modes of operation display, 8-bit
OD 1A00 sub3	6064h	Position actual value, 32-bit
OD 1A00 sub4	606Ch	Velocity actual value, 32-bit
OD 1A00 sub5	6077h	Max motor speed, 32-bit
OD 1A00 sub6	603Fh	Error code, 16-bit
OD 1A00 sub0	6	Set 6 for the number of RxPDO mappings.

5) Set the PDO mapping configuration: set OD 1C12 sub 1 to 0x1601 (RxPDO) and OD 1C13 sub 1 to 0x1A01 (TxPDO).
6) Enable the PDO configuration: set OD 1C12 sub 0 to 1 (RxPDO) and OD 1C13 sub 0 to 1 (TxPDO).

CiA402 Equipment Regulation

This section describes the modes of operation specified by CiA402 when the drive is in the EtherCAT mode. The contents include basic operation and setting of related objects. The host controller controls the drive through the control word (OD 6040h) and read the current status of the drive through the status word (OD 6041h). The drive follows the commands from the host controller to run the motors.

CANopen over Ethernet (CoE) State Machine



NOTE: As shown in the diagram above, the strings beside the arrows are the control words and the strings in the squares are the status words.

The state machine can be divided into three blocks.

Block	Description
Power Disable	Drive doesn't have PWM output.
Power Enable	Drive has PWM output.
Fault	Faults occur

The three big blocks are composed of 9 statuses:

Status	Description
Start	Power-on
Not Ready to Switch On	The drive is initializing.
Switch On Disable	The drive finishes initializing.
Ready to Switch On	The drive is waiting to be switched on (energized). The motor isn't excited.
Switch On	The drive now has PWM output. The reference command is invalid.

Status	Description
Operation Enable	Motor is enabled, it runs by following control commands.
Quick Stop Active	Motor stops by following parameter setting.
Fault Reaction Active	The drive detects warning / fault and stops by following parameter settings. The motor is still excited.
Fault	The motor is not excited.

Control Word (controlword, OD 6040h): Description of Bit:

15–9	8	7	6–4	3	2	1	0
Reserved	Halt	Fault reset	Operation mode specific	Enable operation	Quick stop	Enable voltage	Switch on

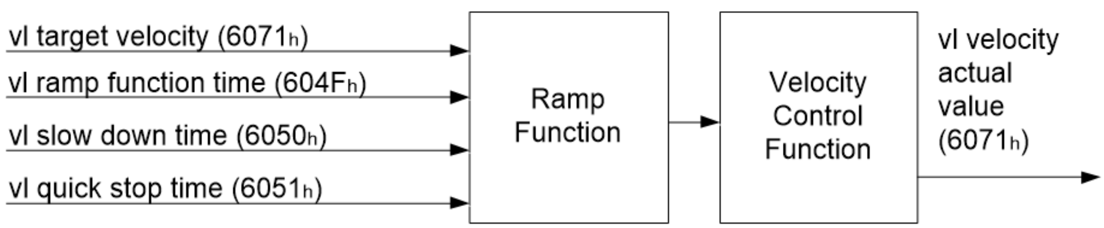
Status Word (statusword, OD 6041h): Description of Bit:

15–14	13–12	11	10	9	8	7
Reserved	Operation mode specific	Reserved	Target reached	Remote	Reserved	Warning
6	**5**	**4**	**3**	**2**	**1**	**0**
Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enable	Switch on	Ready to switch on

EtherCAT Operation Mode

Velocity Mode

The host controller sends velocity command and acceleration / deceleration data to a drive. Then the drive controls the velocity.



Operation Steps are as follows:

1) Set mode: OD 6060h = 02h as velocity mode
2) Set velocity command. OD 6042h (unit: RPM)
3) Set acceleration time OD 604Fh (unit: ms)
4) Set deceleration time OD 6050h (unit: ms)
   a) Set control commands OD 6040h. By following the control word commands listed below to do the setup, the motor drive operates as mentioned above. Refer to the description of OP 6041h to see the contents of the state machine.
   b) OD 6040h = 06h, the motor drive goes into < Ready to Switch On > state.
   c) OD 6040h = 0Eh, the motor drive goes into < Switch On > Servo On state.
   d) OD 6040h = 0Fh, the motor drive goes into < Operation Enable > state.
   e) OD 6040h = 7Fh, the motor drive starts running.

Control commands are defined as follows:

Step	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
(1)	0	0	0	0	1	1	0	Shutdown
(2)	0	0	0	0	1	1	1	Switch On (Enable Servo On ready)
(3)	0	0	0	1	1	1	1	Enable Operation (Enable Servo On)
(4)	1	1	1	1	1	1	1	Runs to the target speed.

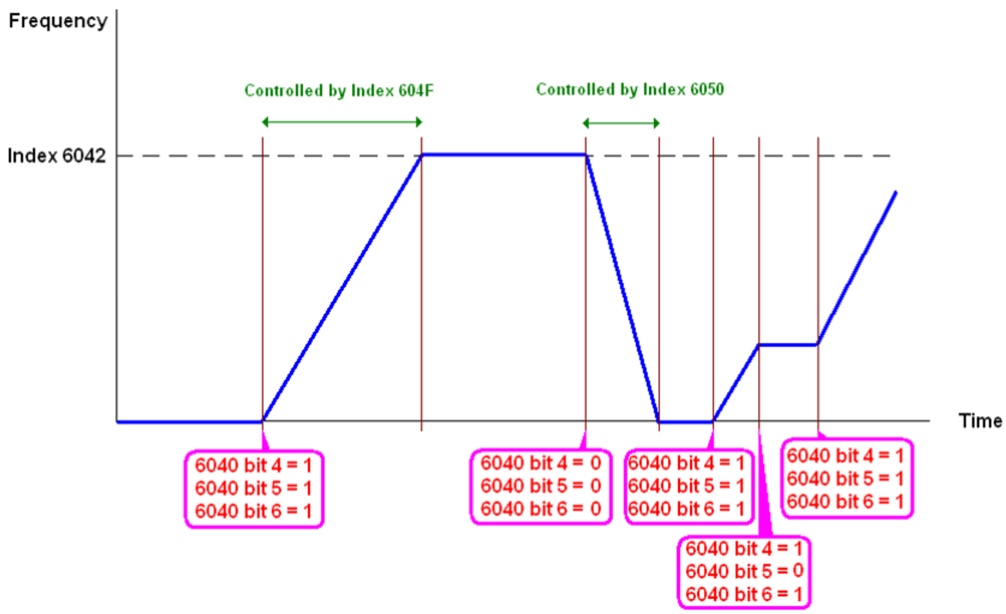
When using the velocity mode (OD 6060h = 02h), the controlword bit (bit 4 ~ bit 6) is defined as follows:

OD 6040h			Description
bit 6	bit 5	bit 4	
1	0	1	Maintain current speed
1	1	1	Run to the target speed
X	X	X	Decelerate to 0 RPM

Read Drive Data

OD 606Ch: to observe motor rotation speed.

OD 6041h: Drive's state word, bit 10 target reached (0: Not running to target speed; 1: Run to the target speed)



Index Related to the Drive

Index	Definition	Form	Attribute
6040h	Controlword	UNSIGNED16	RW
6041h	Statusword	UNSIGNED16	RO
6060h	Mode of operation	INTEGER8	RW
6061h	Mode of operation display	INTEGER8	RO
6042h	vl target velocity	INTEGER16	RW
6043h	vl velocity demand	INTEGER16	RO
6044h	vl velocity actual value	INTEGER16	RO
604Fh	vl ramp function time	INTEGER16	RW
6050h	vl slow down time	INTEGER16	RW

Communication Warning / Fault Table

Drive Warning/Fault Table

ID No.	Warning/ Fault Code	Warning/Fault Name	Description	Corrective Action
81	ECto_WARN	EtherCAT communication time out	Timer out warning on the Communication between communication card and the host controller.	-Verify if communication system is wiring correctly. -Verify if the upperhost is connecting correctly.
89	ECCb_WARN	Communication card disconnected	Warning on the disconnected communication card	-Reinstall the communication card. -Change a new communication card or change a new motor drive.
111	SYCE_WARN	Synchronization warning	The source of communication is not the communication card. Loss of synchronization signal (data packet) after setting up the synchronization mode. A warning message pops up.	-Reinstall a motor drive to the upperhost.
161	SYCE_ERR	Synchronization fault	The source of command is the communication card. Loss of synchronization signal (data packet) after setting up the synchronization mode. A fault message pops up.	Reinstall a motor drive to the upperhost.

SDO Abort Code

SDO Abort Code	Description
0x05030000	Deflection fault while doing segment transmission
0x05040000	SDO time out.
0x05040001	Client / servo command are invalid or don’t exist.
0x05040005	Register overflow when running SDO.
0x06010000	Not supported access
0x06010001	Try to read a write-only object
0x06010002	Try to write a read-only object
0x06010003	Unable to write into sub-index. The sub-index has to be 0.
0x06020000	The object doesn’t exist in the object dictionary.
0x06040041	Unable to map the object to PDO
0x06040042	The number and the length of the objects mapped to PDO is longer than PDO.
0x06040043	Format of the parameter is not compatible.
0x06040047	Compatibility issue of motor drive.
0x06060000	Fail to save due to hardware error. (Saving or returning to origin fault)
0x06070010	Incorrect data type; wrong parameter length.
0x06070012	Incorrect data type; parameter length is too long
0x06070013	Incorrect data type; parameter length is too short.
0x06090011	Sub-index doesn’t exist.
0x06090030	The parameter value is out of bounds.
0x06090031	Setting value is too big.
0x06090032	Setting value is too small.
0x06090033	Detected Module Ident List (0xF030) and Configured Module Ident list (0xF050) don’t match.
0x06090036	Setting value is smaller than the lower limit.
0x08000000	General error
0x08000020	Data cannot be read or written.
0x08000021	Data access denied due to local control.
0x08000022	Data access denied due to current status.
0x08000023	Object dictionary doesn’t exist.

Description of Object Specification

Object Type

Object Type	Description
Variable	A single value such as a UNSIGNED8, a Boolean, a float and an INTEGER16
Array	An object with multiple data fields composed of multiple variables of the same data type such as UNSIGNED16. The Sub-index 0 data belongs to UNSIGNED8, so it's not classified as array data
Record	An object with multiple data fields composed of multiple variables of the same data type. The Sub-index 0 data belongs to UNSIGNED8, so it's not classified as record data.

Data Type

Data Type	Data Size	Range
BOOLEAN	1 bit	0~1
UNSIGNED8	1 byte	0~255
UNSIGNED16	2 bytes	0~65535
UNSIGNED32	4 bytes	0~4294967295
INTEGER8	1 byte	-128~127
INTEGER16	2 bytes	-32768~327671
INTEGER32	4 bytes	-2147483648~2147483647
VISIBLE STRING	-	-

Object Dictionary

OD 1000h Communication Group

Index	Object Type	Name	Data Type	Attribute
1000h	Variable	Device type	UNSIGNED32	RO
1001h	Variable	Error register	UNSIGNED8	RO
1008h	Variable	Device name	STRING	RO
100Ah	Variable	Software version	STRING	RO
1018h	Record	Identity	IDENTITY	RO
1600h	Record	Receive PDO mapping	PDOMAPPING	RW
1A00h	Record	Transmit PDO mapping	PDOMAPPING	RW
1C12h	Array	RxPDO assign	UNSIGNED16	RW
1C13h	Array	TxPDO assign	UNSIGNED16	RW

OD 3000h Drive's Parameter Group

The objects defined here are related to the settings of the motor drive's parameters. The setting methods are as follows:

Index 300Xh are related to motor drive's parameter Group X. The sub-index 1h–64h (hexadecimal) correspond to the parameter Group X-00 to Group X-99.

For example:

Set P05.33 (Induction motor or permanent magnet synchronous motors selection). The Index is 3005h and the sub-index is 22h (34).

OD 6000h Communication Object Group

Index	Object Type	Name	Data Type	Attribute	PDO Mapping
6007h	Variable	Abort connection option code	INTEGER16	RW	N
603Fh	Variable	Error code	UNSIGNED16	RO	Y
6040h	Variable	Controlword	UNSIGNED16	RW	Y
6041h	Variable	Statusword	UNSIGNED16	RO	Y
6042h	Variable	vl target velocity	INTEGER16	RW	Y
6043h	Variable	vl velocity demand	INTEGER16	RO	N
6044h	Variable	vl velocity actual value	INTEGER16	RO	Y
604Fh	Variable	vl ramp function time	INTEGER16	RW	N
6050h	Variable	vl slow down time	INTEGER16	RW	N
6051h	Variable	vl quick stop time	INTEGER16	RW	N
605Ah	Variable	Quick stop option code	INTEGER16	RW	N
605Ch	Variable	Disable operation option code	INTEGER16	RW	N
6060h	Variable	Modes of operation	INTEGER8	RW	Y
6061h	Variable	Modes of operation display	INTEGER8	RO	Y
6502h	Variable	Supported drive modes	INTEGER32	RO	N

Detailed Information about Objects

OD 1000h Communication Group

Object 1000h: Device Type

Index	1000h
Name	Device type
Object Type	Variable
Data Type	UNSIGNED32
Read-Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

Object 1000h: Error Register

Index	1001h
Name	Error register
Object Type	Variable
Data Type	UNSIGNED8
Read-Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED8

Object 1008h: Device Name

Index	1008h
Name	Device name
Object Type	Variable
Data Type	STRING
Read-Write Permission	RO
PDO Mapping Setting	No

Object 100Ah: Software Version

Index	100Ah
Name	Software version
Object Type	Variable
Data Type	STRING
Read-Write Permission	RO
PDO Mapping Setting	No

Object 1018h: Identity

Index	1018h
Name	Identity
Object Type	RECORD
Read-Write Permission	RO
PDO Mapping Setting	No

Sub-index	0
Name	SubIndex 000
Data Type	UNSIGNED8
Read-Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED8

Sub-index	1
Name	Vendor ID
Data Type	UNSIGNED32
Read-Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

Sub-index	2
Name	Product code
Data Type	UNSIGNED32
Read-Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

Sub-index	3
Name	Revision
Data Type	UNSIGNED32
Read-Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

Sub-index	4
Name	Serial number
Data Type	UNSIGNED32
Read-Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

Object 1600h–1603h: Receive PDO Mapping Parameter

Index	1600h / 1601h / 1602h / 1603h
Name	Receive PDO mapping
Object Type	RECORD
Data Type	PDO mapping
Read-Write Permission	RW
PDO Mapping Setting	No
Note	The total length of a PDO set cannot be longer than 64-bit.

Sub-index	0
Name	Number of Objects
Data Type	UNSIGNED8
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	0: Disable 1–8: Set number of PDO mapping and enable this function.
Factory Setting	0

Sub-index	1–8
Name	Mapping entry (n)
Data Type	UNSIGNED32
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED32
Factory Setting	0

Object 1A00h–1A03h: Transmit PDO Mapping Parameter

Index	1A00h / 1A01h / 1A02h / 1A03h
Name	Transmit PDO Mapping Parameter
Object Type	RECORD
Data Type	PDO mapping
Read-Write Permission	RW
Note	The total length of a PDO set cannot be longer than 64-bit.

Sub-index	0
Name	Number of Objects
Data Type	UNSIGNED8
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	0: Disable 1–8: Set number of PDO mapping and enable this function.
Factory Setting	0

Sub-index	1–8
Name	Mapping entry (n)
Data Type	UNSIGNED32
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED32
Factory Setting	0

Object 1C12h: RxPDO Assign

Index	1C12h
Name	RxPDO assign
Object Type	ARRAY
Data Type	UNSIGNED16
Read-Write Permission	RW
PDO Mapping Setting	No

Sub-index	0
Name	Number of assigned RxPDOs
Data Type	UNSIGNED8
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	0–1
Factory Setting	1

Sub-index	1
Name	Index of assigned RxPDO
Data Type	UNSIGNED16
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	0x1600 / 0x1601 / 0x1602 / 0x1603
Factory Setting	0x1600

Object 1C13h: TxPDO Assign

Index	1C13h
Name	TxPDO assign
Object Type	ARRAY
Data Type	UNSIGNED16
Read-Write Permission	RW
PDO Mapping Setting	No

Sub-index	0
Name	Number of assigned TxPDOs
Data Type	UNSIGNED8
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	0–1
Factory Setting	1

Sub-index	1
Name	Index of assigned TxPDO
Data Type	UNSIGNED16
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	0x1A00 / 0x1A01 / 0x1A02 / 0x1A03
Factory Setting	0x1A00

OD 3000h Drive's Parameter Group

Index	3XXXh
Name	Driver parameter
Object Type	Variable
Data Type	UNSIGNED16
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED16
Factory Setting	N/A

You can read/write drive's parameters via this object group. The drive's parameter can only be changed by SDO.

The setting methods are as follows:

Index 300Xh are related to drive's parameter Group X. The sub-index 1h–64h (hexadecimal) corresponds to the parameter Group X-00 to Group X-99.

For example:

Set P05.33 (Induction motor or permanent magnet synchronous motors selection). The Index is 3005h and the sub-index is 22h (34).

OD 6000h Communication Object Group

Object 6007h: Abort Connection Option Code

Index	6007h
Name	Abort connection option code
Object Type	Variable
Data Type	INTEGER16
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	0: No function 2: Switch on Disable 3: Quick Stop
Factory Setting	2

- *When object 6007h = 0, CANopen ignores a disconnection fault, no warning and do nothing.*
- *When object 6007h =2, CANopen turns to Switch on Disable and displays ECto. CANopen then follows the setting at object 605Ah to trigger parking. When reconnection is successful, the warning code disappears.*
- *When object 6007h = 3, CANopen turns to Quick Stop and displays ECto. CANopen then follows the set=ting at object 605Ch to trigger parking. When reconnection is successful, the warning code clears.*

Object 603Fh: Error code

Index	603Fh
Name	Error code
Object Type	Variable
Data Type	UNSIGNED16
Read-Write Permission	RO
PDO Mapping Setting	Yes
Setting Range	UNSIGNED32
Factory Setting	0

Object 6040h: Controlword

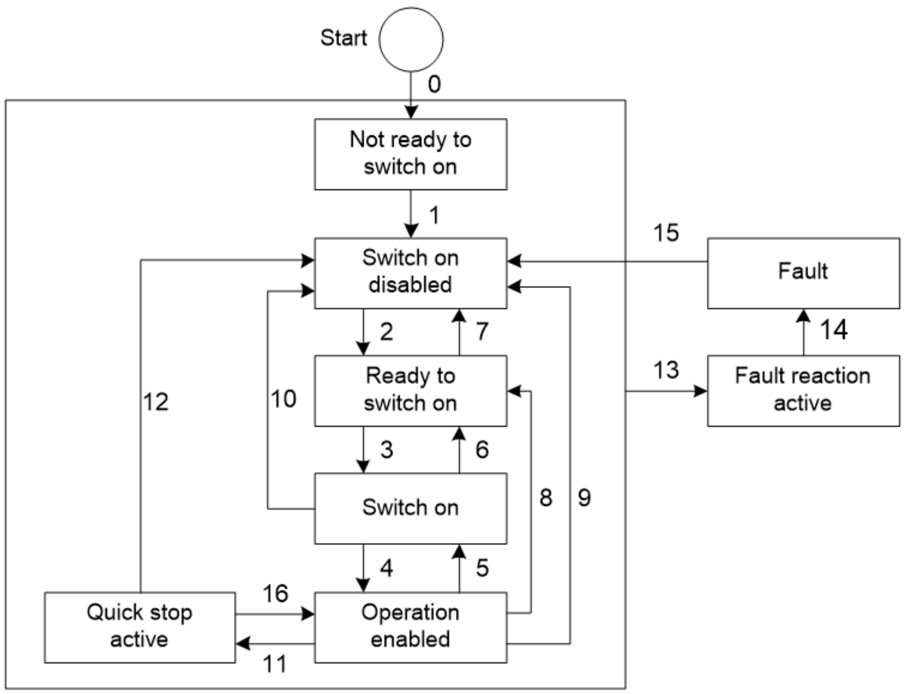
Index	6040h
Name	Controlword
Object Type	Variable
Data Type	UNSIGNED16
Read-Write Permission	RW
PDO Mapping Setting	Yes
Setting Range	UNSIGNED16
Factory Setting	0

a) Description of Different Bits

Bit	***Function***	***Description***
Bit 0	Switch on	-
Bit 1	Enable voltage	-
Bit 2	Quick stop	-
Bit 3	Enable operation	-
Bit 4–Bit 6	Operation mode specific	Refer to the Specific Model Definition table blow
Bit 7	Fault reset	-
Bit 8	Halt	-
Bit 9–Bit 15	Reserved	-

b) Specific Model Definition Table

Bit	Specific Model Definition						
	VL	PP	Homing	IP	PT	CSP	CST
Bit 4	Enable ramp	New set-point	Homing operation start	Enable interpolation	-	-	-
Bit 5	Unlock ramp	Change set immediately	-	-	-	-	-
Bit 6	Reference ramp	0: Absolute target position 1: Relative target position	-	-	-	-	
Bit 8	Halt	Halt	Halt	Halt	-	-	-



c) Status Switching Definition Table

Status Switching	Event	Action
0–1	Auto run after powering on	Activate the device and initialize.
2	Shutdown command	N/A
3	Switch on command	Motor drive prepares for servo on
4	Enable operation command	Motor drive has servo on and is in operation.
5	Disable operation command	Servo has servo off.
6	Shutdown command	N/A
7	Disable voltage or Quick stop command	N/A
8	Shutdown command	Motor drive has servo off.
9	Disable voltage command	Motor drive has servo off.
10	Disable voltage or Quick stop command	N/A
11	Quick stop command	Enable Quick Stop function.
12	Disable voltage command	Motor drive has servo off
13–14	Warning / Fault codes pop up	Motor drive has servo off.
15	Warning / Fault codes clear	N/A
16	Enable operation; no alarm command	Restart operation command.

d) Via Controlword (6040h), status can be changed, the commands are as follows:

Command	Bit of Controlword (6040h)					Status Change
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shutdown	0	X	1	1	0	2,6,8
Switch on	0	0	1	1	1	3
Switch on + Enable operation	0	1	1	1	1	3 + 4
Disable voltage	0	X	X	0	X	7,9,10,12
Quick stop	0	X	0	1	X	7,10,11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4-16
Fault reset		X	X	X	X	15

NOTE: 0=Bit is off; 1=Bit is on; X=Bit is not affected; = positive edge triggering

Object 6041h: Statusword

Index	6041h
Name	Statusword
Object Type	Variable
Data Type	UNSIGNED16
Read-Write Permission	RO
PDO Mapping Setting	Yes
Setting Range	UNSIGNED16
Factory Setting	0

a) Description of Different Bits

Bit	Function	Description
Bit 0	Ready to switch on	Bit 0 to Bit6 display current status of the motor drive. See table below for details.
Bit 1	Switched on	
Bit 2	Operation enabled	
Bit 3	Fault	
Bit 4	Voltage enabled	
Bit 5	Quick stop	
Bit 6	Switch on disabled	
Bit 7	Warning	Warning status: motor drive still has servo on.
Bit 8	Reserved	-
Bit 9	Remote	-
Bit 10	Target reached	Target reached
Bit 11	Reserved	-
Bit 12–Bit 13	Operation mode specific	See Specific Model Definition table below.
Bit 14	Reserved	-
Bit 15	Reserved	-

Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
0	-	-	0	0	0	0	Not ready to switch on
1	-	-	0	0	0	0	Switch on disabled
0	1	-	0	0	0	1	Ready to switch on
0	1	-	0	0	1	1	Switch on
0	1	-	0	1	1	1	Operation enabled
0	0	-	0	1	1	1	Quick stop active
0	-	-	1	1	1	1	Fault reaction active
0	-	-	1	0	0	0	Fault

NOTE: 0=Bit is off; 1=Bit is on; - means bit is not functional.

b) Specific Model Definition Table

Bit	Specific Model Definition						
	VL	PP	Homing	IP	PT	CSP	CST
Bit 10	-	Target reached	Target reached	Target reached	Target reached	-	-
Bit 12	-	-	Homing attained	-	-	-	-
Bit 13	-	Following error	Homing error	Following error	-	Following error	-

Object 6042h: vl Target Velocity

This object is a velocity command value under the velocity mode.

Index	6042h
Name	vl target velocity
Object Type	Variable
Data Type	INTEGER16
Read-Write Permission	RW
PDO Mapping Setting	Yes
Setting Range	INTEGER16
Factory Setting	0
Unit	RPM

Object 6043h: vl Velocity Demand

This object is a velocity command calculated by the motor drive under the velocity mode.

Index	6043h
Name	vl velocity demand
Object Type	Variable
Data Type	INTEGER16
Read-Write Permission	RO
PDO Mapping Setting	No
Setting Range	INTEGER16
Unit	RPM

Object 6044h: vl Velocity Actual Value

This object is the actual running speed under the velocity mode.

Index	6044h
Name	vl velocity actual value
Object Type	Variable
Data Type	INTEGER16
Read-Write Permission	RO
PDO Mapping Setting	Yes
Setting Range	INTEGER16
Unit	RPM

Object 604Fh: vl Ramp Function Time

This object is the time spent when the motor drive accelerates from 0 RPM to 6042h under the Velocity Mode.

Index	604Fh
Name	vl ramp function time
Object Type	Variable
Data Type	UNSIGNED32
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED32
Factory Setting	10000
Unit	ms

Object 6050h: vl Slow Down Time

This object is the time spent when the motor drive decelerates from 6042h to 0 RPM under the Velocity Mode.

Index	6050h
Name	vl slow down time
Object Type	Variable
Data Type	UNSIGNED32
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	UNSIGNED32
Factory Setting	10000
Unit	ms

Object 6051h: vl Quick Stop Time

This object is at velocity mode. It’s the time required for decelerating from 6402h to 0 RPM.

Index	6051h
Name	vl quick stop time
Object Type	Variable
Data Type	UNSIGNED32
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	Motor drive parameter P01.45 P01.45=0, Setting Range: 10–600000 P01.45=1, Setting Range: 100–6000000
Factory Setting	1000
Unit	ms

Object 605Ah: Quick Stop Option Code

This object is a choice behavior when 6040h (Controlword) triggers Quick Stop bit.

Index	605Ah
Name	Quick stop option code
Object Type	Variable
Data Type	INTEGER16
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	0: Disable motor drive function 1: Decelerate to stop by slow down ramp then Switch on Disabled (cannot be back to OP) 2: Decelerate to stop by quick stop ramp then Switch on Disabled (cannot be back to OP) 5: Decelerate to stop by slow down ramp and keep on Quick Stop status (can be back to OP) 6: Decelerate to stop by quick stop ramp and keep on Quick Stop status (can be back to OP)
Factory Setting	2

Object 605Ch: Disable Operation Option Code

This object is a choice behavior of the motor drive when the status switches from Operation Enable to Switched On.

Index	605Ch
Name	Disable operation option code
Object Type	Variable
Data Type	INTEGER16
Read-Write Permission	RW
PDO Mapping Setting	No
Setting Range	0: Disable motor drive 1: Decelerate to stop; disable motor drive
Factory Setting	1

Object 6060h: Modes of Operation

This object is to set up the operation mode.

Index	6060h
Name	Modes of operation
Object Type	Variable
Data Type	INTEGER8
Read-Write Permission	RW
PDO Mapping Setting	Yes
Setting Range	UNSIGNED32
Factory Setting	8

The operation modes are as follows:

Setting Value	Operation Mode
0	Reserved
1	Profile Position Mode
2	Velocity Mode
3	Reserved
4	Profile Torque Mode
5	Reserved
6	Homing Mode
7	Interpolated Position Mode
8	Cyclic Synchronous Position Mode
9	Reserved
10	Cyclic Synchronous Torque Mode

Object 6061h: Modes of Operation Display

This object shows the current operation mode.

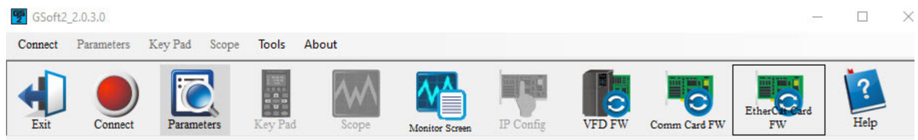
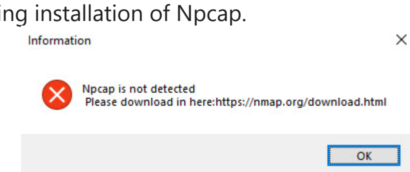
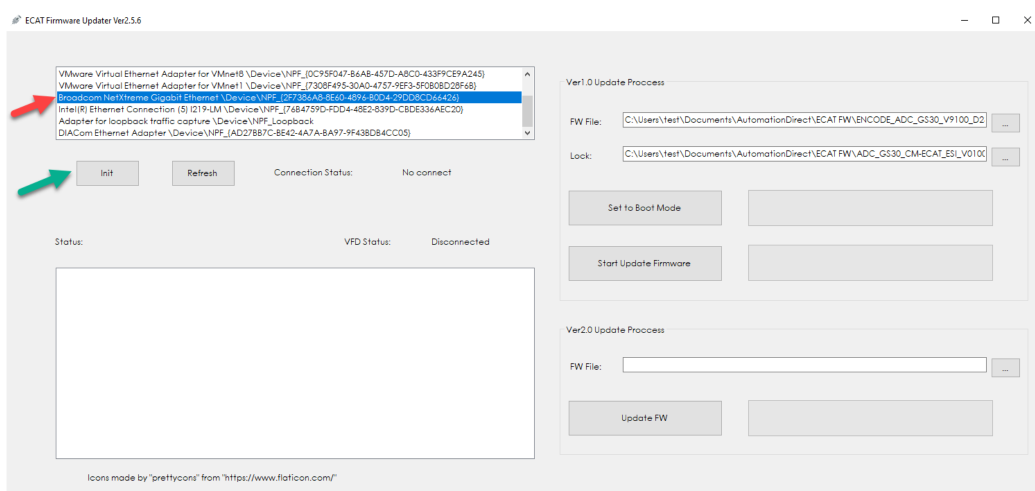
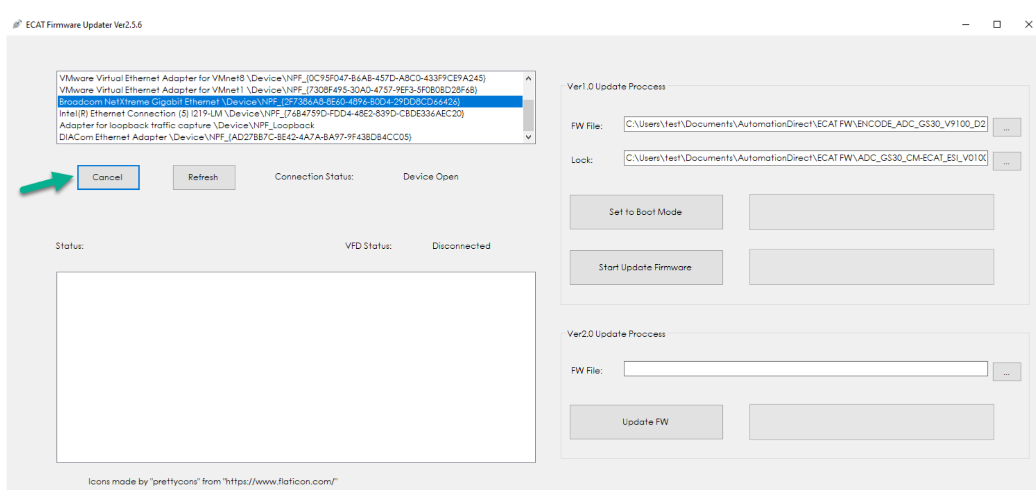
Index	6061h
Name	Modes of operation display
Object Type	Variable
Data Type	INTEGER8
Read-Write Permission	RO
PDO Mapping Setting	Yes
Setting Range	INTEGER8
Factory Setting	0

Object 6502h: Support Drive Modes

Index	6502h
Name	Supported drive modes
Object Type	Variable
Data Type	UNSIGNED32
Read-Write Permission	RO
PDO Mapping Setting	No
Setting Range	UNSIGNED32

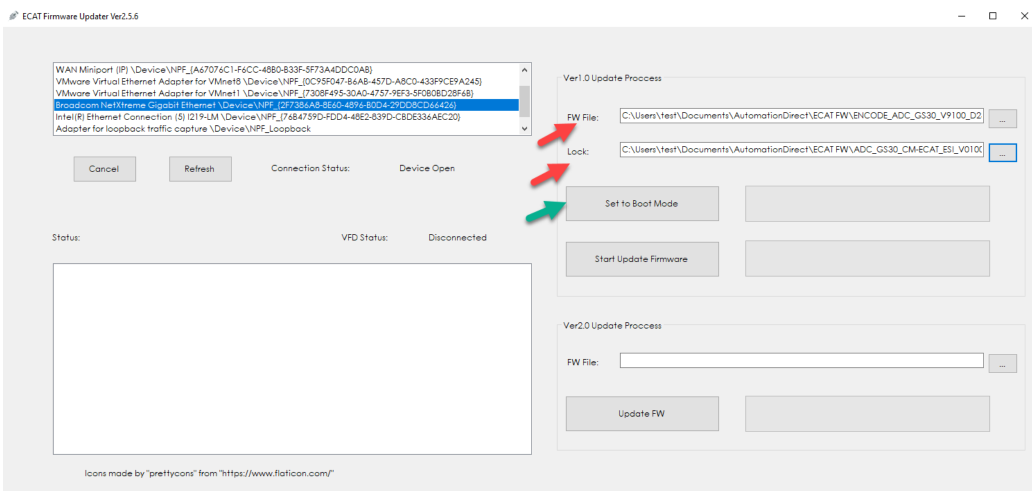
EtherCAT Firmware Update

Follow the steps below to update the firmware of the GS30A-CM-ECAT card.

GS30A-CM-ECAT Firmware Update	
Step	**Description**
1	Open EtherCAT firmware update by clicking **EtherCAT Card FW** on the GSoft2 menu bar. 
2	You may get a pop-up prompting installation of Npcap.  You can download it for free here: https://nmap.org/download If you already have Npcap installed, you can skip this step.
3	Select the Ethernet card the drive is connected to and click **Init**. 
4	Verify that the **Init** button has changed to **Cancel**. 

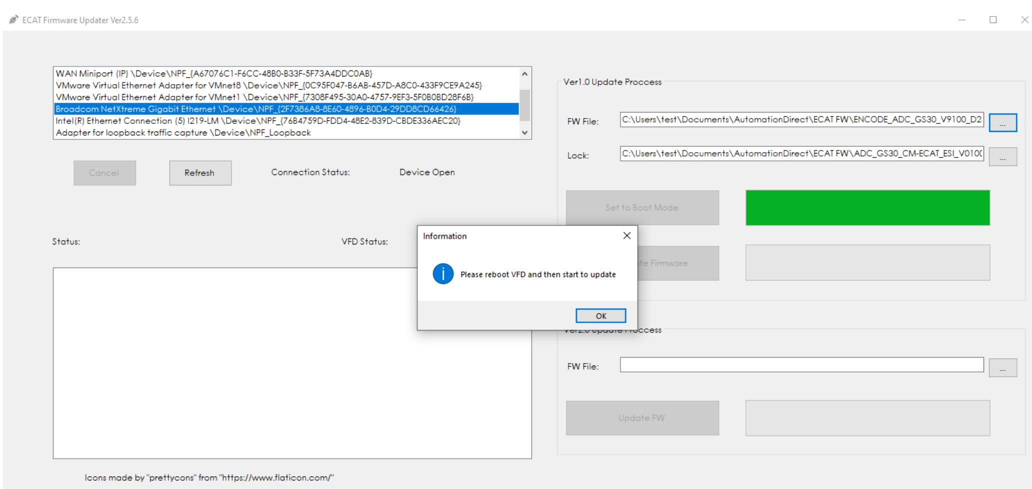
<table>
<tr><th colspan="2">GS30A-CM-ECAT Firmware Update</th></tr>
<tr><th>Step</th><th>Description</th></tr>
<tr><td>5</td><td>

a) In **Ver 1.0 Update Process**, for **FW File** select the **ENCODE_ADC_GS30_V9100_D23295.BIN** file.
b) In **Ver 1.0 Update Process**, for **Lock** select the **ADC_GS30_CM-ECAT_ESI_V0100.bin** file.
c) Click **Set to Boot Mode**.



</td></tr>
<tr><td>6</td><td>

The **Set to Boot Mode** progress bar will change to green. Click **OK** at the prompt and cycle drive power.



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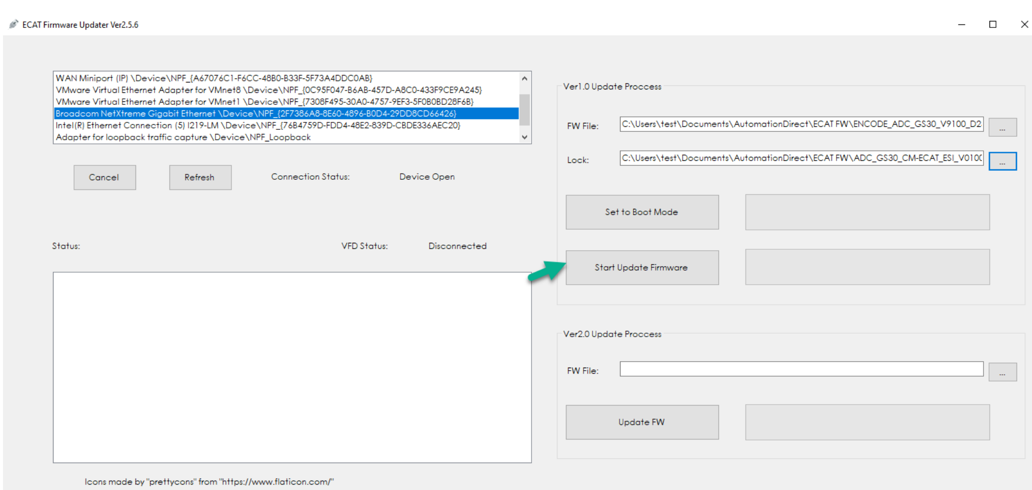
<tr><td>7</td><td>

After power cycle, click **Start Update Firmware**.



</td></tr>
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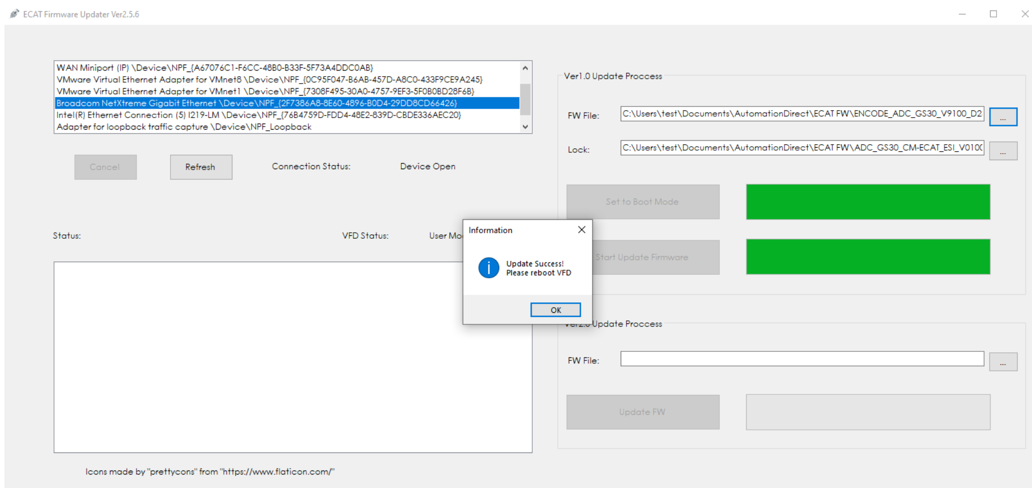
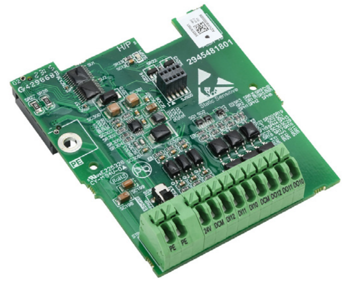
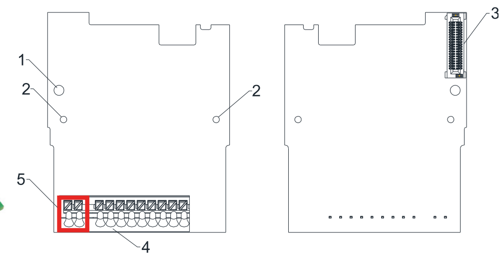
GS30A-CM-ECAT Firmware Update	
Step	**Description**
8	The **Start Updated Firmware** progress bar will change to green. After the firmware is updated, click **OK** at the prompt and cycle drive power again. 

GS30A-06CDD

The GS30A-06CDD is a digital combo module with 3-point input and 3-point output. This card is for use with GS30 series AC drives in installation Position 1 only.





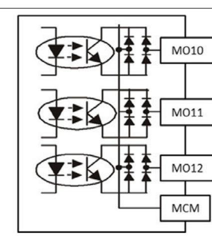
GS30-06CDD

GS30A-06CDD Overview			
Drawing Item	***Description***	***Wiring Info***	***Screw Torque***
1	Screw fixing hole	Wire gauge: 0.25–0.75 mm^2 [24–18 AWG] Stripping length: 9mm	Screw torque: 2 kg-cm / [1.7 Ib-in.] / [0.2 N•m]
2	Positioning hole		
3	AC drive connection port		
4	Terminal block		
5	Ground terminal block		

Features

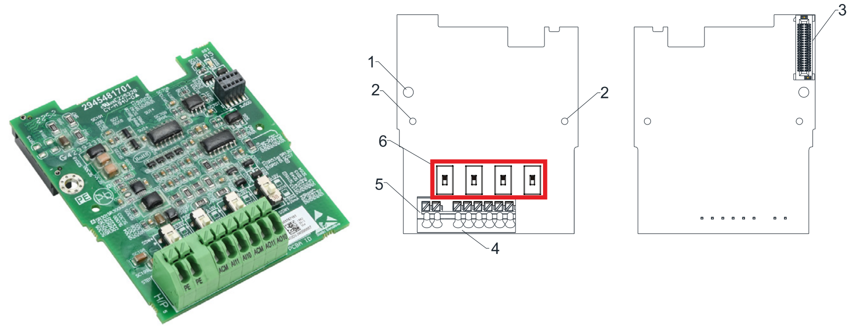
- *Input: 3-point, 24VDC, sinking/sourcing selectable*
- *Ouput: 3-point, 48VDC, sinking/sourcing selectable, 50mA resistive output current*

Specifications

GS30A-06CDD Specifications		
Terminals		
24V, DCM	Output power: +24VDC ±5% < 30mA	
DI10–DI12	• Choose SINK (NPN) / SOURCE (PNP) by SWW1 • Internal power is supplied by terminal 24V: +24VDC ±5% • If external power is +24VDC, the maximum voltage is 30VDC and the minimum voltage is 19VDC • ON: activation current is 6.5 mA • OFF: leakage current tolerance is 10µA	
DO10–DO12	• The drive outputs various monitor signals, such as drive in operation, frequency reached and overload indication through the transistor (open collector) • DO output signal: each DO terminal needs a pull-up resistor, the maximum external power voltage is 48VDC / 50mA	
DCM	Common for digital output terminals DO10–DO12 (photocoupler)	
PE	Grounding terminals. To decrease noise, properly ground this terminal.	
Environment		
Noise immunity	ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Test (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)	
Operation / storage	Operation: -10°C~50°C [14°F~122°F] (temperature), 90% (humidity) Storage: -25°C~70°C [-13°F~158°F] (temperature), 95% (humidity)	
Vibration / shock immunity	International standard: IEC 61800-5-1, IEC 60068-2-6/IEC 61800-5-1, IEC 60068-2-27	

GS30A-2AD2DA

The GS30A-2AD2DA is an analog combo module with 2-channel input and 2-channel output. This card is for use with GS30 series AC drives in installation Position 1 only.



GS30-2AD2DA

GS30A-2AD2DA Overview			
Drawing Item	***Description***	***Wiring Info***	***Screw Torque***
1	Screw fixing hole	Wire gauge: 0.25–0.75 mm^2 [24–18 AWG] Stripping length: 9mm	Screw torque: 2 kg-cm / [1.7 lb-in.] / [0.2 N•m]
2	Positioning hole		
3	AC drive connection port		
4	Terminal block		
5	Switch (SSW1–SSW4)		

Features

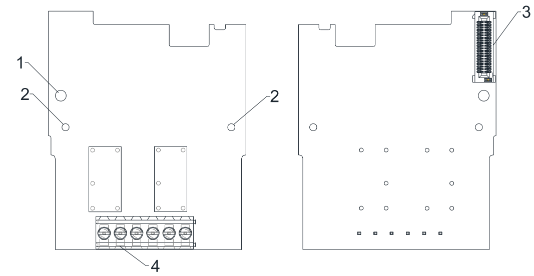
- *Input: 2-channel, current/voltage, 0–20 mA and 4–20 mA, 0–10 VDC*
- *Ouput: 2-channel, current/voltage, 0–20 mA and 4–20 mA, 0–10 VDC*

Specifications

GS30A-2AD2DA Specifications	
Terminals	
ACM	Common output signal and input signal terminals.
AI10, AI11	Two sets of AI ports: SSW3, SSW4 switch for AI1, AI2 (default is AI1) • AI1: input 0–10 V • AI2: input 0–20 mA
AO10–AO11	Two sets of AO ports: SSW1, SSW2 switch for AVO or ACO (default is ACO). • AVO: output 0–10 V • ACO: output 0–20 mA
PE	Gournding terminal. to decrease noise, properly ground this terminal.
Environment	
Noise immunity	ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Test (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)
Operation / storage	Operation: -10°C~50°C [14°F~122°F] (temperature), 90% (humidity) Storage: -25°C~70°C [-13°F~158°F] (temperature), 95% (humidity)
Vibration / shock immunity	International standard: IEC 61800-5-1, IEC 60068-2-6/IEC 61800-5-1, IEC 60068-2-27

GS30A-02TRC

The GS30A-02TRC is a relay output module with (2) SPDT relays. This card is for use with GS30 series AC drives in installation Position 1 only.



GS30-02TRC

GS30A-02TRC Overview			
Drawing Item	***Description***	***Wiring Info***	***Screw Torque***
1	Screw fixing hole	Wire gauge: 0.25–1.5 mm^2 [24–16 AWG] Stripping length: 6mm	Screw torque: 5 kg-cm / [4.3 Ib-in.] / [0.49 N•m]
2	Positioning hole		
3	AC drive connection port		
4	Terminal block		

Features

- *240VAC/30VDC*
- *(2) Form C (SPDT) relays*
- *1 isolated common*
- *1 point per common*
- *Screw terminal blocks included*

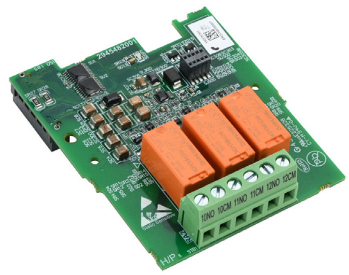
Specifications

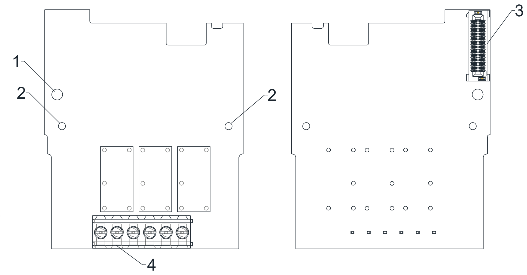
See parameters P02.36 and P02.37 for configuration.

GS30A-02TRC Specifications	
Terminals	
10NO-10NC-10CM (DO10)	Resistive load: 5A (N.O.) / 250VAC Function: outputs the monitor signals, such as drive in operation, frequency reached, or overload indication.
11NO-11NC-11CM (DO11)	
Environment	
Noise immunity	ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Test (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)
Operation / storage	Operation: -10°C~50°C [14°F~122°F] (temperature), 90% (humidity) Storage: -25°C~70°C [-13°F~158°F] (temperature), 95% (humidity)
Vibration / shock immunity	International standard: IEC 61800-5-1, IEC 60068-2-6/IEC 61800-5-1, IEC 60068-2-27

GS30A-03TRA

The GS30A-03TRA is a relay output module with (3) SPST relays. This card is for use with GS30 series AC drives in installation Position 1 only.





GS30-03TRA

GS30A-03TRA Overview			
Drawing Item	***Description***	***Wiring Info***	***Screw Torque***
1	Screw fixing hole	Wire gauge: 0.25–1.5 mm^2 [24–16 AWG] Stripping length: 6mm	Screw torque: 5 kg-cm / [4.3 lb-in.] / [0.49 N•m]
2	Positioning hole		
3	AC drive connection port		
4	Terminal block		

Features

- *250VAC/30VDC*
- *(3) Form A (SPST) relays*
- *1 isolated common*
- *1 point per common*
- *Screw terminal blocks included*

Specifications

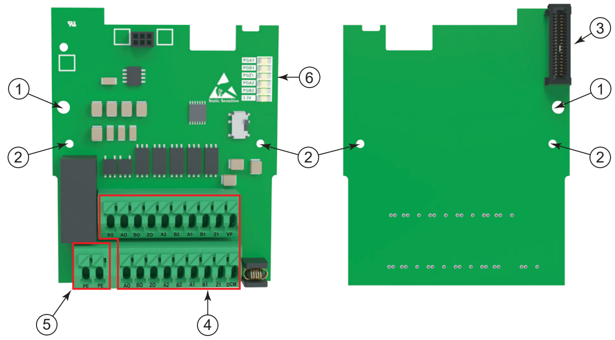
See parameters P02.36–P02.38 for configuration.

GS30A-03TRA Specifications	
Terminals	
10NO-10CM (DO10)	Resistive load: 6A (N.O.) / 250VAC Function: outputs the monitor signals, such as drive in operation, frequency reached, or overload indication.
11NO-11CM (DO11)	
12NO-12CM (DO12)	
Environment	
Noise immunity	ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Test (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)
Operation / storage	Operation: -10°C~50°C [14°F~122°F] (temperature), 90% (humidity) Storage: -25°C~70°C [-13°F~158°F] (temperature), 95% (humidity)
Vibration / shock immunity	International standard: IEC 61800-5-1, IEC 60068-2-6/IEC 61800-5-1, IEC 60068-2-27

GS30A-FB-LD

The GS30A-FB-LD is a line driver (differential) encoder module. This card is for use with GS30 series AC drives in installation Position 1 only.

For encoder parameter setup, see Group P10.xx Details – Speed Feedback Control Parameters” on page 4–234.



GS30-FB-LD

GS30A-FB-LD Overview			
Drawing Item	**Description**	**Wiring Info**	**Screw Torque**
1	Screw fixing hole	Wire gauge: 0.25–0.75 mm² [24–18 AWG] Stripping length: 9mm	Screw torque: 5 kg-cm / [4.3 lb-in.] / [0.49 N•m]
2	Positioning hole		
3	AC drive connection port		
4	Terminal block		
5	Ground terminal block		
6	Channel indicator LEDs		

Features

- *Line driver (differential) encoder input*
- *1-phase or 2-phase input*

Specifications

GS30A-FB-LD Specifications		
Terminals		
Encoder PG1	**VP**	• Power output voltage: +5V ±5% or +12V ±5% • Maximum output current: 200mA (+5V)
	DCM	Common for power and signal
	A1, $\overline{A1}$, B1, $\overline{B1}$, Z1, $\overline{Z1}$	• Encoder input signal (applicable for line driver or open collector • Open collector input voltage +5–24 VDC • Supports 1-phase and 2-phase input • Maximum input signal: 300kHz
Pulse Command PG2	**A2, $\overline{A2}$, B2, $\overline{B2}$**	• Pulse input signal (applicable for line driver or open collector) • Open collector input voltage +5–24 VDC • Supports 1-phase and 2-phase input • Maximum input signal: 300kHz
PG OUT	**AO, $\overline{AO}$, BO, $\overline{BO}$, ZO, $\overline{ZO}$, SG**	• Encoder (PG1) feedback signal output, supports frequency elimination: 1–255 times • Maximum output voltage of the line driver: 5VDC • Maximum output current: 15mA • Maximum output frequency: 300kHz • SG, the referenced electric potential for encoder output signal, serves as the ground for host controller or PLC to make the output signal become the common point. Do not use common grounding with SG and DCM as it may influence the signal quality
Ground	**PE**	Grounding terminal. To decrease noise, properly ground this terminal.
Environment		
Noise immunity		ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Test (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)

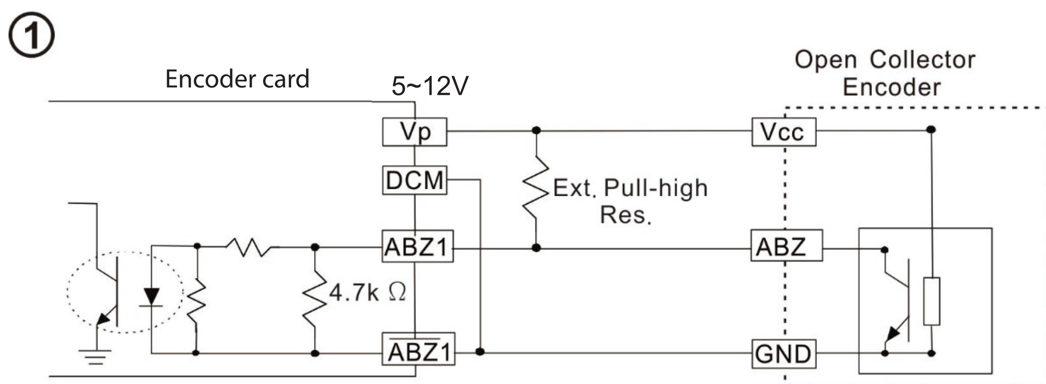
GS30A-FB-LD Specifications (continued)	
Operation / storage	Operation: -10°C~50°C [14°F~122°F] (temperature), 90% (humidity) Storage: -25°C~70°C [-13°F~158°F] (temperature), 95% (humidity)
Vibration / shock immunity	International standard: IEC 61800-5-1, IEC 60068-2-6/IEC 61800-5-1, IEC 60068-2-27

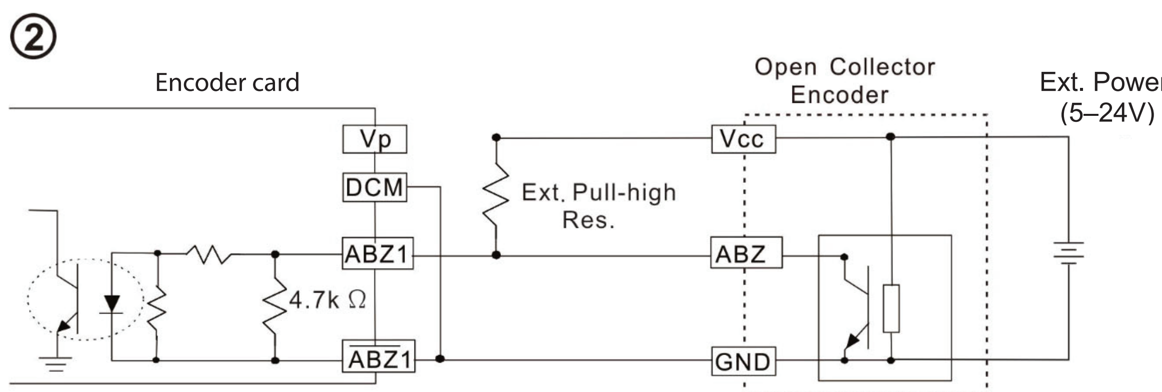
NOTE: Open collector applicatoin: input current 5-15 mA to each set and each set needs one pull-up resistor. If the input voltage of the open collector is 24V, power for the encoder must be connected exernally.

Input Voltage	***Recommendation***
5V	Recommended pull-up resistor: above 100–220Ω, 1/2 W
12V	Recommended pull-up resistor: above 510Ω–1.35 kΩ, 1/2 W
24V	Recommended pull-up resistor: above 1.8–3.3 kΩ, 1/2 W

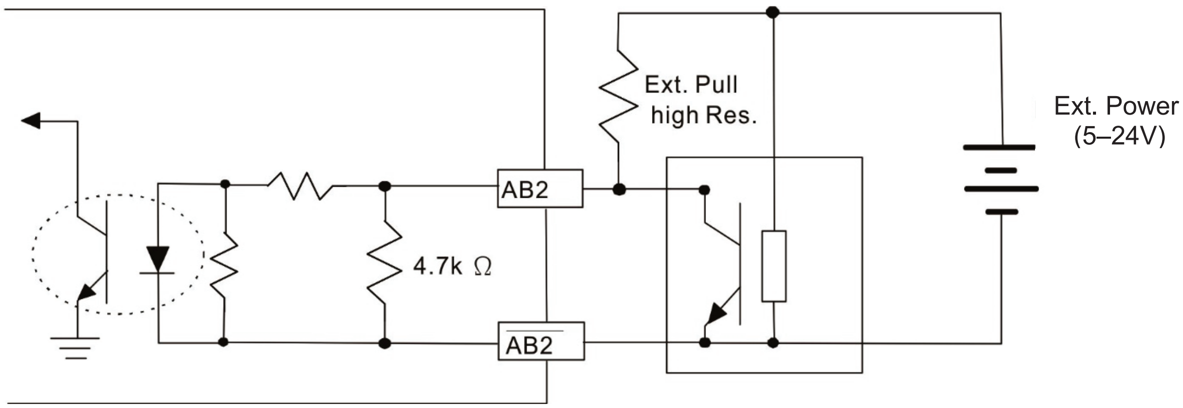
Wiring Diagrams

Encoder Wiring Diagram



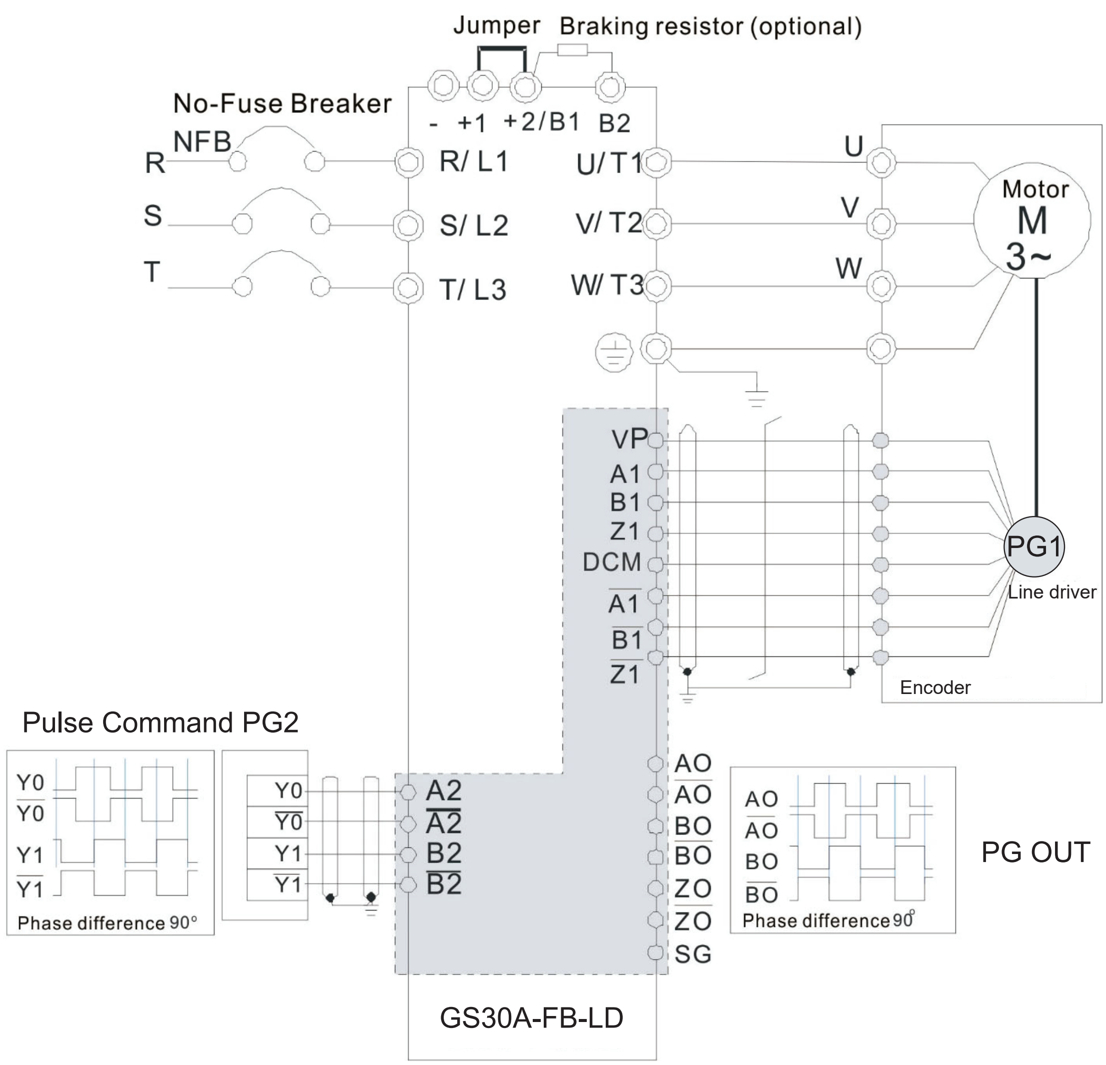


Encoder Wiring Diagram



GS30A-FB-LD Wiring

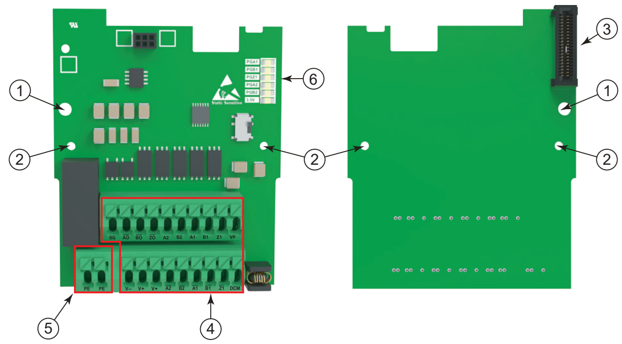
- *Use a shielded cable to prevent interference. Do not run control wires parallel to any high voltage AC power line (200VAC and above)*
- *Recommended wire size: 0.0509–1.31mm² (30-16 AWG)*
- *Cable length: less than 100m*



GS30A-FB-OC

The GS30A-FB-OC is an open collector encoder module. This card is for use with GS30 series AC drives in installation Position 1 only.

For encoder parameter setup, see Group P10.xx Details – Speed Feedback Control Parameters” on page 4–234.



GS30-FB-OC

GS30A-FB-OC Overview			
Drawing Item	***Description***	***Wiring Info***	***Screw Torque***
1	Screw fixing hole	Wire gauge: 0.25–0.75 mm^2 [24–18 AWG] Stripping length: 9mm	Screw torque: 5 kg-cm / [4.3 lb-in.] / [0.49 N•m]
2	Positioning hole		
3	AC drive connection port		
4	Terminal block		
5	Ground terminal block		
6	Channel indicator LEDs		

Features

- *NPN/PNP open collector encoder input*
- *1-phase or 2-phase input*

Specifications

GS30A-FB-OC Specifications		
Terminals		
Encoder PG1	***VP***	• Power output voltage: +5V ±5% or +12V ±5% • Maximum output current: 200mA (+5V)
	DCM	Common for power and signal
	A1, $\overline{A1}$, B1, $\overline{B1}$, Z1, $\overline{Z1}$	• Encoder input signal (applicable for line driver or open collector • Open collector input voltage +5–24 VDC • Supports 1-phase and 2-phase input • Maximum input signal: 300kHz
Pulse Command PG2	***A2, $\overline{A2}$, B2, $\overline{B2}$***	• Pulse input signal (applicable for line driver or open collector) • Open collector input voltage +5–24 VDC • Supports 1-phase and 2-phase input • Maximum input signal: 300kHz
PG OUT	***V+, V+***	• Needs an external power source for the PG OUT circuit • Input voltage: +7–24 V
	V-	The negative side for external power supply
	$\overline{AO}$, $\overline{BO}$, $\overline{ZO}$	• Encoder (PG1) feedback signal output: supports frequency elimination: 1–255 times • Open collector's output signal: add a pull-up resistor on each PG out external power • Maximum input frequency: 300kHz
Environment		
Noise immunity		ESD (IEC 61800-5-1, IEC 61000-4-2) EFT (IEC 61800-5-1, IEC 61000-4-4) Surge Test (IEC 61800-5-1, IEC 61000-4-5) Conducted Susceptibility Test (IEC 61800-5-1, IEC 61000-4-6)

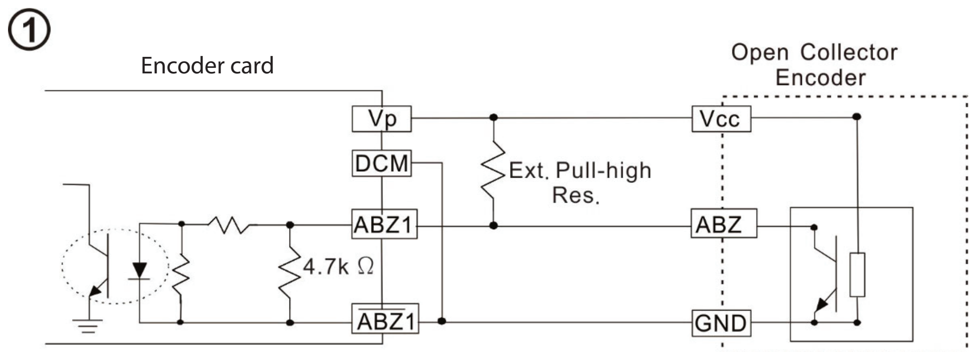
Operation / storage	Operation: -10°C~50°C [14°F~122°F] (temperature), 90% (humidity) Storage: -25°C~70°C [-13°F~158°F] (temperature), 95% (humidity)
Vibration / shock immunity	International standard: IEC 61800-5-1, IEC 60068-2-6/IEC 61800-5-1, IEC 60068-2-27

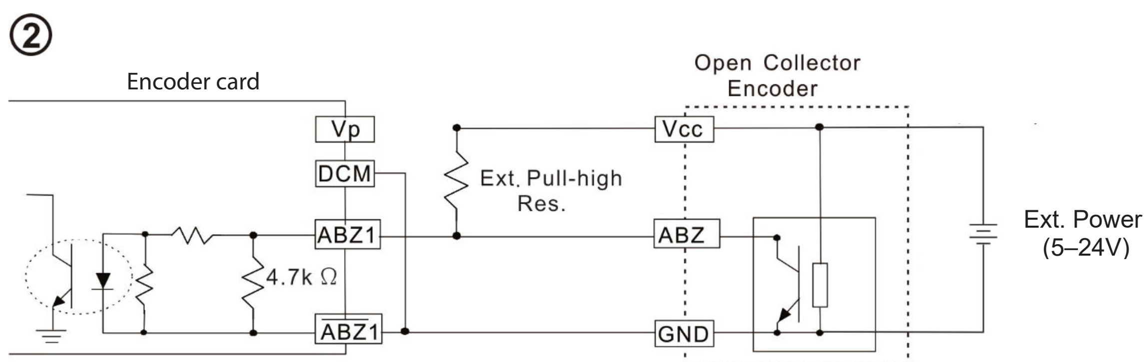
NOTE: Open collector applicatoin: input current 5-15 mA to each set and each set needs one pull-up resistor. If the input voltage of the open collector is 24V, power for the encoder must be connected exernally.

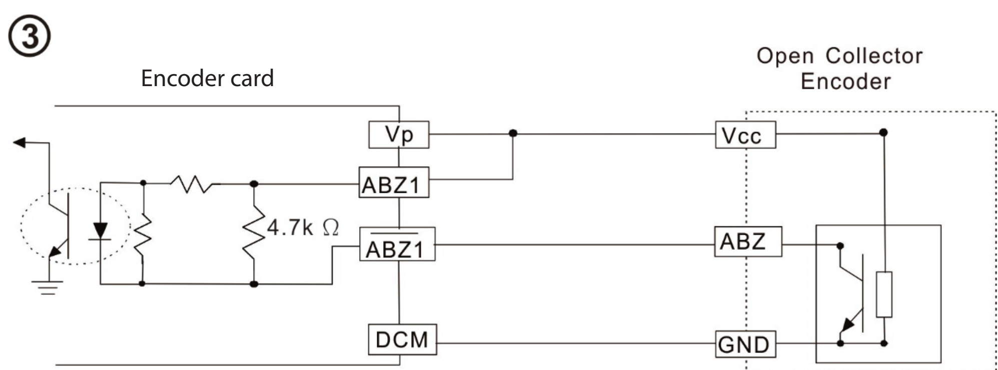
Input Voltage	*Recommendation*
5V	Recommended pull-up resistor: above 100–220Ω, 1/2 W
12V	Recommended pull-up resistor: above 510Ω–1.35 kΩ, 1/2 W
24V	Recommended pull-up resistor: above 1.8–3.3 kΩ, 1/2 W

Wiring Diagrams

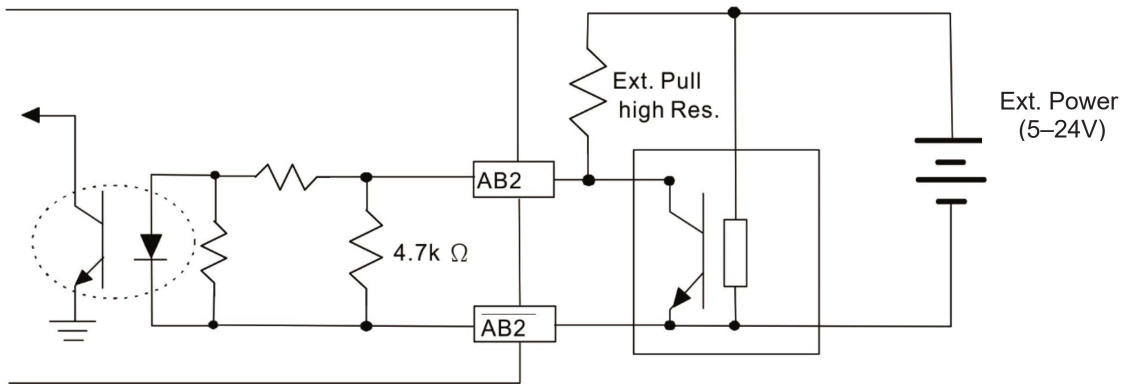
Encoder Wiring Diagram





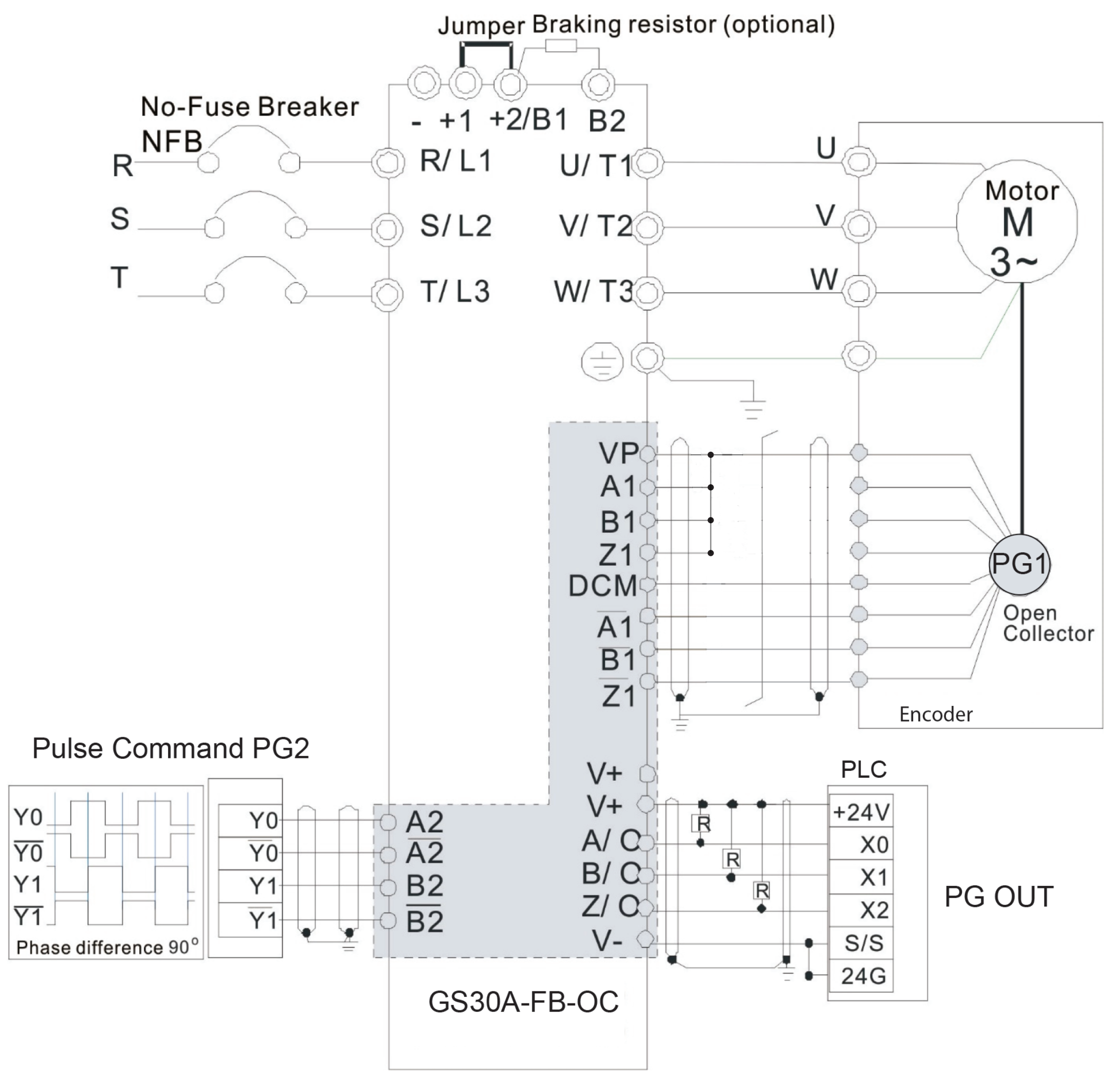


Encoder Wiring Diagram



GS30A-FB-OC Wiring

- *Use a shielded cable to prevent interference. Do not run control wires parallel to any high voltage AC power line (200VAC and above)*
- *Recommended wire size: 0.0509–1.31mm² (30-16 AWG)*
- *Cable length: less than 30m*



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Appendix C: Digital and Analog I/O Parameter Maps

Introduction

This section contains worksheets to help with designing and programming the physical inputs and outputs of the GS30 (digital, analog, and frequency interfaces). These worksheets provide the GS30 parameters and addresses associated with each input and output. For detailed parameter descriptions, please see Chapter 4 “AC Drive Parameters”. For more detailed wiring information, please see Chapter 2 “Installation and Wiring.

Digital and analog I/O parameter maps begin on the following page.

GS30 Digital Inputs

GS30 Digital Inputs								
GS30 Terminals	FWD/DI1	REV/DI2	DI3	DI4	DI5	DI6	DI7	Comments
PLC Address	X0	X1	X2	X3	X4	X5	X6	
Parameter	**P02.00** if ≠ 0, else: **P02.01**	**P02.00** if ≠ 0, else: **P02.02**	(**P02.00** if=**3 or 6)** else **P02.03**	**P02.04**	**P02.05**	**P02.06**	**P02.07**	See Digital Input Configurations Below
Default Setting	**P2.00**=1, **P02.01**=0	**P02.00**=1, **P02.02**=0	1	2	3	4	0	
Default Configuration	2 wire mode: FWD/STOP	2 wire mode: REV/STOP	Multi Spd 1	Multi Spd 2	Multi Spd 3	Multi Spd 4	No Function	
User Defined Selection / Value								
DI - N.C. / N.O. Select **P02.12 - Bit #**	0	1	2	3	4	5	6	0 = N.O. 1 = N.C.
Default Configuration	0 = Normally Open							
User Defined Selection / Value								
DI - Response Time	**P02.11**							0 to 30.000 seconds
Default Configuration	0.005 seconds							
User Defined Selection / Value								
DI - Active Status Monitor **P02.50 - Bit #**	0	1	2	3	4	5	6	Read Only!
DI - PLC Status Monitor **P02.52 - Bit #**	0	1	2	3	4	5	6	

* *Note for PLC Address: When an external input is used in the PLC and the PLC is in Run or Stop mode, the PLC then controls that input and any Multi-Function Input setting assigned via P02.00~P02.07 is void. To read the status of an input into the PLC while maintaining the multifunction input setting use the RPR command on the DI Status Register (P02.50). The control of the IO can be given back to the drive by disabling the PLC either through the Keypad or Digital Inputs when they are assigned values 51 and 52.*

Digital Input Configurations – Parameters P02.01~P02.07

0: No function
1: Multi-step speed command 1
2: Multi-step speed command 2
3: Multi-step speed command 3
4: Multi-step speed command 4
5: Reset
6: JOG [by external control or GS4-KPD (optional)]
7: Acceleration / deceleration speed inhibit
8: 1st and 2nd acceleration / deceleration time selection
9: 3rd and 4th acceleration / deceleration time selection
10: External Fault (EF) Input (P07.20)
11: Base Block (B.B.) input from external source
12: Output stop
13: Cancel the setting of autoacceleration / auto-deceleration time
15: Frequency command from AI1
16: Frequency command from AI2
18: Force to stop (P07.20)
19: Digital up command
20: Digital down command
21: PID function disabled
22: Clear the counter
23: Input the counter value (DI6)
24: FWD JOG command
25: REV JOG command
26: TQC / FOC mode selection
27: ASR1 / ASR2 selection
28: Emergency stop (EF1)
29: Signal confirmation for Y-connection
30: Signal confirmation for δ-connection
31: High torque bias (P11.30)
32: Middle torque bias (P11.31)
33: Low torque bias (P11.32)
38: Disable writing EEPROM function
39: Torque command direction
40: Force coasting to stop
41: HAND switch
42: AUTO switch
48: Mechanical gear ratio switch
49: Enable drive
50: Slave dEb action to execute
51: Selection for PLC mode bit 0
52: Selection for PLC mode bit 1
56: Local / Remote selection
58: Enable fire mode (with RUN command)
59: Enable fire mode (without RUN command)
70: Force auxiliary frequency return to 0
71: Disable PID function, force PID output return to 0
72: Disable PID function, retain the output value before disabled
73: Force PID integral gain return to 0, disable integral
74: Reverse PID feedback
81: Simple positioning zero point position signal input
82: OOB loading balance detection
83: Multi-motor (IM) selection bit 0
84: Multi-motor (IM) selection bit 1

GS30 Digital Outputs

GS30 Digital Outputs				
GS30 Terminals	R1-R1C-R1O	DO1-DOC	DO2-DOC	Comments
PLC Address	Y0	Y3	Y4	
Parameter	**P02.13**	**P02.16**	**P02.17**	See Digital Output Configurations Below
Default Setting	11	0	0	
Default Configuration	Malfunction Indication	No Function		
User Defined Selection / Value				
DO - N.C. / N.O. Select **P02.18 - Bit #**	0	3	4	0 = N.O. 1 = N.C.
Default Configuration	0	0	0	
User Defined Selection / Value				
DO - Active Status Monitor **P02.51 - Bit #**	0	3	4	Read Only!
DO - PLC Status Monitor **P03.53 - Bit #**	0	3	4	

** Note for PLC Address: When an external output is used in the PLC and the PLC is in Run or Stop mode, the PLC then controls that output and any Multi-Function Output setting assigned via P02.13, P02.16, and P02.17 is void. To read the status of an output from the PLC while maintaining the multifunction output setting, use the RPR command on the DO Status Register (P02.51). The ownership of the IO can be given back to the drive by disabling the PLC either through the Keypad or Digital Inputs when they are assigned values 51 and 52.*

Digital Output Configurations – Parameters P02.13, P02.16, and P02.17

0: No function
1: Indication during RUN
2: Operation speed reached
3: Desired frequency reached 1 (P02.22)
4: Desired frequency reached 2 (P02.24)
5: Zero speed (Frequency command)
6: Zero speed including STOP (Frequency command)
7: Over-torque 1 (P06.06–06.08)
8: Over-torque 2 (P06.09–06.11)
9: Drive is ready
10: Low voltage warning (Lv) (P06.00)
11: Malfunction indication
13: Overheat warning (P06.15)
14: Software brake signal indicator (P07.00)
15: PID feedback error (P08.13, P08.14)
16: Slip error (oSL)
17: Count value reached, does not return to 0 (P02.20)
18: Count value reached, return to 0 (P02.19)
19: External interrupt B.B. input (Base Block)
20: Warning output
21: Over-voltage
22: Over-current stall prevention
23: Over-voltage stall prevention
24: Operation mode
25: Forward command
26: Reverse command
29: Output when frequency ≥ P02.34
30: Output when frequency < P02.34
31: Y-connection for the motor coil
32: δ-connection for the motor coil
33: Zero speed (actual output frequency)
34: Zero speed including STOP (actual output frequency)
35: Error output selection 1 (P06.23)
36: Error output selection 2 (P06.24)
37: Error output selection 3 (P06.25)
38: Error output selection 4 (P06.26)
40: Speed reached (including STOP)
42: Crane function
43: Motor speed detection
44: Low current output (use with P06.71–06.73)
45: UVW output electromagnetic valve switch
46: Master dEb output
51: Analog output control for RS-485 interface
52: Output control for communication cards
53: Fire mode indication
66: SO output logic A
67: Analog input level reached
68: SO output logic B
73: Over-torque 3
74: Over-torque 4
75: Forward RUN status
76: Reverse RUN status

GS30 Analog Common Parameters

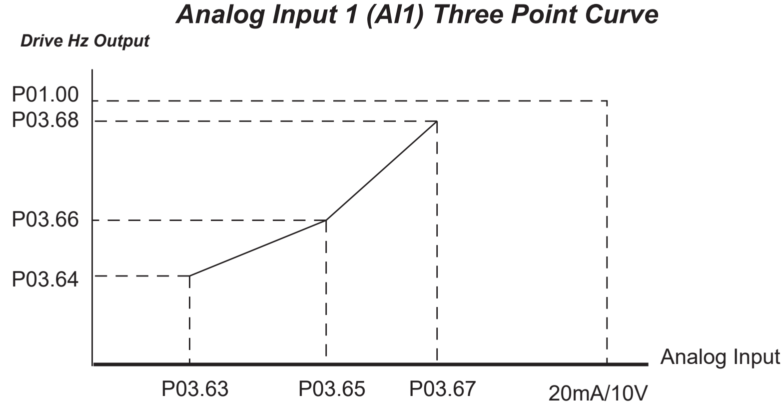
GS30 – AI1 and AI2 – Common Parameters				
Parameter		**Selection / Value**	**Default**	**User Selection**
P00.20	Master frequency command source (AUTO, REMOTE)	0: Digital keypad 1: RS-485 communication input 2: External analog input (Refer to P03.00) 3: External UP / DOWN terminal (digital input terminals) 4: Pulse input (DI7) without direction command 6: Not used 7: Reserved 8: Communication card 9: PID controller	0	
P00.30	Master frequency command source (HAND, LOCAL)		0	

GS30 Analog Input 1 Parameters

GS30 – AI1 Specific Parameters				
Parameter		**Selection / Value**	**Default**	**User Selection**
Terminals		**AI1 – ACM**	**N/A**	**N/A**
PLC Address		**D1028**	**N/A**	**N/A**
P03.00	Analog input selection (AI1)	1: Frequency command 2: Torque command (torque limit under speed mode) 3: Torque compensation command 4: PID target value 5: PID feedback signal 6: Thermistor (PTC) input value 7: Positive torque limit 8: Negative torque limit 9: Regenerative torque limit 10: Positive / negative torque limit 11: PT100 RTD input value 12: Auxiliary frequency input 13: PID compensation value	1	
P03.28	AI1 terminal input selection	0: 0–10 V (P03.63–P03.68 is valid) 3: -10–10 V (P03.63–P03.74 are valid)	0	
P03.03	Analog input bias (AI1)	-100.0% to +100.0%	0	
P03.07	Positive / negative bias mode (AI1)	0: No bias 1: Lower than or equal to bias 2: Greater than or equal to bias 3: The absolute value of the bias voltage while serving as the center 4: Bias serves as the center	0	
P03.11	Analog input gain (AI1)	-500.0% to +500.0%	100.0	
P03.15	Analog input filter (LPF) time (AI1)	0.00~20.00 sec	0.01	
P03.47	AI1%	-100 to 100%	0	
P03.50	Analog input curve calculation selection	0: Normal curve 1: Three-point curve of AI1 2: Three-point curve of AI2 3: Three-point curve of AI1 & AI2	0	
Parameters below are used to characterize the GS30 drive output frequency with three point curve parameters if using AI1 for speed reference (bias and gain parameters above are not used when P03.50 ≠ 0).				
P03.63	AI1 votage lowest point	0.00~10.00V	0	
P03.64	AI1 proportional lowest point	-100.00~100.00%	0	
P03.65	AI1 voltage mid-point	0.00~10.00V	5	
P03.66	AI1 proportional mid-point	-100.00~100.00%	50.00	
P03.67	AI1 voltage highest point	0.00~10.00V	10	

GS30 – AI1 Specific Parameters (continued)				
Parameter		**Selection / Value**	**Default**	**User Selection**
P03.68	AI1 proportional highest point	-100.00~100.00%	100.00	
P03.69	Negative AI1 voltage highest point	-10.00–0.00 V (valid when P03.28 sets as -10–10 V)	0.00	
P03.70	Negative AI1 proportional highest point	-100.00–100.00% (valid when P03.28 sets as -10–10 V)	0.00	
P03.71	Negative AI1 voltage mid-point	-10.00–0.00 V (valid when P03.28 sets as -10–10 V)	-5.00	
P03.72	Negative AI1 proportional mid-point	-100.00–100.00% (valid when P03.28 sets as -10–10 V)	-50.00	
P03.73	Negative AI1 voltage lowest point	-10.00–0.00 V (valid when P03.28 sets as -10–10 V)	-10.00	
P03.74	Negative AI1 proportional lowest point	-100.00–100.00% (valid when P03.28 sets as -10–10 V)	-100.00	

Analog Input 1 (AI1) Three Point Curve



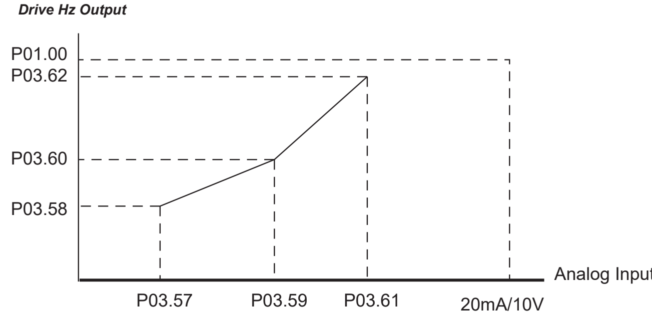
GS30 Analog Input 2 Parameters

GS30 – AI2 Specific Parameters				
Parameter		**Selection / Value**	**Default**	**User Selection**
Terminals		**AI2 – ACM**	**N/A**	**N/A**
PLC Address		**D1029**	**N/A**	**N/A**
P03.01	Analog input selection (AI2)	1: Frequency command 2: Torque command (torque limit under speed mode) 3: Torque compensation command 4: PID target value 5: PID feedback signal 6: Thermistor (PTC) input value 7: Positive torque limit 8: Negative torque limit 9: Regenerative torque limit 10: Positive / negative torque limit 11: PT100 RTD input value 12: Auxiliary frequency input 13: PID compensation value	0	
P03.29	AI2 terminal input selection	0: 4–20 mA 1: 0–10 V 2: 0–20 mA	0	
P03.04	Analog input bias (AI2)	-100.0% to +100.0%	0	

GS30 – AI2 Specific Parameters (continued)				
Parameter		**Selection / Value**	**Default**	**User Selection**
P03.08	Positive/negative bias mode (AI2)	0: No bias 1: Lower than or equal to bias 2: Greater than or equal to bias 3: The absolute value of the bias voltage while serving as the center 4: Bias serves as the center	0	
P03.12	Analog input gain (AI2)	-500.0% to +500.0%	100.0	
P03.16	Analog input filter (LPF) time (AI2)	0.00~20.00 sec	0.01	
P03.48	AI2%	-100 to 100%	0	
P03.50	Analog input curve calculation selection	0: Normal curve 1: Three-point curve of AI1 2: Three-point curve of AI2 3: Three-point curve of AI1 & AI2	0	
Parameters below are used to characterize the GS30 drive output frequency with three point curve parameters if using AI2 for speed reference (bias and gain parameters above are not used when P03.50 ≠ 0).				
P03.57	AI2 lowest point	P03.29=0: 4.00~20.00mA P03.29=1: 0.00~10.00V P03.29=2: 0.00~20.00mA	P03.29=0: 4.00mA P03.29=1: 0.00V P03.29=2: 0.00mA	
P03.58	AI2 proportional lowest point	0.00~100.00%	0	
P03.59	AI2 voltage mid-point	P03.29=0: 4.00~20.00mA P03.29=1: 0.00~10.00V P03.29=2: 0.00~20.00mA	P03.29=0: 12.00mA P03.29=1: 5.00V P03.29=2: 10.00mA	
P03.60	AI2 proportional mid-point	0.00~100.00%	50.00	
P03.61	AI2 voltage highest point	P03.29=0: 4.00~20.00mA P03.29=1: 0.00~10.00V P03.29=2: 0.00~20.00mA	P03.29=0: 20.00mA P03.29=1: 10.00V P03.29=2: 20.00mA	
P03.62	AI2 proportional highest point	0.00~100.00%	100.00	

P03.19 (Loss of AI2) determines the drive behavior if the 4~20mA signal is lost.

Analog Input 2 (AI2) Three Point Curve



GS30 Analog Output 1 Parameters

GS30 – AO1 Specific Parameters				
Parameter		***Selection / Value***	***Default***	***User Selection***
Terminals		***AO1 – ACM***	***N/A***	***N/A***
PLC Address		***D1040***	***N/A***	***N/A***
P03.20	Multi-function output (A01)	0: Output frequency (Hz) 1: Frequency command (Hz) 2: Motor speed (Hz) 3: Output current (rms) 4: Output voltage 5: DC bus voltage 6: Power factor 7: Power 8: Output torque 9: AI1 10: AI2 12: Iq current command 13: Iq feedback value 14: Id current command 15: Id feedback value 16: Vq-axis voltage command 17: Vd-axis voltage command 18: Torque command 19: Encoder Pulse (DI7) frequency command 21: RS-485 analog output 22: Communication card analog output 23: Constant voltage output	0	
P03.21	Analog output gain (A01)	0.0~500.0%	100.0	
P03.22	Analog output in REV direction (A01)	0: Absolute Value 1: 0V When Negative 2: Offset 5V = 0 Value	0	
P03.27	A01 output bias	-100.00–100.00%	0.00	
P03.31	A01 output selection	0: 0–10 V output 1: 0–20 mA output 2: 4–20 mA output	0	
P03.32	A01 DC output setting level	0.00~100.00%	0.00	
P03.35	A01 output filter time	0.00–20.00 sec.	0.01	

GS30 Frequency Output Parameters

GS30 – Frequency Output Specific Parameters				
Parameter		***Selection / Value***	***Default***	***User Selection***
Terminals		***DO – DCM***	***N/A***	***N/A***
PLC Address		***N/A***	***N/A***	***N/A***
P02.21	Digital output gain (DO) (Pulse per second output = actual output frequency x P3.38)	1~55 (1 = no scaling)	1	

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Appendix D Overview

The material presented here will help you connect your GS30 drive to an ADC PLC. The concepts and techniques used can also be applied to any 3rd party PLC.

There are two ways a PLC can control the drive; via communications or via physical inputs. The GS30 supports serial Modbus via the built-in RS-485 connections. Ethernet communication is available by installing an EtherNet/IP option card (that can be configured as Ethernet/IP or Modbus TCP).

GS30 supports a variety of I/O on the main control board.

- *7 Sinking/sourcing DC inputs (includes 1 Hi-speed pulse input, 30V/30mA/33kHz max)*
- *2 Sinking/sourcing DC outputs*
- *1 Form C relay output (inductive load [cosØ 0.4] 1.2A [NO or NC] @ 250VAC)*
- *2 Analog inputs (0~10V, -10~10V, 0~20 mA, 4~20 mA)*
- *1 Analog output (0~10V, -10~10V, 4~20 mA)*
- *1 Hi-speed pulse output (30V/30mA/33kHz max)*

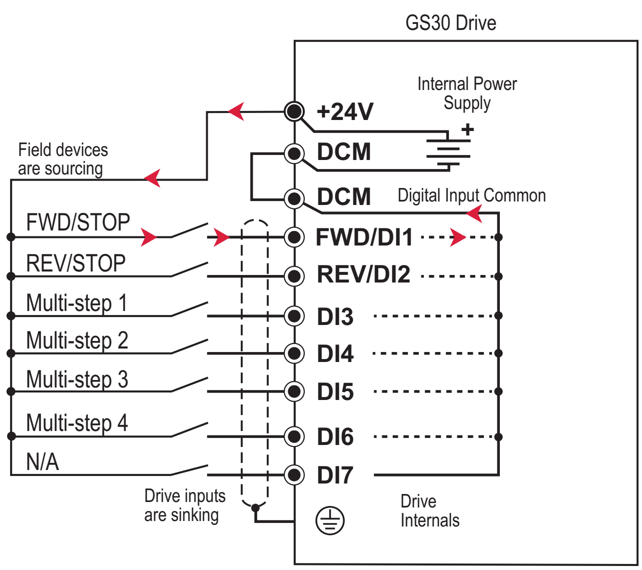
Sinking/Sourcing Basics

GS30 DC inputs and outputs can be sinking or sourcing, depending on how they are wired. If you understand the basics of how sinking and sourcing work, the two options can be easily applied.

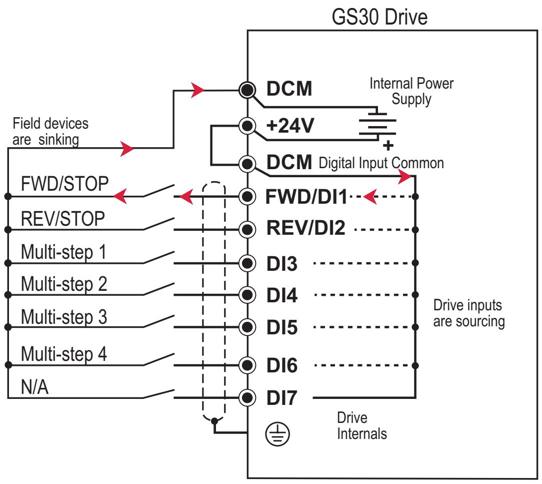
- *For a detailed technical explanation of sink and source, please follow this link: www.automationdirect.com/static/specs/sinksource.pdf*

The term "sinking" means that the device "sinks" current into itself. It does not supply current. Sinking inputs are ON when you apply voltage (and thus, current) to them. A "sinking" device needs to have a "sourcing" device attached to it to supply current.

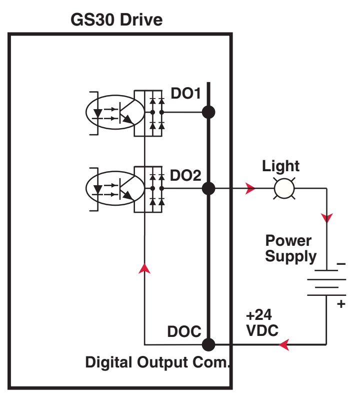
So, if the GS30 inputs are wired for sinking, they require the external device (FWD/STOP switch in this example) to supply current (when closed, the external device will "source" current). Notice the current flow represented by the red arrows. The GS30 input "sinks" the current flow.



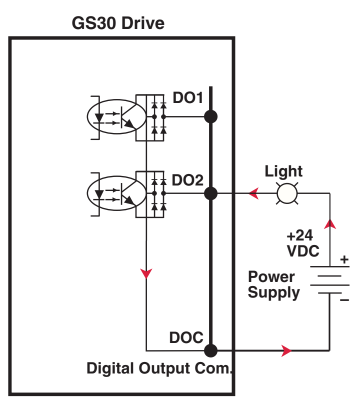
GS30 DC inputs can also be wired for sourcing. In this configuration, notice that the 24VDC supply is feeding into the DIC (Digital Input Common) terminal and the current is coming out of the drive input (GS30 is sourcing) and the field device is sinking the current.



GS30 DC outputs can also be wired as sinking or sourcing. A sourcing output supplies current. This requires a device (pilot light, buzzer, PLC input card) that will sink the current. Notice how the electronics of the output allow current to flow out the DO1 or DO2 terminal. The DOC (Digital Output Common) terminal is connected to +24VDC.



The same drive output circuit can be used to sink current. Notice below that the DOC terminal is now connected to the power supply common. The pilot light sources the current into the drive. The drive output sinks the current. (Even though the light has 24V on it at all times, it will not light up unless current is flowing through it and into the drive output).

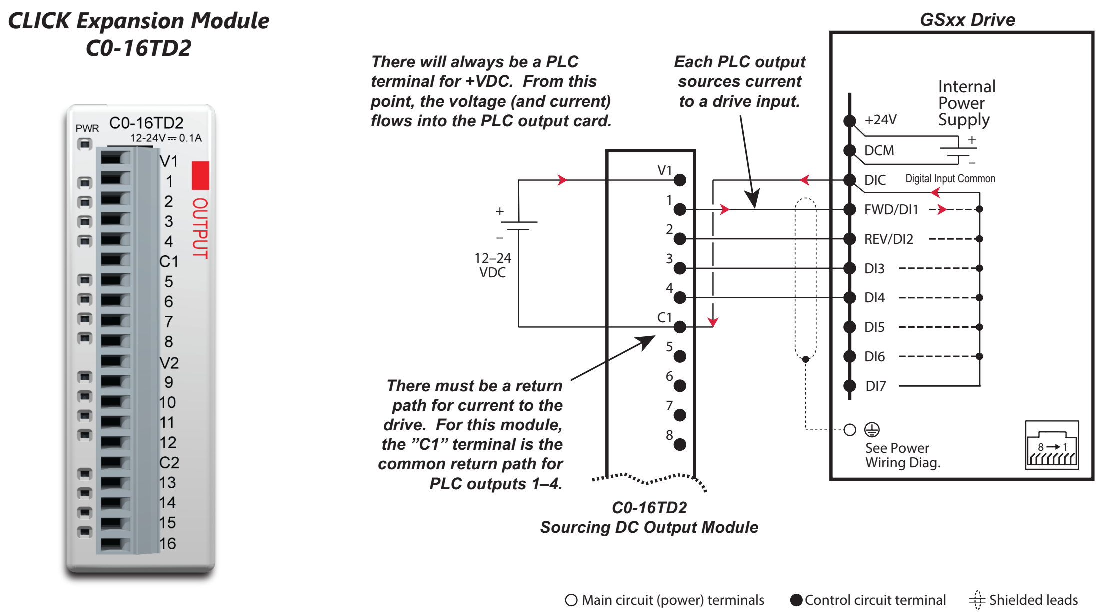


NOTE: GS30 output can be wired as sinking or sourcing, but not both at the same time.

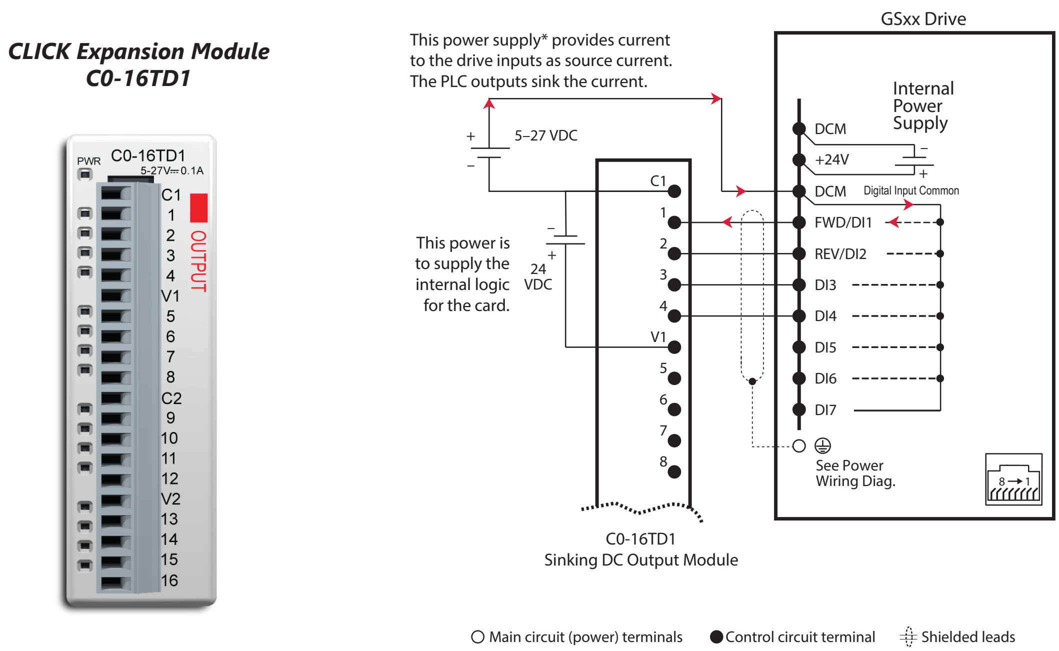
GS30-to-PLC I/O Wiring Examples

This section shows typical wiring examples of PLC inputs and outputs connected to a GS30 drive. While we are using CLICK PLCs in the examples, the samples should be relevant to most PLCs. The terminal designation of other PLCs may be different, but the general connections should be the same (i.e. in the 1st example below, all PLC sourcing output modules will have a +VDC connection, a DC common terminal, and individual outputs). In the examples below, we make note of the typical connections involved. We also indicate current flow (with red arrows) to emphasize which modules are sourcing and which modules are sinking.

Drive Wired with DC Sinking Inputs (PLC output card is sourcing)



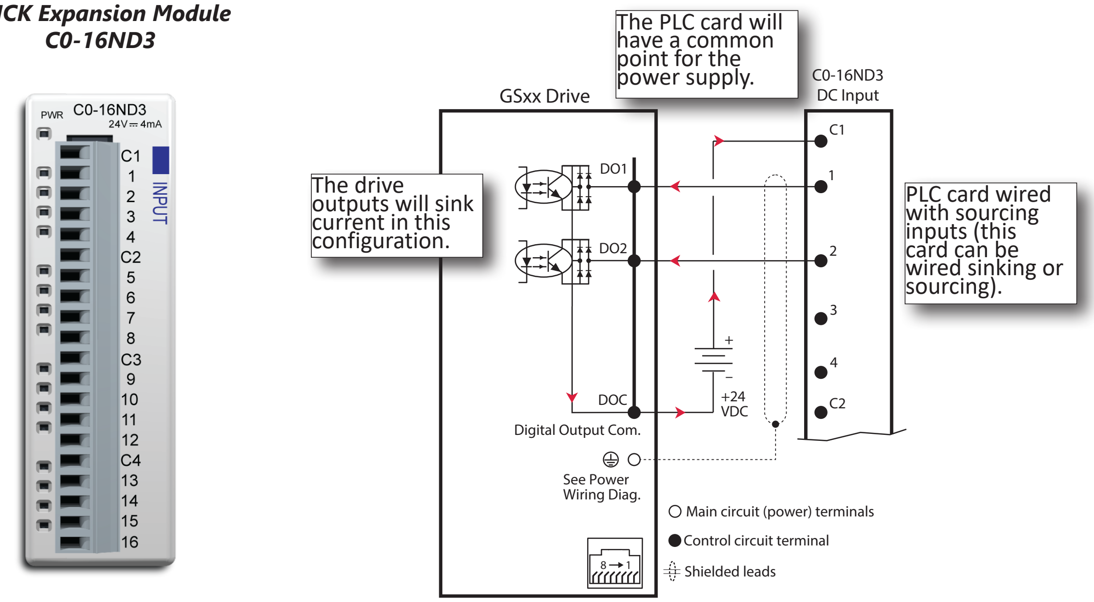
Drive Wired with DC Sourcing Inputs (PLC output card is sinking)



*Alternately, the drive internal power supply (+24V) could be used. However, the

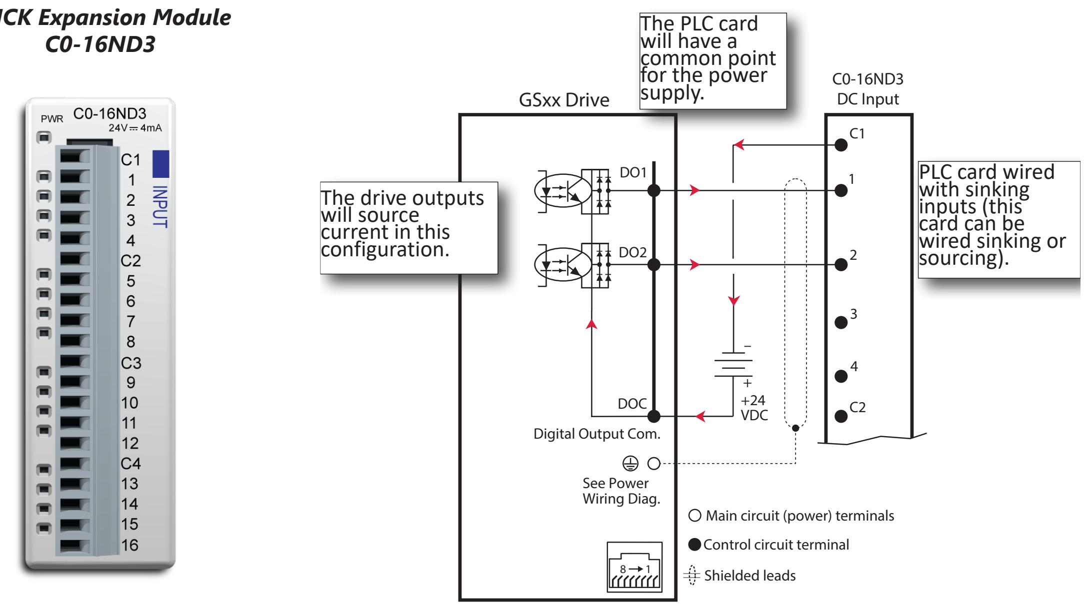
Drive Wired with DC Sinking Outputs (PLC input card is sourcing)

CLICK Expansion Module C0-16ND3



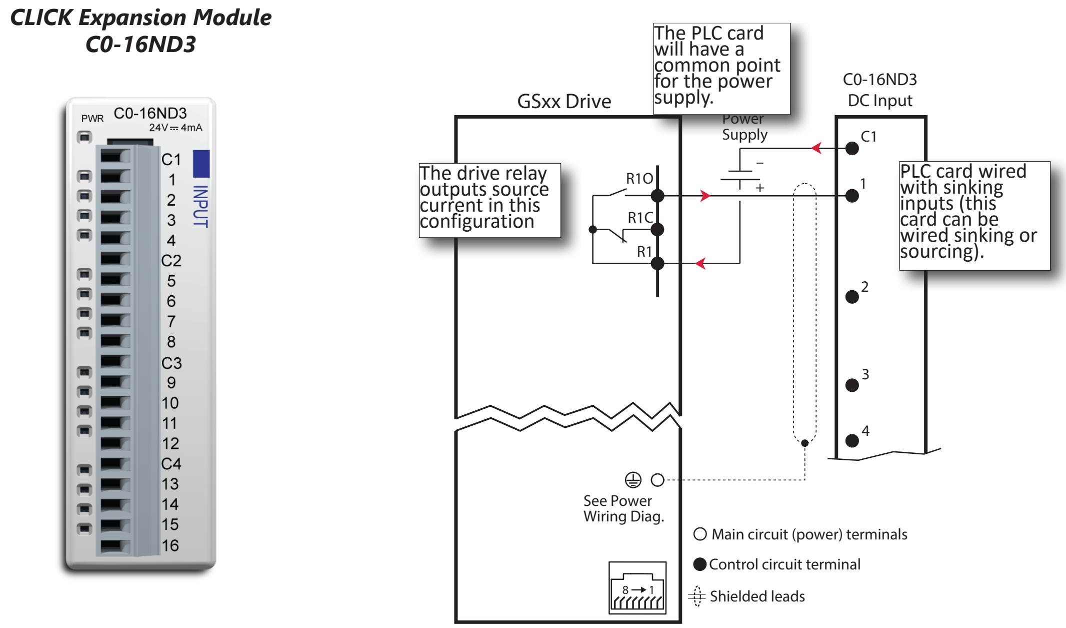
Drive Wired with DC Sourcing Outputs (PLC input card is sinking)

CLICK Expansion Module C0-16ND3



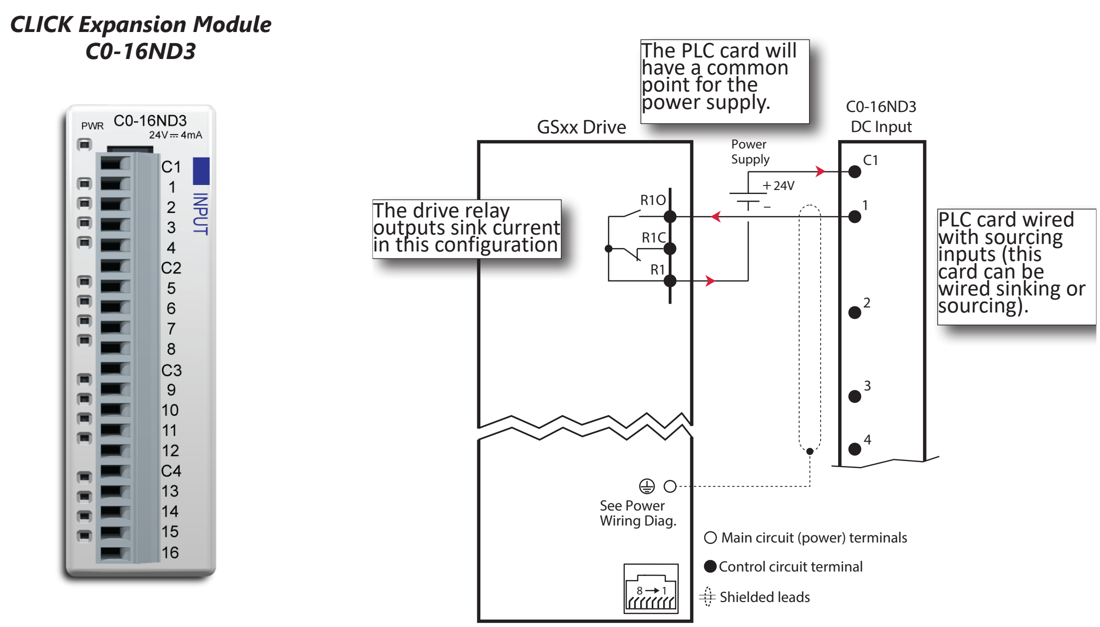
Drive Relay Outputs Wired with Sinking PLC Modules

In this example, the inputs are wired to the Normally-Open contacts (R1O). You could also wire to the Normally-Closed contacts (R1C), but you would not be able to tell if the drive lost power or if the drive outputs are simply OFF.



Drive Relay Outputs Wired with Sourcing PLC Modules

In this example, the inputs are wired to the Normally-Open contacts (R1O). You could also wire to the Normally-Closed contacts (R1C), but you would not be able to tell if the drive lost power or if the drive outputs are simply OFF.



Drive Analog Inputs

The GS30 has 2 analog inputs (AI1 and AI2) that can be configured for a variety of input functions. AI1 and AI2 must be configured via drive parameters group 3. AI2 has a DIP switch located above the I/O terminal strip that allows configuration as voltage or current input. AI1 is voltage input only. Both inputs have a variety of settings in Parameter Group 3 (P03.xx) that allows you to customize their scaling, offset, etc.

- *AI1: 0~10V, -10V to +10V*
- *AI2: 0~10V, 4~20 mA, 0~20 mA (See P03.29 and the DIP switch AI2 above the I/O terminals)*

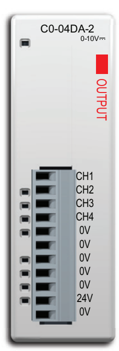
Connecting the analog inputs to PLC outputs is very straightforward. Both analog inputs share the same common.

NOTE: The GS30 AI2 analog input does not supply the current when configured for 0~20 mA or 4~20 mA. The analog output device needs to supply the loop power.

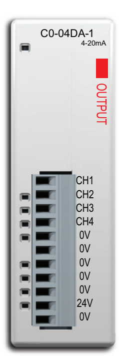
Analog Input Wired for Voltage and Current

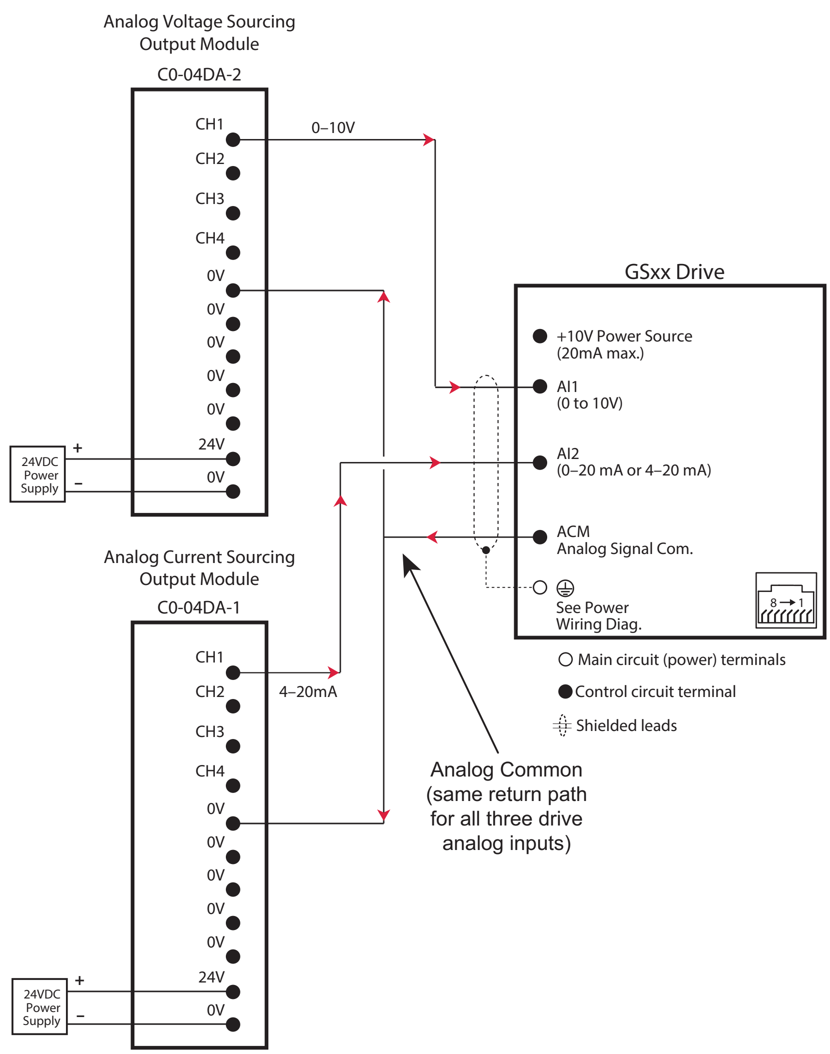
In this example, AI1 is configured for 0~10V (P03.28). AI2 is configured for 4~20 mA (DIP switch and P03.29).

CLICK Expansion Module C0-04DA-2



CLICK Expansion Module C0-04DA-1





Drive Analog Outputs

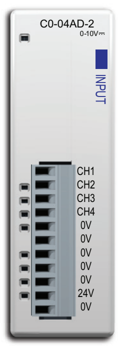
The GS30 has one analog output (AO1) which can be configured for a variety of uses. The output is configured via parameters and DIP switch settings (located above the I/O terminal strip). There are several parameters associated with the analog output that defines the signal and adjusts gain, offset, etc.

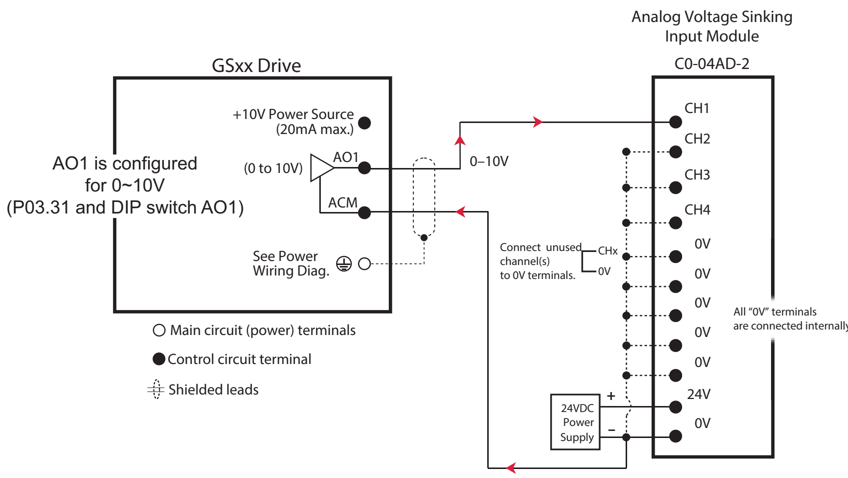
- *AO1: 0~10V or 0~2mA or 4~20mA (see P03.31 and the DIP switch AO1 above the I/O terminals)*

Analog Output Wired for Voltage and Current

In this example AO1 is configured for voltage signal, 0-10V (P03.31 and DIP switch AO1).

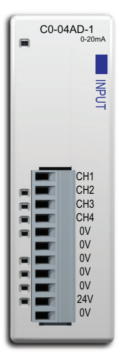
CLICK Expansion module C0-04AD-2

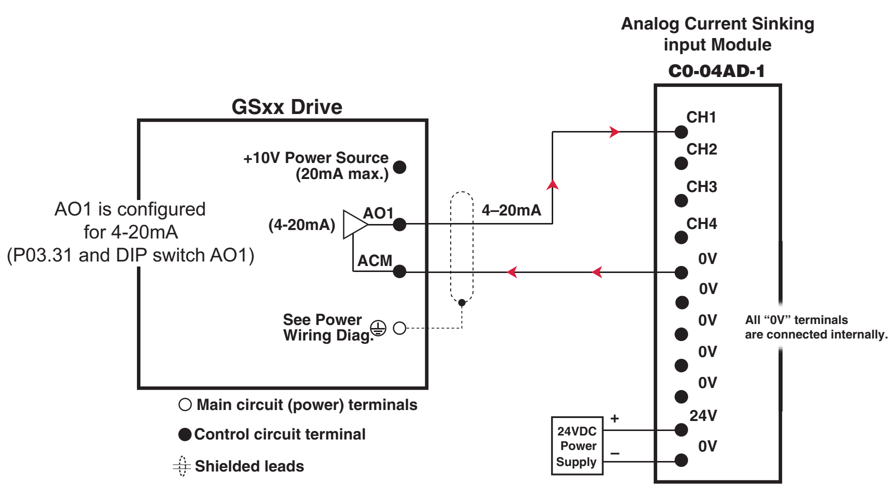




In this example AO1 is configured for current signal, 4-20mA (P03.31 and DIP switch AO1).

CLICK Expansion module C0-04AD-1





Drive Frequency Output (High-speed Pulse Output)

The GS30 has one high-speed pulse train output: DO. This pulse train output is based on the actual frequency output of the drive. A scaling factor is available to adjust the frequency.

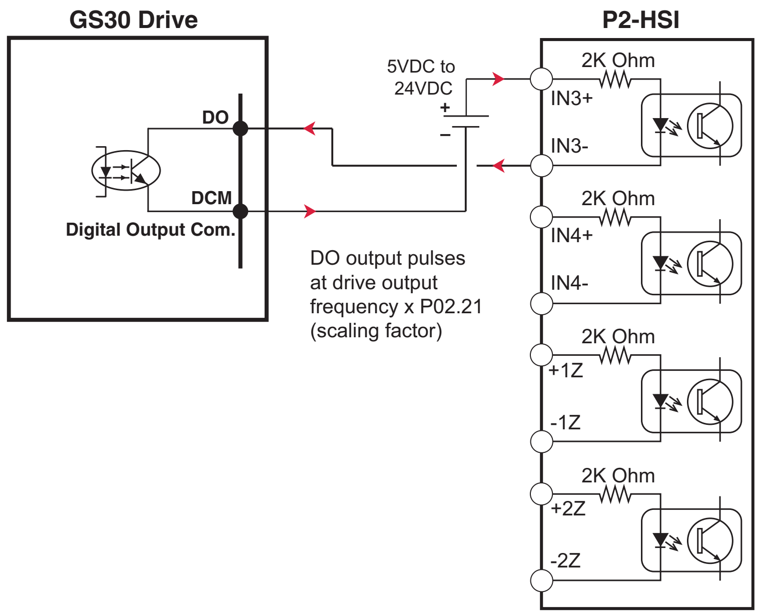
P02.21 Frequency Output Scaling Factor:

- *Actual DO pulses per second output = GS30 output frequency (Hz) x P02.21*

Drive DO output is limited to 30V@ 30mA max. Max frequency is 33kHz (50% duty cycle).

The PLC high-speed input will have a certain amount of resistance built-in (P2-HSI module has 2kΩ resistance). The drive terminal DO needs to see a minimum of 1kΩ resistance.

P2 Expansion Module
P2-HSI



Communication with GS30 Drives

The GS30 drive supports two types of communication:

- *Serial Modbus (built-in RS-485 port)*
- *EtherNet/IP (optional GS30A-CM-EIPx card)*
- *EtherCAT® (optional GS30A-CM-ECAT card)*

Note: Only one serial protocol can be used at a time. Only one Ethernet option card can be installed at a time (You can have serial Modbus and one Ethernet card running at the same time).

Getting Started

This section will point out the "need to know" details of how to connect to your PLC to a GS30 drive.

The first thing to do with the GS30 drive after the basic wiring, is to set up the motor information and protection features. Detailed information on drive setup can be found in Chapter 4: Parameters. After powering up the drive and ensuring that your E-stop and/or STO input work, press MENU on the keypad.

Configure the following minimal set of parameters:

DURA GS30 Parameter Settings – Quick Configuration				
Parameter	***Description***	***Range***	***Default***	***User***
P00.00	GS30 Model ID	Read Only	n/a	
P00.01	Displays AC drive rated current	Displays value based on model	n/a	
P00.02	Restore to default	0=No function 1=Parameter write protect 5=Reset kWH display to 0 6=Reset PLC 7=Reserved 8=Keypad doesn't respond 9=Reset 50Hz defaults 10=Reset 60Hz defaults 11=Reset 50Hz defaults (keep user config) 12=Reset 60Hz defaults (keep user config)	0	
P00.06	Firmware Version	Read Only	n/a	
P00.10	Control Mode	0=Velocity mode 1=P2P APR mode 2=Torque mode	0	
P00.11	Speed Control Mode	0=VF Open Control 1=VF Closed Control 2=SVC 3=IM FOC Encoder Control 4=PM FOC Encoder Control 5=FOC Sensorless 7=IPM Sensorless	0	
P00.16	Load Selection	0=VT 1=CT	1	
P00.20	Frequency Command Source (Auto)	0=Digital keypad 1=Communication RS-485 input 2=External analog input (refer to parm 03.00) 3=Digital keypad dial 4=Encoder reference without direction 5=Encoder reference with direction 8=Comm card 9=PID	0	
P00.21	Operation Command Source (Auto)	0=Digital keypad 1=External terminals 2=Communication RS-485 input 5=Communication card	0	
P00.22	Stop Method	0=Ramp to stop 1=Coast to stop	0	

DURAPULSE GS30 Parameter Settings – Quick Configuration (continued)				
Parameter	***Description***	***Range***	***Default***	***User***
P00.23	Motor Direction	0=Enable forward/reverse 1=Disable reverse 2=Disable forward	0	
P00.29	Local/Remote Selection	0=Standard HOA function 1=Switching Local/Remote, the drive stops 2=Switching Local/Remote, the drive runs as the REMOTE setting for frequency and operation status 3=Switching Local/Remote, the drive runs as the LOCAL setting for frequency and operation status 4=Switching Local/Remote, the drive runs as LOCAL setting when switched to Local and runs as REMOTE setting when switched to Remote for frequency and operation status	0	
P00.30	Master Frequency Command Source (Hand)	0=Digital keypad 1=Communication RS-485 input 2=External analog input (refer to parm 03.00) 3=Digital keypad dial 4=Encoder reference without direction 5=Encoder reference with direction 8=Comm card 9=PID	0	
P00.31	Operation Command Source (Hand)	0=Digital keypad 1=External terminals 2=Communication RS-485 input 5=Communication card	0	
P01.00	Motor 1 Max Frequency	0.00-599.00 Hz	60	
P01.01	Motor 1 Base Frequency	0.00-599.00 Hz	60	
P01.02	Motor 1 Rated Voltage	110V/230V: 0.0~255.0 460V: 0.0~510.0V	220.0 440.0	
P01.09	Startup Frequency	0.00-599.0 Hz	0.5	
P01.12	Acceleration Time 1	P01.45=0: 0.00-600.00 sec P01.45=1: 0.00-6000.00 sec	10.00 10.00	
P01.13	Deceleration Time 1	P01.45=0: 0.00-600.00 sec P01.45=1: 0.00-6000.00 sec	10.00 10.00	
P01.20	Jog Acceleration Time	P01.45=0: 0.00-600.00 sec P01.45=1: 0.00-6000.00 sec	10.00 10.00	
P01.21	Jog Deceleration Time	P01.45=0: 0.00-600.00 sec P01.45=1: 0.00-6000.00 sec	10.00 10.00	
P01.22	Jog Frequency	0.00-599.0 Hz	0.5	
P02.00	2-wire / 3-wire Control	0=No function 1=2-wire mode 1, power on for operation control (D1: FWD/STOP, D2: REV/STOP) 2=2-wire mode 2, power on for operation control (D1: RUN/STOP, D2 REV/FWD) 3=3-wire, power on for operation control (D1: RUN, D2: REV/FWD, D3: STOP) 4=2-wire mode 1, fast start up (D1: FWD/STOP, D2: REV/STOP) 5=2-wire mode 2, fast start up (D1: RUN/STOP, D2: REV/FWD) 6=3-wire, fast start up (D1: RUN, D2: REV/FWD, D3: STOP) Note: In fast start up mode, the drive skips detecting IGBT signal and will run immediately. When using fast start up mode: Terminal output stays in ready status and drive responds to commands immediately. The output terminal will have higher voltage If the drive is short circuited an OC error will display when running up	1	

DURAPULSE GS30 Parameter Settings – Quick Configuration (continued)				
Parameter	***Description***	***Range***	***Default***	***User***
P05.01	Motor 1 Full Load Amps (FLA)	10-120% of drive rated current	#.##	
P05.03	Motor 1 Rated RPM	0-65535	1710	
P05.04	Motor 1 Number of poles	2-20	4	
P06.13	Motor 1 Electronic Thermal Overload Relay	0=Inverter motor (with external forced cooling) 1=Standard motor (motor with fan on the shaft) 2=Disabled	2	
P06.14	Motor 1 Electronic Thermal Relay Time	30.0-600.0	60	
P06.55	Drive Derating Method	0=Constant rated current and limit carrier wave by load current and temperature 1=Constant carrier frequency and limit load current by setting carrier wave 2=Constant rated current (same as setting 0) but no current limit	0	
P13.00	Application Selection	00=Disabled 01=User parameter 02=Compressor 03=Fan 04=Pump 05=Conveyor 06=Machine tool 07=Packing 08=Textiles 10=Logistics 11=PID 12=PID + Auxiliary	0	

NOTE: If you have changed many parameters and cannot get your drive to function the way you want, go to Parameter P00.02 Parameter Reset and enter a value of 9 or 10. This will reset your drive to its factory default settings. Then review the quick start parameters to ensure they are configured as needed.

Your drive should now be ready to function from the keypad and be able to properly protect the motor from an overload. The drive should start and stop by pressing the RUN and STOP keys. The output speed can be changed by turning the dial while the display is showing the “F” setting (frequency). Make sure P00.20 is set to 7 to use the VR/Potentiometer dial on the drive. If the drive doesn’t run, check all power and control wiring, especially wiring associated with STO (E-Stop).

Serial Modbus Monitoring and Control

Serial Modbus connections over RS485 can be made to the GS30 drive using two methods.

The GS30 drive is equipped with one RJ45 port. Using this port, the GS30 drive can be connected to an RS485 network using standard Ethernet cables. For longer cable runs, use the SG+, SG- and SGND terminals, also located on the control terminal board, with shielded cable. See Chapter 2 for detailed wiring specifications and Chapter 5 for detailed Modbus information.

The most common serial port parameters are shown below:

Serial Port Parameters		
GS30	***Description***	***Default***
P09.00	VFD Comm Address	1
P09.01	MODBUS Baud Rate	9.6 kbps
P09.04	MODBUS Protocol (Range Setting)	12: 8N1 (RTU)

Before starting to control the drive or to write to critical parameters, you should ensure that you are addressing the correct values. To check that your PLC is pointing to the correct location, read and write from a non-critical parameter. A good example is P01.17, Deceleration Time 3. As you can see in the Parameter Summary Table (partial from Ch 4 shown below), the Modbus address for P01.17 is 0111H or 40274 decimal (The hex address = the parameter number).

Parameter Summary Table (Excerpt from Table in Ch4)						
Parameter	***Description***	***Range***	***Run Read/ Write***	***MODBUS Address***		***Settings***
				HEX	***Decimal****	***Default***
P01.17	Deceleration Time 3	P01.45=0: 0.00~600.00 sec P01.45=1: 0.0~6000.00 sec	R/W	0111H	40274	10.00
P01.18	Acceleration Time 4	P01.45=0: 0.00~600.00 sec P01.45=1: 0.0~6000.00 sec	R/W	0112H	40275	10.00
P01.19	Deceleration Time 4	P01.45=0: 0.00~600.00 sec P01.45=1: 0.0~6000.00 sec	R/W	0113H	40276	10.00
**Decimal value is a calculation of the Modbus hex address and a decimal constant. For example: 273(decimal value of 0111h) + 40001(decimal constant) = 40274.*						

From the GS30 keypad, change the default value of P01.18 from 10 to 9.97. Now read this value with your PLC to verify your PLC addressing is correct. If your PLC reads back a value of 10, use the keypad to change P01.17 to 9.96 and P1.19 to 9.98. Then try to read again. Remember, some PLCs use Base 0 and some use Base 1 addressing. So, you may need to offset your addressing by 1. If you still have issues, please refer to the detailed Modbus information in Chapter 5.

Once you have verified that your PLC addressing is correct, serial control for the drive is straightforward. Enter the following values to set up PLC Control via RS485 for the drive:

Parameter Settings Table					
Parameter	***MODBUS Address***		***Description***	***Setting Value***	***Note***
	HEX	***Decimal***			
P00.20	0014	40021	Remote source of frequency	1: RS485 Communication 8: Comm card	This allows the RS-485 commands to set the drive speed.
P00.21	0015	40022	Remote source of operation	2: RS-485 Communication 5: Comm card	This allows the RS-485 commands to start and stop the drive.

Now when the P00.20 and P00.21 are set to RS485 or Comm Card, the drive will start via serial commands. The drive will stop by either serial command or by pressing the STOP button on the keypad. To return to local control, set both P00.20 and P00.21 to option 0. The drive will Start and Stop with the keypad. When “F” is displayed on the drive, the dial will set the speed.

There are three command words to control the drive over serial Modbus. Toggling these bits and setting the Frequency Command will control the drive.

Parameter Settings Table			
MODBUS Address		***Description***	***Range***
HEX	***Decimal***		
2000	48193	Bit 0~1	00: no function
			01: Stop
			10: Run
			11: Jog+Run (at P5.00 Jog speed)
		Bit 2~3	reserved
		Bit 4~5	00: no function
			01: FWD
			10: REV
			11: no function
		Bit 6~15	reserved
2001*	48194*	Frequency Command / PID Setpoint *	In 1/100 of Hz (1500 = 15.00 Hz output)
2002	48195	External Fault Input	Bit 0: Trigger External Fault (EF) Bit 1: Reset EF Bit 2: External Interruption (B.B) = ON Bit 5: Enable Fire Mode Bits 6~15: reserved

** For 2001h: When the GS30 drive is configured with Frequency Reference as RS-485, Modbus TCP, or EtherNet/IP (P00.20=1 or 8 and drive in Remote/Auto) – OR – (P00.30=1 or 8 and drive in Local/hand) – AND – Reference > P01.00 Max Output Freq, then the drive will go up to Max Freq where it will remain until Max Freq is modified lower or a lower Freq Ref or a Stop signal is sent to the drive.*

NOTE: The bits are retentive, meaning that you set them once and they will remain in effect until another command changes operation. Example: if you send the Run command, the drive will run. Clearing the Run bit will have no effect. You must send the Stop bit to make the drive Stop.

The status of the drive is reported back in registers 2100h~2110h (48449~48465 decimal). The six most recent faults are found in P06.17–P06.22 (0611h-0616h , 41555 - 41559 decimal). See Chapter 5 for more detailed explanations of these registers.

GS30 Status Addresses (Read Only)						
Description		***Range***		***Modbus Address***		
				Hex	***Dec***	***Octal***
Status Monitor 1	Fault Codes	0: No fault record 1: Over-current during acceleration (ocA) 2: Over-current during deceleration (ocd) 3: Over-current during steady operation (ocn) 4: Ground fault (GFF) 6: Over-current at stop (ocS) 7: Over-voltage during acceleration (ovA) 8: Over-voltage during deceleration (ovd) 9: Over-voltage during constant speed (ovn) 10: Over-voltage at stop (ovS) 11: Low-voltage during acceleration (LvA) 12: Low-voltage during deceleration (Lvd) 13: Low-voltage during constant speed (Lvn) 14: Low-voltage at stop (LvS) 15: Phase loss protection (orP) 16: IGBT overheating (oH1) 18: IGBT temperature detection failure (tH1o) 21: Over load (oL) 22: Electronic thermal relay 1 protection (EoL1) 23: Electronic thermal relay 2 protection (EoL2) 24: Motor PTC overheating (oH3) 26: Over torque 1 (ot1) 27: Over torque 2 (ot2) 28: Under current (uC) 31: EEPROM read error (cF2) 33: U-phase error (cd1) 34: V-phase error (cd2) 35: W-phase error (cd3) 36: cc (current clamp) hardware error (Hd0) 37: oc (over-current) hardware error (Hd1) 40: Auto-tuning error (AUE) 41: PID loss AI2 (AFE) 43: PG feedback loss (PGF2) 44: PG feedback stall (PGF3) 45: PG slip error (PGF4) 48: AI2 loss (ACE) 49: External fault (EF) 50: Emergency stop (EF1) 51: External base block (bb) 52: Password is locked (Pcod) 54: Illegal command (CE1) 55: Illegal data address (CE2)	56: Illegal data value (CE3) 57: Data is written to read-only address (CE4) 58: Modbus transmission time-out (CE10) 61: Y-connection / Δ-connection switch error (ydc) 62: Deceleration energy backup error (dEb) 63: Over slip error (oSL) 72: STO Loss (STL1) 76: STO (STo) 77: STO Loss 2 (STL2) 78: STO Loss 3 (STL3) 79: U-phase over-current before run (Aoc) 80: V-phase over-current before run (boc) 81: W-phase over-current before run (coc) 82: Output phase loss U phase (oPL1) 83: Output phase loss V phase (oPL2) 84: Output phase loss W phase (oPL3) 87: Low frequency overload protection (oL3) 89: Rotor position detection error (roPd) 97: Ethernet Card Timeout (CD10) 111: InrCOM time-out error (ictE) 121: Internal communication error (CP20) 123: Internal communication error (CP22) 124: Internal communication error (CP30) 126: Internal communication error (CP32) 127: Internal communication error (CP33) 128: Over-torque 3 (ot3) 129: Over-torque 4 (ot4) 134: Internal communication error (EoL3) 135: Internal communication error (EoL4) 140: Oc hardware error (Hd6) 141: GFF occurs before run (b4GFF) 142: Auto-tune error 1 (DC test stage) (AuE1) 143: Auto-tune error 2 (High frequency test stage) (AuE2) 144: Auto-tune error 3 (Rotary test stage) (AuE3) 149: Auto-tune error 5 (Rotor resistance measure test stage) (AuE5)	0611	41554	3021
(table continued next page)						

<table>
<tr><th colspan="6">GS30 Status Addresses (Read Only) (continued)</th></tr>
<tr><th rowspan="2">Description</th><th rowspan="2" colspan="2">Range</th><th colspan="3">Modbus Address</th></tr>
<tr><th>Hex</th><th>Dec</th><th>Octal</th></tr>
<tr><td rowspan="22">Status monitor read only</td><td colspan="2">High byte: Warning code / Low Byte: Error code</td><td>2100</td><td>48449</td><td>20400</td></tr>
<tr><td>bit 1–0</td><td>AC motor drive operation status
00B: The drive stops
01B: The drive is decelerating
10B: The drive is in standby status
11B: The drive is operating</td><td rowspan="10">2101</td><td rowspan="10">48450</td><td rowspan="10">20401</td></tr>
<tr><td>bit 2</td><td>1: JOG command</td></tr>
<tr><td>bit 4–3</td><td>Operation direction
00B: FWD running
01B: From REV running to FWD running
10B: From FWD running to REV running
11B: REV running</td></tr>
<tr><td>bit 8</td><td>1: Master frequency controlled by the communication interface</td></tr>
<tr><td>bit 9</td><td>1: Master frequency controlled by the analog / external terminal signal</td></tr>
<tr><td>bit 10</td><td>1: Operation command controlled by the communication interface</td></tr>
<tr><td>bit 11</td><td>1: Parameter locked</td></tr>
<tr><td>bit 12</td><td>1: Enable to copy parameters from keypad</td></tr>
<tr><td>bit 15–13</td><td>Reserved</td></tr>
<tr><td colspan="2">Frequency command (XXX.XX Hz)</td></tr>
<tr><td colspan="2">Output frequency (XXX.XX Hz)</td><td>2103</td><td>48452</td><td>20403</td></tr>
<tr><td colspan="2">Display the drive’s output current (XX.XX A). When the current is higher than 655.35, it automatically shifts one decimal place as (XXX.X A). Refer to the high byte of 211F for information on the decimal places.</td><td>2104</td><td>48453</td><td>20404</td></tr>
<tr><td colspan="2">DC bus voltage (XXX.X V)</td><td>2105</td><td>48454</td><td>20405</td></tr>
<tr><td colspan="2">Output voltage (XXX.X V)</td><td>2106</td><td>48455</td><td>20406</td></tr>
<tr><td colspan="2">Current step for the multi-step speed operation</td><td>2107</td><td>48456</td><td>20407</td></tr>
<tr><td colspan="2">Reserved</td><td>2108</td><td>48457</td><td>20410</td></tr>
<tr><td colspan="2">Counter value</td><td>2109</td><td>48458</td><td>20411</td></tr>
<tr><td colspan="2">Output power factor angle (XXX.X)</td><td>210A</td><td>48459</td><td>20412</td></tr>
<tr><td colspan="2">Output torque (XXX.X %)</td><td>210B</td><td>48460</td><td>20413</td></tr>
<tr><td colspan="2">Actual motor speed (XXXXX rpm)</td><td>210C</td><td>48461</td><td>20414</td></tr>
</table>

Ethernet/IP and Modbus TCP Monitor and Control

EtherNet/IP and ModTCP are very similar to serial Modbus control. After installing the GS30A-CM-EIPx option card (see Appendix B for more information on card installation), set the following parameters:

GS30 Parameter Settings for Ethernet/IP, Modbus TCP Monitor and Control						
Parameter		**Setting**	**Run 1) Read/ Write**	**Modbus Address Hex**	**Modbus Address Dec**	**Note**
P00.21	1st Source of Operation Command [Remote]	5: Comm Card	R/W	0015	40022	This allows Ethernet commands to start and stop the drive while the drive is in Local or Remote mode
P00.31	2nd Source of Operation Command [Local]		R/W	001F	40032	
P00.20	1st Source of Frequency Command [Remote]	8: Comm Card	♦R/W	0014	40021	This allows Ethernet commands to set the drive speed while the drive is in Local or Remote mode
P00.30	2nd Source of Frequency Command [Local]		♦R/W	001E	40031	
P09.74	Set Comm Master Protocol setting	0: Both Ethernet and Modbus 1: Ethernet/IP 2: Modbus TCP	♦R/W	094A	42379	Select Ethernet and/or Modbus depending on desired control

Other key parameters that must be modified (or at least must be known) to set up Ethernet communications					
P09.75	Comm Card IP Configuration	0: Static IP 1: Dynamic IP (DHCP)	R/W	0930	42353
P09.76	Comm Card IP Address Octet 1	0~255	R/W	0931	42354
P09.77	Comm Card IP Address Octet 2	0~255	R/W	0932	42355
P09.78	Comm Card IP Address Octet 3	0~255	R/W	0933	42356
P09.79	Comm Card IP Address Octet 4	0~255	R/W	0934	42357
P09.80	Comm Card Mask Octet 1	0~255	R/W	0935	42358
P09.81	Comm Card Mask Octet 2	0~255	R/W	0936	42359
P09.82	Comm Card Mask Octet 3	0~255	R/W	0937	42360
P09.83	Comm Card Mask Octet 4	0~255	R/W	0938	42361
P09.84	Comm Card Gateway Octet 1	0~255	R/W	0939	42362
P09.85	Comm Card Gateway Octet 2	0~255	R/W	093A	42363
P09.86	Comm Card Gateway Octet 3	0~255	R/W	093B	42364
P09.87	Comm Card Gateway Octet 4	0~255	R/W	093C	42365

Refer to Appendix B for detailed information and an example on how to set up these parameters. We recommend using Static IP (P09.75=0) and testing the communications between drive and PC/PLC with either an Ethernet crossover cable or a simple Ethernet hub/switch *Do not try to commission Ethernet communications for the first time on a larger, managed network*.

Set P09.74 = 2: Modbus TCP for Modbus master control.

Once communications have been established, please refer to the serial Modbus section above for all the relevant Command and Status Words.

Appendix B details all the Implicit and Explicit data that can be transferred to and from the GS30. Below is a list of the Implicit (I/O messaging) data that will be automatically transferred back and forth between the PLC and drive once the connection is configured.

GS30A-CM-EIPx EtherNet/IP I/O Messaging (Implicit Messaging)

- *Trigger type: Cyclic*
- *Transport class: 1*
- *Application behavior: Exclusive owner*

Parameter	O→T	T→O
Data size	Fixed	Fixed
Connection type	Multicast, Point to Point	Mulitcast, Point to Point

GS30A-CM-EIPx EtherNet/IP Communication Parameter

- *Input buffer register: In Assembly Instance = 101, Width = 16 bits, Size = 16*
- *Output buffer register: Out Assembly Instance = 100, Width = 16 bits, Size = 3*
- *Configuration: Instance = 102, Width = 8 bits, Size = 0*

See “GS30A-CM-EIPx EtherNet/IP Communication Protocol Parameter Address Definitions” on page B–31 for more information.

Modbus Remote I/O Control Applications (use MODRW)

The GS30's internal PLC supports RS485 read/write functions, which can be realized using the MODRW command. However, the RS485 serial port must be defined as available for the PLC's RS485 use before writing a program, and P09.31 must be set as -12. After completing settings, the standard functions defined by RS485 can be used to implement read/write commands at other stations. Communications speed is defined by P09.01, the communications format is defined by P09.04, and the PLC's current station number is defined by P09.35. The GS30 currently supports the functions read coil (0x01), read input (0x02), read register (0x03), write to single register (0x06), write to several coils (0x0F), and write to several registers (0x10). Explanations and the usage of these functions are provided as follows:

MODRW Command					***General Meaning***	***Slave Device is GS30 PLC Meaning***	***Slave Device is GS30 Converter Meaning***
S1	***S2***	***S3***	***S4***	***S5***			
Node ID	***Command***	***Address***	***Return D Area***	***Length***			
K3	H01	H500	D0	K18	Read coil (bit)	Read 18 bits of data corresponding to slave station 3 PLC Y0 to Y21. This data is stored by bit 0 to 15 of the station's D0 and bit 0 to bit 3 of D1.	Does not support this function
K3	H02	H400	D10	K10	Read input (bit)	Read 10 bits of data corresponding to slave station 3 PLC X0 to X11. This data is stored by bit 0 to 9 of this station's D10.	Does not support this function
K3	H03	H600	D20	K3	Read register (word)	Read 3 words of data corresponding to slave station 3 PLC T0 to T2. This data is stored by D20 to D22.	Read 3 words of data corresponding to slave station 3 converter parameters P06.00 to P06.02. This data is stored by D20 to D22
K3	H06	H610	D30	n/a	Write to single register (word)	Write slave station 3 PLC's T16 to this station's D30 value	Write slave station 3 converter 06 to 16 parameter to this station's D30 value
K3	H0F	H509	D40	K10	Write to multiple coils (bit)	Write slave station 3 PLC's Y11 to Y22 to bit 0 to 9 of D40.	Does not support this function
K3	H10	H602	D50	K4	Write to multiple registers (word)	Write slave station 3 PLC's T2 to T5 to D50 to D53	Write slave station 3 converter P06.02 to P06.05 parameters to this station's D50 to D53

After implementing MODRW, the status will be displayed in M1077 (485 read/write complete), M1078 (485 read/write error), and M1079 (485 read/write time out). M1077 is defined so as to immediately revert to 0 after the MODRW command has been implemented. However, any of three situations—a report of no error, a data error report, or time out with no report—will cause the status of M1077 to change to On.

Program Examples Using AutomationDirect PLCs

Please see the AutomationDirect support website for sample program downloads. A range of examples for various applications are available.

NOTE: The PLC program can be downloaded from the support resources section of the GS30 drive item page on the AutomationDirect website.

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Appendix E: Safe Torque Off Function

Introduction

Safe Function Failure Rate

Refer to the table below for relevant safe torque off performance and standards.

Item	Definition	Standard	Performance
SFF	Safe Torque Off	IEC61508	STO1-SCM: 88.35% STO2-SCM: 88.2%
HFT (Type A Subsystem)	Hardware Fault Tolerance	IEC61508	1
SIL	Safe Integrity Level	IEC61508	SIL 2
		IEC62061	SILCL 2
PFH	Average Frequency of Dangerous Failure [h-1]	IEC61508	1.36×10^{-9}
PFD_{av}	Probability of Dangerous Failure on Demand	IEC61508	5.99×10^{-6}
PTI	Proof Test Interval	IEC61508	1 year
Category	Category	ISO13849-1	Category 3
PL	Performance Level	ISO13849-1	d
$MTTF_d$	Mean Time to Dangerous Failure	ISO13849-1	High
DC	Diagnostic Coverage	ISO13849-1	Low
For more information on the above performance levels, please refer to the appropriate standard.			

Safe Torque Off Terminal Function Description

The Safe Torque Off (STO) function turns off the power supplied to the motor through the hardware, so that the motor cannot produce torque. This method of removing power from the motor is considered an emergency power off, also known as “coast to stop.”

The Safe Torque Off function utilizes two independent hardware circuits to control the motor current drive signal, and thus turns off the inverter power module output in order to achieve the status of safe stop. In normal E-stop situations, both circuits will be opened (using a dual-channel safety relay, etc.). To restart the drive, the Reset input must be turned ON and the Run command must be cycled from low to high. **If only one of the circuits is opened during an E-stop, the drive considers this an STLx fault and power must be cycled to the drive to clear the error**.

If unknown STO faults occur, the on-board +24V might be getting shorted to ground (+24V to SCM).

STO Terminal Function Descriptions		
Terminals	***Function***	***Description***
+24V	When the STO function is not used, you can disable the STO function by shorting STO1 and STO2 with + 24V.	Output voltage range: +24V ± 10% Output voltage capacity: 100 mA
STO1	Signal input for STO function channel 1	**STO1–SCM / STO2–SCM** Rated input voltage: +24 VDC ± 10%; maximum input voltage: +30 VDC ± 10% Rated input current: 6.67 mA ± 10% **STO activation mode** Input voltage level: 0 VDC < STO1–SCM and STO2–SCM < 5 VDC STO response time: ≤ 20 ms (time required for STO1 / STO2 to operate until the drive stops outputting) **STO cut-off mode** Input voltage level: 11 VDC < STO1–SCM and STO2–SCM < 30 VDC
STO2	Signal input for STO function channel 2	
SCM	Reference ground for STO1 and STO2 signal	

Operation Conditions Description						
Signal	***Channel***	***STO Input Status***				
STO Signal	STO1~SCM	ON	ON	OFF	OFF	x
	STO2~SCM	ON	OFF	ON	OFF	x
Driver Output Status		Ready	STL2 Mode (Torque Output Off)	STL1 Mode (Torque Output Off)	STO Mode (Torque Output Off)	STL3 Mode (Torque Output Off)
Error Displayed on Keypad		No error displayed	STL2	STL1	STO	STL3
Response Time		n/a	≤20ms			
Method of Reset		n/a	Cycle power to drive	Cycle power to drive	Press RESET directly	Cannot reset; Internal Drive failure

<u>Definitions</u>
- STO = Channel 1 and 2 operate simultaneously and enter Safe Torque Off
- STL1 = Channel 1 operates
- STL2 = Channel 2 operates
- STL3 = There is an error detected in the internal loop of channel 1 or channel 2
- STO1-SCM/STO2-SCM ON = STO1-SCM/STO2-SCM inputs a power supply > 11VDC
- STO1-SCM/STO2-SCM OFF = STO1-SCM/STO2-SCM inputs a power supply < 5VDC

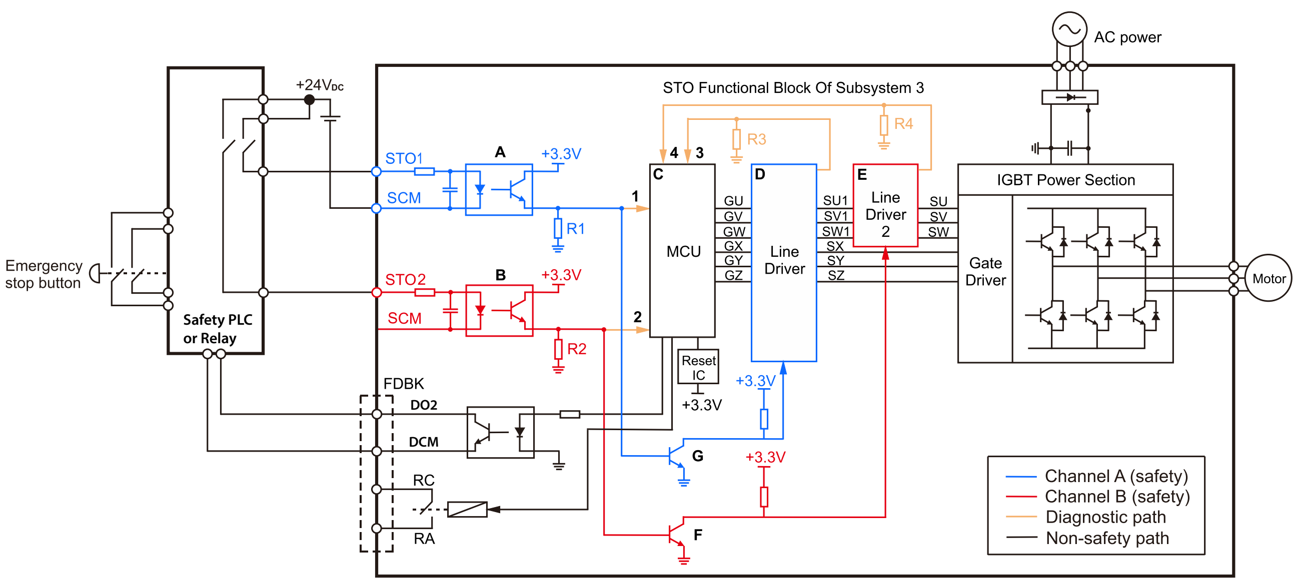
STO alarm is the expected method of Emergency Stop. Both channels open at the same time.

Internal STO Circuit Wiring Diagrams

The GS30 series provides a Safe Torque Off (STO) function. The GS30 uses dual-channel STO1 and STO2 signal inputs to turn off IGBT switching, further preventing the generation of motor torque in order to achieve a safe stop.

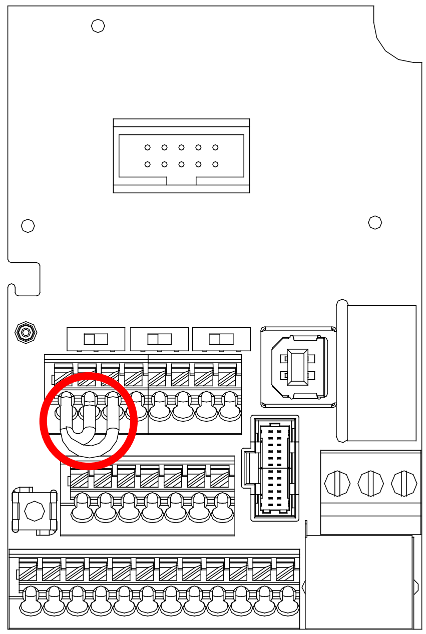
The GS30 Safe Torque Off function meets the following international standards:

- *ISO 13849-1: 2015 Category 3 PL d*
- *IEC 61508 SIL2*
- *EN 62061 SIL CL 2*
- *EN 60204-1 Category 0*



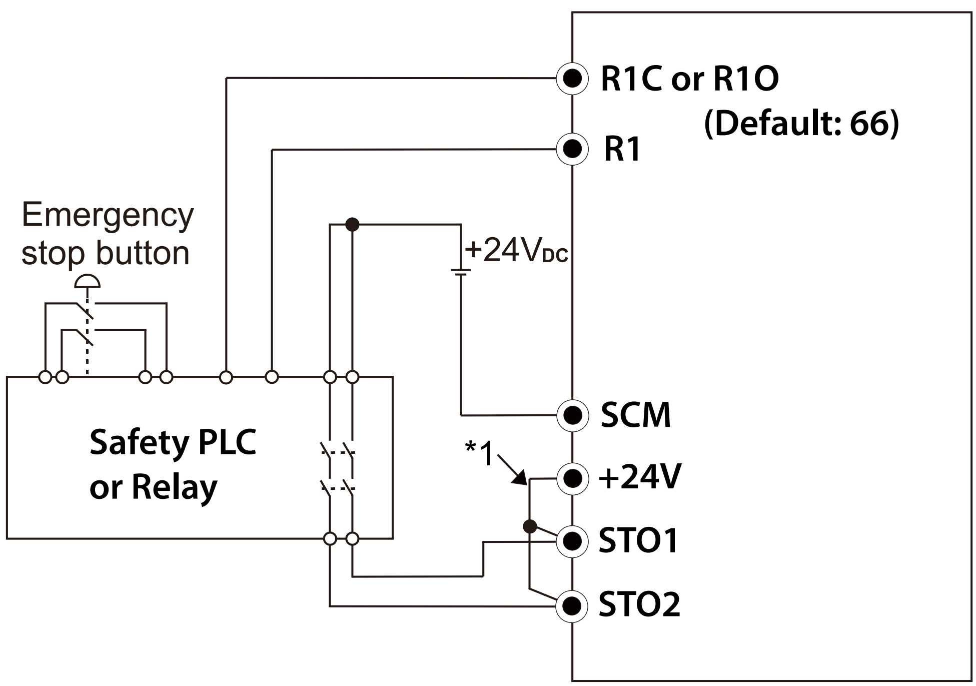
Control Loop Wiring

The illustration below shows the internal circuit diagram of the safe control loop. The terminals of the safe control loop + 24V-STO1-STO2 are short-circuited together with the jumper wire at the factory.



Refer to the safe control loop wiring diagram below:

1) Remove the jumper wire from +24V-STO1-STO2.
2) The wiring is shown below. Normally, you must close the ESTOP contact switch, so the drive can output without displaying an error.
3) In STO mode, the switch ESTOP is turned on. The drive stops outputting and the keypad displays STO.



*NOTE: *1 is factory jumper wire shorting +24V-STO1-STO2. To use the Safety function, remove this jumper wire. To disable the Safety function, short-circuit +24V-STO1-STO2 with a jumper wire.*

STO Parameters

Use P06.44 to specify the reset method when an STO alarm occurs.

		Type	*Hex Addr*	*Dec Addr*
P06.44	***STO Latch Selection***	♦R/W	062C	41581
	Range/Units (Format: 16-bit binary)	*Default*		
	0: STO Latch 1: STO No Latch	0		

Use P06.44 to select STO latch.

- *P06.44 = 0: STO Alarm Latch. After you clear the cause of the STO Alarm, use a Reset command to clear the STO Alarm.*
- *P06.44 = 1: STO Alarm no Latch. After you clear the cause of the STO Alarm, the STO Alarm clears automatically.*

All of the STL1–STL3 errors are “Alarm Latch” mode (in STL1–STL3 mode, the P06.44 function is not available).

		Type	*Hex Addr*	*Dec Addr*
P02.35	***External Operation Control Selection after Reset and Reboot***	♦R/W	0223	40548
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Drive runs if the RUN command remains after reset or reboot.	0		

P02.35 allows the drive to resume running after a reset or reboot if an external control is still commanding it to RUN.

Setting value 1:

- *Situation 1: After the drive is powered up and the external terminal for RUN stays ON, the drive runs.*
- *Situation 2: After clearing a detected fault and while the external terminal for RUN stays ON, you can run the drive by pressing the RESET key.*

NOTE: When Safe Torque Off (STO) alarms STL1 or STL2 are activated, a power cycle is required to reset the drive. When P02.35 is set to 1, the drive will start on power-up while performing this reset condition.

		Type	*Hex Addr*	*Dec Addr*
P02.13	***Multi-function Output 1 (R1)***	♦R/W	020D	40526
	Range/Units (Format: 16-bit binary)	*Default*		
	66: SO output logic A 68: SO output logic B	11		

Use P02.13 to set the STO functions of multi-function terminal R1.

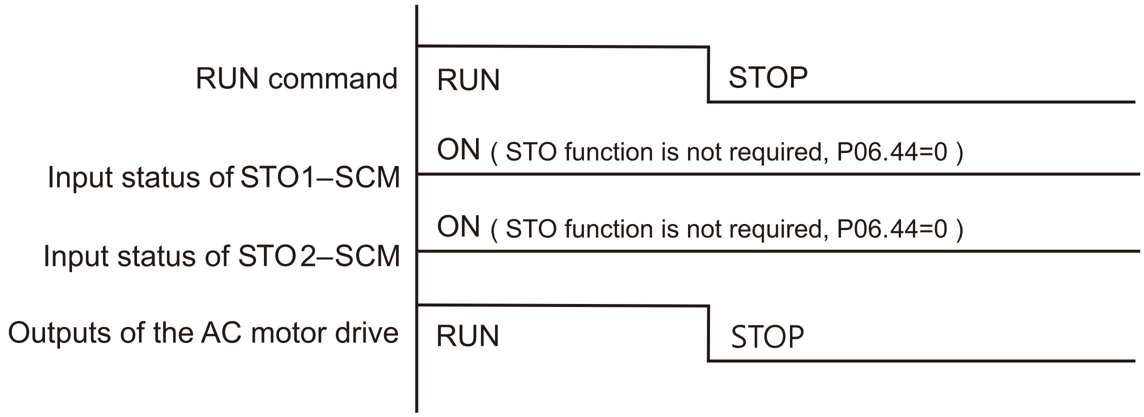
Drive Status	***Safety Output***
–	NO (P02.13=66)
Normal Run	open
STO	close
STL1~STL3	close

Timing Diagram Description

The following timing diagrams show the status of relevant signals under different conditions.

Normal operation status

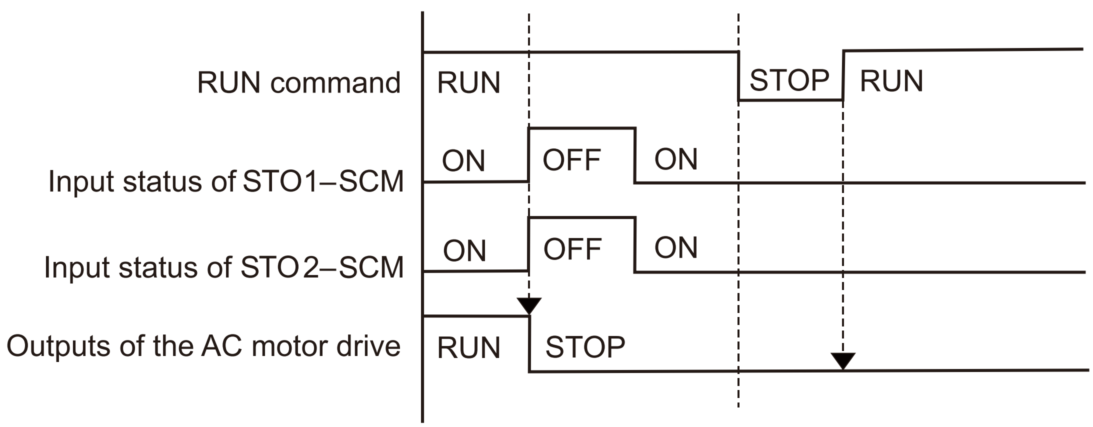
When STO1–SCM and STO2–SCM are ON (STO function is not required), the drive executes Operating or Output Stop according to RUN command.



STO, P06.44=0, P02.35=0

(External operation control selection after reset / reboot, 0=disable)

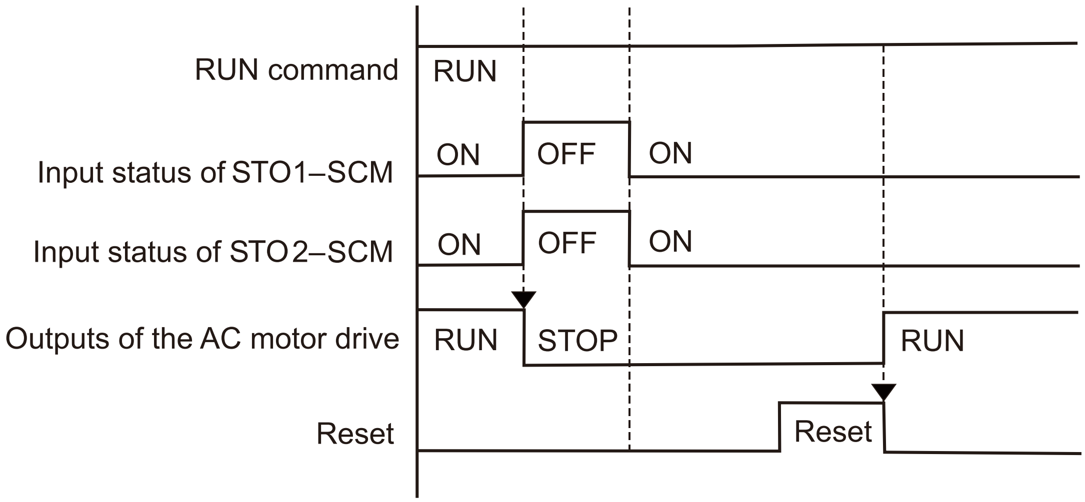
When both STO1–SCM and STO2–SCM are OFF during operation (STO function is required), the drive stops outputting when it enters safe mode regardless of whether the RUN command is in ON or OFF status.



STO, P06.44=0, P02.35=1

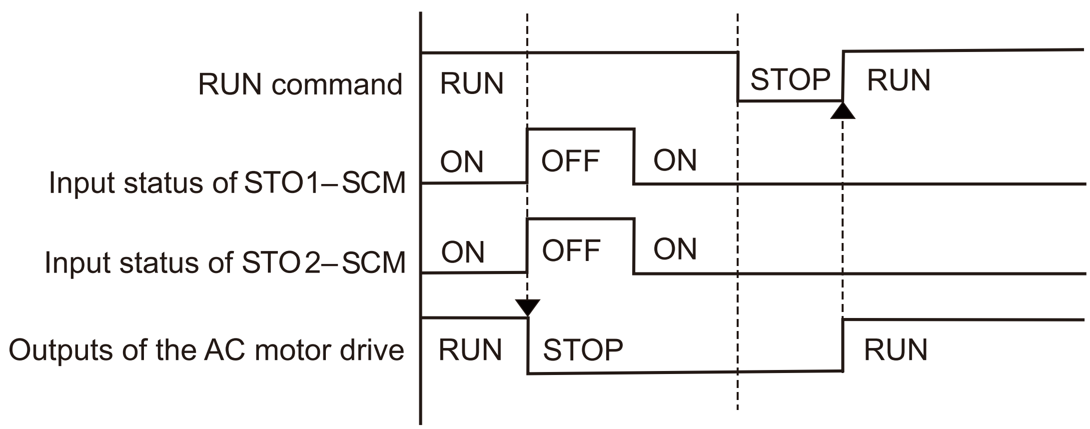
(External operation control selection after reset / reboot, 1= drive runs if the RUN command remains after reset or reboot)

The action is the same as in the previous example; however, because P02.35=1, if the RUN command remains after reset, the drive immediately executes the RUN command again.



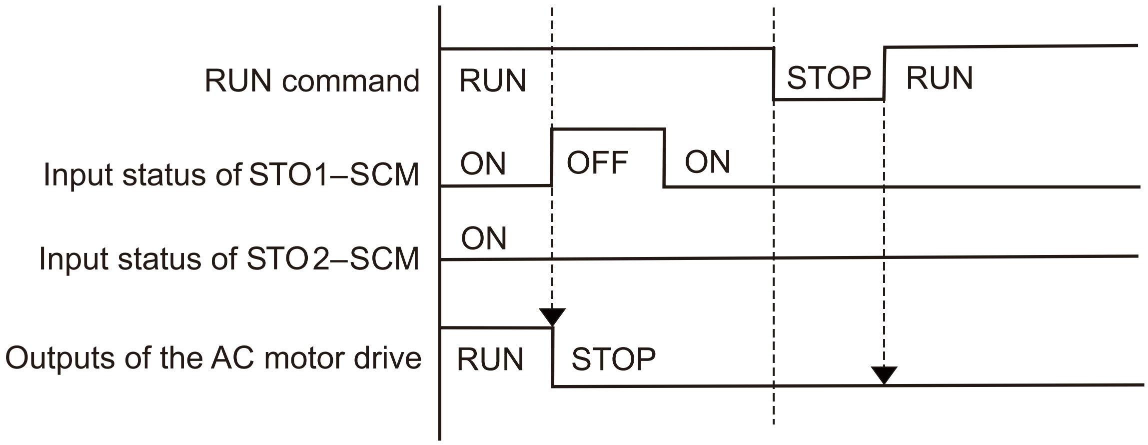
STO, P06.44=1

When both of STO1–SCM and STO2–SCM are OFF during operation (STO function is required), the drive stops outputting. When the STO1 / STO2 status is restored (ON), the STO alarm clears automatically. The drive outputs when the RUN command is executed again.



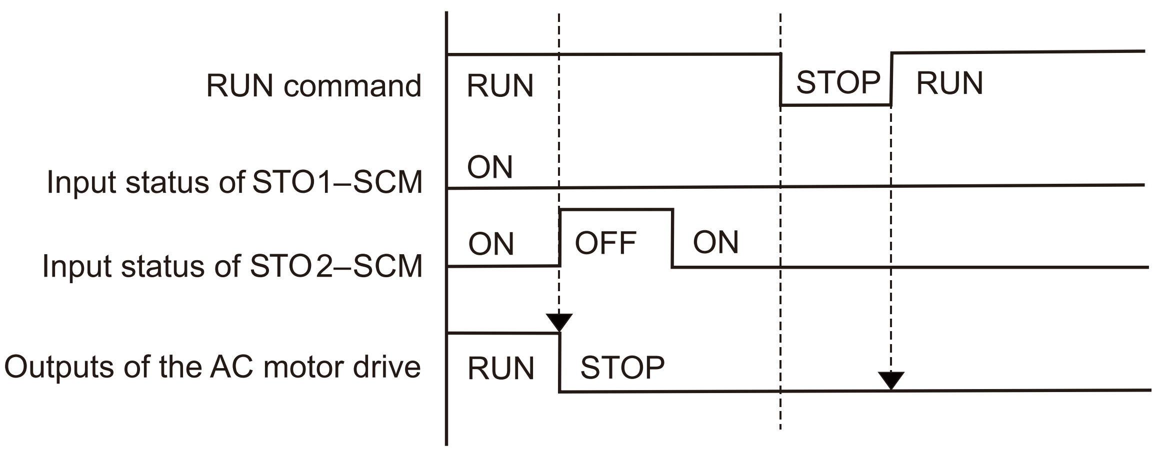
STL1, P06.44=0 or 1

When STO1–SCM is OFF during operation (STO function is required) and STO2–SCM is ON (STO function is not required), the drive stops outputting and the keypad shows the STL1 error. However, you cannot reset the STL1 error even if the STO1 status is restored (ON) regardless of the parameter setting. You must cycle the power to reset and to restore the drive to the normal standby state.



STL2, P06.44=0 or 1

When STO1–SCM is ON during operation (STO function is not required) and STO2–SCM is OFF (STO function is required), the drive stops outputting and the keypad shows the STL2 error. However, you cannot reset the STL2 error even if the STO2 status is restored (ON) regardless of the parameter setting. You must cycle the power to reset and to restore the drive to the normal standby state.



Error Code and Troubleshooting Instructions

Error Code Description

Refer to P06.17–P06.22 for the fault record; the relevant STO error codes are 72/76/77/78. The definition is described below.

		Type	Hex Addr	Dec Addr
P06.17	***Fault Record 1***	Read	0611	41554
P06.18	***Fault Record 2***	Read	0612	41555
P06.19	***Fault Record 3***	Read	0613	41556
P06.20	***Fault Record 4***	Read	0614	41557
P06.21	***Fault Record 5***	Read	0615	41558
P06.22	***Fault Record 6***	Read	0616	41559

Range/Units (Format: 16-bit binary) — *Default*: 0

72: STO Loss (SrL1)
76: STO (Sro)
77: STO Loss 2 (SrL2)
78: STO Loss 3 (SrL3)

Error Code	Name	Description
72 (SrL1)	STO Loss 1	STO1–SCM1 internal loop detection error
76 (SrO)	Safe Torque Off	Safe Torque Off function active
77 (SrL2)	STO Loss 2	STO2–SCM2 internal loop detection error
78 (SrL3)	STO Loss 3	STO1–SCM1 and STO2–SCM2 internal loop detection error

Troubleshooting Instructions

Refer to the following instructions for troubleshooting when STO / STL1 / STL2 / STL3 appear on the keypad (refer to Fault Codes in Chapter 6 for details).

<table>
<tr><th colspan="4">STO Fault Codes</th></tr>
<tr><th>ID Number</th><th>Keypad Display</th><th colspan="2">Description</th></tr>
<tr><td rowspan="6">72</td><td rowspan="6">SrL1</td><td colspan="2">STO1–SCM1 internal loop detection error.</td></tr>
<tr><th>Cause</th><th>Corrective Action</th></tr>
<tr><td>STO1 and SCM1 short circuit lines are not connected.</td><td>Re-connect the short circuit line.</td></tr>
<tr><td>Hardware failure</td><td>After you make sure all the wiring is correct, if STL1 fault still exists after cycling the power, contact AutomationDirect technical support..</td></tr>
<tr><td>Poor connection of the IO card</td><td>1) Check if the PIN of the IO card is broken.
2) Check if the IO card connects to the control board correctly, and if the screws are tightened well.</td></tr>
<tr><td>The IO card does not match the version of the control board</td><td>Contact AutomationDirect technical support.</td></tr>
</table>

STO Fault Codes (continued)				
ID Number	**Keypad Display**	**Description**	**Cause**	**Corrective Action**
76	STo	Safe Torque Off function active.		
			The switch action of STO1/SCM1 and STO2/SCM2 (OPEN)	Reset the switch (ON) and cycle the power.
			Poor connection of the IO card	1) Check if the PIN of the IO card is broken. 2) Check if the IO card connects to the control board correctly, and if the screws are tightened well.
			The IO card does not match the version of the control board	Contact AutomationDirect technical support.
77	STL2	STO2–SCM2 internal loop detection error.		
			STO2 and SCM2 short circuit lines are not connected	Re-connect the short circuit line.
			Hardware failure	After you make sure all the wiring is correct, if STL2 fault still exists after cycling the power, contact AutomationDirect technical support.
			Poor connection of the IO card	1) Check if the PIN of the IO card is broken. 2) Check if the IO card connects to the control board correctly, and if the screws are tightened well.
			The IO card does not match the version of the control board	Contact AutomationDirect technical support.
78	STL3	STO1–SCM1 and STO2–SCM2 internal loop detection error.		
			STO1 and SCM1, or STO2 and SCM2 short circuit lines are not connected	Re-connect the short circuit line.
			Hardware failure	After you make sure all the wiring is correct, if STL3 fault still exists after cycling the power, contact AutomationDirect technical support.
			Poor connection of the IO card	1) Check if the PIN of the IO card is broken. 2) Check if the IO card connects to the control board correctly, and if the screws are tightened well.
			The IO card does not match the version of the control board	Contact AutomationDirect technical support.

Test and Fault Confirmation

After wiring the STO circuit in accordance with the wiring diagram, follow the steps below to verify that the STO and related detection functions work normally.

1) When the drive is powered on, make sure that the STO1–SCM and STO2–SCM voltage falls between 11–30 VDC. At this time, the drive should enter Standby mode and wait for RUN command. There is no error displayed on the keypad.
2) Press RUN on the keypad and use the emergency button or other method to make the STO1–SCM and STO2–SCM voltage fall between 0–5 VDC. At the same time, after the output frequency is reached, the drive should enter Torque Stop mode STO and stop outputting voltage. The keypad displays the STO error, and the response time of the STO1 and STO2 signals to cause the drive to stop outputting voltage should be ≤ 20 ms. Then restore the STO1–SCM and STO2–SCM voltage to 11–30 VDC, and press RESET button on the keypad to clear the STO error. The drive should enter Standby mode and wait for RUN command.
3) Press RUN on the keypad and use the emergency button or other method to make the STO1–SCM voltage fall between 0–5 VDC, and the STO2–SCM voltage remain between 11–30 VDC after the output frequency is reached. At this time, the drive should enter Torque Stop mode STL1 and stop outputting voltage. The keypad displays the STL1 error, and the response time of STO1 signals to cause the drive to stop outputting voltage should be ≤ 20 ms. Then restore the STO1–SCM voltage to 11–30 VDC. However, pressing RESET button on the keypad cannot clear the STL1 error. You must cycle the power to the drive. Make sure that the STO1–SCM and STO2–SCM voltage falls between 11–30 VDC and then cycle the power to the drive, then the STL1 error is cleared. The drive should enter Standby mode and wait for RUN command.
4) Press RUN on the keypad and use the emergency button or other method to make the STO2–SCM voltage fall between 0–5 VDC, and the STO1–SCM voltage remain between 11–30 VDC after the output frequency is reached. At this time, the drive should enter Torque Stop mode STL2 and stop outputting voltage. The keypad displays the STL2 error, and the response time of the STO2 signals to cause the drive to stop outputting voltage should be ≤ 20 ms. Then restore the STO2–SCM voltage to 11–30 VDC. However, pressing RESET button on the keypad cannot clear the STL2 error. You must cycle the power to the drive. Make sure that the STO1–SCM and STO2–SCM voltage falls between 11–30 VDC and then cycle the power to the drive, then the STL2 error is cleared. The drive should enter Standby mode and wait for RUN command.
5) If you can conduct these four steps normally in sequence with no other error, then the Safe Torque Off function loop is normal. However, if you get a different result or if STL3 occurs, then the Safe Torque Off function loop does not work normally. Refer to the Error Code and Troubleshooting section for details.

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Function of PID Control

GS30 series AC drives can be used to control an automated process by the Proportional-Integral-Derivative (PID) control method.

NOTE: A PID Configuration Spreadsheet tool is available for download from the drive item page support resources section.

What Does PID Control Accomplish?

The primary benefit of PID control is that it acheives and maintains the desired steady-state condition of a process better and more smoothly than does ON-OFF control.

The GS30 drive PID algorithm constantly assesses the amount and rate of change of the quantity being controlled (Process Variable) and its deviation (Process Error) from the desired steady-state value (Setpoint). The GS30 drive then variably adjusts its frequency output as much or as little as needed to keep the Process Variable as close as possible to the Setpoint.

Simple ON-OFF control systems, on the other hand, continually bounce back and forth above and below the Setpoint value, but cannot maintain the Process Variable at the Setpoint value.

PID Control Analogy

PID controllers are all around us. Many times we don't realize that we are the PID controller in a control loop. For example, the driver of a car is the PID controller for the car's speed.

PID Control System Variables:

- *Desired Speed ≈ Setpoint*
- *Actual Speed ≈ Process Variable*
- *Gas Pedal ≈ Control Variable*
- *Speedometer ≈ Feedback*

Proportional Control: The farther away you are from your Desired Speed, the more you press the gas pedal. If you did this starting from a stand-still, you would floor it and probably shoot far past the Desired Speed. Once the speed "settled in," you would never hold exactly at your Desired Speed because the difference between Desired and Actual Speed would get very small and you only have so much control over the pedal and your foot; not enough to hold the perfect speed consistently. So, Proportional Control adjusts the output based on the *difference* between the Setpoint and Process Variable much more accurately in a fine-tuned way.

Integral Control: If your Desired Speed is 70mph and your car consistently goes 69mph, you will realize that you need to press the gas pedal a little more (to overcome wind resistance, a hill, etc.). The longer you are under the Desired Speed, the more gas you give the car. That is fundamentally what Integral Control does; adjust the output based on *how long* the system is away from the setpoint.

Derivative Control: In the situation above, assume that you start going up a hill. The car's Actual Speed gets farther away from the Desired Speed, so the Proportional Control makes you press the gas pedal more. The longer the speed stays below setpoint, Integral Control makes you press the gas even more. Now assume that your car tops the hill and starts going downhill. Your speed suddenly gets faster (the error between Desired Speed and Actual Speed), so Proportional causes you to slightly let off the gas. But Integral still keeps adding to the pedal (since you still haven't reached Desired Speed). Your internal Derivative Control sees that you are rapidly approaching the Desired Speed, so you begin to let off the gas quickly. That is Derivative Control; it adds or subtracts to the Control Variable based on *how quickly* the system is approaching (or leaving) the setpoint.

Common Applications for PID Control

1) *Flow control: A flow sensor is used to feed back the flow rate in a pipe, and the GS30 drive PID adjusts its output frequency to the pump that forces the liquid or gas throught that pipe.*
2) *Level control: A level sensor is used to feed back the liquid level in a resevoir or tank, and the GS30 drive PID adjusts its output frequency to the pump that fills or empties that tank.*
3) *Pressure control: A pressure sensor is used to feed back the pressure in a tank, and the GS30 drive PID adjusts its output frequency to the pump that pressurizes or vacuums that tank.*
4) *Speed control: A speed sensor is used to feed back the shaft speed of a motor or machine driven by that motor, and the GS30 drive PID adjusts its output frequency to that motor.*
5) *Temperature control: A thermocouple or thermistor is used to feed back the temperature of an area or device, and the GS30 drive PID adjusts its output frequency to the fan that affects that temperature.*

Definition of PID Loop “Directions”

Please note that the following nomenclature describes how the GS30 PID system operates, which may differ from the operation of some other PID systems.

Forward-Acting PID Loop (Heating Loop) (Negative-Feedback Loop)

The terms “Forward-Acting,” “Direct-Acting,” “Heating,” and “Negative-Feedback” are used to describe a PID loop that can be used to control processes such as pressure, heating, and flow (among others).

- *Greater Output Frequency (Hz) drives the Process Variable (PV) upward toward the Setpoint (SP)*
- *GS30 drive frequency output increases if the Process Error is negative (SP>PV)*

Reverse-Acting PID Loop (Cooling Loop) (Positive-Feedback Loop)

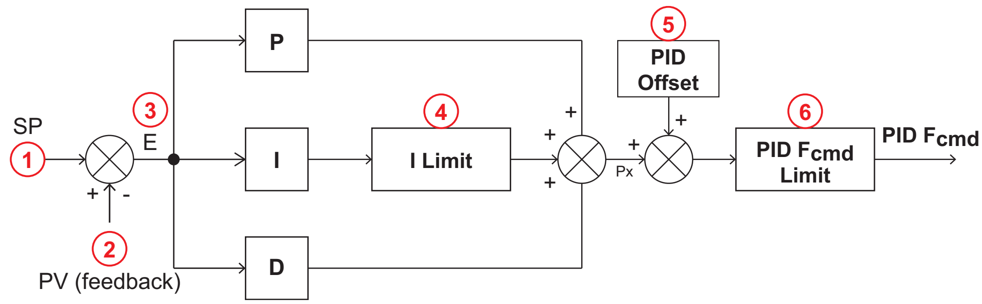
The terms “Reverse-Acting,” “Cooling,” and “Positive-Feedback” are used to describe a PID loop that can be used to control applications such as cooling.

- *Greater Output Frequency (Hz) drives the Process Variable (PV) downward toward the Setpoint (SP)*
- *GS30 drive frequency output increases if the Process Error is positive (SP<PV)*

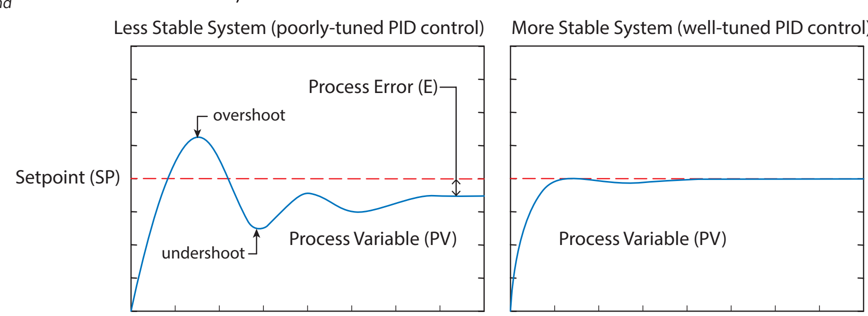
PID Control Overview

PID control is a closed output and feedback loop for the purpose of automatically controlling a portion of a process to a specific condition by utilizing a target setpoint and the process's actual condition as feedback to the controller. You determine the setpoint and let the system reach that setpoint using the process's conditional feedback and the PID control system.

- *P = Proportional control (also known as "Gain")*
- *I = Integral control (also known as "Reset")*
- *D = Derivative control (also known as "Rate")*
- *Process Variable (PV) = the quantity being measured and controlled*
- *Setpoint (SP) (also known as Target Value) = the desired value of the Process Variable*
- *Error (E) = the difference between the Setpoint and the Process Variable*



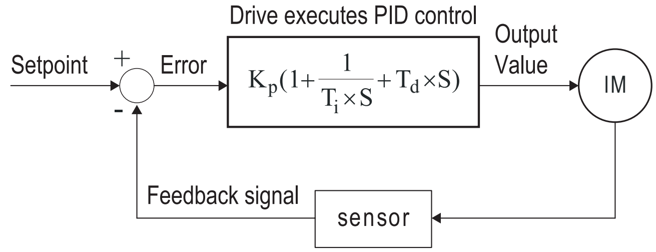
1) *Setpoint: -100% to +100% (PID Setpoint Gain + PID Setpoint Offset)*
2) *Feedback: -100% to +100% (Feedback Gain)*
3) *Error: -100% to +100% (in percent change)*
4) *I Limit: 0~150% (Upper Limit for Integral Time P08.04)*
5) *PID Offset: P08.16 determines how the PID Offset will be controlled; by P08.17, or by an Analog Input (P03.00, P03.01)*
6) *PID F_{cmd} Limit: See P01.10, P01.11*



Since a PID controller relies only on the measured Process Variable, instead of knowledge of the underlying process, it is applicable to a broad variety of system processes. By tuning the three parameters of the model, a PID controller can deal with specific process requirements. The response of the controller can be described in terms of its responsiveness to an error, the degree to which the system overshoots a setpoint, and the degree of any system oscillation. The use of the PID algorithm does not guarantee optimal control of the system or even its stability.

Some applications may require using only one or two terms to provide the appropriate system control. This is achieved by setting the other parameters to zero. A PID controller is called a PI, PD, P, or I controller in the absence of the other respective control actions. PI controllers are fairly common, since Derivative action is sensitive to measurement noise, whereas the absence of an Integral term may prevent the system from reaching its target value.

Concept of GS30 PID Control & Tuning



K_p: Proportional Gain (P) T_i: Integral Time (I) T_d: Derivative Value (D) S: Operator

When ***GS30 drive PID is enabled by P08.00 [PID Action/Mode]***, P08.65 "reflects" the PID Setpoint Source determined by what is set in P00.20 (Remote) or P00.30 (Local), and what Mode the Drive is in, i.e. Remote or Local Mode. PID control operates with the feedback signal as reflected by P08.65 either 0~10V voltage or 4~20mA current.

Proportional Gain (P)

The first parameter of GS30 PID control is *Proportional Gain (P08.01)*.

The GS30 drive's frequency output is proportional to the Process Error (when the GS30 is configured for PID control). If only the Proportional Gain control component is used, the controller will not be able to get the Process Variable to exactly match the Setpoint at steady-state.

For a given process, if the Proportional Gain value is set too low, the control action will be too sluggish. If the Proportional Gain value is set too high, the control action will be unstable. To find the correct setting for Proportional Gain, set the Integral Time (I) and Derivative Value (D) to zero (0). Begin tuning the process with a low Proportional Gain value, and increase the Proportional value until the system becomes unstable. When instability is reached, reduce the Proportional value slightly until the system becomes stable (smaller values reduce system gain).

Integral Time (I)

The second parameter of GS30 PID control is *Integral Time (P08.02)*.

The GS30 drive's frequency output compensation due to the integral component is proportional to the integral of the Process Error. To eliminate the steady-state Process Error, an "integral component" needs to be added to the controller.

The Integral Time (I) decides the relation between integral component and Process Error. The integral component will be increased even if the error is small. It gradually increases the controller output to eliminate the error until it is 0.

Begin tuning with a higher number for Integral Time (100.0 is max; 1.0 is default), and slowly move to a smaller number until you reach the setpoint with minimized overshoot/undershoot. Tuning is normally done utilizing the GSoft2 software scope function (or an oscilloscope) to monitor the Process Variable as you incrementally change the Integral Time value until the Setpoint is satisfactorily maintained.

- *Overshoot: The Process Variable moves further past the Setpoint than desired.*
- *Undershoot: The Process Variable does not reach the desired Setpoint.*

Refer to "Tuning Example for PID Control" on page F–7 of this appendix for more PID tuning information.

Derivative Value (D)

The third parameter of GS30 PID control is *Derivative Value (P08.03)*.

The GS30 drive's frequency output compensation due to the derivative component is proportional to the derivative of the Process Error. Derivative Value (D)control is performed based on the quickness of changes in the Process Error.

When the Proportional Gain (P) and Integral Time (I) control components are set to eliminate the Process Error so that the system runs at steady state, outside forces may suddenly cause oscillation or instability within the system. Without a Derivative Value component, the control output may be too sluggish to quickly respond to these sudden changes. The derivative component can suppress these effects by acting before the error occurs.

Begin tuning with a high Derivative Value and reduce the value to the point of system instability. Then increase the Derivative Value until the control output regains stability. Stability can be tested by moving between two wide-spread setpoint values.

Since Derivative Control is performed based on sudden changes in Process Error, it is a very sensitive control. Therefore, it may also react to extraneous signals and noise, and can easily lead to unstable system control. Derivative control is not normally required for the control of processes such as flow, pressure and temperature.

Refer to "Tuning Example for PID Control" on page F–7 of this appendix for more PID tuning information.

Proportional Integral Control (PI)

When processes are controlled by Proportional Gain only, Process Error cannot be eliminated entirely. Proportional + Integral control (PI) can be used to eliminate Process Error incurred by the targeted value changes and the constant external disturbances. However, if the I action is excessively powerful, it will delay the responding correction, and will allow unstable system operation.

Proportional Derivative Control (PD)

In deciding when to use Proportional-Derivative Control, we need to understand how the system would react as a Proportional-Integral-Derivative system. When a Process Error due to a disturbance in the process occurs in a controlled system, the system sees a greater load than the derivative has provided energy to control. If that Process Error is small, the system PV can oscillate if the Proportional Gain and the Integral Time are being applied to the system too often within a small length of time. To prevent this type of system reaction, the use of Proportional and Derivative (PD) alone may be warranted. The use of Proportional Gain *and* the feed-forward action of the Derivative Value can result in a faster-acting operation to stabilize the system.

Proportional Integral Derivative Control (PID)

When choosing to use Proportional-Integral-Derivative (sometimes called PID) control, the Integral Time is utilized to provide better control of the Process Error while the Derivative Value is used to restrain PV oscillation.

Tuning Example for PID Control

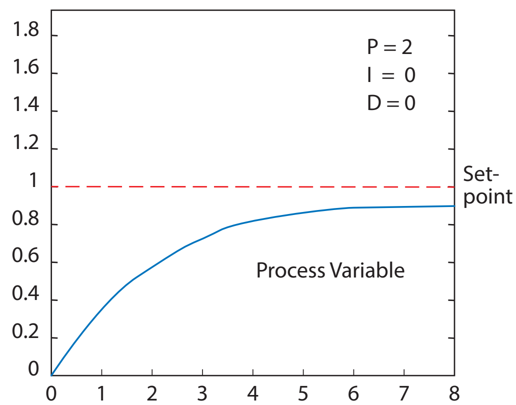
The PID settings should be adjusted, or "tuned," with the controlled process in actual operation while monitoring the actual Process Variable. The tuning can be done using the GSoft2 software scope function, or with an oscilloscope.

We recommend starting by first adjusting the Proportion Gain only, with the Integral Time and Derivative Value set to zero. The following hypothetical example illustrates PID tuning with settings as shown:

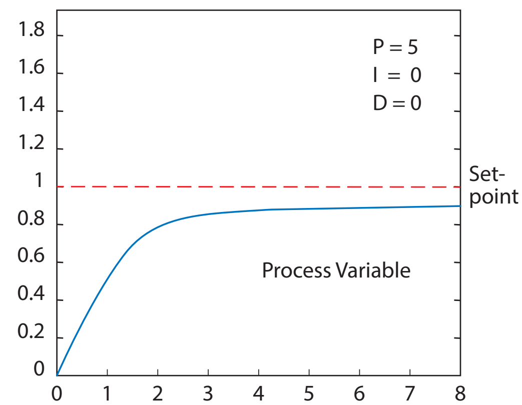
- *P = Proportional Gain = GS30 drive parameter P08.01,*
- *I = Integral Time = GS30 drive parameter P08.02,*
- *D = Derivative Value = GS30 drive parameter P08.03.*

Proportional Gain: Adjust the P setting so that the PV response is neither too sluggish, nor too fast, and without excessive overshoot or undershoot. (Process error cannot be eliminated by P)

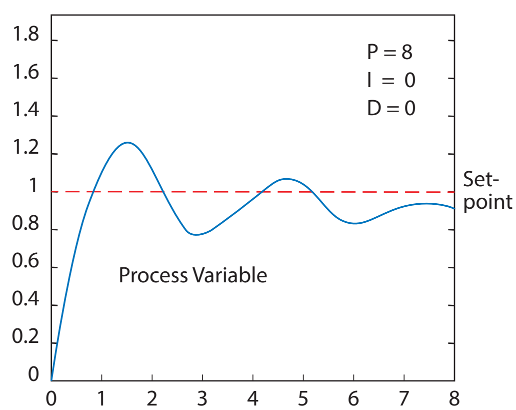
Sluggish PV response; process error



More practical PV response; process error



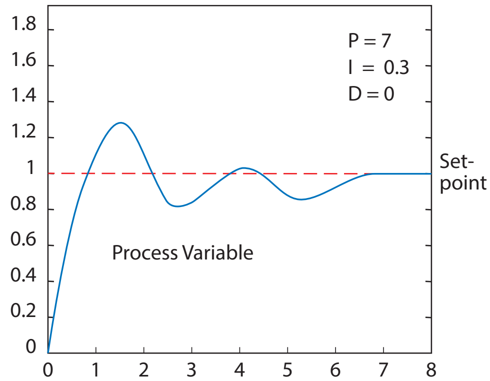
Overshoot & undershoot; process error

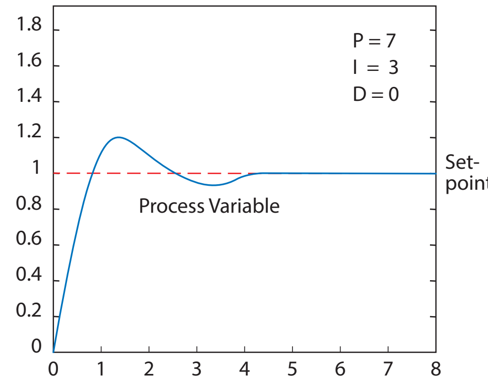


(Example continued next page)

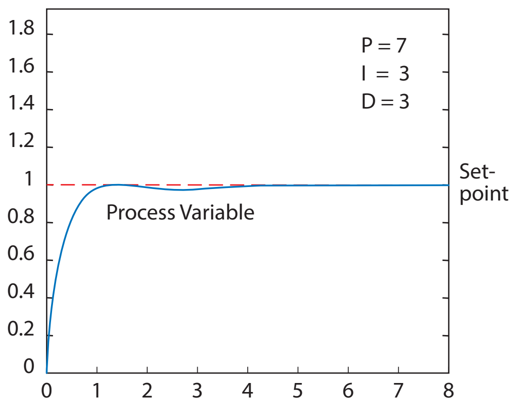
PID Tuning Example (continued)

Integral Time: Adjust the I setting to minimize over/undershoot, and to eliminate the process error.





Derivative Value: Adjusting the D setting may not be neccessary for all processes, but it can be particularly helpful in reducing over/undershoot and instability that may be caused by sudden changes in the system input variable.



DURApulse GS30 Parameters Involved in PID Control

The following GS30 AC drive parameters are often involved in setting up PID control.

NOTE: The information provided herein is applicable only to the PID function. For fully detailed parameter information and for the complete set of parameters, please refer to "Chapter 4: AC Drive Parameters."

DURA GS30 PID Parameter Comparisons – Summary	
GS30 PID Parameter	
P08.00	Terminal selection of PID feedback
P08.01	Proportional gain (P)
P08.02	Integral time (I)
P08.03	Differential time (D)
P08.04	Upper limit of integral control
P08.05	PID output command limit (positive limit)
P08.06	PID feedback value by communication protocol
P08.07	PID delay time
P08.08	Feedback signal detection time
P08.09	Feedback signal fault treatment
P08.10	Sleep frequency
P08.11	Wake-up frequency
P08.12	Sleep time
P08.13	PID feedback signal error deviation level
P08.14	PID feedback signal error deviation detection time
P08.15	PID feedback signal filter time
P08.16	PID compensation selection
P08.17	PID compensation
P08.18	Sleep mode function setting
P08.19	Wake-up integral limit
P08.20	PID mode selection
P08.21	Enable PID to change the operation direction
P08.22	Wake-up delay time
P08.23	PID control flag
P08.26	PID output command limit (reverse limit)
P08.27	Acceleration / deceleration time for PID command
P08.29	Frequency base corresponding to 100.00% PID
P08.31	Proportional gain 2
P08.32	Integral time 2
P08.33	Differential time 2
P08.65	PID target value source
P08.66	PID target value setting
P08.67	Master and auxiliary reverse running cutoff frequency
P08.68	PID deviation limit
P08.69	Integral separation level
P08.70	Smart start-up level
P08.71	Smart start-up frequency command
P08.72	Smart start-up acceleration time
P08.75	PID2 parameter switch condition
P08.76	PID2 parameter switch deviation 1
P08.77	PID2 parameter switch deviation 2
P08.78	Allowed reverse running time after start-up
P08.79	WireBreak High
P08.80	WireBreak Low
P08.81	WireBreak Time

DURA **GS30 PID Parameter Comparisons (continued)**	
GS30 PID Parameter	
P08.82	WireBreak Handle Select
P00.03	Start-up display Selection
P00.04	User Display (Can be set to display PID values)
P00.25	User-defined characteristics (COEFF ATT)
P00.26	User-defined maximum value (COEFF MAX)
P00.27	User-defined value (COEFF SET)
P02.01 - P02.07	Multi function inputs selections: 71: Disable PID function, force PID output return to 0 72: Disable PID function, retain the output value before disabled 73: Force PID integral gain return to 0, disable integral 74: Reverse PID feedback
P02.13, P02.16, P02.17	Multi function outputs selections: 15: PID feedback error (P08.13, P08.14)
P03.00, P03.01	Multi function analog input selections: 4: PID target value 5: PID feedback signal 13: PID compensation value
P03.20	Multi function Analog output selections. 0: Output frequency 1: Frequency command 9: AI1 10: AI2 21: RS-485

DURAPULSE GS30 Parameters Involved in Tension Control

The following GS30 AC drive parameters are often involved in setting up Tension control.

NOTE: The information provided herein is applicable only to the Tension function. For fully detailed parameter information and for the complete set of parameters, please refer to "Chapter 4: AC Drive Parameters."

DURA **GS30 Tension Parameter Comparisons – Summary**	
GS30 Tension Parameter	
P12.00	Tension control selection
P12.01	Winding mode
P12.02	Mechanical gear A at load side
P12.03	Mechanical gear B at motor side
P12.04	PID target source
P12.05	PID target value
P12.06	PID feedback source selection
P12.07	Tension PID auto-tuning selection
P12.08	Tension PID P Gain 1
P12.09	Tension PID I Integral Time 1
P12.11	Tension PID P Gain 2
P12.12	Tension PID I Integral Time 2
P12.14	Tension PID output status selection
P12.15	Tension PID output limit
P12.16	Tension PID Output command limit (negative limit)
P12.17	Tension PID feedback upper limit
P12.18	Tension PID feedback lower limit
P12.19	Linear speed input command source
P12.20	Maximum linear speed
P12.21	Minimum linear speed
P12.22	Pulses per meter
P12.23	Current linear speed
P12.24	Linear speed low pass filter time
P12.25	Linear speed command acceleration time
P12.26	Linear speed command deceleration time
P12.27	Reel diameter source
P12.28	Maximum reel diameter
P12.29	Empty reel diameter
P12.30	Initial reel diameter source
P12.31	Initial reel diameter
P12.32	Initial Reel Diameter 1
P12.33	Initial Reel Diameter 2
P12.34	Pulses per revolution
P12.35	Revolutions per layer
P12.36	Material thickness
P12.37	Reel diameter filter time
P12.38	Automatic reel diameter compensation
P12.39	Reel diameter calculation delay time
P12.40	Current reel diameter
P12.41	Minimum output frequency for reel diameter calculation
P12.42	Pre-startup mode selection
P12.43	Switching level for pre-startup and PID enablement
P12.44	Pre-startup frequency
P12.45	Pre-startup acceleration time
P12.46	Broken belt detection function

DURA GS30 Tension Parameter Comparisons (continued)	
GS30 Tension Parameter	
P12.47	Minimum linear speed of broken belt detection
P12.48	Reel diameter error of broken belt detection
P12.49	Broken belt detection time
P12.50	Tension PID feedback error control
P12.51	Tension PID feedback error detection time
P12.52	Tension PID feedback error treatment
P12.54	Tension command source selection
P12.55	Maximum tension value
P12.56	Tension command setting value
P12.57	Zero-speed tension setting source
P12.58	Zero-speed tension setting value
P12.59	Zero-speed tension threshold (linear speed)
P12.60	Dynamic friction torque compensation
P12.61	Material inertia compensation coefficient
P12.62	Accleration inertia compensation gain
P12.63	Inertia compensation filter time
P12.64	Deceleration inertia compensation gain
P12.65	Tension taper curve selection
P12.66	Tension taper setting source
P12.67	Tension taper value
P12.68	Tension taper curve compensation value
P12.69	Multi-step Taper Reel Diameter 1
P12.70	Multi-step Taper Reel Diameter 2
P12.71	Multi-step Taper Value 1
P12.72	Multi-step Taper Value 2
P12.73	Pre-drive frequency gain
P12.74	Pre-drive acceleration time
P12.75	Pre-drive deceleration time
P12.76	Speed limit gain
P12.77	Tension control flag
P03.00 ***P03.01***	Analog input selection: 14: Tension PID feedback signal 15: Line speed 16: Reel diameter 17: Tension PID target value 18: Tension setting value 19: Zero-speed tension 20: Tension taper