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DURAPULSE GS4 AC DRIVE USER MANUAL

GS4_UMW

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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.

All 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 GS4 AC Drive
User Manual Revision History

Please include the Manual Number and the Manual Issue, both shown below, when communicating with Technical Support regarding this publication.

Manual Number: ***GS4_UMW***
Issue: ***First Edition, Revision N***
Issue Date: ***04/02/2025***

Publication History		
Issue	***Date***	***Description of Changes***
First Edition	10/18/2017	Original Issue
1st Ed, Rev A	10/20/2017	Ch1: Drive specifications Ch4: Analog input parameter examples, Parameter explanations Ch8: Various explanation revisions, screen capture examples, etc. AppxA: Fuses AppxB: GS4-06CDD Digital Inputs Wiring AppxC: Added AI1 note AppxF: P7.25 diagrams
1st Ed, Rev B	11/17/2017	Ch3: Display setup back-light info Ch4: Parameter information AppxA: EMI filters AppxB: Info re GS4-CM-ENETIP external controller's RPI AppxD: CLICK PLC program examples AppxF: Parameter explanations
1st Ed, Rev C	05/07/2018	Ch2: AI3 diagram Ch4: Various parameter settings and explanations Ch5: Recommended communication cable; various parameter settings AppxB: Option Card Installation, ENet/IP Comm Protocol Param Addresses AppxF: Revised explanations
1st Ed, Rev D	07/06/2018	Ch4: Various parameter settings and explanations AppxF: Revised PID explanations
1st Ed, Rev E	10/31/2018	AppxF: Revised "Definition of PID Loop "Directions""
1st Ed, Rev F	04/18/2019	Ch6: Revised ovA fault corrective action AppxB: Revised GS4-CM-ENETIP specs, GS4-CM-MODTCP specs & error code 86
1st Ed, Rev G	07/18/2019	Ch1: Environmental Conditions Ch2: Added frame sizes and markers for note #2 in "Airflow and Power Dissipation" table Ch4: P4.09 descriptions AppxA: Added flange mounting instructions for frame sizes D0, D, E, F AppxB: Revised GS4-CM-ENETIP error code 86 & "Using Speed Mode as a Control Method"
1st Ed, Rev H	03/25/2020	AppxA: Added new line reactors and output filters; Revised note for class J fuses AppxB: Revised address "2" of "Communication Protocol Parameter Address Definition" "Commands to GS4"; added Comm Card firmware update instructions
1st Ed, Rev I	08/18/2020	Ch4,7,8: Various updates AppxB: Updated accessory card images to show new FW upgrade jumper and added instructions for FW upgrade AppxD: Updated table on D-23 to match table on B-17
1st Ed, Rev J	12/21/2020	Ch4: Added missing option for P6.36 AppxB: Added new bit 6 ~ 15 functions that were previously reserved
1st Ed, Rev K	01/29/2021	AppxB: Changed bits 13 and 14 on pages 17 and 24 to reserved.
1st Ed, Rev L	10/21/2021	Updates for firmware version 1.42. Ch1: Added note for 230V drives, frame C-E Ch4-Ch5: New and updated parameters and status addresses

Publication History, continued		
Issue	***Date***	***Description of Changes***
1st Ed, Rev M	03/14/2022	IE2 efficiency data added for all GS4 drive models.
1st Ed, Rev N	04/02/2025	New keypad errors, faults, and warnings added to Chapter 3.

DURAPULSE GS4 AC DRIVE USER MANUAL TABLE OF CONTENTS

CONTENTS

GETTING STARTED

CHAPTER 1

TABLE OF CONTENTS

User Manual Overview

Overview of this Publication

The *DURAPULSE* GS4 AC Drive User Manual describes the installation, configuration, and methods of operation of the *DURAPULSE* GS4 Series AC Drive.

Who Should Read This Manual

This manual contains important information for those who will install, maintain, and/or operate any of the GS4 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 generally 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 applications are generally easier to start; typically fans and pumps. Most other applications outside fans and pumps fall into the Constant Torque category (machine control, conveyors, etc.). If you are unsure of the application, assume Constant Torque. The specification, derating, and selection tables are generally segregated by Constant Torque and Variable Torque.

Selecting the Proper Drive Rating (continued)

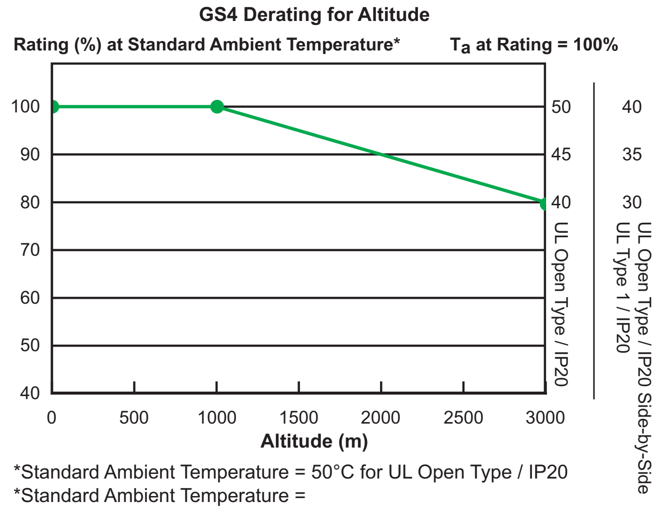
Installation Altitude

AC drives rely on air flow for cooling. As the altitude increases, the air becomes less dense, and 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 1000~3000m, decrease 1% of the rated current or lower 0.5°C of temperature for every 100m increase in altitude.*
- *Maximum altitude for Corner Grounded is 2000m.*



*Standard Ambient Temperature = 50°C for UL Open Type / IP20
*Standard Ambient Temperature =
40°C for UL Type 1 / IP 20 & UL Open Type / IP20 Side-by-Side

Selecting the Proper Drive Rating (continued)

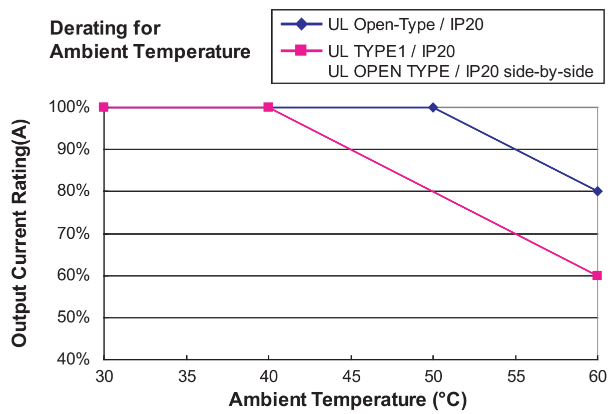
Determine Maximum Enclosure Internal Temperature

AC drives generate a significant amount of heat and will 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 Type 1 / IP20 *	When the GS4 drive is operating at rated current, the ambient temperature has to be between -10°C and +40°C. When ambient temperature exceeds 40°C, decrease the rated current by 2% for every 1°C temperature increase. Maximum allowable temperature is 60°C.
UL Open Type / IP20 *	When the GS4 drive is operating at rated current, the ambient temperature has to be between -10°C and +50°C. When ambient temperature exceeds 50°C, decrease the rated current by 2% for every 1°C temperature increase. Maximum allowable temperature is 60°C.
** For more information about environmental ratings, refer to the "Operating Temperature and Protection Level" table on page 1–9 of this chapter.*	



Selecting the Proper Drive Rating (continued)

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 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. Heavy Duty applications typically run around 2~4kHz.

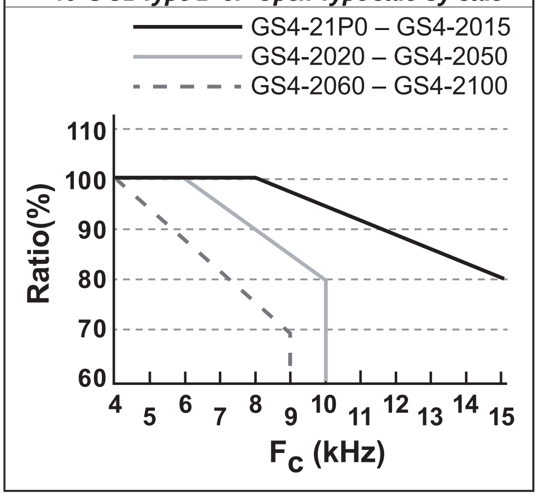
Selecting the Proper Drive Rating (continued)

Carrier Frequency Derating (continued)

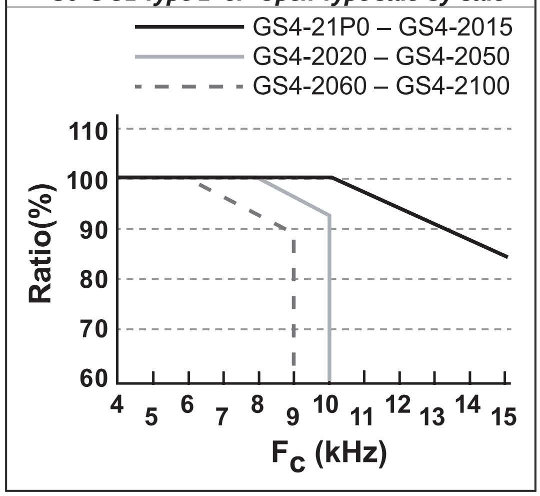
These Variable Torque (VT) and Constant Torque (CT) derating curves are for drives with 3-phase input power. The 230VAC, CT curves also apply equally whether the drive is supplied with 3-phase or 1-phase input power.

230V Variable Torque Carrier Frequency Derating

For 230V Variable Torque
VT/CT Duty Selection P6.34 = 0
Method of Derating P6.33 = 0, 1, or 2
50°C UL Open Type
40°C UL Type 1 or Open Type side-by-side

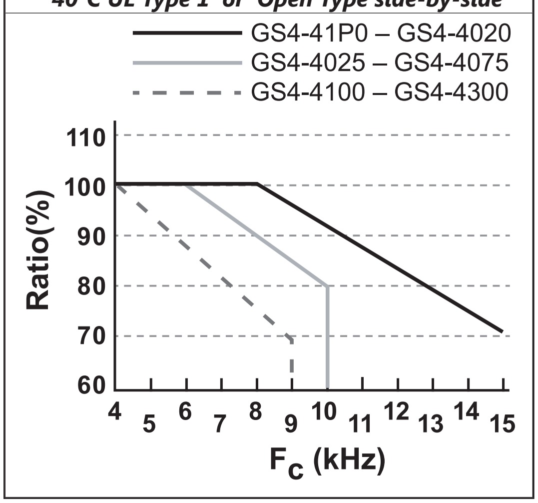


For 230V Variable Torque
VT/CT Duty Selection P6.34 = 0
Method of Derating P6.33 = 0 or 2
40°C UL Open Type
30°C UL Type 1 or Open Type side-by-side

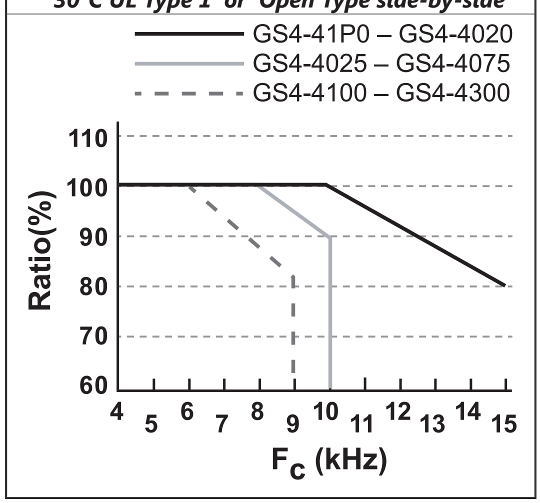


460V Variable Torque Carrier Frequency Derating

For 460V Variable Torque
VT/CT Duty Selection P6.34 = 0
Method of Derating P6.33 = 0, 1, or 2
50°C UL Open Type
40°C UL Type 1 or Open Type side-by-side



For 460V Variable Torque
VT/CT Duty Selection P6.34 = 0
Method of Derating P6.33 = 0 or 2
40°C UL Open Type
30°C UL Type 1 or Open Type side-by-side



Reference Chapter 4, Parameters, for complete descriptions of parameters P6.33 and P6.34.

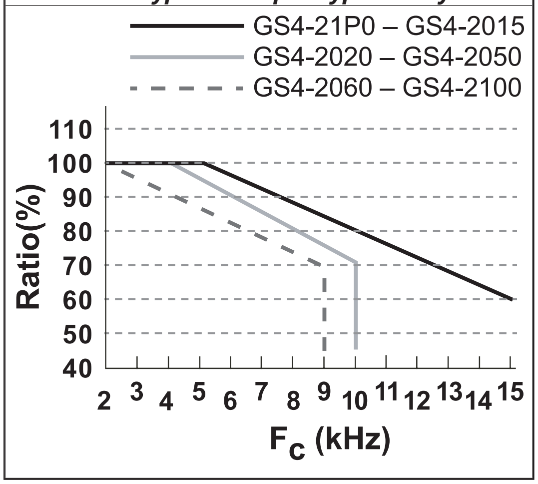
When working with P6.33 (Drive Derating Method), and P6.34 (VT/CT Duty Selection), refer to P2.10 (PWM Carrier Frequency) for the carrier frequency setting. When P6.34 is set it will change P2.10, while P6.00/P6.02 (Electronic Thermal Overload Relay (Motor1)/(Motor2)) must be set independently.

Selecting the Proper Drive Rating (continued)

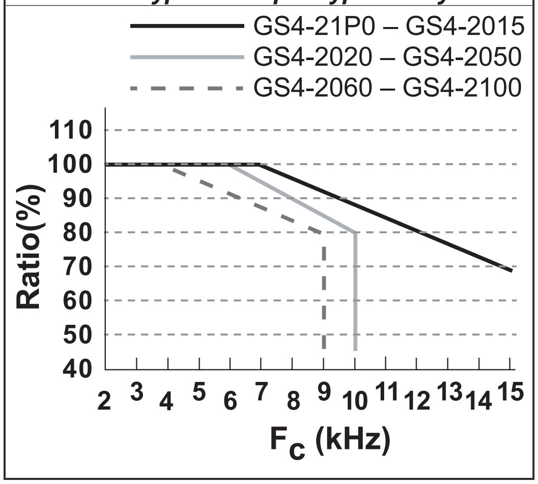
Carrier Frequency Derating (continued)

230V Constant Torque Carrier Frequency Derating

For 230V Constant Torque
VT/CT Duty Selection P6.34 = 1
Method of Derating P6.33 = 0, 1, or 2
50°C UL Open Type
40°C UL Type 1 or Open Type side-by-side

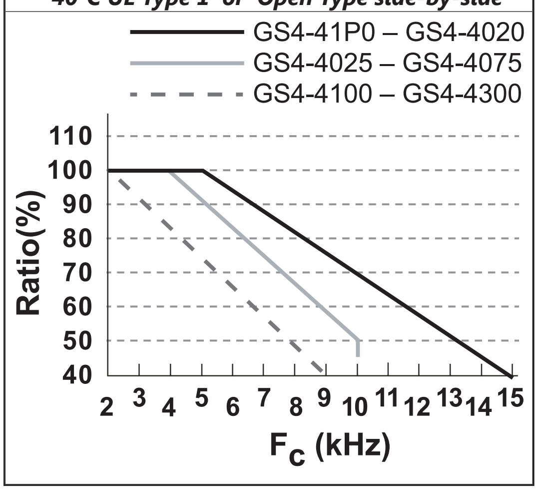


For 230V Constant Torque
VT/CT Duty Selection P6.34 = 1
Method of Derating P6.33 = 0 or 2
40°C UL Open Type
30°C UL Type 1 or Open Type side-by-side

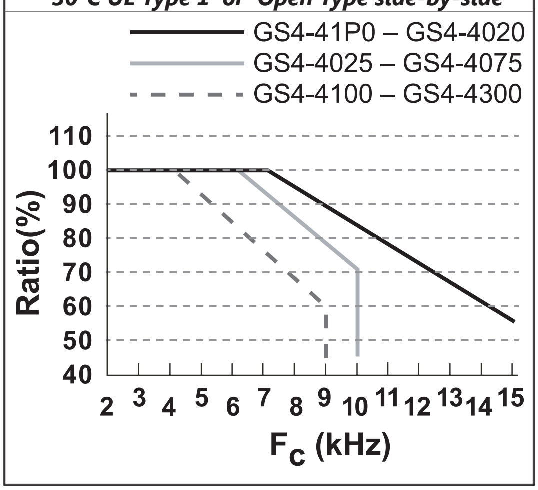


460V Constant Torque Carrier Frequency Derating

For 460V Constant Torque
VT/CT Duty Selection P6.34 = 1
Method of Derating P6.33 = 0, 1, or 2
50°C UL Open Type
40°C UL Type 1 or Open Type side-by-side



For 460V Constant Torque
VT/CT Duty Selection P6.34 = 1
Method of Derating P6.33 = 0 or 2
40°C UL Open Type
30°C UL Type 1 or Open Type side-by-side



Reference Chapter 4, Parameters, for complete descriptions of parameters P6.33 and P6.34.

When working with P6.33 (Drive Derating Method), and P6.34 (VT/CT Duty Selection), refer to P2.10 (PWM Carrier Frequency) for the carrier frequency setting. When P6.34 is set it will change P2.10, while P6.00/P6.02 (Electronic Thermal Overload Relay (Motor1)/(Motor2)) must be set independently.

DURAPULSE GS4 AC Drive Environmental Information

Storage and Transportation

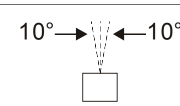
AC drives should be kept in the shipping cartons or crates until they are installed. In order to retain the warranty coverage, they should be stored as described below if not to be installed and used within three months.

- *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.)

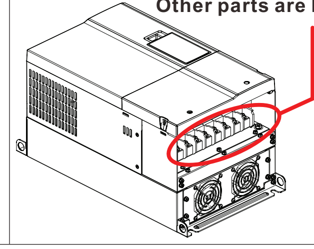
Environmental Conditions

Environmental* Conditions for GS4 AC Drives

Condition	Operation	Storage	Transportation
Installation Location	IEC60364-1/IEC60664-1 Pollution degree 2, Indoor use only	n/a	n/a
Ambient Temperature	see separate Operating Temperature table below	-25°C to +70°C	
	allowed only in non-condensation, non-frost, non-conductive environment		
Relative Humidity	Max 95%; allowed only in non-condensation, non-frost, non-conductive environment		
Air Pressure	86 to 106 kPa		70 to 106 kPa
Pollution Level	IEC60721-3-3; allowed only in non-condensation, non-frost, non-conductive environment		
	Class 3C2; Class 3S2	Class 1C2; Class 1S2	Class 2C2; Class 2S2
Altitude	0~1000m (see separate derating section for altitudes of 1000~3000m)	n/a	n/a
Package Drop	n/a	ISTA procedure 1A (according to weight) IEC60068-2-31	
Vibration	1.0mm, peak to peak value range from 2Hz to 13.2 Hz; 0.7G~1.0G range from 13.2Hz to 55Hz; 1.0G range from 55Hz to 512 Hz. Comply with IEC 60068-2-6		
Impact	IEC/EN 60068-2-27		
Installation Orientation	 Max allowed offset angle ±10° (from vertical installation position)		

DO NOT expose the GS4 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/cm^2 every year.

Operating Temperature and Protection Level

Frame Size		***Top cover***	***Conduit Box***	***Protection Level***	***Operating Temperature***
A~C	***230V: 1.0~30 hp***	With top cover removed	Standard conduit plate	IP20 / UL Open Type	-10~50°C [14~122°F]
	460V: 1.0~40 hp	With top cover in place		IP20 / UL Type1 / NEMA1	-10~40°C [14~104°F]
D0~G	***230V: >30hp*** ***460V: >40hp***	N/A	With conduit box	IP20 / UL Type1 / NEMA1	-10~40°C [14~104°F]
	230V: >30hp ***460V: >40hp***	N/A	Without conduit box	IP00 / IP20 / UL Open Type * **Only the circled area is IP00.** **Other parts are IP20.** 	-10~50°C [14~122°F]

* *Only the exposed terminal blocks are IP00; the other components are IP20*

DURAPULSE GS4 AC Drive Specifications

230V Class

230V Class GS4 Model-Specific Specifications; Frame Sizes A~B
For Use With Three-Phase Motors Only

Model Name: GS4-xxxx				21P0	22P0	23P0	25P0	27P5	2010	2015
Frame Size				A				B		
Output Rating	Constant Torque (CT)	Max Motor Output (1-phase/3-phase)	hp	0.5/1	0.75/2	1/3	2/5	3/7.5	3/10	5/15
			kW	0.37/0.75	0.55/1.5	0.75/2.2	1.5/3.7	2.2/5.5	2.2/7.5	3.7/11
		Rated Output Capacity (1-phase/3-phase)	kVA	1.0/1.9	1.3/2.8	2.0/4.0	3.2/6.4	4.4/9.6	4.4/12	6.8/19
		Rated Output Current (1-phase/3-phase)	A	2.4/4.8	3.2/7.1	5/10	8/16	11/24	11/31	17/47
		Carrier Frequency	kHz	2 to 6						
	Variable Torque (VT)	Max Motor Output	hp	1	2	3	5	7.5	10	15
			kW	0.75	1.5	2.2	3.7	5.5	7.5	11
		Rated Output Capacity	kVA	2.0	3.2	4.4	6.8	10	13	20
		Rated Output Current	A	5	8	11	17	25	33	49
		Carrier Frequency	kHz	2 to 15						
Input Rating *	CT	Rated Input Current * (1-phase/3-phase)	A	6.4/6.1	9.7/11	15/15	20/18.5	26/26	26/34	40/50
	VT	Rated Input Current *	A	6.4	12	16	20	28	36	52
	CT	Rated Voltage/Frequency		1-phase/3-phase 200~240 VAC (-15% to +10%), 50/60Hz						
	VT			3-phase 200~240 VAC (-15% to +10%), 50/60Hz						
	Operating Voltage Range			170~265 VAC						
	Frequency Tolerance			47~63 Hz						
	Short Circuit Withstand (SCCR) (A, rms symmetrical)			100kA						
IE2 Efficiency – Relative Power Loss				3.1%	2.8%	2.5%	2.1%	2.3%	2.1%	2.2%
Weight (kg [lb])				2.6 [5.7]				5.4 [11.9]		
Watt Loss 100% I (W)				61	88	115	159	264	335	529
Cooling Method				Air-cooled	fan					
Braking Chopper				built in						
DC Reactor				optional						
EMI Filter				optional						

** If 3-phase power source is non-symmetrical, refer to "Circuit Connections – RFI Jumper" in Chapter 2: Installation and Wiring, page 2–14.*

** Please refer to "Appendix A: Accessories" for input fusing information.*

***Note:** For single phase models with identical HP and current ratings, choosing a larger size drive will provide greater tolerance to heavy current and loads.*

<table>
<tr><th colspan="12">230V Class GS4 Model-Specific Specifications; Frame Sizes C~E
For Use With Three-Phase Motors Only</th></tr>
<tr><td colspan="4">Model Name: GS4-xxxx</td><td>2020</td><td>2025</td><td>2030</td><td>2040</td><td>2050</td><td>2060</td><td>2075</td><td>2100</td></tr>
<tr><td colspan="4">Frame Size</td><td colspan="3">C</td><td colspan="2">D</td><td colspan="3">E</td></tr>
<tr><td rowspan="10">Output Rating</td><td rowspan="5">Constant Torque (CT)</td><td rowspan="2">Max Motor Output (1-phase/3-phase)</td><td>hp</td><td>7.5/20</td><td>10/25</td><td>10/30</td><td>10/40</td><td>10/50</td><td>15/60</td><td>20/75</td><td>25/100</td></tr>
<tr><td>kW</td><td>5.5/15</td><td>7.5/18.5</td><td>7.5/22</td><td>7.5/30</td><td>7.5/37</td><td>11/45</td><td>15/55</td><td>18.5/75</td></tr>
<tr><td>Rated Output Capacity (1-phase/3-phase)</td><td>kVA</td><td>10/25</td><td>13/28</td><td>13/34</td><td>13/45</td><td>13/55</td><td>20/68</td><td>26/81</td><td>30/96</td></tr>
<tr><td>Rated Output Current (1-phase/3-phase)</td><td>A</td><td>25/62</td><td>33/71</td><td>33/86</td><td>33/114</td><td>33/139</td><td>49/171</td><td>65/204</td><td>75/242</td></tr>
<tr><td>Carrier Frequency</td><td>kHz</td><td colspan="8">2 to 6</td></tr>
<tr><td rowspan="5">Variable Torque (VT)</td><td rowspan="2">Max Motor Output</td><td>hp</td><td>20</td><td>25</td><td>30</td><td>40</td><td>50</td><td>60</td><td>75</td><td>100</td></tr>
<tr><td>kW</td><td>15</td><td>18.5</td><td>22</td><td>30</td><td>37</td><td>45</td><td>55</td><td>75</td></tr>
<tr><td>Rated Output Capacity</td><td>kVA</td><td>26</td><td>30</td><td>36</td><td>48</td><td>58</td><td>72</td><td>86</td><td>102</td></tr>
<tr><td>Rated Output Current</td><td>A</td><td>65</td><td>75</td><td>90</td><td>120</td><td>146</td><td>180</td><td>215</td><td>255</td></tr>
<tr><td>Carrier Frequency</td><td>kHz</td><td colspan="3">2 to 10</td><td colspan="5">2 to 6</td></tr>
<tr><td rowspan="7">Input Rating *</td><td>CT</td><td>Rated Input Current * (1-phase/3-phase)</td><td>A</td><td>58/68</td><td>76/78</td><td>76/95</td><td>63/118</td><td>63/136</td><td>94/162</td><td>124/196</td><td>143/233</td></tr>
<tr><td>VT</td><td>Rated Input Current *</td><td>A</td><td>72</td><td>83</td><td>99</td><td>124</td><td>143</td><td>171</td><td>206</td><td>245</td></tr>
<tr><td>CT</td><td colspan="2" rowspan="2">Rated Voltage/Frequency</td><td colspan="8">1-phase/3-phase 200~240 VAC (-15% to +10%), 50/60Hz</td></tr>
<tr><td>VT</td><td colspan="8">3-phase 200~240 VAC (-15% to +10%), 50/60Hz</td></tr>
<tr><td colspan="3">Operating Voltage Range</td><td colspan="8">170~265 VAC</td></tr>
<tr><td colspan="3">Frequency Tolerance</td><td colspan="8">47~63 Hz</td></tr>
<tr><td colspan="3">Short Circuit Withstand (SCCR) (A, rms symmetrical)</td><td colspan="8">100kA</td></tr>
<tr><td colspan="4">IE2 Efficiency – Relative Power Loss</td><td>2.3%</td><td>2.4%</td><td>2.3%</td><td>1.9%</td><td>2.1%</td><td>1.9%</td><td>1.9%</td><td>2.7%</td></tr>
<tr><td colspan="4">Weight (kg [lb])</td><td colspan="3">9.8 [21.6]</td><td colspan="2">38.5 [84.9]</td><td colspan="3">64.8 [143]</td></tr>
<tr><td colspan="4">Watt Loss 100% I (W)</td><td>616</td><td>733</td><td>865</td><td>1099</td><td>1311</td><td>1518</td><td>1709</td><td>2139</td></tr>
<tr><td colspan="4">Cooling Method</td><td colspan="8">fan</td></tr>
<tr><td colspan="4">Braking Chopper</td><td colspan="3">built in</td><td colspan="5">optional</td></tr>
<tr><td colspan="4">DC Reactor</td><td colspan="3">optional</td><td colspan="5">built in</td></tr>
<tr><td colspan="4">EMI Filter</td><td colspan="8">optional</td></tr>
<tr><td colspan="12">* If 3-phase power source is non-symmetrical, refer to “Circuit Connections – RFI Jumper” in Chapter 2: Installation and Wiring, page 2–14.
* Please refer to “Appendix A: Accessories” for input fusing information.
Note: For single phase models with identical HP and current ratings, choosing a larger size drive will provide greater tolerance to heavy current and loads.</td></tr>
</table>

460V Class

460V Class GS4 Model-Specific Specifications											
Model Name: GS4-xxxx				***41P0***	***42P0***	***43P0***	***45P0***	***47P5***	***4010***	***4015***	***4020***
Frame Size				A					B		
Output Rating	***Constant Torque (CT)***	***Max Motor Output***	***hp***	1	2	3	5	7.5	10	15	20
			kW	0.75	1.5	2.2	3.7	5.5	7.5	11	15
		Rated Output Capacity	***kVA***	2.3	3.0	4.5	6.5	8.8	14	18	24
		Rated Output Current	***A***	2.9	3.8	5.7	8.1	11	17	23	30
		Carrier Frequency	***kHz***	2 to 6							
	Variable Torque (VT)	***Max Motor Output***	***hp***	1	2	3	5	7.5	10	15	20
			kW	0.75	1.5	2.2	3.7	5.5	7.5	11	15
		Rated Output Capacity	***kVA***	2.4	3.2	4.8	7.2	9.6	14	19	25
		Rated Output Current	***A***	3	4	6	9	12	18	24	32
		Carrier Frequency	***kHz***	2 to 15							
Input Rating *	***CT***	***Rated Input Current***	***A***	4.1	5.6	8.3	13	16	19	25	33
	VT			4.3	5.9	8.7	14	17	20	26	35
	Rated Voltage/Frequency			3-phase 380~480 VAC (-15% to +10%), 50/60Hz							
	Operating Voltage Range			323~528 VAC							
	Frequency Tolerance			47~63 Hz							
	Short Circuit Withstand (SCCR) (A, rms symmetrical)			100kA							
IE2 Efficiency – Relative Power Loss				2.6%	2.3%	2.2%	2.0%	1.9%	2.1%	2.0%	1.8%
Weight (kg [lb])				2.6 [5.7]					5.4 [11.9]		
Watt Loss 100% I (W)				59	74	104	141	180	292	380	518
Cooling Method				natural convection		fan					
Braking Chopper				built in							
DC Reactor				optional							
EMI Filter				optional							

** If 3-phase power source is non-symmetrical, refer to "Circuit Connections – RFI Jumper" in Chapter 2: Installation and Wiring, page 2–14.*
Please refer to "Appendix A: Accessories" for input fusing information.

460V Class GS4 Model-Specific Specifications (continued)										
Model Name: GS4-xxxx				**4025**	**4030**	**4040**	**4050**	**4060**	**4075**	**4100**
Frame Size				**C**			**D0**		**D**	
Output Rating	**Constant Torque (CT)**	**Max Motor Output**	**hp**	25	30	40	50	60	75	100
			kW	18.5	22	30	37	45	55	75
		Rated Output Capacity	**kVA**	29	34	45	55	69	84	114
		Rated Output Current	**A**	36	43	57	69	86	105	143
		Carrier Frequency	**kHz**	2 to 6						
	Variable Torque (VT)	**Max Motor Output**	**hp**	25	30	40	50	60	75	100
			kW	18.5	22	30	37	45	55	75
		Rated Output Capacity	**kVA**	30	36	48	58	73	88	120
		Rated Output Current	**A**	38	45	60	73	91	110	150
		Carrier Frequency	**kHz**	2 to 10						
Input Rating *	**CT**	**Rated Input Current**	**A**	38	45	60	70	96	108	149
	VT			40	47	63	74	101	114	157
	Rated Voltage/Frequency			3-phase 380~480 VAC (-15% to +10%), 50/60Hz						
	Operating Voltage Range			323~528 VAC						
	Frequency Tolerance			47~63 Hz						
	Short Circuit Withstand (SCCR) (A, rms symmetrical)			100kA						
IE2 Efficiency – Relative Power Loss				1.6%	1.6%	1.6%	1.6%	1.6%	1.4%	1.3%
Weight (kg [lb])				9.8 [21.6]			27.0 [59.5]		38.5 [84.9]	
Watt Loss 100% I (W)				507	635	866	993	1147	1413	1742
Cooling Method				fan						
Braking Chopper				built in			optional			
DC Reactor				optional			built in			
EMI Filter				optional						

** If 3-phase power source is non-symmetrical, refer to "Circuit Connections – RFI Jumper" in Chapter 2: Installation and Wiring, page 2–14.*
Please refer to "Appendix A: Accessories" for input fusing information.

460V Class GS4 Model-Specific Specifications (continued)										
Model Name: GS4-xxxx				**4125**	**4150**	**4175**	**4200**	**4250**	**4300**
Frame Size				**E**		**F**		**G**	
Output Rating	**Constant Torque (CT)**	**Max Motor Output**	**hp**	125	150	175	215	250	300
			kW	90	110	132	160	185	220
		Rated Output Capacity	**kVA**	136	167	197	235	280	348
		Rated Output Current	**A**	171	209	247	295	352	437
		Carrier Frequency	**kHz**	2 to 6					
	Variable Torque (VT)	**Max Motor Output**	**hp**	125	150	175	215	250	300
			kW	90	110	132	160	185	220
		Rated Output Capacity	**kVA**	143	175	207	247	295	367
		Rated Output Current	**A**	180	220	260	310	370	460
		Carrier Frequency	**kHz**	2 to 9					
Input Rating *	**CT**	**Rated Input Current**	**A**	159	197	228	285	361	380
	VT			167	207	240	300	380	400
	Rated Voltage/Frequency			3-phase 380~480 VAC (-15% to +10%), 50/60Hz					
	Operating Voltage Range			323~528 VAC					
	Frequency Tolerance			47~63 Hz					
	Short Circuit Withstand (SCCR) (A, rms symmetrical)			100kA					
IE2 Efficiency – Relative Power Loss				1.2%	1.2%	1.3%	1.3%	1.4%	1.5%
Weight (kg [lb])				64.8 [143]		86.5 [191]		134 [295]	
Watt Loss 100% I (W)				2092	2599	3081	3783	4589	5772
Cooling Method				fan					
Braking Chopper				optional					
DC Reactor				built in					
EMI Filter				optional					

** If 3-phase power source is non-symmetrical, refer to "Circuit Connections – RFI Jumper" in Chapter 2: Installation and Wiring, page 2–14.*
Please refer to "Appendix A: Accessories" for input fusing information.

Specifications Applicable to All GS4 Models

GS4 General Specifications (Applicable to All Models)		
Control Characteristics	***Control Method***	1: V/F (V/Hz control); 2: SVC (sensorless vector control)
	Starting Torque	Up to 120% (VT) or 150% (CT) for one minute
	V/F Curve	4 point adjustable V/F curve and square curve
	Speed Response Ability	5Hz
	Torque Limit	VT: 170% torque current CT: 180% torque current
	Torque Accuracy	±5%
	Max Output Frequency (Hz)	230V series: 599.00 Hz (75hp & above: 400.00 Hz) 460V series: 599.00 Hz (125hp & above: 400.00 Hz)
	Output Frequency Accuracy	Digital command: ±0.01%, -10°C to +40°C Analog command: ±0.1%, 25±10°C
	Output Frequency Resolution	Digital command: 0.01Hz Analog command: (0.03) x (max output frequency) / 60Hz [±11 bit]
	Overload Tolerance	VT duty: rated output current is 120% for 60 seconds CT duty: rated output current is 150% for 60 seconds
	Frequency Setting Signal	+10V to -10V, 0 to 10V, 4~20mA, 0~20mA
	Accel/Decel Time	0.00~600.00 / 0.0~6000.0 seconds
	Main Control Function	Fault restart; Parameter copy; Dwell; BACnet communication; Momentary power loss ride-through; Speed search; Over-torque detection; Torque limit; 16-step speed (max); Accel/Decel time switch; S-curve accel/decel; 3-wire sequence; Auto-Tuning (rotational, stationary); Frequency upper/lower limit settings; Cooling fan on/off switch; Slip compensation; Torque compensation; JOG frequency; MODBUS communication (RS-485 RJ45, max 115.2 kbps); DC injection braking at start/stop; Smart stall; PID control (with sleep function); Energy saving control
	Fan Control	230V model GS4-2020 and above: PMW control 230V model GS4-2015 and below: ON/OFF switch control 460V model GS4-4025 and above: PMW control 460V model GS4-4020 and below: ON/OFF switch control
Protection Characteristics	***Motor Protection***	Electronic thermal relay protection
	Over-current Protection	For drive model 230V and 460V: Over-current protection for 240% rated current Current clamp: VT duty 170–175%; CT duty 180~185%
	Over-voltage Protection	230V: drive will stop when DC-BUS voltage exceeds 410V 460V: drive will stop when DC-BUS voltage exceeds 820V
	Over-temperature Protection	Built-in temperature sensor
	Stall Prevention	Stall prevention during acceleration, deceleration, and running independently
	Restart After Instantaneous Power Failure	Parameter setting up to 20 seconds
	Ground Leakage Current Protection	Leakage current is higher than 50% of rated current of the AC motor drive
Agency Approvals		CE, $_{C}UL_{US}$, Reach, RoHS (Agency approvals do not apply to accessory conduit box kits, fan kits, flange mount kits, and braking resistors.)

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 GS4 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.

Receiving and Inspection

Drive Package Contents

After receiving the GS4 AC drive, please check the following:

1) Make sure that the package includes the DURAPULSE GS4 AC drive and the DURAPULSE GS4 AC Drive Quick-Start Guide.
2) Carefully follow the unpacking instructions contained in this chapter of this user manual when unpacking your DURAPULSE GS4 AC drive.
3) 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.
4) Make sure that the part number indicated on the nameplate corresponds with the part number of your order.
5) Make sure that the voltage for the wiring lies within the range as indicated on the nameplate. Please install the GS4 AC drive according to this manual.
6) Before applying the power, please make sure that all the devices, including power, motor, control board, and digital keypad are connected correctly.
7) When wiring the GS4 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.
8) When power is applied, select the language and set parameter groups via the digital keypad (GS4-KPD). When executing a trial run, please begin with a low speed, and then gradually increase the speed until the desired speed is reached.

The GS4 AC drive should be kept in the shipping carton or crate before installation. In order to retain the warranty coverage, the GS4 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

GS4- 4 7P5

Applicable Motor Capacity*

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	125: 125hp
150: 150hp	175: 175hp	200: 200hp	250: 250hp
300: 300hp			

*Not all capacities are available in each voltage.

Input Voltage
2: 230VAC
4: 460VAC

Series Name

Nameplate Information

MODEL : GS4-21P0
INPUT : (Variable Torque / Constant Torque)
VT : 3PH 200-240V 50/60Hz 6.4A
CT : 3PH 200-240V 50/60Hz 6.1A
CT : 1PH 200-240V 50/60Hz 6.4A
OUTPUT : (Variable Torque / Constant Torque)
VT : 3PH 0-240V 5A 2.0KVA 0.75KW/1HP
CT : 3PH 0-240V 4.8A 1.9KVA 0.75KW/1HP
CT : 3PH 0-240V 2.4A 1.0KVA 0.37KW/0.5HP
FREQUENCY RANGE : 0-600Hz
SHORT CIRCUIT CURRENT : 100KA
IP20 / UL Open-Type with top cover removed
(rated -10°C to 50°C Ambient).
IP20 / NEMA 1 / UL Type 1 with top cover
Installed (rated -10°C to 40°C Ambient).
Refer to user manual.

G S 4 - 2 1 P 0 + W 1 5 1 7 0 0 1 7

Automationdirect.com
Ver : 01.00 ***MADE IN CHINA***

MODEL : GS4-41P0
INPUT : (Variable Torque / Constant Torque)
VT : 3PH 380-480V 50/60Hz 4.3A
CT : 3PH 380-480V 50/60Hz 4.1A
OUTPUT : (Variable Torque / Constant Torque)
VT : 3PH 0-480V 3.0A 2.4KVA 0.75KW/1HP
CT : 3PH 0-480V 2.9A 2.3KVA 0.75KW/1HP
FREQUENCY RANGE : 0-600Hz
SHORT CIRCUIT CURRENT : 100KA
IP20 / UL Open-Type with top cover removed
(rated -10°C to 50°C Ambient).
IP20 / NEMA 1 / UL Type 1 with top cover
Installed (rated -10°C to 40°C Ambient).
Refer to user manual.

G S 4 - 4 1 P 0 + W 1 5 1 5 0 0 0 1

Automationdirect.com
Ver : 01.00 ***MADE IN CHINA***

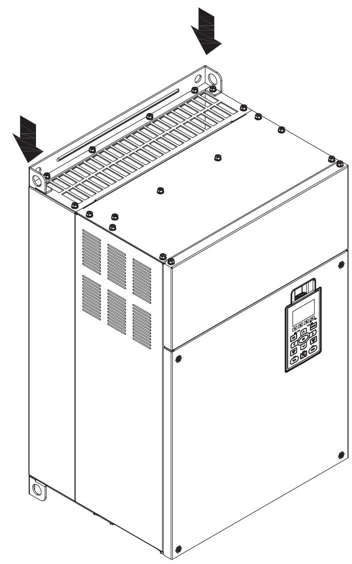
Unpacking Your GS4 *DURApulse* AC Drive

CAUTION: The larger GS4 DURApulse AC drives, frame sizes D through G, can easily be permanently damaged during unpacking, unless the following instructions are followed carefully.

Lifting Eye Locations and Instructions

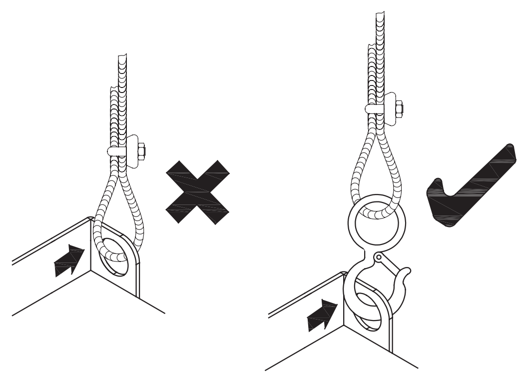
1)

GS4 *DURApulse* AC drives frame sizes D(0) through G have lifting eyes built in to the four corners of the backplane, as shown in this typical drawing.

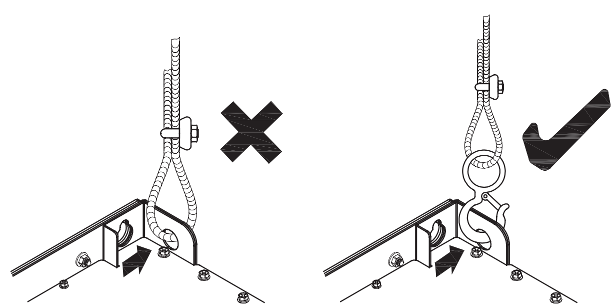


2)

Frames D through E:
Ensure that the lifting hook properly goes through the lifting eyes, as shown.



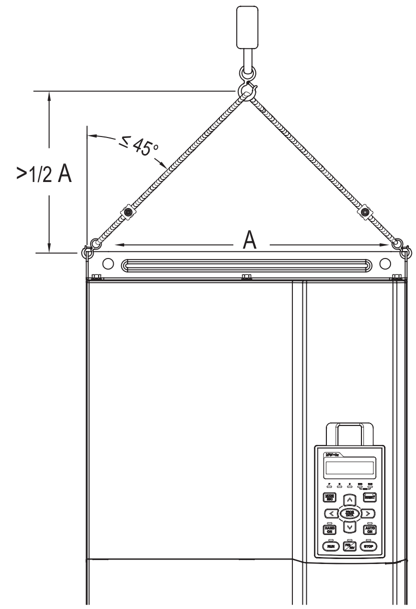
Frames F through G:
Ensure that the lifting hook properly goes through the lifting eyes, as shown.



3)

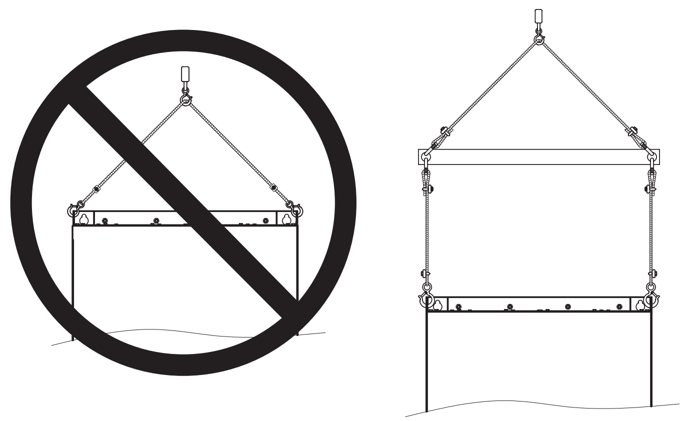
Frames D(0) through E:

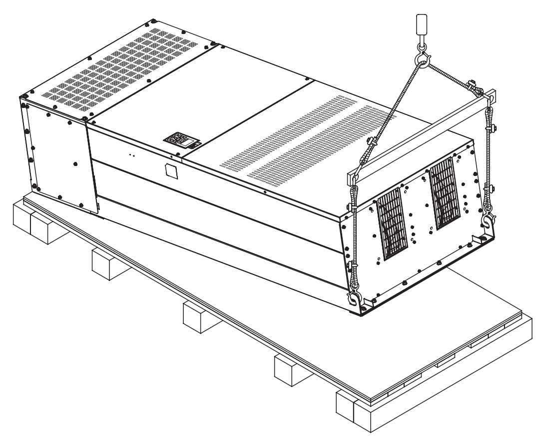
Ensure that the angle between the lifting eyes and the lifting device is within the specification, as shown.



Frames F through G:

Ensure that the angle between the lifting eyes and the lifting device is within the specification, as shown. Use a spreader bar to avoid bending the lifting eyes.



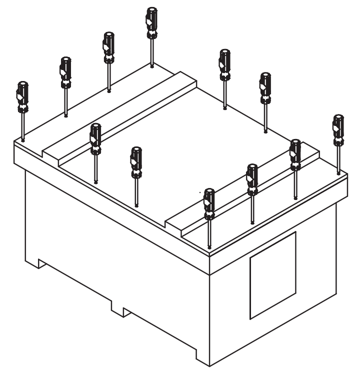


Unpacking the Drive

Unpacking Frame Size D(0) Drives

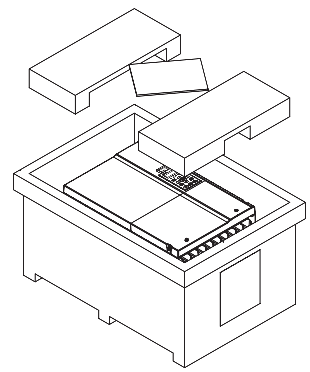
1)

Remove the 12 cover screws to open the crate.



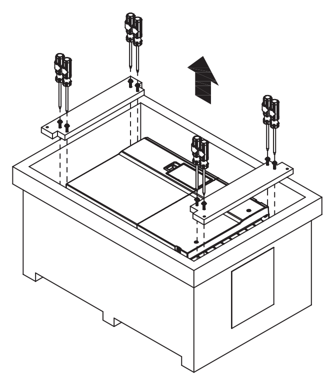
2)

Remove the packing filler and Quick-Start Guide.



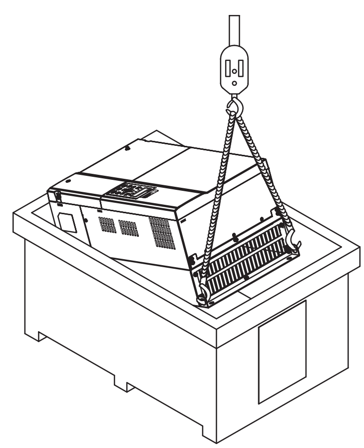
3)

Remove the 8 screws that are fastened on the pallet, and remove the wooden plate.



4)

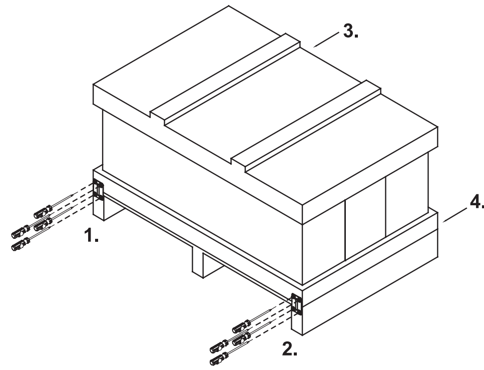
Lift the drive by hooking the lifting eyes. The drive is now ready for installation.



Unpacking Frame Size E Drives

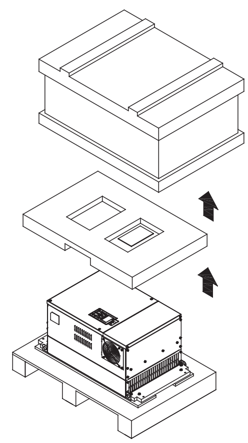
1)

Remove the 4 screws on the iron plates. There are 4 iron plates and a total of 16 screws.



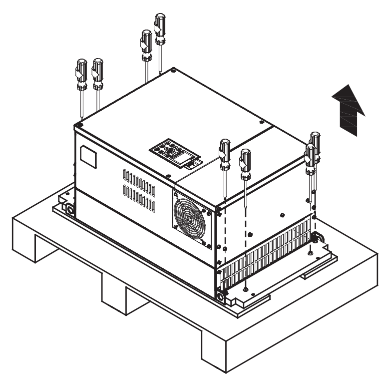
2)

Remove the crate cover, packing filler, and Quick-Start Guide.



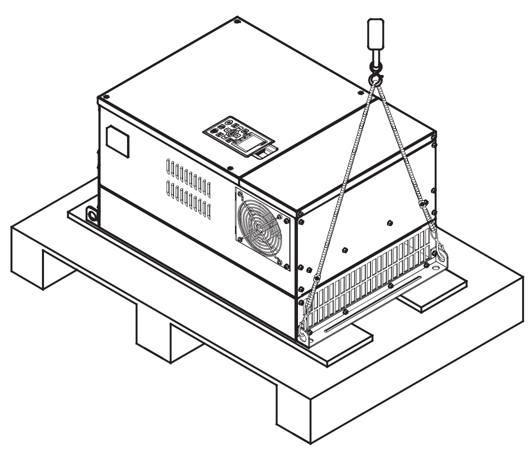
3)

Remove the 8 screws that hold the drive to the pallet.



4)

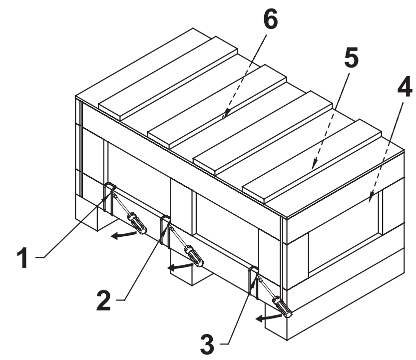
Lift the drive by hooking the lifting eyes. The drive is now ready for installation.



Unpacking Frame Size F Drives

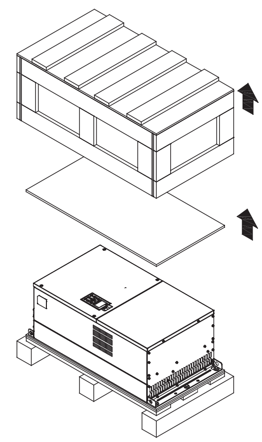
1)

Remove the 6 clips on the side of the crate with a flat-head screwdriver.



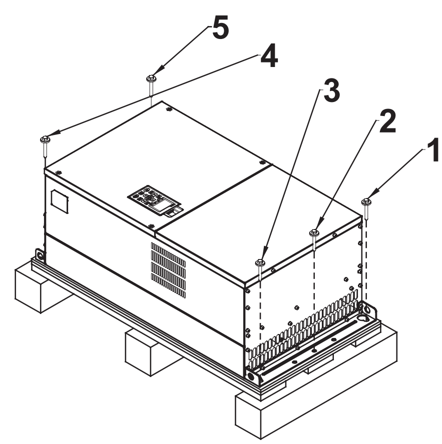
2)

Remove the crate cover, packing filler, and Quick-Start Guide.



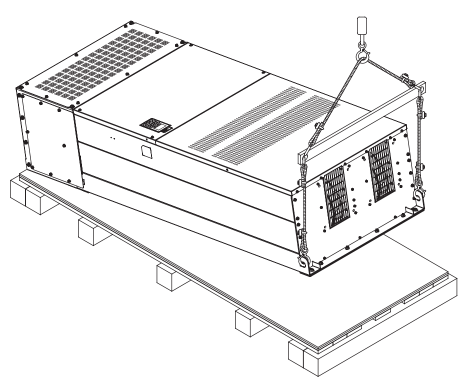
3)

Remove the 5 screws that hold the drive to the pallet.



4)

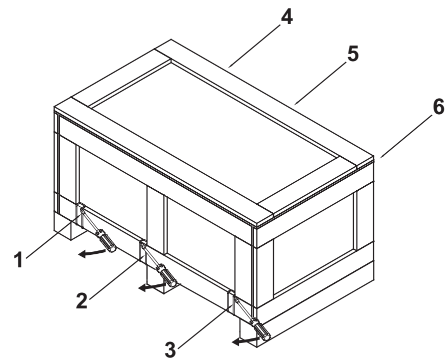
Use a spreader bar to avoid bending the lifting eyes, and lift the drive by hooking the lifting eyes. The drive is now ready for installation.



Unpacking Frame Size G Drives

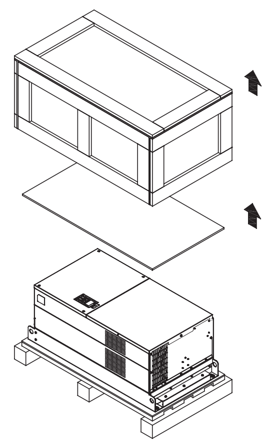
1)

Remove the 6 clips on the side of the crate with a flat-head screwdriver.



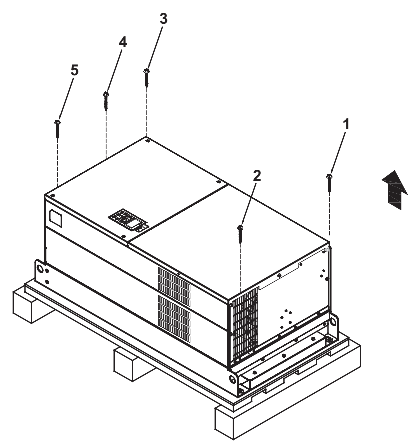
2)

Remove the crate cover, packing filler, and Quick-Start Guide.



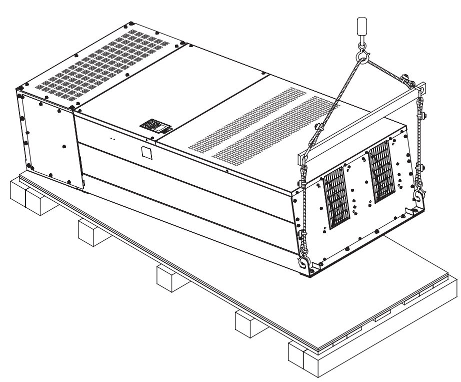
3)

Remove the 5 screws that hold the drive to the pallet.



4)

Use a spreader bar to avoid bending the lifting eyes, and lift the drive by hooking the lifting eyes. The drive is now ready for installation.



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Installation and Wiring

Chapter 2

Table of Contents

Drive Models by Frame Size

GS4 *DURApulse* Drive Models by Frame Size	
Frame	***Drive***
A	GS4-21P0; GS4-41P0; GS4-22P0; GS4-42P0; GS4-23P0; GS4-43P0; GS4-25P0; GS4-45P0; GS4-47P5
B	GS4-27P5; GS4-2010; GS4-4010; GS4-2015; GS4-4015; GS4-4020
C	GS4-2020; GS4-2025; GS4-4025; GS4-2030; GS4-4030; GS4-4040
D0	GS4-4050; GS4-4060
D	GS4-2040; GS4-2050; GS4-4075; GS4-4100
E	GS4-2060; GS4-2075; GS4-2100; GS4-4125; GS4-4150
F	GS4-4175; GS4-4200
G	GS4-4250; GS4-4300

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 metal 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.*
- *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.

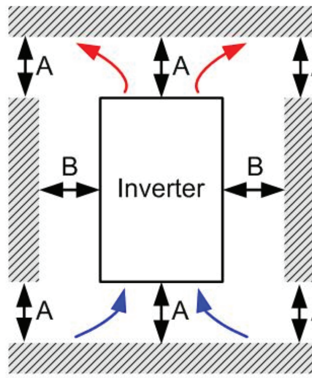
Minimum Clearances and Air Flow

Diagram Directional Arrows

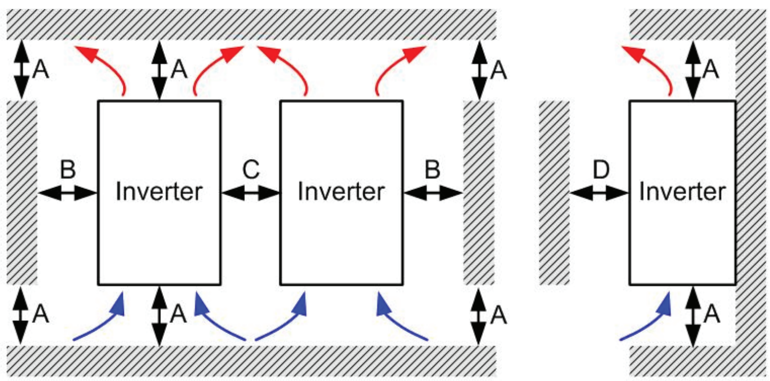
- *Air Inflow: Blue Arrow →→*
- *Air Outflow: Red Arrow →→*
- *Distance: Black Arrows ↔↔*

Minimum Clearance Distances

1) *Single Drive Installation (Frames A–G)*

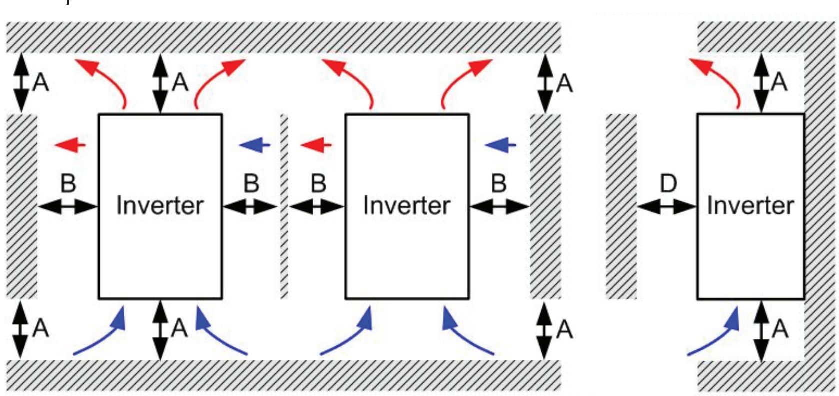


2) *Multiple Drives Side-By-Side (Frames A–C)*

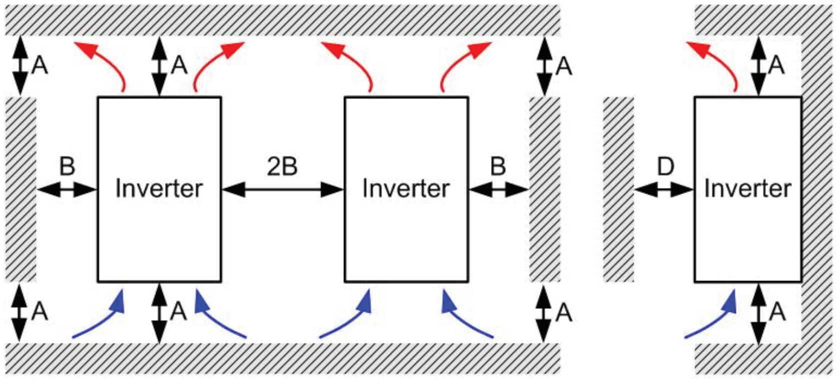


3) *Multiple Drives Side-By-Side (Frames D0, D, E, F)*

- *Install a metal separator between the drives.*

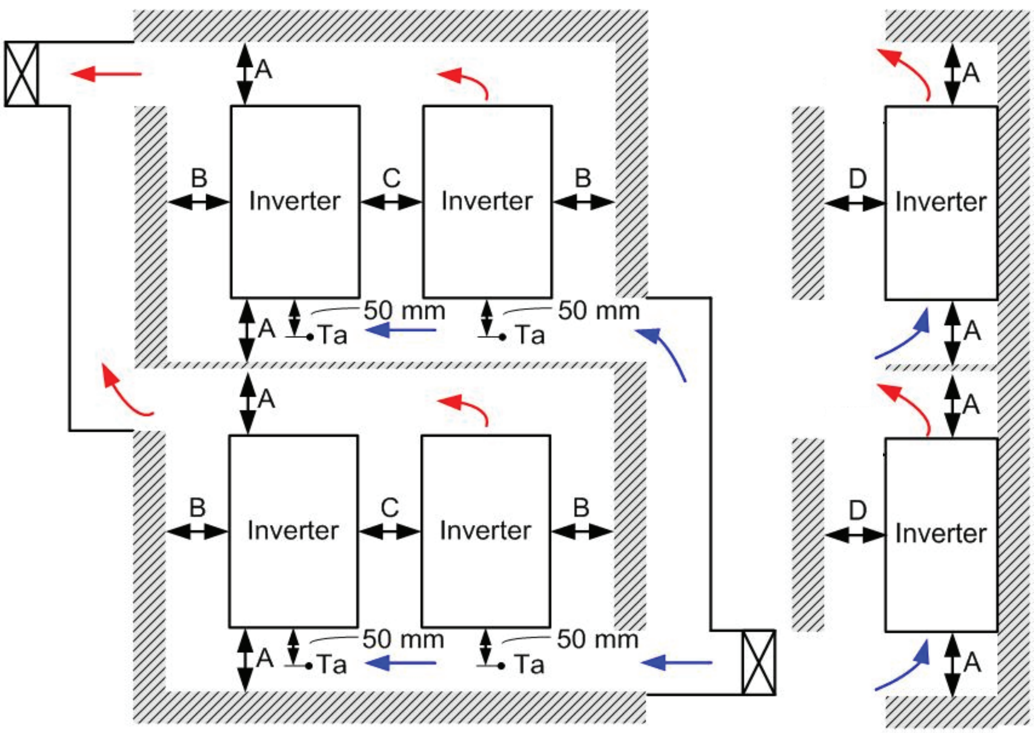


4) Multiple Drives Side-By-Side (Frame G)

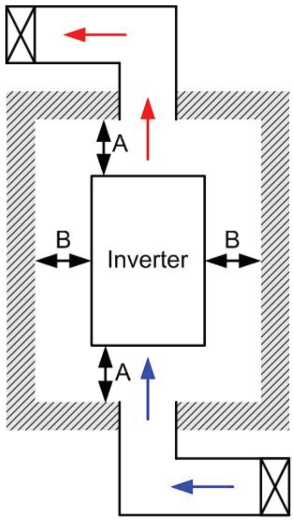


5) Multiple Drives Side-By-Side and Over/Under (Frames A–G)

- *When installing one AC motor drive below another one (over/under installation), use a metal separator between the drives to prevent mutual heating.*
- *The temperature measured at the fan's inflow side must be lower than the temperature measured at the operation side.*
- *If the fan's inflow temperature is higher, use a larger metal separator.*
- *T_a = ambient air temperature measured at 50mm away from the fan's inflow side.*



Dimensions for Minimum Clearance Figures 1–5 *				
Frame Size	***A (mm / in)***	***B (mm / in)***	***C (mm / in)***	***D (mm / in)***
A–C	60 / 2.4	30 / 1.2	10 / 0.4	0 / 0
D(0)–F	100 / 4.0	50 / 2.0	n/a	0 / 0
G	200 / 7.9	100 / 4.0	n/a	0 / 0
** The minimum mounting clearances stated in this table applies to GS4 drives frames A to G. Failure to follow the minimum mounting clearances may cause the fan to malfunction and cause a heat dissipation problem.*				



- *Mounting clearances stated in the figure are for installing the drive in an open area. To install the drive in a confined space (such as cabinet or electric box), please observe these three rules: (1) Maintain the minimum mounting clearances. (2) Install ambient air ventilation equipment or an air conditioner to keep surrounding temperature lower than operation temperature. (3) Refer to parameter setting and set up P2.10 Carrier Frequency, P6.00/P6.02 Electronic Thermal Overload Relay, P6.33 Method of Derating, and P6.34 VT/CT Duty Selection.*
- *The following table shows the heat dissipation and the required air volume when installing a single drive in a confined space. When installing multiple drives, the required air volume should be multiplied by the number of drives.*
- *Refer to the following chart (Air flow rate for cooling) for ventilation equipment design and selection.*
- *Refer to the following chart (Power dissipation) for air conditioner design and selection.*

Airflow and Power Dissipation

Airflow and Power Dissipation										
Model Number	Frame Size	Airflow Rate(1) for Cooling						Power Dissipation(2)		
		Flow Rate(1) (cfm)			Flow Rate(1) (m^3/hr)			Power Dissipation(2) (Watt)		
		External	Internal	Total	External	Internal	Total	Loss External (Heat sink)	Internal	Total
GS4-21P0	A	–	–	–	–	–	–	33	27	60
GS4-22P0	A	14	–	14	24	–	24	56	31	87
GS4-23P0	A	14	–	14	24	–	24	79	36	115
GS4-25P0	A	10	–	10	17	–	17	113	46	159
GS4-27P5	B	40	14	54	68	24	92	197	67	264
GS4-2010	B	66	14	80	112	24	136	249	86	335
GS4-2015	B	58	14	73	99	24	123	409	121	530
GS4-2020	C	166	12	178	282	20	302	455	161	616
GS4-2025	C	166	12	178	282	20	302	549	184	733
GS4-2030	C	166	12	178	282	20	302	649	216	865
GS4-2040	D	179	30	209	304	51	355	913	186	1099
GS4-2050	D	179	30	209	304	51	355	1091	220	1311
GS4-2060	E	228	73	301	387	124	511	1251	267	1518
GS4-2075	E	228	73	301	387	124	511	1401	308	1709
GS4-2100	E	246	73	319	418	124	542	1770	369	2139
GS4-41P0	A	–	–	–	–	–	–	33	25	58
GS4-42P0	A	–	–	–	–	–	–	45	29	74
GS4-43P0	A	14	–	14	24	–	24	71	33	104
GS4-45P0	A	10	–	10	17	–	17	103	38	141
GS4-47P5	A	10	–	10	17	–	17	134	46	180
GS4-4010	B	40	14	54	68	24	92	216	76	292
GS4-4015	B	66	14	80	112	24	136	287	93	380
GS4-4020	B	58	14	73	99	24	123	396	122	518
GS4-4025	C	99	21	120	168	36	204	369	138	507
GS4-4030	C	99	21	120	168	36	204	476	158	634
GS4-4040	C	126	21	147	214	36	250	655	211	866
GS4-4050	D0	179	30	209	304	51	355	809	184	993
GS4-4060	D0	179	30	209	304	51	355	929	218	1147
GS4-4075	D	179	30	209	304	51	355	1156	257	1413
GS4-4100	D	186	30	216	316	51	367	1408	334	1742
GS4-4125	E	257	73	330	437	124	561	1693	399	2092
GS4-4150	E	223	73	296	379	124	503	2107	491	2598
GS4-4175	F	224	112	336	381	190	571	2502	579	3081
GS4-4200	F	289	112	401	491	190	681	3096	687	3783
GS4-4250	G	–		454	–		771	–		4589
GS4-4300	G			454			771			5772

- The required airflow shown in chart is for installing a single GS4 drive in a confined space.
- When installing multiple GS4 drives, the required air volume would be the required air volume for a single GS4 drive multiplied by the number of GS4 drives.

- Heat dissipation shown in the chart is for installing a single GS4 drive in a confined space.
- When installing multiple drives, the volume of heat dissipation should be the heat dissipated by a single GS4 drive multiplied by the number of GS4 drives.
- Heat dissipation for each model is calculated by rated voltage, current and default carrier frequency.

1) *External flow rate is across the heat sink.*
Internal flow rate is through the chassis.
Published flow rates are the result of active cooling using fans; factory-installed in the drive.
Unpublished flow rates (-) are the result of passive cooling in drives without factory-installed fans.
2) *When calculating power dissipation (Watt Loss) use the total value if the drive is foot mounted, or the internal value if the drive is flange mounted. Where only a total value is published, these models cannot be flange mounted.*

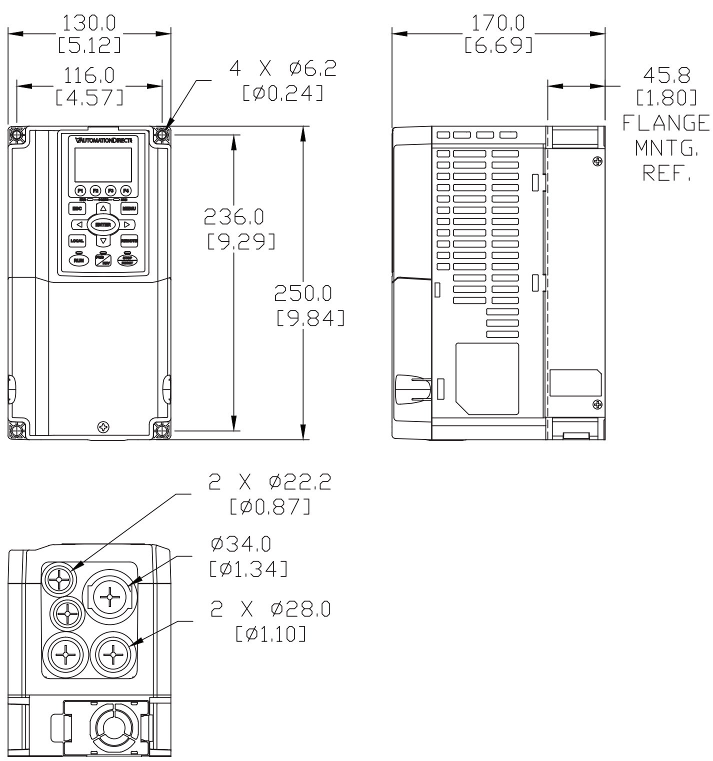
Dimensions

(Units = mm [in])

See our website: www.AutomationDirect.com for complete engineering drawings.

GS4 DURApulse Frame Sizes by Drive Model				
230V			***460V***	
Drive	***Frame***		***Drive***	***Frame***
GS4-21P0	***A***		***GS4-41P0***	***A***
GS4-22P0			***GS4-42P0***	
GS4-23P0			***GS4-43P0***	
GS4-25P0			***GS4-45P0***	
GS4-27P5	***B***		***GS4-47P5***	
GS4-2010			***GS4-4010***	***B***
GS4-2015			***GS4-4015***	
GS4-2020	***C***		***GS4-4020***	
GS4-2025			***GS4-4025***	***C***
GS4-2030			***GS4-4030***	
GS4-2040	***D***		***GS4-4040***	
GS4-2050			***GS4-4050***	***D0***
GS4-2060	***E***		***GS4-4060***	
GS4-2075			***GS4-4075***	***D***
GS4-2100			***GS4-4100***	
			GS4-4125	***E***
			GS4-4150	
			GS4-4175	***F***
			GS4-4200	
			GS4-4250	***G***
			GS4-4300	

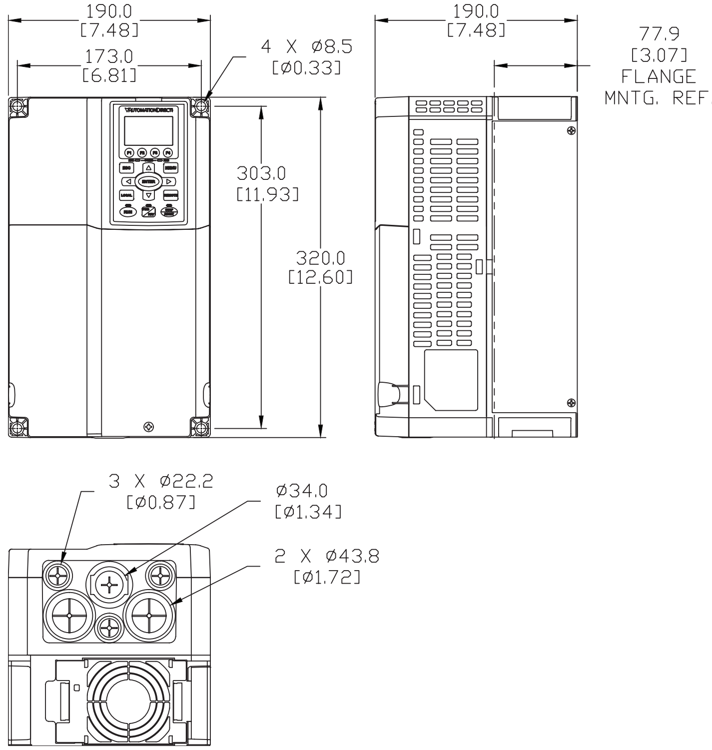
Frame Size A



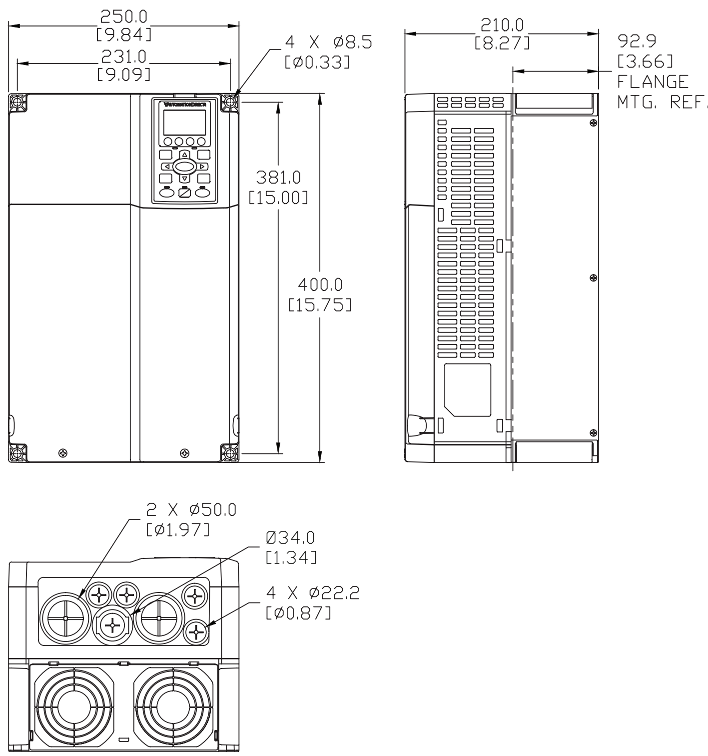
DIMENSIONS (Units = mm [in])

See our website: www.AutomationDirect.com for complete engineering drawings.

FRAME SIZE B



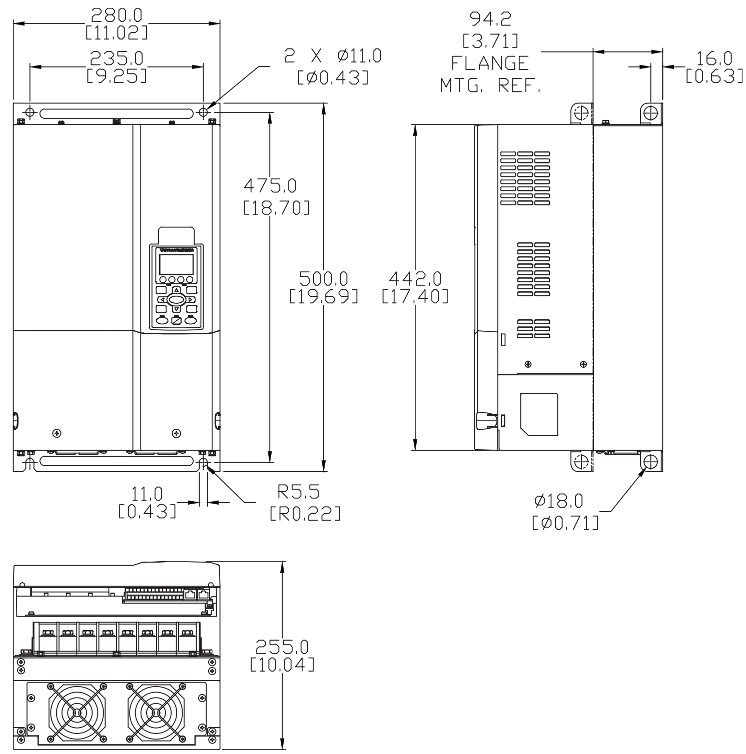
FRAME SIZE C



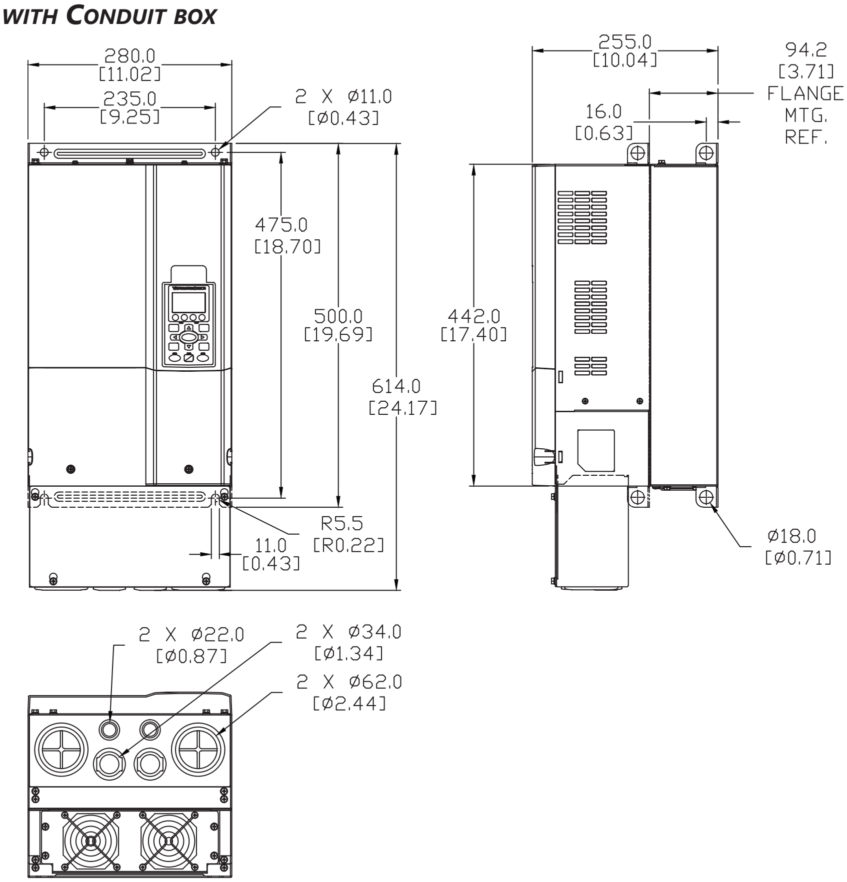
Dimensions (Units = mm [in])

See our website: www.AutomationDirect.com for complete engineering drawings.

Frame Size D0



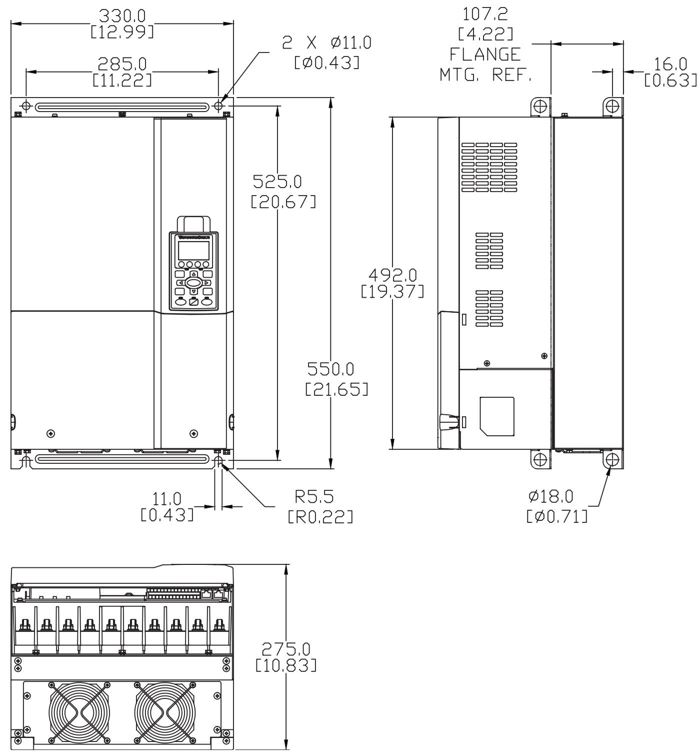
Frame Size D0 with Conduit box



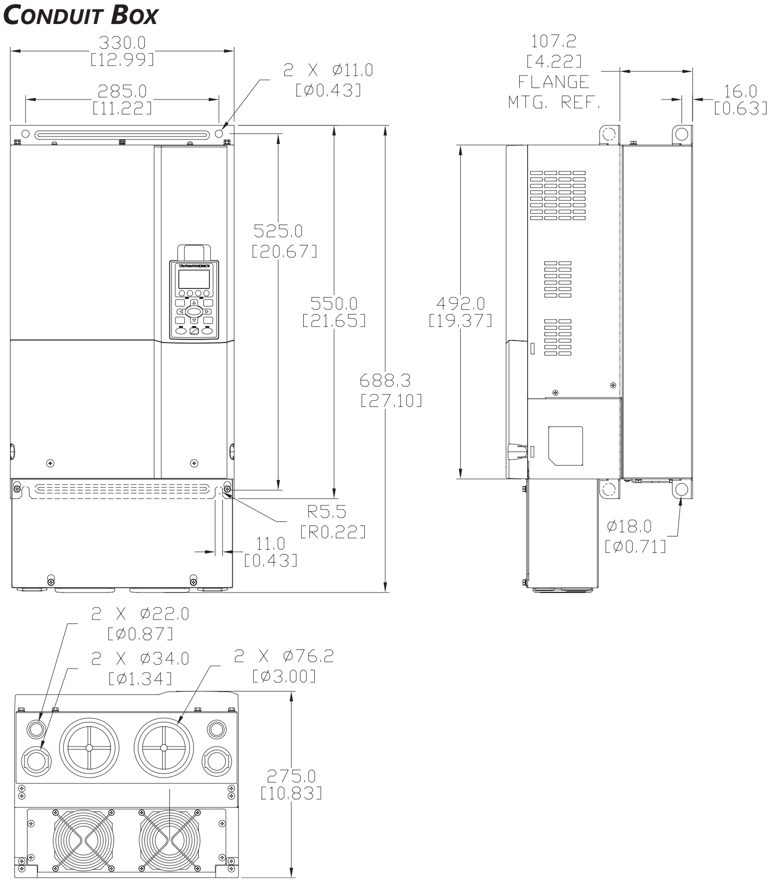
Dimensions (Units = mm [in])

See our website: www.AutomationDirect.com for complete engineering drawings.

Frame Size D



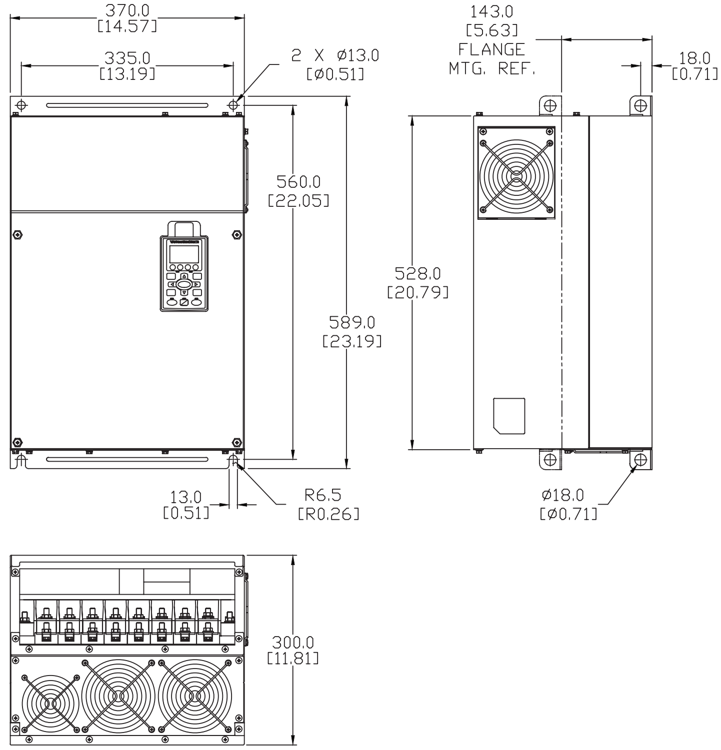
Frame Size D with Conduit Box



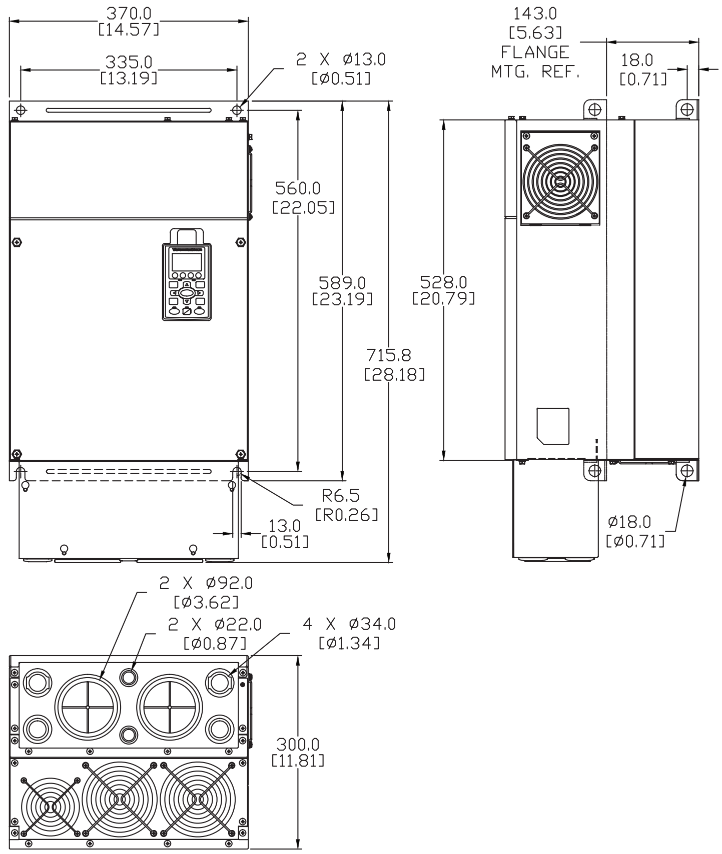
Dimensions (Units = mm [in])

See our website: www.AutomationDirect.com for complete engineering drawings.

Frame Size E



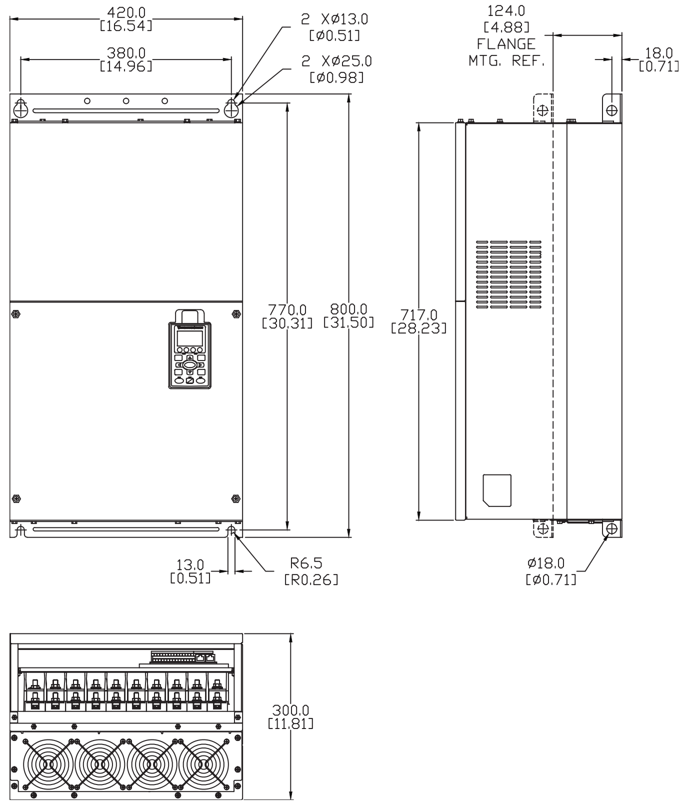
Frame Size E with Conduit box



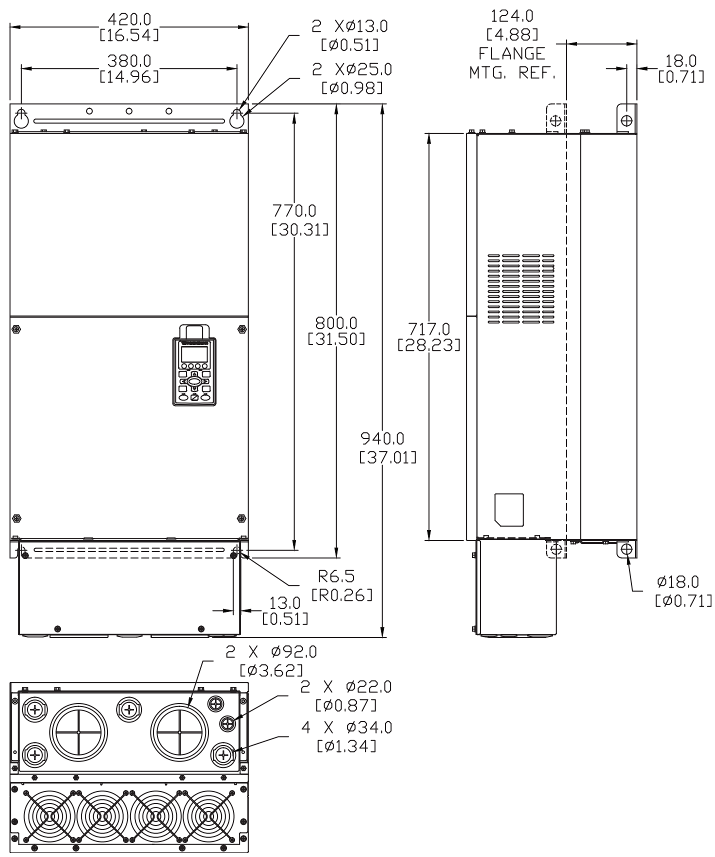
Dimensions (Units = mm [in])

See our website: www.AutomationDirect.com for complete engineering drawings.

Frame Size F



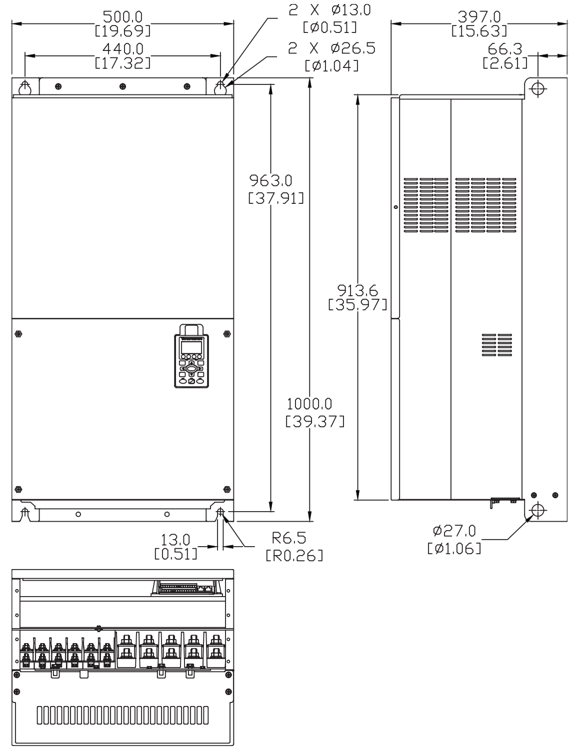
Frame Size F with Conduit box



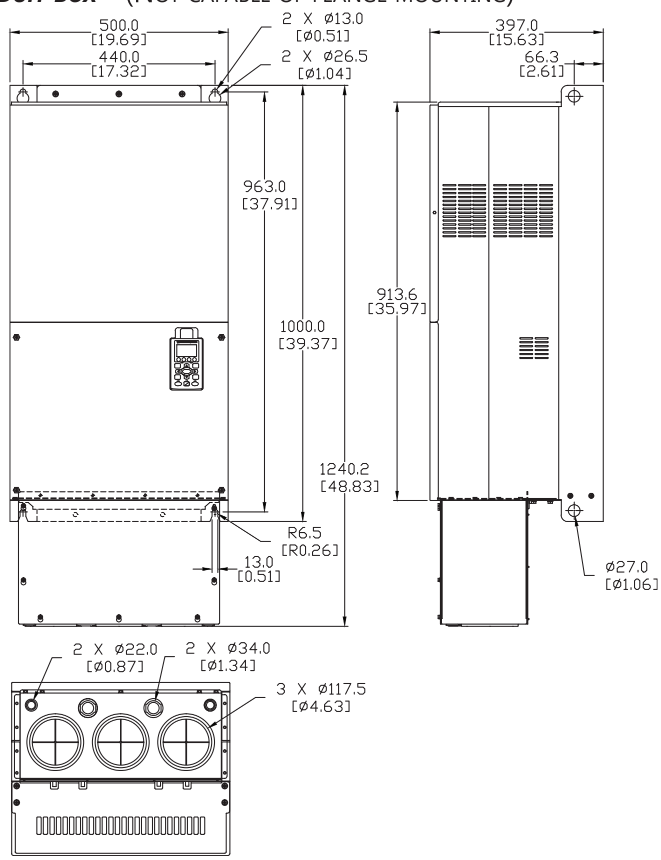
Dimensions (Units = mm [in])

See our website: www.AutomationDirect.com for complete engineering drawings.

Frame Size G (Not capable of flange mounting)



Frame Size G with Conduit box (Not capable of flange mounting)



Circuit Connections – RFI Jumper

RFI Jumper: The GS4 drive may emit electrical noise. The RFI jumper, when left in place, enables an internal filter to supress radio frequency interference on the power line.

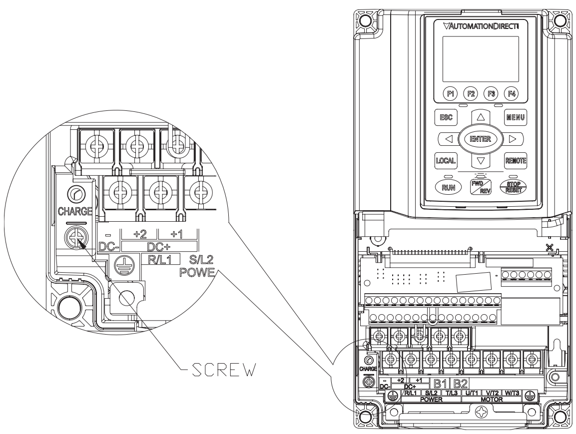
RFI Jumper Removal

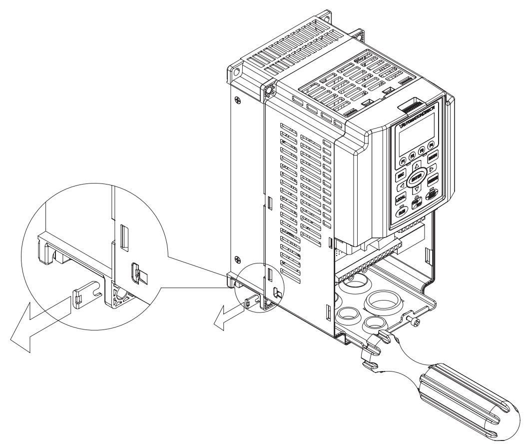
The RFI jumper may need to be removed in some cases, such as situations in which the GS4 drive is powered from an Asymmetric Ground System (Corner Grounded TN System), as described on page 2–16.

Frames A~C

Screw Torque: 8~10 kg·cm [6.9~8.7 lb·in]

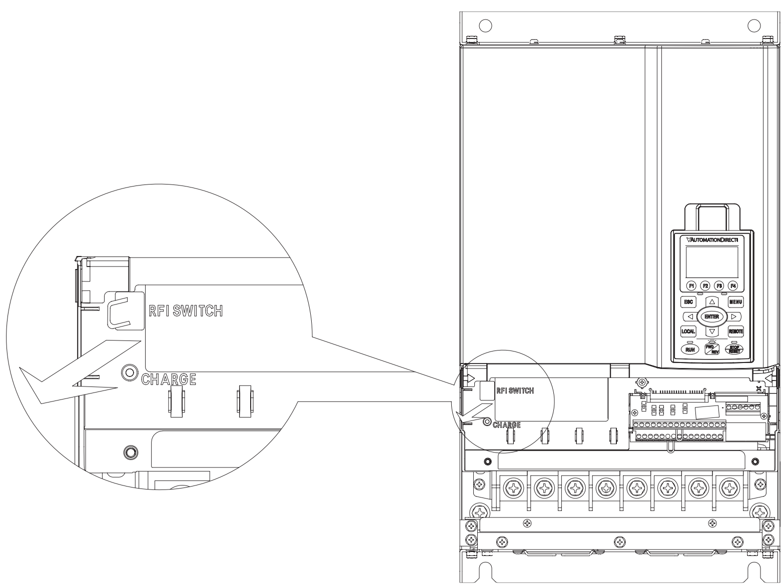
Loosen the screw indicated in the view below, and remove the RFI jumper. Tighten the screw to the specified torque after the RFI jumper is removed.





Frames D0~G

Remove the MOV-PLATE by hand; no screws need to be loosened.



Isolating Main Power from Ground

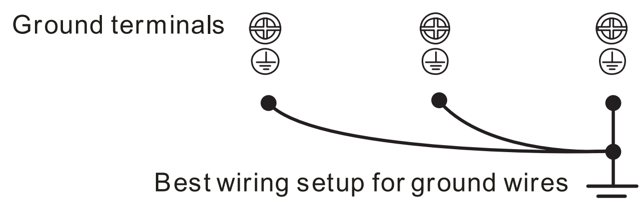
WARNING: If the power distribution system supplying the GS4 drive is single phase, the RFI jumper must be removed.

WARNING: If the power distribution system supplying the GS4 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 GS4 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, proper operation, and to reduce electromagnetic radiation, the GS4 drive must be properly grounded during installation.*
- *The diameter of the cables must meet the size specified by applicable codes and regulations.*
- *The grounding cable must be connected to the ground of the GS4 drive to meet safety regulations.*
- *The grounding cable can be used as the ground for equipment only when the aforementioned points are met.*
- *When installing multiple GS4 drives, do not connect the grounds of the AC motor drive in series. Instead, utilize a single-point grounding scheme (as shown below), or provide individual grounding rods for each GS4 drive.*



Pay particular attention to the following WARNINGS:

WARNING: Do not remove the RFI jumper while power is applied to the GS4 drive.

WARNING: Cutting the RFI short-circuit cable will also cut off the conductivity of the capacitor. Gap discharge may occur once the transient voltage exceeds 1000V.

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

WARNING: The RFI jumper may not be removed while conducting high voltage tests.

WARNING: When conducting a high voltage test to the entire facility, the main power and the motor must be disconnected if leakage current is too high.

Floating Ground System (IT Systems)

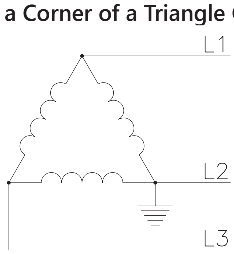
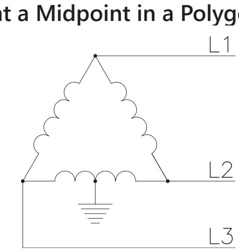
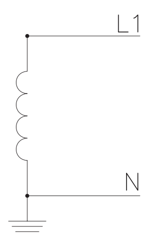
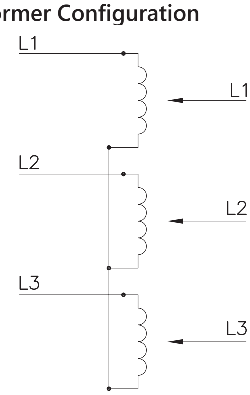
A floating ground system is also called an IT system, an ungrounded system, or a high impedance/resistance grounding system (greater than 30Ω).

> ***CAUTION: <u>Do not install an external RFI/EMC filter</u>! The EMC filter will pass through the RFI capacitor, thus connecting power input to ground. <u>This is very dangerous</u> and can easily damage the GS4 drive.***

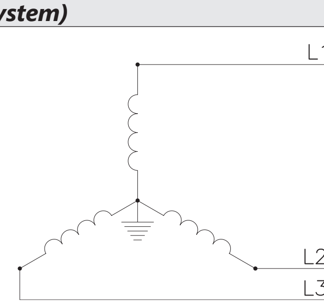
Asymmetric Ground System (Corner Grounded TN Systems)

> ***CAUTION: Do not remove the RFI jumper while the input terminals of the GS4 drive carries power.***

<u>The RFI jumper must be removed in the following four situations</u>. This is to prevent the system from grounding through the RFI capacitor, damaging the GS4 drive.

<table>
<tr><th colspan="2">RFI Jumper Must Be <u>Removed</u> (Asymmetric Ground / Corner Grounded TN Systems)</th></tr>
<tr><td>1) Grounding at a Corner of a Triangle Configuration

</td><td>2) Grounding at a Midpoint in a Polygonal Configuration

</td></tr>
<tr><td>3) Grounding at One End in a Single-Phase Configuration

</td><td>4) No Stable Neutral Grounding in a Three-Phase Autotransformer Configuration

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

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

<table>
<tr><th colspan="2">RFI Jumper <u>Left In Place</u> (Symmetrical Ground System)</th></tr>
<tr><td>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.</td><td>
</td></tr>
</table>

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 listing.

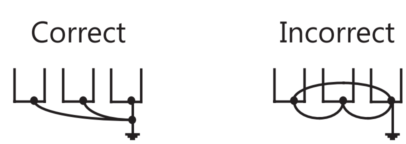
Warning: Do not connect the AC input power to the T1, T2, and T3 output terminals. Doing this will damage the AC drive.

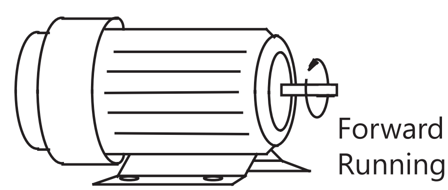
Warning: Do not connect single-phase power to a three-phase drive model.

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 "DURApulse GS4 AC 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 GS4 AC drive is activated.
5) Do not use a power circuit contactor or disconnect switch for normal run/stop control of the GS4 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 GS4 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 GS4 AC drives can be installed in one location. All of the units should be grounded directly to a common ground terminal. The GS4 AC drive ground terminals may also be connected in parallel, as shown in the figure below.
   Make sure there are no ground loops.





10) When the GS4 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 GS4 AC drive.
12) Do not attach or remove wiring when power is applied to the GS4 AC drive.
13) Do not inspect components unless inside "POWER" lamp is turned off.
14) Do not monitor the signals on the circuit board while the GS4 AC drive is in operation.
15) GS4 series AC drives ***cannot be used with single-phase motors***.

16) Route the power and control wires separately, or at 90 degree angle to each other.
17) 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.
18) If a filter is required for reducing EMI (Electro Magnetic Interference), install it as close as possible to the GS4 AC drive. EMI can also be reduced by lowering the Carrier Frequency.
    Please refer to the "Applied EMI/RFI Techniques" white paper at support.automationdirect.com.
19) If the GS4 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 GS4 AC drive. Do not use a Capacitor, L-C Filter (Inductance-Capacitance), or R-C Filter (Resistance-Capacitance).
20) 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 GS4 460VAC 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 GS4 AC drive by turning input power ON/OFF. Start/stop the GS4 AC drive using RUN/STOP commands via control terminals or the keypad. If you must start/stop the GS4 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, L-C (Inductance-Capacitance) , or R-C (Resistance Capacitance) capacitors to the output terminals U/T1, V/T2, W/T3 of the GS4 AC drive.*
- *DO NOT connect phase-compensation capacitors or surge absorbers to the output terminals of the GS4 AC drive.*
- *Use a well-insulated motor suitable for inverter operation.*

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

- *Terminals +1 and +2 are used to connect an optional DC reactor to improve the power factor. For the factory setting, they are connected by a short-circuit jumper. Remove this jumper before connecting a DC reactor.*
- *When the GS4 AC Drive is connected directly to a large-capacity power transformer (600kVA or above) or when a phase lead capacitor is switched, excess peak currents may occur in the power input circuit due to the load changes. The converter section may be damaged. To avoid this damage, it is recommend to use a serial connected AC input reactor at the GS4 AC Drive mains input side to reduce the current and improve the input power efficiency.*
- *Connect an optional brake resistor or brake unit in applications with frequent deceleration ramps, short deceleration time, too low brake torque or requiring increased brake torque.*
- *For GS4 frame sizes A–C, the external brake resistor should be connected to the terminals (B1, B2) of GS4 drives.*
- *For the models without built-in braking chopper, connect external brake unit and brake resistor (both of them are optional) to increase brake torque.*
- *If the terminals [+1], [+2], and [-] are not used, leave these three terminals open.*
- *DO NOT connect [+1, -], [+2, -], [+1/DC+, -/DC-], or brake resistor directly to prevent drive damage.*
- *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 GS4 AC drive to operate a standard 3-phase induction motor, notice that the energy loss is greater than for an inverter duty motor.
2) Avoid running a standard induction motor at low speed, which may cause the motor temperature to exceed the motor rating due to limited airflow produced by the motor's fan.
3) When the standard motor operates at low speed, the output load must be decreased.
4) If **100% output torque** is desired at low speed, it may be necessary to use a special **"inverter-duty" rated motor**.

Short Circuit Withstand (SCCR)

All *DURApulse* GS4 series drives are suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes.

The maximum voltage is 240V for all 230V models, and 480V for all 460V models.

Applicable Codes

All *DURApulse GS4* 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 U.L. standards is required.

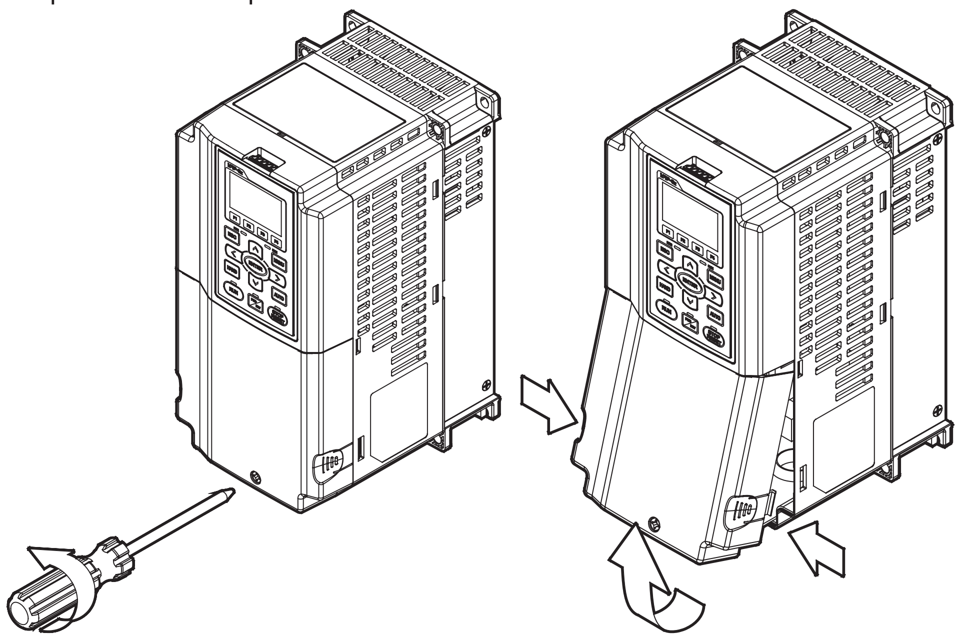
Wiring Terminal Access

Control Terminal Access

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

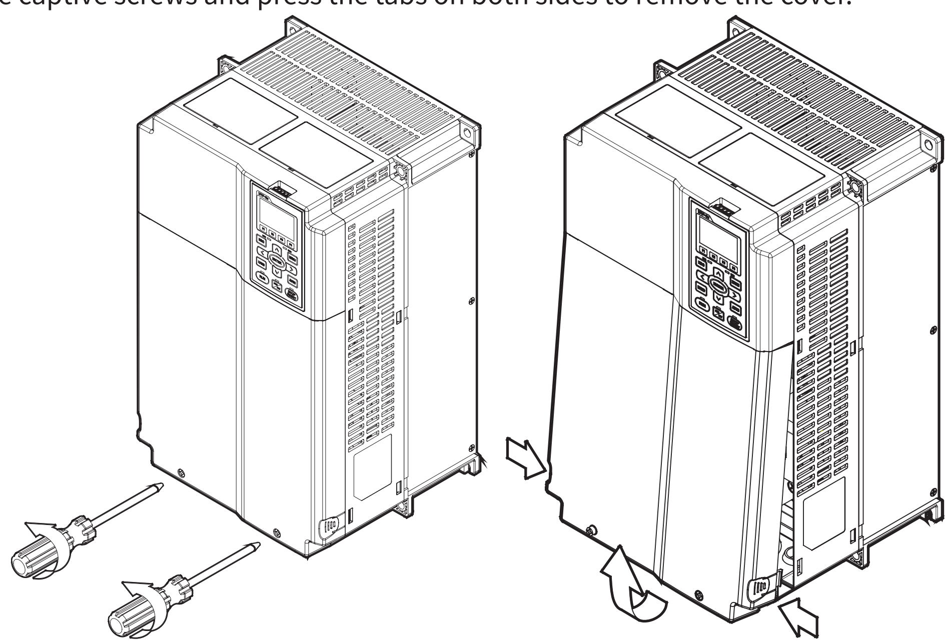
Drive Frames A and B

Loosen the captive screw and press the tabs on both sides to remove the cover.



Drive Frames C and D

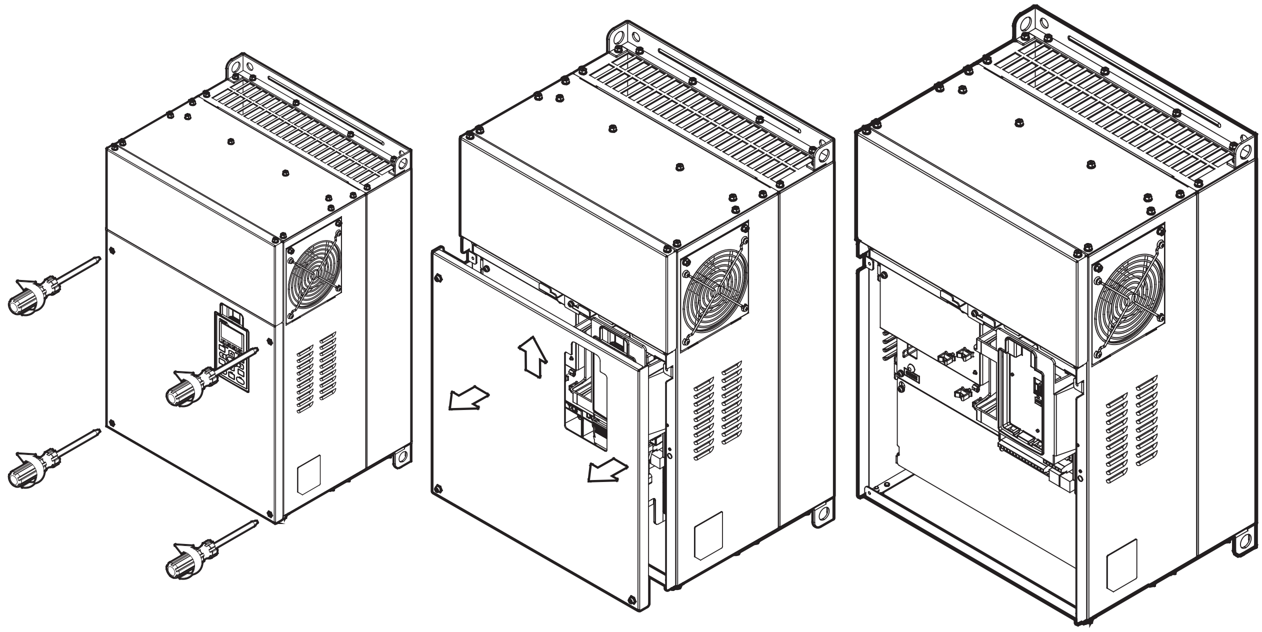
Loosen the captive screws and press the tabs on both sides to remove the cover.



Control Terminal Access (continued)

Drive Frame E, F, and G

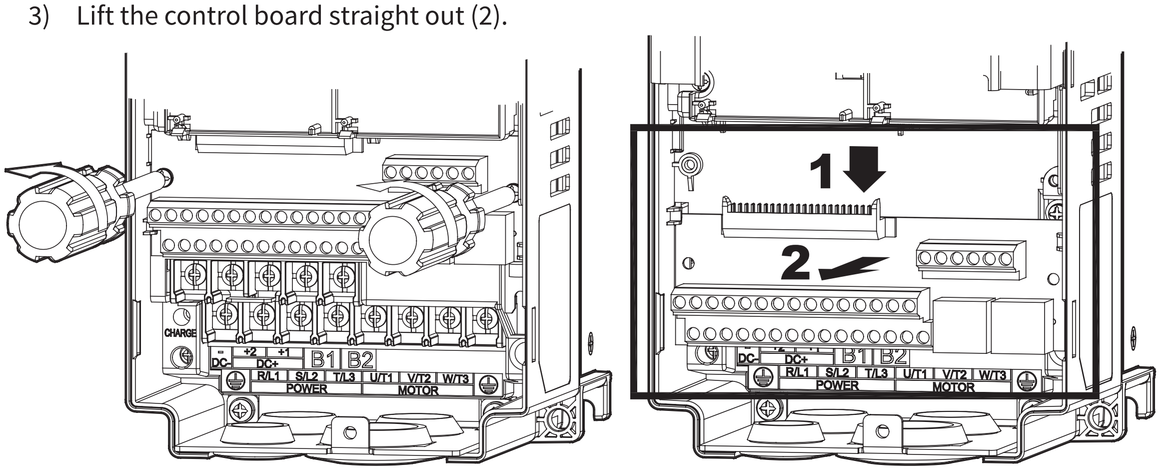
Loosen the captive screws, lift the cover slightly, and pull it outward.
(Frame E shown)



Removing the Control Terminal Block

The control terminal block is removable for ease of wiring.

1) Loosen the captive screws.
2) Slide the control board toward the bottom of the drive to disconnect the pins (1).
3) Lift the control board straight out (2).



Main Circuit Wiring Terminals

Main Terminal Specifications

Main Circuit Terminals	
Terminal	***Description***
R/L1	Input Power – phase 1
S/L2	Input Power – phase 2
T/L3	Input Power – phase 3
U/T1, V/T2, W/T3	AC Drive Output
+1, +2	DC Choke Connection (frames A–C)
B1, B2	Braking Resistor Connection (frames A–C)
+1/DC+, -/DC-	External Dynamic Brake Unit (frames D–G)
⏚	Ground

Main Circuit Wiring Specifications				
AC Drive Frame Size	***AC Drive Model***	***Wire Range (AWG [mm²])***		***Terminal Tightening Torque (kg·cm [lb·in])***
		Max	***Min***	
A	***GS4-21P0***	8 [8.4]	14 [2.1]	20 [17.4]
	GS4-22P0		12 [3.3]	
	GS4-23P0		10 [5.3]	
	GS4-25P0		8 [8.4]	
	GS4-41P0		14 [2.1]	
	GS4-42P0			
	GS4-43P0			
	GS4-45P0		10 [5.3]	
	GS4-47P5			
B	***GS4-27P5***	4 [21.2]	8 [8.4]	35 [30.4]
	GS4-2010		6 [13.3]	
	GS4-2015		4 [21.2]	
	GS4-4010		8 [8.4]	
	GS4-4015			
	GS4-4020		6 [13.3]	
C	***GS4-2020***	1/0 [53.5]	1 [42.4]	80 [69.4]
	GS4-2025		1/0 [53.5]	
	GS4-2030			
	GS4-4025		4 [21.2]	
	GS4-4030			
	GS4-4040		2 [33.6]	
D0	***GS4-4050***	2/0 [67.4]	1/0 [53.5]	81.6 [70.8]
	GS4-4060		2/0 [67.4] 1/0 [53.5]*	
D	***GS4-2040***	300 MCM [152] 4/0 [107]*	4/0 [107] 3/0 [85]*	200 [173]
	GS4-2050		250 MCM [127] 4/0 [107]*	
	GS4-4075		3/0 [85] 2/0 [67.4]*	
	GS4-4100		300 MCM [152] 4/0 [107]*	
E	***GS4-2060***	300 MCM x2 [152 x2] 4/0 x2 [107 x2]*	1/0 x2 [53.5 x2]	200 [173]
	GS4-2075		3/0 x2 [85 x2] 2/0 x2 [67.4 x2]*	
	GS4-2100		4/0 x2 [107 x2] 3/0 x2 [85 x2]*	
	GS4-4125		1/0 x2 [53.5 x2]	
	GS4-4150		3/0 x2 [85 x2] 2/0 x2 [67.4 x2]*	
** Wiring specifications for drives with optional conduit box*				
(continued next page)				

Main Circuit Wiring Specifications (continued)				
AC Drive Frame Size	AC Drive Model	Wire Range (AWG [mm²])		Terminal Tightening Torque (kg·cm [lb·in])
		Max	Min	
F	GS4-4175	300 MCM x2 [152 x2] 4/0 x2 [107 x2]*	4/0 x2 [107 x2] 3/0 x2 [85 x2]*	200 [173]
	GS4-4200		4/0 x2 [107 x2]	
G	Terminals R/L11,12; S/L21,22; T/L31,32			
	GS4-4250	300 MCM x4 [152 x4]	2/0 x4 [67.4 x4] 1/0 x4 [53.5 x4]*	200 [173]
	GS4-4300		3/0 x4 [85 x4] 2/0 x4 [67.4 x4]*	
	Terminals U/T1, V/T2, W/T3, +1/DC+, -/DC-			
	GS4-4250	500 MCM x2 [253 x2]	400 MCM x2 [203 x2] 300 MCM x2 [152 x2]*	400 [354]
	GS4-4300		500 MCM x2 [253 x2] 400 MCM x2 [203 x2]*	
* Wiring specifications for drives with optional conduit box				

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

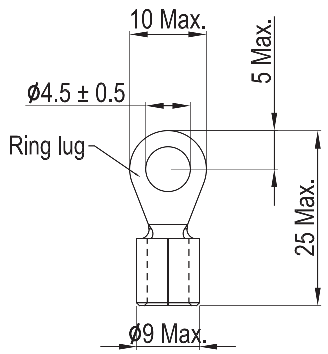
Wiring Terminal Connector Dimensions – Main-Circuit Terminals

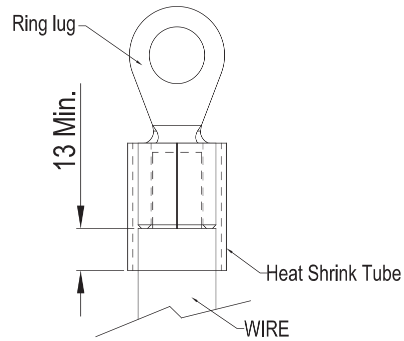
Dimensions = mm

Frame Size A (GS4 model #s: 21P0, 22P0, 23P0, 25P0, 41P0, 42P0, 43P0, 45P0, 47P5)

NOTE: Crimp connectors are NOT required on A, B, and C frame drives.
NOTE: Heat shrink should comply with UL (600V, YDPU2).

Power Terminal Wiring Connectors: ***Heat Shrink Tubing:***

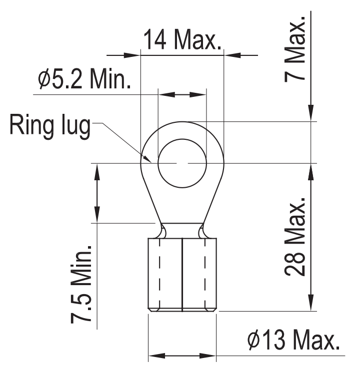


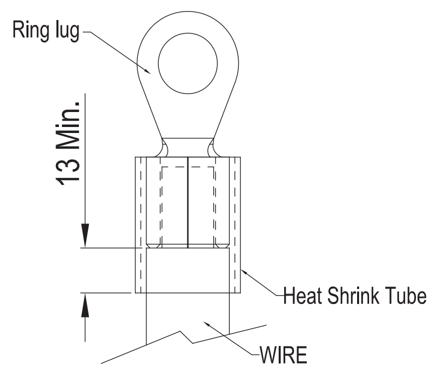


Frame Size B (GS4 model #s: 27P5, 2010, 2015, 4010, 4015, 4020)

NOTE: Crimp connectors are NOT required on A, B, and C frame drives.
NOTE: Heat shrink should comply with UL (600V, YDPU2).

Power Terminal Wiring Connectors: ***Heat Shrink Tubing:***





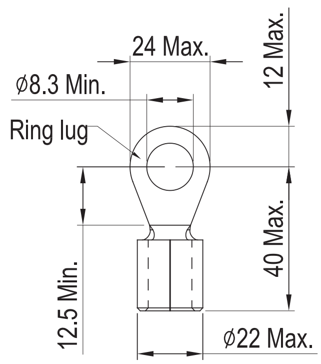
Main Circuit Crimp Connector Specifications (continued)

Dimensions = mm

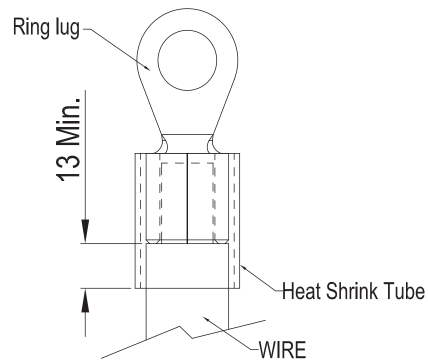
Frame Size C (GS4 model #s: 2020, 2025, 2030, 4025, 4030, 4040)

<u>NOTE</u>: Crimp connectors are NOT required on A, B, and C frame drives.
<u>NOTE</u>: Heat shrink should comply with UL (600V, YDPU2).

Power Terminal Wiring Connectors:



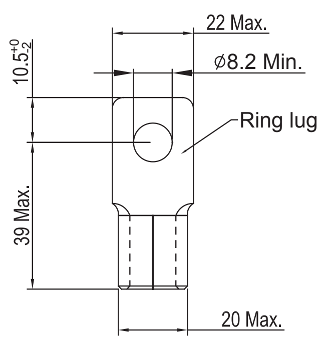
Heat Shrink Tubing:



Frame Size D0 (GS4 model #s: 4050, 4060)

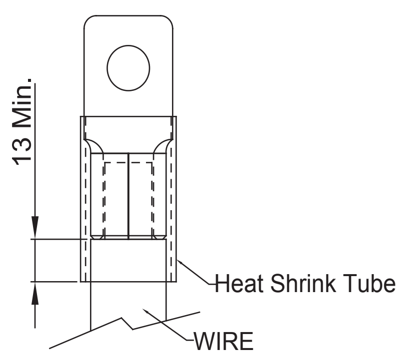
NOTE: Crimp connectors ARE required on D0, D, E, F, and G frame drives.
<u>NOTE</u>: Heat shrink should comply with UL (600V, YDPU2).

Power Terminal Wiring Connectors:
(<u>except Ground</u> Terminal Connectors)

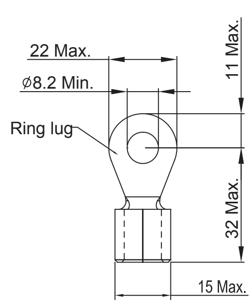


Terminal Size

Heat Shrink Tubing:
(non-ground power connectors)

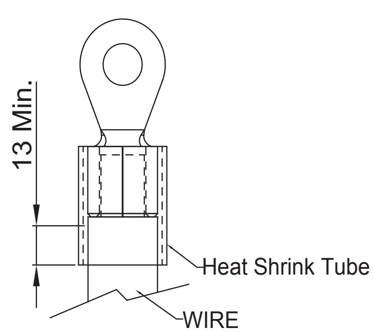


<u>GROUND</u> Terminal Wiring Connectors <u>ONLY</u>:



Terminal Size (Ground)

Heat Shrink Tubing:
(ground terminal power connectors)



Main Circuit Crimp Connector Specifications (continued)

Dimensions = mm

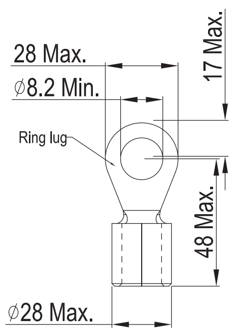
Frame Size D (GS4 model #s: 2040, 2050, 4075, 4100)

NOTE: Crimp connectors ARE required on D0, D, E, F, and G frame drives.

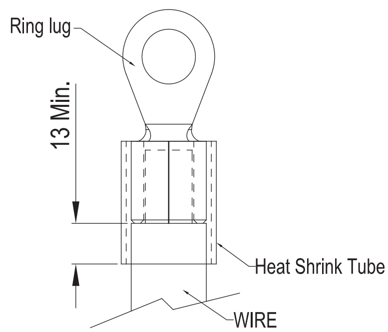
NOTE: ADC ring terminal part #s for GS4 A-frame drives: V70RK004011, V70RK004012, V70RK004017, V70RK004018

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

Power Terminal Wiring Connectors:



Heat Shrink Tubing:

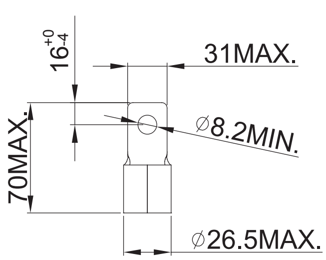


Frame Size E (GS4 model #s: 2060, 2075, 2100, 4125, 4150)

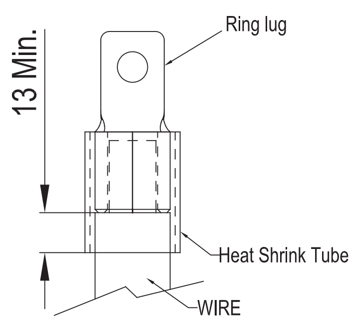
NOTE: Crimp connectors ARE required on D0, D, E, F, and G frame drives.

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

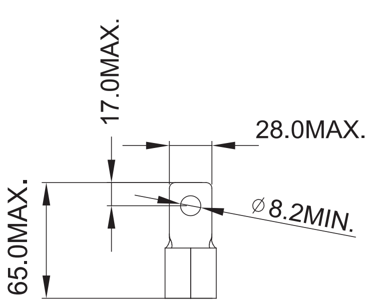
Power Terminal Wiring Connectors: (except Ground Terminal Connectors)



Heat Shrink Tubing:



GROUND Terminal Wiring Connectors ONLY:



Main Circuit Crimp Connector Specifications (continued)

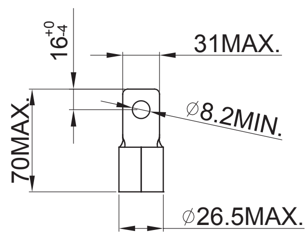
Dimensions = mm

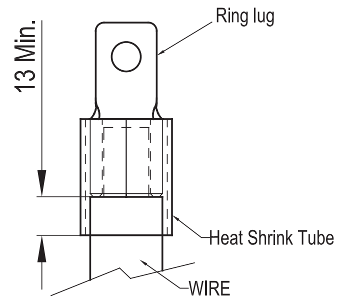
Frame Size F (GS4 model #s: 4175, 4200)

NOTE: Crimp connectors ARE required on D0, D, E, F, and G frame drives.

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

Power Terminal Wiring Connectors: ***Heat Shrink Tubing:***





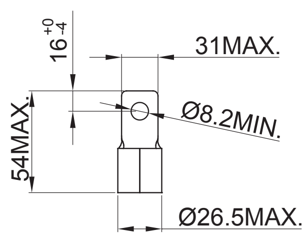
Frame Size G (GS4 model #s: 4250, 4300)

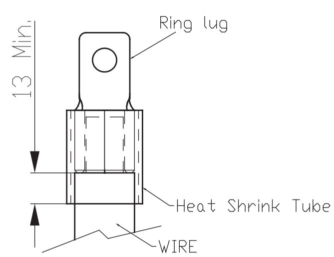
NOTE: Crimp connectors ARE required on D0, D, E, F, and G frame drives.

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

For Terminals: R/L11, R/L12, S/L21, S/L22, T/L31, T/L32:

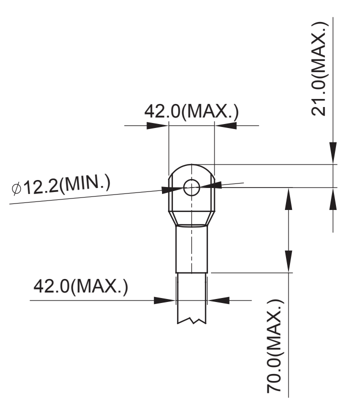
Power Terminal Wiring Connectors ***Heat Shrink Tubing:***

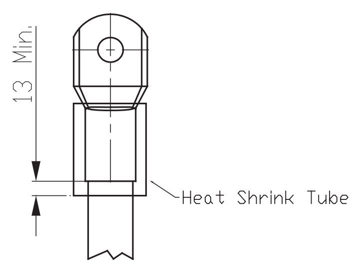




For Terminals: U/T1, V/T2, W/T3, +1/DC+, -/DC-

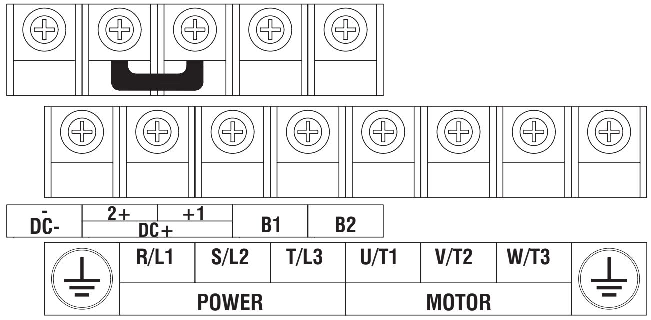
Power Terminal Wiring Connectors ***Heat Shrink Tubing:***



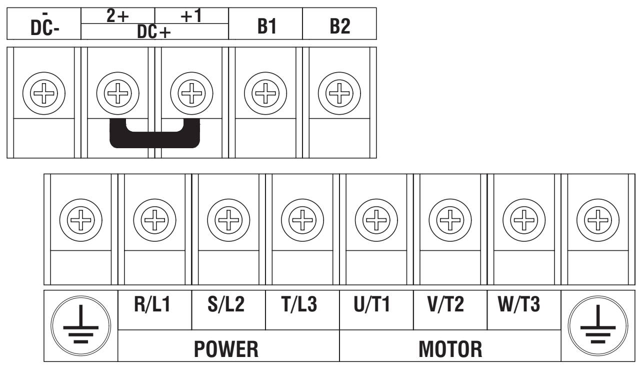


Main Terminal Diagrams

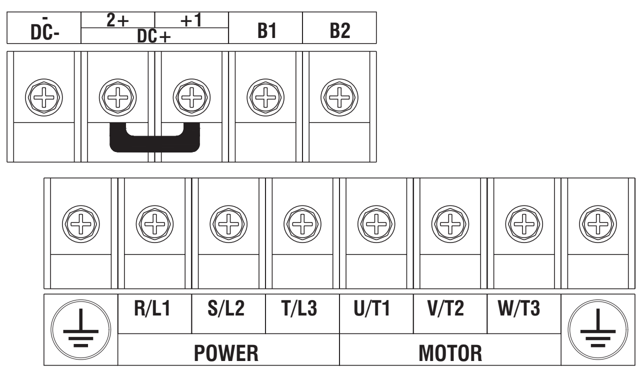
Frame Size A Main Terminals



Frame Size B Main Terminals

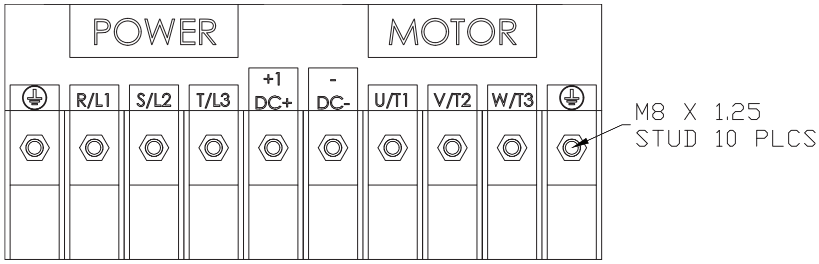


Frame Size C Main Terminals

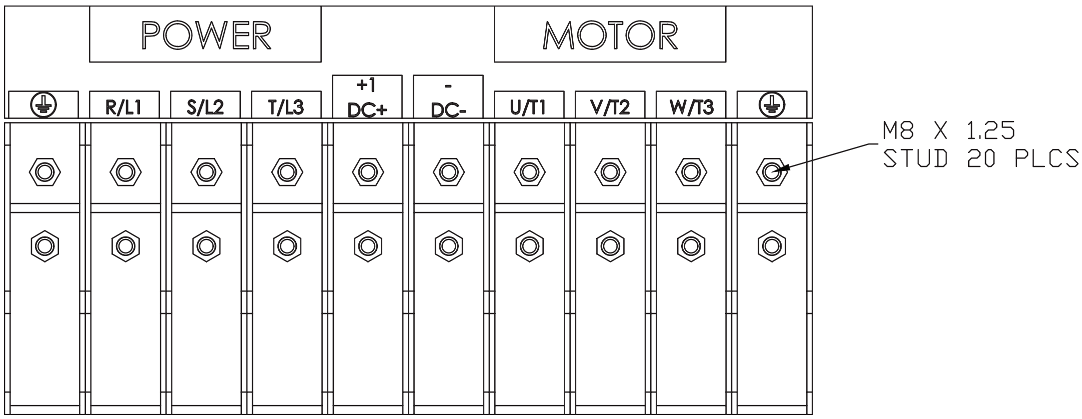


Main Terminal Diagrams (continued)

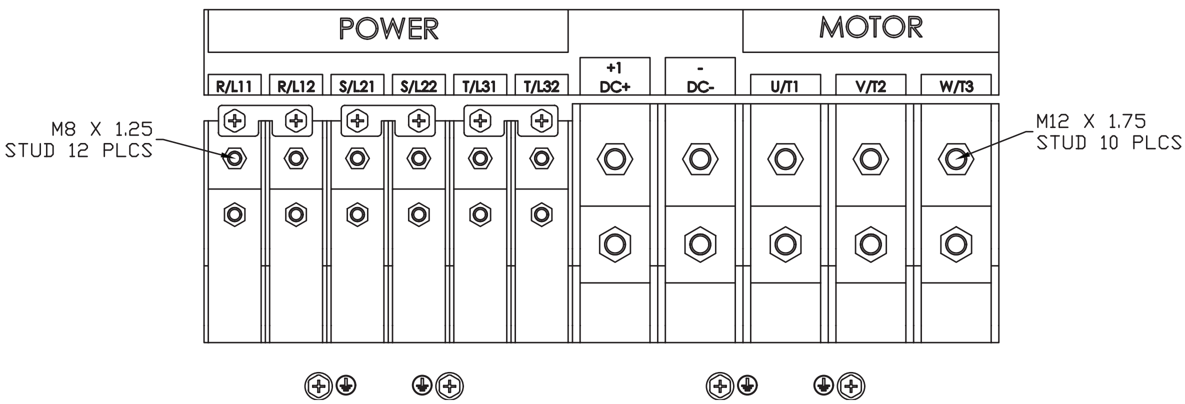
Frame Size D0, D Main Terminals



Frame Size E–F Main Terminals



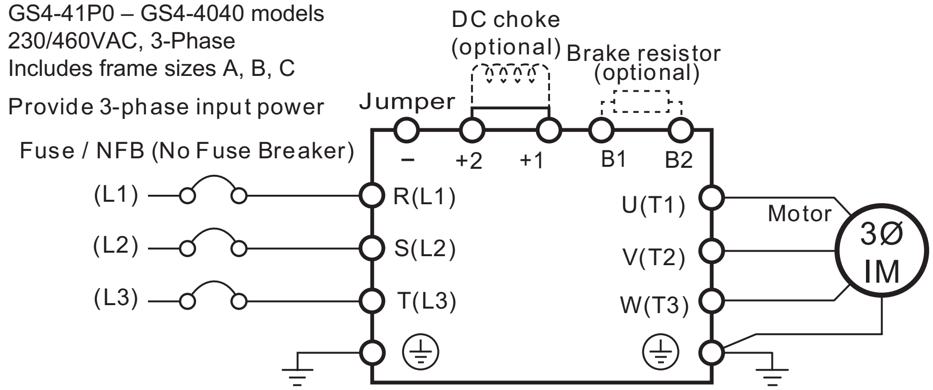
Frame Size G Main Terminals



Main Circuit Wiring Diagrams

Frame Sizes A, B, C Main Wiring Diagram, Three-Phase

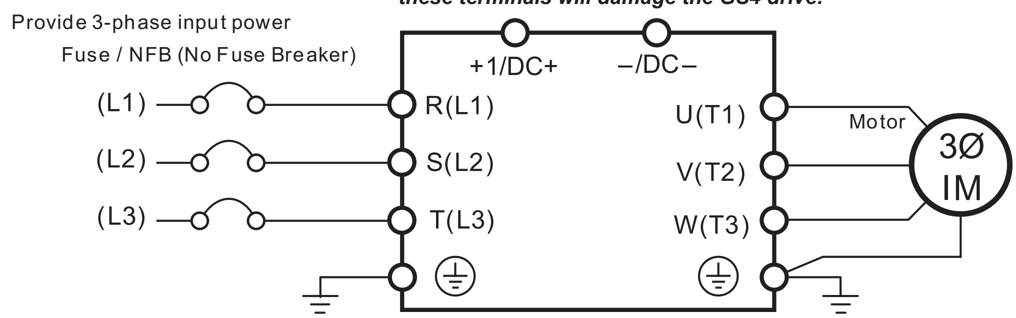
GS4-21P0 – GS4-2030
GS4-41P0 – GS4-4040 models
230/460VAC, 3-Phase
Includes frame sizes A, B, C



Frame Sizes D0, D, E, F Main Wiring Diagram, Three-Phase

GS4-2040 – GS4-2100
GS4-4050 – GS4-200 models
230/460VAC, 3-Phase
Includes frame sizes D0, D, E, F

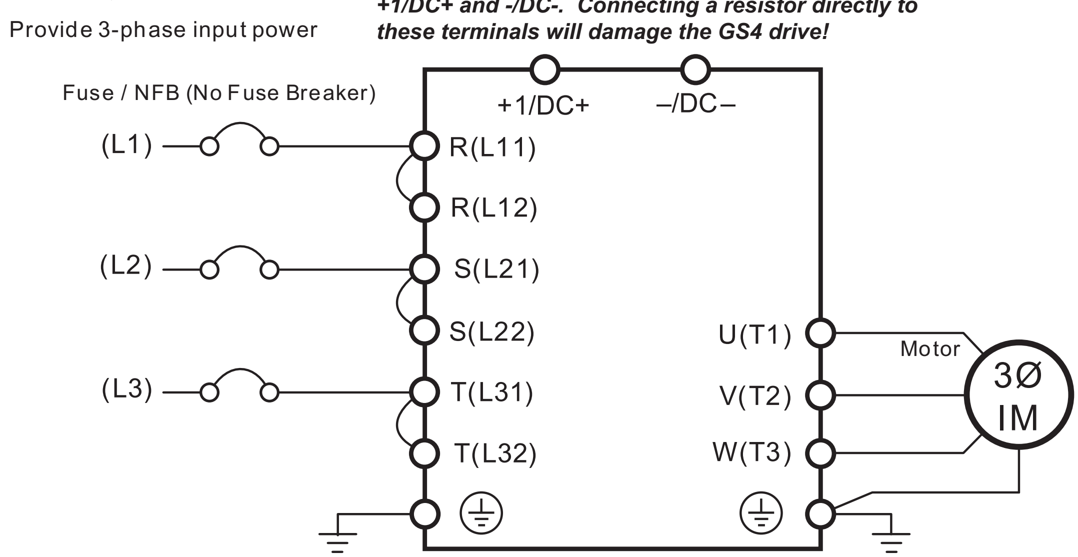
+1/DC+ & -/DC- terminals are for the connection of an optional GS-xDBU dynamic braking unit.
Do NOT connect a braking resistor directly to terminals +1/DC+ and -/DC-. Connecting a resistor directly to these terminals will damage the GS4 drive!



Frame Size G Main Wiring Diagram, Three-Phase

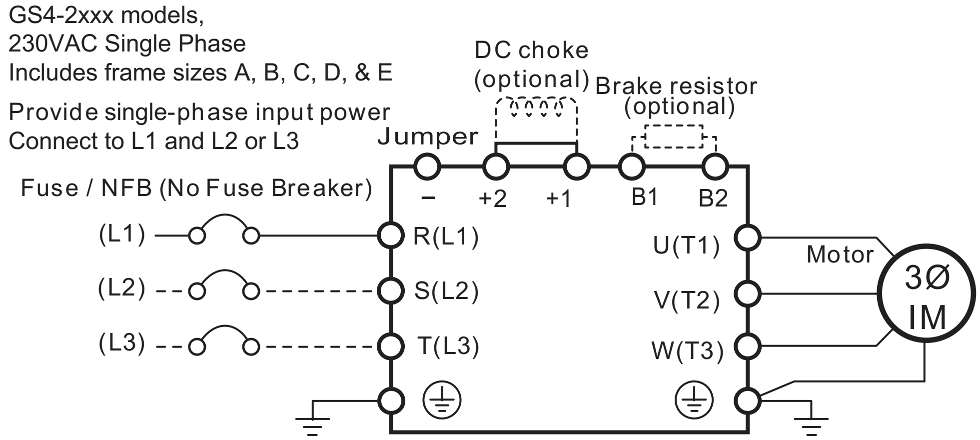
GS4-4250 &
GS4-4300 models
460VAC, 3-Phase

+1/DC+ & -/DC- terminals are for the connection of an optional GS-xDBU dynamic braking unit.
Do NOT connect a braking resistor directly to terminals +1/DC+ and -/DC-. Connecting a resistor directly to these terminals will damage the GS4 drive!



Main Circuit Wiring Diagrams (continued)

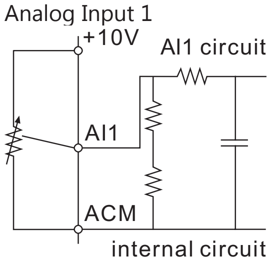
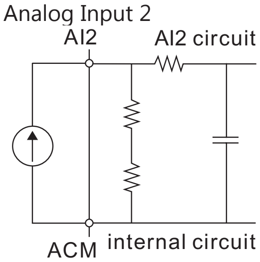
Single-Phase Main Wiring Diagram, GS4 230V Models

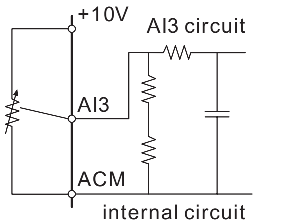
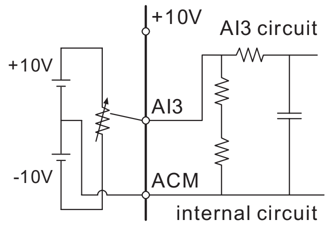
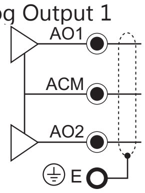
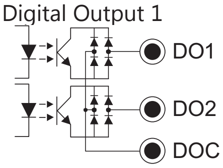


Connect 230VAC, Single-Phase power to any two of the R, S, or T terminals

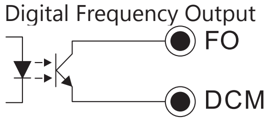
Control Circuit Wiring Terminals

Control Terminal Specifications

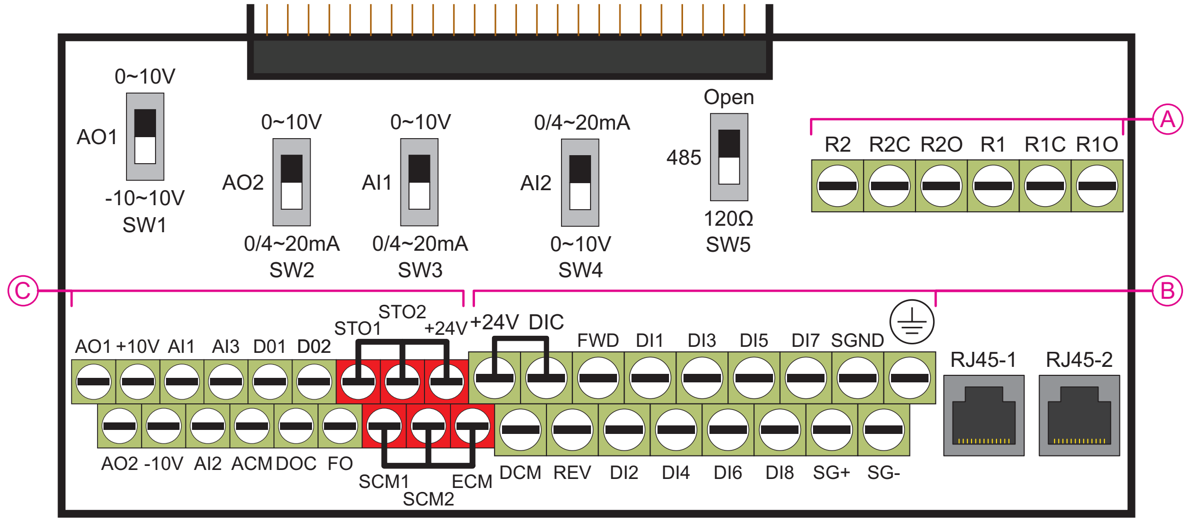
Control Circuit Terminals		
Terminal Symbol	***Description***	***Remarks***
+10V	Potentiometer Power Supply	Analog frequency setting: +10VDC 20mA max output
-10V		Analog frequency setting: -10VDC 20mA max output
+24V	Digital Control Signal Source	+24V±5%, 200mA max output; use with DCM
AI1	Analog Input 1 	Impedance: 20kΩ Range: 0~10V → 0/4~20mA = 0~Max Output Frequency AI1 switch = SW3; factory setting is 0~10V 0–10V SW3 (for AI1) 0–20mA / 4–20mA
AI2	Analog Input 2 	Impedance: 250Ω Range: 0/4~20mA → 0~10V = 0~Max Output Frequency AI2 Switch = SW4; factory setting is 0~20mA 0–20mA / 4–20mA SW4 (for AI2) 0–10V
(continued next page)		

Control Circuit Terminals (continued)		
Terminal Symbol	***Description***	***Remarks***
AI3	Analog Input 3 Internally Supplied, 0V to +10V (unipolar)  Externally Supplied, -10V to +10V (bipolar) 	Impedance: 20kΩ Range: -10 to +10 VDC = 0~Max Output Frequency *Note:* *For internally supplied -10V to +10V operation (bipolar), connect the pot to +10V and -10V. Keep the pot wiper connected to AI3.*
ACM	Analog Common	Common for analog terminals
AO1	Analog Output 1 	-10 to 10V max output current 2mA; max load 5kΩ Resolution: 0~10V corresponds to max operation frequency Range: 0~10V → -10 to +10V AO1 Switch = SW1, factory setting is 0~10V  0–10V SW1 (for AO1) -10 – +10V
AO2	Analog Output 2 (internal circuit same as AO1)	0–10V max output current 2mA; max load 5kΩ 0–20mA max output current 20mA; max load 500Ω Resolution: 0–10V corresponds to max operation frequency Range: 0~10V → 0/4~20mA AO2 Switch = SW2; factory setting is 0~10V  0–10V SW2 (for AO2) 0–20mA / 4–20mA
DIC	Digital Signal Common Rail	Common terminal for multi-function inputs; Can be tied to DCM (for sinking) or to +24V (for sourcing)
DI1	Digital Input 1	ON: the activation current is 3.3mA ≥ 11VDC OFF: leakage current tolerance is 1.4mA ≤ 5VDC
DI2	Digital Input 2	
DI3	Digital Input 3	
DI4	Digital Input 4	
DI5	Digital Input 5	
DI6	Digital Input 6	
DI7	Digital Input 7	
DI8	Digital Input 8	
DCM	Digital Signal Common	Refer to terminals FO, FWD, REV
DO1	Digital Output 1 	The AC motor drive releases various monitor signals such as drive in operation, frequency attained, and overload indication via transistor (open collector). Can be used sinking or sourcing. Use with DOC (common terminal). 5~48VDC / 50mA
DO2	Digital Output 2 (internal circuit same as DO1)	Multi-function Output 2 (photocoupler). Can be used sinking or sourcing. Use with DOC (common terminal). 5~48VDC / 50mA
DOC	Digital Output Common	Max 48VDC, 50mA

(continued next page)

Control Circuit Terminals (continued)		
Terminal Symbol	***Description***	***Remarks***
+24V	STO Control Signal Source	Safe Torque Off function. Refer to Appendix E: Safe Torque Off for more details.
ECM	EStop Common	
SCM1	STO Input 1 Common	
SCM2	STO Input 2 Common	
STO1	STO Input 1	
STO2	STO Input 2	
FO	Digital Frequency Output 	High-speed pulse output. Use with DCM. Digital Frequency Out = Drive Output Frequency [Hz] x P3.38 [Frequency Output Multiplier]. Duty-cycle: 50% ±1% Min load impedance: 1kΩ/100pf Max current: 30mA Max voltage: 30VDC
FWD	Forward Command	Use with DCM. ON → forward running OFF → deceleration to stop
R1	R1 Relay Common	Resistive Load: 3A(N.O.) / 3A(N.C.); 250VAC 5A(N.O.) / 3A(N.C.); 30VDC Inductive Load (COS 0.4): 1.2A(N.O.) / 1.2A(N.C.); 250VAC These terminals are to output monitoring signals, such as drive in operation, frequency attained, or overload indication. Note: R1 and R2 have N.O. and N.C. contacts.
R1C	R1 Relay N.C.	
R1O	R1 Relay N.O.	
R2	R2 Relay Common	
R2C	R2 Relay N.C.	
R2O	R2 Relay N.O.	
REV	Reverse Command	Use with DCM. ON → reverse running OFF → deceleration to stop
RJ45-1	RJ45 Port 1	Pins 1,2,7,8: Reserved Pins 3,6: SGND Pin 4: SG- Pin 5: SG+
RJ45-2	RJ45 Port 2	
SG+	Modbus RS-485	
SG-		
SGND		
⏚	Digital Control Ground	

Control Terminal Block Diagram & Wiring Specifications



- *SW1 sets AO1: 0~10V (default) or -10 to +10V*
- *SW2 sets AO2: 0~10V (default) or 0/4–20mA*
- *SW3 sets AI1: 0~10V (default) or 0/4–20mA*
- *SW4 sets AI2: 0/4~20mA (default) or 0~10V*
- *SW5 sets RS-485: open (default) or 120Ω terminated*

Control Circuit Wiring Specifications

AC Drive Model	Terminal #	Wire Range (AWG)	Tightening Torque (kg·cm [lb·in])
GS4-xxxx	A	24~16	5 [4.3]
	B	26~16	8 [6.9]
	C	24~16	2 [1.7]

Control Terminal Wiring Instructions

Digital Inputs

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

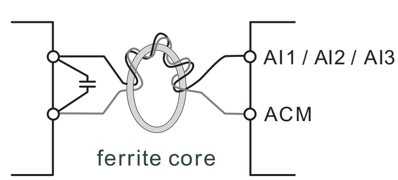
Wiring Multiple Drives Together – Digital Inputs

- *With drive Digital Inputs in SINKING mode, as shown on page 2–36: 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. [Otherwise, do NOT connect the different drive DCM terminals together if the drive DI are sourcing.]*
- *With drive Digital Inputs in SOURCING mode, as shown on page 2–37 (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 (as shown on page 2–37: 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.*
- *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

- *Make sure to connect the digital outputs to the correct polarity.*
- *When connecting a relay to the digital outputs, connect a surge absorber across the coil and check the polarity.*

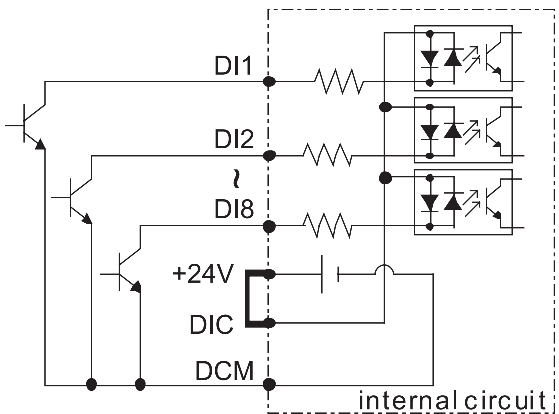
Analog Outputs

- *When setting **SW1**, and using it as a current source (external 500Ω resistor is required), ensure **P4.53 AO1 0~20mA/4~20mA selection** is set appropriately.*
- *When seting **SW2** to 0/4~20mA ensure to set **P4.57 AO2 0~20mA/4~20mA selection** appropriately. When setting to 0~10V (or leaving as default) ensure P4.57 is set to zero.*

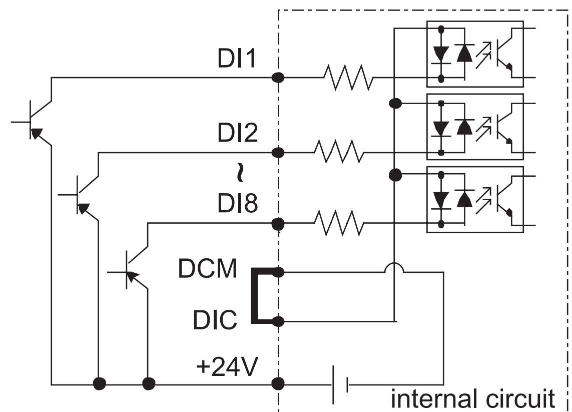
Control Circuit Wiring Diagrams

Digital Inputs

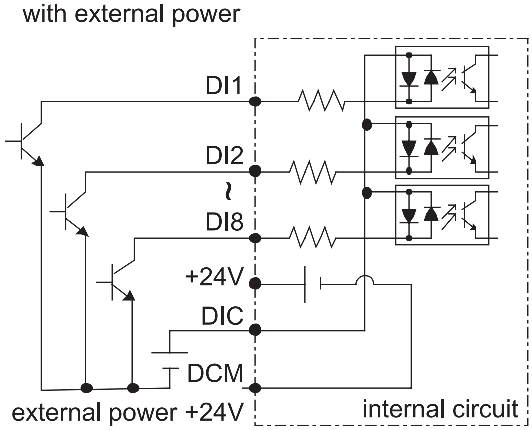
1 Drive Source Mode (field devices are sinking) with internal power (+24VDC)



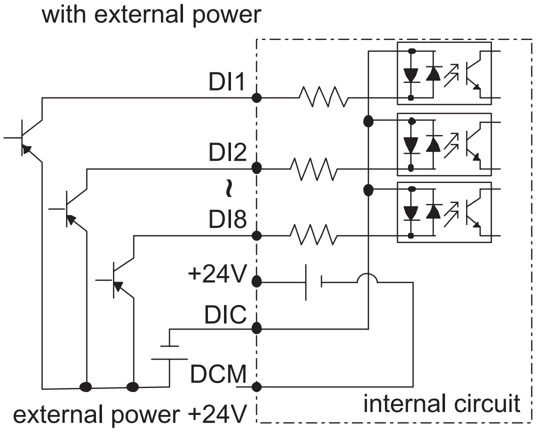
2 Drive Sink Mode (field devices are sourcing) with internal power (+24VDC)



3 Drive Source Mode (field devices are sinking) with external power

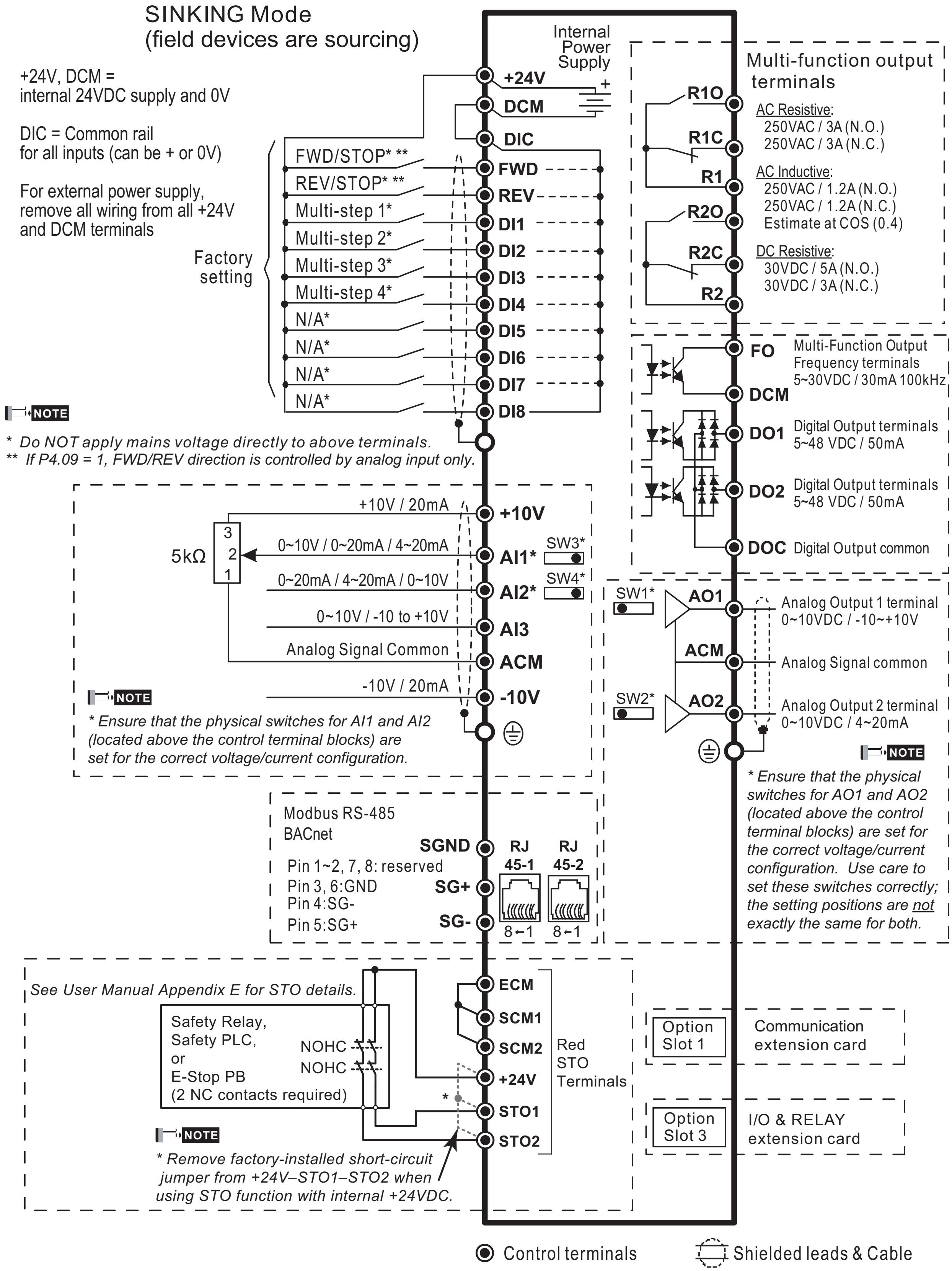


4 Drive Sink Mode (field devices are sourcing) with external power



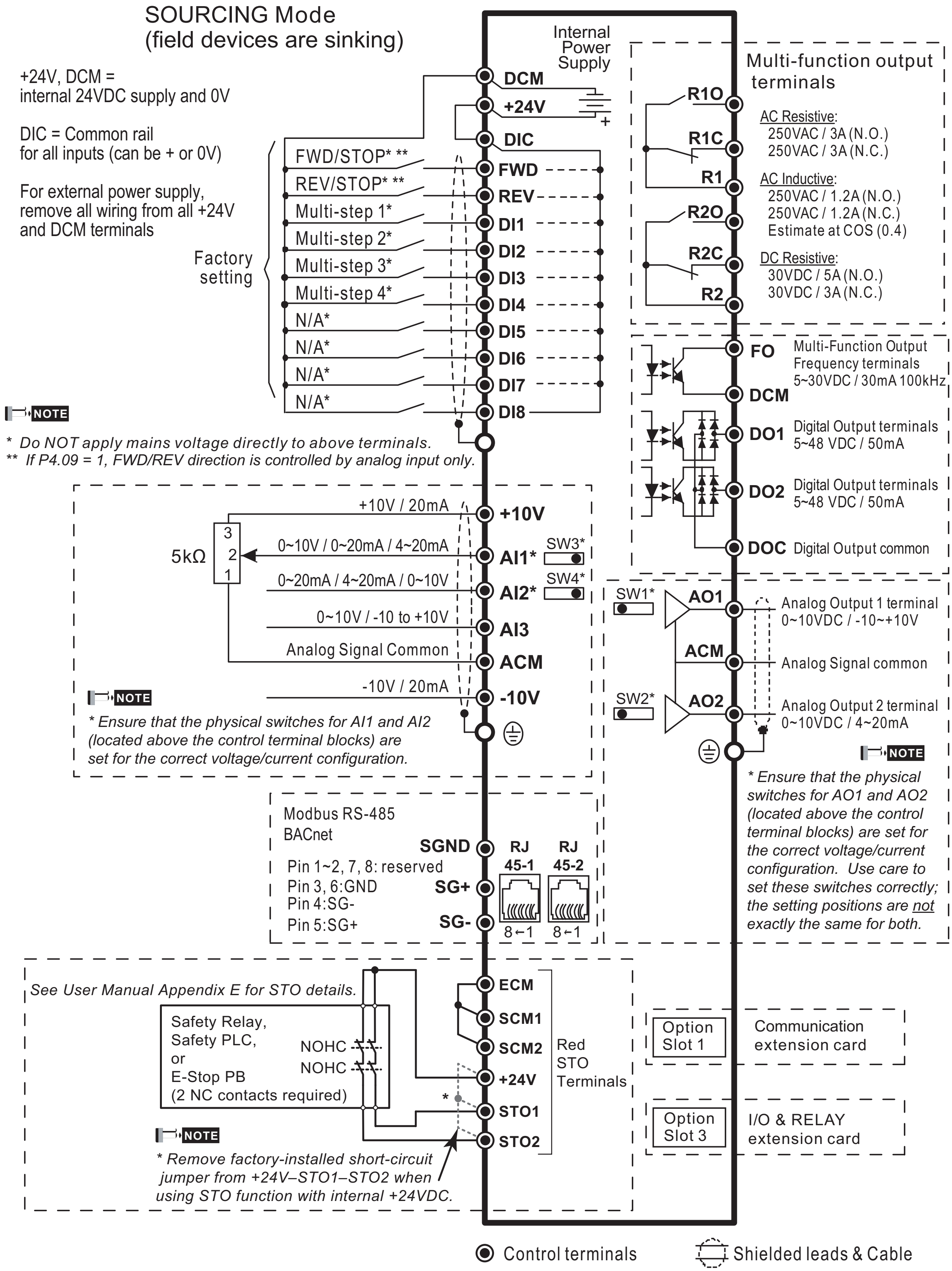
Control Circuit Wiring Diagrams (continued)

Full I/O with Sinking Inputs



Control Circuit Wiring Diagrams (continued)

Full I/O with Sourcing Inputs



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Keypad Operation and Quick-Start

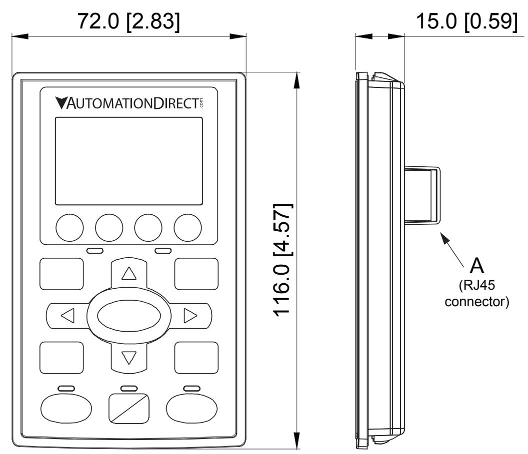
Chapter 3

Table of Contents

The DURApulse GS4 Digital Keypad

The GS4 removable keypad can be installed flat on the surface of the control box (with or without bezel GS4-BZL) with the appropriate hole punched in the control box cover (See Arrow "A"). Use the supplied RJ45 connector and an RJ45 cable to connect to the GS4 drive. The front cover is IP56 rated. The keypad may be mounted remotely and connected to the drive with a standard RJ45 CAT5e straight through patch cable. (An RJ45 crossover cable will NOT work as the keypad extension cable.) **The maximum RJ45 extension lead is 5m (16ft)**. No other wiring is required.

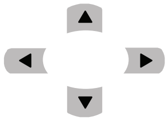
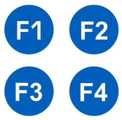
RJ45 Connector



Dimensions mm [in]

Descriptions of Keypad Functions	
RUN	**RUN Key** • Valid only when the source of operation command is from the keypad. • The RUN LED light (above the button) turns ON when the drive is running. • RUN can be pressed even when drive is in process of stopping. • When in "LOCAL" mode, RUN is only valid when the source of operation command is from the keypad.
STOP RESET	**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 parameters such as P3.00, P3.01, P3.03~P3.16.*
FWD REV	**Operation Direction Key** • This key only controls the operation direction and does NOT activate the drive. FWD: forward. REV: reverse. • Refer to the LED descriptions for more details.
ENTER	**ENTER Key** Press ENTER to 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

Continued on next page.

Descriptions of Keypad Functions (continued)	
	**Direction: Left/Right/Up/Down** • In the numeric value setting mode, the arrows are used to move the cursor and change the numeric value. • In the menu/text selection mode, the arrows are used for item selection.
	**Function Keys** • F1 is JOG function. • The F2, F3 keys are reserved for future use. The F4 key is used to ADD parameters to the user-defined My-Menu Quick-Start Menu (see "My Menu" in the Quick-Start section of this chapter for more information).
	**LOCAL Key** • This key causes the drive to follow the LOCAL (2nd source) settings for frequency command and operation.* The factory settings of both source of Local frequency and Local operation are the Digital Keypad. • Pressing the LOCAL key with the drive stopped will switch the operation and frequency to the LOCAL source (P3.01 and P4.01). Pressing the LOCAL key with the drive running can be configured to keep running or to stop upon transition. See P3.58 for more information. • The selected mode, LOCAL or REMOTE, will be displayed on the GS4-KPD. • When P3.58=0 then LOCAL correlates to HAND mode. The Digital Input Definition must not be set to 33 (LOC/REM Switch). **Refer to P3.58 for more detail and other options on how the drive behaves when switching between LOCAL and REMOTE. Refer to P3.00, P3.01, P4.00 and P4.01 for defining LOCAL and REMOTE sources of operation and frequency.*
	**REMOTE Key** • This key causes the drive to follow the REMOTE (1st source) settings for frequency command and operation.* The factory settings of both source of Remote frequency and Remote operation are the Digital Keypad. • 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 can be configured to keep running or to stop upon transition. See P3.58 for more information. • The selected mode, LOCAL or REMOTE, will be displayed on the GS4-KPD. • When P3.58=0 then LOCAL correlates to HAND mode. The Digital Input definition must not be set to 33 (LOC/REM Switch). **Refer to P3.58 for more detail and other options on how the drive behaves when switching between LOCAL and REMOTE. Refer to P3.00, P3.01, P4.00 and P4.01 for defining LOCAL and REMOTE sources of operation and frequency.*

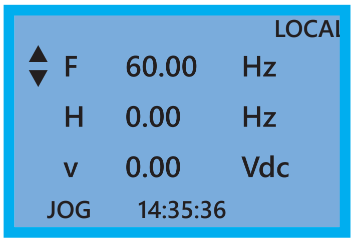
Descriptions of LED Functions	
	**Steady ON**: Drive is running. **Blinking**: Drive is stopping or in base block. **Steady OFF**: Drive is not running.
	**Steady ON**: Drive is stopped or in the process of stopping. **Blinking**: Drive is in standby; selected speed reference source is at zero. (If expecting movement, confirm that a speed reference is present.) **Steady OFF**: Drive is running. *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 parameters such as P3.00, P3.01, P3.03~P3.16.*
	**Operation Direction LED** • Green light is on, the drive is running forward or will run forward when given a run command. • Red light is on, the drive is running backwards or will run backwards when given a run command. • Alternating green/red light: the drive is changing direction.
	**ERR_COMM_RUN** These LEDs represent the status of RS-485 communication through COM port 1. **RUN-LED Flashing**: RS485 is transferring **ERR-LED Red:** Latest Tx or Rx failed **Off**: Latest Tx or RX = OK **Flashing**: Please check the RS-485 master for proper configuration/communication, and also check the PLC code for proper operation if serial comm is enabled inside the PLC.

GS4 Start-Up Display

At power up, the Start-up Page displays the *DURAPULSE*, GS4 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



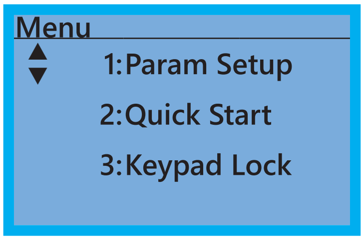
Drive status:
Press the LOCAL key to allow local control of the drive.
Press the REMOTE key to allow remote control of the drive.
Pressing the Up and Down Direction keys allow the user to scroll through the Status Page items.
F X.xx Hz (actual GS4 command frequency)
H X.xx Hz (actual GS4 output frequency)
U XXX.x User defined value (in this example P8.00 = 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 GS4 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 GS4 default settings F/H/U/A. While the order F/H/U/A is always fixed, P8.01 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 P8.00 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 P8.00 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.*

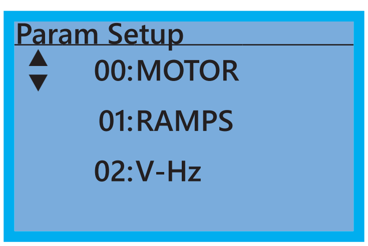
Menu Page



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
Set typically used parameters to allow quick drive startup.
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.

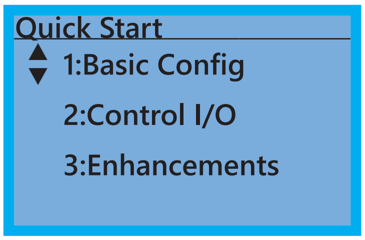
00: MOTOR
01: RAMPS
02: V-Hz
03: DIGITAL
04: ANALOG
05: PRESETS
06: PROTECT
07: PID
08: DISPLAY
09: COMMUNICATION
10: PUMP
11: FAULTS

Quick-Start – Quick-Start Page

The Quick Start function allows the user to set typically used parameters for quick drive startup and motor protection.

For basic applications, it may only be necessary to enter parameters into the "Basic Configuration" Menu. The "Basic" menu contains Motor definition/protection information and a bare minimum set of parameters that will need to be set. "Control I/O" allows for customization of the most common I/O settings, and each subsequent menu configures additional features and allows more customization of the drive.

If the GS4 drive has been previously configured, it is advisable to restore the default settings (by using parameter P9.08) before reconfiguring the drive.



The Quick Start function allows the user to quickly set typically used parameters. Not all of the six Quick Start categories need to be configured for every application, but the categories that are needed for the particular application should be configured in sequential order as shown below (starting with 1:Basic Config).

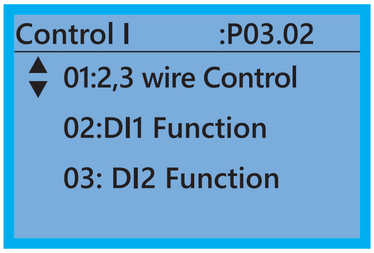
1: Basic Config
2: Control I/O
3: Enhancements
4: Protection
5: PID
6: My Menu (User Defined Quick Start Menu)

1: Basic Config

Parameters in the Basic Configuration menu:

1	P0.00	Motor 1 Maximum Output Voltage
2	P0.01	Motor 1 Rated Current
3	P0.02	Motor 1 Base Frequency
4	P0.03	Motor 1 Rated RPM
5	P0.04	Drive Maximum Output Frequency
6	P0.08	Motor 1 Rated Horsepower (HP)
7	P0.09	Motor 1 Number of Poles
8	P1.00	Stop Method
9	P1.01	Acceleration Time 1
10	P1.02	Deceleration Time 1
11	P3.00	1st Source of Operation Command [Remote]
12	P3.01	2nd Source of Operation Command [Local]
13	P4.00	1st Source of Frequency Command [Remote]
14	P4.01	2nd Source of Frequency Command [Local]
15	P6.00	Electronic Thermal Overload Relay (Motor 1)
16	P6.01	Electronic Thermal Characteristic (Motor 1)
17	P6.33	Drive Derating Method
18	P6.34	Variable/Constant Torque Duty Selection
19	P9.08	Restore to Default

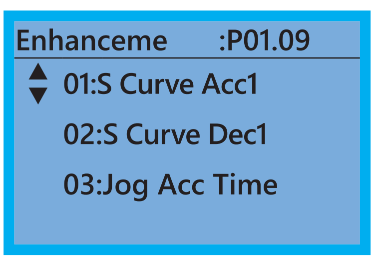
2: Control I/O



Parameters in the Control I/O menu:

1	P3.02	2/3 Wire Operation Mode
2	P3.03	Multi-Function Input (DI1)
3	P3.04	Multi-Function Input (DI2)
4	P3.05	Multi-Function Input (DI3)
5	P3.06	Multi-Function Input (DI4)
6	P3.17	Multi-Function Output Terminal 1 (Relay 1)
7	P3.18	Multi-Function Output Terminal 2 (Relay 2)
8	P4.02	Analog Input 1 (AI1) Function
9	P4.03	Analog Input 2 (AI2) Function
10	P4.05	AI1 – I/V Selection
11	P4.06	AI2 – I/V Selection
12	P4.09	Analog Frequency Command for Reverse Run
13	P4.10	AI1 Input Bias (Offset)
14	P4.11	AI1 Input Bias (Offset) Polarity
15	P4.12	AI1 Input Gain
16	P4.13	AI1 Filter
17	P4.15	AI2 Input Bias (Offset)
18	P4.16	AI2 Input Bias (Offset) Polarity
19	P4.17	AI2 Input Gain
20	P4.18	AI2 Filter
21	P4.50	Analog Output 1 (AO1)
22	P4.51	AO1 Gain
23	P4.52	AO1 Negative Value Handle
24	P4.53	AO1 0~20mA/4~20mA Selection
25	P4.60	AO1 Output Constant Level
26	P5.01	Multi-Speed 1
27	P5.02	Multi-Speed 2
28	P5.03	Multi-Speed 3
29	P5.04	Multi-Speed 4

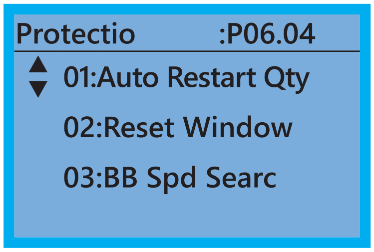
3: Enhancements



Parameters in the Enhancements menu:

1	P1.09	S-curve Accel Time 1
2	P1.10	S-curve Decel Time 1
3	P1.13	Jog Acceleration Time
4	P1.14	Jog Deceleration Time
5	P5.00	Jog Frequency
6	P1.19	Skip Frequency 1 Upper Limit
7	P1.20	Skip Frequency 1 Lower Limit
8	P1.25	DC Injection Current Level
9	P1.26	DC Injection Time During Start-up
10	P1.27	DC Injection Time During Stopping
11	P1.28	Start-Point for DC Injection During Stopping
12	P2.00	Volts/Hertz Settings
13	P2.01	Slip Compensation Gain
14	P2.25	Slip Compensation Filter
15	P2.02	Torque Compensation Gain
16	P2.03	Torque Compensation Filter
17	P2.10	PWM Carrier Frequency
18	P2.11	Control Mode
19	P2.18	Zero Speed Select
20	P6.25	Upper Limit of Output Frequency
21	P2.23	Automatic Energy-Saving Operation
22	P2.24	Power Saving Gain
23	P2.26	Slip Deviation Level
24	P2.27	Slip Deviation Detection time
25	P2.28	Slip Deviation Treatment

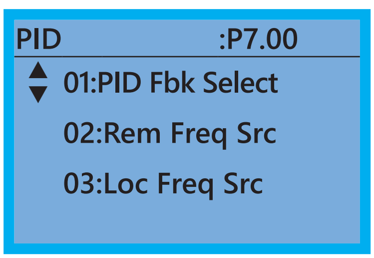
4: Protection



Parameters in the Protection menu:

1	P6.04	Auto Restart after Fault
2	P6.05	Reset Time for Auto Restart after fault
3	P6.06	Base Block Speed Search after Fault (oc,ov,bb)
4	P6.09	Fwd/Rev Direction Inhibit
5	P6.13	Auto Adjustable Accel/Decel
6	P6.14	Over-torque Detection Mode (OT1)
7	P6.15	Over-torque Detection Level (OT1)
8	P6.16	Over-torque Detection Time (OT1)
9	P6.26	Lower Limit of Output Frequency
10	P6.28	Dynamic Braking Voltage Level
11	P6.29	Line Start Lockout
12	P6.31	Cooling Fan Control
13	P6.32	PWM Fan Speed
14	P6.45	Output Phase Loss (OPhL) Detection Selection
15	P6.46	Output Phase Loss Detection time
16	P6.47	Output Phase Loss Current Detection Level
17	P6.49	Input Phase Loss Treatment
18	P6.69	Input Phase Loss Detection Time
19	P6.70	Input Phase Loss Ripple Detection
20	P6.50	GFF Detect Current Level (% of INV I-Rated)
21	P6.51	GFF Low Pass Filter Gain
22	P6.71	STO Alarm Latch

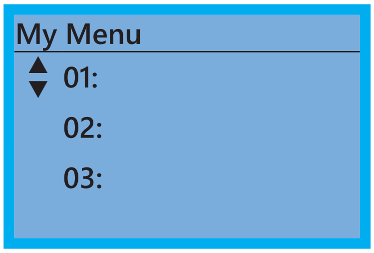
5: PID



Parameters in the PID menu:

1	P7.00	PID Action/Mode
2	P4.00	1st Source of Frequency Command [Remote]
3	P4.01	2nd Source of Frequency Command [Local]
4	P4.02	Analog Input 1 (AI1) Function
5	P4.03	Analog Input 2 (AI2) Function
6	P4.04	Analog Input 3 (AI3) Function
7	P4.05	AI1 – I/V Selection
8	P4.06	AI2 – I/V Selection
10	P7.03	PID Feedback Gain
11	P7.04	PID Offset Value
12	P7.13	Proportional Gain
13	P7.14	Integral Time
14	P7.15	Derivative Value
15	P7.18	PID Output Frequency Limit
16	P7.20	Feedback Signal Detection Time
17	P7.21	PID Feedback Loss
18	P7.22	PID Feedback Loss Speed Level Default
19	P7.25	PID Mode Selection
20	P7.26	PID Reverse Enable
21	P8.00	User Display
22	P8.01	Start-up Display Selection
23	P8.02	User Defined Format
24	P8.03	User Defined Max
25	P8.04	User Defined Setpoint

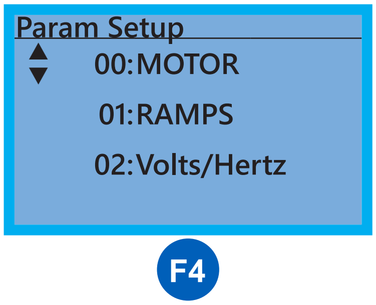
6: My Menu



My Menu allows the user to store up to 32 parameters of their choosing into a custom Quick Start menu. Storing parameters in the My Menu menu can be accomplished in two steps.

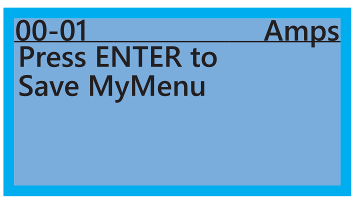
Step 1:

From the main menu, go to the parameter you want to add under "1: Param Setup."

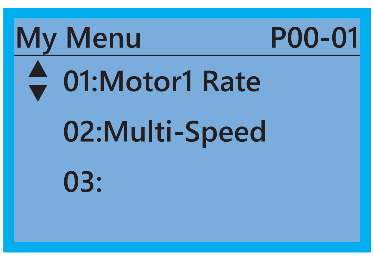


Step 2:

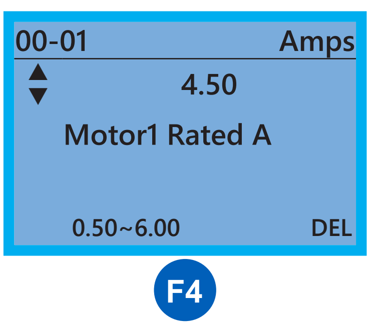
When you are on the page where you can adjust the parameter value, notice that the word ADD is above function key F4. Press the F4 key to ADD the displayed parameter to "My Menu".



Select the desired parameter group and parameter to include in the My Menu menu. Press Enter to add the selected parameter to My Menu.

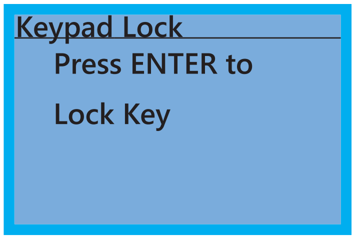


To delete a My Menu parameter, in the My Menu menu, position the cursor next to the parameter you wish to delete and press Enter.



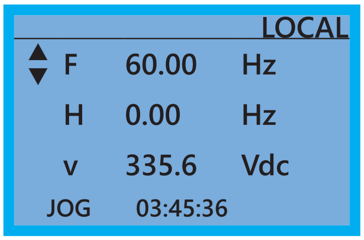
Notice that "DEL" appears above the F4 key. Press the F4 key and then Enter to delete from My Menu.

Keypad Lock - Keypad Lock Page

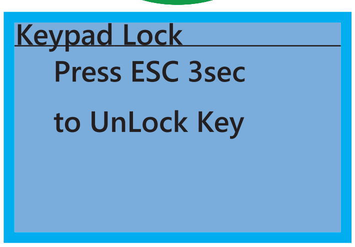


Keypad Lock is used to lock the keypad from unintentional activation during operation.

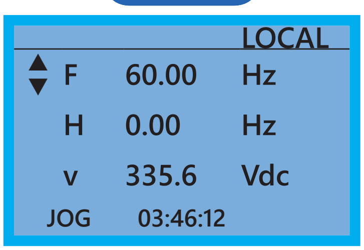
Press the Enter key to lock the keypad.



The Status Page will again display.

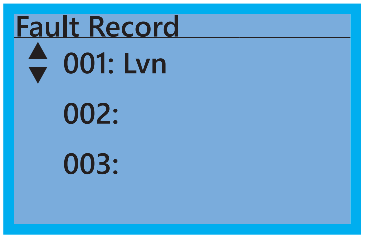


Pressing ANY key will display the message Press ESC to UnLock Key.



Press and hold the ESC key for 3 seconds to unlock the keypad. The display will return to the Status Page.

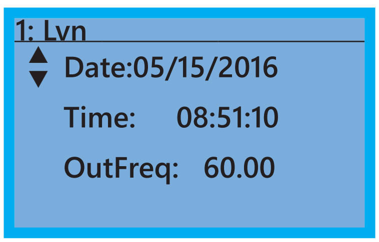
Fault Record - Fault Record Page



GS4 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.

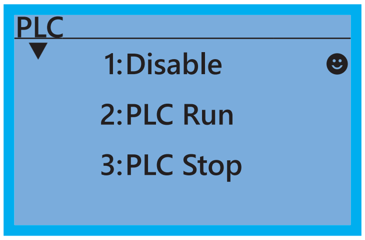
1:
2:
3:
▲
▼
18:
19:
20:

Press the Enter key to display information about the drive status when the fault occurred.



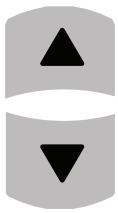
Date: 00/00/0000
Time: 00:00:00
OutFreq: 0.00
OutAmp: 0.00
OutVolt 0.0
DCBus: 0.0

PLC - PLC Function Page



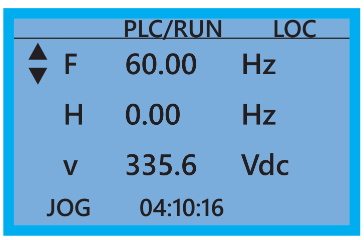
PLC Function is used to Enable/Disable and Run/Stop the internal PLC. The active selection is marked by a smiley face character on the far right of the display.

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.



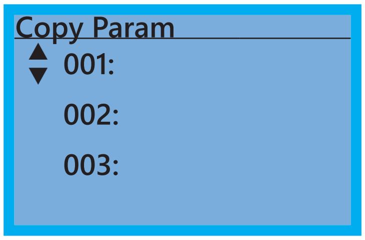
Use the Up and Down Direction keys to select Disable, PLC Run or PLC Stop.

Press the Enter key to confirm the selection.



Selecting PLC Run will activate the GS4 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 GS4 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.

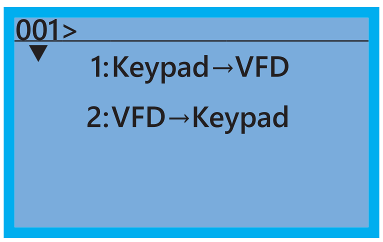
Copy Param - Copy Parameters Page (Keypad Copy)



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.

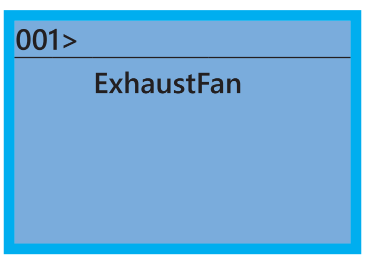
001: ExhaustFan
002: IntakeFan1
003: Filename02
004:

Press the Enter key to select the desired location for writing the current parameter settings.



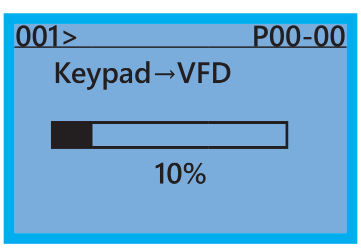
Use the Up and Down Direction keys to select Keypad→VFD to copy the current parameter settings from the keypad to the drive or VFD→Keypad to write the current parameter settings from the drive to the keypad. Press the Enter key.

VFD→ Keypad



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 parameters from the drive into the keypad.

Keypad→ VFD



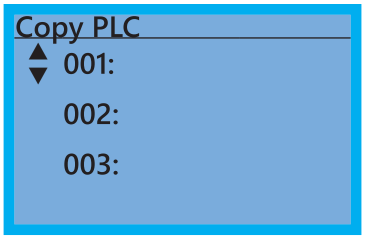
When Keypad→VFD is selected, the keypad will begin the transfer of the preselected file parameters from the keypad into the drive.

As shown in the example to the left, “001” is the file to be transferred.

(NOTE: P9.06, Parameter Copy Enable, must first be set to 1.)

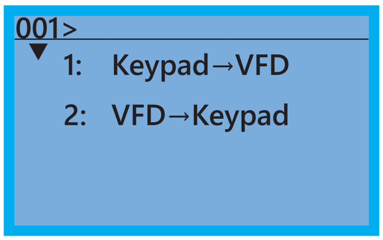
Pressing F4 while in the Copy Param menu will prompt you to Delete All 4 saved programs (“Press ENTER to clear”).

Copy PLC - Copy PLC Page



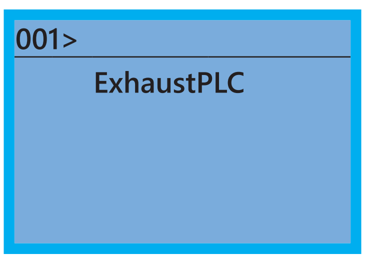
Copy PLC is used to copy previously saved PLC program from the keypad to the drive or from the drive to the keypad. Use the Up and Down Direction keys to scroll through the four available Copy PLC locations. If the field is blank, then no copies have been made.

Press the Enter key to select the desired location for writing the current program.



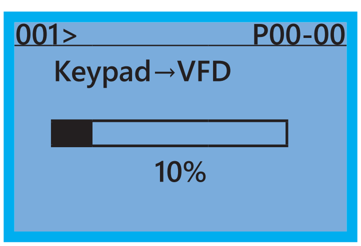
Use the Up and Down Direction keys to select Keypad→VFD to copy the previously saved PLC settings from the keypad to the drive or VFD→Keypad to write the current PLC program from the drive to the keypad.

VFD→ Keypad



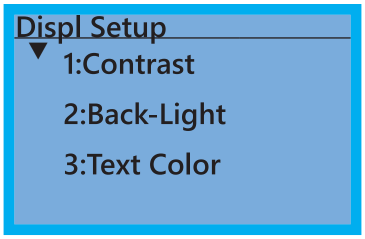
When VFD→Keypad is selected, the keypad will prompt you for a filename to save the existing configuration into. Use the Left/Right arrows to scroll from character to character and the Up/Down arrows to change the alphanumeric character. Pressing Enter will begin the transfer of PLC program from the drive into the keypad.

Keypad→ VFD



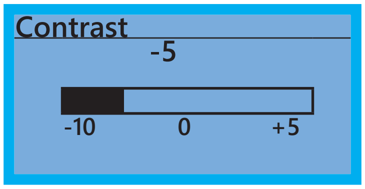
When Keypad→VFD is selected, the keypad will begin the transfer of PLC program from the keypad into the drive.

Displ Setup - Display Setup Page

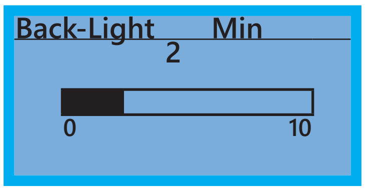


The Display Setup Page allows the user to adjust the Contrast, Backlight time and Text Color of the display.

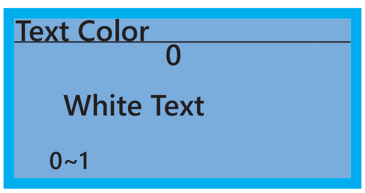
1: Contrast
2: Backlight
3: Text Color



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.

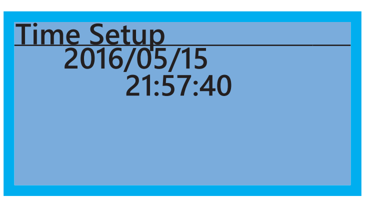


Use the Up and Down direction arrows to adjust the time when the display backlight turns off. The range of adjustment is from 0 to 10 minutes. The default value is 5 minutes.



Use the Up and Down direction arrows to select from white text or blue text for the display.

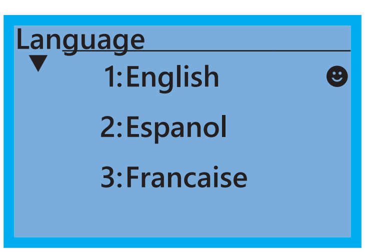
Time Setup - Time Setup Page



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.

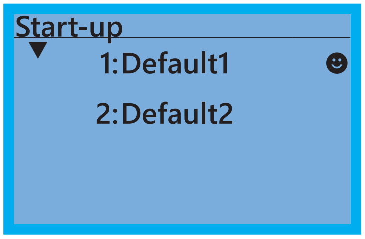
The real time clock (RTC) is maintained in the keypad. A capacitor is used to provide power for the RTC during power loss. The capacitor can maintain power for the RTC for 7 days with no drive power applied.

Language - Language Page



The Language Page sets the language shown on the display. Select from English, Spanish or French.

Start-up - Start-up Page

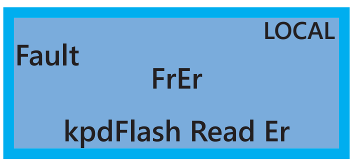


The Start-up Page allows the user to select from three different screens that display during initial start-up. Default1 setting displays the GS4 logo screen, Default2 setting displays "Initializing, Please Wait."

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.

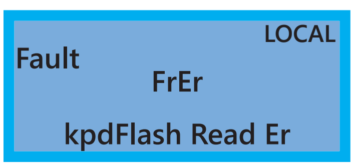
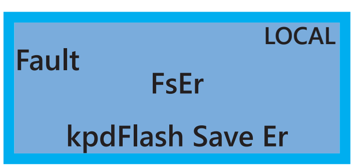
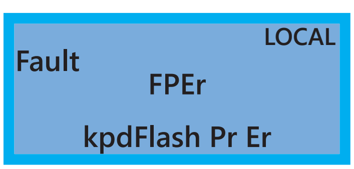
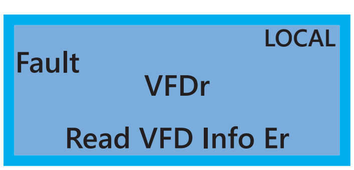
①
②
③



① Display error signal

② Abbreviated error code
The code is displayed as shown on GS4-KPD

③ Display error description

Display	Description	Corrective Actions
	Flash memory read error (FrEr) 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.
	Flash memory save error (FsEr) 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.
	Flash memory parameter error (FPEr) 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.
	Reading AC motor drive data error (VFDr) 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.

Continued on next page

Display	*Description*	*Corrective Actions*
LOCAL Fault CPUEr CPU Error	CPU error (CPUEr) Keypad CPU error	A serious error in the keypad's CPU. 1. Check for any problem on CPU clock. 2. Check for any problem on Flash IC. 3. Check for any problem on RTC IC. 4. Verify that the communication quality of the RS-485 cable is good. 5. mShut down the system, wait for ten minutes, and then restart the system. If the error remains, contact technical support.
LOCAL Warning CK1 Comm Command Er	Communication command error 1 (CK1) Keypad communication data, illegal function code (Keypad auto-detects this error and displays it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2. 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If the error remains, contact technical support.
LOCAL Warning CK2 Comm Address Er	Communication address error (CK2) Keypad communication data, illegal data address (keypad auto-detects this error and displays it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2. 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If the error remains, contact technical support.
LOCAL Warning CK3 Comm Data Error	Communication data error (CK3) Keypad communication data, illegal data value (keypad auto-detects this error and displays it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2. 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If the error remains, contact technical support.
LOCAL Warning CK4 Comm Slave Error	Communication slave error (CK4) Keypad communication data is written to read-only address (keypad auto-detects this error and displays it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2. 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If the error remains, contact technical support.
LOCAL Warning CK10 KpdComm Time Out	Keypad communication time out (CK10) Keypad communication data, transmission time-out (keypad auto-detects this error and displays it)	Keypad does not accept the motor drive's communication command. 1. Remove the keypad and reconnect it. 2. Verify if the Baud rate = 19200 bps, and the Format = RTU8, N, 2. 3. Verify if the keypad is properly connected to the motor drive on the communication contact by a communication cable such as RJ45. If the error remains, contact technical support.
LOCAL Warning TPNO TP No Object	Keypad communication timeout (TPNO) Object not supported by TPEditor	Keypad's TPEditor uses an unsupported object. 1. Verify that the TPEditor is not using an unsupported object or setting. Delete unsupported objects and unsupported settings. 2. Re-edit the object in the TPEditor, and then download it to the keypad. 3. Verify that the motor drive supports the TP functions. If the drive does not support TP function, the main page displays Default. If the error remains, contact technical support.

File Copy Setting Fault Description

These faults occur when the keypad cannto perform the command after clicking the ENTER key in the copy function.

①	001>	P00.00
②	ERR1	
③	Read Only	

← Current position where the fault occurs on the parameter.

① To be saved in keypad parameter file 1

② Abbreviated error code
The code is displayed as shown on GS4-KPD

③ Displays error description

Display	*Description*	*Corrective Actions*
001> P00.00 ERR1 Read Only	Read only (ERR1) Parameter and file are read only	The parameter/file is read only and cannot be written to. 1. Verify the specification in the user manual. If the error remains, contact technical support.
001> P00.00 ERR2 Write Fail	Write in error (ERR2) Fail to write parameter and file.	An error occured while writing to a parameter/file. 1. Check for any problem on the Flash IC. 2. Shut down the system, wait for ten minutes, and then restart the system. If the error remains, contact technical support.
001> P00.00 ERR3 VFD Running	Drive operating (ERR3) AC motor drive is in operating status	A setting cannot be changed while the motor drive is in operation. 1. Verify that the drive is not in operation. If the error remains, contact technical support.
001> P00.00 ERR4 Pr Lock	Parameter locked (ERR4) AC motor drive parameter is locked.	A setting cannot be changed because a parameter is locked. 1. Check if the parameter is locked. If it is locked, unlock it and try to set the parameter again. If the error remains, contact technical support.
001> P00.00 ERR5 Pr Changing	Parameter changing (ERR5) AC motor drive parameter is changing	A setting cannot be changed because a parameter is being modified. 1. Check if the parameter is being modified. If it is not being modified, try to change that parameter again. If the error remains, contact technical support.
001> P00.00 ERR6 Fault Code	Fault code (ERR6) Fault code is not cleared	A setting cannot be changed because an error has occured in the motor drive. 1. Check if any error occured in the motor drive. If there is no error, try to change the setting again. If the error remains, contact technical support.
001> P00.00 ERR7 Warning Code	Warning code (ERR7) Warning code is not cleared	A setting cannot be changed because of a warning message given to the motor drive. 1. Check if there is a warning message given to the motor drive. If the error remains, contact technical support.

Continued on next page

Display	Description	Corrective Actions
001> P00.00 ERR8 Type Mismatch	File type mismatch (ERR8) File type mismtach	Data to be copied are not the correct type, so the setting cannot be changed. 1. Check if the products' serial numbers to be copied are in the same category. If they are in the same category, try to copy the setting again. If the error remains, contact technical support.
001> P00.00 ERR9 Password Lock	Password locked (ERR9) File is locked with password	A setting cannot be changed because some data are locked. 1. Check if the data are unlocked or able to be unlocked. If the data are unlocked, try to change the setting again. 2. Shut down the system, wait for ten minutes, and then restart the system. If the error remains, contact technical support.
001> P00.00 ERR10 Password Fail	Password fail (ERR10) File password mismatch	A setting cannot be changed because the password is incorrect. 1. Check if the password is correct. If the password is correct, try to change the setting again. 2. Shut down the system, wait for ten minutes, and then restart the sytem. If the error remains, contact technical support.
001> P00.00 ERR11 Version Fail	Version fail (ERR11) File version mismatch	A settings cannot be changed because the version of the data is incorrect. 1. Check if the version of the data matches the motor drive. If it matches, try to change the setting again. If the error remains, contact technical support.
001> P00.00 ERR12 VFD Time Out	VFD time out (ERR12) AC motor drive copy function time-out	A setting cannot be changed because the data copying time-out expired. 1. Try copying the data again. 2. Check if copying data is authorized. If it is authorized, try to copy the data again. 3. Shut down the system, wait for ten minutes, and then restart the system. If the error remains, contact technical support.

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Page

AC Drive Parameters

Chapter 4

Table of Contents

Chapter 4: AC Drive Parameters

DURAPULSE GS4 Parameter Summary

Motor Parameters Summary (P0.xx)

For detailed information about the P0.xx parameter group, please refer to *page 4–30*.

GS4 Parameters Summary – Motor Parameters (P0.xx)							
Parameter		***Range***	***Run[1] Read/ Write***	***Modbus Address Hex***	***Dec***	***Settings 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 P9.08.							
P0.00	Motor 1 Maximum Output Voltage	230V: 0.0~255.0V 460V: 0.0~510.0V	R/W	0000	40001	GS4-2xxx: 230.0 GS4-4xxx: 460.0	
P0.01	Motor 1 Rated Current	10~120% drive rated Amps	R/W	0001	40002	90% rated I of GS4	
P0.02	Motor 1 Base Frequency	0.00~599.00 Hz	R/W	0002	40003	60.00	
P0.03	Motor 1 Rated RPM	0 to (120 x P0.02/P0.09)-1	♦R/W	0003	40004	1710 (60Hz 4-pole) 1410 (50Hz 4-pole)	
P0.04	Drive Maximum Output Frequency	230V series: 599.00 Hz (75hp & above: 400.00 Hz) 460V series: 599.00 Hz (125hp & above: 400.00 Hz)	R/W	0004	40005	50.00/60.00	
P0.05	Motor Auto Tune	0: Disable 1: Measure motor in dynamic status (motor spinning) 2: Measure motor in static status (motor not spinning)	R/W	0005	40006	0	
P0.06	Motor 1 Resistance	0~65.535Ω	R/W	0006	40007	0	
P0.07	Motor 1 No-Load Current	0~100% motor rated Amps	R/W	0007	40008	40% of Motor1 Rated I	
P0.08	Motor 1 Rated Horsepower (HP)	0.00~655.35hp	♦R/W	0008	40009	Rated hp of GS4	
P0.09	Motor 1 Number of Poles	2 to (120 x P0.02/P0.03)	R/W	0009	40010	4	
P0.10	Motor 1 or 2 Selection	1: Motor 1 2: Motor 2	R/W	000A	40011	1	
P0.11	Motor 2 Maximum Output Voltage	230V: 0.0~255.0V 460V: 0.0~510.0V	R/W	000B	40012	GS4-2xxx: 230.00 GS4-4xxx: 460.00	
P0.12	Motor 2 Rated Current	10~120% drive rated Amps	R/W	000C	40013	90% rated I of GS4	
P0.13	Motor 2 Base Frequency	0.00~599.00 Hz	R/W	000D	40014	60.00	
P0.14	Motor 2 Rated RPM	0 to [(120 x P0.13/P0.18)-1] rpm	♦R/W	000E	40015	1710 (60Hz 4-pole) 1410 (50Hz 4-pole)	
P0.15	Motor 2 Resistance	0~65.535Ω	R/W	000F	40016	0	
P0.16	Motor 2 No-Load Current	0~100% motor rated Amps	R/W	0010	40017	40% of Motor2 Rated I	
P0.17	Motor 2 Rated Horsepower (HP)	0.00~655.35 hp	♦R/W	0011	40018	Rated hp of GS4	
P0.18	Motor 2 Number of Poles	2 to (120 x P0.13/P0.14)	R/W	0012	40019	4	

Ramps Parameters Summary (P1.xx)

For detailed information about the P1.xx parameter group, please refer to page 4–36.

GS4 Parameters Summary – Ramps Parameters (P1.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 P9.08.							
P1.00	Stop Method	0: Ramp to stop 1: Coast to stop	♦R/W	0100	40257	0	
P1.01	Acceleration Time 1	P1.15=0: 0.00~600.00 sec P1.15=1: 0.0~6000.0 sec	♦R/W	0101	40258	10.00	
P1.02	Deceleration Time 1		♦R/W	0102	40259	10.00	
P1.03	Acceleration Time 2		♦R/W	0103	40260	10.00	
P1.04	Deceleration Time 2		♦R/W	0104	40261	10.00	
P1.05	Acceleration Time 3		♦R/W	0105	40262	10.00	
P1.06	Deceleration Time 3		♦R/W	0106	40263	10.00	
P1.07	Acceleration Time 4		♦R/W	0107	40264	10.00	
P1.08	Deceleration Time 4		♦R/W	0108	40265	10.00	
P1.09	S-curve Accel Time 1	P1.15=0: 0.00~25.00 sec P1.15=1: 0.0~250.0 sec	♦R/W	0109	40266	0.20	
P1.10	S-curve Decel Time 1		♦R/W	010A	40267	0.20	
P1.11	S-curve Accel Time 2		♦R/W	010B	40268	0.20	
P1.12	S-curve Decel Time 2		♦R/W	010C	40269	0.20	
P1.13	Jog Acceleration Time	P1.15=0: 0.00~600.00 sec P1.15=1: 0.0~6000.0 sec	♦R/W	010D	40270	10.00	
P1.14	Jog Deceleration Time		♦R/W	010E	40271	10.00	
P1.15	Time Unit for Accel/Decel & S-curve	0: unit 0.01sec 1: unit 0.1sec	R/W	010F	40272	1	
P1.16	Accel/Decel Transition Method	0: rmp2 from terminal 1: transition frequencies P1.17 & P1.18	♦R/W	0110	40273	0	
P1.17	Accel Transition Frequency 1-2	0.00~599.00 Hz	♦R/W	0111	40274	0.00	
P1.18	Decel Transition Frequency 1-2		♦R/W	0112	40275	0.00	
P1.19	Skip Frequency 1 Upper Limit	0.00~599.00 Hz	R/W	0113	40276	0.00	
P1.20	Skip Frequency 1 Lower Limit		R/W	0114	40277	0.00	
P1.21	Skip Frequency 2 Upper Limit		R/W	0115	40278	0.00	
P1.22	Skip Frequency 2 Lower Limit		R/W	0116	40279	0.00	
P1.23	Skip Frequency 3 Upper Limit		R/W	0117	40280	0.00	
P1.24	Skip Frequency 3 Lower Limit		R/W	0118	40281	0.00	
P1.25	DC Injection Current Level	0~100%	♦R/W	0119	40282	0	
P1.26	DC Injection Time During Start-up	0.0~60.0 sec	♦R/W	011A	40283	0.0	
P1.27	DC Injection Time During Stopping		♦R/W	011B	40284	0.0	
P1.28	Start-Point for DC Injection During Stopping	0.00~599.00 Hz	♦R/W	011C	40285	0.00	
P1.29	Deceleration Method	0: Normal Ramp Deceleration 1: Over Fluxing Deceleration 2: Traction Energy Control	R/W	011D	40286	0	

V/Hz Parameters Summary (P2.xx)

For detailed information about the P2.xx parameter group, please refer to page 4–46.

GS4 Parameters Summary – V/Hz Parameters (P2.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address Hex**	**Dec**	**Settings 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 P9.08.							
P2.00	Volts/Hertz Settings	0: General Purpose 1: High Starting Torque (TQR) 2: Fans and Pumps 3: Custom 4: 1.5 Power Curve 5: Square Curve	R/W	0200	40513	0	
P2.01	Slip Compensation Gain	0.00~10.00	♦R/W	0201	40514	0.00 (V/Hz mode) 1.00 (Vector mode)	
P2.02	Torque Compensation Gain	0~10	♦R/W	0202	40515	0	
P2.03	Torque Compensation Filter	0.001~10.000 sec	♦R/W	0203	40516	0.500	
P2.04	Motor 1 Middle Output Frequency 1	0.00~599.00 Hz	R/W	0204	40517	3.00	
P2.05	Motor 1 Middle Output Voltage 1	230V: 0.0~240.0V 460V: 0.0~480.0V	♦R/W	0205	40518	GS4- 21P0~27P5: 15.0V 2010+: 14.0V GS4- 41P0~47P5: 30.0V 4010+: 28.0V	
P2.06	Motor 1 Middle Output Frequency 2	0.00~599.00 Hz	R/W	0206	40519	3.00	
P2.07	Motor 1 Middle Output Voltage 2	230V: 0.0~240.0V 460V: 0.0~480.0V	♦R/W	0207	40520	GS4- 21P0~27P5: 15.0V 2010+: 14.0V GS4- 41P0~47P5: 30.0V 4010+: 28.0V	
P2.08	Motor 1 Minimum Output Frequency	0.00~599.99 Hz	R/W	0208	40521	1.50	
P2.09	Motor 1 Minimum Output Voltage	230V: 0.0~240.0V 460V: 0.0~480.0V	♦R/W	0209	40522	GS4- 21P0~27P5: 9.0V 2010+: 7.0V GS4- 41P0~47P5: 18.0V 4010+: 14.0V	
P2.10	PWM Carrier Frequency *Note: There are interdependencies between P2.10, P6.00/P6.02, P6.33, P6.34. Refer to Parameter Details when setting these parameters.*	2~15 kHz	R/W	020A	40523	model specific; refer to param. details	
P2.11	Control Mode	0: V/Hz Open Loop Control 1: SVC Sensorless	♦R/W	020B	40524	0	
P2.12	Motor 2 Middle Output Frequency 1	0.00~599.00 Hz	R/W	020C	40525	3.00	
P2.13	Motor 2 Middle Output Voltage 1	230V: 0.0~240.0V 460V: 0.0~480.0V	♦R/W	020D	40526	GS4- 21P0~27P5: 15.0V 2010+: 14.0V GS4- 41P0~47P5: 30.0V 4010+: 28.0V	
P2.14	Motor 2 Middle Output Frequency 2	0.00~599.00 Hz	R/W	020E	40527	3.00	

(table continued next page)

GS4 Parameters Summary – V/Hz Parameters (P2.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P2.15	Motor 2 Middle Output Voltage 2	230V: 0.0~240.0V 460V: 0.0~480.0V	♦R/W	020F	40528	GS4- 21P0~27P5: 15.0V 2010+: 14.0V GS4- 41P0~47P5: 30.0V 4010+: 28.0V	
P2.16	Motor 2 Minimum Output Frequency	0.00~599.99 Hz	R/W	0210	40529	1.50	
P2.17	Motor 2 Minimum Output Voltage	230V: 0.0~240.0V 460V: 0.0~480.0V	♦R/W	0211	40530	GS4- 21P0~27P5: 9.0V 2010+: 7.0V GS4- 41P0~47P5: 18.0V 4010+: 14.0V	
P2.18	Zero Speed Select	0: Standby 1: Zero Hold 2: Fmin (Min Hz Output)	R/W	0212	40531	0	
P2.19	Start Frequency	0.00~599.00 Hz	R/W	0213	40532	0.50	
P2.20	Y-D Switching Frequency	0.00~599.00 Hz	♦R/W	0214	40533	60.00	
P2.21	Y-D Switching Enable	0: Disable 1: Enable	R/W	0215	40534	0	
P2.22	Delay Time for Y-D Switching	0.000~600.000 sec	♦R/W	0216	40535	0.200	
P2.23	Automatic Energy-Saving Operation	0: Disable 1: Enable	♦R/W	0217	40536	0	
P2.24	Power Saving Gain	10~1000%	♦R/W	0218	40537	100	
P2.25	Slip Compensation Filter	0.001~10.000 sec	♦R/W	0219	40538	0.100	
P2.26	Slip Deviation Level	0.0~100.0	♦R/W	021A	40539	0.0	
P2.27	Slip Deviation Detection time	0.0~10.0	♦R/W	021B	40540	1.0	
P2.28	Slip Deviation Treatment	0: Warn and continue OP 1: Warn and Ramp to Stop 2: Warn and Coast to stop 3: No Warn	♦R/W	021C	40541	0	
P2.29	Hunting Gain	0~10000	♦R/W	021D	40542	1000	

Digital Parameters Summary (P3.xx)

For detailed information about the P3.xx parameter group, please refer to page 4–60.

GS4 Parameters Summary – Digital Parameters (P3.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 P9.08.							
P3.00	1st Source of Operation Command [Remote]	0: Digital Keypad 1: External Terminal; Keypad/RS-485 STOP is enabled 2: External Terminal; Keypad/RS-485 STOP is disabled 3: RS485 (Modbus/BACnet); Keypad STOP is enabled 4: RS485 (Modbus/BACnet); Keypad STOP is disabled 5: Comm Card; Keypad STOP is enabled 6: Comm Card; Keypad STOP is disabled	R/W	0300	40769	0	
P3.01	2nd Source of Operation Command [Local]		R/W	0301	40770	0	
P3.02	2/3 Wire Operation Mode	0: 2-wire mode 1 (Fwd, Rev) 1: 2-wire mode 2 (Run, Direction) 2: 3-wire mode	R/W	0302	40771	0	

(table continued next page)

GS4 Parameters Summary – Digital Parameters (P3.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P3.03	Multi-Function Input (DI1)	0: No function 1: Multi-Speed/PID Multi-Setpoint bit 1 2: Multi-Speed/PID Multi-Setpoint bit 2 3: Multi-Speed/PID Multi-Setpoint bit 3 4: Multi-Speed bit 4 5: Reset 6: JOG 7: Accel/Decel speed inhibit (Speed Hold) 8: 1st~4th Accel/Decel time selection, bit 0 9: 1st~4th Accel/Decel time selection, bit 1 10: External Fault Input by P3.56 (EF error) 11: Base Block Input 12: reserved 13: Disable Auto Accel/Decel Time 14: Switch between drive settings 1 and 2 15: Operation speed command from AI1 16: Operation speed command from AI2 17: Operation speed command from AI3 18: Forced Ramp Stop by P3.56 (no error) 19: Digital Freq Up Command 20: Digital Freq Down Command 21: PID function Disable 22: Clear counter 23: Increment counter value (DI6 only) 24: FWD JOG 25: REV JOG 26: Emergency Stop EF1 (Coast stop)(EF1 error) 27: Signal Confirmation for Y-connection 28: Signal Confirmation for Delta connection 29: Disable EEPROM Write 30: Forced Coast Stop 31: Hand Contact for HOA Control 32: Auto Contact for HOA Control 33: LOCAL/REMOTE Selection 34: Drive Enable 35: Decel Energy Backup (DEB) Enable 36: PLC Mode select bit0 37: PLC Mode select bit1 38: Output MCR Auxiliary Confirmation 39: reserved 40: Fire mode and force drive run 41: Fire mode and maintain operation 42: Disable all motors 43: Disable Motor #1 44: Disable Motor #2 45: Disable Motor #3 46: Disable Motor #4 47: Disable Motor #5 48: Disable Motor #6 49: Disable Motor #7 50: Disable Motor #8	R/W	0303	40772	1	
P3.04	Multi-Function Input (DI2)		R/W	0304	40773	2	
P3.05	Multi-Function Input (DI3)		R/W	0305	40774	3	
P3.06	Multi-Function Input (DI4)		R/W	0306	40775	4	
P3.07	Multi-Function Input (DI5)		R/W	0307	40776	0	
P3.08	Multi-Function Input (DI6)		R/W	0308	40777	0	
P3.09	Multi-Function Input (DI7)		R/W	0309	40778	0	
P3.10	Multi-Function Input (DI8)		R/W	030A	40779	0	
P3.11	Multi-Function Input (option card DI10 or PLC X12)		R/W	030B	40780	0	
P3.12	Multi-Function Input (option card DI11 or PLC X13)		R/W	030C	40781	0	
P3.13	Multi-Function Input (option card DI12 or PLC X14)		R/W	030D	40782	0	
P3.14	Multi-Function Input (option card DI13 or PLC X15)		R/W	030E	40783	0	
P3.15	Multi-Function Input (option card DI14 or PLC X16)		R/W	030F	40784	0	
P3.16	Multi-Function Input (option card DI15 or PLC X17)		R/W	0310	40785	0	

(table continued next page)

<table>
<tr><th colspan="10">GS4 Parameters Summary – Digital Parameters (P3.xx) – (continued)</th></tr>
<tr><th colspan="2" rowspan="2">Parameter</th><th colspan="2" rowspan="2">Range</th><th rowspan="2">Run Read/ Write</th><th colspan="2">Modbus Address</th><th colspan="2">Settings</th></tr>
<tr><th>Hex</th><th>Dec</th><th>Default</th><th>User</th></tr>
<tr><td>P3.17</td><td>Multi-Function Output Terminal 1 (Relay 1 or PLC Y0)</td><td rowspan="15">0: no function
1: AC Drive Running
2: At Frequency Setpoint
3: At Speed 1 (P3.32)
4: At Speed 2 (P3.34)
5: At Zero Speed Including Drive Running
6: At Zero Speed Drive not Running
7: Over Torque Level 1
8: Over Torque Level 2
9: Drive Ready
10: Low Voltage warning (Lv)
11: Error indication (All faults, Except for Lv Stop)
12: Brake Release Function (P3.51)
13: Over-temp Warning
14: Dynamic Braking Output
15: PID deviation error
16: Over Slip (oSL)
17: Middle Count Value Attained (P3.45)
18: Final Count Value Attained (P3.44)
19: Base Block Indication
20: Warning Output
21: Overvoltage Alarm
22: Oc Stall Alarm
23: Ov Stall Alarm
24: External Control Mode
25: Forward Command
26: Reverse Command
27: Above Current Output (≥ P3.52)
28: Below Current Output (< P3.52)
29: Wye Connected Command</td><td rowspan="15">30: Delta Connected Command
31: Zero Speed at Drive Running
32: Zero Speed including Drive Stop
33: Fault Option 1 (P11.00)
34: Fault Option 2 (P11.01)
35: Fault Option 3 (P11.02)
36: Fault Option 4 (P11.03)
37: At Speed (Setpoint include 0Hz)
38: reserved
39: Under Ampere (Low Current)
40: UVW Motor Contactor Enable
41: DEB active
42: Brake Released at Stop
43: RS485 Digital Output
44: Comm Card Digital Output
45: Fire Mode Indication
46: Fire Bypass Indication
47: Motor #1 Selected
48: Motor #2 Selected
49: Motor #3 Selected
50: Motor #4 Selected
51: Motor #5 Selected
52: Motor #6 Selected
53: Motor #7 Selected
54: Motor #8 Selected
55: Mtr1/Mtr2 Nameplate Parameters Select
56: Safety N.O. STO A
57: Safety N.C. STO B
58: Above Frequency Output (≥ P3.53)
59: Below Frequency Output (< P3.53)</td><td>♦R/W</td><td>0311</td><td>40786</td><td>11</td><td></td></tr>
<tr><td>P3.18</td><td>Multi-Function Output Terminal 2 (Relay 2 or PLC Y1)</td><td>♦R/W</td><td>0312</td><td>40787</td><td>1</td><td></td></tr>
<tr><td>P3.19</td><td>Multi-Function Output Terminal 3 (DO1 or PLC Y3)</td><td>♦R/W</td><td>0313</td><td>40788</td><td>0</td><td></td></tr>
<tr><td>P3.20</td><td>Multi-Function Output Terminal 4 (DO2 or PLC Y4)</td><td>♦R/W</td><td>0314</td><td>40789</td><td>0</td><td></td></tr>
<tr><td>P3.21</td><td>Multi-Function Output Terminal 5 (option card DO10 or RO10, or PLC Y5)</td><td>♦R/W</td><td>0315</td><td>40790</td><td>0</td><td></td></tr>
<tr><td>P3.22</td><td>Multi-Function Output Terminal 6 (option card DO11 or RO11, or PLC Y6)</td><td>♦R/W</td><td>0316</td><td>40791</td><td>0</td><td></td></tr>
<tr><td>P3.23</td><td>Multi-Function Output Terminal 7 (option card RO12 or PLC Y7)</td><td>♦R/W</td><td>0317</td><td>40792</td><td>0</td><td></td></tr>
<tr><td>P3.24</td><td>Multi-Function Output Terminal 8 (option card RO13 or PLC Y10)</td><td>♦R/W</td><td>0318</td><td>40793</td><td>0</td><td></td></tr>
<tr><td>P3.25</td><td>Multi-Function Output Terminal 9 (option card RO14 or PLC Y11)</td><td>♦R/W</td><td>0319</td><td>40794</td><td>0</td><td></td></tr>
<tr><td>P3.26</td><td>Multi-Function Output Terminal 10 (option card RO15 or PLC Y12)</td><td>♦R/W</td><td>031A</td><td>40795</td><td>0</td><td></td></tr>
<tr><td>P3.27</td><td>Multi-Function Virtual Output 11 (DO16, PLC Y13)</td><td>♦R/W</td><td>031B</td><td>40796</td><td>0</td><td></td></tr>
<tr><td>P3.28</td><td>Multi-Function Virtual Output 12 (DO17, PLC Y14)</td><td>♦R/W</td><td>031C</td><td>40797</td><td>0</td><td></td></tr>
<tr><td>P3.29</td><td>Multi-Function Virtual Output 13 (DO18, PLC Y15)</td><td>♦R/W</td><td>031D</td><td>40798</td><td>0</td><td></td></tr>
<tr><td>P3.30</td><td>Multi-Function Virtual Output 14 (DO19, PLC Y16)</td><td>♦R/W</td><td>031E</td><td>40799</td><td>0</td><td></td></tr>
<tr><td>P3.31</td><td>Multi-Function Virtual Output 15 (DO20, PLC Y17)</td><td>♦R/W</td><td>031F</td><td>40800</td><td>0</td><td></td></tr>
<tr><td>P3.32</td><td>Desired Frequency 1</td><td colspan="2">0.00~599.00 Hz</td><td>♦R/W</td><td>0320</td><td>40801</td><td>60.00</td><td></td></tr>
<tr><td>P3.33</td><td>Desired Frequency 1 Width</td><td colspan="2">0.00~599.00 Hz</td><td>♦R/W</td><td>0321</td><td>40802</td><td>2.00</td><td></td></tr>
<tr><td>P3.34</td><td>Desired Frequency 2</td><td colspan="2">0.00~599.00 Hz</td><td>♦R/W</td><td>0322</td><td>40803</td><td>60.00</td><td></td></tr>
<tr><td>P3.35</td><td>Desired Frequency 2 Width</td><td colspan="2">0.00~599.00 Hz</td><td>♦R/W</td><td>0323</td><td>40804</td><td>2.00</td><td></td></tr>
<tr><td>P3.36</td><td>PID Deviation Level</td><td colspan="2">1.0~50.0%</td><td>♦R/W</td><td>0324</td><td>40805</td><td>10.0</td><td></td></tr>
<tr><td>P3.37</td><td>PID Deviation Time</td><td colspan="2">0.1~300.0 sec</td><td>♦R/W</td><td>0325</td><td>40806</td><td>5.0</td><td></td></tr>
<tr><td>P3.38</td><td>Frequency Output (FO) Scaling Factor</td><td colspan="2">1~166</td><td>♦R/W</td><td>0326</td><td>40807</td><td>1</td><td></td></tr>
<tr><td colspan="10">(table continued next page)</td></tr>
</table>

GS4 Parameters Summary – Digital Parameters (P3.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P3.39	Increase/Decrease Speed Mode	0.000: Following Accel/Decel Time 0.001~1.000 Hz/ms: Following Constant Speed	♦R/W	0327	40808	0	
P3.40	DI6 Counter Debounce Filter	0.00~30.00 sec	♦R/W	0328	40809	0.02	
P3.41	Digital Input Response Time	0~30.000 sec	♦R/W	0329	40810	0.005	
P3.42	Multi-Function Input Contact Selection (0=N.O. / 1=N.C.)	0~65535	R/W	032A	40811	0	
P3.43	Multi-Function Output Contact Selection (0=N.O. / 1=N.C.)	0~65535	♦R/W	032B	40812	0	
P3.44	Final Counter Value	0~65500	♦R/W	032C	40813	0	
P3.45	Mid-point Counter Value	0~65500	♦R/W	032D	40814	0	
P3.46	Digital Input Active Status	0~65535	Read	032E	40815	0	
P3.47	Digital Output Active Status	0~65535	Read	032F	40816	0	
P3.48	PLC – Digital Input Mask	0~65535	Read	0330	40817	0	
P3.49	PLC – Digital Output Mask	0~65535	Read	0331	40818	0	
P3.50	Increase/Decrease Speed Command Record	0~600.00	Read	0332	40819	60	
P3.51	Brake Delay Time	0.000~65.000 sec	R/W	0333	40820	0	
P3.52	Desired Current	0~150% of GS4 VT current rating	♦R/W	0334	40821	0	
P3.53	Output Frequency Threshold for Multi-Function Output Terminals	0.00~599.00 Hz	♦R/W	0335	40822	0	
P3.54	reserved	n/a	n/a	0336	40823	n/a	
P3.55	reserved	n/a	n/a	0337	40824	n/a	
P3.56	Emergency Stop (EF) & Force Stop Selection	0: Coast Stop 1: Deceleration Time 1 2: Deceleration Time 2 3: Deceleration Time 3 4: Deceleration Time 4 5: System Deceleration 6: Automatic Deceleration	R/W	0338	40825	0	
P3.57	AUTO to HAND Switching Behavior	0~Fh bit 0: Sleep function control bit bit 1: Parameter units displayed on keypad bit 2: PID control bit bit 3: Source of frequency control bit	♦R/W	0339	40826	0	
P3.58	Local/Remote Switch Mode	0: HAND/OFF/AUTO control 1: Always Stop When Switching 2: Follow Remote Mode 3: Follow Local Mode 4: Follow Local and Remote Mode	R/W	033A	40827	4	

Analog Parameters Summary (P4.xx)

For detailed information about the P4.xx parameter group, please refer to page 4–89.

GS4 Parameters Summary – Analog Parameters (P4.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 P9.08.							
P4.00	1st Source of Frequency Command [Remote]	0: Digital Keypad 1: RS485 Communication (Modbus/BACnet) 2: Analog Input 3: External UP/DOWN Terminal 4: Comm Card	♦R/W	0400	41025	0	
P4.01	2nd Source of Frequency Command [Local]		♦R/W	0401	41026	0	
P4.02	Analog Input 1 (AI1) Function	0: no Function 1: Frequency Command/PID Setpoint REMOTE 2: Frequency Command/PID Setpoint LOCAL 3: Frequency Command/PID Setpoint REMOTE & LOCAL 4: reserved 5: PID Feedback Signal 6: PTC Thermistor Input Value 7: PID Setpt Offset 8~10: reserved 11: PT100 RTD Input Value	♦R/W	0402	41027	1	
P4.03	Analog Input 2 (AI2) Function		♦R/W	0403	41028	0	
P4.04	Analog Input 3 (AI3) Function		♦R/W	0404	41029	0	
P4.05	AI1 – I/V Selection	0: AI_v Selection (0~10V) 1: AI_i Selection (4~20mA) 2: AI_i Selection (0~20mA)	♦R/W	0405	41030	0	
P4.06	AI2 – I/V Selection		♦R/W	0406	41031	1	
P4.07	Trim Reference Frequency	0.00~599.00 Hz	R/W	0407	41032	0.0	
P4.08	Trim Selection	0: Disable Trim Function 1: 1st Source Freq + 2nd Source Freq 2: 1st Source Freq - 2nd Source Freq 3: Speed Source + Trim Ref Freq 4: Speed Source - Trim Ref Freq	R/W	0408	41033	0	
P4.09	Analog Frequency Command for Reverse Run	0: Negative Frequency Input is Disabled. Forward and reverse directions are controlled by digital keypad or by external terminal. 1: Negative Frequency Input is Enabled. Forward direction when positive frequency; reverse direction when negative frequency. Forward and reverse directions are NOT controlled by digital keypad or by external terminal.	♦R/W	0409	41034	0	
P4.10	AI1 Input Bias (Offset)	-100.0% to +100.0%	♦R/W	040A	41035	0	
P4.11	AI1 Input Bias (Offset) Polarity	0: NO Offset 1: Positive Offset 2: Negative Offset	♦R/W	040B	41036	0	
P4.12	AI1 Input Gain	-500.0% to +500.0%	♦R/W	040C	41037	100.0	
P4.13	AI1 Filter	0.00~20.00 sec	♦R/W	040D	41038	0.01	
P4.14	reserved	n/a	n/a	040E	41039	n/a	
P4.15	AI2 Input Bias (Offset)	-100.0% to +100.0%	♦R/W	040F	41040	0	
P4.16	AI2 Input Bias (Offset) Polarity	0: NO Offset 1: Positive Offset 2: Negative Offset	R/W	0410	41041	0	

(table continued next page)

GS4 Parameters Summary – Analog Parameters (P4.xx) – (continued)							
Parameter		***Range***	***Run Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default***	***User***
P4.17	AI2 Input Gain	-500.0% to +500.0%	♦R/W	0411	41042	100.0	
P4.18	AI2 Filter	0.00~20.00 sec	♦R/W	0412	41043	0.01	
P4.19	AI3 Input Bias (Offset)	-100.0% to +100.0%	♦R/W	0413	41044	0	
P4.20	AI3 Input Bias (Offset) Polarity	0: NO Offset 1: Positive Offset 2: Negative Offset	R/W	0414	41045	0	
P4.21	+AI3 Input Gain	-500.0% to +500.0%	♦R/W	0415	41046	100.0	
P4.22	-AI3 Input Gain	-500.0% to +500.0%	♦R/W	0416	41047	100.0	
P4.23	AI3 Filter	0.00~20.00 sec	♦R/W	0417	41048	0.01	
P4.24	AI V/Hz Calculated Selection	0: All Inputs Use Bias and Gain 1: AI1 Custom V/Hz 2: AI2 Custom V/Hz 3: AI1 and AI2 Custom V/Hz 4: AI3 Custom V/Hz 5: AI1 & AI3 Custom V/Hz 6: AI2 & AI3 Custom V/Hz 7: All Custom V/Hz	R/W	0418	41049	0	
P4.25	AI1 Low V/A	P4.05=0: 0.00~10.00V P4.05=1: 4.00~20.00mA P4.05=2: 0.00~20.00mA	R/W	0419	41050	P4.05=0: 0.00V P4.05=1: 4.00mA P4.05=2: 0.00mA	
P4.26	AI1 Low Hz Percent	0.00~100.00%	R/W	041A	41051	0	
P4.27	AI1 Mid V/A	P4.05=0: 0.00~10.00V P4.05=1: 4.00~20.00mA P4.05=2: 0.00~20.00mA	R/W	041B	41052	P4.05=0: 5.00V P4.05=1: 12.00mA P4.05=2: 10.00mA	
P4.28	AI1 Mid Hz Percent	0.00~100.00%	R/W	041C	41053	50.00	
P4.29	AI1 High V/A	P4.05=0: 0.00~10.00V P4.05=1: 4.00~20.00mA P4.05=2: 0.00~20.00mA	R/W	041D	41054	P4.05=0: 10.00V P4.05=1: 20.00mA P4.05=2: 20.00mA	
P4.30	AI1 High Hz Percent	0.00~100.00%	R/W	041E	41055	100.00	
P4.31	AI2 Low V/A	P4.06=0: 0.00~10.00V P4.06=1: 4.00~20.00mA P4.06=2: 0.00~20.00mA	R/W	041F	41056	P4.06=0: 0.00V P4.06=1: 4.00mA P4.06=2: 0.00mA	
P4.32	AI2 Low Hz Percent	0.00~100.00%	R/W	0420	41057	0	
P4.33	AI2 Mid V/A	P4.06=0: 0.00~10.00V P4.06=1: 4.00~20.00mA P4.06=2: 0.00~20.00mA	R/W	0421	41058	P4.06=0: 5.00V P4.06=1: 12.00mA P4.06=2: 10.00mA	
P4.34	AI2 Mid Hz Percent	0.00~100.00%	R/W	0422	41059	50.00	

(table continued next page)

GS4 Parameters Summary – Analog Parameters (P4.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address Hex	Dec	Settings Default	User
P4.35	AI2 High V/A	P4.06=0: 0.00~10.00V P4.06=1: 4.00~20.00mA P4.06=2: 0.00~20.00mA	R/W	0423	41060	P4.06=0: 10.00V P4.06=1: 20.00mA P4.06=2: 20.00mA	
P4.36	AI2 High Hz Percent	0.00~100.00%	R/W	0424	41061	100.00	
P4.37	AI3 Low Voltage Unipolar	0.00~10.00V	R/W	0425	41062	0	
P4.38	AI3 Low Hz Percent Unipolar	0.00~100.00%	R/W	0426	41063	0	
P4.39	AI3 Mid Voltage Unipolar	0.00~10.00V	R/W	0427	41064	5.00	
P4.40	AI3 Mid Hz Percent Unipolar	0.00~100.00%	R/W	0428	41065	50.00	
P4.41	AI3 High Voltage Unipolar	0.00~10.00V	R/W	0429	41066	10.00	
P4.42	AI3 High Hz Percent Unipolar	0.00~100.00%	R/W	042A	41067	100.00	
P4.43	-AI3 High Voltage Bipolar	-10.00V to 0.00V	R/W	042B	41068	0.00	
P4.44	-AI3 High Hz Percent Bipolar	-100.00% to +100.00%	R/W	042C	41069	0.00	
P4.45	-AI3 Mid Voltage Bipolar	-10.00V to 0.00V	R/W	042D	41070	–5.00	
P4.46	-AI3 Mid Hz Percent Bipolar	-100.00% to +100.00%	R/W	042E	41071	–50.00	
P4.47	-AI3 Low Voltage Bipolar	-10.00V to 0.00V	R/W	042F	41072	–10.00	
P4.48	-AI3 Low Hz Percent Bipolar	-100.00% to +100.00%	R/W	0430	41073	–100.00	
P4.49	reserved	n/a	n/a	0431	41074	n/a	
P4.50	Analog Output 1 (AO1)	0: Output Frequency (Hz) 1: Frequency Command (Hz) 2: Motor Speed (Hz) 3: Output Current (A_{rms}) 4: Output Voltage (V) 5: DC Bus Voltage (V) 6: Power Factor (%) 7: Power (% Rated) 8: AI1 (%) 9: AI2 (%) 10: AI3 (%) 11: As 485 AO 12: As COMM Card AO 13: Fixed Voltage	♦R/W	0432	41075	0	
P4.51	AO1 Gain	0.0~500.0%	♦R/W	0433	41076	100.0	
P4.52	AO1 Negative Value Handle	0: Absolute Value 1: 0V When Negative 2: Offset 5V = 0 Value	♦R/W	0434	41077	0	
P4.53	AO1 0~20mA/4~20mA Selection	0: 0~20mA 1: 4~20mA	R/W	0435	41078	0	
P4.54	Analog Output 2 (AO2)	0: Output Frequency (Hz) 1: Frequency Command (Hz) 2: Motor Speed (Hz) 3: Output Current (A_{rms}) 4: Output Voltage (V) 5: DC Bus Voltage (V) 6: Power Factor (%) 7: Power (% Rated) 8: AI1 (%) 9: AI2 (%) 10: AI3 (%) 11: As 485 AO 12: As COMM Card AO 13: Fixed Voltage	♦R/W	0436	41079	0	
P4.55	AO2 Gain	0.0~500.0%	♦R/W	0437	41080	100.0	

(table continued next page)

GS4 Parameters Summary – Analog Parameters (P4.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address Hex**	**Dec**	**Settings Default**	**User**
P4.56	AO2 Negative Value Handle	0: Absolute Value 1: 0V When Negative 2: Offset 5V = 0 Value	♦R/W	0438	41081	0	
P4.57	AO2 0~20mA/4~20mA Selection	0: 0~20mA 1: 4~20mA	R/W	0439	41082	0	
P4.58	reserved	n/a	n/a	043A	41083	n/a	
P4.59	AO2 Offset (Bias)	-100.00% to +100.00%	♦R/W	043B	41084	0.00	
P4.60	AO1 Output Constant Level	0.00~100.00%	R/W	043C	41085	0.00	
P4.61	AO2 Output Constant Level	0.00~100.00%	R/W	043D	41086	0.00	
P4.62	PLC Analog Output Mask	0 to 65535	♦R/W	043E	41087	0	
P4.63	Loss of AI1 Signal (4~20mA)	0: Disable 1: Run at Last Freq (ANL Warning) 2: Decelerate to 0Hz (ANL Warning) 3: Stop (ACE Fault)	R/W	043F	41088	0	
P4.64	Loss of AI2 Signal (4~20mA)			0440	41089	0	
P4.65	AI1%	-100% to 100%	Read	0441	41090	0	
P4.66	AI2%	-100% to 100%	Read	0442	41091	0	
P4.67	AI3%	-100% to 100%	Read	0443	41092	0	

Presets Parameters Summary (P5.xx)

For detailed information about the P5.xx parameter group, please refer to *page 4–119*.

GS4 Parameters Summary – Presets Parameters (P5.xx)							
Parameter		**Range**	**Run[1] Read/ Write**	**Modbus Address Hex**	**Dec**	**Settings 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 P9.08.							
P5.00	Jog Frequency	0.00~599.00 Hz	♦R/W	0500	41281	6.0	
P5.01	Multi-Speed 1	0.00~599.00 Hz	♦R/W	0501	41282	0.0	
P5.02	Multi-Speed 2	0.00~599.00 Hz	♦R/W	0502	41283	0.0	
P5.03	Multi-Speed 3	0.00~599.00 Hz	♦R/W	0503	41284	0.0	
P5.04	Multi-Speed 4	0.00~599.00 Hz	♦R/W	0504	41285	0.0	
P5.05	Multi-Speed 5	0.00~599.00 Hz	♦R/W	0505	41286	0.0	
P5.06	Multi-Speed 6	0.00~599.00 Hz	♦R/W	0506	41287	0.0	
P5.07	Multi-Speed 7	0.00~599.00 Hz	♦R/W	0507	41288	0.0	
P5.08	Multi-Speed 8	0.00~599.00 Hz	♦R/W	0508	41289	0.0	
P5.09	Multi-Speed 9	0.00~599.00 Hz	♦R/W	0509	41290	0.0	
P5.10	Multi-Speed 10	0.00~599.00 Hz	♦R/W	050A	41291	0.0	
P5.11	Multi-Speed 11	0.00~599.00 Hz	♦R/W	050B	41292	0.0	
P5.12	Multi-Speed 12	0.00~599.00 Hz	♦R/W	050C	41293	0.0	
P5.13	Multi-Speed 13	0.00~599.00 Hz	♦R/W	050D	41294	0.0	
P5.14	Multi-Speed 14	0.00~599.00 Hz	♦R/W	050E	41295	0.0	
P5.15	Multi-Speed 15	0.00~599.00 Hz	♦R/W	050F	41296	0.0	

Protection Parameters Summary (P6.xx)

For detailed information about the P6.xx parameter group, please refer to *page 4–121*.

GS4 Parameters Summary – Protection Parameters (P6.xx)							
Parameter		***Range***	***Run[1] Read/ Write***	***Modbus Address Hex***	***Dec***	***Settings 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 P9.08.							
P6.00	Electronic Thermal Overload Relay (Motor 1) *Note: There are interdependencies between P2.10, P6.00/P6.02, P6.33, P6.34. Refer to Parameter Details when setting these parameters.*	0: Constant Torque 1: Variable Torque 2: Inactive	♦R/W	0600	41537	1	
P6.01	Electronic Thermal Characteristic (Motor 1)	30.0~600.0 sec	♦R/W	0601	41538	60.0	
P6.02	Electronic Thermal Overload Relay (Motor 2) *Note: There are interdependencies between P2.10, P6.00/P6.02, P6.33, P6.34. Refer to Parameter Details when setting these parameters.*	0: Constant Torque 1: Variable Torque 2: Inactive	♦R/W	0602	41539	2	
P6.03	Electronic Thermal Characteristic (Motor 2)	30.0~600.0 sec	♦R/W	0603	41540	60.0	
P6.04	Auto Restart after Fault	0~10	♦R/W	0604	41541	0	
P6.05	Reset Time for Auto Restart after fault	0.0~6000.0 sec	♦R/W	0605	41542	60.0	
P6.06	Base Block Speed Search after Fault (oc,ov,bb)	0: Disable 1: Speed search starts with current speed reference 2: Speed search starts with minimum output frequency	♦R/W	0606	41543	0	
P6.07	Speed Search at Start	0: Disable 1: Speed search from maximum output frequency 2: Speed search from start-up motor frequency 3: Speed search from minimum output frequency	♦R/W	0607	41544	0	
P6.08	Momentary Power Loss	0: Disable 1: Speed search for last frequency command 2: Speed search for the minimum output frequency	♦R/W	0608	41545	0	
P6.09	Fwd/Rev Direction Inhibit	0: Enable Fwd/Rev 1: Disable Reverse Operation 2: Disable Forward Operation	♦R/W	0609	41546	0	
P6.10	Auto Voltage Regulation	0: AVR Enable 1: AVR Disable 2: AVR Disable during Decel	♦R/W	060A	41547	0	
P6.11	Over-Voltage Stall Prevention	0: Enable Over-voltage Stall Prevention 1: Disable Over-voltage Stall Prevention	R/W	060B	41548	0	
P6.12	Selection for Over-voltage Stall Prevention	0: Traditional Over-voltage Stall Prevention 1: Advanced Over-voltage Prevention	♦R/W	060C	41549	0	

(table continued next page)

GS4 Parameters Summary – Protection Parameters (P6.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address Hex**	**Dec**	**Settings Default**	**User**
P6.13	Auto Adjustable Accel/ Decel	0: Linear Accel/Decel 1: Auto Accel, Linear Decel 2: Linear Accel, Auto Decel 3: Auto Accel, Auto Decel 4: Auto Accel/Decel Stall Prevention (limited by P1.01~P1.08 and P1.13~P1.14)	♦R/W	060D	41550	0	
P6.14	Over-Torque Detection Mode (OT1)	0: Disable 1: Enable during at speed 2: Enable during at speed and Stop 3: Enable during OP 4: Enable during OP and Stop	♦R/W	060E	41551	0	
P6.15	Over-Torque Detection Level (OT1)	10~200%	♦R/W	060F	41552	120	
P6.16	Over-Torque Detection Time (OT1)	0.1~60.0 sec	♦R/W	0610	41553	0.1	
P6.17	Over-Torque Detection Mode (OT2)	0: Disable 1: Enable during at speed 2: Enable during at speed and Stop 3: Enable during OP 4: Enable during OP and Stop	♦R/W	0611	41554	0	
P6.18	Over-Torque Detection Level (OT2)	10~200%	♦R/W	0612	41555	120	
P6.19	Over-Torque Detection Time (OT2)	0.1~60.0 sec	♦R/W	0613	41556	0.1	
P6.20	Over-Current Stall Prevention Level During Accel	0~160% (by P6.34 setup; VT: 0~130%; CT: 0~160%) 0: Disable	♦R/W	0614	41557	VT: 120 CT: 150	
P6.21	Over-Current Stall Prevention Level During Operation	0~160% (by P6.34 setup; VT: 0~130%; CT: 0~160%) 0: Disable	♦R/W	0615	41558	VT: 120 CT: 150	
P6.22	Maximum Allowable Power Loss Time	0.0~20.0 sec	♦R/W	0616	41559	2.0	
P6.23	Base-Block Time for Speed Search	0.1~20.0 sec	♦R/W	0617	41560	0.5	
P6.24	Maximum Speed Search Current Level	20~200%	♦R/W	0618	41561	100	
P6.25	Upper Limit of Output Frequency	0.00~599.00 Hz	♦R/W	0619	41562	599.00	
P6.26	Lower Limit of Output Frequency	0.00~599.00 Hz	♦R/W	061A	41563	0.00	
P6.27	Over-Voltage Stall Prevention Level	230V: 300.0~450.0 VDC 460V: 600.0~900.0 VDC	♦R/W	061B	41564	390.0 780.0	
P6.28	Dynamic Braking Voltage Level	230V: 350.0~450.0 VDC 460V: 700.0~900.0 VDC	♦R/W	061C	41565	390.0 780.0	
P6.29	Line Start Lockout	0: Enable start-up lockout 1: Disable start-up lockout	♦R/W	061D	41566	0	
P6.30	Heat Sink OH Warning Level	0.0~110.0 °C	♦R/W	061E	41567	105.0	
P6.31	Cooling Fan Control	0: Always ON 1: Fan OFF 1 minute after Stop 2: Run fan ON/Stop fan OFF 3: Heat sink temperature 4: Always OFF	♦R/W	061F	41568	0	
P6.32	PWM Fan Speed	0~100%	R/W	0620	41569	60	

(table continued next page)

GS4 Parameters Summary – Protection Parameters (P6.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P6.33	Drive Derating Method NOTE: THERE ARE INTERDEPENDENCIES BETWEEN P2.10, P6.00/P6.02, P6.33, P6.34. REFER TO PARAMETER DETAILS WHEN SETTING THESE PARAMETERS.	0: Constant rated current 1: Constant carrier frequency 2: Constant rated current (with higher current limit)	R/W	0621	41570	0	
P6.34	Variable/Constant Torque Duty Selection NOTE: THERE ARE INTERDEPENDENCIES BETWEEN P2.10, P6.00/P6.02, P6.33, P6.34. REFER TO PARAMETER DETAILS WHEN SETTING THESE PARAMETERS.	0: VT, 3-phase input 1: CT, 3-phase input 2: CT, 230V 1-phase input	♦R/W	0622	41571	0	
P6.35	Low Voltage Level	230V Frame <E: 150.0~220.0 VDC 230V Frame ≥E: 190.0~220.0 VDC 460V Frame <E: 300.0~440.0 VDC 460V Frame ≥E: 380.0~440.0 VDC	♦R/W	0623	41572	180.0 200.0 360.0 400.0	
P6.36	OC Stall Preventation Accel/Decel Time Selection at Normal Speed	0: Follow System Accel/Decel Time 1: Follow the 1st Accel/Decel Time 2: Follow the 2nd Accel/Decel Time 3: Follow the 3rd Accel/Decel Time 4: Follow the 4th Accel/Decel Time 5: Auto Accel/Decel	♦R/W	0624	41573	0	
P6.37	OC Stall Preventation Limit for operation over Rated Speed	0~100%	♦R/W	0625	41574	50	
P6.38	Torque Limit (Current Limit)	0~200%	♦R/W	0626	41575	150	
P6.39	PTC/RTD Detection Selection	0: Warn and Run 1: Warn and Ramp Stop 2: Warn and Coast Stop 3: No Warning	♦R/W	0627	41576	0	
P6.40	PTC Level	0.0~100.0%	♦R/W	0628	41577	50.0	
P6.41	RTD (PT100) Level 1, PTC Level Detection Selection	0.000~10.000V	R/W	0629	41578	5.000	
P6.42	RTD (PT100) Level 2, PTC Level Detection Selection	0.000~10.000V	R/W	062A	41579	7.000	
P6.43	RTD (PT100) Drop Frequency for PT100 Level 1	0.00~599.00 Hz	R/W	062B	41580	0.00	
P6.44	RTD (PT100) Treatment Delay Time	0~6000 sec	R/W	062C	41581	60	
P6.45	Output Phase Loss (OPhL) Detection Selection	0: Warn and continue to operate 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning	R/W	062D	41582	3	
P6.46	Output Phase Loss Detection time	0.000~65.535 sec	R/W	062E	41583	0.500	
P6.47	Output Phase Loss Current Detection Level	0.00~100.00% (of max current)	R/W	062F	41584	1.00	
P6.48	Output Phase Loss DCI Time	0.000~65.535 sec	R/W	0630	41585	0.000	
P6.49	Input Phase Loss Treatment	0: Warn and ramp to stop 1: Warn and coast to stop	R/W	0631	41586	0	
P6.50	GFF Detect Current Level (% of INV I-Rated)	0.0~100.0%	R/W	0632	41587	60.0	
P6.51	GFF Low Pass Filter Gain	0.00~655.35	R/W	0633	41588	0.10	

(table continued next page)

GS4 Parameters Summary – Protection Parameters (P6.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P6.52	Low Current Level	0.0~100.0%	R/W	0634	41589	0.0	
P6.53	Low Current Detection Time	0.00~360.00 sec	R/W	0635	41590	0.00	
P6.54	Low Current Action	0: Disable, no warning 1: Warn and coast to stop 2: Warn and ramp to stop by 2nd decel time 3: Warn and continue operation	R/W	0636	41591	0	
P6.55	Fire Mode	0: Disable 1: Forward Operation 2: Reverse Operation	R/W	0637	41592	0	
P6.56	Fire Mode Operation Frequency	0.00~599.00 Hz	R/W	0638	41593	60.00	
P6.57	Fire Mode Enable Bypass	0: Disable Bypass 1: Enable Bypass	R/W	0639	41594	0	
P6.58	Fire Mode Bypass Delay Time	0.0~6550.0 sec	R/W	063A	41595	0.0	
P6.59	Fire Mode Auto Restart Counter	0~10	R/W	063B	41596	0	
P6.60	Fire Mode Auto Restart Counter Reset Time	0.0~6000.0 sec	R/W	063C	41597	60.0	
P6.61	Decel Energy Backup (DEB) Decel Selection	0: Disable 1: 1st Decel Time 2: 2nd Decel Time 3: 3rd Decel Time 4: 4th Decel Time 5: Current Decel Time 6: Auto Decel Time	♦R/W	063D	41598	0	
P6.62	DEB Offset Level	230V models: 0.0~100.0 VDC 460V models: 0.0~200.0 VDC	R/W	063E	41599	40.0 80.0	
P6.63	DEB Disable Voltage Level	230V models: 0.0~200.0 VDC 460V models: 0.0~400.0 VDC	R/W	063F	41600	150.0 300.0	
P6.64	DEB Delay Time	0.0~25.0 sec	♦R/W	0640	41601	0.0	
P6.65	Dwell Time at Accel	0.00~600.00 sec	♦R/W	0641	41602	0	
P6.66	Dwell Frequency at Accel	0.00~599.00 Hz	♦R/W	0642	41603	0	
P6.67	Dwell Time at Decel	0.00~600.00 sec	♦R/W	0643	41604	0	
P6.68	Dwell Frequency at Decel	0.00~599.00 Hz	♦R/W	0644	41605	0	
P6.69	Input Phase Loss Detection Time	0.00~600.00 sec	R/W	0645	41606	0.20	
P6.70	Input Phase Loss Ripple Detection	230V models: 0.0~160.0 VDC 460V models: 0.0~320.0 VDC	R/W	0646	41607	30.0 60.0	
P6.71	STO Alarm Latch	0: STO Alarm Latch 1: STO Alarm no Latch	♦R/W	0647	41608	0	
P6.72	IGBT Temperature	-3,276.7 to 3,276.7 °C	Read	0648	41608	0	
P6.73	Cap Temperature	-3,276.7 to 3,276.7 °C	Read	0649	41609	0	

PID Parameters Summary (P7.xx)

For detailed information about the P7.xx parameter group, please refer to page 4–160.

GS4 Parameters Summary – PID Parameters (P7.xx)							
Parameter		***Range***	***Run1) Read/ Write***	***Modbus Address***		***Settings***	
				Hex	***Dec***	***Default2)***	***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 P9.08.							
P7.00	PID Action/Mode	0: PID Disabled 1: PID Reverse Local/Remote 2: PID Forward Local/Remote 3: PID Reverse Remote Only 4: PID Forward Remote Only 5: PID Reverse Local Only 6: PID Forward Local Only	♦R/W	0700	41793	0	
P7.01	reserved	~	~	0701	41794	~	
P7.02	PID Setpoint Source Display (when PID enabled, this parameter data will be mapped from P4.00~P4.01 dependent upon whether in Remote=4.00 or Local=4.01)	00: Keypad 01: RS485 02: AI1 03: AI2 04: AI3 05: Ext Up/Down Key 06: Comm Card 07: Multi-Step Inputs 08: PID off	Read	0702	41795	7	
P7.03	PID Feedback Gain	0.00 to 300.00%	♦R/W	0703	41796	100.00	
P7.04	PID Offset Value	-100.0% to +100.0%	♦R/W	0704	41797	0.0	
P7.05	Keypad PID Setpoint	0.00~100.00%	Read	0705	41798	0.0	
P7.06	PID Multi-Setpoint 1	0.00~100.00%	♦R/W	0706	41799	0.00	
P7.07	PID Multi-Setpoint 2	0.00~100.00%	♦R/W	0707	41800	0.00	
P7.08	PID Multi-Setpoint 3	0.00~100.00%	♦R/W	0708	41801	0.00	
P7.09	PID Multi-Setpoint 4	0.00~100.00%	♦R/W	0709	41802	0.00	
P7.10	PID Multi-Setpoint 5	0.00~100.00%	♦R/W	070A	41803	0.00	
P7.11	PID Multi-Setpoint 6	0.00~100.00%	♦R/W	070B	41804	0.00	
P7.12	PID Multi-Setpoint 7	0.00~100.00%	♦R/W	070C	41805	0.00	
P7.13	Proportional Gain	0.0~100.0	♦R/W	070D	41806	1.0	
P7.14	Integral Time	0.00~100.00 sec	♦R/W	070E	41807	1.00	
P7.15	Derivative Value	0.00~1.00 sec	♦R/W	070F	41808	0.00	
P7.16	Upper Limit for Integral Time	0.0~100.0%	♦R/W	0710	41809	100.0	
P7.17	Derivative Filter Time Constant	0.0~2.5 sec	♦R/W	0711	41810	0.0	
P7.18	PID Output Frequency Limit	0.0~100.0%	♦R/W	0712	41811	100.0	
P7.19	PID Feedback Value	-200.00% to +200.00%	Read	0713	41812	0.00	
P7.20	Feedback Signal Detection Time	0.0~3600.0 sec	♦R/W	0714	41813	0.0	
P7.21	PID Feedback Loss	0: Warn and Continue Operation 1: Warn (fault) and Ramp to Stop 2: Warn (fault) and Coast to Stop 3: Warn and Operate at Last Frequency 4: Warn and Run at P7.22	R/W	0715	41814	0	
P7.22	PID Feedback Loss Speed Level Default	0.00~400.00 Hz	♦R/W	0716	41815	0.00	
P7.23	reserved	~	~	0717	41816	~	
P7.24	PID Offset Selection	0: Set by P7.04 1: Set by an AI Input	♦R/W	0718	41817	0	
P7.25	PID Mode Selection	0: Old PID mode, Kp, Kp*Ki, Kp*Kd 1: New PID mode, Kp, Ki, Kd are independent	R/W	0719	41818	0	

(table continued next page)

GS4 Parameters Summary – PID Parameters (P7.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P7.26	PID Reverse Enable	0: PID can't change command direction 1: PID can change command direction	R/W	071A	41819	0	
P7.27	Source of Sleep	0: Frequency / PID Command Frequency (CV) 1: Feedback	R/W	071B	41820	0	
P7.28	Integral Limit During Sleep	0.0~200.0	R/W	071C	41821	50.0	
P7.29	Sleep Reference	P7.27=0: 0.0~599.00 Hz P7.27=1: 0.0~200.00%	♦R/W	071D	41822	0.00	
P7.30	Wake-up Reference	P7.27=0: 0.0~599.00 Hz P7.27=1: 0.0~200.00%	♦R/W	071E	41823	0.00	
P7.31	Sleep Time	0.0~6000.0 sec	♦R/W	071F	41824	0.0	
P7.32	Wake-up Delay Time	0.00~600.00 sec	R/W	0720	41825	0.00	

Display Parameters Summary (P8.xx)

For detailed information about the P8.xx parameter group, please refer to page 4–171.

GS4 Parameters Summary – Display Parameters (P8.xx)								
Parameter		**Range**		**Run1) Read/ Write**	**Modbus Address**		**Settings**	
					Hex	**Dec**	**Default2)**	**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 P9.08.								
P8.00	User Display	0: Output Amps 1: Counter Value 2: Actual Freq 3: DC Bus Voltage 4: Output Voltage 5: Power Factor 6: Output Power 7: Calculated RPM 8~9: reserved 10: PID Feedback % 11: AI1 % 12: AI2 % 13: AI3 % 14: IGBT Temperature 15: Cap Temperature 16: DI Input Status 17: DO Output Status 18: Multi-Speed Step 19: CPU DI Status 20: CPU DO Status 21~24: reserved 25: Overload %	26: Ground Fault % 27: DC Bus Ripple 28: PLC D1043 Value 29: reserved 30: User-Defined 31: Out Hz x P8.05 32~33: reserved 34: Fan Speed 35: reserved 36: Carrier Frequency 37: reserved 38: Drive Status 39: reserved 40: reserved 41: kWh 42: PID Reference 43: PID Offset 44: PID Output Hz 45: Reserved 46: STO Version 47: STO Chksum High 48: STO Chksum Low	♦ R/W	0800	42049	3	
P8.01	Start-up Display Selection	0: Freq Setpoint 1: Output Hz 2: User Display (P8.00) 3: Output Amps		♦ R/W	0801	42050	0	
(table continued next page)								

GS4 Parameters Summary – Display Parameters (P8.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P8.02	User Defined Format	Bits 0~3: User defined decimal place: 0000b: no decimal place 0001b: one decimal place 0010b: two decimal place 0011b: three decimal place Bits 4~9: 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: °C 014xh: °F 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: m^3/s 022xh: m^3/h 023xh: gpm 024xh: cfm	R/W	0802	42051	0	
P8.03	User Defined Max	0: Disable 0~65535 (when P8.02 set to no decimal place) 0.0~6553.5 (when P8.02 set to 1 decimal place) 0.00~655.35 (when P8.02 set to 2 decimal place) 0.000~65.535 (when P8.02 set to 3 decimal place)	R/W	0803	42052	0	
P8.04	User Defined Setpoint	0~65535	Read	0804	42053	0	~
P8.05	Output Frequency Gain	0.00~160.00	R/W	0805	42054	1.00	
P8.06	Password Input	0~65535	♦ R/W	0806	42055	0	
P8.07	Password Set Up	0~65535	♦ R/W	0807	42056	0	
P8.08	Power On Counter	0~65535	Read	0808	42057	~	~
P8.09	Power On Day	0~65535	Read	0809	42058	~	~
P8.10	Power On Minute	0~1439	Read	080A	42059	~	~

(table continued next page)

GS4 Parameters Summary – Display Parameters (P8.xx) – (continued)							
Parameter		**Range**	**Run Read/ Write**	**Modbus Address**		**Settings**	
				Hex	**Dec**	**Default**	**User**
P8.11	Accumulative Motor Operation Time (minute)	0~1439	Read	080B	42060	~	~
P8.12	Accumulative Motor Operation Time (day)	0~65535	Read	080C	42061	~	~
P8.13	Keypad Communication Fault Treatment	0: Warn & Continue Operation 1: Warn & Ramp to Stop 2: Warn & Coast to Stop 3: No Warning & Continue Operation	R/W	080D	42062	2	
P8.14	Keypad Time Out	0.0~100.0 sec	R/W	080E	42063	1.0	~
P8.15	reserved	~	~	080F	42064	0	~
P8.16	reserved	~	~	0810	42065	0	~
P8.17	reserved	~	~	0811	42066	0	~
P8.18	reserved	~	~	0812	42067	0	~
P8.19	reserved	~	~	0813	42068	0	~
P8.20	PLC Buffer 1	0~65535	R/W	0814	42069	0	
P8.21	PLC Buffer 2	0~65535	R/W	0815	42070	0	
P8.22	PLC Buffer 3	0~65535	R/W	0816	42071	0	
P8.23	PLC Buffer 4	0~65535	R/W	0817	42072	0	
P8.24	PLC Buffer 5	0~65535	R/W	0818	42073	0	
P8.25	PLC Buffer 6	0~65535	R/W	0819	42074	0	
P8.26	PLC Buffer 7	0~65535	R/W	081A	42075	0	
P8.27	PLC Buffer 8	0~65535	R/W	081B	42076	0	
P8.28	PLC Buffer 9	0~65535	R/W	081C	42077	0	
P8.29	PLC Buffer 10	0~65535	R/W	081D	42078	0	
P8.30	PLC Buffer 11	0~65535	R/W	081E	42079	0	
P8.31	PLC Buffer 12	0~65535	R/W	081F	42080	0	
P8.32	PLC Buffer 13	0~65535	R/W	0820	42081	0	
P8.33	PLC Buffer 14	0~65535	R/W	0821	42082	0	
P8.34	PLC Buffer 15	0~65535	R/W	0822	42083	0	
P8.35	PLC Buffer 16	0~65535	R/W	0823	42084	0	
P8.36	PLC Buffer 17	0~65535	R/W	0824	42085	0	
P8.37	PLC Buffer 18	0~65535	R/W	0825	42086	0	
P8.38	PLC Buffer 19	0~65535	R/W	0826	42087	0	
P8.39	PLC Buffer 20	0~65535	R/W	0827	42088	0	

Serial Communication Parameters Summary (P9.xx)

For detailed information about the P9.xx parameter group, please refer to page 4–178.

GS4 Parameters Summary – Serial Communication Parameters (P9.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 P9.08.								
P9.00	VFD Comm Address	1 to 254		♦ R/W	0900	42305	1	
P9.01	Modbus Baud Rate	0: 4.8k 1: 9.6k 2: 19.2k	3: 38.4k 4: 57.6k 5: 115.2k	♦ R/W	0901	42306	1	
P9.02	Modbus Protocol	1: 7N2 (ASCII) 2: 7E1 (ASCII) 3: 7O1 (ASCII) 4: 7E2 (ASCII) 5: 7O2 (ASCII) 6: 8N1 (ASCII) 7: 8N2 (ASCII) 8: 8E1 (ASCII) 9: 8O1 (ASCII)	10: 8E2 (ASCII) 11: 8O2 (ASCII) 12: 8N1 (RTU) 13: 8N2 (RTU) 14: 8E1 (RTU) 15: 8O1 (RTU) 16: 8E2 (RTU) 17: 8O2 (RTU)	♦ R/W	0902	42307	12	
P9.03	Modbus Fault Select	0: Warn & Continue Operation 1: Warn & Ramp to Stop 2: Warn & Coast to Stop 3: No Warning & Continue Operation		♦ R/W	0903	42308	3	
P9.04	Modbus Time Out Detection	0: Disable 1: Enable		♦ R/W	0904	42309	0	
P9.05	Modbus Time Out Duration	0.1 to 100.0 seconds		♦ R/W	0905	42310	0.5	
P9.06	Parameter Copy	0: Disable Copy Keypad Function 1: Enable Copy Keypad Function		♦ R/W	0906	42311	0	
P9.07	Parameter Lock	0: Normal Operation (allow changes) 1: Prevent any Changes to Parameters		R/W	0907	42312	0	~
P9.08	***Restore to Default***	0: no function 1: Parameter Lock 2: no function 3: no function 4: no function 5: Reset kWh Display to Zero 6: Reset PLC (clear PLC) 7: no function 8: no function 9: Reset 50Hz Default 10: Reset 60Hz Default		R/W	0908	42313	0	
(table continued next page)								

GS4 Parameters Summary – Serial Communication Parameters (P9.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P9.09	Block Transfer Data Location 1	0~65535 * P9.09~P9.24 can be set in run mode if the corresponding Block Transfer Address Pointer (P9.69~P9.84) is pointing to a register that allows writes while in run mode.	* R/W	0909	42314	0	
P9.10	Block Transfer Data Location 2			090A	42315		
P9.11	Block Transfer Data Location 3			090B	42316		
P9.12	Block Transfer Data Location 4			090C	42317		
P9.13	Block Transfer Data Location 5			090D	42318		
P9.14	Block Transfer Data Location 6			090E	42319		
P9.15	Block Transfer Data Location 7			090F	42320		
P9.16	Block Transfer Data Location 8			0910	42321		
P9.17	Block Transfer Data Location 9			0911	42322		
P9.18	Block Transfer Data Location 10			0912	42323		
P9.19	Block Transfer Data Location 11			0913	42324		
P9.20	Block Transfer Data Location 12			0914	42325		
P9.21	Block Transfer Data Location 13			0915	42326		
P9.22	Block Transfer Data Location 14			0916	42327		
P9.23	Block Transfer Data Location 15			0917	42328		
P9.24	Block Transfer Data Location 16			0918	42329		
P9.25	reserved	n/a	n/a	0919	42330	n/a	
P9.26	RS485 Speed Reference	0.00~599.00 Hz	Read	091A	42331	60.00	~
P9.27	RS485 RUN Command	0: Stop 1: Run	♦ R/W	091B	42332	0	
P9.28	RS485 Direction Command	0: Forward 1: Reverse	♦ R/W	091C	42333	0	
P9.29	RS485 External Fault	0: No Fault 1: External Fault	♦ R/W	091D	42334	0	
P9.30	RS485 Fault Reset	0: No Action 1: Fault Reset	♦ R/W	091E	42335	0	
P9.31	RS485 JOG Command	0: Stop 1: Jog	♦ R/W	091F	42336	0	
P9.32	reserved	n/a	n/a	0920	42337	n/a	
P9.33	GS4 Drive Rated Amps	0.00~655.34A	Read	0921	42338	#.##	~
P9.34	PLC Command Mask (status only)	0~65535	Read	0922	42339	0	~
P9.35	Response Delay Time	0.0~200.0 ms	♦ R/W	0923	42340	2.0	
P9.36	reserved	n/a	n/a	0924	42341	n/a	
P9.37	PLC Address	1~254	R/W	0925	42342	2	
P9.38	Firmware Date Code	Format: yywwd • yy = year (2017 = 17) • ww = week (01~52) • d = day of week (1~7; Mon=1, Sun=7)	Read	0926	42343	#####	
P9.39	Firmware version	x.xx	Read	0927	42344	#.##	~
P9.40	reserved	n/a	n/a	0928	42345	n/a	
P9.41	GS Series Number	0~9	Read	0929	42346	4	

(table continued next page)

GS4 Parameters Summary – Serial Communication Parameters (P9.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P9.42	GS Model ID	00: GS4-21P0 (230V 1ph/3ph 1.0hp) 01: GS4-22P0 (230V 1ph/3ph 2.0hp) 02: GS4-23P0 (230V 1ph/3ph 3.0hp) 03: GS4-25P0 (230V 3ph 5.0hp) 04: GS4-27P5 (230V 3ph 7.5hp) 05: GS4-2010 (230V 3ph 10hp) 06: GS4-2015 (230V 3ph 15hp) 07: GS4-2020 (230V 3ph 20hp) 08: GS4-2025 (230V 3ph 25hp) 09: GS4-2030 (230V 3ph 30hp) 10: GS4-2040 (230V 3ph 40hp) 11: GS4-2050 (230V 3ph 50hp) 12: GS4-2060 (230V 3ph 60hp) 13: GS4-2075 (230V 3ph 75hp) 14: GS4-2100 (230V 3ph 100hp) 15: GS4-41P0 (460V 3ph 1.0hp) 16: GS4-42P0 (460V 3ph 2.0hp) 17: GS4-43P0 (460V 3ph 3.0hp) 18: GS4-45P0 (460V 3ph 5.0hp) 19: GS4-47P5 (460V 3ph 7.5hp) 20: GS4-4010 (460V 3ph 10hp) 21: GS4-4015 (460V 3ph 15hp) 22: GS4-4020 (460V 3ph 20hp) 23: GS4-4025 (460V 3ph 25hp) 24: GS4-4030 (460V 3ph 30hp) 25: GS4-4040 (460V 3ph 40hp) 26: GS4-4050 (460V 3ph 50hp) 27: GS4-4060 (460V 3ph 60hp) 28: GS4-4075 (460V 3ph 75hp) 29: GS4-4100 (460V 3ph 100hp) 30: GS4-4125 (460V 3ph 125hp) 31: GS4-4150 (460V 3ph 150hp) 32: GS4-4175 (460V 3ph 175hp) 33: GS4-4200 (460V 3ph 200hp) 34: GS4-4250 (460V 3ph 250hp) 35: GS4-4300 (460V 3ph 300hp)	Read	092A	42347	##	
P9.43	Ignore Comm Card Warning	0: Disable function (do NOT ignore) 1: Enable function (ignore warning)	1	092B	42348	1	
P9.44	Comm Card Type	0: No Communication Card 1: reserved 2: reserved 3: reserved 4: MODBUS-TCP Slave 5: EtherNet/IP Slave 6: reserved 7: reserved 8: reserved	Read	092C	42349	0	~
P9.45	Comm Card Version	0~65535	Read	092D	42350	0	~
P9.46	Comm Card Production Code	0~65535	Read	092E	42351	0	~
P9.47	Comm Card Fault Code	0~65535	Read	092F	42352	0	~
P9.48	Comm Card IP Configuration	0: Static IP 1: Dynamic IP (DHCP)	R/W	0930	42353	0	
P9.49	Comm Card IP Address Octet 1	0~255	R/W	0931	42354	0	
P9.50	Comm Card IP Address Octet 2	0~255	R/W	0932	42355	0	
P9.51	Comm Card IP Address Octet 3	0~255	R/W	0933	42356	0	
P9.52	Comm Card IP Address Octet 4	0~255	R/W	0934	42357	0	
P9.53	Comm Card Mask Octet 1	0~255	R/W	0935	42358	0	
P9.54	Comm Card Mask Octet 2	0~255	R/W	0936	42359	0	

(table continued next page)

GS4 Parameters Summary – Serial Communication Parameters (P9.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address Hex	Modbus Address Dec	Settings Default	Settings User
P9.55	Comm Card Mask Octet 3	0~255	R/W	0937	42360	0	
P9.56	Comm Card Mask Octet 4	0~255	R/W	0938	42361	0	
P9.57	Comm Card Gateway Octet 1	0~255	R/W	0939	42362	0	
P9.58	Comm Card Gateway Octet 2	0~255	R/W	093A	42363	0	
P9.59	Comm Card Gateway Octet 3	0~255	R/W	093B	42364	0	
P9.60	Comm Card Gateway Octet 4	0~255	R/W	093C	42365	0	
P9.61	reserved	~	~	093D	42366	0	~
P9.62	reserved	~	~	093E	42367	0	~
P9.63	Comm Card Factory Reset	0: No Action 1: Reset to the Factory Setting	R/W	093F	42368	0	
P9.64	Comm Card External Set	0, 2 Bit 0 = reserved Bit 1 = Write Ethernet Parameters to Comm Card Bit 2 = reserved	R/W	0940	42369	0	
P9.65	reserved	~	~	0941	42370	0	
P9.66	reserved	~	~	0942	42371	~	~
P9.67	reserved	~	~	0943	42372	~	~
P9.68	reserved	~	~	0944	42373	~	~
P9.69	Block Transfer Address Pointer 1	0~65535	♦ R/W	0945	42374	999	
P9.70	Block Transfer Address Pointer 2			0946	42375		
P9.71	Block Transfer Address Pointer 3			0947	42376		
P9.72	Block Transfer Address Pointer 4			0948	42377		
P9.73	Block Transfer Address Pointer 5			0949	42378		
P9.74	Block Transfer Address Pointer 6			094A	42379		
P9.75	Block Transfer Address Pointer 7			094B	42380		
P9.76	Block Transfer Address Pointer 8			094C	42381		
P9.77	Block Transfer Address Pointer 9			094D	42382		
P9.78	Block Transfer Address Pointer 10			094E	42383		
P9.79	Block Transfer Address Pointer 11			094F	42384		
P9.80	Block Transfer Address Pointer 12			0950	42385		
P9.81	Block Transfer Address Pointer 13			0951	42386		
P9.82	Block Transfer Address Pointer 14			0952	42387		
P9.83	Block Transfer Address Pointer 15			0953	42388		
P9.84	Block Transfer Address Pointer 16			0954	42389		
P9.85	PLC Frequency Command Force to 0	0~1h Bit 0 = 1: Before PLC scan, set up PLC Target Frequency = 0	R/W	0955	42390	0	
P9.86	COMM1 Protocol (via RS-485)	0: Modbus 1: BACnet	Read	0956	42391	0	
P9.87	BACnet Address	0~127	R/W	0957	42392	10	
P9.88	BACnet Baud Rate	9.6~76.8 Kbps	R/W	0958	42393	38.4	
P9.89	BACnet Device Instance Low Word	0~65535	R/W	0959	42394	10	
P9.90	BACnet Device Instance High Byte	0~63	R/W	095A	42395	0	
P9.91	BACnet Max Polling Address	0~127	R/W	095B	42396	127	
P9.92	BACnet Password	0~65535	R/W	095C	42397	0	
P9.93	Ethernet 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	
P9.94	Ethernet Comm Card Time Out Detection	0: Disable 1: Enable	♦ R/W	095E	42399	0	

(table continued next page)

GS4 Parameters Summary – Serial Communication Parameters (P9.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P9.95	Ethernet Comm Card Time Out Duration	0.1 to 100.0 seconds	♦ R/W	095F	42400	0.5	
P9.96	reserved	~	~	095F	42401	~	~
P9.97	reserved	~	~	0960	42402	~	~
P9.98	reserved	~	~	0961	42403	~	~
P9.99	reserved	~	~	0962	42404	~	~

Pump Parameters Summary (P10.xx)

For detailed information about the P10.xx parameter group, please refer to page 4–190.

GS4 Parameters Summary – Pump Parameters (P10.xx)							
Parameter		Range	Run1) Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default2)	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 P9.08.							
P10.00	Circulative Control	0: no function 1: Time Circulation 2: Quantity Cycle 3: Quantity Control 4: Time Circulation + Quantity Cycle 5: Time Circulation + Quantity Control	R/W	0A00	42561	0	
P10.01	Number of Connected Motors	1~8	R/W	0A01	42562	1	
P10.02	Desired Run Time of Each Motor in Minutes	0~65500 min	R/W	0A02	42563	0	
P10.03	Motor Switch Delay Time During Increasing Demand	0.0~3600.0 sec	R/W	0A03	42564	1.0	
P10.04	Motor Switch Delay Time During Decreasing Demand	0.0~3600.0 sec	R/W	0A04	42565	1.0	
P10.05	Aux Motor Switch Delay Time During Fix Amount Circulation in Seconds	0.0~3600.0 sec	♦ R/W	0A05	42566	10.0	
P10.06	Aux Motor Switch Frequency During Fix Amount Circulation in Hz	0.00~599.00 Hz	♦ R/W	0A06	42567	60.00	
P10.07	Circulative Control Malfunction Action	0: Turn Off All Aux 1: Keep Aux Running	R/W	0A07	42568	0	
P10.08	AUX Motor Stop Frequency	0.00~599.00 Hz	♦ R/W	0A08	42569	0	

Fault Parameters Summary (P11.xx)

For detailed information about the P11.xx parameter group, please refer to page 4–203.

GS4 Parameters Summary – Fault 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 P9.08.*							
P11.00	Fault Output Option 1	0: No Error 1~65535: (refer to Fault bit code)	♦R/W	0B00	42817	0	
P11.01	Fault Output Option 2		♦R/W	0B01	42818	0	
P11.02	Fault Output Option 3		♦R/W	0B02	42819	0	
P11.03	Fault Output Option 4		♦R/W	0B03	42820	0	
(table continued next page)							

GS4 Parameters Summary – Fault Parameters (P11.xx) – (continued)									
Parameter		***Range***		***Run Read/ Write***	***Modbus Address***		***Settings***		
					Hex	***Dec***	***Default***	***User***	
P11.04	First Fault Record	0: No Error 1: Overcurrent during Accel (ocA) 2: Overcurrent during Decel (ocd) 3: Overcurrent during normal speed (ocn) 4: Ground Fault (GFF) 5: IGBT short circuit (occ) 6: Overcurrent during Stop (ocS) 7: Overvoltage during Accel (ovA) 8: Overvoltage during Decel (ovd) 9: Overvoltage during normal speed (ovn) 10: Overvoltage during Stop (ovS) 11: Low voltage during Accel (LvA) 12: Low voltage during Decel (Lvd) 13: Low voltage during normal speed (Lvn) 14: Low voltage during Stop (LvS) 15: Output ripple / Input phase loss (OrP) 16: IGBT Overheat 1 (oH1) 17: Cap Overheat 2 (oH2) 18: Thermister 1 open (tH1o) 19: Thermister 2 open (tH2o) 20: Power Reset Off (PWR) 21: Overload (oL) (150% 1Min, Inverter) 22: Motor1 Thermal Overload (EoL1) 23: Motor2 Thermal Overload (EoL2) 24: Motor Overheat-PTC (oH3) 25: reserved 26: Over Torque 1 (ot1) 27: Over Torque 2 (ot2) 28: Under current (uc) 29: reserved 30: EEPROM write error (cF1) 31: EEPROM read error (cF2) 32: reserved 33: U phase current sensor detection error (cd1) 34: V phase current sensor detection error (cd2) 35: W phase current sensor detection error (cd3) 36: CC Hardware Logic error 0 (Hd0) 37: OC Hardware Logic error 1 (Hd1) 38: OV Hardware Logic error 2 (Hd2)	39: OCC Hardware Logic error 3 (Hd3) 40: Motor auto tune error (AuE) 41: PID Feedback loss (AFE) 42~47: reserved 48: Analog input signal loss (ACE) 49: External Fault (EF) 50: Emergency Stop (EF1) 51: Base Block (bb) 52: Password Error (Pcod) 53: Software Code lock (ccod) 54: PC Command error (CE1) 55: PC Address error (CE2) 56: PC Data error (CE3) 57: PC Slave error (CE4) 58: PC Communication Time Out (CE10) 59: PC Keypad Time out (CP10) 60: Braking Transistor Fault (bf) 61: Y-Delta connection Error (ydc) 62: Decel Energy Backup Error (dEb) 63: Over Slip Error (oSL) 64: Electromagnet switch error (ryF) 65~71: reserved 72: STO Loss1 (STL1) STO1~SCM1 internal hardware detect error 73: ES1 Emergency Stop (S1) 74: In Fire Mode (Fire) 75: reserved 76: Safety Torque Off function active (STO) 77: STO Loss2 (STL2) STO2~SCM2 internal hardware detect error 78: STO Loss3 (STL3) – STO1~SCM1 and STO2~SCM2 internal hardware detect errors 79: U Phase Short (Uoc) 80: V Phase Short (Voc) 81: W Phase Short (Woc) 82: U Phase Loss (UPHL) 83: V Phase Loss (VPHL) 84: W Phase Loss (WPHL) 85~89: reserved 90: PLC Force Stop (FStp) 91~96: reserved 97: Ethernet Card Timeout (CD10) 98: reserved 99: CPU Command error (TRAP) 100~110: reserved 111: InrCom Time Out (ictE)	Read	0B04	42821	0		
P11.05	Second Most Recent Fault Record			Read	0B05	42822	0		
P11.06	Third Most Recent Fault Record			Read	0B06	42823	0		
P11.07	Fourth Most Recent Fault Record			Read	0B07	42824	0		
P11.08	Fifth Most Recent Fault Record			Read	0B08	42825	0		
P11.09	Sixth Most Recent Fault Record			Read	0B09	42826	0		

(table continued next page)

GS4 Parameters Summary – Fault Parameters (P11.xx) – (continued)							
Parameter		Range	Run Read/ Write	Modbus Address		Settings	
				Hex	Dec	Default	User
P11.10	Operating Time of Present Fault Record (Day)	0~65535 day	Read	0B0A	42827	0	
P11.11	Operating Time of Present Fault Record (Minute)	0~1439 min	Read	0B0B	42828	0	
P11.12	Operating Time of Second Most Recent Fault Record (Day)	0~65535 day	Read	0B0C	42829	0	
P11.13	Operating Time of Second Most Recent Fault Record (Minute)	0~1439 min	Read	0B0D	42830	0	
P11.14	Operating Time of Third Most Recent Fault Record (Day)	0~65535 day	Read	0B0E	42831	0	
P11.15	Operating Time of Third Most Recent Fault Record (Minute)	0~1439 min	Read	0B0F	42832	0	
P11.16	Operating Time of Fourth Most Recent Fault Record (Day)	0~65535 day	Read	0B10	42833	0	
P11.17	Operating Time of Fourth Most Recent Fault Record (Minute)	0~1439 min	Read	0B11	42834	0	
P11.18	Frequency Command at Fault	0.00~655.35 Hz	Read	0B12	42835	0	
P11.19	Output Frequency at Fault	0.00~655.35 Hz	Read	0B13	42836	0	
P11.20	Output Voltage at Fault	0.0~6553.5V	Read	0B14	42837	0	
P11.21	DC Bus Voltage at Fault	0.0~6553.5V	Read	0B15	42838	0	
P11.22	Output Current at Fault	0.00~655.35A	Read	0B16	42839	0	
P11.23	IGBT Temperature at Fault	-3276.7 to 3276.7 °C	Read	0B17	42840	0	
P11.24	HeatSink Temperature at Fault	-3276.7 to 3276.7 °C	Read	0B18	42841	0	
P11.25	RPM of Motor at Fault	-32767 to 32767 rpm	Read	0B19	42842	0	
P11.26	Digital Input Status at Fault	0~65535	Read	0B1A	42843	0	
P11.27	Digital Output Status at Fault	0~65535	Read	0B1B	42844	0	
P11.28	Drive Status at Fault	0~65535	Read	0B1C	42845	0	

DURAPULSE GS4 PARAMETER DETAILS

EXPLANATION OF PARAMETER DETAILS FORMAT

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

Where:

- Px.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 P9.08.)

GROUP P0.XX DETAILS – MOTOR PARAMETERS

		Type	Hex Addr	Dec Addr
P0.00	**Motor 1 Maximum Output Voltage**	R/W	0000	40001
	Range/Units (Format: 16-bit unsigned)	Default		
	230V: 0.0~255.0V 460V: 0.0~510.0V	GS4-2xxx: 230.0 GS4-4xxx: 460.0		

This parameter determines the Maximum Output Voltage of the GS4 drive. The Maximum Output Voltage setting must be less than or equal to the rated voltage of the motor as indicated on the motor nameplate.

		Type	Hex Addr	Dec Addr
P0.01	**Motor 1 Rated Current**	R/W	0001	40002
	Range/Units (Format: 16-bit unsigned)	Default		
	10~120% drive rated Amps	90% rated current of GS4		

Set the value of this parameter according to the full load amperage rating (FLA) of the motor as indicated on the motor nameplate. The Default setting is 90% of the GS4 drive (Variable Torque) rated current. Motor 1 Rated Current is used in the GS4 drive as the threshold for motor overload calculations, when Motor 1 is the selected motor.

Example:

- *The rated output current for the GS4-47P5 drive is 12A. The default setting will be 10.8A, which is 90% of the GS4 drive VT current rating.*
- *The range of the parameter is 10% to 120% of the GS4 VT current rating.*
  (12 x 10% = 1.2A and 12 x 120% = 14.4A).

		Type	Hex Addr	Dec Addr
P0.02	***Motor 1 Base Frequency***	R/W	0002	40003
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz (Format: 16-bit unsigned)	60.00		

The value of this parameter should be set according to the base frequency of the motor as indicated on the motor nameplate. The output Volts per Hertz ratio is established by the Motor 1 Maximum Output Voltage (P0.00) divided by the Motor 1 Base Frequency (P0.02).

		Type	Hex Addr	Dec Addr
P0.03	***Motor 1 Rated RPM***	♦R/W	0003	40004
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0 to (120 x P0.02/P0.09)-1 (Format: 16-bit unsigned)	1710 (60Hz 4-pole) 1410 (50Hz 4-pole)		

Set the rated speed (rpm) of the motor according to the value indicated on the motor nameplate.
For a given motor pole setting (P0.09), Motor 1 Rated RPM (P0.03) can only be decreased from the motor Base RPM defined by “Base RPM = (120 x Freq/# of Poles)-1.”
(Pole setting is P0.09 for Motor 1 or P0.18 for Motor 2)

- *The # of poles must be adjusted down **before** you can increase the value in P0.03.*
- *Rated RPM must be adjusted down **before** you can increase number of poles.*

		Type	Hex Addr	Dec Addr
P0.04	***Drive Maximum Output Frequency***	R/W	0004	40005
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V: 0–599.00 Hz (0–400.00 Hz for models > 75hp) 460V: 0–599.00 Hz (0–400.00 Hz for models > 125hp) (Format: 16-bit unsigned)	50.00/60.00		

This parameter determines the GS4 drive Maximum Output Frequency, which is used to set the desired maximum for the specific application. All of the GS4 drive frequency command sources (analog inputs 0 to +10V, 4 to 20mA, 0 to 20mA, and ±10V) are scaled to correspond to the output frequency range.

WARNING: The Maximum Output Frequency parameter (P0.04) should never exceed the maximum rpm rating for the motor you are using. If this information is not readily available, consult your motor manufacturer.

- *This value cannot be set lower than Motor 1 Rated RPM (P0.03).*
- *This parameter, along with P0.02 and P0.03, determines the Maximum Output Frequency of the GS4 Drive. The Maximum Output Frequency can be calculated as follows:*
  Motor1 Max Out Freq [P0.04] =
  (Mtr Max RPM [from motor nameplate]) / (Mtr1 Rated RPM [P0.03]) x (Mtr1 Base Freq [P0.02])
- *If an output limit based on maximum output speed is desired, use the following equation to determine the corresponding value for Motor Maximum RPM:*
  Motor1 Max RPM =
  (Mtr1 Max Out Freq [P0.04]) / (Mtr1 Base Freq [P0.02]) x (Mtr1 Rated RPM [P0.03])

		Type	*Hex Addr*	*Dec Addr*
P0.05	***Motor Auto Tune***	R/W	0005	40006

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

0: Disable
1: Measure motor in dynamic status (motor spinning)
2: Measure motor in static status (motor not spinning)

Measured values will be written to (P0.06: Motor 1 Rs and P0.07: Motor 1 No-Load Current for motor #1) or (P0.15: Motor 2 Rs and P0.16: Motor 2 No-Load Current for motor #2) automatically by the GS4 drive.

NOTE: When auto-tuning 2 motors, the user needs to set a multi-function input terminal to setting 14 for motor selection or change P0.10 for motor 1/motor 2 selection.

NOTE: The rated speed (P0.03) can't be larger than or equal to 120xF/P; [where F = rated frequency P0.02 or P0.13; P = number of motor poles P0.09 or P0.18].

Auto-Tuning (Dynamic):

1) *Make sure that the motor wiring is correct.*
2) *Make sure that you can start and stop the drive (e.g. using the Run key if in Local Mode, or with digital inputs if using terminals), and that an E-stop is wired.*
3) *Make sure that the parameter values in the table below are correct:*

Parameter	***Motor 1***	***Motor 2***
Maximum Output Voltage	P0.00	P0.11
Motor Rated Current	P0.01	P0.12
Motor Base Frequency	P0.02	P0.13
Motor Rated RPM	P0.03	P0.14
Motor Rated Horsepower	P0.08	P0.17
Motor Pole Numbers	P0.09	P0.18

4) *Before dynamic auto-tuning, make sure the motor output shaft is not connected to a load. If the motor cannot be separated from the load, static auto-tuning (P0.05=2) is recommended.*
5) *Set P0.05=1 to select dynamic auto-tuning. Trigger the Run command; either keypad <RUN> or external terminals depending on how you have P3.00 and P3.01 configured.*
WARNING: Within a few seconds, the motor shaft will begin to turn. An "Auto Tuning" warning will begin to flash on the keypad display, and will continue until auto tuning is complete. If the motor has to be stopped during Auto Tuning, an "Auto Tune Error" will be generated. To restart Auto Tuning, clear the error and restart this procedure again.
6) *When auto-tuning is complete, P0.05 will default back to 0, and Motor1 parameters (P0.06 and P0.07) and/or Motor2 parameters (P0.15 and P0.16) will be written to the drive.*

If the motor is statically auto-tuned (P0.05=2), the GS4 drive will NOT measure no-load current. It is the responsibility of the user to obtain the motor no-load current value and manually enter the value in P0.07 for Motor1 and P0.16 for Motor2. Motor no-load current may be available on the motor nameplate or in the motor manufacturer's performance specifications.

		Type	*Hex Addr*	*Dec Addr*
P0.06	***Motor 1 Resistance***	R/W	0006	40007

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

0~65.535Ω

Motor Auto Detection (P0.05) will set this parameter value. Before using Motor Auto Detection, set P0.10 to Motor 1. Motor 1 Rs (P0.06) value may be entered manually. If this information is not on the motor nameplate, consult the manufacturer specifications.
Note: Motor 1 Resistance is stator resistance.

		Type	Hex Addr	Dec Addr
P0.07	***Motor 1 No-Load Current***	R/W	0007	40008
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~100% motor rated Amps	40% of P0.01 Motor 1 Rated Current		

The setting of the Motor No-Load current will affect slip compensation. The value entered must be less than or equal to Motor 1 Rated Current (P0.01). Motor Auto Detection (P0.05) will also set this parameter value. Before using Motor Auto Detection, set P0.10 to Motor 1.

		Type	Hex Addr	Dec Addr
P0.08	***Motor 1 Rated Horsepower (HP)***	♦R/W	0008	40009
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~655.35 hp	rated hp of GS4		

Used to set rated horsepower of motor 1.

Set the value of this parameter according to the horsepower rating on the motor nameplate.

		Type	Hex Addr	Dec Addr
P0.09	***Motor 1 Pole No.***	R/W	0009	40010
	Range/Units (Format: 16-bit unsigned)	*Default*		
	2 to (120 x P0.02/P0.03)	4		

Used to set the number of motor poles (must be an even number).

For a given Motor 1 Rated RPM (P0.03) value, Motor 1 Pole Number (P0.09) can only be decreased from the # of poles defined by "# of Poles = (120 x Freq/Base RPM)." The Motor 1 Rated RPM (P0.03) value must be adjusted to a lower speed before the pole count can be adjusted up.

- *The # of poles must be adjusted down* ***before*** *you can increase the value in P0.03.*
- *Rated RPM must be adjusted down* ***before*** *you can increase number of poles.*

Motor Synchronous Speed (RPM)	900	1200	1800	3600
Number of Motor Poles (#)	8	6	4	2

		Type	Hex Addr	Dec Addr
P0.10	***Motor 1 or 2 Selection***	R/W	000A	40011
	Range/Units (Format: 16-bit binary)	*Default*		
	1: Motor 1 2: Motor 2	1		

Selects the motor that is driven by the GS4 drive. Selecting Motor 1 will apply parameters P0.00~P0.04, P0.06~P0.09 to the drive. Selecting Motor 2 will apply parameters P0.04, P0.11~P0.18 to the drive.

		Type	Hex Addr	Dec Addr
P0.11	***Motor 2 Maximum Output Voltage***	R/W	000B	40012
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V: 0.0~255.0V 460V: 0.0~510.0V	GS4-2xxx: 230.00 GS4-4xxx: 460.00		

This parameter determines the Maximum Output Voltage of the GS4 drive. The Maximum Output Voltage setting must be less than or equal to the rated voltage of the motor as indicated on the motor nameplate.

		Type	Hex Addr	Dec Addr
P0.12	***Motor 2 Rated Current***	R/W	000C	40013
	Range/Units (Format: 16-bit unsigned)	*Default*		
	10~120% drive rated Amps	90% rated current of GS4		

Set the value of this parameter according to the full load amperage rating (FLA) of the motor as indicated on the motor nameplate. The Default setting is 90% of the GS4 drive (Variable Torque) rated current. Motor 2 Rated Current is used in the GS4 drive as the threshold for motor overload calculations, when Motor 2 is the selected motor.

Example:

- *The rated output current for the GS4-47P5 drive is 12A, and the default setting is 10.8A, which is 90% of the GS4 drive VT current rating.*
- *The range of the parameter is 10% to 120% of the GS4 VT current rating. (12 x 10% = 1.2A and 12 x 120% = 14.4A).*

		Type	Hex Addr	Dec Addr
P0.13	***Motor 2 Base Frequency***	R/W	000D	40014
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	60.00/50.00		

The value of this parameter should be set according to the base frequency of the motor as indicated on the motor nameplate. The output Volts per Hertz ratio is established by the Motor 2 Maximum Output Voltage (P0.11) divided by the Motor 2 Base Frequency (P0.13).

		Type	Hex Addr	Dec Addr
P0.14	***Motor 2 Rated RPM***	♦R/W	000E	40015
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0 to [(120 x P0.13/P0.18)-1] rpm	1710 (60Hz 4-pole) 1410 (50Hz 4-pole)		

Sets the rated speed (rpm) of the motor according to the value indicated on the motor nameplate.
For a given motor pole setting (P0.18), Motor 2 Rated RPM (P0.14) can only be decreased from the motor Base RPM defined by “Base RPM = (120 x Freq/# of Poles)-1.”
(Pole setting is P0.09 for Motor 1 or P0.18 for Motor 2)

- *The # of poles must be adjusted down* ***before*** *you can increase the value in P0.14.*
- *Rated RPM must be adjusted down* ***before*** *you can increase number of poles.*

		Type	Hex Addr	Dec Addr
P0.15	***Motor 2 Resistance***	R/W	000F	40016
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~65.535Ω	0		

Motor Auto Detection (P0.05) will set this parameter value. Before using Motor Auto Detection, set P0.10 to Motor 2. Motor 2 Rs (P0.15) value may be entered manually. If this information is not on the motor nameplate, consult the manufacturer specifications.
Note: Motor 2 Resistance is stator resistance.

		Type	Hex Addr	Dec Addr
P0.16	***Motor 2 No-Load Current***	R/W	0010	40017
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~100% motor rated Amps	40% of P0.12 Motor 2 Rated Current		

The setting of the Motor No-Load current will affect slip compensation. The value entered must be less than or equal to Motor 2 Rated Current (P0.12). Motor Auto Detection (P0.05) will also set this parameter value. Before using Motor Auto Detection, set P0.10 to Motor 2.

		Type	Hex Addr	Dec Addr
P0.17	***Motor 2 Rated Horsepower (HP)***	♦R/W	0011	40018
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~655.35 hp	rated hp of GS4		

Used to set rated horsepower of Motor 2.

Set the value of this parameter according to the horsepower rating on the motor nameplate.

		Type	Hex Addr	Dec Addr
P0.18	***Motor 2 Pole No.***	R/W	0012	40019
	Range/Units (Format: 16-bit unsigned)	*Default*		
	2 to (120 x P0.13/P0.14)	4		

Used to set the number of motor poles (must be an even number).

For a given Motor 2 Rated RPM (P0.14) value, Motor 2 Pole Number (P0.18) can only be decreased from the # of poles defined by "# of Poles = (120 x Freq/Base RPM)." The Motor 2 Rated RPM (P0.14) value must be adjusted to a lower speed before the pole count can be adjusted up.

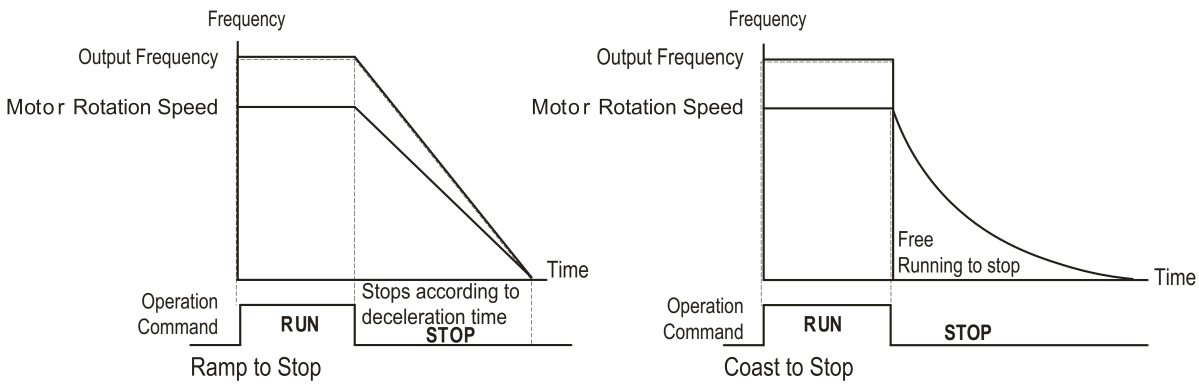
- *The # of poles must be adjusted down **before** you can increase the value in P0.14.*
- *Rated RPM must be adjusted down **before** you can increase number of poles.*

Motor Synchronous Speed (RPM)	900	1200	1800	3600
Number of Motor Poles (#)	8	6	4	2

Group P1.xx Details – Ramps Parameters

		Type	Hex Addr	Dec Addr
P1.00	**Stop Method**	♦R/W	0100	40257
	Range/Units (Format: 16-bit binary)	Default		
	0: Ramp to stop 1: Coast to stop	0		

This parameter determines how the motor is stopped when the GS4 drive receives a valid stop command.



Ramp to stop: The GS4 drive decelerates by the time setting of Deceleration Time to 0 or Minimum Output Frequency (P2.08) and will then stop. The ramp rate is set by Maximum Output Frequency (P0.04) and the currently selected Deceleration Time (P1.02, P1.04, P1.06, or P1.08).

- *Example 1: Maximum Frequency = 60Hz, Motor is running at 60Hz, and Deceleration Time is set for 10s. The motor will ramp to stop in 10s. If the motor is running at 30Hz, the motor will ramp to stop in 5s.*
- *Example 2: Maximum Frequency is set to 120Hz, the motor is running at 60Hz, and the Decel Time is set for 10s. The motor will ramp to stop in 5s.*

When stopping high inertia loads in ramp-to-stop method, it may be necessary to add a braking resistor.

Coast to stop: The GS4 drive stops the output instantly upon a STOP command, and the motor coasts to a complete stop.

- *We recommend using "ramp to stop" for safety of personnel or to prevent material from being wasted in applications where the motor has to stop after the drive is stopped. The deceleration time has to be set accordingly.*
- *If the motor free running is allowed or the load inertia is large, we recommend to selecting "coast to stop." For example: blowers, punching machines, and pumps.*

		Type	Hex Addr	Dec Addr
P1.01	***Acceleration Time 1***	♦R/W	0101	40258
P1.02	***Deceleration Time 1***	♦R/W	0102	40259

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

P1.15=0: 0.00~600.00 sec — 10.00
P1.15=1: 0.0~6000.0 sec

The Acceleration Time determines the length of time required for the GS4 drive to ramp from 0.0Hz to the Drive Maximum Output Frequency (P0.04).

The Deceleration Time determines the length of time required for an GS4 drive to decrease from the Drive Maximum Output Frequency (P0.04) to 0.00Hz.

The Acceleration/Deceleration Time is invalid when P6.13 Auto Adjustable Acceleration/ Deceleration is set to Auto.

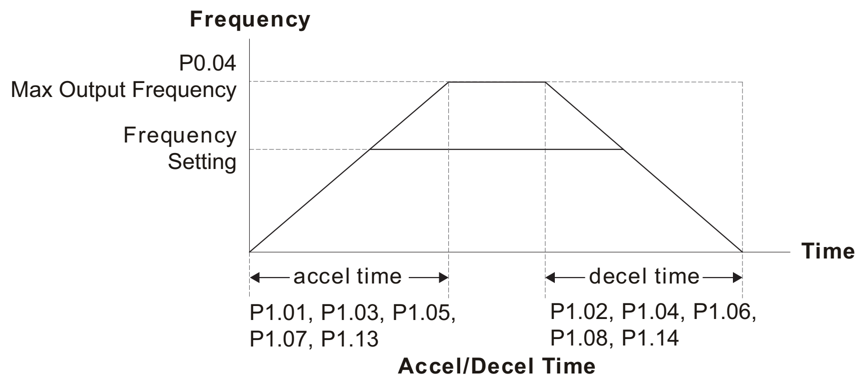
The Acceleration/Deceleration Times 1, 2, 3, 4 are selected according to the Multi-Function Input Terminals settings (P3.03~P3.16 = 8 and 9). The factory settings are Accel/Decel Time 1. These are also used if no Digital Inputs are assigned as Acceleration/Deceleration selection.

When enabling torque limits and stalls prevention function, actual Accel/Decel Times may be longer than the action time set up above.

Please note that the drive may cause motor damage or may trigger protection functions (P6.20 Over-current Stall Prevention during Acceleration or P6.27 Over-voltage Stall Prevention) when the Accel/Decel Times are too short, which can cause higher than desired currents.

When enabling P1.09~P1.12 (S-curve settings), the actual Accel/Decel Times will be longer than the setting of P1.01~P1.08.

Use a suitable brake resistor (see Chapter 06 Accessories) to decelerate in a short time and prevent over-voltage.



SEE ALSO P1.16 ACCEL/DECEL TRANSITION METHOD (page 4–41) TO USE MULTIPLE ACCELS/DECELS IN THE SAME RAMP.

		Type	Hex Addr	Dec Addr
P1.03	***Acceleration Time 2***	♦R/W	0103	40260
P1.04	***Deceleration Time 2***	♦R/W	0104	40261
P1.05	***Acceleration Time 3***	♦R/W	0105	40262
P1.06	***Deceleration Time 3***	♦R/W	0106	40263
P1.07	***Acceleration Time 4***	♦R/W	0107	40264
P1.08	***Deceleration Time 4***	♦R/W	0108	40265

Range/Units (Format: 16-bit unsigned)	Default
P1.15=0: 0.00~600.00 sec	10.00
P1.15=1: 0.0~6000.0 sec	

Parameters P1.03, P1.05, and P1.07 allow additional Acceleration Time settings which operate the same way as does Acceleration Time 1, P1.01 (page 4–37).

Parameters P1.04, P1.06, and P1.08 allow additional Deceleration Time settings which operate the same way as does Deceleration Time 1, P1.02 (page 4–37).

See also P3.03~P3.16 Multi-Function Input Terminal Function Settings 8 and 9 (page 4–63) to select the different Acceleration and Deceleration Times.

		Type	Hex Addr	Dec Addr
P1.09	***S-Curve Accel Time 1***	♦R/W	0109	40266
P1.10	***S-Curve Decel Time 1***	♦R/W	010A	40267
P1.11	***S-Curve Accel Time 2***	♦R/W	010B	40268
P1.12	***S-Curve Decel Time 2***	♦R/W	010C	40269

Range/Units (Format: 16-bit unsigned)	*Default*
P1.15=0: 0.00~25.00 sec P1.15=1: 0.0~250.0 sec	0.20

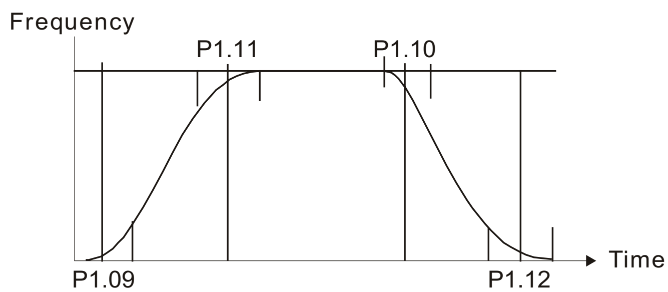
Parameters P1.09 and P1.10 work in conjunction with P1.11 and P1.12 to provide smooth transitions (S-Curve) when accelerating or decelerating. Expressed in seconds; Accel and Decel S-Curves are enabled by entering non-zero values in the s-curve parameters. When enabled, s-curve will lengthen accel and decel times.

Accel and Decel S-Curves are disabled by entering ZERO in the respective parameters. It is recommended to keep a non-zero value in these S-Curve parameters. Frequency transitions (acceleration or deceleration) are much smoother when S-Curve is enabled.

As shown in the illustration P1.09 (S-Curve Accel Time 1) defines the Acceleration S-Curve at the *bottom* of the acceleration ramp, while P1.11 (S-Curve Accel Time 2) defines the Acceleration S-Curve at the *top* of the ramp. The Deceleration S-Curve parameters P1.10 and P1.12 (S-Curve Decel Time 1 and S-Curve Decel Time 2) work the same way for deceleration, with P1.10 defining the Deceleration S-Curve at the *top* of the deceleration ramp and P1.12 at the *bottom* of the ramp.

Acceleration and Deceleration S-Curves defined by these parameters apply to *all* accel and decel times, regardless of selection.

- *Formula for Actual Acceleration Time:*
  Actual Acceleration Time = (Accel Time) + (S-Curve Accel Time)/2
  Actual Acceleration Time = (P1.01 or P1.03 or P1.05 or P1.07) + (P1.09 + P1.11 / 2)
  [This formula is an approximation. Actual motor Accel will vary depending on load.]
- *Formula for Actual Deceleration Time:*
  Actual Deceleration Time = (Decel Time) + (S-Curve Decel Time)/2
  Actual Deceleration Time = (P1.02 or P1.04 or P1.06 or P1.08) + (P1.10 + P1.12 / 2)
  [This formula is an approximation. Actual motor Decel will vary depending on load.]



		Type	Hex Addr	Dec Addr
P1.13	***Jog Acceleration Time***	♦R/W	010D	40270
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P1.15=0: 0.00~600.00 sec P1.15=1: 0.0~6000.0 sec	10.00		

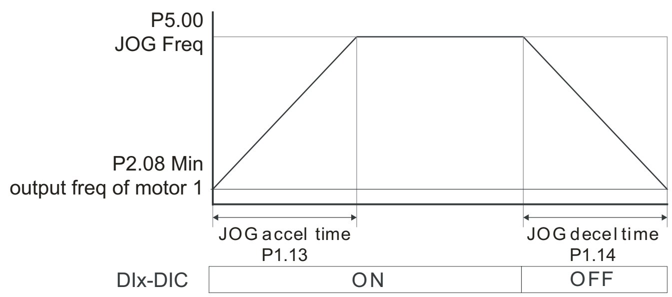
		Type	Hex Addr	Dec Addr
P1.14	***Jog Deceleration Time***	♦R/W	010E	40271
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P1.15=0: 0.00~600.00 sec P1.15=1: 0.0~6000.0 sec	10.00		

Parameters P1.13 and P1.14 set the Acceleration and Deceleration times used for jogging motors.

P1.13 sets the time to accelerate from 0.0Hz to the JOG Frequency (P5.00).

P1.14 sets the time to decelerate from the JOG Frequency (P5.00) to 0.0Hz.

NOTE: Jog Acceleration and Deceleration parameters define the time to accelerate the GS4 drive from zero speed to Jog speed, or to decelerate the GS4 drive from Jog speed to zero speed.
These Jog Acceleration parameters should not be confused with the running Acceleration and Deceleration parameters 1 thru 4.



		Type	Hex Addr	Dec Addr
P1.15	***Time Unit for Accel/Decel & S-curve***	R/W	010F	40272
	Range/Units (Format: 16-bit binary)	*Default*		
	0: unit 0.01sec 1: unit 0.1sec	1		

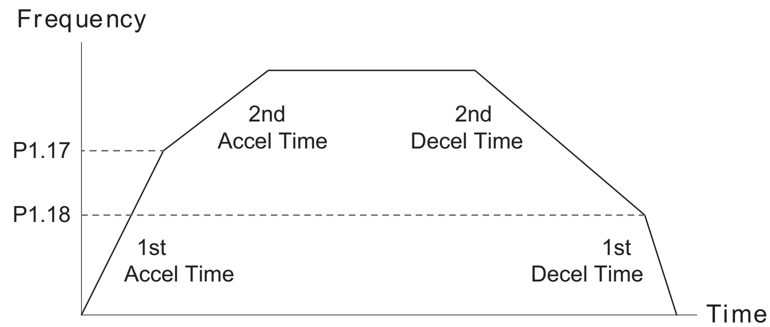
Changing this value does not change the scaling of values previously entered into the various acceleration and times P1.01~P1.14. (If P1.15=0 and P1.01=3.21 seconds, changing P1.15=1 will truncate the last digit; P1.01 will now = 3.2 seconds.)

		Type	Hex Addr	Dec Addr
P1.16	***Accel/Decel Transition Method***	♦R/W	0110	40273
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Transition according to Digital Input Terminals (Two Multi-Function Inputs (P3.03~P3.16) set to 8 and 9) (Four different accel/decel ramps can be selected using P1.01~P1.08) 1: Transition according to Transition Frequencies P1.17 and P1.18 (Only accel/decel ramps one and two (P1.01~P1.04) are used)	0		

This parameter selects whether the Acceleration/Deceleration will be changed mid-ramp by changing the digital inputs, or if the Acceleration/Deceleration changes at Transition frequencies (P1.17 and P1.18).

If using Transition Frequencies, acceleration starts at Acceleration Time 1 and transitions to Acceleration Time 2; deceleration begins with Deceleration Time 2 and transitions to Deceleration Time 1.

S-Curve Time settings are also in effect and will smooth the transition from one rate to the another.



Auto Accel/Decel Switching when P1.16 = 1

If using P1.16=1 (Transition Frequencies), do not set any Mult-Function Inputs to #8 or #9 (Accel/Decel selection by Input terminals). The inputs can overwrite the Transition Frequencies.

		Type	Hex Addr	Dec Addr
P1.17	***Accel Transition Frequency 1-2***	♦R/W	0111	40274
P1.18	***Decel Transition Frequency 1-2***	♦R/W	0112	40275
P1.17 and P1.18	*Range/Units (Format: 16-bit unsigned)*	*Default*		
	0.00~599.00 Hz	0.00		

These parameters set the frequency at which the acceleration ramp transitions automatically from Accel Time 1 (P1.01) to Accel Time 2 (P1.03), and the frequency to transition from Decel Time 2 (P1.04) to Decel Time 1 (P1.02).

- *These parameters are active only if Accel/Decel Transition Method (P1.16) is set to 1.*
- *Acceleration Time 1 (P1.01) is the first Accel Time used. Once the frequency set in P1.17 is reached, Acceleration Time 2 (P1.03) is used until commanded speed is achieved.*
- *Deceleration Time 2 (P1.04) is the first Decel Time used. Once the frequency set in P1.18 is reached, Deceleration Time 1 (P1.02) is used until a full stop is achieved.*

Refer to P1.16 (Accel/Decel Transition Method, page 4–41) for more information for parameters P1.17 and P1.18.

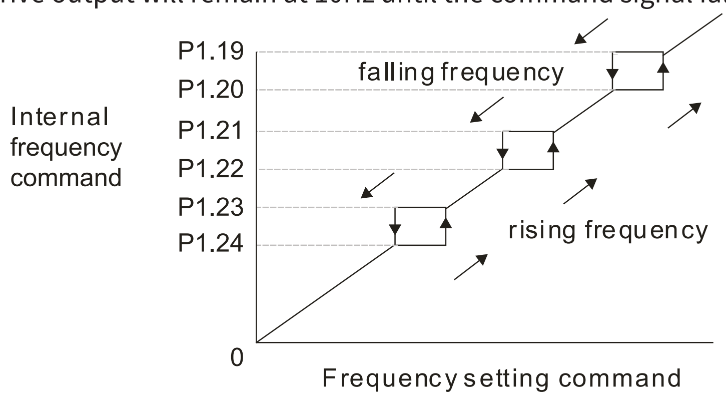
		Type	Hex Addr	Dec Addr
P1.19	***Skip Frequency 1 Upper Limit***	R/W	0113	40276
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	0		

		Type	Hex Addr	Dec Addr
P1.20	***Skip Frequency 1 Lower Limit***	R/W	0114	40277
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	0		

These parameters (P1.19~P1.24) are used to set skip frequency zones for the GS4 drive, but the frequency output is continuous. These skip frequencies are useful when a motor has vibration at specific frequency bandwidths. The vibration can be avoided by skipping these frequencies, and the GS4 offers three Skip Frequency zones for this purpose.

- *The limits (other than 0.0) of these three zones are parameters P1.19 ≥ P1.20 ≥ P1.21 ≥ P1.22 ≥ P1.23 ≥ P1.24.*
- *Do not overlap Skip Frequencies.*
- *An individual skip frequency will be ignored when both Upper and Lower Limit are set to 0.0 (i.e., Skip Frequencies 1 and 3 can be active, even if Skip Frequency 2 limits are set to 0.0).*
- *The commanded frequency for the drive can be set within the range of these Skip Frequency Upper and Lower Limits. At this moment, the actual output frequency of the drive will be limited by the Skip Frequency Limit settings.*
- *When accelerating/decelerating, the output frequency will still pass through the range of skip frequencies according to Accel and Decel Times.*
- *These values can only be set when the drive is not in RUN.*

Example: Set P1.19 = 10Hz. Set P1.20 = 5Hz. When following an analog input command, the drive's output frequency will not follow the input command between 5Hz and 10Hz. When accelerating, the drive output will remain at 5Hz until the command increases above 10Hz. When decelerating, the drive output will remain at 10Hz until the command signal falls below 5Hz.



		Type	Hex Addr	Dec Addr
P1.21	**Skip Frequency 2 Upper Limit**	R/W	0115	40278

		Type	Hex Addr	Dec Addr
P1.22	**Skip Frequency 2 Lower Limit**	R/W	0116	40279

		Type	Hex Addr	Dec Addr
P1.23	**Skip Frequency 3 Upper Limit**	R/W	0117	40280

		Type	Hex Addr	Dec Addr
P1.24	**Skip Frequency 3 Lower Limit**	R/W	0118	40281

P1.21 thru P1.24	Range/Units (Format: 16-bit unsigned)	Default
	0.00~599.00 Hz	0

These parameters allow additional Skip Frequency Upper Limit and Lower Limit settings.

The Skip Frequency Upper Limit parameters operate the same way as does Skip Frequency Upper Limit 1, P1.19 (page 4–42).

The Skip Frequency Lower Limit parameters operate the same way as does Skip Frequency Lower Limit 1, P1.20 (page 4–42).

		Type	Hex Addr	Dec Addr
P1.25	**DC Injection Current Level**	♦R/W	0119	40282
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~100%	0.00		

This parameter sets the level of DC Brake Current output to the motor during start-up and stopping. When setting DC Injection Current Level percentage, the drive Rated Current is regarded as 100%. It is recommended to start with a low DC Brake Current Level and then increase until proper holding torque has been attained.

		Type	Hex Addr	Dec Addr
P1.26	**DC Injection Time During Start-up**	♦R/W	011A	40283
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~60.0 sec	0		

DC Brake at Start-up is used for loads that may move before the GS4 drive starts, such as fans and pumps. Under such circumstances, DC Brake can be used to hold the load in position before setting it in motion.

When the drive doesn’t have any output, the motor may be in the rotation status due to external force or its inertia. If the drive is used with the motor at this moment, it may cause motor damage or drive protection due to over current. This parameter can be used to output DC current before motor operation to stop the motor and get a stable start. This parameter determines the duration of the DC Brake current after a RUN command. When P1.26 is set to 0.0, DC Injection is not used during start-up.

Example: P1.26 is set to 3 (and there is a non-zero value in P1.25). When the drive is given a RUN command, the DC output (P1.25) will be applied for 3 seconds, then the normal acceleration ramp will begin.

Related parameters: P1.25 DC Injection Current Level; P3.51 Brake Delay Time, Multi-Function Output = #12 or #42.

		Type	Hex Addr	Dec Addr
P1.27	***DC Injection Time During Stopping***	♦R/W	011B	40284
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~60.0 sec	0		

DC injection braking at stop is used to shorten stopping time and also to hold a stopped load in position, such as a crane or cutting machine.

Due to external force or motor inertia, the motor may continue to rotate after a drive stop command. The GS4 drive can output DC current to force the motor to stop. When P1.27 is set to 0.0, DC injection braking is not used when stopping.

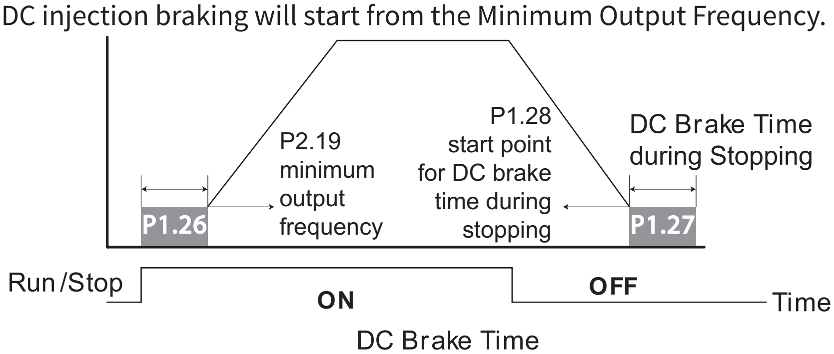
This parameter determines the duration of the DC injection braking current during stopping.

- *The DC Injection function is active when P1.00 (Stop Method) is set to 0 (Ramp to Stop).*
- *The DC Injection function is inactive when P1.00 (Stop Method) is set to 1 (Coast to Stop).*

Related parameters: P1.00 Stop Method; P1.28 Start-point for DC Brake; P3.51 Brake Delay Time, Multi Function Output = #12 or #42.

		Type	Hex Addr	Dec Addr
P1.28	***Start-Point for DC Injection During Stopping***	♦R/W	011C	40285
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	0		

This parameter determines the frequency when DC injection braking will begin during deceleration. When this setting is less than Minimum Output Frequency (P2.08 or P2.15), the start-point for DC injection braking will start from the Minimum Output Frequency.



		Type	Hex Addr	Dec Addr
P1.29	***Deceleration Method***	R/W	011D	40286
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Normal Ramp Deceleration 1: OverFluxing Deceleration 2: Traction Energy Control	0		

Setting 0: Normal Ramp Deceleration

Deceleration or stop will occur according to the deceleration method determined by the settings of P1.00, P1.02, P1.04, P1.06, or P1.08.

Setting 1: OverFluxing Deceleration

The drive will control the deceleration time according to the Over-Voltage Stall Prevention Level (P6.27) setting value and DC BUS voltage.

- *If the DC BUS > 95% of P6.27 Over-Voltage Stall Prevention setting value, the drive will enable Over Fluxing Deceleration method only if P6.11=0 ((Enable Over-Voltage Stall Prevention).*
- *If the Over-Voltage Stall Prevention P6.11=0, the drive will enable Over Fluxing Deceleration method according to the operating voltage and DC BUS regenerative voltage. This method will use the Deceleration Time setting (P 1.02 or P1.04 or P1.06 or P1.08). The actual deceleration time will take longer than the deceleration time setting because of the Over-Voltage Stall Prevention function.*
- *When P1.29=1, use the parameter Over-Voltage Stall Prevention P6.12=1 to get a better over voltage suppression effect during deceleration.*

Setting 2: Traction Energy Control

This function is based on the ability of the drive to auto-adjust output frequency and voltage in order to get faster DC BUS energy consumption, and the actual deceleration time will be as consistent as possible with the deceleration parameter set-up time. If the real deceleration time is longer than the programmed deceleration time (this can cause over-voltage faults), use P1.29=2 to attempt to shorten the deceleration time.

Note – Comparison of Settings 1 & 2:

P1.29=1 (OverFluxing) limits deceleration by monitoring the DC bus level. This method is smoother than Traction Energy Control.

P1.29=2 (TEC) will attempt to prevent an OV (Over-Voltage) fault with faster deceleration and higher current. TEC controls limits decel by monitoring current (limiting output to Rated Current).

Please also see note at P6.12 (Over-Voltage Stall Prevention).

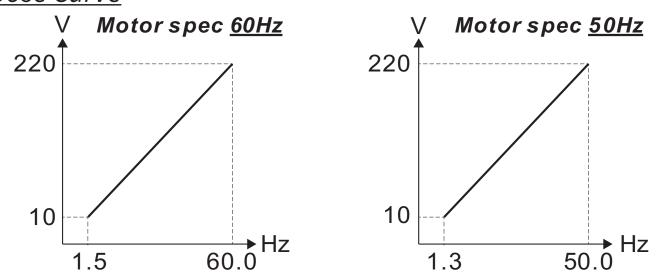
Group P2.xx Details – V/Hz Parameters

		Type	Hex Addr	Dec Addr
P2.00	**Volts/Hertz Settings**	R/W	0200	40513
	Range/Units (Format: 16-bit binary)	Default		
	0: General Purpose 1: High Starting Torque (TQR) 2: Fans and Pumps 3: Custom 4: 1.5 Power Curve 5: Squared Curve	0		

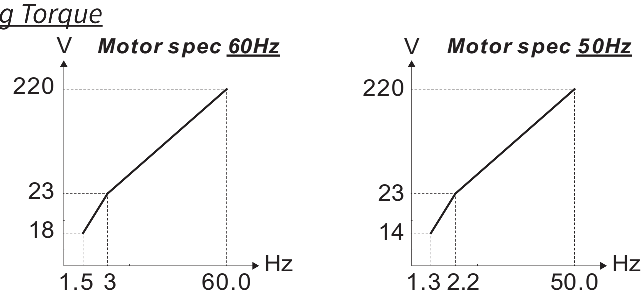
Common setting of V/Hz curve.

- *When setting to 1 or 2, the 2nd and the 3rd voltage frequency setting are invalid.*
- *If a motor load is a variable torque load (the torque is in direct proportion to the speed, such as the load of a fan or a pump), the drive will decrease input voltage to reduce flux loss and iron loss of the motor at low speed with low load torque to raise the overall efficiency.*
- *When setting the higher power V/Hz curves (selection #4 or #5), low frequency torque will be even lower than General Purpose. Therefore it is not suitable for fast acceleration/deceleration. It is recommended NOT to apply this parameter for any fast acceleration/deceleration.*

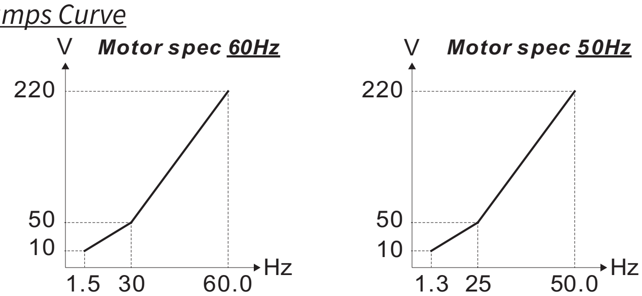
Setting 0: General Pupose Curve



Setting 1: High Starting Torque



Setting 2: Fans and Pumps Curve



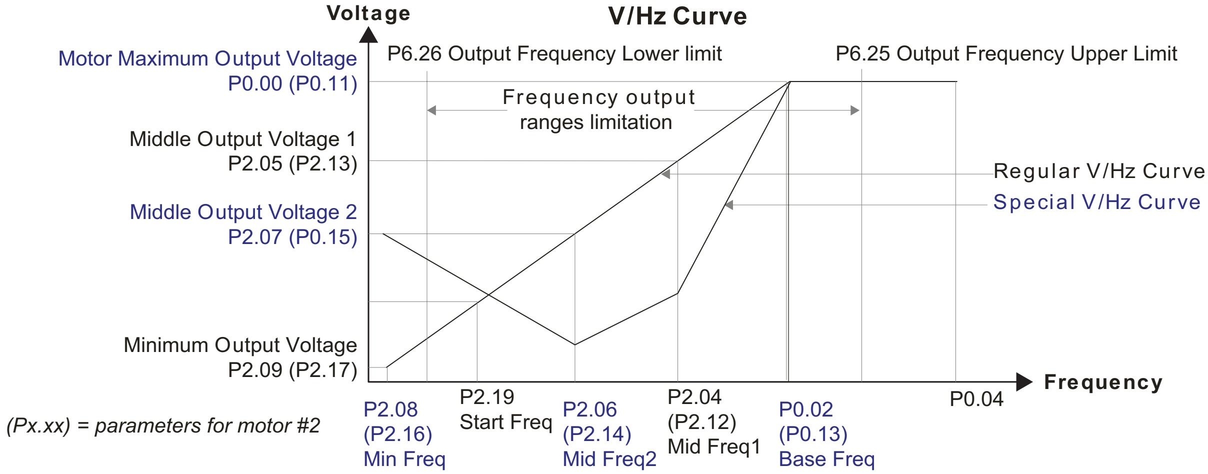
Setting 3: Custom

The setting of a custom V/Hz curve usually follows the load characteristics of a motor. If the workload exceeds a motor's capacity, pay attention to its heat dissipation, dynamic balance, and bearing lubrication.

Custom V/Hz curves are used when "General Purpose," "High Starting Torque," or "Fan and Pump" curves do not deliver the voltage required for the application.

If the voltage setting at low frequency is set to too high a value, it can cause motor insulation or coil damage through motor overheating, cause a motor stall prevention event, and/or contribute to over current protection faults. Care must be given to the determination of this parameter's value to best protect the motor and provide the best application experience.

The V/Hz curve of Motor 1 is shown below. The V/Hz Curve of Motor 2 will be similar, using comparable parameters for Motor 2 as shown in ().



NOTE: P2.04~P2.09 and P2.12~17 are used only when the V/Hz parameter (P2.00) is set to 03.

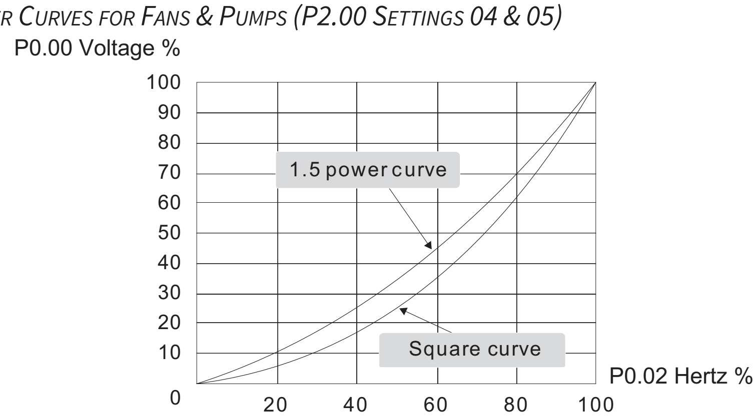
Setting 4: 1.5 Power Curve

- $V_{out} = [(P0.00\text{-}P2.09) \times ([(F_x\text{-}P2.08)/(P0.00\text{-}P2.09)]^3)^{0.5}] + P2.09$
- *Where: V_{out} is GS4 drive output voltage; F_x is GS4 drive output frequency*
- *Refer to "Energy Saving Power Curves for Fans & Pumps" V/Hz curve below Setting 05.*

Setting 5: Square Curve

- $V_{out} = [(P0.00\text{-}P2.09) \times ([(F_x\text{-}P2.08)/(P0.00\text{-}P2.09)]^2)] + P2.09$
- *Where: V_{out} is GS4 drive output voltage; F_x is GS4 drive output frequency*
- *Refer to "Energy Saving Power Curves for Fans & Pumps" V/Hz curve below.*

Energy Saving Power Curves for Fans & Pumps (P2.00 Settings 04 & 05)



		Type	Hex Addr	Dec Addr
P2.01	***Slip Compensation Gain***	♦R/W	0201	40514
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00 to 10.00	V/Hz mode: 0.00 Vector mode: 1.00		

P2.01 sets the compensation frequency in order to reduce slip and increase drive accuracy when the motor is running at loads approaching the motor's rated current. When drive output current is larger than the motor's No-Load Current (P0.07 or P0.16), drive output frequency will be compensated by this parameter (P2.01).

- *The induction motor needs constant slip to produce torque. It can be ignored at higher motor speeds, such as rated speed or 2-3% slip.*
- *In operation at variable frequency, slip and the synchronous frequency will be in reverse proportion to produce the same torque. That is, slip will increase with the reduction in synchronous frequency. The motor may stop when/if synchronous frequency is decreased to a specific value. Therefore, slip greatly affects the accuracy of the motor speed at low speed.*

When the Control Mode (P2.11) is changed from V/Hz mode to Sensorless Vector mode, this parameter will automatically be set to 1.00. Otherwise, it will be set to 0.00. Please set the compensation of slip after setting overload and acceleration. The compensation value should be increased from small to large gradually. That is to add the output frequency with motor rated slip X P2.01 Slip Compensation Gain when the motor is at rated load. If the actual speed ratio is slower than expectation, please increase the setting. Otherwise, decrease the setting.

		Type	Hex Addr	Dec Addr
P2.02	***Torque Compensation Gain***	♦R/W	0202	40515
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0 to 10	0		

- *When motor load is large, a part of drive output voltage is lost due to the resistance of the stator winding. This causes insufficient voltage and results in increased drive output current and insufficient motor torque. The drive can auto adjust output voltage for the load and keep the air gap magnetic fields stable to get the optimal operation.*
- *In V/Hz control, drive output voltage is decreased in direct proportion to decreasing output frequency, resulting in decreased torque at lower speeds. Therefore, the auto Torque Compensation function will increase drive output voltage at lower output frequencies to achieve higher starting torque.*
- *When P2.02 is set too large, it may cause motor overflux and result in too large output current, motor overheat, or trigger protection functions.*

		Type	Hex Addr	Dec Addr
P2.03	***Torque Compensation Filter***	♦R/W	0203	40516
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.001 to 10.000 (sec)	0.500		

Longer filter times provide stable control, but with delayed response. Shorter filter times provide for quick response, but control may be unstable.

		Type	Hex Addr	Dec Addr
P2.04	***Motor 1 Middle Output Frequency 1***	R/W	0204	40517
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz • P2.04 value cannot be greater than the value in P0.02, Motor 1 Base Frequency. • P2.04 value cannot be less than the value in P2.08, Motor 1 Minimum Output Frequency.	3.00		

		Type	Hex Addr	Dec Addr
P2.05	***Motor 1 Middle Output Voltage 1***	♦R/W	0205	40518
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V: 0.0~240.0V 460V: 0.0~480.0V	230V: GS4-21P0~27P5: 15.0V; GS4-2010+: 14.0V 460V: GS4-41P0~47P5: 30V; GS4-4010+: 28.0V		

		Type	Hex Addr	Dec Addr
P2.06	***Motor 1 Middle Output Frequency 2***	R/W	0206	40519
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz • P2.06 value cannot be greater than the value in P2.04, Motor 1 Middle Output Frequency 1. • P2.06 value cannot be less than the value in P2.08, Motor 1 Minimum Output Frequency.	3.00		

		Type	Hex Addr	Dec Addr
P2.07	***Motor 1 Middle Output Voltage 2***	♦R/W	0207	40520
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V: 0.0~240.0V 460V: 0.0~480.0V	230V: GS4-21P0~27P5: 15.0V; GS4-2010+: 14.0V 460V: GS4-41P0~47P5: 30V; GS4-4010+: 28.0V		

		Type	Hex Addr	Dec Addr
P2.08	***Motor 1 Minimum Output Frequency***	R/W	0208	40521
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.99Hz • P2.08 value cannot be greater than or equal to the value in P2.06, Motor 1 Middle Output Frequency 2.	1.50		

		Type	Hex Addr	Dec Addr
P2.09	***Motor 1 Minimum Output Voltage***	♦R/W	0209	40522
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V: 0.0~240.0V 460V: 0.0~480.0V	230V: GS4-21P0~27P5: 9.0V; GS4-2010+: 7.0V 460V: GS4-41P0~47P5: 18.0V; GS4-4010+: 14.0V		

Parameters P2.04~P2.09 are used to establish the V/Hz curve of Motor 1, and are used only with “Custom” V/Hz parameter settings; when P2.00 is set to 03.

Refer to P2.00 (Volts/Hertz Settings, page 4–46) for operational information for parameters P2.04~P2.09.

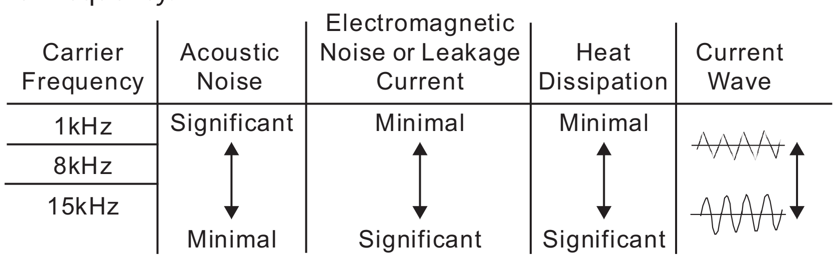
		Type	Hex Addr	Dec Addr
P2.10	***PWM Carrier Frequency***	R/W	020A	40523
	Range/Units (Format: 16-bit unsigned)	Default		
	2~15 kHz	model specific; refer to table below		

Model-Specific PWM Carrier Frequency Defaults				
230V/3Ø Drive		*Supplied 3Ø/230V Variable Torque*	*Supplied 3Ø/230V Constant Torque*	*Supplied 1Ø/230V Constant Torque*
Frame	*Model GS4-*			
A	21P0, 22P0, 23P0, 25P0	8kHz	2kHz	12 kHz
B	27P5, 2010, 2015			
C	2020, 2025			
	2030	6kHz		
D	2040, 2050			
E	2060, 2075, 2100	4kHz		
460V/3Ø Drive		*Supplied 3Ø/460V Variable Torque*	*Supplied 3Ø/460V Constant Torque*	*N/A*
Frame	*Model GS4-*			
A	41P0, 42P0, 43P0, 45P0, 47P5	8kHz	2kHz	n/a
B	4010, 4015, 4020			
C	4025, 4030, 4040	6kHz		
D0	4050, 4060			
D	4075			
	4100	4kHz		
E	4125, 4150			
F	4175, 4200			
G	4250, 4300			

This parameter determines the PWM carrier frequency of the GS4 drive.

- *When carrier frequency is higher than the factory setting, reference parameter P6.33 Drive Derating Method for frequency derating of the GS4 drive.*
- *When P6.34 (VT/CT Duty Selection) is set, it can change this parameter (P2.10).*
- *P6.00/P6.02 (Electronic Thermal O/L Relay) must be set independently.*

As shown in the diagram below, the PWM carrier frequency has a significant influence on electromagnetic noise, GS4 drive heat dissipation, and motor acoustic noise. Therefore, if surrounding ambient noise is greater than motor noise, then lowering the carrier frequency will help to reduce temperature rise in the motor. Although motor noise is reduced at the higher carrier frequencies, the entire wiring and interference resistance should be considered before choosing a higher frequency.

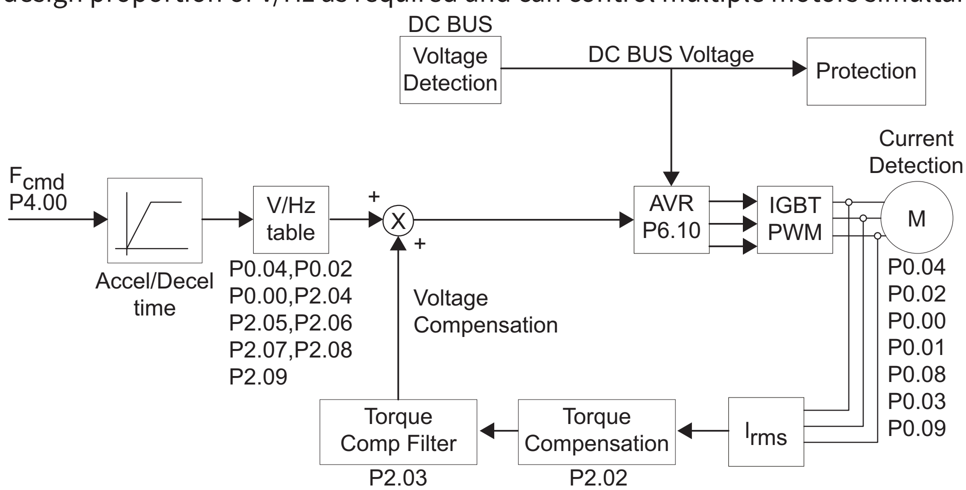


		Type	Hex Addr	Dec Addr
P2.11	**Control Mode**	♦R/W	020B	40524
	Range/Units (Format: 16-bit binary)	*Default*		
	0: V/Hz Open Loop Control	0		
	1: SVC Sensorless Vector			

This parameter determines the control method of the GS4 drive:

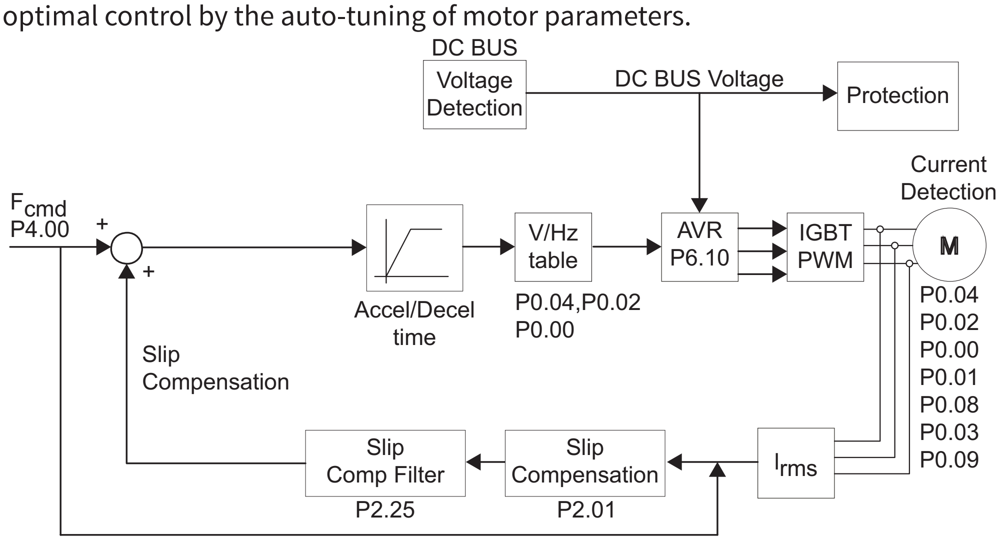
Setting 0: V/Hz open loop control

User can design proportion of V/Hz as required and can control multiple motors simultaneously.



Setting 1: SVC Sensorless Vector

Get the optimal control by the auto-tuning of motor parameters.



		Type	Hex Addr	Dec Addr
P2.12	***Motor 2 Middle Output Frequency 1***	R/W	020C	40525
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	3.00		

		Type	Hex Addr	Dec Addr
P2.13	***Motor 2 Middle Output Voltage 1***	♦R/W	020D	40526
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V: 0.0~240.0V 460V: 0.0~480.0V	230V: GS4-21P0~27P5: 15.0V; GS4-2010+: 14.0V 460V: GS4-41P0~47P5: 30V; GS4-4010+: 28.0V		

		Type	Hex Addr	Dec Addr
P2.14	***Motor 2 Middle Output Frequency 2***	R/W	020E	40527
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	3.00		

		Type	Hex Addr	Dec Addr
P2.15	***Motor 2 Middle Output Voltage 2***	♦R/W	020F	40528
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V: 0.0~240.0V 460V: 0.0~480.0V	230V: GS4-21P0~27P5: 15.0V; GS4-2010+: 14.0V 460V: GS4-41P0~47P5: 30V; GS4-4010+: 28.0V		

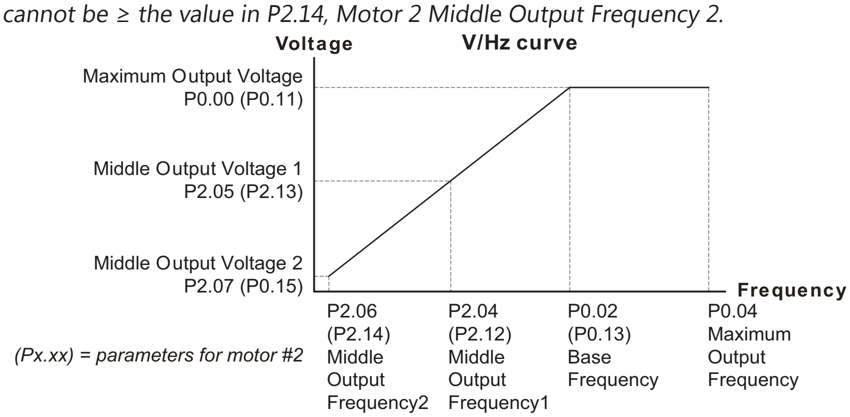
		Type	Hex Addr	Dec Addr
P2.16	***Motor 2 Minimum Output Frequency***	R/W	0210	40529
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.99 Hz	1.50		

		Type	Hex Addr	Dec Addr
P2.17	***Motor 2 Minimum Output Voltage***	♦R/W	0211	40530
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V: 0.0~240.0V 460V: 0.0~480.0V	230V: GS4-21P0~27P5: 9.0V; GS4-2010+: 7.0V 460V: GS4-41P0~47P5: 18.0V; GS4-4010+: 14.0V		

Parameters P0.11, P0.13, and P2.12~ P2.17 are used to establish the V/Hz curve of Motor 2. When multi-function input terminals P3.04~P3.10 and P3.11~P3.16 (expansion card) are set to 14, and enabled, then the drive will operate by following V/Hz curve of Motor 2.

P2.12~P2.17 are used only with "Custom" V/Hz parameter settings; when P2.00 is set to 03.

- *P2.12 value cannot be > the value in P0.13, Motor 2 Base Frequency.*
- *P2.12 & P2.14 value cannot be < the value in P2.16, Motor 2 Minimum Output Frequency.*
- *P2.14 value cannot be > the value in P0.13, Motor 2 Base Frequency.*
- *P2.16 value cannot be ≥ the value in P2.14, Motor 2 Middle Output Frequency 2.*



Refer to P2.00 (Volts/Hertz Settings, page 4–46) for operational information for parameters P2.12~P2.17.

		Type	Hex Addr	Dec Addr
P2.18	***Zero Speed Select***	R/W	0212	40531
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Standby 1: Zero Hold 2: Min Hz Output	0		

When the output frequency is less than Motor Minimum Output Frequency (P2.08, P2.16), the GS4 drive will operate by this parameter.

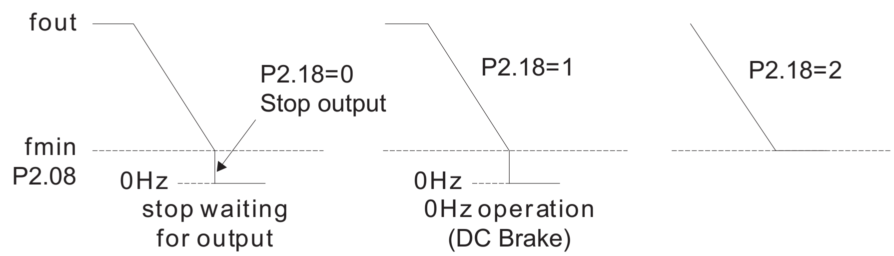
When P2.18 is set to 0, the GS4 drive will be in waiting mode with no voltage output from terminals U/V/W.

When P2.18 is set to 1, the GS4 drive will execute DC brake by Motor Minimum Output Voltage (P2.09, P2.17) in V/Hz and SVC modes.

When P2.18 is set to 2, the GS4 drive will run by Motor Minimum Output Frequency (P2.08, P2.16) and Motor Minimum Output Voltage (P2.09, P2.17) in V/Hz and Sensorless Vector modes.

When P2.18 is set to 2, and if the setting of P6.26 (Output Frequency Lower Limit) is higher than Motor Minimum Output Frequency, then the GS4 drive will run in accordance with the setting of P6.26 in V/Hz and SVC mode.

In V/Hz and SVC modes:



		Type	Hex Addr	Dec Addr
P2.19	***Start Frequency***	R/W	0213	40532
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	0.50		

When start frequency is higher than the minimum output frequency, GS4 drive output will be from start frequency to the setting frequency. Please refer to the following diagram for details.

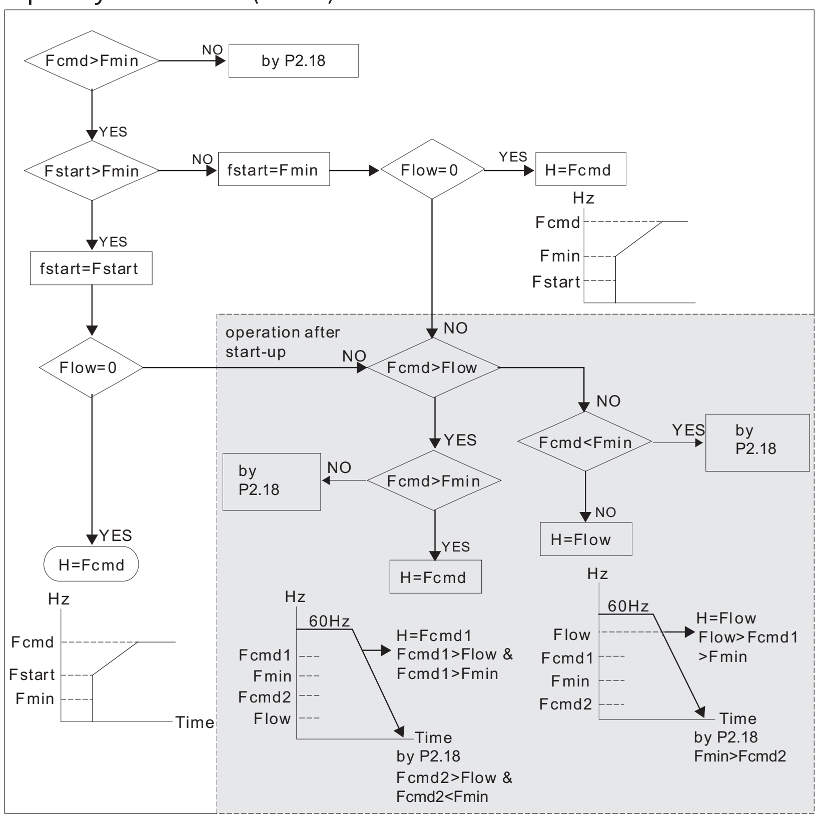
F_{cmd} = frequency command

F_{start} = start frequency (P2.19)

f_{start} = actual start frequency of drive

F_{min} = 4th output frequency setting (P2.08/P2.16)

F_{low} = output frequency lower limit (P6.26)



		Type	Hex Addr	Dec Addr
P2.20	***Y-D Switching Frequency***	♦R/W	0214	40533
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	60.00		

		Type	Hex Addr	Dec Addr
P2.21	***Y-D Switching Enable***	R/W	0215	40534
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Enable	0		

		Type	Hex Addr	Dec Addr
P2.22	***Delay Time for Y-D Switching***	♦R/W	0216	40535
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000~600.000 sec	0.200		

Explanations for parameters P2.20~P2.22:

P2.20~P2.22 are applied with wye-delta (or star-delta) motors where the drive will control the switching of Y-connection/Δ-connection as required. This method reduces voltage by changing the motor phase connections such that the winding is wye-connected for starting. This connection puts less than line voltage on each phase, which softens the start. After starting, the motor phase connections are changed to a delta configuration, which allows for phase voltage equal to line voltage while running. Effectively, the voltage is reduced by a factor of 1.732 during wye starting. The impedance seen by the power system is 3 times the impedance of the delta run connection.

Three-lead motors are not capable of being controlled via wye-start and delta (star)-run. *Six-lead*, *9-lead*, and *12-lead* motors can typically be run in wye-delta. Check your motor documentation to be sure.

P2.21 is used to enable/disable Y-connection/Δ-connection switch.

When P2.21 is set to 1, the drive will select by P2.20 setting and current motor frequency to switch motor to Y-connection or Δ-connection. At the same time, it will also affect motor parameters.

P2.22 is used to set the delay time at the start of any Y or Delta transition. Delay time affects the following:

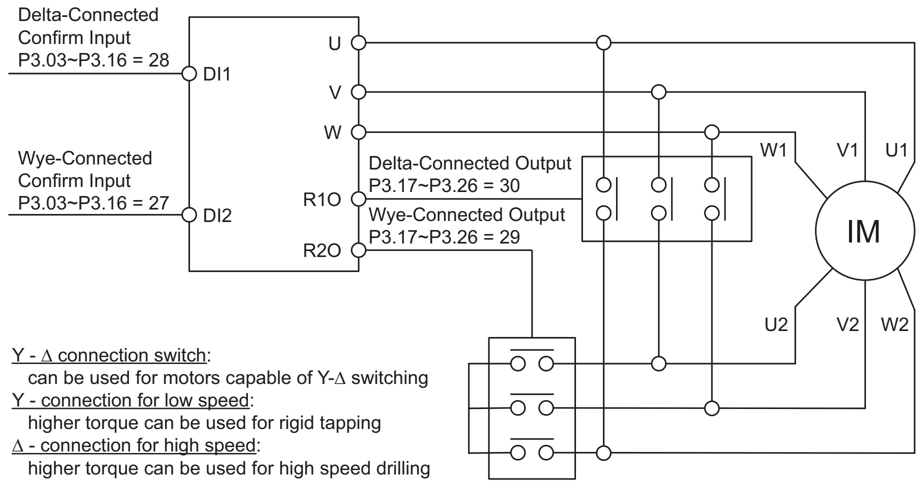
- *Error time between Run command given and Y-connected confirmation.*
- *Coast time and Error time between Δ-connected output on and Δ-connected confirmation on acceleration.*
- *Coast time and Error time between Y-connected output on and Y-connected confirmation on deceleration.*

When the drive's output frequency reaches the P2.20 Y-connection/Δ-connection switch frequency, the drive will delay by P2.22 before multi-function output terminals are active.

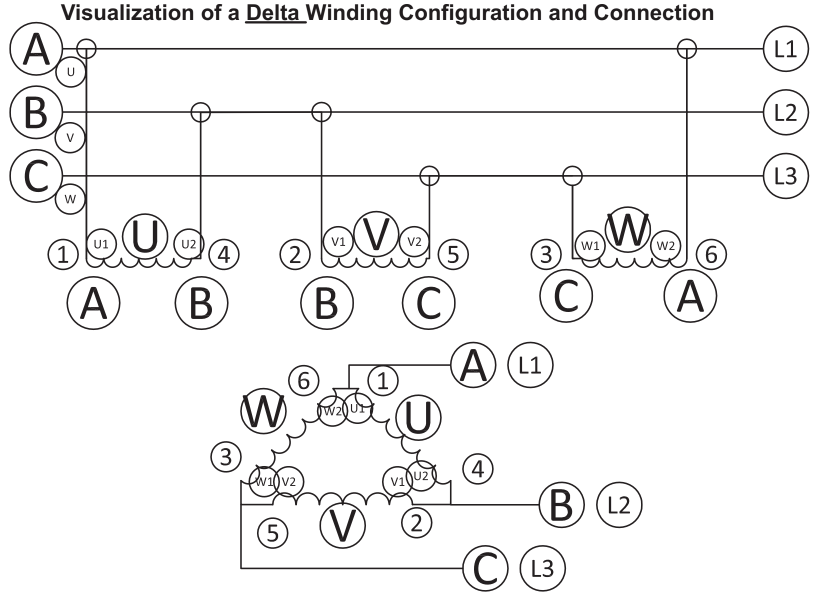
The use of Y-Δ will require the use of two Digital Inputs and two Digital Outputs.

Refer to the following Wiring Diagram and Timing Charts:

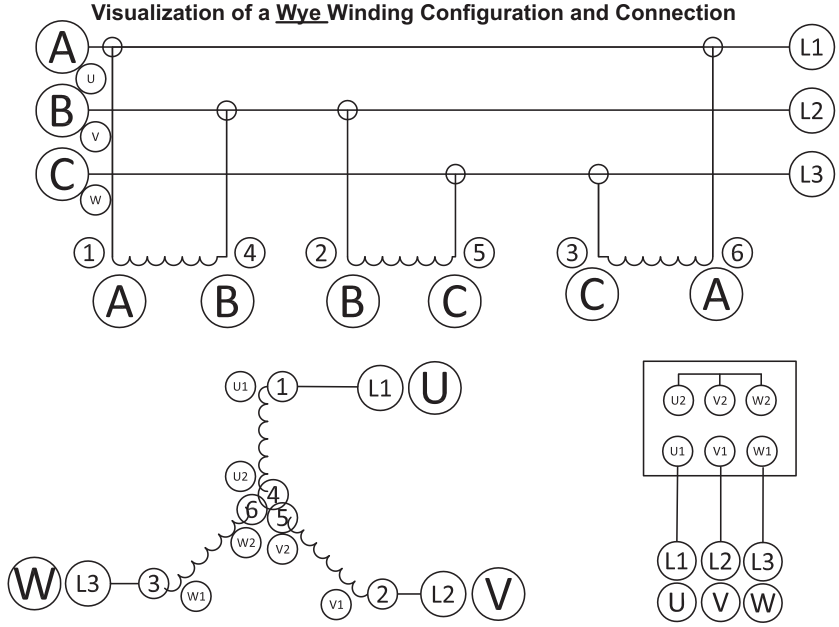
Wiring Diagram for Y-Δ Starting:



Visualization of a Delta Winding Configuration and Connection



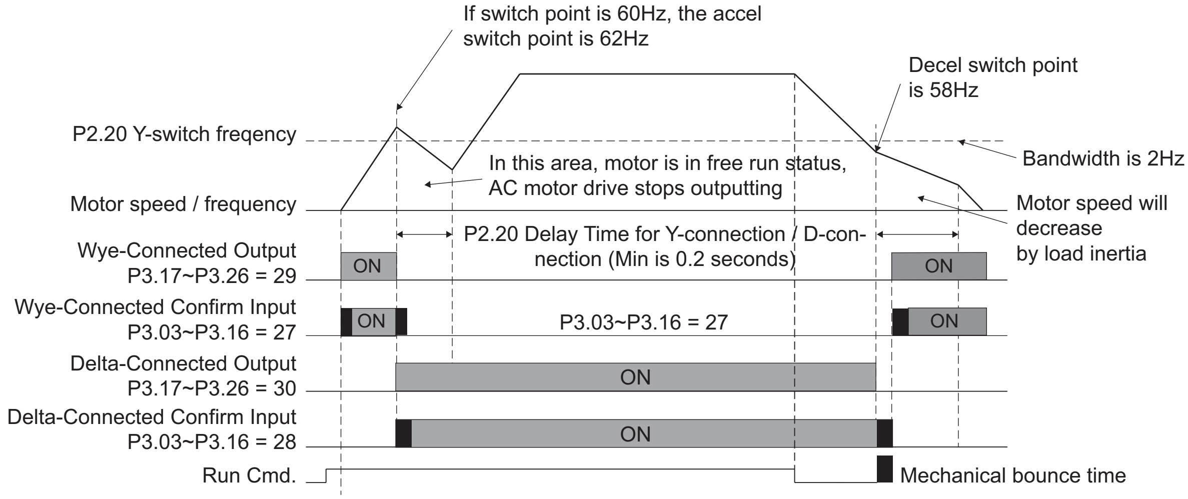
Visualization of a Wye Winding Configuration and Connection



Timing Charts for Y-Δ Starting:

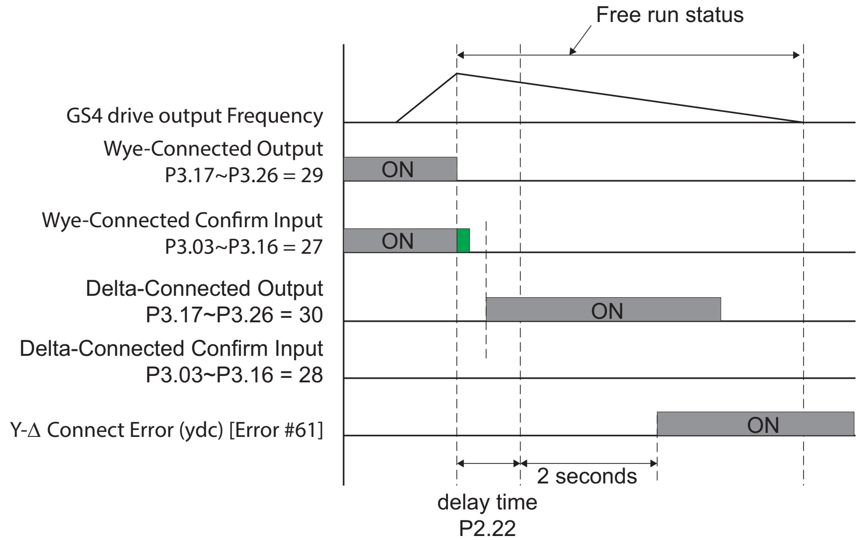
What happens when Y-Δ switching occurs properly:

- *The delta confirmation signal is generated, and the drive output continues*



What happens when Y-Δ switching does not occur properly:

- *In this example, the delta-connection confirmation input does not turn on. Two seconds after Delay Time for Y-D Switching (P2.22) has elapsed, the GS4 drive sets a Y-D Connect Error (61).*



		Type	Hex Addr	Dec Addr
P2.23	***Automatic Energy-Saving Operation***	♦R/W	0217	40536
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable	0		
	1: Enable			

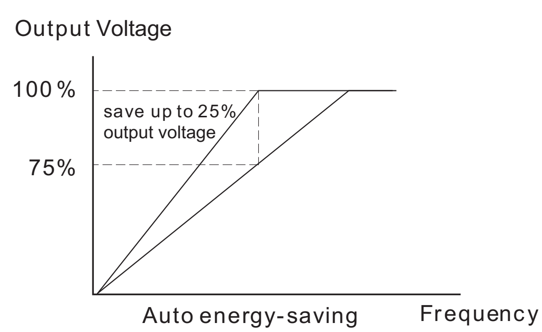
When P2.23 is set to 1, the acceleration and deceleration will operate with full voltage. During constant speed operation, the drive will auto calculate the best voltage value by the load power for the load. This function is not suitable for constantly changing loads or applications where the motor is near full-load (>70~80% of FLA).

When P2.23=1, the frequency command signal (keypad entry, analog input, etc.) must be stable for approximately 30s before Automatic Energy Saving Mode will turn on and reduce the output voltage. If the drive is in Energy Saving Mode and the frequency command signal changes (increases or decreases), Automatic Energy Saving Mode will temporarily stop. After the frequency command has become stable for 30s, the drive will re-enter Automatic Energy Saving Mode and reduce the output voltage to the motor.

When a motor runs at full load, the current flowing in the stator produces enough flux to generate full torque. Unfortunately, when a motor is lightly loaded, the stator current at full voltage stays the same (resulting in a lot of wasted energy). P2.23 automatically reduces the voltage delivered to the motor, which will reduce the unnecessary/excess current in the stator. Because AC motor speed is determined by frequency (and not voltage), the speed will remain the same. Therefore, the drive will operate at the required speed with minimum power (drawing less current).

To see the effect of Automatic Energy Saving Mode, set P2.23=1. Run an unloaded motor from the keypad (P4.00 or P4.01 = Digital Keypad frequency command). On the keypad, set P8.00 User Display setting to VAC (Output Voltage), and allow the unloaded motor to run without changing the frequency command. After 30s, you should see the output voltage (and output current) drop significantly.

If the incoming line voltage is low (at or near the bottom of the allowable input range), Automatic Energy Savings may not be able to reduce the output voltage.



NOTE:

The amount of power savings is highly dependent on the application. A small, very lightly loaded motor (5hp, 40~50% loaded) could see an energy savings approaching 10%.

Since the flux-generating current is a much smaller % of the total current in a larger motor (100hp), the % of savings will be smaller in larger motors (less than 5%). However, the total energy saved (in kWH or $$) could be higher.

Unfortunately, the only true way to determine energy savings is to run the drive with and without Energy-Savings enabled, and measure the difference in energy consumption.

Rough estimates of energy reduction can be seen by monitoring output current and voltage with P2.23=0, then P2.23=1.

The P8.00 User Display setting allows you to view Power (P), AC Output Voltage (E), and output Amps (A).

		Type	Hex Addr	Dec Addr
P2.24	***Power Saving Gain***	♦R/W	0218	40537
	Range/Units (Format: 16-bit unsigned)	*Default*		
	10~1000%	100		

When P2.23 is set to 1, this parameter (P2.24) can be used to adjust the gain of energy-saving. Decrease the gain to increase power savings. Increase the gain if the motor oscillates.

		Type	Hex Addr	Dec Addr
P2.25	***Slip Compensation Filter***	♦R/W	0219	40538
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.001~10.000 sec	0.100		

P2.25 and P2.03 can be used to change the response time of slip and torque compensation, respectively.

If P2.25 and P2.03 are set to 10 seconds, the response time of compensation is the slowest. But the system may be unstable when the setting is too short. The higher the value, the longer the time and the slower the response, resulting in increased damping of the signal. The smaller the value, the shorter the time and the faster the response, which can result in instability if the response is too fast.

		Type	Hex Addr	Dec Addr
P2.26	***Slip Deviation Level***	♦R/W	021A	40539
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~100.0%	0.0		

P2.26, Slip Deviation Level; P2.26 = xx.x% of 20.00Hz.

Slip deviation is calculated on motor current. Slip deviation is valid in V/Hz or Sensorless Vector control modes. If P2.01>0, then slip deviation level is active.

		Type	Hex Addr	Dec Addr
P2.27	***Slip Deviation Detection time***	♦R/W	021B	40540
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~10.0 seconds	1.0		

		Type	Hex Addr	Dec Addr
P2.28	***Slip Deviation Treatment***	♦R/W	021C	40541
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Warn and continue operating 1: Warn and Ramp to Stop 2: Warn and Coast to stop 3: No Warning	0		

P2.26 to P2.28 are used to set allowable slip level/time and over slip treatment when the drive is running.

		Type	Hex Addr	Dec Addr
P2.29	***Hunting Gain***	♦R/W	021D	40542
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~10000 (0=disable)	1000		

The motor could develop an oscillating motion around some specific frequency. This situation can be improved by setting this parameter. (If the oscillation occurs at a high frequency, try lowering this value, even to 0 if necessary. If the oscillation occurs at a low frequency, then increase this parameter.)

GROUP P3.XX DETAILS – DIGITAL PARAMETERS

		Type	Hex Addr	Dec Addr
P3.00	***1st Source of Operation Command [Remote/Auto]***	R/W	0300	40769
	Range/Units (Format: 16-bit binary)	*Default*		

0: Digital Keypad — Default: 0
1: External Terminal; Keypad/RS-485 STOP is enabled
2: External Terminal; Keypad/RS-485 STOP is disabled
3: RS485 (Modbus/BACnet); Keypad STOP is enabled
4: RS485 (Modbus/BACnet); Keypad STOP is disabled
5: Comm Card; Keypad STOP is enabled
6: Comm Card; Keypad STOP is disabled

Sets the source of run and stop control when in REMOTE mode (AUTO if P3.58=0). When the operation command is controlled by the keypad (GS4-KPD), the keys RUN, STOP, and JOG (F1) are valid.

P4.00 is for setting the frequency source for the REMOTE Source of Operation. The LOCAL/REMOTE mode can be switched by the keypad GS4-KPD or multi-function input terminal (DI =33).

The factory setting of frequency source and operation source is REMOTE mode. **Control will return to REMOTE mode whenever power is cycled to the drive**. If there is a multi-function input terminal used to switch LOCAL/REMOTE modes, then the multi-function input terminal has priority.

When the motor is running and the source of operation is changed from 1st to 2nd source or 2nd to 1st source, the motor will ramp to a stop regardless of the presence of a run command at either source (if P3.58 = default of 0). The drive looks for a rising edge or transition on the start command for each source of operation to allow the drive to start the motor. The drive does not look at the state; only the state change for start operations.

Refer to P3.58 LOCAL/REMOTE Selection to define how the drive handles starting and stopping when transitioning between Local and Remote Modes, and to enable bumpless transfer between the two modes.

NOTE: If the GS4 PLC is running the drive and P3.00 or P3.01 is set to 1, 3, or 5, then the keypad stop button will stop the drive.

NOTE: P8.13 and P8.14 can be configured to stop the drive if the keypad is removed.

Related parameter: P8.13 Keypad Communication Fault Treatment

		Type	Hex Addr	Dec Addr
P3.01	***2nd Source of Operation Command [Local/Hand]***	R/W	0301	40770
	Range/Units (Format: 16-bit binary)	*Default*		
	same settings as P3.00	0		

Sets the source of run and stop control when in LOCAL mode (HAND if P3.58=0). When the operation command is controlled by the keypad (GS4-KPD), the keys RUN, STOP, and JOG (F1) are valid.

P4.01 is for setting the frequency source for the Local Source of Operation. The LOCAL/REMOTE mode can be switched by the keypad GS4-KPD or multi-function input terminal (DI).

The factory setting of frequency source and operation source is REMOTE mode. **Control will return to REMOTE mode whenever power is cycled to the drive**. If there is a multi-function input terminal used to switch LOCAL/REMOTE modes, then the multi-function input terminal has priority.

When the motor is running and the source of operation is changed from 1st to 2nd source or 2nd to 1st source, the motor will ramp to a stop regardless of the presence of a run command at either source (if P3.58 = default of 0). The drive looks for a rising edge or transition on the start command for each source of operation to allow the drive to start the motor. The drive does not look at the state; only the state change for start operations.

Refer to P3.58 LOCAL/REMOTE Selection to define how the drive handles starting and stopping when transitioning between Local and Remote Modes, and to enable bumpless transfer between the two modes.

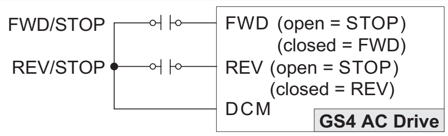
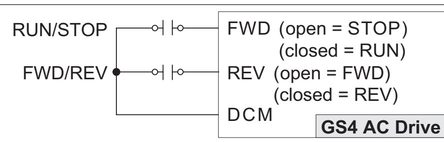
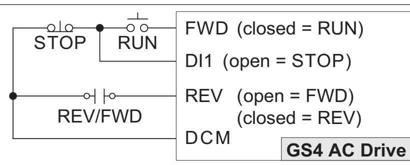
NOTE: If PLC is running the drive and P3.00 or P3.01 is set to 1, 3, or 5, then the keypad stop button will stop the drive.

NOTE: P8.13 and P8.14 can be configured to stop the drive if the keypad is removed.

Related parameter: P8.13 Keypad Communication Fault Treatment

		Type	Hex Addr	Dec Addr
P3.02	***2/3 Wire Operation Mode***	R/W	0302	40771
	Range/Units (Format: 16-bit binary)	*Default*		
	0: 2-wire mode 1 (Fwd, Rev) 1: 2-wire mode 2 (Run, Direction) 2: 3-wire mode	0		

Sets the type of control when Remote source (P3.00) or Local source (P3.01) control is set to External Terminal operation method. There are three different control modes, as described below. When P3.02 is set for three-wire operation control (P3.02=2), the terminal DI1 becomes the STOP contact. P3.02 cannot be changed during operation. At any transition of a Run, Stop, FWD, or REV command the drive will re-evaluate the state of the control terminals and apply or stop motion as commanded. The FWD and REV terminals are only configurable through the P3.02 parameter.

P3.02	***External Terminal Control Circuit Diagram***
Setting 0 2-wire mode 1 FWD/STOP REV/STOP	
Setting 1 2-wire mode 2 RUN/STOP REV/FWD	
Setting 2 3-wire mode	

Setting 0: Two-wire control mode 1 (Fwd, Rev)

- *FWD Terminal: Open = stop. Maintained close = Run forward.*
- *REV Terminal: Open = stop. Maintained close = Run reverse.*
- *If both terminals are open or both closed, the drive will not run. After an External Fault and subsequent Reset the drive will not run until is sees a high or low transition from either the FWD or REV terminal.*

FWD Input Terminal	open	closed	open	closed
REV Input Terminal	open	open	closed	closed
Drive Action	Stop	Forward	Reverse	Stop

Setting 1: Two-wire control mode 2 (Run, Direction)

- *FWD Terminal: Open = stop. Maintained close = Run. After an External Fault and subsequent Reset, the Run command will have to be cycled off then back on to run.*
- *REV Terminal: Open = FWD. Maintained close = REV.*

Setting 2: Three-wire control mode

- *FWD Terminal: The Run command needs a momentary high in order for the drive to run. If a Run command is high when drive is commanded to stop, the stop will take precedence. Once the Stop command is realeased the drive will start if the Run command is active.*
- *DI1 Terminal: The Stop command is maintained closed in order to allow drive to run. A momentary opening of the Stop command will cause the motor to stop if there is no Run command present. If there is a Run command present at the the time the Stop command opens, the drive will stop but will will restart if the Stop contact is closed while the Run command is high. DI1 is automatically assigned as the STOP contact and cannot be altered while P3.01=2.*
- *REV Terminal: The choice is a maintained selection: Open = FWD. Closed = REV.*
- *After an External Fault and subsequent Reset the drive will not run until is sees a high or low transition from either the Run, Stop, or FWD/REV command.*

		Type	Hex Addr	Dec Addr
P3.03~P3.16	**Multi-Function Input (MFI) Terminal Functions**	R/W	varies by parameter	
	Range/Units (Format: 16-bit unsigned)	Default		
	0~50 (see P3.03~P3.16 Input Function Settings table below)	varies by parameter		

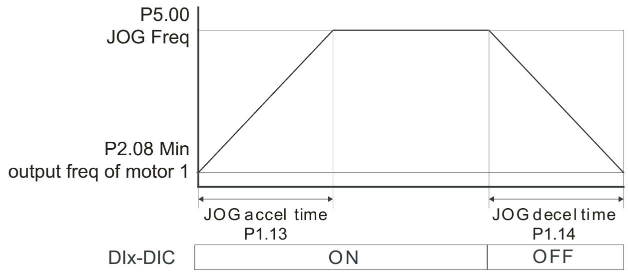
These parameters set the functions of the Multi-Function Input terminals.

- *See Appendix C for Digital Input worksheet (page C–3).*
- *Terminals for parameters P3.11 to P3.16 are located on the optional extention cards, if installed. If there is no expansion card installed, these parameters remain virtual terminals. For example, after installing the multiple function expansion card "GS4-06CDD," parameter P3.11 to P3.14 are defined as corresponding parameters for terminals DI10 to DI13, but parameters P3.15 to P3.16 are still virtual terminals.*
- *When terminals are defined as virtual, you need a digital keypad such as GS4-KPD or a communication mode to modify status of bits 8~15 (0=ON, 1=OFF) at Parameter P3.42.*
- *If an MFI will not take a setting, then most likely that setting is already assigned to a different input. MFI inputs also cannot be changed when the drive is running.*
- *When an external input is used in the GS4 PLC and the PLC is in Run or Stop mode, the PLC then owns that input and any Multi-Function Input setting assigned via P3.03~P3.16 is void. To read the status of an input into the PLC while maintaining the MFI setting, use the RPR command on the DI Status Register (P3.46). The ownership of the I/O can be returned to the drive by disabling the PLC either through the keypad or digital inputs when they are assigned values 36 and 37.*

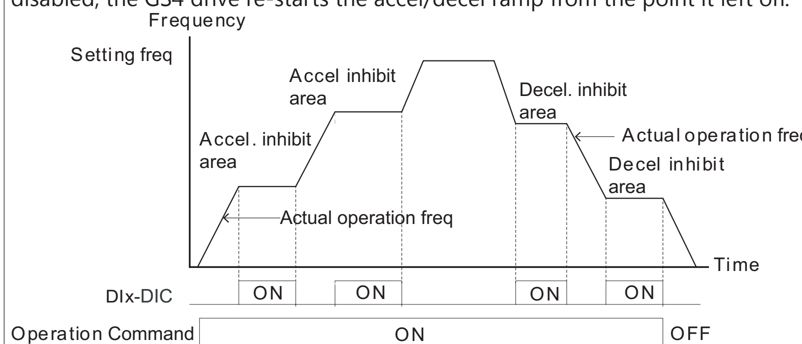
Multi-Function Input Terminal Function Settings (P3.03~P3.16)	
Setting: Function	***Function Description***
0: No function	Setting a Multi-Function Input to 0 will disable that input. The purpose of this function is to provide isolation for unused Multi-Function Input Terminals. ***Any unused terminals should be programmed to 0 to make sure they have no effect on drive operation.***
1: Multi-Speed/PID Multi-Setpoint bit 1 2: Multi-Speed/PID Multi-Setpoint bit 2 3: Multi-Speed/PID Multi-Setpoint bit 3 4: Multi-Speed bit 4	15 speeds can be commanded through the digital status of the 4 terminals; total of 16 speeds if the master speed is included. (Refer to parameter group P5 for settings.) When settings 1, 2, & 3 are selected and registers P7.06~P7.12 are populated, the Multi-Function Inputs refer to PID Multi-Setpoints. The SPs are determined by P7.06~P7.12. 1) In order to use the Multi-PID SPs, P7.06~P7.12 must be set, and P7.00≠0. 2) When all PID Multi-Setpoint inputs are off, the GS4 drive reverts to the PID Setpoint Source (P7.02).
5: Reset	After the error of the drive is eliminated, use this terminal to reset the drive.
(table continued next page)	

Multi-Speed / PID Setpoint				***Selection***	
Bit 4	***Bit 3***	***Bit 2***	***Bit 1***	***Speed***	***PID Setpoint***
OFF	OFF	OFF	OFF	P4.00/P4.01	P7.02: SP Source
OFF	OFF	OFF	ON	P5.01: Speed 1	P7.06: Setpoint 1
OFF	OFF	ON	OFF	P5.02: Speed 2	P7.07: Setpoint 2
OFF	OFF	ON	ON	P5.03: Speed 3	P7.08: Setpoint 3
OFF	ON	OFF	OFF	P5.04: Speed 4	P7.09: Setpoint 4
OFF	ON	OFF	ON	P5.05: Speed 5	P7.10: Setpoint 5
OFF	ON	ON	OFF	P5.06: Speed 6	P7.11: Setpoint 6
OFF	ON	ON	ON	P5.07: Speed 7	P7.12: Setpoint 7
ON	OFF	OFF	OFF	P5.08: Speed 8	–
ON	OFF	OFF	ON	P5.09: Speed 9	–
ON	OFF	ON	OFF	P5.10: Speed 10	–
ON	OFF	ON	ON	P5.11: Speed 11	–
ON	ON	OFF	OFF	P5.12: Speed 12	–
ON	ON	OFF	ON	P5.13: Speed 13	–
ON	ON	ON	OFF	P5.14: Speed 14	–
ON	ON	ON	ON	P5.15: Speed 15	–

<table>
<tr><th colspan="2">Multi-Function Input Terminal Function Settings (P3.03~P3.16) (continued)</th></tr>
<tr><th>Setting: Function</th><th>Function Description</th></tr>
<tr><td>6: JOG</td><td>Before executing this function, wait for the drive to stop completely. While the drive is running, the operating direction can be modified and the STOP key on the keypad is still valid. Once the external terminal receives OFF command, the motor will stop by the JOG deceleration time. Refer to P1.13, P1.14 and P5.00 for details.

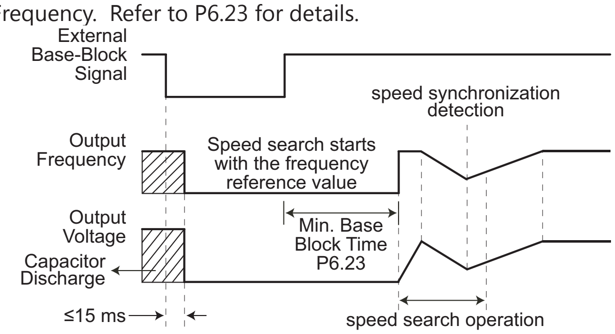


</td></tr>
<tr><td>7: Accel/Decel speed inhibit (Speed Hold)</td><td>When this function is enabled, the acceleration and deceleration are stopped right away and the drive maintains a constant speed. After this function is disabled, the GS4 drive re-starts the accel/decel ramp from the point it left off.



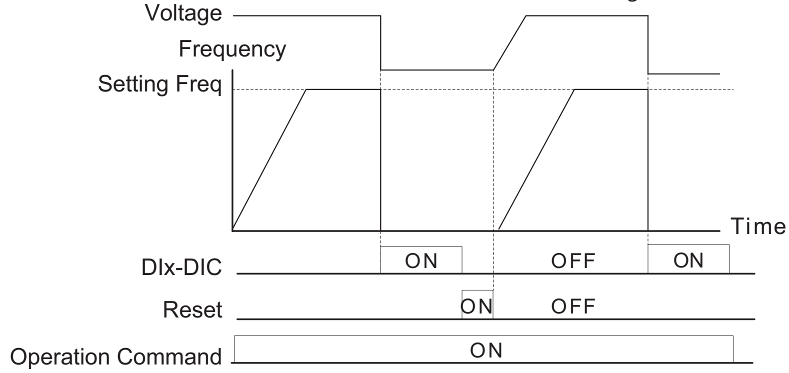
</td></tr>
<tr><td>8: 1st~4th Accel/Decel time selection, bit 0

9: 1st~4th Accel/Decel time selection, bit 1</td><td>The acceleration/deceleration time of the drive can be selected from the status of these two digital inputs configured to setting 8 and 9. there are 4 acceleration/deceleration speeds in total for selection.
<table>
<tr><th><u>DIx = 9</u></th><th><u>DIx = 8</u></th><th><u>Accel/Decel</u></th></tr>
<tr><td>OFF</td><td>OFF</td><td>1st Accel/Decel</td></tr>
<tr><td>OFF</td><td>ON</td><td>2nd Accel/Decel</td></tr>
<tr><td>ON</td><td>OFF</td><td>3rd Accel/Decel</td></tr>
<tr><td>ON</td><td>ON</td><td>4th Accel/Decel</td></tr>
</table>
</td></tr>
<tr><td>10: External Fault Input by P3.56 (EF error)</td><td>External fault input terminal. The drive decelerates by P3.56 setting. The External Fault will be saved to the error log. Fault must be cleared and the drive reset before drive can run again.</td></tr>
<tr><td>11: Base Block Input</td><td>When this contact is ON, output of the drive will be cut off immediately, and the motor will be in coast and display “b.b.” When the External Base Block is deactivated, the GS4 drive will start the speed search function and synchronize with the motor speed if P6.06 ≠ 0. The GS4 drive will then accelerate to the Master Frequency. Refer to P6.23 for details.



</td></tr>
<tr><td>12: reserved</td><td>n/a</td></tr>
<tr><td colspan="2">(table continued next page)</td></tr>
</table>

Multi-Function Input Terminal Function Settings (P3.03~P3.16) (continued)	
Setting: Function	**Function Description**
13: Disable Auto Accel/Decel Time	Before using this function, P6.13 should be set to mode 01, 02, 03, or 04. When this function is enabled, accel and decel time is linear when input is activated or ON. When input is deactivated or OFF, the accel and decel times are determined by P6.13.
14: Switch between drive settings 1 and 2	When contact is ON: Drive uses parameters of motor 2 (P0.11~P0.18). When contact is OFF: Drive uses parameters of motor 1 (P0.00~P0.04, P0.06~P0.09).
15: Operation speed command from AI1	When contact is ON, the source of the frequency has to be from AI1. Set P4.02=1 (Freq Reference). If multiple DI terminals are set to AI1, AI2, and AI3 operation speed commands at the same time, the priority is AI1>AI2>AI3.
16: Operation speed command from AI2	When contact is ON, the source of the frequency has to be from AI2. Set P4.03=1 (Freq Reference). If multiple DI terminals are set to AI1, AI2, and AI3 operation speed commands at the same time, the priority is AI1>AI2>AI3.
17: Operation speed command from AI3	When contact is ON, the source of the frequency has to be from AI3. Set P4.04=1 (Freq Reference). If multiple DI terminals are set to AI1, AI2, and AI3 operation speed commands at the same time, the priority is AI1>AI2>AI3.
18: Forced Ramp Stop by P3.56 (no error)	When contact is ON, the drive will ramp to a stop by the setting of P3.56. The External Fault will NOT be saved to the error log. The drive will not need to be reset, but the fault will need to be cleared before the drive will run again.
19: Digital Freq Up Command 20: Digital Freq Down Command	Before using this function, set 1st or 2nd Source of Frequency Command (P4.00 or P4.01) equal to external up/down input. If this input is constantly ON, the frequency will be increased or decreased by the rate defined in parameter P3.39. After a stop from this speed mode and a subsequent restart, the drive will start again at the last frequency given according ramp selected in P1.01 to P1.08. The increase and decrease speed functions can be adjusted while the motor is stopped. *NOTE: If P3.39 > the actual drive acc/dec (p1.01 and P1.02), the command freq will reach desired speed well before the drive output reaches setpoint.*
21: PID function Disable	When the contact is activated, the PID function is disabled.
22: Clear counter	When the contact is activated, it will clear current counter value and display “0”. When this function is deactivated the counter will continue to count.
23: Increment counter value (DI6 only)	The counter value will increase 1 count when ON. Count occurs during the rising edge of an input and must be on for at least 1ms. The input is not debounced; user supplied switch debouncing is recommended if needed. P3.44 (Final Count) needs to be set before counter will work. *This setting (23) can be assigned only to DI6.* *P3.40 can be adjusted to vary the debounce time for this setting.* *Adjustments to P3.41 (Digital Input Response Time) will <u>not</u> affect DI6.* *P3.44 (Final Counter Value) must have a value set for counter to count.*
24: FWD JOG	When contact is ON, the drive will execute *forward* Jog command. Jog functions can only be initated from a stop state. Jog Accel/Decel Time: P1.13, P1.14; Jog Frequency: P5.00.
25: REV JOG	When contact is ON, the drive will execute *reverse* Jog command. Jog functions can only be initated from a stop state. Jog Accel/Decel Time: P1.13, P1.14; Jog Frequency: P5.00.
(table continued next page)	

<table>
<tr><th colspan="2">Multi-Function Input Terminal Function Settings (P3.03~P3.16) (continued)</th></tr>
<tr><th>Setting: Function</th><th>Function Description</th></tr>
<tr><td>26: Emergency Stop EF1
(Coast stop) (EF1 error)</td><td>When contact is ON, the drive will execute emergency stop and display EF1 on the keypad. The motor stays in the free run until the error is cleared (terminal's status is back to normal). Only after pressing RESET (EF1: Emergency Stop), the motor can continue to run. EF1 Fault is recorded in the error log.

</td></tr>
<tr><td>27: Signal Confirmation for
Y-connection</td><td>When the control mode is V/Hz (P2.11=0) and the contact is ON, the drive will operate by following the 1st V/Hz. The following parameters must also be configured P2.20~P2.22, and two digital outputs (P3.17~P3.31) must be set to 29 and 30.</td></tr>
<tr><td>28: Signal Confirmation for Delta
connection</td><td>When the control mode is V/Hz (P2.11=0) and the contact is ON, the drive will operate by following the 2nd V/Hz. The following parameters must also be configured P2.20~P2.22, and two digital outputs (P3.17~P3.31) must be set to 29 and 30.</td></tr>
<tr><td>29: Disable EEPROM Write</td><td>When this contact is ON, write to EEPROM is disabled. The modified values changed while this contact is on will revert back to the old values after restarting the drive. (When input is ON, any values that are modified will not be retained when power is cycled)
The RPR instruction in the PLC will not affect the EEPROM.
The WPR instruction will contribute to the 10^9 maximum life time EEPROM writes to the FRAM memory in the drive.</td></tr>
<tr><td>30: Forced Coast Stop</td><td>When this contact is ON during an operation, the drive will coast to stop.</td></tr>
<tr><td>31: Hand Contact for HOA Control</td><td rowspan="2">When controlling the drive using the standard HOA (Hand/Off/Auto) function, settings 31 & 32 should be used together. When these multi-function input terminals are both on or both off, the drive executes a STOP command. That means when switching Hand to Auto or Auto to Hand the switch configuration must pass through a Stop state causing the drive to always stop when changing modes.
Local/Remote buttons on the keypad and MFI setting 33 will not be operational when digital inputs are configured for 31 & 32.
MFI settings 31 & 32 have priority over P3.58 settings.
The digital keypad will display the drive's status ("HAND," "OFF," "AUTO") in the upper right corner of the keypad, depending on what control mode the drive is in.
P3.57 contains additional behavior settings when switching from Auto to Hand.
<table><tr><td rowspan="4"><u>DI1 = 31</u>
<u>DI2 = 32</u></td><td>(DI2, DI1) = 00</td><td>OFF</td><td>Off</td></tr><tr><td>(DI2, DI1) = 01</td><td>HAND</td><td>Follows LOCAL source (P3.01 & P4.01)</td></tr><tr><td>(DI2, DI1) = 10</td><td>AUTO</td><td>Follows REMOTE source (P3.00 & P4.00)</td></tr><tr><td>(DI2, DI1) = 11</td><td>OFF</td><td>Off</td></tr></table></td></tr>
<tr><td>32: Auto Contact for HOA Control</td></tr>
<tr><td>33: LOCAL/REMOTE Selection</td><td>DI=0: (Switches to REMOTE source, P3.00 & P4.00)
DI=1: (Switches to LOCAL source, P3.01 & P4.01)
If another MFI is set to 31 or 32, then this input will be ignored.
This function is enabled when P3.58 is <u>not</u> set to 0.
Keypad "LOCAL" and "REMOTE" buttons will be disabled.
The digital keypad will display the drive's states ("LOC","REM") in the upper right corner of the keypad.
MFO setting 24 will indicate the position of this function.</td></tr>
<tr><td colspan="2">(table continued next page)</td></tr>
</table>

<table>
<tr><th colspan="2">Multi-Function Input Terminal Function Settings (P3.03~P3.16) (continued)</th></tr>
<tr><th>Setting: Function</th><th>Function Description</th></tr>
<tr><td>34: Drive Enable</td><td>When drive is Enabled, the drive will run when commanded to do so. When drive is not Enabled, the drive will not run. If the drive is running and the enable switch is deactivated, then the motor will coast to stop.</td></tr>
<tr><td>35: Decel Energy Backup (DEB) Enable</td><td>Decel Energy Backup at momentary power loss. Allows controlled stopping during a power failure or predetermined behavior during a power brown out. See P6.61~P6.64 for related settings.</td></tr>
<tr><td>36: PLC Mode select bit0</td><td rowspan="2"><table>
<tr><th><u>PLC status</u></th><th><u>Bit 1</u></th><th><u>Bit 0</u></th><th><u>Note</u></th></tr>
<tr><td>Disable PLC function (PLC 0)</td><td>0</td><td>0</td><td rowspan="4">PLC mode selection through MFI terminals will trump the selection made through the keypad menu. GSLogic will override these settings. On a power cycle these bits will take priority.</td></tr>
<tr><td>Trigger PLC to run (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>Maintain last state</td><td>1</td><td>1</td></tr>
</table></td></tr>
<tr><td>37: PLC Mode select bit1</td></tr>
<tr><td>38: reserved</td><td>n/a</td></tr>
<tr><td>39: reserved</td><td>n/a</td></tr>
<tr><td>40: Fire mode and force drive run</td><td>Enable this function under Fire Mode (P6.55) to force the drive to run.
Other than Safety Torque Off (STO), the drive will run at the Fire Mode frequency regardless of when this function is activated.
When STO is activated, the drive will <u>not</u> output. Fire mode will <u>not</u> override STO while there is an active alarm.
If the drive is stopped or running when this DI turns ON, the drive will run. When the DI goes off, the drive will stop ("In Fire Mode") regardless of the state of the RUN input. To restart the drive, either turn this DI back ON, or clear the fault (using the Reset input) and turn the RUN input on.
Related parameters: P6.55~P6.60.</td></tr>
<tr><td>41: Fire mode and maintain operation</td><td>Enable this function under Fire Mode (P6.55). Current state of operation of the drive will continue.
Other than Safety Torque Off (STO), the drive will run if currently running, but will be limited in frequency by P6.56. If the drive is currently in a stop state, the drive will remain in a stop state.
WARNING: Use #40 if you want the drive to always RUN when in Fire Mode.
When STO is activated, the drive will <u>not</u> output. Fire mode will <u>not</u> override STO while there is an active alarm.
Keypad will display "In Fire Mode." When the Fire Mode DI goes off, the drive will stop ("In Fire Mode") regardless of the state of the RUN input. To restart the drive, clear the fault (using the Reset input) and then turn the RUN input on. (when using Mode 41, the DI will not cause the drive to RUN when in Fire Mode).
Related parameters: P6.55~P6.60.</td></tr>
<tr><td>42: Disable all motors</td><td>When the multi-motor circulative control (P10.00) is enabled, all motors will be disabled when this function is activated.</td></tr>
<tr><td>43: Disable Motor #1</td><td rowspan="8">When the multi-motor circulative control (P10.00) is enabled, motors #1 to #8 can be disabled. If one or more motors (1~8) are out of order or under maintenance, enable this terminal to bypass that motor.</td></tr>
<tr><td>44: Disable Motor #2</td></tr>
<tr><td>45: Disable Motor #3</td></tr>
<tr><td>46: Disable Motor #4</td></tr>
<tr><td>47: Disable Motor #5</td></tr>
<tr><td>48: Disable Motor #6</td></tr>
<tr><td>49: Disable Motor #7</td></tr>
<tr><td>50: Disable Motor #8</td></tr>
</table>

		Type	Hex Addr	Dec Addr
P3.03	**Multi-Function Input (DI1 or PLC X2)**	R/W	0303	40772
	Range/Units (Format: 16-bit unsigned)	Default		
	See P3.03~P3.16 (page 4–63)	1		

This parameter sets the function of Multi-Function Input (DI1).

- *Represented by Bit 2 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 2 in P3.42.*

		Type	Hex Addr	Dec Addr
P3.04	**Multi-Function Input (DI2 or PLC X3)**	R/W	0304	40773
	Range/Units (Format: 16-bit unsigned)	Default		
	See P3.03~P3.16 (page 4–63)	2		

This parameter sets the function of Multi-Function Input (DI2).

- *Represented by Bit 3 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 3 in P3.42.*

		Type	Hex Addr	Dec Addr
P3.05	**Multi-Function Input (DI3 or PLC X4)**	R/W	0305	40774
	Range/Units (Format: 16-bit unsigned)	Default		
	See P3.03~P3.16 (page 4–63)	3		

This parameter sets the function of Multi-Function Input (DI3).

- *Represented by Bit 4 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 4 in P3.42.*

		Type	Hex Addr	Dec Addr
P3.06	**Multi-Function Input (DI4 or PLC X5)**	R/W	0306	40775
	Range/Units (Format: 16-bit unsigned)	Default		
	See P3.03~P3.16 (page 4–63)	4		

This parameter sets the function of Multi-Function Input (DI4).

- *Represented by Bit 5 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 5 in P3.42.*

		Type	Hex Addr	Dec Addr
P3.07	**Multi-Function Input (DI5 or PLC X6)**	R/W	0307	40776
	Range/Units (Format: 16-bit unsigned)	Default		
	See P3.03~P3.16 (page 4–63)	0		

This parameter sets the function of Multi-Function Input (DI5).

- *Represented by Bit 6 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 6 in P3.42.*

		Type	Hex Addr	Dec Addr
P3.08	**Multi-Function Input (DI6 or PLC X7)**	R/W	0308	40777
	Range/Units (Format: 16-bit unsigned)	Default		
	Same as P3.03~P3.16 except multi-function setting 23 (Increment Counter Value) can only be used with DI6 (page 4–63)	0		

This parameter sets the function of Multi-Function Input (DI6).

- *Represented by Bit 7 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 7 in P3.42.*

		Type	Hex Addr	Dec Addr
P3.09	**Multi-Function Input (DI7 or PLC X10)**	R/W	0309	40778
	Range/Units (Format: 16-bit unsigned)	Default		
	See P3.03~P3.16 (page 4–63)	0		

This parameter sets the function of Multi-Function Input (DI7).

- *Represented by Bit 8 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 8 in P3.42.*

		Type	Hex Addr	Dec Addr
P3.10	**Multi-Function Input (DI8 or PLC X11)**	R/W	030A	40779
	Range/Units (Format: 16-bit unsigned)	Default		
	See P3.03~P3.16 (page 4–63)	0		

This parameter sets the function of Multi-Function Input (DI8).

- *Represented by Bit 9 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 9 in P3.42.*

		Type	Hex Addr	Dec Addr
P3.11	**Multi-Function Input (option card DI10 or PLC X12)**	R/W	030B	40780
	Range/Units (Format: 16-bit unsigned)	Default		
	See P3.03~P3.16 (page 4–63)	0		

This parameter sets the function of Multi-Function Input (DI10).

- *DI10 is available only on extension cards GS4-06NA & GS4-06CDD.*
- *Represented by Bit 10 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 10 in P3.42.*

		Type	Hex Addr	Dec Addr
P3.12	**Multi-Function Input (option card DI11 or PLC X13)**	R/W	030C	40781
	Range/Units (Format: 16-bit unsigned)	Default		
	See P3.03~P3.16 (page 4–63)	0		

This parameter sets the function of Multi-Function Input (DI11).

- *DI11 is available only on extension cards GS4-06NA & GS4-06CDD.*
- *Represented by Bit 11 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 11 in P3.42.*

		Type	Hex Addr	Dec Addr
P3.13	**Multi-Function Input (option card DI12 or PLC X14)**	R/W	030D	40782
	Range/Units (Format: 16-bit unsigned)	Default		
	See P3.03~P3.16 (page 4–63)	0		

This parameter sets the function of Multi-Function Input (DI12).

- *DI12 is available only on extension cards GS4-06NA & GS4-06CDD.*
- *Represented by Bit 12 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 12 in P3.42.*

		Type	Hex Addr	Dec Addr
P3.14	**Multi-Function Input (option card DI13 or PLC X15)**	R/W	030E	40783
	Range/Units (Format: 16-bit unsigned)	Default		
	See P3.03~P3.16 (page 4–63)	0		

This parameter sets the function of Multi-Function Input (DI13).

- *DI13 is available only on extension cards GS4-06NA & GS4-06CDD.*
- *Represented by Bit 13 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 13 in P3.42.*

		Type	Hex Addr	Dec Addr
P3.15	***Multi-Function Input (option card DI14 or PLC X16)***	R/W	030F	40784
	Range/Units (Format: 16-bit unsigned)	*Default*		
	See P3.03~P3.16 (page 4–63)	0		

This parameter sets the function of Multi-Function Input (DI14).

- *DI14 is available only on extension card GS4-06NA.*
- *Represented by Bit 14 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 14 in P3.42.*

		Type	Hex Addr	Dec Addr
P3.16	***Multi-Function Input (option card DI15 or PLC X17)***	R/W	0310	40785
	Range/Units (Format: 16-bit unsigned)	*Default*		
	See P3.03~P3.16 (page 4–63)	0		

This parameter sets the function of Multi-Function Input (DI15).

- *DI15 is available only on extension card GS4-06NA.*
- *Represented by Bit 15 on the "DI Status" (P3.46) bit map.*
- *NO/NC behavior is controlled by Bit 15 in P3.42.*

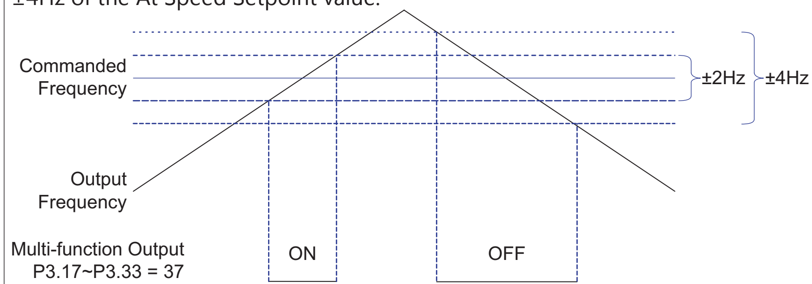
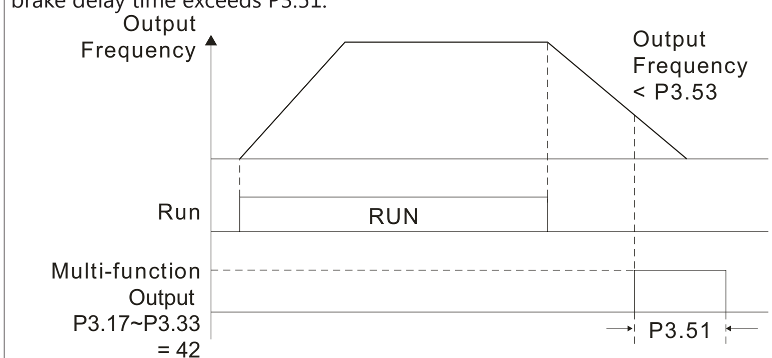
		Type	Hex Addr	Dec Addr
P3.17~P3.31	***Multi-Function Output (MFO) Terminal Functions***	♦R/W	varies by parameter	
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~55 (see P3.17~P3.31 Output Function Settings table below)	varies by parameter		

These parameters set the functions of the Multi-Function output terminals.

- *If an MFO will not take a setting, then most likely the setting is already assigned to a different output. MFO outputs also cannot be changed when the drive is running.*
- *See Appendix C for digital and analog I/O worksheet.*

Multi-Function Output Terminal Function Settings (P3.17~P3.31)	
Setting: Function	***Function Description***
0: No Function	Output terminal has no function configured.
1: AC Drive Running	Active when the drive is not at STOP.
2: At Frequency Setpoint	Active when the GS4 drive reaches the output frequency setting.
3: At Speed 1 (P3.32)	Active when desired frequency #1 (P3.32) is attained. ON state frequency band determined by P3.33.
4: At Speed 2 (P3.34)	Active when desired frequency #2 (P3.34) is attained. ON state frequency band determined by P3.35.
5: At Zero Speed Including Drive Running	Active when frequency command =0 and the drive is in RUN mode.
6: At Zero Speed Drive not Running	Active when frequency command =0 or stop.
7: Over Torque Level 1	Active when detecting over-torque. Refer to P6.15 (over-torque detection level-OT1) and P6.16 (over-torque detection time-OT1). Refer to P6.14~P6.16.
8: Over Torque Level 2	Active when detecting over-torque. Refer to P6.18 (over-torque detection level-OT2) and P6.19 (over-torque detection time-OT2). Refer to P6.17~P6.19.
9: Drive Ready	Active when the drive is ON and no faults or abnormality detected. Drive is ready for a start.
10: Low Voltage warning (Lv)	Active when the DC Bus voltage is too low. (refer to P6.35 low voltage level)
11: Error indication (All faults, Except for Lv Stop)	Active when fault occurs (except Lv stop). Output will not deactivate until fault is cleared and drive is reset back to ready state.
12: Brake release function	This function should be used with an external DC brake, and it is recommended to use contact "b" (N.C) (P3.43). This output turns ON at the beginning of the accel ramp and turns OFF at the end of the decel ramp. To use the P3.51 Brake Delay Timer, use MFO selection #42. (See P3.51 for more details and timing diagrams.)
(table continued next page)	

Multi-Function Output Terminal Function Settings (P3.17~P3.31) (continued)	
Setting: Function	***Function Description***
13: Over-temp warning	Active when IGBT or heat sink overheats. To prevent an OH fault from turning off the output to the drive. (refer to P6.30 for OH warning level)
14: Dymamic braking output	Active when the dynamic brake function is ON. If DC Bus voltage is greater than the braking voltage level set in parameter P6.28 (Dynamic Braking Voltage level), then any output configured for function 14 will change state.
15: PID deviation error	Active when the feedback signal is abnormal. The output will be activated when the GS4 drive exceeds the PID Deviation Level (P3.36) for longer than the PID Deviation Time (P3.37).
16: Over Slip (oSL)	Active when the slip error is detected.
17: Mid-point Counter Value Attained (P3.45)	Active when the counter reaches Middle Counter Value (P3.45). This output will only be active for the count number specified, once the counter input is incremented one more count the output will be deactivated. DI6 must be configured to 23 "Input Counter." This output won't activate if the middle counter value is greater than final counter value.
18: Final Count Value Attained (P3.44)	Active when the counter reaches Final Counter Value (P3.44). This output will only be active for the count number specified, once the counter input is deactivated from the achieved final count the count value will automatically reset to 0. DI6 must be configured to 23 "Input Counter."
19: Base Block Indication	Active when the output of the GS4 Drive is shut off during base block. A mulit-function input must be configured to 11 "Base Block Inhibit."
20: Warning Output	Active when a warning is detected.
21: Overvoltage Alarm	Active when an over-voltage is detected.
22: Oc Stall Alarm	Active when an over-current stall prevention is detected.
23: Ov Stall Alarm	Active when an over-voltage stall prevention is detected.
24: External Control Mode	Active when the operation command (P3.00, P3.01) is controlled by RS-485, External Terminals, or Communication Card. This setting takes into account if the drive is in LOCAL or REMOTE mode. The drive does not need to be running for this output to energize.
25: Forward Command	Active when the commanded drive direction is forward. Does not indicate actual direction of rotation of motor. If motor is running REV and then commanded to run FWD this output will turn on, but the motor will still need time to ramp down in order to change direction.
26: Reverse Command	Active when the commanded drive direction is reverse. Does not indicate actual direction of rotation of motor. If motor is running FWD and then commanded to run REV this output will turn on, but the motor will still need time to ramp down in order to change direction.
27: Above Desired Current (≥ P3.52)	Active when current is ≥P3.52.
28: Below Desired Current (< P3.52)	Active when current is <P3.52.
29: Wye Connected Command	Used to trigger the switching contactors for a Wye-connected motor when switching from Wye to Delta starting of a motor. Use P2.20~P2.22 to enable and set up this feature. Two digital ***inputs*** must be set to 27 and 28.
30: Delta Connected Command	Used to trigger the switching contactors for a Delta-connected motor when switching from Wye to Delta starting of a motor. Use P2.20~P2.22 to enable and set up this feature. Two digital ***inputs*** must be set to 27 and 28.
31: Zero Speed at Drive Running	Active when the actual output frequency is 0. (The drive should be in RUN mode.)
32: Zero Speed including Drive Stop	Active when the actual output frequency is 0 or Stop.
33: Fault Option 1 (P11.00)	Active when fault group selected in P11.00 is ON.
34: Fault Option 2 (P11.01)	Active when fault group selected in P11.01 is ON.
35: Fault Option 3 (P11.02)	Active when fault group selected in P11.02 is ON.
36: Fault Option 4 (P11.03)	Active when fault group selected in P11.03 is ON.
(table continued next page)	

<table>
<tr><th colspan="2">Multi-Function Output Terminal Function Settings (P3.17~P3.31) (continued)</th></tr>
<tr><th>Setting: Function</th><th>Function Description</th></tr>
<tr><td>37: At Speed (Setpoint include 0Hz)</td><td>Active when the output frequency reaches frequency setting including an output frequency of 0Hz. The output will be activated when the output frequency reaches ±2Hz of the At Speed Setpoint, and go off when the frequency exceeds ±4Hz of the At Speed Setpoint value.

</td></tr>
<tr><td>38: reserved</td><td>n/a</td></tr>
<tr><td>39: Under Ampere (Low Current)</td><td>This function needs to be used with P6.52, P6.53, P6.54. If P6.54 is not 0, the corresponding multi-function terminal will be ON if the current is less than P6.52 level and time elapsed is greater than P6.53.</td></tr>
<tr><td>40: UVW Motor Contactor ON</td><td>Set an MFI=34 (drive enable) and MFO=40 (Motor Contactor ON). The magnetic contactor will then follow the drive enable status.</td></tr>
<tr><td>41: DEB Active (Decel Energy Backup)</td><td>Active when DEB activation is on.</td></tr>
<tr><td>42: Brake Released at Stop
(Brake Engaged During Decel)</td><td>This function is typically used in conjunction with a mechanical brake.
When drive stops, the corresponding Multi-Function Output terminal will be ON if the frequency is less than P3.53. After it is ON, the output will turn OFF when brake delay time exceeds P3.51.


<u>Note</u>: With a long deceleration and a short brake time, the output could energize (for P3.51) and de-energize before the ramp is complete.</td></tr>
<tr><td>43: RS485 Digital Output</td><td>Enables user control of an output via RS-485. When the MFO is set to 43, writing to the correct bit in address 2640h (Modbus 49793) will turn on the associated output. This address will reset to zero when written to via RS-485 (but the output will stay ON because the bit was set). Digital Output Status should always be read from P3.47 (Modbus decimal address 40816).
<table>
<tr><td>Bit</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td>Out</td><td>R1</td><td>R2</td><td>xx</td><td>DO1</td><td>DO2</td><td>DO10</td><td>DO12</td><td>DO13</td><td>DO14</td><td>DO15</td></tr>
</table>
<u>Example</u>:
Set P3.17 = 43 (Sets R1 to RS485 Digital Output)
Write a 1 to Bit 0 of 49793. R1 will turn ON.
Bit 0 of 49793 will read 0 (49793 auto-resets to 0).
Bit 0 of 40816 (P3.47 Digital Output Status) will read 1.
Write a 0 to Bit 0 of 49793 to turn R1 OFF.</td></tr>
<tr><td>44: COMM Card Digital Output</td><td>Allows user to control Digital Outputs via Ethernet Comm Card. Each output has a corresponding bit in 49793 (see option 43 for bit map). Only writes from the Ethernet card will cause the output to turn ON if #44 is selected. The value in 49793 is maintained when written to over Ethernet.</td></tr>
<tr><td colspan="2">(table continued next page)</td></tr>
</table>

Multi-Function Output Terminal Function Settings (P3.17~P3.31) (continued)	
Setting: Function	**Function Description**
45: Fire Mode Indication	An activation of setting 45 indicates fire mode is active. Requires Multi-Function Input P3.03~3.16 configured for 40: Fire Mode with RUN Command, or 41: Fire Mode without RUN Command. Requires Fire Mode P6.55 to be enabled. When the DI for Fire Mode turns ON, the DO associated with this input will also turn ON. The output is not retentive; the output turns ON and OFF with the Fire Mode DI.
46: Fire Bypass Indication	Requires Fire Mode Enable Bypass P6.57 to be enabled. The bypass will activate after the Bypass Delay Time. Once Fire Mode input is turned OFF, the bypass will be turned OFF. *Only certain types of faults are able to be bypassed in Fire Mode.* The list of fault codes, including which ones can and cannot be bypassed in Fire Mode, is shown in the "Fault Codes" table in Chapter 6: Maintenance and Troubleshooting (*page 6–16*).
47: Motor #1 Selected	When setting multi-motor circulative function, the Multi-Function Output terminal will automatically set up P3.17(R1), 3.18(R2), and P3.21(R10)~P3.26(R15) in accordance with P10.01's (Number of Connected Motors) setting (*page 4–192*).
48: Motor #2 Selected	
49: Motor #3 Selected	
50: Motor #4 Selected	
51: Motor #5 Selected	
52: Motor #6 Selected	
53: Motor #7 Selected	
54: Motor #8 Selected	
55: Mtr1/Mtr2 Nameplate Parameters	Indicates which motor is selected from P0.10 or MFI setting 14.
56: Safety STO A	Normally Open Auxiliary output for STO indication. *Not safety rated*.
57: Safety STO B	Normally Closed Auxiliary output for STO indication. *Not safety rated*.
58: Frequency Output Above P3.53	Active when current frequency output is ≥ the value in P3.53.
59: Frequency Output Below P3.53	Active when current frequency output is < the value in P3.53.

		Type	*Hex Addr*	*Dec Addr*
P3.17	***Multi-Function Output Terminal 1 (Relay 1) or (PLC Y0)***	♦R/W	0311	40786
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Same as P3.17~P3.31 (page 4–70)	11		

This parameter (P3.17) sets the function of Multi-Function Output Terminal 1 (Relay 1).

Relay 1 (R1) has a normally open (R1O) and normally closed (R1C) dry contact located on the drive terminal board.

- *Represented by Bit 0 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 0 in P3.43.*

		Type	*Hex Addr*	*Dec Addr*
P3.18	***Multi-Function Output Terminal 2 (Relay 2) or (PLC Y1)***	♦R/W	0312	40787
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Same as P3.17~P3.31 (page 4–70)	1		

This parameter sets the function of Multi-Function Output Terminal 2 (Relay 2).

Relay 2 (R2) has a normally open (R2O) and normally closed (R2C) dry contact located on the drive.

- *Represented by Bit 1 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 1 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.19	***Multi-Function Output Terminal 3 (DO1) or (PLC Y3)***	♦R/W	0313	40788
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Same as P3.17~P3.31 (page 4–70)	0		

This parameter sets the function of Multi-Function Output Terminal 3 (DO1).

DO1 can be wired for a sink or source configuration, and is located on the drive.

- *Represented by Bit 3 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 3 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.20	***Multi-Function Output Terminal 4 (DO2) or (PLC Y4)***	♦R/W	0314	40789
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Same as P3.17~P3.31 (page 4–70)	0		

This parameter sets the function of Multi-Function Output Terminal 4 (DO2).

DO2 can be wired for a sink or source configuration, and is located on the drive.

- *Represented by Bit 4 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 4 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.21	***Multi-Function Output Terminal 5 (option card DO10 or RO10) or (PLC Y5)***	♦R/W	0315	40790
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Same as P3.17~P3.31 (page 4–70)	0		

This parameter sets the function of Multi-Function Output Terminal 5 (DO10) or (RO10) (option card), and can be used only after installing the optional card.

DO10 can be wired for a sink or source configuration, and is located on the GS4-06CDD expansion card.

RO10 has a normally open dry contact located on the GS4-06TR expansion card.

- *Represented by Bit 5 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 5 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.22	***Multi-Function Output Terminal 6 (option card DO11 or RO11) or (PLC Y6)***	♦R/W	0316	40791
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Same as P3.17~P3.31 (page 4–70)	0		

This parameter sets the function of Multi-Function Output Terminal 6 (DO11) or (RO11) (option card), and can be used only after installing the optional card.

DO11 can be wired for a sink or source configuration; located on the GS4-06CDD expansion card.

RO11 has a normally open dry contact located on the GS4-06TR expansion card.

- *Represented by Bit 6 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 6 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.23	**Multi-Function Output Terminal 7 (option card RO12) or (PLC Y7)**	♦R/W	0317	40792
	Range/Units (Format: 16-bit unsigned)	Default		
	Same as P3.17~P3.31 (page 4–70)	0		

This parameter sets the function of Multi-Function Output Terminal 7 (RO12) (option card), and can be used only after installing the optional card.

RO12 has a normally open dry contact located on the GS4-06TR expansion card.

- *Represented by Bit 7 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 7 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.24	**Multi-Function Output Terminal 8 (option card RO13) or (PLC Y10)**	♦R/W	0318	40793
	Range/Units (Format: 16-bit unsigned)	Default		
	Same as P3.17~P3.31 (page 4–70)	0		

This parameter sets the function of Multi-Function Output Terminal 8 (RO13) (option card), and can be used only after installing the optional card.

RO13 has a normally open dry contact located on the GS4-06TR expansion card.

- *Represented by Bit 8 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 8 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.25	**Multi-Function Output Terminal 9 (option card RO14) or (PLC Y11)**	♦R/W	0319	40794
	Range/Units (Format: 16-bit unsigned)	Default		
	Same as P3.17~P3.31 (page 4–70)	0		

This parameter sets the function of Multi-Function Output Terminal 9 (RO14) (option card), and can be used only after installing the optional card.

RO14 has a normally open dry contact located on the GS4-06TR expansion card.

- *Represented by Bit 9 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 9 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.26	**Multi-Function Output Terminal 10 (option card RO15) or (PLC Y12)**	♦R/W	031A	40795
	Range/Units (Format: 16-bit unsigned)	Default		
	Same as P3.17~P3.31 (page 4–70)	0		

This parameter sets the function of Multi-Function Output Terminal 10 (RO15) (option card), and can be used only after installing the optional card.

RO15 has a normally open dry contact located on the GS4-06TR expansion card.

- *Represented by Bit 10 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 10 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.27	**Multi-Function Virtual Output 11 (DO16) or (PLC Y13)**	♦R/W	031B	40796
	Range/Units (Format: 16-bit unsigned)	Default		
	Same as P3.17~P3.31 (page 4–70)	0		

This parameter sets the function of Multi-Function Virtual Output 11 (PLC DO16).
This output is a virtual terminal used by the PLC; there is no physical wiring point.

- *Represented by Bit 11 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 11 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.28	***Multi-Function Virtual Output 12 (DO17) or (PLC Y14)***	♦R/W	031C	40797
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Same as P3.17~P3.31 (page 4–70)	0		

This parameter sets the function of Multi-Function Virtual Output 12 (PLC DO17).
This output is a virtual terminal used by the PLC; there is no physical wiring point.

- *Represented by Bit 12 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 12 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.29	***Multi-Function Virtual Output 13 (DO18) or (PLC Y15)***	♦R/W	031D	40798
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Same as P3.17~P3.31 (page 4–70)	0		

This parameter sets the function of Multi-Function Virtual Output 13 (PLC DO18).
This output is a virtual terminal used by the PLC; there is no physical wiring point.

- *Represented by Bit 13 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 13 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.30	***Multi-Function Virtual Output 14 (DO19) or (PLC Y16)***	♦R/W	031E	40799
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Same as P3.17~P3.31 (page 4–70)	0		

This parameter sets the function of Multi-Function Virtual Output 14 (PLC DO19).
This output is a virtual terminal used by the PLC; there is no physical wiring point.

- *Represented by Bit 14 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 14 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.31	***Multi-Function Virtual Output 15 (DO20) or (PLC Y20)***	♦R/W	031F	40800
	Range/Units (Format: 16-bit unsigned)	*Default*		
	Same as P3.17~P3.31 (page 4–70)	0		

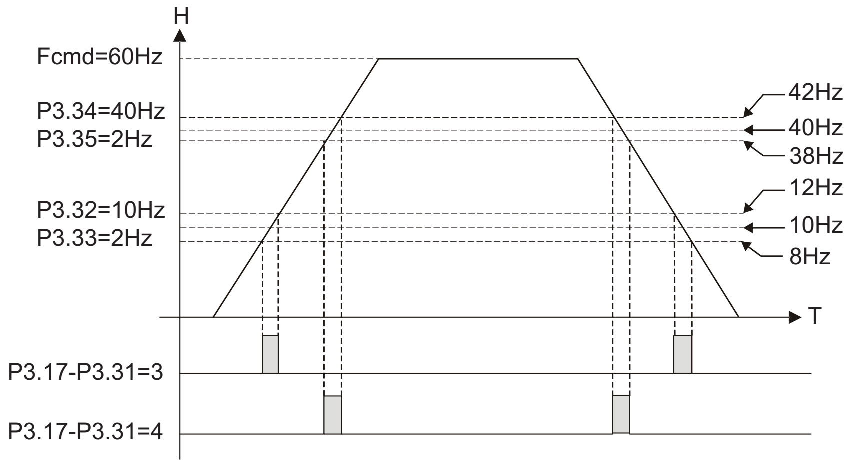
This parameter sets the function of Multi-Function Virtual Output 15 (PLC DO20).
This output is a virtual terminal used by the PLC; there is no physical wiring point.

- *Represented by Bit 15 on the "DO Status" (P3.47) bit map.*
- *NO/NC behavior is controlled by Bit 15 in P3.43.*

		Type	Hex Addr	Dec Addr
P3.32	***Desired Frequency 1***	♦R/W	0320	40801
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	60.00		

If a Multi-Function Output terminal is set to function "At Speed" (P3.17~P3.31 = 03 or 04), then the output will be activated when the programmed frequency is attained and within the window set in P3.33.

- *Once output frequency reaches desired frequency (± width) and the corresponding multi-function output terminal is set to 3 or 4 (P3.17~P3.31), this multi-function output terminal will be ON.*



		Type	Hex Addr	Dec Addr
P3.33	***Desired Frequency 1 Width***	♦R/W	0321	40802
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	2.00		

Sets the window of when the "Desired Frequency 1" (P3.32) will be activated. The value set here represents a plus and minus range surrounding the P3.32 setting. The overall window width will be twice the value set here.

- *Refer to timing chart at P.3.32.*

		Type	Hex Addr	Dec Addr
P3.34	***Desired Frequency 2***	♦R/W	0322	40803
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	60.00		

If a Multi-Function Output terminal is set to function "At Speed" (P3.17~P3.31 = 03 or 04), then the output will be activated when the programmed frequency is attained and within the window set in P3.35.

- *Refer to timing chart at P.3.32.*

		Type	Hex Addr	Dec Addr
P3.35	***Desired Frequency 2 Width***	♦R/W	0323	40804
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	2.00		

Sets the window of when the "Desired Frequency 2" (P3.34) will be activated. The value set here represents a plus and minus range surrounding the P3.34 setting. The overall window width will be twice the value set here.

- *Refer to timing chart at P.3.32.*

		Type	Hex Addr	Dec Addr
P3.36	***PID Deviation Level***	♦R/W	0324	40805
	Range/Units (Format: 16-bit unsigned)	Default		
	1.0~50.0%	10.0		

If a Multi-Function Output terminal is set to PID Deviation Alarm (setting = 15), then the output will be activated when the amount of deviation between the SP (set point) and PV (process variable) in the PID loop exceeds the threshold set by this parameter for the period of time set by P3.37.

- *This parameter is used in conjunction with P3.37, PID Deviation Time.*

		Type	Hex Addr	Dec Addr
P3.37	***PID Deviation Time***	♦R/W	0325	40806
	Range/Units (Format: 16-bit unsigned)	Default		
	0.1~300.0 sec	5.0		

If a Multi-Function Output terminal is set to PID Deviation Alarm (setting = 15), then the output will be activated when the amount of deviation between the SP (set point) and PV (process variable) in the PID loop exceeds the threshold set by P3.36 for the period of time set by this parameter.

- *This parameter is used in conjunction with P3.36, PID Deviation Level, as seen above.*

		Type	Hex Addr	Dec Addr
P3.38	***Frequency Output (FO) Scaling Factor***	♦R/W	0326	40807
	Range/Units (Format: 16-bit unsigned)	Default		
	1~166	1		

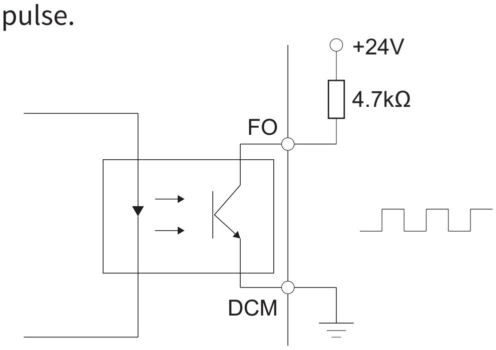
This parameter determines the scaling factor that is used to scale the frequency at the Digital Frequency Output terminals (FO-DCM). The number of output pulses per second at terminal FO is equal to the GS4 drive output frequency multiplied by P3.38.

- *(Pulse per second = actual output frequency x P3.38).*

Example 1: When drive frequency is 60.0Hz and P3.38 = 10; 60.0Hz x 10 = 600.0Hz; Frequency of FO's outputted square wave is 600.0Hz

Example 2: When drive output frequency = 400.0Hz and P3.38 = 20; 400.0Hz x 20 = 8kHz; FO's output frequency is 8kHz.

FO is an open collector circuit. A 50% duty cycle square wave is generated. To use a 24VDC source, insert a 4.7kΩ resistor between the FO and 24V supply. Then read or use the output square wave at the FO terminal for a 24V pulse.

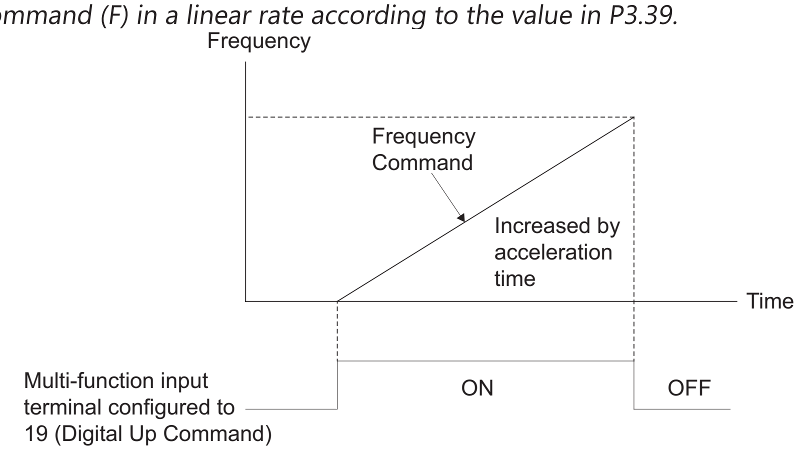


		Type	Hex Addr	Dec Addr
P3.39	***Increase/Decrease Speed Mode***	♦R/W	0327	40808
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000: External Up/Down Terminal used for frequency change follows Accel/Decel Time (P1.01 & P1.02) 0.001~1.000 Hz/ms: External Up/Down Terminal used for frequency change follows constant speed	0		

P3.39 adjusts the rate for the Frequency Up/Down Commands when Multi-Function Input Terminals are set to 19 or 20 (Digital Freq Up/Down Commands). If P3.39 = 0.000, the Frequency Up/Down Commands follow the Accel/Decel Time (P1.01 & P1.02). Any setting higher than 0.000 would be the constant speed rate value in P3.39.

Before using this function, set 1st or 2nd Source of Frequency Command equal to External Up/Down Terminal (P4.00 or P4.01 = 3).

- *When P3.39 is set to 0.00, activate the external terminal Up/Down input to increase/decrease the frequency command according to the system ramps (P1.01 & P1.02).*
- *When P3.39 is set >0, activate the external terminal Up/Down input to increase/decrease the frequency command (F) in a linear rate according to the value in P3.39.*



NOTE: If P3.39>0 and if the UP/DOWN acc/dec P3.39 is faster than the actual drive acc/dec (P1.01 and P1.02), the command frequency will reach desired speed well before the drive output reaches setpoint.

		Type	Hex Addr	Dec Addr
P3.40	***DI6 Counter Debounce Filter***	♦R/W	0328	40809
	Range/Units (Format: 16-bit unsigned)	*Default*		
	00.00~30.00 sec	00.02		

When Digital Input 6 (DI6) is configured for Incremental Counter (P3.08 setting 23), mechanical debounce can be adjusted using P3.40.

- *If the counter is a mechanical switch with a lot of jitter during transitions, the debounce time should be increased.*
- *Debounce time will be applied to both rising and falling edges of the trigger.*

		Type	Hex Addr	Dec Addr
P3.41	***Digital Input Response Time***	♦R/W	0329	40810
	Range/Units	Default		
	0~30.000 sec	0.005		

This parameter sets the response time of the digital input terminals FWD, REV, and DI1~DI8.
NOTE: The response time of DI6 will not be affected by P3.41 when DI6=23. Use P3.40 for response time when DI6=23.

This setting is for digital input terminal signal delay and confirmation. The delay time is confirmation time to prevent some uncertain interference that would cause error in the input of the digital terminals. Under this condition, increasing P3.41 would decrease the likelihood of false triggers. Adjusting this response time effectively acts as a debounced input for some applications.

Use caution when adjusting this Response Time > default. If using Terminals for RUN/STOP or for INC/DEC speed commands, the inputs will respond with the delay set in P3.41 (delay in responding to an input coming ON and going OFF). For most applications, keep this response time as low as possible to reduce unintended consequences.

		Type	Hex Addr	Dec Addr
P3.42	***Multi-Function Input Contact Selection (0=N.O. / 1=N.C.)***	R/W	032A	40811
	Range/Units (Format: 16-bit unsigned)	Default		
	0~65535	0		

The setting of this parameter is in hexadecimal (0 to FFFFh).

The parameter value entered selects the normally open or normally closed state for each of the drive's digital inputs. The value entered here has no affect on SINK/SOURCE configuration, nor will a change in SINK/SOURCE affect the normally-open/normally-closed settings selected here.

This parameter value can be changed from the keypad or through communications with the GS4 drive.

Changes to the NO/NC state of a given digital input, whether from the keypad or from a communications link, will *not* result in a change of that input's logical True/False state.

Example: You cannot select a multi-speed setpoint merely by changing the state of a digital input configured for that purpose.

Bit#	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Input	DI15	DI14	DI13	DI12	DI11	DI10	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1	REV	FWD

NOTE: **Bit #0 = FWD and Bit #1 = REV, normally open contact selection CANNOT be changed!**

		Type	Hex Addr	Dec Addr
P3.43	***Multi-Function Output Contact Selection (0=N.O. / 1=N.C.)***	♦R/W	032B	40812
	Range/Units	Default		
	0~65535	0		

The setting of this parameter is in hexadecimal (0 to FFFFh).

This parameter sets the normally open or normally closed default state for individual digital outputs. If a bit is 1, the corresponding output acts in the opposite way.

Example: If bit0 =1 and P3.17=1, relay output 1 (normally-open contact) is open when the drive is running and is closed when the drive is stopped.

Bit#	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Output*	DO20	DO19	DO18	DO17	DO16	DO15	DO14	DO13	DO12	DO11	DO10	DO2	DO1	reserved	R2*	R1*

**NOTE: Outputs R1 and R2 are SPDT relays with both a normally open and a normally closed output. Be aware of which contact you are wired to in order to correctly anticipate the output state.*

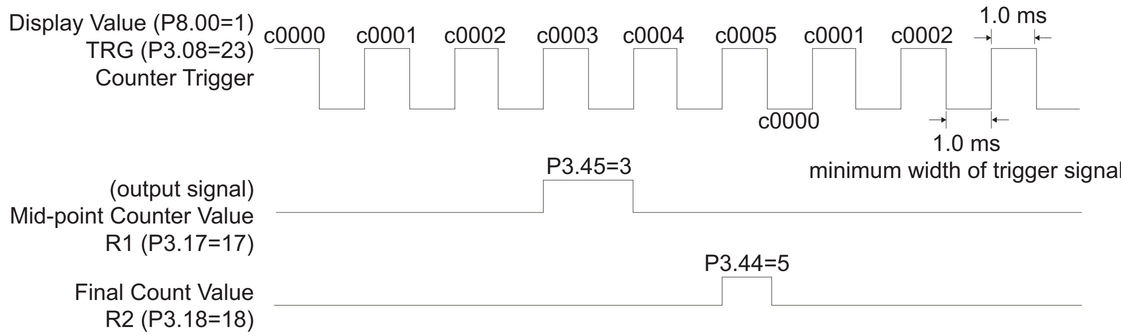
NOTE: This parameter can be used to set digital outputs ON/OFF with remote communications.

		Type	Hex Addr	Dec Addr
P3.44	**Final Counter Value**	♦R/W	032C	40813
	Range/Units	Default		
	0~65500	0		

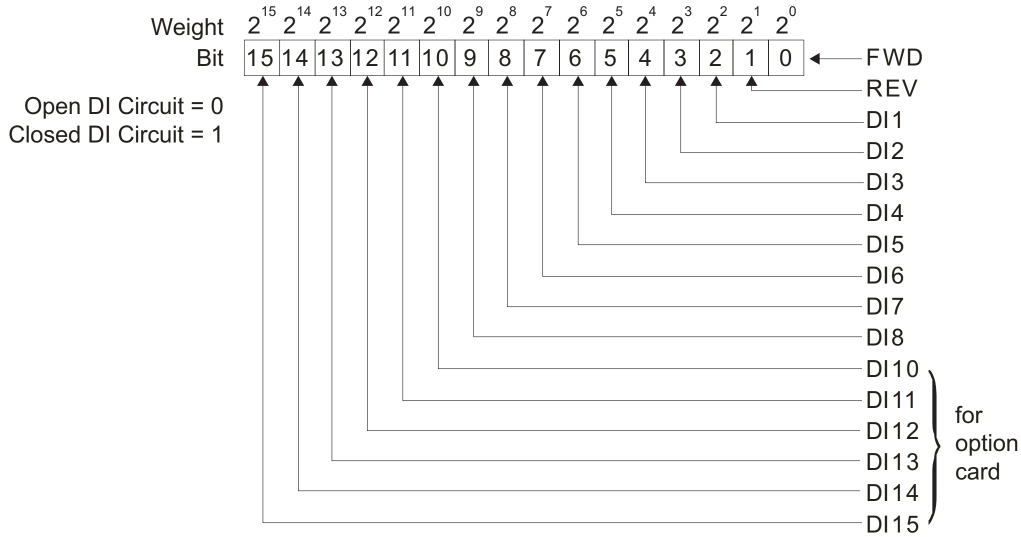
The counter trigger can be incremented by the Multi-Function Input Terminal DI6 (set P3.08 to 23). Once the counter has reached the value in P3.44, the specified output terminal will be activated (any Multi-Function Output = 18). When the final count trigger is deactivated the count automatically returns to 0.

		Type	Hex Addr	Dec Addr
P3.45	**Mid-point Counter Value**	♦R/W	032D	40814
	Range/Units (Format: 16-bit unsigned)	Default		
	0~65500	0		

When the counter value reaches the value set in this parameter, the corresponding Multi-Function Output Terminal (set to 17) will be activated only for that count. Once DI6 is triggered again to the next count, the associated output terminal will be deactivated, as shown below.

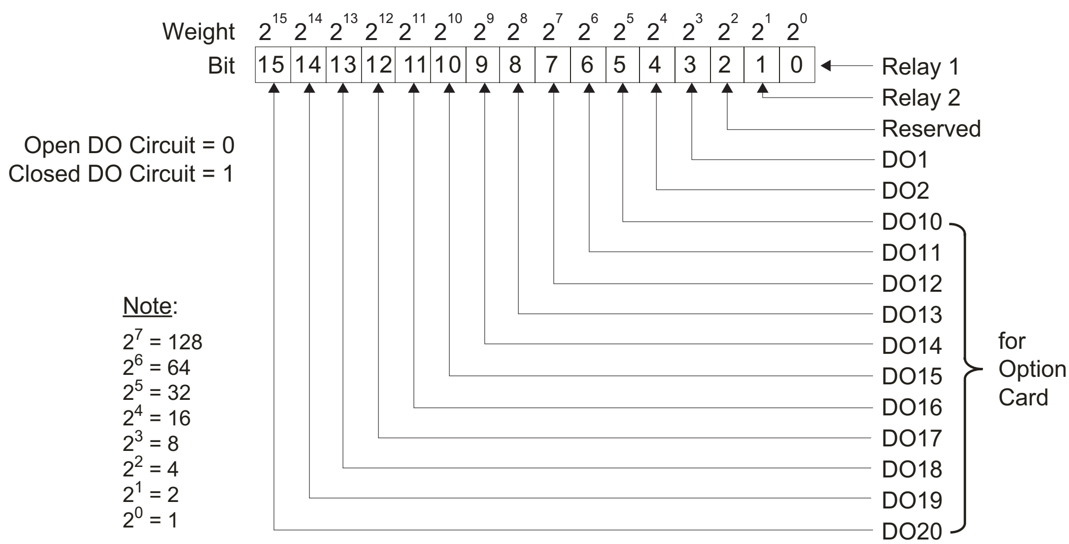


		Type	*Hex Addr*	*Dec Addr*
P3.46	***Digital Input Active Status***	Read	032E	40815
	Range/Units	*Default*		
	0~65535	0		



Example: If P3.46 displays 0034h (Hex), 110100 (binary), it means that DI1, DI3, and DI4 are active if these inputs are in an NO configured state according to P3.42.

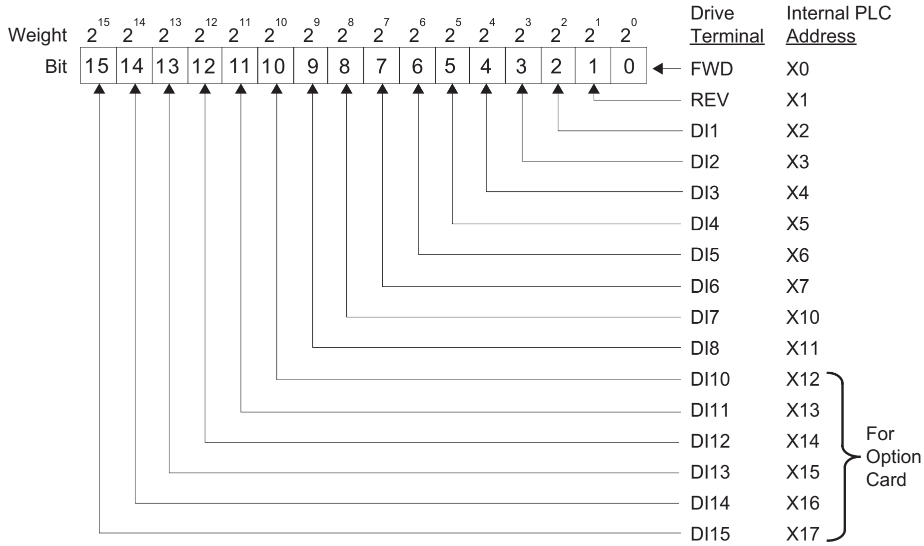
		Type	*Hex Addr*	*Dec Addr*
P3.47	***Digital Output Active Status***	Read	032F	40816
	Range/Units (Format: 16-bit binary)	*Default*		
	0~65535	0		



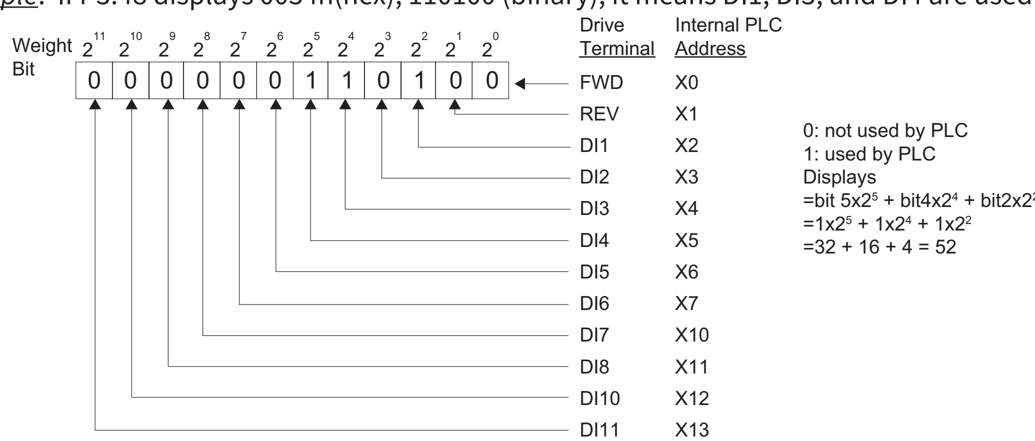
Example: If P3.47 displays 00013h (Hex), 10011 (binary), it means R1, R2, and DO2 are active (or conducting) if these outputs are in an NO configured state according to P3.43.

		Type	*Hex Addr*	*Dec Addr*
P3.48	***PLC – Digital Input Mask***	Read	0330	40817
	Range/Units (Format: 16-bit binary)	*Default*		
	0~65535	0		

P3.48 shows the external Multi-Function Input terminals that are controlled by the PLC.

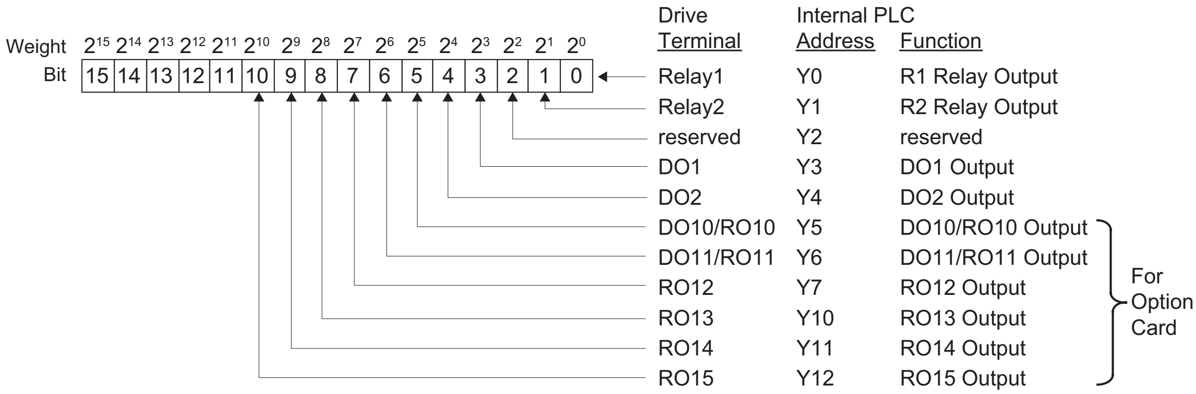


Example: If P3.48 displays 0034h(hex), 110100 (binary), it means DI1, DI3, and DI4 are used by PLC.

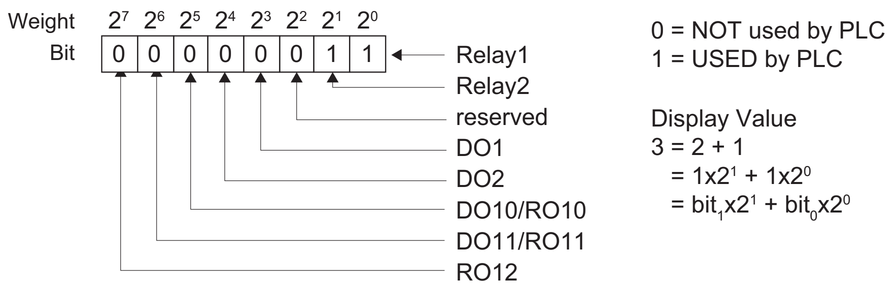


		Type	Hex Addr	Dec Addr
P3.49	***PLC – Digital Output Mask***	Read	0331	40818
	Range/Units (Format: 16-bit binary)	*Default*		
	0~65535	0		

P3.49 shows the external Multi-Function Output terminals that are controlled by the PLC.



Example: If the value of P3.49 displays 0003h (Hex), it means R1and R2 are used by PLC.



		Type	Hex Addr	Dec Addr
P3.50	***Increase/Decrease Speed Command Record***	Read	0332	40819
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~599.00	60.00		

When the source of frequency command comes from the external terminal and a fault occurs at this time, the frequency command of the external terminal will be saved in this parameter. (Not the actual current frequency of the drive at time of fault, just the last *commanded* frequency.)

		Type	Hex Addr	Dec Addr
P3.51	**Brake Delay Time**	R/W	0333	40820
	Range/Units (Format: 16-bit unsigned)	Default		
	0.000~65.000 sec	0		

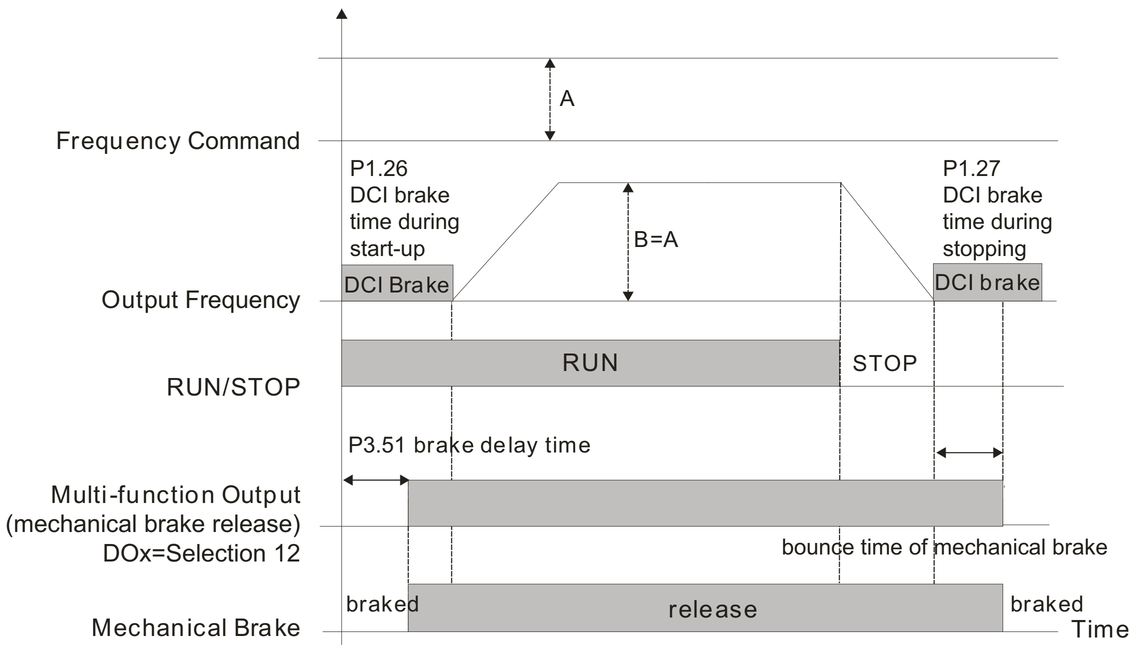
When P3.51 is used with MFO selection #42, see the MFO definition #42 (P3.17) for more details.

When P3.51 is used with MFO selection #12 AND the GS4 drive runs after P3.51 delay time, the corresponding Multi-Function Output terminal (12: brake release function) will be ON when used with DC Injection Braking (P1.25, P1.26, P1.27).

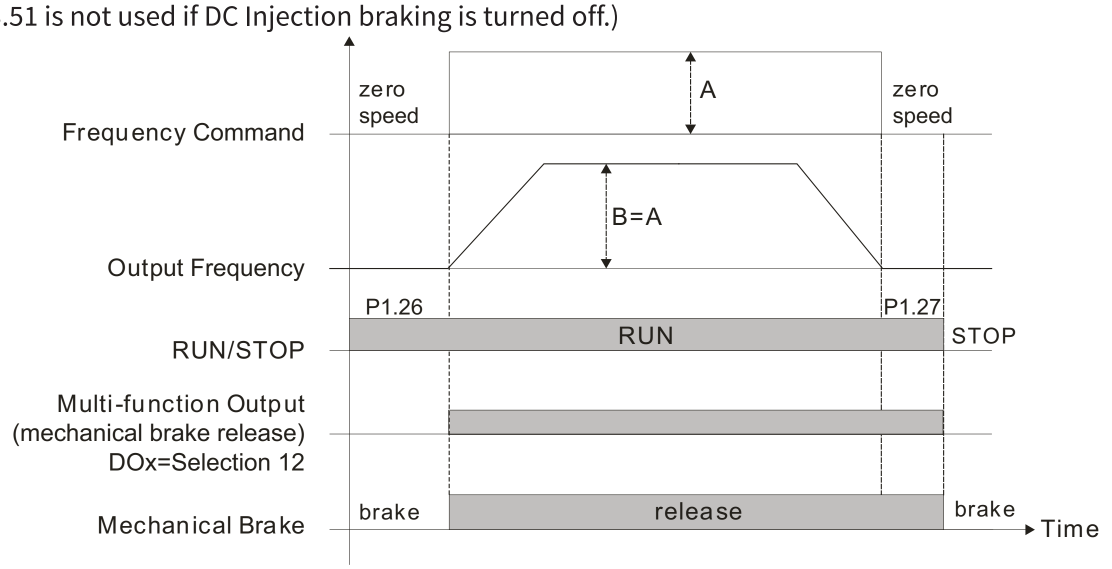
Timing chart for parameter P3.51 used with DC Injection (DCI) braking:

If Brake Delay Time is longer than DCI Start Time, the Brake output will energize at the Start of the Accel ramp (total delay time is never more than DCI Start Time).

If Brake Delay Time is longer than DCI Stop Time, the brake output will energize at the end of DCI Stop Time (the total delay time is never more than DCI Stop Time).



Timing chart for parameter P3.51 used without DC Injection (DCI) braking (P1.25 > 0):
(P3.51 is not used if DC Injection braking is turned off.)



Related parameters: P3.52, P3.53. (Parameters related to P3.51)

		Type	Hex Addr	Dec Addr
P3.52	***Desired Current***	♦R/W	0334	40821
	Range/Units	*Default*		
	0~150% of GS4 VT current rating	0		

Output Current Level Setting for Multi-Function Output Terminals.

When output current to the motor is greater than or equal to P3.52, it will activate the Multi-Function Output terminal that is set to 27 (Above Current Output).

When output current to the motor is less than P3.52, it will activate Multi-Function Output terminal that is set to 28 (Below Current Output).

NOTE: The % of Desired Current P3.52 is based on the Drive's VT Current Rating (not motor current rating).

Related parameters: P3.51, P3.53 (refer to P3.51, page 4–85).

		Type	Hex Addr	Dec Addr
P3.53	***Output Frequency Limit for Multi-Function Output Terminals***	♦R/W	0335	40822
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	0		

When a Multi-Function Output setting = #42 (Brake Released at Stop), the output will activate when the drive is stopped and decels past P3.53. In this mode, the output will only stay on for the time in P3.51 (Brake Delay Time). With a long decel ramp and a short brake time, the output could energize (for P3.51 seconds) and then de-energize before the deceleration ramp is complete.

- *When a Multi-Function Output setting = #58 (Frequency Output Above P3.53), the output will activate when the drive's output frequency is ≥ P3.53.*
- *When a Multi-Function Output setting = #59 (Frequency Output Below P3.53), the output will activate when the drive's output frequency is < P3.53.*

Related parameters: P3.51, P3.52 (refer to P3.51, page 4–85).

		Type	Hex Addr	Dec Addr
P3.54	***reserved***	n/a	0336	40823
	Range/Units	*Default*		
	n/a	n/a		

		Type	Hex Addr	Dec Addr
P3.55	***reserved***	n/a	0337	40824
	Range/Units	*Default*		
	n/a	n/a		

		Type	*Hex Addr*	*Dec Addr*
P3.56	***Emergency Stop (EF) & Force Stop Selection***	R/W	0338	40825

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

0: Coast Stop
1: Stop by 1st Deceleration Time (P1.02)
2: Stop by 2nd Deceleration Time (P1.04)
3: Stop by 3rd Deceleration Time (P1.06)
4: Stop by 4th Deceleration Time (P1.08)
5: System Deceleration
(The drive will ramp down according to the current deceleration time selected. This could be 1st~4th decel time.)
6: Automatic Deceleration
(The drive will try to ramp down to a stop within 1 second.)

P3.56 determines GS4 drive stop method. When the multi-function input terminal is set to 10 or 18 and is activated, the drive will stop according to the setting in P3.56.

		Type	*Hex Addr*	*Dec Addr*
P3.57	***AUTO to HAND Switching Behavior***	♦R/W	0339	40826

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

0~Fh

bit 0: Sleep function control bit
0: Cancel sleep function
1: Sleep function follows setting of Auto mode (P7.27~P7.32)

bit 1: Parameter (units) displayed on keypad
0: Change the unit to be Hz in Hand mode and display units in P8.02 in Auto mode.
1: Change the unit to display units in P8.02 in Auto and Hand modes.

bit 2: PID control bit
0: Cancel PID control
1: PID control follows the setting of Auto mode (P8.02)

bit 3: Source of frequency control bit
0: The source of frequency is set by parameters. If the multi-step speed setting is activated then multi-step speed has the priority.
1: In Auto mode the source of frequency is set by P4.01, no matter whether or not the multi-step speed setting is activated.

P3.58 does not need to be set to 0 for P3.57 to be valid.

		Type	Hex Addr	Dec Addr
P3.58	***Local/Remote Switch Mode***	R/W	033A	40827

Range/Units (Format: 16-bit binary) — *Default*: 4

0: Used for HAND/OFF/AUTO control from external terminals if MFI settings 31 and 32 are configured. If no multi-function inputs are configured for 31 or 32, then only HAND/AUTO control will be available by using the keypad LOCAL (HAND) and REMOTE (AUTO). The OFF feature of HOA will not be available. MFI setting 33 will not be valid when P3.58= 0.

1: Always Stop When Switching: If the drive is running when switching from Local to Remote or Remote to Local, the drive will stop when switched unless there is an active RUN command applied to the switched-to mode. If the drive is already stopped, it still remains stopped.

2: Follow Remote Mode: The drive still follows the setting at Remote while switching to Local. For example, if the setting at Remote is "running," the drive keeps on "running" even after the drive is switched from Remote to Local. Unless a "stop" command is given, then the drive will be stopped under Local mode.

3: Follow Local Mode: The drive still follows the setting at Local while switching to Remote. For example, if the setting at Local is “stop,” the drive keeps “stopping” even after the drive is switched to Remote mode. Unless a “running” command is present or given in Remote mode, then the drive will start to run under Remote mode.

4: Follow Local and Remote Mode: The drive follows the settings of both Local and Remote. When switching from one mode to another, the drive follows the command of the previous mode unless a new command is given on the switched-to mode.

Source of operation must be defined in P3.00, P3.01, P4.00, and P4.01.

Settings 0~4:

When set to 0, upper right corner of screen will display “HAND” or “AUTO”. When set to 1, 2, 3, or 4, the upper right corner of the screen will display “LOC” or “REM.”

If P3.58 ≠ 0 and a multi-function input is set to 31 or 32, then HOA control has priority and the upper right corner of the screen will display “HAND” or “AUTO.”

Group P4.xx Details – Analog Parameters

		Type	Hex Addr	Dec Addr
P4.00	**1st Source of Frequency Command [Remote]**	♦R/W	0400	41025
P4.01	**2nd Source of Frequency Command [Local]**	♦R/W	0401	41026

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

0: Digital Keypad [see Note below]* — P4.00: 0
1: RS485 Communication (Modbus/BACnet) [see Warning below]** — P4.01: 0
2: Analog Input [must also configure P4.02, P4.03, or P4.04]
3: External UP/DOWN Terminal
4: Comm Card [see Warning below]**

These parameters, P4.00 & P4.01, set the source of the master Frequency.

- *Parameter P4.00 selects the source of the Frequency Command in REMOTE mode.*
- *Parameter P4.01 selects the source of the Frequency Command in LOCAL mode.*

"Local/Remote Selection." Reference parameter P3.03, setting #33.

The factory setting of Frequency and Operation source is for REMOTE mode. The drive will always power-up in REMOTE mode unless a Multi-Function Input terminal is used to switch LOCAL/REMOTE mode. The highest priority is the Multi-Function Input terminal.

Related parameters: P3.00 & P3.01 set the source of the Operation Command.

- *Parameter P3.00 selects the source of the Operation Command in REMOTE mode.*
- *Parameter P3.01 selects the source of the Operation Command in LOCAL mode.*

Related parameter: P3.58 Local/Remote Switch Mode

- *Parameter P3.58 determines the drive behavior while switching from one mode to another.*

Related parameter: P4.09 sets the Analog Frequency Command for Reverse Run.

- *If P4.09 is set to 0, the command signal will be treated as an absolute value (always positive), and the motor will always turn in the direction commanded by the digital inputs (or FWD/REV buttons).*
- *Set P4.09=1 if you want the analog signal to change the motor's direction. Use this setting with AI3 (which can be +/-10V) to achieve positive and negative frequency commands.*
  Non-bipolar analog signals (0~10V, 4~20ma, etc.) can achieve positive and negative frequency command by applying a -50% bias.
  Example: if a 0~10V signal is used on AI1, entering a bias of -50% in P4.10 (AI1 Input Bias) will allow positive and negative direction command. [0~5V will cause reverse rotation, and 5~10V will cause forward rotation. 5V will be the new zero speed.]

Related Parameters: PID parameters P7.00.

- *When PID is enabled (P7.00>0), data will map from P4.00 or P4.01 to P7.02, depending upon whether in Remote or Local. The Source of Frequency Command selected in P4.00 or P4.01 will be the PID Setpoint.*

NOTE: GS4's output frequency can be affected by the Trim Function. If P4.08 Trim Function is set to a non-zero value, the drive's actual output frequency may not match the Local or Remote Command Frequency. See P4.08 for ways to add or subtract to the command frequency.

**NOTE: there is only one Keypad frequency. If both P4.00 and P4.01 are set for 0: Digital Keypad, the Frequency Command will be the same in both Local and Remote modes.*

*****WARNING! IF THE GS4 DRIVE 1ST OR 2ND "SOURCE OF FREQUENCY COMMAND" IS "RS-485 COMMUNICATION" OR "COMM CARD" (P4.00 OR P4.01 = 1 OR 4), AND THE FREQUENCY COMMAND IS GREATER THAN THE "DRIVE MAXIMUM OUTPUT FREQUENCY (P0.04), THE GS4 DRIVE WILL ACCELERATE TO THE "DRIVE MAXIMUM OUTPUT FREQUENCY AS DEFINED IN (P0.04).***

		Type	Hex Addr	Dec Addr
P4.02	***Analog Input 1 (AI1) Function***	♦R/W	0402	41027
P4.03	***Analog Input 2 (AI2) Function***	♦R/W	0403	41028
P4.04	***Analog Input 3 (AI3) Function***	♦R/W	0404	41029

Range/Units (Format: 16-bit binary)	Default
0: no Function	P4.02: 1
1: Frequency Command/PID Setpoint REMOTE*	P4.03: 0
2: Frequency Command/PID Setpoint LOCAL*	P4.04: 0
3: Frequency Command/PID Setpoint REMOTE & LOCAL*	
4: reserved	
5: PID Feedback Signal*	
6: PTC Thermistor Input Value*	
7: PID Setpoint Offset*	
8~10: reserved	
11: PT100 RTD Input Value*	

*(*1,2,3,5,7) PID functions 1, 2, 3, 5 & 7: Refer to Parameter Group 7 to define the analog inputs for PID Setpoint, Feedback, and PID Setpoint Offset use.*

*(*6) PTC Thermistor Input Value: Refer to P6.39~P6.40. When the input goes above the value set in P6.40, the action in P6.39 will occur. The PTC Warning and/or Fault will be oH3: Motor Over Heat. (For Option 6 to work, P6.43 PT Drop Freq must be > 0.)*

*(*11) RTD (PT100) Thermistor Input Value: Refer to P6.41~P6.44. The PT100 Warning and/or Fault will also be oH3: Motor Over Heat. (For Option 11 to work, P6.43 PT100 Drop Frequency must be > 0.)*

These three parameters, P4.02~P4.04, assign functions for the three analog inputs, AI1~AI3.

Please note that parameter settings 1, 2, and 3 can assign any of the analog inputs to be Frequency Command/PID Setpoint for REMOTE mode only (#1), for LOCAL mode only (#2), or for both REMOTE and LOCAL modes (#3).

Example: An application requires analog input control from a PLC while the process is running, but speed control from a local potentiometer is needed for setup/jogging.

- *Set both P4.00 (REMOTE) AND P4.01 (LOCAL) = 2 (Analog Input).*
- *Wire the PLC signal to AI1, and set P4.02 = 1 (AI1 = Freq Command in REMOTE).*
- *Wire the potentiometer to AI2, and set P4.03 = 2 (AI2 = Freq Command in LOCAL).*

With these settings and control wiring, the system will respond to the PLC signal when the REMOTE button is pressed, and will follow the potentiometer when the LOCAL button is pressed.

Note: If multiple registers are selected for the same function, the priority (which one wins) is AI1>AI2>AI3.
Example: If a "1" is entered into all 3 of these parameters, AI1 will be the active "Frequency Command/PID Setpoint REMOTE".

Note: AI3 is always ±10V.

Related parameters: P0.04 (Drive Max Output Frequency), P4.00~P4.01 (Remote/Local Source of Freq Command), P6.39~P6.44 (for details on setting up RTD or PTC), P7.xx (PID)

		Type	Hex Addr	Dec Addr
P4.05	***AI1 – I/V Selection***	♦R/W	0405	41030
P4.06	***AI2 – I/V Selection***	♦R/W	0406	41031

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

0: AI1v Selection (0~10V) — P4.05: 0
1: AI1i Selection (4~20mA) — P4.06: 1
2: AI1i Selection (0~20mA)

P4.05 configures Analog Input 1 (AI1) for either voltage or current input.
(P4.63 determines the drive behavior if the AI1 4~20mA signal is lost.)

P4.06 configures Analog Input 2 for either voltage or current input.
(P4.64 determines the drive behavior if the AI2 4~20mA signal is lost.)

This setting must match the DIP switch setting of switch SW3 (for P4.05) or SW4 (for P4.06). (Switches are located just above the control wiring terminal strip)

If ±10V is needed, use AI3.

See P6.39~P6.44 for RTD/PTC setup.

		Type	Hex Addr	Dec Addr
P4.07	***Trim Reference Frequency***	R/W	0407	41032

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

0.00~599.00 Hz — 0.0

The Trim Reference Frequency is used with P4.08 to add or subtract to the drive command frequency. This parameter can also be used as an offset or bias to the command signal. Commonly used with communication control.

		Type	Hex Addr	Dec Addr
_P4.08_	**_Trim Selection_**	R/W	0408	41033

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

0: Disable Trim Function
1: 1st Source Freq + 2nd Source Freq
2: 1st Source Freq - 2nd Source Freq
3: Speed Source + Trim Ref Freq
4: Speed Source - Trim Ref Freq

Trim Selection is used to combine multiple signals into one speed reference. For Options 1 and 2, P4.07 Trim Reference Frequency does not change the output frequency. For options 3 and 4, the currently selected source of frequency is combined with the Trim Frequency (P4.07).

NOTE: P4.09 determines if the frequency command signal can change motor direction. If P4.09=1, and the frequency command goes negative, the motor will spin in the opposite direction. If P4.09=0, the drive will always treat the frequency command as a positive number (direction will not change). The result of this (P4.09=0)calculation is an Absolute Value (no negatives).

NOTE: The Trim function works as expected with all analog signals and setting speed via communication (RS-485 or Ethernet). Care must be used if the Trim function is used while one of the Sources of Operation = Keypad (P3.00 or P3.01=0). The operation is repeatable, but must be understood: When the frequency command is changed via the keypad, the drive interprets that value as the new command value from the keypad (as expected). However, if the Trim function is active, once that frequency command is entered via the keypad, the Trim function will then act upon that new value according to P4.08 (and may not result in expected behavior, until you understand the process).

Example:

- *P4.08 = 1 (output freq = Source 1 + Source 2)*
- *P4.00 = 2 (1st Source of Freq [Remote] = Analog Input 3).*
  [The incoming analog signal = 1V = 6Hz command.]
- *P4.04 = 1 (AI3 = Frequency Command when in Remote mode)*
- *P4.01 = 0 (2nd Source of Freq [Local] = Keypad)*

If you press “LOCAL”, the source of frequency command will be from the keypad. If you enter 0Hz into the frequency command via the keypad, as soon as you press ESC (to get out of the “value entry” mode), the drive will add the entered value to the 6Hz command coming from AI3 (because you selected P4.08 Trim = 1 to add the two sources). The new frequency command will be 6Hz. Now, press “ENTER” to adjust the frequency command again. Don’t change any value (leave the setting at 6Hz). As soon as you press ESC (to get out of the “value entry” mode), the drive will add the 6Hz you just entered to the AI3 value of 6Hz. The new command frequency will be 12Hz. This is the programmed behavior when using the Trim function and Keypad frequency control.

		Type	Hex Addr	Dec Addr
P4.09	***Analog Frequency Command for Reverse Run***	♦R/W	0409	41034

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

0: Negative Frequency Input is Disabled.
Forward and reverse directions are controlled by digital keypad or by external terminal.

1: Negative Frequency Input is Enabled.
Forward direction when positive frequency; reverse direction when negative frequency.
Forward and reverse directions are NOT controlled by digital keypad or by external terminal.
Use this setting with AI3 (which can be up to ±10V), or with bias settings to achieve positive and negative frequency commands.
Negative analog signals can be generated by AI3 (which has ability for ±10V signal), or by any of the analog inputs used with bias. (A bias of -50% used with a 0~10V signal will result in 0~5V = reverse rotation, and 5~10V = forward rotation)

NOTE: Fwd/Rev Direction Inhibit P6.09 can also eliminate reverse (or forward) motor direction.

NOTE: Refer to the detailed Analog Input Example #4 (page 4–112) at the end of these "Group P4.xx Details – Analog Parameters" listings for more information.

		Type	Hex Addr	Dec Addr
P4.10	***AI1 Input Bias (Offset)***	♦R/W	040A	41035
	Range/Units (Format: 16-bit signed)	*Default*		
	–100.0% to +100.0%	0		

		Type	Hex Addr	Dec Addr
P4.11	***AI1 Input Bias (Offset) Polarity***	♦R/W	040B	41036
	Range/Units (Format: 16-bit binary)	*Default*		
	0: NO Offset 1: Positive Offset 2: Negative Offset	0		

		Type	Hex Addr	Dec Addr
P4.12	***AI1 Input Gain***	♦R/W	040C	41037
	Range/Units (Format: 16-bit signed)	*Default*		
	–500.0% to +500.0%	100.0		

Parameters P4.10 to P4.13 are used when the source of the Frequency Command is an analog voltage signal connected to AI1. The relationship between the external input voltage (current) and setting frequency: 0~10V (4~20mA) corresponds to 0~60Hz.

- *P4.10 adjusts the bias (offset) for Analog Input #1.*
- *P4.11 sets the offset polarity for Analog Input #1.*
  If the application requires a negative offset, but the PLC cannot supply a negative number, choose "Negative Offset" and enter a positive number in P4.10.
- *P4.12 adjusts the gain for Analog Input #1.*
- *P4.13 provides a delay to serve as an electrical noise filter for Analog Input #1.*

	Offset	Polarity	Analog Command Calculation
P4.10 thru P4.12	Positive	P4.11=1	Frequency Output (Hz) = [(Analog In %) x (Gain %) + (Bias %)] x (Max Out Hz)
	Negative	P4.11=2	Frequency Output (Hz) = [(Analog In %) x (Gain %) - (Bias %)] x (Max Out Hz)
	Calculation by Parameter #s		Frequency Output (Hz) = [(AI Volts / 10) x (P4.12) ± (P4.10)] x (P0.04)

NOTE: P4.24 must be set to enable bias and gain calculations for this AI.

NOTE: Refer to the detailed Analog Input Examples (page 4–108) at the end of these "Group P4.xx Details – Analog Parameters" listings for more information.

		Type	Hex Addr	Dec Addr
P4.13	***AI1 Filter***	♦R/W	040D	41038
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~20.00 sec	0.01		

This parameter sets a delay for Analog Input #1 to filter a noisy signal.

When the setting of P4.13 is too large, the reading of AI1 will be more stable but the control response will be slower. When the setting of P4.13 is too small, the control response will be faster but the control may be unstable due to a noisy AI1 reading. To find the optimal setting, adjust the setting according to the desired amount of response vs signal accuracy.

		Type	Hex Addr	Dec Addr
P4.14	***reserved***	n/a	040E	41039
	Range/Units	*Default*		
	n/a	n/a		

		Type	Hex Addr	Dec Addr
P4.15	***AI2 Input Bias (Offset)***	♦R/W	040F	41040
	Range/Units (Format: 16-bit signed)	*Default*		
	–100.0% to +100.0%	0		

		Type	Hex Addr	Dec Addr
P4.16	***AI2 Input Bias (Offset) Polarity***	R/W	0410	41041
	Range/Units (Format: 16-bit binary)	*Default*		
	0: NO Offset 1: Positive Offset 2: Negative Offset	0		

		Type	Hex Addr	Dec Addr
P4.17	***AI2 Input Gain***	♦R/W	0411	41042
	Range/Units (Format: 16-bit signed)	*Default*		
	–500.0% to +500.0%	100.0		

Parameters P4.15 to P4.18 are used when the source of the Frequency Command is an analog current signal connected to AI2. The relationship between the external input current (voltage) and setting frequency: 4~20mA (0~10V) corresponds to 0~60Hz.

- *P4.15 adjusts the bias (offset) for Analog Input #2.*
- *P4.16 sets the offset polarity for Analog Input #2.*
  If the application requires a negative offset, but the PLC cannot supply a negative number, choose "Negative Offset" and enter a positive number in P4.15.
- *P4.17 adjusts the gain for Analog Input #2.*
- *P4.18 provides a delay to serve as an electrical noise filter for Analog Input #2.*

	Offset	***Polarity***	***Analog Command Calculation***
P4.15 thru P4.17	Positive	P4.16=1	Frequency Output (Hz) = [(Analog In %) x (Gain %) + (Bias %)] x (Max Out Hz)
	Negative	P4.16=2	Frequency Output (Hz) = [(Analog In %) x (Gain %) - (Bias %)] x (Max Out Hz)
	Calculation by Parameter #s		Frequency Output (Hz) = [(AI Volts / 10) x (P4.17) ± (P4.15)] x (P0.04)

NOTE: P4.24 must be set to enable bias and gain calculations for this AI.

NOTE: Refer to the detailed Analog Input Examples (page 4–108) at the end of these "Group P4.xx Details – Analog Parameters" listings for more information.

		Type	Hex Addr	Dec Addr
P4.18	***AI2 Filter***	♦R/W	0412	41043
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~20.00 sec	0.01		

This parameter sets a delay for Analog Input #2 to filter a noisy signal.

When the setting of P4.18 is too large, the reading of AI2 will be more stable but the control response will be slower. When the setting of P4.18 is too small, the control response will be faster but the control may be unstable due to a noisy AI2 reading. To find the optimal setting, adjust the setting according to the desired amount of response vs signal accuracy.

		Type	Hex Addr	Dec Addr
P4.19	***AI3 Input Bias (Offset)***	♦R/W	0413	41044
	Range/Units (Format: 16-bit signed)	*Default*		
	–100.0% to +100.0%	0		

		Type	Hex Addr	Dec Addr
P4.20	***AI3 Input Bias (Offset) Polarity***	R/W	0414	41045
	Range/Units (Format: 16-bit binary)	*Default*		
	0: NO Offset 1: Positive Offset 2: Negative Offset	0		

		Type	Hex Addr	Dec Addr
P4.21	***+AI3 Input Gain***	♦R/W	0415	41046
P4.22	***-AI3 Input Gain***	♦R/W	0416	41047
	Range/Units (Format: 16-bit signed)	*Default*		
	–500.0% to +500.0%	100.0		

Parameters P4.19 to P4.23 are used when the source of the Frequency Command is an analog voltage signal connected to AI3.

- *AI3 is the only input that has ± voltage capability.*
- *Bias is the same regardless of AI3 value, but Gain is different for positive/negative input.*

The relationship between the external input voltage and setting frequency:

- *If P4.09=0: -10V to +10V corresponds to 0~60Hz.*
- *If P4.09=1: 0V to +10V corresponds to 0~60Hz foward direction.*
  0V to -10V corresponds to 0~60Hz reverse direction.
- *P4.19 adjusts the bias (offset) for Analog Input #3.*
- *P4.20 sets the offset polarity for Analog Input #3.*
  If the application requires a negative offset, but the PLC cannot supply a negative number, choose "Negative Offset" and enter a positive number in P4.19.
- *P4.21 adjusts the gain for Analog Input #3 when the input is positive.*
- *P4.22 adjusts the gain for Analog Input #3 when the input is negative.*
- *P4.23 provides a delay to serve as an electrical noise filter for Analog Input #3.*

	Offset	Polarity	Analog Command Calculation
P4.19 thru P4.22	Positive	P4.20=1	Frequency Output (Hz) = [(Analog In %) x (Gain %) + (Bias %)] x (Max Out Hz)
	Negative	P4.20=2	Frequency Output (Hz) = [(Analog In %) x (Gain %) - (Bias %)] x (Max Out Hz)
	Calculation by Parameter #s		Frequency Output (Hz) = [(AI Volts / 10) x (P4.21 or P4.22) ± (P4.19)] x (P0.04)

NOTE: P4.24 must be set to enable bias and gain calculations for this AI.

NOTE: Gain% is dependent on P4.20 setting. If P4.20=1 use P4.21 for Gain% calculation. If P4.20=2 use P4.22 for Gain% calculation.

NOTE: *Refer to the detailed Analog Input Examples (page 4–108) at the end of these "Group P4.xx Details – Analog Parameters" listings for more information.*

		Type	Hex Addr	Dec Addr
P4.23	***AI3 Filter***	♦R/W	0417	41048
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~20.00 sec	0.01		

This parameter sets a delay for Analog Input #3 to filter a noisy signal.

When the setting of P4.23 is too large, the reading of AI3 will be more stable but the control response will be slower. When the setting of P4.23 is too small, the control response will be faster but the control may be unstable due to a noisy AI3 reading. To find the optimal setting, adjust the setting according to the desired amount of response vs signal accuracy.

		Type	Hex Addr	Dec Addr
P4.24	***AI V/Hz Calculated Selection***	R/W	0418	41049

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

0: All Inputs Use Bias and Gain
1: AI1 Custom V/Hz
2: AI2 Custom V/Hz
3: AI1 & AI2 Custom V/Hz
4: AI3 Custom V/Hz
5: AI1 & AI3 Custom V/Hz
6: AI2 & AI3 Custom V/Hz
7: All Custom V/Hz

This parameter selects the type of V/Hz calculation to be used by each Analog Input.

Detailed Descriptions of P4.24 AI V/Hz Calculated Selection Settings	
Setting: Function	***Function Description***
0: All Inputs Use Bias and Gain	All analog input signals are calculated by using bias and gain (P4.10~P4.23).
1: AI1 Custom V/Hz	AI1 is calculated by using frequency and voltage/current in Low/Mid/High-Point format (P4.25~P4.48). Other analog input signals are calculated by using bias and gain.
2: AI2 Custom V/Hz	AI2 is calculated by using frequency and voltage/current in Low/Mid/High-Point format (P4.31~P4.36). Other analog input signals are calculated by using bias and gain.
3: AI1 & AI2 Custom V/Hz	AI1 & AI2 are calculated by using frequency and voltage/current in Low/Mid/High-Point format (P4.25~P4.36). Other analog input signals are calculated by using bias and gain.
4: AI3 Custom V/Hz	AI3 is calculated by using frequency and voltage in Low/Mid/High-Point format (P4.37~P4.48). Other analog input signals are calculated by using bias and gain.
5: AI1 & AI3 Custom V/Hz	AI1 & AI3 are calculated by using frequency and voltage/current in Low/Mid/High-Point format (P4.25~P4.30, P4.37~P4.48). Other analog input signals are calculated by using bias and gain.
6: AI2 & AI3 Custom V/Hz	AI2 & AI3 are calculated by using frequency and voltage/current in Low/Mid/High-Point format (P4.31~P4.48). Other analog input signals are calculated by using bias and gain.
7: All Custom V/Hz	All analog input signals are calculated by using frequency and voltage/current in Low/Mid/High-Point format (P4.25~P4.48).

<u>NOTE</u>: *Refer to the detailed Analog Input Example #9 (page 4–117) at the end of these "Group P4.xx Details – Analog Parameters" listings for more information.*

		Type	Hex Addr	Dec Addr
P4.25	***AI1 Low V/A***	R/W	0419	41050
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P4.05=0: 0.00~10.00V P4.05=1: 4.00~20.00mA P4.05=2: 0.00~20.00mA	P4.05=0: 0.00V P4.05=1: 4.00mA P4.05=2: 0.00mA		

		Type	Hex Addr	Dec Addr
P4.26	***AI1 Low Hz Percent***	R/W	041A	41051
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~100.00%	0		

		Type	Hex Addr	Dec Addr
P4.27	***AI1 Mid V/A***	R/W	041B	41052
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P4.05=0: 0.00~10.00V P4.05=1: 4.00~20.00mA P4.05=2: 0.00~20.00mA	P4.05=0: 5.00V P4.05=1: 12.00mA P4.05=2: 10.00mA		

		Type	Hex Addr	Dec Addr
P4.28	***AI1 Mid Hz Percent***	R/W	041C	41053
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~100.00%	50.00		

		Type	Hex Addr	Dec Addr
P4.29	***AI1 High V/A***	R/W	041D	41054
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P4.05=0: 0.00~10.00V P4.05=1: 4.00~20.00mA P4.05=2: 0.00~20.00mA	P4.05=0: 10.00V P4.05=1: 20.00mA P4.05=2: 20.00mA		

		Type	Hex Addr	Dec Addr
P4.30	***AI1 High Hz Percent***	R/W	041E	41055
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~100.00%	100.00		

Parameters P4.25 to P4.30 are used to configure custom V/Hz settings when the source of the Frequency Command is a current or voltage analog signal at AI1.

		Type	Hex Addr	Dec Addr
P4.31	**AI2 Low V/A**	R/W	041F	41056
	Range/Units (Format: 16-bit unsigned)	Default		
	P4.06=0: 0.00~10.00V P4.06=1: 4.00~20.00mA P4.06=2: 0.00~20.00mA	P4.06=0: 0.00V P4.06=1: 4.00mA P4.06=2: 0.00mA		

		Type	Hex Addr	Dec Addr
P4.32	**AI2 Low Hz Percent**	R/W	0420	41057
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00~100.00%	0		

		Type	Hex Addr	Dec Addr
P4.33	**AI2 Mid V/A**	R/W	0421	41058
	Range/Units (Format: 16-bit unsigned)	Default		
	P4.06=0: 0.00~10.00V P4.06=1: 4.00~20.00mA P4.06=2: 0.00~20.00mA	P4.06=0: 5.00V P4.06=1: 12.00mA P4.06=2: 10.00mA		

		Type	Hex Addr	Dec Addr
P4.34	**AI2 Mid Hz Percent**	R/W	0422	41059
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00~100.00%	50.00		

		Type	Hex Addr	Dec Addr
P4.35	**AI2 High V/A**	R/W	0423	41060
	Range/Units (Format: 16-bit unsigned)	Default		
	P4.06=0: 0.00~10.00V P4.06=1: 4.00~20.00mA P4.06=2: 0.00~20.00mA	P4.06=0: 10.00V P4.06=1: 20.00mA P4.06=2: 20.00mA		

		Type	Hex Addr	Dec Addr
P4.36	**AI2 High Hz Percent**	R/W	0424	41061
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00~100.00%	100.00		

Parameters P4.31 to P4.36 are used to configure custom V/Hz settings when the source of the Frequency Command is a current or voltage analog signal at AI2.

		Type	Hex Addr	Dec Addr
P4.37	***AI3 Low Voltage Unipolar***	R/W	0425	41062
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~10.00V	0		
		Type	*Hex Addr*	*Dec Addr*
P4.38	***AI3 Low Hz Percent Unipolar***	R/W	0426	41063
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~100.00%	0		
		Type	*Hex Addr*	*Dec Addr*
P4.39	***AI3 Mid Voltage Unipolar***	R/W	0427	41064
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~10.00V	5.00		
		Type	*Hex Addr*	*Dec Addr*
P4.40	***AI3 Mid Hz Percent Unipolar***	R/W	0428	41065
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~100.00%	50.00		
		Type	*Hex Addr*	*Dec Addr*
P4.41	***AI3 High Voltage Unipolar***	R/W	0429	41066
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~10.00V	10.00		
		Type	*Hex Addr*	*Dec Addr*
P4.42	***AI3 High Hz Percent Unipolar***	R/W	042A	41067
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~100.00%	100.00		

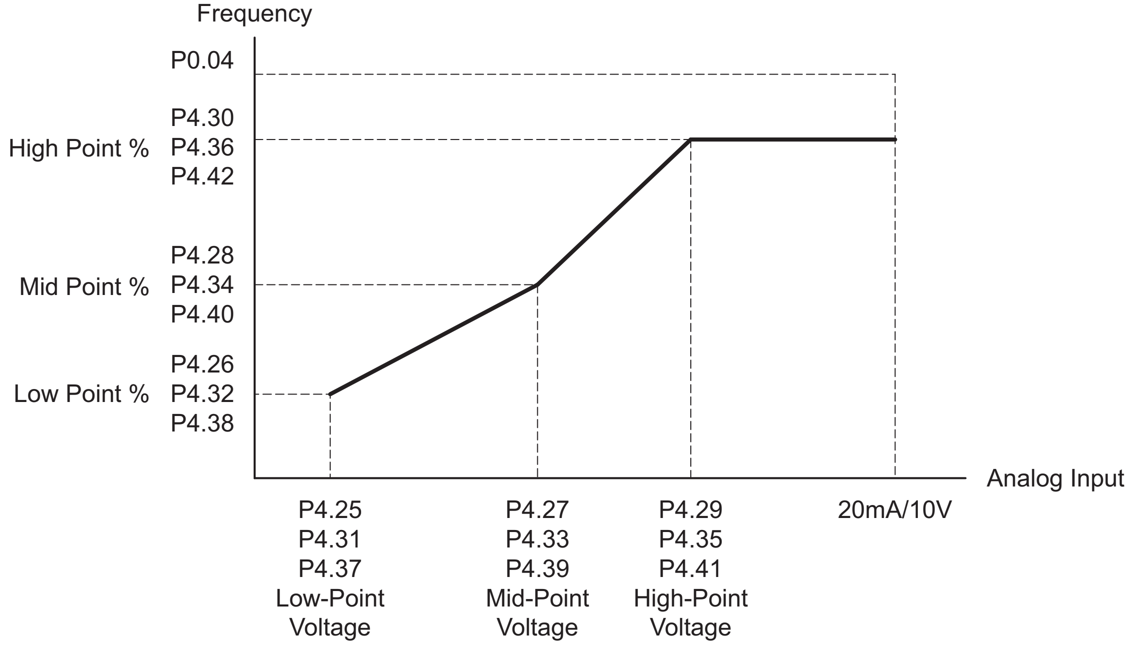
Parameters P4.37 to P4.42 are used to configure custom V/Hz settings when the source of the Frequency Command is a unipolar voltage analog signal at AI3.

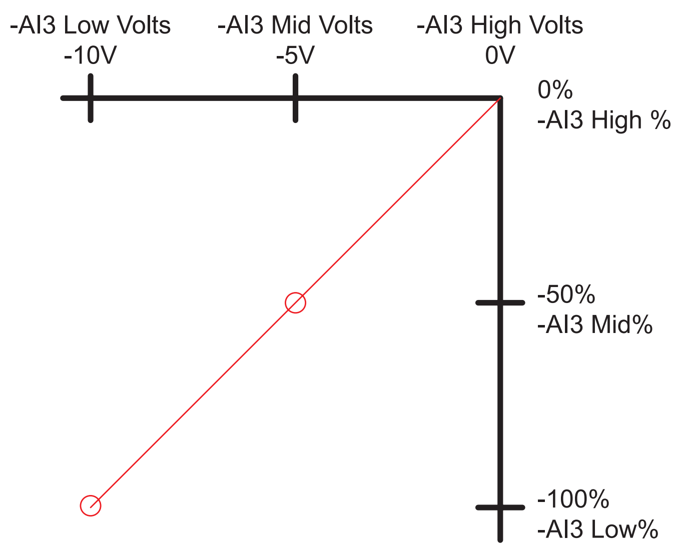
		Type	Hex Addr	Dec Addr
P4.43	***-AI3 High Voltage Bipolar***	R/W	042B	41068
	Range/Units (Format: 16-bit signed)	*Default*		
	–10.00V to 0.00V	0.00		
		Type	*Hex Addr*	*Dec Addr*
P4.44	***-AI3 High Hz Percent Bipolar***	R/W	042C	41069
	Range/Units (Format: 16-bit signed)	*Default*		
	–100.00% to +100.00%	0.00		
		Type	*Hex Addr*	*Dec Addr*
P4.45	***-AI3 Mid Voltage Bipolar***	R/W	042D	41070
	Range/Units (Format: 16-bit signed)	*Default*		
	–10.00V to 0.00V	–5.00		
		Type	*Hex Addr*	*Dec Addr*
P4.46	***-AI3 Mid Hz Percent Bipolar***	R/W	042E	41071
	Range/Units (Format: 16-bit signed)	*Default*		
	–100.00% to +100.00%	–50.00		
		Type	*Hex Addr*	*Dec Addr*
P4.47	***-AI3 Low Voltage Bipolar***	R/W	042F	41072
	Range/Units (Format: 16-bit signed)	*Default*		
	–10.00V to 0.00V	–10.00		
		Type	*Hex Addr*	*Dec Addr*
P4.48	***-AI3 Low Hz Percent Bipolar***	R/W	0430	41073
	Range/Units (Format: 16-bit signed)	*Default*		
	–100.00% to +100.00%	–100.00		

Parameters P4.43 to P4.48 are used to configure custom V/Hz settings when the source of the Frequency Command is a bipolar voltage analog signal at AI3.

P4.24 must be set to use Low/Mid/High Point customization.

The corresponding functions of open-loop control are shown as images below.





		Type	Hex Addr	Dec Addr
P4.49	***reserved***	n/a	0431	41074
	Range/Units			*Default*
	n/a			n/a

		Type	Hex Addr	Dec Addr
P4.50	***Analog Output 1 (AO1)***	n/a	0432	41075
	Range/Units	*Default*		

Range/Units		Default
0: Output Frequency (Hz)	7: Power (% rated)	0
1: Frequency Command (Hz)	8: AI1 (%)	
2: Motor Speed (Hz)	9: AI2 (%)	
3: Output Current (A_{rms})	10: AI3 (%)	
4: Output Voltage (V)	11: RS485 AO	
5: DC Bus Voltage (V)	12: Comm Card AO	
6: Power Factor (%)	13: Fixed Voltage	

NOTE: AO1 is a voltage output. To use AO1 as an analog current output, external resistance needs to be supplied. See the detailed information in P4.53.
If only 1 analog current output is needed, consider using AO2. AO2 is capable of supplying a true current output (no external resistors needed between the GS4 analog output and the other device's analog input).

The Parameter memory can only be written to 10^9 (10 to the 9th) times before a memory error will occur. This memory error will not occur if using setting #11 or #12.
• Use setting #11 or #12 if the AO value will be changed frequently.
• Use setting #13 if the value will not be changed frequently.

DIP SW1 (above the terminals) sets AO1 to be either 0~10VDC output or -10 to +10VDC output.

- *For 0~10V switch setting: 0=0V; 5000=5V; 10,000=10V.*
- *For -10 to +10V setting: 0=-10V; 5000=0V; 10,000=10V.*

Setting #11: As 485 AO

- *Write to 26A0 hex (49889 dec) via the RS-485 port to control the output. 0~10,000 ==> 0~100%. The register will not maintain the value, but the analog signal will remain (if you write a value of 5000 to 26A0h, the analog output will produce 5V but the register will read zero). Writing via the Ethernet cards will have no effect.*

Setting #12: As COMM Card AO

- *Write to 26A0 hex (49889 dec) via the Ethernet card to control the output. 0~10,000 ==> 0~100%. The register will not maintain the value, but the analog signal will remain (if you write a value of 5000 to 26A0h, the analog output will produce 5V but the register will read zero). Writing via RS-485 will have no effect.*

Setting #13: Fixed Value

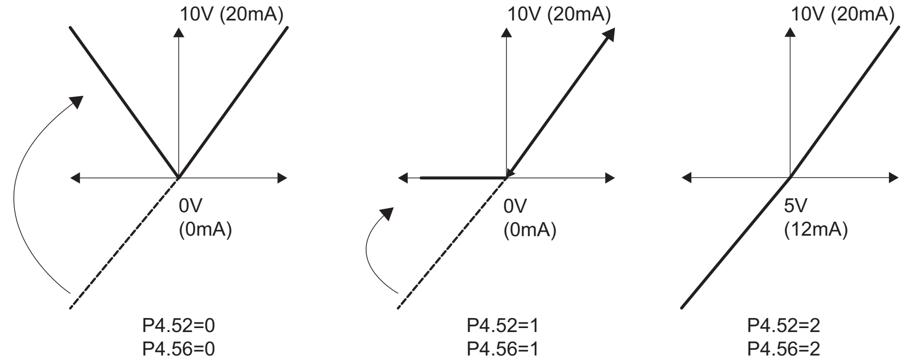
- *Adjust the value of P4.60 via the keypad to increase or decrease the analog output. Writing to P4.60 via RS-485 or Ethernet does change the output value.*

		Type	Hex Addr	Dec Addr
P4.51	***AO1 Gain***	♦R/W	0433	41076
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~500.0%	100.0		

Scaling factor for the analog output AO1. This parameter adjusts the analog voltage level of the output.
NOTE: For 100% of gain via communications, write a value of 1000.

		Type	Hex Addr	Dec Addr
P4.52	***AO1 Negative Value Handle***	♦R/W	0434	41077
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Absolute Value 1: 0V When Negative 2: Offset 5V = 0 Value	0		

This parameter setting can be used for determining AO1 output direction in Forward and Reverse, but the positive and negative output voltages can be used for other types of signals as well.



		Type	Hex Addr	Dec Addr
P4.53	***AO1 0~20mA/4~20mA Selection***	R/W	0435	41078
	Range/Units (Format: 16-bit binary)	*Default*		
	0: 0~20mA 1: 4~20mA	0		

This parameter determines the scaling and offset for Analog Output 1 (AO1).

See also DIP switch AO1 located above the control terminal strip.

- *If using AO1 as a 0~20mA output, set P4.53=0.*
- *If using AO1 as a 4~20mA output, set P4.53=1.*
- *If using AO1 as a 0~10V or ±10V output, set P4.53=0.*

Although AO1 is an analog voltage output, it can emulate an analog current output.

If 500Ω* of total resistance is connected across AO1 and ACM, the output will effectively become an analog current output.

Selecting 1: 4~20mA output will adjust the range so that 0~100% will be output as 2~10V (can be used with an external 500Ω resistance to create a 4~20mA output).

This analog output can be set to fixed levels (thru comms, keypad, etc.). P4.50 must be set for 13: Fixed Voltage to use AO1. If writing via comms, the values are 0~10000 for 0~100.00%. (Gains = 100%, 0~20mA selection = 0~20mA, Negative Value Handle (P4.52) ≠2)

P4.60 works with the setting "#13 Fixed Voltage" of P4.50 to set up the constant voltage at AO1.

Example: Set P4.60 to 0~100.00% to correspond to the 0~10V of AO1.

**NOTE: The 500 Ohms across AO1 and ACM must include the other device's analog input circuitry.*

- *Example: GS4's AI2 input circuit resistance is 250Ω. If you want to connect output AO1 to input AI2 (configuring AI2 parameters and DIP switch as a 0~20mA input), you must add a 250Ω resistor between terminals AO1 and AI2 for a total resistance of 500Ω.*

Related parameters: P4.50 (Analog Output 1), P4.60 (AO1 Output Constant Level)

		Type	Hex Addr	Dec Addr
P4.54	***Analog Output 2 (AO2)***	♦R/W	0436	41079
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Output Frequency (Hz) 1: Frequency Command (Hz) 2: Motor Speed (Hz) 3: Output Current (A_{rms}) 4: Output Voltage (V) 5: DC Bus Voltage (V) 6: Power Factor (%) 7: Power (% rated) 8: AI1 (%) 9: AI2 (%) 10: AI3 (%) 11: RS485 AO 12: Comm Card AO 13: Fixed Voltage	0		

DIP SW2 (above the terminals) sets AO2 to be either a voltage output (0~10VDC) or a true current output (0~20mA or 4~20mA per P4.57).

The Parameter memory can only be written to 10^9 times before a memory error will occur. This memory error will not occur if using setting #11 or #12.

- *Use setting #11 or #12 if the AO value will be changed frequently.*
- *Use setting #13 if the value will not be changed frequently.*

Setting #11: As 485 AO

- *Write to 26A1 hex (49890dec) via the RS-485 port to control the output. 0~10,000 ==> 0~100%. The register will not maintain the value, but the analog signal will remain (if you write a value of 5000 to 26A0h, the analog output will produce 5V but the register will read zero). Writing via the Ethernet cards will have no effect.*

Setting #12: As COMM Card AO

- *Write to 26A1 hex (49890dec) via the Ethernet card to control the output. 0~10,000 ==> 0~100%. The register will not maintain the value, but the analog signal will remain (if you write a value of 5000 to 26A0h, the analog output will produce 5V but the register will read zero). Writing via RS-485 will have no effect.*

Setting #13: Fixed Value

- *Adjust the value of P4.61 via the keypad to increase or decrease the analog output. Writing to P4.61 via RS-485 or Ethernet does change the output value.*

		Type	*Hex Addr*	*Dec Addr*
P4.55	***AO2 Gain***	♦R/W	0437	41080
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~500.0%	100.0		

Scaling factor for the analog output AO2. This parameter adjusts the analog voltage level of the output.

NOTE: For 100% of gain via communications, write a value of 1000.

		Type	*Hex Addr*	*Dec Addr*
P4.56	***AO2 Negative Value Handle***	♦R/W	0438	41081
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Absolute Value 1: 0V When Negative 2: Offset 5V = 0 Value	0		

This parameter setting can be used for determining AO2 output direction, the same as described in P4.52 (page 4–102).

		Type	*Hex Addr*	*Dec Addr*
P4.57	***AO2 0~20mA/4~20mA Selection***	R/W	0439	41082
	Range/Units (Format: 16-bit binary)	*Default*		
	0: 0~20mA 1: 4~20mA	0		

This parameter determines the scaling and offset for Analog Output 2 (AO2).

See also DIP switch AO2 located above the control terminal strip.

This analog output can be set to fixed levels (thru comms, keypad, etc.). P4.54 must be set for 13: Fixed Voltage to use AO2. If writing via comms, the values are 0~10000 for 0~100.00%. (Gains = 100%, 0~20mA selection = 0~20mA, Negative Value Handle (P4.56) ≠2)

		Type	*Hex Addr*	*Dec Addr*
P4.58	***reserved***	♦R/W	043A	41083
	Range/Units	*Default*		

		Type	Hex Addr	Dec Addr
P4.59	**AO2 Offset (Bias)**	♦R/W	043B	41084
	Range/Units (Format: 16-bit signed)	Default		
	–100.00% to +100.00%	0.00		

This parameter is used to add or subtract from the AO2 signal.

Example 1:

If AO2 0~10V is set to Output Frequency (P4.54 = 0: Output Freq), the output equation is:

10V x AO2 Gain x (Output Frequency / Max Output Frequency) + 10V x AO2 Offset (Bias)

10V x P4.55 x (Output Frequency / P0.04) + 10V x P4.59)

Example 2:

If AO2 0~20mA is set to Output Frequency (P4.54 = 0: Output Freq), the output equation is:

20mA x AO2 Gain x (Output Frequency / Max Output Frequency) + 20mA x AO2 Offset (Bias)

20mA x P4.55 x (Output Frequency / P0.04) + 20mA x P4.59)

Example 3:

If AO2 4~20mA is set to Output Frequency (P4.54 = 0: Output Freq), the output equation is:

4mA + (16mA x AO2 Gain) x (Output Frequency / Max Output Frequency) + 16mA x AO2 Offset (Bias)

4mA + (16mA x P4.55) x (Output Frequency / P0.04) + 16mA x P4.59)

		Type	Hex Addr	Dec Addr
P4.60	***AO1 Output Constant Level***	R/W	043C	41085
P4.61	***AO2 Output Constant Level***	R/W	043D	41086
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~100.00%	0.00		

The Parameter memory can only be written to 10^9 times before a memory error will occur. This memory error will not occur if using P4.50/P4.54 setting #11 or #12.

- *Use P4.50/P4.54 setting #11 or #12 if the AO value will be changed frequently.*
- *Use P4.50/P4.54 setting #13 if the value will not be changed frequently.*

The analog outputs can be set to fixed levels through communications, keypad, etc.

- *To use AO1, P4.50 must be set for 13: Fixed Voltage.*
- *To use AO2, P4.54 must be set for 13: Fixed Voltage.*

For P4.50/P4.54 Setting #13: Fixed Value

- *Adjust the value of P4.60 via the keypad to increase or decrease the analog output. Writing to P4.60 via RS-485 or Ethernet does change the output value.*

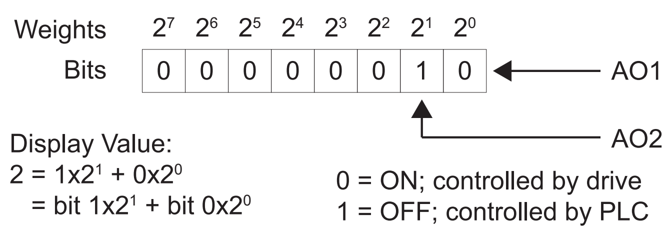
If writing via comms, the values are 0~10000 for 0.00~100.00% gains.

- *P4.51/P4.55 Gain = 100%*
- *P4.52/P4.56 Negative Value Handle ≠ 2*
- *P4.53/P4.57 AOx mA Selection = 0~20mA*

		Type	Hex Addr	Dec Addr
P4.62	***PLC Analog Output Mask***	♦R/W	043E	41087
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0 to 65535	0		

P4.62 shows the external Analog Output terminals that are controlled by the PLC.

Example: If the value of P4.62 displays 0002h(Hex), it shows that AO1 is controlled by the drive and AO2 is controlled by the PLC.



		Type	Hex Addr	Dec Addr
P4.63	**Loss of AI1 Signal (4~20mA)**	R/W	043F	41088
P4.64	**Loss of AI2 Signal (4~20mA)**	R/W	0440	41089

Range/Units (Format: 16-bit binary) — *Default*: P4.63: 0; P4.64: 0

0: Disable (will decelerate to 0Hz and will not generate an error or fault; will restart when signal returns)
1: Continue Run at Last Freq and display "AnL" (ANL Warning) (will follow AIx signal if it returns)
2: Decelerate to 0Hz and display "AnL" Warning (will restart if signal returns)
3: Stop immediately and display "ACE" Fault (will not restart)

These parameters determine the behavior of the GS4 drive when AI1 or AI2 signal is lost when set to 4~20mA.

- *P4.63 configuration is valid only if AI1 is set for 4-20mA (per P4.05).*
- *P4.64 configuration is valid only if AI2 is set for 4-20mA (per P4.06).*

If P4.63/P4.64 is set to 1 or 2 and AI1/AI2 signal is lost, warning code "AnL" will blink on the keypad display. The keypad will continue to blink "AnL" until the signal is restored.

If P4.63/P4.64 is set to 3 and AI1/AI2 signal is lost, warning code "ACE" will blink on the keypad display. The keypad will continue to blink until the signal is restored, and a reset command is issued (STOP/RESET key, etc.).

NOTE: Both of these faults/warnings (ACE/AnL) are active only if the drive is currently looking for the analog signal. (Can switch to the alternate Local/Remote Mode to temporarily bypass the fault).

		Type	Hex Addr	Dec Addr
P4.65	**AI1%**	Read	0441	41090

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

-100% to 100%

		Type	Hex Addr	Dec Addr
P4.66	**AI2%**	Read	0442	41091

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

-100% to 100%

		Type	Hex Addr	Dec Addr
P4.67	**AI3%**	Read	0443	41092

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

-100% to 100%

Parameters P4.65 - P4.67 allow the user to monitor the actual input signal to the analog inputs. The configured voltage or current signal will display as -100 to 100%. These registers are read only.

When AI1 Voltage/Current Selection (P4.05) is voltage, the setting range of P4.25, P4.27, and P4.29 have to be 0.00~10.00 or 0.00~20.00.

When AI2 Voltage/Current Selection (P4.06) is voltage, the setting range of P4.31, P4.33, and P4.35 have to be 0.00~10.00 or 0.00~20.00. (Ex: If AI2 is set for 0~10V input, do not use 4~20mA settings to calculate Low/Mid/High Points.)

The analog input values can be set at P4.25~P4.42, and the Maximum Operating Frequency can be set at P0.04.

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.

Use the equations below when calculating the values for the Drive Maximum Output Frequency, Analog Input Offset, Analog Input Gain, and the Mid-point Frequency.

A) **Drive Maximum Output Frequency** = P0.04 = ((Desired Max RPM)/(Base RPM)) x Base Freq

B) **Analog Offset %** = AIx Input Bias
(Input bias determines the offset)

Analog Input (AIx)	***AI1***	***AI2***	***AI3***
AIx Bias (Offset) Parameter	P4.10	P4.15	P4.19
AIx Bias (Offset) Polarity Parameter	P4.11	P4.16	P4.20

Determine your required settings for these parameters as follows:
Analog Offset (Bias) = (DesiredOffsetFreq / MaxFreqOut) x 100

C) **Analog Gain %** = AIx Input Gain

Analog Input	***AI1***	***AI2***	***AI3***	
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22

[(Max Freq Reference - Min Freq Reference) / P0.04] x 100

D) **Mid-point Frequency** = [(Max Freq Reference - Min Freq Reference) / 2] + Min Freq Reference

The Mid-point Frequency calculation shows the frequency reference of the drive when the potentiometer or other analog input device is at its mid-point.

Equations

AI1	***Offset***	***Polarity***	***Analog Command Calculation***
P4.10 thru P4.12	Positive	P4.11=1	Frequency Output (Hz) = [(Analog_In%*) x (Gain%) + (Bias%)] x Max_Out (Hz)
	Negative	P4.11=2	Frequency Output (Hz) = [(Analog_In%*) x (Gain%) - (Bias%)] x Max_Out (Hz)
Calculation by Parameter #s			Frequency Output (Hz) = [($AI_{(volts)}$ / 10) x (P4.12) ± (P4.10)] x (P0.04)
AI2	***Offset***	***Polarity***	***Analog Command Calculation***
P4.15 thru P4.17	Positive	P4.16=1	Frequency Output (Hz) = [(Analog_In%*) x (Gain%) + (Bias%)] x Max_Out (Hz)
	Negative	P4.16=2	Frequency Output (Hz) = [(Analog_In%*) x (Gain%) - (Bias%)] x Max_Out (Hz)
Calculation by Parameter #s			Frequency Output (Hz) = [($AI_{(volts)}$ / 10) x (P4.17) ± (P4.15)] x (P0.04)
AI3	***Offset***	***Polarity***	***Analog Command Calculation***
P4.19 thru P4.22	Positive	P4.20=1	Frequency Output (Hz) = [(Analog_In%*) x (Gain%) + (Bias%)] x Max_Out (Hz)
	Negative	P4.20=2	Frequency Output (Hz) = [(Analog_In%*) x (Gain%) - (Bias%)] x Max_Out (Hz)
Calculation by Parameter #s			Frequency Output (Hz) = [($AI_{(volts)}$ / 10) x (P4.21 or P4.22) ± (P4.19)] x (P0.04)

** Analog_In% = Analog_Signal$_{(volts)}$ / 10 → for 0~10V inputs*
Analog_Signal$_{(mA)}$ / 20 → for 0~20mA or 4~20mA inputs

*For AI1, AI2, and AI3: **P4.24 (AI V/Hz Calculated Selection) MUST BE SET TO ZERO (All Inputs Use Bias and Gain) TO ENABLE BIAS AND GAIN CALCULATIONS.***

For AI3: Gain% is dependent on P4.20 setting. If P4.20=1 use P4.21 for Gain% calculation. If P4.20=2, use P4.22 for Gain% calculation.

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 = 60 Hz*

For AI1, AI2, and AI3: ***P4.24 (AI V/Hz Calculated Selection) MUST BE SET TO ZERO (All Inputs Use Bias and Gain) TO ENABLE BIAS AND GAIN CALCULATIONS.***

Calculations (see page 4–108 for formulas)

A) **Drive Maximum Output Frequency** = P0.04 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Offset %** = (0Hz / 60Hz) x 100 = 0%

Analog Input (AIx)	***AI1***	***AI2***	***AI3***
AIx Bias Parameter	P4.10	P4.15	P4.19

C) **Analog Gain %** = [(60Hz - 0Hz) / 60Hz] x 100 = 100% = AIx Input Gain

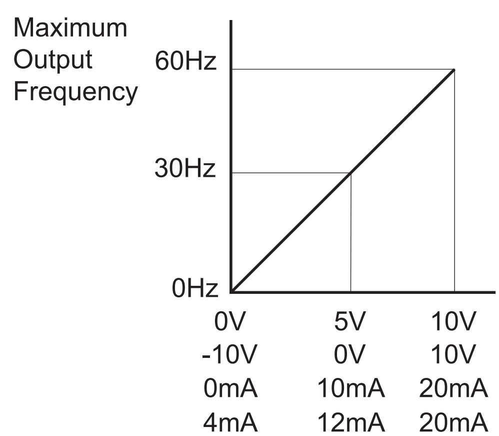
Analog Input	***AI1***	***AI2***	***AI3***	
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22

D) **Mid-point Frequency** = [(60Hz - 0Hz) / 2] + 0Hz = 30Hz

Parameter Settings

Analog Input	***AI1 or***	***AI2 or***	***AI3***		***Parameter Settings***
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)	
AIx Bias Parameter	P4.10	P4.15	P4.19		0.0%
AIx Polarity Parameter	P4.11	P4.16	P4.20		0: No Offset
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22	100.0%
Reverse Run Parameter	P4.09				0: Digital FWD/REV
Drive Max Output Freq	P0.04				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 P0.04, Drive Maximum Output Frequency. (Motors produce reduced output torque when running above their base speed.)

Warning: The Drive Maximum Output Frequency parameter (P0.04) should never exceed the maximum speed rating for the motor you are using. If this information is not readily available, consult your motor manufacturer.

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 (P4.00 of P4.01) 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, and AI3: ***P4.24 (AI V/Hz Calculated Selection) MUST BE SET TO ZERO (All Inputs Use Bias and Gain) TO ENABLE BIAS AND GAIN CALCULATIONS.***

Calculations (see page 4–108 for formulas)

A) **Drive Maximum Output Frequency** = P0.04 = (2042 rpm / 1750 rpm) x 60Hz = 70Hz

B) **Analog Offset %** = [0Hz / (70Hz)] x 100 = 0%

Analog Input (AIx)	*AI1*	*AI2*	*AI3*
AIx Bias Parameter	P4.10	P4.15	P4.19

C) **Analog Gain %** = [(70Hz – 0Hz) / 70Hz] x 100 = 100% = AIx Input Gain

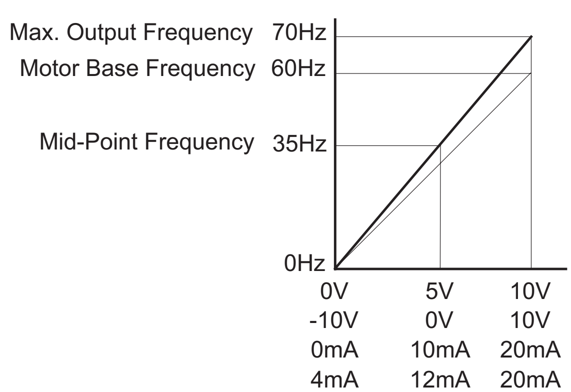
Analog Input	*AI1*	*AI2*	*AI3*	
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22

D) **Mid-point Frequency** = [(70Hz – 0Hz) / 2] + 0Hz = 35Hz

Parameter Settings

Analog Input	*AI1 or*	*AI2 or*	*AI3*		*Parameter Settings*
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)	
AIx Bias Parameter	P4.10	P4.15	P4.19		0.0%
AIx Polarity Parameter	P4.11	P4.16	P4.20		0: No Offset
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22	100.0%
Reverse Run Parameter	P4.09				0: Digital FWD/REV
Drive Max Output Freq	P0.04				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.

- *Minimum Frequency Reference = 10Hz*
- *Maximum Frequency Reference = 60Hz*

For AI1, AI2, and AI3: ***P4.24 (AI V/Hz Calculated Selection) MUST BE SET TO ZERO (All Inputs Use Bias and Gain) TO ENABLE BIAS AND GAIN CALCULATIONS.***

Calculations (see *page 4–108* for formulas)

A) **Drive Maximum Output Frequency** = P0.04 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Offset %** = (10Hz / 60Hz) x 100 = 16.7%

Analog Input (AIx)	***AI1***	***AI2***	***AI3***
AIx Bias Parameter	P4.10	P4.15	P4.19

C) **Analog Gain %** = [(60Hz – 10Hz) / 60Hz] x 100 = 83.3% = AIx Input Gain

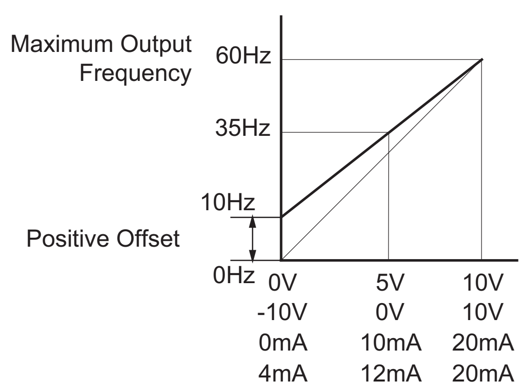
Analog Input	***AI1***	***AI2***	***AI3***	
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22

D) **Mid-point Frequency** = [(60Hz – 10Hz) / 2] + 10Hz = 35Hz

Parameter Settings

Analog Input	***AI1 or***	***AI2 or***	***AI3***		***Parameter Settings***
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)	
AIx Bias Parameter	P4.10	P4.15	P4.19		16.7%
AIx Polarity Parameter	P4.11	P4.16	P4.20		1: Positive Offset
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22	83.3%
Reverse Run Parameter	P4.09				0: Digital FWD/REV
Drive Max Output Freq	P0.04				60Hz

Results



Examples

- *Output Freq = [(Analog_In%) x (Gain%) + (Bias%)] x Max_Out (Hz)*
- *For AI1 set to 0~10V, and an analog input of 1 Volt:*
  Output Freq = [(1/10) x (0.833) + (0.167)] x 60Hz = 15Hz
- *For analog input of 7 Volts:*
  Output Freq = [(7/10) x (0.833) + (0.167)] x 60Hz = 45Hz

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. Parameter P4.09 must be set to enable reverse motion.

When calculating the values for the Analog Input using reverse motion, polarity matters in the Bias/Offset Parameter (P4.10, P4.15, or P4.19) AND in the Polarity Parameter (P4.11, P4.16, or P4.20). If both parameters are negative, the resulting offset will be positive (double negatives). If a negative offset is required, either the Bias/Offset value OR the Polarity Parameter needs to be negative (not both). If your PLC does not handle negative values easily, use the Polarity Parameter to create a negative bias/offset.

- *Minimum Frequency Reference = -60Hz (reverse)*
- *Maximum Frequency Reference = 60Hz*

For AI1, AI2, and AI3: ***P4.24 (AI V/Hz Calculated Selection) MUST BE SET TO ZERO (All Inputs Use Bias and Gain) TO ENABLE BIAS AND GAIN CALCULATIONS.***

Calculations (see page 4–108 for formulas)

A) **Drive Maximum Output Frequency** = P0.04 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Offset %** = [(-60Hz) / (60Hz)] x 100 = -100%

Analog Input (AIx)	***AI1***	***AI2***	***AI3***
AIx Bias Parameter	P4.10	P4.15	P4.19

The negative (-) value for the Analog Offset shows that you can use either a negative value in the Offset/Bias Parameter (P4.10, P4.15, or P4.19) or a negative setting in the Polarity Parameter (P4.12, P4.17, or P4.21). Do not put a negative into both.

C) **Analog Gain %** = [(60Hz – (-60Hz)) / 60Hz] x 100 = 200% = AIx Input Gain

Analog Input	***AI1***	***AI2***	***AI3***	
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22

D) **Mid-point Frequency** = [(60Hz – (-60Hz)) / 2] + (-60Hz) = 0Hz

Parameter Settings

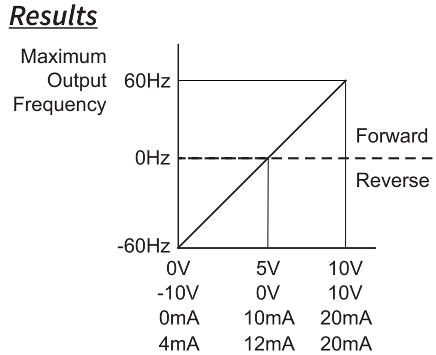
Analog Input	***AI1***	***AI2***	***AI3***		***Parameter Settings***
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)	
AIx Bias Parameter	P4.10	P4.15	P4.19		-100.0% *
AIx Polarity Parameter	P4.11	P4.16	P4.20		1: Positive Offset *
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22	200.0%
Reverse Run Parameter	P4.09				1: AI Bias FWD/REV
Drive Max Output Freq	P0.04				60Hz

** This example uses Bias = -100% and Positive Bias Polarity.*
The example will work exactly the same with Bias = +100% and a Negative Bias Polarity.

Examples

- *Output Freq = [(Analog_In%) x (Gain%) + (Bias%)] x Max_Out (Hz)*
- *For AI1 set to 0~10V, and an analog input of 5 Volts:*
  Output Freq = [(5/10) x (2.00) + (-1.00)] x 60Hz = 0Hz
- *For analog input of 10 Volts:*
  Output Freq = [(10/10) x (2.00) + (-1.00)] x 60Hz = 60Hz

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.

When calculating the values for the Analog Input using reverse motion, the reverse frequency reference should be shown using a negative (-) number. Pay special attention to signs (+/-) for values representing reverse motion.

- *Minimum Frequency Reference = -15Hz (reverse)*
- *Maximum Frequency Reference = 60Hz*

For AI1, AI2, and AI3: ***P4.24 (AI V/Hz Calculated Selection) MUST BE SET TO ZERO (All Inputs Use Bias and Gain) TO ENABLE BIAS AND GAIN CALCULATIONS.***

Calculations (see *page 4–108* for formulas)

A) **Drive Maximum Output Frequency** = P0.04 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Offset %** = [(-15Hz) / (60Hz)] x 100 = -25%

Analog Input (AIx)	***AI1***	***AI2***	***AI3***
AIx Bias Parameter	P4.10	P4.15	P4.19

The negative (-) value for the Analog Offset % shows that a negative offset is needed for P4.11, P4.16, or P4.20, or a negative value in P4.10, P4.15, or P4.19. Do not use negatives in both parameters.

C) **Analog Gain %** = [(60Hz – (-15Hz)) / 60Hz] x 100 = 125% = AIx Input Gain

Analog Input	***AI1***	***AI2***	***AI3***	
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22

D) **Mid-point Frequency** = [(60Hz – (-15Hz)) / 2] + (-15Hz) = 22.5Hz

Parameter Settings

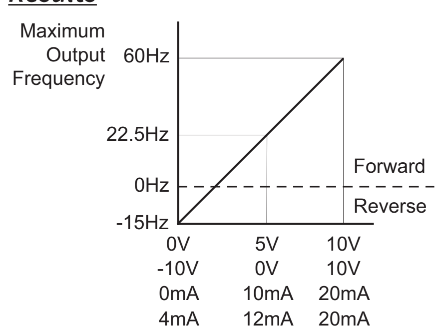
Analog Input	***AI1 or***	***AI2 or***	***AI3***		***Parameter Settings***
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)	
AIx Bias Parameter	P4.10	P4.15	P4.19		-25.0% *
AIx Polarity Parameter	P4.11	P4.16	P4.20		1: Positive Offset *
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22	125.0%
Reverse Run Parameter	P4.09				1: AI Bias FWD/REV

* *This example uses Bias = -20% and Polarity = 1: Positive Offset.*
The example will work exactly the same with Bias = +20% and Polarity = 2: Negative Offset.

Examples

- *Output Freq = [(Analog_In%) x (Gain%) + (Bias%)] x Max_Out (Hz)*
- *For AI1 set to 0~10V, and an analog input of 1 Volt:*
  Output Freq = [(1/10) x (1.25) + (-0.25)] x 60Hz = -7.5Hz
- *For analog input of 7 Volts:*
  Output Freq = [(7/10) x (1.25) + (-0.25)] x 60Hz = 37.5Hz

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.

- *Minimum Frequency Reference = 0Hz*
- *Maximum Frequency Reference = 50Hz*

For AI1, AI2, and AI3: ***P4.24 (AI V/Hz Calculated Selection) MUST BE SET TO ZERO (All Inputs Use Bias and Gain) TO ENABLE BIAS AND GAIN CALCULATIONS.***

Calculations (see page 4–108 for formulas)

A) **Drive Maximum Output Frequency** = P0.04 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Offset %** = [(0Hz) / (60Hz)] x 100 = 0%

Analog Input (AIx)	***AI1***	***AI2***	***AI3***
AIx Bias Parameter	P4.10	P4.15	P4.19

C) **Analog Gain %** = [(50Hz – 0Hz) / 60Hz] x 100 = 83.3% = AIx Input Gain

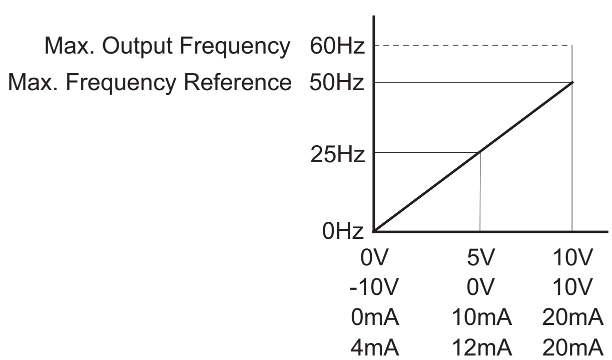
Analog Input	***AI1***	***AI2***	***AI3***	
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22

D) **Mid-point Frequency** = [(50Hz – 0Hz) / 2] + 0Hz = 25Hz

Parameter Settings

Analog Input	***AI1 or***	***AI2 or***	***AI3***		***Parameter Settings***
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)	
AIx Bias Parameter	P4.10	P4.15	P4.19		0.0%
AIx Polarity Parameter	P4.11	P4.16	P4.20		0: No Offset
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22	83.3%
Reverse Run Parameter	P4.09				0: Digital FWD/REV

Results



Examples

- *Output Freq = [(Analog_In%) x (Gain%) + (Bias%)] x Max_Out (Hz)*
- *For AI1 set to 0~10V, and an analog input of 5 Volts:*
  Output Freq = [(5/10) x (0.833) + (0)] x 60Hz = 25Hz
- *For analog input of 10 Volts:*
  Output Freq = [(10/10) x (0.833) + (0)] x 60Hz = 50Hz

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 = 11.5Hz*
- *Maximum Frequency Reference = 39.6Hz*

For AI1, AI2, and AI3: ***P4.24 (AI V/Hz Calculated Selection) MUST BE SET TO ZERO (All Inputs Use Bias and Gain) TO ENABLE BIAS AND GAIN CALCULATIONS.***

Calculations (see page 4–108 for formulas)

A) **Drive Maximum Output Frequency** = P0.04 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Offset %** = (11.5Hz / 60Hz) x 100 = 19.2%

Analog Input (AIx)	***AI1***	***AI2***	***AI3***
AIx Bias Parameter	P4.10	P4.15	P4.19

C) **Analog Gain %** = [(39.6Hz – 11.5Hz) / 60Hz] x 100 = 46.8% = AIx Input Gain

Analog Input	***AI1***	***AI2***	***AI3***	
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22

D) **Mid-point Frequency** = [(39.6Hz – 11.5Hz) / 2] + 11.5Hz = 25.6Hz

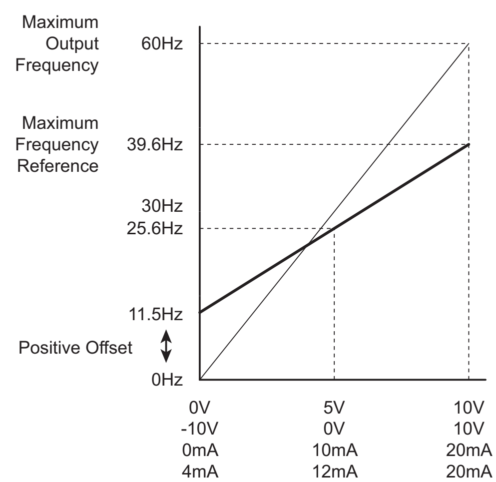
Parameter Settings

Analog Input	***AI1 or***	***AI2 or***	***AI3***		***Parameter Settings***
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)	
AIx Bias Parameter	P4.10	P4.15	P4.19		19.2%
AIx Polarity Parameter	P4.11	P4.16	P4.20		1: Positive Offset
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22	46.8%
Reverse Run Parameter	P4.09				0: Digital FWD/REV

Examples

- *Output Freq = [(Analog_In%) x (Gain%) + (Bias%)] x Max_Out (Hz)*
- *For AI1 set to 0~10V, and an analog input of 5 Volts:*
  Output Freq = [(5/10) x (0.468) + (0.192)] x 60Hz = 25.6Hz
- *For analog input of 10 Volts:*
  Output Freq = [(10/10) x (0.468) + (0.192)] x 60Hz = 39.6Hz

Results



Analog Input Parameter Example 8: Trim Mode

This example illustrates using the drive in Trim Mode with a Trim Reference Frequency.

- *Minimum Frequency Reference = 0Hz*
- *Maximum Frequency Reference = 45Hz*
- *Actual Drive Output Frequency (when P4.08 = 4) = Frequency Command - Trim Reference Frequency*
- *Trim Frequency Reference P4.07 = 15Hz*
  (use comms or keypad to adjust this value based on the application needs)

For AI1, AI2, and AI3: ***P4.24 (AI V/Hz Calculated Selection) MUST BE SET TO ZERO (All Inputs Use Bias and Gain) TO ENABLE BIAS AND GAIN CALCULATIONS.***

Calculations (see page 4–108 for formulas)

A) **Drive Maximum Output Frequency** = P0.04 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Offset %** = [0Hz / (0Hz)] x 100 = 0%

Analog Input (AIx)	AI1	AI2	AI3
AIx Bias Parameter	P4.10	P4.15	P4.19

C) **Analog Gain %** = [(60Hz - 0Hz) / 60Hz] x 100 = 100% = AIx Input Gain

Analog Input	AI1	AI2	AI3	
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22

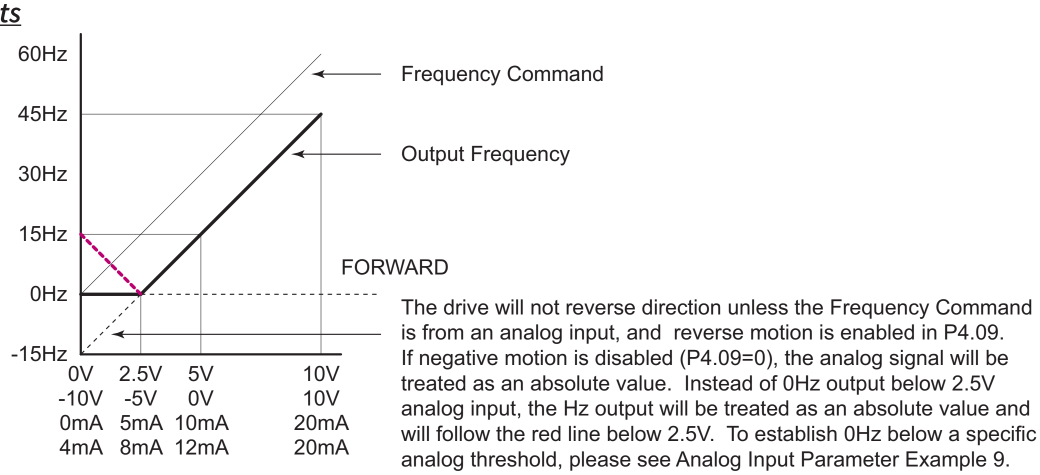
D) **Mid-point Frequency** = [(45Hz – 0Hz) / 2] + 0Hz = 22.5Hz

E) **Actual Output Frequency$_{\mathbf{P4.08=04}}$** = Freq Command – Trim Ref Freq

Parameter Settings

Analog Input	AI1 or	AI2 or	AI3		Parameter Settings
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)	
AIx Bias Parameter	P4.10	P4.15	P4.19		0.0%
AIx Polarity Parameter	P4.11	P4.16	P4.20		0: No Offset
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22	100.0%
Reverse Run Parameter	P4.09				1: AI Bias FWD/REV
Trim Selection	P4.08				4: Speed Source - Trim Ref Freq
Trim Reference Freq	P4.07				15.00Hz

Results



Examples

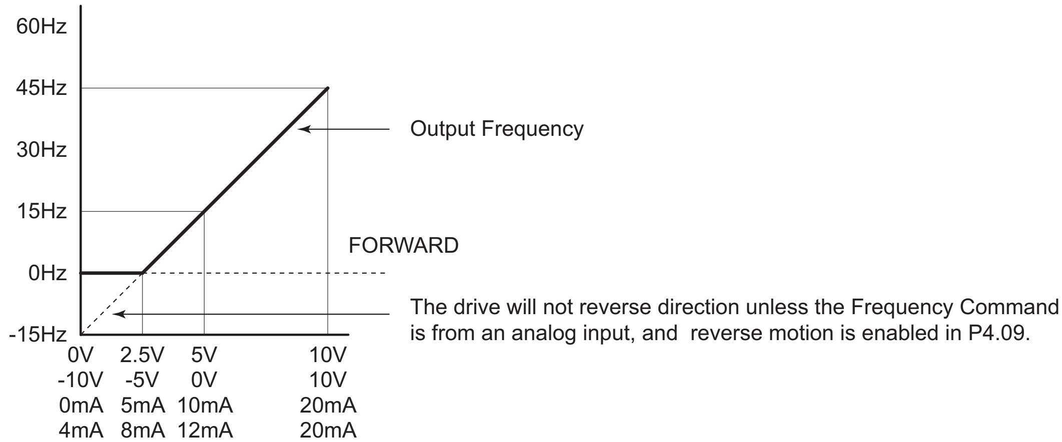
- *Output Freq = [[(Analog_In%) x (Gain%) + (Bias%)] x Max_Out (Hz)] - Trim Freq (when P4.08=4)*
- *For AI1 set to 0~10V, and an analog input of 5 Volts:*
  Output Freq = [[(5/10) x (1.00) + (0)] x 60Hz] - 15 = 15Hz
- *For analog input of 10 Volts:*
  Output Freq = [[(10/10) x (1.00) + (0)] x 60Hz] - 15 = 45Hz

Analog Input Parameter Example 9: 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

- *Minimum Frequency Reference = 0Hz*
- *Maximum Frequency Reference = 45Hz*

Results



NOTE: Due to the way Bias, Gain, and Reverse works, the graph above cannot be achieved with the Bias and Gain settings: If Reverse is enabled (P4.09), the motor will run reverse when the signal goes below 2.5V. If reverse is disabled, the analog value will be evaluated as an absolute value (what would have been negative motion will now result in positive motion).

Set P4.24 to use Low Point, Mid Point, and High Point settings for analog input conditioning (instead of Bias and Gain). Use the following settings to create a deadband from 0~2.5V analog input:

- *Low Point = 0V input; 0Hz output; chart coordinates 0,0*
- *Mid Point = 2.5V input; 0Hz output; chart coordinates 2.5,0*
- *High Point = 10V input; 45Hz output; chart coordinates 10,45*

NOTE: The Low/Mid/High Point method uses % output, instead of Hz. Therefore, the High Point value in this example = 45Hz / 60Hz Max Output = 75%.

Parameter Settings

Analog Input	***AI1 or***	***AI2 or***	***AI3***		***Parameter Settings***
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)	
AI V/Hz Calculated Selection	P4.24 = 1, 3, 5, or 7	P4.24 = 2, 3, 6, or 7	P4.24 = 4, 5, 6, or 7		as shown to left, or 7: All Custom V/Hz
AIx Low V/A	P4.25	P4.31	P4.37	P4.43	0V
AIx Low Hz Percent	P4.26	P4.32	P4.38	P4.44	0%
AIx Mid V/A	P4.27	P4.33	P4.39	P4.45	2.5V
AIx Mid Hz Percent	P4.28	P4.34	P4.40	P4.46	0%
AIx High V/A	P4.29	P4.35	P4.41	P4.47	10V
AIx High Hz Percent	P4.30	P4.36	P4.42	P4.48	75%
Reverse Run Parameter	P4.09				0: Digital FWD/REV

Analog Input Parameter Example 10: 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.

- *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, and AI3: ***P4.24 (AI V/Hz Calculated Selection) MUST BE SET TO ZERO (All Inputs Use Bias and Gain) TO ENABLE BIAS AND GAIN CALCULATIONS.***

Calculations (see page 4–108 for formulas)

A) **Drive Maximum Output Frequency** = P0.04 = (1750 rpm / 1750 rpm) x 60Hz = 60Hz

B) **Analog Offset %** = (60Hz / 60Hz) x 100 = 100%

Analog Input (AIx)	***AI1***	***AI2***	***AI3***
AIx Bias Parameter	P4.10	P4.15	P4.19

C) **Analog Gain %** = [(0Hz - 60Hz) / 60Hz] x 100 = -100% = AIx Input Gain

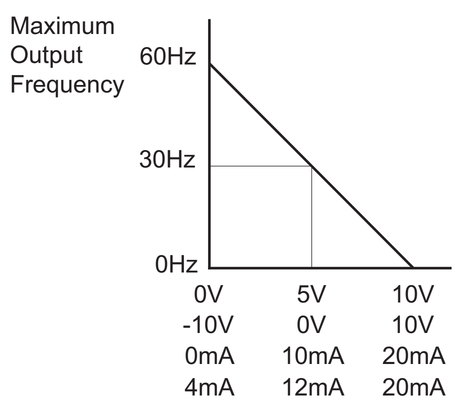
Analog Input	***AI1***	***AI2***	***AI3***	
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22

D) **Mid-point Frequency** = [(60Hz - 0Hz) / 2] + 0Hz = 30Hz

Parameter Settings

Analog Input	***AI1 or***	***AI2 or***	***AI3***		***Parameter Settings***
Polarity	Positive (+)	Positive (+)	Positive (+)	Negative (-)	
AIx Bias Parameter	P4.10	P4.15	P4.19		100.0%
AIx Polarity Parameter	P4.11	P4.16	P4.20		1: Positive Offset
AIx Gain Parameter	P4.12	P4.17	P4.21	P4.22	-100.0%
Reverse Run Parameter	P4.09				0: Digital FWD/REV
Drive Max Output Freq	P0.04				60Hz

Results



Group P5.xx Details – Presets Parameters

		Type	Hex Addr	Dec Addr
P5.00	***Jog Frequency***	♦R/W	0500	41281
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	6.0		

Both external terminal JOG and key "F1" on the keypad GS4-KPD can be used. F1 is active when the drive is in LOCAL mode (using the keypad for source of operation). The JOG Terminal is active when the drive is in REMOTE mode (using the terminals for source of operation). When the jog command is ON, the GS4 drive will accelerate from 0Hz to Jog Frequency (P5.00). When the jog command is OFF, the GS4 drive will decelerate from Jog Frequency to zero. The Jog Accel/Decel Time (P1.13,P1.14) is the time that the drive accelerates from 0.0Hz to P5.00 JOG Frequency. (In contrast, all of the Accel/Decels in the P1 parameter group are referenced from 0 to Max Speed.)

The JOG command cannot be executed when the GS4 drive is running (or decelerating to STOP). Similarly, the RUN command is invalid when the JOG command is being executed.

JOG and RUN commands are edge-triggered inputs. Therefore, a RUN input will be ignored if it is initiated before the JOG input turns off. The drive needs to see the RUN input transition from off to on while the JOG input is off, and also would need to see a JOG input transition from off to on after the RUN input turns off.

		Type	Hex Addr	Dec Addr
P5.01	***Multi-Speed 1***	♦R/W	0501	41282
P5.02	***Multi-Speed 2***	♦R/W	0502	41283
P5.03	***Multi-Speed 3***	♦R/W	0503	41284
P5.04	***Multi-Speed 4***	♦R/W	0504	41285
P5.05	***Multi-Speed 5***	♦R/W	0505	41286
P5.06	***Multi-Speed 6***	♦R/W	0506	41287
P5.07	***Multi-Speed 7***	♦R/W	0507	41288
P5.08	***Multi-Speed 8***	♦R/W	0508	41289
P5.09	***Multi-Speed 9***	♦R/W	0509	41290
P5.10	***Multi-Speed 10***	♦R/W	050A	41291
P5.11	***Multi-Speed 11***	♦R/W	050B	41292
P5.12	***Multi-Speed 12***	♦R/W	050C	41293
P5.13	***Multi-Speed 13***	♦R/W	050D	41294
P5.14	***Multi-Speed 14***	♦R/W	050E	41295
P5.15	***Multi-Speed 15***	♦R/W	050F	41296

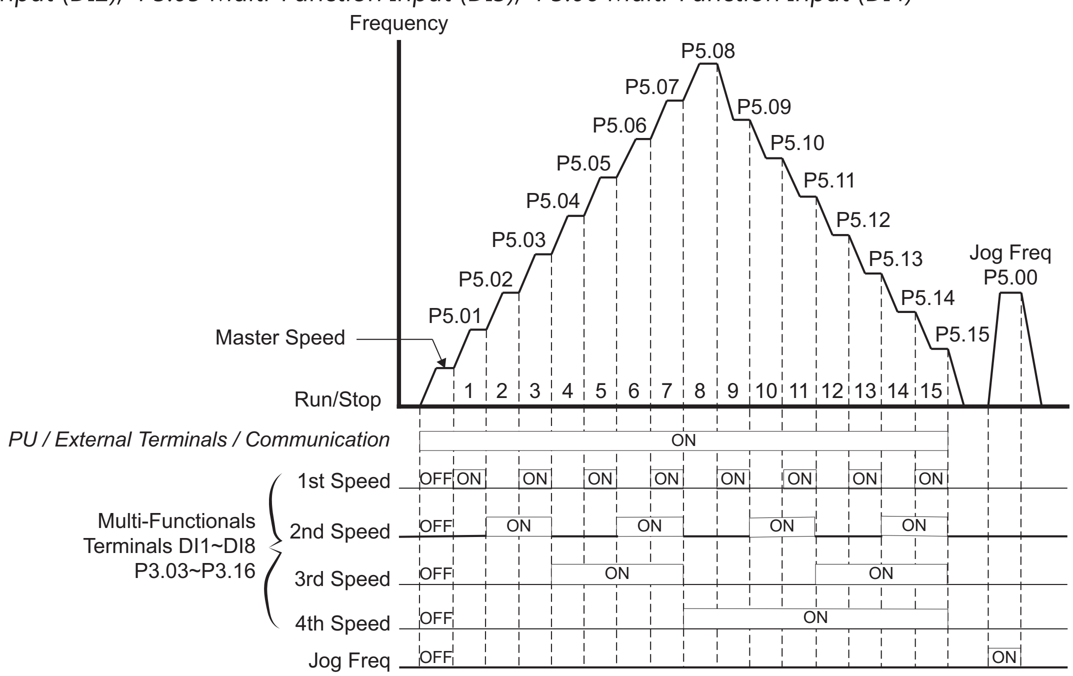
Range/Units (Format: 16-bit unsigned)	Default
0.00~599.00 Hz	0.0

The Multi-Function Input Terminals (DI1~DI15) are used to select individual Multi-Speed frequencies (max. 15). The speeds (frequencies) are determined by the values placed in parameters P5.01 through P5.15.

- *Multi-Function inputs (DI1, DI2, DI3, and DI4) are configured for "Multi-Speed" by default.*
- *Reference P3.03~P3.10 (page 4–63) to configure GS4 local Multi-Function Inputs (DI1~DI8).*
- *Reference P3.11~P3.16 (page 4–63) to configure GS4 optional Multi-Function Inputs (DI10~DI15), if used.*

Timing diagram for multi-step speeds and external terminals:

- *P5.01~15: setting multi-speed frequencies (to set the frequency of each step speed)*
- *P3.03~16: setting multi-function input terminals (multi-step speeds 1~4)*
- *Related parameters: P5.00 JOG Frequency; P3.03 Multi-Function Input (DI1); P3.04 Multi-Function Input (DI2); P3.05 Multi-Function Input (DI3); P3.06 Multi-Function Input (DI4)*



Multi-Speed via External Terminals

Group P6.xx Details – Protection Parameters

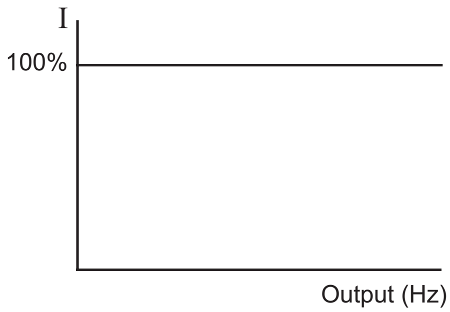
		Type	Hex Addr	Dec Addr
P6.00	**Electronic Thermal Overload Relay (Motor 1)**	♦R/W	0600	41537
	Range/Units (Format: 16-bit binary)	Default		
	0: Constant Torque 1: Variable Torque 2: Inactive	1		

The Electronic Thermal Relay Selection is used to prevent a self-cooled motor from overheating under low speed. This setting limits the drive's output power.

This parameter determines the drive's motor overload protection characteristic. The Variable Torque setting (01) allows less motor current at lower speeds than does the Constant Torque setting (00).

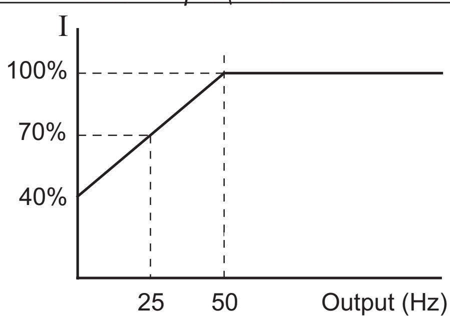
Related parameter: P6.01

Setting 0: Constant Torque (Recommended for ***inverter/vector duty motors****)*



Use this setting when using the GS4 drive with motors designed specifically for AC drive outputs, and for running at low speeds with high currents. Motor currents will be 100% throughout the speed range, and can be up to 150% for one minute.

Setting 1: Variable Torque (Recommended for ***fan-cooled standard motors****)*



Use this setting when using the GS4 drive with motors which are NOT designed specifically for AC drive outputs. Motors with shaft mounted fans offer poor cooling at low speeds, therefore the output can be derated at lower output frequencies. This derated current is for protecting the motor at lower speeds.

The output current is derated as follows:

- I_{output} (%) = [f_{output} (Hz) x 1.2 %/Hz] + 40%

Example: If the rated motor current is 10A, and the output frequency is 25Hz, the derating will be 70%, and the overload will be 10.5A (150%) for one minute:

- I_{output} (%) = [(25Hz) (1.2 %/Hz)] + 40% = 70%
- *10A x 70% = 7A*
- *7A x 150% = 10.5A*

Setting 2: Inactive

NOTE: P6.00/P6.02 (Electronic Overload Relay) must be set independently, yet in conjunction with P6.33 (Drive Derating Method), and P6.34 (VT/CT Duty Selection).
When P6.34 is set, it can change P2.10 (PWM Carrier Frequency); refer to P2.10.

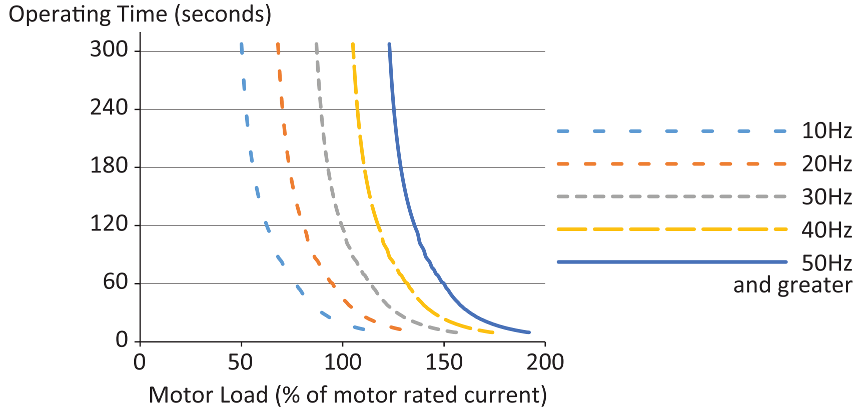
		Type	Hex Addr	Dec Addr
P6.01	***Electronic Thermal Characteristic (Motor 1)***	♦R/W	0601	41538
	Range/Units (Format: 16-bit unsigned)	*Default*		
	30.0~600.0 sec	60.0		

The parameter uses the default overload of 60 seconds when the motor is running at 150% of the motor rated current. When P6.01 and P6.03 are adjusted to some value other than 60 seconds or a time until trip is needed when operating for a different time period, use the following graph and formula to determine the trip time. The time entered into P6.01 and P6.03 is not necessarily the trip time; refer to examples below. When the trip time has elapsed the keypad will display "EoL1/EoL2" and the motor will coast to a stop.

P6.01 and P6.03 are EoL1/EoL2 detection time for P6.00 and P6.02.

EOL Fault Time = Operating Time from graph × P6.01/60s

Example 1: Set P6.01 = 100 seconds, and get the operation time from the graph below. Find the time that lines up with the 50Hz curve at 150%. If the output frequency is 50Hz and the output current is 150% of motor rated current, then the operating time is 60 seconds. Plug that time into the formula 60s x 100s/60s = 100 seconds.



Example 2: P6.01 = 250s; output frequency = 40Hz; output current = 120%; operating time = 60s.

- *Detection Time = 125s x 250s/60s = 521 seconds.*

Example 3: P6.01 = 48s; output frequency = 50Hz; output current = 132%; operating time = 60s.

- *Detection Time = 150s x 48s/60s = 120 seconds.*

Example 4: P6.01 = 8s; output frequency = 20Hz; output current = 72%; operating time = 60s.

- *Detection Time = 275s x 8s/60s = 36 seconds.*

Related parameters: P6.00

		Type	Hex Addr	Dec Addr
P6.02	***Electronic Thermal Overload Relay (Motor 2)***	♦R/W	0602	41539
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Constant Torque 1: Variable Torque 2: Inactive	2		

This parameter is the same as P6.00, except that it applies to motor #2.

Related parameters: P6.03

		Type	Hex Addr	Dec Addr
P6.03	***Electronic Thermal Characteristic (Motor 2)***	♦R/W	0603	41540
	Range/Units (Format: 16-bit unsigned)	*Default*		
	30.0~600.0 sec	60.0		

This parameter is the same as P6.01, except that it applies to motor #2.

Related parameter: P6.02

		Type	Hex Addr	Dec Addr
P6.04	***Auto Restart after Fault***	♦R/W	0604	41541
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~10	0		

The value in this parameter determines the number of reset/restarts following a drive fault. The maximum number of restarts is 10. [Allowable faults: over-current OC (ocA, ocd, ocn, ocS), over-voltage OV (ovA, ovd, ovn, ovS), and short circuit (OCC)].

When this parameter is set to 0, there will be no resets or restarts.

When auto reset/restarts are enabled, the GS4 Drive will follow the setting at P6.06 to do a speed search before the drive is activated again.

When the number of faults occured exceeds P6.04 and is within the time specified in P6.05, the GS4 drive will not restart. Please press the “RESET” key to continue operation.

To set the fault recovery time after a fault, please see P6.23 baseblock time for speed search.

Related parameters: P6.05, P6.06, P6.23

		Type	Hex Addr	Dec Addr
P6.05	***Reset Time for Auto Restart after fault***	♦R/W	0605	41542
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~6000.0 sec	60.0		

This parameter defines the time period for accumulating drive faults such as ov, oc, occ. If the number of faults accumulated during this time span exceeds the value in parameter P6.04, then the drive will not reset until the “RESET” key is pressed. If, however, the number of faults accumulated does NOT exceed the number in P6.04, then the accumulated fault count will be reset and begin from zero on the next restart of the drive.

Related parameters: P6.04, P6.06, P6.23

		Type	Hex Addr	Dec Addr
P6.06	***Base Block Speed Search after Fault (oc,ov,bb)***	♦R/W	0606	41543
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Speed search starts with current speed reference 2: Speed search starts with minimum output frequency	0		

Fault includes: Base Block BB, over-current OC, over-voltage OV, short circuit OCC. To restart after oc, ov, occ, P6.04 cannot be set to 0.

Related parameters: P6.04, P6.05, P6.23

		Type	Hex Addr	Dec Addr
P6.07	***Speed Search at Start***	♦R/W	0607	41544
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Speed search from maximum output frequency 2: Speed search from start-up motor frequency 3: Speed search from minimum output frequency	0		

This parameter is used for starting and stopping a motor with a high inertia. A motor with high inertia will take 2–5 minutes or longer to stop completely. By setting this parameter, the user does not need to wait for the motor to come to a complete stop before restarting the GS4 drive.

Related parameters: P6.24 (sets the output current)

		Type	Hex Addr	Dec Addr
P6.08	***Momentary Power Loss***	♦R/W	0608	41545
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Speed search from last frequency command 2: Speed search from the minimum output frequency	0		

This parameter determines the operation mode when the GS4 drive restarts from a momentary power loss. The power connected to the drive may power off momentarily due to many reasons. This function allows the drive to keep running after power comes back on line; won't cause drive stop.

Setting Explanations:

0: Stop operation after momentary power loss.

1: Operation continues after momentary power loss, speed search starts with the Master Frequency reference value after drive output frequency, and motor rotator speed is synchronous. The motor will have a closer characteristic of a lot of inertia and low resistance. For example, in equipment with a big inertia wheel, the motor will take a long time to stop. The drive does not need to wait for the wheel to stop in order to start again.

2: Operation continues after momentary power loss, speed search starts with the minimum output frequency after drive output frequency, and motor rotational speed is synchronous. The motor will have a closer characteristics of less inertia and more resistance.

Related parameters: P6.04, P6.05

		Type	Hex Addr	Dec Addr
P6.09	***Fwd/Rev Direction Inhibit***	♦R/W	0609	41546

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

0: Enable Fwd/Rev
1: Disable Reverse Operation
A forward or reverse command will run the motor forward.
2: Disable Forward Operation
A forward or reverse command will run the motor reverse.

This parameter enables/prohibits the GS4 drive to run in the forward or reverse direction. It may be used to prevent a motor from running in a direction that would consequently injure the user or damage the equipment.

		Type	Hex Addr	Dec Addr
P6.10	***Auto Voltage Regulation (AVR)***	♦R/W	060A	41547

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

0: AVR Enable
1: AVR Disable
2: AVR Disable during Decel

The rated voltage of the motor is usually 220V/200VAC 60Hz/50Hz, and the input voltage of the GS4 drive may vary between 180~264 VAC 50Hz/60Hz. Therefore, when the GS4 drive is used without AVR function, the output voltage will be the same as the input voltage. When the motor runs at voltages exceeding the rated voltage by 12~20%, the lifespan of the motor may be decreased due to damage from higher temperature, failing insulation, and can also result in unstable torque output.

The AVR function automatically regulates the GS4 drive output voltage to the motor rated voltage (P0.00). For instance, if V/Hz curve is set at 200VAC/50Hz and the input voltage is at 200~264 VAC, then the motor Output Voltage will automatically be reduced to a maximum of 200VAC/50Hz. If the input voltage is at 180~200 VAC, output voltage to motor and input power will be in direct proportion.

Setting Explanations:

0: When AVR function is enabled, the drive will calculate the output voltage by actual DC-bus voltage. The output voltage will *not* be changed by DC bus voltage.

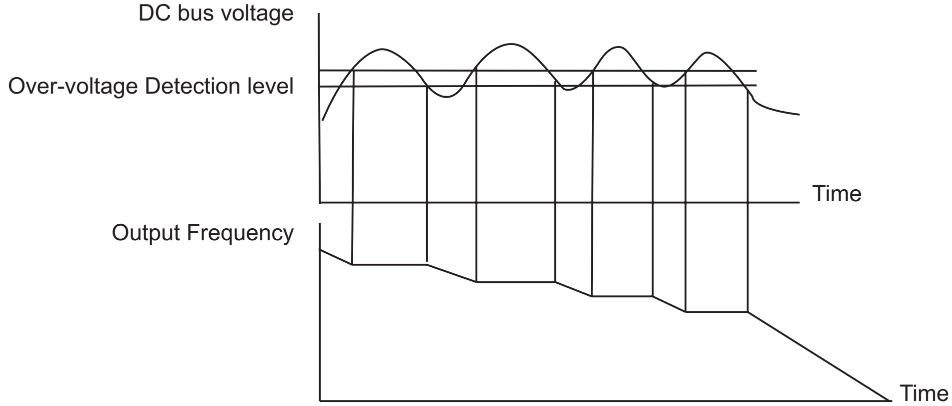
1: When AVR function is disabled, the drive will calculate the output voltage by DC-bus voltage. The output voltage *will* be changed by DC bus voltage. It may cause insufficient/ over current.

2: The drive will disable the AVR during deceleration, such as operating from high speed to low speed.

When the motor ramps to a stop with a long deceleration time, set P6.10 to 2 along with auto acceleration/deceleration, and the deceleration will be much quicker.

		Type	Hex Addr	Dec Addr
P6.11	***Over-Voltage Stall Prevention***	R/W	060B	41548
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Enable Over-voltage Stall Prevention	0		
	1: Disable Over-voltage Stall Prevention			

During deceleration, the GS4 drive DC bus voltage may exceed its Maximum Allowable Value due to motor regeneration. When this function is enabled, the GS4 drive will stop decelerating, and maintain a constant output frequency. The drive will resume deceleration when the voltage drops below the factory-preset value.



NOTE: With moderate inertial loads, over-voltage during deceleration should not occur. For applications with high inertia loads, the GS4 drive will automatically extend the deceleration time. If deceleration time is critical for the application, a dynamic braking resistor should be used. Set this parameter to 1 (disable) when using a dynamic braking resistor.

Related parameters: P6.11, P6.12, P6.27

		Type	Hex Addr	Dec Addr
P6.12	***Selection for Over-Voltage Stall Prevention***	♦R/W	060C	41549

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

0: Traditional Over-Voltage Stall Prevention
1: Advanced Over-Voltage Prevention

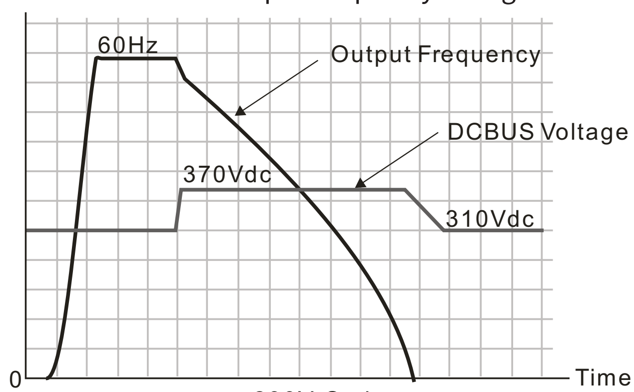
This function is used if there is a potential for high load inertia. When stopping a normal load, an over-voltage won't occur during deceleration, and deceleration time will be followed. If the load has high inertia, the drive may not stop the motor due to over-voltage during deceleration. During this situation the drive will auto adjust the deceleration time until the drive stops.

See P6.11 to enable/disable Over-Voltage Stall Prevention. These settings are not used when a Dynamic Braking Resistor is in use.

Setting Explanations:

0: During deceleration, the DC bus voltage may exceed its maximum allowable value due to motor regeneration in some situations, such as a high inertial load or the decel time set too short. When Traditional Over-Voltage Stall Prevention is enabled, the drive will not decelerate further. It will keep the output frequency constant until the voltage drops below the setting value again (P6.27).

1: The drive will maintain DC bus voltage when decelerating and prevent OV. The Advanced setting will provide a smoother output frequency change than traditional.



230V Series

Related parameters: P1.29, P6.11, P6.27

Over-Voltage Stall Prevention will try to prevent an OV (Over-Voltage) fault. (P6.12 setting #1: Frequency is decelerated in a smoother way than Traditional OVSP.) (See P1.29) P1.29 setting #2 TEC will attempt to prevent an OV fault with faster deceleration and higher current. (P1.29 setting #1: control using DCbus; P1.29 setting #2: control using RateCurrent) (See P6.12)

		Type	Hex Addr	Dec Addr
P6.13	***Auto Adjustable Accel/Decel***	♦R/W	060D	41550

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

0: Linear Accel/Decel
1: Auto Accel, Linear Decel
2: Linear Accel, Auto Decel
3: Auto Accel, Auto Decel
4: Auto Accel/Decel Stall Prevention (limited by P1.01~P1.08 and P1.13~P1.14)

In regards to auto accel and auto decel ramps, this parameter helps to decrease the mechanical vibration when a motor starts/stops a load, and helps prevent complicated auto-tuning processes. It auto-detects the torque size of a load, and then accelerates to reach the frequency of your setting within the shortest time and the smoothest start-up current. It can also auto-detect the re-generated voltage of a load, and then decelerates to stop the motor within the shortest time and in a smoothest way.

Setting Explanations:

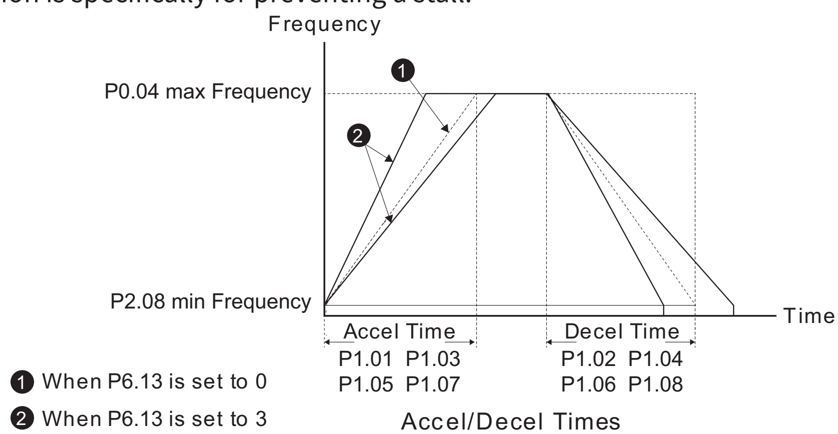
0: Linear acceleration and deceleration operation by P1.01~P1.08 acceleration/deceleration times.

1: Automatic acceleration; linear deceleration (Acceleration by automatic operation; Deceleration by P1.02, P1.04, P1.06, or P1.08 decel time).

2: Linear acceleration; automatic deceleration (Acceleration by P1.01, P1.03, P1.05, or P1.07 accel time; Deceleration by automatic operation).

3: Automatic acceleration and deceleration. (Operation by GS4 drive auto adjustable control). The drive won't stall during acceleration, so a brake resistor is not required. If the acceleration/deceleration is in a reasonable range, the drive will accelerate/decelerate in accordance with the setting of P1.01~P1.08. If the Accel/Decel Time setting is too short, the actual accel/decel time will be greater than the setting of Accel/Decel Time.

4: Auto acceleration; deceleration is for stall protection only. The auto accel/decel will not be quicker than the settings for Accel and Decel Times (P1.02~P1.08 and P1.13~P1.14). The operation is specifically for preventing a stall.

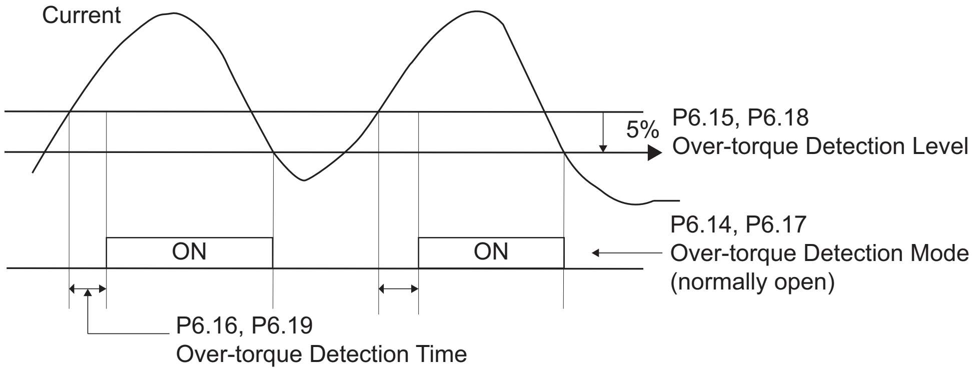


		Type	Hex Addr	Dec Addr
P6.14	***Over-Torque Detection Mode (OT1)***	♦R/W	060E	41551
	Range/Units (Format: 16-bit binary)	Default		
	0: Disable 1: Enable during at speed 2: Enable during at speed and Stop 3: Enable during operation 4: Enable during operation and Stop	0		

Over-Torque detection is determined by the following method:

If the output current exceeds the Over-Torque Detection Level (P6.15/P6.18) and also exceeds the Over-Torque Detection Time (P6.16/P6.19), the fault code “ot1/ot2” will appear. If a Multi-Functional Output Terminal is set to Over-Torque Detection (setting 7 or 8), the output will come on. When the output frequency decreases and passes under the over-torque detection level, there will be a 5% delay (it decreases to 95% of P6.15/P6.18). Then the over-torque detection stops.

P6.14 reacts to the detection level set in P6.15.



Setting Explanations:

0: Disable.

1: Over-Torque detection during constant speed operation, continue to operate after detection. *Keypad will display a warning message but will not record the event.*

2: Over-Torque detection during constant speed operation, stop operation after detection. *Keypad will display a warning message and will record the event.*

3: Over-Torque detection during operation (acceleration and constant speed), continue to operate after detection. *Keypad will display a warning message but will not record the event.*

4: Over-Torque detection during operation (acceleration and constant speed), stop operation after detection. *Keypad will display a warning message and will record the event.*

		Type	Hex Addr	Dec Addr
P6.15	***Over-Torque Detection Level (OT1)***	♦R/W	060F	41552
	Range/Units	Default		
	10~200%	120		

This parameter sets the first Over-Torque Detection Level (OT1) in 1% increments. A setting of 100% is proportional to the Rated Output Current of the drive.

Refer to P6.14 for explanation of operation of parameters P6.14~P6.19.

		Type	Hex Addr	Dec Addr
P6.16	***Over-Torque Detection Time (OT1)***	♦R/W	0610	41553
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.1~60.0 sec	0.1		

This parameter sets the first Over-Torque Detection Time (OT1) in units of 0.1 seconds.

Refer to P6.14 for explanation of operation of parameters P6.14~P6.19.

		Type	Hex Addr	Dec Addr
P6.17	***Over-Torque Detection Mode (OT2)***	♦R/W	0611	41554
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Enable during at speed 2: Enable during at speed and Stop 3: Enable during operation 4: Enable during operation and Stop	0		

P6.17 reacts to the detection level set in P6.18.

Setting Explanations: Same as P6.14.

Refer to P6.14 for explanation of operation of parameters P6.14~P6.19.

		Type	Hex Addr	Dec Addr
P6.18	***Over-Torque Detection Level (OT2)***	♦R/W	0612	41555
	Range/Units (Format: 16-bit unsigned)	*Default*		
	10~200%	120		

This parameter sets the second Over-Torque Detection Level (OT2) in 1% increments. A setting of 100% is proportional to the Rated Output Current of the drive.

Refer to P6.14 for explanation of operation of parameters P6.14~P6.19.

		Type	Hex Addr	Dec Addr
P6.19	***Over-Torque Detection Time (OT2)***	♦R/W	0613	41556
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.1~60.0 sec	0.1		

This parameter sets the second Over-Torque Detection Time (OT2) in units of 0.1 seconds.

Refer to P6.14 for explanation of operation of parameters P6.14~P6.19.

		Type	Hex Addr	Dec Addr
P6.20	***Over-Current Stall Prevention Level During Accel***	♦R/W	0614	41557

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

If P6.34 = VT (light duty): 0~130% of drive rated current — VT: 120
If P6.34 = CT (normal duty): 0~160% of drive rated current — CT: 150
00 = Disable

Light Duty (Variable Torque) or Normal Duty (Constant Torque) will be automatically selected depending on the setting chosen in P6.34.

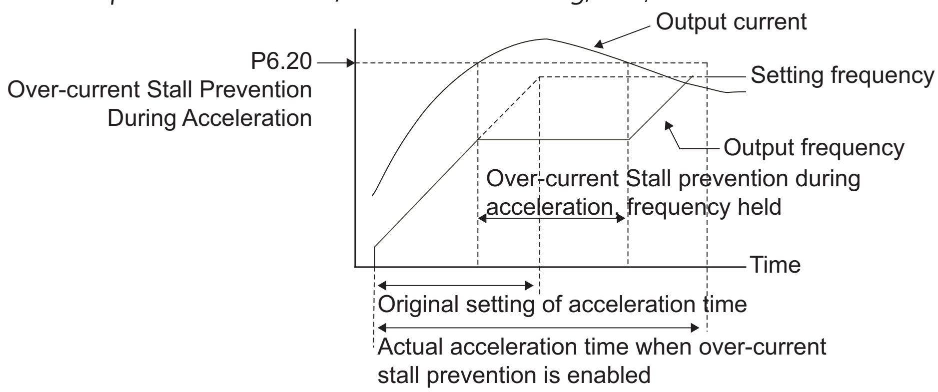
If the motor load is too large or drive acceleration time is too short, GS4 drive output current may increase abruptly during acceleration resulting in possible motor damage or fault protection functions (OL or OC). This parameter is used to prevent this situation.

During acceleration, the GS4 drive output current may increase abruptly and exceed the value specified by P6.20 due to rapid acceleration or excessive load on the motor. When this function is enabled, the GS4 drive will stop accelerating and keep the output frequency constant until the current drops below the maximum value.

When the Over-current Stall Prevention is enabled, drive acceleration time can be greater than the system acceleration time.

If there is any problem with acceleration time, refer to the following items to solve it:

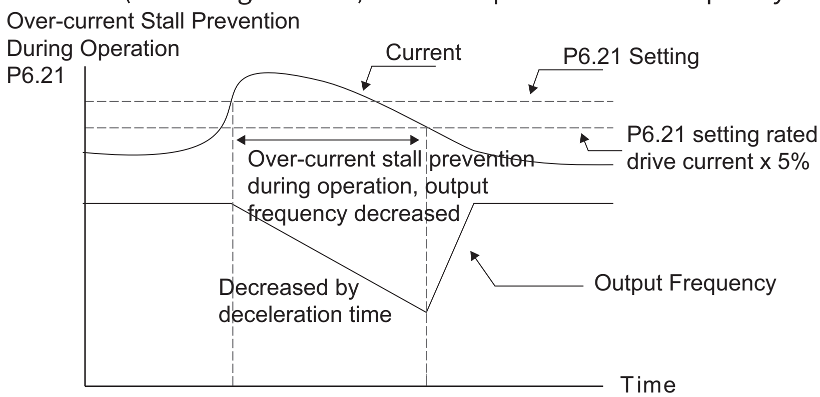
- *1. Increase the acceleration time to a suitable level.*
- *2. Set P6.13 Optimal Acceleration/Deceleration Setting, to 1, 3 or 4.*



Related parameters: P6.34 VT/CT Duty Selection, P1.01 Accel Time 1, P1.03 Accel Time 2, P1.05 Accel Time 3, P1.07 Accel Time 4, P6.13 Optimal Acceleration/Deceleration Setting, any multi-function output.

		Type	Hex Addr	Dec Addr
P6.21	***Over-Current Stall Prevention Level During Operation***	♦R/W	0615	41558
	Range/Units (Format: 16-bit unsigned)	*Default*		
	If P6.34 = VT (light duty): 0~130% of drive rated current	VT: 120		
	If P6.34 = CT (normal duty): 0~160% of drive rated current	CT: 120		
	00 = Disable			

During steady-state operation with motor load rapidly increasing, the GS4 drive output current may exceed the limit specified in P6.21. If output current exceeds the setting specified in P6.21 when the drive is operating, the drive will decrease its output frequency (according to P6.36) to prevent a motor stall. If the output current is lower than the setting specified in P6.21, the drive will resume acceleration (according to P6.36) to catch up with the set frequency command value.



Over-current stall prevention during operation

Related parameters: P6.34 VT/CT Duty Selection,
P6.36 OC Stall Prevention Accel/Decel Time Selection at Normal Speed

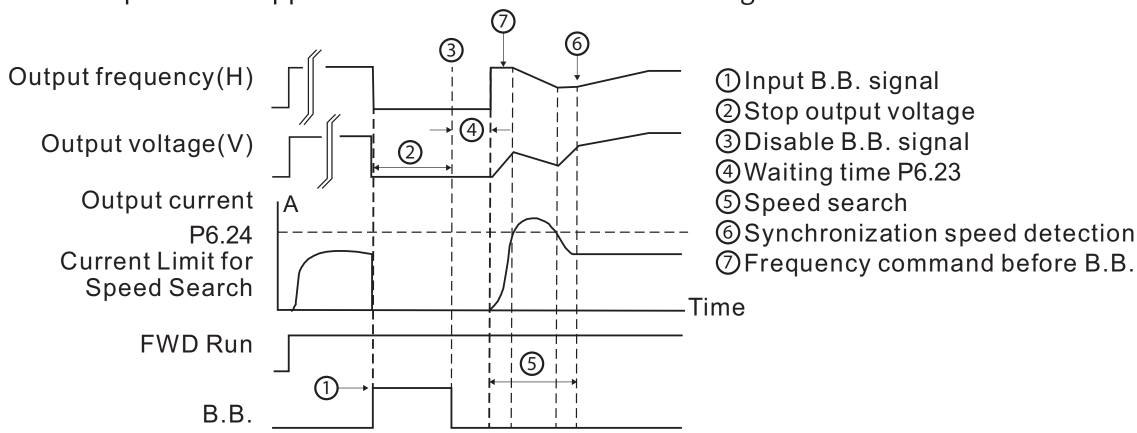
		Type	Hex Addr	Dec Addr
P6.22	***Maximum Allowable Power Loss Time***	♦R/W	0616	41559
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~20.0 sec	2.0		

If the duration of a power loss is less than this parameter setting, the GS4 drive will resume operation. If it exceeds the Maximum Allowable Power Loss Time, the GS4 drive output is then turned off (coast stop).

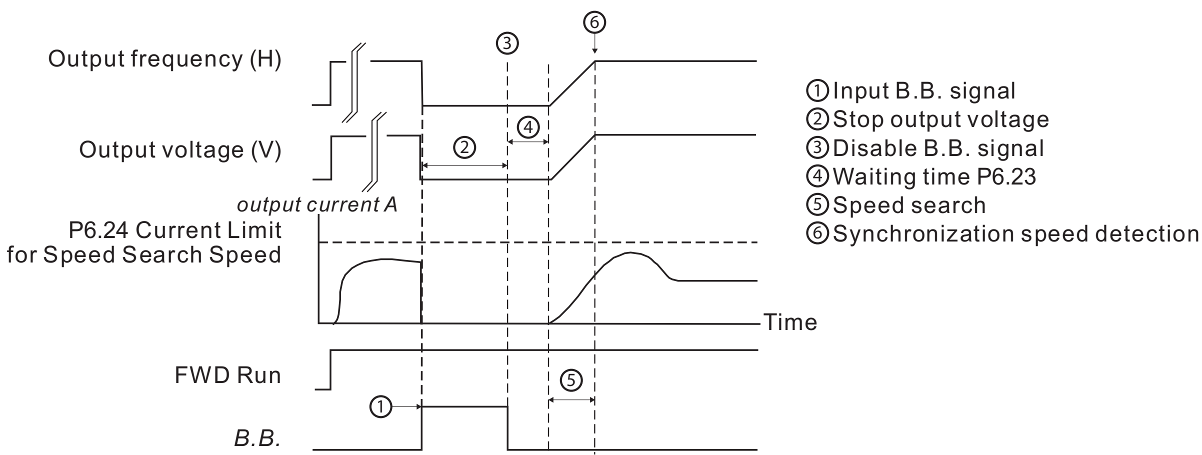
The selected operation after power loss in P6.08 is only executed when the maximum allowable power loss time is ≤ 20 seconds and the GS4 drive displays “LU.” But if the GS4 drive is powered off due to overload, even if the maximum allowable power loss time is ≤5 seconds, the operation mode as set in P6.08 is *not* executed. In that case the drive starts up normally.

		Type	Hex Addr	Dec Addr
P6.23	***Base-Block Time for Speed Search***	♦R/W	0617	41560
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.1~20.0 sec	0.5		

When momentary power loss is detected, the GS4 drive will block its output and then wait for a specified period of time (determined by P6.23, Base-Block Time) before resuming operation. This parameter should be set at a value to ensure that any residual voltage regenerated from the motor onto the output has disappeared before the drive is activated again.



B.B. Search with last output frequency downward timing chart



B.B. Search with minimum output frequency upward timing chart

Related parameters: P6.03, P6.04, P6.05, P6.06, P6.20, P6.24.

		Type	Hex Addr	Dec Addr
P6.24	***Maximum Speed Search Current Level***	♦R/W	0618	41561
	Range/Units (Format: 16-bit unsigned)	*Default*		
	20~200%	100		

Following a momentary power loss, the GS4 drive will begin speed search operation only if the output current is greater than the value set by P6.24.

When performing speed search, the V/Hz curve is determined by parameter group 1. The maximum current for the optimum accel/decel and start speed search is set by P6.24.

The speed search current level will affect the synchronization time. The drive and motor will synchronize faster when this parameter is set to a larger value, but a value that is too large may activate overload protection.

		Type	Hex Addr	Dec Addr
P6.25	***Upper Limit of Output Frequency***	♦R/W	0619	41562
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	599.00		

		Type	Hex Addr	Dec Addr
P6.26	***Lower Limit of Output Frequency***	♦R/W	061A	41563
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	0.00		

The setting of output frequency upper/lower limit is used to prevent mis-operation, machine damage, overheating due to too low operation frequency, and damage due to too high speed.

P6.25 Output Frequency Upper Limit:

- *This setting limits the maximum output frequency of the drive. When the drive frequency command or feedback control frequency is higher than this setting, the drive output frequency will be limited by the upper limit of output frequency.*
- *This parameter must be equal to or greater than the Lower Limit of Output Frequency (P6.26).*
- *If the Upper Limit of Output Frequency is 50Hz and the Maximum Output Frequency is 60Hz, then any Command Frequency above 50Hz will generate a 50Hz output from the drive.*
- *If the frequency output upper limit is 60Hz and frequency command is also 60Hz, the drive won't exceed 60Hz even after slip compensation. If the output frequency needs to exceed 60Hz, then increase output frequency upper limit or max operation frequency.*
- *When the drive enters into the function of slip compensation (P2.01) or PID feedback control, the drive output frequency may exceed the frequency command but still be limited by this setting.*
- *The Output Frequency is also limited by the Motor Maximum RPM (P0.04).*

P6.26 Output Frequency Lower Limit:

- *This setting limits the minimum output frequency of the drive. When the drive frequency command or feedback control frequency is lower than this setting, the drive output frequency will be limited by the lower limit of output frequency.*
- *This parameter must be equal to or less than the Upper Limit of Output Frequency (P6.25).*
- *When the drive starts, it will operate from min output frequency (P2.08, 2.12) and accelerate to the setting frequency. The starting ramp won't be limited by this parameter setting; it will only limit the minimum setpoint frequency.*
- *If the Lower Limit of Output Frequency is 10Hz, and the Minimum Output Frequency (P2.08, P2.16) is set at 5.0Hz, then any Command Frequency between 5~10 Hz will generate a 10Hz output from the drive. A Command Frequency of less than 5Hz will not result in an output from the drive.*
- *When the drive enters into the function of slip compensation (P2.01) or PID feedback control, the drive output frequency may exceed the frequency command but still be limited by this setting.*
- *When P2.18 is set to 2, and if the setting of P6.26 (Output Frequency Lower Limit) is higher than Motor Minimum Output Frequency (Mtr1=P2.08; Mtr2=P2.16), then the GS4 drive will run in accordance with the setting of P6.26 in V/Hz and SVC mode (P2.11).*

Related parameters: P0.04, P2.01, P2.08, P2.16, P2.18, P6.25

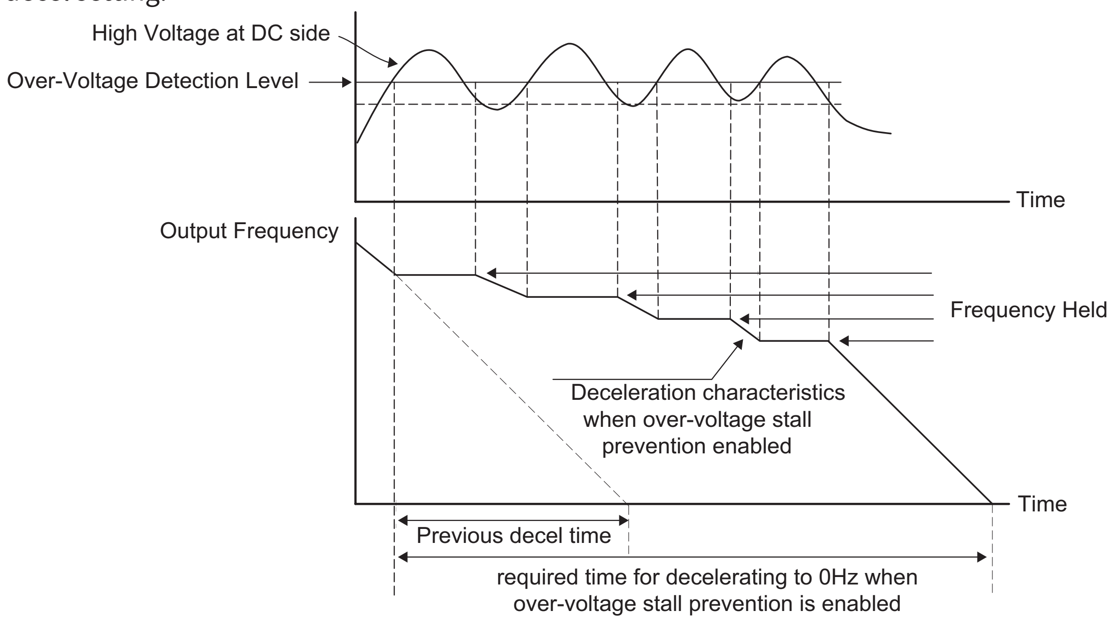
		Type	Hex Addr	Dec Addr
P6.27	**Over-Voltage Stall Prevention Level**	♦R/W	061B	41564
	Range/Units (Format: 16-bit unsigned)	Default		
	230V: 300.0~450.0 VDC	390.0		
	460V: 600.0~900.0 VDC	780.0		

Sets the voltage level of the DC bus when overvoltage stall prevention is activated.

During deceleration, the DC bus voltage may exceed its Maximum Allowable Value due to motor regeneration. When this function is enabled (Over-Voltage Stall Prevention P6.11=00), the drive will not decelerate further and will keep the output frequency constant until the voltage drops below the preset value again (P6.27).

This function is used if there is a potential for high load inertia. When stopping a normal load, an over-voltage won't occur during deceleration, and deceleration time will be followed. If the load has a high inertia, the GS4 drive may not stop the motor due to over-voltage during deceleration. During this situation drive will auto adjust the deceleration time until drive stops.

When the over-voltage stall prevention is enabled, drive deceleration time could be longer than the decel setting.



Related parameters: P1.29, P6.11, P6.12 (decel times: P1.02, P1.04, P1.06, or P1.08)

		Type	Hex Addr	Dec Addr
P6.28	**Dynamic Braking Voltage Level**	♦R/W	061C	41565
	Range/Units (Format: 16-bit unsigned)	Default		
	230V: 350.0~450.0 VDC	390.0		
	460V: 700.0~900.0 VDC	780.0		

This parameter establishes the Dynamic Braking Voltage Level threshold based on the DC Bus voltage. With the drive running and with DC Bus voltage above the braking level threshold, the braking transistor internal to the drive is gated ON, connecting the external braking resistor across the DC Bus to dissipate the excess voltage as heat.

Refer to Appendix A, Accessories, for detailed information on braking resistors.

Parameter P6.28 is valid only for the models below 40hp for 460 series and 30hp for 230 series (unless a braking resistor is used, in which case larger model drives can be used). Larger GS4 models use external dynamic braking units (DBUs) to determine dynamic braking voltage level.

		Type	Hex Addr	Dec Addr
P6.29	***Line Start Lockout***	♦R/W	061D	41566
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Enable start-up lockout 1: Disable start-up lockout	0		

Setting Explanations:

0: Enable. When this parameter is enabled, the GS4 drive will not start the motor when powered up with a RUN command already applied. The drive must see the RUN command change from STOP to RUN before it will start.

1: Disable. When this parameter is disabled, the GS4 drive will start the motor when powered up with a RUN command already applied.

When Safe Torque Off (STO) alarms STL1 or STL2 are activated, a power cycle is required to reset the drive. The drive will start on power up while performing this reset condition when P6.29 is set to 1.

		Type	Hex Addr	Dec Addr
P6.30	**Heat Sink OH Warning Level**	♦R/W	061E	41567
	Range/Units (Format: 16-bit unsigned)	Default		
	0.0~110.0 °C	105.0		

This parameter sets the temperature at which a warning will occur for heat sink monitoring.

If this parameter is set at 110.0°C and the GS4 drive temperature reaches 110.0°C, the drive will trigger an error and stop, instead of just warning. The heat sink FAULT level is 110°C and cannot be changed.

For Frame C and above, when IGBT temperature reaches (P6.30 setting minus 15°C), the heatsink fan will accelerate to the highest speed. When IGBT temperature is lower than (P6.30 setting minus 35°C), and capacitor temperature is lower than (OH2 capacitor warning level minus 10°C), the heatsink fan will return to its setting speed.

If this parameter is set lower than 35°C, the level will remain at 35°C.

<table>
<tr><th colspan="10">IGBT and Capacitor Over-Heat Fault Levels* (°C)</th></tr>
<tr><th rowspan="3">Model # (230V)</th><th rowspan="3">Frame Size</th><th>OH1</th><th colspan="2">OH2</th><th rowspan="3">Model # (460V)</th><th rowspan="3">Frame Size</th><th>OH1</th><th colspan="2">OH2</th></tr>
<tr><th>IGBT</th><th colspan="2">Capacitor</th><th>IGBT</th><th colspan="2">Capacitor</th></tr>
<tr><th>CT & VT*</th><th>CT*</th><th>VT*</th><th>CT & VT*</th><th>CT*</th><th>VT*</th></tr>
<tr><td>GS4-21P0</td><td rowspan="4">A</td><td rowspan="8">110</td><td>95</td><td>90</td><td>GS4-41P0</td><td rowspan="5">A</td><td rowspan="6">110</td><td>95</td><td>90</td></tr>
<tr><td>GS4-22P0</td><td rowspan="4">100</td><td rowspan="4">95</td><td>GS4-42P0</td><td>100</td><td>95</td></tr>
<tr><td>GS4-23P0</td><td>GS4-43P0</td><td>105</td><td>100</td></tr>
<tr><td>GS4-25P0</td><td>GS4-45P0</td><td rowspan="3">100</td><td rowspan="3">95</td></tr>
<tr><td>GS4-27P5</td><td rowspan="3">B</td><td>GS4-47P5</td></tr>
<tr><td>GS4-2010</td><td rowspan="5">80</td><td rowspan="5">75</td><td>GS4-4010</td><td rowspan="3">B</td></tr>
<tr><td>GS4-2015</td><td>GS4-4015</td><td rowspan="5">105</td><td rowspan="3">80</td><td rowspan="3">75</td></tr>
<tr><td>GS4-2020</td><td rowspan="3">C</td><td>GS4-4020</td></tr>
<tr><td>GS4-2025</td><td rowspan="5">105</td><td>GS4-4025</td><td rowspan="3">C</td></tr>
<tr><td>GS4-2030</td><td>GS4-4030</td><td rowspan="3">85</td><td rowspan="3">80</td></tr>
<tr><td>GS4-2040</td><td rowspan="2">D</td><td>75</td><td>70</td><td>GS4-4040</td></tr>
<tr><td>GS4-2050</td><td rowspan="4">65</td><td rowspan="4">55</td><td>GS4-4050</td><td rowspan="2">D0</td><td>110</td></tr>
<tr><td>GS4-2060</td><td rowspan="3">E</td><td>GS4-4060</td><td rowspan="3">105</td><td rowspan="8">65</td><td rowspan="8">55</td></tr>
<tr><td>GS4-2075</td><td rowspan="2">110</td><td>GS4-4075</td><td rowspan="2">D</td></tr>
<tr><td>GS4-2100</td><td>GS4-4100</td></tr>
<tr><td rowspan="6" colspan="5"></td><td>GS4-4125</td><td rowspan="2">E</td><td rowspan="6">110</td></tr>
<tr><td>GS4-4150</td></tr>
<tr><td>GS4-4175</td><td rowspan="2">F</td></tr>
<tr><td>GS4-4200</td></tr>
<tr><td>GS4-4250</td><td rowspan="2">G</td></tr>
<tr><td>GS4-4300</td><td>70</td><td>60</td></tr>
<tr><td colspan="10">* The over heating <u>warning</u> levels for OH1 and OH2 are 5°C less than the listed <u>fault</u> temperatures.
CT = Constant Torque (normal duty).
VT = Variable Torque (light duty).</td></tr>
</table>

Related parameters: P6.39 & P6.40 determine the Motor Overheating Level (OH3)

		Type	Hex Addr	Dec Addr
P6.31	***Cooling Fan Control***	♦R/W	061F	41568
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Always ON (Fan is always ON.) 1: Fan OFF 1 minute after Stop 2: Run fan ON / Stop fan OFF (Fan is ON when drive runs; fan turns OFF when drive stops.) 3: Heat sink temperature (Fan turns ON when preliminary heat sink temperature (around 60°C) is attained.) 4: Always OFF (Fan is always OFF.)	0		

		Type	Hex Addr	Dec Addr
P6.32	***PWM Fan Speed***	R/W	0620	41569
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~100%	60		

Adjusts the speed of the internal cooling fan.

Fan speed settings have no effect on smaller-frame GS4 drives with ON/OFF fan control. In these smaller frame sizes, the fan speed setting is ignored and the fan is either ON or OFF.

Fan Control:

230V model GS4-2015 and smaller: ON/OFF switch control
230V model GS4-2020 and larger: PMW control

460V model GS4-4020 and smaller: ON/OFF switch control
460V model GS4-4025 and larger: PMW control.

		Type	Hex Addr	Dec Addr
P6.33	**Drive Derating Method**	R/W	0621	41570

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

0: Constant rated current (reduce carrier frequency)
1: Constant carrier frequency (limit load current)
2: Constant rated current (same as setting 0, but with higher current limit)

Setting 0: Constant rated current

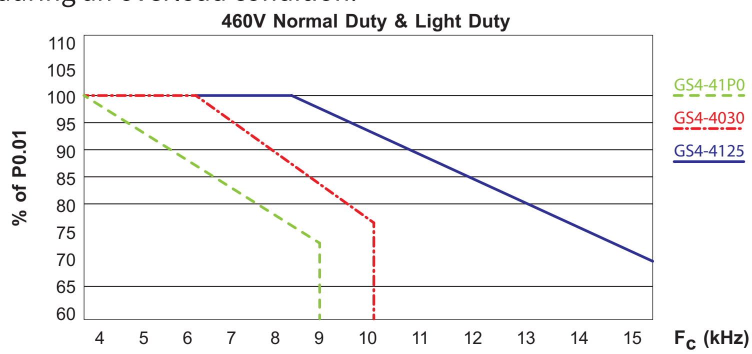
The rated current is constant, the PWM carrier frequency (F_C) output of the GS4 drive will auto decrease according to temperature, overload output current, and time. If an overload situation is not frequent and a constant carrier frequency is not a must, then setting 0 is the best option. The main drawback to reducing the carrier frequency is that you may hear some audible noise in the motor. The carrier frequency will change only during short overload situations in order to try to mitigate the overload current. The OL time at any point along the curve is for 1 minute.

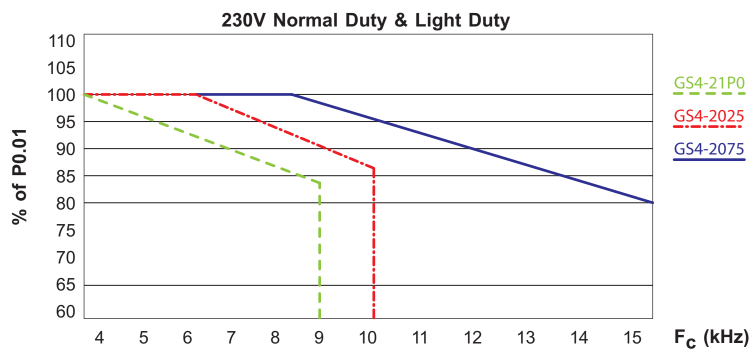
Example 1:

Refer to the following diagram for the auto carrier frequency level at various current levels.

- *GS4-41P0 drive wired 460V set for normal duty, surrounding temperature 50°C with independent installation and UL open-type.*
- *Motor rated current (P0.01) = 100% of drive rated current.*

When the carrier frequency is set to 15kHz, it corresponds to 72% rated output current. When current demand is higher the carrier frequency will automatically decrease to the frequency required in order to supply current demand. If the current demand increases to 83% rated current then the carrier frequency will auto-decrease to 12kHz. This setting will also auto decrease the carrier frequency during an overload condition.





Example 2:

- *Max motor rated current (P0.01) is 120% of the drive's rated current.*
- *Carrier frequency is 15kHz.*

The current is limited to (120%)(72%) = 86% of the drive's rated current for one minute. After one minute the carrier frequency will decrease to the factory setting of 4kHz.

Setting 1: Constant carrier frequency

The carrier frequency is fixed and will not change. The drive will not adjust the PWM carrier frequency; it will only shorten the OL trigger time. The OL time at any point along the curve is for one minute.

Example: Refer to the previous diagram for the current derating percent.

- *GS4-41P0 drive set for normal duty.*

The carrier frequency is a constant 15kHz resulting in the rated current being decreased to 72%. The drive will activate OL protection when the current is (120%)(72%) = 86% for one minute.

Setting 2: Constant rated current

The protection method and current reduction actions are the same as setting 0, except that the drive implements the (% of P0.01)(160% of output current) for normal duty, and the (% of P0.01)(130% of output current) for light duty.

The advantage is that the drive can provide higher output current due to a higher current limit than the factory setting according to the carrier frequency curve. The disadvantage is that the drive decreases the carrier frequency quicker and more often when sensing an overload.

NOTE: Air flow, ventilation, and temperature derating information can be found in Chapter 1: Getting Started and Chapter 2: Installation and Wiring.

NOTE: Additional carrier frequency derating information can be found in Chapter 1: Getting Started.

NOTE: Use this parameter (P6.33) for frequency derating of the GS4 drive when P2.10 (PWM Carrier Frequency) is higher than the factory setting.

NOTE: Refer to P2.10 and P6.34. When setting P6.34 the value in P2.10 changes.

		Type	Hex Addr	Dec Addr
P6.34	***Variable/Constant Torque Duty Selection***	♦R/W	0622	41571
	Range/Units (Format: 16-bit binary)	Default		
	0: VT, 3-phase input (light duty) 1: CT, 3-phase input (normal duty) 2: CT, 230V 1-phase input (normal duty)	0		

- *When working with P6.33 (Drive Derating Method), and P6.34 (VT/CT Duty Selection), refer to P2.10 (PWM Carrier Frequency) for the carrier frequency setting. When P6.34 is set, it will change P2.10. P6.00/P6.02 (Electronic Termal O/L Relay) must be set independently.*
- *Refer to model# specifications (P9.42 & P9.33) for the drive model and rated current.*

Setting 0: VT, 3-phase input (light duty)

When the output current is 110% of the rated output current, the maximum run time is 60 seconds. When the output current is 130% of the rated output current, the maximum run time is 3 seconds.

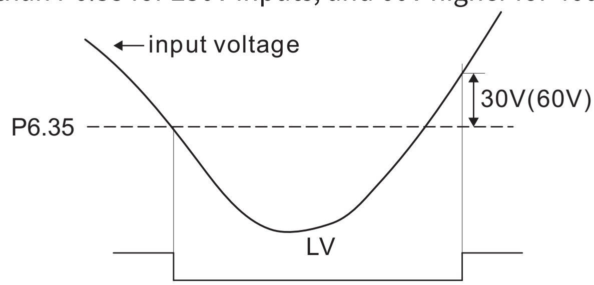
Settings 1 & 2: CT (normal duty)

When the output current is 120% of the rated output current, the maximum run time is 60 seconds. When the output current is 160% of the rated output current, the maximum run time is 3 seconds.

NOTE: When P6.34 is set, it can change P2.10 (PWM Carrier Frequency); refer to P2.10.

		Type	Hex Addr	Dec Addr
P6.35	***Low Voltage Level***	♦R/W	0623	41572
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V Frame <E: 150.0~220.0 VDC	180.0		
	230V Frame ≥E: 190.0~220.0 VDC	200.0		
	460V Frame <E: 300.0~440.0 VDC	360.0		
	460V Frame ≥E: 380.0~440.0 VDC	400.0		

This parameter is used to set the low voltage level. When the drive is in a low input voltage sag, the drive will coast the motor to a stop. The drive will start the motor again once the input voltage reaches 30 volts higher than P6.35 for 230V inputs, and 60V higher for 460V inputs.



		Type	Hex Addr	Dec Addr
P6.36	***OC Stall Prevention Accel/Decel Time Selection at Normal Speed***	♦R/W	0624	41573
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Follow System Accel/Decel Time (the accel/decel time currently selected for the drive)	0		
	1: Follow the 1st Accel/Decel Time			
	2: Follow the 2nd Accel/Decel Time			
	3: Follow the 3rd Accel/Decel Time			
	4: Follow the 4th Accel/Decel Time			
	5: Auto Accel/Decel			

Used to follow the Accel/Decel Time Selection (P1.01~1.08) when Over-Current Stall prevention (P6.21) occurs at normal speed.

		Type	Hex Addr	Dec Addr
P6.37	***OC Stall Prevention Limit for Operation Over Rated Speed***	♦R/W	0625	41574
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~100%	50		

This parameter is used when operation frequency is greater than P0.02 and P0.13 Motor Base Frequency.

Example: When P6.20=150%, P6.21=100%, and P6.37=80%, then:

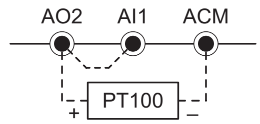
- *Stall Prevention Level during Accel over motor base frequency = P6.20 x P6.37 = 150% x 80% =120%.*
- *Stall Prevention Level at constant speed over motor base frequency = P6.21 x P6.37 = 100% x 80% = 80%.*

		Type	Hex Addr	Dec Addr
P6.38	***Torque Limit (Current Limit)***	♦R/W	0626	41575
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~200% (of drive's rated current)	150		

This parameter sets the maximum current output of the drive.

P6.39~P6.44 PTC/RTD(PT100) Parameters

Parameters P6.39~P6.44 define how the drive protects the motor when either a PT100 RTD or a PTC is used to monitor motor temperature. An analog output is used to supply current through the temperature detecting device and an analog input is used to measure the voltage generated. From the known excitation current and the measured voltage, the resistance of the device can be calculated.



For an RTD, this resistance can be used to look up the corresponding temperature (PT100 has a standard resistance/degree chart).

A PTC has a very abrupt change to its resistance/degree. PTCs are ordered based on the temperature where this abrupt change occurs. Below the switching threshold, the PTC will have very little resistance (could be ≈100Ω, depending on PTC). At the switching threshold, the resistance increases dramatically (the resistance increases by ≈1MΩ over an ≈20°C increase in temperature).

RTD(PTD100) vs. PTC Characteristics

- *An RTD(PTD100) can give you fairly accurate feedback of the motor temperature.*
- *A PTC can only tell you if the motor temperature has passed the PTC's switching temperature (set during PTC manufacturing).*

Examples of how to set up each type of sensor follow P6.44.

		Type	Hex Addr	Dec Addr
P6.39	**PTC/RTD Detection Selection**	♦R/W	0627	41576
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn and Run 1: Warn and Ramp Stop 2: Warn and Coast Stop 3: No Warning	0		

For PTC (Positive Temperature Coefficient) operation (analog input = #6, PTC Thermistor), this parameter defines the behavior of the drive when the PTC thermistor on the motor gets too hot as defined by P6.40.

For PT100 RTD (P4.02, P4.03, or P4.04 Analog Input = #11 PT100 input), this parameter defines the behavior of the drive when the RTD on the motor gets too hot as defined by P6.41 and P6.42.

Related parameters: P6.39~P6.44; *refer to further information following P6.44.*

		Type	Hex Addr	Dec Addr
P6.40	**PTC Level**	♦R/W	0628	41577
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~100.0%	50.0		

This parameter sets the PTC trip level. The corresponding value for 100% is the maximum analog input value. For most applications, a value of 50% will work.

The PTC will allow current to pass freely until the temperature reaches the PTC's switching point. When the PTC resistance starts to change, it changes rapidly. A 70°C PTC may stay at ≈100Ω until it reaches 70°C. At that point, the resistance will jump up to >1MΩ. (This will cause the analog voltage input to jump well over the 50% default level set in P6.40).

- *For PTC faults to work, PT Drop Freq (P6.43) must be = 0.*
- *One of the analog input functions (P4.02~P4.04) needs to be set to 6 (PTC thermistor input value).*
- *P6.40 must be >0.*

Related parameters: P6.39~P6.44; *refer to further information following P6.44.*

		Type	Hex Addr	Dec Addr
P6.41	***RTD (PT100) Level 1, PTC Level Detection Selection***	R/W	0629	41578
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000~10.000V*	5.000		

*RTD Level 1 must be set lower than RTD Level 2.

The analog input voltage that triggers Level 1 RTD warning (oH3 Motor Overheat).

- *Works with P6.44 RTD Treatment Delay Time.*

Related parameters: P6.39~P6.44; *refer to further information following P6.44 (page 4–144).*

		Type	Hex Addr	Dec Addr
P6.42	***RTD (PT100) Level 2, PTC Level Detection Selection***	R/W	062A	41579
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000~10.000V*	7.000		

*RTD Level 2 must be set higher than RTD Level 1.

The analog input voltage that triggers Level 2 RTD Fault (oH3 Motor Overheat-PTC).

- *This fault is instantaneous (does NOT use P6.44 RTD Treatment Delay Time).*

Related parameters: P6.39~P6.44; *refer to further information following P6.44 (page 4–144).*

		Type	Hex Addr	Dec Addr
P6.43	***RTD (PT100) Drop Frequency for PT100 Level 1***	R/W	062B	41580
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	0.00		

The frequency that the drive will "drop" to when P6.41 RTD Level 1 is reached (after P6.44 Delay Time).

When the temperature drops below P6.41, the drive will not return to the original Frequency Command (P4.00, P4.01) until the P6.44 RTD Delay has timed out.

- *When P6.43=0.00Hz, the RTD fault function is disabled.*
- *When P6.43≠0, the PTC faults are disabled.*
- *(Only one temp monitoring type can be active.)*

Related parameters: P6.39~P6.44; *refer to further information following P6.44 (page 4–144).*

		Type	Hex Addr	Dec Addr
P6.44	***RTD (PT100) Treatment Delay Time***	R/W	062C	41581
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~6000 sec	60		

The Delay Time is how long after crossing Level 1 (P6.41) that the Level 1 Frequency Protection (P6.43) is initiated. The delay time is also applicable to when the temperature is cooling and passes Level 1 again. The frequency protection will not turn off until the delay time has passed.

Related parameters: P6.39~P6.44; *refer to further information following P6.44 (page 4–144).*

P6.39~P6.44 Settings Summary for P6.39~P6.44 for PTC and RTD (PT100) Operation

Explanation for P6.39~P6.44:

P6.43 = 0 enables PTC protection and disables both RTD level alarms. If P6.43>0 and the PT100 goes above Level 1, the drive output will drop to P6.43 after the delay time. If the PT100 level goes above Level 2, the drive will fault according to the setting of P6.39.

P6.39 changes behavior for PTC faults and for Level 2 PT100 faults; P6.39 does *not* affect Level 1 PT100 warnings.

P6.44 Delay only affects the Level 1 PT100 fault. Level 2 fault is instant.

PTC and RTD (Resistance Temperature Detector) Operation

The PTC/RTD (voltage) input can come into AI1, AI2, or AI3. Whichever input is selected, it must be switched and selected for 0~10V input. AO2 will provide the fixed excitation current. (See next page for wiring info.)

1) Choose **only one** of the one of the following **analog voltage inputs** to configure for the PTC or RTD (PT100) input:
   a) AI1: Place SW3 on the terminal board to the 0~10V position (sets AI1 = 0~10V input).
      i) P4.02=6 (AI1 Function = PTC input).
         OR
         P4.02=11 (AI1 Function = RTD PT100 input).
      ii) P4.05=0 (AI1 I/V Selection = 0~10V).
      OR
   b) AI2: Place SW4 on the terminal board to the 0~10V position (sets AI2 = 0~10V input).
      i) P4.03=6 (AI2 Function = PTC input).
         OR
         P4.03=11 (AI2 Function = RTD PT100 input).
      ii) P4.06=0 (AI2 I/V Selection = 0~10V).
      OR
   c) AI3: AI3 is 0~10V only, so no hardware switch requires setting.
      i) P4.04=06 (AI3 Function = PT100 input).
         OR
         P4.04=11 (AI3 Function = RTD PT100 input)
2) Set P4.54=13 (AO2 to constant current output). Switch SW2 to 0~20mA/4~20mA on the I/O control terminal block (sets AO2 to 0~20mA/4~20mA).
3) Set P4.57 = 0. This sets AO2 to use 0~20mA output (instead of 4~20mA).
4) P4.61 is for adjusting the constant voltage or constant current of AO2. Set constant current output to 9mA by setting P4.61=45. The AO2 constant output current is 20mA x 45% = 9mA. This is the recommended setting for PTC or RTD(PT100) use. Any effect of RTD self-heating at the 9mA excitation level will be insignificant.

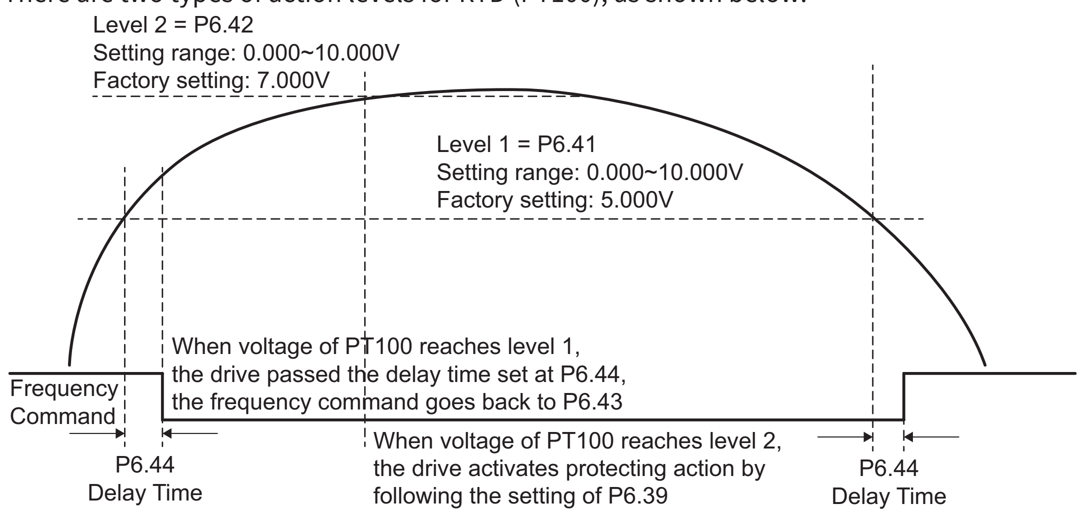
5) Settings for Temperature Sensors:

a) *Settings for **RTD (PT100)** Operation:*

Set The trip levels (P6.41, P6.42), drop frequency P6.43, and delay time P6.44.
P6.41 and P6.42 must be set to appropriate levels (in volts) to protect the motor. NEMA motor insulation is graded by how hot it can get without damage. P6.41 and P6.42 should be set to protect the motor.

NEMA Motor Design	Max Insulation Temperature (1.0 SF)	Typically Protect at Temperature	Ohms (from table*)	AI Volts (P6.41,42) with AO2=9mA
A	105°C	90°C	134.71	1.21 V
B	130°C	110°C	142.29	1.28 V
F	155°C	135°C	151.71	1.36 V
H	180°C	155°C	159.19	1.43 V
*Table lookup for PT100 Temperature/Resistance chart (coefficient = 0.00385): http://www.pyromation.com/Downloads/Data/385_c.pdf				

As you can see, P6.41 and P6.42 can be set with values similar to the "AI Volts" column. Please check your motor documentation for maximum allowable temperature. Reduce the trip levels by several degrees to allow for hot spots within the motor and to extend motor insulation life (motor life decreases when subjected to high temperatures).
If using an RTD, P6.42 must be > P6.41. Also, P6.43 must be >0. If you do not want to use a drop frequency, you still must enter a non-zero value into P6.43. To bypass the drop frequency, set P6.42 to 0.001V > P6.41. This setting will ensure that the P6.41 oH3 **fault** occurs instead of the P6.42 oH3 **warning**.
There are two types of action levels for RTD (PT100), as shown below:



b) *Settings for **PTC** Operation:*

Set P6.40 to 50%. This setting will work with most PTCs. When 9mA is pushed through the PTC at low temperature (low resistance), the resulting voltage will be very low (usually around 1V). When the temperature goes above the PTCs switching temperature, the resistance will increase exponentially. AO2 will not be able to push 9mA through the PTC, but it will increase its output voltage to the maximum 10V. That 10V will be read by the Analog input as 100%, triggering the Motor Overheat fault oH3. The only variable when using a PTC is selecting the appropriate temperature (the PTC's switching temperature is defined during manufacturing).

Example for P6.39~P6.44 with RTD (PT100):

An RTD (PT100) is installed to the drive. If motor temperature reaches 135°C (275°F) or higher, the drive will decrease motor frequency to the setting of P6.43 (Level 1 Frequency Protection). Motor will operate at this frequency until the motor temperature decreases to 135°C (275°F) or lower. If the motor temperature exceeds 150°C (302°F), the motor will decelerate to stop and output an ‘oH3’ fault. (oH3 warning is immediate for Level 2; there is the delay for oH# warning when temp reaches Level 1.)

Set up process:

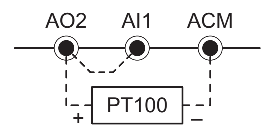
1) Switch AO2 (SW2) to 0/4~20mA on the I/O control terminal block.
(Control terminal details are shown in Chapter 2, Installation and Wiring.)

Wiring:

Connect the RTD (+) wire and sense wire to terminal AO2 (for 3-wire RTDs, connect both positive leads to AO2).

Connect the RTD (-) wire to terminal ACM.

Jumper terminals AO2 and AI1 together to form a short-circuit.



2) Referring to manufacturer’s applicable RTD temperature and resistance comparison table:
   a) Level 1: Desired Temperature = 135°C
   b) Level 1: Corresponding Resistance = 151.71Ω
   c) Level 1: Voltage at 9mA ≈ 1.37VDC [Volts = (Ohms)(Amps)]
   d) Level 2: Desired Temperature = 150°C
   e) Level 2: Corresponding Resistance = 157.33Ω
   f) Level 2: Voltage at 9mA ≈ 1.42VDC
3) Set the following parameters:
   a) P4.02=11 (Analog Input 1 Function = RTD PT100)
   b) P4.54=13 (Analog output 2. This will be constant current when switch AO2 is set to 0~20mA)
   c) P4.61=45% (AO2 output constant level = 20mA x 0.45 = 9mA)
   d) P4.57 = 0 (AO2 mA Select = 0~20mA)
   e) P6.41=1.37 (RTD Detect Level 1)
   f) P6.43=10Hz (PT100 Drop Frequency)
   Set P6.44 to the desired delay time (for RTD Level 1 activation)
   When the RTD temperature increases to 135°C or higher, the drive will decelerate to the selected frequency and display an oH3 warning.
4) P6.42=1.42 (RTD Detect Level 2)
5) P6.39=1 (warning and ramp to a stop)
When the RTD temperature increases to 150°C or higher, the drive will ramp to a stop and displays an ‘oH3’ fault.

If you prefer to not use the drop frequency, set P6.41 to 0.001V less than P6.42. In this example, P6.41 would be set to 1.419V

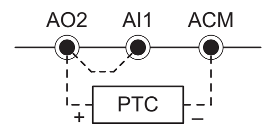
Example for P6.39~P6.44 with PTC:

A PTC is installed to the drive. If the motor temperature exceeds 150°C (302°F), the motor will decelerate to stop and output an ‘oH3’ fault.

Set up process:

1) Switch AO2 (SW2) to 0/4~20mA on the I/O control terminal block.
(Control terminal details are shown in Chapter 2, Installation and Wiring.)

Wiring:
Connect the PTC (+) wire to terminal AO2 (for 3-wire PTCs, connect both positive leads to AO2).
Connect the PTC (-) wire to terminal ACM.
Jumper terminals AO2 and AI1 together to form a short-circuit.



2) Choose a PTC with the appropriate switching temperature (150 deg C in this example).
3) Set the following parameters:
   a) P4.02=6 (Analog Input 1 Function = PTC)
   b) P4.54=13 (Analog output 2. This will be constant current when switch AO2 is set to 0~20mA)
   c) P4.61=45% (AO2 output constant level = 20mA x 0.45 = 9mA)
   d) P4.57=0 (AO2 mA Select = 0~20mA)
   e) P6.41=1.37 (PTC Detect Level)
   f) P6.40=50% (this PTC Level will work for most PTCs)
4) P6.39=1 (warning and ramp to a stop)
When the RTD temperature increases to 150°C or higher, the drive will ramp to a stop and displays an ‘oH3’ fault.

		Type	Hex Addr	Dec Addr
P6.45	***Output Phase Loss (OPhL) Detection Selection***	R/W	062D	41582
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn and continue to operate 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning	3		

This parameter defines the behavior of the drive if there is a phase loss on the output of the drive.

P6.45~P6.48 are parameters for output phase loss. When the motor's current is less than the current level in P6.47 and is longer than the time set in P6.46, the result will be seen as output phase loss. An error message OPHL will be shown on the keypad.

- *When P6.45≠3, OPhL Detection is enabled.*
- *When P6.45=3, all OPhL parameters are disabled (P6.45~P6.48).*

Related parameters: P6.45~P6.48; refer to further information following P6.48 (page 4–149).

		Type	Hex Addr	Dec Addr
P6.46	***Output Phase Loss Detection time***	R/W	062E	41583
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000~65.535 sec	0.500		

This setting will determine the time lapsed from when an output phase loss is detected to when the action selection is initiated in P6.45.

Related parameters: P6.45~P6.48; refer to further information following P6.48 (page 4–149).

		Type	Hex Addr	Dec Addr
P6.47	***Output Phase Loss Current Detection Level***	R/W	062F	41584
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~100.00% (of max current)	1.00		

This parameter sets the Level of Detection for OPhL monitoring.

Related parameters: P6.45~P6.48; refer to further information following P6.48 (page 4–149).

		Type	Hex Addr	Dec Addr
P6.48	***Output Phase Loss DC Injection Brake (DCI) Time***	R/W	0630	41585
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.000~65.535 sec	0.000		

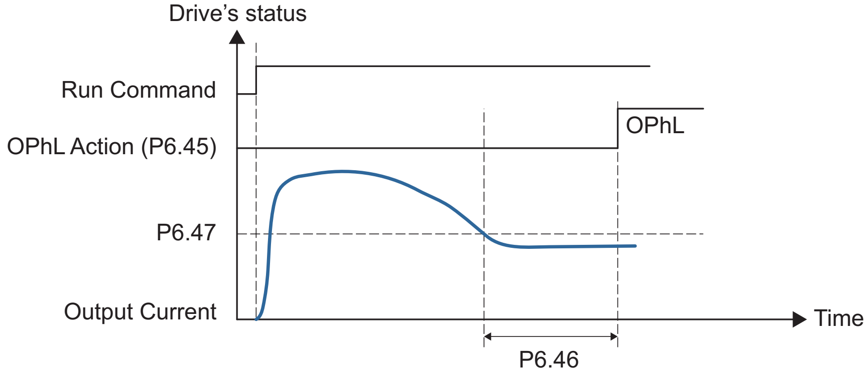
When this parameter is 0, the OPhL DCI Brake function is disabled. When P6.48 >0, the DCI brake current will be monitored against (20)x(P6.47 level). The drive will trigger an OPhL fault If any phase falls below the (20)x(P6.47 level) for a time period of (P6.48)/(2).

Related parameters: P6.45~P6.48; refer to further information following P6.48 (page 4–149).

P6.45~P6.48: Output Phase Loss (OPhL) Summary for P6.45~P6.48

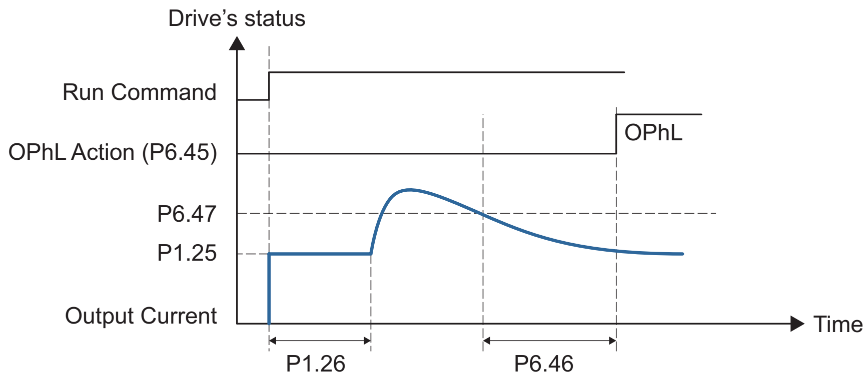
Condition 1: Drive is running; P6.48=0

The drive will perform the action selected in P6.45 if any phase is less than P6.47 (Output Phase Loss Current Detection Level Bandwidth) and exceeds P6.46 (Output Phase Loss Detection Time).



Condition 2: Using standard DC Current Injection Braking; Drive stopped; P6.48=0; P1.26≠0 sec (DCI Time during Start-up)

After drive starts, DC Injection braking will be applied according to P1.25 (DCI Current Level) and P1.26 (DCI Time During Start-up). During this period, OPhL detection will not be monitored. After DCI braking time is complete, the drive will start to run and then monitor the OPhL protection as mentioned in condition 1.

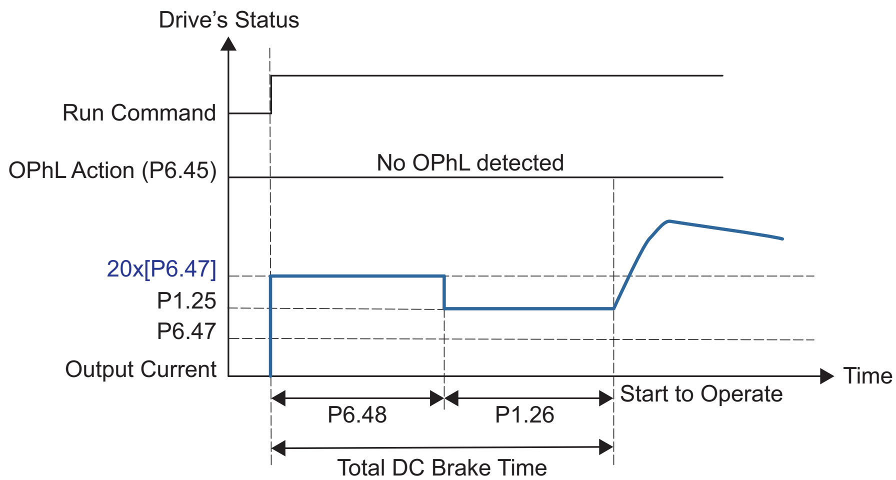


Condition 3: Using OPhL DC Current Injection Braking and Standard DC Current Injection Braking; Drive is stopped; P6.48≠0 ; P1.26≠0 (DCI Time during Start-up)

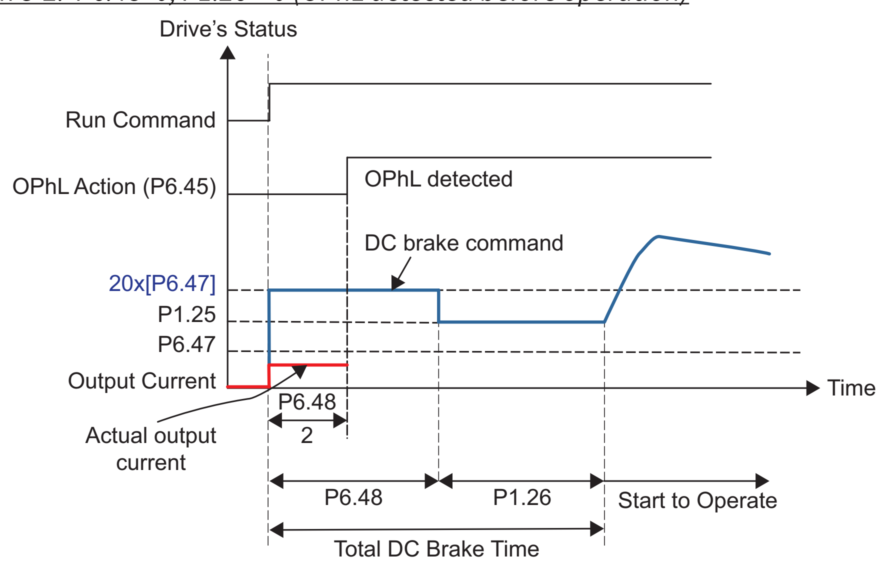
When the drive starts, it will apply DCI injection for time period P6.48 and then P1.26. DC brake current level in this condition includes two parts, one is 20 times the P6.47 setting for the duration of the P6.48 setting time, and the P1.25 setting value for the P1.26 time. Total DC brake time is T=P6.48+P1.26.

In this period, if an OPhL happens, the drive starts to count until P6.48/2 elapses, the drive then performs the actions set in P6.45.

Condition 3-1: P6.48≠0, P1.26≠0 (No OPhL detected before operation)



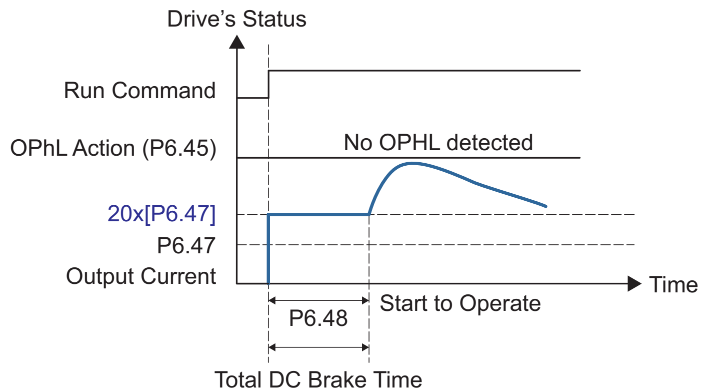
Condition 3-2: P6.48≠0, P1.26 ≠ 0 (OPhL detected before operation)



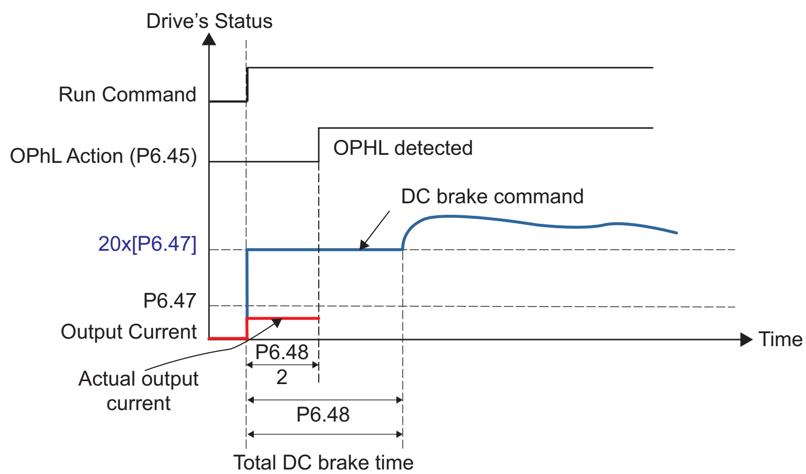
Condition 4: Using OPhL DC Current Injection Braking; Drive stopped; P6.48≠0; P1.26=0

When the drive starts, it will utilize P6.48 as a DC brake. The DC brake current level is 20 times that of the P6.47 value. In this period, if an OPhL happens, the drive starts to count until P6.48/2, the drive will then follow the setting of P6.45.

Condition 4-1: P6.48≠0, P1.26=0 (No OPhL detected before operation)



Condition 4-2: P6.48≠0, P1.26=0 (OPhL detected before operation)



		Type	Hex Addr	Dec Addr
P6.49	***Input Phase Loss Treatment (OrP)***	R/W	0631	41586
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn and ramp to stop 1: Warn and coast to stop	0		

Over ripple protection.

To prevent damage to the capacitors from overheating due to an input phase loss, the drive will monitor the input phases. This is done by monitoring the DC bus ripple amplitude and frequency. The detection time is related to the output current shown below.

Current (%)	50	75	120	150	200
Time (seconds)	432	225	60	32	15

When the input voltage is greater than the setting in P6.70 for the time determined in the table above, this situation is seen as an input phase loss. An error message OrP will be shown on the keypad.

Related parameters: P6.69, P6.70

		Type	Hex Addr	Dec Addr
P6.50	***GFF Detect Current Level (% of INV I-Rated)***	R/W	0632	41587
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~100.0% (% of drive rated current)	60.0		

The Ground Fault Filter (GFF) level is a user settable level of output current difference between phases that can be tolerated within the time frame specified in P6.51.

		Type	Hex Addr	Dec Addr
P6.51	***GFF Low Pass Filter Gain***	R/W	0633	41588
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~655.35 seconds	0.10		

When the drive detects the unbalanced three-phase output current that is higher than the setting of P6.50 for the time specified in P6.51, GFF protection will be activated. The drive will stop at this point.

		Type	Hex Addr	Dec Addr
P6.52	***Low Current Level***	R/W	0634	41589
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~100.0%	0.0		

Percentage of drive's rated current that will trigger the action selected in P6.54 if the current is below P6.52 for the time specified in P6.53. An under-current fault (uC) will occur if enabled.

		Type	Hex Addr	Dec Addr
P6.53	***Low Current Detection Time***	R/W	0635	41590
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~360.00 sec	0.00		

The current must be greater than the setting in P6.52 before the time limit specified in P6.53 elapses or else the action selected in P6.54 will be initiated. An under-current (uC) will occur if enabled.

		Type	Hex Addr	Dec Addr
P6.54	**Low Current Action**	R/W	0636	41591

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

0: Disable, no warning
1: Warn and coast to stop
2: Warn and ramp to stop by 2nd decel time
3: Warn and continue operation

This parameter selects the action associated with Low Current parameters P6.52~P6.54.

		Type	Hex Addr	Dec Addr
P6.55	**Fire Mode**	R/W	0637	41592

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

0: Disable
1: Forward Operation
2: Reverse Operation

This parameter needs to work with multi-input terminal functions #40 or #41 (P3.03~P3.11, page 4–63), and multi-output terminal functions #45 and #46 (P3.17~P3.26, page 4–70). Two digital inputs cannot be set to functions 40 and 41; only one input function can be selected. If there is a machine or building fire, this setting allows the drive to operate as configured in P6.55~P6.60 regardless of most drive faults and safety settings. After Fire Mode has been initiated, the drive must be reset in order for normal control to resume.

Setting Explanations:

0: Fire mode is disabled
1: Motors will operate in the Fwd direction when there is a fire.
2: Motors will operate in the Rev direction when there is a fire.

Related parameters: P6.55~P6.60

		Type	Hex Addr	Dec Addr
P6.56	**Fire Mode Operation Frequency**	R/W	0638	41593

Range/Units (Format: 16-bit unsigned) — Default: 60.00

0.00~599.00 Hz

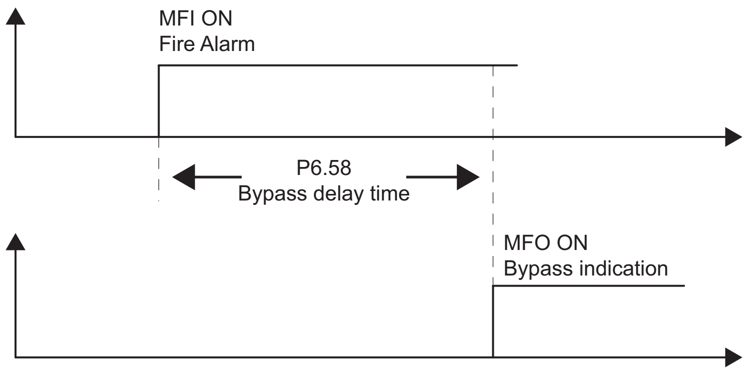
This parameter sets up the drive's output frequency when fire mode is activated by setting a multi-function input to 40 or 41 (P3.03~P3.11, page 4–63).

Related parameters: P6.55~P6.60

		Type	Hex Addr	Dec Addr
P6.57	***Fire Mode Enable Bypass***	R/W	0639	41594
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable Bypass 1: Enable Bypass	0		

The settings of P6.57~P6.60 decide whether to switch motors to operation on line power.

Bypass Function Sequence Diagram:



Conditions required to enable the bypass function:

P6.57 must be set to 1 (enable Bypass), and one of the following two conditions must be met:

1) *During Fire Mode operation if certain faults occur, and the set time elapses according to the time setting of P6.58, then the bypass function will be activated. MFO bypass indication will be ON (one of the outputs P3.17~P3.26 must be set to function #46).*
   Only certain types of faults can be bypassed in Fire Mode; the bypass function cannot bypass every particular fault. The list of fault codes, including which faults can and cannot be automatically bypassed in Fire Mode, is shown in the "Fault Codes Table" in Chapter 6: Maintenance and Troubleshooting.
2) *During Fire Mode operation if there is an fault on auto-reset, and the number of time to auto-reset remains zero or the fire alarm rings according to the time setting of P6.58, then the bypass function will be activated. MFO bypass indication will be ON. If the auto reset is successful before the bypass function is enabled, then the bypass delay counter will return to zero to wait for next trigger.*

Related parameters: P6.55~P6.60

NOTE: The Bypass timer will be reset when the Fire Alarm input turns OFF (or when the fault condition that forces Bypass is cleared - see parameters P6.59 and P6.60).

		Type	Hex Addr	Dec Addr
P6.58	***Fire Mode Bypass Delay Time***	R/W	063A	41595
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~6550.0 sec	0.0		

Delay time from when Fire Mode is triggered to when Fire Mode Bypass is activated.

Related parameters: P6.55~P6.60

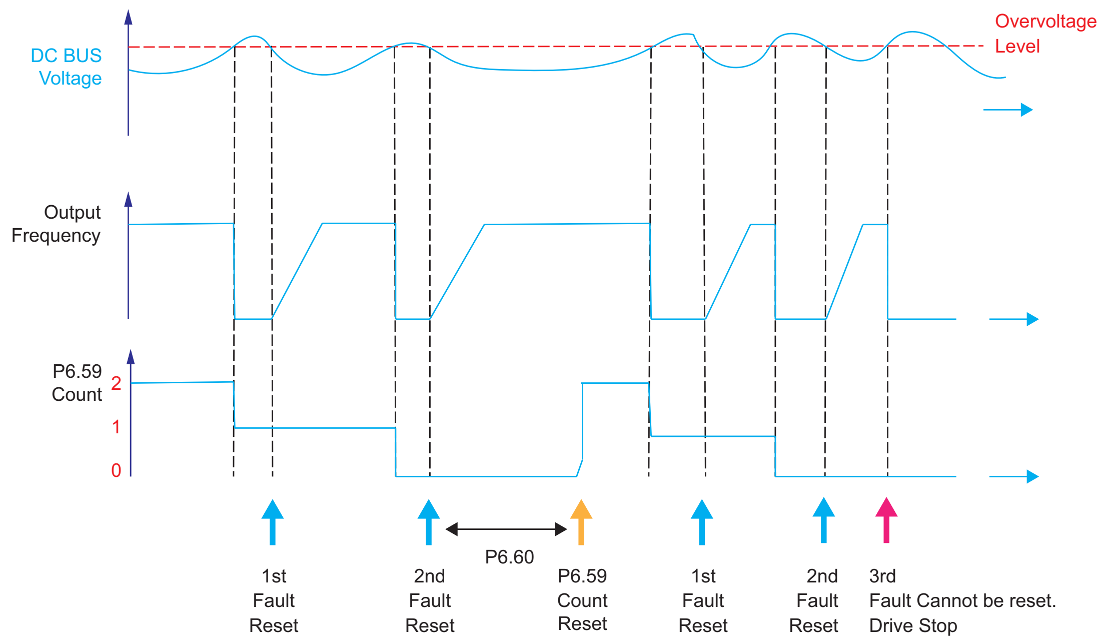
		Type	Hex Addr	Dec Addr
P6.59	***Fire Mode Auto Restart Counter***	R/W	063B	41596
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~10	0		

The number of times that a fault can be automatically reset within the time specified in P6.60. The drive will stop if number of faults exceeds P6.59 within time prescribed in P6.60. Applies only when in Fire Mode.

Related parameters: P6.55~P6.60

		Type	Hex Addr	Dec Addr
P6.60	***Fire Mode Auto Restart Counter Reset Time***	R/W	063C	41597
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~6000.0 sec	60.0		

The length of time that the P6.59 count can be reset during this time period. If the fault count exeeds the value set in P6.59, the drive will coast to a stop instead of automatically resetting. Applies only when in Fire Mode.



Related parameters: P6.55~P6.60

		Type	Hex Addr	Dec Addr
P6.61	***Decel Energy Backup (DEB) Decel Selection***	♦R/W	063D	41598
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: 1st Decel Time 2: 2nd Decel Time 3: 3rd Decel Time 4: 4th Decel Time 5: Current Decel Time 6: Auto Decel Time	0		

This parameter is used for the Decel Time Selection for momentary power loss.

Related parameters: P6.61~P6.64; refer to further information following P6.64 (page 4–157).

		Type	Hex Addr	Dec Addr
P6.62	***DEB Offset Level***	R/W	063E	41599
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V models: 0.0~100.0 VDC	40.0		
	460V models: 0.0~200.0 VDC	80.0		

The Decel Energy Backup Offset Level is the bias that is added to the DEB Disable Voltage Level (P6.63) which creates the DEB Activation Level. The DEB Activation Level is the point when the DEB function is initiated.

Related parameters: P6.61~P6.64; refer to further information following P6.64 (page 4–157).

		Type	Hex Addr	Dec Addr
P6.63	***DEB Disable Voltage Level***	R/W	063F	41600
	Range/Units (Format: 16-bit unsigned)	*Default*		
	230V models: 0.0~200.0 VDC	150.0		
	460V models: 0.0~400.0 VDC	300.0		

The DEB (Decel Energy Backup) will be disabled when the voltage of the DC Bus is lower than the setting at P6.63. The drive will then coast to a stop.

Related parameters: P6.61~P6.64; refer to further information following P6.64 (page 4–157).

		Type	Hex Addr	Dec Addr
P6.64	***DEB Delay Time***	♦R/W	0640	41601
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~25.0 sec	0.0		

The drive will not ramp up to commanded speed until the DEB Delay Time has elapsed.

Related parameters: P6.61~P6.64; refer to further information following P6.64 (page 4–157).

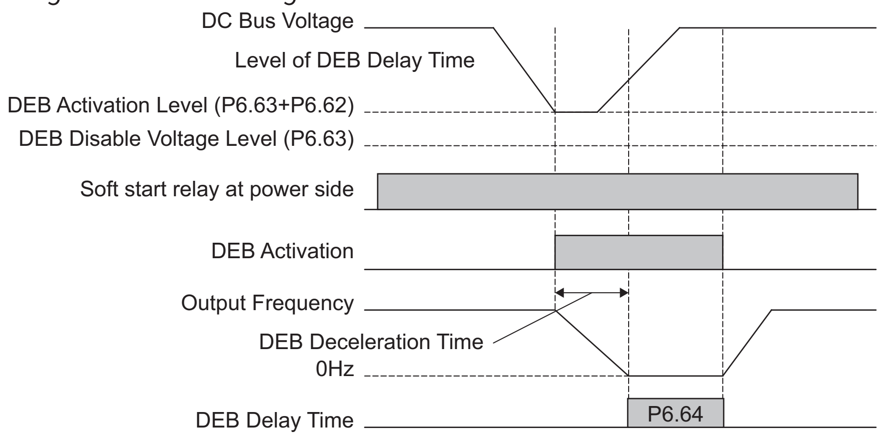
P6.61~P6.64: *Decel Energy Backup (DEB) Summary for P6.61~P6.64*

The DEB feature allows the drive to decelerate to a stop after a momentary power loss. When a momentary power loss occurs, this function can be used to have the motor decelerate to 0 speed with a predefined deceleration stop method (P6.61). When the supply power comes back on to rated voltage, the motor will run again after the DEB Delay Time (P6.64). The DEB delay time starts after the voltage level has reached the "Level of DEB Delay Time," as defined below.

Level of DEB Delay Time definitions:

- *460V series Frame E and above: "Level of DEB Delay Time" = P6.35 + 180VDC*
- *460V series Frame D and below: "Level of DEB Delay Time" = P6.35 + 160VDC*
- *230V series Frame E and above: "Level of DEB Delay Time" = P6.35 + 90VDC*
- *230V series Frame D and below: "Level of DEB Delay Time" = P6.35 + 80VDC*

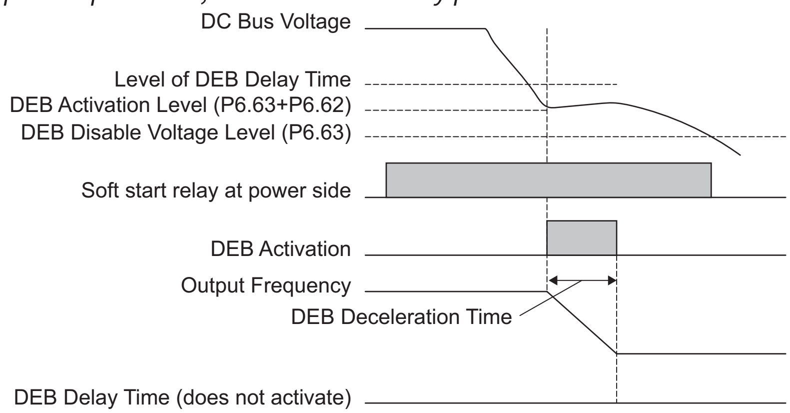
Example 1: *Insufficient power supply due to momentary power loss, or unstable power due to low voltage or sudden loading:*



NOTE: If P6.64 is set to 0, then a STOP command will be given. The drive will not accelerate to reach the commanded frequency before DEB even if the power comes back on. If P6.64 is not set to 0, a command of zero speed will be given and wait for the power on.

NOTE: DEB active level is when the DC BUS voltage level is lower than the DEB Disable Voltage Level (P6.63) plus the DEB Offset Level (P6.62). Defaults are: 230V series: Lv level + 20VDC; 460V series: Lv level + 40VDC.

Example 2: *Unexpected power off, such as momentary power loss:*



Example Application: There are always several machines running at the same time in a textile factory. To prevent broken stitching when powering down, these machines have to decelerate to a stop in a synchronous manner. So when there is a sudden power loss, the host controller will notify the GS4 Drive to use the DEB function with a deceleration time via EF.

NOTE: DEB active level is when the DC BUS voltage level is lower than the DEB Disable Voltage Level (P6.63) plus the DEB Offset Level (P6.62).

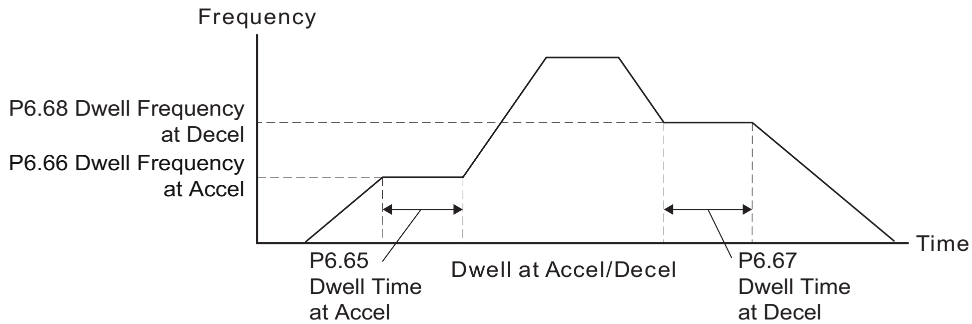
		Type	Hex Addr	Dec Addr
P6.65	***Dwell Time at Accel***	♦R/W	0641	41602
P6.66	***Dwell Frequency at Accel***	♦R/W	0642	41603
P6.67	***Dwell Time at Decel***	♦R/W	0643	41604
P6.68	***Dwell Frequency at Decel***	♦R/W	0644	41605

Range/Units — *Default*

P6.65, P6.67 Time: 0.00~600.00 sec — 0.00

P6.66, P6.68 Frequency: 0.00~599.00 Hz

P6.65 to P6.68 is for heavy loads in order to prevent OV or OC faults. A heavy load will be accelerated to P6.66 and remain there for the time specified in P6.65, then continue to accelerate to the commanded speed. The same behavior occurs for the Dwell Frequency and Time for the Decel portion.



		Type	Hex Addr	Dec Addr
P6.69	***Input Phase Loss Detection Time***	R/W	0645	41606

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

0.00~600.00 sec — 0.20

This parameter sets the monitoring time interval to detect an input phase loss. The factory setting is 0.20 second, which means the drive will check every 0.20 second.

Related parameters: P6.49, P6.70

		Type	Hex Addr	Dec Addr
P6.70	***Input Phase Loss Ripple Detection***	R/W	0646	41607

Range/Units — *Default*

230V models: 0.0~160.0 VDC — 30.0

460V models: 0.0~320.0 VDC — 60.0

When the input voltage is greater than the setting in P6.70 for the time determined as shown below, this situation is seen as input phase loss.

Current (%)	50	75	120	150	200
Time (seconds)	432	225	60	32	15

An error message OrP will be shown on the keypad, and the drive will react according to the setting of P6.49.

Related parameters: P6.49, P6.69

		Type	Hex Addr	Dec Addr
P6.71	**STO Alarm Latch**	♦R/W	0647	41608
	Range/Units (Format: 16-bit binary)	*Default*		
	0: STO Alarm Latch 1: STO Alarm no Latch	0		

Setting Explanations:

0: STO Alarm Latch: After the reason for an STO Alarm is cleared, a Reset command is needed to clear the STO Alarm unless Fire Mode is turned ON. Once the STO Alarm is cleared, Fire Mode can run the drive without first having received a reset signal. Fire Mode will also run the drive after an STL1 or STL2 alarm is cleared without needing a power cycle.

1: STO Alarm no Latch: After the reason for an STO Alarm is cleared, the STO Alarm will be cleared automatically. Cycling the run command OFF then ON is required, even if P6.29=1 (Line Start Lockout disabled).

All of the STL1~STL3 errors are “Alarm Latch” mode. (In STL1~STL3 mode, the P6.71 function is not effective.)

		Type	Hex Addr	Dec Addr
P6.72	**IGBT Temperature**	Read	0648	41609
	Range/Units (Format: 16-bit unsigned)	*Default*		
	-3,276.7 to +3,276.7 °C	0		

		Type	Hex Addr	Dec Addr
P6.73	**Cap Temperature**	Read	0649	41610
	Range/Units (Format: 16-bit unsigned)	*Default*		
	-3,276.7 to +3,276.7 °C	0		

Parameters P6.72 and P6.73 allow the user the monitor the IGBT and CAP temperatures in degrees Celcius. These registers are read only.

Group P7.xx Details – PID Parameters

NOTE: For detailed information about the PID control process, including applicable parameters from other parameter groups, please refer to Appendix F: PID Control.

		Type	*Hex Addr*	*Dec Addr*
P7.00	***PID Action/Mode***	♦R/W	0700	41793

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

0: PID Disabled
1: PID Reverse Local/Remote
2: PID Forward Local/Remote
3: PID Reverse Remote Only
4: PID Forward Remote Only
5: PID Reverse Local Only
6: PID Forward Local Only

This parameter sets the input terminal to use for the process variable PID feedback.

		Type	*Hex Addr*	*Dec Addr*
P7.01	***reserved***	~	0701	41794

		Type	*Hex Addr*	*Dec Addr*
P7.02	***PID Setpoint Source Display***	Read	0702	41795

Range/Units (Format: 16-bit binary) — *Default*: 7

00: Keypad
01: RS485
02: AI1
03: AI2
04: AI3
05: Ext Up/Down Key
06: Comm Card
07: Multi-Step Inputs
08: PID off

This is a Read-Only Parameter which displays the PID Setpoint source.

When PID is enabled (P7.00>0), P7.02 parameter data will be mapped from P4.00~P4.01 dependent upon whether in Remote (P4.00) or Local (P4.01).

This parameter indicates the source for the PID Setpoint, which is determined by setting of the appropriate parameter P4.00 (Remote) or P4.01 (Local).

The user can change the display to show the PID Setpoint by changing parameter P8.00 to 42, PID Reference.

		Type	*Hex Addr*	*Dec Addr*
P7.03	***PID Feedback Gain***	♦R/W	0703	41796

Range/Units (Format: 16-bit unsigned) — *Default*: 100.00

0.00~300.00%

This parameter can be used to set a gain for the Process Variable feedback signal.

		Type	Hex Addr	Dec Addr
P7.04	***PID Offset Value***	♦R/W	0704	41797
	Range/Units (Format: 16-bit signed)	*Default*		
	-100.0% to +100.0%	0.0		

This parameter is for fine tuning a PID setting. The PID Offset Value is added to the PID Output (Frequency Command). See the control diagrams on page 4–165. You can input a PID offset to provide the desired operating condition. It functions similarly to parameters P4.10, P4.15, and P4.19.

		Type	Hex Addr	Dec Addr
P7.05	***Keypad PID Setpoint***	Read	0705	41798
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~100.00%	0.0		

This parameter is used for keypad and serial communication PID Setpoints.

If keypad is the source of Frequency Command when Lv or Fault occurs, the present Frequency Command will be saved in this parameter.

		Type	Hex Addr	Dec Addr
P7.06	***PID Multi-Setpoint 1***	♦R/W	0706	41799
P7.07	***PID Multi-Setpoint 2***	♦R/W	0707	41800
P7.08	***PID Multi-Setpoint 3***	♦R/W	0708	41801
P7.09	***PID Multi-Setpoint 4***	♦R/W	0709	41802
P7.10	***PID Multi-Setpoint 5***	♦R/W	070A	41803
P7.11	***PID Multi-Setpoint 6***	♦R/W	070B	41804
P7.12	***PID Multi-Setpoint 7***	♦R/W	070C	41805
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~100.00%	0.00		

Parameters P7.06~P7.12 are used to provide seven different PID Setpoints. Multi-Function Input Terminals DI1~DI15 are assigned in parameters P3.03~P3.16 to select which one of the PID Multi-Setpoints is to be used.

Multi-Function Input Terminal Function Settings (P3.03~P3.16) for Input Terminals DI1~DI16 *(Abbreviated listing; includes only settings applicable to PID)*	
Setting: Function	***Function Description***
0: No function	Setting a Multi-Function Input to 0 will disable that input. The purpose of this function is to provide isolation for unused Multi-Function Input Terminals. ***Any unused terminals should be programmed to 0 to make sure they have no effect on drive operation.***
1: Multi-Speed/PID Multi-Setpoint bit 1 2: Multi-Speed/PID Multi-Setpoint bit 2 3: Multi-Speed/PID Multi-Setpoint bit 3	When settings 1, 2, & 3 are selected and registers P7.06~P7.12 are populated, the Multi-Function Inputs refer to PID Multi-Setpoints. The SPs are determined by P7.06~P7.12. 1) In order to use the Multi-PID SPs, P7.06~P7.12 must be set, and P7.00≠0. 2) When all PID Multi-Setpoint inputs are off, the GS4 drive reverts to the PID Setpoint Source (P7.02).

PID Setpoint			***Selection***
Bit 3	***Bit 2***	***Bit 1***	***PID Setpoint***
OFF	OFF	OFF	P7.02: SP Source
OFF	OFF	_ON_	P7.06: Setpoint 1
OFF	_ON_	OFF	P7.07: Setpoint 2
OFF	_ON_	_ON_	P7.08: Setpoint 3
_ON_	OFF	OFF	P7.09: Setpoint 4
_ON_	OFF	_ON_	P7.10: Setpoint 5
_ON_	_ON_	OFF	P7.11: Setpoint 6
_ON_	_ON_	_ON_	P7.12: Setpoint 7

		Type	Hex Addr	Dec Addr
P7.13	***Proportional Gain (P)***	♦R/W	070D	41806
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~100.0	1.0		

Proportional Gain is used to eliminate system error. It is most often used to decrease error and increase response speed. But a P7.13 setting value that is too large may cause system oscillation and instability.

If the other two controls (I and D) are set to zero, Proportional Gain is the only one effective in the PID loop.

		Type	Hex Addr	Dec Addr
P7.14	***Integral Time (I)***	♦R/W	070E	41807
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~100.00 sec	1.00		

This parameter is used to set the time of the Integral (I) controller. The integral controller is used to eliminate error in a stable system. The integral time of the PID controller is acted upon by the change in integral time. When the integral time is long, it will provide a small gain of integral control, a slower response, and less sloppy external control. When the integral time is short, it will provide a large gain of Integral control, a faster response ,and more rapid external control. The Integral Time doesn't stop working until error is 0. The smaller integral time is set, the stronger integral action will be. This function is helpful to reduce overshoot and oscillation to make a stable system. As it functions the decreasing error will be slowed. The Integral Time is often used with the other two controls to become PI controller or PID controller. Remember when the integral time is too small, it may cause system oscillation.

If the integral time is set as 0.00, P7.14 will be disabled.

		Type	Hex Addr	Dec Addr
P7.15	***Derivative Value (D)***	♦R/W	070F	41808
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~1.00 sec	0.00		

This parameter is used to set the value of the Derivative (or Differential) (D) controller to decide the response of error change. A suitable differential time can reduce the overshoot of a P and I controller to decrease oscillation for a more stable system. The differential controller is used to show the change of system error, is helpful to preview the change of error, and is used to eliminate error to improve a systems operating state. With a suitable differential time, it can reduce overshoot and shorten adjustment time. However, the differential operation does increase (because of its effect) noise interference. Please note that too large of a differential can cause a large amount of noise interference. The differential shows the change and the output of the differential will be 0 when there is no change. Therefore, the differential control can't be used independently. It needs to be used with the other two controllers to make a PD controller or PID controller. Too long a differential time may cause system oscillation. The differential controller acts to minimize the change of error and can't filter noise. It is not recommended to use this function in noisy or noise-prone applications.

NOTE: Differential Control cannot be used independently. It needs to be used with the other PID controls to make a PD controller or PID controller.

P7.16	***Upper Limit for Integral Time***	*Type*	*Hex Addr*	*Dec Addr*
	Range/Units (Format: 16-bit unsigned)	♦R/W	0710	41809
	0.0~100.0%	*Default* 100.0		

This parameter defines an upper limit for the Integral Time (I), and therefore limits the Master Frequency.

- *Integral upper limit = Maximum Output Frequency (P0.04) x Upper Limit for Integral Time (P7.16).*

An integral value that is too high will slow the system response due to sudden load changes, and therefore may cause motor stall or machine damage. Therefore, use caution when setting this parameter.

P7.17	***Derivative Filter Time Constant***	*Type*	*Hex Addr*	*Dec Addr*
	Range/Units (Format: 16-bit unsigned)	♦R/W	0711	41810
	0.0~2.5 sec	*Default* 0.0		

To avoid amplification of measured noise in the controller output, a digital filter is inserted. This filter helps smooth oscillations. Larger values for P7.17 provide more smoothing.

P7.18	***PID Output Frequency Limit***	*Type*	*Hex Addr*	*Dec Addr*
	Range/Units (Format: 16-bit unsigned)	♦R/W	0712	41811
	0.0~100.0%	*Default* 100.0		

This parameter defines the percentage of output frequency limit during PID control.

- *Output frequency limit = Maximum Output Frequency (P0.04) x PID Output Frequency Limit (P7.18).*

P7.19	***PID Feedback Value***	*Type*	*Hex Addr*	*Dec Addr*
	Range/Units (Format: 16-bit signed)	Read	0713	41812
	-200.00% to +200.00%	*Default* 0.00		

This parameter shows the value of feedback signal under PID control.

P7.20	***Feedback Signal Detection Time***	*Type*	*Hex Addr*	*Dec Addr*
	Range/Units (Format: 16-bit unsigned)	♦R/W	0714	41813
	0.0~3600.0 sec	*Default* 0.0		

This parameter is valid only when the feedback signal is AI2 4~20mA.

This parameter defines the time during which the PID feedback must be abnormal before a warning is given. It also can be modified according to the system feedback signal time.

If this parameter is set to 0.0, the system would not detect any signal abnormality.

		Type	Hex Addr	Dec Addr
P7.21	**PID Feedback Loss**	R/W	0715	41814
	Range/Units (Format: 16-bit binary)	Default		
	0: Warn and Continue Operation 1: Warn (fault) and Ramp to Stop 2: Warn (fault) and Coast to Stop 3: Warn and Operate at Last Frequency 4: Warn and Run at P7.22	0		

Loss detected only if P7.20 (Loss Detect Time) > 0.

This parameter is valid only when the feedback signal is AI2 4~20mA.

GS4 AC drive acts when the feedback signals (analog PID feedback) are abnormal.

If the command frequency falls below the Sleep Reference frequency (P7.29), for the specified Sleep Time (P7.31), then the drive will shut off the output and wait until the command frequency rises above Wake-up Reference (P7.30).

Setting Explanations:

0: Drive goes to 0Hz, but does not fault (warning only). Drive will restart if signal returns.

1 & 2: AFE Fault (PID Feedback AI2 Loss). Requires reset.

3: Drive warns and runs at the last PID Feedback Frequency.

4: Drive warns and runs at setting of P7.22.

IF P7.21 = 0 OR 3 (KEEP RUNNING ON 4-20MA LOSS) AND P7.00 PID FEEDBACK IS SET FOR "FORWARD OPERATION" (P7.00 = 2, 4, OR 6), THE DRIVE WILL ACCELERATE TO P7.18 PID OUTPUT LIMIT IF THE ANALOG SIGNAL IS LOST.

		Type	Hex Addr	Dec Addr
P7.22	**PID Feedback Loss Speed Level Default Value**	♦R/W	0716	41815
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00~400.00 Hz	0.00		

This parameter sets the speed of operation of the GS4 drive when there is a loss of the PID feedback signal, if P7.21 is set to 4.

Loss is detected only if P7.20 (Feedback Signal Detection Time) > 0.

		Type	Hex Addr	Dec Addr
P7.23	**reserved**	~	0717	41816

		Type	Hex Addr	Dec Addr
P7.24	**PID Offset Selection**	♦R/W	0718	41817
	Range/Units (Format: 16-bit binary)			Default
	0: Set by P7.04 1: Set by an Analog Input [AI1 (P4.02), AI2 (P4.03), or AI3 (P4.04) must be set to 7: PID Offset (Input)]			0

This parameter sets the source of the PID Offset.

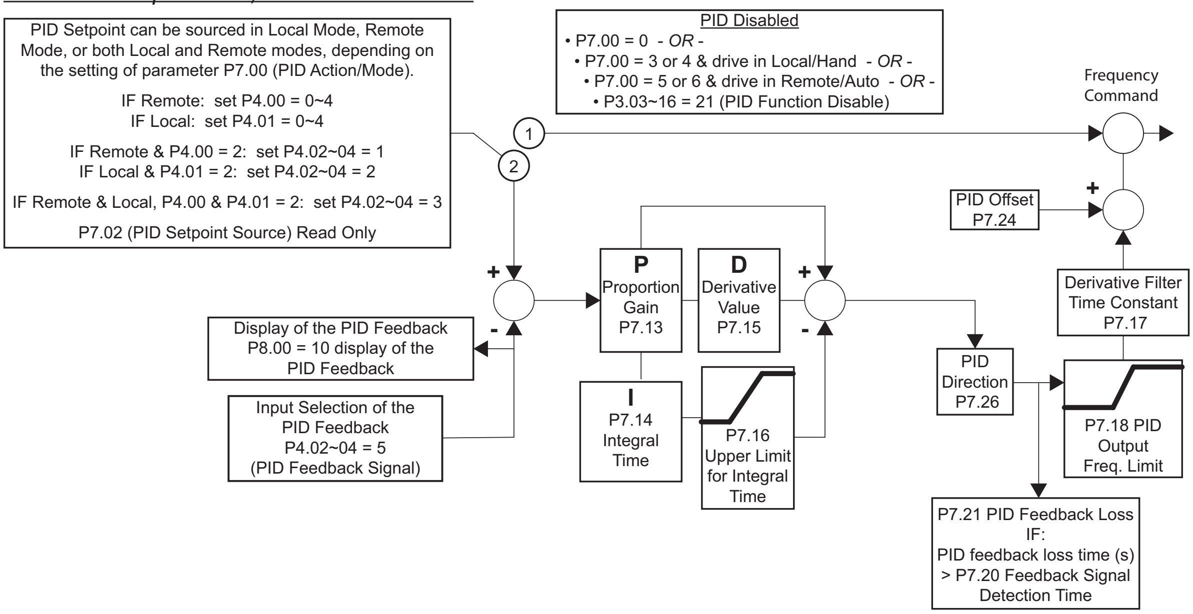
		Type	Hex Addr	Dec Addr
P7.25	***PID Mode Selection***	R/W	0719	41818

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

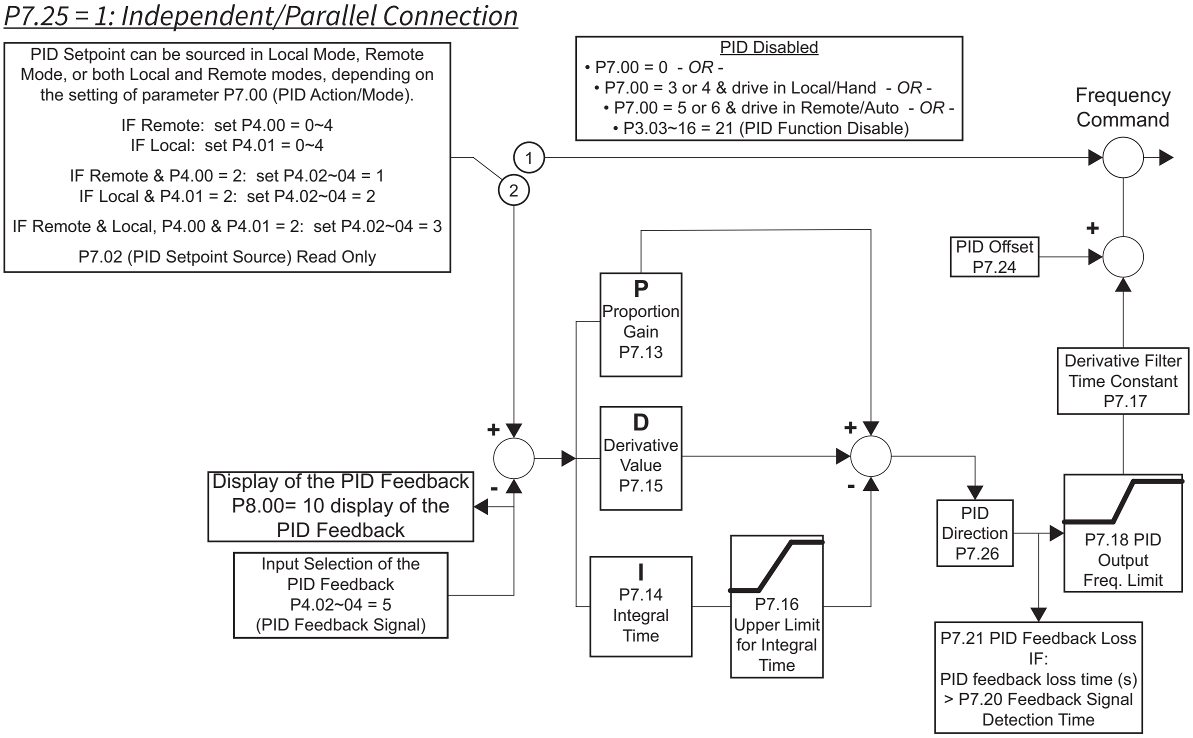
0: Old PID mode, Kp, Kp•Ki, Kp•Kd are dependent/serial
1: New PID mode, Kp, Ki, Kd are independent/parallel
NOTE: Refer to diagrams below for P7.25=0 and P7.25=1
- *Kp = Proportional Gain/Control (P7.13)*
- *Ki = Integral Time/Control (P7.14)*
- *Kd = Derivative Value/Time (P7.15)*

The Serial or parallel connection PID mode selections are explained in the 2 graphics found in the detailed information found below.

P7.25 = 0: Dependent/Serial Connection



P7.25 = 1: Independent/Parallel Connection



		Type	Hex Addr	Dec Addr
P7.26	***PID Reverse Enable***	R/W	071A	41819
	Range/Units (Format: 16-bit binary)	*Default*		
	0: PID can't change command direction 1: PID can change command direction	0		

This parameter when engaged changes the ability of PID to change the direction of the drive.

- *When set to 0 it prevents PID from changing the direction of the output.*
- *When set to a 1 it enables the changing of direction by the level of PID.*

		Type	Hex Addr	Dec Addr
P7.27	***Source of Sleep***	R/W	071B	41820
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Frequency/PID Command Frequency (CV) 1: Feedback	0		

This parameter selects how the Sleep Mode function will be actuated; either by the *Command Frequency (speed reference)* if the drive is operating with *PID disabled*, or by the *PID Command Frequency (CV)* if the *PID is enabled*.

In application, the trigger for sleep mode is the commanded frequency, (speed reference or PID, CV) and *NOT* the actual drive output frequency.

		Type	Hex Addr	Dec Addr
P7.28	***Integral Limit During Sleep***	R/W	071C	41821
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~200.0	50.0		

This upper integral limit of the drive is to avoid running at high speed right after the drive has been awakened.

		Type	Hex Addr	Dec Addr
P7.29	***Sleep Reference***	♦R/W	071D	41822
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P7.27=0: 0.0~599.00 Hz P7.27=1: 0.0~200.00%	0.00		

		Type	Hex Addr	Dec Addr
P7.30	***Wake-up Reference***	♦R/W	071E	41823
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P7.27=0: 0.0~599.00 Hz P7.27=1: 0.0~200.00%	0.00		

		Type	Hex Addr	Dec Addr
P7.31	***Sleep Time***	♦R/W	071F	41824
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~6000.0 sec	0.0		

		Type	Hex Addr	Dec Addr
P7.32	***Wake-up Delay Time***	R/W	0720	41825
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~600.00 sec	0.00		

Parameters P7.29, P7.30, P7.31, P7.32:

The Sleep Reference point (P7.29) provides the setpoint at which, should the drive reach or go below, causes the drive to go to sleep. When asleep the drive does nothing (its output being off) besides monitoring its operating point.

In order to Wake-up and again operate, it should reach the Wake-up Reference point (P7.30). If the Command Frequency falls below the Sleep Reference point (P7.29) for the Sleep Time specified in P7.31, then the drive will shut off the output and wait until the Command Frequency rises above what is set in Wake-Up Reference point (P7.30).

The Wake-up Delay Time (P7.32) delays the drive from Waking-Up once the Wake-Up Level has been exceeded by the amount of time set in this parameter.

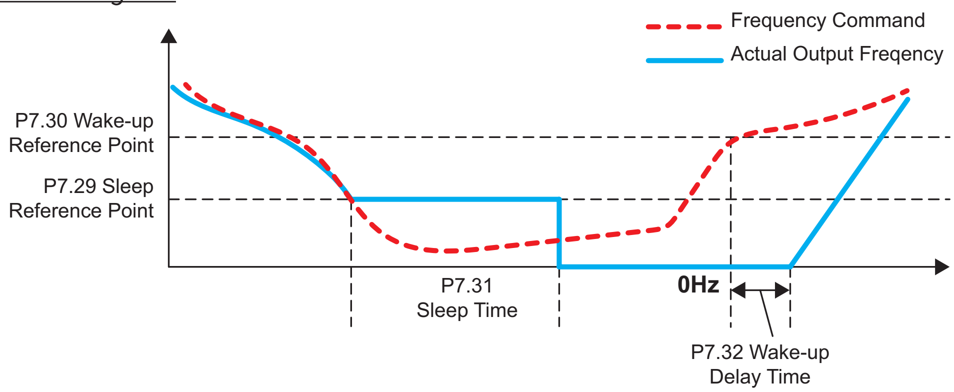
The Wake-up Timer is not cumulative: the reference needs to stay above Wake-up Reference for the entire length of Wake-up Delay, otherwise the Delay timer will reset.

There are three types of Sleep mode and Wakeup mode.

Sleep/Wake-up Mode #01: Frequency Command (Not using PID; P7.00=0)

- *When the GS4 frequency command falls below the setting in P7.29 (Sleep Reference), the GS4 output frequency will remain at the "Sleep Reference" frequency.*
- *When sleep time equals the setting in P7.31 (Sleep Time)and the frequency command remains below the "Wake-up Reference" value in P7.30, the GS4 drive will sleep at 0Hz.*
- *When the frequency command exceeds the "Wake-up Reference" value in P7.30, the "Wake-up Delay" timer will increment until elapsed time equals the setting in P7.32. With "wake-up" time elapsed, the GS4 drive will accelerate to the commanded output frequency.*
- *For Sleep Function to be active in LOCAL and REMOTE modes, P3.57 bit 0 must be set to 1. For Sleep Mode to be active in REMOTE mode only, P3.57 bit 0 = 0.*

Sleep Mode Diagram

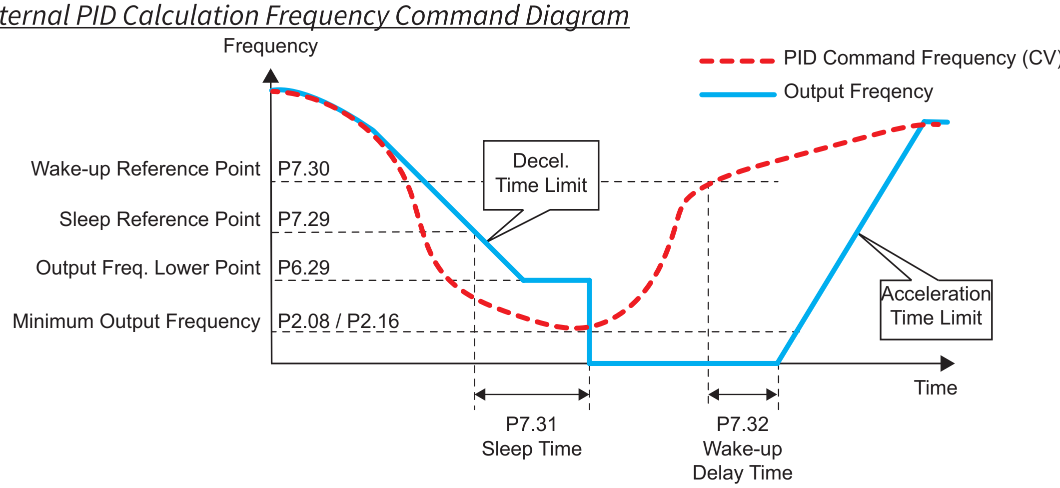


Sleep/Wake-up Mode #02:

Internal PID Frequency Calculation Command (Using PID; P7.00 = 1 or 2, OR P7.00 = 3 or 4 and in Remote/Auto Mode, OR P7.00 = 5 or 6 and in Local/Hand Mode)

- *As the command frequency falls, the output frequency follows at a rate determined by the active deceleration parameter (P1.02, 04, 06, or 08). As output frequency falls below the "Sleep Reference" setting (P7.29), "Sleep Time" (P7.31) begins to increment.*
- *Depending on the rate of deceleration and the "Sleep Time" setting, the output frequency may plateau at the "Lower Limit of Output Frequency" set in P6.26 if "Sleep Time" is not complete, or continue deceleration to zero output frequency if "Sleep Time" had elapsed.*
- *When command frequency rises above the "Wake-up Reference" value set in P7.30, the "Wake-up Delay Time" (P7.32) begins to increment. When elapsed, the output frequency begins to increase at a rate determined by the selected acceleration parameter (P1.01, 03, 05, or 07).*
- *For Sleep Function to be active in LOCAL and REMOTE modes, P3.57 bit 0 must be set to 1. For Sleep Mode to be active in REMOTE mode only, P3.57 bit 0 = 0.*

Internal PID Calculation Frequency Command Diagram



Refer to Appendix F: PID Control for more information about PID control.

Sleep/Wake-up Mode #03:

Internal PID Frequency Calculation Command (Using PID; P7.00 = 1 or 2, OR P7.00 = 3 or 4 and in Remote/Auto Mode, OR P7.00 = 5 or 6 and in Local/Hand Mode)

- *As the PID Feedback Value (PV) rises above the "Sleep Reference" value set in P7.29, the output frequency decreases at a rate determined by the active deceleration parameter (P1.02, 04, 06, or 08). At the same time, "Sleep Time" (P7.31) begins to accumulate.*
- *Depending on the rate of deceleration and the "Sleep Time" setting, the output frequency may plateau at the "Lower Limit of Output Frequency" (P6.26) if "Sleep Time" is not complete, or continue deceleration to zero output frequency if "Sleep Time" had elapsed.*
- *When the PID Feedback Value (PV) falls below the "Wake-up Reference" value set in P7.30, then "Wake-up Delay Time" (P7.32) begins to increment. When elapsed, the output frequency will begin to increase. If "Lower Limit of Output Frequency" P6.26 > 0Hz, then the output frequency will step to that frequency and then ramp at a rate determined by the selected acceleration parameter P1.01, 03, 05, or 07.*
- *For Sleep Function to be active in LOCAL and REMOTE modes, P3.57 bit 0 must be set to 1. For Sleep Mode to be active in REMOTE mode only, P3.57 bit 0 = 0.*

Mode #03 Example #1: Forward-Acting PID

Zone	***PID Feedback (PV)***
Sleep	PV > P7.29 (1,800gal)
Transition	P7.30 < PV < P7.29 (1,500 to 1,800 gal)
Wake-up	PV < P7.30 (1,500gal)

PID controlling tank level. Drive output frequency varies fill pump flow rate to fill the tank. The tank is emptied using a variable position drain valve controlled separately. Pump capacity is sized to fill the tank at a rate suitable to maintain tank level with drain valve at full open position.

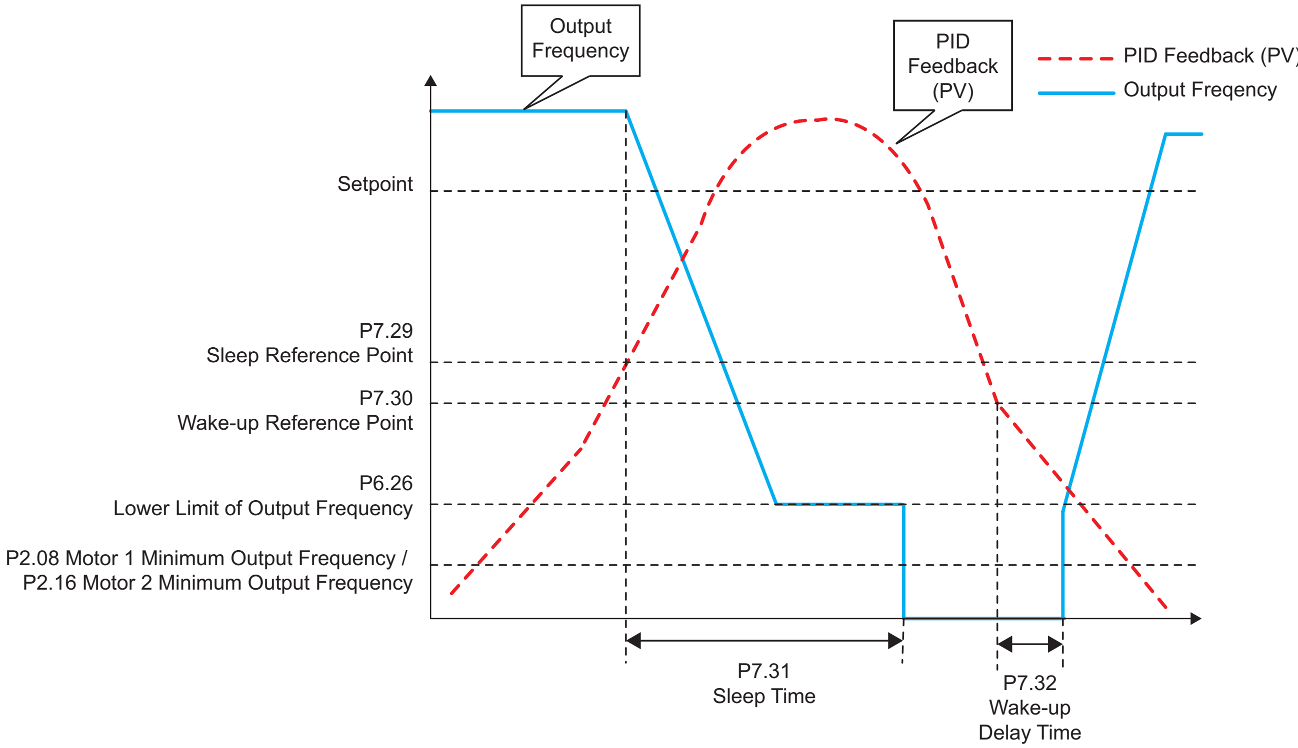
- *Tank volume = 10,000 gallons*
- *PV Range = 0 to 10,000 gallons*
- *Setpoint = 60% = 6,000 gallons*

Set the following parameters:

- *Analog Input 1 (AI1) Function P4.02 = 5: PID Feedback Signal*
- *PID Action Mode P7.00 = 2: PID Forward Local/Remote, or 4: PID Forward Remote Only, or 6: PID Forward Local Only*
- *Sleep Reference P7.29 = 30% = (30% of 6,000 = 1,800 gallons)*
- *Note: P7.29 value must be greater than P7.30 value*
- *Wake-up Reference P7.30 = 25% = (25% of 6,000 = 1,500 gallons)*
- *Sleep Time P7.31 = 20.0 seconds (for this example)*
- *Wake-up Delay Time P7.32 = 10.00 seconds (for this example)*
- *Lower Limit of Output Frequency P6.26 = 10Hz (for this example)*

• Case #1:
- *PID Feedback (PV) > Sleep Reference P7.29 = 30% (1,800 gal) – then drive output frequency decreases*

• Case #2:
- *PID Feedback (PV) < Wake-up Reference P7.30 = 25% (1,500gal) – then drive output frequency increases*



Refer to Appendix F: PID Control for more information about PID control.

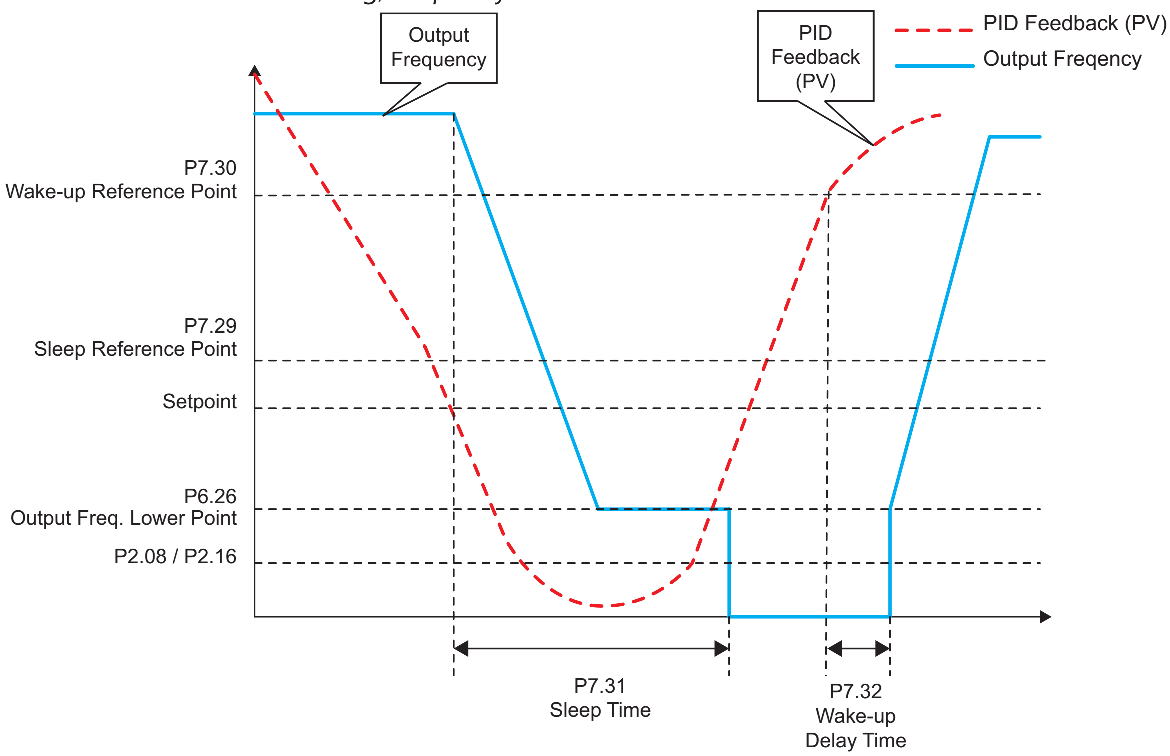
Mode #03 Example #2: Reverse-Acting PID

- *P7.29 must be less than P7.30.*
- *30kg is the setpoint (same as example #1).*

Zone	*PID Physical Quantity*
Sleep Zone	When greater that 36kg, the GS4 drive goes to sleep
Transition Zone	When between 33kg~36kg, the GS4 drive remains in its previous status
Wake-up Zone	When less than 33kg; in this case 30kg is the setpoint.

Set the following parameters:

- *P4.03 = 5 (AI1 as PID Feedback Signal)*
- *P7.00 = 1: (PID Reverse Local/Remote), 3: (PID Reverse Remote Only), or 5: (PID Reverse Local Only)*
- *P7.29 = 110% [Sleep Reference 33kg = (110%)·(30kg)]*
- *P7.30 = 120% [Wake-up Reference 36kg = (120%)·(30kg)]*
- *Case #1: If Feedback < 33kg, frequency decreases*
- *Case #2: If Feedback > 36kg, frequency increases*



Refer to Appendix F: PID Control for more information about PID control.

Group P8.xx Details – Display Parameters

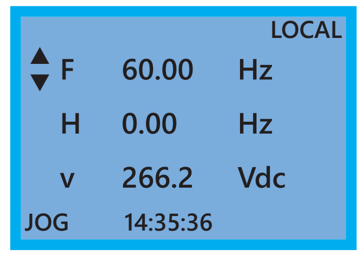
Type	Hex Addr	Dec Addr
♦ R/W	0800	42049

Default: 3

P8.00 **User Display**

Range/Units (Format: 16-bit binary)

As Seen During Setup	As Displayed During Operation		
0: Output Amps	A	displayed value	Amps
1: Counter Value	c	displayed value	CNT
2: Actual Freq	H.	displayed value	Hz
3: DC Bus Voltage	v	displayed value	Vdc
4: Output Voltage	E	displayed value	Vac
5: Power Factor	n	displayed value	deg
6: Output Power	P	displayed value	kW
7: Calculated RPM	r	displayed value	rpm
8: reserved		n/a	
9: reserved		n/a	
10: PID Feedback %	B	displayed value	%
11: AI1 %	1.	(note 1)	%
12: AI2 %	2.	(note 1)	%
13: AI3 %	3.-	(note 1)	%
14: IGBT Temperature	i.	displayed value	oC
15: Cap Temperature	c.	displayed value	oC
16: DI Input Status	i	displayed value	h
17: DO Output Status	o	displayed value	h
18: Multi-Speed Step	S	displayed value	
19: CPU DI Status	d	(note 2)	h
20: CPU DO Status	0.	(note 3)	h
21: reserved		n/a	
22: reserved		n/a	
23: reserved		n/a	
24: reserved		n/a	
25: Overload %	L	(note 4)	%
26: Ground Fault %	G.	displayed value	%
27: DC Bus Ripple	r.	displayed value	Vdc
28: PLC D1043 Value	C	displayed value	h
29: reserved		n/a	
30: User-Defined	U	displayed value	
31: Out Hz x P8.05	K	displayed value	
32: reserved		n/a	
33: reserved		n/a	
34: Fan Speed	f	displayed value	%
35: reserved		n/a	
36: Carrier Frequency	J.	displayed value	
37: reserved		n/a	
38: Drive Status	6.	(note 5)	h
39: reserved		n/a	
40: reserved		n/a	
41: kWh	J	displayed value	kWh
42: PID Reference	h.	displayed value	%
43: PID Offset	o.	displayed value	%
44: PID Output Hz	b.	displayed value	Hz
45: Reserved			
46: STO Version	d	displayed value	decimal
47: STO Chksum High	d	displayed value h	hex
48: STO Chksum Low	d	displayed value h	hex



Explanation of display shown:

F = Commanded Frequency (setpoint)

H = Frequency the drive is actually outputting (0 means this drive is stopped)

v = DC Bus Voltage (This is the User Display line resulting from setting P8.00 = 3. The User Display appears in the 3rd row by default, but it can be moved to the top row per the setting of P8.01.)

<u>Note 1 (For P8.00 = 11: AI1, 12: AI2, 13: AI3)</u>: The value can display negative values when setting analog input bias (P4.09, P4.10, P4.15, P4.19, P4.11, P4.16, & P4.20).

<u>Note 2 (For P8.00 = 19: CPU DI Status)</u>: Example: If REV, DI1 and DI6 are ON, the following table shows the status of the terminals (0 means OFF; 1 means ON).

Terminal	DI15	DI14	DI13	DI12	DI11	DI10	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1	REV	FWD
Status	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0

DI10~DI15 are the terminals for extension cards (P3.11~P3.16).
If REV, DI1 and DI6 are ON, the value is 0000 0000 1000 0110 in binary, and 0086h in HEX. When P8.00 is set to "16" or "19," it will display "0086h." The setting 16 is the status of Digital Inputs in parameter P3.46, and the setting 19 is the corresponding CPU pin status of Digital Input. User can set to 16 to monitor Digital Input status and then set to 19 to check if the internal connections of the drive have failed. The DI status follows the behavior of the NO/NC contact selection in P3.42.

<u>Note 3 (For P8.00 = 20: CPU DO Status)</u>: Assume that Multi-Function Output Terminal 1 (R1: P3.17) is set to 9 (Drive Ready). After applying power to the GS4 drive, if there is no other abnormal status, the contact will be OFF. The display status will be shown as follows (0 = OFF; 1 = ON)

Terminal	DO20~DO18				DO17~DO14				DO13~DO10				DO2	DO1	reserved	R2	R1
Status	~	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

If P8.00 is set to 17 (Digital Output Status) or 20 (CPU Digital Output Status), the keypad will display status in hexadecimal "0001h" with LED U is ON on the keypad. The setting 17 is the status of Digital Output by P3.43 setting and the setting 20 is the corresponding CPU pin status of Digital Output. User can set 17 to monitor the Digital Output status and then set to 20 to check if the wire is normal. The DO status follows the behavior of the NO/NC contact selection in P3.43.

<u>Note 4 (For P8.00 = 25: Overload %)</u>: When display value reaches 100.00%, the drive will show "oL" as an overload warning.

<u>Note 5 (For P8.00 = 38: Drive Status)</u>: Bit 0: The drive is running forward. Bit 1: The drive is running backward. Bit 2: The drive is ready. Bit 3: Errors occurred on the drive. Bit 4: The drive is running. Bit 5: Warnings on the drive.

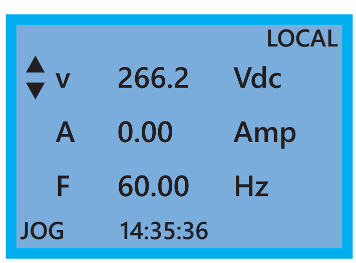
		<u>Type</u>	*<u>Hex Addr</u>*	*<u>Dec Addr</u>*
<u>P8.01</u>	***Start-up Display Selection***	♦ R/W	0801	42050

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

0: Freq Setpoint (F)
1: Output Hz (H)
2: User Display (U)
3: Output Amps (A)

This parameter determines the start-up display page after power is applied to the drive. The sequence does not change; the order of appearance is always (F), (H), (U), then (A). Only three parameters can be displayed on the keypad screen at a time. P8.01 specifies only which parameter appears on the top row when the drive is powered up. All four parameters can always be scrolled to using the keypad up and down arrows. User defined choice (U) displays values and units according to the setting in P8.00.

<u>Example</u>: If P8.00 = 3, the User Display shows DC Bus Voltage.
If P8.01 = 2, the User Display appears in the top row at power up.



		Type	Hex Addr	Dec Addr
P8.02	***User Defined Format***	R/W	0802	42051
	Range/Units (Format: 16-bit binary)	*Default*		

Bits 0~3: User defined decimal place
- 0000b: no decimal place
- 0001b: one decimal place
- 0010b: two decimal place
- 0011b: three decimal place

Bits 4~9: 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: °C
- 014xh: °F
- 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: m^3/s
- 022xh: m^3/h
- 023xh: gpm
- 024xh: cfm

Default: 0

The user defined format sets the attributes (or units) that are enabled when P8.03 > 0. These settings allow the user to define a display field according to specific system processes. The frequency command signal will be scaled according to P0.04 (Max Output Freq) and P8.03 (User Coefficient Max)

Example:
- *P0.04 Max Output Freq = 60 Hz*
- *P8.00 User Display = 30 (User Defined)*
- *P8.02 User Defined Format = 0072h (unit = ppm, two decimal places)*
- *P8.03 User Defined Max = 115.00*

An analog frequency setting of 50% will result a 30Hz setting, but the keypad will display the user format 57.50ppm (50% x 115.00ppm). Likewise a commanded frequency input value of 100.00ppm will result in an output frequency of 52.17Hz = (100ppm/115ppm) x 60Hz.
Note: *Running in forward or reverse will display a positive value.*

		Type	Hex Addr	Dec Addr
P8.03	***User Defined Max***	R/W	0803	42052
	Range/Units (Format: 16-bit unsigned)	*Default*		

0: Disable
0~65535 (when P8.02 set to no decimal place)
0.0~6553.5 (when P8.02 set to 1 decimal place)
0.00~655.35 (when P8.02 set to 2 decimal place)
0.000~65.535 (when P8.02 set to 3 decimal place)

Default: 0

User defined is enabled when P8.03 is not 0. The setting of P8.03 is linearly scaled to P0.04 (Max Output Frequency).

See example in P8.02 for further information.

		Type	Hex Addr	Dec Addr
P8.04	***User Defined Setpoint***	Read	0804	42053
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~65535	0		

This parameter shows commanded frequency or user defined value when P8.03 is not set to 0.

		Type	Hex Addr	Dec Addr
P8.05	***Output Frequency Gain***	R/W	0805	42054
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~160.00	1.00		

This parameter sets coefficient gain in actual output frequency. Set P8.00 = 31 to display the calculation result on the screen (calculation = Output Frequency [Hz] x P8.05).

		Type	Hex Addr	Dec Addr
P8.06	***Password Input***	♦ R/W	0806	42055
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~65535	0		

This parameter allows user to enter the password (*which is created in P8.07*) to unlock the parameter protection for the drive and to make changes to the parameters.

After you set up this parameter (in P8.07), make sure that you note its value for any future use.

Enter into P8.06 the password that you previously created by entering it into *P8.07*. The value displayed here in P8.06 (after you enter the password) is the number of times the password was entered incorrectly; it will *not* show you the password you have entered.

NOTE: Once four attempts have been made to unlock the drive, the ability to run the drive is locked. (The number of password attempts 0~4 will show on the display.)

The purpose of having P8.06 and P8.07 is to prevent unauthorized changes to the GS4 drive configuration. *The result of a lost password or a change of password will be a resetting of the parameters within the drive*.

To recover from a lost password or to reset the password because of a change in operating/ engineering personnel, reset the password by inputing 9999 and pressing the Enter key. Then input 9999 again and press Enter again within 10 seconds. ***All drive settings will return to factory default settings***.

NOTE: When password protection is on, all parameter values show a value of 0, except parameter P8.07.

P8.07 Procedure for setting password:

1) Go to P8.07 and value should be 0, indicating password is not set or is unlocked.
2) Enter a password of your choosing and press Enter. (Password can be from 1~65535. Use arrows to move the cursor and increase/decrease the value.)
3) After the password has been entered, the value of P8.07 is now 1, which indicates the parameters are locked from editing or viewing. All other parameters will display a value of 0 when locked. Any attempt to change parameters will result in "ERR" being displayed.
4) To unlock the drive, go to P8.06 and enter the password you set up in P8.07 and press Enter.

		Type	Hex Addr	Dec Addr
P8.07	***Password Set Up***	♦ R/W	0807	42056
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~65535	0		

This parameter sets up a password to protect parameter settings from unauthorized modifications. For the first set up, enter a password of your choice. When finished entering the password, the setting of parameter P8.07 will be 1. Then password protection is activated. All parameters will display a value of 0 when locked. If you want to modify any parameter, go to parameter P8.06, enter the password that you set up here. Then you can modify the parameter. If all parameters are locked and P8.07 reads a 0, then P9.08 is most likely set to 1.

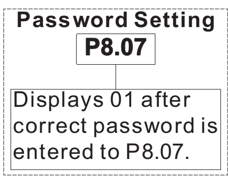
Password setting is permanently effective. If you need to modify any parameter, decode the parameter protection at Parameter P8.06.

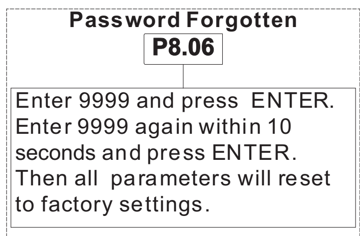
To disable the password lock set first enter the currect password in P8.06, then set P8.07 = 0. Password protection will remain off even during power cycles until a new password is set up.

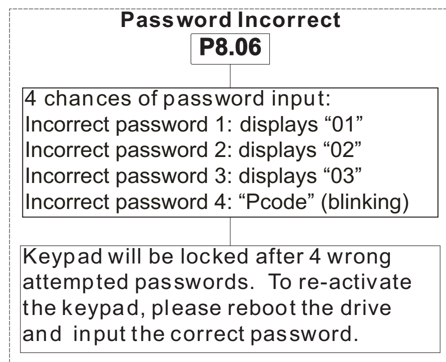
If you would like a new password you must first enter your old password to unlock the drive, then enter a new password in P8.07 and press enter. The drive parameter protection is now locked with the new password in effect.

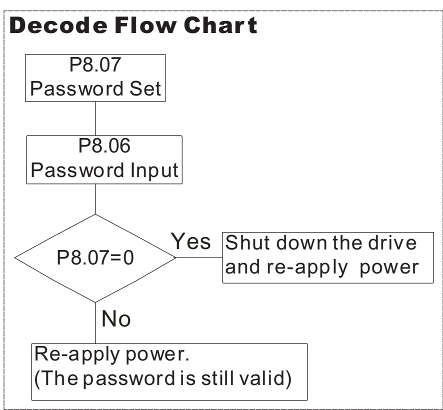
How to re-start the parameter protection after the password is decoded:

- *Method 01: Cycle power to the GS4 drive to restore the password protection if set.*
- *Method 02: Input any value into P8.06 (Do not enter the correct password).*









		Type	Hex Addr	Dec Addr
P8.08	***Power On Counter***	Read	0808	42057
P8.09	***Power On Day***	Read	0809	42058
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~65535	~		

P8.08 records the number of power cycles.
P8.09 records the number of days the drive has been powered on.

		Type	Hex Addr	Dec Addr
P8.10	***Power On Minute***	Read	080A	42059
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~1439	~		

Records the number of minutes the drive has been powered on.
After this parameter reaches 1,439 minutes it will roll over to 0, and P8.09 will increment by 1 day.

		Type	Hex Addr	Dec Addr
P8.11	***Accumulative Motor Operation Time (minute)***	Read	080B	42060
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~1439	~		

		Type	Hex Addr	Dec Addr
P8.12	***Accumulative Motor Operation Time (day)***	Read	080C	42061
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~65535	~		

P8.11 and P8.12 record motor operation time. Both parameters can be cleared by setting to 00. Operation time less than 60 seconds will not be recorded.
Motor operation time will accumulate as long as a Run command is present; *even if the speed reference is zero Hz*.

		Type	Hex Addr	Dec Addr
P8.13	***Keypad Communication Fault Treatment***	R/W	080D	42062
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn & Continue Operation 1: Warn & Ramp to Stop 2: Warn & Coast to Stop 3: No Warning & Continue Operation	2		

This parameter sets the response to a keypad communication fault.
NOTE: Use this parameter with P8.14 to enable Keypad Loss Detection. This is especially useful when the drive is being controlled from the keypad or from External Terminals (with Keypad Stop Enabled).
NOTE: P8.14 must be > 0 for this Parameter to enable Keypad Timeout (disconnected keypad).

		Type	Hex Addr	Dec Addr
P8.14	***Keypad Time Out***	R/W	080E	42063
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~100.0 sec	1.0		

This parameter sets the keypad time out. After the time-out period ends with no communications, the keypad will display “Keypad time out” “CP10,” and the drive will respond according to the setting of P8.13 (Keypad Communication Fault Treatment).
NOTE: If P8.13 = 3 (No Warning), the drive will not respond to a loss of keypad communication.

		Type	Hex Addr	Dec Addr
P8.15	***reserved***	~	080F	42064
P8.16	***reserved***	~	0810	42065
P8.17	***reserved***	~	0811	42066
P8.18	***reserved***	~	0812	42067
P8.19	***reserved***	~	0813	42068

		Type	Hex Addr	Dec Addr
P8.20	***PLC Buffer 1***	R/W	0814	42069
P8.21	***PLC Buffer 2***	R/W	0815	42070
P8.23	***PLC Buffer 4***	R/W	0817	42072
P8.24	***PLC Buffer 5***	R/W	0818	42073
P8.25	***PLC Buffer 6***	R/W	0819	42074
P8.26	***PLC Buffer 7***	R/W	081A	42075
P8.27	***PLC Buffer 8***	R/W	081B	42076
P8.28	***PLC Buffer 9***	R/W	081C	42077
P8.29	***PLC Buffer 10***	R/W	081D	42078
P8.30	***PLC Buffer 11***	R/W	081E	42079
P8.31	***PLC Buffer 12***	R/W	081F	42080
P8.32	***PLC Buffer 13***	R/W	0820	42081
P8.33	***PLC Buffer 14***	R/W	0821	42082
P8.34	***PLC Buffer 15***	R/W	0822	42083
P8.35	***PLC Buffer 16***	R/W	0823	42084
P8.36	***PLC Buffer 17***	R/W	0824	42085
P8.37	***PLC Buffer 18***	R/W	0825	42086
P8.38	***PLC Buffer 19***	R/W	0826	42087
P8.39	***PLC Buffer 20***	R/W	0827	42088

Range/Units (Format: 16-bit unsigned)	Default
0~65535	0

Parameters P8.20~P8.29 can be used for conveniently transferring data to third party devices.

These buffers are used as a data memory storage location so that other devices can access them from those parameter addresses. Users can change these parameter value by keypad or communication. This data will be retained on a power cycle.

The internal GS4 PLC can read and write to these Parameters (as well as all GS4 Parameters) using the RPR (Read Parameter) and WPR (Write Parameter) functions. So, these buffers can be used to transfer information from the internal PLC to external devices without having to program the external device to read data separately from the internal PLC and the Drive.

Group P9.xx Details – Serial Communication Parameters

		Type	Hex Addr	Dec Addr
P9.00	**VFD Comm Address**	♦ R/W	0900	42305
	Range/Units (Format: 16-bit unsigned)	*Default*		
	1 to 254	1		

If the GS4 drive is controlled by a communication protocol (MODBUS RTU, MODTCP, EtherNetIP, or BACnet) the communication address for this drive must be set via this parameter. The communication address for each AC motor drive on the same network must be different and unique.

		Type	Hex Addr	Dec Addr
P9.01	**Modbus Baud Rate**	♦ R/W	0901	42306
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: 4.8k 1: 9.6k 2: 19.2k 3: 38.4k 4: 57.6k 5: 115.2k	1		

This parameter is used to set the transmission speed between the RS-485 master (PLC, PC, etc.) and the drive.

		Type	Hex Addr	Dec Addr
P9.02	**Modbus Protocol**	♦ R/W	0902	42307
	Range/Units (Format: 16-bit binary)	*Default*		
	1: 7N2 (ASCII) 2: 7E1 (ASCII) 3: 7O1 (ASCII) 4: 7E2 (ASCII) 5: 7O2 (ASCII) 6: 8N1 (ASCII) 7: 8N2 (ASCII) 8: 8E1 (ASCII) 9: 8O1 (ASCII) 10: 8E2 (ASCII) 11: 8O2 (ASCII) 12: 8N1 (RTU) 13: 8N2 (RTU) 14: 8E1 (RTU) 15: 8O1 (RTU) 16: 8E2 (RTU) 17: 8O2 (RTU)	12		

Computer Link Control by PC or PLC (Computer Link).

A GS4 drive can be set up to communicate on Modbus networks using one of the following modes:

- *ASCII (American Standard Code for Information Interchange).*
  Uses 10-bit protocol string for 7 data bits, plus start, stop, and parity bits.
  Example: 7N2 = (1 start + 7 data + 0 parity + 2 stop) bits
- *RTU (Remote Terminal Unit).*
  Uses 11-bit protocol string for 8 data bits, plus start, stop, and parity bits.
  Example: 8E1 = (1 start + 8 data + 1 parity + 1 stop) bits

Modbus RTU is the prevalent protocol for serial Modbus communication. It is more efficient and has better error-checking than Modbus ASCII. We recommend using RTU over ASCII if the external device supports both modes.

Refer to "Chapter 5: Serial Communications" for detailed Modbus serial communication information.

		Type	Hex Addr	Dec Addr
P9.03	**Modbus Fault Select**	♦ R/W	0903	42308
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn & Continue Operation 1: Warn & Ramp to Stop 2: Warn & Coast to Stop 3: No Warning & Continue Operation	3		

This parameter is used to detect a serial communication error and take appropriate action.
NOTE: P9.03 applies only to serial communications.
Related Parameters: P9.04, P9.05

		Type	Hex Addr	Dec Addr
P9.04	**Modbus Time Out Detection**	♦ R/W	0904	42309
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Enable	0		

This parameter Enables or Disables time-out detection for serial communications.
NOTE: P9.04 applies only to serial communications.
Related Parameters: P9.03, P9.05

		Type	Hex Addr	Dec Addr
P9.05	**Modbus Time Out Duration**	♦ R/W	0905	42310
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.1 to 100.0 seconds	0.5		

When parameter P9.04 is set to 1, the communications Time Out Detection is Enabled. If a delay in communications for more than the Time Out Duration (P9.05) is detected, the action selected by the Transmission Fault Treatment (P9.03) will be used.
NOTE: P9.05 applies only to serial communications.
Related Parameters: P9.03, P9.04

		Type	Hex Addr	Dec Addr
P9.06	**Parameter Copy**	♦ R/W	0906	42311
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable Copy Keypad function 1: Enable Copy Keypad function	0		

The "Copy Param" function in the keypad can always copy parameter values from the drive to the keypad. If you want to copy parameters from the keypad to the drive, P9.06 must be set to 1 first; or else an SE1 error will appear on the keypad. This parameter is used to upload or download parameters from the keypad to the drive. After a power cycle P9.06 will default to 0.
NOTE: This parameter can be changed only by keypad entry. Writing to this parameter (Modbus, etc.) will result in a communications failure.

		Type	Hex Addr	Dec Addr
P9.07	**Parameter Lock**	R/W	0907	42312
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Normal Operation (allow changes) 1: Prevent any Changes to Parameters	0		

This parameter lock is global; it *affects all parameters in the GS4 drive*.

P9.08 is also capable of "parameter lock," and it should be checked if the drive parameter settings cannot be changed.

		Type	Hex Addr	Dec Addr
P9.08	**Restore to Default**	R/W	0908	42313

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

0: no function	6: Reset PLC (clear PLC)
1: Parameter Lock	7: no function
2: no function	8: no function
3: no function	9: Reset 50Hz Default
4: no function	10: Reset 60Hz Default
5: Reset kWh Display to Zero	

When this parameter is set to 1, all parameters except P9.08, P8.06, and P8.07 (Password Set Up) become read only. (P9.07 is capable of locking all of the drive parameters, and it should be checked if the drive parameter settings cannot be changed.)

Set P9.08 to 0 before changing other parameter settings.

- *When set to 5, kWh display value can be reset to 0, even when the drive is operating.*
- *When set to 6, the internal PLC program will be cleared.*
- *When set to 9 or 10, all parameters will be reset to factory settings. If the password is set in P8.07, input the password set in P8.06 to reset to factory settings.*
- *When set to 6, 9, or 10, power must be cycled on the drive for setting to take effect.*
- *Resets cannot be performed while PLC is running or in stop mode; PLC must be in Disable mode.*
- *If an "Err" appears on the keypad after performing a default action, then the default action did not take affect. The keypad will report back "End" if the default was performed correctly.*

This parameter does not reset the communication settings inside the Ethernet communication card. (Any new communication card parameter values must be "pushed" from the P9 parameters to the card. See P9.64)

		Type	Hex Addr	Dec Addr
P9.09	**Block Transfer Data Location 1**	* R/W	0909	42314
P9.10	**Block Transfer Data Location 2**	* R/W	090A	42315
P9.11	**Block Transfer Data Location 3**	* R/W	090B	42316
P9.12	**Block Transfer Data Location 4**	* R/W	090C	42317
P9.13	**Block Transfer Data Location 5**	* R/W	090D	42318
P9.14	**Block Transfer Data Location 6**	* R/W	090E	42319
P9.15	**Block Transfer Data Location 7**	* R/W	090F	42320
P9.16	**Block Transfer Data Location 8**	* R/W	0910	42321
P9.17	**Block Transfer Data Location 9**	* R/W	0911	42322
P9.18	**Block Transfer Data Location 10**	* R/W	0912	42323
P9.19	**Block Transfer Data Location 11**	* R/W	0913	42324
P9.20	**Block Transfer Data Location 12**	* R/W	0914	42325
P9.21	**Block Transfer Data Location 13**	* R/W	0915	42326
P9.22	**Block Transfer Data Location 14**	* R/W	0916	42327
P9.23	**Block Transfer Data Location 15**	* R/W	0917	42328
P9.24	**Block Transfer Data Location 16**	* R/W	0918	42329

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

0~65535

*P9.09~P9.24 can be set in run mode if the corresponding Block Transfer Address Pointer (P9.69~P9.84) is pointing to a register that allows writes while in run mode.

This block of parameters (P9.09 to P9.24) contains parameter data values. The pointer addresses for these data are defined in parameters P9.69 to P9.84.

Refer to "Block Transfer Explanation" (page 4–189) for details about transferring blocks of data.

		Type	Hex Addr	Dec Addr
P9.25	***reserved***	~	0919	42330

		Type	Hex Addr	Dec Addr
P9.26	***RS485 Speed Reference***	Read	091A	42331
	Range/Units (Format: 16-bit unsigned)	Default		
	0.00~599.00 Hz	60.00		

When the Source of Frequency Command parameters P4.00 or P4.01 are set to 1 (RS-485 Communication), write the desired command frequency to this register. This parameter is used if the command frequency will not change constantly (more than ≈once per second). The physical memory used for Parameters has a finite number of times each location can be written to (usually in the millions of cycles).

If the GS4 will be sent new frequency commands millions of times over its life span, please write the frequency value to register 2001h (normally identified as Command Frequency for ModTCP Ethernet communication). The 2001h memory location does not have this limitation.

An example of this high number of writes: a dancer arm connected to an external PLC determines the drive's command frequency. The command frequency could change every PLC scan (≈10ms) and be sent via RS-485 to the drive. This frequency should be written to 2001h. See "GS4-CM-MODTCP Control Words" in Appendix B: "Optional I/O and Communication Cards" for more details on 2001h.

- *If both P9.26 and 2001h are written to, the last value written will determine the output frequency.*
- *Sending a value of 6000 to P9.26 or 2001h will represent 60.00Hz.*

When using RS-485, use the following parameters (P9.27, P9.29, P9.30, P9.31) for Run/Stop, Jog, Direction, and Fault Reset (instead of 2000h).

When the GS4 drive is set up with reference as RS-485, ModbusTCP, or EtherNet I/P (P4.00 = 1 or 4 & drive in Remote/Auto) – OR – (P4.01 = 1 or 4 & drive in Local/Hand) – AND – Reference > (is greater than) P0.04, Max Hz Output – Drive goes up to Max Frequency where it remains until Max Freq modified or Lower Frequency Reference is sent or stop is sent to the drive.

Writing to and Reading from the RS-485 Run and Direction Commands work as expected with RS-485 communication.
If you are also simultaneously writing to Address 2000h via Ethernet (the Control word for Ethernet control - see Ch5, page 5-6), these RS-485 Run and Direction words may not read back correctly with the current status. (Please use RS-485 OR Ethernet for exact feedback, but not both.)

When controlling the drive via RS-485, do not send a Jog Command while the drive is running. Also, do not send a Run Command while the drive is jogging. When the second command is sent, the drive will respond with "Illegal Data Value."

		Type	Hex Addr	Dec Addr
P9.27	***RS485 RUN Command***	♦ R/W	091B	42332
	Range/Units (Format: 16-bit binary)	Default		
	0: Stop 1: Run	0		

In order for this parameter to function, the Source of Operation Command (P3.00 or P3.01) must be set to 03 or 04.

NOTE: Do not write both RUN (P9.27) and JOG (P9.31) Commands in the same write instruction. Use separate write instructions from the master computer or PLC.

Writing to and Reading from the RS-485 Run and Direction Commands work as expected with RS-485 communication.
If you are also simultaneously writing to Status Address 2000h via Ethernet (the Control word for Ethernet control - see Ch5, page 5-6), these RS-485 Run and Direction words may not read back correctly with the current status. (Please use RS-485 OR Ethernet for exact feedback, but not both.)

		Type	Hex Addr	Dec Addr
P9.28	***RS485 Direction Command***	♦ R/W	091C	42333

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

0: Forward
1: Reverse

This parameter sets the direction for the Run Command.

		Type	Hex Addr	Dec Addr
P9.29	***RS485 External Fault***	♦ R/W	091D	42334

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

0: No Fault
1: External Fault

Use this parameter to initiate an external fault via RS-485.

		Type	Hex Addr	Dec Addr
P9.30	***RS485 Fault Reset***	♦ R/W	091E	42335

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

0: No Action
1: Fault Reset

Use this parameter to reset a fault via RS-485.

		Type	Hex Addr	Dec Addr
P9.31	***RS485 JOG Command***	♦ R/W	091F	42336

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

0: Stop
1: Jog

Use this parameter to issue a Jog Command via RS-485.
NOTE: Do not write both RUN (P9.27) and JOG (P9.31) Commands in the same write instruction. Use separate write instructions from the master computer or PLC.

When controlling the drive via RS-485, do not send a Jog Command while the drive is running. Also, do not send a Run Command while the drive is jogging. When the second command is sent, the drive will respond with "Illegal Data Value."

		Type	Hex Addr	Dec Addr
P9.32	***reserved***	~	0920	42337

		Type	Hex Addr	Dec Addr
P9.33	***GS4 Drive Rated Amps***	Read	0921	42338

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

0.00~655.34A

This parameter shows the rated currents of the GS4 AC Drives. The rated currents are listed according to the ID codes shown in P9.42.

- *By default, the current ratings shown are for light duty (variable torque).*
- *To display normal duty (constant torque) current ratings, set P6.34 (Variable/Constant Torque Duty Selection) to 1.*

		Type	*Hex Addr*	*Dec Addr*
P9.34	***PLC Command Mask (status only)***	Read	0922	42339

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

0~65535
Bit 0: Control Commands Controlled by PLC
Bit 1: Frequency Commands Controlled by PLC
Bit 2: reserved
Bit 3: reserved

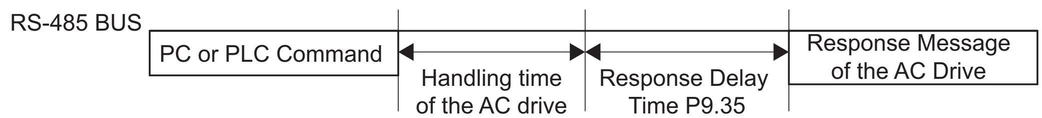
This parameter shows if the Source Of Operation Command (SOOC) or the Source of Operation Frequency (SOOF) is controlled by the internal PLC or controlled by the drive.

		Type	*Hex Addr*	*Dec Addr*
P9.35	***Response Delay Time***	♦ R/W	0923	42340

Range/Units (Format: 16-bit unsigned) — *Default*: 2.0

0.0~200.0 ms

This parameter is the response delay time after the AC drive receives a serial Modbus or BACnet communication command as shown below.



		Type	*Hex Addr*	*Dec Addr*
P9.36	***reserved***	~	0924	42341

		Type	*Hex Addr*	*Dec Addr*
P9.37	***PLC Address***	R/W	0925	42342

Range/Units (Format: 16-bit unsigned) — *Default*: 2

1~254

Modbus node address of the PLC. Cannot be same as the communication address of drive (P9.00).

		Type	*Hex Addr*	*Dec Addr*
P9.38	***Firmware Date Code***	~	0926	42343

Range/Units — *Default*: #####

Format: yywwd
- yy = year (2017 = 17)
- ww = week (01~52)
- d = day of week (1~7; Mon=1, Sun = 7)

		Type	*Hex Addr*	*Dec Addr*
P9.39	***Firmware version***	Read	0927	42344

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

x.xx

This parameter shows the firmware version of the GS4 AC Drive.
To see firmware version of the Keypad instead of the drive, hold the UP key during boot up.
Updating firmware will not change the values of the parameters.

		Type	*Hex Addr*	*Dec Addr*
P9.40	***reserved***	~	0928	42345

		Type	*Hex Addr*	*Dec Addr*
P9.41	***GS Series Number***	Read	0929	42346

Range/Units — *Default*: 4

0~9

		Type	Hex Addr	Dec Addr
P9.42	**Manufacturer Model**	Read	092A	42347

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

00: GS4-21P0 (230V 1ph/3ph 1.0hp)
01: GS4-22P0 (230V 1ph/3ph 2.0hp)
02: GS4-23P0 (230V 1ph/3ph 3.0hp)
03: GS4-25P0 (230V 3ph 5.0hp)
04: GS4-27P5 (230V 3ph 7.5hp)
05: GS4-2010 (230V 3ph 10hp)
06: GS4-2015 (230V 3ph 15hp)
07: GS4-2020 (230V 3ph 20hp)
08: GS4-2025 (230V 3ph 25hp)
09: GS4-2030 (230V 3ph 30hp)
10: GS4-2040 (230V 3ph 40hp)
11: GS4-2050 (230V 3ph 50hp)
12: GS4-2060 (230V 3ph 60hp)
13: GS4-2075 (230V 3ph 75hp)
14: GS4-2100 (230V 3ph 100hp)
15: GS4-41P0 (460V 3ph 1.0hp)
16: GS4-42P0 (460V 3ph 2.0hp)
17: GS4-43P0 (460V 3ph 3.0hp)
18: GS4-45P0 (460V 3ph 5.0hp)
19: GS4-47P5 (460V 3ph 7.5hp)
20: GS4-4010 (460V 3ph 10hp)
21: GS4-4015 (460V 3ph 15hp)
22: GS4-4020 (460V 3ph 20hp)
23: GS4-4025 (460V 3ph 25hp)
24: GS4-4030 (460V 3ph 30hp)
25: GS4-4040 (460V 3ph 40hp)
26: GS4-4050 (460V 3ph 50hp)
27: GS4-4060 (460V 3ph 60hp)
28: GS4-4075 (460V 3ph 75hp)
29: GS4-4100 (460V 3ph 100hp)
30: GS4-4125 (460V 3ph 125hp)
31: GS4-4150 (460V 3ph 150hp)
32: GS4-4175 (460V 3ph 175hp)
33: GS4-4200 (460V 3ph 200hp)
34: GS4-4250 (460V 3ph 250hp)
35: GS4-4300 (460V 3ph 300hp)

This parameter shows the model number and ID code of the GS4 AC Drive. Use this P9.42 ID code to find the drive rated current in P9.33.

		Type	Hex Addr	Dec Addr
P9.43	**Ignore Comm Card Warning**	R/W	092B	42348

Range/Units — *Default*: 1

0: Disable Ignore function (do NOT ignore warning)
1: Enable Ignore function (ignore warning)

Enabling P9.43 will cause the drive to ignore Comm Card warnings.

		Type	Hex Addr	Dec Addr
P9.44	**Comm Card Type**	Read	092C	42349

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

0: No Communication Card
1: reserved
2: reserved
3: reserved
4: MODBUS-TCP Slave
5: EtherNet/IP Slave
6: reserved
7: reserved
8: reserved

This parameter displays the type of the currently installed communications card.

		Type	Hex Addr	Dec Addr
P9.45	**Comm Card Version**	Read	092D	42350

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

0~65535

This parameter displays the firmware version of the currently installed communications card.

		Type	Hex Addr	Dec Addr
P9.46	**Comm Card Production Code**	Read	092E	42351

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

0~65535

This parameter displays the production code of the currently installed communications card.

		Type	Hex Addr	Dec Addr
P9.47	***Comm Card Fault Code***	Read	092F	42352
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~65535	0		

This parameter displays applicable Fault Codes for the currently installed communications card.
NOTE: Fault Parameters are explained in Parameter Group P11.xx (page 4–203), and the Fault Code error messages are show in Chapter 6: Maintenance and Troubleshooting (page 6–16).

		Type	Hex Addr	Dec Addr
P9.48	***Comm Card IP Configuration***	R/W	0930	42353
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Static IP – User needs to set the IP address manually. 1: Dynamic IP (DHCP) – IP address will be automatically set by the host controller.	0		

This parameter displays the configuration of the currently installed communications card.

We strongly recommend using the Static IP setting. If using Dynamic IP, the DHCP server may unexpectedly change the GS4 IP address. This could cause any external PLCs, HMIs, etc., to lose communication to the drive.

		Type	Hex Addr	Dec Addr
P9.49	***Comm Card IP Address Octet 1***	♦ R/W	0931	42354
P9.50	***Comm Card IP Address Octet 2***	♦ R/W	0932	42355
P9.51	***Comm Card IP Address Octet 3***	♦ R/W	0933	42356
P9.52	***Comm Card IP Address Octet 4***	♦ R/W	0934	42357
P9.53	***Comm Card Mask Octet 1***	♦ R/W	0935	42358
P9.54	***Comm Card Mask Octet 2***	♦ R/W	0936	42359
P9.55	***Comm Card Mask Octet 3***	♦ R/W	0937	42360
P9.56	***Comm Card Mask Octet 4***	♦ R/W	0938	42361
P9.57	***Comm Card Gateway Octet 1***	♦ R/W	0939	42362
P9.58	***Comm Card Gateway Octet 2***	♦ R/W	093A	42363
P9.59	***Comm Card Gateway Octet 3***	♦ R/W	093B	42364
P9.60	***Comm Card Gateway Octet 4***	♦ R/W	093C	42365
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~255	0		

The octet addresses 1 through 4 are from left to right.
For more detailed Ethernet information, refer to Appendix B: Optional I/O and Communication Cards.

When P9.xx parameters are changed, the new communication card parameter values must be "pushed" from the P9 parameters to the card. See P9.64.

		Type	Hex Addr	Dec Addr
P9.61	***reserved***	~	093D	42366
P9.62	***reserved***	~	093E	42367

		Type	Hex Addr	Dec Addr
P9.63	***Comm Card Factory Reset***	R/W	093F	42368
	Range/Units (Format: 16-bit binary)	*Default*		
	0: No Action 1: Reset to the Factory Setting	0		

When the card is reset to Factory Defaults, the P9 parameters still retain their values (IP addresses, Masks, etc.) in the GS4 AC drive. To re-write the drive parameters back into the card, use P9.64.

		Type	Hex Addr	Dec Addr
P9.64	***Comm Card External Set***	R/W	0940	42369

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

0, 2
- Bit 0 = reserved
- Bit 1 = Write Ethernet Parameters to the Comm Card
- Bit 2 = reserved

The Ethernet communication cards have their own internal set of configuration registers. The P9.xx parameters must be "pushed" into the Ethernet comm cards before they take effect.

Bit 1: Internet parameters enable

Set Bit 1 (enter a decimal value of 2) to write Ethernet-related parameter values into the comm card after the comm card parameters have been set up in the GS4 drive. This bit will change to 0 when it finishes saving the update of internet parameters. If the value does not automatically reset to 0 after entering "2" and pressing Enter, then the parameters did not get pushed down to the comm card.

When comm card is reset to factory defaults, the P9 parameters still reside in the drive. Bit 1 must be set high to write the Drive Parameters to the comm card.

For more detailed information, refer to Appendix B: Optional I/O and Communication Cards.

		Type	Hex Addr	Dec Addr
P9.65	***reserved***	~	0941	42370
P9.66	***reserved***	~	0942	42371
P9.67	***reserved***	~	0943	42372
P9.68	***reserved***	~	0944	42373

		Type	Hex Addr	Dec Addr
P9.69	***Block Transfer Address Pointer 1***	R/W	0945	42374
P9.70	***Block Transfer Address Pointer 2***	R/W	0946	42375
P9.71	***Block Transfer Address Pointer 3***	R/W	0947	42376
P9.72	***Block Transfer Address Pointer 4***	R/W	0948	42377
P9.73	***Block Transfer Address Pointer 5***	R/W	0949	42378
P9.74	***Block Transfer Address Pointer 6***	R/W	094A	42379
P9.75	***Block Transfer Address Pointer 7***	R/W	094B	42380
P9.76	***Block Transfer Address Pointer 8***	R/W	094C	42381
P9.77	***Block Transfer Address Pointer 9***	R/W	094D	42382
P9.78	***Block Transfer Address Pointer 10***	R/W	094E	42383
P9.79	***Block Transfer Address Pointer 11***	R/W	094F	42384
P9.80	***Block Transfer Address Pointer 12***	R/W	0950	42385
P9.81	***Block Transfer Address Pointer 13***	R/W	0951	42386
P9.82	***Block Transfer Address Pointer 14***	R/W	0952	42387
P9.83	***Block Transfer Address Pointer 15***	R/W	0953	42388
P9.84	***Block Transfer Address Pointer 16***	R/W	0954	42389

Range/Units (Format: 16-bit unsigned) — Default: 999

0~65535

This block of parameters (P9.69~P9.84) define the pointer addresses for Block Transfer. The actual parameter data is read from and written into parameters P9.09~P9.24.

Refer to "Block Transfer Explanation" (page 4–189) for details about transferring blocks of data.

		Type	Hex Addr	Dec Addr
P9.85	***PLC Frequency Command Force to 0***	R/W	0955	42390
	Range/Units (Format: 16-bit binary)	*Default*		
	0, 1 Bit 0 = 1: Before PLC scan, set up PLC Target Frequency = 0	0		

If Bit 0 is set to one (1), the GS4 drive Frequency Command will be reset to zero before the GS4 PLC next scan.

		Type	Hex Addr	Dec Addr
9.86	***COM1 Protocol (via RS-485)***	R/W	0956	42391
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Modbus 1: BACnet	0		
P9.87	***BACnet Address***	R/W	0957	42392
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~127	10		
P9.88	***BACnet Baud Rate***	R/W	0958	42393
	Range/Units (Format: 16-bit unsigned)	*Default*		
	9.6~76.8 Kbps	38.4		
P9.89	***BACnet Device Instance Low Word***	R/W	0959	42394
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~65535	10		
P9.90	***BACnet Device Instance High Byte***	R/W	095A	42395
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~63	0		
P9.91	***BACnet Max Polling Address***	R/W	095B	42396
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~127	127		
P9.92	***BACnet Password***	R/W	095C	42397
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~65535	0		

Parameters P9.86~P9.92 are applicable for BACnet serial communications.

		Type	Hex Addr	Dec Addr
P9.93	***Ethernet Communication Card Fault Select***	♦ R/W	095D	42398
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Warn & Continue Operation 1: Warn & Ramp to Stop 2: Warn & Coast to Stop 3: No Warning & Continue Operation	3		

This parameter is used to detect an Ethernet communication error and take appropriate action.
Related Parameters: *P9.94, P9.95*

		Type	Hex Addr	Dec Addr
P9.94	***Ethernet Communication Card Time Out Detection***	♦ R/W	095E	42399
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Disable 1: Enable	0		

This parameter Enables or Disables time-out detection for Ethernet communications.
Related Parameters: *P9.93, P9.95*

		Type	Hex Addr	Dec Addr
P9.95	***Ethernet Communication Card Time Out Duration***	♦ R/W	095F	42400
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.1 to 100.0 seconds	0.5		

When parameter P9.94 is set to 1, the communications Time Out Detection is Enabled. If a delay in communications for more than the Time Out Duration (P9.95) is detected, the action selected by the Transmission Fault Treatment (P9.93) will be used.
Related Parameters: *P9.93, P9.94*

Block Transfer Explanation

Parameters P9.09~P9.24 and P9.69~P9.84

Block Transfer allows parameters from many different Parameter Groups to be consolidated into one Modbus communication message. This can greatly simplify PLC programming and reduce network traffic. Unlike previous GS drives*****, the GS4 has two sets of Block Transfer Parameters:

A) New Pointer Parameters P9.69~P9.84 (where you enter the addresses that you want to consolidate)

B) Data Location Parameters P9.09~P9.24 (where you push data into, or pull data out of)

GS4 Parameters Summary – Serial Communication Parameters – Block Transfer Parameter Map												
Parameter / Address Description	***Block Transfer Address Pointers***					***Block Transfer Data***					***Default Setting***
	Para-meter	***Description (Range)***	***Modbus Address***			***Para-meter***	***Description (Range)***	***Modbus Address***			
			Hex	***Dec***	***Octal***			***Hex***	***Dec***	***Octal***	
Block Transfer 1	***P9.69***	0~65535 Format as xxyy, where: xx = target parameter group # yy = target parameter #	0945	42374	4505	***P9.09***	Dependent upon the target address. Example: If Block Transfer points to a digital parameter, range = 0,1. If it points to analog parameter, the range could be 0–65535.	0909	42314	4411	0
Block Transfer 2	***P9.70***		0946	42375	4506	***P9.10***		090A	42315	4412	0
Block Transfer 3	***P9.71***		0947	42376	4507	***P9.11***		090B	42316	4413	0
Block Transfer 4	***P9.72***		0948	42377	4510	***P9.12***		090C	42317	4414	0
Block Transfer 5	***P9.73***		0949	42378	4511	***P9.13***		090D	42318	4415	0
Block Transfer 6	***P9.74***		094A	42379	4512	***P9.14***		090E	42319	4416	0
Block Transfer 7	***P9.75***		094B	42380	4513	***P9.15***		090F	42320	4417	0
Block Transfer 8	***P9.76***		094C	42381	4514	***P9.16***		0910	42321	4420	0
Block Transfer 9	***P9.77***		094D	42382	4515	***P9.17***		0911	42322	4421	0
Block Transfer 10	***P9.78***		094E	42383	4516	***P9.18***		0912	42323	4422	0
Block Transfer 11	***P9.79***		094F	42384	4517	***P9.19***		0913	42324	4423	0
Block Transfer 12	***P9.80***		0950	42385	4520	***P9.20***		0914	42325	4424	0
Block Transfer 13	***P9.81***		0951	42386	4521	***P9.21***		0915	42326	4425	0
Block Transfer 14	***P9.82***		0952	42387	4522	***P9.22***		0916	42327	4426	0
Block Transfer 15	***P9.83***		0953	42388	4523	***P9.23***		0917	42328	4427	0
Block Transfer 16	***P9.84***		0954	42389	4524	***P9.24***		0918	42329	4430	0

Example:
You want to consolidate the parameters Multi-Speed 15 (P5.15), Skip Frequency 3 Lower Limit (P1.24), and Circulation Time (P10.02). Enter the following values into P9.69, P9.70, and P9.71:

	Address Pointers	Data Locations (to Push Data to, or Pull Data from)
Block Transfer 1	P9.69 = 515 (points to P5.15)	P9.09
Block Transfer 2	P9.70 = 124 (points to P1.24)	P9.10
Block Transfer 3	P9.71 = 1002 (points to P10.02)	P9.11
The Address Pointers use xxyy format, where:	*• xx = Parameter Group# and • yy = Parameter# in that group.*	

All of the data is now in consecutive order so that you can write one Modbus message to P9.09 with a length of three registers, and it will change P5.15, P1.24, and P10.02. Or you can use one Modbus Read message that will collect all three parameters at once. Without Block Transfer, reading or writing these three parameters would require three separate communication commands from an external PLC.

***** *Previous GS Drives had only one set of parameters for Block Transfer, and the Pointer Addresses had to be manually entered into the keypad. Only then would any read or write into that Block Transfer address actually be linked to the desired data. Unfortunately, this meant that you would have to manually enter Block Transfer addresses via the keypad for any new drive. With the GS4 method, the Pointer Addresses are in separate parameters. Thus, the complete configuration can be downloaded via software (no keypad entry necessary).*

Group P10.xx Details – Pump Parameters

Pump Parameters Overview

Parameter Group 10 has three basic control modes of operation. Each control mode can use PID feedback as a reference signal. The entire P10 group was developed to allow one GS4 to control multiple pumps. The control modes can be selected individually, or some of them can be combined (see P10.00).

In the explanations below, "Drive-powered" means that the pump gets its power from the drive's IGBTs. "Line-powered" means that the pump is connected to mains power (50 or 60 Hz) through a contactor. The contactors are turned ON and OFF by relays on the GS4.

Time Circulation: This control mode typically has up to 8 similar-sized pumps that can be drive-powered, but only one pump can be ON at a time. The drive will sequentially cycle through the pumps to keep the run-time of all pumps equal. This prevents one pump from accumulating many hours of run time, while other pumps may never get used. When Time Circulation is selected (P10.00 = 1), only one pump is ON at a time.

This mode can be used with PID control, or it can be used with any other input control signal (analog input, serial communication, etc.).

The following two P10.00 control modes allow for multiple pumps to be ON at the same time. These "Quantity" Modes are for use with PID control (an analog input control signal is used for PID feedback; not a frequency reference).

If the "Quantity" modes are used with a frequency reference signal (e.g. Analog Input 1 = a speed reference), pump switching will only occur when the frequency setpoint goes above P10.06 (increasing demand) or when the frequency setpoint goes below P10.08 (decreasing demand).

Quantity Control: This control mode typically has one large pump (Motor 0) that is drive powered. There can also be up to 8 Auxiliary pumps that are line powered. The Auxiliary pumps are switched ON and OFF by contactors controlled by the GS4 relay outputs (R1, R2, R10~R15). The contactors feed the Auxiliary pumps with line power only. In Quantity Control, the Auxiliary pumps are never fed with drive power.

Quantity Cycle: This control mode typically has up to 4 similar-sized pumps. Each pump can be drive-powered (one at a time) or switched to line power (multiple pumps running at the same time). Each pump requires two contactors (and two GS4 relay outputs) per pump: one contactor connects the pump to line power, and the other contactor connects the pump to drive power. The contactors must be electrically interlocked so that both cannot be on at the same time (see the wiring diagrams). The drive will try to satisfy the system demand with one pump connected to drive power. If the system demand is not met with one pump, the drive will switch the first pump over to line power, then start up the second pump on drive power. This continues until all pumps are running line power except for the last pump (it remains on drive power).

Each of the above modes can be selected individually (P10.00 = 1, 2, or 3). The Quantity modes can also be combined with Time Circulation to get the best of both worlds: multiple pump control with the ability to even out the run times of each pump (P10.00 = 4 or 5).

NOTE: For circulative control applications requiring more than two outputs, the GS4-06TR relay output card is required.

Pump Parameters Details

Parameters P10.00~P10.08 provide five different methods for cyclical control of pumps, consisting of the three previously described control modes plus two combined modes.

		Type	Hex Addr	Dec Addr
P10.00	**Circulative Control**	R/W	0A00	42561

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

0: no function
1: Time Circulation
2: Quantity Cycle
3: Quantity Control
4: Time Circulation + Quantity Cycle
5: Time Circulation + Quantity Control

Parameter P10.00 selects one of five Circulative Control modes. The table below associates the P10 parameters with each of the five modes. Only in mode 4, Quantity Cycle + Time Circulation, are all nine parameters used.

Descriptions and timing charts for of each of these five circulative control modes can be found in the subsequent pages of this section following the P10 parameter descriptions.

P10.00~P10.08 – Circulative Control Modes – Related Parameters

Param#	Description	No Fn.	T.Circ.	Q.Cycle	Q.Cont.	Q.Cy.+T.C.	Q.Co.+T.C.
P10.00	Circulative Control	0	1	2	3	4	5
P10.01	Number of Connected Motors	~	√	√	√	√	√
P10.02	Desired Run Time of Each Motor	~	√	~	~	√	√
P10.03	Motor Switch Delay Time During Increasing Demand	~	√	√	√	√	√
P10.04	Motor Switch Delay Time During Decreasing Demand	~	~	√	√	√	√
P10.05	Motor Switch Delay Time During Fix Amount Circulation	~	~	√	√	√	√
P10.06	Motor Switch Frequency During Fix Amount Circulation	~	~	√	√	√	√
P10.07	Circulative Control Malfunction Action	~	~	√	~	√	~
P10.08	AUX Motor Stop Frequency	~	~	√	√	√	√

Disable Motor Outputs

GS4 drive Multi-Function Inputs can be configured to disable all motor outputs, or individual motor outputs. The settings are:

Multi-Function Input Settings to Disable Motor Outputs

P3.03~P3.16 =	42	43	44	45	46	47	48	49	50
Disable Motor Output	all	1	2	3	4	5	6	7	8

When a motor output is disabled, the motor will be de-energized and will coast stop.

		Type	Hex Addr	Dec Addr
P10.01	***Number of Connected Motors***	R/W	0A01	42562
	Range/Units (Format: 16-bit binary)	*Default*		
	1~8	1		

Parameter P10.01 sets the Number of Motors (maximum 8). The number of motors defined in this parameter will automatically configure multi-function output terminals to the following settings:

Multi-Function Output Terminals on Circulating Motors*

Circulative Control	***P10.01***	***01***	***02***	***03***	***04***	***05***	***06***	***07***	***08***	***Modes 1,3,5***	***Modes 2,4***
Multi-Function Output (R1)	P3.17	47	47	47	47	47	47	47	47	Motor 1	Motor 1 on Drive
Multi-Function Output (R2)	P3.18		48	48	48	48	48	48	48	Motor 2	Motor 1 on AC Line
Multi-Function Output (R10)	P3.21			49	49	49	49	49	49	Motor 3	Motor 2 on Drive
Multi-Function Output (R11)	P3.22				50	50	50	50	50	Motor 4	Motor 2 on AC Line
Multi-Function Output (R12)	P3.23					51	51	51	51	Motor 5	Motor 3 on Drive
Multi-Function Output (R13)	P3.24						52	52	52	Motor 6	Motor 3 on AC Line
Multi-Function Output (R14)	P3.25							53	53	Motor 7	Motor 4 on Drive
Multi-Function Output (R15)	P3.26								54	Motor 8	Motor 4 on AC Line

**NOTE*: The order of motors (1~8 or 1~4) is fixed in GS4 firmware, and cannot be changed.*

Reducing the number of motors in P10.01 will remove settings associated with outputs R1, R2, & RO10~RO15 depending on the current number of motors selected in P10.01.

Example: changing P10.01 from 8 motors to 6 motors will automatically change P3.25 from “54: Mtr 8 On” to “0: No Function,” and P3.24 from “53: Mtr 7 On” to “0: No Function.”

		Type	Hex Addr	Dec Addr
P10.02	***Desired Run Time of Each Motor in Minutes***	R/W	0A02	42563
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~65500 min	0		

This parameter sets the Desired Run Time of Each Motor in minutes for each of the connected motors defined in parameter P10.01.

Stopping and then restarting the drive will reset the timer. (If the desired run time is 60 minutes, and the drive is stopped and restarted at 59 minutes, the active pump will continue to run for another 60 minutes.)

A value of zero in P10.02 stops timing. *In that event, a connected motor that is currently running will continue to run until a stop command is received by the GS4 drive*.

		Type	Hex Addr	Dec Addr
P10.03	***Motor Switch Delay Time During Increasing Demand***	R/W	0A03	42564
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~3600.0 sec	1.0		

As demand increases, this parameter defines the Delay Time in seconds from turn-off of the connected motor to turn-on of the next motor in the sequence.

When the connected motor elapsed Run Time equals the value in P10.02, the GS4 drive turns off that motor, and Delay Time begins to increment.

When the Delay Time in parameter P10.03 has elapsed, the GS4 drive will turn on the next connected motor in the sequence.

		Type	Hex Addr	Dec Addr
P10.04	***Motor Switch Delay Time During Decreasing Demand***	R/W	0A04	42565
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~3600.0 sec	1.0		

As demand decreases, this parameter defines the Delay Time in seconds from turn-off of the connected motor to turn-off of the next motor in the sequence.

When the connected motor elapsed Run Time equals the value in P10.02, the GS4 drive turns off that motor, and Delay Time begins to increment.

When the Delay Time in parameter P10.04 has elapsed and the demand is still decreasing, the GS4 drive will turn off the next connected motor in the sequence. Refer to the Decreasing Demand timing charts beginning on page 4–195.

		Type	Hex Addr	Dec Addr
P10.05	***Aux Motor Switch Delay Time During Fix Amount Circulation in Seconds***	♦ R/W	0A05	42566
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~3600.0 sec	10.0		

This parameter defines the Switch Delay Time in seconds for the connected motor. The delay time in P10.05 begins to increment when the GS4 output frequency equals the value in P10.06 or P10.08, depending on the control mode. When elapsed, the connected motor is switched off.

Refer to Timing Chart P10.00 = 1 (page 4–194) for details.

		Type	Hex Addr	Dec Addr
P10.06	***Aux Motor Switch Frequency During Fix Amount Circulation in Hz***	♦ R/W	0A06	42567
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	60.00		

When the GS4 drive output frequency equals the value in P10.06, the system will start preparing to switch motors.

		Type	Hex Addr	Dec Addr
P10.07	***Circulative Control Malfunction Action***	R/W	0A07	42568
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Turn Off All Aux 1: Keep Aux Running	0		

This parameter determines which of two actions the GS4 drive will take in the event that the circulative control malfunctions.

- *Setting 0: Turn off all AUX*
- *Setting 1: Keep AUX running*

		Type	Hex Addr	Dec Addr
P10.08	***AUX Motor Stop Frequency***	♦ R/W	0A08	42569
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~599.00 Hz	0		

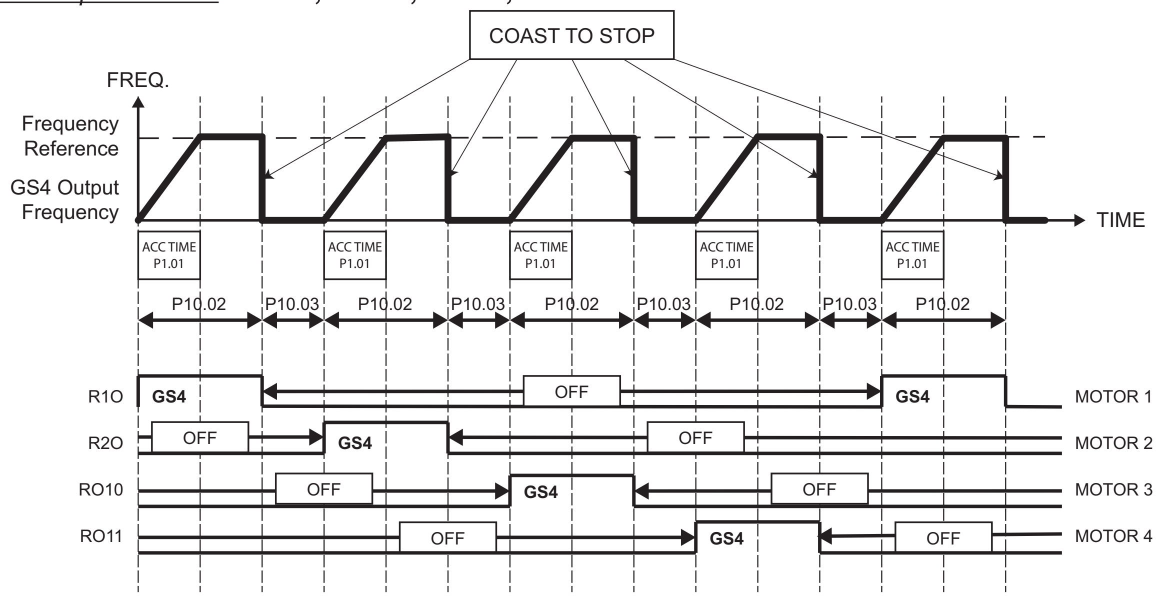
When the GS4 drive output frequency is below the value in P10.08 and remains below that value until the time set in P10.04 has elapsed, the GS4 drive will begin turning off motors one after another, in sequence.

Timing Charts for Circulative Control Modes P10.01 through P10.08

Timing Chart P10.00 = 1: Time Circulation

Up to 8 pumps can be drive-powered (only one is powered at a time). This mode ensures that each pump gets the same amount of run time.

Related parameters: P10.00, P10.01, P10.02, P10.03



P10.00 = 1 – Time Circulation Control

In this mode, the GS4 drive can individually control up to 8 motors.

- *The total number of motors controlled is set in parameter P10.01.*
- *The run time (in minutes) of each motor is set in parameter P10.02.*
- *The delay time (in seconds) between motors is set in parameter P10.03.*

When the motor run time equals the time set in P10.02, the GS4 drive will stop that motor. After the delay time set in parameter P10.03, has elapsed, the next motor in the sequence will start.

Stopping and then restarting the drive will reset the timer. (If the desired run time is 60 minutes, and the drive is stopped and restarted at 59 minutes, the active pump will continue to run for another 60 minutes.)

Timing Chart P10.00 = 2: Quantity Cycle

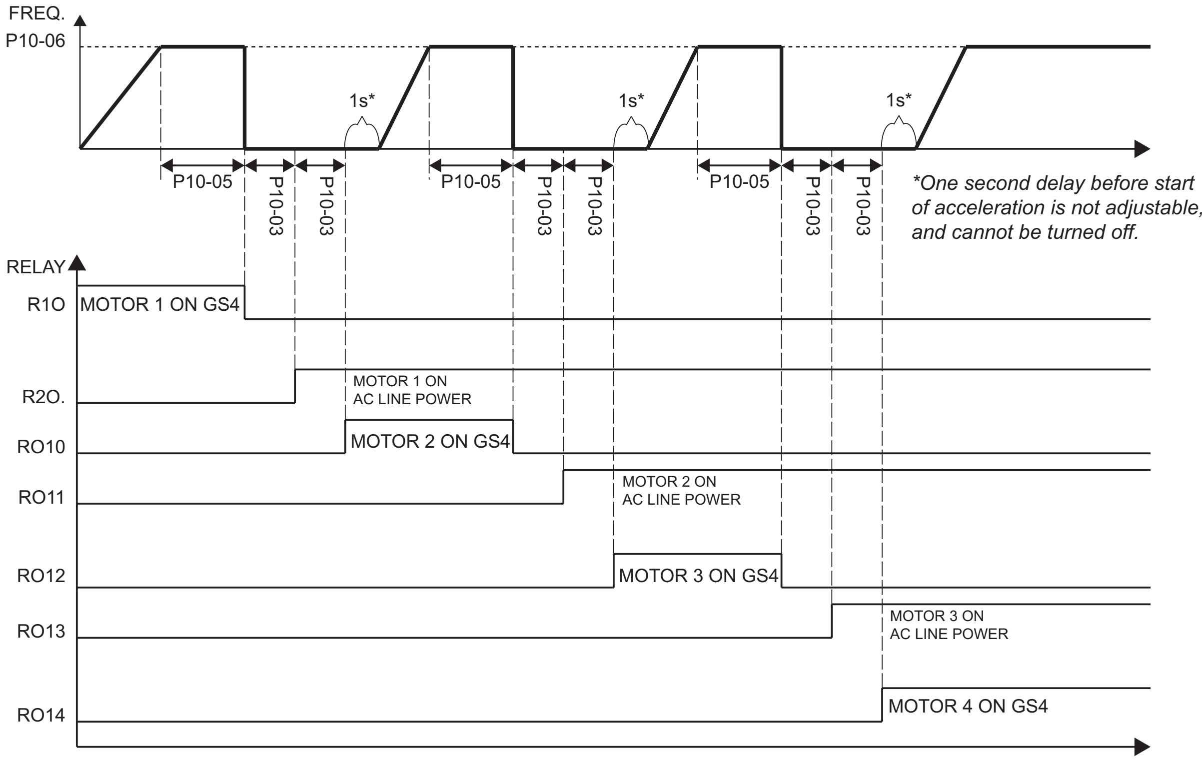
The drive powers one pump at a time. When demand increases, the drive-powered pump is switched to line power, and the next pump is started up on drive power. Up to 4 motors can be ON at the same time (only one will be powered by drive power at a time).

In *decreasing demand*, the last pump that is on drive power stays on drive power. When demand increases, the active pump will be switched to line power and the next pump will start up with drive power.

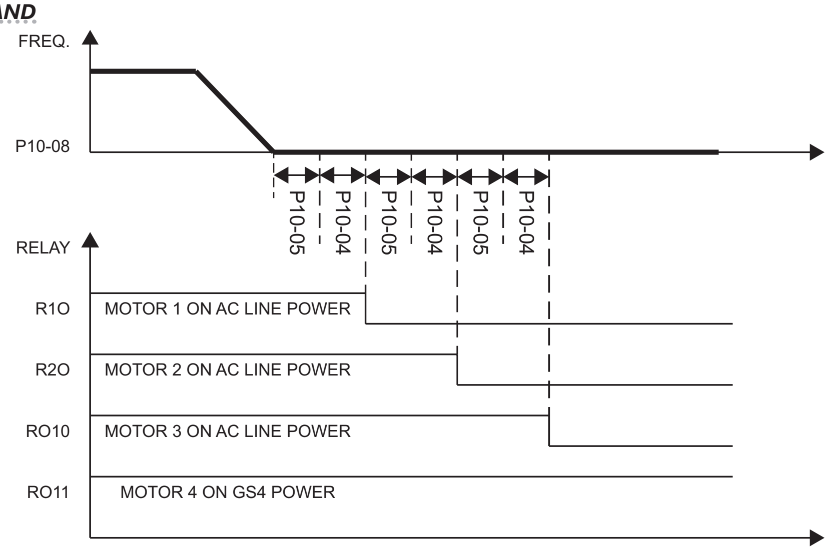
Example: Assume Pumps 1, 2, and then 3 were required to satisfy the load and then demand decreased to zero. Pump 1 and 2 (were on line power) would turn OFF, and Pump 3 would go to 0Hz (on drive power). When demand increased, Pump 3 would ramp to max frequency and then get switched to line power. Pump 4 would then get drive power (then Pump 1, then Pump 2, etc.).

Related parameters: P10.00, P10.01, P10.03, P10.04, P10.05, P10.06, P10.07, P10.08

Increasing Demand



Decreasing Demand

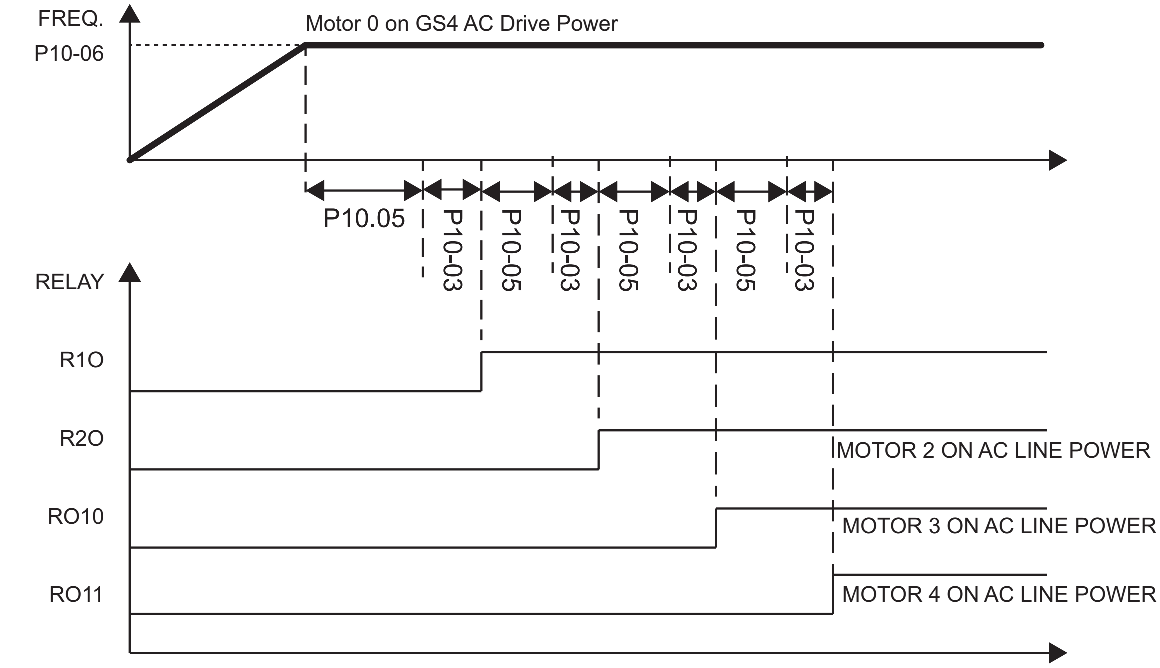


Timing Chart P10.00 = 3: Quantity Control

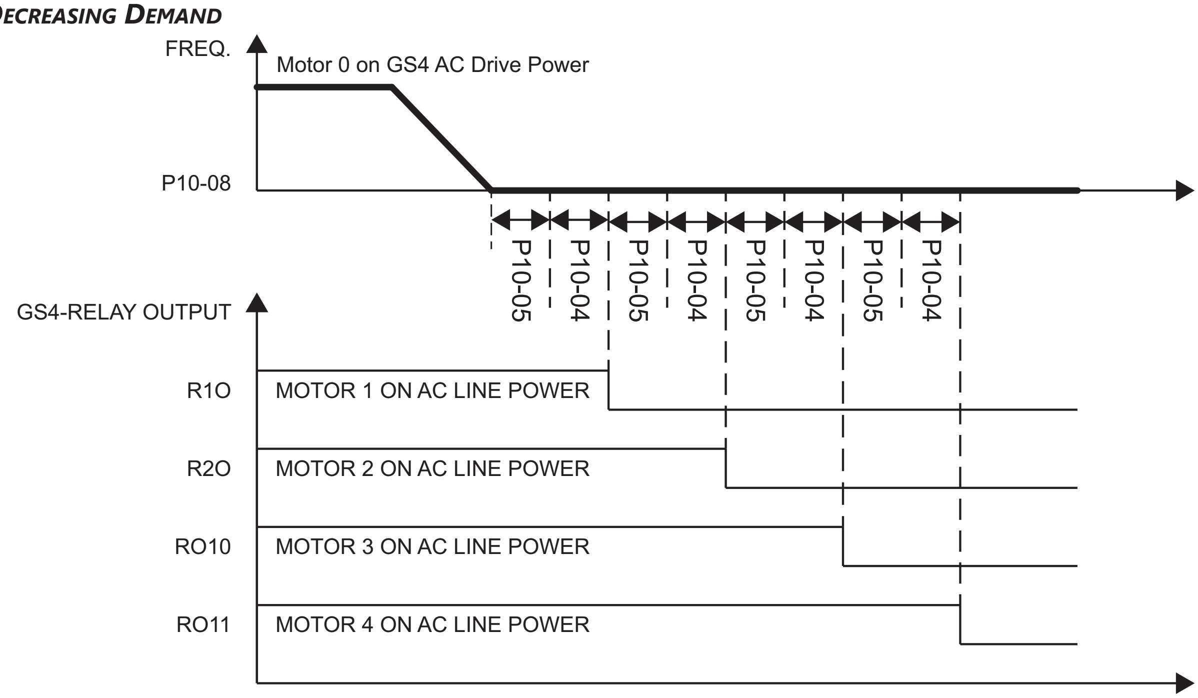
Only one motor will ever be drive-powered. Up to 8 auxiliary motors can be switched ON and OFF to satisfy demand. *The auxiliary motors are line-powered only*.

Related parameters: P10.00, P10.01, P10.03, P10.04, P10.05, P10.06, P10.08

Increasing Demand



Decreasing Demand

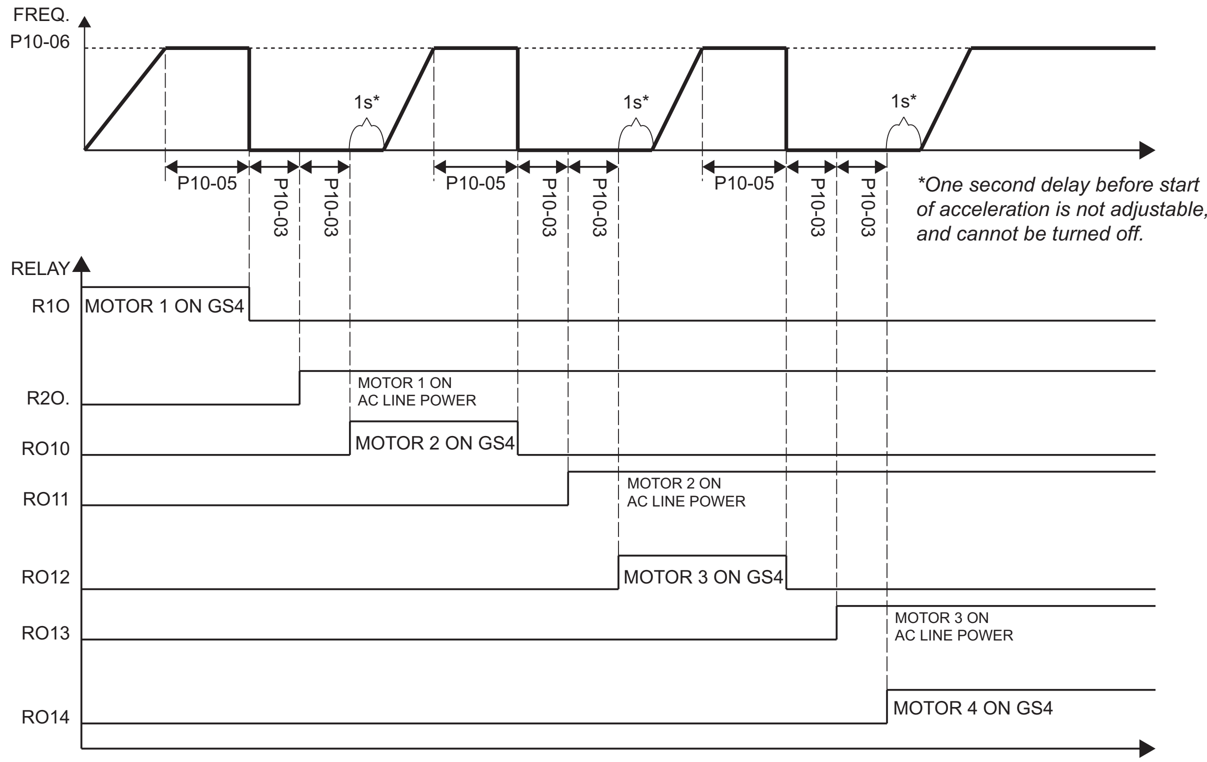


Timing Chart P10.00 = 4: Time Circulation + Quantity Cycle

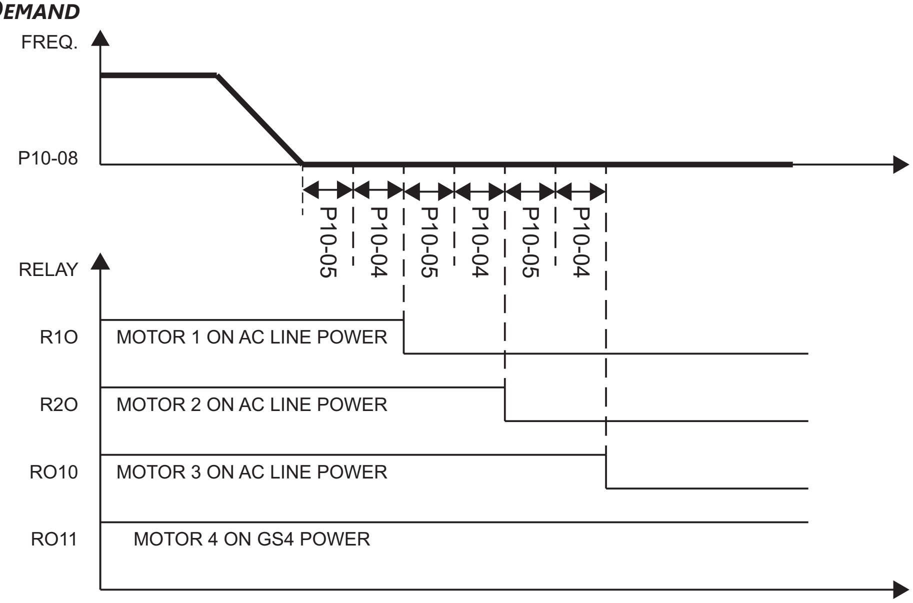
Incorporates the logic of Mode 2 (Quantity Cycle) and Mode 1 (Time Circulation): Up to 4 similar-size pumps with equal run time.

Related parameters: P10.00, P10.01, P10.02, P10.03, P10.04, P10.05, P10.06, P10.07, P10.08

Increasing Demand

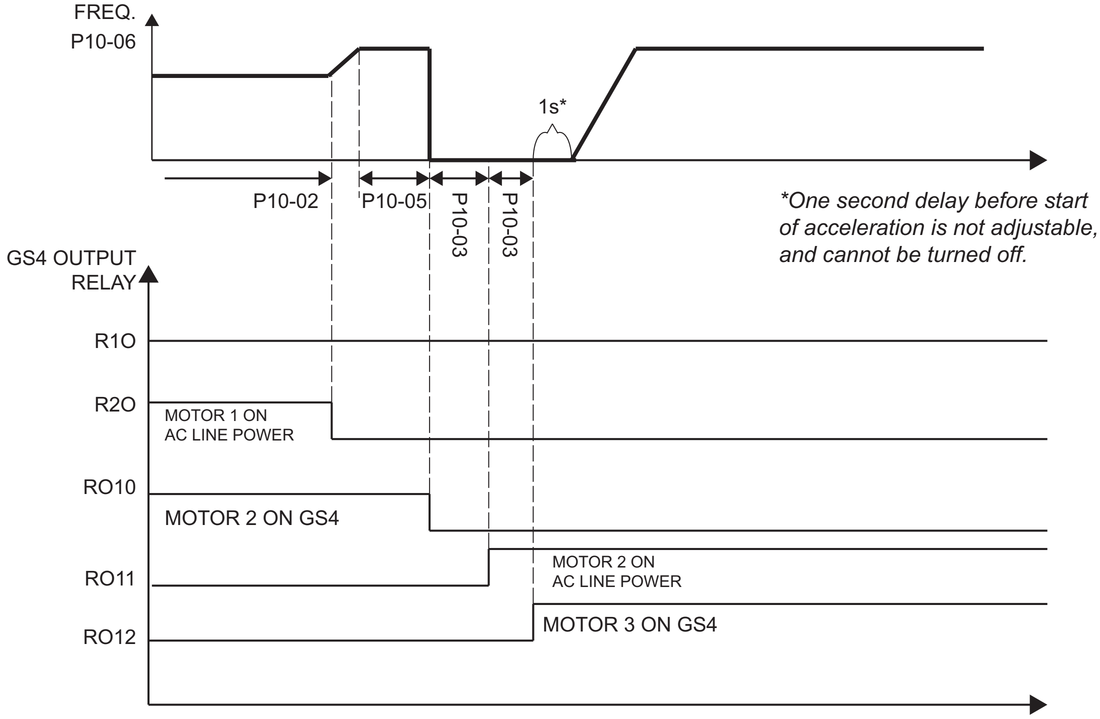


Decreasing Demand



(Timing Chart P10.00 = 4: Time Circulation + Quantity Cycle (continued))

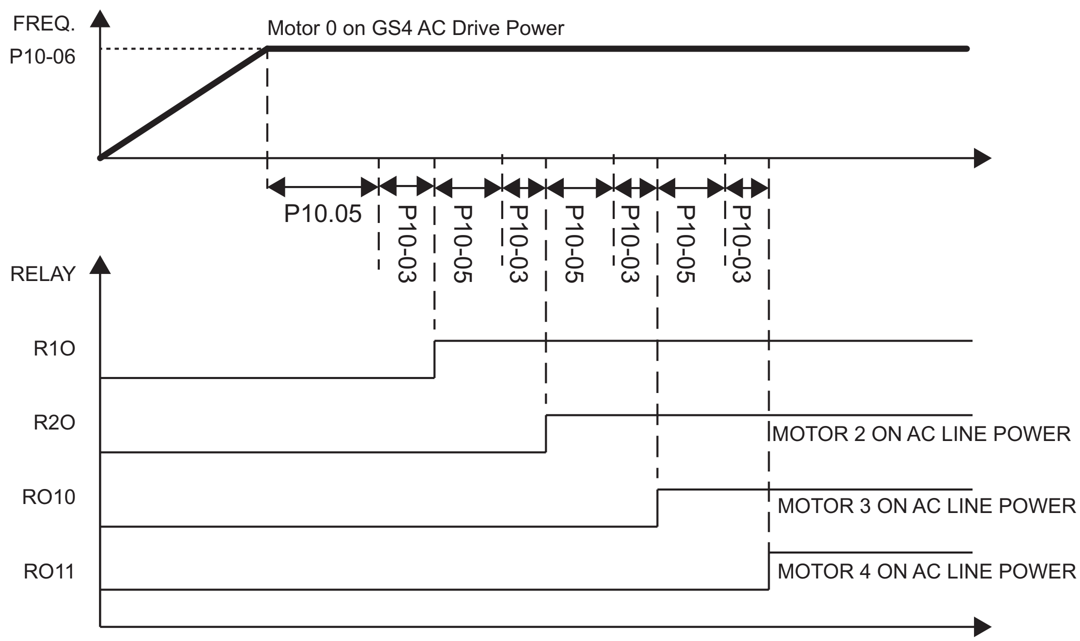
Time Circulation + Quantity Cycle



Timing Chart P10.00 = 5: Time Circulation + Quantity Control

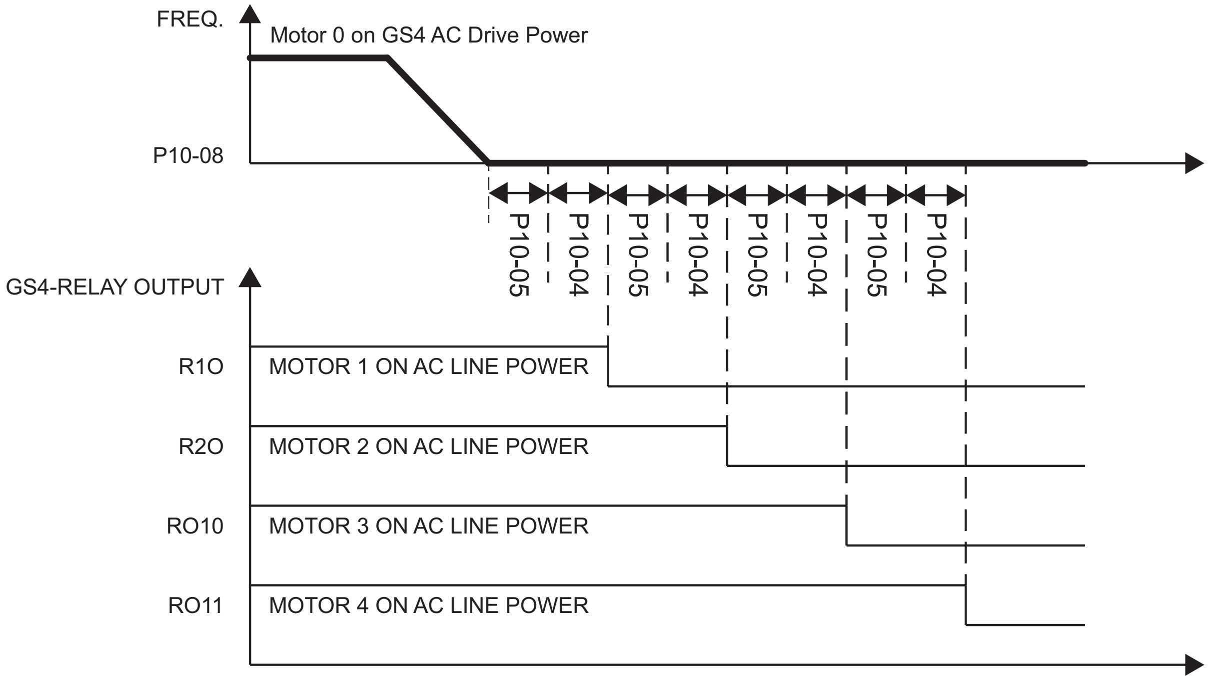
Incorporates the logic of Mode 3 (Quantity Control) with Mode 1 (Time Circulation): one drive-powered motor plus up to 8 auxiliary motors that have equal run time.

Increasing Demand

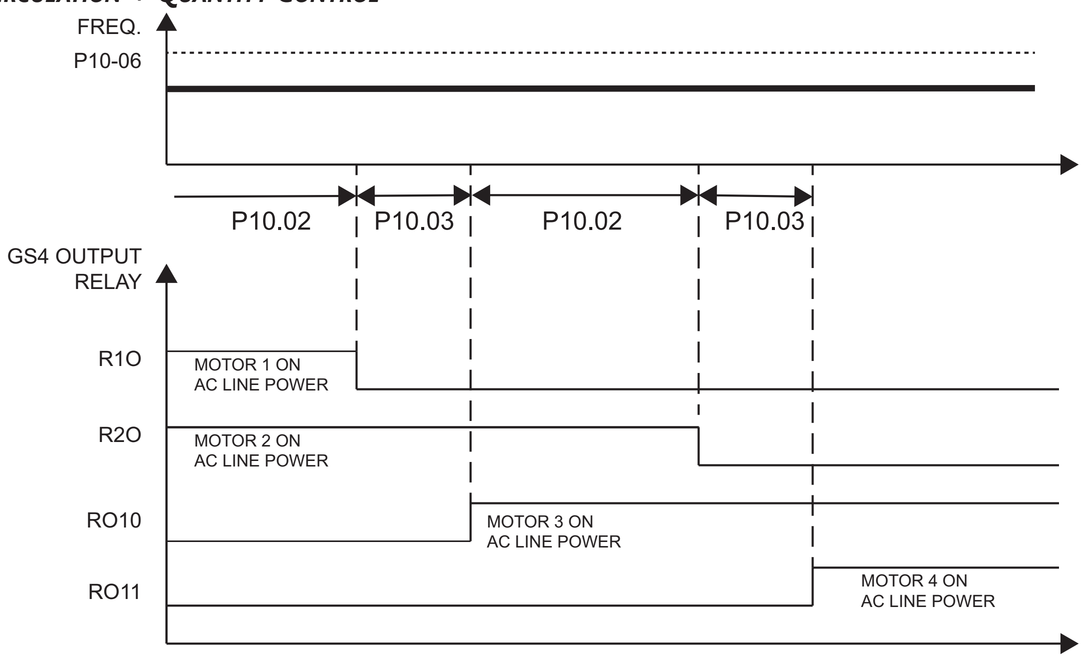


(Timing Chart P10.00 = 5: Time Circulation + Quantity Control (continued))

Decreasing Demand



Time Circulation + Quantity Control



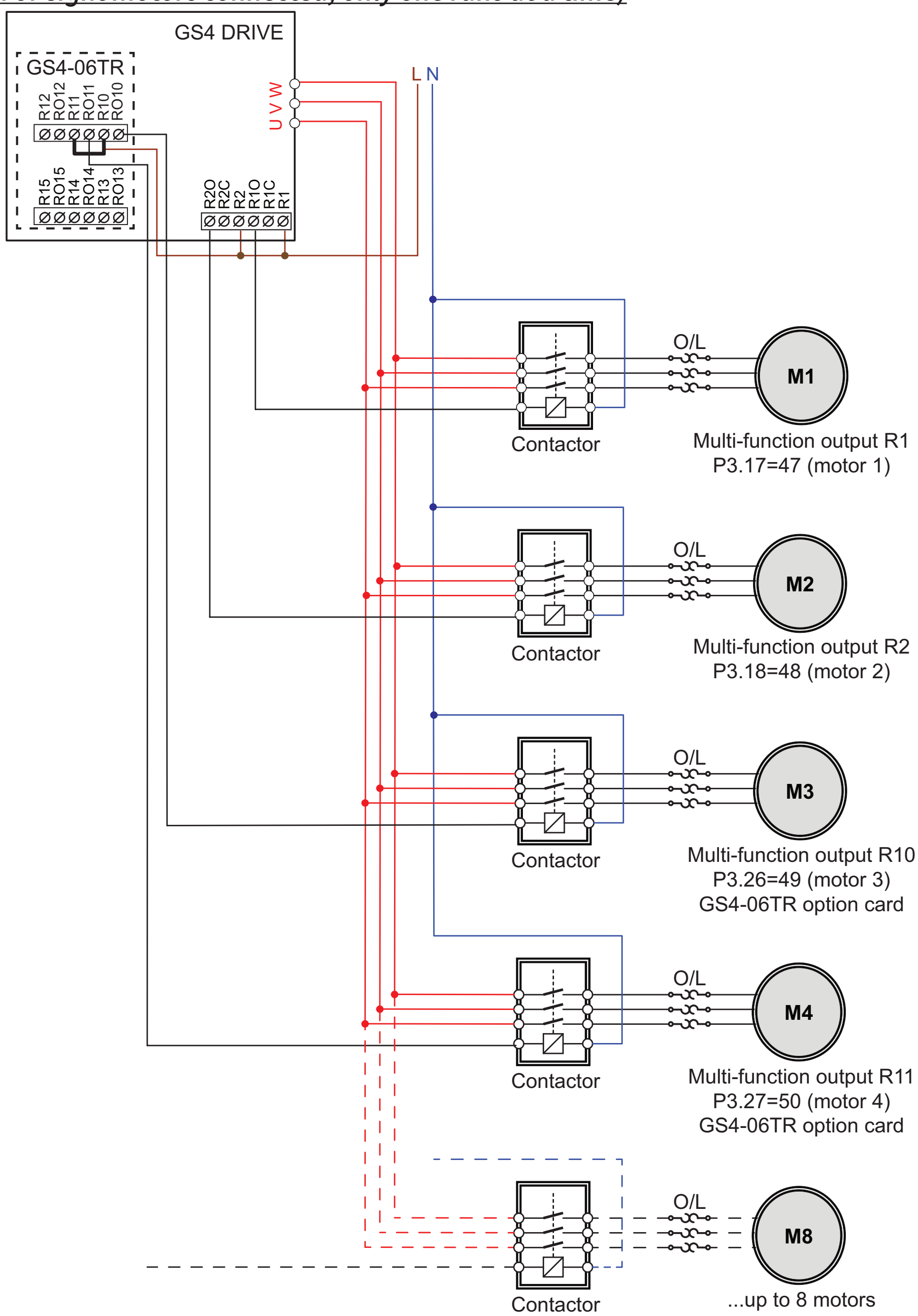
Terminal Specifications for GS4-06TR (Optional Six-Relay Output Card)

Terminal Specifications for GS4-06TR (Optional Six-Relay Output Card)		
Part #	**Terminals**	**Description**
GS4-06TR	R10~R15 RO10~RO15	Refer to P3.21~P3.26 for Multi-function Output selection Resistive Load: 5A(NO) @ 250VAC 5A(NO) @ 30VDC Inductive Load (COSØ 0.4): 2A(NO) @ 250VAC Six SPST relay outputs Rxx = separate common for each relay ROxx = normally open output

Wiring Diagrams for Cyclical Pump Control

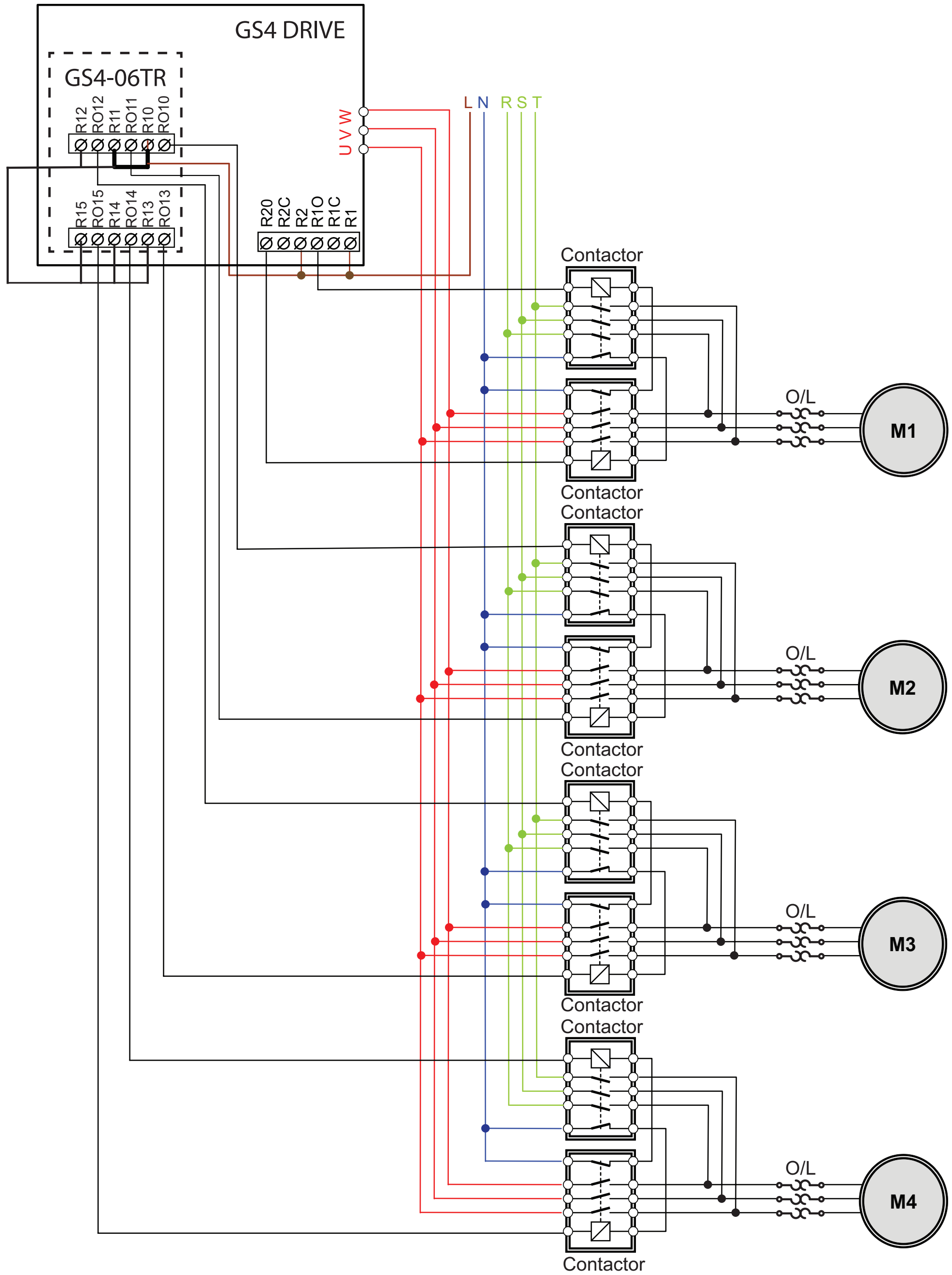
Time Circulation Control (P10.00=1) – Wiring

(Maximum of eight motors connected; only one runs at a time)



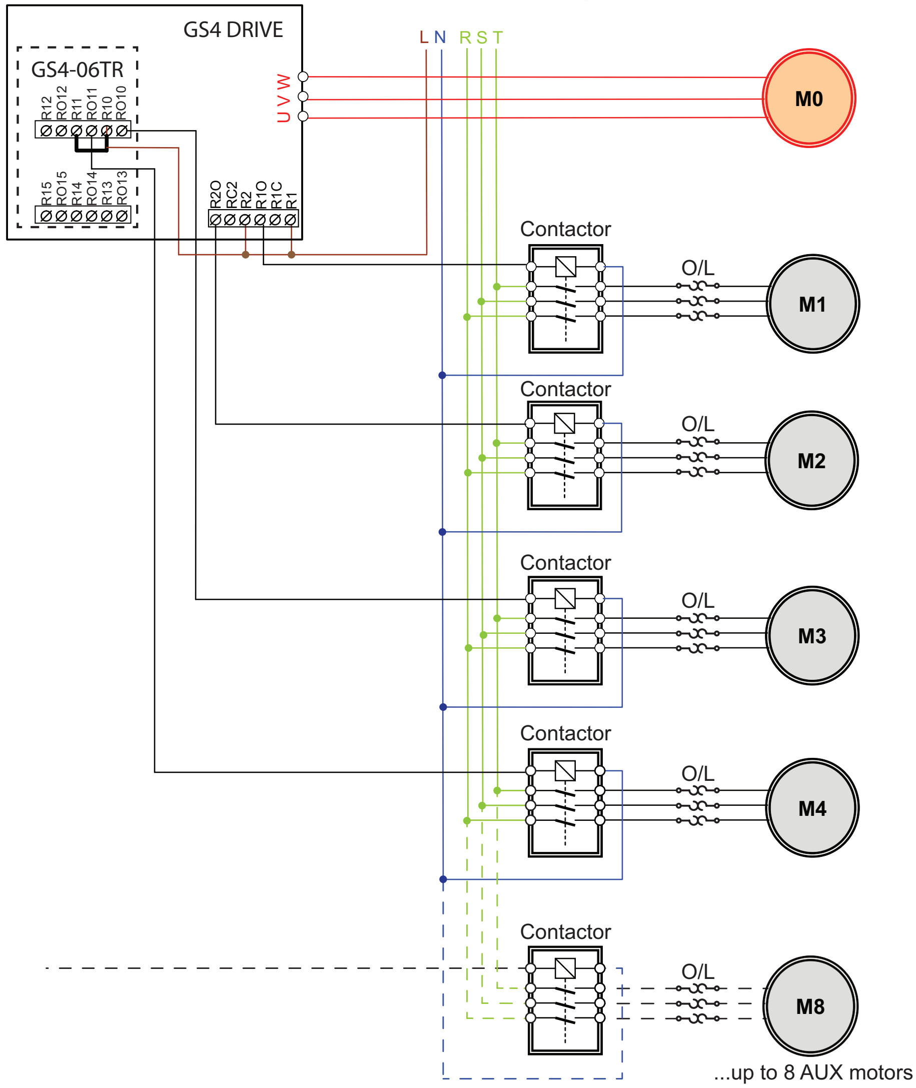
Quantity Cycle (P10.00 = 2 or 4) – Wiring

(Maximum four motors. M1~M4 can be drive powered (one at a time), or bypassed to line power.)



Quantity Control (P10.00 = 3 or 5) – Wiring

(Maximum nine motors. M0 is drive-powered. The other eight AUX motors are line-powered only.)



Group P11.xx Details – Fault Parameters

		Type	Hex Addr	Dec Addr
P11.00	**Fault Output Option 1**	♦R/W	0B00	42817
P11.01	**Fault Output Option 2**	♦R/W	0B01	42818
P11.02	**Fault Output Option 3**	♦R/W	0B02	42819
P11.03	**Fault Output Option 4**	♦R/W	0B03	42820

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

0: No Error — 0

1~65535: (refer to Fault Bit Codes table)

These parameters can be used with a Multi-Function Output set to 33~36 for a specific monitoring requirement. When a fault occurs, the corresponding MFO terminals will be activated. Each Fault option parameter can contain multiple monitord bits. Parameter can contain up to 127decimal (7F hex or 1111111 binary). Values are entered in decimal.

Related parameters: P3.17~P3.31 (page 4–70)

Example: If DO1=36 (FO1) and P11.00 (FO1) = 34 (22 hex, 0100010 bin), then when an external fault (EF, EF1, bb..) or a voltage related fault occurs DO1 will be activated.

Representation of bits:

- *Bit0: Current-related fault*
- *Bit1: Voltage-related fault*
- *Bit2: Overload-related fault*
- *Bit3: System-related fault*
- *Bit4: Feedback-related fault*
- *Bit5: External Fault-related fault*
- *Bit6: Communication-related fault*

Table of Fault Bit Codes

Fault Code	Bit6 CE	Bit5 EXI	Bit4 FBK	Bit3 SYS	Bit2 OL	Bit1 Volt	Bit0 Current
0: No Error							
1: Overcurrent during Accel (ocA)							•
2: Overcurrent during Decel (ocd)							•
3: Overcurrent during normal speed (ocn)							•
4: Ground Fault (GFF)							•
5: IGBT short circuit (occ)							•
6: Overcurrent during Stop (ocS)							•
7: Overvoltage during Accel (ovA)						•	
8: Overvoltage during Decel (ovd)						•	
9: Overvoltage during normal speed (ovn)						•	
10: Overvoltage during Stop (ovS)						•	
11: Low voltage during Accel (LvA)						•	
12: Low voltage during Decel (Lvd)						•	
13: Low voltage during normal speed (Lvn)						•	
14: Low voltage during Stop (LvS)						•	
15: Outout ripple / Input phase loss (OrP)						•	
16: IGBT Overheat 1 (oH1)					•		
17: Cap Overheat 2 (oH2)					•		
18: Thermister 1 open (tH1o)					•		
19: Thermister 2 open (tH2o)					•		
20: Power Reset Off (PWR)					•		
21: Overload (oL) (150% 1Min, Inverter)					•		
22: Motor1 Thermal Overload (EoL1)					•		
23: Motor2 Thermal Overload (EoL2)					•		
24: Motor Overheat-PTC (oH3)					•		
25: reserved	–						
26: Over Torque 1 (ot1)					•		
27: Over Torque 2 (ot2)					•		
28: Under current (uc)							•
29: reserved	–						
30: EEPROM write error (cF1)				•			

(table continued next page)

Table of Fault Bit Codes (continued)

Fault Codes	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
	CE	EXI	FBK	SYS	OL	Volt	Current
31: EEPROM read error (cF2)				•			
32: reserved				•			
33: U phase current sensor detection error (cd1)				•			
34: V phase current sensor detection error (cd2)				•			
35: W phase current sensor detection error (cd3)				•			
36: CC Hardware Logic error 0 (Hd0)				•			
37: OC Hardware Logic error 1 (Hd1)				•			
38: OV Hardware Logic error 2 (Hd2)				•			
39: OCC Hardware Logic error 3 (Hd3)				•			
40: Motor auto tune error (AuE)				•			
41: PID Feedback loss (AFE)			•				
42~47: reserved	–						
48: Analog input signal loss (ACE)			•				
49: External Fault (EF)		•					
50: Emergency Stop (EF1)		•					
51: Base Block (bb)		•					
52: Password Error (Pcod)				•			
53: Software Code lock (ccod)				•			
54: PC Command error (CE1)	•						
55: PC Address error (CE2)	•						
56: PC Data error (CE3)	•						
57: PC Slave error (CE4)	•						
58: PC Communication Time Out (CE10)	•						
59: PC Keypad Time out (CP10)	•						
60: Braking Transistor Fault (bf)		•					
61: Y-Delta connection Error (ydc)		•					
62: Decel Energy Backup Error (dEb)						•	
63: Over Slip Error (oSL)		•					
64: Electromagnet switch error (ryF)		•					
65~71: reserved	–						
72: STO Loss1 (STL1) STO1~SCM1 internal hardware detect error		•					
73: ES1 Emergency Stop (S1)				•			
74: In Fire Mode (Fire)		•					
75: reserved	–						
76: Safety Torque Off function active (STO)		•					
77: STO Loss2 (STL2) STO2~SCM2 internal hardware detect error		•					
78: STO Loss3 (STL3) – STO1~SCM1 and STO2~SCM2 internal hardware detect errors		•					
79: U Phase Short (Uoc)							•
80: V Phase Short (Voc)							•
81: W Phase Short (Woc)							•
82: U Phase Loss (UPHL)							•
83: V Phase Loss (VPHL)							•
84: W Phase Loss (WPHL)							•
85~89: reserved	–						
90: PLC Force Stop (FStp)				•			
91~96: reserved	–						
97: Ethernet Card Timeout (CD10)	•						
98: reserved	–						
99: CPU Command error (TRAP)				•			
100~111: reserved	–						

For detailed fault descriptions, please refer to "Fault Codes" in Chapter 6: Maintenance and Troubleshooting.

		Type	Hex Addr	Dec Addr
P11.04	***First Fault Record***	Read	0B04	42821
P11.05	***Second Most Recent Fault Record***	Read	0B05	42822
P11.06	***Third Most Recent Fault Record***	Read	0B06	42823
P11.07	***Fourth Most Recent Fault Record***	Read	0B07	42824
P11.08	***Fifth Most Recent Fault Record***	Read	0B08	42825
P11.09	***Sixth Most Recent Fault Record***	Read	0B09	42826

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

Range is comprised of the full list of fault codes in "Table of Fault Bit Codes" (page 4–203) — 0

When a fault occurs and forces stopping, it will be recorded in this parameter.

- *At stop with low voltage Lv (LvS warn, no record). During operation with mid-low voltage Lv (LvA, Lvd, Lvn error, will record).*
- *For setting 62: Decel Energy Backup Error (dEb). When dEb function is enabled, the drive will execute dEb and record the fault in P11.04 to P11.09.*

		Type	Hex Addr	Dec Addr
P11.10	***Operating Time of Present Fault Record (Day)***	Read	0B0A	42827

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

0~65535 day

		Type	Hex Addr	Dec Addr
P11.11	***Operating Time of Present Fault Record (Minute)***	Read	0B0B	42828

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

0~1439 min

		Type	Hex Addr	Dec Addr
P11.12	***Operating Time of Second Most Recent Fault Record (Day)***	Read	0B0C	42829

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

0~65535 day

		Type	Hex Addr	Dec Addr
P11.13	***Operating Time of Second Most Recent Fault Record (Minute)***	Read	0B0D	42830

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

0~1439 min

		Type	Hex Addr	Dec Addr
P11.14	***Operating Time of Third Most Recent Fault Record (Day)***	Read	0B0E	42831

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

0~65535 day

		Type	Hex Addr	Dec Addr
P11.15	***Operating Time of Third Most Recent Fault Record (Minute)***	Read	0B0F	42832

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

0~1439 min

		Type	Hex Addr	Dec Addr
P11.16	***Operating Time of Fourth Most Recent Fault Record (Day)***	Read	0B10	42833

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

0~65535 day

		Type	Hex Addr	Dec Addr
P11.17	***Operating Time of Fourth Most Recent Fault Record (Minute)***	Read	0B11	42834

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

0~1439 min

Parameters P11.10~P11.17 are used to record the operation times by day and minute for the four most recent malfunctions. It can also check if there is anything wrong with the drive according to the internal time.

When malfunctions occur during operation, P11.04~11.09 record the six most recent faults, and P11.10~P11.17 record the operation times of the four most recent faults.

These parameter relationships are shown in the following example:

Example of Drive Fault Records

If the first fault ovA occurs after operation 3000 minute, second fault ovd occurs at 3482 min, third fault ovA occurs at 4051 min, fourth fault ocA at 5003 min, fifth fault ocA at 5824 min, sixth fault ocd occurs at 6402 min, and seventh fault ocS at 6951 min, they are recorded as follows:

Drive Fault	Fault Record Parameter	Fault Type	Fault Day Parameter	Fault Minutes Parameter	Fault Time
1st Fault	P11.04	ovA	P11.10	P11.11	3000
2nd Fault	P11.04	ovd	P11.10	P11.11	3482
	P11.05	ovA	P11.12	P11.13	3000
3rd Fault	P11.04	ovA	P11.10	P11.11	4051
	P11.05	ovd	P11.12	P11.13	3482
	P11.06	ovA	P11.14	P11.15	3000
5th Fault	P11.04	ocA	P11.10	P11.11	5824
	P11.05	ovA	P11.12	P11.13	5003
	P11.06	ovA	P11.14	P11.15	4051
	P11.07	ovd	P11.16	P11.17	3482
	P11.08	ovA	n/a	n/a	n/a
6th Fault	P11.04	ocS	P11.10	P11.11	6951
	P11.05	ocA	P11.12	P11.13	6402
	P11.06	ocA	P11.14	P11.15	5824
	P11.07	ovA	P11.16	P11.17	5003
	P11.08	ovd	n/a	n/a	n/a
	P11.09	ovA	n/a	n/a	n/a

		Type	*Hex Addr*	*Dec Addr*
P11.18	***Frequency Command at Fault***	Read	0B12	42835
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~655.35 Hz	0		

P11.18 shows the Frequency Command at the time of last drive fault. If another fault occurs, the previous record will be overwritten.

		Type	*Hex Addr*	*Dec Addr*
P11.19	***Output Frequency at Fault***	Read	0B13	42836
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~655.35 Hz	0		

P11.19 shows the Output Frequency at the time of last drive fault. If another fault occurs, the previous record will be overwritten.

		Type	*Hex Addr*	*Dec Addr*
P11.20	***Output Voltage at Fault***	Read	0B14	42837
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~6553.5V	0		

P11.20 shows the Output Voltage at the time of last drive fault. If another fault occurs, the previous record will be overwritten.

		Type	*Hex Addr*	*Dec Addr*
P11.21	***DC Bus Voltage at Fault***	Read	0B15	42838
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~6553.5V	0		

P11.21 shows the DC Bus Voltage at the time of last drive fault. If another fault occurs, the previous record will be overwritten.

		Type	Hex Addr	Dec Addr
P11.22	***Output Current at Fault***	Read	0B16	42839
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~655.35A	0		

P11.22 shows the Output Current at the time of last drive fault. If another fault occurs, the previous record will be overwritten.

		Type	Hex Addr	Dec Addr
P11.23	***IGBT Temperature at Fault***	Read	0B17	42840
	Range/Units (Format: 16-bit signed)	*Default*		
	-3276.7 to 3276.7 °C	0		

P11.23 shows the IGBT Temperature at the time of last drive fault. If another fault occurs, the previous record will be overwritten.

		Type	Hex Addr	Dec Addr
P11.24	***HeatSink Temperature at Fault***	Read	0B18	42841
	Range/Units (Format: 16-bit signed)	*Default*		
	-3276.7 to 3276.7 °C	0		

P11.24 shows the HeatSink Temperature at the time of last drive fault. If another fault occurs, the previous record will be overwritten.

		Type	Hex Addr	Dec Addr
P11.25	***RPM of Motor at Fault***	Read	0B19	42842
	Range/Units (Format: 16-bit signed)	*Default*		
	-32767 to 32767 rpm	0		

P11.25 shows the Motor Speed in rpm at the time of last drive fault. If another fault occurs, the previous record will be overwritten.

		Type	Hex Addr	Dec Addr
P11.26	***Digital Input Status at Fault***	Read	0B1A	42843
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~65535	0		

P11.26 captures the value of P3.46, Digital Input Active Status, at the instant of last drive fault. If another fault occurs, the previous record will be overwritten.

		Type	Hex Addr	Dec Addr
P11.27	***Digital Output Status at Fault***	Read	0B1B	42844
	Range/Units (Format: 16-bit binary)	*Default*		
	0~65535	0		

P11.27 captures the value of P3.47, Digital Output Active Status, at the instant of last drive fault. If another fault occurs, the previous record will be overwritten.

Representation of bits:

- *Bit1~Bit0: 00: RUN LED light off; STOP LED light on (Drive Stop)*
  01: RUN LED blink; STOP LED light on (Drive Decelerating during stopping)
  10: RUN LED light on; STOP LED blink (Drive Standby)
  11: RUN LED light on; STOP LED light off (Drive Run)
- *Bit2: 1: JOG active*
- *Bit4~Bit3: 00: REV LED light off; FWD LED light on (Forward)*
  01: REV LED blink; FWD LED light on (Reverse to Forward)
  10: REV LED light on; FWD LED blink (Forward to Reverse)
  11: REV LED light on; FWD LED light off (Reverse)
- *Bit5: 1: Factory parameters group opened state*
- *Bit6: 1: Advance parameter group opened state*
- *Bit7: 1: Operation command controlled by external terminal*
- *Bit8: 1: Main frequency controlled by communication*
- *Bit9: 1: Main frequency controlled by external terminal (AI)*
- *Bit10: 1: Operation command controlled by communication (PU)*
- *Bit11: 1: Parameters have been locked*
- *Bit12: 1: Copy command enable*
- *Bit15~Bit13: 0: HOA mode OFF*
  1: HOA mode HAND-ON
  2: HOA mode AUTO-ON
  3: LOC/REM mode LOC-ON
  4: LOC/REM mode REM-ON

		Type	Hex Addr	Dec Addr
P11.28	***Drive Status at Fault***	Read	0B1C	42845
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~65535	0		

P11.28 shows the Drive Status from "Status Monitor 2" (2101H) at the time of last drive fault. If another fault occurs, the previous record will be overwritten.

Refer to the Status Addresses table in chapter 5 (page 5–6) for bit-level descriptions of Status Monitor 2.

Serial Communications

Chapter 5

Table of Contents

Communications Parameters Summary

A summary of the GS4 AC drives Communications Parameters is listed below. Refer to “Parameters” Chapter 4 for a complete listing of all GS4 AC drives parameters, including details and Modbus addresses.

For EtherNet/IP and Modbus TCP card parameters and information, please see Appendix B.

For detailed BACnet parameter information, please see the BACnet section of this chapter, page 5-18.

Summary – Serial Communication Parameters

GS4 Serial Communication Parameters Summary (P9.xx)							
Parameter		***Range***		***Modbus Address***			***Default Setting***
				Hex	***Dec***	***Octal***	
P9.00	VFD Comm Address	1 to 254		0900	42305	4400	1
P9.01	Modbus Baud Rate	0: 4.8k 1: 9.6k 2: 19.2k	3: 38.4k 4: 57.6k 5: 115.2k	0901	42306	4401	1
P9.02	Modbus Protocol	1: 7N2 (ASCII) 2: 7E1 (ASCII) 3: 7O1 (ASCII) 4: 7E2 (ASCII) 5: 7O2 (ASCII) 6: 8N1 (ASCII) 7: 8N2 (ASCII) 8: 8E1 (ASCII) 9: 8O1 (ASCII)	10: 8E2 (ASCII) 11: 8O2 (ASCII) 12: 8N1 (RTU) 13: 8N2 (RTU) 14: 8E1 (RTU) 15: 8O1 (RTU) 16: 8E2 (RTU) 17: 8O2 (RTU)	0902	42307	4402	12
P9.03	Modbus Fault Select	0: Warn & Continue Operation 1: Warn & Ramp to Stop 2: Warn & Coast to Stop 3: No Warning & Continue Operation		0903	42308	4403	3
P9.04	Time Out Detection	0: Disable 1: Enable		0904	42309	4404	0
P9.05	Time Out Duration	0.1 to 100.0 seconds		0905	42310	4405	0.5
P9.06	Parameter Copy	0: Disable Copy Keypad Function 1: Enable Copy Keypad Function		0906	42311	4406	0
P9.07	Parameter Lock	0: Normal Operation (allow changes) 1: Prevent any Changes to Parameters		0907	42312	4407	0
P9.08	*Restore to Default*	0: no function 1: Parameter Lock 2: no function 3: no function 4: no function 5: Reset kWh Display to Zero 6: Reset PLC (clear PLC) 7: no function 8: no function 9: Reset 50Hz Default 10: Reset 60Hz Default		0908	42313	4410	0
P9.09~P9.24	Block Transfer Parameters; refer to separate “Block Transfer Parameters” summary table, page 5–5						
P9.25	reserved	n/a		0919	42330	4431	n/a
P9.26	RS-485 Last Known Speed Reference	0.00~599.00 Hz		091A	42331	4432	60.00
P9.27	RS-485 RUN Command	0: Stop 1: Run		091B	42332	4433	0
P9.28	RS-485 Direction Command	0: Forward 1: Reverse		091C	42333	4434	0
P9.29	RS-485 External Fault	0: No Fault 1: External Fault		091D	42334	4435	0

(table continued next page)

GS4 Parameters Summary – Serial Communication Parameters (P9.xx) – (continued)						
Parameter		**Range**	**Modbus Address**			**Settings**
			Hex	**Dec**	**Octal**	**Default**
P9.30	RS-485 Fault Reset	0: No Action 1: Fault Reset	091E	42335	4436	0
P9.31	RS-485 JOG Command	0: Stop 1: Jog	091F	42336	4437	0
P9.32	reserved	n/a	0920	42337	4440	n/a
P9.33	GS4 Drive Rated Amps	0.00~655.34A	0921	42338	4441	#.##
P9.34	PLC Command Mask (status only)	0~65535	0922	42339	4442	0
P9.35	Response Delay Time	0.0~200.0 ms	0923	42340	4443	2.0
P9.36	reserved	n/a	0924	42341	4444	n/a
P9.37	PLC Address	1~254	0925	42342	4445	2
P9.38	Firmware Date Code	Format: yywwd • yy = year (2017 = 17) • ww = week (01~52) • d = day of week (1~7; Mon=1, Sun=7)	0926	42343	4446	#####
P9.39	Firmware version	x.xx	0927	42344	4447	#.##
P9.40	reserved	n/a	0928	42345	4450	n/a
P9.41	GS Series Number	0~9	0929	42346	4451	4
P9.42	GS Model ID	00: GS4-21P0 (230V 1ph/3ph 1.0hp) 01: GS4-22P0 (230V 1ph/3ph 2.0hp) 02: GS4-23P0 (230V 1ph/3ph 3.0hp) 03: GS4-25P0 (230V 3ph 5.0hp) 04: GS4-27P5 (230V 3ph 7.5hp) 05: GS4-2010 (230V 3ph 10hp) 06: GS4-2015 (230V 3ph 15hp) 07: GS4-2020 (230V 3ph 20hp) 08: GS4-2025 (230V 3ph 25hp) 09: GS4-2030 (230V 3ph 30hp) 10: GS4-2040 (230V 3ph 40hp) 11: GS4-2050 (230V 3ph 50hp) 12: GS4-2060 (230V 3ph 60hp) 13: GS4-2075 (230V 3ph 75hp) 14: GS4-2100 (230V 3ph 100hp) 15: GS4-41P0 (460V 3ph 1.0hp) 16: GS4-42P0 (460V 3ph 2.0hp) 17: GS4-43P0 (460V 3ph 3.0hp) 18: GS4-45P0 (460V 3ph 5.0hp) 19: GS4-47P5 (460V 3ph 7.5hp) 20: GS4-4010 (460V 3ph 10hp) 21: GS4-4015 (460V 3ph 15hp) 22: GS4-4020 (460V 3ph 20hp) 23: GS4-4025 (460V 3ph 25hp) 24: GS4-4030 (460V 3ph 30hp) 25: GS4-4040 (460V 3ph 40hp) 26: GS4-4050 (460V 3ph 50hp) 27: GS4-4060 (460V 3ph 60hp) 28: GS4-4075 (460V 3ph 75hp) 29: GS4-4100 (460V 3ph 100hp) 30: GS4-4125 (460V 3ph 125hp) 31: GS4-4150 (460V 3ph 150hp) 32: GS4-4175 (460V 3ph 175hp) 33: GS4-4200 (460V 3ph 200hp) 34: GS4-4250 (460V 3ph 250hp) 35: GS4-4300 (460V 3ph 300hp)	092A	42347	4452	##
P9.43	Ignore Comm Card Warning	0: Disable function (do NOT ignore) 1: Enable function (ignore warning)	092B	42348	4453	1

(table continued next page)

GS4 Parameters Summary – Serial Communication Parameters (P9.xx) – (continued)						
Parameter		**Range**	**Modbus Address**			**Settings**
			Hex	**Dec**	**Octal**	**Default**
P9.44	Comm Card Type	0: No Communication Card 1: reserved 2: reserved 3: reserved 4: MODBUS-TCP Slave 5: EtherNet/IP Slave 6: reserved 7: reserved 8: reserved	092C	42349	4454	0
P9.45	Comm Card Version	0~65535	092D	42350	4455	0
P9.46	Comm Card Production Code	0~65535	092E	42351	4456	0
P9.47	Comm Card Fault Code	0~65535	092F	42352	4457	0
P9.48	Comm Card IP Configuration	0: Static IP 1: Dynamic IP (DHCP)	0930	42353	4460	0
P9.49	Comm Card IP Address Octet 1	0~255	0931	42354	4461	0
P9.50	Comm Card IP Address Octet 2	0~255	0932	42355	4462	0
P9.51	Comm Card IP Address Octet 3	0~255	0933	42356	4463	0
P9.52	Comm Card IP Address Octet 4	0~255	0934	42357	4464	0
P9.53	Comm Card Mask Octet 1	0~255	0935	42358	4465	0
P9.54	Comm Card Mask Octet 2	0~255	0936	42359	4466	0
P9.55	Comm Card Mask Octet 3	0~255	0937	42360	4467	0
P9.56	Comm Card Mask Octet 4	0~255	0938	42361	4470	0
P9.57	Comm Card Gateway Octet 1	0~255	0939	42362	4471	0
P9.58	Comm Card Gateway Octet 2	0~255	093A	42363	4472	0
P9.59	Comm Card Gateway Octet 3	0~255	093B	42364	4473	0
P9.60	Comm Card Gateway Octet 4	0~255	093C	42365	4474	0
P9.61	reserved	~	093D	42366	4475	0
P9.62	reserved	~	093E	42367	4476	0
P9.63	Comm Card Factory Reset	0: No Action 1: Reset to the Factory Setting	093F	42368	4477	0
P9.64	Comm Card External Set	0, 2 Bit 0 = reserved Bit 1 = Write Ethernet Parameters to Comm Card Bit 2 = reserved	0940	42369	4500	0
P9.65	reserved	~	0941	42370	4501	0
P9.66	reserved	~	0942	42371	4502	~
P9.67	reserved	~	0943	42372	4503	~
P9.68	reserved	~	0944	42373	4504	~
P9.69~P9.84	Block Transfer Parameters; refer to separate “Block Transfer Parameters” summary table, page 5–5					
P9.85	PLC Frequency Command Force to 0	0~1h Bit 0 = 1: Before PLC scan, set up PLC Target Frequency = 0	0955	42390	4525	0
P9.86	COMM1 Protocol (via RS-485)	0: Modbus 1: BACnet	0956	42391	4526	0
P9.87	BACnet Address	0~127	0957	42392	4527	10
P9.88	BACnet Baud Rate	9.6~76.8 Kbps	0958	42393	4530	38.4
P9.89	BACnet Device Instance Low Word	0~65535	0959	42394	4531	10
P9.90	BACnet Device Instance High Byte	0~63	095A	42395	4532	0
P9.91	BACnet Max Polling Address	0~127	095B	42396	4533	127
P9.92	BACnet Password	0~65535	095C	42397	4534	0

Summary – Block Transfer Parameters

GS4 Communications Parameters Summary – Block Transfer Parameters											
Parameter / Address Description	**Block Transfer Data Locations**					**Block Transfer Address Pointers**					
	Para-meter	**Description (Range)**	**Modbus Address**			**Para-meter**	**Description (Range)**	**Modbus Address**			**Default Setting**
			Hex	**Dec**	**Octal**			**Hex**	**Dec**	**Octal**	
Block Transfer _ 1	**P9.09**	Dependent upon the target address. Example: If Block Transfer points to a digital parameter, range = 0,1. If it points to analog parameter, the range could be 0–65535.	0909	42314	4411	**P9.69**	0–65535 Format as xxyy, where: xx = target parameter group # yy = target parameter #	0945	42374	4505	0
Block Transfer _ 2	**P9.10**		090A	42315	4412	**P9.70**		0946	42375	4506	0
Block Transfer _ 3	**P9.11**		090B	42316	4413	**P9.71**		0947	42376	4507	0
Block Transfer _ 4	**P9.12**		090C	42317	4414	**P9.72**		0948	42377	4510	0
Block Transfer _ 5	**P9.13**		090D	42318	4415	**P9.73**		0949	42378	4511	0
Block Transfer _ 6	**P9.14**		090E	42319	4416	**P9.74**		094A	42379	4512	0
Block Transfer _ 7	**P9.15**		090F	42320	4417	**P9.75**		094B	42380	4513	0
Block Transfer _ 8	**P9.16**		0910	42321	4420	**P9.76**		094C	42381	4514	0
Block Transfer _ 9	**P9.17**		0911	42322	4421	**P9.77**		094D	42382	4515	0
Block Transfer _ 10	**P9.18**		0912	42323	4422	**P9.78**		094E	42383	4516	0
Block Transfer _ 11	**P9.19**		0913	42324	4423	**P9.79**		094F	42384	4517	0
Block Transfer _ 12	**P9.20**		0914	42325	4424	**P9.80**		0950	42385	4520	0
Block Transfer _ 13	**P9.21**		0915	42326	4425	**P9.81**		0951	42386	4521	0
Block Transfer _ 14	**P9.22**		0916	42327	4426	**P9.82**		0952	42387	4522	0
Block Transfer _ 15	**P9.23**		0917	42328	4427	**P9.83**		0953	42388	4523	0
Block Transfer _ 16	**P9.24**		0918	42329	4430	**P9.84**		0954	42389	4524	0

Block Transfer Explanation

Block Transfer allows Parameters from many different Parameter Groups to be consolidated into one Modbus communication message. This can greatly simplify PLC programming and reduce network traffic.

Unlike previous GS drives*, the GS4 has two sets of Block Transfer Parameters:

- *<u>Pointer</u> Parameters (where you enter the address that you want to consolidate)*
- *<u>Data</u> Locations (where you push data into, or pull data out of)*

Example: To consolidate the parameters Multi-Speed 15 (P5.15), Skip Frequency 3 Lower Limit (P1.24), and Circulation Time (P10.02), enter the following values into P9.69, P9.70, and P9.71:

Pointer Address	***Push Data to (or Pull data from)***
Block Transfer _ 1 P9.69 = 515 (points to P5.15)	P9.09
Block Transfer _ 2 P9.70 = 124 (points to P1.24)	P9.10
Block Transfer _ 3 P9.71 = 1002 (points to P10.02)	P9.11

(Note that the Pointer Addresses use xxyy format where xx=Parameter Group and yy=Parameter# in that group.)

Now you can write 1 Modbus message to P9.09 with a length of three registers that will change P5.15, P1.24, and P10.02, or use 1 Modbus Read message to collect all 3 parameters at once.

* *Previous GS Drives only had one set of parameters for Block Transfer. The Pointer address had to be manually entered into the keypad. Only then would any read or write into that Block Transfer address actually be linked to the desired data. Unfortunately, this meant that you would have to manually enter Block Transfer addresses via the keypad for any new drive. With the GS4 method, the Pointer Addresses are in separate parameters. Thus, the complete configuration can be downloaded via software (no keypad entry necessary).*

Serial Modbus Status Addresses

The *DURAPULSE* GS4 AC drive has status memory addresses that are used to monitor the AC drive.

Status Addresses (Read Only)

GS4 Status Addresses (Read Only)						
Description		***Range***		***Modbus Address***		
				Hex	***Dec***	***Octal***
Status Monitor 1	Error Codes	0: No Error 1: Overcurrent during Accel (ocA) 2: Overcurrent during Decel (ocd) 3: Overcurrent during normal speed (ocn) 4: Ground Fault (GFF) 5: IGBT short circuit (occ) 6: Overcurrent during Stop (ocS) 7: Overvoltage during Accel (ovA) 8: Overvoltage during Decel (ovd) 9: Overvoltage during normal speed (ovn) 10: Overvoltage during Stop (ovS) 11: Low voltage during Accel (LvA) 12: Low voltage during Decel (Lvd) 13: Low voltage during normal speed (Lvn) 14: Low voltage during Stop (LvS) 15: Input phase loss (OrP) 16: IGBT Overheat 1 (oH1) 17: Cap Overheat 2 (oH2) 18: Thermister 1 open (tH1o) 19: Thermister 2 open (tH2o) 20: Power Reset Off (PWR) 21: Overload (oL) (150% 1Min, Inverter) 22: Motor1 Thermal Overload (EoL1) 23: Motor2 Thermal Overload (EoL2) 24: Motor Overheat-PTC (oH3) 25: reserved 26: Over Torque 1 (ot1) 27: Over Torque 2 (ot2) 28: Under current (uc) 29: reserved 30: EEPROM write error (cF1) 31: EEPROM read error (cF2) 32: reserved 33: U phase current sensor detection error (cd1) 34: V phase current sensor detection error (cd2) 35: W phase current sensor detection error (cd3) 36: CC Hardware Logic error 0 (Hd0) 37: OC Hardware Logic error 1 (Hd1) 38: OV Hardware Logic error 2 (Hd2) 39: OCC Hardware Logic error 3 (Hd3)	40: Motor auto tune error (AuE) 41: PID Feedback loss (AFE) 42~47: reserved 48: Analog input signal loss (ACE) 49: External Fault (EF) 50: Emergency Stop (EF1) 51: Base Block (bb) 52: Password Error (Pcod) 53: Software Code lock (ccod) 54: PC Command error (CE1) 55: PC Address error (CE2) 56: PC Data error (CE3) 57: PC Slave error (CE4) 58: PC Communication Time Out (CE10) 59: PC Keypad Time out (CP10) 60: Braking Transistor Fault (bf) 61: Y-Delta connection Error (ydc) 62: Decel Energy Backup Error (dEb) 63: Over Slip Error (oSL) 64: Electromagnet switch error (ryF) 65~71: reserved 72: STO Loss1 (STL1) STO1~SCM1 internal hardware detect error 73: ES1 Emergency Stop (S1) 74: In Fire Mode (Fire) 75: reserved 76: Safety Torque Off function active (STO) 77: STO Loss2 (STL2) STO2~SCM2 internal hardware detect error 78: STO Loss3 (STL3) – STO1~SCM1 and STO2~SCM2 internal hardware detect errors 79: U Phase Short (Uoc) 80: V Phase Short (Voc) 81: W Phase Short (Woc) 82: U Phase Loss (UPHL) 83: V Phase Loss (VPHL) 84: W Phase Loss (WPHL) 85~89: reserved 90: PLC Force Stop (FStp) 91~98: reserved 99: CPU Command error (TRAP) 100~110: reserved 111: InrCom Time Out (ictE)	2100	48449	20400

(table continued next page)

GS4 Status Addresses (continued from previous page)					
Description		Range	Modbus Address		
			Hex	Dec	Octal
Status Monitor 2	Bit 0,1	0: Stop 1: Decelerate during the drive stopping 10: The drive standby 11: Run	2101	48450	20401
	Bit 2	1: JOG active			
	Bit 3,4	0: FWD 1: REV to FWD 10: FWD to REV 11: REV			
	Bit 5	Reserved			
	Bit 6	Reserved			
	Bit 7	Operation Command controlled by external terminal (If P3.00 = 1 or 2; then Bit 7 = 1)			
	Bit 8	Master Frequency controlled by communication interface (If P4.00 = 0, 1, or 4; then Bit 8 = 1)			
	Bit 9	Master Frequency controlled by analog signal (If P4.00 = 2; then Bit 9 = 1)			
	Bit 10	Operation Command controlled by communication interface (If P3.00=0, 1, 3, or 5; then Bit 10 = 1)			
	Bit 11	1: Parameters have been locked			
	Bit 12	Running Status 0: Drive stopped 1: Drive running (including Standby)			
	Bit 13 to Bit 15	Reserved			
Frequency command F (xxx.x) *			2102	48451	20402
Output Frequency H (xxx.x)			2103	48452	20403
Output Current A (xxx.x)			2104	48453	20404
DC-BUS Voltage U (xxx.x)			2105	48454	20405
Output Voltage E (xxx.x)			2106	48455	20406
Multi-Speed or PID Inputs current Step Number			2107	48456	20407
Active Warning			2108	48457	20410
DI6 Counter Value (must set P3.44)			2109	48458	20411
Power Factor angle (cos θ)			210A	48459	20412
Reserved			210B	48460	20413
Motor Actual RPM			210C	48461	20414
reserved			210D	48462	20415
reserved			210E	48463	20416
Output Power (kW)			210F	48464	20417
reserved			2110	48465	20420
Error/ Warning	Low Byte	Active Error [2100h = Active Error/Fault]	2118	48473	20430
	High Byte	Active Warning [2108h = Active Warning]			
Display signal of AI1 analog input terminal, 0–10V corresponds to 0.00–100.00%			220Bh	48716	21013
Display signal of AI2 analog input terminal, 4–20mA / 0–10V corresponds to 0.00–100.00%			220Ch	48717	21014
Display signal of AI3 analog input terminal, -10V–10V corresponds to -100.00–100%			220Dh	48718	21015
IGBT temperature of drive power module (XXX.X °C)			220Eh	48719	21016
The temperature of capacitance (XXX.X °C)			220Fh	48720	21017

* *If frequency command is greater than the Drive Maximum Output Frequency (P0.04), the GS4 drive will accelerate to the Drive Maximum Output Frequency, as defined in (P0.04).*

Serial Communications Overview

The *DURAPULSE* GS4 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 1000 meters (4000 feet) of cable. RS-232 signals can be converted to RS-485 by using a separate converter.

The *DURAPULSE* GS4 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 *DURAPULSE* GS4 AC drive can be configured to communicate using either Modbus or BACnet. The desired protocol is selected in parameter P9.86, COM1 Protocol. (The GS4 drive cannot utilize both protocols simultaneously.)

- *Standard Modbus protocol using ASCII or RTU transmission modes.*
  Parameter P9.02, 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.
- *BACnet protocol.*

DURApulse GS4 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 P9.03 (Communication Fault Operation), P9.04 (Time Out Detection), and P9.05 (Time Out Duration).

Ethernet connectivity for EtherNet/IP communication is possible with an optional communication card # GS4-CM-ENETIP.
Ethernet connectivity for Modbus TCP communication is possible with an optional communication card # GS4-CM-MODTCP.
Refer to "Appendix B: Optional I/O and Communication Cards" for details.

Serial Communications Connectivity

This section contains information regarding wiring connections to the GS4 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***
P3.00 = 03 or 04	1st Source of Operation Command [Remote]	3: RS-485 (Modbus/BACnet), Keypad STOP is Enabled 4: RS-485 (Modbus/BACnet), Keypad STOP is Disabled
P3.01 = 03 or 04	2nd Source of Operation Command [Local]	3: RS-485 (Modbus/BACnet), Keypad STOP is Enabled 4: RS-485 (Modbus/BACnet), Keypad STOP is Disabled
P3.03~P3.16 = 33	Digital Input Definition	33: Local/Remote Control Select (can also be switched via Local and Remote buttons on the keypad)
P4.00 = 01	1st Source of Frequency Command [Remote]	1: RS-485 Communication (Modbus/BACnet)
P4.01 = 01	2nd Source of Frequency Command [Local]	1: RS-485 Communication (Modbus/BACnet)
P9.00 = 1~254	Communication Address	01~254 Drive Comm Address
P9.01 = 4.8~115.2	Transmission Speed	0: 4.8Kbps; 1: 9.6Kbps; 2: 19.2Kbps; 3: 38.4Kbps; 4: 57.6Kbps; 5: 115.2Kbps
P9.02 = 12	Communication Protocol	12: <8 data bits, no parity, 1 stop bit, RTU>
P9.86 = 00 or 01	COM1 Protocol	0: Modbus 485 1: BACnet

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 GS4 drive (for GS4 Ethernet connectivity and control, refer to the Ethernet option 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, BRX/Do-more, DirectLogic (DL06 or D2-260). Other PLC-Drive connectivity is possible: Please refer to the “Typical ADC PLC to GS4 Serial Connectivity Matrix” below.

Typical ADC PLC to GS4 Serial Communications Connectivity

Typical ADC PLC to GS4 Serial Communications Connectivity Matrix*

Recommended PLC Connectivity			Communication	Direct Cable	GS4	
PLC	**Port #**	**Port Type**			**Port Type**	**Port #**
CLICK	3	3 screw terminals	RS-485	L19954 cable	RJ45 or SG+ SG- SGND	RJ45-1 RJ45-2 or 3 screw terminals
D2-260	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	L19954 cable		
Do-more H2-DM1	RS-232	RJ12	RS-232 to RS-485	FA-ISOCON with L19954 cable		
P1 CPUs	RS-485	screw terminals	RS-485	L19954 cable		
P2 CPUs	RS-485	screw terminals	RS-485	L19954 cable		
P3 CPUs	RS-485	screw terminals	RS-485	L19954 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 L19954 cable		
DL05	2	RJ12	RS-232 to RS-485	FA-ISOCON with L19954 cable		
DL06 + DCM	2	HD15	RS-485	D2-DSCBL-2		
Do-more H2-DM1 + H2-SERIO-4	3	5 screw terminals	RS-485	L19954 cable		
Do-more T1H-DM1	RS-232	RJ12	RS-232 to RS-485	FA-ISOCON with L19954 cable		
P2-SCM	4	4 screw terminals	RS-485	L19954 cable		
P3-SCM	4	4 screw terminals	RS-485	L19954 cable		

** Ethernet connectivity for EtherNet/IP communication is possible with an optional communication card # GS4-CM-ENETIP. Refer to “Appendix B: Optional I/O and Communication Cards” for details.*

** Ethernet connectivity for Modbus TCP communication is possible with an optional communication card # GS4-CM-MODTCP. Refer to “Appendix B: Optional I/O and Communication Cards” for details.*

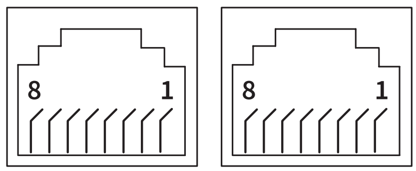
Connecting Communication Cables

The GS4 AC drive includes an "RS-485" switch on the control board that will switch in a 120Ω terminating resistor for the RS-485 network. an external terminating resistor is not 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* GS4 serial communication port is an RS-485 input. Please note that terminals SG+ and SG- are shared with the RJ45 connectors. That means the user can use standard RJ45 patch cables or industrial RS-485 cabling to access the comm port. GS4 to GS4 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 5–11).

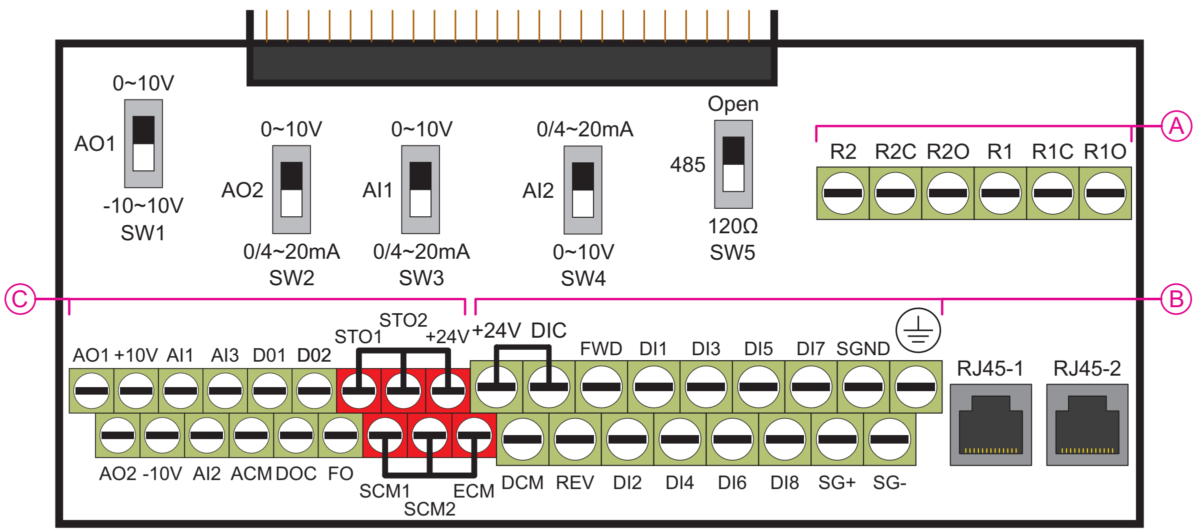
DURAPULSE GS4 RS-485 Serial Comm Ports

GS4 Serial Comm Ports (2)
RS-485 Interface



1: reserved*
2: reserved*
3: GND
4: SG–
5: SG+
6: GND
7: reserved*
8: reserved*

* Reserved pins 1, 2, 7, & 8 are open and unused.



Control circuit board is removable from the GS4 (for ease of wiring)

Recommended RS-485 cable: Belden 9842, AutomationDirect L19954 series, or equivalent.

RS-232C to RS-485 Conversion

An RS-485 network cable can span up to 1000 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.

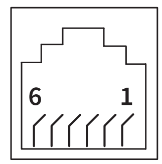
If an FA-ISOCON module is used, set the module dipswitches as required.
Refer to the FA-ISOCON manual for more detailed information.

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.

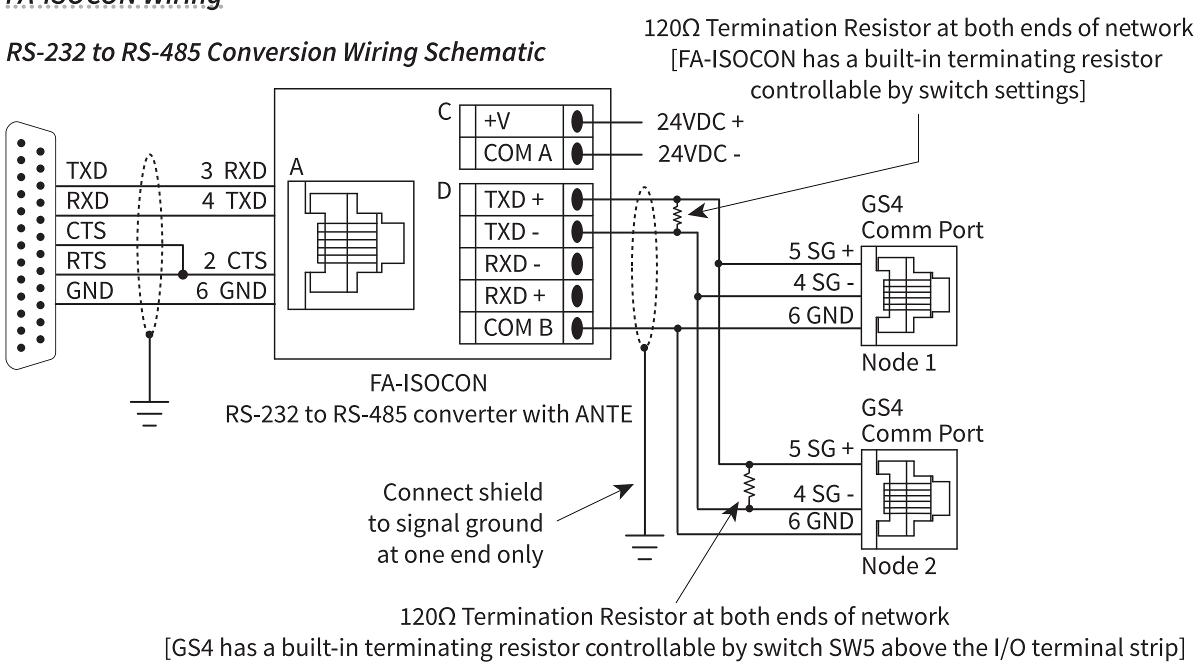
FA-ISOCON RJ-12 Serial Comm Port A
RS-232 Input Port



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



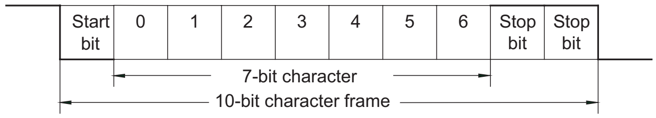
For information regarding configuration of AutomationDirect PLCs or other PLCs, please refer to Appendix D of this user manual, or to the applicable PLC user manual for your application.

Detailed Serial Modbus Communication Information

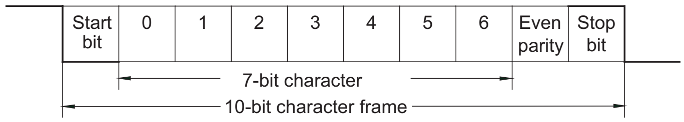
Data Format

ASCII Mode: 10-bit character frame (For 7-bit character):

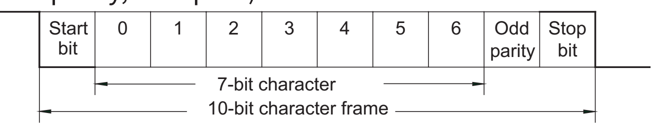
P9.02 = 00 (7 data bits, no parity, 2 stop bits)



P9.02 = 01 (7 data bits, even parity, 1 stop bit)

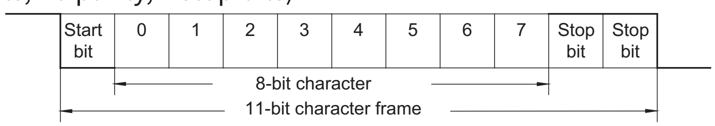


P9.02 = 02 (7 data bits, odd parity, 1 stop bit)

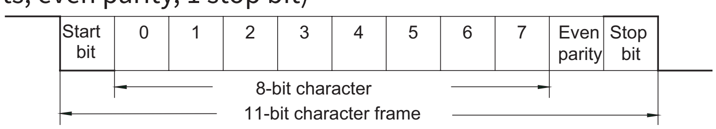


RTU Mode: 11-bit character frame (For 8-bit character):

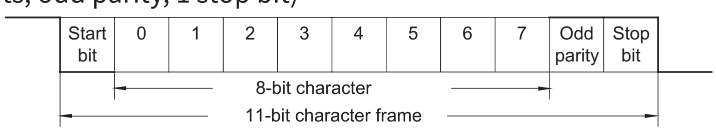
P9.02 = 03 (8 data bits, no parity, 2 stop bits)



P9.02 = 04 (8 data bits, even parity, 1 stop bit)



P9.02 = 05 (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	
STX	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'6'
Data Address	'0'
	'1'
	'0'
	'0'
	'1'
	'7'
	'7'
	'0'
LRC CHK 1	'7'
LRC CHK 0	'1'
END 1	CR
END 0	LF

Response Message	
STX ':'	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'0'
CMD 0	'6'
Data Address	'0'
	'1'
	'0'
	'0'
Data Content	'1'
	'7'
	'7'
	'0'
LRC CHK 1	'7'
LRC CHK 0	'1'
END 1	CR
END 0	LF

RTU mode:

This is an example of using function code 16 for writing to multiple registers.

Command Message	
ADR	01H
CMD	10H
Starting data address	20H
	00H
Number of registers	00H
	02H
Byte count	04H
Content of data address 2000H	00H
	02H
Content of data address 2001H	02H
	58H
CRC CHK Low	CBH
CRC CHK High	34H

Response Message	
ADR	01H
CMD	10H
Starting data address	20H
	00H
Number of data (Count by word)	00H
	02H
CRC CHK Low	4AH
CRC CHK High	08H

NOTE Concerning 2100h: When GS4 drive is setup with reference RS-485, ModbusTCP, or EtherNet/IP (P4.00 = 1 or 4, & drive in Remote/Auto) -OR- (P4.00 = 1 or 4, & drive in Local/Hand) -AND- Reference > P0.04 Drive Max Out Freq, the GS4 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:

1) Load a 16-bit register (called CRC register) with FFFFh.
2) 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.
3) Shift the CRC register one bit to the right with MSB zero filling. Extract and examine the LSB.
4) If the LSB of CRC register is 0, repeat step 3; else Exclusive or the CRC register with the polynomial value A001h.
5) Repeat step 3 and 4 until eight shifts have been performed. When this is done, a complete 8-bit byte will have been processed.
6) 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.

BACnet Serial Communication

About BACnet

BACnet is an ASHRAE communication protocol for building automation and control networks.

(ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.).

GS4's BACnet is based on BACnet-2004 (ver.1, rev.4).

BACnet's regulations are related to several kinds of physical layers' interfaces. The physical layer built inside GS4 is achieved via MS/TP interface.

The BACnet of GS4 supports a device type called B-ASC. B-ASC supports six types of services such as DS-RP-B, DS-RPM-B, DS-WP-B, DM-DDB-B, DM-DOB, and DM-DCC-B.

Parameter Summary for BACnet

GS4 Communications Parameters Summary – BACnet Communication Parameters						
Parameter		***Range***	***Modbus Address***			***Default Setting***
			Hex	***Dec***	***Octal***	
P9.86	COM1 Protocol	0: Modbus 485 1: BACnet	0956	42391	4526	0
P9.87	BACnet Address	0~127	0957	42392	4527	10
P9.88	BACnet Baud Rate	9.6~76.8Kbps	0958	42393	4530	38.4
P9.89	BACnet Device ID L	0~65535	0959	42394	4531	10
P9.90	BACnet Device ID H	0~63	095A	42395	4532	0
P9.91	BACnet Max Address	0~127	095B	42396	4533	127
P9.92	BACnet Password	0~65535	095C	42397	4534	0

GS4 BACnet Object and Property

In GS4, BACnet supports three object types: Device, AnalogValue (AV), and BinaryValue (BV), as shown in the following list.

GS4 Supported BACnet Objects and Properties List				
Property ID		***Object Type***		
		Device	***Analog Value***	***Binary Value***
#4	ACTIVE TEXT			V
#11	APDU_TIMEOUT	V		
#12	APPLICATION_SOFTWARE_VERSION	V		
#28	DESCRIPTION	V	V	V
#30	DEVICE ADDRESS BINDING	V	V	
#36	EVENT STATE		V	V
#44	FIRMWARE_REVISION	V		
#46	INACTIVE TEXT			V
#62	MAX_APDU_LENGTH_ACCEPTED	V		
#63	MAX_INFO_FRAMES	V		
#64	MAX_MASTER	V		
#70	MODEL_NAME	V		
#73	NUMBER_OF_APDU_RETRIES	V		
#75	OBJECT_IDENTIFIER	V*	V	V
#76	OBJECT_LIST	V		
#77	OBJECT_NAME	V*	V	V
#79	OBJECT_TYPE	V	V	V
#81	OUT OF SERVICE		V	V
#85	PRESENT VALUE		V**	V**
#87	PRIORITY ARRAY		V***	V***
#96	PROTOCOL_OBJECT_TYPES_SUPPORTED	V		
#97	PROTOCOL_SERVICES_SUPPORTED	V		
#98	PROTOCOL_VERSION	V		
#104	RELINQUISH DEFAULT		V***	V***
#107	SEGMENTATION_SUPPORTED	V		
#111	STATUS FLAGS		V	V
#112	SYSTEM_STATUS	V		
#117	UNITS		V	
#120	VENDOR_IDENTIFIER	V		
#121	VENDOR_NAME	V		
#139	PROTOCOL_REVISION	V		
#155	DATABASE_REVISION	V		
** The Object_ID and Object_Name Properties of Device are writeable.*				
*** The Present_Value Property of some AV and BV objects is writeable.*				
**** Only Writeable objects support Priority_Array and Relinquish_Default.*				

AV objects have writeable and read-only cases.

- *Writeable case: We can use Write_Service to access the Present_Value property of writeable AV objects. Thus, the writeable AV objects are linking to the Control_Word and Pr_Word in GS4.*
- *Read only case: We can use Read_Service to access the Present_Value property of read-only AV objects. Thus, these read-only AV objects are linking to the Status_Word in GS4.*

BV objects also have writeable and read-only cases.

- *Writeable case: We can use Write_Service to access the Present_Value property of writeable BV objects. Thus, the writeable BV objects are linking to the Control_Bit in GS4.*
- *Read-only case: We can use Read_Service to access the Present_Value property of read-only BV objects. Thus, these read-only BV objects are linking to the Status_Bit in GS4.*

Writeable Analog Value Object

In GS4, we have AV_000–AV_026 supporting writeable Present_Value property. For these AV_ Objects, we also can use (Multi)Read_Service to access Priority_Array and Relinquish_Default properties.

Analog Value Objects				
Object Number	***R/W***	***Object Name***	***Object Description***	***Unit***
AV 000	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 001	RW	FreqRefValue	Frequency Reference Value	UNITS_HERTZ
AV 002	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 003	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 004	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 005	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 006	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 007	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 008	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 009	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 010	RW	Reserved	Reserved	UNITS_NO_UNITS
AV 011	RW	(P9.09 map set)	AV011 will modify the data that is mapped to P9.09	Depends
AV 012	RW	(P9.10 map set)	AV012 will modify the data that is mapped to P9.10	Depends
AV 013	RW	(P9.11 map set)	AV013 will modify the data that is mapped to P9.11	Depends
AV 014	RW	(P9.12 map set)	AV014 will modify the data that is mapped to P9.12	Depends
AV 015	RW	(P9.13 map set)	AV015 will modify the data that is mapped to P9.13	Depends
AV 016	RW	(P9.14 map set)	AV016 will modify the data that is mapped to P9.14	Depends
AV 017	RW	(P9.15 map set)	AV017 will modify the data that is mapped to P9.15	Depends
AV 018	RW	(P9.16 map set)	AV018 will modify the data that is mapped to P9.16	Depends
AV 019	RW	(P9.17 map set)	AV019 will modify the data that is mapped to P9.17	Depends
AV 020	RW	(P9.18 map set)	AV020 will modify the data that is mapped to P9.18	Depends
AV 021	RW	(P9.19 map set)	AV021 will modify the data that is mapped to P9.19	Depends
AV 022	RW	(P9.20 map set)	AV022 will modify the data that is mapped to P9.20	Depends
AV 023	RW	(P9.21 map set)	AV023 will modify the data that is mapped to P9.21	Depends
AV 024	RW	(P9.22 map set)	AV024 will modify the data that is mapped to P9.22	Depends
AV 025	RW	(P9.23 map set)	AV025 will modify the data that is mapped to P9.23	Depends
AV 026	RW	(P9.24 map set)	AV026 will modify the data that is mapped to P9.24	Depends

Status (Read-only) Analog Value Object

In GS4, we have AV_027–AV_068 with read-only Present_Value property. For these AV_Objects, we do NOT have Priority_Array and Relinquish_Default properties.

Status Analog Value Objects				
Object Number	***R/W***	***Object Name***	***Object Description***	***Unit***
AV 027	R	Reserved	Reserved	UNITS_NO_UNITS
AV 028	R	Reserved	Reserved	UNITS_NO_UNITS
AV 029	R	Reserved	Reserved	UNITS_NO_UNITS
AV 030	R	Reserved	Reserved	UNITS_NO_UNITS
AV 031	R	Output frequency	Display output frequency (Hz)	UNITS_HERTZ
AV 032	R	Reserved	Reserved	UNITS_NO_UNITS
AV 033	R	Reserved	Reserved	UNITS_NO_UNITS
AV 034	R	Reserved	Reserved	UNITS_NO_UNITS
AV 035	R	Output torque (%)	Display output torque (%)	UNITS_PERCENT
AV 036	R	Reserved	Reserved	UNITS_NO_UNITS
AV 037	R	Reserved	Reserved	UNITS_NO_UNITS
AV 038	R	Reserved	Reserved	UNITS_NO_UNITS
AV 039	R	Status word	Display status word,made from BV16–BV31	UNITS_NO_UNITS
AV 040	R	Reserved	Reserved	UNITS_NO_UNITS
AV 041	R	Driver type code	Driver type code	UNITS_NO_UNITS
AV 042	R	Warn code	Warn code	UNITS_NO_UNITS
AV 043	R	Error code	Error code	UNITS_NO_UNITS
AV 044	R	Output current	Display output current (Amp)	UNITS_AMPERES
AV 045	R	DC-bus voltage	Display DC-BUS voltage (Volt)	UNITS_VOLTS
AV 046	R	Output Voltage	Display output voltage of U, V, W (Volt)	UNITS_VOLTS
AV 047	R	Count Value	Display counter value of TRG terminal	UNITS_NO_UNITS
AV 048	R	Power Angle	Display output power angle of U, V, W	UNITS_POWER_FACTOR
AV 049	R	Output Power	Display actual output power of U, V, W (kW)	UNITS_KILOWATTS
AV 050	R	IGBT temperature	Display the IGBT temperature	UNITS_DEGREES_CELSIUS
AV 051	R	Temperature of driver	Display the temperature of capacitance	UNITS_DEGREES_CELSIUS
AV 052	R	Real carry frequency	Display real carrier frequency of the drive(KHz)	UNITS_HERTZ
AV 053	R	PID feedback value	Display PID feedback value (%)	UNITS_PERCENT
AV 054	R	Overload rate	Display overload condition (%)	UNITS_PERCENT
AV 055	R	Ground fail detect level	Display GND fail detect level (%)	UNITS_PERCENT
AV 056	R	DC bus ripple	Display DCbus voltage ripples (Volt)	UNITS_VOLTS
AV 057	R	Fan Speed	Fan speed of the drive (%)	UNITS_PERCENT
AV 058	R	Output speed (rpm)	Output speed (rpm)	UNITS_REVOLUTIONS_PER_MINUTE
AV 059	R	KW per Hour	KW per Hour	UNITS_KILOWATTS
AV 060	R	Multi-speed switch	Real multi-speed switch	UNITS_NO_UNITS
AV 061	R	AVI input value	0–10V corresponds to 0–100%	UNITS_PERCENT
AV 062	R	ACI input value	4–20mA/0–10V corresponds to 0–100%	UNITS_PERCENT
AV 063	R	AUI input value	-10V–10V corresponds to -100–100%	UNITS_PERCENT
AV 064	R	Digital input status	Refer to P2-12	UNITS_NO_UNITS
AV 065	R	Digital output status	Refer to P2-18	UNITS_NO_UNITS
AV 066	R	CPU pin status of DI	Corresponding CPU pin status of digital input	UNITS_NO_UNITS
AV 067	R	CPU pin status of DO	Corresponding CPU pin status of digital output	UNITS_NO_UNITS
AV 068	R	PLC D1043 value	PLC D1043 value	UNITS_NO_UNITS

Writeable Binary Value Object

In GS4, we have BV_000–BV_015 supporting writeable Present_Value property. For these BV_ Objects, we also can use (Multi)Read_Service to access Priority_Array and Relinquish_Default properties.

Writeable Binary Value Objects			
Object Number	***R/W***	***Object Name***	***Object Description***
BV 000	RW	ACTIVE CMD	(0)FreqCmd=0; (1)FreqCmd=FreqRefValue
BV 001	RW	FWD/REV CMD	(0)Forward; (1)Reverse
BV 002	RW	Reserved	Reserved
BV 003	RW	HALT CMD	(0)None; (1)RampDown to 0Hz
BV 004	RW	LOCK CMD	(0)None; (1)OutputFreq stays at current freqency
BV 005	RW	Reserved	Reserved
BV 006	RW	QSTOP CMD	(0)None; (1)Force driver quick stop
BV 007	RW	ServoPower CMD	(0)PowerOff(free run to stop); (1)PowerOn
BV 008	RW	Reserved	Reserved
BV 009	RW	Reserved	Reserved
BV 010	RW	Reserved	Reserved
BV 011	RW	Reserved	Reserved
BV 012	RW	Reserved	Reserved
BV 013	RW	Reserved	Reserved
BV 014	RW	Reserved	Reserved
BV 015	RW	RESET	RESET:(0)Do nothing;(1)Reset fault

Status (Read-only) Binary Value Object

In GS4, we have BV_016–BV_031 with read-only Present_Value property. For these BV_Objects, we do NOT have Priority_Array and Relinquish_Default properties.

Status Binary Value Objects			
Object Number	***R/W***	***Object Name***	***Object Description***
BV 016	R	ARRIVE STATE	(0)Not yet; (1)Arrive (OutputFreq=FreqCmd)
BV 017	R	FWD/REV STATE	(0)Forward; (1)Reverse
BV 018	R	WARN STATE	(0)No Warn; (1)Occur Warn
BV 019	R	ERROR STATE	(0)No Error; (1)Occur Error
BV 020	R	Reserved	Reserved
BV 021	R	Reserved	Reserved
BV 022	R	QSTOP STATE	(0)No QSTOP; (1)Occur QSTOP
BV 023	R	ServoPower STATE	(0)PowerOff(free run to stop); (1)PowerOn
BV 024	R	Reserved	Reserved
BV 025	R	Reserved	Reserved
BV 026	R	Reserved	Reserved
BV 027	R	Reserved	Reserved
BV 028	R	Reserved	Reserved
BV 029	R	Reserved	Reserved
BV 030	R	Reserved	Reserved
BV 031	R	Reserved	Reserved

Steps to Setup the GS4 Parameters for BACnet

Related to BACnet function in GS4, we have to configure two parts of the parameters.

- *Part1. Setup parameter group 9 related to Communication.*
- *Part2. Setup parameter groups 3 and 4 related to Digital and Analog I/O.*

Part1. Parameter Group9, Communication

1) Set P9.86 =1, BACnet is enabled, then the COM1_Port will be accessed by BACnet. When this is set, the COM1_Port communication format will be changed to RTU 8N1.
(Note: The HW Pins of COM1_Port are shared by RJ45 and RS-485. When BACnet is enabled, BACnet will access the COM1_Port, that also means we can NOT have Modbus, PLC connections, Gsoft2, or GSLogic connected by COM1_Port.)
2) Set P9.87, Default =10, BACnet's MS/TP station number 0–127.
3) Set P9.88, Default =38400, BACnet communication baud rate, 9600, 19200, 38400, or 76800bps.
4) Set P9.89 and P9.90, The default setting of Device Object_Identifier is 0x0010.
(P9.89 =10, P9.90 =00). Device Object_Identifier is the combination of P9.89 and P9.90, thus the setting range can be 0–4194303.)
For example, P9.90 =12(0Ch) and P9.89 =3456(0D80h), then the device Identifier's value =12*65536+3456 =789888(0C0D80h).
5) Set P9.91, Default =127, the highest allowable address for master nodes on the same MS/TP network. GS4 uses this setting to establish the Max search range.
6) Set P9.92, setup the BACnet password. If setup is successful, the keypad will display 8888.

Part2. Parameter Group 3 and 4, Digital and Analog I/O Parameters.

1) Set P4.00 =1 (RS-485). That means the source of the Frequency command is from RS-485 Interface (accessed by BACnet).
2) Set P3.00 = 3 or 4. That means the source of the Operation command is from RS-485 Interface (accessed by BACnet).
   - Selecting 3 keeps the Stop button on the keypad active (preferred setting).
   - Selecting 4 disables the keypad's Stop button.

Example:

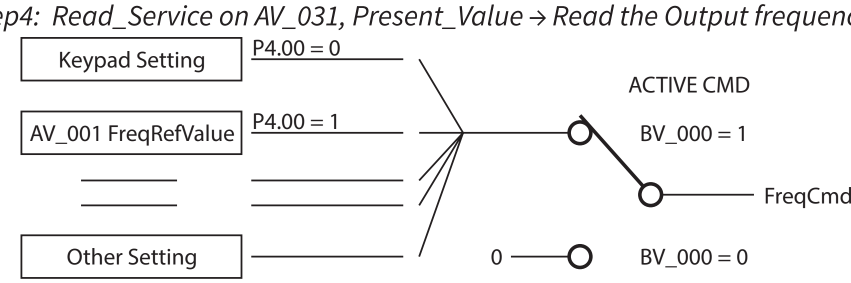
After setting up the two parts of the parameters, we can enable the BACnet function in GS4. Then, we can access some BACnet objects to make the GS4 Run or Stop.

Step1: Write_Service on AV_001, Present_Value =60 → Setup Frequency Reference Value.

Step2: Write_Service on BV_007, Present_Value =Active → Setup Drive PowerOn.

Step3: Write_Service on BV_000, Present_Value =Active → Setup Active CMD.

Step4: Read_Service on AV_031, Present_Value → Read the Output frequency.



As shown in the diagram above, the GS4 can get its Frequency Command from a variety of sources. A typical configuration is to set P4.00 REMOTE Frequency Source = 1 (RS-485/BACnet), and to set P4.01 LOCAL Frequency Source = 0 (Keypad). This way, when the REMOTE button is pressed on the drive's keypad, the drive will be commanded by BACnet. If you experience network problems (or need to spin the motor during commissioning), you can press the LOCAL button on the keypad and control the drive from the keypad.

(See parameters P3.00, P3.01, P4.00, and P4.01 for more details.)

BACnet Protocol Implementation Conformance Statement

Date: July 24, 2014

Vendor Name: AutomationDirect

Product Name: GS4

Product Model Number: GS4

Applications Software Version: Ver 01.04- 201406 **Firmware Revision**: Ver 01.04 **BACnet Protocol Revision**: 7

Product Description:

ADC GS4 is a Variable Frequency AC motor Drive with BACnet embedded.

In GS4, the BACnet connection is by MS/TP, RS-485-based. GS4 provides a BACnet communication function that permits it as a server and supports BIBBs defined by the BACnet B-ASC.

GS4 BACnet provides the capability to control and monitor the GS4 machine.

BACnet Standardized Device Profile (Annex L):

❒ BACnet Operator Workstation (B-OWS)

❒ BACnet Building Controller (B-BC)

❒ BACnet Advanced Application Controller (B-AAC)

☑ BACnet Application Specific Controller (B-ASC)

❒ BACnet Smart Sensor (B-SS)

❒ BACnet Smart Actuator (B-SA)

List all BACnet Interoperability Building Blocks Supported (Annex K):

Data Sharing BIBBs

Data Sharing-ReadProperty-B (DS-RP-B)

Data Sharing-WriteProperty-B (DS-WP-B)

Data Sharing-ReadPropertyMultiple-B (DS-RPM-B)

Device and Network Management BIBBs

Device Management-Dynamic Device Binding-B (DM-DDB-B)

Device Management-Dynamic Object Binding-B (DM-DOB-B)

Device Management-DeviceCommunicationControl-B (DM-DCC-B)

Segmentation Capability:

❒ Segmented requests supported Window Size ___________

❒ Segmented responses supported Window Size ___________

Standard Object Types Supported:

Analog Value

Binary Value

Device

Object instantiation is static. Refer to table at end of this document for object details.

Data Link Layer Options:

☐ BACnet IP, (Annex J)

☐ BACnet IP, (Annex J), Foreign Device

☐ ISO 8802-3, Ethernet (Clause 7)

☐ ANSI/ATA 878.1, 2.5 Mb. ARCNET (Clause 8)

☐ ANSI/ATA 878.1, RS-485 ARCNET (Clause 8), baud rate(s) ___________

☑ MS/TP master (Clause 9), baud rate(s): 9600, 19200, 38400, 76800

☐ MS/TP slave (Clause 9), baud rate(s): ___________

☐ Point-To-Point, EIA 232 (Clause 10), baud rate(s): ___________

☐ Point-To-Point, modem, (Clause 10), baud rate(s): ___________

☐ LonTalk, (Clause 11), medium: ___________

☐ Other: ___________

Device Address Binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) ☐ Yes ☑ No

Networking Options:

☐ Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.

☐ Annex H, BACnet Tunneling Router over IP

☐ BACnet/IP Broadcast Management Device (BBMD)

Does the BBMD support registrations by Foreign Devices? ☐ Yes ☐ No

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

☑ ANSI X3.4	☐ IBM™/Microsoft™ DBCS	☐ ISO 8859-1
☐ ISO 10646 (UCS-2)	☐ ISO 10646 (UCS-4)	☐ JIS C 6226

If this product is a communication gateway, describe the types of non-BACnet equipment/ networks(s) that the gateway supports:

____

____

____

The Properties of Objects

Property ID		Object Type		
		Device	Analog Value	Binary Value
#4	ACTIVE TEXT			V
#11	APDU_TIMEOUT	V		
#12	APPLICATION_SOFTWARE_VERSION	V		
#28	DESCRIPTION	V	V	V
#30	DEVICE ADDRESS BINDING	V	V	
#36	EVENT STATE		V	V
#44	FIRMWARE_REVISION	V		
#46	INACTIVE TEXT			V
#62	MAX_APDU_LENGTH_ACCEPTED	V		
#63	MAX_INFO_FRAMES	V		
#64	MAX_MASTER	V		
#70	MODEL_NAME	V		
#73	NUMBER_OF_APDU_RETRIES	V		
#75	OBJECT_IDENTIFIER	V *1	V	V
#76	OBJECT_LIST	V		
#77	OBJECT_NAME	V *1	V	V
#79	OBJECT_TYPE	V	V	V
#81	OUT OF SERVICE		V	V
#85	PRESENT VALUE		V *2	V *2
#87	PRIORITY ARRAY		V *3	V *3
#96	PROTOCOL_OBJECT_TYPES_SUPPORTED	V		
#97	PROTOCOL_SERVICES_SUPPORTED	V		
#98	PROTOCOL_VERSION	V		
#104	RELINQUISH DEFAULT		V *3	V *3
#107	SEGMENTATION_SUPPORTED	V		
#111	STATUS FLAGS		V	V
#112	SYSTEM_STATUS	V		
#117	UNITS		V	
#120	VENDOR_IDENTIFIER	V		
#121	VENDOR_NAME	V		
#139	PROTOCOL_REVISION	V		
#155	DATABASE_REVISION	V		

*1. The Object_ID and Object_Name Properties of Device are writeable.
*2. The Present_Value Property of some AV and BV objects are commandable.
*3. Only Commandable objects support Priority_Array and Relinquish_Default.

MAINTENANCE AND TROUBLESHOOTING

CHAPTER

6

TABLE OF CONTENTS

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 GS4 drive in its optimal condition, and to ensure a long life. We recommend that a qualified technician perform a regular inspection of the GS4 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 are/may be 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 GS4 drive and make sure the voltage is within the operating range. Check the voltage with a voltmeter.*

Annual Inspection

Check the following items once annually.

1) *Check the torque of the GS4 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 GS4 drive! Wait at least two 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 GS4 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.

LOCAL
① Warning
② CE1
③ Comm. Error 1

① Display error signal type
② Abbreviated error code
The code is displayed as shown on GS4-KPD
③ Display error description

Warning Codes		
Display on GS4-KPD Keypad	***Warning Code in 2108h Active Warning***	***Descriptions***
n/a	0	No error
LOCAL Warning CE1 Comm. Error 1	1	Modbus function code error This error is generated if any command code other than 0x03, 0x06, 0x08 or 0x10 is seen.
LOCAL Warning CE2 Comm. Error 2	2	Address of Modbus data error
LOCAL Warning CE3 Comm. Error 3	3	Modbus data error
LOCAL Warning CE4 Comm. Error 4	4	Modbus communication error
LOCAL Warning CE10 Comm. Error 10	5	Modbus transmission time-out
LOCAL Warning CP10 Keypad Time Out	6	Keypad transmission time-out

(continued next page)

Warning Codes (continued)		
Display on GS4-KPD Keypad	***Warning Code in 2108h Active Warning***	***Descriptions***
LOCAL Warning SE1 Save Error 1	7	**Keypad COPY error 1** Keypad transfer (check) error, including communication delays, communication error (keypad received error FF86) and parameter value error. P9.06 must be set to 1 for a keypad to drive copy.
LOCAL Warning SE2 Save Error 2	8	**Keypad COPY error 2** Keypad transfer (check) done, parameter write error
LOCAL Warning oH1 Over heat 1 warn	9	IGBT over-heating warning
LOCAL Warning oH2 Over heat 2 warn	10	Capacitor over-heating warning
LOCAL Warning PID PID FBK Error	11	PID feedback error
LOCAL Warning ANL Analog Loss	12	AIx 4~20mA Signal Loss AI1 or AI2 signal drops below 4mA when P4.05 or P4.06 are set to 1 (4~20mA). Enabled with P4.63 and P4.64 (AIx 4~20mA Loss Detection).
LOCAL Warning uC Under Current	13	Low current
LOCAL Warning AUE Auto-tune Error	14	Auto tuning error
n/a	15~18	reserved

(continued next page)

Warning Codes (continued)		
Display on GS4-KPD Keypad	**Warning Code in 2108h Active Warning**	**Descriptions**
LOCAL Warning PHL Phase Loss Warn	19	Input phase Loss
LOCAL Warning ot1 Over Torque 1	20	Over torque 1
LOCAL Warning ot2 Over Torque 2	21	Over torque 2
LOCAL Warning oH3 Motor Over Heat	22	Motor over-heating
LOCAL Warning c.c. cc Warn	23	Current clamp warning
LOCAL Warning oSL Over Slip Warn	24	Over Slip
LOCAL Warning tUn Auto tuning	25	Auto tuning processing
n/a	26~27	reserved
LOCAL Warning OPHL Output PHL Warn	28	Output phase loss
n/a	29	reserved

(continued next page)

Warning Codes (continued)		
Display on GS4-KPD Keypad	***Warning Code in 2108h Active Warning***	***Descriptions***
LOCAL Warning SE3 CopyEn/Model Err	30	**Keypad COPY error 3** P9.06 is not set to 1 before the copy function is started. If COPYing from Keypad to VFD (AC drive), make sure P9.06 Parameter Copy is set to 1 before copying.
n/a	31~46	reserved
LOCAL Warning PLrA RTC Adjust	47	The Real Time Clock has been adjusted.
n/a	48	reserved
LOCAL Warning PLrt Keypad RTC TOut	49	Keypad Real Time Clock timout Turn power on and off after making sure that the keypad is securely connected.
LOCAL Warning PLod PLC Out of Range	50	Drive PLC requesting register address or block of addresses that is out of range or does not exist.
LOCAL Warning PLSv Save mem defect	51	Save error of PLC download
LOCAL Warning PLdA Data defect	52	Data error during PLC operation
LOCAL Warning PLFn Function defect	53	Function code of PLC download error (occurs on PLC register overflow. Also occurs if the PLC is set to RUN, and there is no program installed)
LOCAL Warning PLor Buf overflow	54	PLC register overflow
(continued next page)		

Warning Codes (continued)		
Display on GS4-KPD Keypad	***Warning Code in 2108h Active Warning***	***Descriptions***
LOCAL Warning PLFF Function defect	55	Function code of PLC operation error
LOCAL Warning PLSn Check sum error	56	PLC checksum error
LOCAL Warning PLEd No end command	57	PLC end command is missing
n/a	58	reserved
LOCAL Warning PLdF Download fail	59	PLC download fail
LOCAL Warning PLSF Scan time fail	60	PLC scan time exceed
n/a	61~69	reserved
LOCAL Warning ECid ExCom ID failed	70	Duplicate MAC ID error Node address setting error
LOCAL Warning ECLv ExCom pwr loss	71	Low voltage of communication card
LOCAL Warning ECtt ExCom Test Mode	72	Communication card in test mode

(continued next page)

Warning Codes (continued)		
Display on GS4-KPD Keypad	***Warning Code in 2108h Active Warning***	***Descriptions***
LOCAL Warning ECbF ExCom Bus off	73	ExCom Bus off
LOCAL Warning ECnP ExCom No power	74	ExCom No power
LOCAL Warning ECFF ExCom Facty def	75	Factory default setting error
LOCAL Warning ECif ExCom Inner err	76	Serious internal error
LOCAL Warning ECio ExCom IONet brk	77	IO connection break
LOCAL Warning ECPP ExCom Pr data	78	ExCom Pr data
LOCAL Warning ECPi ExCom Conf data	79	ExCom Conf data
LOCAL Warning ECEF ExCom Link fail	80	Ethernet Link fail. If a communications card is installed but not connected to an active network, this warning will appear. Please connect to valid network link. Reset card to default and/or re-flash comm card firmware if problem persists.

(continued next page)

Warning Codes (continued)		
Display on GS4-KPD Keypad	***Warning Code in 2108h Active Warning***	***Descriptions***
LOCAL Warning ECto ExCom Inr T-out	81	Communication time-out for communication card and drive
LOCAL Warning ECCS ExCom Inr CRC	82	Check sum error for communication card and drive
LOCAL Warning ECrF ExCom Rtn def	83	Communication card returns to default setting
LOCAL Warning ECo0 ExCom MTCP over	84	Modbus TCP exceeded maximum communication value
LOCAL Warning ECo1 ExCom EIP over	85	EtherNet/IP exceeded maximum communication value
LOCAL Warning ECiP ExCom IP fail	86	IP fail
n/a	87	reserved
LOCAL Warning ECbY ExCom Busy	88	Communication card busy
LOCAL Warning ECCb ExCom Card brk	89	Loss of communication between Communication Card and GS4 drive. To recover: Power down the drive and remove all communication cables. Remove and re-seat the comm card. Do not reconnect any comm cables. Power up the drive. If the ECCb fault still exists, replace the comm card.
(continued next page)		

Warning Codes (continued)		
Display on GS4-KPD Keypad	***Warning Code in 2108h Active Warning***	***Descriptions***
LOCAL Warning WdCPLP Copy PLC Pass	90	Copy PLC password error
LOCAL Warning RdCPL0 Copy PLC Mode	91	Copy PLC read mode error
LOCAL Warning WtCPL1 Copy PLC Mode	92	Copy PLC write mode error
LOCAL Warning CPLv Copy PLC Version	93	Copy PLC version error
LOCAL Warning CPLS Copy PLC Size	94	Copy PLC capacity size error
LOCAL Warning CPLF Copy PLC Func	95	Copy PLC: Disable PLC functions to copy *Warning Code 95 could also show up as ERR7 if the PLC is in STOP mode. Disable the PLC before copying.*
LOCAL Warning CPLt Copy PLC TimeOut	96	Copy PLC time-out Resettable only by cycling power to the drive
LOCAL Warning CD10 Card TimeOut	97	Ethernet communication has not been received from the external controller (within the Ethernet Timeout window).

Fault Codes

The GS4 drive has a comprehensive fault diagnostic system that include a variety of fault messages. When a fault is detected, the GS4 drive will shut down in order to protect internal components. The following faults are displayed as shown on the GS4 digital keypad display.

	Display	
	LOCAL	
①	Fault	① Display error signal type
②	ocA	② Abbreviate error code The code is displayed as shown on GS4-KPD
③	OC at Accel	③ Display error description

Gaps in the fault ID numbers below are set aside as "reserved" faults for possible future use. Should your GS4 drive repeatedly display a reserved fault, please note the fault ID number and contact AutomationDirect technical support.

Fault Codes				
Display on GS4-KPD Kepad	***Fault Code in Status Monitor 1***	***Fault Description***	***Corrective Action***	***Can be Bypassed in Fire Mode (Yes / no)***
n/a	0	no error	none needed	n/a
LOCAL Fault ocA OC at Accel	1	Over-current during acceleration (Output current exceeds triple rated current during acceleration.)	1) Short circuit at motor output: Check for possible poor insulation at the output. 2) Acceleration Time too short: Increase the Acceleration Time. 3) GS4 drive output power is too small: Replace the GS4 drive with the next higher power model.	Yes
LOCAL Fault ocd OC at decel	2	Over-current during deceleration (Output current exceeds triple rated current during deceleration.)	1) Short circuit at motor output: Check for possible poor insulation at the output. 2) Deceleration Time too short: Increase the Deceleration Time. 3) GS4 drive output power is too small: Replace the GS4 drive with the next higher power model.	Yes
LOCAL Fault ocn OC at Speed	3	Over-current during steady state operation (Output current exceeds triple rated current during constant speed.)	1) Short circuit at motor output: Check for possible poor insulation at the output. 2) Sudden increase in motor loading: Check for possible motor stall. 3) GS4 drive output power is too small: Replace the GS4 drive with the next higher power model.	Yes
LOCAL Fault GFF Ground Fault	4	Ground fault	When (one of) the output terminal(s) is grounded, short-circuit current is more than 50% of the GS4 drive rated current, the GS4 drive power module may be damaged. NOTE: The short-circuit protection is provided for AC motor drive protection; not for protecting the user. 1) Check the wiring connections between the GS4 drive and motor for possible short circuits, also to ground. 2) Check whether the IGBT power module is damaged. 3) Check for possible poor insulation at the output.	Yes
(continued next page)				

Fault Name	***Fault Code in Status Monitor 1***	***Fault Descriptions***	***Corrective Actions***	***Can be Bypassed in Fire Mode (Yes / no)***
LOCAL Fault occ IGBT Short Ckt	5	Short-circuit is detected between upper bridge and lower bridge of the IGBT module	Replace the drive. If still under warranty, please contact AutomationDirect Returns Department.	Yes
LOCAL Fault ocS OC at Stop	6	Hardware failure in current detection	Replace the drive. If still under warranty, please contact AutomationDirect Returns Department.	Yes
LOCAL Fault ovA OV at Accel	7	DC BUS over-voltage during acceleration (230V: DC 450V; 460V: DC 900V)	1) Check if the input voltage falls within the rated GS4 drive input voltage range. 2) Check for possible voltage transients. 3) May be the result of starting the drive into a spinning load such as a fan, pump or overhauling load. Avoid starting the drive with the motor spinning. DC braking using parameters P1.25 (DC Injection Current Level) and P1.26 (DC Injection Time During Start-up), can help to stop the spinning motor before the drive begins to ramp up the output frequency, thereby eliminating the source of regeneration.	Yes
LOCAL Fault ovd OV at Decel	8	DC BUS over-voltage during deceleration (230V: DC 450V; 460V: DC 900V)	1) Check if the input voltage falls within the rated GS4 drive input voltage range. 2) Check for possible voltage transients. 3) If DC BUS over-voltage due to regenerative voltage, please increase the Deceleration Time or add an optional brake resistor.	Yes
LOCAL Fault ovn OV at Speed	9	DC BUS over-voltage at constant speed (230V: DC 450V; 460V: DC 900V)	1) Check if the input voltage falls within the rated GS4 drive input voltage range. 2) Check for possible voltage transients.	Yes
LOCAL Fault ovS OV at Stop	10	Hardware failure in voltage detection.	1) Check if the input voltage falls within the rated GS4 drive input voltage range. 2) Check for possible voltage transients.	Yes
LOCAL Fault LvA LV at Accel	11	DC BUS voltage is less than P6.35 during acceleration	1) Check if the input voltage is normal. 2) Check for possible sudden load.	no
LOCAL Fault Lvd LV at Decel	12	DC BUS voltage is less than P6.35 during deceleration	1) Check if the input voltage is normal. 2) Check for possible sudden load.	no

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Fault Name	*Fault Code in Status Monitor 1*	*Fault Descriptions*	*Corrective Actions*	*Can be Bypassed in Fire Mode (Yes / no)*
LOCAL Fault Lvn LV at Speed	13	DC BUS voltage is less than P6.35 in constant speed	1) Check if the input voltage is normal. 2) Check for possible sudden load.	no
LOCAL Fault LvS LV at Stop	14	DC BUS voltage is less than P6.35 at stop	1) Check if the input voltage is normal 2) Check for possible sudden load	no
LOCAL Fault OrP Input Phase loss	15	Output Ripple / Phase Loss	Check Power Source Input if all 3 input phases are connected without loose contacts. For models 40hp and above, please check if the fuse for the AC input circuit is blown.	Yes
LOCAL Fault oH1 IGBT Over Heat	16	IGBT overheating IGBT temperature exceeds protection level	1) Ensure that the ambient temperature falls within the specified temperature range. 2) Make sure that the ventilation holes are not obstructed. 3) Remove any foreign objects from the heatsinks and check for possible dirty heat sink fins. 4) Check the fan and clean it. 5) Provide enough spacing for adequate ventilation.	Yes
LOCAL Fault oH2 Cap Over Heat	17	Heatsink overheating Capacitance temperature exceeds cause heatsink overheating.	1) Ensure that the ambient temperature falls within the specified temperature range. 2) Make sure heat sink is not obstructed. Check if the fan is operating 3) Check if there is enough ventilation clearance for the GS4 drive.	Yes
LOCAL Fault tH1o Thermister1 Open	18	IGBT Hardware Error	Internal drive error. Replace the drive. If still under warranty, please contact AutomationDirect Returns Department.	Yes
LOCAL Fault tH2o Thermister2 Open	19	Capacitor Hardware Error	Internal drive error. Replace the drive. If still under warranty, please contact AutomationDirect Returns Department.	Yes
LOCAL Fault PWR Power Reset Off	20	Power Loss (Power Down)	Check for loose input power connections. Restore line power.	no

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Fault Name	***Fault Code in Status Monitor 1***	***Fault Descriptions***	***Corrective Actions***	***Can be Bypassed in Fire Mode (Yes / no)***
LOCAL Fault oL Overload	21	Overload The GS4 drive detects excessive drive output current.	1) Check if the motor is overloaded. 2) Use the next higher HP drive model.	no
LOCAL Fault EoL1 Mtr1 Thermal OL	22	Electronic thermal relay 1 protection	1) Check the setting of electronics thermal relay (P6.01) 2) Use the next higher HP drive model.	no
LOCAL Fault EoL2 Mtr2 Thermal OL	23	Electronic thermal relay 2 protection	1) Check the setting of electronics thermal relay (P6.03) 2) Use the next higher HP drive model.	no
LOCAL Fault oH3 Mtr Overheat-PTC	24	Motor overheating The GS4 drive detecting internal temperature exceeds the setting of P6.40 (PTC level)	1) Make sure that the motor is not obstructed. 2) Ensure that the ambient temperature falls within the specified temperature range. 3) Use the next higher HP drive model.	Yes
n/a	25	reserved	n/a	n/a
LOCAL Fault ot1 Over Torque 1	26	These two fault codes will be displayed when output current exceeds the over-torque detection level (P6.15 or P6.18) and exceeds over-torque detection (P6.16 or P6.19) and it is set to 2 or 4 in P6.14 or P6.17.	1) Check whether the motor is overloaded. 2) Check whether motor rated current setting (P0.01) is suitable 3) Use the next higher HP drive model.	no
LOCAL Fault ot2 Over Torque 2	27			no
LOCAL Fault uC Under Current	28	Low current detection (uC does *not* cause drive to stop if in Fire Mode)	Check P6.52, P6.53, P6.54.	no
n/a	29	reserved	n/a	n/a
LOCAL Fault cF1 EEPROM Write Err	30	Internal EEPROM can not be programmed.	1) Reset to factory settings. 2) Replace the drive. If still under warranty, please contact AutomationDirect Returns Department.	no

(continued next page)

Fault Name	*Fault Code in Status Monitor 1*	*Fault Descriptions*	*Corrective Actions*	*Can be Bypassed in Fire Mode (Yes / no)*
LOCAL Fault cF2 EEPROM Read Err	31	Internal EEPROM can not be read.	1) Reset to factory settings. 2) Replace the drive. If still under warranty, please contact AutomationDirect Returns Department.	no
n/a	32	reserved	n/a	n/a
LOCAL Fault cd1 Amp Err: U Phase	33	U-phase error	Power cycle the drive allowing the capacitor bank to discharge. Should this fault be consistently displayed, the drive is most likely damaged and needs repair or replacement.	no
LOCAL Fault cd2 Amp Err: V Phase	34	V-phase error	Power cycle the drive allowing the capacitor bank to discharge. Should this fault be consistently displayed, the drive is most likely damaged and needs repair or replacement.	no
LOCAL Fault cd3 Amp Err: W Phase	35	W-phase error	Power cycle the drive allowing the capacitor bank to discharge. Should this fault be consistently displayed, the drive is most likely damaged and needs repair or replacement.	no
LOCAL Fault Hd0 CC HW Error	36	CC (current clamp)	Power cycle the drive allowing the capacitor bank to discharge. Should this fault be consistently displayed, the drive is most likely damaged and needs repair or replacement.	no
LOCAL Fault Hd1 OC HW Error	37	OC hardware error	Power cycle the drive allowing the capacitor bank to discharge. Should this fault be consistently displayed, the drive is most likely damaged and needs repair or replacement.	no
LOCAL Fault Hd2 OV HW Error	38	OV hardware error	Power cycle the drive allowing the capacitor bank to discharge. Should this fault be consistently displayed, the drive is most likely damaged and needs repair or replacement.	no
LOCAL Fault Hd3 OCC HW Error	39	OCC hardware error	Power cycle the drive allowing the capacitor bank to discharge. Should this fault be consistently displayed, the drive is most likely damaged and needs repair or replacement.	no

(continued next page)

Fault Name	***Fault Code in Status Monitor 1***	***Fault Descriptions***	***Corrective Actions***	***Can be Bypassed in Fire Mode (Yes / no)***
LOCAL Fault AUE Auto Tuning Err	40	Auto tuning error	1) Check cabling between drive and motor 2) Try again.	no
LOCAL Fault AFE PID Fbk Loss	41	PID loss (ACI)	1) Check the wiring of the PID feedback. 2) Check the PID parameters settings.	no
n/a	42~47	reserved	n/a	n/a
LOCAL Fault ACE Analog Loss Err	48	Analog Signal Loss Error (4~20mA)	1) Check the 4~20mA signal wiring (AI1 or AI2). 2) Check if the analog signal is less than 4mA. *NOTE*: P4.63 or P4.64 must be set to 3 to enable the Analog Loss Fault. This fault can be temporarily bypassed by switching Local/Remote Mode. (The Fault is active only if the drive is actively looking for the analog signal).	no
LOCAL Fault EF External Fault	49	External Fault	1) Input EF (N.O.) on external terminal is closed to GND. Output U, V, W will be turned off. 2) Press Reset after fault has been cleared.	no
LOCAL Fault EF1 Emergency Stop	50	Emergency stop	1) When the multi-function input terminals DI1 to DI6 are set to emergency stop, the GS4 drive stops output U, V, W and the motor coasts to stop. 2 Press RESET after fault has been cleared.	no
LOCAL Fault bb Base Block	51	External Base Block	1) When the external input terminal (B.B) is active, the GS4 drive output will be turned off. 2) Deactivate the external input terminal (B.B) to operate the GS4 drive again.	no
LOCAL Fault Pcod Password Error	52	Password is locked	Keypad will be locked. Power cycle the drive then re-enter the correct password. See P8.06 and P8.07.	no
LOCAL Fault ccod SW Code Lock	53	Software version error	The firmware version is corrupt. Please re-download the firmware.	no

(continued next page)

Fault Name	*Fault Code in Status Monitor 1*	*Fault Descriptions*	*Corrective Actions*	*Can be Bypassed in Fire Mode (Yes / no)*
LOCAL Fault CE1 PC Cmd Error	54	Illegal function code	Check if the function code is correct (function code must be 03, 06, 10, 63).	no
LOCAL Fault CE2 PC Address Error	55	Illegal data address (00H to 254H)	Check if the communication address is correct.	no
LOCAL Fault CE3 PC Data Error	56	Illegal data value	Check if the data value exceeds max/min value.	no
LOCAL Fault CE4 PC Slave Fault	57	Data is written to read-only address	Check to see if the correct communication address is being utilized.	no
LOCAL Fault CE10 PC TimeOut	58	Modbus transmission time-out	For a CE10 Fault to be displayed, the User must first have enabled the communication time out detection (P9.03 is not 3 and P9.05 is not 0). Should the drive not receive a message from the host computer (such as PC, HMI, PLC...) for the time set in P9.05 the drive will trigger the CE10 fault. Corrective action is to restore the communication between the host computer and the drive with messaging set lower/faster than the time set in P9.05.	no
LOCAL Fault CP10 Keypad Timeout	59	Keypad transmission time-out	For a CP10 Fault to be displayed the User must first enable the communication time out detection (P8.13 is not 3 and P8.14 is not 0). Should the drive not receive a message from Keypad for the time set in P8.14, the Drive will trigger the CP10 fault. Corrective action is to restore the communication between Keypad and the drive. Typical use for this parameter is for Remote Keypad use and monitoring of healthy Keypad to Drive communication.	no
LOCAL Fault bF Braking Fault	60	Brake resistor fault	If the fault code is still displayed on the keypad after pressing “RESET” key, please return to the factory.	no

(continued next page)

Fault Name	Fault Code in Status Monitor 1	Fault Descriptions	Corrective Actions	Can be Bypassed in Fire Mode (Yes / no)
LOCAL Fault ydc Y-Delta Connect	61	Y-connection/Δ-connection switch error	1) Check the wiring of the Y-connection/Δ-connection. 2) Check the parameters settings.	no
LOCAL Fault dEb DEB Error	62	When P6.61 is not set to 0 and momentary power is turned off, it will display dEb during accel/decel stop.	1) Set P6.61 to 0. 2) Check if input power is stable.	no
LOCAL Fault oSL Over Slip Error	63	It will be displayed when slip exceeds P2.26 setting and time exceeds P2.27 setting.	1) Check if motor parameter is correct (please decrease the load if overload). 2) Check the settings of P2.26 and P2.27.	no
LOCAL Fault ryF Emag SwitchError	64	Electric valve switch error when executing Soft Start. (This warning is for frames E and higher frame of GS4 drives)	Do not disconnect RST when drive is still operating.	no
n/a	65~71	reserved	n/a	n/a
LOCAL Fault STL1 STO Loss 1	72	STL1	STO1~SCM1 internal hardware detect error. (See Appendix E for corrective action.)	no
LOCAL Fault S1 ES1 E-Stop	73	Emergency stop for external safety	Fault S1 is generated upon a loss of the E-Stop input at ES1. The corrective action is to restore the E-Stop input to the drive at ES1.	no
LOCAL Fault Fire In Fire Mode	74	In Fire mode	Fire fault is due to the multi-function input set as 40 or 41 and that DI is ON. For some installations, particularly exhaust fan operation where smoke is detected and requires evacuation, it is highly desired for the drive to run the fan as long as is needed to exhaust that smoke.	Yes
n/a	75	reserved	n/a	n/a
LOCAL Fault STO STO	76	STO	Safety Torque Off function active. (See appendix E for corrective action.) If unknown STO faults occur, the onboard +24V might be getting shorted (+24V to DCM).	no

(continued next page)

Fault Name	*Fault Code in Status Monitor 1*	*Fault Descriptions*	*Corrective Actions*	*Can be Bypassed in Fire Mode (Yes / no)*
LOCAL Fault STL2 STO Loss 2	77	STL2	STO2~SCM2 internal hardware detect error. (See appendix E for corrective action.)	no
LOCAL Fault STL3 STO Loss 3	78	STL3	STO1~SCM1 and STO2~SCM2 internal hardware detect error. (See appendix E for corrective action.)	no
LOCAL Fault Uoc U Phase Short	79	Phase U short circuit		Yes
LOCAL Fault Voc V Phase Short	80	Phase V short circuit		Yes
LOCAL Fault Woc W Phase Short	81	Phase W short circuit		Yes
LOCAL Fault UPHL U Phase Loss	82	Output phase loss (Phase U)	Check to insure that the motor cable is properly connected to the drive.	Yes
LOCAL Fault VPHL V Phase Loss	83	Output phase loss (Phase V)	Check to insure that the motor cable is properly connected to the drive.	Yes
LOCAL Fault WPHL W Phase Loss	84	Output phase loss (Phase W)	Check to insure that the motor cable is properly connected to the drive.	Yes
n/a	85~89	reserved	n/a	n/a
(continued next page)				

Fault Name	***Fault Code in Status Monitor 1***	***Fault Descriptions***	***Corrective Actions***	***Can be Bypassed in Fire Mode (Yes / no)***
LOCAL Fault FStp PLC Force Stop	90	If the GS4 drive is running in PLC mode, parameter P3.00 is equal to 1, 3 or 5, and Remote Operation is selected; or parameter P3.01 is equal to 1, 3, or 5, and Local operation is selected, the drive can be forced to stop by pressing the STOP key on the keypad.		no
n/a	91~96	reserved	n/a	n/a
LOCAL Fault CD10 Card TimeOut	97	Ethernet communication has not been received from the external controller (within the Ethernet Timeout window).	Initiate Ethernet communications from the master controller again, or Disable checking for Ethernet Timeout in P9.94.	
n/a	98	reserved	n/a	n/a
LOCAL Fault TRAP CPU Command Err	99	CPU trap error	Should a CPU Trap error fault persist, please send the drive back to the factory for evaluation.	no
n/a	100~111	reserved	n/a	n/a

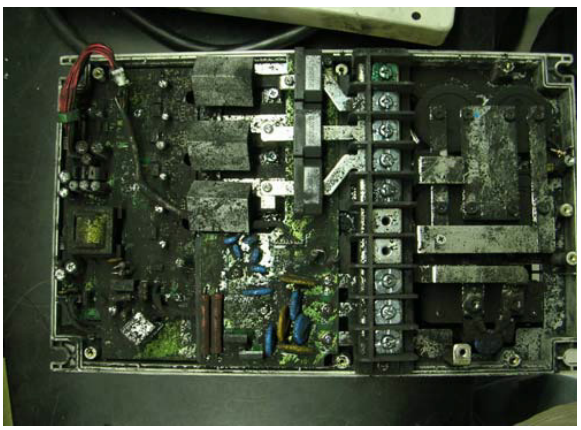
Typical AC Drive Problems and Solutions

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 GS4 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 GS4 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.

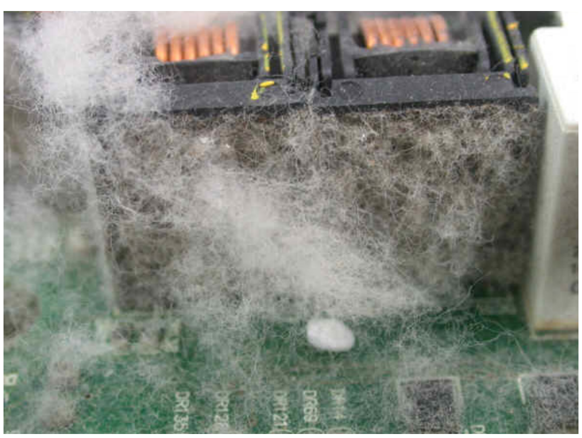


Fiber Dust Problem

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 GS4 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 GS4 drive failure or damage as a result of wet fiber dust adhering to components within the drive.*

Solution:
Install the GS4 drive in a suitable enclosure to protect it from fiber dust. Clean and remove fiber dust regularly to prevent damage to the drive.

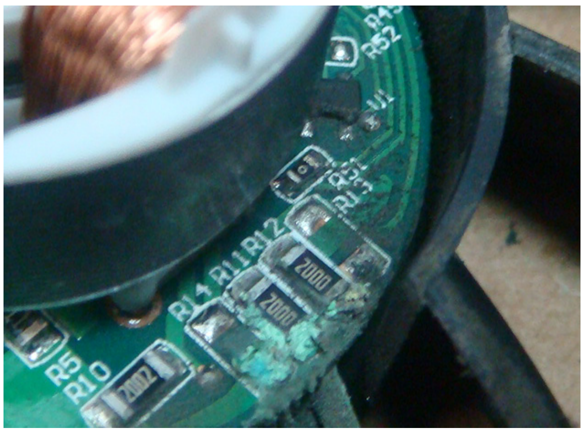


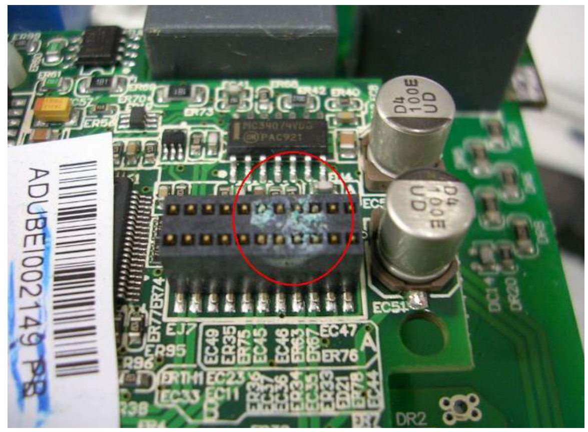
Corrosion Problem

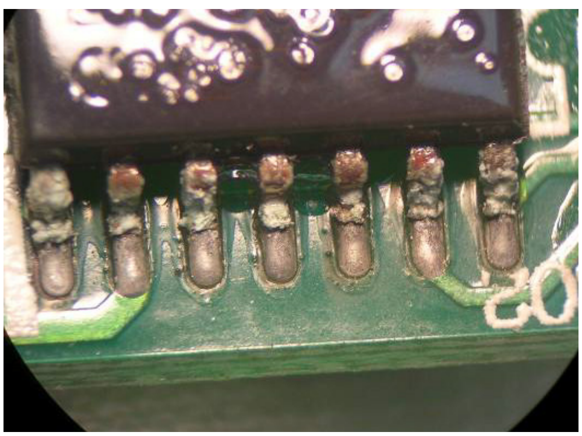
Corrosion problems may occur if any fluids or liquid in vapor form flows into the GS4 drive. Please be aware of the damage that corrosion may cause to your drive.

- *Corrosion of internal components may cause the GS4 drive to malfunction and possibly explode.*

Solution:
Install the GS4 drive in a suitable enclosure to protect it from fluids. Clean the drive regularly to prevent corrosion.





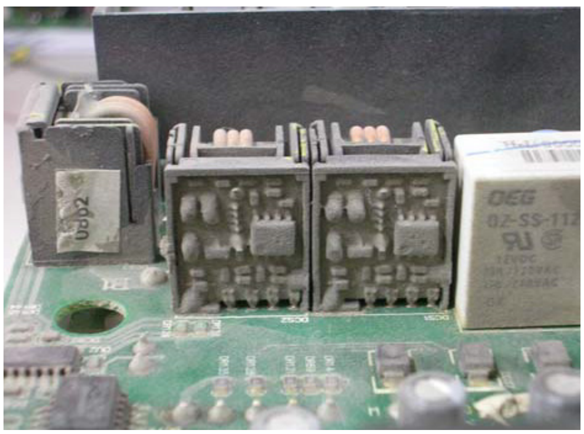


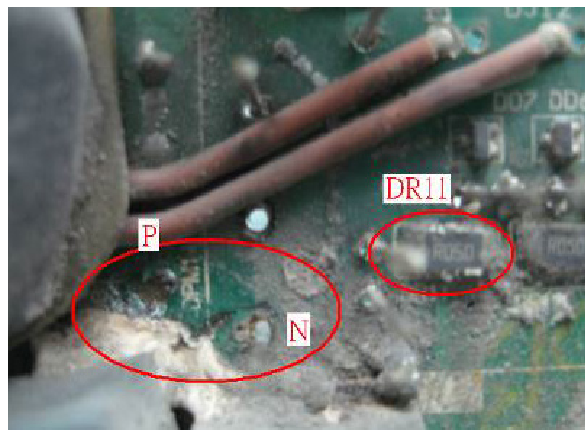
Industrial Dust Problem

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 GS4 drive in a suitable enclosure and protect it from dust. Clean the cabinet and ventilation filter regularly for good ventilation.



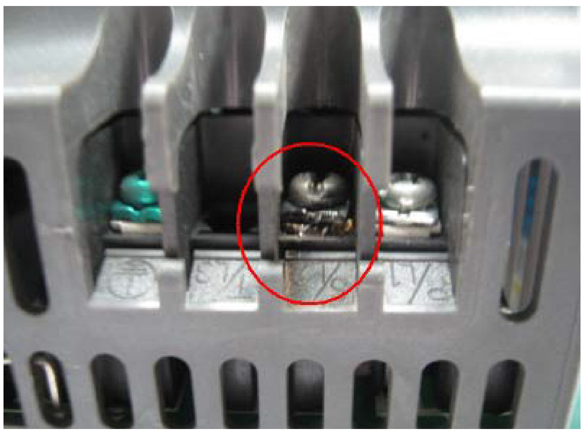


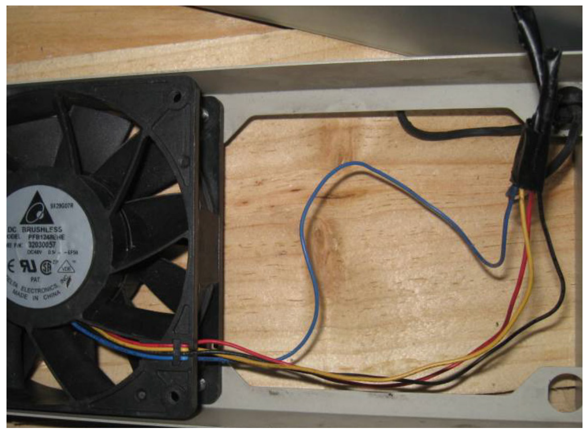
Wiring and Installation Problem

When wiring the GS4 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 GS4 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 GS4 drive have been modified, components on the affected boards may have been damaged.*

Solution:
Inspect all power and control terminal connections in the GS4 drive to ensure adequate wire insertion. Do not attempt to disassemble or repair control boards in the GS4 drive.



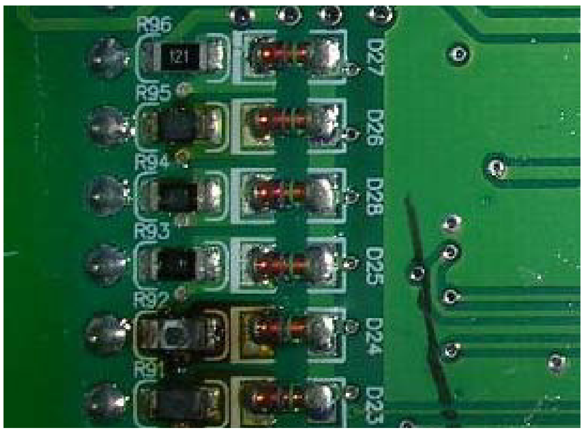


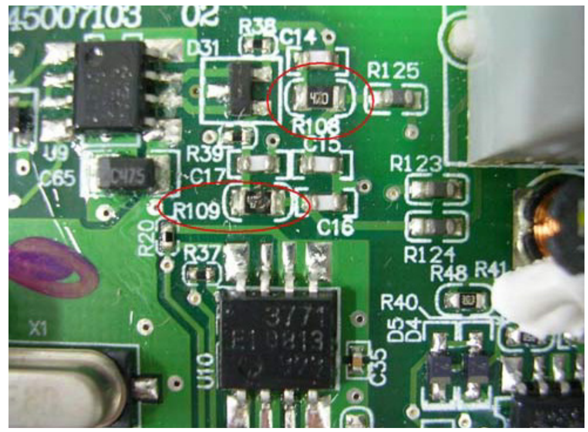
Digital Input/Output Terminal Problems

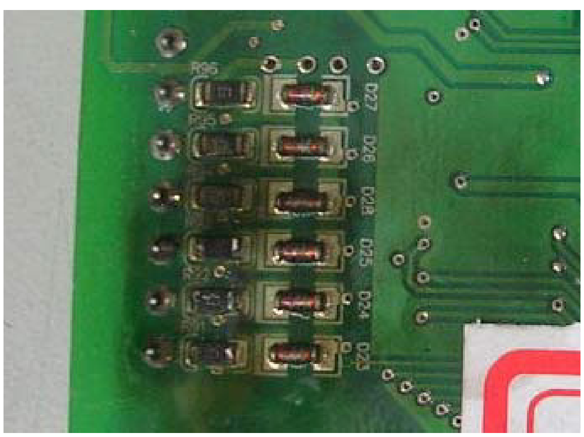
Problems with digital I/O are usually the result of improper termination, or failure to segregate control wiring from power wiring. This may result in errant signals due to induced voltage, capacitive coupling or electrical noise. Incorrect voltage levels applied to the digital I/O terminals can damage 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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GSoft2 – Getting Started

Chapter 7

<u>*Table of Contents*</u>

GS4 Drive Configuration Software

GSoft2 is the configuration software for the Automation Direct GS4 family of drives. It is designed to allow you to connect a personal computer to drives in the GS4 family, 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 from AutomationDirect.com (search for GSoft2).

System Requirements

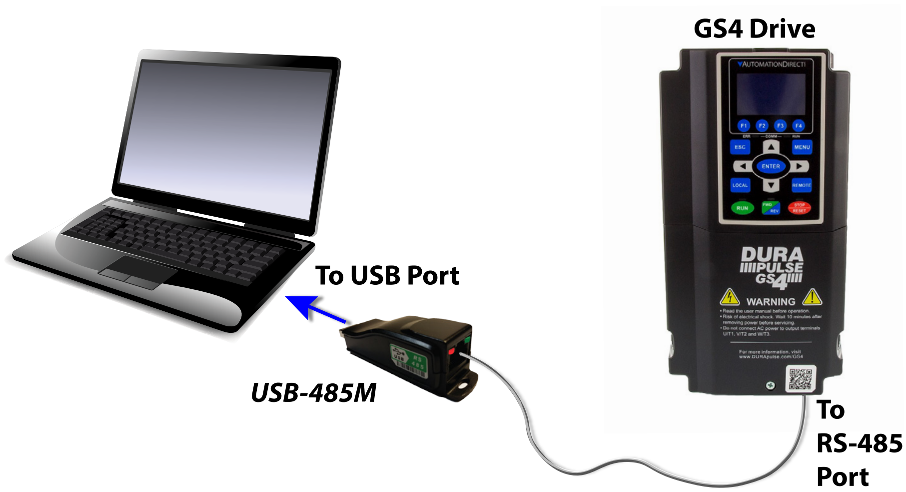
GSoft2 will run on PCs that meet the following requirements:

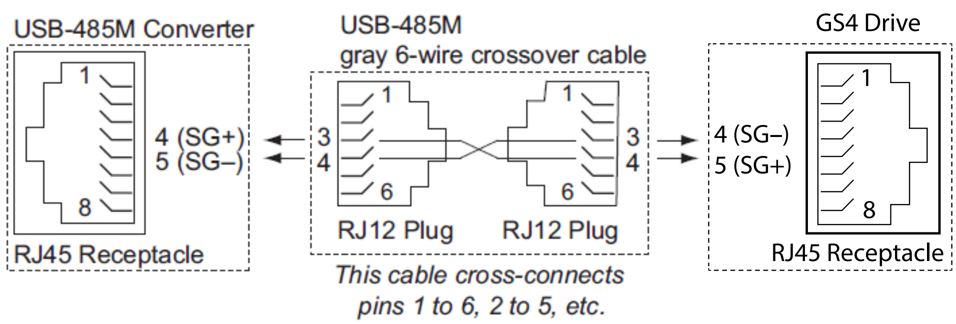
- *Windows OS: 7: 32 & 64 bit, 8: 32 & 64 bit, 8.1: 32 & 64 bit, 10: 64 bit*
- *Edge or Chrome (for HTML help support)*
- *32 Mb of available memory*
- *10 Mb hard drive space*
- *Available USB port (for USB-485M USB-to-RS485 converter)*

Installation Guide

System Requirement Configuration

Verify the GS4 drive RS-485 connection to PC/Laptop computer through one of the GS4 RS485 ports using an RS-485 port connecting cable (RJ45). Alternatively you can link to a PC USB port through a USB-485M (P/N USB-485M) adapter communication converter normally used to link RS485 to a USB supported device (See Chapter 5 for discussion on GS4 drive communications).





Ethernet connectivity for EtherNet/IP communication is possible with optional communication card # GS4-CM-ENETIP. Ethernet connectivity for Modbus TCP communication is possible with optional communication card # GS4-CM-MODTCP. ZL-RJ12-CBL-2 can also be used between the USB-485M and the GS4. Refer to "Appendix B: Optional I/O and Communication Cards" for details.

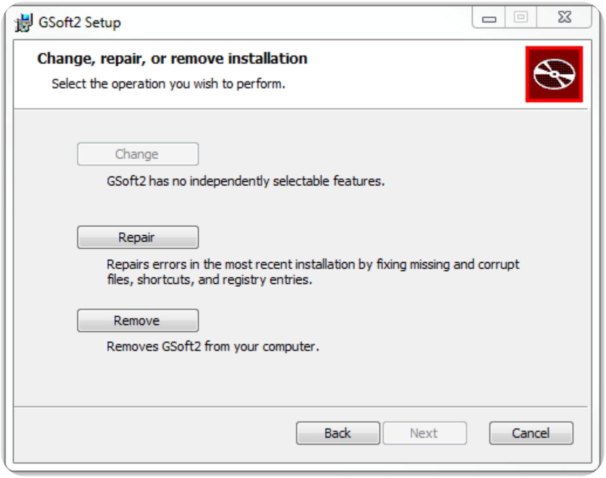
For the 2-wire cable (RJ12 to flying leads) included with the USB-485M: Red wire plugs into terminal SG+ on the drive. Green wire plugs into SG- on the drive. Also, the included 6-conductor RJ12 cable connects the USB-485M directly to the RS485 RJ45 ports on the GS4. (The drives' RJ45 ports can accept 6-conductor RJ12 connectors).

Software Installation

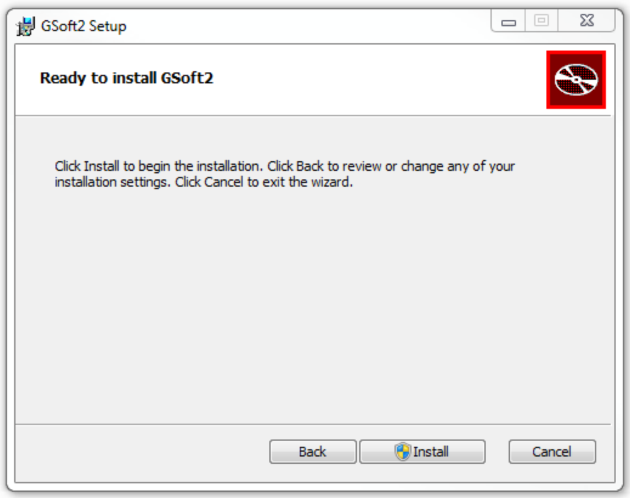
Step 1: Download the installation file from AutomationDirect.com or insert the GSoft2 USB drive into a USB port on your PC. If Autoplay is not enabled, doubleclick Setup.msi to start the installation process.

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.

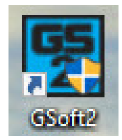


Opening GSoft2 Software Program

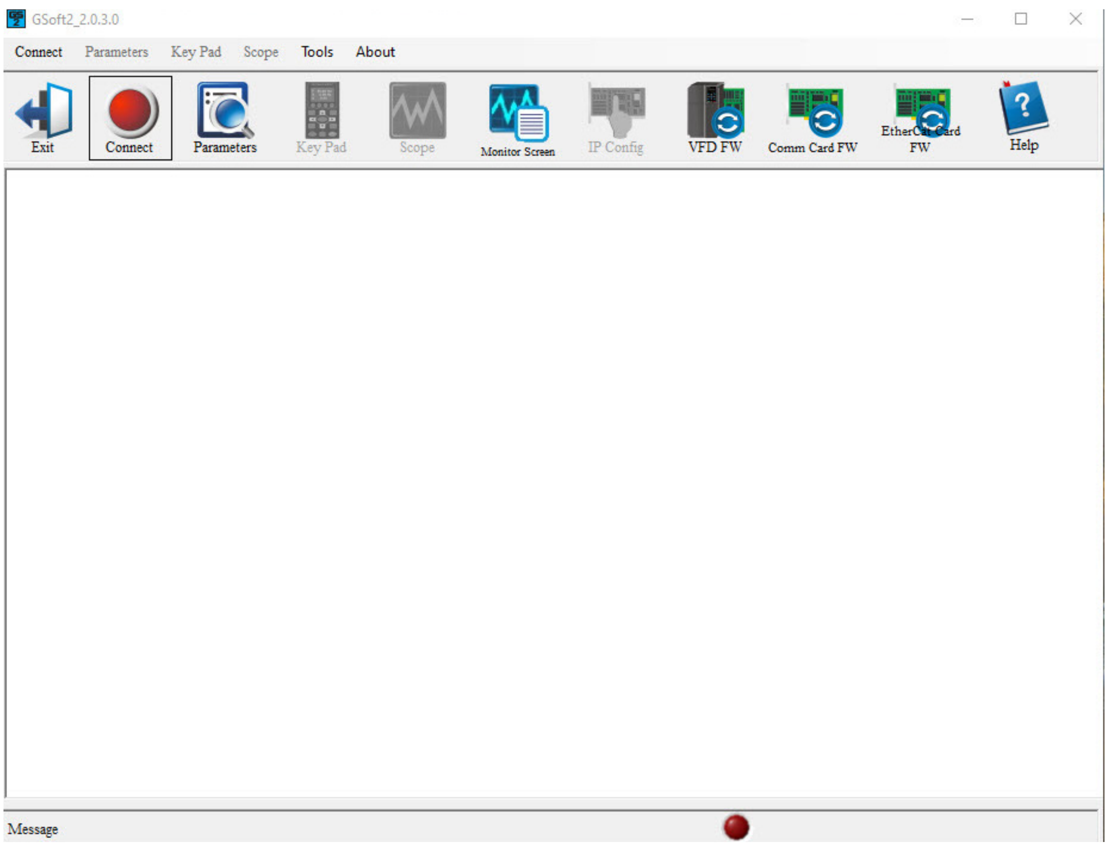
GSoft2 includes an integral help file with software instructions.

GSoft2 offers the user a PC based software configuration tool for creating and editing a GS4 Drive configuration. The configuration tool provides access to GS4 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 GS4 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.

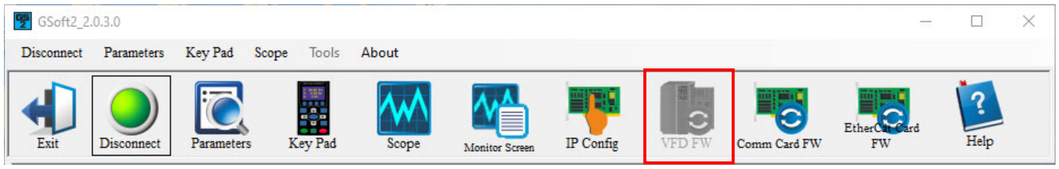
Double click the GSoft2 shortcut to open the program; OR click in the search box in the lower left corner of Desktop and type GSoft2.



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.

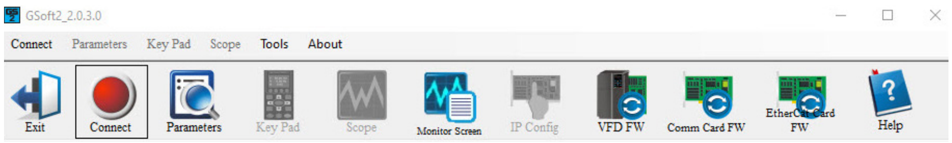


Icons within the red rectangles below will be grayed out after successfully connecting to the drive. Menu Bar commands will now appear in bold text (available).

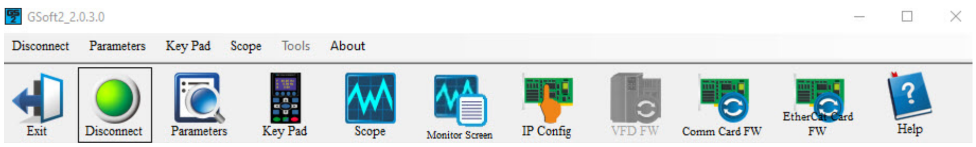


Software Functions

Icon Appearance Before Connecting to Drive



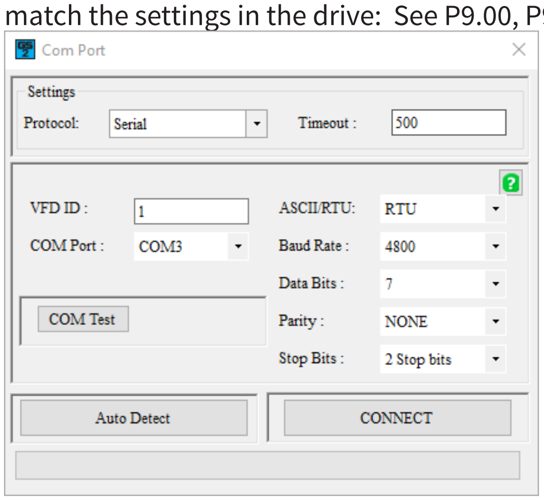
Icon Appearance After Connecting to Drive



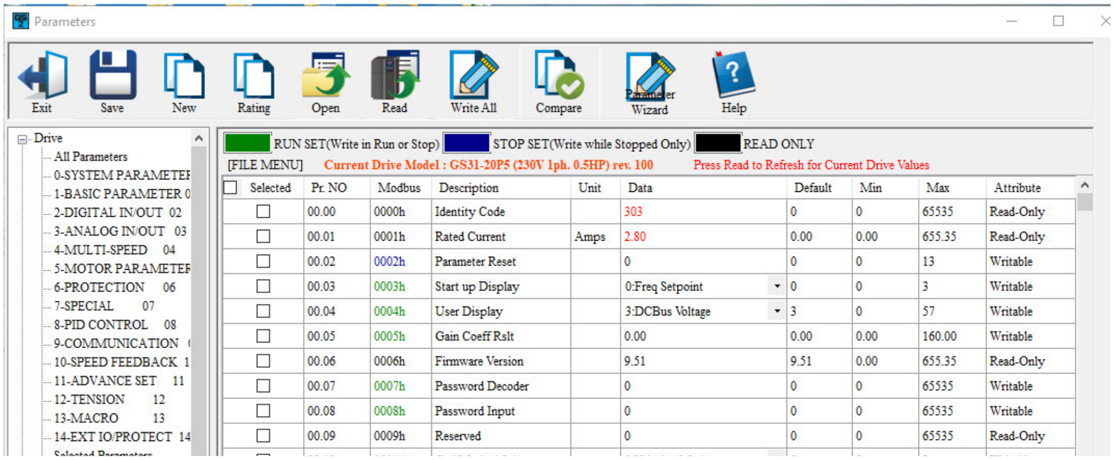
Icon Functions

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 RS485 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. The ASCII/RTU settings in this window must match the settings in the drive: See P9.00, P9.01 and P9.02 in the drive.



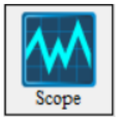
PARAMETERS: Opens GSoft2 drive parameters table. The Parameters screen allows the user to upload and download entire configurations to and from the drive. Individual parameters can be changed "live" as well. There is also the ability to Open and Save files on the PC's hard drive, and the ability to Compare parameter information to a drive's default values. See the online help file for more information.



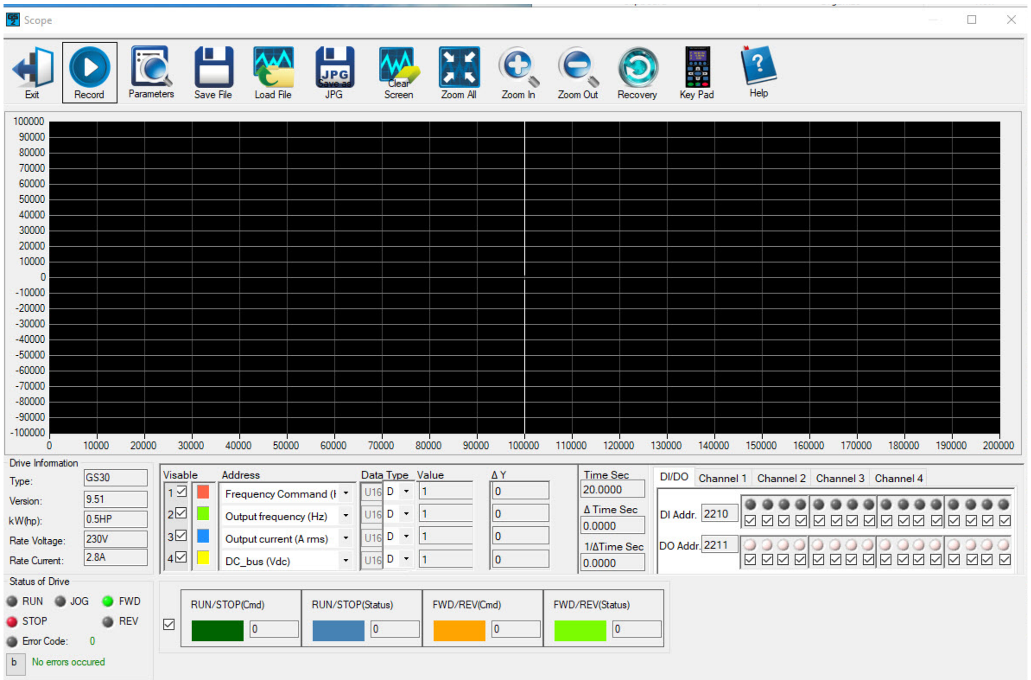
KEYPAD: Opens a graphical representation of the drive's keypad. Several buttons will be grayed-out (ESC, MENU, and several other keys are non-functional).

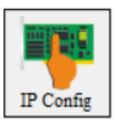
<u>Operational Instructions</u>:

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 P3.00/P3.01 and P4.00/P4.01 for the drive to accept commands from RS485).

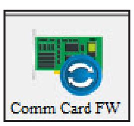


SCOPE: Opens a functional graphic interface for testing and viewing selected drive parameter data values (See the GSoft2 online helpfile for further detailed description).





IP Config: Allows manual configuration of an optional Ethernet card's IP address. GSoft2 uses the serial USB connection to communicate to the GS4 Drive ethernet communication card. Gsoft2 does not communicate via ethernet.

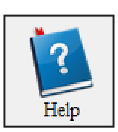


Comm Card FW: Use when upgrading firmware to any newer GS4 Network card with J2 jumper or any GS4 Ethernet comm card. Please read the important *"Firmware Upgrade Notes" on page 7–10*. See the GSoft2 Helpfile for details on how to upgrade communication card firmware.

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 7–10*. 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: The GS4 drive does not .support the use of an EtherCAT card.



Help: Use the icon to show the help file which provides detailed instructions on all features and detailed procedures.

Firmware Upgrade Notes

When upgrading firmware, the drive should be disconnected from all power sources (incoming AC power and control-level DC power).

All unnecessary USB peripherals should be disconnected from the host PC; Especially any USB to serial converters (USB-485M, USB-RS232-1, etc.) (drivers may conflict with the USB FW upgrade driver).

The host PC must be connected to the upgrade port of the GS4 via a standard USB A-to-B cable (USB-CBL-AB6 or similar).

Once the PC is connected to the GS4, the drive will be recognized as a USB-serial converter COM port. Open Device Manager to determine which port number has been assigned.

Follow the software's instructions to upgrade the GS4 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 GS4 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:

- *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 GS4 drive firmware. The help File also contains detailed information concerning the GS4 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.

GSLogic Introduction

Chapter 8

Table of Contents

Purpose of This Chapter

This chapter is intended as an overview and quick-start guide to get your first GS4 PLC program quickly up and running.

For More Detailed Information

For further explanation of the GS4 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 GS4 PLC*
- *Special Function registers*
- *All GS4 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 GS4 drive PLC programming software for the AutomationDirect GS4 family of drives. It is designed to enable you to perform a variety of GS4 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 GS4 drive PLC program files to the onboard PLC*
- *Create new GS4 drive PLC programs*
- *Edit GS4 drive PLC programs*
- *Archive/store multiple drive PLC programs on your PC or the GS4 drive keypad*
- *Control GS4 drive PID loops (FPID instructions)*
- *View in real time all GS4 PLC registers*
- *Print GS4 drive PLC program files*

GSLogic includes an integral help file that includes software instructions, how to use GSLogic, and how to use the GS4 PLC.

GS4 PLC Summary

Introduction

The GS4 drive includes a built-in PLC. Programmed in ladder logic, the GS4 PLC provides a comprehensive set of basic and application-specific instructions. This chapter is intended to provide an overview of the GS4 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 is included with every GS4 drive, and 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 GS4 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 GS4 drive or PLC. The keypad of the GS4 is capable of storing multiple PLC programs (PLC must be disabled to perform a keypad copy).

There are *two methods* for communicating with the GS4 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 GS4 AC drive parameter in the same physical drive, but not to other GS4 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 GS4 Modbus TCP and EtherNet/IP communication cards cannot address the PLC. If the Modbus TCP or EtherNet/IP cards are the desired method of communication, then parameters P8.20~P8.39 (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 or EtherNet/IP cards can then read the VFD parameters.

For more detailed communication parameter information, refer to Chapter 5: Serial Communications.

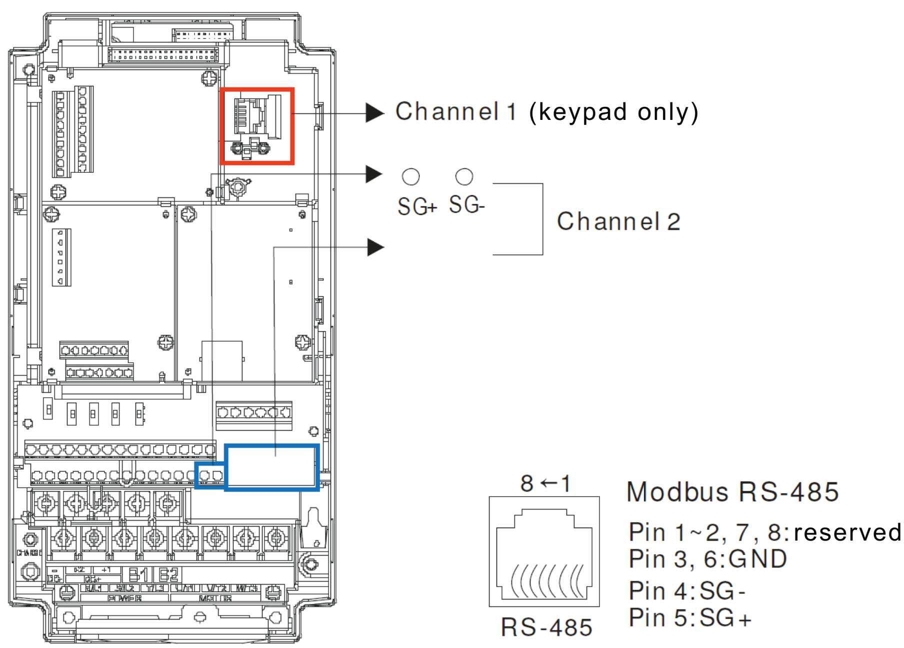
Caution: If the PLC is in control of specific inputs and outputs, once the PLC is disabled the behavior of the inputs and outputs are now controlled by P3.03~P3.31. It is good practice to set the I/O that is used in the PLC to "No Function," so when the PLC is disabled there is not sudden or unexpected motion.

Notes on Using GSLogic, the GS4 PLC, and the GS4 Drive

1) The GS4 PLC default node address is 2. The PLC node address can be changed in parameter P9.37, but this address cannot be the same as the GS4 drive node address of P9.00, which has a default node of 1. If multiple GS4 drives and PLCs will be connected to a third-party Modbus Master, *be sure to avoid duplicate node numbers*.
2) The GS4 drive provides two RJ45 ports and one set of terminals (SG+ & SG-) for serial RS-485 communications, internally wired in parallel, that can be used to download PLC programs (see figure below).

   Channel 1 (RJ45 for keypad communication only) has a fixed communications format, and can only be used with the supplied keypad.

   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 connectors (ideal for connecting multiple drives together with standard RJ45 cables) or via the SG+, SG-, and SGND terminals. Channel 2 has a default communications setting of 9600, 8, N, 1 Modbus RTU (two RJ45 ports and one set of terminals for RS-485). If communication settings in P9.01 and P9.02 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. P9.01 and P9.02 are used to set up the serial communication rate and protocol.



3) A client can simultaneously access data from the GS4 drive and the internal PLC. This is performed by using the two node numbers. For instance, if the GS4 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 GS4 drive parameter P4.00. 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.
4) The PLC program will be disabled from running when uploading/downloading programs.

5) Please note when using WPR (Write to Drive Parameters) commands, values may be modified up to a maximum of 10^9 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*
P2.11	Control Mode
P1.01~P1.08	1st~4th Acc/Dec Time
P3.42	Multi-Function Input Contact Selection
P3.43	Multi-Function Output Contact Selection
P8.20~P8.39	PLC buffer 1~20
P7.16	Upper Limit for Integral Time
P7.18	PID Output Frequency Limit

6) When parameter P8.00 is set to 28 (User Display = PLC D1043 Value), the GS4 keypad displayed value will be the value of PLC register D1043 (see the 3rd line in the figure below).
Digital Keypad GS4-KPD Can Display 0~65535

7) In the PLC Run and PLC Stop modes, the parameter P9.08 cannot be set to 9 or 10 (cannot be reset to factory defaults). PLC must be in Disable mode for this. A power cycle is needed after setting P9.08 = 9 or 10.
8) The PLC memory will be cleared and the program erased from the PLC when parameter P9.08 is set to 6.
9) When the PLC controls the GS4 drive operation, control commands will be entirely controlled by the PLC, and will *not* be affected by the setting of parameter P3.00 or P3.01.
10) When the PLC controls the GS4 drive frequency commands, the commanded frequency will *not* be affected by parameter P4.00, P4.01, or the Hand ON/OFF configuration.
11) 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 P9.34 for details about what the PLC controls.
12) While the PLC is enabled and controlling the GS4 drive operation, if the keypad Stop button is pressed, an "Fstp" error will be triggered and cause the drive output to stop if P3.00 or P3.01 is set to 1, 3, or 5. A Special Function Relay (M1005) in the PLC will also be triggered. The PLC will continue to scan through the ladder code. When the keypad Stop/Reset is pressed again, the drive control is returned to the PLC.
13) 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 GS4 AC Drive to PLC Input/Output Cross Reference tables, page 8–8 & page 8–8.)*

14) Several parameters in the GS4 drive are directly related to the GS4 PLC operation, monitoring, or control.

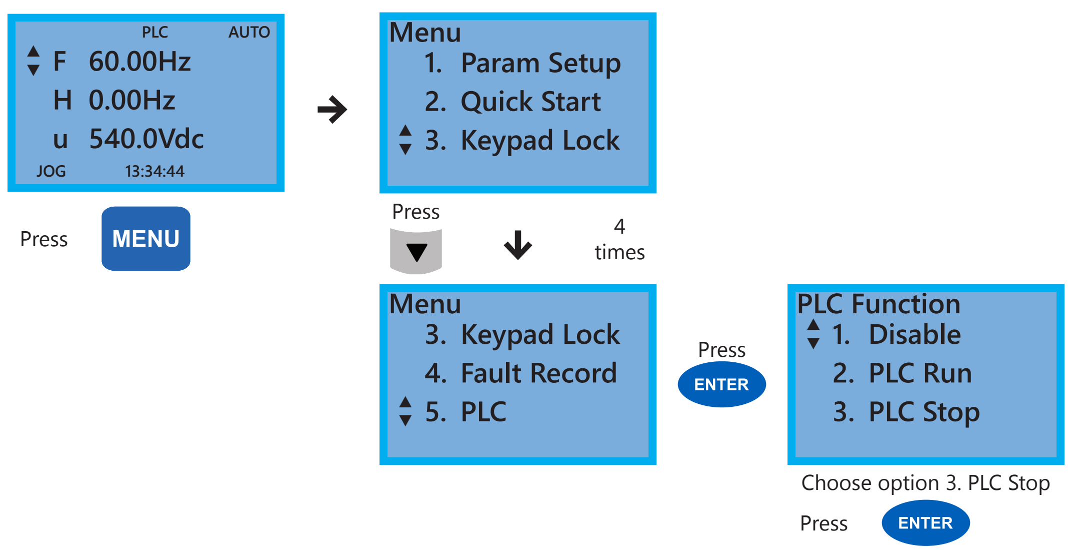
GS4 AC Drive Parameters Related to GS4 PLC	
Parameter/Setting Number	***Parameter/Setting Description***
P3.03~P3.16 = 36	Multi-Function Inputs = PLC Mode Select bit 0
P3.03~P3.16 = 37	Multi-Function Inputs = PLC Mode Select bit 1
P3.48	PLC Digital Input Mask
P3.49	PLC Digital Output Mask
P4.62	PLC Analog Output Mask
P8.00 = 28	User Display = PLC D1043 Value (displayed only in hexadecimal)
P8.20~P8.39	PLC Buffers
P9.01 = 1	Modbus Baud Rate = 9.6k
P9.02 = 12	Modbus Protocol = 8,N,1 (RTU)
P9.08 = 6	Restore to Default = Reset PLC (clear PLC)
P9.34	PLC Command Mask
P9.37 = 2	PLC Address = 2 (Cannot be the same as the address of the drive (P9.00))
P9.85	PLC Frequency Command Force to 0

Getting Started

Connect to PLC

Start operation of PLC functions in accordance with the following four steps.

1) Using the Menu key on the GS4 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.

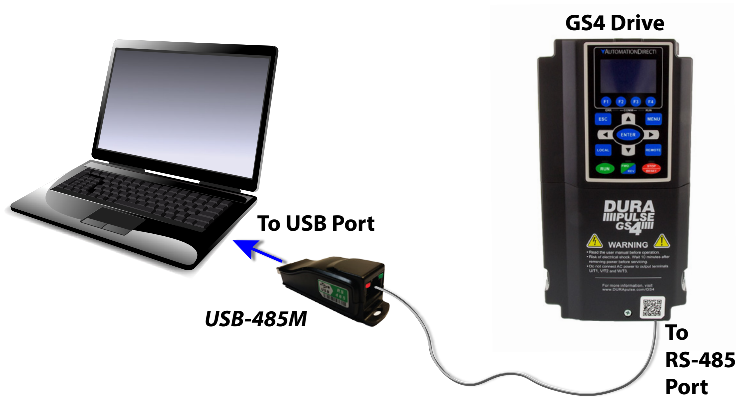
1: Disable: No function

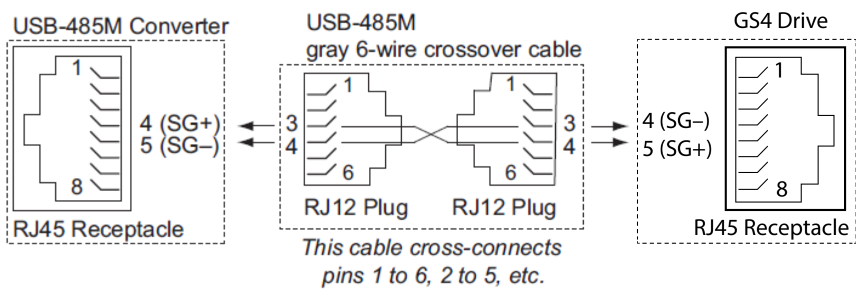
2: PLC Run: Enable PLC functions

3: 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 GS4 drive RJ-45 communication interface to a PC via the RS485 port.





For the 2-wire cable (RJ12 to flying leads) included with the USB-485M: Red wire connects into terminal SG+ on the drive; Green wire connects into SG- on the drive.
Also, the included 6-conductor RJ12 cable connects the USB-485M directly to the RS-485 RJ45 ports on the GS4 (the drives' RJ45 ports can accept 6-conductor RJ12 connectors).

When the external Multi-Functional Input terminals (DI1 to DI8, P3.03 to P3.10) are set to function 36 or 37 (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 (37)***	***Select Bit0 (36)***
Disable	OFF	OFF
PLC Run	OFF	ON
PLC Stop	ON	OFF
Maintain Previous State	ON	ON

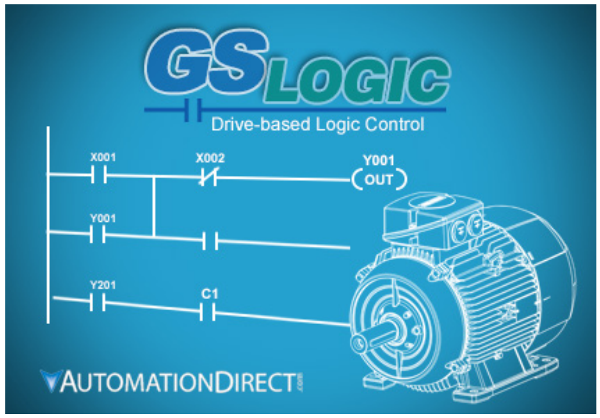
GS4 AC Drive to PLC *Input* Cross Reference						
GS4 Main Control Board DI		***GS4 Option Card Digital Inputs***			***GS4 Main Control Board AI***	
GS4 Input	***PLC Address***	***GS4-06NA***	***GS4-06CDD***	***PLC Address***	***GS4 Analog***	***PLC Address***
FWD	X0	DI10	DI10	X12	AI1	D1028
REV	X1	DI11	DI11	X13	AI2	D1029
DI1	X2	DI12	DI12	X14	AI3	D1030
DI2	X3	DI13	DI13	X15	–	
DI3	X4	DI14	–	X16		
DI4	X5	DI15		X17		
DI5	X6	–				
DI6	X7					
DI7	X10					
DI8	X11					

GS4 AC Drive to PLC *Output* Cross Reference						
GS4 Main Control Board DO/RO		***GS4 Option Card Digital Outputs***			***GS4 Main Control Board AO***	
GS4 Output	***PLC Address***	***GS4-06TR***	***GS4-06CDD***	***PLC Address***	***GS4 Analog***	***PLC Address***
R1-R1C-R1O	Y0	R10-RO10	DO10-DOC	Y5	AO1	D1040
R2-R2C-R2O	Y1	R11-RO11	DO11-DOC	Y6	AO2	D1045
reserved	Y2	R12-RO12	–	Y7	–	
DO1-DOC	Y3	R13-RO13		Y10		
DO2-DOC	Y4	R14-RO14		Y11		
–		R15-RO15		Y12		
GS4 Virtual Digital Outputs (PLC use only)						
GS4 Virtual Output	***PLC Address***	–				
DO16	Y13	GS4 virtual outputs can be used as internal coils in the GS4 PLC. To monitor the MFO status assigned to DO16~DO20, read P3.47 (Digital Output Status).				
DO17	Y14					
DO18	Y15					
DO19	Y16					
DO20	Y17					

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 P3.03~P3.31 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 P3.17 will be ineffective because these terminal functions are already being used by the PLC.

NOTE 2: When the PLC uses the special registers D1040/D1045, the corresponding Analog Outputs AO1/AO2 will only be used by the PLC overriding the multifunction configuration. The AO multifunction assignments, when they are drive controlled, are configured by parameters P4.50/P4.54.

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*
- *SVGA 1024x768 pixels resolution (1280x1024 pixels resolution recommended)*
- *300MB free hard-disk space*
- *RAM: Windows 7 & 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 GS4; USB-485M serial adapter required*

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 GS4 PLC system. After you have completed the steps, your GS4 controller will be running the ladder logic project that you programmed.

Software and Online Help Files

The GSLogic programming software is available as a download from our website:

www.automationdirect.com/pn/gslogic

The GSLogic software includes searchable online help topics covering all aspects of the software, instruction set, setup, and communications.

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:

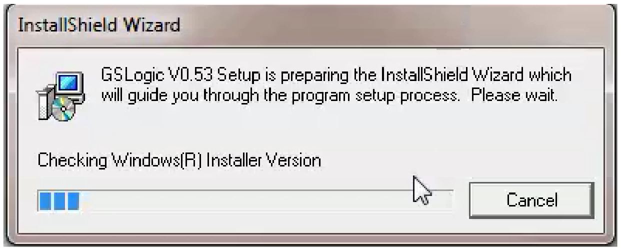
1–770–844–4200

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.

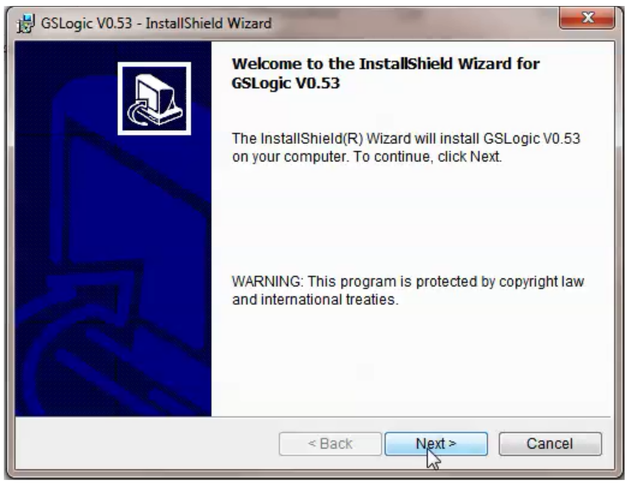
https://www.automationdirect.com

Installing GSLogic Programming Software

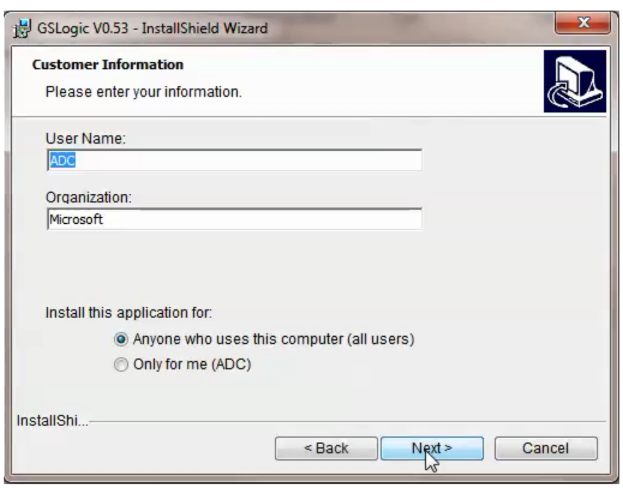
1) Download the latest version of the GSLogic Software, (See ADC's website for GSLogic editing software: www.automationdirect.com/pn/gslogic). Or, if the GSLogicSoftware USB is available, insert it into your PC USB port. Open the GSLogic setup.exe file.
2) The "InstallShield Wizard" popup (shown below) will appear briefly while the software is checking for previous installs.



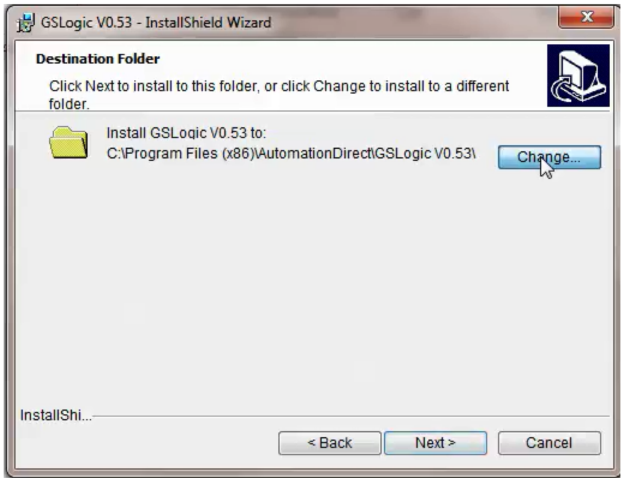
3) The Welcome popup will appear, allowing you to choose to proceed or not. Click the "Next" button to install.



4) The "Customer Information" window will open next. Enter a User Name and Organization name, then click "Next."

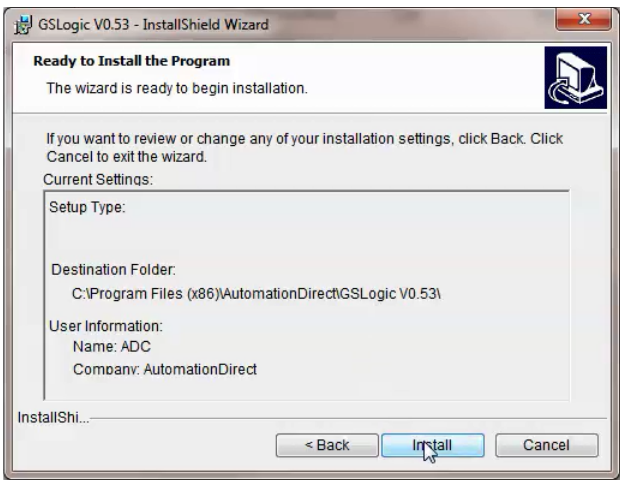


5) The Destination Folder popup will appear, showing the default path to the destination file; click "Next" to continue. Should you want to change to another destination, Click "Change" and another dialog box will appear, allowing entry of a new file path.

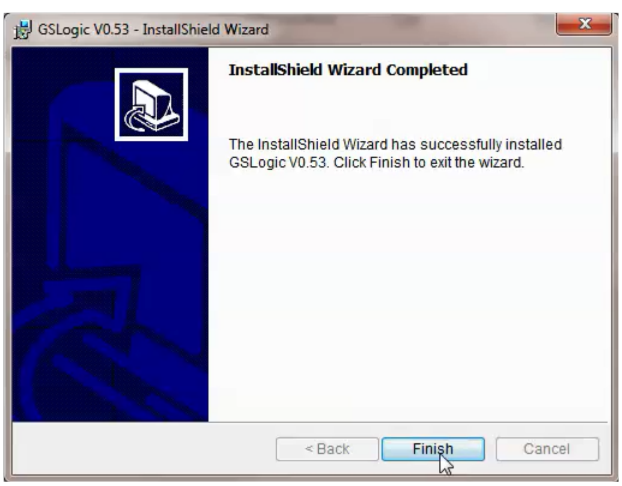


The default installation folder is:
C:\Program Files (x86)\
AutomationDirect\GSLogic Vx.xx

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.



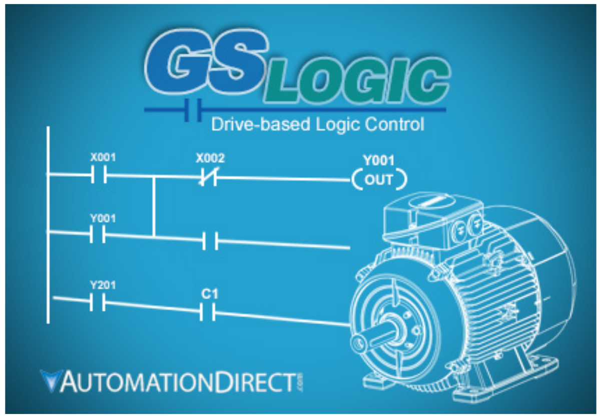
7) The Installation is now complete. Click "Finish." Double-click on the GSLogic icon or navigate to the AutomationDirect folder in the start menu to open the GSLogic programming environment.



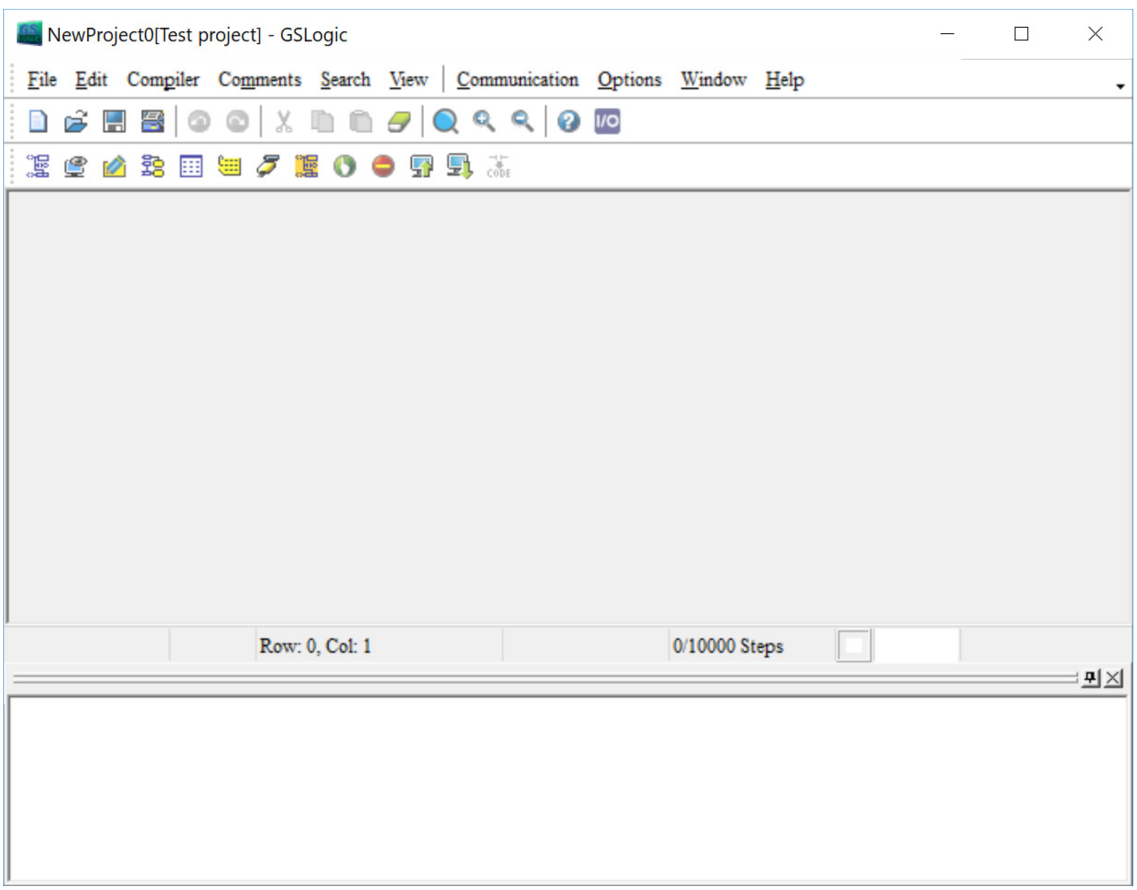
Program Writing

Connecting GSLogic PC to GS4 PLC

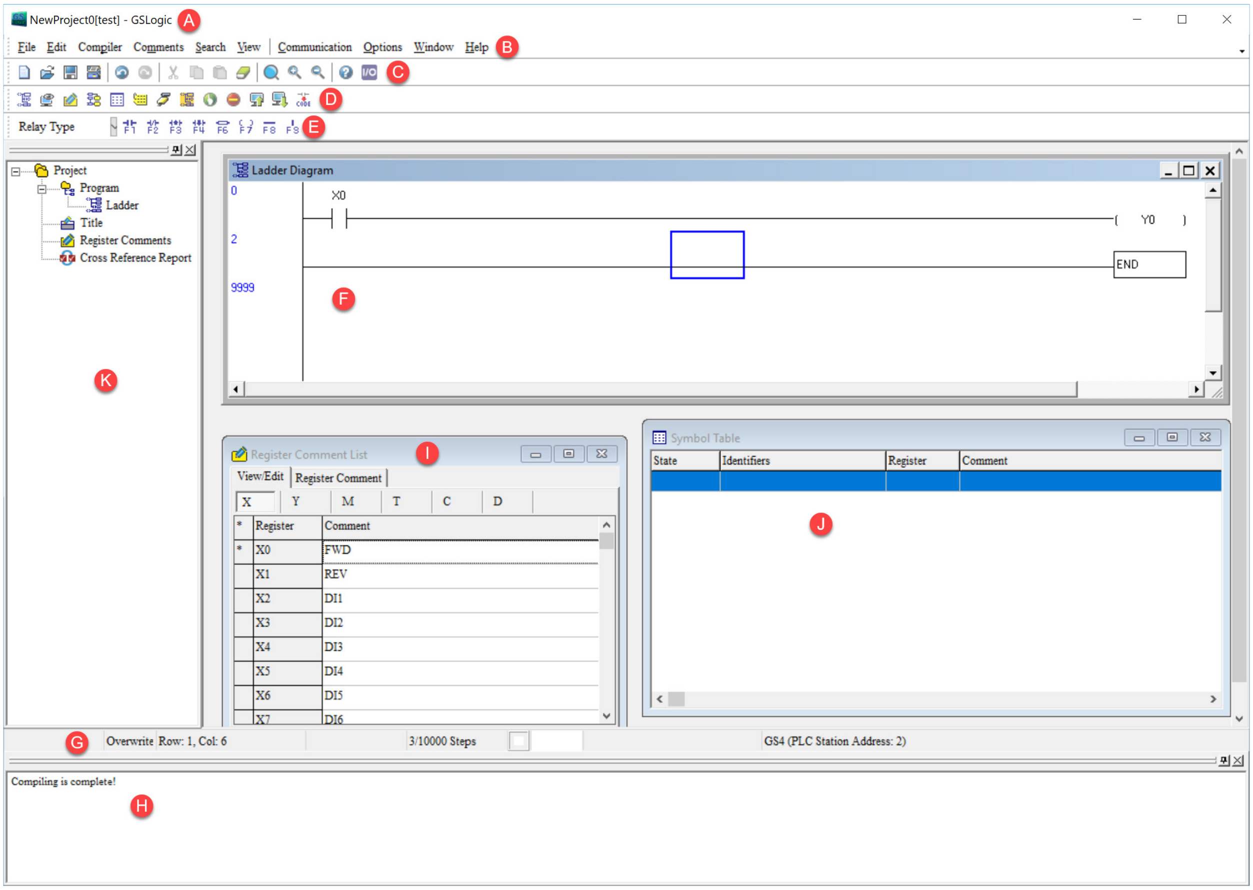
In order to connect to the PLC with GSLogic, the PLC must be enabled by either selecting PLC Run or PLC Stop in the keypad. Also, no other Modbus master can be connected to the GS4 drive; *this includes GSOFT2*.



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.

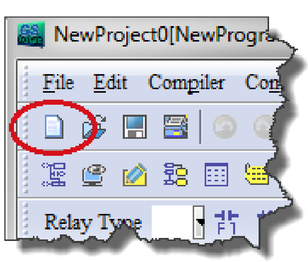


After running GSLogic for the second time, the last file edited will open and be displayed in the editing window.

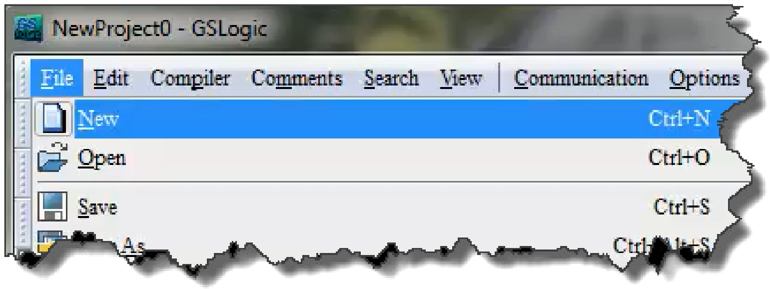


Following is a brief description of the various areas in the GSLogic editing software window shown above.

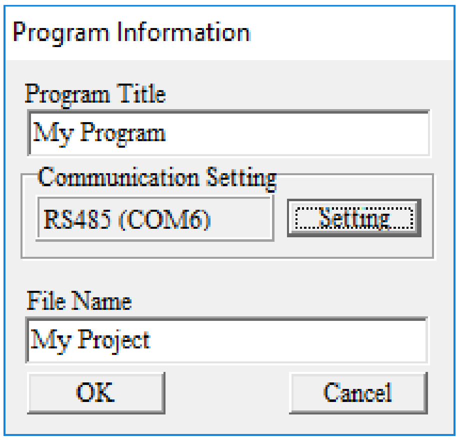
Symbol	Name	Description
A	Project Title Toolbar	Project File Name and Project Title shown here (File Name [Project Title])
B	Menu Toolbar	Individual drop-down menu options
C	Standard Editing Toolbar	Contains standard Windows application features
D	PLC Quick Access Toolbar	Allows easy access to the most 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.



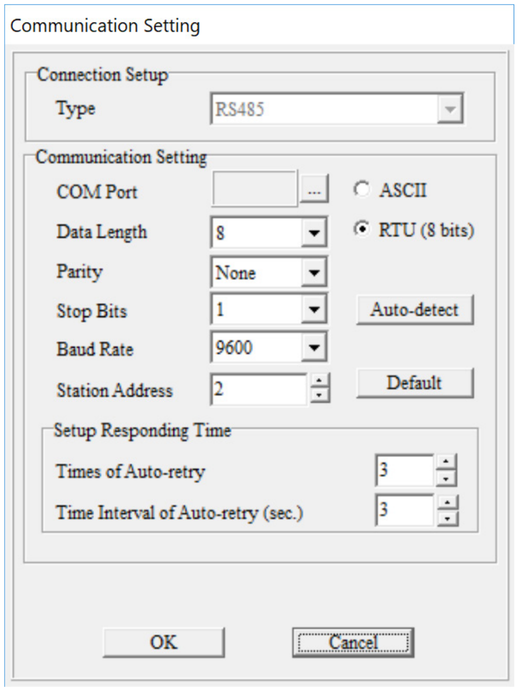
Click the "NEW FILE" icon on the toolbar to open a new file (Ctrl+N).
You can also use "File (F)"=>New file (N) (Ctrl+N).



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.



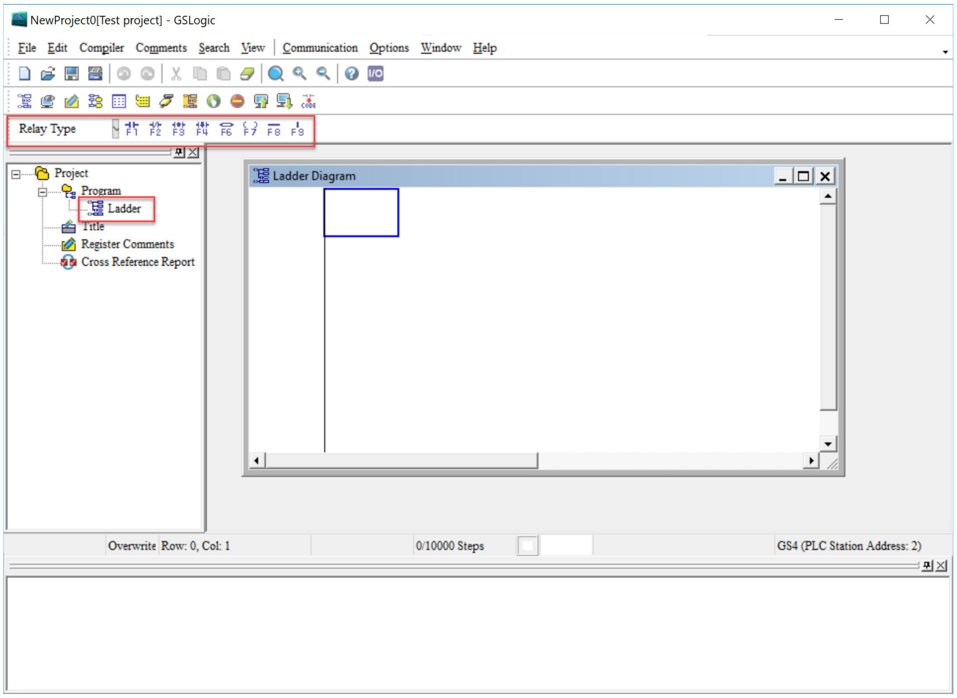
Select "Setting" to choose the communication settings to be used. To adjust communication settings on an existing project, go to the Communication menu and select "Communication Settings." These PLC communication settings must be the same as the Drive's Modbus settings found in P9.01 and P9.02.



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 GS4 Drive's station address. The Drive's default address =1.)

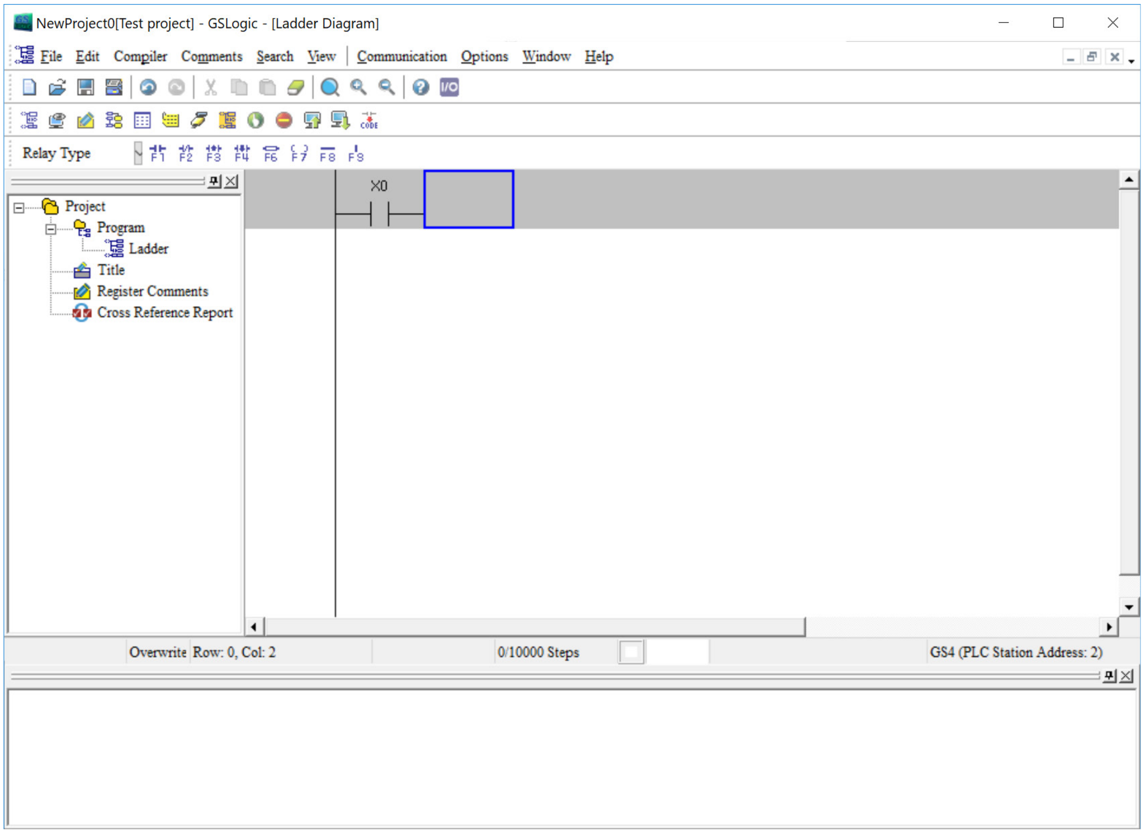
Click "OK" after completing settings to return to program editing in ladder diagram mode.

In ladder diagram mode, you can perform program editing using the buttons on the Ladder Diagram Toolbar.

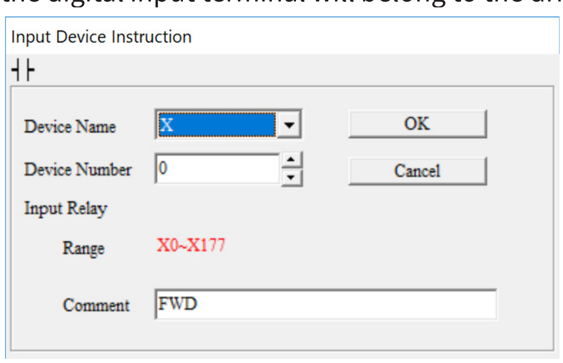


Basic Ladder Program Example

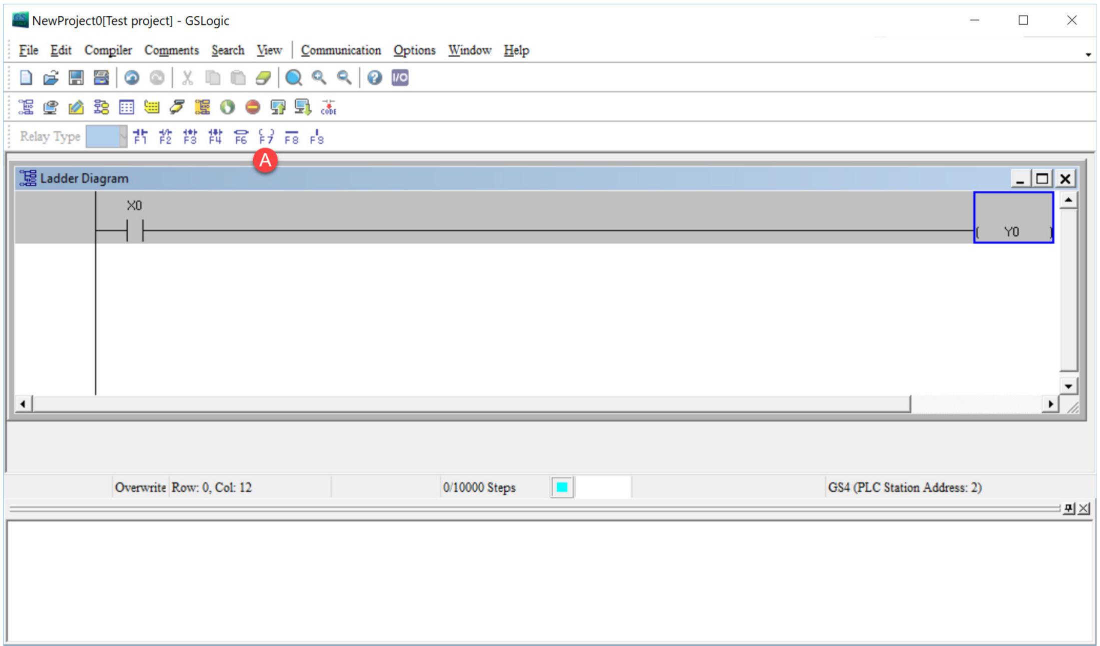
1) With the cursor in the ladder diagram editor window, select a “Normally Open” contact icon from the Ladder Editing Tool Bar, or use keyboard function key (F1) operation.



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.

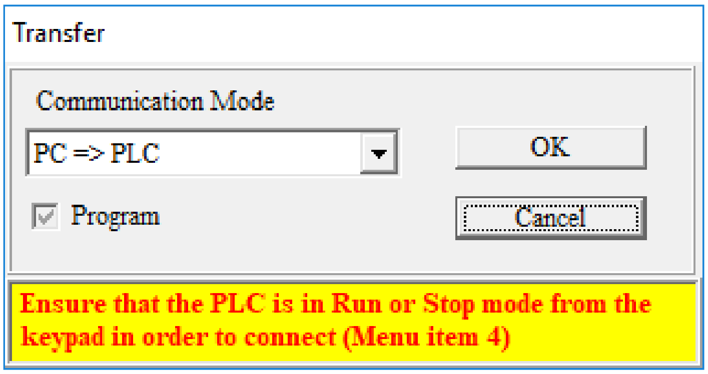


4) While the cursor edit box is on the next row, double-click in the cursor box to bring up the Input Instruction text box (or press F6 to invoke the Instruction List dialogue box). Type in “End” and click OK to add the end instruction rung to the ladder program. This signals the end of the ladder program.

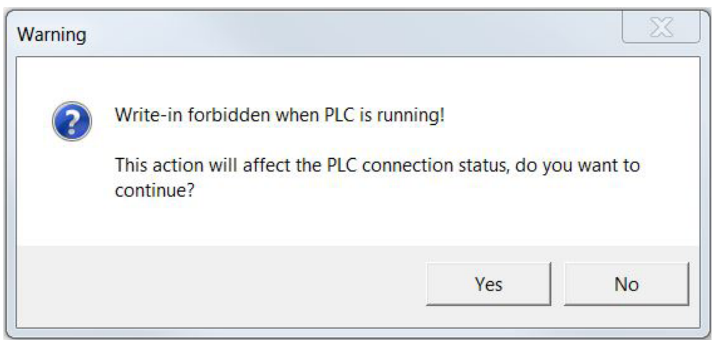
5) Click on the compile (CODE) icon on the tools ribbon. After compiling, the number of steps will appear on the left side of the editor window. The PLC can only accept 10,000 steps.
<u>*Note*</u>:
Steps in the PLC program are not proportionally related to rungs. One rung of code with a single contact 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

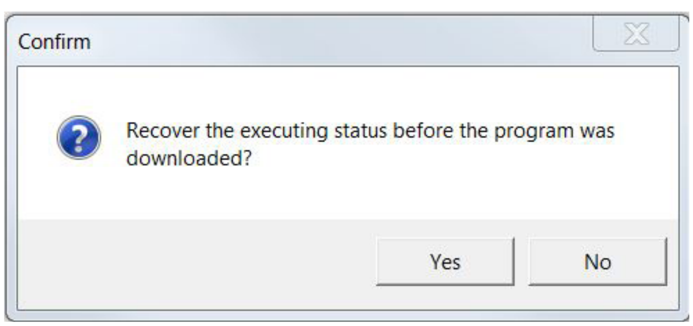
Be sure the PLC is NOT in Disabled mode on the GS4 keypad. After creating and compiling a program using GSLogic, select the Write to PLC icon on the tool ribbon (). When the Transfer Setup window appears, make sure that the Communication Mode is set to “PC => PLC,” which will download the program to the PLC. GSLogic will perform program download with the GS4 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.



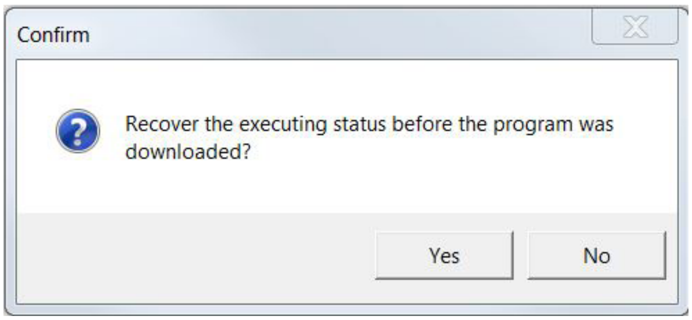
After the program has downloaded, GSLogic will ask you to confirm that you want to put the PLC back in the previous run/stop state it was in before the download. Click Yes if you would like to recover this state.

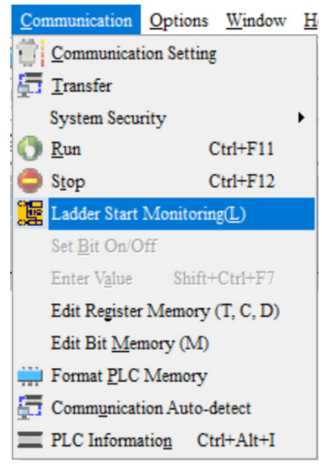


If the PLC is in Run mode, then the ladder code is now running on the GS4 PLC.

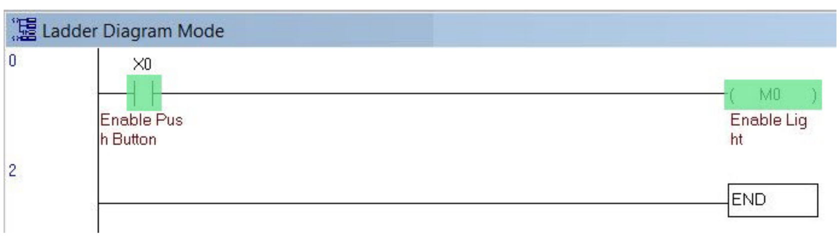
Program Monitoring

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).

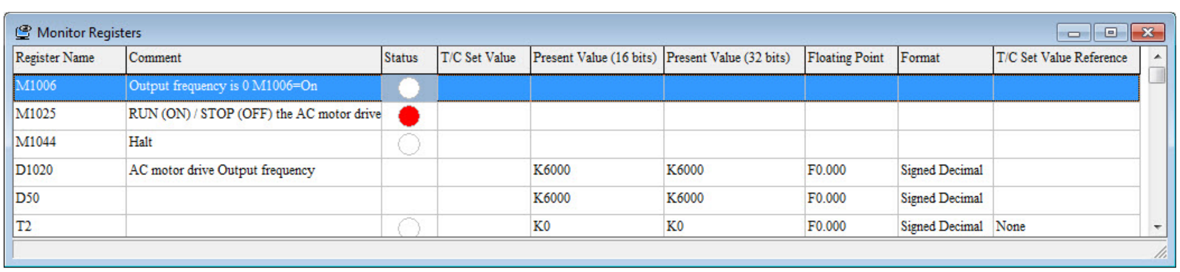




If you select the Ladder Start Monitoring icon, a live view of the ladder diagram can be viewed similar to the image below. A contact, coil, or instruction highlighted in *green* indicates that it is *conducting* if it is a *contact*, and it is *activated* if it is a *coil or instruction*.



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

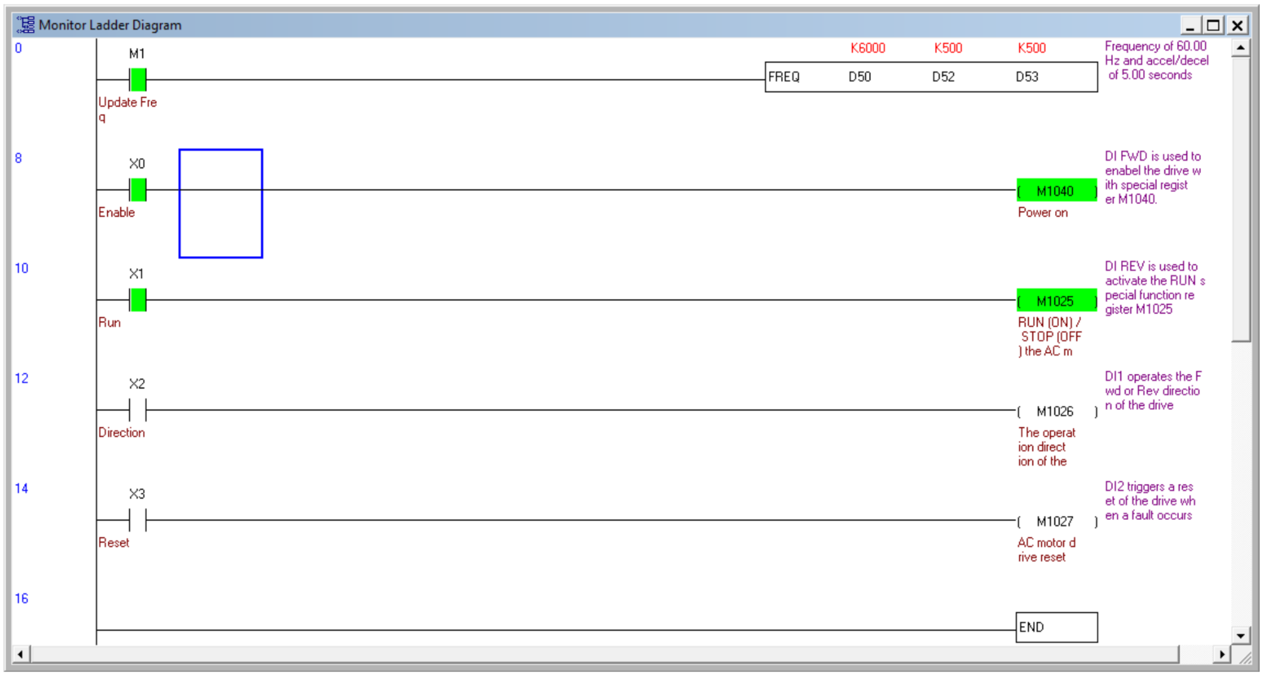
This chapter is designed to be an overview and quick-start guide to get you quickly up and running your first PLC program. For more details and further explanation of the user interface, instruction set, and implementing the PLC, please refer to the GSLogic Help File. This Help File can be accessed under 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.

GS4 GSLogic Program Examples

Ex 1: GS4 Drive Control from GS4 PLC

Below is an example (available in the root directory where GSLogic was installed) in which the drive PLC has control of the drive run, stop, direction, reset, and speed controls.

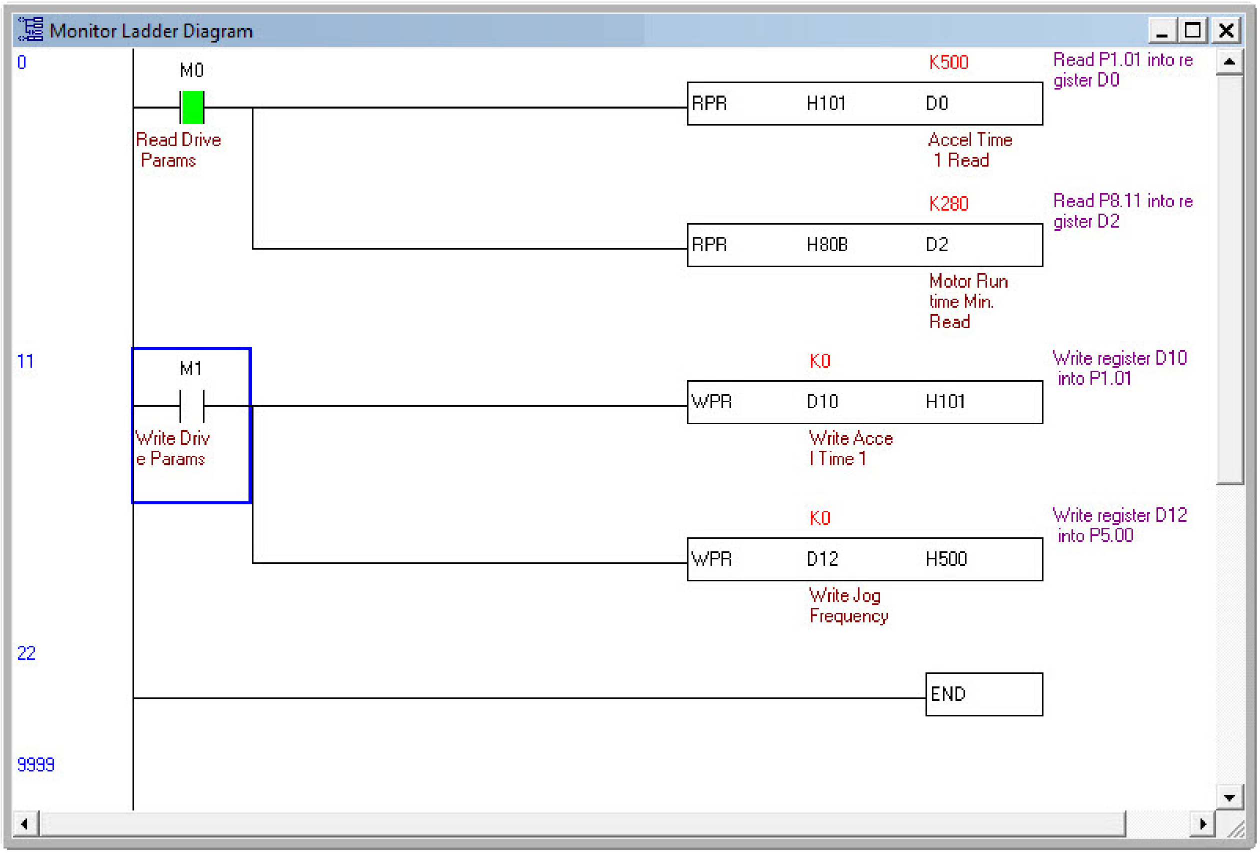
- *Rung 1: When bit M1 is on the FREQ instruction will write the values in D50, D52, and D53 to the drive. This instruction will not cause the drive to run on its own. M1 can be turned on either via Modbus or through GSLogic. The values of D50, D52, and D53 are populated using GSLogic by modifying the 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 1) will change the direction of rotation of the motor.*
- *Rung 5: X3 (Digital input 2) will reset any resettable faults in the drive, if they occur.*



Ex 2: GS4 PLC - GS4 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.



Appendix A

Accessories

Table of Contents

Line/Load Reactors

When the GS4 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 GS4 drive.

To avoid this, it is recommended to install a line reactor in series with the GS4 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

Supply: 230V, 1Ø, 50/60 Hz (*Constant* Torque; reactor installed *Line* Side)					
GS4 Model	**Derated Output (hp) (1)**	**CT: 1Ø Input Amps (rms) (2)**	**Saturation Amps (rms)**	**Max Motor kW**	**Line Reactor**
GS4-21P0	0.5	4.2	7.6	0.37	**LR-20P5-1PH (3)** **LR2-20P5-1PH**
GS4-22P0	0.75	5.6	10.1	0.55	**LR-21P0-1PH**
GS4-23P0	1	8.7	15.7	0.75	**LR-21P0-1PH**
GS4-25P0	2	14	25	1.5	**LR-22P0-1PH**
GS4-27P5	3	19	34	2.2	**LR-23P0-1PH**
GS4-2010	3	19	34	2.2	**LR-23P0-1PH**
GS4-2015	5	30	54	3.7	**LR-2010**
GS4-2020	7.5	43	77	5.5	**LR-2015**
GS4-2025	10	57	103	7.5	**LR-2020**
GS4-2030	10	57	103	7.5	**LR-2020**
GS4-2040	10	57	103	7.5	**LR-2020**
GS4-2050	10	57	103	7.5	**LR-2020**
GS4-2060	15	85	153	11	**LR-2025**
GS4-2075	20	113	203	15	**LR-2040**
GS4-2100	25	130	234	18.5	**LR-2050**

1) Drive output HP is derated when supplied single phase.
2) Amperage ratings expressed in the column CT: 1Ph Input Amps (rms) are with a line reactor installed on the line side of the drive.
3) This reactor is recommended for existing installations only; product will be discontinued after existing stock is depleted.

Supply: 230V, 1Ø, 50/60 Hz (*Constant* Torque; reactor installed *Load* Side)					
GS4 Model	**Derated Output (hp) (1)**	**CT: 3Ø Output Amps (rms) (2)**	**Saturation Amps (rms)**	**Max Motor kW**	**Line Reactor**
GS4-21P0	0.5	2.4	4.3	0.37	**LR-20P5 (3)** **LR2-20P5**
GS4-22P0	0.75	3.2	5.8	0.55	**LR-21P0 (3)** **LR2-21P0**
GS4-23P0	1	5.0	9.0	0.75	**LR-21P0 (3)** **LR2-21P0**
GS4-25P0	2	8	14	1.5	**LR-23P0**
GS4-27P5	3	11	20	2.2	**LR-23P0**
GS4-2010	3	11	20	2.2	**LR-23P0**
GS4-2015	5	17	31	3.7	**LR-25P0**
GS4-2020	7.5	25	45	5.5	**LR-27P5**
GS4-2025	10	33	59	7.5	**LR-2010**
GS4-2030	10	33	59	7.5	**LR-2010**
GS4-2040	10	33	59	7.5	**LR-2010**
GS4-2050	10	33	59	7.5	**LR-2010**
GS4-2060	15	49	88	11	**LR-2015**
GS4-2075	20	65	117	15	**LR-2020**
GS4-2100	25	75	135	18.5	**LR-2025**

1) Drive output HP is derated when supplied single phase.
2) Amperage ratings are 3-phase output reactor ratings when the drive is supplied with a single-phase input.
3) This reactor is recommended for existing installations only; product will be discontinued after existing stock is depleted.

Line/Load Reactors Selection Charts (continued)

Supply: 230V, 3Ø, 50/60 Hz (*Variable* Torque; reactor installed *Line* or *Load* Side)					
GS4 Model	Drive hp	VT: 3Ø Output Amps (rms)	Saturation Amps (rms)	Max Motor kW	Line Reactor
GS4-21P0	1	5	8.7	0.75	LR-21P0 (1) LR2-21P0
GS4-22P0	2	8	12.8	1.5	LR-23P0 (2)
GS4-23P0	3	11	18	2.2	LR-23P0
GS4-25P0	5	17	29	3.7	LR-25P0
GS4-27P5	7.5	25	43	5.5	LR-27P5
GS4-2010	10	33	56	7.5	LR-2010
GS4-2015	15	49	85	11	LR-2015
GS4-2020	20	65	112	15	LR-2020
GS4-2025	25	75	128	18.5	LR-2025
GS4-2030	30	90	155	22	LR-2040 (2)
GS4-2040	40	120	205	30	LR-2040
GS4-2050	50	146	250	37	LR-2050
GS4-2060	60	180	308	45	LR-2060
GS4-2075	75	215	367	55	LR-2075
GS4-2100	100	255	436	75	LR-2100

1) This reactor is recommended for existing installations only; product will be discontinued after existing stock is depleted.
2) Some GS4 drive and reactor combinations do not fit the typical "pattern" of having similar part numbers, due to some GS4 models having higher outputs than previous GS DURApulse drives.

Supply: *460V*, 3Ø, 50/60 Hz (*Variable* Torque; reactor installed *Line* or *Load* Side)					
GS4 Model	Drive hp	VT: 3Ø Output Amps (rms)	Saturation Amps (rms)	Max Motor kW	Line Reactor
GS4-41P0	1	3	5.2	0.75	LR-41P0 (1) LR2-41P0
GS4-42P0	2	4	6.8	1.5	LR-42P0 (1) LR2-42P0
GS4-43P0	3	6	10.3	2.2	LR-43P0 (1) LR2-43P0
GS4-45P0	5	9	14.6	3.7	LR-45P0 (1) LR2-45P0
GS4-47P5	7.5	12	20	5.5	LR-47P5 (1) LR2-47P5
GS4-4010	10	18	31	7.5	LR-4010
GS4-4015	15	24	41	11	LR-4015
GS4-4020	20	32	54	15	LR-4020
GS4-4025	25	38	65	18.5	LR-4025
GS4-4030	30	45	77	22	LR-4030
GS4-4040	40	60	103	30	LR-4040
GS4-4050	50	73	124	37	LR-4050
GS4-4060	60	91	155	45	LR-4060
GS4-4075	75	110	189	55	LR-4075
GS4-4100	100	150	257	75	LR-4100
GS4-4125	125	180	308	90	LR-4125
GS4-4150	150	220	376	110	LR-4150
GS4-4175	175	260	445	132	LR-4200
GS4-4200	215	310	531	160	LR-4250
GS4-4250	250	370	634	185	LR-4250
GS4-4300	300	460	787	220	LR-4300

1) This reactor is recommended for existing installations only; product will be discontinued after existing stock is depleted.

Line/Load Reactor Specification Charts

Line Reactors Specifications 230V Models							
Part Number	***Dimension Dwg #***	***Wire Range AWG***	***Terminal Torque lb·in***	***Fasteners***	***Temperature Range Operating***	***Temperature Range Storage***	***Environ-ment***
LR-20P5-1PH	1	18–12	10	#6-32 x 5/16in flathead screw	-40 to +104°F [-40 to +40°C]	-40 to +149°F [-40 to +65°C]	NEMA: open IP00 no corrosive gases
LR2-20P5-1PH	17	22–12	9	n/a - trapped	122°F [50°C] max		
LR-21P0-1PH	1	18–12	10	#6-32 x 5/16 in flathead screw	-40 to +104°F [-40 to +40°C]		
LR-22P0-1PH	2	18–4	20	1/4-28 x 3/8 set screw			
LR-23P0-1PH	2	18–12	20				
LR-20P5	3	18–12	10	#6-32 x 5/16in flathead screw			
LR2-20P5	16	22–12	9	n/a - captive	122°F [50°C] max		
LR-21P0	3	18–12	10	#6-32 x 5/16 in flathead screw	-40 to +104°F [-40 to +40°C]		
LR2-21P0	17	22–12	9	n/a - captive	122°F [50°C] max		
LR-22P0	3	18–12	10	n/a - captive	-40 – 104 °F [-40 – 40 °C]		
LR-23P0	3	18–12	10	#6-32 x 5/16 in flathead screw			
LR-25P0	4	18–4	20	1/4 in-28 x 3/8 in setscrew			
LR-27P5	4	18–4	20				
LR-2010	5	18–4	20				
LR-2015	5	18–4	20				
LR-2020	5	18–4	20				
LR-2025	6	18–4	18–16 AWG; 25 14–6 AWG; 30 4AWG; 35	captive Phillips screw			
LR-2030	7	6–2/0 (Al or Cu)	120	7/16 in-20 x 5/8 in setscrew			
LR-2040	7						
LR-2050	8	6 – 250kcmil (Al or Cu)	275				
LR-2060	18	6AWG – 250MCM	275	5/8-18 x 3/4 set screw			
LR-2075	19	4AWG – 600MCM	500	3/4-16 x 3/4 set screw			
LR-2100	19						

Line Reactors Specifications 460V Models							
Part Number	***Dimension Dwg #***	***Wire Range AWG***	***Terminal Torque lb·in***	***Fasteners***	***Temperature Range Operating***	***Temperature Range Storage***	***Environ-ment***
LR-41P0	3	18–12	10	#6-32 x 5/16 in flathead screw	-40 to +104°F [-40 to +40°C]	-40 to +149°F [-40 to +65°C]	NEMA: open IP00 no corrosive gases
LR2-41P0	16	22–12	9	n/a - trapped	122°F [50°C] max		
LR-42P0	3	18–12	10	#6-32 x 5/16 in flathead screw	-40 to +104°F [-40 to +40°C]		
LR2-42P0	16	22–12	9	n/a - trapped	122°F [50°C] max		
LR-43P0	3	18–12	10	#6-32 x 5/16 in flathead screw	-40 to +104°F [-40 to +40°C]		
LR2-43P0	16	22–12	9	n/a - trapped	122°F [50°C] max		
LR-45P0	3	18–12	10	#6-32 x 5/16 in flathead screw	-40 to +104°F [-40 to +40°C]		
LR2-45P0	17	22–12	9	n/a - trapped	122°F [50°C] max		
LR-47P5	3	18–12	10	#6-32 x 5/16 in flathead screw	-40 to +104°F [-40 to +40°C]		
LR2-47P5	17	22–12	9	n/a - trapped	122°F [50°C] max		
LR-4010	3	18–12	10	#6-32 x 5/16 in flathead screw	-40 to +104°F [-40 to +40°C]		
LR-4015	4	18–4	20	1/4 in-28 x 3/8 in setscrew			
LR-4020	4						
LR-4025	5						
LR-4030	5						
LR-4040	6						
LR-4050	9	22–4	22–16 AWG; 25 14–6 AWG; 30 4AWG; 35	captive Phillips screw			
LR-4060	9						
LR-4075	7	6–2/0 (Al or Cu)	120	7/16 in - 20 x 5/8 in setscrew			
LR-4100	10	6 – 250kcmil (Al or Cu)	275	5/8 in - 18 x 7/8 in setscrew			
LR-4125	10						
LR-4150	10						
LR-4200	11	(1) 4 – 600kcmil (2) 1/0 – 250kcmil	500	7/8 in - 14 x 1 setscrew			
LR-4250 *	12	(2)* 4 – 350kcmil (AL or CU)	275	5/8 in - 18 x 7/8 in setscrew			
LR-4300 *	12						
** LR-4250 & LR-4300 have dual-connector lugs, and will require multiple conductors per phase of the appropriate size to fit the lugs.*							

DC Reactors (Choke) Specification Charts

Supply: 230V, 1Ø, 50/60 Hz DC Reactors*					
GS4 Model	HP	Nominal Amps (rms)	Saturation Amps (rms)	Inductance (mH)	
				3% Impedance	5% Impedance
GS4-21P0	0.5	4.2	7.5	5.284	8.806
GS4-22P0	0.75	5.6	10.0	3.963	6.604
GS4-23P0	1	8.7	15.6	2.536	4.227
GS4-25P0	2	14	25	1.585	2.642
GS4-27P5	3	19	34	1.153	1.921
GS4-2010	3	19	34	1.153	1.921
GS4-2015	5	30	53	0.746	1.243
GS4-2020	7.5	43	78	0.507	0.845
GS4-2025	10	57	103	0.384	0.640
GS4-2030	10	57	103	0.384	0.640
GS4-2040	10	N/A	N/A	N/A	N/A
GS4-2050	10	N/A	N/A	N/A	N/A
GS4-2060	15	N/A	N/A	N/A	N/A
GS4-2075	20	N/A	N/A	N/A	N/A
GS4-2100	25	N/A	N/A	N/A	N/A
* Drive output HP is derated when supplied with single-phase input					

Supply: 230V, 3Ø, 50/60 Hz DC Reactors					
GS4 Model	HP	Nominal Amps (rms)	Saturation Amps (rms)	Inductance (mH)	
				3% Impedance	5% Impedance
GS4-21P0	1	5.8	8.6	4.392	7.607
GS4-22P0	2	9.2	12.8	2.745	4.754
GS4-23P0	3	13	18	1.996	3.457
GS4-25P0	5	20	29	1.293	2.239
GS4-27P5	7.5	29	43	0.878	1.521
GS4-2010	10	38	56	0.637	1.104
GS4-2015	15	57	85	0.430	0.745
GS4-2020	20	75	112	0.325	0.562
GS4-2025	25	87	128	0.293	0.507
GS4-2030	30	104	155	0.245	0.424
GS4-2040	40	N/A	N/A	N/A	N/A
GS4-2050	50	N/A	N/A	N/A	N/A
GS4-2060	60	N/A	N/A	N/A	N/A
GS4-2075	75	N/A	N/A	N/A	N/A
GS4-2100	100	N/A	N/A	N/A	N/A

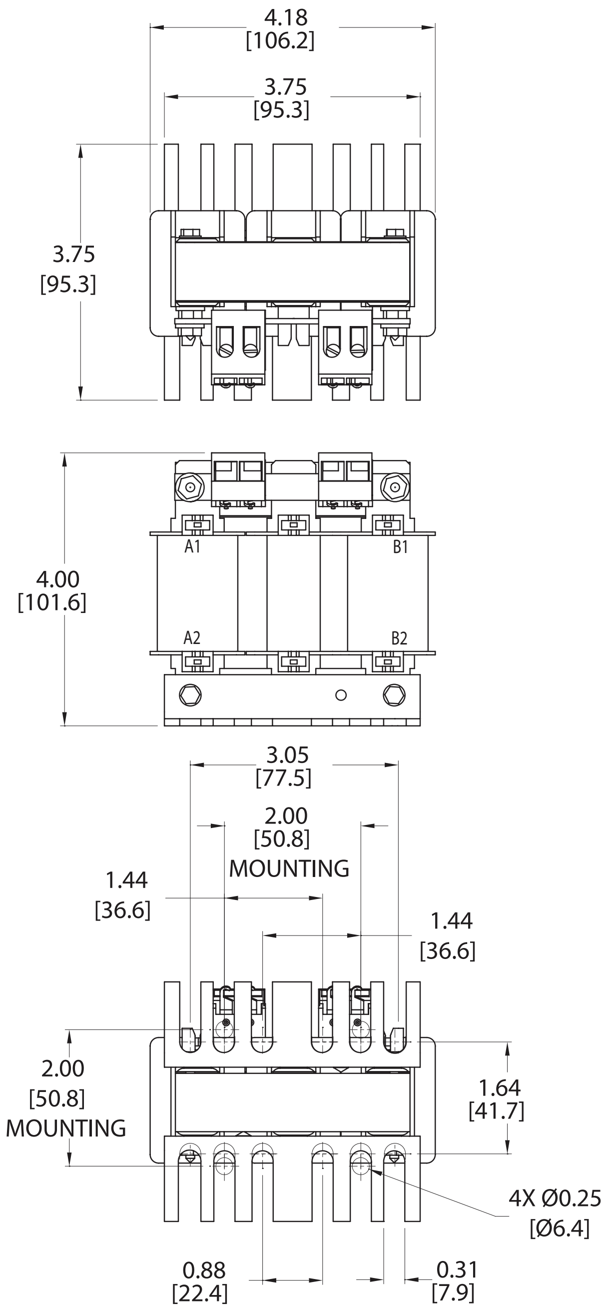
Supply: 460V, 3Ø, 50/60 Hz DC Reactors					
GS4 Model	HP	Nominal Amps (rms)	Saturation Amps (rms)	Inductance (mH)	
				3% Impedance	5% Impedance
GS4-41P0	1	3.5	5.2	14.032	23.387
GS4-42P0	2	4.6	6.8	10.525	17.541
GS4-43P0	3	6.9	10.3	7.015	11.692
GS4-45P0	5	10.4	14.6	4.677	7.795
GS4-47P5	7.5	14	20	3.508	5.846
GS4-4010	10	21	31	2.338	3.897
GS4-4015	15	28	41	1.755	2.925
GS4-4020	20	37	54	1.315	2.191
GS4-4025	25	44	65	1.107	1.846
GS4-4030	30	52	77	0.936	1.560
GS4-4040	40	73	103	0.701	1.169
GS4-4050	50	N/A	N/A	N/A	N/A
GS4-4060	60	N/A	N/A	N/A	N/A
GS4-4075	75	N/A	N/A	N/A	N/A
GS4-4100	100	N/A	N/A	N/A	N/A
GS4-4125	125	N/A	N/A	N/A	N/A
GS4-4150	150	N/A	N/A	N/A	N/A
GS4-4175	175	N/A	N/A	N/A	N/A
GS4-4200	215	N/A	N/A	N/A	N/A
GS4-4250	250	N/A	N/A	N/A	N/A
GS4-4300	300	N/A	N/A	N/A	N/A

Line Reactor Dimensions

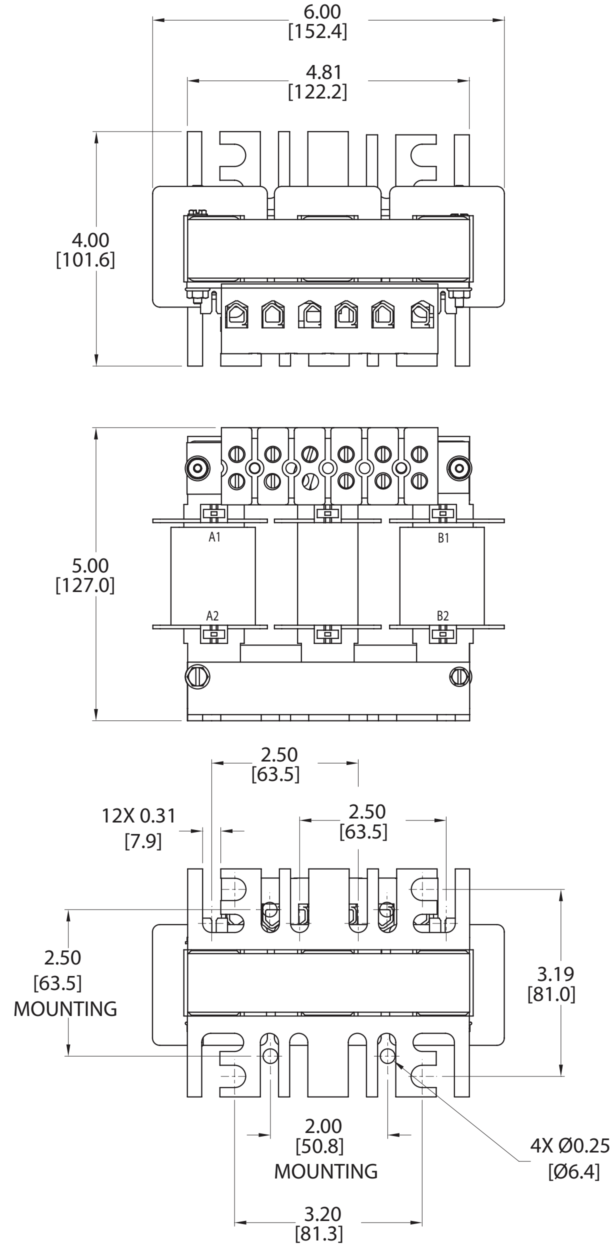
(Units = in [mm])

See our website: www.AutomationDirect.com for complete engineering drawings.

1) LR(2) Line Reactors Dimension Drawing #1
<u>LR-10P2-1PH, LR-10P5-1PH, LR-20P5-1PH, LR-21P0-1PH</u>



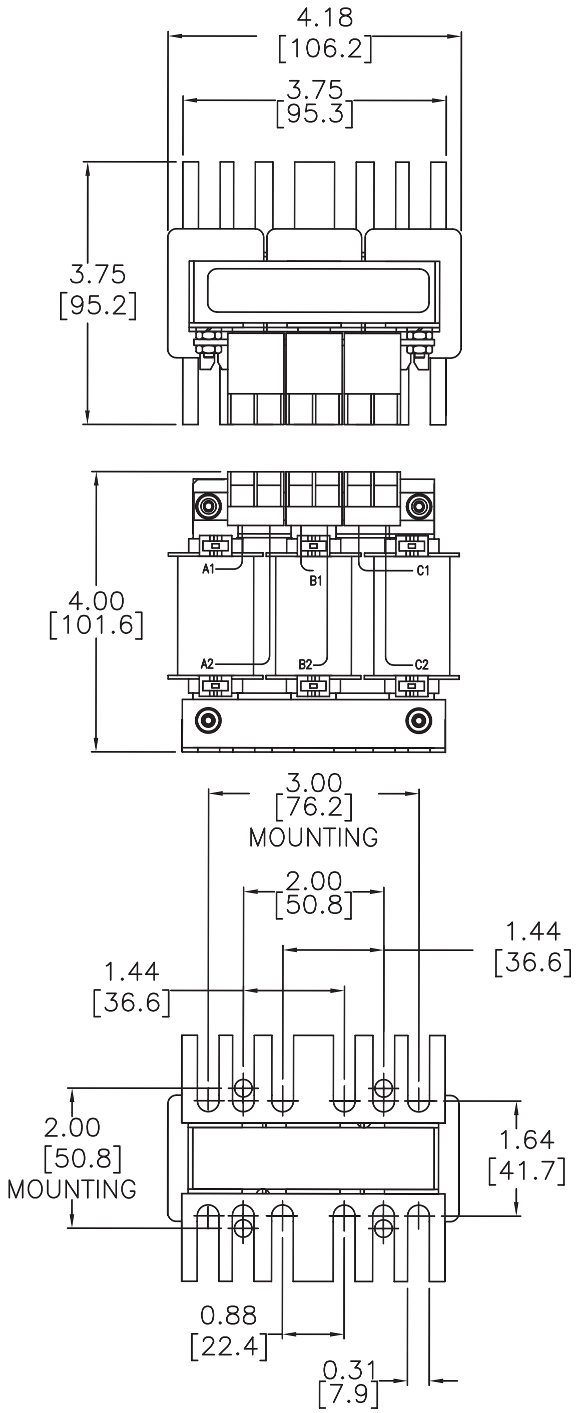
2) LR(2) Line Reactors Dimension Drawing #2
<u>LR-11P0-1PH, LR-22P0-1PH, LR-23P0-1PH</u>



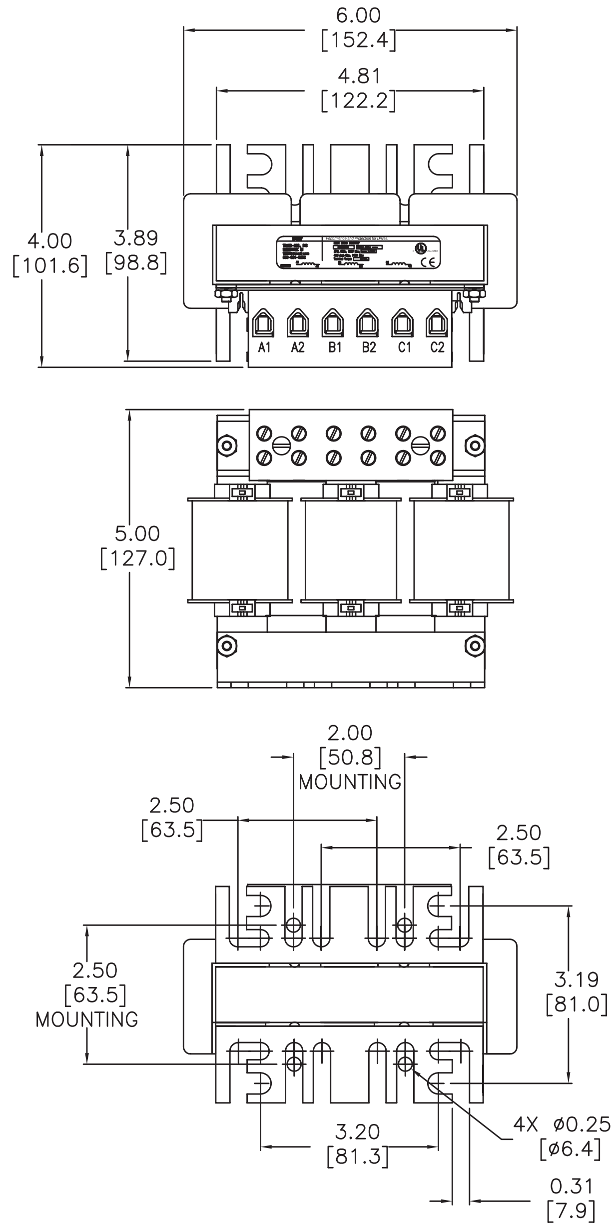
Line Reactor Dimensions (Units = in [mm])

See our website: www.AutomationDirect.com for complete engineering drawings.

3) LR(2) Line Reactors Dimension Drawing #3
LR-20P5, LR-21P0, LR-22P0, LR-23P0, LR-4010, LR-41P0, LR-42P0, LR-43P0, LR-45P0, LR-47P5, LR-5010, LR-51P0, LR-52P0, LR-53P0, LR-55P0



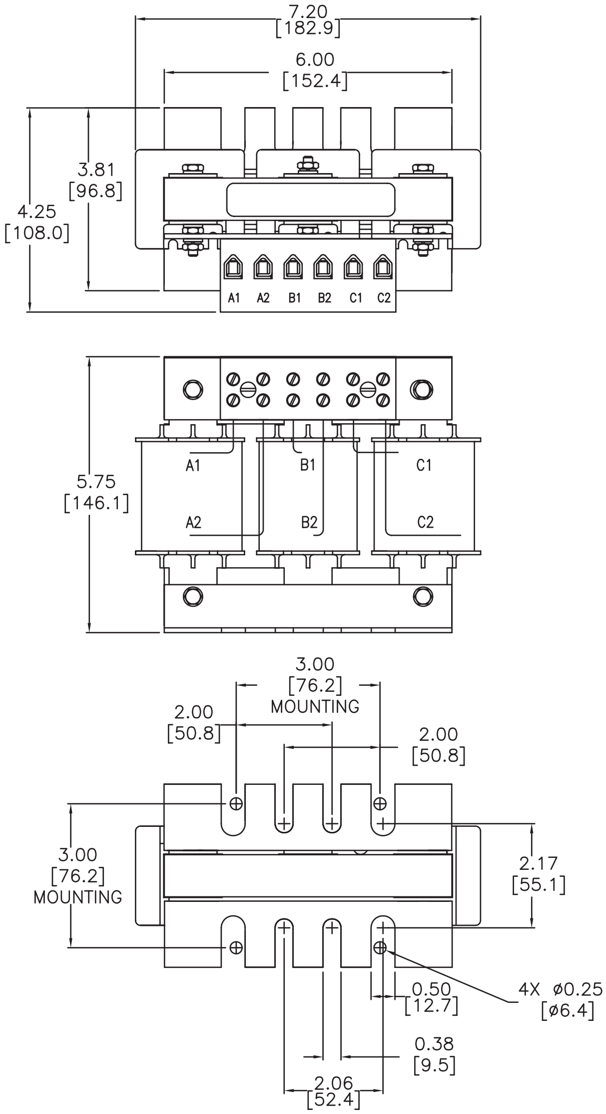
4) LR(2) Line Reactors Dimension Drawing #4
LR-25P0, LR-27P5, LR-4015, LR-4020



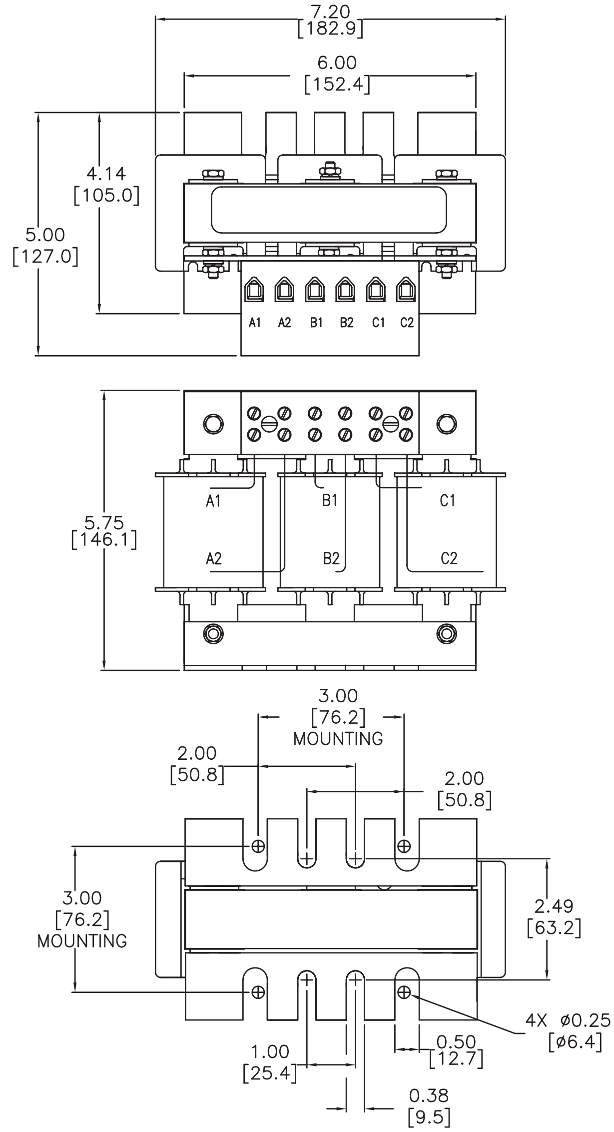
Line Reactor Dimensions *(Units = in [mm])*

See our website: www.AutomationDirect.com for complete engineering drawings.

5) LR(2) Line Reactors Dimension Drawing #5
LR-2010, LR-2015, LR-2020, LR-4025, LR-4030



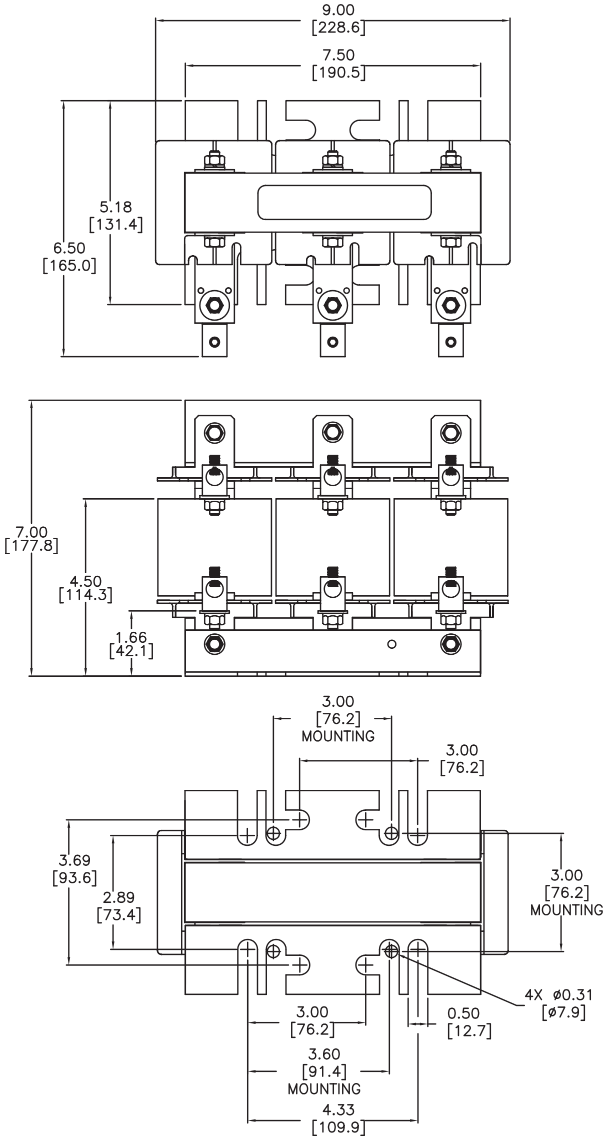
6) LR(2) Line Reactors Dimension Drawing #6
LR-2025, LR-4040



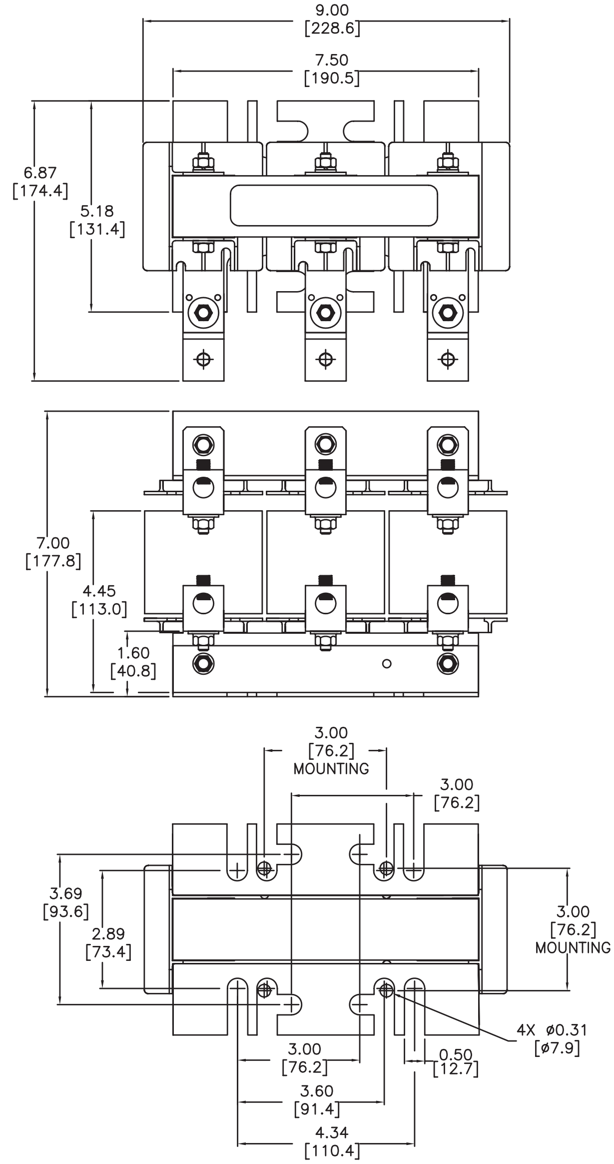
Line Reactor Dimensions (Units = in [mm])

See our website: www.AutomationDirect.com for complete engineering drawings.

7) LR(2) Line Reactors Dimension Drawing #7
LR-2030, LR-2040, LR-4075



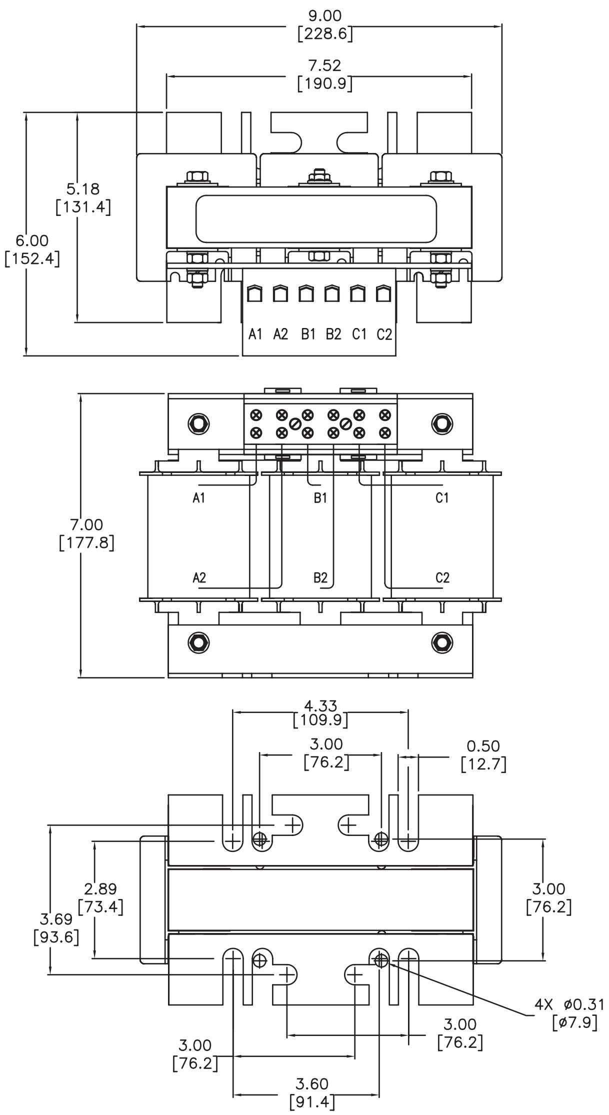
8) LR(2) Line Reactors Dimension Drawing #8
LR-2050



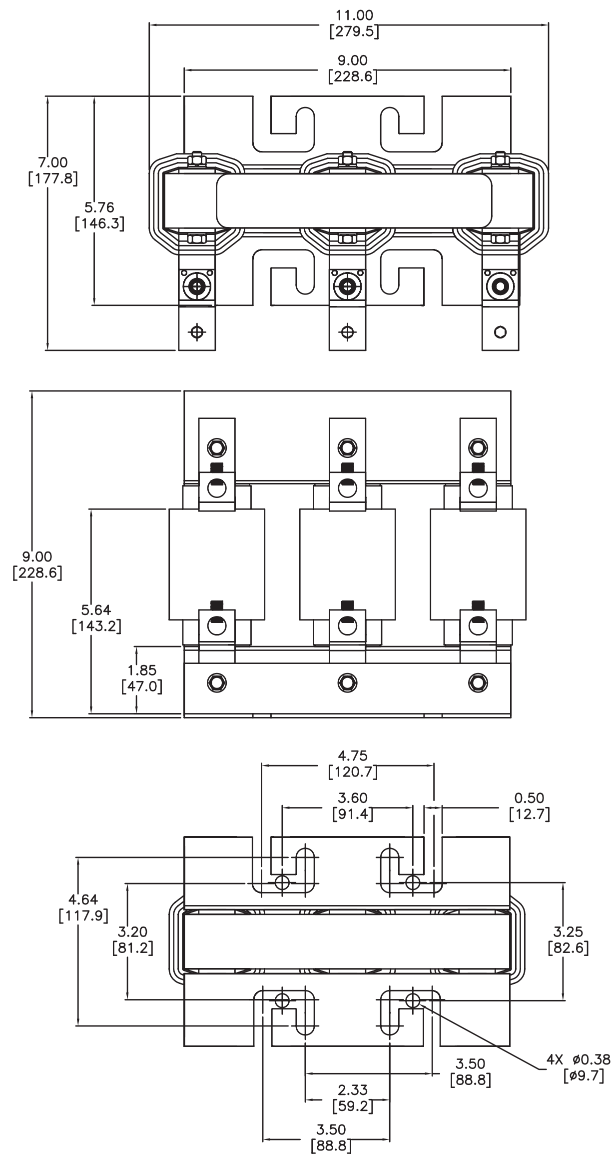
Line Reactor Dimensions (Units = in [mm])

See our website: www.AutomationDirect.com for complete engineering drawings.

9) LR(2) Line Reactors Dimension Drawing #9
LR-4050, LR-4060



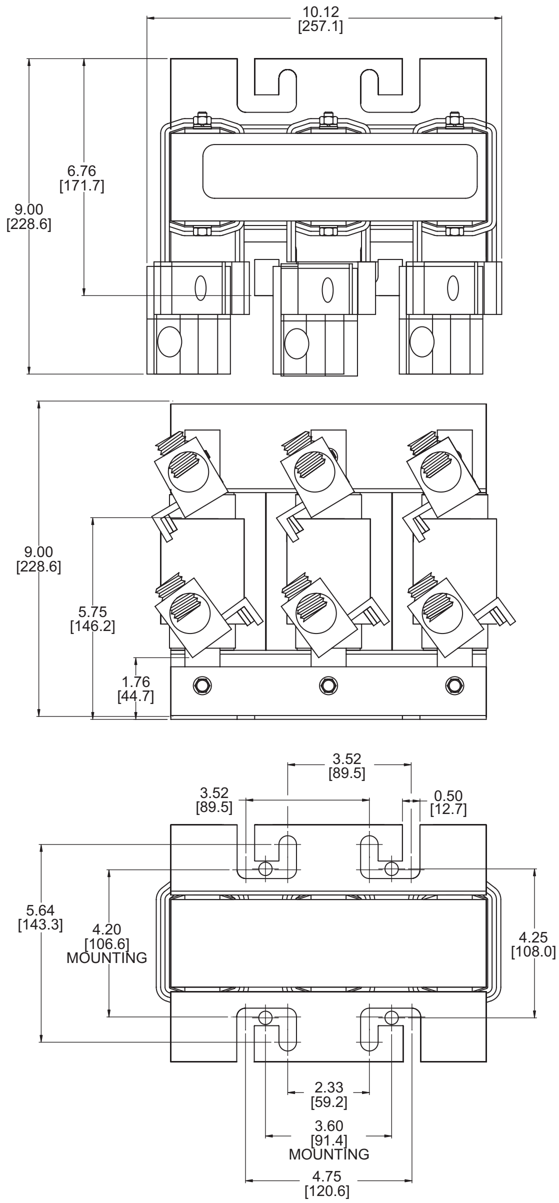
10) LR(2) Line Reactors Dimension Drawing #10
LR-4100, LR-4125, LR-4150



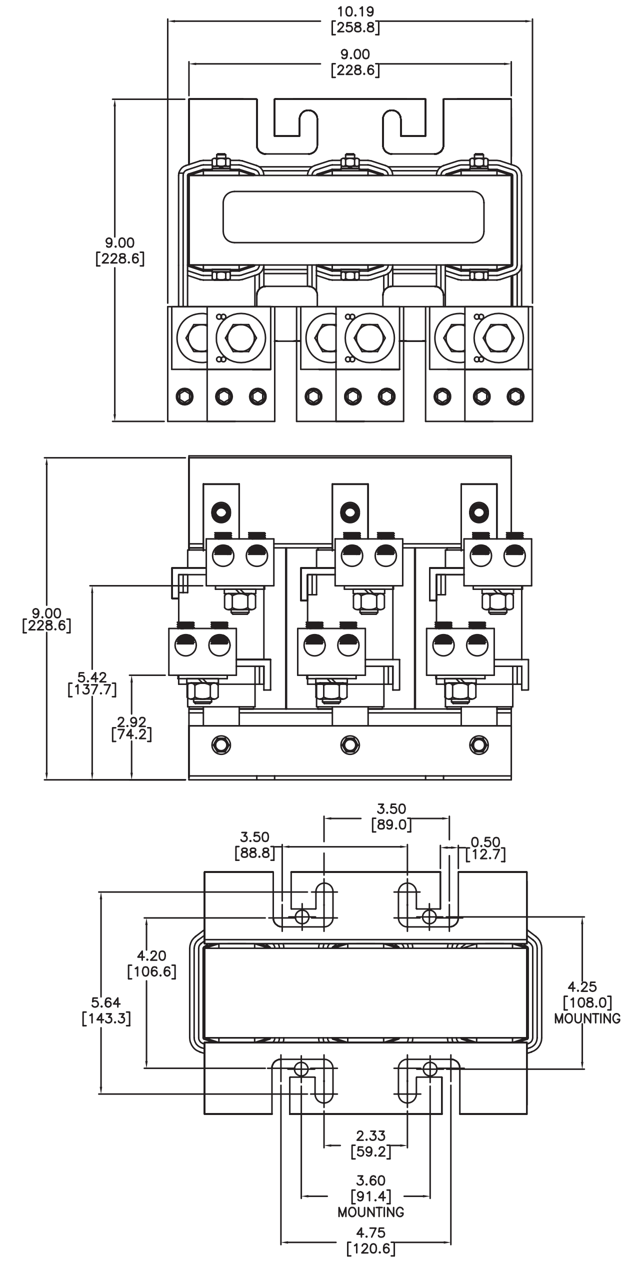
Line Reactor Dimensions (Units = in [mm])

See our website: www.AutomationDirect.com for complete engineering drawings.

11) LR(2) Line Reactors Dimension Drawing #11
LR-4200



12) LR(2) Line Reactors Dimension Drawing #12
LR-4250, LR-4300

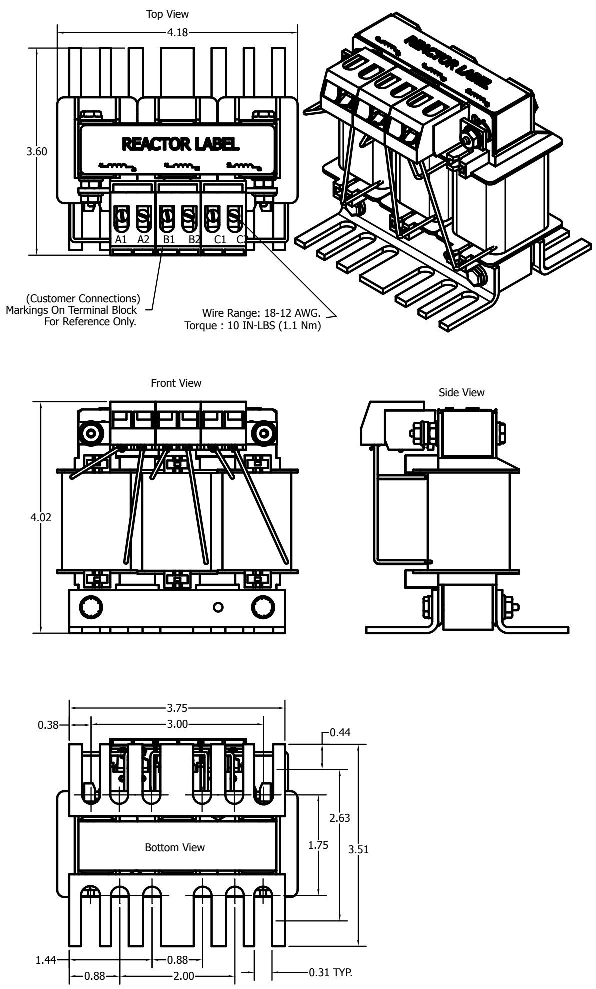


Line Reactor Dimensions (Units = in [mm])

See our website: www.AutomationDirect.com for complete engineering drawings.

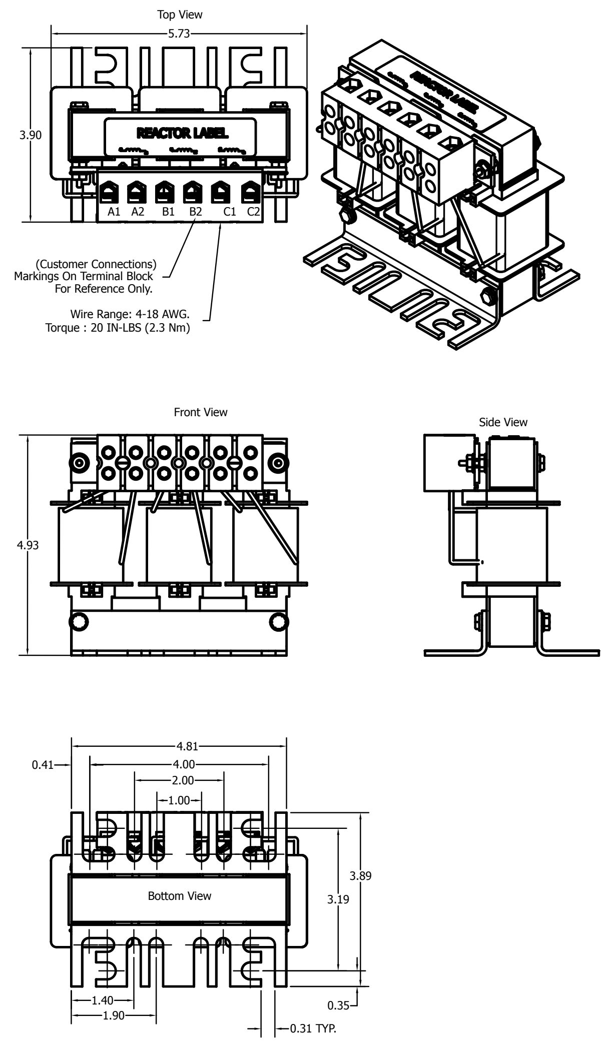
13) LR(2) Line Reactors Dimension Drawing #13

LR2-10P2-1PH, LR2-10P5-1PH, LR2-21P0-1PH, LR2-21P5-1PH



14) LR(2) Line Reactors Dimension Drawing #14

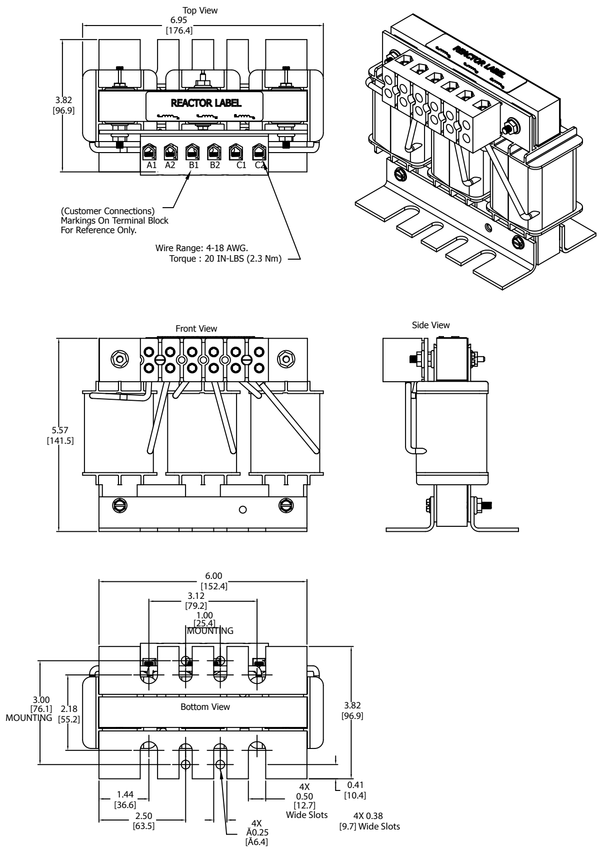
LR2-11P0-1PH, LR2-22P0-1PH



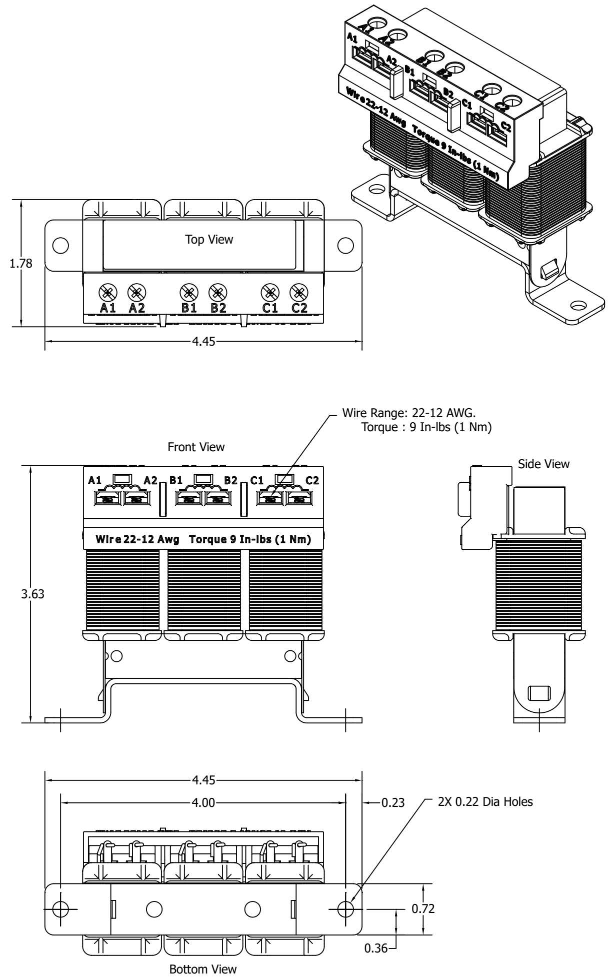
Line Reactor Dimensions (Units = in [mm])

See our website: www.AutomationDirect.com for complete engineering drawings.

15) LR(2) Line Reactors Dimension Drawing #15
<u>LR2-11P5-1PH</u>



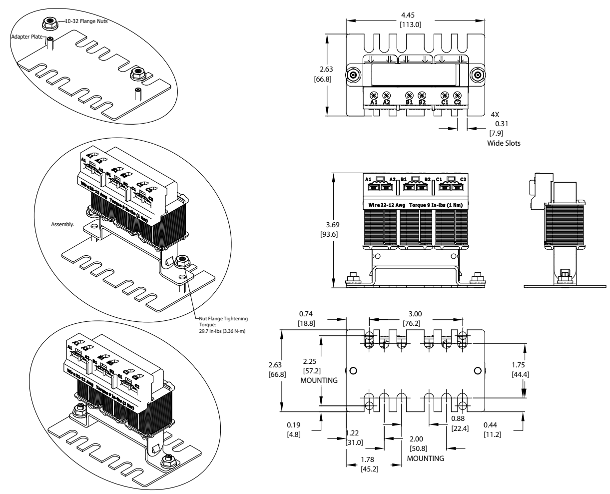
16) LR(2) Line Reactors Dimension Drawing #16
<u>LR2-20P2-1PH, LR2-20P2, LR2-20P5, LR2-40P2, LR2-40P3, LR2-40P5, LR2-40P7, LR2-41P0, LR2-41P5, LR2-42P0, LR2-43P0, LR2-51P0, LR2-51P5, LR2-52P0</u>



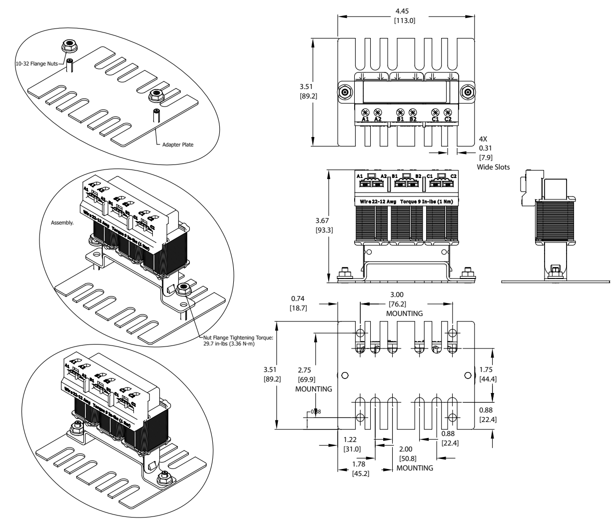
Line Reactor Dimensions (Units = in [mm])

See our website: www.AutomationDirect.com for complete engineering drawings.

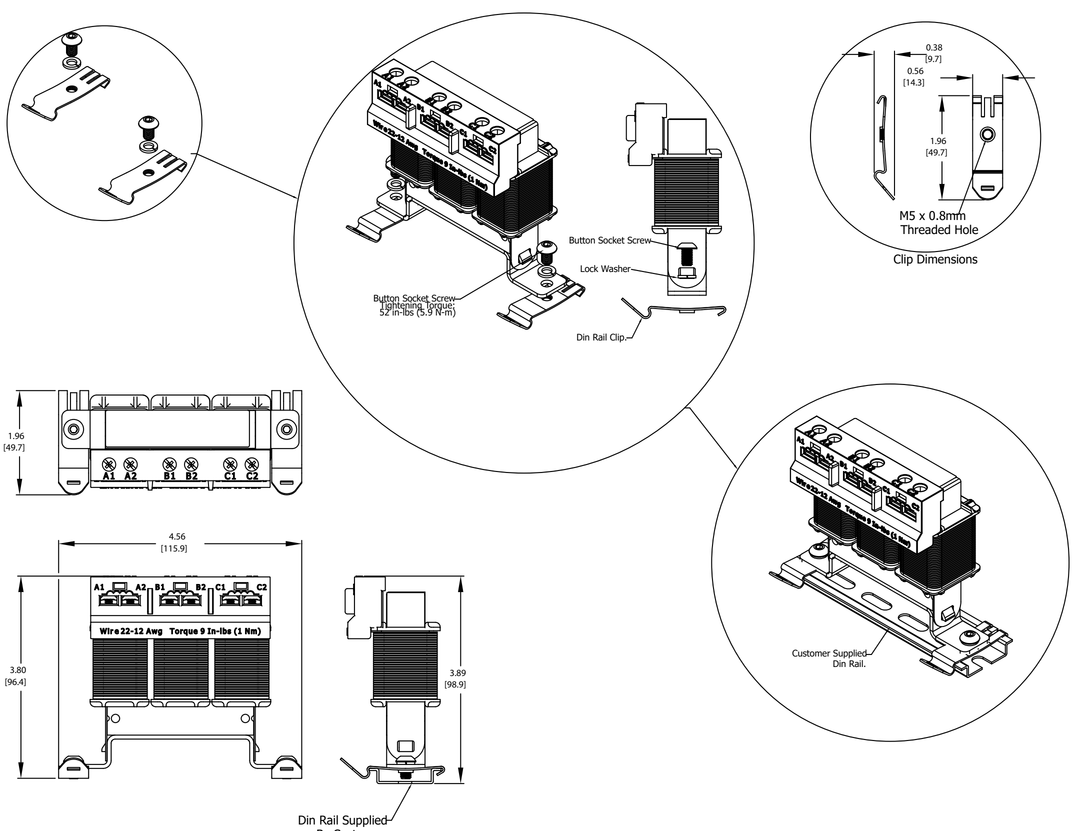
16a) LR(2) Line Reactors Dimension Drawing #16a
LR2-AP1 Adapter Plate for Universal Mounting for:
LR2-20P2-1PH, LR2-20P2, LR2-20P5, LR2-40P2, LR2-40P3, LR2-40P5, LR2-40P7, LR2-41P0, LR2-41P5, LR2-42P0, LR2-43P0, LR2-51P0, LR2-51P5, LR2-52P0



16b) LR(2) Line Reactors Dimension Drawing # 16b
LR2-AP2 Adapter Plate for Universal Mounting for:
LR2-20P2-1PH, LR2-20P2, LR2-20P5, LR2-40P2, LR2-40P3, LR2-40P5, LR2-40P7, LR2-41P0, LR2-41P5, LR2-42P0, LR2-43P0, LR2-51P0, LR2-51P5, LR2-52P0



16c) LR(2) Line Reactors Dimension Drawing #16c
LR2-DR1 Hardware Kit for DIN Rail Mounting for:
LR2-20P2-1PH, LR2-20P2, LR2-20P5, LR2-40P2, LR2-40P3, LR2-40P5, LR2-40P7, LR2-41P0, LR2-41P5, LR2-42P0, LR2-43P0, LR2-51P0, LR2-51P5, LR2-52P0

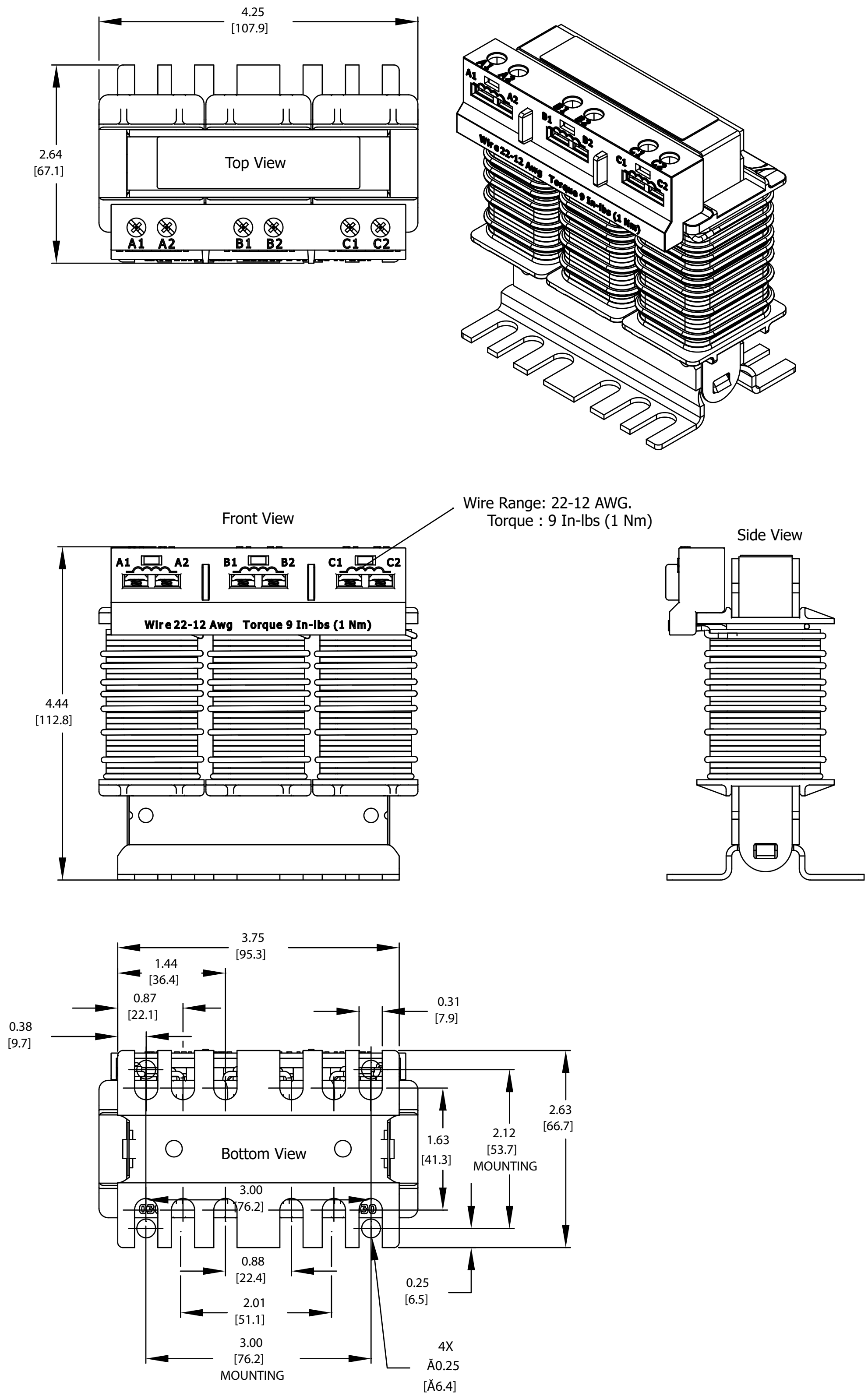


Line Reactor Dimensions (Units = in [mm])

See our website: www.AutomationDirect.com for complete engineering drawings.

17) LR(2) Line Reactors Dimension Drawing #17

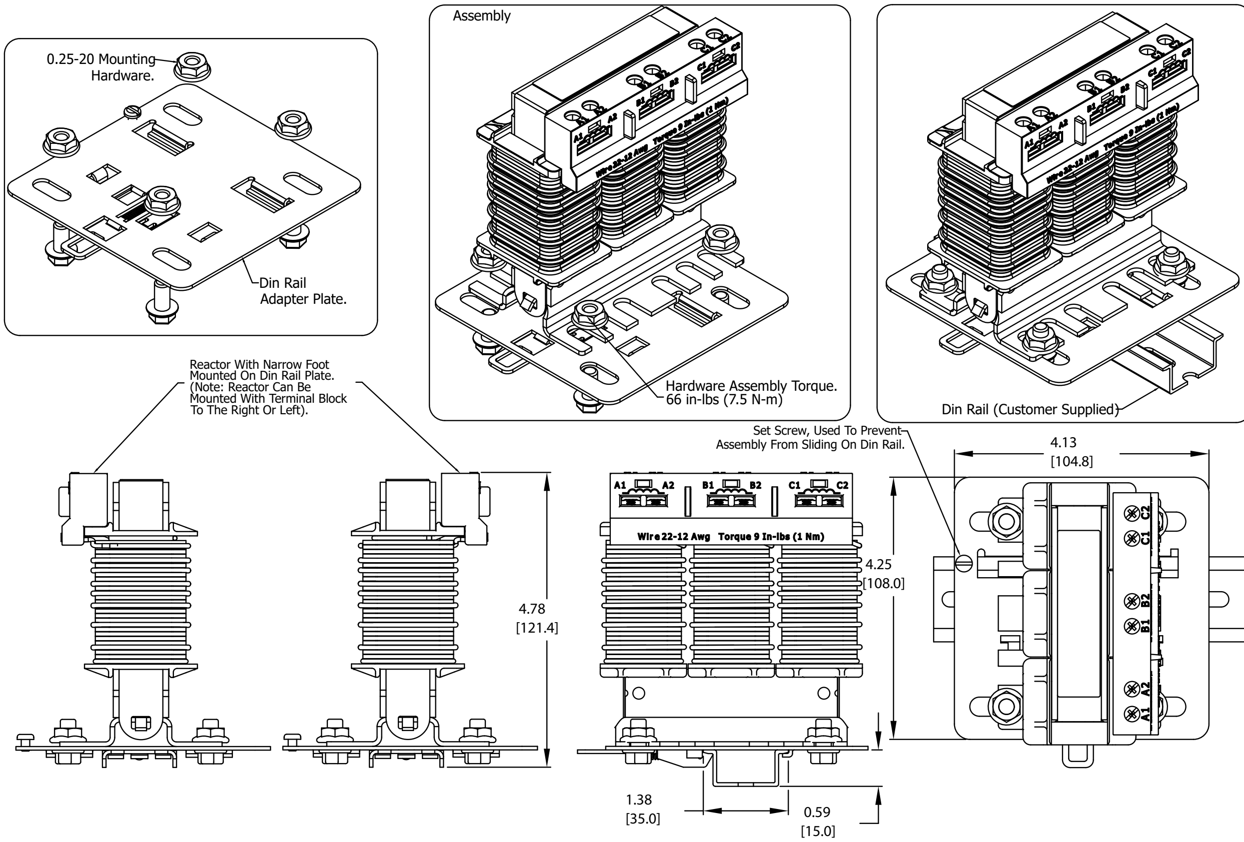
LR2-20P5-1PH, LR2-20P7, LR2-21P0, LR2-21P5, LR2-22P0, LR2-44P0, LR2-45P0, LR2-47P5, LR2-53P0, LR2-54P0, LR2-55P0, LR2-57P5



Line Reactor Dimensions (Units = in [mm])

See our website: www.AutomationDirect.com for complete engineering drawings.

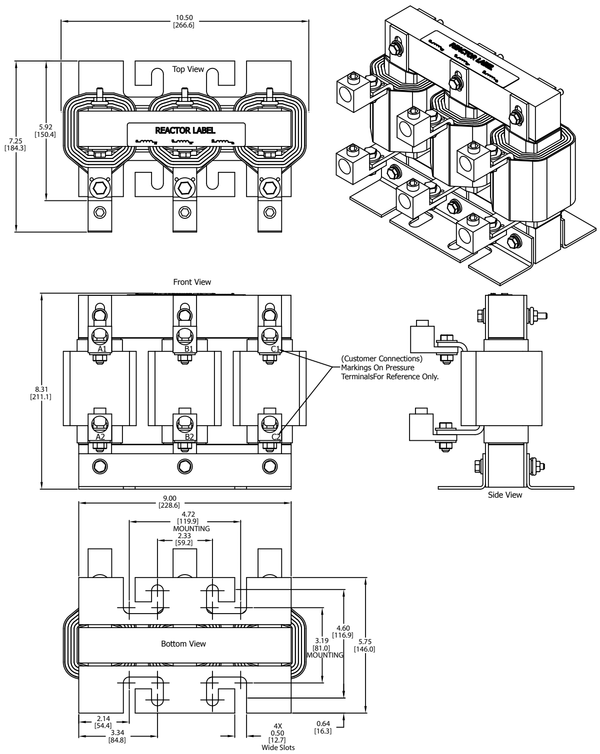
17a) LR(2) Line Reactors Dimension Drawing #17a
LR2-DR2 Hardware Kit for DIN Rail Mounting for:
LR2-20P5-1PH, LR2-20P7, LR2-21P0, LR2-21P5, LR2-22P0, LR2-44P0, LR2-45P0, LR2-47P5, LR2-53P0, LR2-54P0, LR2-55P0, LR2-57P5



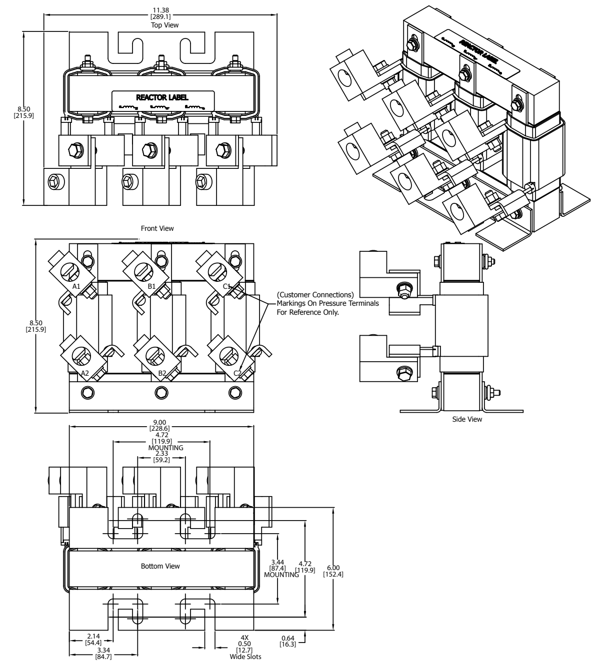
LINE REACTOR DIMENSIONS (Units = in [mm])

See our website: www.AutomationDirect.com for complete engineering drawings.

18) LR(2) Line Reactors Dimension Drawing #18
LR-2060



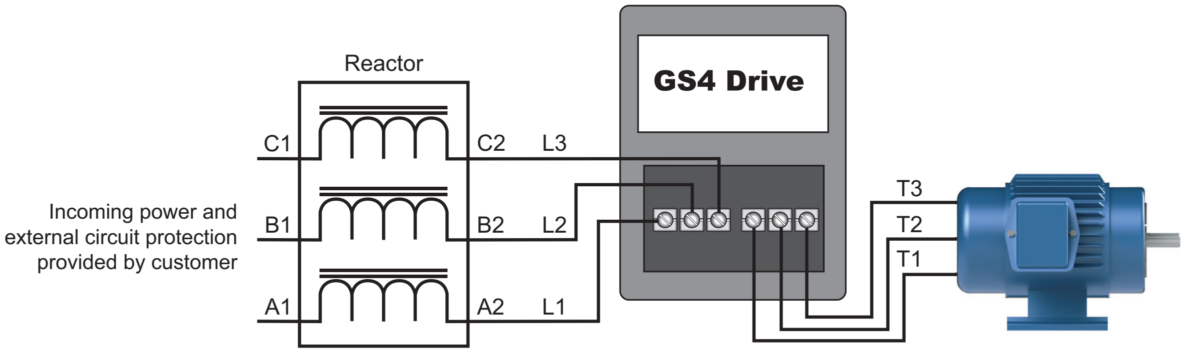
19) LR(2) Line Reactors Dimension Drawing #19
LR2075, LR2100



Line Reactor Applications and Wiring Connections

Input Side of AC Drive

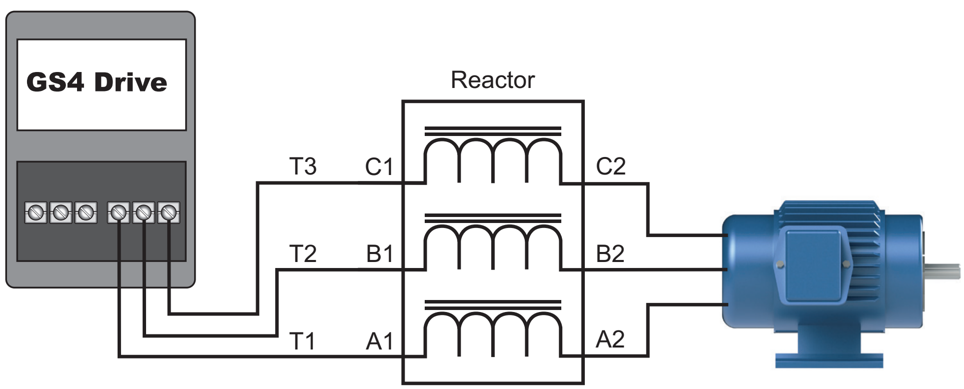
When installed on the input side of the GS4 drive, a line reactor will reduce line notching, current peaks, voltage spikes and surges from the incoming line, as well as reduce the available short circuit current. A line reactor will also reduce harmonic distortion from the GS4 drive onto the line. The line reactor is installed in front of the GS4 drive as shown.



Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS4 drive.

Output Side of AC Drive

When installed on the output side of the GS4 drive, line (load) reactors help to protect the GS4 drive from short circuits at the load. Voltage and current waveforms from the GS4 drive are enhanced, reducing motor overheating and noise emissions.

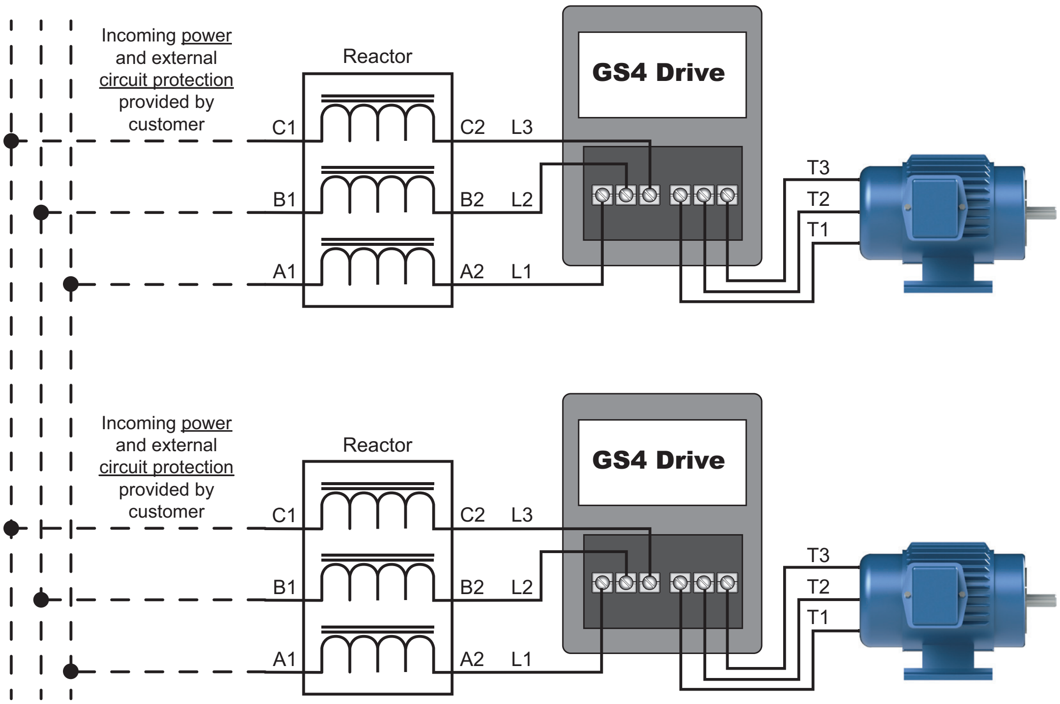


Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS4 drive.

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

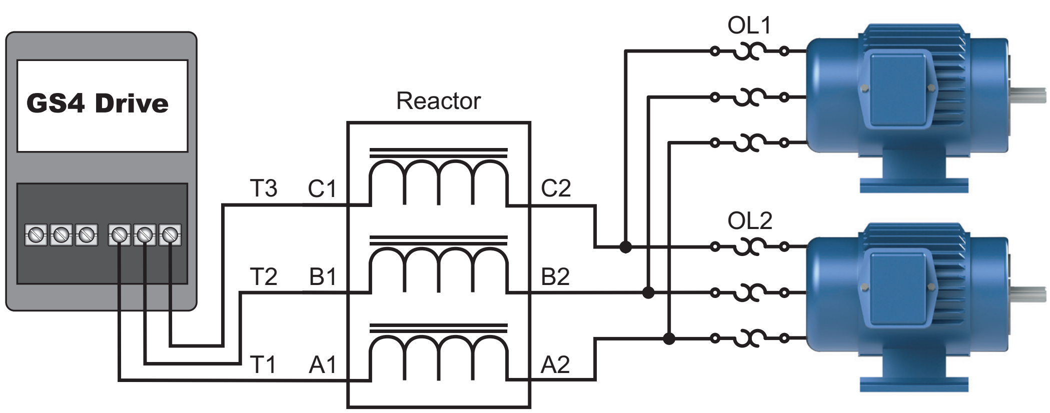
Individual line reactors are recommended when installing multiple GS4 drives on the same power line. Individual line reactors eliminate cross-talk between multiple GS4 drives and provide isolated protection for each GS4 drive for its own specific load.



Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS4 drive.

Multiple Motors

A single output (load) reactor can be used with multiple motors on the same GS4 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.

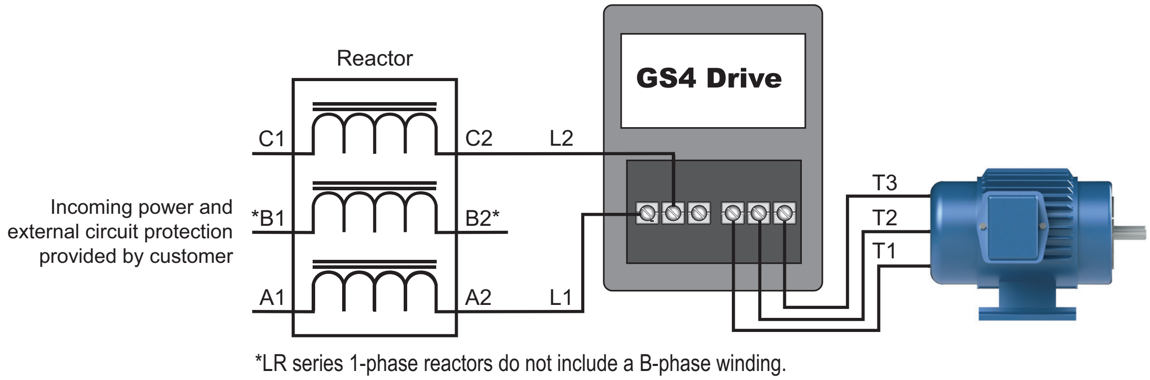


Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS4 drive.

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).



Please refer to "Chapter 2: Installation and Wiring" for detailed wiring information for the GS4 drive.

ENSURE THAT YOU PROPERLY INSULATE TERMINALS B1 AND B2 BEFORE MAKING ANY CONNECTIONS TO SINGLE-PHASE POWER.

DRIVE OUTPUT FILTERS

Extend the life of your motors and cables by reducing the harmful effects of voltage spikes due to voltage wave reflection. Voltage wave reflection is a function of the voltage rise time (dV/dT) and the length of the motor cables.

AutomationDirect VTF series drive output filters protect motors and cables by combining a patented dampening circuit with a low pass filter to increase the voltage rise time (dT out of dV/dT), thereby preventing voltage spikes from exceeding 1,000V.

- *Protect cable runs and reduce motor heating, noise, and vibration.*
- *Prevent motor failure with protection against motor insulation breakdown.*
- *Reduce Common Mode by a minimum of 30%.*
- *Improve system productivity and increase bearing life and up-time.*
- *Protect long lead lengths up to 1,000 feet.*

NOTE: Install Drive Output Filters on the output side of the AC Drive only. The Output Filters are to provide a dV/dT solution for leads up to 1,000 ft. For lengths in excess of 1000 feet, please consult technical support.

VTF PART NUMBER EXPLANATION

VTF – **xxx** – **xxx**

HP @ corresponding Voltage:
A = 0.25
B = 0.33
C = 0.5
D = 0.75
E = 1
F = 1.5
G = 2
H = 3
J = 5
K = 7.5
L = 10
M = 15
N = 20
P = 25
Q = 30
R = 40
S = 50
T = 60
U = 75
V = 100
W = 125

VOLTAGE:
2 = 220/230/240 VAC
4 = 440/460/480 VAC
6 = 575/600 VAC

SERIES NAME:
VTF = Voltage Time Filter

For example:
Model VTF-246-SVW is a Voltage Time Filter for a 230V/50hp, or 460V/100hp, or 575V/125hp AC Drive

VTF Specifications

Electrical Specifications & Drive Compatibility

VTF Series Drive Output Filters – Electrical Specifications & Drive Compatibility

Part Number	Rated HP 230V	Rated HP 460V	Rated HP 575V	Max Rated Amps	Max Rated Voltage	Phases	GS4 Drive * w 1Ø Input	GS4 Drive * w 3Ø Input	Drive HP
VTF-46-DE	–	0.75	1	2	600	3	–	–	–
VTF-246-CFG	0.5	1.5	2	3			GS4-21P0 –	– GS4-41P0	0.5 1
VTF-246-DGH	0.75	2	3	4			GS4-22P0 –	– GS4-42P0	0.75 2
VTF-24-FH	1.5	3	–	6			GS4-23P0 –	GS4-21P0 GS4-43P0	1 3
VTF-246-GJJ	2	5	5	8			GS4-25P0 –	GS4-22P0 GS4-45P0	2 5
VTF-246-HKL	3	7.5	10	12			GS4-27P5 GS4-2010 –	GS4-23P0 – GS4-47P5	3 3 7.5
VTF-24-JL	5	10	–	16			–	–	–
VTF-46-LM	–	10	15	18			GS4-2015 –	GS4-25P0 GS4-4010	5 10
VTF-4-M	–	15	–	21			–	GS4-4015	15
VTF-246-KMN	7.5	15	20	25			GS4-2020 –	GS4-27P5 GS4-2010	7.5 10
VTF-46-NP	–	20	25	27			–	GS4-4020	20
VTF-246-LPQ	10	25	30	35			GS4-2025 GS4-2030 GS4-2040 GS4-2050 –	– – – – GS4-4025	10 10 10 10 25
VTF-246-MQR	15	30	40	45			–	GS4-4030	30
VTF-246-NRS	20	40	50	55			GS4-2060 –	GS4-2015 GS4-4040	15 40
VTF-246-PSU	30	60	75	80			GS4-2075 GS4-2100 – –	GS4-2020 GS4-2025 GS4-4050 GS4-4060	20 25 50 60
VTF-246-RUV	40	75	100	110			– –	GS4-2030 GS4-4075	30 75
VTF-246-SVW	50	100	125	130			–	GS4-2040	40

** VTF drive output filters are not available for GS4-4100 thru -4300, nor for 3Ø input GS4-2050 thru -2100.*

Electrical Specifications & Drive Compatibility

VTF Series Drive Output Filters – Additional Specifications

Part Number	Wire Range (AWG)	Terminal Torque (lb·in)	Fasteners	Weight (lb)	Dimension Drawing #
VTF-46-DE	14–12	10	6/40 x 5/16 flathead	8	1
VTF-246-CFG					
VTF-246-DGH					
VTF-24-FH					
VTF-246-GJJ					
VTF-246-HKL					
VTF-24-JL	12–4	20	1/4-28 x 3/8	12	2
VTF-46-LM	10–4				
VTF-4-M					
VTF-246-KMN	8–4				
VTF-46-NP				14	
VTF-246-LPQ	8–6			17	3
VTF-246-MQR	6				
VTF-246-NRS	4–1				
VTF-246-PSU	3–1	35	n/a (captive)	23	4
VTF-246-RUV	1/0 – 2/0	50	7/16-20 x 9/16	40	5
VTF-246-SVW	2/0			55	6

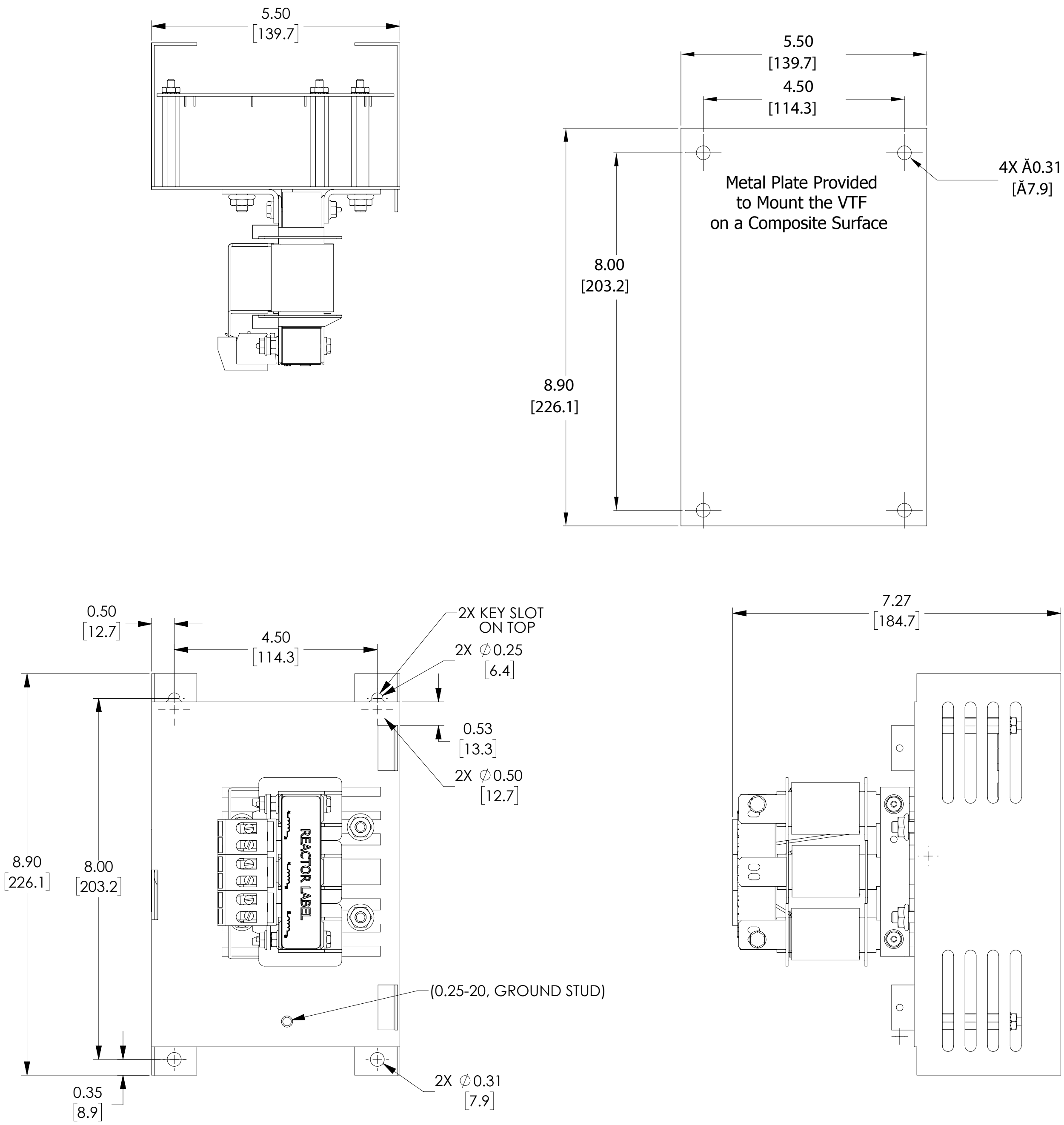
Output Filter Dimensions – VTF Series

1) VTF Filters Dimension Drawing #1

VTF-46-DE, VTF-246-CFG, VTF-246-DGH, VTF-24-FH, VTF-246-GJJ, VTF-246-HKL

See our website: www.AutomationDirect.com for complete engineering drawings.

(Units = inches [mm])

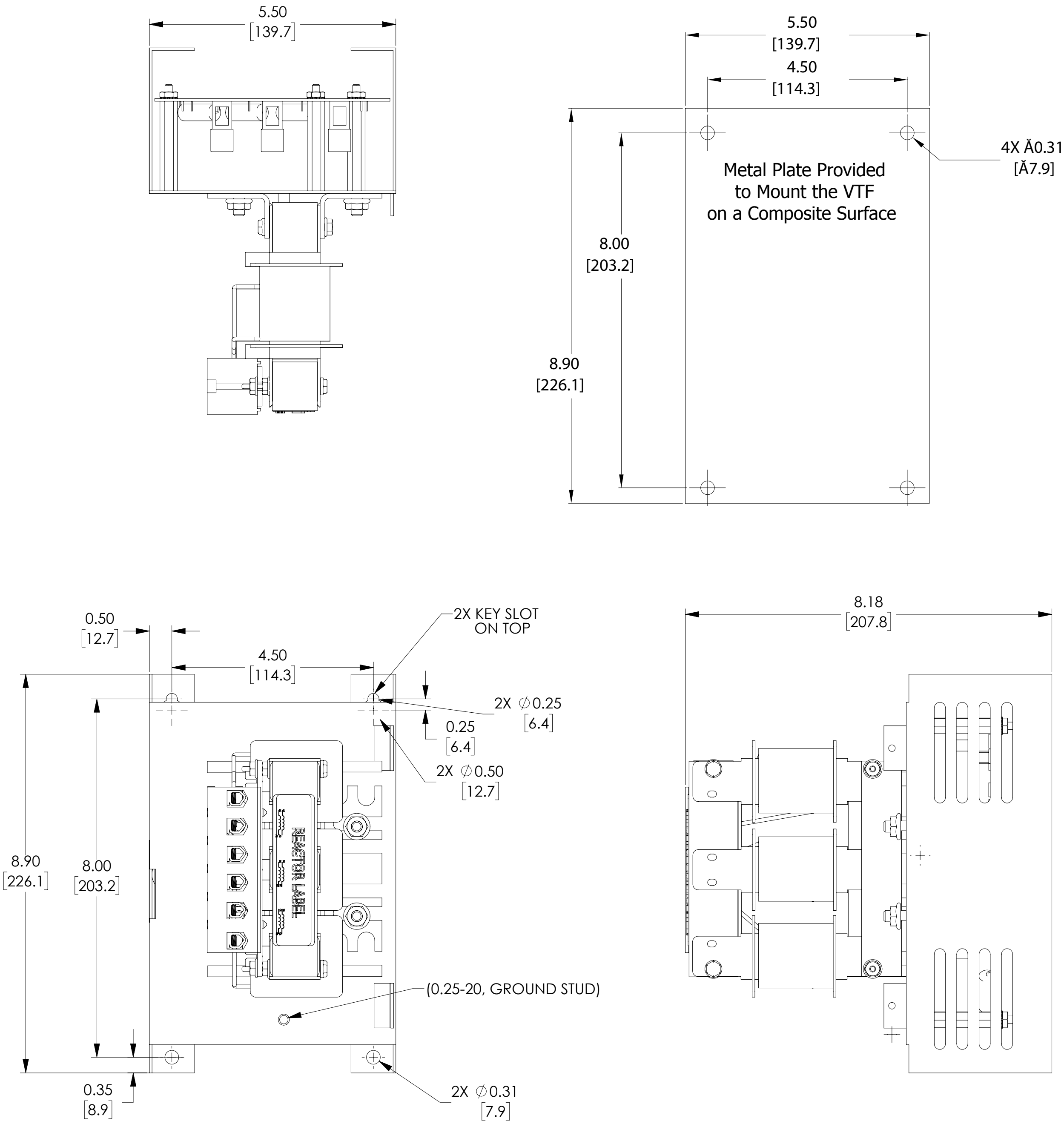


2) VTF Filters Dimension Drawing #2

VTF-24-JL, VTF-246-KMN, VTF-46-LM, VTF-4-M, VTF-46-NP

See our website: www.AutomationDirect.com for complete engineering drawings.

(Units = inches [mm])

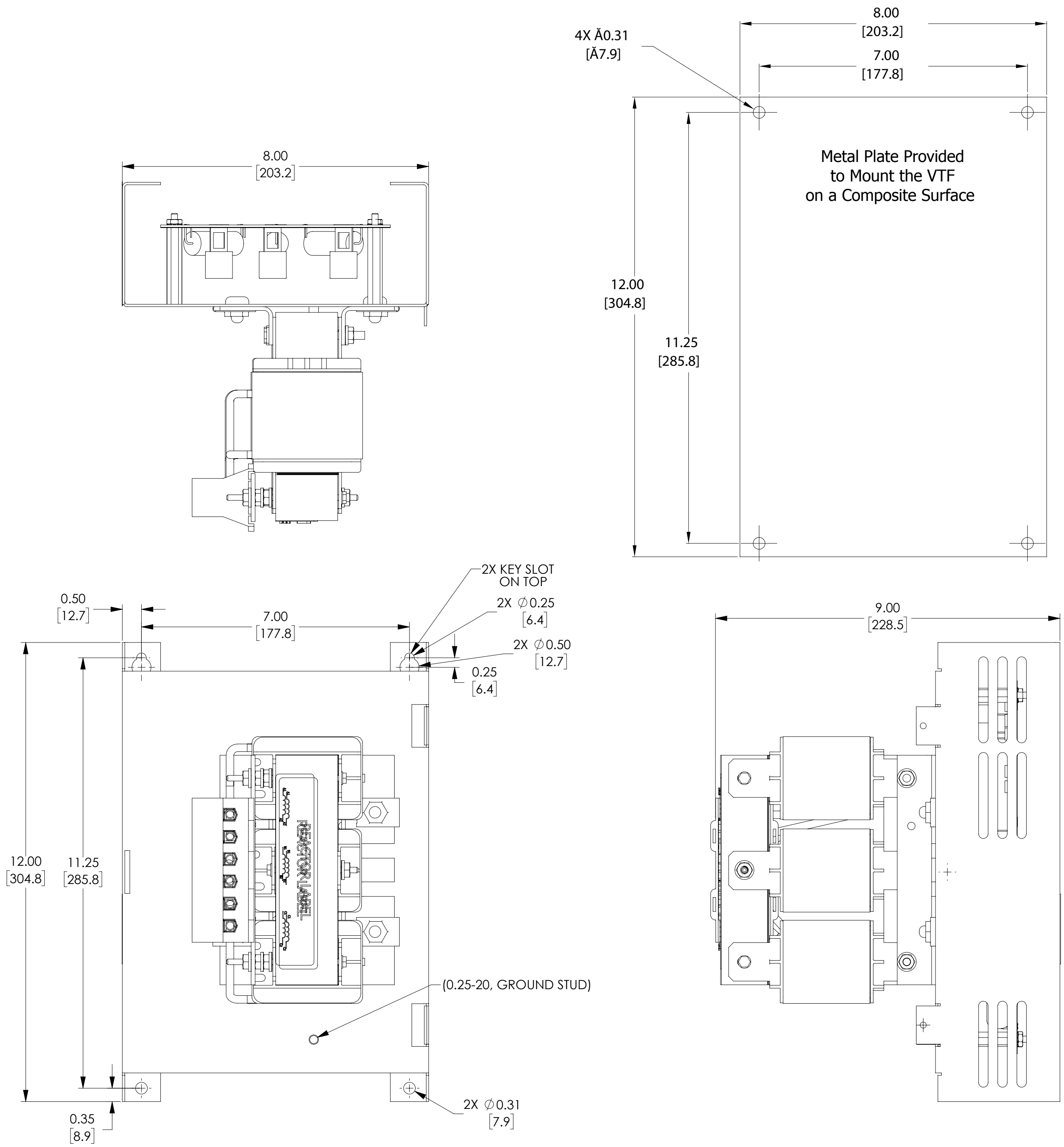


3) VTF Filters Dimension Drawing #3

VTF-246-LPQ, VTF-246-MQR, VTF-246-NRS

See our website: www.AutomationDirect.com for complete engineering drawings.

(Units = inches [mm])

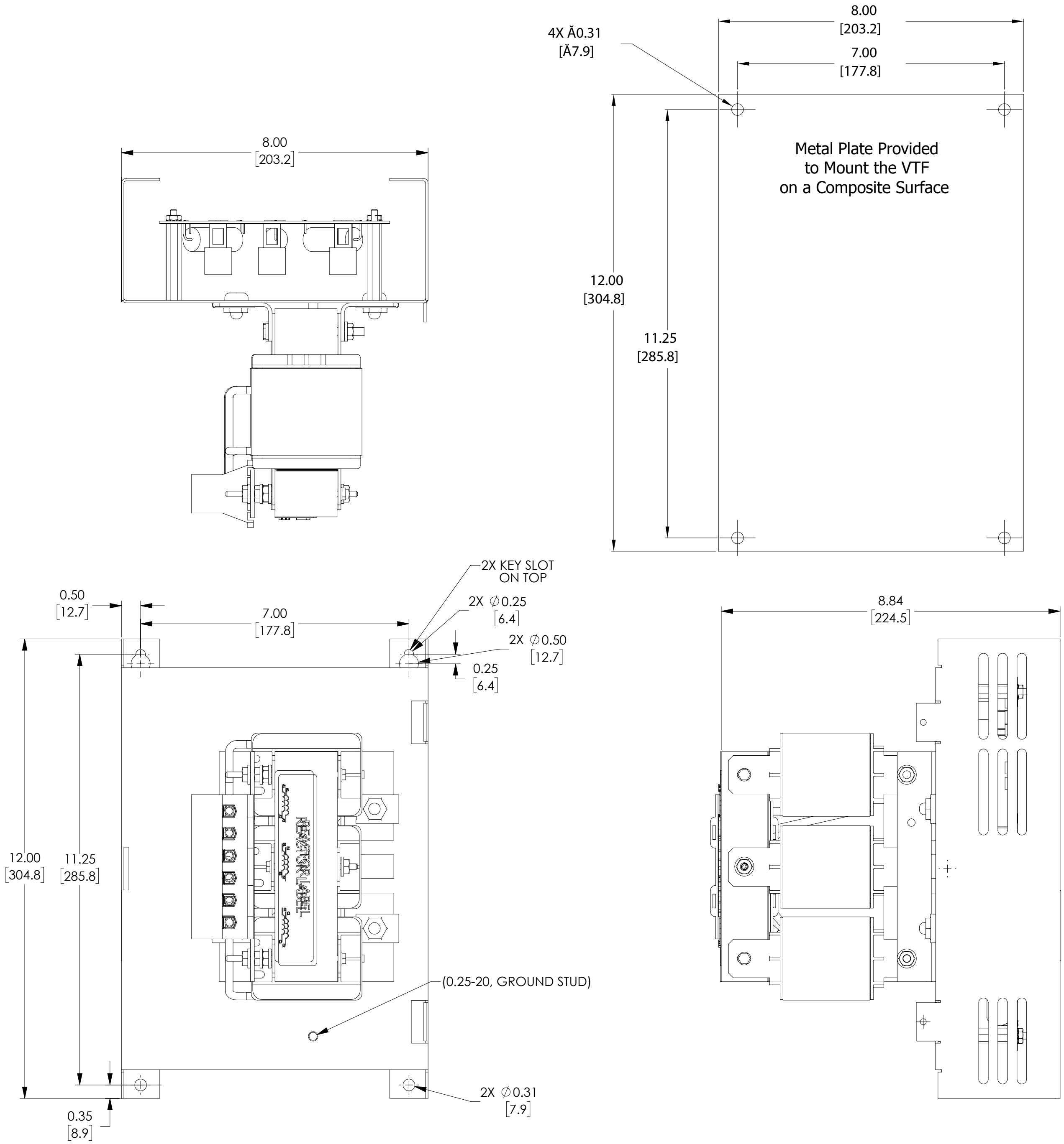


4) VTF Filters Dimension Drawing #4

VTF-246-PSU

See our website: www.AutomationDirect.com for complete engineering drawings.

(Units = inches [mm])

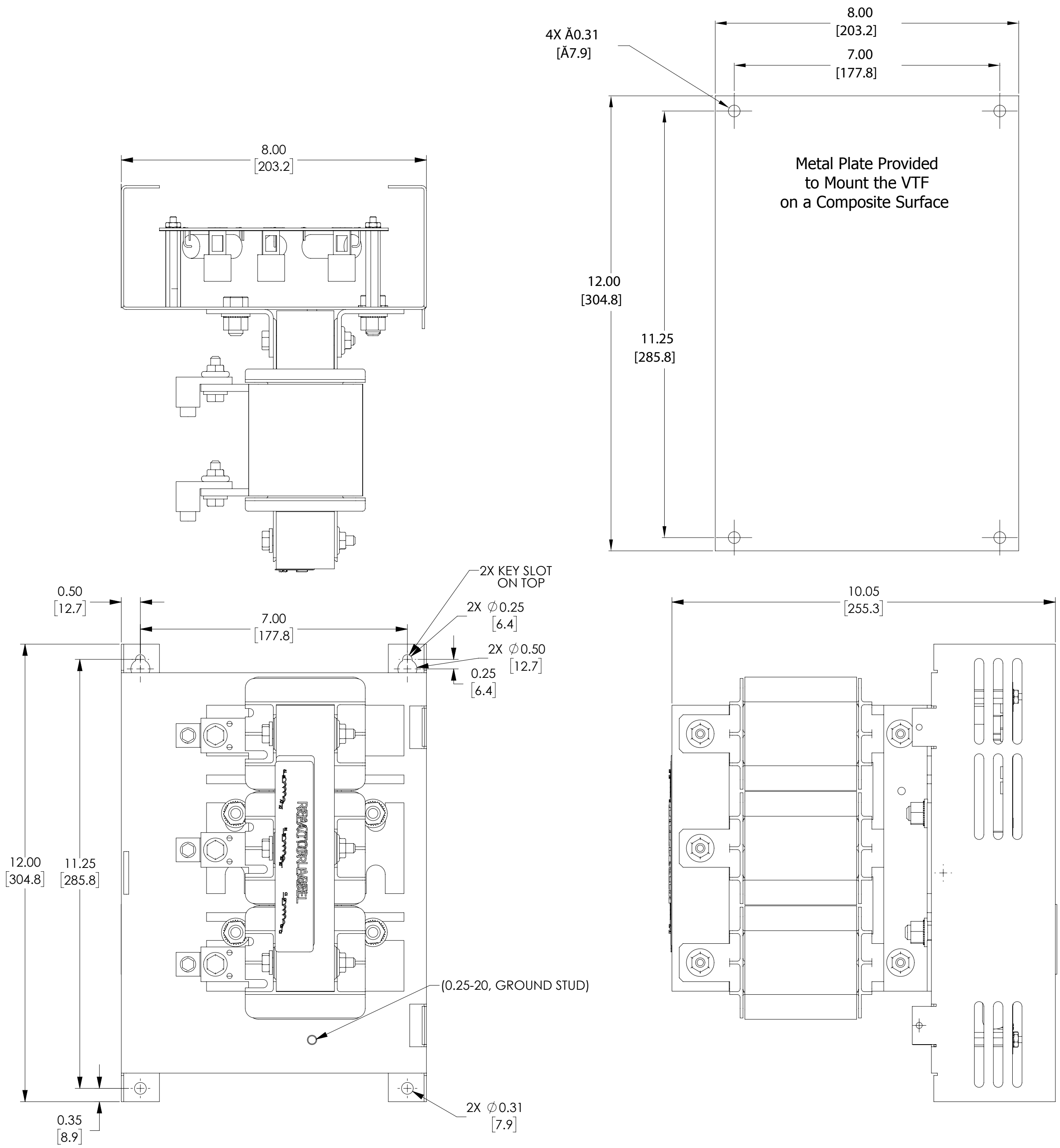


5) VTF Filters Dimension Drawing #5

VTF-246-RUV

See our website: www.AutomationDirect.com for complete engineering drawings.

(Units = inches [mm])

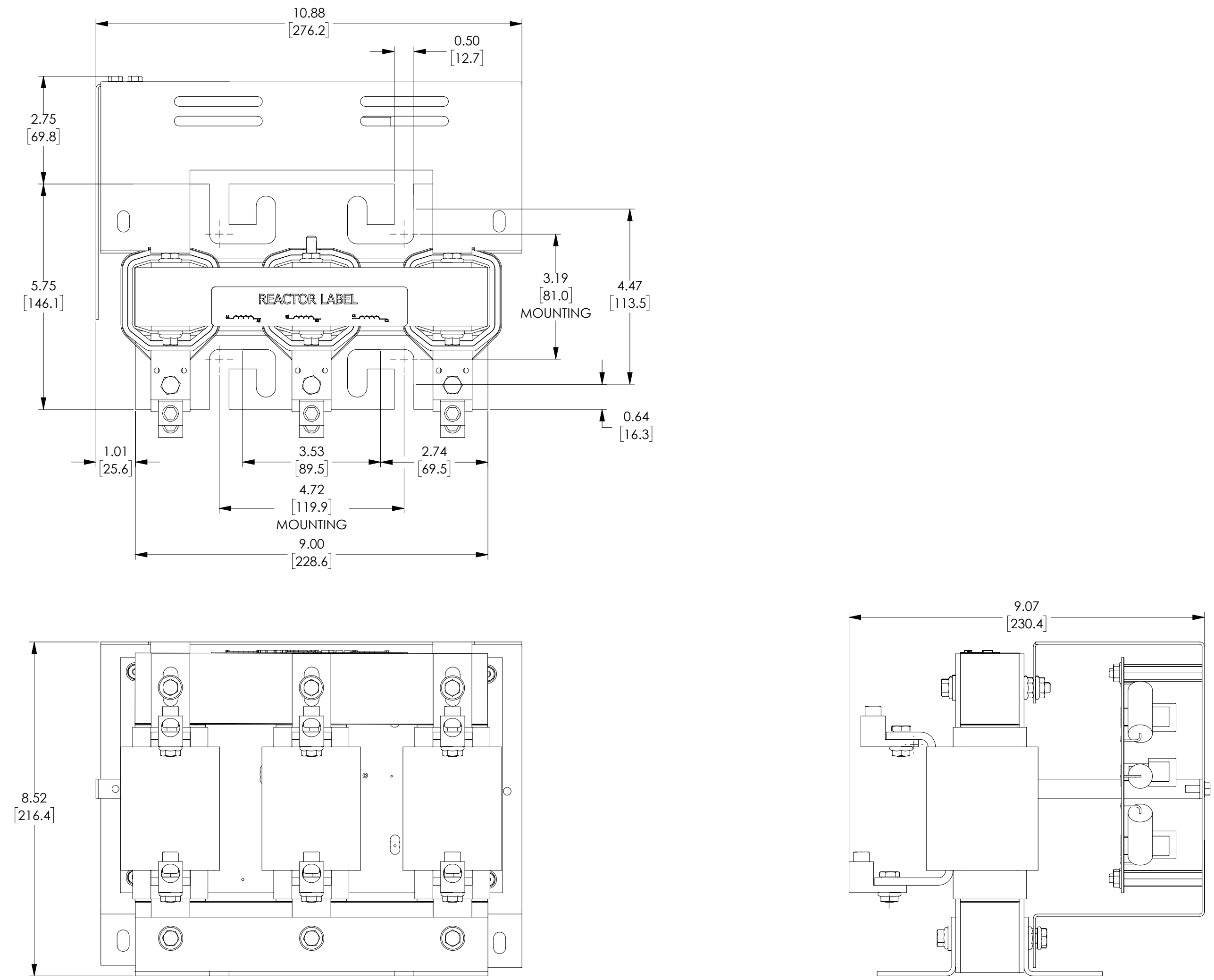


6) VTF Filters Dimension Drawing #6

VTF-246-SVW

See our website: www.AutomationDirect.com for complete engineering drawings.

(Units = inches [mm])



EMI Input Filters

The optional accessories listed in this chapter are available for use with the GS4 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."

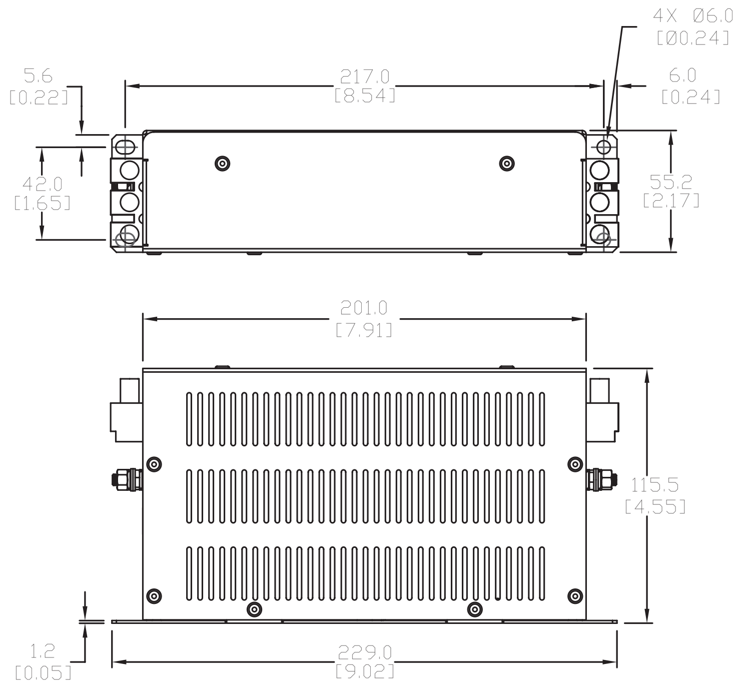
EMI Filters Selection					
Model*	***Description***	***EMI Filter***	***Max Power kW (max/ph)***	***Max Terminal Torque N·m [lb·in]***	***SCCR Rating (kA)***
GS4-41P0	460V 3ph 1.0 hp	***KMF318A***	14.9 / 4.3	2 [17.7]	5
GS4-42P0	460V 3ph 2.0 hp				
GS4-43P0	460V 3ph 3.0 hp				
GS4-45P0	460V 3ph 5.0 hp				
GS4-47P5	460V 3ph 7.5 hp				
GS4-21P0	230V 3ph 1.0 hp	***KMF325A***	20.8 / 6	2 [17.7]	5
GS4-22P0	230V 3ph 2.0 hp				
GS4-23P0	230V 3ph 3.0 hp				
GS4-25P0	230V 3ph 5.0 hp				
GS4-4010	460V 3ph 10hp	***KMF350A***	41.5 / 12	5 [44.3]	10
GS4-4015	460V 3ph 15hp				
GS4-4020	460V 3ph 20hp				
GS4-27P5	230V 3ph 7.5 hp	***KMF370A***	58.1 / 16.8	5 [44.3]	5
GS4-2010	230V 3ph 10hp				
GS4-2015	230V 3ph 15hp				
GS4-4025	460V 3ph 25hp				
GS4-4030	460V 3ph 30hp				
GS4-4040	460V 3ph 40hp				
GS4-2020	230V 3ph 20hp	***KMF3100A***	83 / 24	5 [44.3]	10
GS4-2025	230V 3ph 25hp				
GS4-2030	230V 3ph 30hp				
GS4-4050	460V 3ph 50hp	***MIF375***	62.3 / 18	6 [53.1]	10
GS4-4060	460V 3ph 60hp	***MIF3100***	83 / 24	6 [53.1]	10
GS4-2040	230V 3ph 40hp	***MIF3150***	124.6 / 36	20 [177.0]	10
GS4-2050	230V 3ph 50hp				
GS4-4075	460V 3ph 75hp				
GS4-4100	460V 3ph 100hp				
GS4-2060	230V 3ph 60hp	***MIF3400B***	332.2 / 96	30 [265.5]	30
GS4-2075	230V 3ph 75hp				
GS4-2100	230V 3ph 100hp				
GS4-4125	460V 3ph 125hp				
GS4-4150	460V 3ph 150hp				
GS4-4175	460V 3ph 175hp				
GS4-4200	460V 3ph 200hp				
GS4-4250	460V 3ph 250hp	***MIF3800 & Qty. 3 TOR254***	664.3 / 192	30 [265.5]	30
GS4-4300	460V 3ph 300hp				

** EMI filter selections for GS4-2xxx models are the same whether that particular model is supplied 1-Phase or 3-Phase 230VAC.*

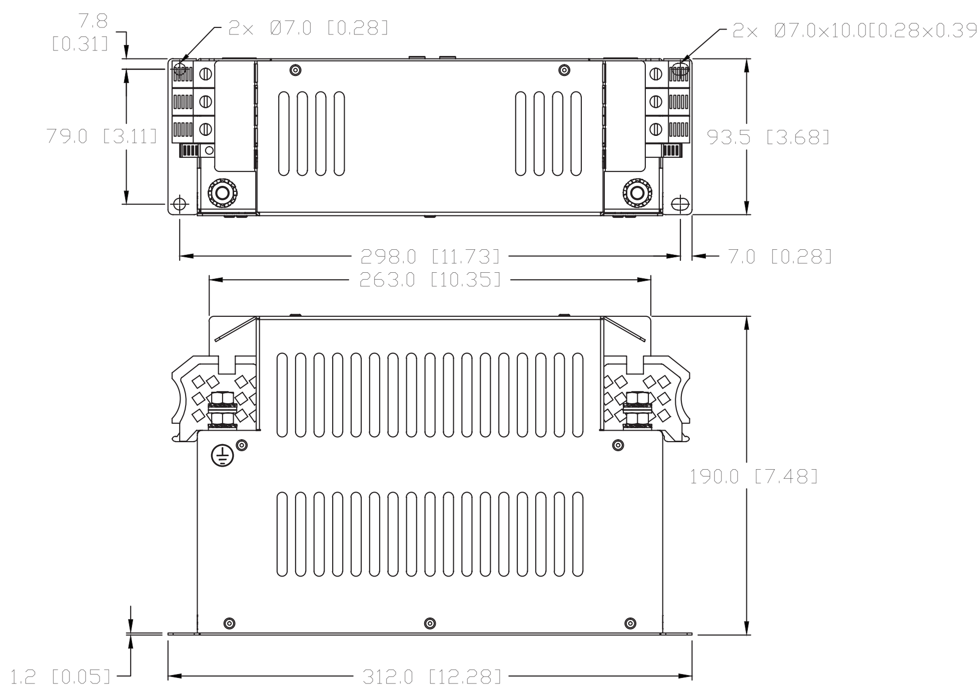
EMI Filter Dimensions

(Units = mm [in])

See our website: www.AutomationDirect.com for complete engineering drawings.



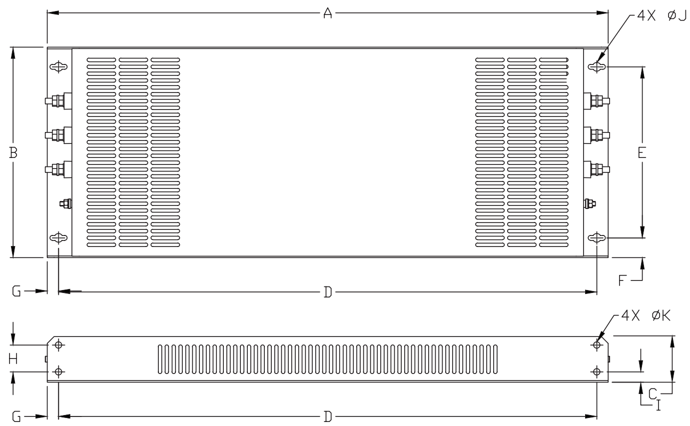
KMF318A KMF325A



KMF350A KMF370A KMF3100A

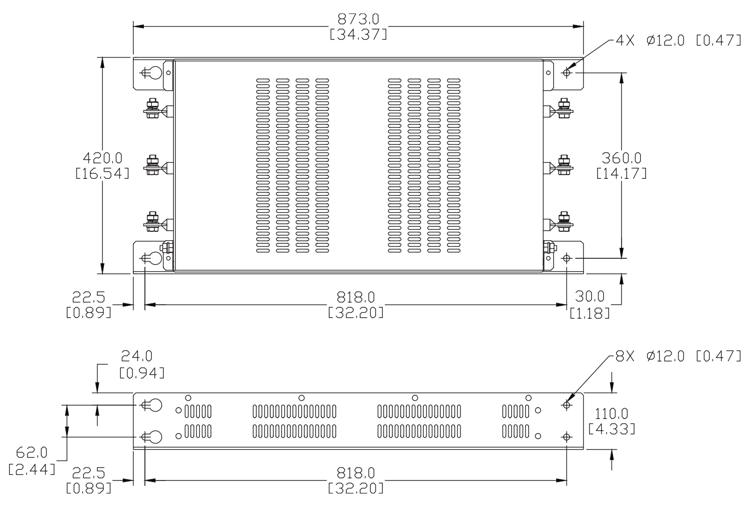
EMI Filter Dimensions (Units = mm [in])

See our website: www.AutomationDirect.com for complete engineering drawings.

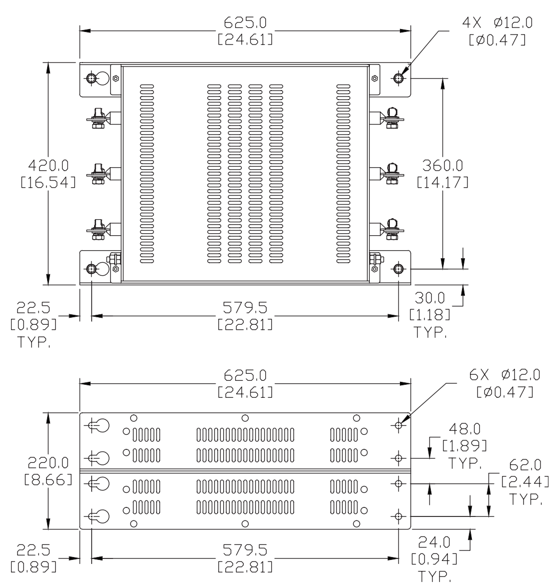


MIF350
MIF375
MIF3150

PART NUMBER	A	B	C	D	E	F	G	H	I	ØJ	ØK
MIF375	686.0 [27.00]	260.9 [10.27]	68.2 [2.68]	646.0 [25.42]	192.0 [7.56]	34.5 [1.36]	20.0 [0.79]	35.0 [1.38]	18.2 [0.72]	12.7 [0.50]	9.0 [0.35]
MIF3100	785.0 [30.89]	274.8 [10.81]	80.2 [3.16]	741.0 [29.16]	215.0 [8.46]	29.9 [1.18]	22.0 [0.87]	47.0 [1.85]	18.2 [0.72]	13.0 [0.51]	9.0 [0.35]
MIF3150	984.0 [38.72]	369.0 [14.52]	81.4 [3.20]	944.0 [37.15]	300.0 [11.81]	34.5 [1.36]	20.0 [0.79]	47.0 [1.85]	18.2 [0.72]	15.0 [0.59]	11.0 [0.43]



MIF3400B



MIF3800

EMI Filter Installation

Electrical equipment like the GS4 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 GS4 family of drives and are recommended for the mitigation of interference and the highest performance (Please refer to the “Input Side of AC Drive” section of the “Line Reactor Applications and Wiring Connections” chapter in this appendix.

When the GS4 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 GS4 drive on the same subpanel or metal plate.*
2) *Install the EMI filter as close as possible to the GS4 drive.*
3) *Keep wiring between the EMI filter and GS4 drive as short as possible.*
4) *The subpanel or metal plate used to support the EMI filter and GS4 drive should be well grounded (minimal resistance to ground is typically less then 1Ω).*
5) *To insure that the EMI filter and GS4 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.*

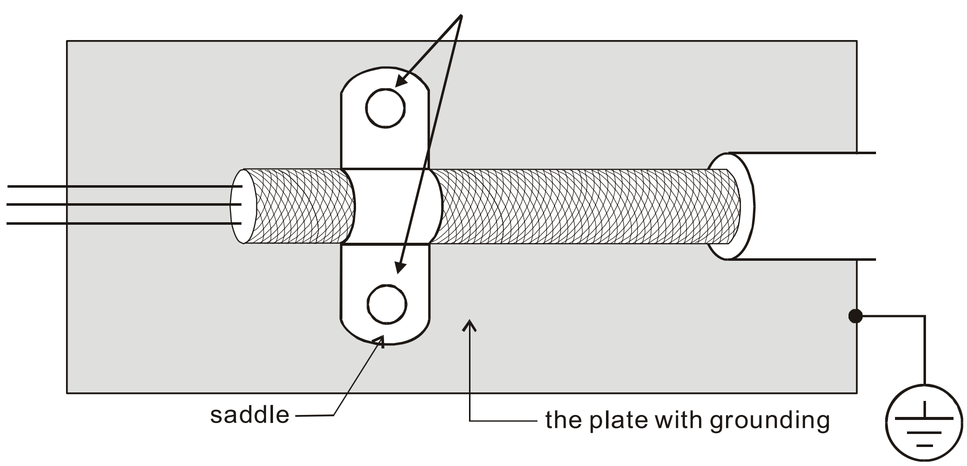


Figure 1

EMI Filter Installation (continued)

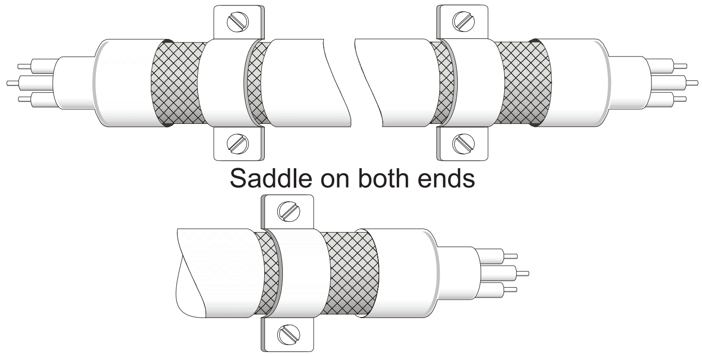


Figure 2

Reflective Wave Phenomenon

The inverter section of a PWM drive like the GS4 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 GS4 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 GS4 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 GS4 drive to each motor.
4) Should an overload relay malfunction occur, lower the GS4 drive carrier frequency (P2.10) or install an output reactor.
5) When operating an AC motor with a PWM drive like the GS4, 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 the following Recommended Cable Length tables.

Motor Cable Length Charts

Maximum Recommended Cable Length - GS4 - Supplied 230VAC, Single Phase						
GS4 Model	kW	hp	Without Output AC Reactor (ft [m])		With 3% Output AC Reactor (ft [m])	
			Shielded Cable	Unshielded Cable	Shielded Cable	Unshielded Cable
GS4-21P0	0.37	0.5	164 [50]	246 [75]	246 [75]	377 [115]
GS4-22P0	0.55	0.75	164 [50]	246 [75]	246 [75]	377 [115]
GS4-23P0	0.75	1	164 [50]	246 [75]	246 [75]	377 [115]
GS4-25P0	1.5	2	164 [50]	246 [75]	246 [75]	377 [115]
GS4-27P5	2.2	3	164 [50]	246 [75]	246 [75]	377 [115]
GS4-2010	2.2	3	164 [50]	246 [75]	246 [75]	377 [115]
GS4-2015	3.7	5	164 [50]	246 [75]	246 [75]	377 [115]
GS4-2020	5.5	7.5	164 [50]	246 [75]	246 [75]	377 [115]
GS4-2025	7.5	10	328 [100]	492 [150]	492 [150]	738 [225]
GS4-2030	7.5	10	328 [100]	492 [150]	492 [150]	738 [225]
GS4-2040	7.5	10	328 [100]	492 [150]	492 [150]	738 [225]
GS4-2050	7.5	10	328 [100]	492 [150]	492 [150]	738 [225]
GS4-2060	11	15	328 [100]	492 [150]	492 [150]	738 [225]
GS4-2075	15	20	328 [100]	492 [150]	492 [150]	738 [225]
GS4-2100	18.5	25	328 [100]	492 [150]	492 [150]	738 [225]

Maximum Recommended Cable Length - GS4 - Supplied 230VAC, Three Phase						
GS4 Model	kW	hp	Without Output AC Reactor (ft [m])		With 3% Output AC Reactor (ft [m])	
			Shielded Cable	Unshielded Cable	Shielded Cable	Unshielded Cable
GS4-21P0	0.75	1	164 [50]	246 [75]	246 [75]	377 [115]
GS4-22P0	1.5	2	164 [50]	246 [75]	246 [75]	377 [115]
GS4-23P0	2.2	3	164 [50]	246 [75]	246 [75]	377 [115]
GS4-25P0	3.7	5	164 [50]	246 [75]	246 [75]	377 [115]
GS4-27P5	5.5	7.5	164 [50]	246 [75]	246 [75]	377 [115]
GS4-2010	7.5	10	328 [100]	492 [150]	492 [150]	738 [225]
GS4-2015	11	15	328 [100]	492 [150]	492 [150]	738 [225]
GS4-2020	15	20	328 [100]	492 [150]	492 [150]	738 [225]
GS4-2025	18.5	25	328 [100]	492 [150]	492 [150]	738 [225]
GS4-2030	22	30	328 [100]	492 [150]	492 [150]	738 [225]
GS4-2040	30	40	328 [100]	492 [150]	492 [150]	738 [225]
GS4-2050	37	50	328 [100]	492 [150]	492 [150]	738 [225]
GS4-2060	45	60	492 [150]	738 [225]	738 [225]	1066 [325]
GS4-2075	55	75	492 [150]	738 [225]	738 [225]	1066 [325]
GS4-2100	75	100	492 [150]	738 [225]	738 [225]	1066 [325]

Maximum Recommended Cable Length - GS4 - Supplied 460VAC, Three Phase						
GS4 Model	kW	hp	Without Output AC Reactor (ft [m])		With 3% Output AC Reactor (ft [m])	
			Shielded Cable	Unshielded Cable	Shielded Cable	Unshielded Cable
GS4-41P0	0.75	1	164 [50]	246 [75]	246 [75]	377 [115]
GS4-42P0	1.5	2	164 [50]	246 [75]	246 [75]	377 [115]
GS4-43P0	2.2	3	164 [50]	246 [75]	246 [75]	377 [115]
GS4-45P0	3.7	5	164 [50]	246 [75]	246 [75]	377 [115]
GS4-47P5	5.5	7.5	164 [50]	246 [75]	246 [75]	377 [115]
GS4-4010	7.5	10	328 [100]	492 [150]	492 [150]	738 [225]
GS4-4015	11	15	328 [100]	492 [150]	492 [150]	738 [225]
GS4-4020	15	20	328 [100]	492 [150]	492 [150]	738 [225]
GS4-4025	18.5	25	328 [100]	492 [150]	492 [150]	738 [225]
GS4-4030	22	30	328 [100]	492 [150]	492 [150]	738 [225]
GS4-4040	30	40	328 [100]	492 [150]	492 [150]	738 [225]
GS4-4050	37	50	328 [100]	492 [150]	492 [150]	738 [225]
GS4-4060	45	60	492 [150]	738 [225]	738 [225]	1066 [325]
GS4-4075	55	75	492 [150]	738 [225]	738 [225]	1066 [325]
GS4-4100	75	100	492 [150]	738 [225]	738 [225]	1066 [325]
GS4-4125	90	125	492 [150]	738 [225]	738 [225]	1066 [325]
GS4-4150	110	150	492 [150]	738 [225]	738 [225]	1066 [325]
GS4-4175	132	175	492 [150]	738 [225]	738 [225]	1066 [325]
GS4-4200	160	215	492 [150]	738 [225]	738 [225]	1066 [325]
GS4-4250	185	250	492 [150]	738 [225]	738 [225]	1066 [325]
GS4-4300	220	300	492 [150]	738 [225]	738 [225]	1066 [325]

Fuses

Protection devices are essential to prevent damage to your GS4 drive and application equipment. Please use the fuse specification chart below to select fuses that are applicable to your GS4 drive. Only use UL-certified fuses which comply with your local regulations.

Fuse Specification Chart GS4 *DURApulse* Drives														
Drive Model	***For Three-Phase Input Power***							***For Single-Phase Input Power***						
		Input Power			***Input Fuse***				***Input Power***			***Input Fuse***		
	HP	***Ø***	***Volts***	***GS4 Amps***	***Fuse Amps***	***Fast Acting Class T***	***Edison Class J****	***HP***	***Ø***	***Volts***	***GS4 Amps***	***Fuse Amps***	***Fast Acting Class T***	***Edison Class J****
GS4-21P0	1	3	230	6.4	10	TJN10	JHL10	0.5	1	230	6.4	10	TJN10	JHL10
GS4-22P0	2	3	230	12	15	TJN15	JHL15	0.75	1	230	9.7	15	TJN15	JHL15
GS4-23P0	3	3	230	16	25	TJN25	JHL25	1	1	230	15	20	TJN20	JHL20
GS4-25P0	5	3	230	20	35	TJN35	JHL35	2	1	230	20	30	TJN30	JHL30
GS4-27P5	7.5	3	230	28	50	TJN50	JHL50	3	1	230	26	40	TJN40	JHL40
GS4-2010	10	3	230	36	70	TJN70	JHL70	3	1	230	26	40	TJN40	JHL40
GS4-2015	15	3	230	52	100	TJN100	JHL100	5	1	230	40	70	TJN70	JHL70
GS4-2020	20	3	230	72	125	TJN125	JHL125	7.5	1	230	58	100	TJN100	JHL100
GS4-2025	25	3	230	83	150	TJN150	JHL150	10	1	230	76	125	TJN125	JHL125
GS4-2030	30	3	230	99	175	TJN175	JHL175	10	1	230	76	125	TJN125	JHL125
GS4-2040*	40	3	230	124	175	TJN175	JHL175	10	1	230	63	90	TJN90	JHL90
GS4-2050*	50	3	230	143	200	TJN200	JHL200	10	1	230	63	90	TJN90	JHL90
GS4-2060	60	3	230	171	250	TJN250	JHL250	15	1	230	94	150	TJN150	JHL150
GS4-2075	75	3	230	206	300	TJN300	JHL300	20	1	230	124	175	TJN175	JHL175
GS4-2100	100	3	230	245	350	TJN350	JHL350	25	1	230	143	200	TJN200	JHL200
GS4-41P0	1	3	460	4.3	6	TJS6	JHL6	n/a						
GS4-42P0	2	3	460	5.9	10	TJS10	JHL10							
GS4-43P0	3	3	460	8.7	15	TJS15	JHL15							
GS4-45P0	5	3	460	14	20	TJS20	JHL20							
GS4-47P5	7.5	3	460	17	25	TJS25	JHL25							
GS4-4010	10	3	460	20	35	TJS35	JHL35							
GS4-4015	15	3	460	26	45	TJS45	JHL45							
GS4-4020	20	3	460	35	60	TJS60	JHL60							
GS4-4025	25	3	460	40	70	TJS70	JHL70							
GS4-4030	30	3	460	47	90	TJS90	JHL90							
GS4-4040*	40	3	460	63	125	TJS100	JHL100							
GS4-4050	50	3	460	74	100	TJS110	JHL110							
GS4-4060	60	3	460	101	125	TJS150	JHL150							
GS4-4075	75	3	460	114	150	TJS150	JHL150							
GS4-4100	100	3	460	157	200	TJS200	JHL200							
GS4-4125	125	3	460	167	250	TJS250	JHL250							
GS4-4150	150	3	460	207	300	TJS300	JHL300							
GS4-4175	175	3	460	240	350	TJS350	JHL350							
GS4-4200	200	3	460	300	450	TJS450	JHL450							
GS4-4250	250	3	460	380	500	TJS500	JHL500							
–	–					***Fast Acting Current Limiting Class L***								
GS4-4300	300	3	460	400	700	LCU700								

** 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 (refer to the drive's user manual for details).
*** Includes DC choke*

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. All GS4 drives have this feature. The need for a Dynamic Braking Unit is determined by the drive size and shown in the chart below. To utilize dynamic braking:

1) Wire the appropriate braking resistor to terminals B1/B2 (refer to page 2–19)
2) Set parameter P06.28 for Dynamic Braking Voltage 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 user manual for correct wiring of the resistors and dynamic braking units.

Dynamic Unit Braking Specifications

GS4 AC Drive Dynamic Braking Specifications

Drive Rating	Motor Power (hp)	Motor Power (kW)	Drive Model	Dynamic Braking Unit Qty.	Dynamic Braking Unit Pt#	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	1	0.7	**GS4-21P0**	–	n/a	63.3	6	2.3	Click here
	2	1.5	**GS4-22P0**			47.5	8	3.0	
	3	2.2	**GS4-23P0**			38.0	10	3.8	
	5	3.7	**GS4-25P0**			19.0	20	7.6	
	7.5	5.5	**GS4-27P5**			14.6	26	9.9	
	10	7.5	**GS4-2010**			14.6	26	9.9	
	15	11	**GS4-2015**			13.6	28	10.6	
	20	15	**GS4-2020**			8.3	46	17.5	
	25	18	**GS4-2025**			8.3	46	17.5	
	30	22	**GS4-2030**			5.8	66	25.1	
	40	30	**GS4-2040**	2	**GS-1DBU**	4.8*	80*	30.4*	
	50	37	**GS4-2050**	2	**GS-2DBU**	3.2*	120*	45.6*	
	60	45	**GS4-2060**	2	**GS-2DBU**	3.2*	120*	45.6*	
	75	55	**GS4-2075**	3	**GS-2DBU**	2.1*	180*	68.4*	
	100	75	**GS4-2100**	4	**GS-2DBU**	1.6*	240*	91.2*	
460V	1	0.7	**GS4-41P0**	–	n/a	190	4	3.0	
	2	1.5	**GS4-42P0**			126.7	6	4.6	
	3	2.2	**GS4-43P0**			108.6	7	5.3	
	5	3.7	**GS4-45P0**			84.4	9	6.8	
	7.5	5.5	**GS4-47P5**			54.3	14	10.6	
	10	7.5	**GS4-4010**			47.5	16	12.2	
	15	11	**GS4-4015**			42.2	18	13.7	
	20	15	**GS4-4020**			26.2	29	22.0	
	25	18	**GS4-4025**			23.0	33	25.1	
	30	22	**GS4-4030**			23.0	33	25.1	
	40	30	**GS4-4040**			14.1	54	41.0	
	50	40	**GS4-4050**	1	**GS-4DBU**	12.7*	60*	45.6*	
	60	45	**GS4-4060**	1	**GS-4DBU**	12.7*	60*	45.6*	
	75	55	**GS4-4075**	2	**GS-3DBU**	9.5*	80*	60.8*	
	100	75	**GS4-4100**	2	**GS-4DBU**	6.3*	120*	91.2*	
	125	90	**GS4-4125**	2	**GS-4DBU**	6.3*	120*	91.2*	
	150	110	**GS4-4150**	1	**GS-5DBU**	6.0*	126*	95.8*	
	175	132	**GS4-4175**	1	**GS-6DBU**	4.0*	190*	144.4*	
	200	160	**GS4-4200**	1	**GS-6DBU**	4.0*	190*	144.4*	
	250	185	**GS4-4250**	1	**GS-7DBU**	3.4*	225*	172.1*	
	300	220	**GS4-4300**	2	**GS-5DBU**	3.0*	252*	190.5*	

** These values are per individual DBU, as seen between DBU terminals B1 and B2.*

*** 10% Duty Cycle with maximum ON (braking) time of 10 seconds.*

For a full list of all brake resistors compatible with GS4 drives, please see the GS4 series braking technical specification: https://cdn.automationdirect.com/static/specs/gs4accbrake.pdf.

Please refer to the Dynamic Braking User Manual for detailed information on DBU installation and wiring: https://cdn.automationdirect.com/static/manuals/gs3dbm/gs-db_ump.pdf

USB to RS-485 PC Adapter

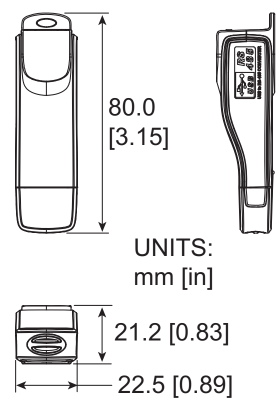
Convenient 2-wire USB to RS-485 serial communication adapter for universal RS-485. Does not require an external power supply or complicated configuration process.

USB-485M Adapter Specifications	
Adapter Part #	USB-485M
Power Supply	No external power supply needed
Power Consumption	0.4 W
Voltage Isolation	3000VDC
Baud Rates Supported	75, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 (bps)
Transmission Type	RS-485 half-duplex (2-wire)
LED Display	Steady Green LED ON: power is ON. Blinking orange LED: data is transmitting.
USB Connector	Type A (plug)
RS-485 Connector	RJ45
Compatibility	USB v6.7.4 specification
PC Compatibility	Windows Operating System required for bridge & driver installation: Windows 7/8/8.1/10 (v6.7.4) Windows XP/Server 2003/Vista/7/8/8.1 (v6.7)

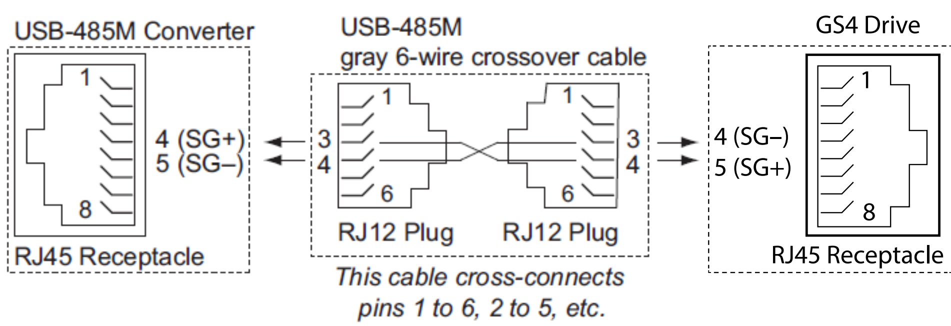
<u>*Note*</u>:

For the 2-wire cable (RJ12 to flying leads) included with the USB-485M; Red wire plugs into terminal SG+ on the drive. Green wire plugs into SG- on the drive.

Also, the included 6-conductor RJ12 crossover cable connects the USB-485M directly to the RS485 RJ45 ports on the GS4. (the drives' RJ45 ports can accept 6-conductor RJ12 connectors).



USB-485M to GS4 Wiring and Pin-out



Conduit Box Kit

Optional conduit box kits can be ordered separately. The kits bolt onto the bottom of the applicable GS4 drive to provide a convenient connection point for conduit entry.

Note: Frames A through C have integral conduit box space built into the drive. No separate conduit box is available.

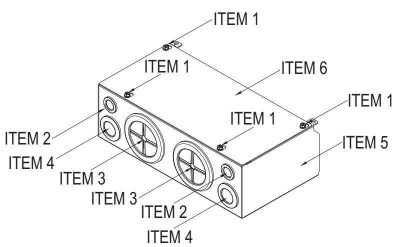
Frame D

Applicable models

GS4-2040; GS4-2050; GS4-4075; GS4-4100

Model GS4-CBX-D

ITEM	Description	Qty.
1	Screw M5x0.8x10L	4
2	Bushing Rubber 28	2
3	Bushing Rubber 44	2
4	Bushing Rubber 88	2
5	Conduit box cover	1
6	Conduit box base	1



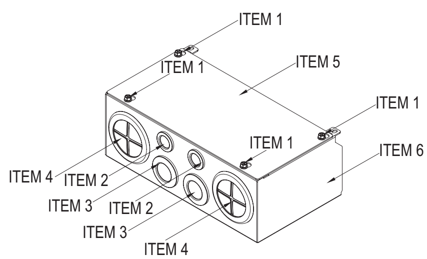
Frame D0

Applicable models

GS4-4060, GS4-4050

Model GS4-CBX-D0

ITEM	Description	Qty.
1	Screw M5x0.8x10L	4
2	Bushing Rubber 28	2
3	Bushing Rubber 44	2
4	Bushing Rubber 73	2
5	Conduit box cover	1
6	Conduit box base	1



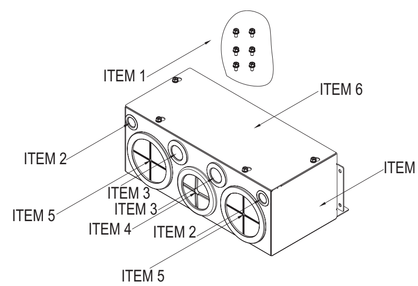
Frame E

Applicable models

GS4-2060; GS4-2075; GS4-2100; GS4-4125; GS4-4150

Model GS4-CBX-E

ITEM	Description	Qty.
1	Screw M5x0.8x10L	6
2	Bushing Rubber 28	2
3	Bushing Rubber 44	4
4	Bushing Rubber 100	2
5	Conduit box cover	1
6	Conduit box base	1



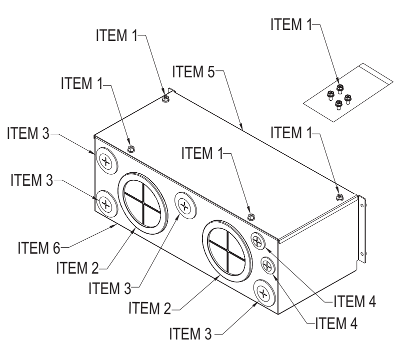
Frame F

Applicable models

GS4-4150; GS4-4200

Model GS4-CBX-F

ITEM	Description	Qty.
1	Screw M5x0.8x10L	8
2	Bushing Rubber 28	2
3	Bushing Rubber 44	4
4	Bushing Rubber 100	2
5	Conduit box cover	1
6	Conduit box base	1



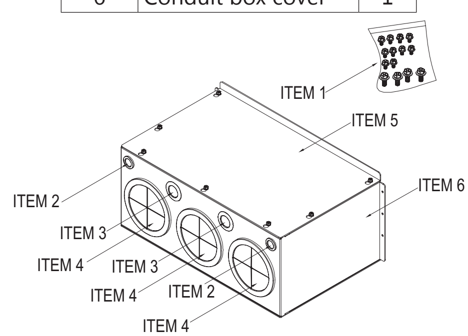
Frame G

Applicable models

GS4-4250; GS4-4300

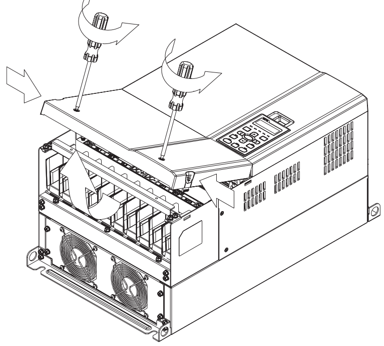
Model GS4-CBX-G

ITEM	Description	Qty.
1	Screw M5x0.8x 10L	10
1	Screw M8x1.25x10L	4
2	Bushing Rubber 28	2
3	Bushing Rubber 44	2
4	Bushing Rubber 130	3
5	Conduit box base	1
6	Conduit box cover	1

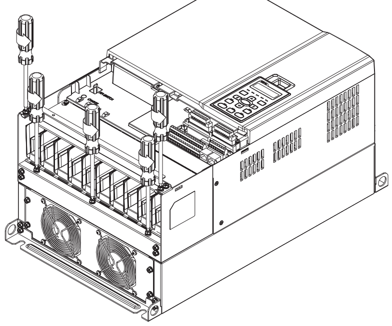


Conduit Box Installation – Frames D0 and D

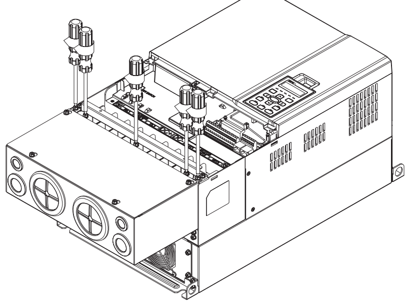
Loosen the cover screws and press the tabs on each side of the cover to remove the cover, as shown in the following figure. Screw torque: 10~12 kg·cm (8.66~10.39 lb·in).



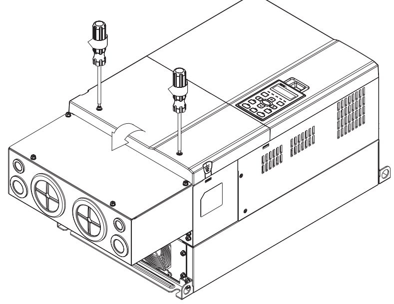
Remove the 5 screws shown in the following figure. Screw torque: 24~26 kg·cm (20.8~22.6 lb·in).



Install the conduit box by fastening the 5 screws shown in the following figure.
Screw torque: 24~26 kg·cm (20.8~22.6 lb·in).



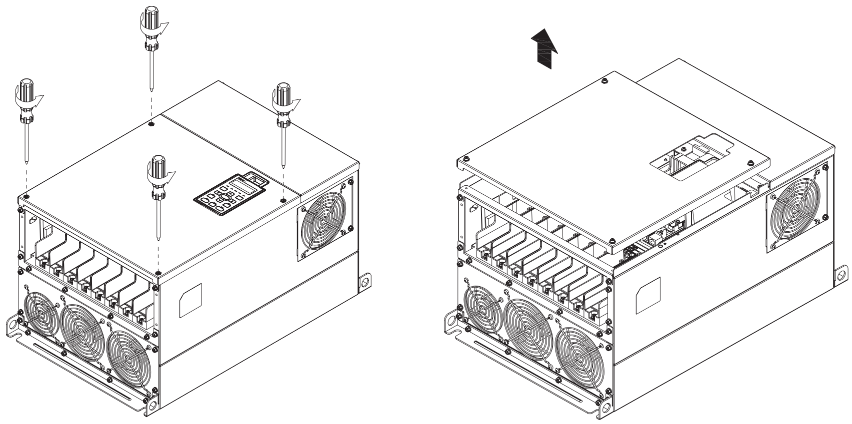
Fasten 2 screws shown in the following figure. Screw torque: 10~12 kg·cm (8.66~10.39 lb·in).



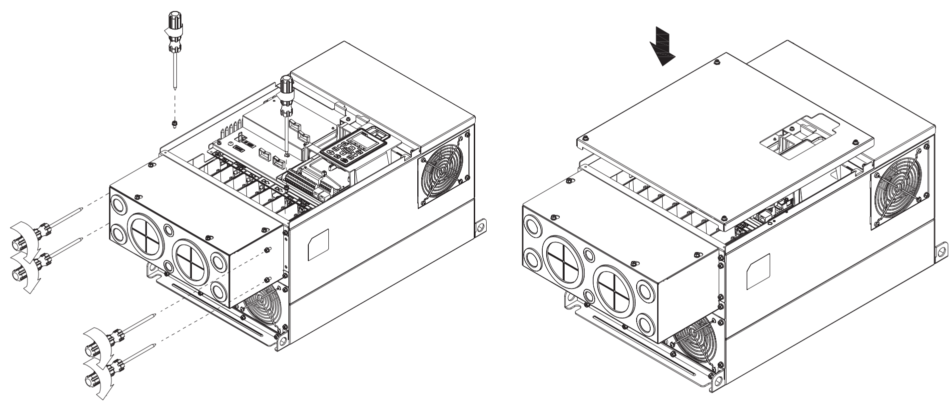
REMOVE POWER FROM DRIVE PRIOR TO INSTALLATION AND/OR REMOVAL OF ACCESSORIES.

Conduit Box Installation – Frame E

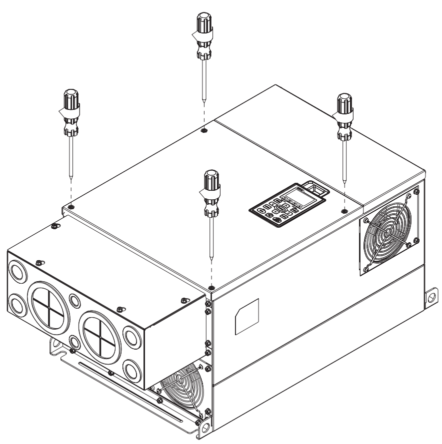
Loosen the 4 cover screws and lift the cover. Screw torque: 12~15 kg·cm (10.4~13 lb·in).



Fasten the 6 screws shown in the following figure and place the cover back to the original position. Screw torque: 24~26 kg·cm (20.8~22.6 Ib·in).



Fasten the 4 screws shown in the following figure. Screw torque: 12~15 kg·cm (10.4~13 Ib·in)

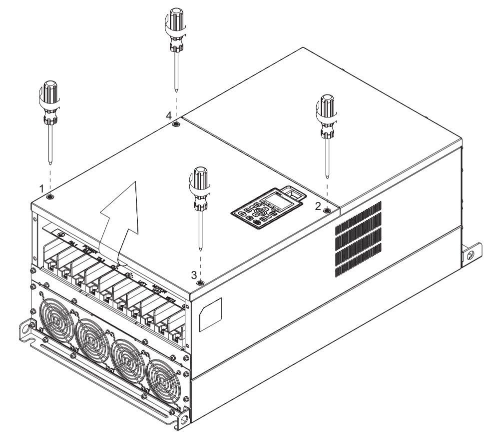


REMOVE POWER FROM DRIVE PRIOR TO INSTALLATION AND/OR REMOVAL OF ACCESSORIES.

Conduit Box Installation – Frame F

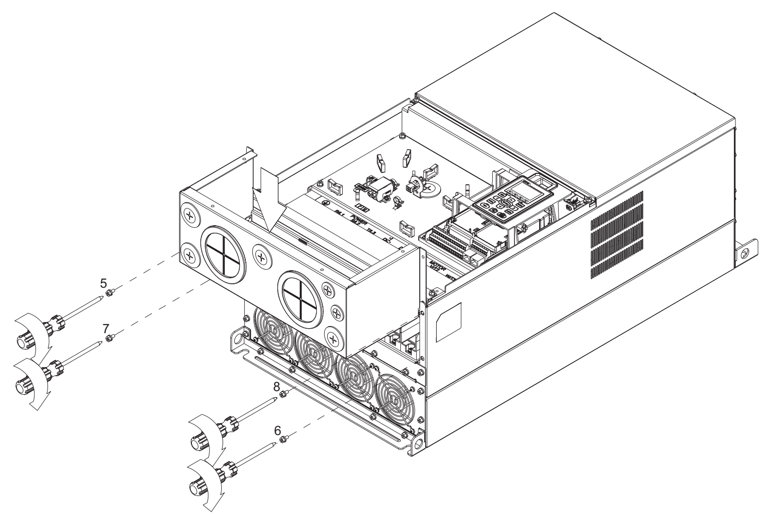
Loosen the cover screws to remove the cover, as shown.

Screw torque: 14~16 kg·cm (12.2~13.9 Ib·in)



Install the conduit box by fastening the 4 screws, as shown.

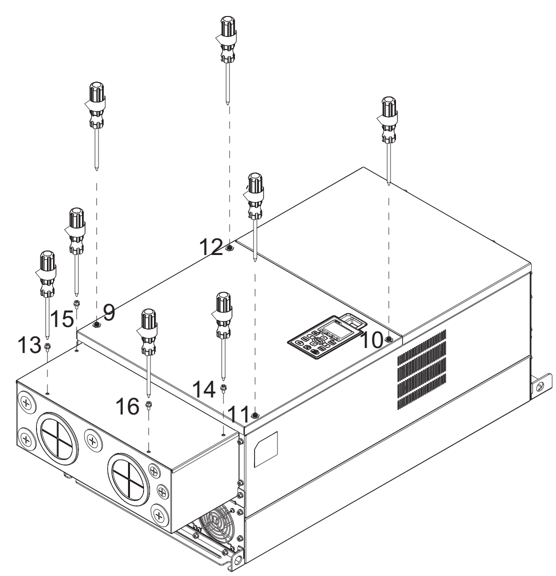
Screw torque:
24~26 kg·cm (20.8~22.6 Ib·in)



Install the covers of conduit box and driver by fastening all the screws as shown.

Screw **#9~12** torque:
14~16 kg·cm (12.2~13.9 lb·in.)

Screw **#13~16** Torque:
24~26 kg·cm (20.8~22.6 lb·in.)



REMOVE POWER FROM DRIVE PRIOR TO INSTALLATION AND/OR REMOVAL OF ACCESSORIES.

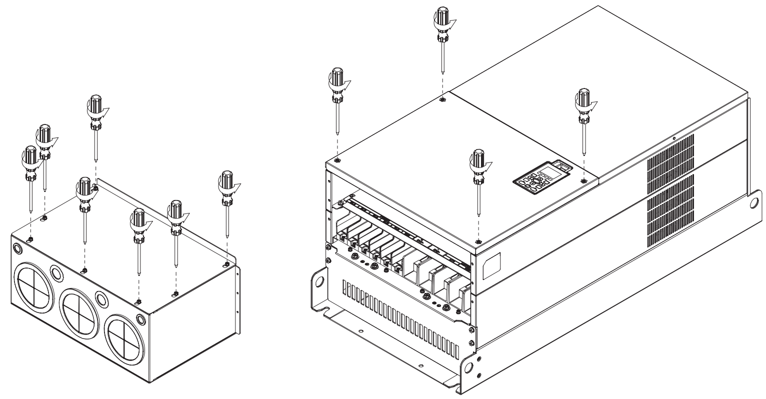
Conduit Box Installation – Frame G

On the conduit box, loosen 7 of the cover screws and remove the cover, as shown.

Screw torque:
24~26 kg·cm (20.8~22.6 lb·in)

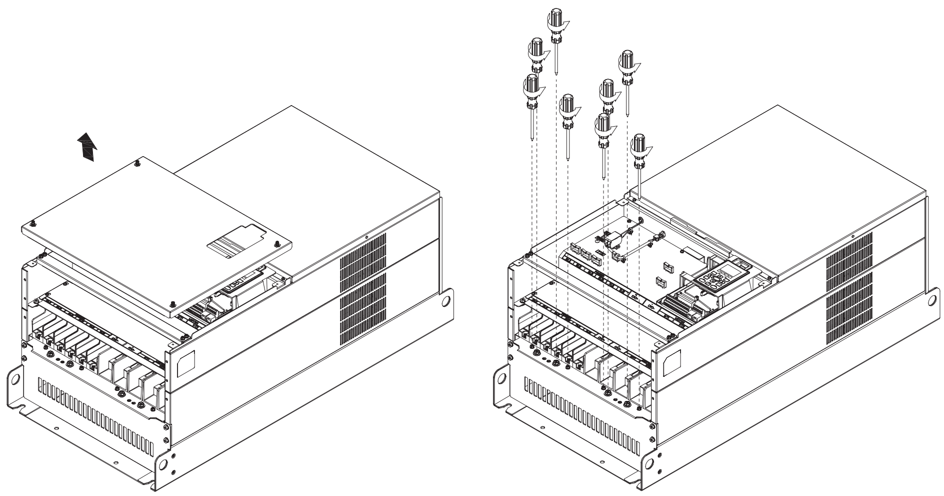
On the drive, loosen 4 of the cover screws to remove the cover, as shown.

Screw torque:
12~15 kg·cm (10.4~13 lb·in).



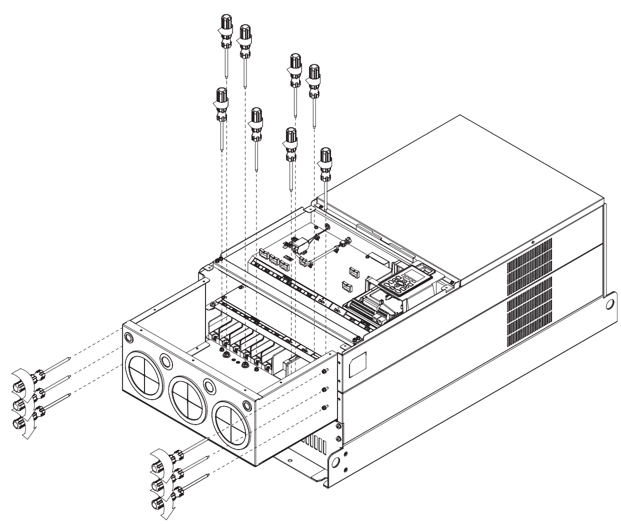
Remove the top cover and loosen the screws, as shown.

Screw torque:
M5:
24~26 kg·cm
(20.8~22.6 lb·in)
M8:
100~120 kg·cm
(86.7~104.2 lb·in)



Install the conduit box by fastening all the screws shown.

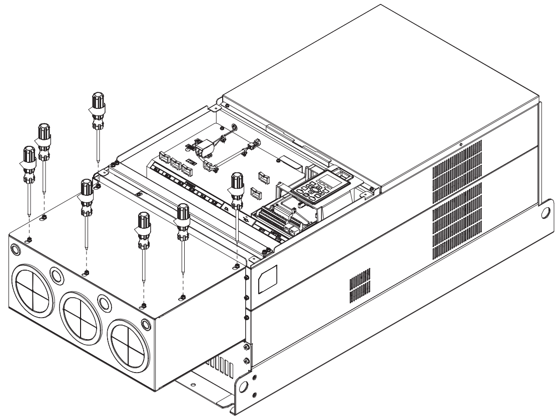
Screw torque:
M5:
24~26 kg·cm (20.8~22.6 lb·in)
M8:
100~120 kg·cm (86.7~104.2 lb·in)



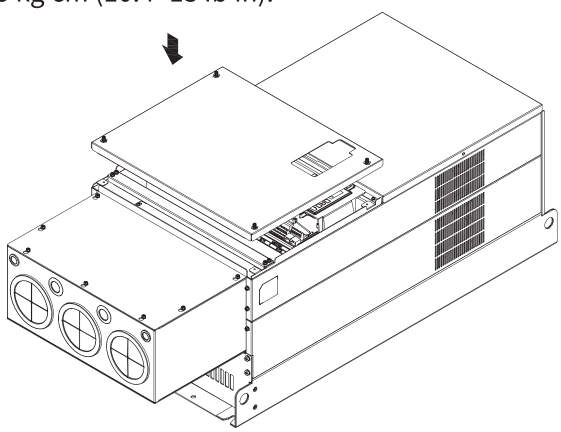
REMOVE POWER FROM DRIVE PRIOR TO INSTALLATION AND/OR REMOVAL OF ACCESSORIES.

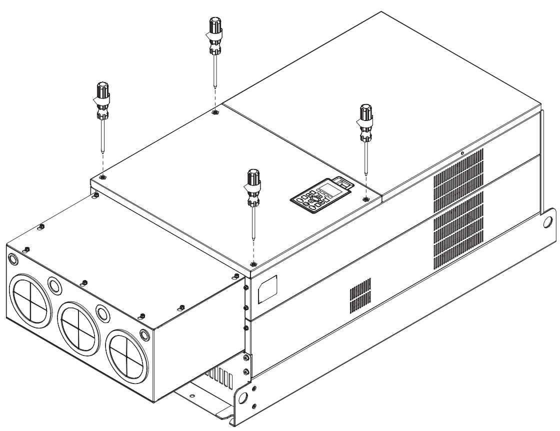
Frame G Conduit Box Installation (continued)

Fasten all the screws. Screw torque: 24~26 kg·cm (20.8~22.6 Ib·in).



Place the cover back to the top and fasten the screws (as shown in the figure).
Screw torque: 12~15 kg·cm (10.4~13 Ib·in).





REMOVE POWER FROM DRIVE PRIOR TO INSTALLATION AND/OR REMOVAL OF ACCESSORIES.

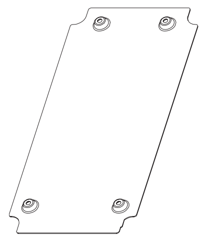
Flange Mounting Kits (Frames A, B, C)

Optional GS4 drive flange mounting kits allow the heat sinks on the back of select GS4 drives to be positioned through the back of the control enclosure. Since a majority of the heat generated by the GS4 drive will be outside the enclosure, heat load will be reduced and a smaller enclosure may possibly be used. These flange mounting kits are applicable to GS4 drive frame sizes A through C. Frames D0, D, E, and F have integral flange mounting hardware (see cutout dimensions below). Frame size G cannot be flange-mounted.

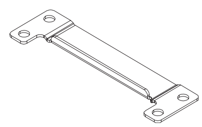
Flange Mounting Kits – Frame A

GS4-FMKIT-1

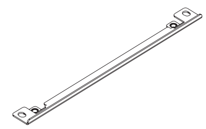
Applicable models: GS4-22P0; GS4-23P0; GS4-43P0



Accessory 1 - Qty. 1



Accessory 2 - Qty. 2



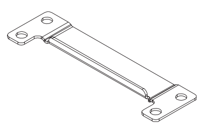
Accessory 3 - Qty. 2

Screw 1 - Qty. 4
M3*P 0.5; L=6mm

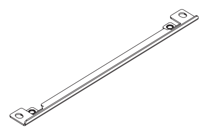
Screw 2 - Qty. 8
M6*P 1.0; L=16mm

GS4-FMKIT-A

Applicable models: GS4-21P0; GS4-25P0; GS4-41P0; GS4-42P0; GS4-45P0; GS4-47P5



Accessory 2 - Qty. 2



Accessory 3 - Qty. 2

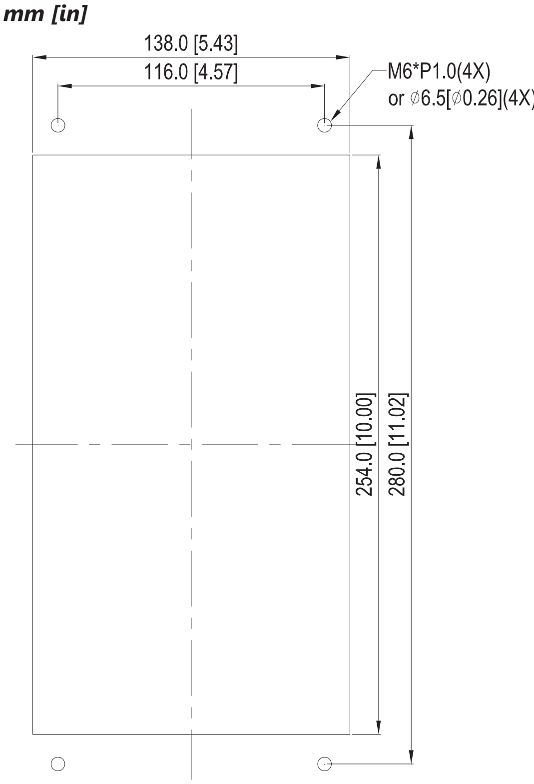
Screw 2 - Qty. 8
M6*P 1.0; L=16mm

Protection Ratings

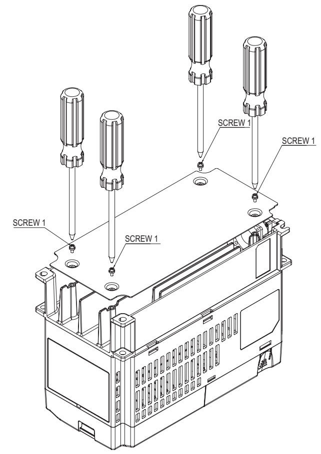
Top Cover Removed:
IP20/UL Open Type

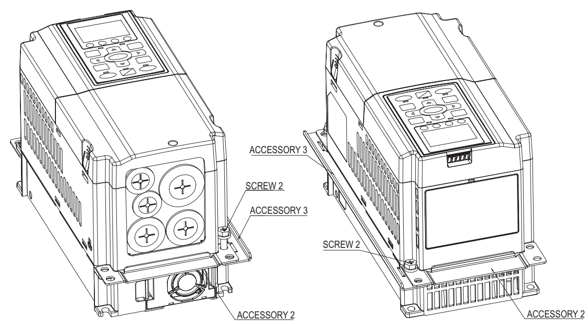
Standard w/Top Cover:
IP20/UL Type 1/NEMA 1

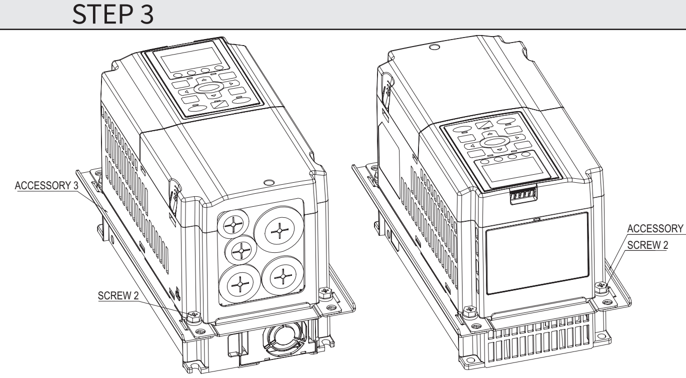
Frame A Cutout Dimensions _ mm [in]

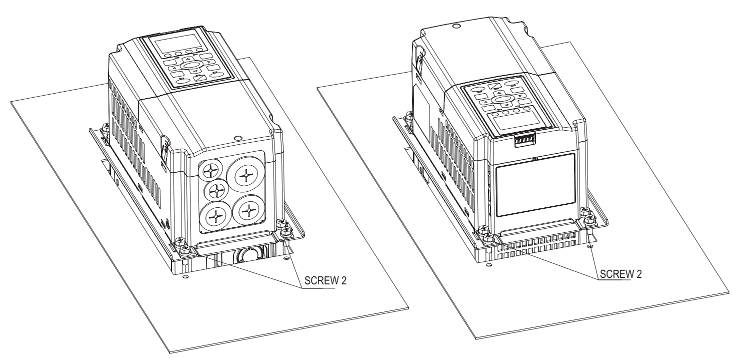


GS4-FMKIT-1 INSTALLATION

STEP 1	
Install **accessory 1** by fastening 4 of the **screws s1**(M3). Screw torque: 6 - 8 kg·cm (5.21 - 6.94 Ib·in).	

STEP 2	
Install **accessories 2 and 3** by fastening 2 of the **screws 2**(M6). Screw torque: 25 - 30 kg·cm (5.21 - 6.94 Ib·in).	

STEP 3	
Install **accessories 2 and 3** by fastening 2 of the **screws 2**(M6). Screw torque: 25 - 30 kg·cm (5.21 - 6.94 Ib·in).	

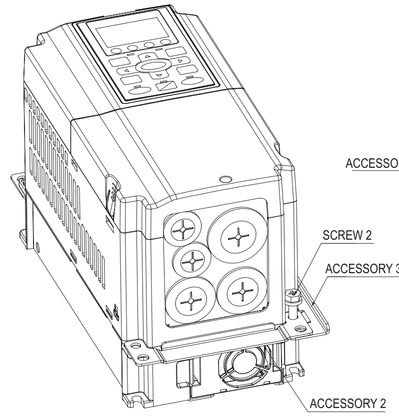
STEP 4	
For plate installation, place 4 of the **screw 2** (M6) through **accessories 2 and 3** and the plate then fasten the screws. Screw torque: 25 - 30 kg·cm (5.21 - 6.94 Ib·in).	

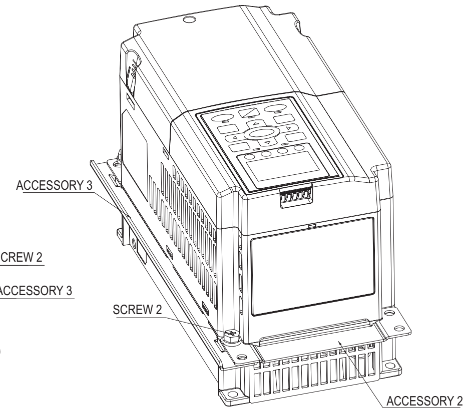
GS4-FMKIT-A INSTALLATION

STEP 1

Install **accessories 2 and 3** by fastening 2 of the **screws 2**(M6).

Screw torque:
25 - 30 kg·cm (5.21 - 6.94 Ib·in).

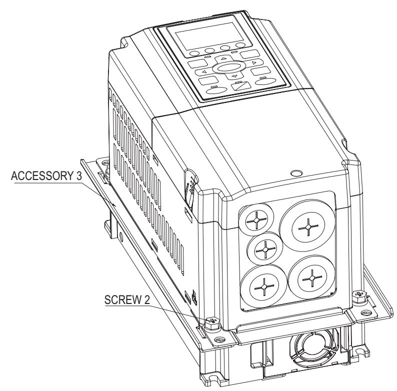


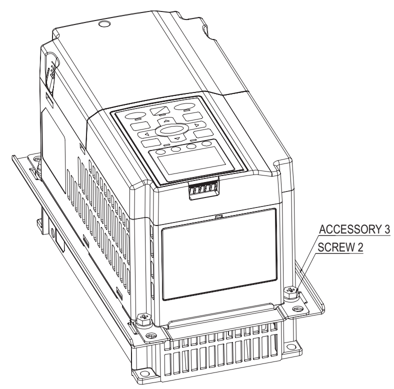


STEP 2

Install **accessories 2 and 3** by fastening 2 of the **screws 2**(M6).

Screw torque:
25 - 30 kg·cm (5.21 - 6.94 Ib·in).

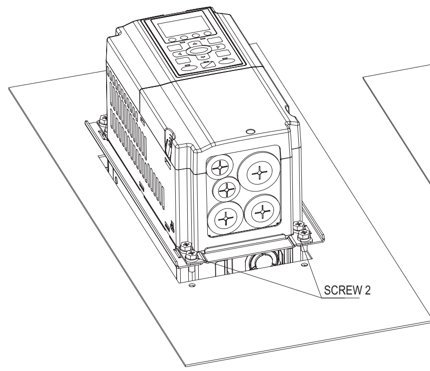


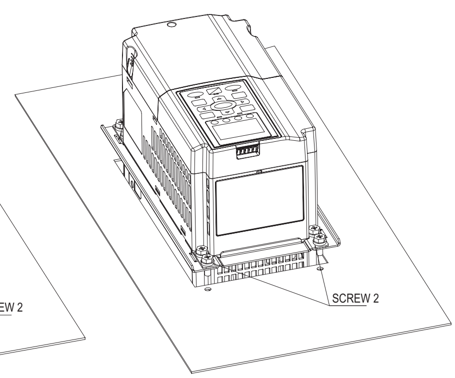


STEP 3

For plate installation, place 4 of the **screws 2** (M6) through **accessories 2 and 3** and the plate, then fasten the screws.

Screw torque:
25 - 30 kg·cm (5.21 - 6.94 Ib·in).

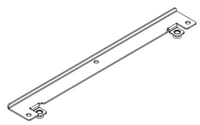




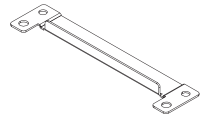
Flange Mounting Kits – Frame B

<u>GS4-FMKIT-B</u>

Applicable models: GS4-27P5; GS4-2010; GS4-2015; GS4-4010; GS4-4015; GS4-4020



Accessory 1 - Qty. 2



Accessory 2 - Qty. 2

Screw 1 - Qty. 4
Size M8xP 1.25

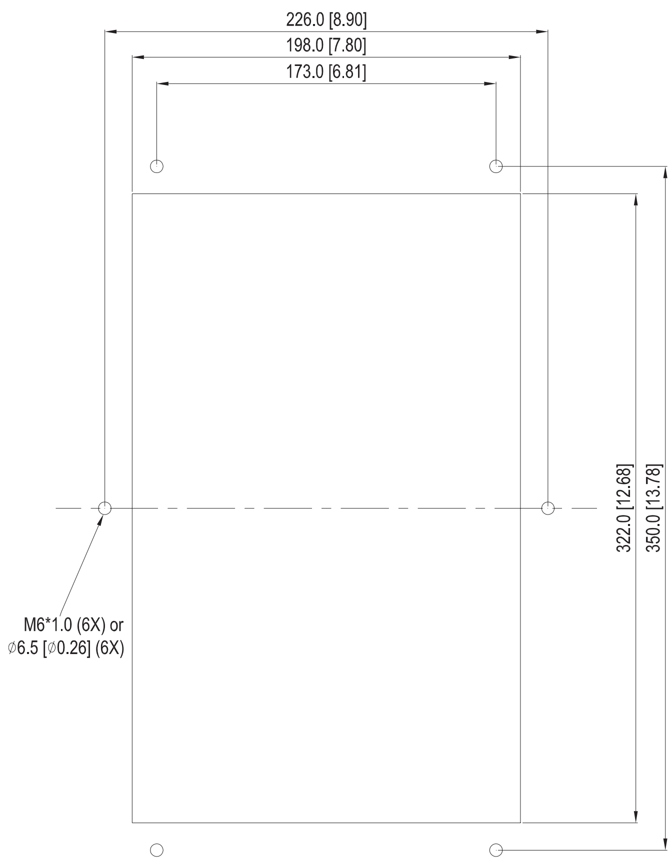
Screw 2 - Qty. 6
Size M6xP 1.0

Protection Ratings

Top Cover Removed:
IP20/UL Open Type

Standard w/Top Cover:
IP20/UL Type 1/NEMA 1

Frame B Cutout Dimensions _ mm [in]

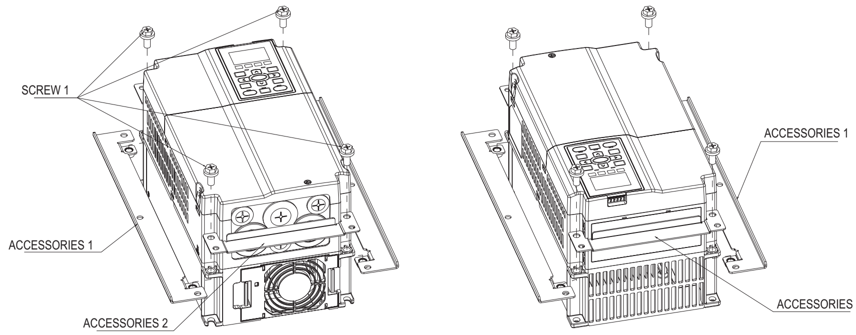


GS4-FMKIT-B Installation

STEP 1

Install **accessories 1 and 2** by fastening 4 of the **screws 1** (M8).

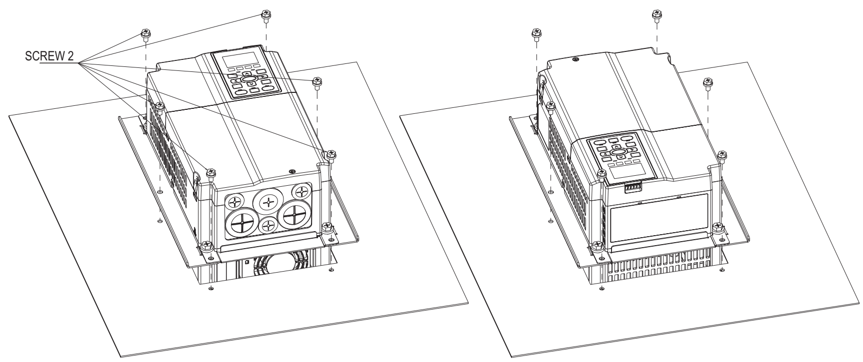
Screw torque:
40 - 45 kg·cm (34.7 - 39.0 Ib·in).



STEP 2

For plate installation, place 6 of the **screws 2** (M6) through **accessories 1 and 2** and fasten to the plate.

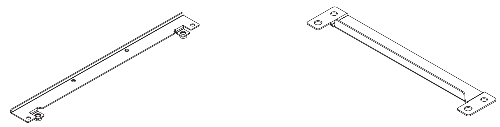
Screw torque:
25 - 30 kg·cm (5.21 - 6.94 Ib·in).



Flange Mounting Kits – Frame C

GS4-FMKIT-C

Applicable models: GS4-2020; GS4-2025; GS4-2030; GS4-4025; GS4-4030; GS4-4040



Accessory 1 - Qty. 2 Accessory 2 - Qty. 2

Screw 1 - Qty. 4
Size M8xP 1.25

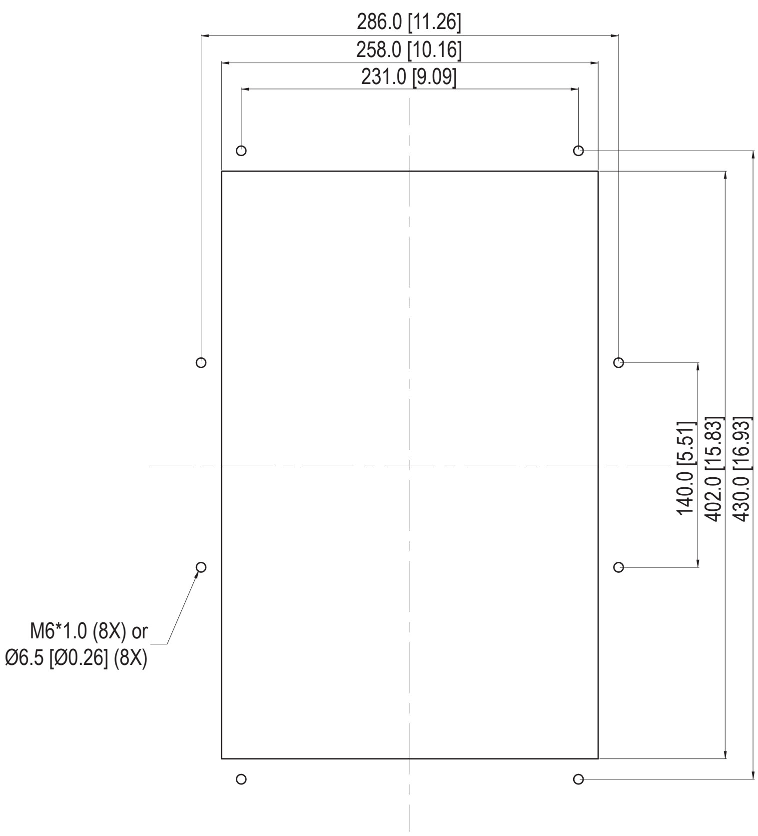
Screw 2 - Qty. 8
Size M6xP 1.0

Protection Ratings

Top Cover Removed:
IP20/UL Open Type

Standard w/Top Cover:
IP20/UL Type 1/NEMA 1

Frame C Cutout Dimensions _ mm [in]

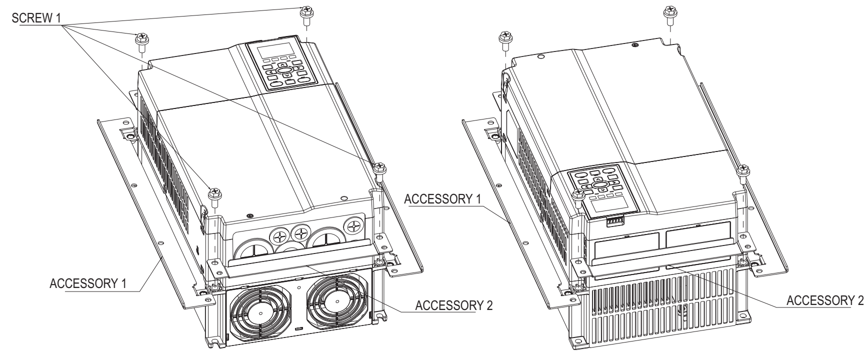


GS4-FMKIT-C Installation

STEP 1

Install **accessories 1 and 2** by fastening 4 of the **screws 1** (M8).

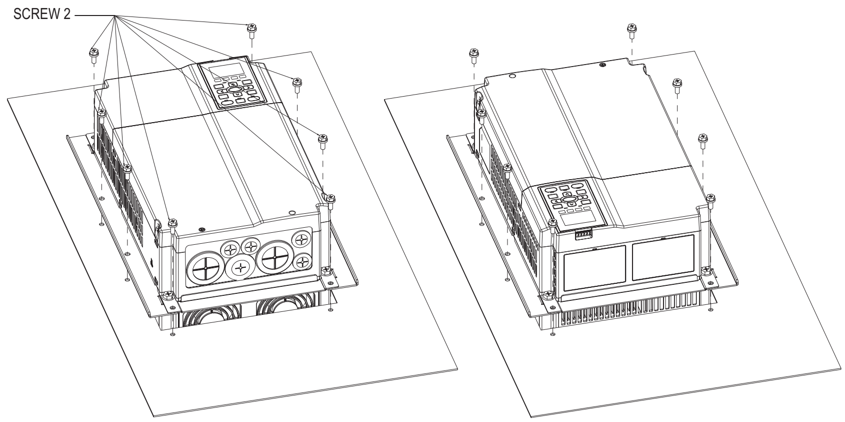
Screw torque:
50 - 55 kg·cm (43.4 - 47.7 Ib·in).



STEP 2

For plate installation, place 8 of the **screws 2** (M6) through **accessories 1 and 2** and then fasten to the plate.

Screw torque:
25 - 30 kg·cm (5.21 - 6.94 Ib·in).

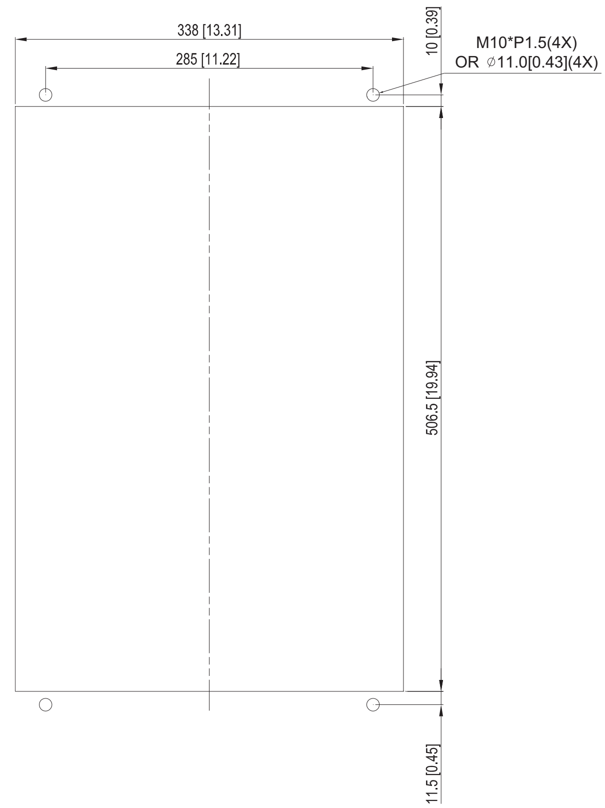


Instructions for Built-in Flange Mounting (Frames D0, D, E, F)

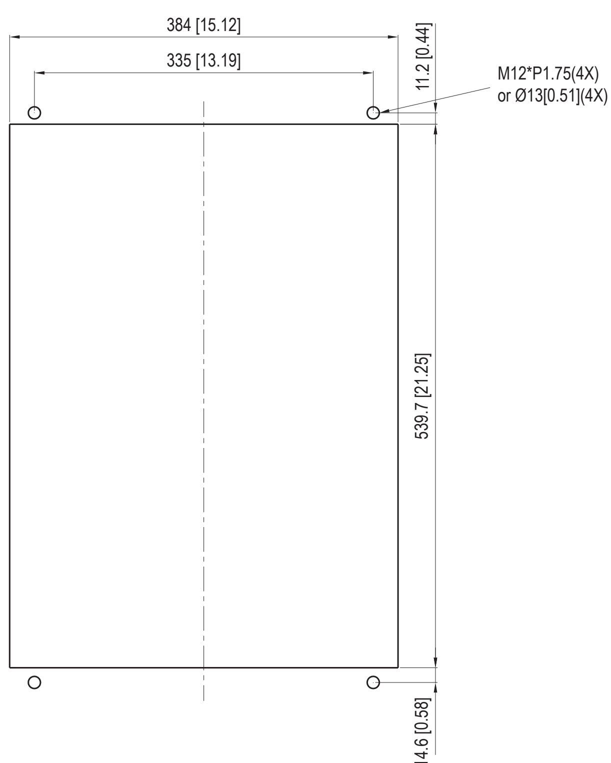
Cutout Dimensions

_Frame D0 Cutout Dimensions _ mm [in]_

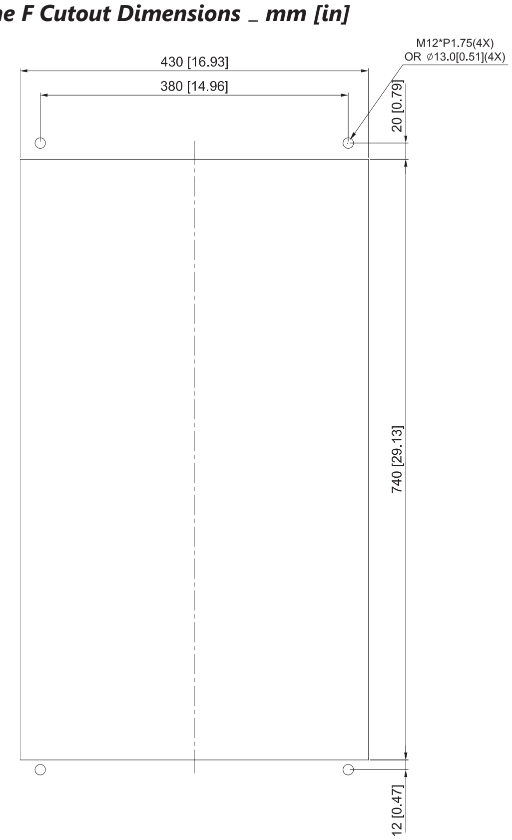
_Frame D Cutout Dimensions _ mm [in]_



_Frame E Cutout Dimensions _ mm [in]_



_Frame F Cutout Dimensions _ mm [in]_

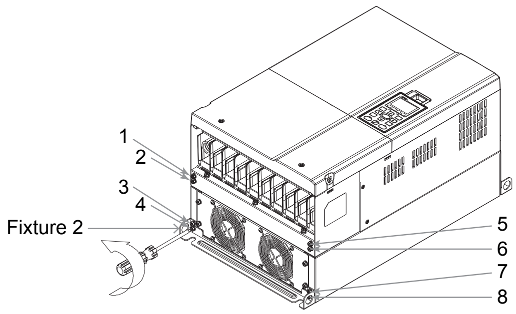


Flange Mounting Instructions – Frames D0, D, E

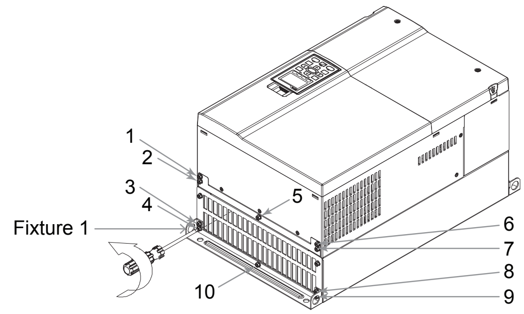
Applicable models: GS4- 2040, 2050, 2060, 2075, 2100, 4050, 4060, 4075, 4100, 4125, 4150

In order to flange mount the drive, move the upper and lower mounting fixtures forward from the base of the integral drive heat sink to the base of the drive itself (as described below).

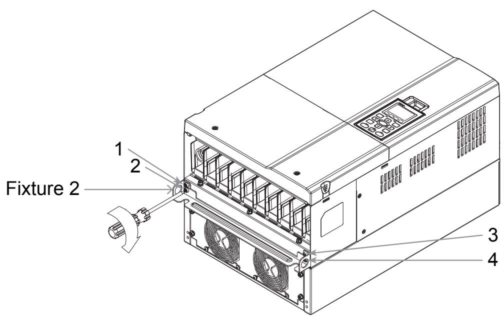
1) (Bottom) Loosen 8 screws and remove Fixture 2 from behind the fans:



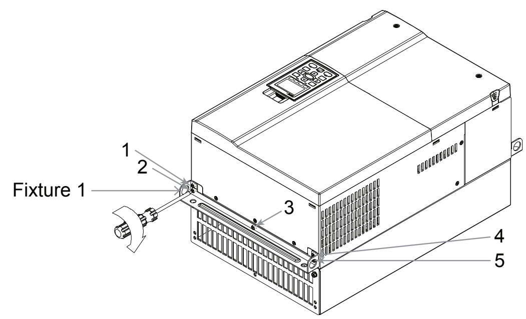
2) (Top) Loosen 10 screws and remove Fixture 1 from behind the vents:



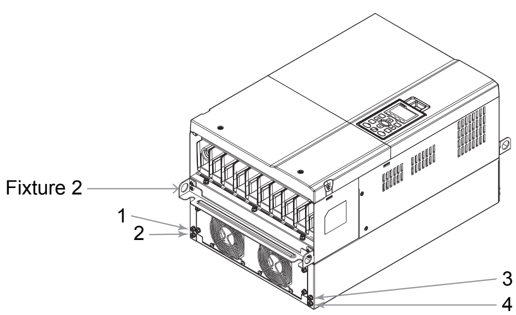
3) (Bottom) Move Fixture 2 forward of the fans and fasten 4 screws [screw torque: 30~32 kg·cm (26.0~27.8 lb·in)]:



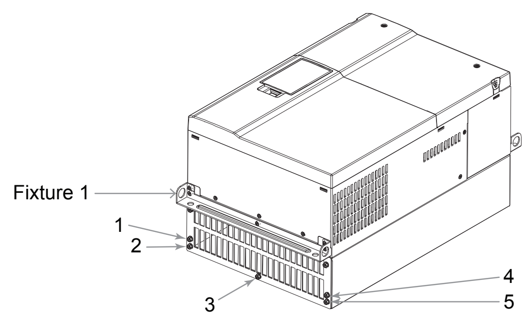
4) (Top) Move Fixture 1 forward of the vents and fasten 5 screws [screw torque: 30~32 kg·cm (26.0~27.8 lb·in)]:



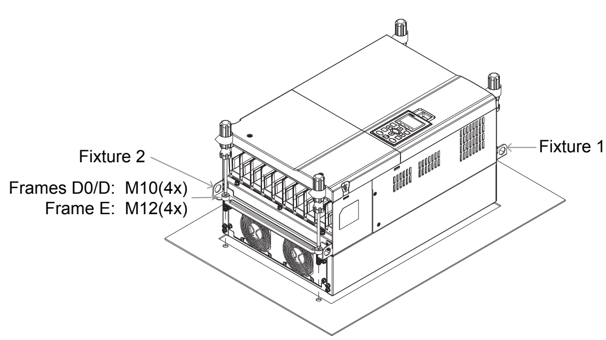
5) (Bottom) Fasten 4 screws rearward of the fans [screw torque: 24~26 kg·cm (20.8~22.6 lb·in)]:



6) (Top) Fasten 5 screws rearward of the vents [screw torque: 24~26 kg·cm (20.8~22.6 lb·in)]:



7) Place 4 screws (M10) through Fixtures 1 & 2 and the plate, and then fasten the screws:
[Frames D0 & D – M10*4 – Screw torque: 200~240 kg·cm (173.6~208.3 lb·in)]
[Frame E – M12*4 – Screw torque: 300~400 kg·cm (260~347 lb·in)]

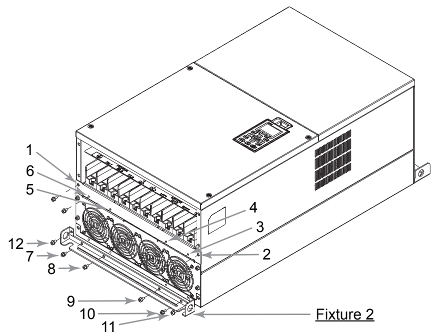


Flange Mounting Instructions – Frame F

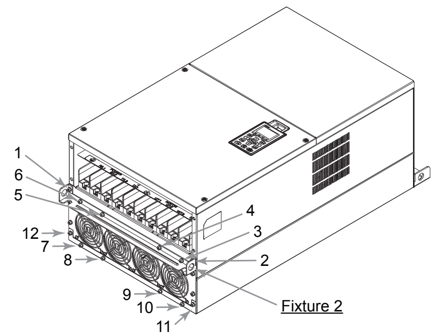
Applicable models: GS4- 4175, 4200

In order to flange mount the drive, move the upper and lower mounting fixtures forward from the base of the integral drive heat sink to the base of the drive itself (as described below).

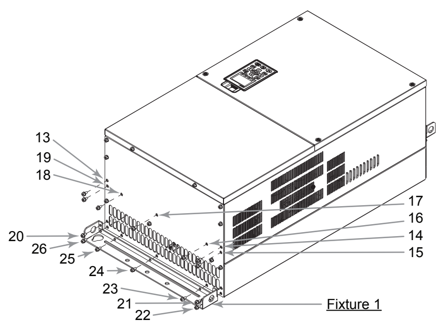
1) (Bottom) Loosen 12 screws and remove Fixture 2 from behind the fans:



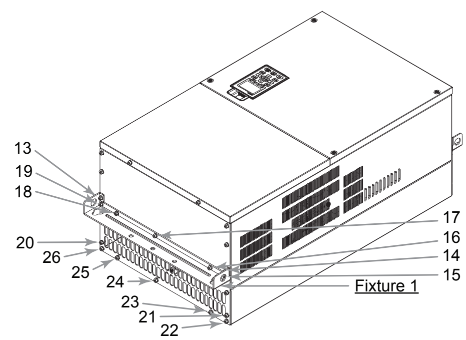
2) (Bottom) Move Fixture 2 forward of the fans and fasten 12 screws [screw torque: 24~26 kg·cm (20.8~22.6 lb·in)]:



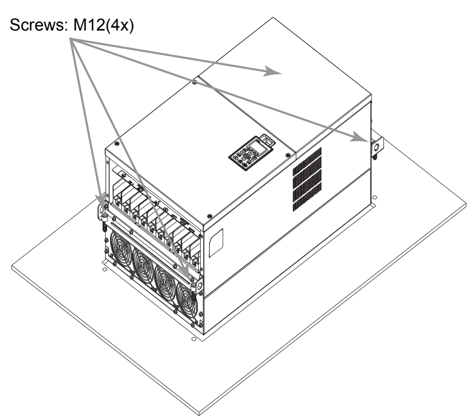
3) (Top) Loosen screws 13~26 and remove Fixture 1 from behind the vents:



4) (Top) Move Fixture 1 forward of the vents and fasten screws 13~26 [screw torque: 24~26 kg·cm (20.8~22.6 lb·in)]:



5) Place 4 screws (M12) through Fixtures 1 & 2 and the plate, and then fasten the screws [screw torque: 300~400 kg·cm (260~347 lb·in)]:

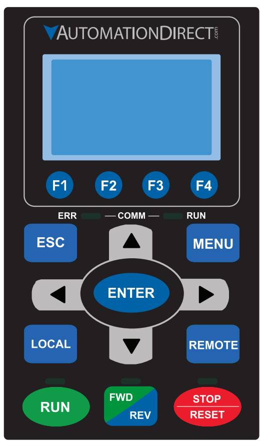


Spare Keypad

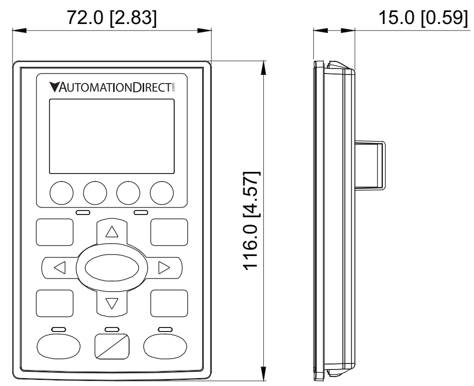
GS4-KPD

Spare or replacement keypad for GS4 drives. The embedded keypad can be installed flat on the surface of the control box (with or without bezel GS4-BZL). The front cover is IP56 rated. The maximum RJ45 extension lead is 5m (16ft). The keypad communication connection back to the drive when mounted remotely can be accomplished by using a standard RJ45 CAT5e straight through patch cable. No other wiring, including power is required. The small RJ45 plastic connector that comes standard with each drive is included with each GS4-KPD kit.

All GS4-KPDs with a date code of +W2242xxxxx or earlier will have FW version 1.12. The FW Code on the KPD will read F112H01.
All GS4-KPDs with a date of +W2243xxxxx or newer with have FW version 1.13. The FW Code on the KPD will read F113H01.
The difference is due to a material change in the keypad itself, and does not change its function. The FW versions are not cross compatible. Please contact Automation Direct technical support with any questions.



RJ45 Connector (included)



Dimensions mm [in]

Descriptions of Keypad Functions	
RUN	**RUN Key** 1) It is only valid when the source of operation command is from the keypad. 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 keypad.
STOP RESET	**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.
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.

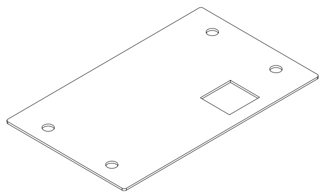
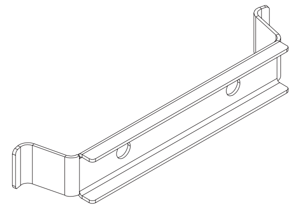
Continued on next page.

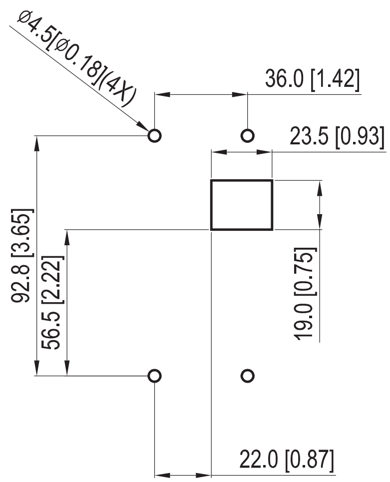
Descriptions of Keypad Functions (*continued*)	
MENU	**MENU Key** Press MENU to return to the main menu. Menu Content: 1) Param Setup 2) Quick Start 3) Keypad Lock 4) Fault Record 5) PLC 6) Copy Param 7) Copy PLC 8) Displ Setup 9) Time Setup 10) Language 11) Start-up
▲ ◀ ▶ ▼	**Direction: Left/Right/Up/Down** 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 P3.58=0 then LOCAL correlates to HAND mode. The Digital Input Definition must not be set to 33 (LOC/REM Switch). *Refer to P3.58 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 factory settings of both source of Remote frequency and Remote operation are the External Terminals (FWD and REV terminals) and Analog In 1 speed signal. 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 P3.58=0 then LOCAL correlates to HAND mode. The Digital Input definition must not be set to 33 (LOC/REM Switch). *Refer to P3.58 for more detail and other options on how the drive behaves when switching between LOCAL and REMOTE.*

Descriptions of LED Functions	
RUN	**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.
STOP RESET	**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.
FWD REV	**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	**ERR_COMM_RUN** Descriptions reserved for future use.

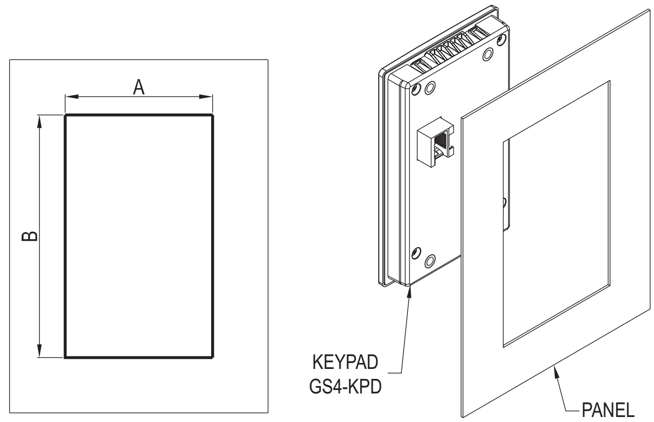
Keypad Panel Mounting Kit GS4-BZL

This panel mounting kit can be used for wall mounting or embedded mounting of the GS4-KPD.

Wall Mounting	Embedded Mounting
Accessory 1  Screws: (4) M4*p 0.7 *L8mm Torque: 10-12 kg·cm (8.7-10.4lb-in.)	Accessory 2  Screws: (4) M4*p 0.7 *L8mm Torque: 10-12 kg·cm (8.7-10.4 lb·in)



Panel cutout dimensions mm [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]

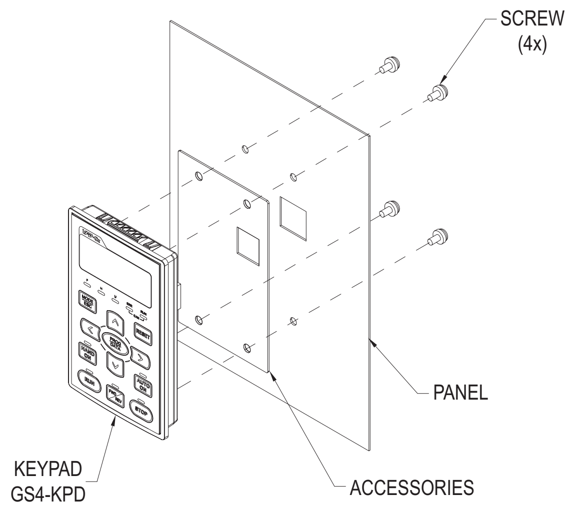
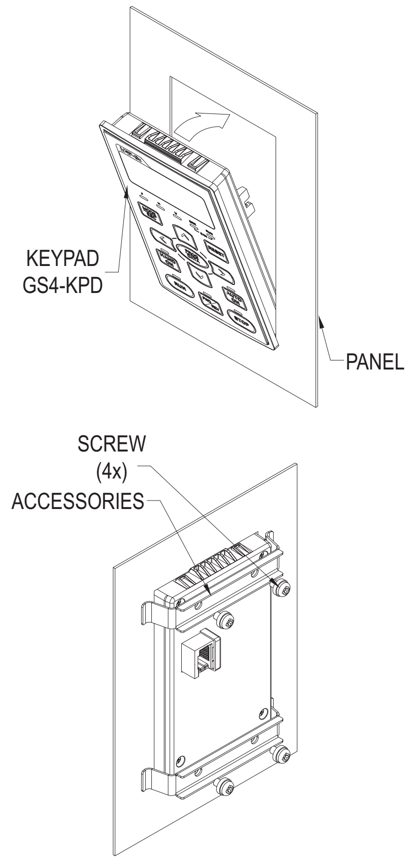
* Deviation: ± 0.15 mm / ± 0.0059 in

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.

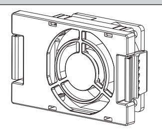
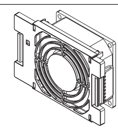
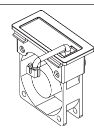
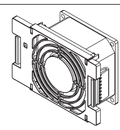
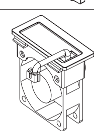
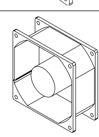
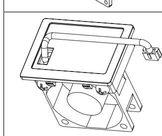
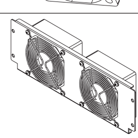
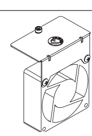
Wall Mounting	Embedded Mounting
	

Spare Fan Kits

Most GS4 drives have built-in cooling fans, and replacement fans are also available. These fans are direct replacements for the internal factory-installed fans.

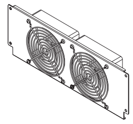
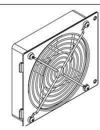
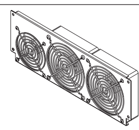
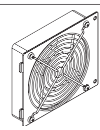
Installation instructions are included in this Appendix.

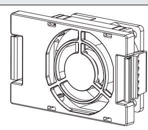
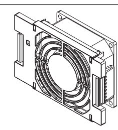
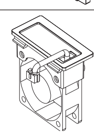
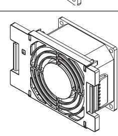
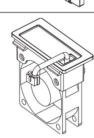
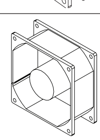
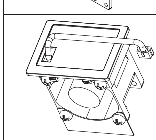
Fan replacement should only be performed by personnel skilled in the disassembly and repair of variable frequency AC drives.

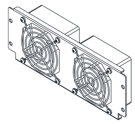
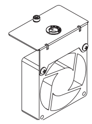
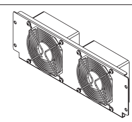
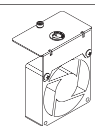
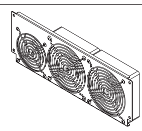
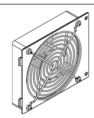
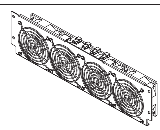
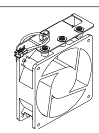
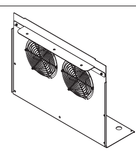
GS4 230V Models – (GS4-2xxx) – Fan Selection Table							
Drive Model	***Fan Model ****		***Description***	***Size***	***Voltage***	***Amps / Fan***	***Fans / Kit***
GS4-22P0 ***GS4-23P0*** ***GS4-25P0***		**GS4-FAN-AM**	Frame A main	40mm	24	0.15	1
GS4-27P5		**GS4-FAN-BM1**	Frame B main	80mm	24	0.33	1
		**GS4-FAN-BB**	Frame B board level	40mm	24	0.18	1
GS4-2010 ***GS4-2015***		**GS4-FAN-BM2**	Frame B main	80mm	24	0.51	1
		**GS4-FAN-BB**	Frame B board level	40mm	24	0.18	1
GS4-2020 ***GS4-2025*** ***GS4-2030***		**GS4-FAN-CM**	Frame C main	92mm	24	0.75	1
		**GS4-FAN-CB1**	Frame C board level	40mm	24	0.18	1
GS4-2040 ***GS4-2050***		**GS4-FAN-DM**	Frame D main	92mm	24	0.75	2
		**GS4-FAN-DB**	Frame D board level	70mm	24	0.33	1

* *Electrical connectors are included.*

(continued next page)

GS4 230V Models – (GS4-2xxx) – Fan Selection Table (continued)							
Drive Model	***Fan Model ****		***Description***	***Size***	***Voltage***	***Amps / Fan***	***Fans / Kit***
GS4-2060 GS4-2075		**GS4-FAN-EM1**	Frame E main	120mm	24	1.08	2
		**GS4-FAN-EB**	Frame E board level	120mm	24	0.76	1
GS4-2100		**GS4-FAN-EM2**	Frame E main	92mm 120mm 120mm	24	0.75 1.08 1.08	3
		**GS4-FAN-EB**	Frame E board level	120mm	24	0.76	1
** Electrical connectors are included.*							

GS4 460V Models - (GS4-4xxx) - Fan Selection Table							
Drive Model	***Fan Model ****		***Description***	***Size***	***Voltage***	***Amps / Fan***	***Fans / Kit***
GS4-43P0 GS4-45P0 GS4-47P5		**GS4-FAN-AM**	Frame A main	40mm	24	0.15	1
GS4-4010		**GS4-FAN-BM1**	Frame B main	80mm	24	0.33	1
		**GS4-FAN-BB**	Frame B board level	40mm	24	0.18	1
GS4-4015 GS4-4020		**GS4-FAN-BM2**	Frame B main	80mm	24	0.51	1
		**GS4-FAN-BB**	Frame B board level	40mm	24	0.18	1
GS4-4025 GS4-4030 GS4-4040		**GS4-FAN-CM**	Frame C main	92mm	24	0.75	1
		**GS4-FAN-CB2**	Frame C board level	40mm	12	0.60	1
** Electrical connectors are included.*							
(continued next page)							

GS4, 460V Models - (GS4-4xxx) - Fan Selection Table (continued)							
Drive Model	**Fan Model ***		**Description**	**Size**	**Voltage**	**Amps / Fan**	**Fans / Kit**
GS4-4050 GS4-4060		**GS4-FAN-D0M**	Frame D0 main	80mm	24	0.75	2
		**GS4-FAN-DB**	Frame D board level	70mm	24	0.33	1
GS4-4075 GS4-4100		**GS4-FAN-DM**	Frame D main	92mm	24	0.75	2
		**GS4-FAN-DB**	Frame D board level	70mm	24	0.33	1
GS4-4125 GS4-4150		**GS4-FAN-EM2**	Frame E main	92mm 120mm 120mm	24	0.75 1.08 1.08	3
		**GS4-FAN-EB**	Frame E board level	120mm	24	0.76	1
GS4-4175 GS4-4200		**GS4-FAN-FM**	Frame F main	92mm	24	0.76	4
		**GS4-FAN-FB**	Frame F board level	120mm	24	1.08	1
GS4-4250 GS4-4300		**GS4-FAN-GM**	Frame G main	250mm	48	2.2	2
** Electrical connectors are included.*							

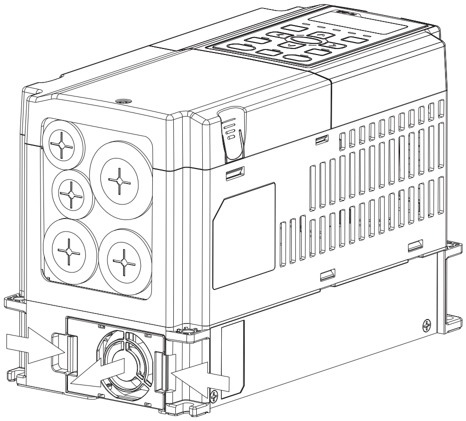
GS4 Fans Screw Specifications		
Fan Part #	**Thread Dimensions**	**Qty**
GS4-FAN-AM	–	–
GS4-FAN-BB		
GS4-FAN-BM1		
GS4-FAN-BM2		
GS4-FAN-CB1		
GS4-FAN-CB2		
GS4-FAN-CM	M4* P0.7* L45	2
GS4-FAN-D0M	M5* P0.8* L10	4
GS4-FAN-DB	–	–
GS4-FAN-DM	M5* P0.8* L10	4
GS4-FAN-EB	M5* P0.8* L10	2
GS4-FAN-EM1	M5* P0.8* L10	4
GS4-FAN-EM2	M5* P0.8* L10	4
GS4-FAN-FB	–	–
GS4-FAN-FM	M5* P0.8* L10	4
GS4-FAN-GM	M4* P0.7* L10	3
	M6* P1.0* L12	5

Fan Removal

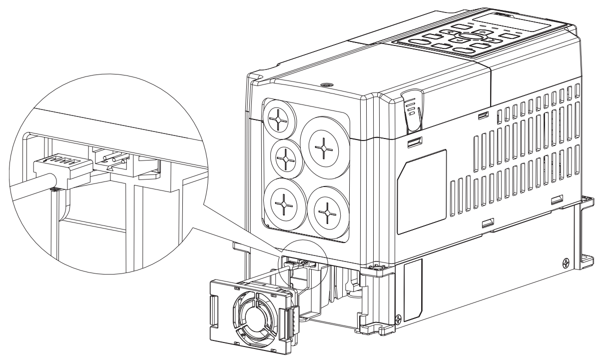
Frame A

Applicable models:
GS4-22P0, GS4-23P0, GS4-25P0
(Other Frame A drives do not have fans - they are convection cooled)

1 Press the tabs on both sides of the fan to successfully remove the fan. (The arrow)



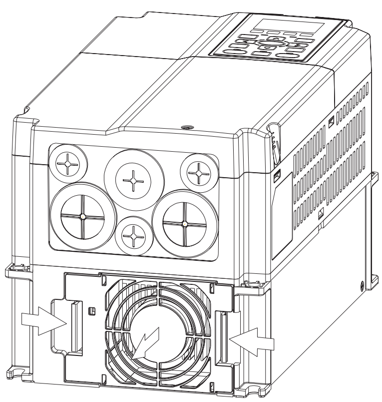
2 Disconnect the power terminal before removing the fan. (As shown below)



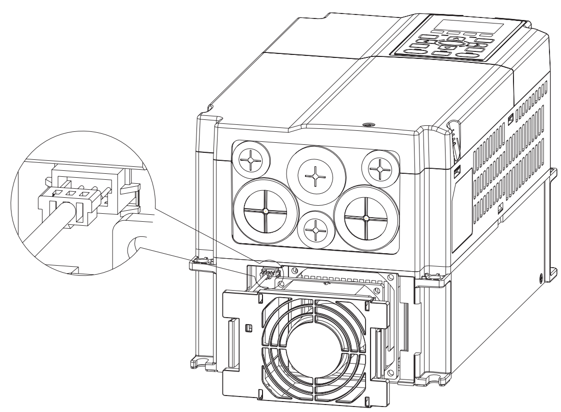
Frame B

Applicable models:
GS4-27P5, GS4-2010, GS4-2015

1 Press the tab on both sides of the fan to successfully remove the fan.



2 Disconnect the power terminal before removing the fan.

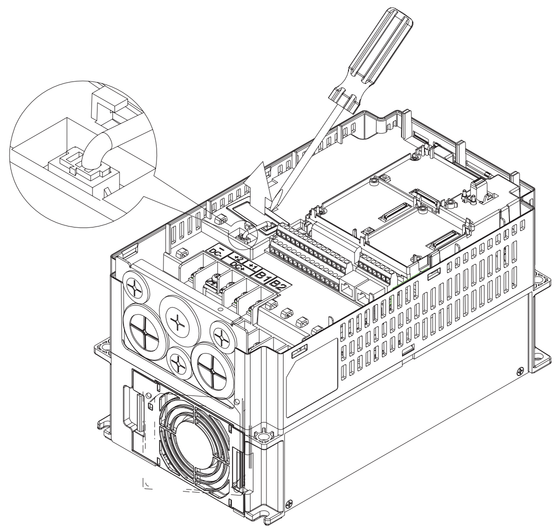


REMOVE POWER FROM DRIVE PRIOR TO INSTALLATION AND/OR REMOVAL OF ACCESSORIES.

Fan Removal (continued)

Frame B&C

Applicable models:
GS4-27P5, GS4-2010, GS4-2015, GS4-2020, GS4-2025, GS4-2030, GS4-4010, GS4-4015, GS4-4020, GS4-4025, GS4-4030, GS4-4040
Disconnect the power terminal with slotted screwdriver to remove the fan cover.



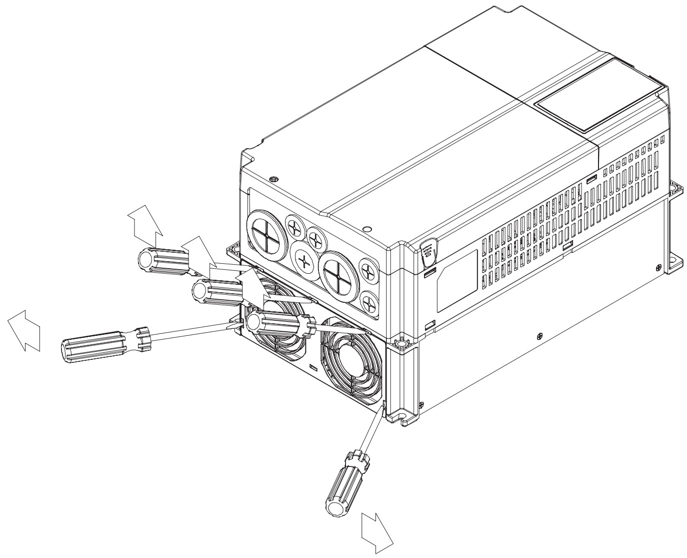
REMOVE POWER FROM DRIVE PRIOR TO INSTALLATION AND/OR REMOVAL OF ACCESSORIES.

Fan Removal (continued)

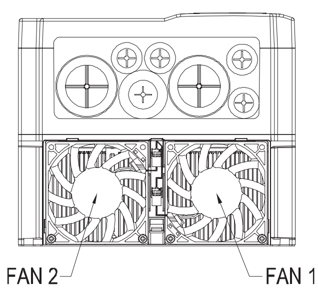
Frame C

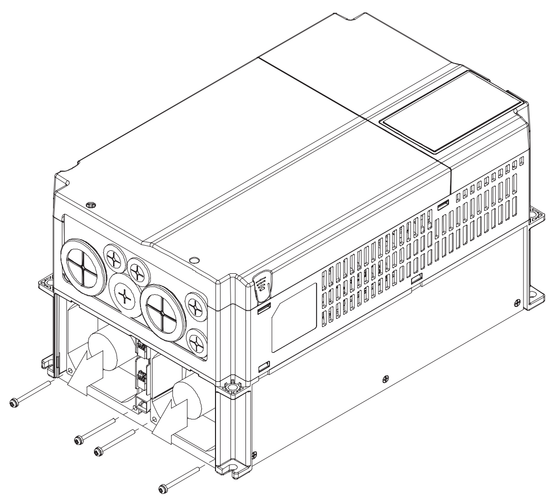
Applicable models:
GS4-4025, GS4-4030, GS4-2020, GS4-2025, GS4-2030

1 Use slotted screwdriver to remove cover.



2 Disconnect the fan power. Pull out the fan after loosening screws. The fan label should face towards the inside of the drive. Screw torque 10 - 12 kg·cm (8.7 - 10.4 lb·in)





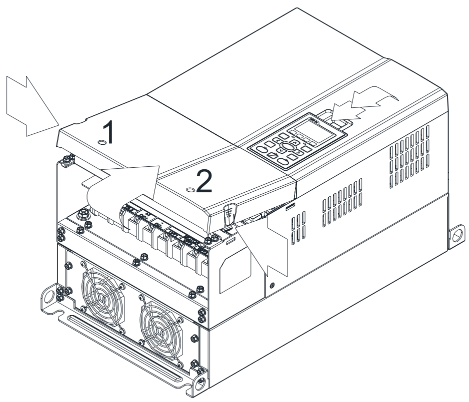
REMOVE POWER FROM DRIVE PRIOR TO INSTALLATION AND/OR REMOVAL OF ACCESSORIES.

Fan Removal (continued)

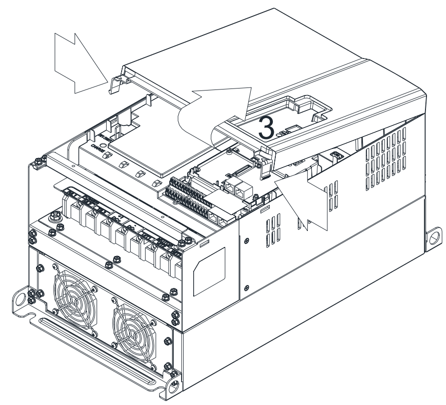
Frame D0

Applicable models:
GS4-4050, GS4-4060

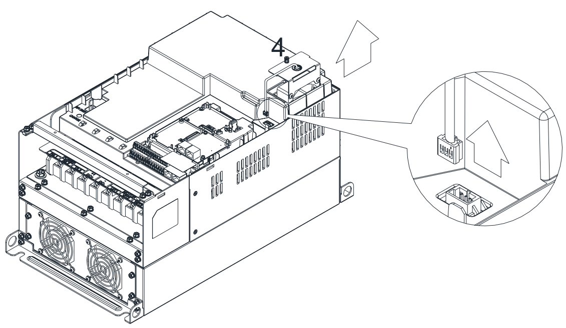
1 Loosen screws 1 and 2, press the tab on the right and the left to remove the cover, follow the direction the arrows indicate. Press the tab on top of digital keypad GS4-KPD to properly remove the keypad.
Screw torque: 10 - 12 kg·cm (8.6 - 10.4 lb·in)



2 Loosen screw 3, press the tab on the right and the left to remove the cover.
Screw torque: 6 - 8 kg·cm (5.2 - 6.9 lb·in)

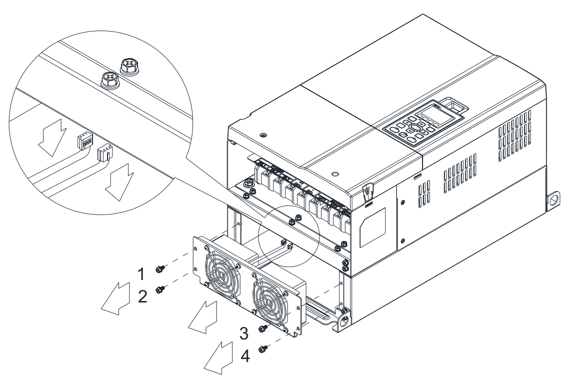


3 Loosen screw 4 and disconnect the fan power.
Screw torque: 10 -12 kg·cm (8.6 - 10.4 lb·in)



4 For heat sink fan:
Step 1. Loosen the screws.
Screw torque: 24 - 26 kg·cm (20.8 - 22.6 lb·in)

Step 2. Disconnect fan power and pull out the fan.



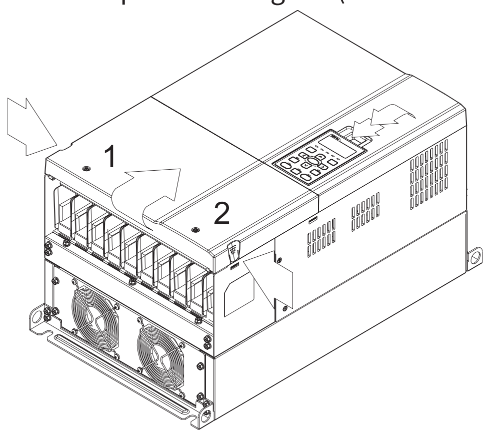
REMOVE POWER FROM DRIVE PRIOR TO INSTALLATION AND/OR REMOVAL OF ACCESSORIES.

Fan Removal (continued)

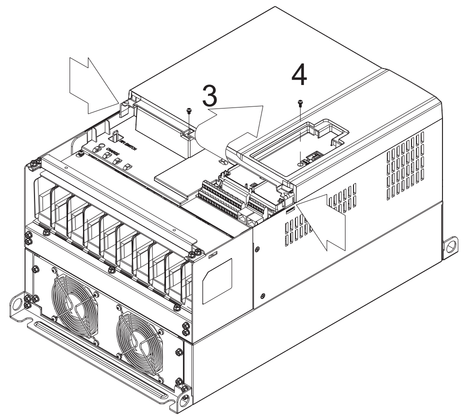
Frame D

Applicable models:
GS4-2040, GS4-2050, GS4-4075, GS4-4100

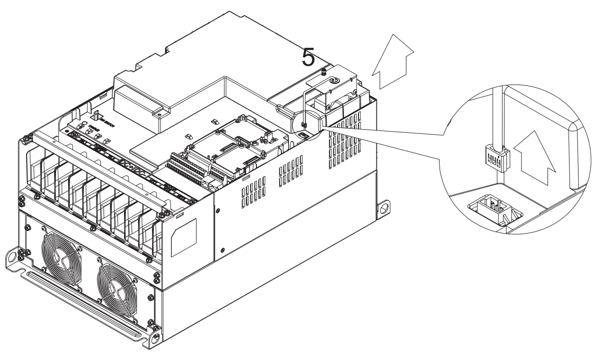
1 Loosen screw 1 and 2, press the tab on the right and the left to remove the cover, follow the direction the arrows indicate. Press the tab on top of digital keypad GS4-KPD to properly remove the keypad.
Screw torque: 10 - 12 kg•cm (8.6 - 10.4 lb·in)



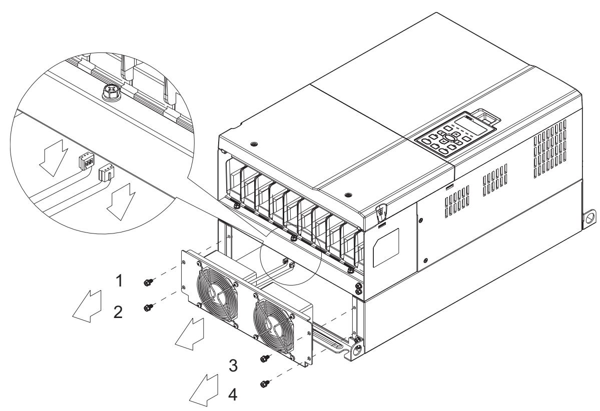
2 Loosen screw 3 and 4, press the tab on the right and the left to remove the cover.
Screw torque: 6 - 8 kg•cm (5.2 - 6.9 lb·in)



3 Loosen screw 5 and disconnect the fan power.
Screw torque: 10 - 12 kg•cm (8.6 - 10.4 lb·in)



4 For heat sink fan:
Step 1. Loosen the screws.
Screw torque: 24 - 26 kg•cm (20.8 - 22.6 lb·in)
Step 2. Disconnect fan power and pull out the fan.



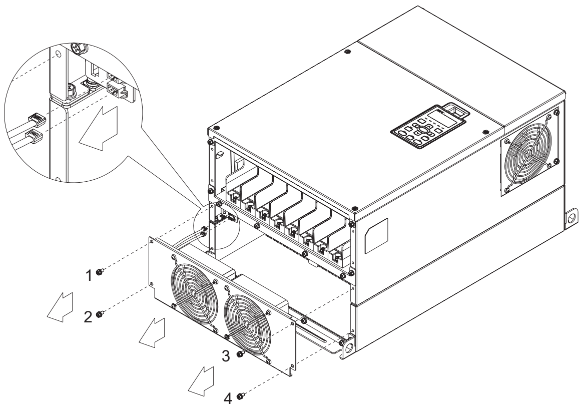
REMOVE POWER FROM DRIVE PRIOR TO INSTALLATION AND/OR REMOVAL OF ACCESSORIES.

Fan Removal (continued)

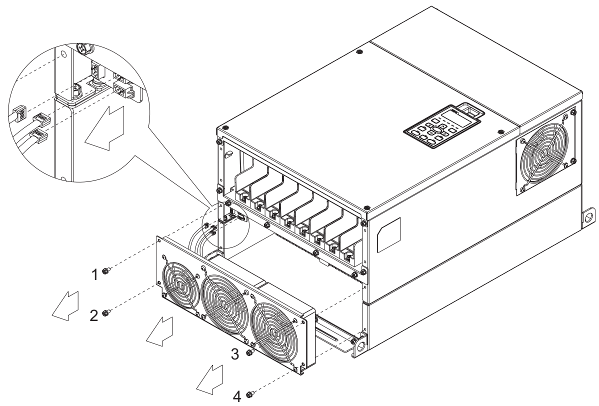
FRAME E

Applicable models:
GS4-2060, GS4-2075, GS4-2100, GS4-4125, GS4-4150

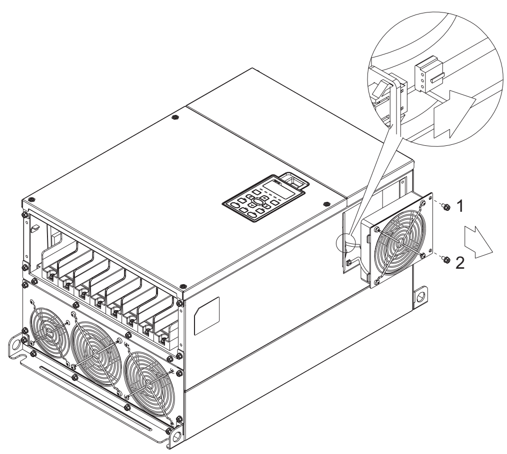
1 Loosen screw 1-4 (as shown in the figure below), and disconnect the fan power then remove the fan.
Screw torque: 24 - 26 kg·cm (20.8 - 22.6 lb·in)



2 Loosen screw 1 - 4 (as shown in the figure below), and disconnect the fan power then remove the fan.
Screw torque: 24 - 26 kg·cm (20.8 - 22.6 lb·in)



3 Loosen screw 1 and screw 2 (as shown in the figure below), and disconnect fan power before removing the fan.
Screw torque: 24 - 26 kg·cm (20.8 - 22.6 lb·in)



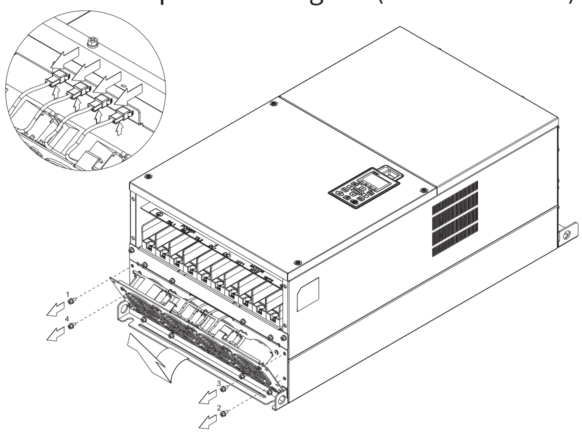
REMOVE POWER FROM DRIVE PRIOR TO INSTALLATION AND/OR REMOVAL OF ACCESSORIES.

Fan Removal (continued)

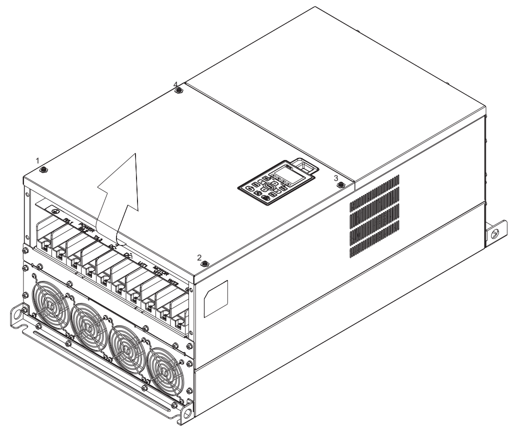
FRAME F

Applicable models:
GS4-4175, GS4-4200

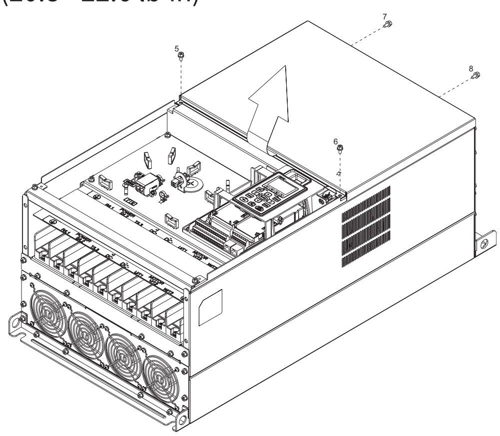
1 Loosen the screws, disconnect the fan power, then remove the fan.
Screw torque: 24 - 26 kg•cm (20.8 - 22.6 Ib•in)



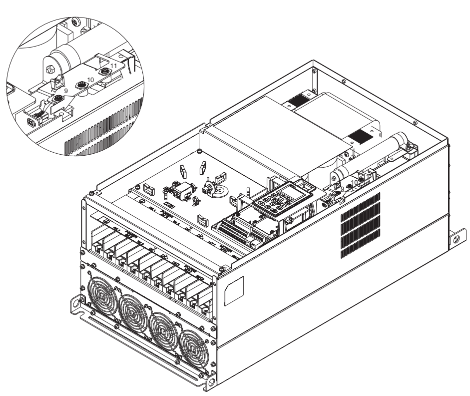
2 Loosen the screw and remove the cover.
Screw torque: 14 - 16 kg•cm (12.2 - 13.9 Ib•in)

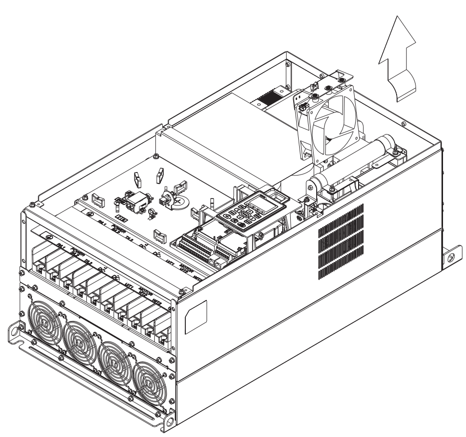


3 Loosen the screw and remove the cover.
Screw torque: 24 - 26 kg•cm (20.8 - 22.6 lb•in)



4 Loosen the screws and disconnect the fan power, then remove the fan.
Screw torque: 14 - 16 kg•cm (12.2 - 13.9 Ib•in)





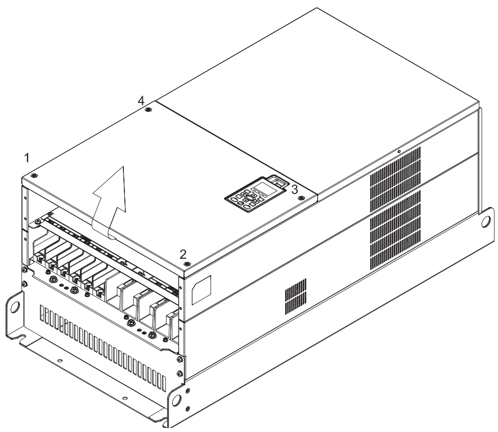
REMOVE POWER FROM DRIVE PRIOR TO INSTALLATION AND/OR REMOVAL OF ACCESSORIES.

Fan Removal (continued)

Frame G

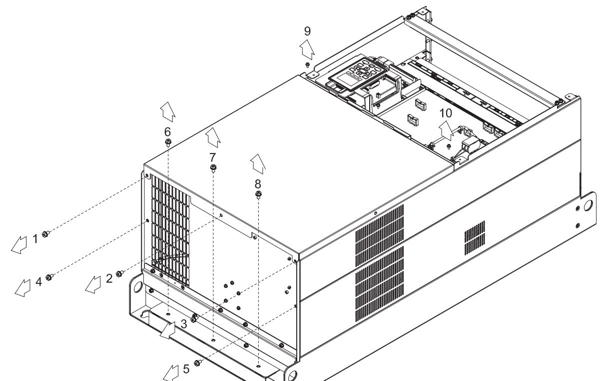
Applicable models:
GS4-4250, GS4-4300

1 Loosen the screw and remove the cover.
Screw torque: 12 - 15 kg·cm (10.4 - 13 Ib·in)

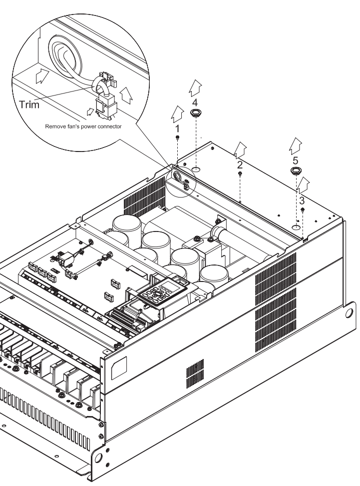


2 For 1-8 shown in the figure: Loosen the screws
Screw torque: 35 - 40 kg·cm (30.4 - 34.7 lb·in)

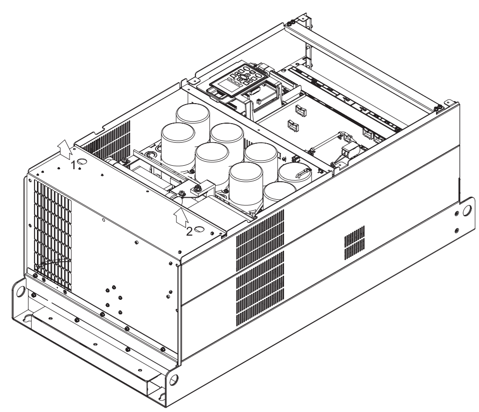
For 9-10 shown in the figure: Loosen the screws and remove the cover.
Screw torque: 14 - 16 kg·cm (12.2 - 13.9 Ib·in)



3 Loosen screw 1 - 3 , remove bushing 4 and 5, and disconnect the fan power.
Screw torque: 14 -16 kg·cm (12.2 - 13.9 lb·in).



4 Pull out the fan.



REMOVE POWER FROM DRIVE PRIOR TO INSTALLATION AND/OR REMOVAL OF ACCESSORIES.

Optional I/O and Communication Cards

Appendix B

Table of Contents

  - *GS4-CM-ENETIP Explicit Messaging* B–24
  - *EtherNet/IP Communication Card Register Settings* B–30
  - *Using Speed Mode as a Control Method* B–30

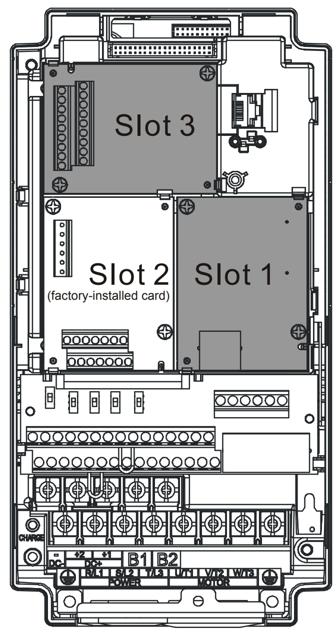
Introduction

GS4 drives have several option cards that can be used to expand the functionality of the drive. Input/Output cards are available to provide additional DC I/O, 120VAC outputs, and relay outputs. Communication interface cards are also available to provide ModbusTCP or EtherNet/IP™ communication. Only one additional I/O card can be installed in a GS4 drive at a time, and only one comm card can be installed in a drive at a time.

Option Card Locations

- *Any optional comm card must be installed in Slot #1.*
- *Slot #2 is reserved for firmware upgrade module. See the GSoft2 helpfile for information on how to upgrade drive, keypad, and comm card firmware.*
- *Any optional I/O card must be installed in Slot 3.*

GS4 Optional I/O and Communication Cards			
Part Number	***Description***	***Placement***	
GS4-06CDD	4-point DC input, 2-point DC output card	Slot 3	
GS4-06NA	6-point AC input card	Slot 3	
GS4-06TR	6-point relay output card	Slot 3	
GS4-CM-MODTCP	Modbus TCP comm card	Slot 1	
GS4-CM-ENETIP	EtherNet/IP comm card	Slot 1	



Removing the Card Slot Cover

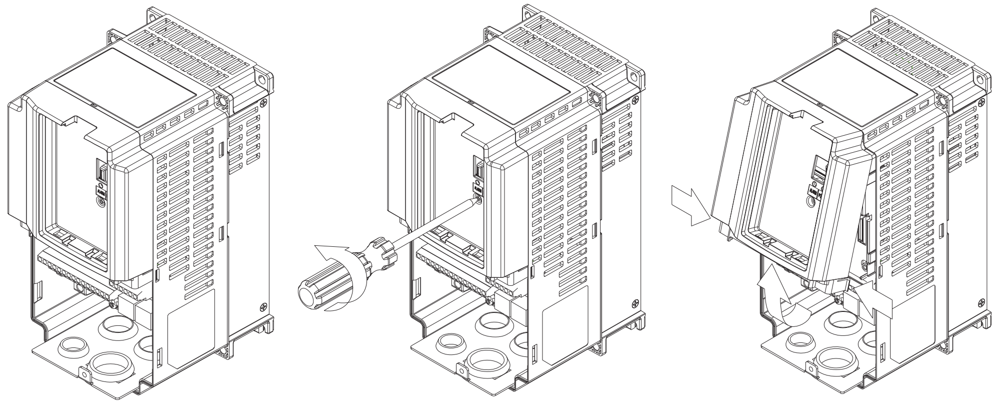
WARNING: AC input power must be disconnected before performing any maintenance. Do not connect or disconnect wires or connectors while power is applied to the circuit. Maintenance must be performed only by a qualified technician.

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.

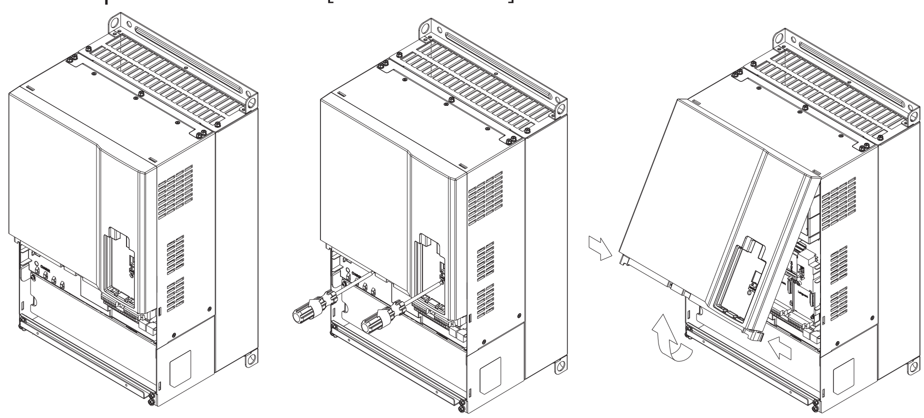
Drive frames A, B, and C

Remove the cover screw and press the tabs on both sides to remove the cover.
Cover screw torque is 6.9~8.7 in·lb [0.78~0.98 N·m].



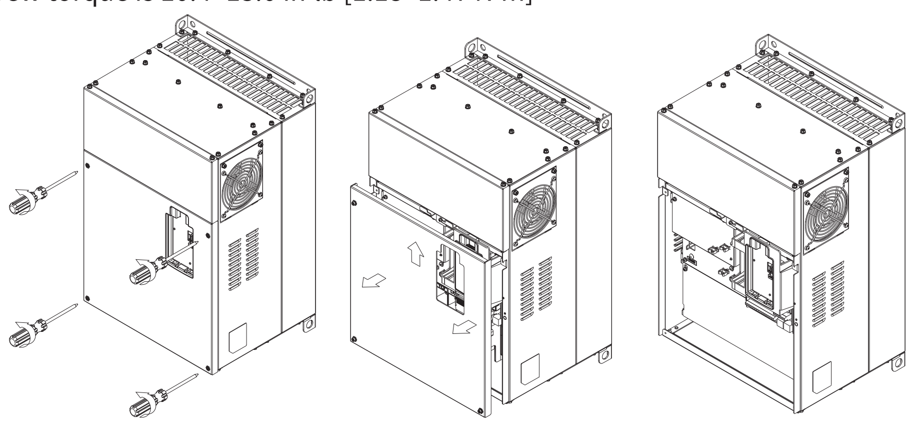
Drive frame D

Loosen the captive screws and press the tabs on both sides to remove the cover.
Cover screw torque is 6.9~8.7 in·lb [0.78~0.98 N·m].



Drive frames E, F, and G

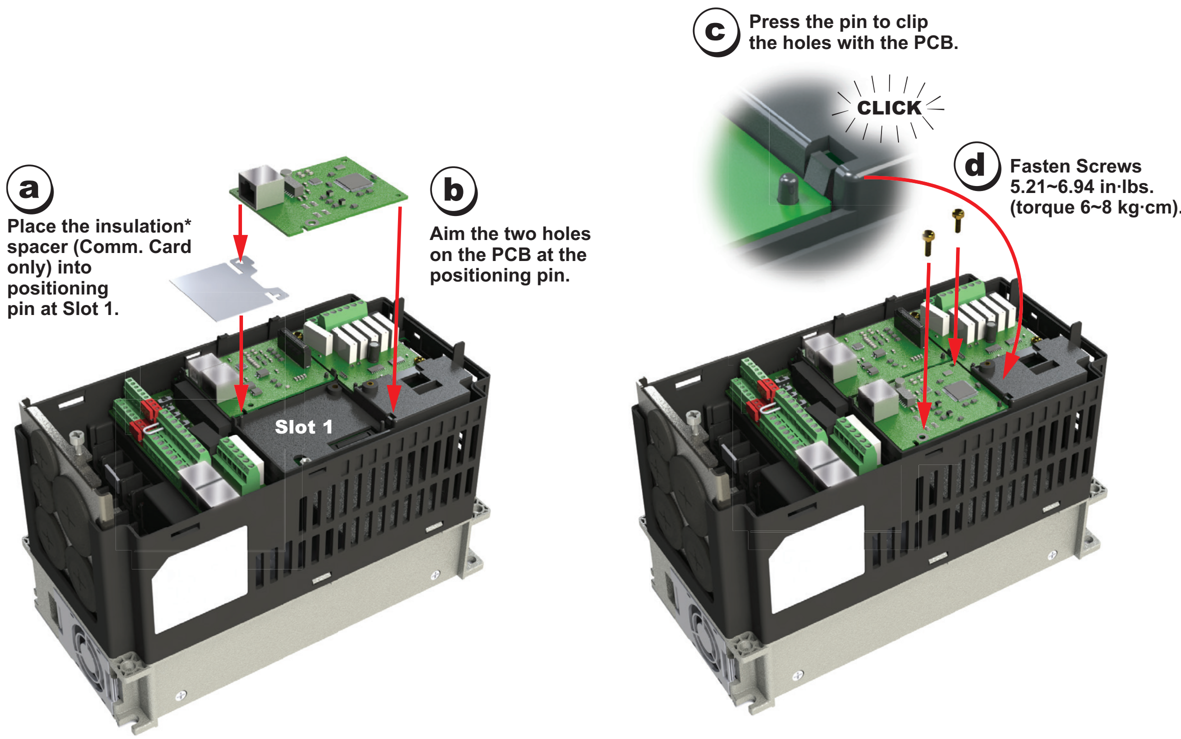
Loosen the captive screws, lift the cover slightly and pull it outward to remove (Frame E shown).
Cover screw torque is 10.4~13.0 in·lb [1.18~1.47 N·m]



Option Card Installation and Removal

Installation

1) Disconnect power to the GS4 AC drive.
2) Remove the digital keypad and cover to the GS4 AC drive. (See “Chapter 2: Installation and Wiring” for detailed instructions.)
3) Install the circuit board.
   a) Place the insulation spacer on the positioning pin at Slot 1 (communication cards only).
   b) Align the two holes on the circuit board with the positioning pin of the GS4 drive slot that is appropriate for the option card being installed (see page B–2).
   c) Push down on the circuit board until the board clicks into place under the retaining clip.
   d) Fasten the circuit board with the M3 x 0.5 x 5mm long mounting screws. Tighten to a torque of 5.21~6.94 in·lb (0.59~0.78 N·m).



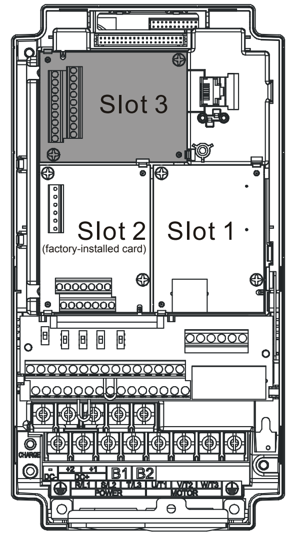
* Insulation spacer assists in preventing accidental contact of cable, board, screw, and relay terminals.

Removal

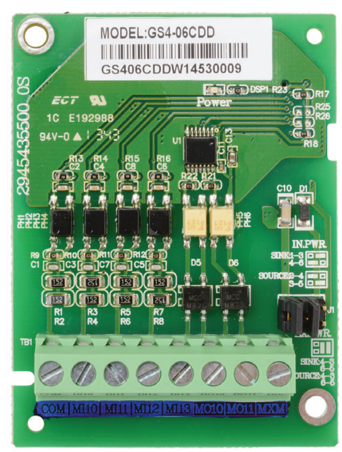
1) Disconnect power to the GS4 AC drive.
2) Remove the digital keypad and cover to the GS4 AC drive. See Chapter 2 - Installation and Wiring detailed instructions.
3) Remove the circuit board.
   a) Remove the M3 x 0.5 x 5mm long mounting screws.
   b) Push back on the retaining clip and lift the circuit board off of the positioning pin

Optional I/O Cards

The following chart lists the optional input/output cards available for GS4 series drives.

GS4 Optional I/O Cards *		
Part Number	***Description***	***Placement***
GS4-06CDD *	*DURAPULSE* combination discrete I/O module, selectable sinking or sourcing 24VDC input, 24VDC output, 4-point input, 2-point output, 1 input common(s), 1 output common(s), 50mA resistive output current. For use with GS4 series AC drives.	
GS4-06NA *	*DURAPULSE* discrete input module, sinking 120VAC input, 6-point input, 1 input common(s). For use with GS4 series AC drives.	
GS4-06TR *	*DURAPULSE* relay output module, Form A (SPST) relays, 6-point output, 6 output common(s). For use with GS4 series AC drives.	
* *I/O cards can be installed only in Slot #3 of the GS4 drive, and only one I/O card at a time can be installed.*		

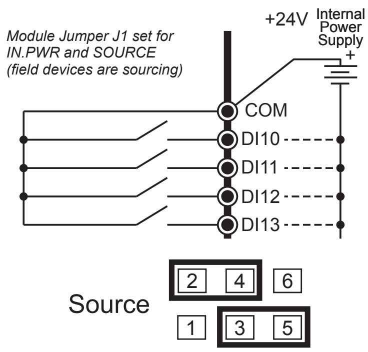
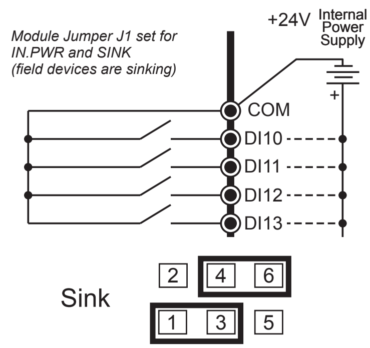
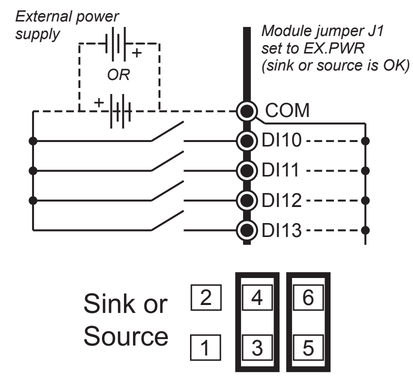
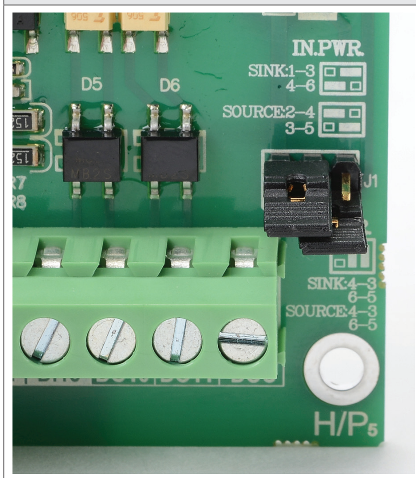
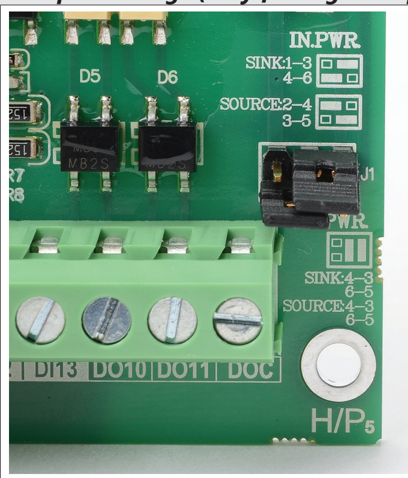
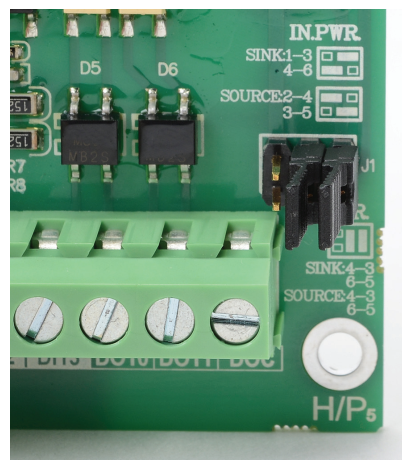
GS4-06CDD Combo I/O card

GS4-06CDD - 4 DC Inputs / 2 DC Outputs			
Part Number	***Terminals***	***Description***	
GS4-06CDD	COM	Common for Multi-Function Input terminals Select SINK(NPN)/SOURCE(PNP) and internal/external power supply with J1 jumper. Jumper is only applicable to the inputs	
	DI10~DI13	Refer to parameters P3.11~P3.14 to program the multi-function inputs DI10~DI13. Internal power is applied from terminal E24: +24VDC ±5% 200mA, 5W External power +24VDC: max. voltage 30VDC, min. voltage 19VDC ON: the activation current is 3.3mA @ ≥ 11VDC OFF: leakage current tolerance is 1.4mA ≤ 5VDC	
	DO10~DO11	Refer to P3.21 and P3.22 to program the multi-function outputs DO10-DO11 Multi-function output terminals (photocoupler) Duty-cycle: 50% ±5% Max. output frequency: 100Hz Max. current: 50mA Max. voltage: 48VDC	
	DOC	Common for multi-function output terminals DO11~DO11 (photocoupler) Max 48VDC 50mA Outputs are bi-directional (can be wired sink or source)	

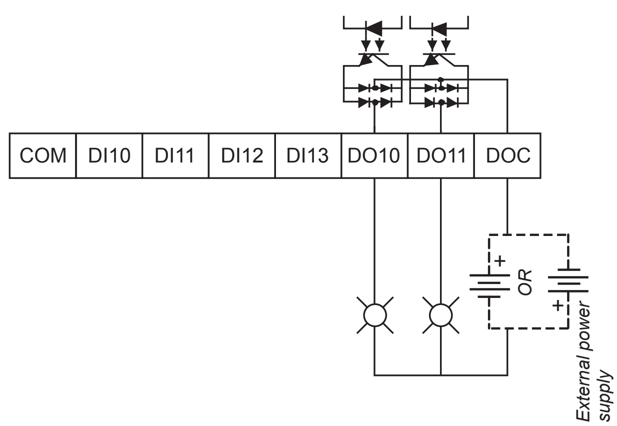
GS4-06CDD Terminal Torque Specs	
Wire Gauge	20~24 AWG
Torque	3.47 in·lb (0.39 N·m)

GS4-06CDD Digital Inputs Wiring

NOTE: When using the Internal 24VDC Power Supply, 3-wire devices (such as proximity switches, photoeyes, etc.) cannot be used because both the positive and negative sides of the power supply are not available. Either use a 2-wire device or use an external power supply.

Internal Power Supply (Sourcing field devices)	Internal Power Supply (Sinking field devices)	External Power Supply (Sinking or Sourcing field devices)
 When jumpered for Source: Dixx terminals will sink current **(field devices are sourcing).** COM terminal provides +24VDC (200mA max).	 When jumpered for Sink: Dixx terminals will provide +24VDC **(field devices are sinking).** Connect COM to GND.	
J1 Jumper Settings (only for Digital Inputs)		
		

GS4-06CDD Digital Outputs Wiring

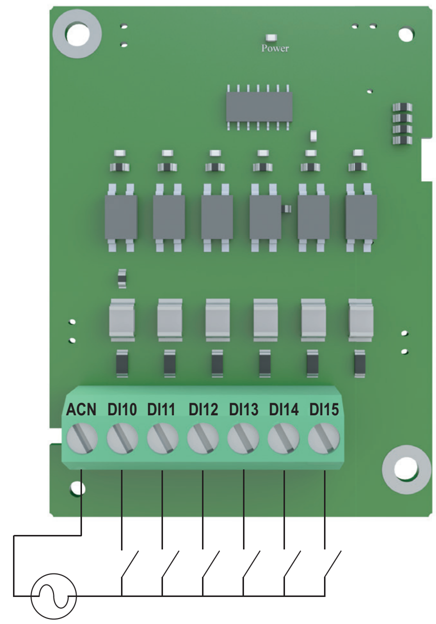


Outputs are bidirectional: can be used in sinking or sourcing applications.

J1 jumper has no effect on digital outputs' operation.)

GS4-06NA Input Card

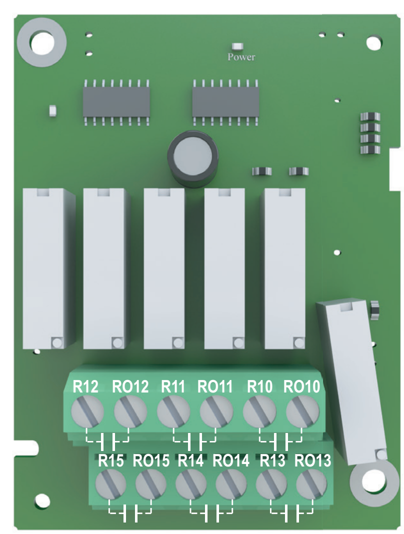
GS4-06NA (Six AC Inputs)		
Part #	**Terminals**	**Description**
GS4-06NA	ACN	AC power Common for multi-function input terminal (Neutral)
	DI10~DI15	Refer to P3.11~P3.16 for multi-function input selection Input voltage: 100~130 VAC Input frequency: 47~63 Hz Input impedance: 27kΩ Terminal response time: ON: 10ms OFF: 20ms



GS4-06NA Terminal Torque Specs	
Wire Gauge	20~24 AWG
Torque	3.47 in·lb (0.39 N·m)

GS4-06TR Output Card

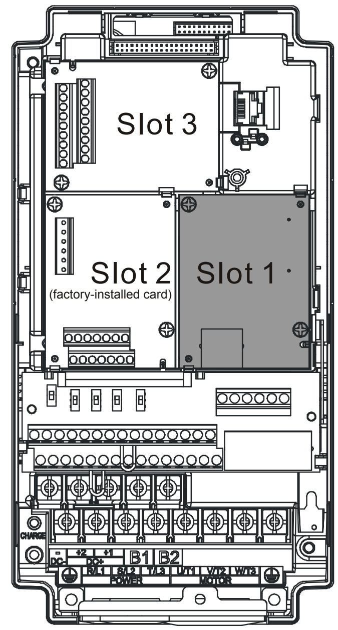
GS4-06TR (Six Relay Outputs)		
Part #	**Terminals**	**Description**
GS4-06TR	R10~R15 RO10~RO15	Refer to P3.21~P3.26 for multi-function output selection Resistive load: 5A(N.O.) / 250VAC 5A(N.O.) / 30VDC Inductive load (COSØ 0.4) 2A(N.O.) / 250VAC Six Form A (SPST-NO) relay outputs Rxx = separate common for each relay R0xx = normally open output



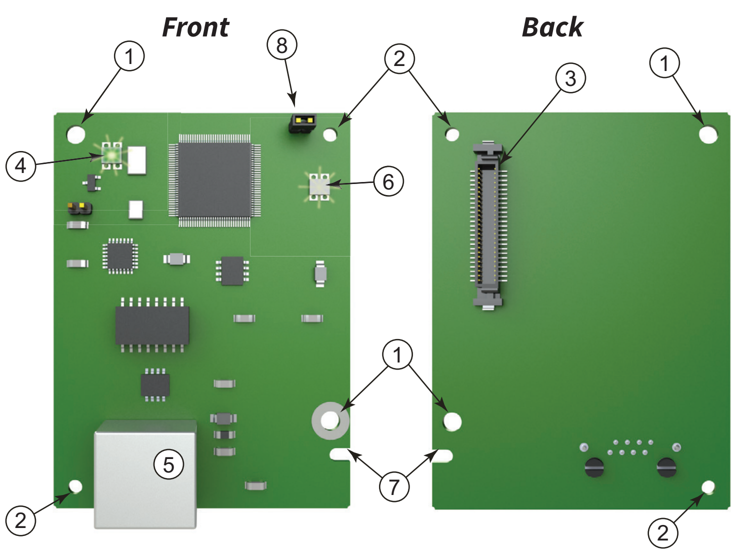
GS4-06TR Terminal Torque Specs	
Wire Gauge	20~26 AWG
Torque	5.21 in·lb (0.59 N·m)

Optional Communications Cards

The following chart lists the optional communication cards available for GS4 series drives.

GS4 Optional Communication Cards *		
Part Number	***Description***	***Placement***
GS4-CM-MODTCP *	DURApulse communication card, Modbus TCP, 10/100 Mbps auto-detect, Ethernet (RJ45) port. For use with GS4 series AC drives.	
GS4-CM-ENETIP *	DURApulse communication card, EtherNet/IP 10/100 Mbps auto-detect, Ethernet (RJ45) port. For use with GS4 series AC drives.	
* *Communication cards can be installed only in Slot #1 of the GS4 drive, and only one comm card at a time can be installed.*		

GS4-CM-xxxxxx Circuit Board Layout

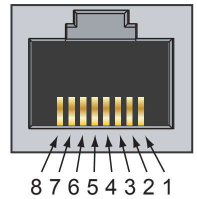


1) Mounting screw hole (qty: 2)
2) Positioning hole (qty: 2)
3) GS4 AC drive connection port
4) LINK LED indicator
5) RJ45 port
6) POWER LED indicator
7) Alignment groove
8) FW upgrade jumper

Connecting Comm Card to PC

GS4-CM-xxxxxx RJ45 Pin Description

PIN Description for GS4-CM-ENETIP & GS4-CM-MODTCP					
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



GS4-CM-xxxxxx Optional Cable

Cat5E patch (straight-through) shielded-twisted-pair cable with RJ45 male connectors:

- *Part # C5E-STPxx-Snn, where:*
  - *xx = color; BK-black, BL-blue, GN-green, GY-gray, OR-orange, PL-purple, RD-red, YL-yellow*
  - *yy = length; 3, 7, 10, 14, 25, or 50 feet*

Communication Card Firmware Update Instructions

These instructions explain how to update firmware via the internet for the following GS4 optional communication cards:

- *GS4-CM-ENETIP – EtherNet/IP™ communication card*
- *GS4-CM-MODTCP – Modbus TCP communication card*

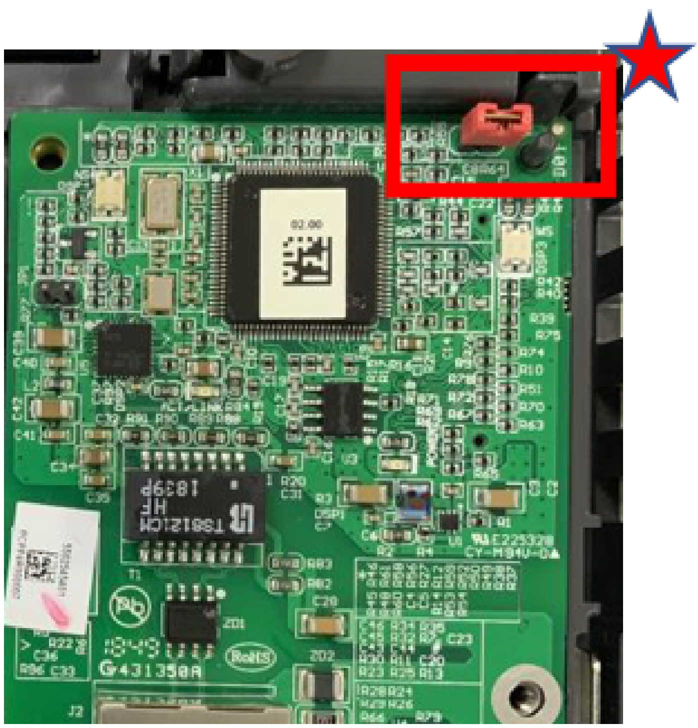
The comm card firmware can be updated via GSOFT2 configuration software for GS4 AC drives, or via an internet browser. The browsers we support are Internet Explorer, Microsoft Edge, Chrome, Firefox and Safari.

Removing the Card Slot Cover

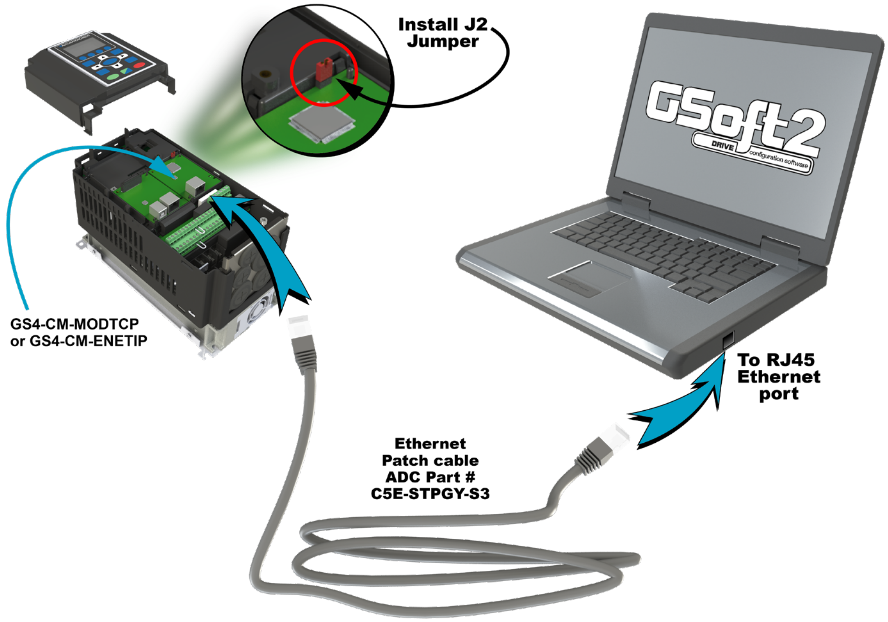
Refer to "Removing the Card Slot Cover" (page B–2) for instructions for gaining physical access to the communications card.

Firmware Update Instructions

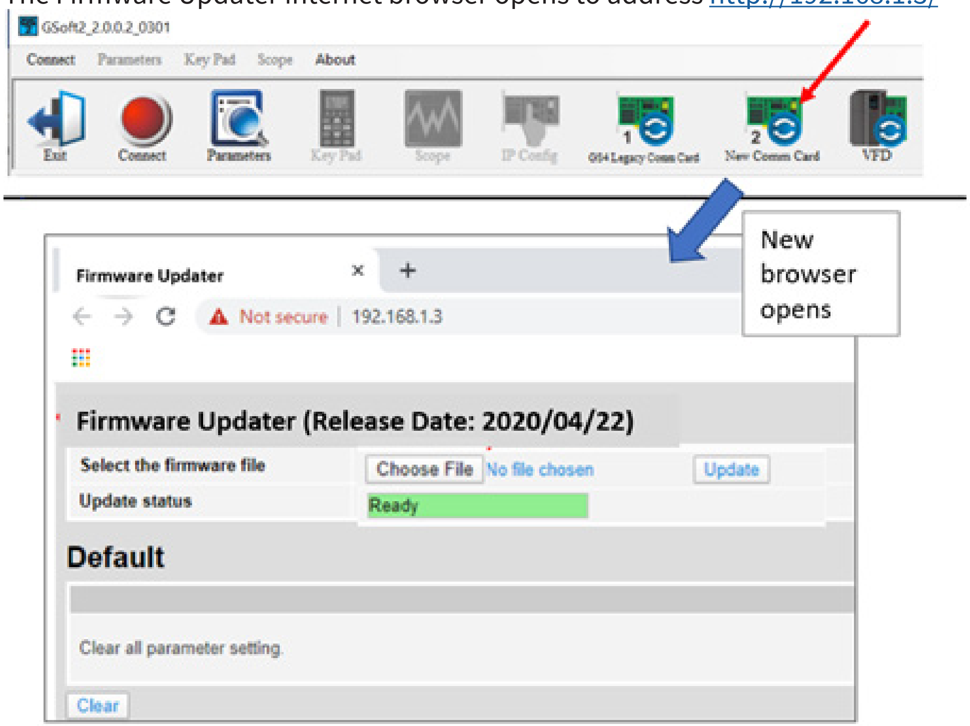
1) Remove power from the drive. Remove necessary drive components to access the Comm card circuitry. Install the jumper on JP2 on the Comm card.
   Ensure the Comm card remains plugged into the drive.



2) Connect the PC and the Comm card with an Ethernet cable (straight-through cable) as shown below:

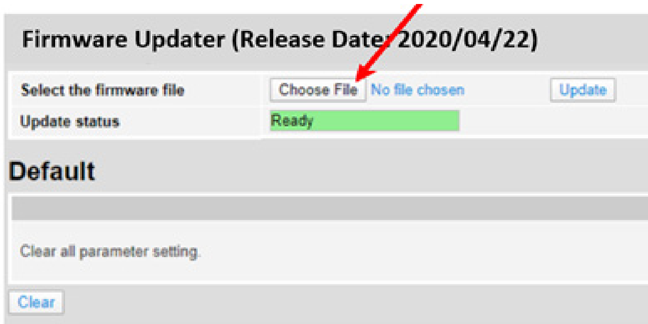


3) Energize the Drive input power to enter the Comm Card FW BOOT mode (jumper must be installed).
4) In GSoft2, click the **New Comm Card** icon in the menu bar.
The Firmware Updater internet browser opens to address http://192.168.1.3/

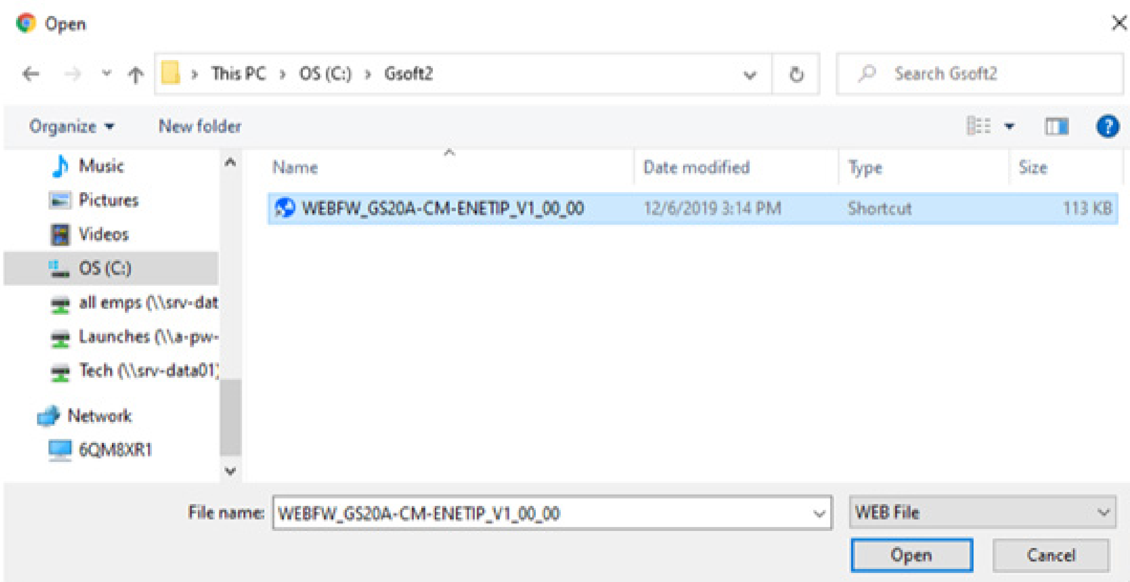


If the internet browser will not connect, validate the network card settings for the PC Ethernet port.

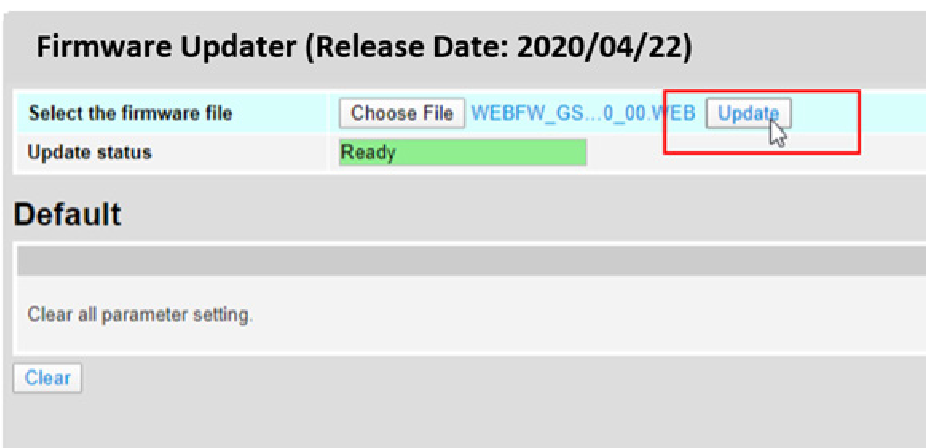
5) After successful connection, the FIrmware update screen will appear in the browser. Click **Choose File**.

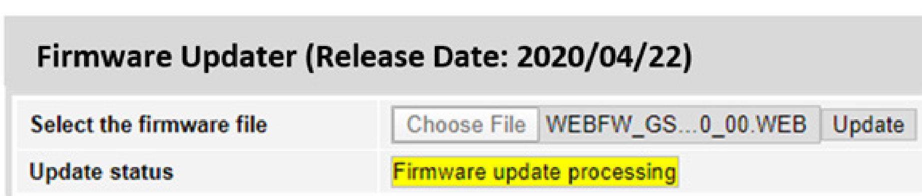


6) Navigate to the Comm Card FW" file. Click **Open**.

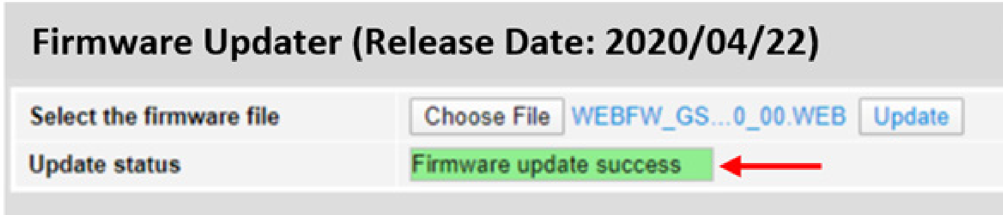


7) Click **Update**.
The firmware update will begin. Typical update time is a few seconds.





8) The message “Firmware Update Success” will indicate the process is completed.



9) **IMPORTANT!** Remove power from the drive, then remove the jumper from J2.

10) Reinstall the Comm card and apply power to the drive.
Verify the new firmware version in the P09.45 parameter value.
If the firmware version is 0, the jumper was not removed and the Comm card will not function.

GS4-CM-MODTCP and GS4-CM-ENETIP 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 P9.63 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 GS4 Drive

Now the IP address of the drive must be set. This can be done in GSoft2 or by the drive's 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 P9.64 causes the drive to push the P9 communication parameters to the card. Bits in P9.64 reset themselves automatically.

GSoft2 method

Connect to the drive thru the RS485 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 P9.64)

Keypad method

Enter the following parameter data in the drive keypad:

GS4 IP Configuration		
Parameter	**Set Value**	**Explanation**
P9.48	0	Set the IP to "Static"
P9.49	192	IP address 1
P9.50	168	IP address 2
P9.51	1	IP address 3
P9.52	10	IP address 4
P9.53	255	Subnet Mask 1
P9.54	255	Subnet Mask 2
P9.55	255	Subnet Mask 3
P9.56	0	Subnet Mask 4
P9.57	192	Gateway Address 1
P9.58	168	Gateway Address 2
P9.59	1	Gateway Address 3
P9.60	1	Gateway Address 4

Enter a "2" into P9.64 (sets bit 1 = 1) and press "Enter" to transfer the network parameters to the comm card. P9.64 will save the parameters to the card and will then reset P9.64 to zero.

GS4-CM-MODTCP Specifications

Features

- *Modbus TCP protocol*
- *MDI/MDI-X auto-detect*
- *Baud rate: 10/100Mbps auto-detect*

GS4-CM-MODTCP Specifications	
Network Interface	
Interface	RJ45 with Auto MDI/MDIX
Number of ports	1 Port
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 TCP, BOOTP
Electrical	
Power supply voltage	5VDC (supplied by the AC motor drive)
Insulation voltage	500VDC
Power consumption	0.8W
Weight	25g
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

GS4-CM-MODTCP LED Indicators and Troubleshooting

There are 2 LED indicators on GS4-CM-MODTCP. The POWER LED displays the status of the power supply, and the LINK LED displays the communication status with the network.

If any of the following 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.

GS4-CM-MODTCP LED Indicators				
LED	***Status***		***Indication***	***How to correct it?***
POWER	Amber	On	Power supply in normal status	–
		Off	No power supply	Check the power supply
LINK	Amber	On	Network connection in normal status	–
		Flashes	Network in operation	–
		Off	Network not connected	Check if the network cable is connected

GS4-CM-MODTCP LED Troubleshooting		
Abnormality	***Cause***	***How to correct it?***
POWER LED off	GS4 drive not powered	Check if GS4 drive is powered, and if the power supply is normal.
	GS4-CM-MODTCP not connected to AC drive	Make sure GS4-CM-MODTCP is connected to AC drive.
LINK LED off	GS4-CM-MODTCP not connected to network	Make sure the network cable is correctly connected to network.
	Poor contact to RJ-45 connector	Make sure RJ-45 connector is connected to Ethernet port.
No COMM Card	GS4-CM-MODTCP not connected to AC drive	Make sure GS4-CM-MODTCP is connected to AC drive.

GS4-CM-MODTCP Error Codes		
ID	***Code***	***Definition***
75	ECFF	Incorrect default setting
76	ECiF	Serious internal error
80	ECEF	Ethernet connection error
81	ECto	Communication timeout between GS4-CM-MODTCP and GS4
82	ECCS	Checksum error in the communication between GS4-CM-MODTCP and GS4
83	ECrF	Reset GS4-CM-MODTCP 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	GS4 is busy.
89	ECCb	Comm Card Break (disconnected) for > 5 seconds.

GS4-CM-MODTCP Common Communication Parameters

When the GS4 drive, is connected via Ethernet, please use the communication parameters in the table below to configure the drive. The Ethernet master will be able to read/write the frequency word and control word for the GS4 drive after the communication parameters are set up.

GS4 Communication Parameters			
Parameter	**Function**	**Set Value (Dec)**	**Explanation**
P4.00	1st Source of Frequency Command [Remote]	4	The frequency command is controlled by communication card.
P3.00	Source of operation command setting	5	The operation command is controlled by communication card.
P9.48	IP setting	0	Static IP(0) / Dynamic distribution IP(1)
P9.49	IP address -1	192	IP address 192.168.1.5
P9.50	IP address -2	168	IP address 192.168.1.5
P9.51	IP address -3	1	IP address 192.168.1.5
P9.52	IP address -4	5	IP address 192.168.1.5
P9.53	Netmask -1	255	Netmask 255.255.255.0
P9.54	Netmask -2	255	Netmask 255.255.255.0
P9.55	Netmask -3	255	Netmask 255.255.255.0
P9.56	Netmask -4	0	Netmask 255.255.255.0
P9.57	Default gateway -1	192	Default gateway 192.168.1.1
P9.58	Default gateway -2	168	Default gateway 192.168.1.1
P9.59	Default gateway -3	1	Default gateway 192.168.1.1
P9.60	Default gateway -4	1	Default gateway 192.168.1.1

Communication Card Special Function Parameters	
Parameter	**Explanation**
P9.63	Communication Card Factory Reset, 1 = Reset to Factory Defaults
P9.64	Communication Card Set, 2 = Write Parameters to Card

After changing any of the P9.xx communication card parameters, enter a “2” into P9.64 (Bit1 = 1). This will write any parameter changes from the drive into the communication card.

GS4-CM-MODTCP Control Words

Communication 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	Reserved
		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 2000h: Writing to and Reading from the 2000h control word works as expected with Ethernet communication. If you are also simultaneously writing to P9.27 and P9.28 via RS-485 (the Control words for RS-485 communication), the Ethernet control word may not read back correctly with the current status. (Please use RS-485 OR Ethernet for exact feedback, but do NOT use both.)*

***Note concerning 2001h: If the Frequency Command (via RS485, Ethernet, Keypad, analog, etc.) is set higher than P0.04 Max Frequency Output, the drive will limit the actual output to P0.04.*

GS4-CM-MODTCP Status Words

Communication Protocol Parameter Address Definitions			
Address		**Definition**	
Modbus Decimal	**Modbus Hex**		
Status Monitor 1 – Warning Codes			
48449	2100	Fault Code: Refer to Troubleshooting – Warning/Fault Codes in Chapter 6: Maintenance and Troubleshooting	
Status Monitor 2 – Status of GS4 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	Warning Codes	
48458	2109	Digital Input Counter Value	
48459	210A	Power Factor Angle (cos Θ)	
48460	210B	reserved	
48461	210C	Actual Motor Speed (rpm)	
48462	210D	reserved	
48463	210E	reserved	
48464	210F	Power Output in kW	

Modbus Communication

GS4-CM-MODTCP Modbus Function Codes	
Code	**Definition**
0x03	Read register(s) in GS4
0x06	Write single register in GS4
0x10	Write multiple data registers in GS4

GS4-CM-ENETIP Specifications

Features

- *Auto-detects transmission speed 10/100 Mbps*
- *MDI/MDI-X auto-detect*
- *Supports MODBUS TCP slave communication protocol (1 connection)*
- *On-line monitoring*
- *Supports Ethernet/IP explicit message Class 3*
- *EtherNet/IP implicit Class 1*

GS4-CM-ENETIP Specifications	
Network Interface	
Interface	RJ45 with Auto MDI/MDIX
Number of ports	1 Port
Transmission method	IEEE 802.3, IEEE 802.3u
Transmission cable	Category 5e shielding 100M
Transmission speed	10/100 Mbps Auto-Detect
Network protocol	ICMP, IP, TCP, UDP, DHCP, Modbus TCP, EtherNet/IP
Electrical	
Power supply voltage	5VDC (supplied by the AC motor drive)
Insulation voltage	500VDC
Power consumption	0.8W
Weight	25g
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: The external controller's RPI must be set greater than 10ms.	

GS4-CM-ENETIP LED Indicators and Troubleshooting

There are 2 LED indicators on GS4-CM-ENETIP. 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.

GS4-CM-ENETIP LED Indicators				
LED	**Status**		**Indication**	**How to correct it?**
POWER	Amber	On	Power supply in normal status	–
		Off	No power supply	Check the power supply
LINK	Amber	On	Network connection in normal status	–
		Flashes	Network in operation	–
		Off	Network not connected	Check if the network cable is connected

GS4-CM-ENETIP LED Troubleshooting		
Abnormality	**Cause**	**How to correct it?**
POWER LED off	AC motor drive not powered	Check if AC motor drive is powered, and if the power supply is normal.
	GS4-CM-ENETIP not connected to AC drive	Make sure GS4-CM-ENETIP is connected to AC motor drive.
LINK LED off	GS4-CM-ENETIP not connected to network	Make sure the network cable is correctly connected to network.
	Poor contact to RJ-45 connector	Make sure RJ-45 connector is connected to Ethernet port.

GS4-CM-ENETIP Error Codes		
ID	**Code**	**Definition**
75	ECFF	Incorrect default setting
76	ECiF	Serious internal error
80	ECEF	Ethernet connection error
81	ECto	Communication timeout between GS4-CM-ENETIP and GS4
82	ECCS	Checksum error in the communication between GS4-CM-ENETIP and GS4
83	ECrF	Reset GS4-CM-ENETIP 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	GS4 is busy.

GS4-CM-ENETIP Common Parameters

When the GS4 drive, is connected via Ethernet, please use the communication parameters in the table below to configure the drive. The Ethernet master will be able to read/write the frequency word and control word for the GS4 drive after the communication parameters are set up.

GS4 Communication Parameters			
Parameter	***Function***	***Set Value (Dec)***	***Explanation***
P4.00	Source of frequency command setting	4	The frequency command is controlled by communication card.
P3.00	Source of operation command setting	5	The operation command is controlled by communication card.
P9.48	IP setting	0	Static IP(0) / Dynamic distribution IP(1)
P9.49	IP address -1	192	IP address 192.168.1.5
P9.50	IP address -2	168	IP address 192.168.1.5
P9.51	IP address -3	1	IP address 192.168.1.5
P9.52	IP address -4	5	IP address 192.168.1.5
P9.53	Netmask -1	255	Netmask 255.255.255.0
P9.54	Netmask -2	255	Netmask 255.255.255.0
P9.55	Netmask -3	255	Netmask 255.255.255.0
P9.56	Netmask -4	0	Netmask 255.255.255.0
P9.57	Default gateway -1	192	Default gateway 192.168.1.1
P9.58	Default gateway -2	168	Default gateway 192.168.1.1
P9.59	Default gateway -3	1	Default gateway 192.168.1.1
P9.60	Default gateway -4	1	Default gateway 192.168.1.1

Communication Card Special Function Parameters	
Parameter	***Explanation***
P9.63	Communication Card Factory Reset, 1 = Reset to factory defaults
P9.64	Communication Card Set, 2 = Write parameters to card

After changing any of the P9.xx communication card parameters, enter a “2” into P9.64 (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.

GS4-CM-ENETIP 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	Point-to-Point		Mulitcast, Point to Point	

GS4-CM-ENETIP 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*

GS4-CM-ENETIP 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.

GS4-CM-ENETIP 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.

GS4-CM-ENETIP Communication Protocol Parameter Address Definitions

Communication Protocol Parameter Address Definitions			
Parameter Content Parameters Set in GS4	***Address***	***Definition***	
Commands to GS4	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	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	Reserved
		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

(Table continued next page.)

<table>
<tr><th colspan="4">Communication Protocol Parameter Address Definitions (continued)</th></tr>
<tr><th>Parameter Content Parameters Set in GS4</th><th>Address</th><th colspan="2">Definition</th></tr>
<tr><td rowspan="35">Monitor GS4 status</td><td>0</td><td colspan="2">Fault Code: Refer to Troubleshooting – Warning/Fault Codes in Chapter 6: Maintenance and Troubleshooting</td></tr>
<tr><td rowspan="20">1</td><td rowspan="4">bit 0~1</td><td>00: Stop</td></tr>
<tr><td>01: Decel during Stop</td></tr>
<tr><td>10: Standby</td></tr>
<tr><td>11: Run</td></tr>
<tr><td>bit 2</td><td>1: JOG active</td></tr>
<tr><td rowspan="4">bit 3~4</td><td>00: Forward</td></tr>
<tr><td>01: Transition from Reverse to Forward</td></tr>
<tr><td>10: Transition from Forward to Reverse</td></tr>
<tr><td>11: Reverse</td></tr>
<tr><td>bit 5~7</td><td>reserved</td></tr>
<tr><td>bit 8</td><td>1: Main frequency comes from communication interface</td></tr>
<tr><td>bit 9</td><td>1: Main frequency comes from analog/external terminal signal input</td></tr>
<tr><td>bit 10</td><td>1: The command is operated by communication interface (keypad)</td></tr>
<tr><td>bit 11</td><td>1: Parameters have been locked</td></tr>
<tr><td>bit 12</td><td>Running status
0: Drive stopped
1: Drive running (including standby)</td></tr>
<tr><td>bit 13~15</td><td>reserved</td></tr>
<tr><td>2</td><td colspan="2">Frequency command (F) / PID Setpoint (6000 = 60.00Hz)</td></tr>
<tr><td>3</td><td colspan="2">Output frequency (H) (6000 = 60.00Hz)</td></tr>
<tr><td>4</td><td colspan="2">Output current (A)</td></tr>
<tr><td>5</td><td colspan="2">DC bus voltage (U)</td></tr>
<tr><td>6</td><td colspan="2">Output voltage (E)</td></tr>
<tr><td>7</td><td colspan="2">Multi-speed or PID Inputs current Step Number</td></tr>
<tr><td>8</td><td colspan="2">Warning codes</td></tr>
<tr><td>9</td><td colspan="2">Digital Input counter value</td></tr>
<tr><td>10</td><td colspan="2">Power Factor angle (cosθ)</td></tr>
<tr><td>11</td><td colspan="2">reserved</td></tr>
<tr><td>12</td><td colspan="2">Actual Motor Speed (rpm)</td></tr>
<tr><td>13</td><td colspan="2">reserved</td></tr>
<tr><td>14</td><td colspan="2">reserved</td></tr>
<tr><td>15</td><td colspan="2">Power Output (kW)</td></tr>
</table>

GS4-CM-ENETIP 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

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: 0x0204
0x04	Get	Revision	STRUCT of: USINT, USINT	Firmware version Major revision Minor revision
0x05	Get	Status	WORD	Summary status of devices; The value is always 0.
0x06	Get	Serial Number	UDINT	32-bit serial number of device
0x07	Get	Product Name	SHORT_STRING	GS4-CM-EN

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		Service Name	Description of service
	Class	Instance		
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

GS4-CM-ENETIP Basic Registers

GS4-CM-ENETIP Basic Registers			
BR#	**Read / Write**	**Content**	**Explanation**
#0	R	Model name	Set up by the system; read only. The model code of GS4-CM-ENETIP=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	GS4 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 GS4-CM-ENETIP is 0204h. Read the model code to confirm connection with GS4-CM-ENETIP.

BR#1 - Firmware Version: The firmware version of GS4-CM-ENETIP 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 - GS4 Drive Station Number: Station number of the GS4 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, GS4-CM-ENETIP 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: GS4 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

GS4-CM-ENETIP Alarm Register

<table>
<tr><th colspan="5">GS4-CM-ENETIP 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	UDINT, STRING	VFD Command Data
0x21	0x00~0x1F	Get	VFD Status	UDINT, STRING	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 GS4 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 GS4 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 GS4Drive 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:

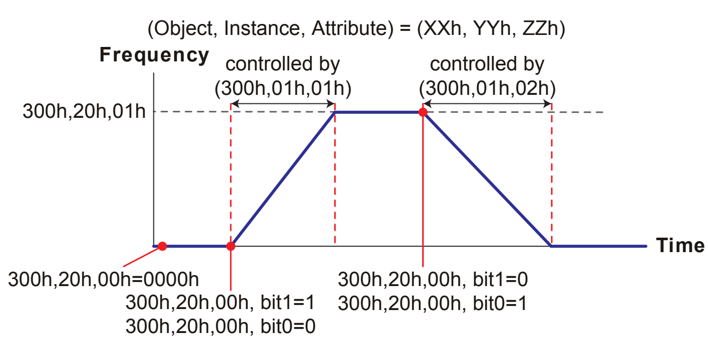
If we wish to write a command for parameter P1.01 (to set Acceleration Time 1), proceed as follows:

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.



Digital and Analog I/O Parameter Maps

Appendix C

Table of Contents

Introduction

This section contains worksheets to help with designing and programming the physical inputs and outputs of the GS4 (digital, analog, and frequency interfaces). These worksheets provide the GS4 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.

GS4 Digital Inputs – Main Control Board

GS4 Digital Inputs - Main Circuit Board											
GS4 Terminals	FWD	REV	DI1	DI2	DI3	DI4	DI5	DI6	DI7	DI8	Comments
PLC Address	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	
Parameter	**P3.02** 2/3 Wire Operation Mode		**(P3.02** if =**3)** else **P3.03**	**P3.04**	**P3.05**	**P3.06**	**P3.07**	**P3.08**	**P3.09**	**P3.10**	See Digital Input Configurations Below
Default Setting	0		1	2	3	4	0	0	0	0	
Default Configuration	2 Wire		(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 **P3.42 - Bit #**	0	1	2	3	4	5	6	7	8	9	0 = N.O. 1 = N.C.
Default Configuration	0 = Normally Open										
User Defined Selection / Value								N/A			
DI - Response Time	**P3.41**							N/A	**P3.41**		0 to 30.000 seconds
Default Configuration	0.005 seconds							N/A	0.005 seconds		
User Defined Selection / Value											
DI - Active Status Monitor **P3.46 - Bit #**	0	1	2	3	4	5	6	7	8	9	Read Only!
DI - PLC Mask **P3.48 - Bit #**	0	1	2	3	4	5	6	7	8	9	

** 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 P3.03~P3.16 is void. To read the status of an input into the PLC while maintaining the MFI setting use the RPR command on the DI Status Register (P3.46). 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 36 and 37.*

Digital Input Configurations – Parameters P3.03~P3.10

0: No function
1: Multi-Speed/PID Multi-Setpoint bit 1
2: Multi-Speed/PID Multi-Setpoint bit 2
3: Multi-Speed/PID Multi-Setpoint bit 3
4: Multi-Speed bit 4
5: Reset
6: JOG
7: Accel/Decel speed inhibit (Speed Hold)
8: 1st~4th Accel/Decel time selection, bit 0
9: 1st~4th Accel/Decel time selection, bit 1
10: Emergency Stop EF Input by P3.56 (EF error)
11: Base Block Input
12: reserved
13: Disable Auto Accel/Decel Time
14: Switch between drive settings 1 and 2
15: Operation speed command from AI1
16: Operation speed command from AI2
17: Operation speed command from AI3
18: Forced Ramp Stop by P3.56 (no error)
19: Digital Freq Up Command
20: Digital Freq Down Command
21: PID function Disable
22: Clear counter
23: Increment counter value (DI6 only)
24: FWD JOG
25: REV JOG
26: Emergency Stop EF1 (Coast stop)(EF1 error)
27: Signal Confirmation for Y-connection
28: Signal Confirmation for Delta connection
29: Disable EEPROM Write
30: Forced Coast Stop
31: Hand Contact for HOA Control
32: Auto Contact for HOA Control
33: LOCAL/REMOTE Selection
34: Drive Enable
35: Decel Energy Backup (DEB) Enable
36: PLC Mode select bit0
37: PLC Mode select bit1
38: Output MCR Auxiliary Confirmation
39: reserved
40: Fire mode and force drive run
41: Fire mode and maintain operation
42: Disable all motors
43: Disable Motor #1
44: Disable Motor #2
45: Disable Motor #3
46: Disable Motor #4
47: Disable Motor #5
48: Disable Motor #6
49: Disable Motor #7
50: Disable Motor #8

GS4 Digital Outputs – Main Control Board

GS4 Digital Outputs – Main Control Board						
GS4 Terminals	R1-R1C-R1O	R2-R2C-R2O	N/A	DO1-DOC	DO2-DOC	Comments
PLC Address	Y0	Y1	N/A	Y3	Y4	
Parameter	**P3.17**	**P3.18**	N/A	**P3.19**	**P3.20**	See Digital Output Configurations Below
Default Setting	11	1	N/A	0	0	
Default Configuration	Error/Fault	Drv Run	N/A	No Function		
User Defined Selection / Value	0	0	N/A	0	0	
DO - N.C. / N.O. Select **P3.43 - Bit #**	0	1	2 Reserved	3	4	0 = N.O. 1 = N.C.
Default Configuration			N/A			
User Defined Selection / Value			N/A			
DO - Active Status Monitor **P3.47 - Bit #**	0	1	2 Reserved	3	4	Read Only!
DO - PLC Mask **P3.49 - Bit #**	0	1	2 Reserved	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 P3.17~P3.31 is void. To read the status of an output from the PLC while maintaining the MFO setting, use the RPR command on the DO Status Register (P3.47). 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 36 and 37.*

Digital Output Configurations – Parameters P3.17~P3.20			
0: no function	15: PID deviation error	30: Delta Connected Command	45: Fire Mode Indication
1: AC Drive Running	16: Over Slip (oSL)	31: Zero Speed at Drive Running	46: Fire Bypass Indication
2: At Frequency Setpoint	17: Middle Count Value Attained (P3.45)	32: Zero Speed including Drive Stop	47: Motor #1 Selected
3: At Speed 1 (P3.32)	18: Final Count Value Attained (P3.44)	33: Fault Option 1 (P11.00)	48: Motor #2 Selected
4: At Speed 2 (P3.34)	19: Base Block Indication	34: Fault Option 2 (P11.01)	49: Motor #3 Selected
5: At Zero Speed Including Drive Running	20: Warning Output	35: Fault Option 3 (P11.02)	50: Motor #4 Selected
6: At Zero Speed Drive not Running	21: Overvoltage Alarm	36: Fault Option 4 (P11.03)	51: Motor #5 Selected
7: Over Torque Level 1	22: Oc Stall Alarm	37: At Speed (Setpoint include 0Hz)	52: Motor #6 Selected
8: Over Torque Level 2	23: Ov Stall Alarm	38: reserved	53: Motor #7 Selected
9: Drive Ready	24: External Control Mode	39: Under Ampere (Low Current)	54: Motor #8 Selected
10: Low Voltage warning (Lv)	25: Forward Command	40: UVW Motor Contactor Enable	55: Mtr1/Mtr2 Nameplate Parameters Select
11: Error indication (All faults, Except for Lv Stop)	26: Reverse Command	41: DEB active	56: Safety N.O. STO A
12: Brake Release Function (P3.51)	27: Above Current Output (≥ P3.52)	42: Brake Released at Stop	57: Safety N.C. STO B
13: Over-temp Warning	28: Below Current Output (< P3.52)	43: RS485 Digital Output	58: Above Frequency Output (≥ P3.53)
14: Dynamic Braking Output	29: Wye Connected Command	44: Comm Card Digital Output	59: Below Frequency Output (< P3.53)

GS4 Digital Inputs – Option Cards

GS4 Digital Inputs - Option Cards							
GS4-06NA Terminals	DI10	DI11	DI12	DI13	DI14	DI15	Comments
GS4-06CDD Terminals	DI10	DI11	DI12	DI13	N/A	N/A	
PLC Address *	X12	X13	X14	X15	X16	X17	
Parameter	**P3.11**	**P3.12**	**P3.13**	**P3.14**	**P3.15**	**P3.16**	See Digital Input Configurations Below
Default Setting	0	0	0	0	0	0	
Default Configuration	No Function						
User Defined Selection / Value							
DI - N.C. / N.O. Select **P3.42 - Bit #**	A	B	C	D	E	F	(0 = N.O. / 1 = N.C.)
Default Configuration	0 = Normally Open						
User Defined Selection / Value							
DI - Active Status Monitor **P3.46 - Bit #**	A	B	C	D	E	F	Read Only!
DI - PLC Mask **P3.48 - Bit #**	A	B	C	D	E	F	

* *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 P3.03~P3.16 is void. To read the status of an input into the PLC while maintaining the MFI setting use the RPR command on the DI Status Register (P3.46). 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 36 and 37.*

Digital Input Configurations		
Parameters P3.11~P3.16		
0: No function	17: Operation speed command from AI3	34: Drive Enable
1: Multi-Speed/PID Multi-Setpoint bit 1	18: Forced Ramp Stop by P3.56 (no error)	35: Decel Energy Backup (DEB) Enable
2: Multi-Speed/PID Multi-Setpoint bit 2	19: Digital Freq Up Command	36: PLC Mode select bit0
3: Multi-Speed/PID Multi-Setpoint bit 3	20: Digital Freq Down Command	37: PLC Mode select bit1
4: Multi-Speed bit 4	21: PID function Disable	38: Output MCR Auxiliary Confirmation
5: Reset	22: Clear counter	39: reserved
6: JOG	23: Increment counter value (DI6 only)	40: Fire mode and force drive run
7: Accel/Decel speed inhibit (Speed Hold)	24: FWD JOG	41: Fire mode and maintain operation
8: 1st~4th Accel/Decel time selection, bit 0	25: REV JOG	42: Disable all motors
9: 1st~4th Accel/Decel time selection, bit 1	26: Emergency Stop EF1 (Coast stop)(EF1 error)	43: Disable Motor #1
10: Emergency Stop EF Input by P3.56 (EF error)	27: Signal Confirmation for Y-connection	44: Disable Motor #2
11: Base Block Input	28: Signal Confirmation for Delta connection	45: Disable Motor #3
12: reserved	29: Disable EEPROM Write	46: Disable Motor #4
13: Disable Auto Accel/Decel Time	30: Forced Coast Stop	47: Disable Motor #5
14: Switch between drive settings 1 and 2	31: Hand Contact for HOA Control	48: Disable Motor #6
15: Operation speed command from AI1	32: Auto Contact for HOA Control	49: Disable Motor #7
16: Operation speed command from AI2	33: LOCAL/REMOTE Selection	50: Disable Motor #8

GS4 Digital Outputs – Option Cards

GS4 Digital Outputs – Option Cards							
GS4-06TR Terminals	R10-RO10	R11-RO11	R12-RO12	R13-RO13	R14-RO14	R15-RO15	Comments
GS4-06CDD Terminals	DO10-DOC	DO11-DOC	N/A				
PLC Address *	Y5	Y6	Y7	Y10	Y11	Y12	
Parameter	**P3.21**	**P3.22**	**P3.23**	**P3.24**	**P3.25**	**P3.26**	See Digital Output Configurations Below
Default Setting	0	0	0	0	0	0	
Default Configuration	No Function						
User Defined Selection / Value							
DO - N.C. / N.O. Select **P3.43 - Bit #**	5	6	7	8	9	10	(0 = N.O. / 1 = N.C.)
Default Configuration	0 = Normally Open						
User Defined Selection / Value							
DO- Active Status Monitor **P3.47 - Bit #**	5	6	7	8	9	10	Read Only!
DO - PLC Mask **P3.49 - Bit #**	5	6	7	8	9	10	

** 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 P3.17~P3.31 is void. To read the status of an output from the PLC while maintaining the MFO setting, use the RPR command on the DO Status Register (P3.47). 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 36 and 37.*

Digital Output Configurations – Parameters P3.21~P3.26

0: no function
1: AC Drive Running
2: At Frequency Setpoint
3: At Speed 1 (P3.32)
4: At Speed 2 (P3.34)
5: At Zero Speed Including Drive Running
6: At Zero Speed Drive not Running
7: Over Torque Level 1
8: Over Torque Level 2
9: Drive Ready
10: Low Voltage warning (Lv)
11: Error indication (All faults, Except for Lv Stop)
12: Brake Release Function (P3.51)
13: Over-temp Warning
14: Dynamic Braking Output
15: PID deviation error
16: Over Slip (oSL)
17: Middle Count Value Attained (P3.45)
18: Final Count Value Attained (P3.44)
19: Base Block Indication
20: Warning Output
21: Overvoltage Alarm
22: Oc Stall Alarm
23: Ov Stall Alarm
24: External Control Mode
25: Forward Command
26: Reverse Command
27: Above Current Output (≥ P3.52)
28: Below Current Output (< P3.52)
29: Wye Connected Command
30: Delta Connected Command
31: Zero Speed at Drive Running
32: Zero Speed including Drive Stop
33: Fault Option 1 (P11.00)
34: Fault Option 2 (P11.01)
35: Fault Option 3 (P11.02)
36: Fault Option 4 (P11.03)
37: At Speed (Setpoint include 0Hz)
38: reserved
39: Under Ampere (Low Current)
40: UVW Motor Contactor Enable
41: DEB active
42: Brake Released at Stop
43: RS485 Digital Output
44: Comm Card Digital Output
45: Fire Mode Indication
46: Fire Bypass Indication
47: Motor #1 Selected
48: Motor #2 Selected
49: Motor #3 Selected
50: Motor #4 Selected
51: Motor #5 Selected
52: Motor #6 Selected
53: Motor #7 Selected
54: Motor #8 Selected
55: Mtr1/Mtr2 Nameplate Parameters Select
56: Safety N.O. STO A
57: Safety N.C. STO B
58: Above Frequency Output (≥ P3.53)
59: Below Frequency Output (< P3.53)

GS4 Digital Outputs – Virtual

GS4 Digital Outputs – Virtual *						
	Virtual Outputs *					Comments
PLC Address **	Y13	Y14	Y15	Y16	Y17	
Parameter	**P3.27**	**P3.28**	**P3.29**	**P3.30**	**P3.31**	
Default Setting	0	0	0	0	0	
Default Configuration	No Function					
User Defined Selection / Value						
DO - N.C. / N.O. Select **P3.43 - Bit #**	B	C	D	E	F	(0 = N.O. / 1 = N.C.)
Default Configuration	0 = Normally Open					
User Defined Selection / Value						
DO - Active Status Monitor **P3.47 - Bit #**	B	C	D	E	F	Read Only!
DO - PLC Mask **P3.49 - Bit #**	B	C	D	E	F	

** GS4 virtual outputs can be used in the PLC while maintaining their Multi-Funciton setting when reading P3.47. Parameters P3.27 thru P3.31 do not have an external termination point to wire to.*

*** 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 P3.17~P3.31 is void. To read the status of an output from the PLC while maintaining the MFO setting, use the RPR command on the DO Status Register (P3.47). 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 36 and 37.*

GS4 Analog Common Parameters

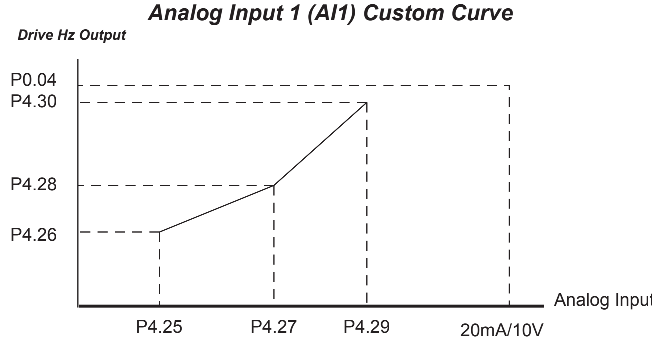
GS4 – AI1, AI2, and AI3 – Common Parameters				
Parameter		***Selection / Value***	***Default***	***User Selection***
P4.00	1st Source of Frequency Command [Remote]	0: Digital Keypad 1: RS485 Communication (Modbus/BACnet) 2: Analog Input 3: External UP/DOWN Terminal 4: Comm Card	2	
P4.01	2nd Source of Frequency Command [Local]		0	

GS4 Analog Input 1 Parameters

GS4 – AI1 Specific Parameters				
Parameter		***Selection / Value***	***Default***	***User Selection***
Terminals		***AI1 – ACM***	***N/A***	***N/A***
PLC Address		***D1028***	***N/A***	***N/A***
P4.02	Analog Input 1 (AI1) Function	0: No Function 1: Frequency Command/PID Setpoint REMOTE 2: Frequency Command/PID Setpoint LOCAL 3: Frequency Command/PID Setpoint REMOTE & LOCAL 4: reserved 5: PID Feedback Signal 6: PTC Thermistor Input Value 7: PID Offset (Input) 8~10: reserved 11: PT100 Thermistor Input Value	1	
P4.05	AI1 – I/V Selection	0: AI1v Selection (0~10V) 1: AI1i Selection (4~20mA) 2: AI1i Selection (0~20mA)	0	
P4.10	AI1 Input Bias (Offset)	-100.0% to +100.0%	0	
P4.11	AI1 Input Bias (Offset) Polarity	0: NO Offset 1: Positive Offset 2: Negative Offset	0	
P4.12	AI1 Input Gain	-500.0% to +500.0%	100.0	
P4.13	AI1 Filter	0.00~20.00 sec	0.01	
Parameters below are used to characterize the GS4 drive output frequency if using AI1 for speed reference.				
P4.25	AI1 Low V/A	P4.05=0: 0.00~10.00V P4.05=1: 4.00~20.00mA P4.05=2: 0.00~20.00mA	P4.05=0: 0.00V P4.05=1: 4.00mA P4.05=2: 0.00mA	
P4.26	AI1 Low Hz Percent	0.00~100.00%	0	
P4. 27	AI1 Mid V/A	P4.05=0: 0.00~10.00V P4.05=1: 4.00~20.00mA P4.05=2: 0.00~20.00mA	P4.05=0: 5.00V P4.05=1: 12.00mA P4.05=2: 10.00mA	
P4. 28	AI1 Mid Hz Percent	0.00~100.00%	50.00	
P4. 29	AI1 High V/A	P4.05=0: 0.00~10.00V P4.05=1: 4.00~20.00mA P4.05=2: 0.00~20.00mA	P4.05=0: 10.00V P4.05=1: 20.00mA P4.05=2: 20.00mA	
P4. 30	AI1 High Hz Percent	0.00~100.00%	100.00	

P4.63 (Loss of AI1) determines the drive behavior if the 4~20mA signal is lost.

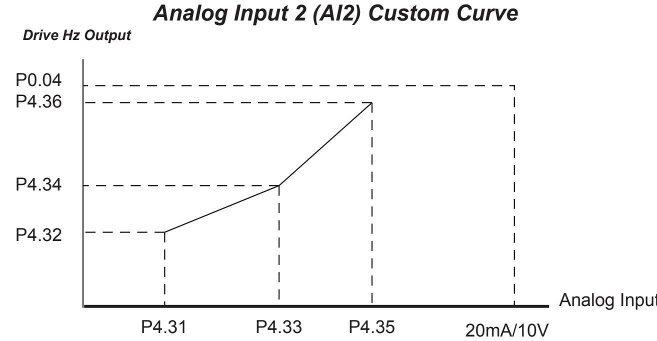
Analog Input 1 (AI1) Custom Curve



GS4 Analog Input 2 Parameters

GS4 – AI2 Specific Parameters				
Parameter		***Selection / Value***	***Default***	***User Selection***
Terminals		***AI2 – ACM***	***N/A***	***N/A***
PLC Address		***D1029***	***N/A***	***N/A***
P4.03	Analog Input 2 (AI2) Function	0: No Function 1: Frequency Command/PID Setpoint REMOTE 2: Frequency Command/PID Setpoint LOCAL 3: Frequency Command/PID Setpoint REMOTE & LOCAL 4: reserved 5: PID Feedback Signal 6: PTC Thermistor Input Value 7: PID Offset (Input) 8~10: reserved 11: PT100 Thermistor Input Value	0	
P4.06	AI2 – I/V Selection	0: AI2i Selection (0~10V) 1: AI2v Selection (4~20mA) 2: AI2i Selection (0~20mA)	0	
P4.15	AI2 Input Bias (Offset)	-100.0% to +100.0%	0	
P4.16	AI2 Input Bias (Offset) Polarity	0: NO Offset 1: Positive Offset 2: Negative Offset	0	
P4.17	AI2 Input Gain	-500.0% to +500.0%	100.0	
P4.18	AI2 Filter	0.00~20.00 sec	0.01	
Parameters below are used to characterize the GS4 drive output frequency if using AI2 for speed reference.				
P4.31	AI2 Low V/A	P4.06=0: 0.00~10.00V P4.06=1: 4.00~20.00mA P4.06=2: 0.00~20.00mA	P4.06=0: 0.00V P4.06=1: 4.00mA P4.06=2: 0.00mA	
P4.32	AI2 Low Hz Percent	0.00~100.00%	0	
P4.33	AI2 Mid V/A	P4.06=0: 0.00~10.00V P4.06=1: 4.00~20.00mA P4.06=2: 0.00~20.00mA	P4.06=0: 5.00V P4.06=1: 12.00mA P4.06=2: 10.00mA	
P4.34	AI2 Mid Hz Percent	0.00~100.00%	50.00	
P4.35	AI2 High V/A	P4.06=0: 0.00~10.00V P4.06=1: 4.00~20.00mA P4.06=2: 0.00~20.00mA	P4.06=0: 10.00V P4.06=1: 20.00mA P4.06=2: 20.00mA	
P4.36	AI2 High Hz Percent	0.00~100.00%	100.00	

Analog Input 2 (AI2) Custom Curve

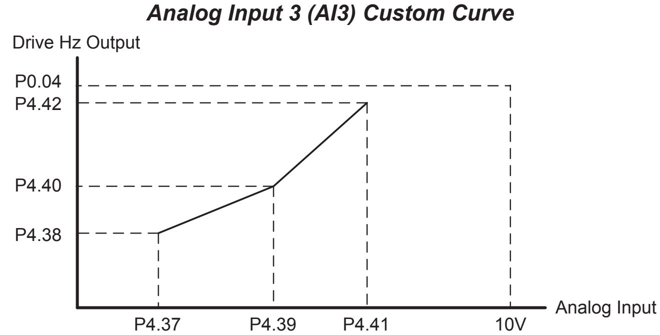


P4.49 (Loss of AI2) determines the drive behavior if the 4~20mA signal is lost.

GS4 Analog Input 3 Parameters

GS4 – AI3 Specific Parameters				
Parameter		***Selection / Value***	***Default***	***User Selection***
Terminals		***AI3 – ACM***	***N/A***	***N/A***
PLC Address		***D1030***	***N/A***	***N/A***
P4.04	Analog Input 3 (AI3) Function	0: No function 1: Frequency command 2: Reserved 3: Reserved 4: Reserved 5: Reserved 6: PTC thermistor input value 11: PT100 (RTD) thermistor input value	0	
P4.19	AI3 Input Bias (Offset)	-100.0% to +100.0%	0	
P4.20	AI3 Input Bias (Offset) Polarity	0: NO Offset 1: Positive Offset 2: Negative Offset	0	
P4.21	+AI3 Input Gain	-500.0% to +500.0%	100.0	
P4.22	-AI3 Input Gain	-500.0% to +500.0%	100.0	
P4.23	AI3 Filter	0.00~20.00 sec	0.01	
Parameters below are used to characterize the GS4 drive output frequency if using AI3 for speed reference. If AI3 is unipolar (0 to 10V) – Parameters define the entire range of the signal. (0 to 10V) If AI3 is bipolar (-10 to 10V) – Parameters define the positive half of the signal (from 0 to +10V)				
P4.37	AI3 Low Voltage Unipolar	0.00~10.00V	0	
P4.38	AI3 Low Hz Percent Unipolar	0.00~100.00%	0	
P4.39	AI3 Mid Voltage Unipolar	0.00~10.00V	5.00	
P4.40	AI3 Mid Hz Percent Unipolar	0.00~100.00%	50.00	
P4.41	AI3 High Voltage Unipolar	0.00~10.00V	10.00	
P4.42	AI3 High Hz Percent Unipolar	0.00~100.00%	100.00	
If AI3 is unipolar (0 to 10V) – Parameters below are unused. If AI3 is bipolar (-10 to +10V) – Parameters define the negative half of the signal (from -10 to 0V)				
P4.43	-AI3 High Voltage Bipolar	-10.00V to 0.00V	0.00	
P4.44	-AI3 High Hz Percent Bipolar	-100.00% to +100.00%	0.00	
P4.45	-AI3 Mid Voltage Bipolar	-10.00V to 0.00V	–5.00	
P4.46	-AI3 Mid Hz Percent Bipolar	-100.00% to +100.00%	–50.00	
P4.47	-AI3 Low Voltage Bipolar	-10.00V to 0.00V	–10.00	
P4.48	-AI3 Low Hz Percent Bipolar	-100.00% to +100.00%	–100.00	

Analog Input 3 (AI3) Custom Curve



GS4 Analog Output 1 Parameters

GS4 – AO1 Specific Parameters				
Parameter		***Selection / Value***	***Default***	***User Selection***
Terminals		***AO1 – ACM***	***N/A***	***N/A***
PLC Address		***D1040***	***N/A***	***N/A***
P4.50	Analog Output 1 (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: AI1 9: AI2 10: AI3 11: As 485 AO 12: As COM Card AO 13: Fixed Value	0	
P4.51	AO1 Gain	0.0~500.0%	100.0	
P4.52	AO1 Negative Value Handle	0: Absolute Value 1: 0V When Negative 2: Offset 5V = 0 Value	0	
P4.53	AO1 0~20mA/4~20mA Selection	0: 0~20mA 1: 4~20mA	0	
P4.60	AO1 Output Constant Level	0.00~100.00%	0.00	
P4.62 Bit 0	PLC Analog Output Mask	0: Drive Controlled 1: PLC Controlled	0	

GS4 Analog Output 2 Parameters

GS4 – AO2 Specific Parameters				
Parameter		***Selection / Value***	***Default***	***User Selection***
Terminals		***AO2 – ACM***	***N/A***	***N/A***
PLC Address		***D1045***	***N/A***	***N/A***
P4.54	Analog Output 2 (AO2)	0: Output Frequency (Hz) 1: Frequency Command (Hz) 2: Motor Speed (Hz) 3: Output Current (Arms) 4: Output Voltage (V) 5: DC Bus Voltage (V) 6: Power Factor (%) 7: Power (% Rated) 8: AI1 (%) 9: AI2 (%) 10: AI3 (%) 11: As 485 AO 12: As COM Card AO 13: Fixed Value	0	
P4.55	AO2 Gain	0.0~500.0%	100.0	
P4.56	AO2 Negative Value Handle	0: Absolute Value 1: 0V When Negative 2: Offset 5V = 0 Value	0	
P4.57	AO2 0~20mA/4~20mA Selection	0: 0~20mA 1: 4~20mA	0	
P4.59	AO2 Offset (Bias)	-100.00% to +100.00%	0.00	
P4.61	AO2 Output Constant Level	0.00~100.00%	0.00	
P4.62 Bit 1	PLC Analog Output Mask	0: Drive Controlled 1: PLC Controlled	0	

GS4 Frequency Output Parameters

GS4 – Frequency Output Specific Parameters				
Parameter		***Selection / Value***	***Default***	***User Selection***
Terminals		***FO – DCM***	***N/A***	***N/A***
PLC Address		***N/A***	***N/A***	***N/A***
P3.38	Frequency Output (FO) Scaling Factor (Pulse per second output = actual output frequency x P3.38)	1~166 (1 = no scaling)	1	

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USING GS4 AC DRIVES WITH AUTOMATIONDIRECT PLCS

APPENDIX

D

TABLE OF CONTENTS

Appendix D Overview

The material presented here will help you connect your GS4 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 GS4 supports either of the following communications: serial Modbus or serial BACnet (only one is available at a time via the built-in RS-485 port). Ethernet communication is available by installing a ModTCP option card or an EtherNet/IP option card (Only one can be installed at a time).

GS4 supports a variety of I/O on the main control board.

- *10 Sinking/sourcing DC inputs*
- *2 Sinking/sourcing DC outputs*
- *2 Form C relay outputs (inductive load [cosØ 0.4] 1.2A [NO or NC] @ 250VAC)*
- *3 Analog inputs (0~10V, -10~10V, 0~20 mA, 4~20 mA)*
- *2 Analog outputs (0~10V, -10~10V, 4~20 mA)*
- *1 Hi-speed pulse output (30V/30mA/100kHz max)*

I/O can be extended by installing optional I/O cards (only one can be installed):

- *6-pt 120VAC input card (100~130 VAC)*
- *4-pt DC input / 2-pt DC output card (min. 19VDC – max. 30VDC input, max. 48VDC output; inputs and outputs are sink/source; jumper selectable)*
- *6-pt Relay output card, SPST (max. 250VAC/30VDC; max. 5A resistive/2A inductive)*

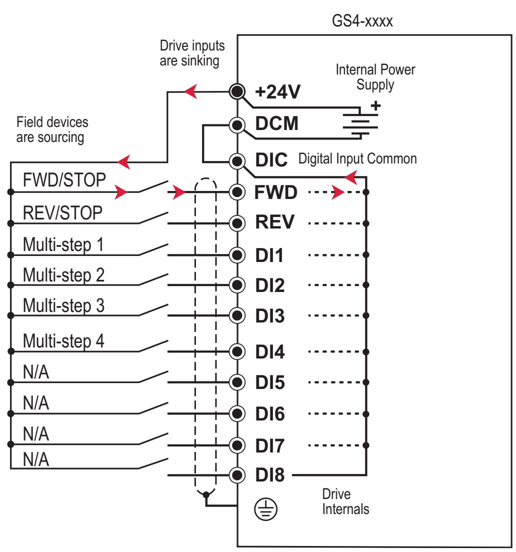
Sinking/Sourcing Basics

GS4 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.

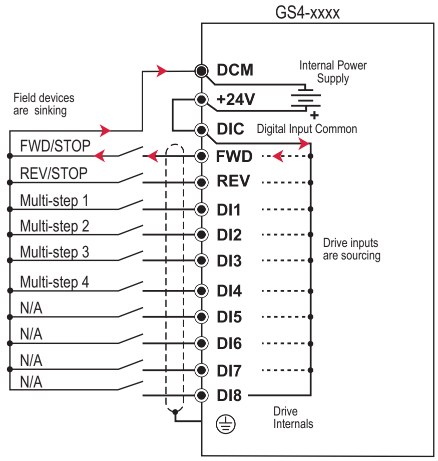
- *For a detailed technical explanation of sink and source, please follow this link: www.automationdirect.com/static/specs/sinksource.pdf*

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.

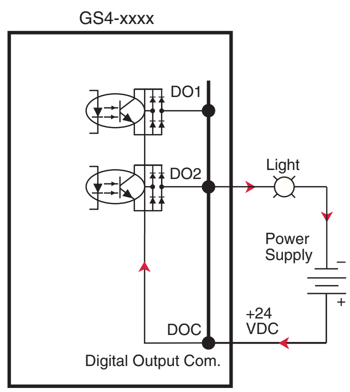
So, if the GS4 inputs are wired for sinking, they require the external device (FWD/STOP switch in this example) to supply current (when closed, the external device will "source" current). Notice the current flow represented by the red arrows. The GS4 input "sinks" the current flow.



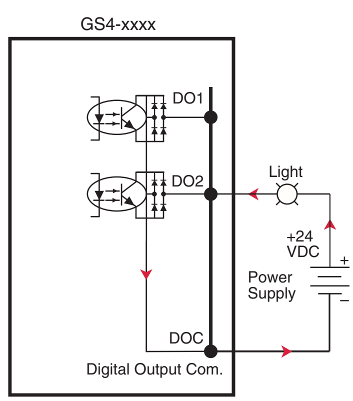
GS4 DC inputs can also be wired for sourcing. In this configuration, notice that the 24VDC supply is feeding into the DIC (Digital Input Common) terminal and the current is coming out of the drive input (GS4 is sourcing) and the field device is sinking the current.



GS4 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).

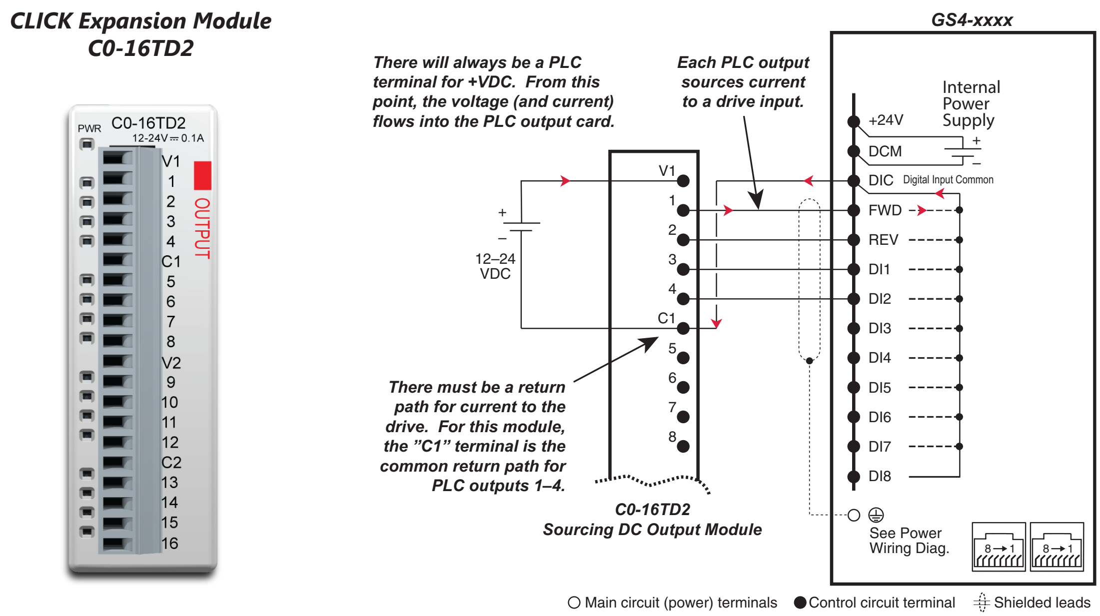


NOTE: GS4 output can be wired as sinking or sourcing, but not both at the same time.

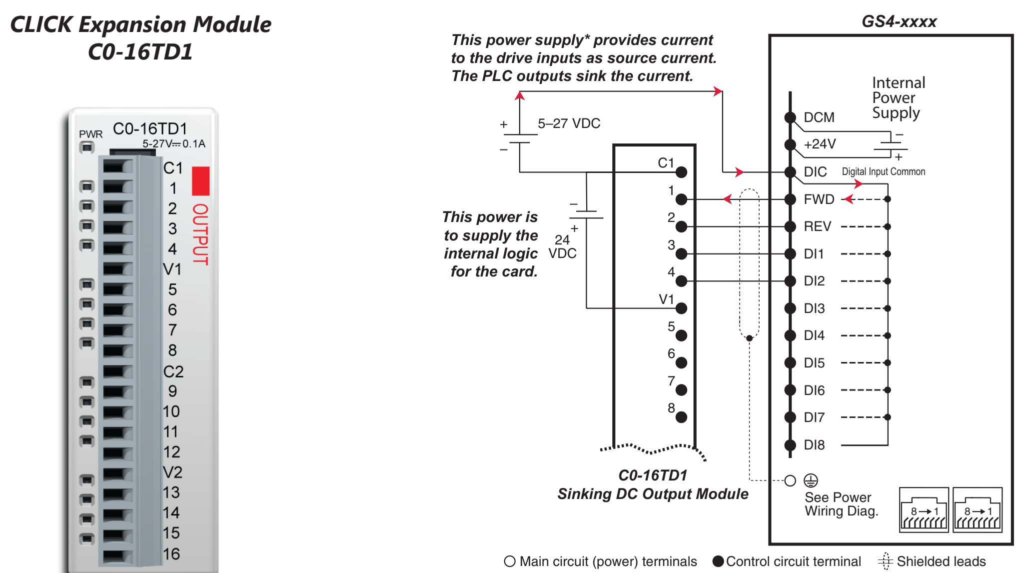
GS4-to-PLC I/O Wiring Examples

This section shows typical wiring examples of PLC inputs and outputs connected to a GS4 drive. While we are using CLICK PLCs in the examples, the samples should be relevant to most any PLC. 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)



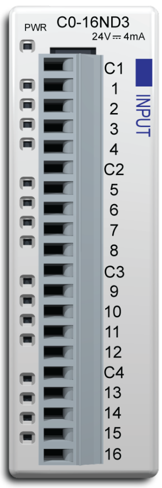
Drive Wired with DC Sourcing Inputs (PLC output card is sinking)

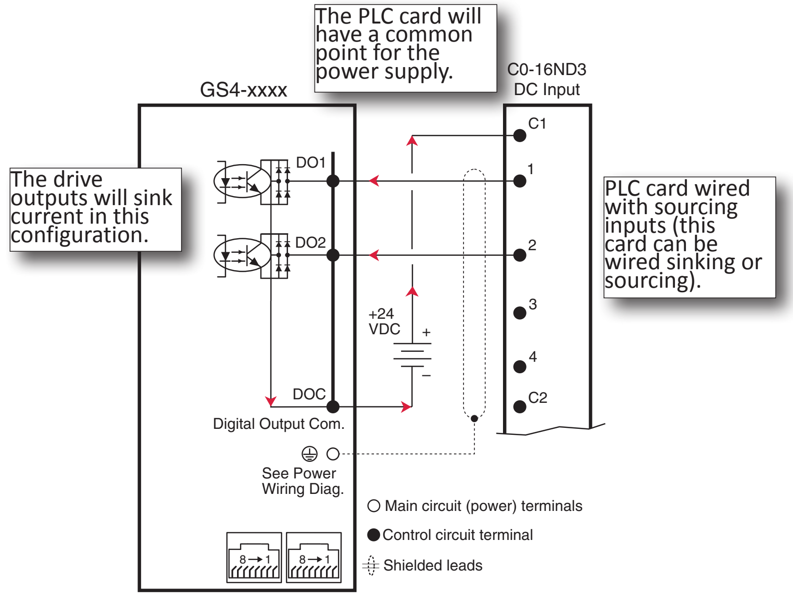


**Alternately, the drive internal power supply (+24V) could be used. However, the DCM common would have to be connected to the PLC power supply common.*

Drive Wired with DC Sinking Outputs (PLC input card is sourcing)

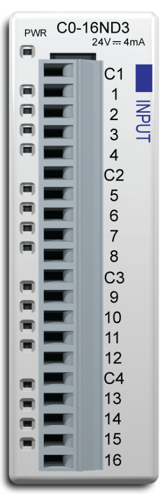
CLICK Expansion Module C0-16ND3

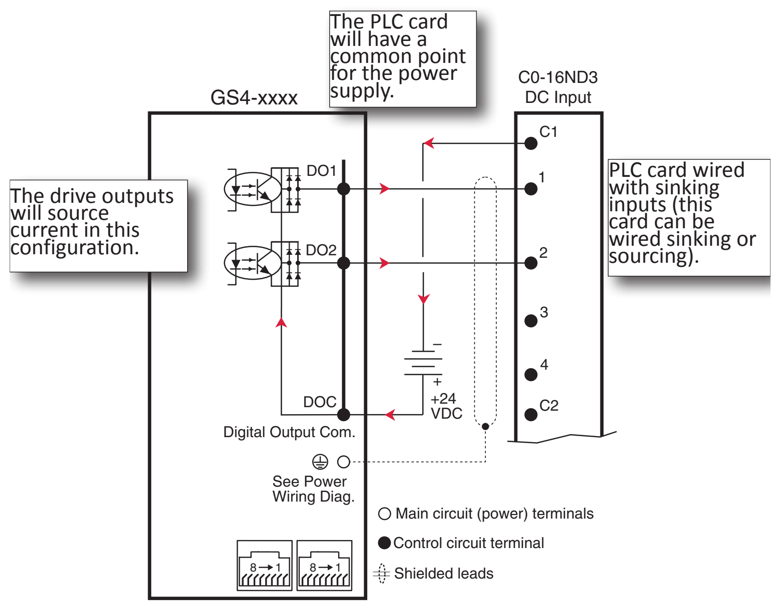




Drive Wired with DC Sourcing Outputs (PLC input card is sinking)

CLICK Expansion Module C0-16ND3

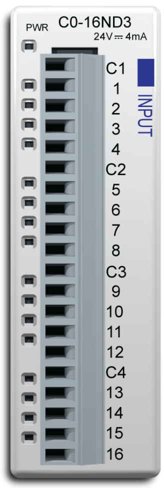


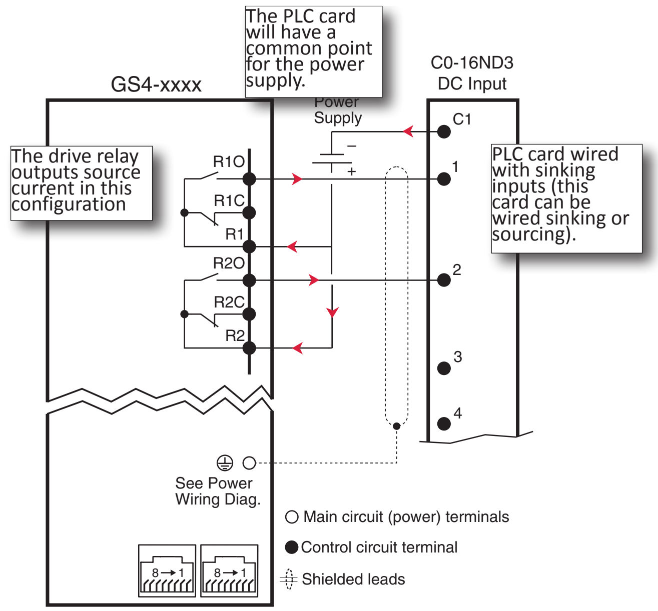


Drive Relay Outputs Wired with Sinking PLC Modules

In this example, the inputs are wired to the Normally-Open contacts (R1O, R2O). You could also wire to the Normally-Closed contacts (R1C, R2C), but you would not be able to tell if the drive lost power or if the drive outputs are simply OFF.

CLICK Expansion Module C0-16ND3

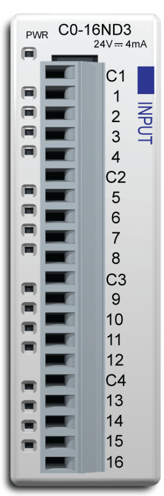


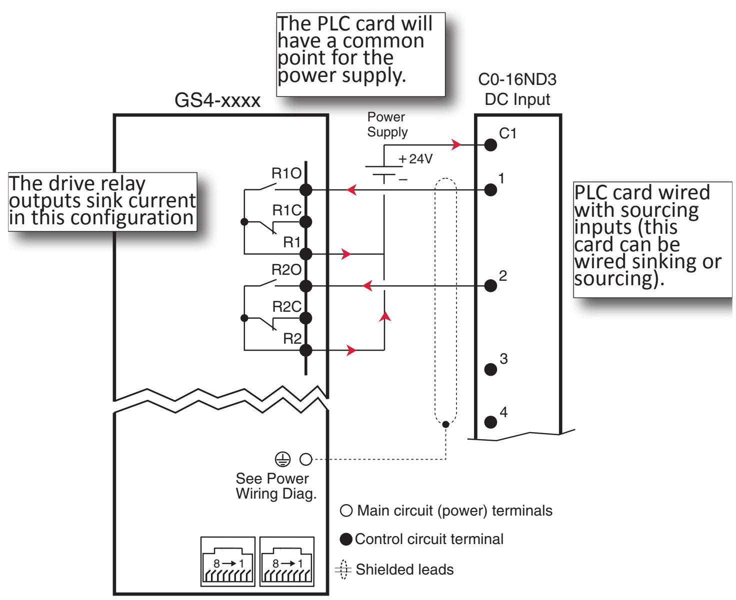


Drive Relay Outputs Wired with Sourcing PLC Modules

In this example, the inputs are wired to the Normally-Open contacts (R1O, R2O). You could also wire to the Normally-Closed contacts (R1C, R2C), but you would not be able to tell if the drive lost power or if the drive outputs are simply OFF.

CLICK Expansion Module C0-16ND3





Drive Analog Inputs

The GS4 has 3 analog inputs (AI1, AI2 and AI3) that can be configured for a variety of input functions. AI1 and AI2 must be configured via a Parameter (P4.05 or P4.06). They also have a DIP switch located above the I/O terminal strip that allows them to be configured as voltage or current inputs. AI3 is voltage input only. All three inputs have a variety of settings in Parameter Group 4 (P4.xx) that allows you to customize their scaling, offset, etc.

- *AI1: 0~10V, 4~20 mA, 0~20 mA (See P4.05 and the DIP switch AI1 above the I/O terminals)*
- *AI2: 0~10V, 4~20 mA, 0~20 mA (See P4.06 and the DIP switch AI2 above the I/O terminals)*
- *AI3: 0~10V, -10V to +10V*

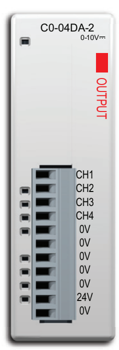
Connecting the analog inputs to PLC outputs is very straightforward. All three analog inputs share the same common.

NOTE: The GS4 analog inputs do not supply the current when configured for 0~20 mA or 4~20 mA. The analog output device needs to supply the loop power.

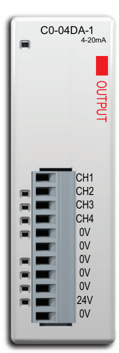
Analog Input Wired for Voltage and Current

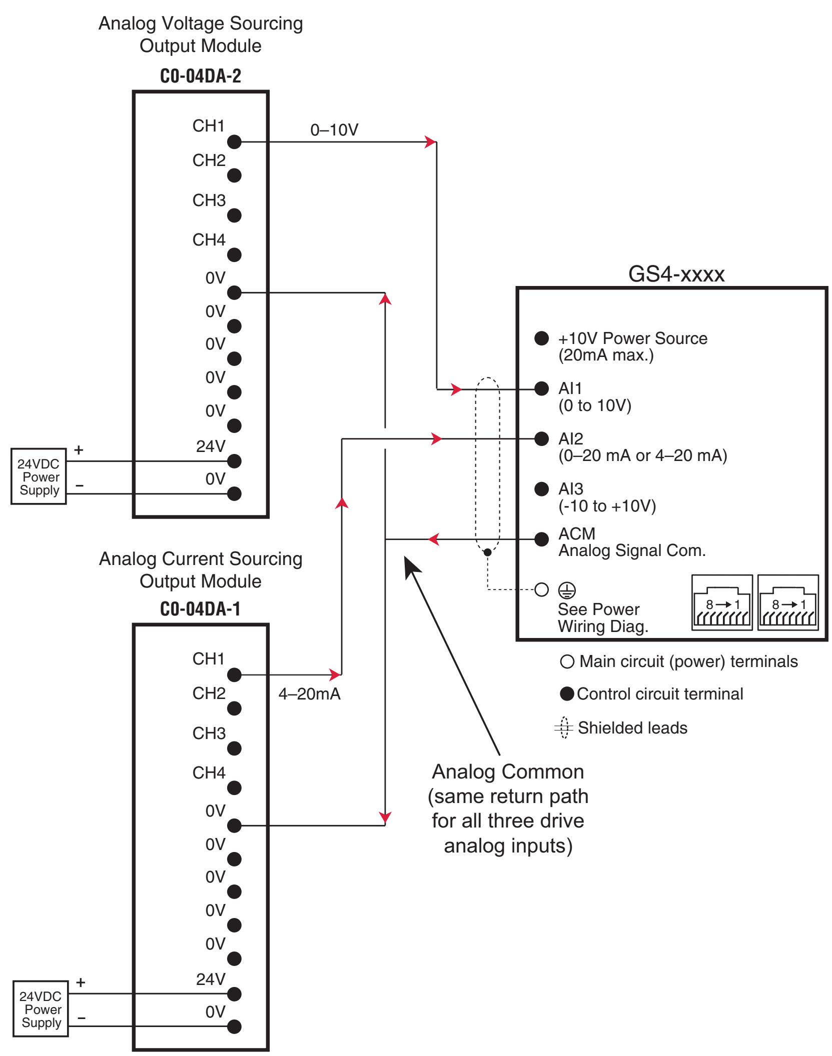
In this example, AI1 is configured for 0~10V (DIP switch and P4.05). AI2 is configured for 4~20 mA (DIP switch and P4.06).

CLICK Expansion Module C0-04DA-2



CLICK Expansion Module C0-04DA-1





Drive Analog Outputs

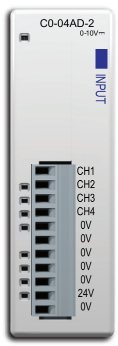
The GS4 has 2 analog outputs (AO1 and AO2) which can be configured for a variety of uses. The outputs are configured via parameters and DIP switch settings (located above the I/O terminal strip). There are several parameters associated with each analog output that defines the signal and adjusts gain, offset, etc. Both outputs share the same Analog Common (ACM).

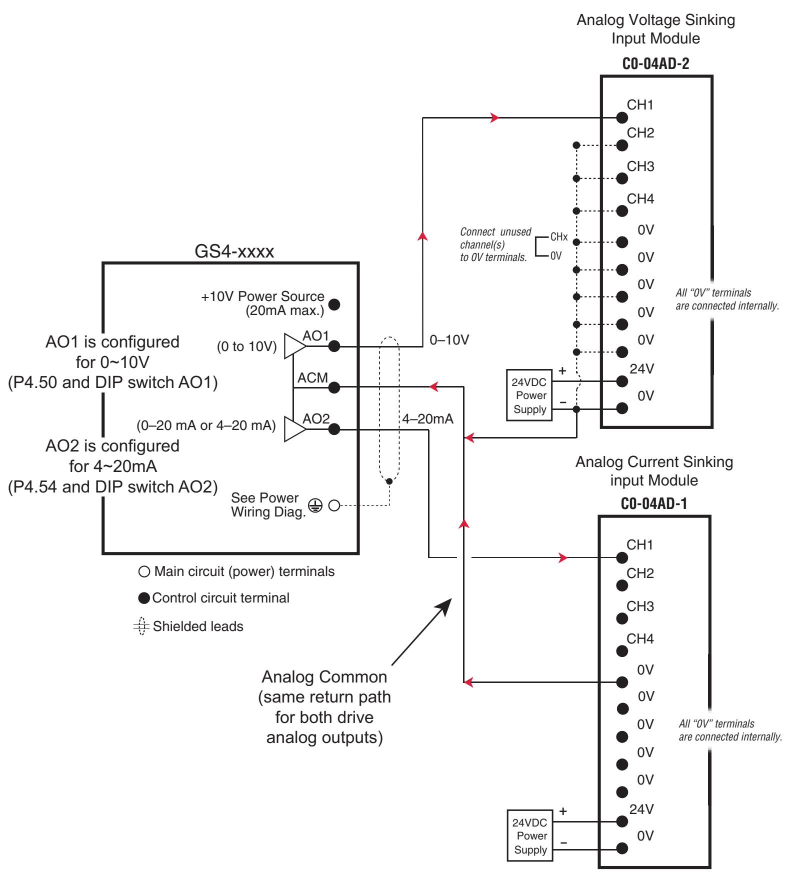
- *AO1: 0~10V or -10V to +10V (see P4.50 and the DIP switch AO1 above the I/O terminals)*
- *AO2: 0~10V or 4–20mA (see P4.54 and the DIP switch AO2 above the I/O terminals)*

Analog Output Wired for Voltage and Current

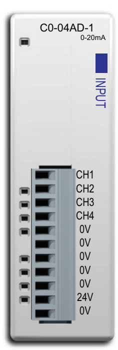
In this example AO1 is configured for 0~10V (P4.50 and DIP switch AO1).

CLICK Expansion module
C0-04AD-2





CLICK Expansion module
C0-04AD-1



Drive Frequency Output (High-speed pulse output)

The GS4 has one high-speed pulse train output: FO. This pulse train output is based on the actual main frequency output of the drive. A scaling factor is available to adjust the frequency.

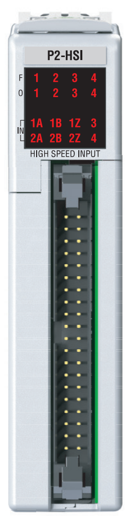
P3.38 Frequency Output Scaling Factor:

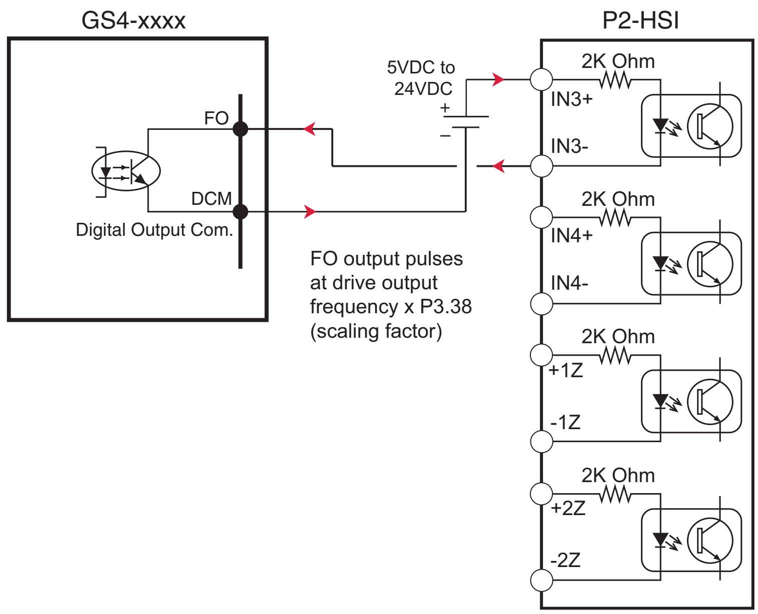
- *Actual FO pulses per second output = GS4 output frequency (Hz) x P3.38*

Drive FO output is limited to 30V@ 30mA max. Max frequency is 100kHz (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 FO needs to see a minimum of 1kΩ resistance.

P2 Expansion Module
P2-HSI





Communication with GS4 Drives

The GS4 drive supports several types of communication:

- *Serial Modbus (built-in RS-485 port)*
- *Serial BACnet (built-in RS-485 port)*
- *Modbus TCP (optional GS4-CM-MODTCP card)*
- *EtherNet/IP (optional GS4-CM-ENETIP 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 GS4 drive. Detailed serial BACnet information can be found in Chapter 5: Communications.

The first thing to do with the GS4 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. The minimal set of parameters that need to be adjusted can be found in the QuickStart Menu. After powering up the drive and ensuring that your E-stop and/or STO input work, press MENU on the keypad. Scroll down to 7: QuickStart and press ENTER. The options inside the QuickStart menu provide the bare essentials to properly set up the drive so that it will run and protect the motor. With the cursor located at 1: Keypad, press Enter. Enter information into the eight parameters listed under the 1: Keypad setting. For more information, see Chapter 3: Keypad Operation and QuickStart.

NOTE: If you have changed many parameters and cannot get your drive to function the way you want, go to Parameter P9.08 Parameter Reset and enter a value of 9 or 10. This will reset your drive to its factory default settings. Then go to the QuickStart Menu and enter the eight parameters listed under "Keypad."

Your drive should now be ready to function from the keypad and be able to properly protect the motor from an overload. From the main screen, press LOCAL. The drive should start and stop by pressing the RUN and STOP keys. The output speed can be changed by pressing ENTER when the cursor is beside the "F" setting (frequency). 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 GS4 drive using two different methods. The GS4 drive is equipped with two RJ45 ports on the main control board. Using these ports, the GS4 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 main control 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		
GS4	***Description***	***Default***
P9.00	VFD Comm Address	1
P9.01	MODBUS Baud Rate	9.6 kbps
P9.02	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 P1.07, Acceleration Time 4. As you can see in the Parameter Summary Table (partial from Ch 4 shown below), the Modbus address for P1.07 is 0107H or 40264 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***
P1.06	Deceleration Time 3	P1.15=0: 0.00~600.00 sec P1.15=1: 0.0~6000.00 sec	R/W	0106H	40263	10.00
P1.07	Acceleration Time 4	P1.15=0: 0.00~600.00 sec P1.15=1: 0.0~6000.00 sec	R/W	0107H	40264	10.00
P1.08	Deceleration Time 4	P1.15=0: 0.00~600.00 sec P1.15=1: 0.0~6000.00 sec	R/W	0108H	40265	10.00
**Decimal value is the Modbus address + hexidecimal value; 40001 + 263(0107H) = 40264).*						

In the GS4 keypad, change the default value of P1.07 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 P1.06 to 9.96 and P1.08 to 9.98. Then try to read again. Remember, some controllers 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 very simple. Enter the following values to set up PLC Control RS485 for the drive:

Parameter Settings Table					
Parameter	***MODBUS Address***		***Description***	***Setting Value***	***Note***
	HEX	***Decimal***			
P3.00	0300	40769	Remote source of operation	3: RS-485, Keypad Stop enabled	This allows the RS-485 commands to start and stop the drive when the REMOTE button is pressed (drive is in REMOTE mode).
P4.00	0400	41025	Remote source of frequency	1: RS485 Communication	This allows the RS-485 commands to set the drive speed when the REMOTE button is pressed (drive is in REMOTE mode).

Now when the REMOTE button is pressed, 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 full keypad control, press the LOCAL button. The drive will Start and Stop with the keypad. Pressing ENTER when the cursor is beside the “F” on the display, will allow the arrow keys to adjust the drive output frequency).

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 Bits 3~15: reserved

** For 2001h: When the GS4 drive is configured with Frequency Reference as RS-485, Modbus TCP, or EtherNet/IP (P4.00=1 or 4 and drive in Remote/Auto) – OR – (P4.01=1 or 4 and drive in Local/hand) – AND – Reference > P0.04 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 edge triggered, 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 P11.04~P11.09 (0B04h~0B09h, 42821~42826 decimal). See Chapter 5 for more detailed explanations of these registers.

GS4 Status Addresses (Read Only)						
Description		***Range***		***Modbus Address***		
				Hex	***Dec***	***Octal***
Status Monitor 1	Fault Codes	0: No Error 1: Overcurrent during Accel (ocA) 2: Overcurrent during Decel (ocd) 3: Overcurrent during normal speed (ocn) 4: Ground Fault (GFF) 5: IGBT short circuit (occ) 6: Overcurrent during Stop (ocS) 7: Overvoltage during Accel (ovA) 8: Overvoltage during Decel (ovd) 9: Overvoltage during normal speed (ovn) 10: Overvoltage during Stop (ovS) 11: Low voltage during Accel (LvA) 12: Low voltage during Decel (Lvd) 13: Low voltage during normal speed (Lvn) 14: Low voltage during Stop (LvS) 15: Input phase loss (OrP) 16: IGBT Overheat 1 (oH1) 17: Cap Overheat 2 (oH2) 18: Thermister 1 open (tH1o) 19: Thermister 2 open (tH2o) 20: Power Reset Off (PWR) 21: Overload (oL) (150% 1Min, Inverter) 22: Motor1 Thermal Overload (EoL1) 23: Motor2 Thermal Overload (EoL2) 24: Motor Overheat-PTC (oH3) 25: reserved 26: Over Torque 1 (ot1) 27: Over Torque 2 (ot2) 28: Under current (uc) 29: reserved 30: EEPROM write error (cF1) 31: EEPROM read error (cF2) 32: reserved 33: U phase current sensor detection error (cd1) 34: V phase current sensor detection error (cd2) 35: W phase current sensor detection error (cd3) 36: CC Hardware Logic error 0 (Hd0) 37: OC Hardware Logic error 1 (Hd1) 38: OV Hardware Logic error 2 (Hd2) 39: OCC Hardware Logic error 3 (Hd3)	40: Motor auto tune error (AuE) 41: PID Feedback loss (AFE) 42~47: reserved 48: Analog input signal loss (ACE) 49: External Fault (EF) 50: Emergency Stop (EF1) 51: Base Block (bb) 52: Password Error (Pcod) 53: Software Code lock (ccod) 54: PC Command error (CE1) 55: PC Address error (CE2) 56: PC Data error (CE3) 57: PC Slave error (CE4) 58: PC Communication Time Out (CE10) 59: PC Keypad Time out (CP10) 60: Braking Transistor Fault (bf) 61: Y-Delta connection Error (ydc) 62: Decel Energy Backup Error (dEb) 63: Over Slip Error (oSL) 64: Electromagnet switch error (ryF) 65~71: reserved 72: STO Loss1 (STL1) STO1~SCM1 internal hardware detect error 73: ES1 Emergency Stop (S1) 74: In Fire Mode (Fire) 75: reserved 76: Safety Torque Off function active (STO) 77: STO Loss2 (STL2) STO2~SCM2 internal hardware detect error 78: STO Loss3 (STL3) – STO1~SCM1 and STO2~SCM2 internal hardware detect errors 79: U Phase Short (Uoc) 80: V Phase Short (Voc) 81: W Phase Short (Woc) 82: U Phase Loss (UPHL) 83: V Phase Loss (VPHL) 84: W Phase Loss (WPHL) 85~89: reserved 90: PLC Force Stop (FStp) 91~98: reserved 99: CPU Command error (TRAP) 100~110: reserved 111: reserved	2100	48449	20400

(table continued next page)

GS4 Status Addresses (Read Only) (continued)					
Description		Range	Modbus Address		
			Hex	Dec	Octal
Status Monitor 2	Bit 0,1	0: Stop 1: Decelerate during the drive stopping 10: The drive standby 11: Run	2101	48450	20401
	Bit 2	1: JOG active			
	Bit 3,4	0: FWD 1: REV to FWD 10: FWD to REV 11: REV			
	Bit 5	reserved			
	Bit 6	reserved			
	Bit 7	reserved			
	Bit 8	1: Source of frequency by communication			
	Bit 9	1: Source of frequency by AI			
	Bit 10	1: Source of operation by communication (If Keypad Stop is enabled (P3.00, P3.01 = 1,3,5), this bit will remain “1” even if the source of operation is not communication.)			
	Bit 11	1: Parameters have been locked			
	Bit 12	Running Status (0: Drive Stopped; 1: Drive Running (including Standby))			
	Bit 13 to Bit 15	reserved			
Frequency command F (xxx.x) *			2102	48451	20402
Output Frequency H (xxx.x)			2103	48452	20403
Output Current A (xxx.x)			2104	48453	20404
DC-BUS Voltage U (xxx.x)			2105	48454	20405
Output Voltage E (xxx.x)			2106	48455	20406
Multi-Speed or PID Inputs current Step Number			2107	48456	20407
Active Warning			2108	48457	20410
DI6 Counter Value (must set P3.44)			2109	48458	20411
Power Factor angle (cos θ)			210A	48459	20412
% Load			210B	48460	20413
Motor Actual Speed (rpm)			210C	48461	20414
PID Feedback Signal (pv)			210D	48462	20415
reserved			210E	48463	20416
reserved			210F	48464	20417
reserved			2110	48465	20420
Error/ Warning	Low Byte	Active Error [2100h = Active Error/Fault]	2118	48473	20430
	High Byte	Active Warning [2108h = Active Warning]			

** If frequency command is greater than the Drive Maximum Output Frequency (P0.04), the GS4 drive will accelerate to the Drive Maximum Output Frequency, as defined in (P0.04).*

ModTCP (Ethernet) Monitor and Control

Ethernet control over ModTCP is very similar to serial Modbus control. After installing the ModTCP option card (see Appendix B for more information on card installation), set the following parameters:

GS4 Parameter Settings for ModTCP (Ethernet) Monitor and Control						
Parameter		***Setting***	***Run1) Read/ Write***	***Modbus Address Hex***	***Modbus Address Dec***	***Note***
P3.00	1st Source of Operation Command [Remote]	5: Comm Card; Keypad STOP is enabled	R/W	0300	40769	This allows Ethernet commands to start and stop the drive after the REMOTE button is pressed (drive is in REMOTE mode).
P3.01	2nd Source of Operation Command [Local]		R/W	0301	40770	
P4.00	1st Source of Frequency Command [Remote]	4: Comm Card	♦R/W	0400	41025	This allows Ethernet commands to set the drive speed after the REMOTE button is pressed (drive is in REMOTE mode).
P4.01	2nd Source of Frequency Command [Local]		♦R/W	0401	41026	

Other key parameters that must be modified (or at least must be known) to set up Ethernet communications					
P9.48	Comm Card IP Configuration	0: Static IP 1: Dynamic IP (DHCP)	R/W	0930	42353
P9.49	Comm Card IP Address Octet 1	0~255	R/W	0931	42354
P9.50	Comm Card IP Address Octet 2	0~255	R/W	0932	42355
P9.51	Comm Card IP Address Octet 3	0~255	R/W	0933	42356
P9.52	Comm Card IP Address Octet 4	0~255	R/W	0934	42357
P9.53	Comm Card Mask Octet 1	0~255	R/W	0935	42358
P9.54	Comm Card Mask Octet 2	0~255	R/W	0936	42359
P9.55	Comm Card Mask Octet 3	0~255	R/W	0937	42360
P9.56	Comm Card Mask Octet 4	0~255	R/W	0938	42361
P9.57	Comm Card Gateway Octet 1	0~255	R/W	0939	42362
P9.58	Comm Card Gateway Octet 2	0~255	R/W	093A	42363
P9.59	Comm Card Gateway Octet 3	0~255	R/W	093B	42364
P9.60	Comm Card Gateway Octet 4	0~255	R/W	093C	42365
P9.64	Comm Card External Set	0, 2 Bit 0 = reserved Bit 1 = Write Ethernet Parameters to Comm Card Bit 2 = reserved	R/W	0940	42369

Refer to Appendix B for detailed information and an example on how to set up these parameters. We recommend using Static IP (P9.48=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 P9.64 = 2 (bit 1) after changing any of these parameters to save the changes to the card firmware.

Once communications have been established, please refer to the serial Modbus section above for all the relevant Command and Status Words.

EtherNet/IP Monitor and Control

After installing the EtherNet/IP option card, set the following parameters:
(See Appendix B for more information on card installation.)

GS4 Parameter Settings for EtherNet/IP Monitor and Control						
Parameter		**Setting**	**Run1) Read/ Write**	**Modbus Address Hex**	**Modbus Address Dec**	**Note**
P3.00	1st Source of Operation Command [Remote]	5: Comm Card; Keypad STOP is enabled	R/W	0300	40769	This allows Ethernet commands to start and stop the drive after the REMOTE button is pressed (drive is in REMOTE mode).
P3.01	2nd Source of Operation Command [Local]		R/W	0301	40770	
P4.00	1st Source of Frequency Command [Remote]	4: Comm Card	♦R/W	0400	41025	This allows Ethernet commands to set the drive speed after the REMOTE button is pressed (drive is in REMOTE mode).
P4.01	2nd Source of Frequency Command [Local]		♦R/W	0401	41026	

Other key parameters that must be modified (or at least must be known) to set up Ethernet communications					
P9.48	Comm Card IP Configuration	0: Static IP 1: Dynamic IP (DHCP)	R/W	0930	42353
P9.49	Comm Card IP Address Octet 1	0~255	R/W	0931	42354
P9.50	Comm Card IP Address Octet 2	0~255	R/W	0932	42355
P9.51	Comm Card IP Address Octet 3	0~255	R/W	0933	42356
P9.52	Comm Card IP Address Octet 4	0~255	R/W	0934	42357
P9.53	Comm Card Mask Octet 1	0~255	R/W	0935	42358
P9.54	Comm Card Mask Octet 2	0~255	R/W	0936	42359
P9.55	Comm Card Mask Octet 3	0~255	R/W	0937	42360
P9.56	Comm Card Mask Octet 4	0~255	R/W	0938	42361
P9.57	Comm Card Gateway Octet 1	0~255	R/W	0939	42362
P9.58	Comm Card Gateway Octet 2	0~255	R/W	093A	42363
P9.59	Comm Card Gateway Octet 3	0~255	R/W	093B	42364
P9.60	Comm Card Gateway Octet 4	0~255	R/W	093C	42365
P9.64	Comm Card External Set	0, 2 Bit 0 = reserved Bit 1 = Write Ethernet Parameters to Comm Card Bit 2 = reserved	R/W	0940	42369

Refer to Appendix B for detailed information and an example on how to set up these parameters. We recommend using Static IP (P9.48=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 P9.64 = 2 (bit 1) after changing any of these parameters to save the changes to the card firmware.

Appendix B details all the Implicit and Explicit data that can be transferred to and from the GS4. 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.

GS4-CM-ENETIP 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

GS4-CM-ENETIP 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*

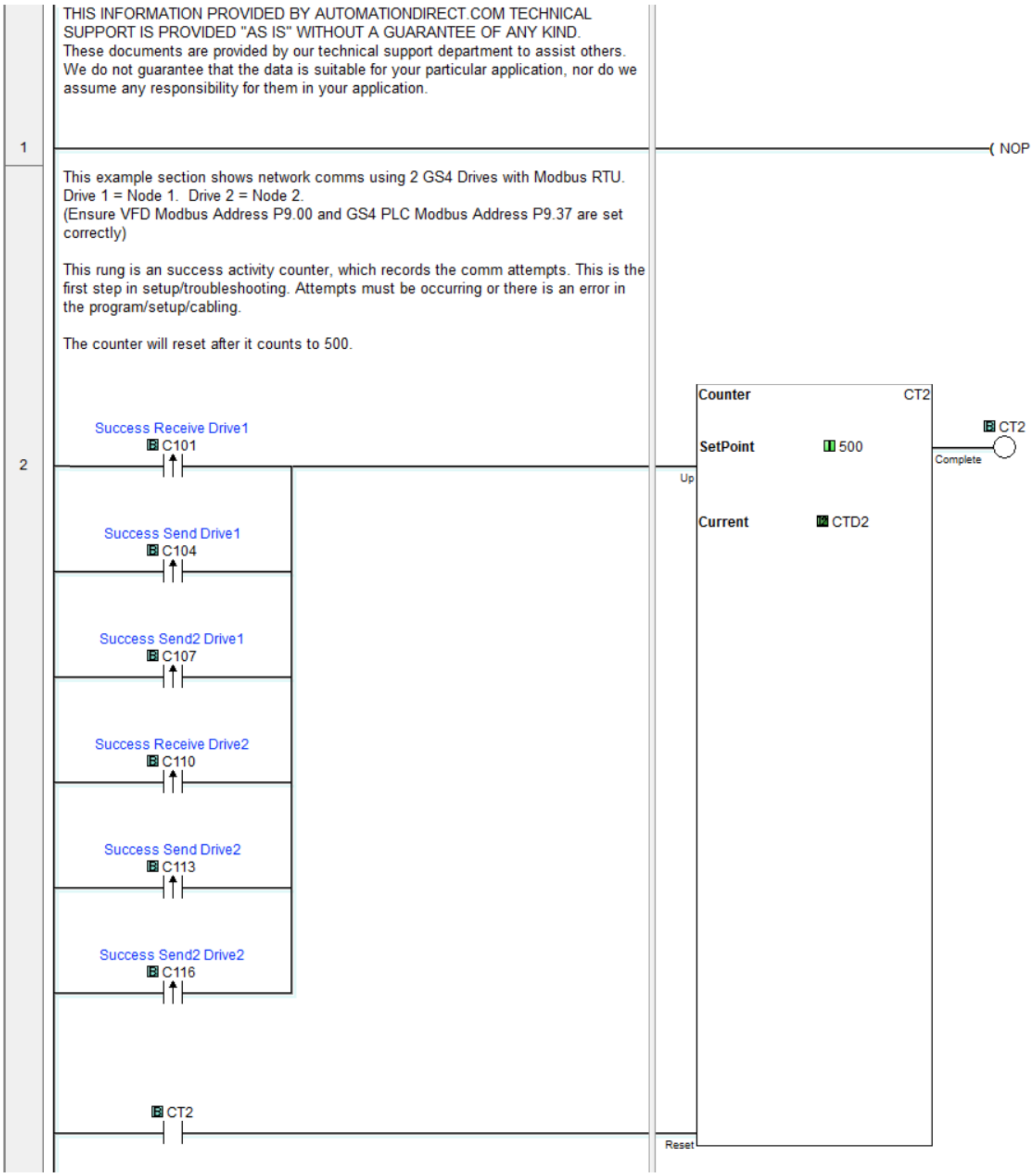
GS4-CM-ENETIP Communication Protocol Parameter Address Definitions

Communication Protocol Parameter Address Definitions			
Parameter Content Parameters Set in GS4	***Address***	***Definition***	
Commands to GS4	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 6~15	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
Monitor GS4 status	0	Warning/Fault Code: Refer to Troubleshooting – Warning/Fault Codes in Chapter 6: Maintenance and Troubleshooting	
	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	Warning codes	
	9	Digital Input counter value	
	10	Power Factor angle (cosθ)	
	11	reserved	
	12	Actual Motor Speed (rpm)	
	13	reserved	
	14	reserved	
	15	Power Output (kW)	

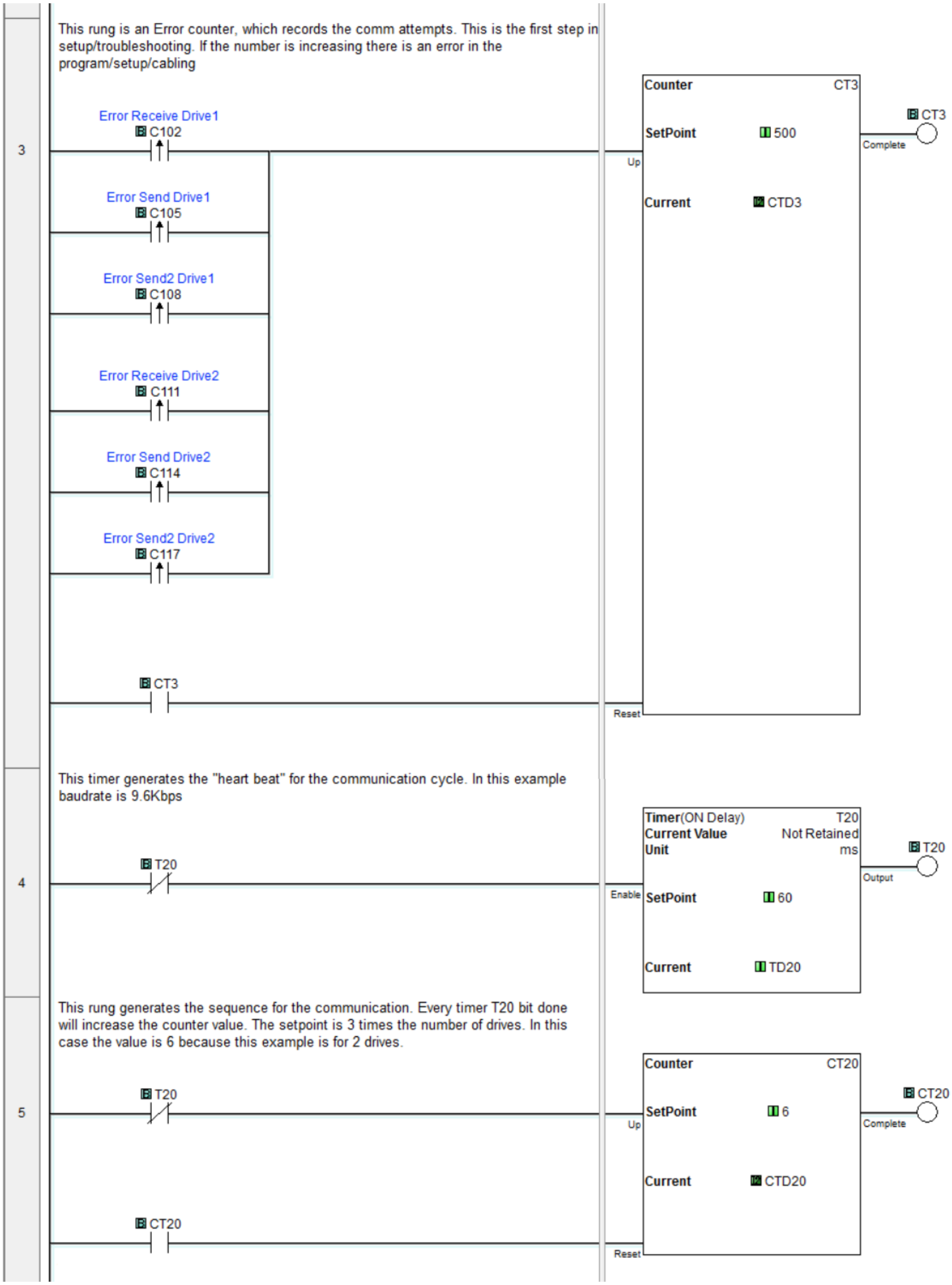
Program Examples Using AutomationDirect CLICK PLC

Modbus RTU CLICK Program Example

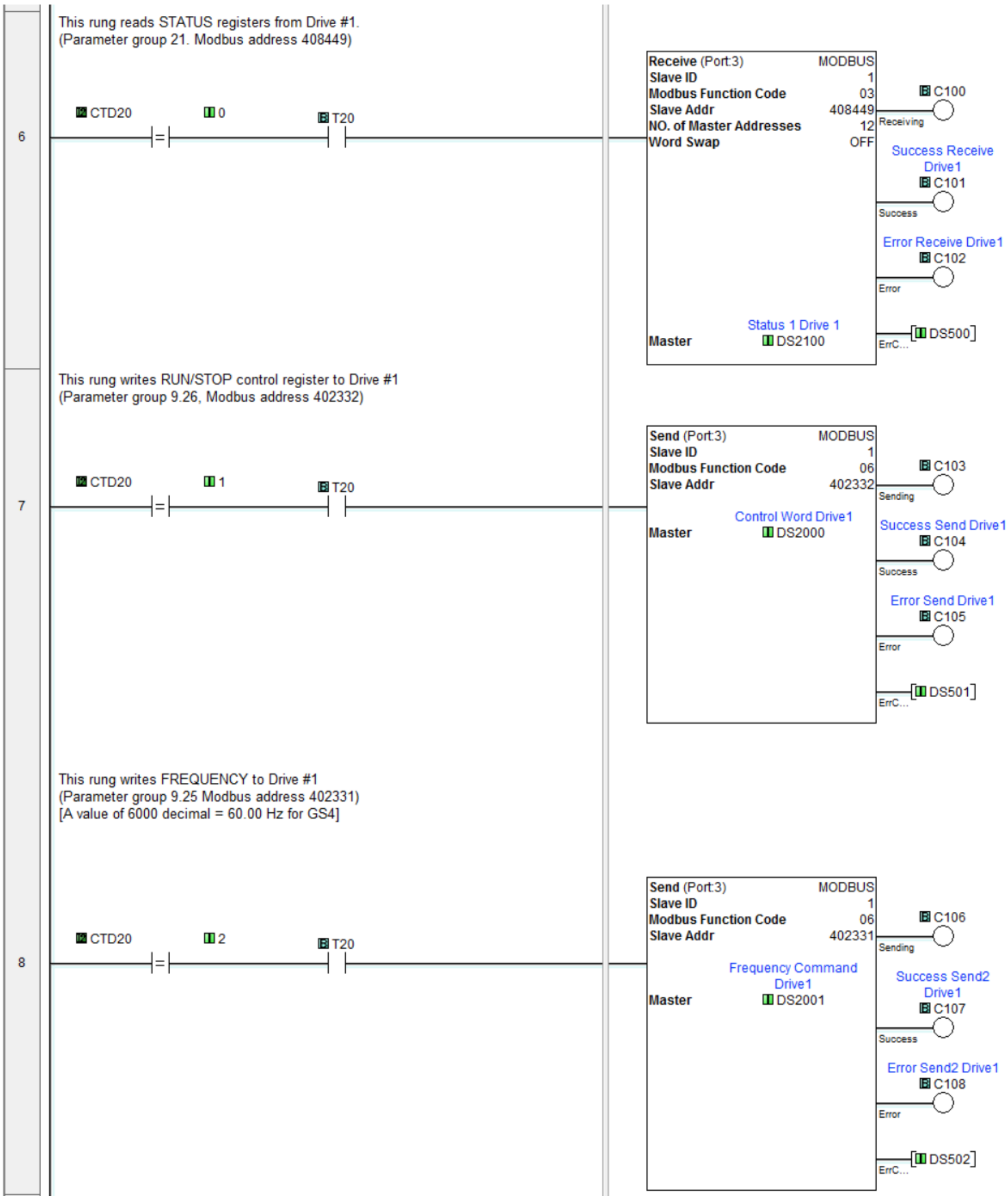
This example section shows CLICK ladder logic designed to show a method of establishing and monitoring network communications when using two GS4 drives with Modbus RTU.



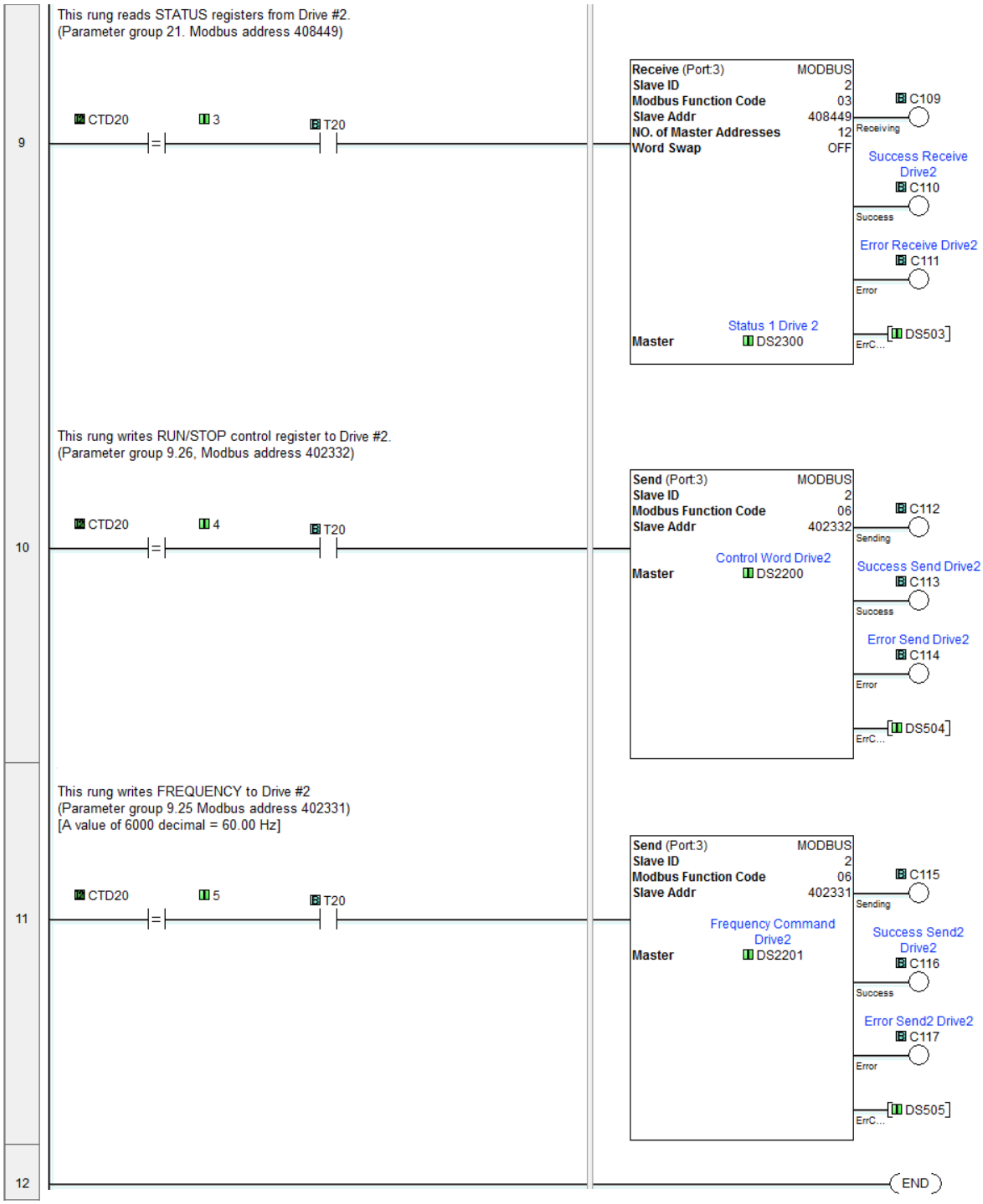
Modbus RTU CLICK Program Example (continued)



Modbus RTU CLICK Program Example (continued)

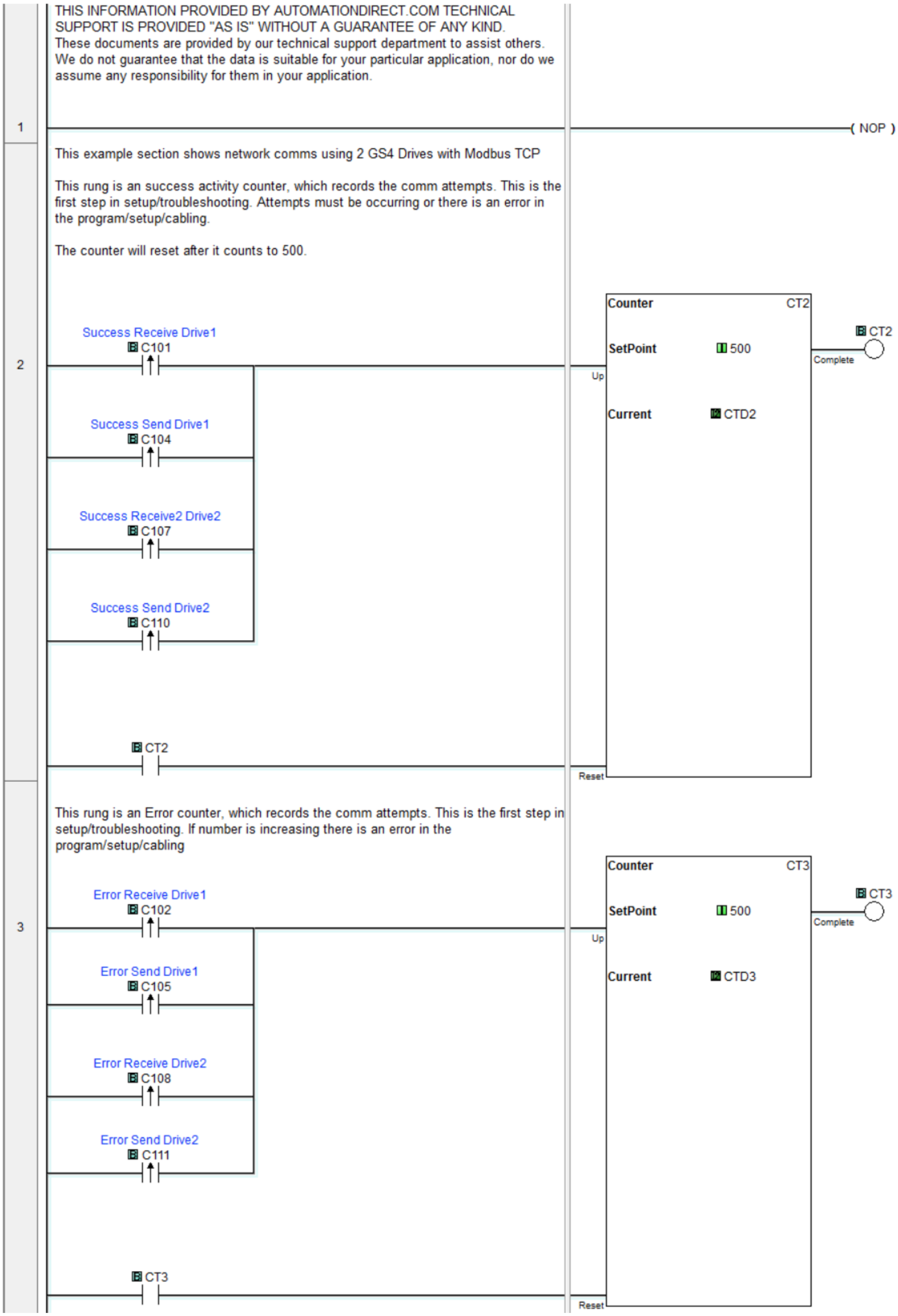


Modbus RTU CLICK Program Example (continued)

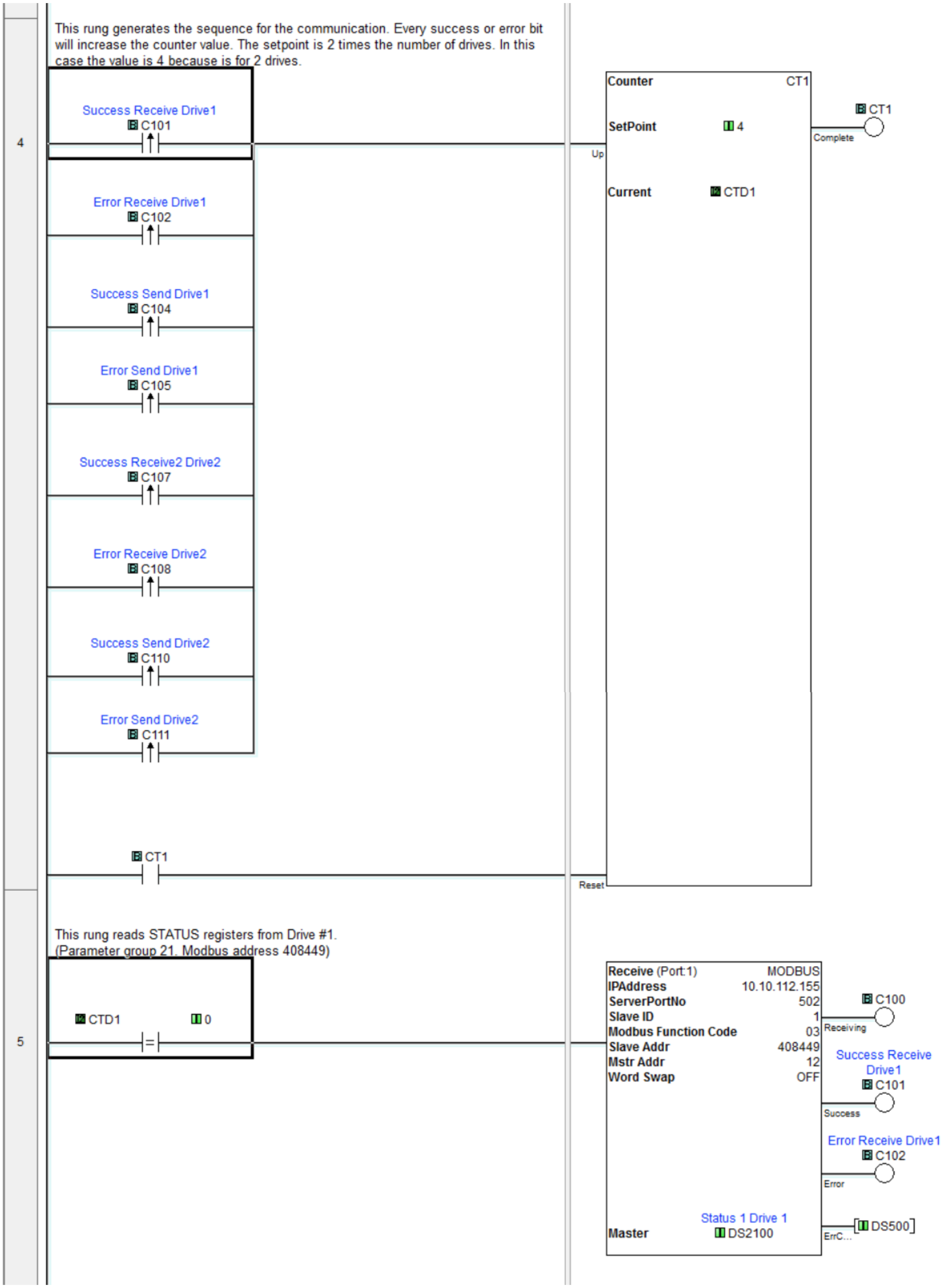


Modbus TCP CLICK Program Example

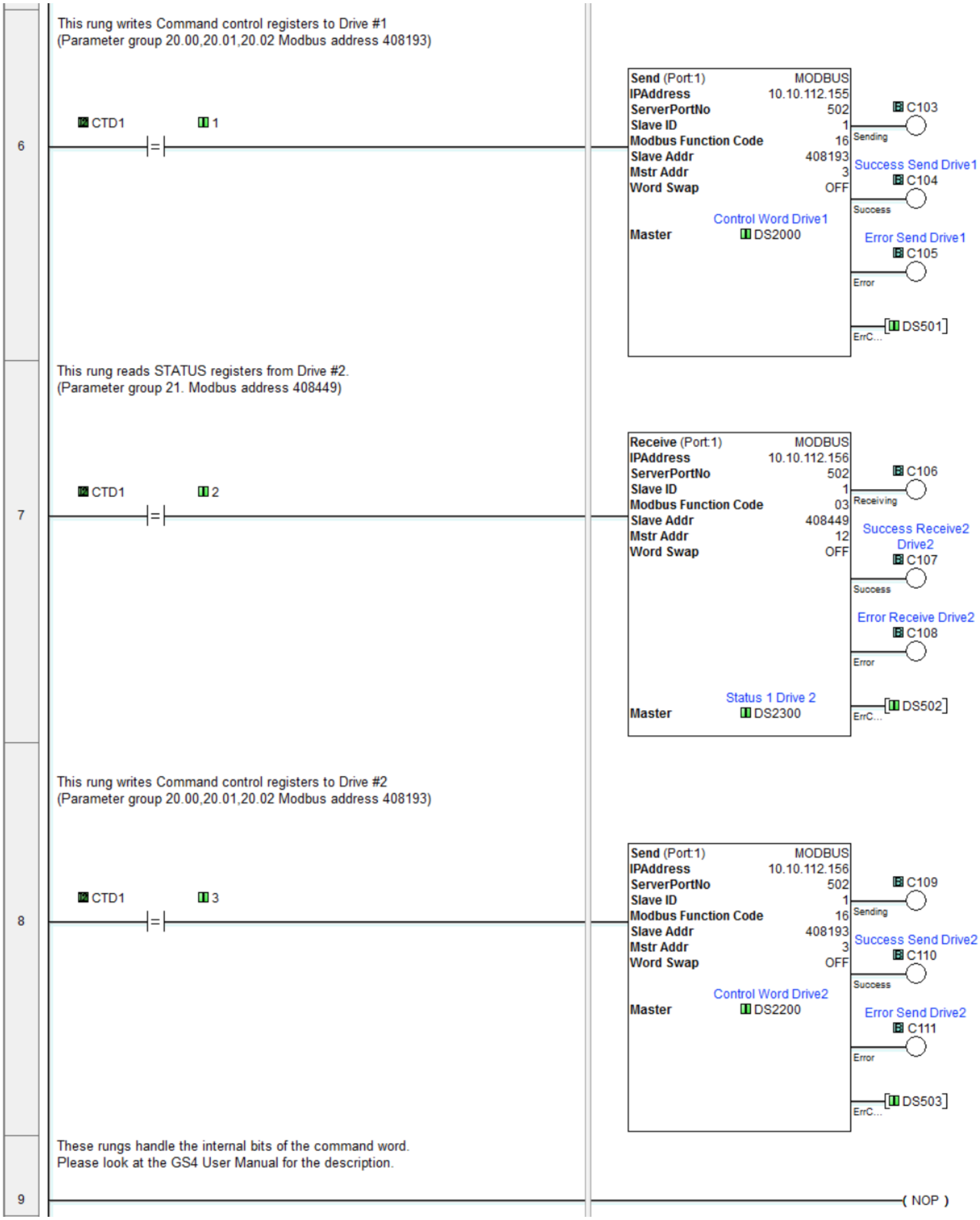
This example section shows CLICK ladder logic designed to show a method of establishing and monitoring network communications when using two GS4 drives with Modbus TCP.



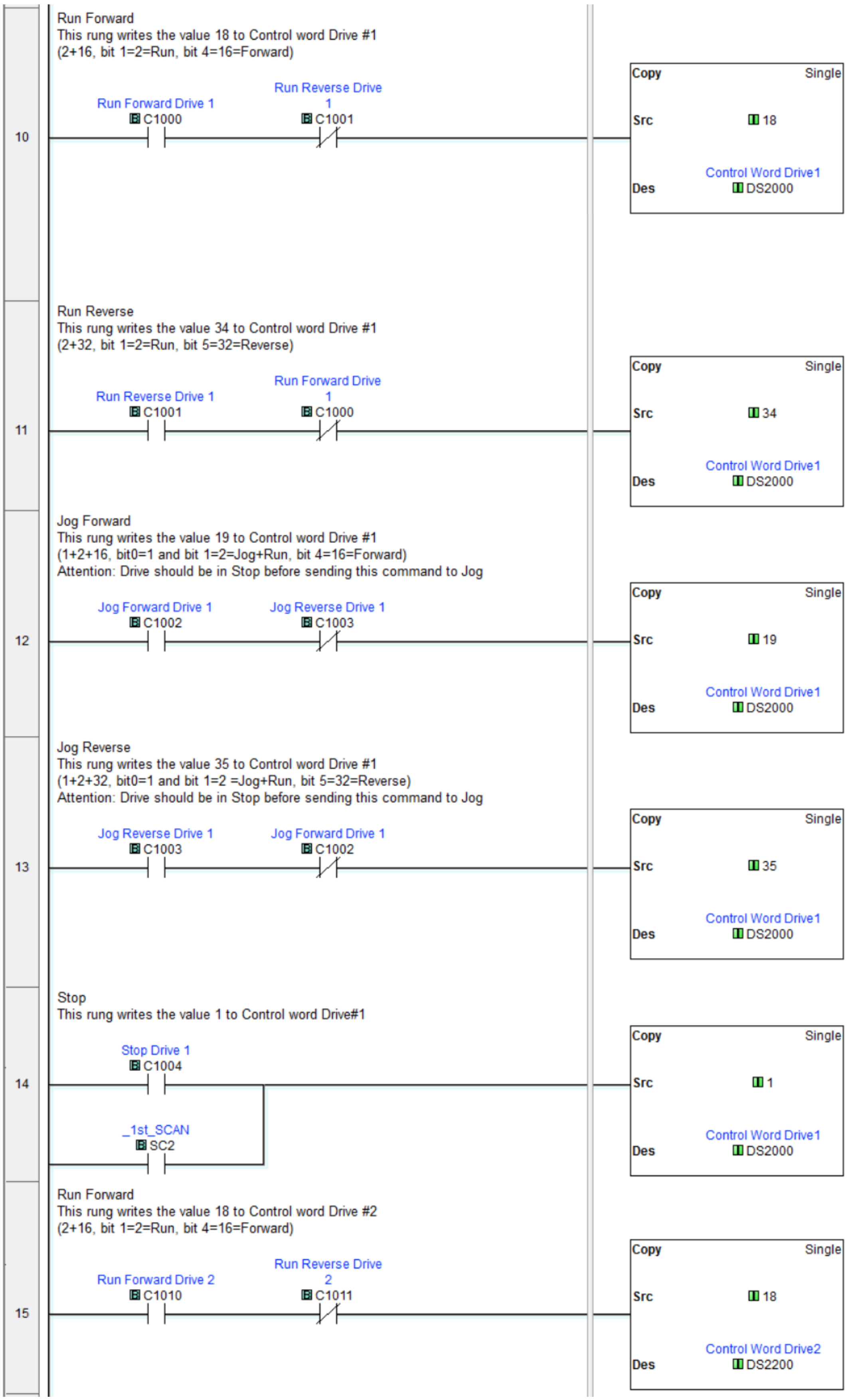
Modbus TCP CLICK Program Example (continued)



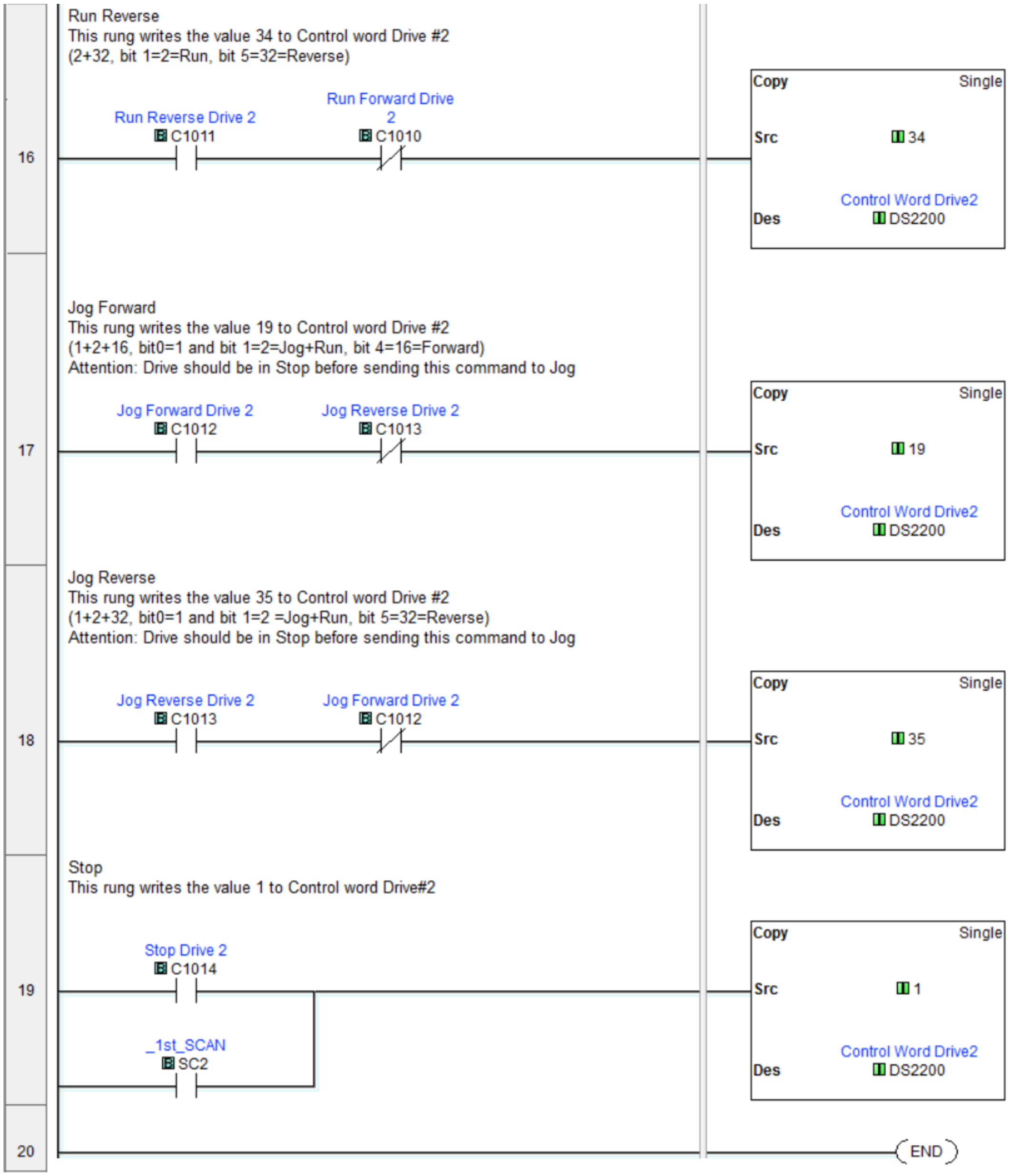
Modbus TCP CLICK Program Example (continued)



Modbus TCP CLICK Program Example (continued)



Modbus TCP CLICK Program Example (continued)



Safe Torque Off

Appendix E

Table of Contents

Safe Function Failure Rate

Item	Definition	Standard	Performance
SFF	Safe Torque Off	IEC61508	Channel 1: 80.08% Channel 2: 68.91%
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	9.56×10^{-10}
PFD_{av}	Probability of Dangerous Failure on Demand	IEC61508	4.18×10^{-6}
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 stop, 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 STL fault and power must be cycled to the drive to clear the error** (see "Method of Reset" in the chart below).

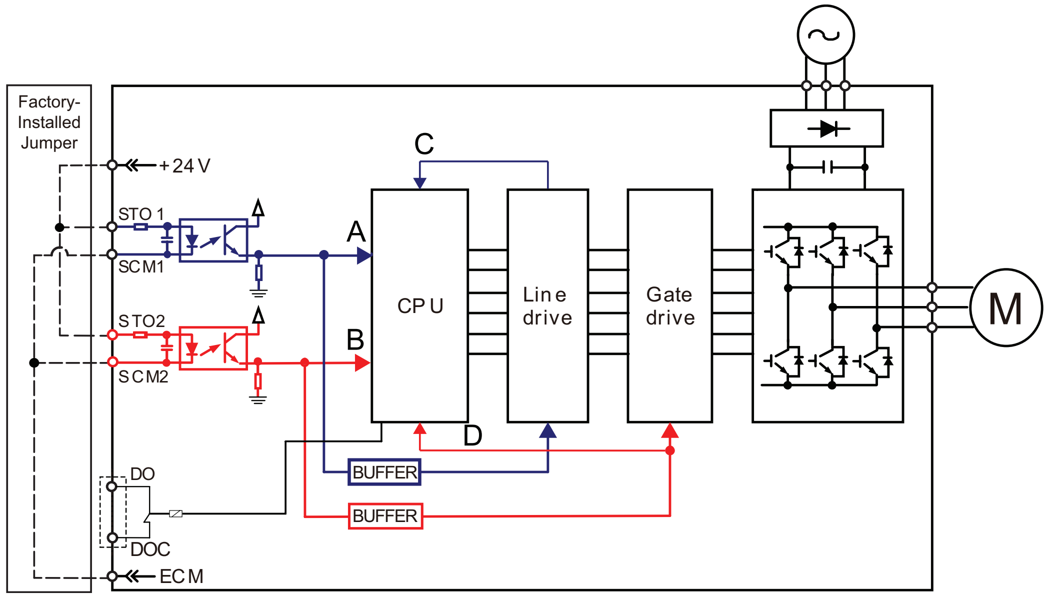
If unknown STO faults occur, the on-board +24V might be getting shorted to ground (+24V to DCM).

<table>
<tr><th colspan="7">Operation Conditions Description</th></tr>
<tr><th>Signal</th><th>Channel</th><th colspan="5">STO Input Status</th></tr>
<tr><td rowspan="2">STO Signal</td><td>STO1~SCM1</td><td>ON (High)</td><td>OFF (Low)</td><td>ON (High)</td><td>OFF (Low)</td><td>x</td></tr>
<tr><td>STO2~SCM2</td><td>ON (High)</td><td>OFF (Low)</td><td>OFF (Low)</td><td>ON (High)</td><td>x</td></tr>
<tr><td colspan="2">Driver Output Status</td><td>Ready</td><td>Normal STO Mode (Torque Output Off)</td><td>STL2 Mode (Torque Output Off)</td><td>STL1 Mode (Torque Output Off)</td><td>STL3 Mode (Torque Output Off)</td></tr>
<tr><td rowspan="3">Method of Reset</td><td>Step 1</td><td rowspan="3">n/a</td><td colspan="3">Clear Fault (set both channels high)</td><td rowspan="3">Cannot reset; Internal Drive failure</td></tr>
<tr><td>Step 2</td><td>Reset button</td><td colspan="2">Cycle Power to Drive</td></tr>
<tr><td>Step 3</td><td colspan="3">Cycle Run Command from low to high</td></tr>
<tr><td colspan="7"><u>Definitions</u>
STO: Safe Torque Off
STL1~STL3: Alarms indicate a non-standard emergency stop. STO Losses 1 and 2 (STL1, STL2) indicate only one channel of the safety circuit has been activated. STO Loss 3 (STL3) indicates an internal failure of the STO monitoring circuitry.
STL3: STO1~SCM1 and STO2~SCM2 internal circuit detected abnormal.
STO1~SCM1 ON(High): STO1~SCM1 has connection to a +24VDC power supply.
STO2~SCM2 ON(High): STO2~SCM2 has connection to a +24VDC power supply.
STO1~SCM1 OFF(Low): STO1~SCM1 has no connection to a +24VDC power supply.
STO2~SCM2 OFF(Low): STO2~SCM2 has no connection to a +24VDC power supply.</td></tr>
<tr><td colspan="7">STO alarm is the expected method of Emergency Stop. Both channels open at the same time.</td></tr>
</table>

Wiring Diagrams

Internal STO Circuit

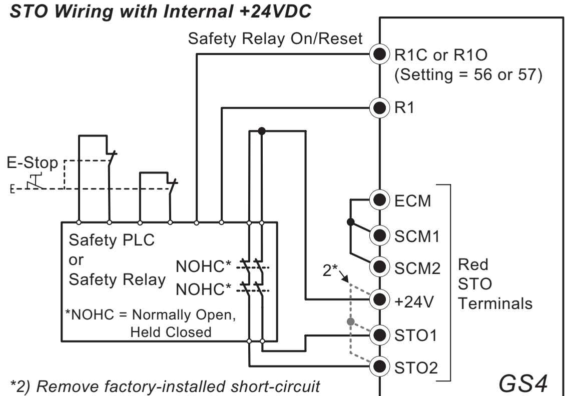
<u>*In the figure below, the factory setting for +24V-STO1-STO2 and SCM1-SCM2-ECM is short circuit*</u>



Control Loop Wiring Diagrams

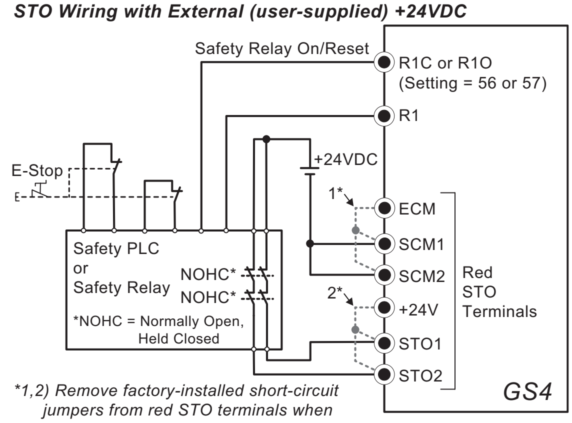
1) *Remove the jumper from +24V–STO1–STO2 and ECM–SCM1–SCM2.*
2) *Wire the STO circuit like the diagrams below. The ESTOP contacts must be in a closed state while in a normal and safe situation for the drive to be able to run.*
3) *When the ESTOP switch is opened, the Safety PLC or Relay will open both sets of contacts. The drive output will immediately stop, and the keypad will display an STO fault.*

STO Wiring with Internal +24VDC



**2) Remove factory-installed short-circuit jumper from +24V–STO1–STO2 when using STO function with internal +24VDC.*

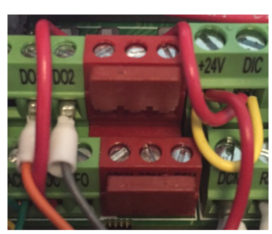
STO Wiring with External (user-supplied) +24VDC



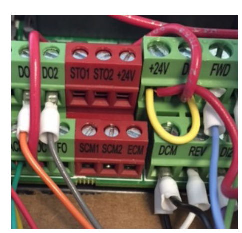
**1,2) Remove factory-installed short-circuit jumpers from red STO terminals when using STO function with external +24VDC.*

**1: Factory short-circuit of ECM–SCM1–SCM2. To use Safety Function with external power source, remove this jumper.*

**2: Factory short-circuit of +24V–STO1–STO2. To use Safety Function, remove this jumper.*



STO Terminals with Jumpers



STO Terminals without Jumpers

STO Parameters

		Type	*Hex Addr*	*Dec Addr*
P6.71	***STO Alarm Latch***	♦R/W	0647	41608

Range/Units — *Default*

0: STO Alarm Latch — 0
1: STO Alarm no Latch

Setting Explanations:

0: STO Alarm Latch: After the reason for an STO Alarm is cleared, a Reset command is needed to clear the STO Alarm unless Fire Mode is turned ON. Once the STO Alarm is cleared, Fire Mode can run the drive without first having received a reset signal. Fire Mode will also run the drive after an STL1 or STL2 alarm is cleared without needing a power cycle.

1: STO Alarm no Latch: After the reason for an STO Alarm is cleared, the STO Alarm will be cleared automatically. Cycling the run command OFF then ON is required, even if P6.29=1 (Line Start Lockout disabled).

All of the STL1~STL3 errors are "Alarm Latch" mode. (In STL1~STL3 mode, the P6.71 function is not effective.)

		Type	*Hex Addr*	*Dec Addr*
P6.29	***Line Start Lockout***	♦R/W	061D	41566

Range/Units — *Default*

0: Enable start-up lockout — 0
1: Disable start-up lockout

Setting Explanations:

0: Enable. When this parameter is enabled, the GS4 drive will not start the motor when powered up with a RUN command already applied. The drive must see the RUN command change from STOP to RUN before it will start.

1: Disable. When this parameter is disabled, the GS4 drive will start the motor when powered up with a RUN command already applied.

When Safe Torque Off (STO) alarms STL1 or STL2 are activated, a power cycle is required to reset the drive. When P6.29 is set to 1, the drive will start on power-up while performing this reset condition.

		Type	*Hex Addr*	*Dec Addr*
P3.17	***Multi-Function Output Terminal 1 (Relay 1)***	♦R/W	0311	40786
P3.18	***Multi-Function Output Terminal 2 (Relay 2)***	♦R/W	0312	40787

Settings Pertaining to STO Function

Settings	*Functions*	*Descriptions*
56	SO Logic A output	Safety Output normally-open contact
57	SO Logic B output	Safety Output normally-closed contact

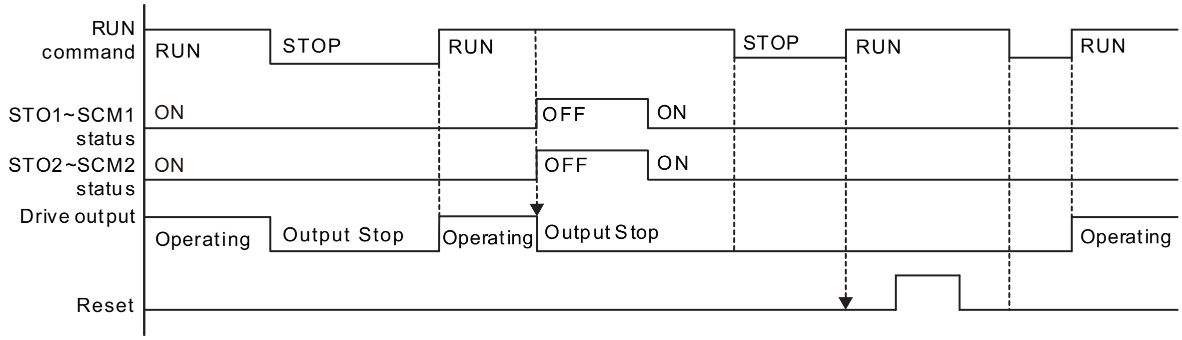
Drive Status	***Safety Output Status***	
–	NO (P3.17/P3.18 = 56)	NC (P3.17/P3.18 = 57)
Normal Run	open	close
STO	close	open
STL1~STL3	close	open

Operating Sequence Description

Normal Operation Status

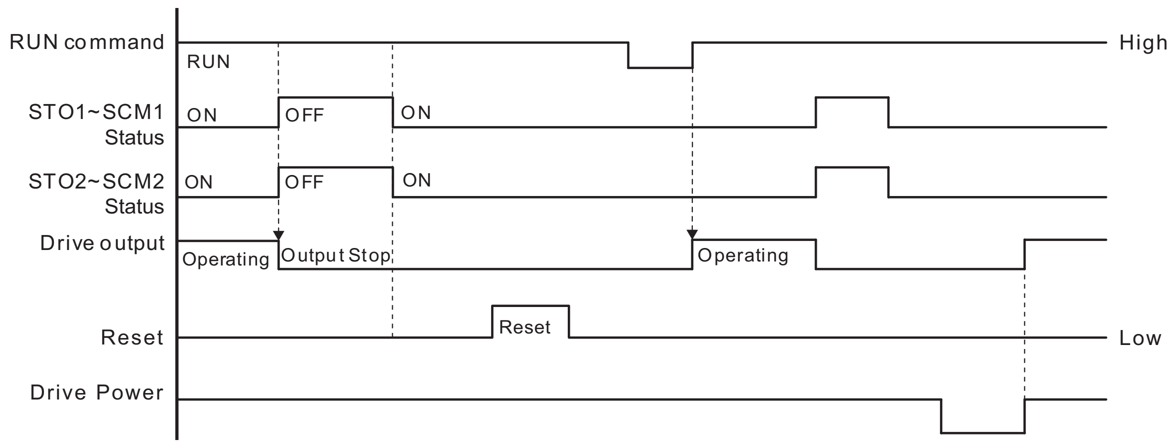
STO P6.71=0

When the STO1~SCM1 and STO2~SCM2 = ON (no STO stop signals given), the drive will execute "Operating" or "Output Stop" according to RUN/STOP command.

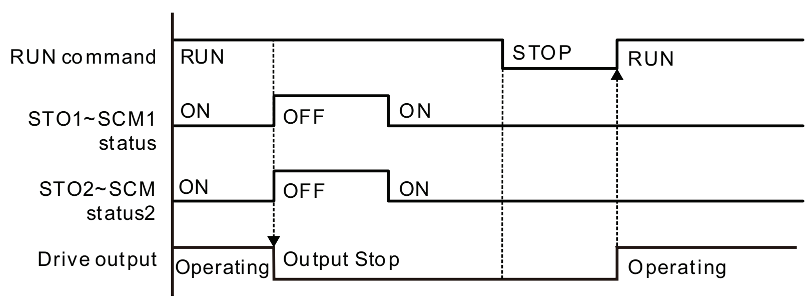


STO P6.71=0, P6.29=1

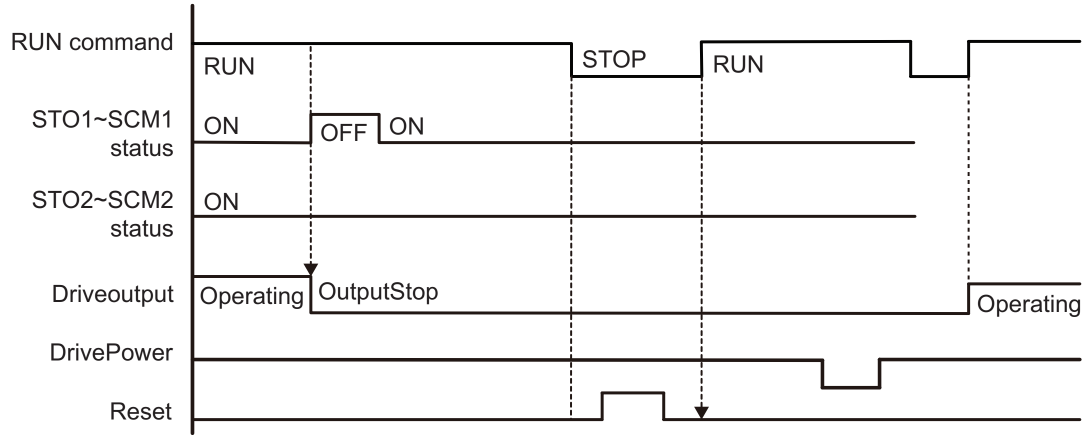
When both of STO1~SCM1 and STO2~SCM2 channels are turned off during operation, the STO function is enabled and the drive will turn off output power, "Output Stop," regardless of the Run command ON or OFF status.



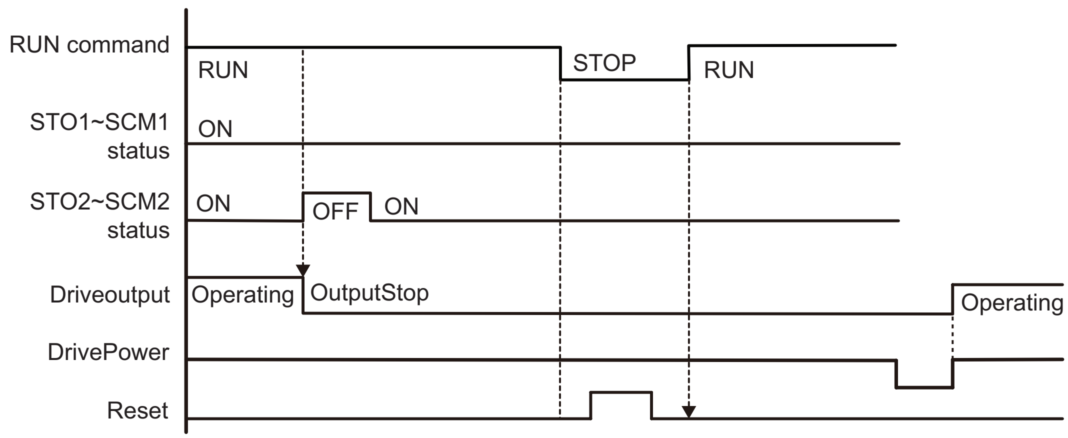
STO P6.71=1



STL1 P6.71=1, P6.29=0



STL2 P6.71=1, P6.29=1



Error Codes for STO Function

		Type	Hex Addr	Dec Addr
P11.04	***First Fault Record***	Read	0B04	42821
P11.05	***Second Most Recent Fault Record***	Read	0B05	42822
P11.06	***Third Most Recent Fault Record***	Read	0B06	42823
P11.07	***Fourth Most Recent Fault Record***	Read	0B07	42824
P11.08	***Fifth Most Recent Fault Record***	Read	0B08	42825
P11.09	***Sixth Most Recent Fault Record***	Read	0B09	42826

Error Codes Pertaining to STO Function	Default
72: STL1 STO1~SCM1 internal hardware detect error	0
76: STO Safety Torque Off function active	
77: STL2 STO2~SCM2 internal hardware detect error	
78: STL3 STO1~SCM1 and STO2~SCM2 internal hardware detect error	

PID CONTROL

APPENDIX F

TABLE OF CONTENTS

Function of PID Control

GS4 series AC drives can be used to control an automated process by the Proportional-Integral-Derivative (PID) control method.

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 GS4 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 GS4 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 GS4 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 GS4 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 GS4 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 GS4 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 GS4 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 GS4 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) <u>upward</u> toward the Setpoint (SP)*
- *GS4 drive frequency output increases if the Process Error is negative (SP>PV)*

Reverse-Acting PID Loop (Cooling Loop) (Positive-Feedback Loop)

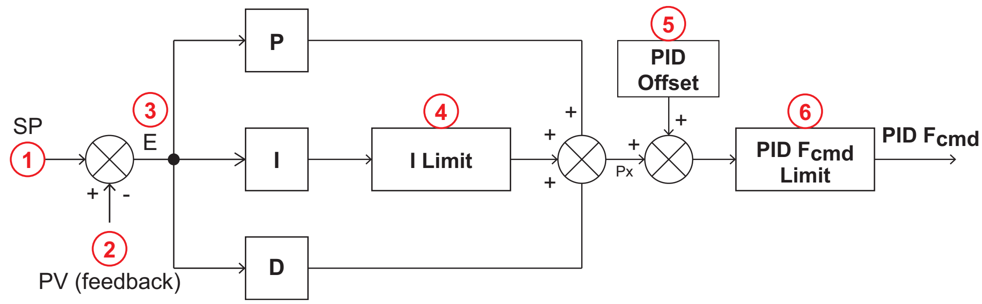
The terms "Reverse-Acting," "Cooling," and "Positive-Feedback" are used to describe a PID loop that can be used to control applications such as cooling.

- *Greater Output Frequency (Hz) drives the Process Variable (PV) <u>downward</u> toward the Setpoint (SP)*
- *GS4 drive frequency output increases if the Process Error is positive (SP<PV)*

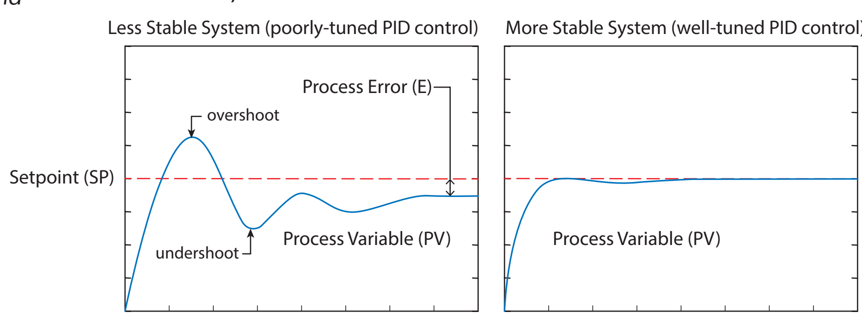
PID Control Overview

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*



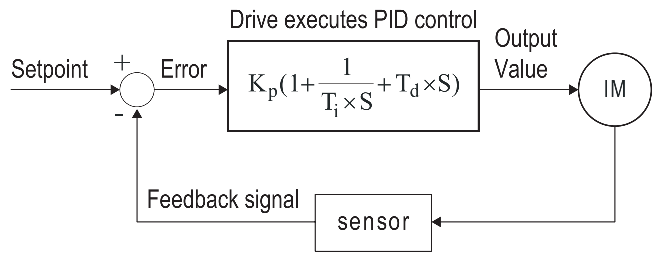
1) *Setpoint: -100% to +100% (PID Setpoint Gain + PID Setpoint Offset)*
2) *Feedback: -100% to +100% (Feedback Gain)*
3) *Error: -100% to +100% (in percent change)*
4) *I Limit: 0~150% (Upper Limit for Integral Time P7.16)*
5) *PID Offset: P7.24 determines how the PID Offset will be controlled; by P7.04, or by an Analog Input (P4.02, P4.03, P4.04)*
6) *PID F_{cmd} Limit: See P6.25/P6.26*



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 GS4 PID Control & Tuning



K_p: Proportional Gain (P) T_i: Integral Time (I) T_d: Derivative Value (D)   S: Operator

When ***GS4 drive PID is enabled by P7.00 [PID Action/Mode]***, P7.02 "reflects" the PID Setpoint Source determined by what is set in P4.00 (Remote) or P4.01 (Local), and what Mode the Drive is in, i.e. Remote or Local Mode. PID control operates with the feedback signal as reflected by P7.02 either 0~10V voltage or 4~20mA current.

Proportional Gain (P)

The first parameter of GS4 PID control is *Proportional Gain (P7.13)*.

The GS4 drive's frequency output is proportional to the Process Error (when the GS4 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 GS4 PID control is *Integral Time (P7.14)*.

The GS4 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 GS4 PID control is *Derivative Value (P7.15)*.

The GS4 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

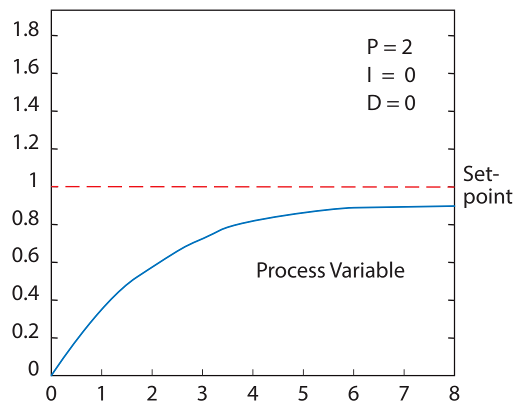
The PID settings should be adjusted, or "tuned," with the controlled process in actual operation while monitoring the actual Process Variable. The tuning can be done using the GSoft2 software scope function, or with an oscilloscope.

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:

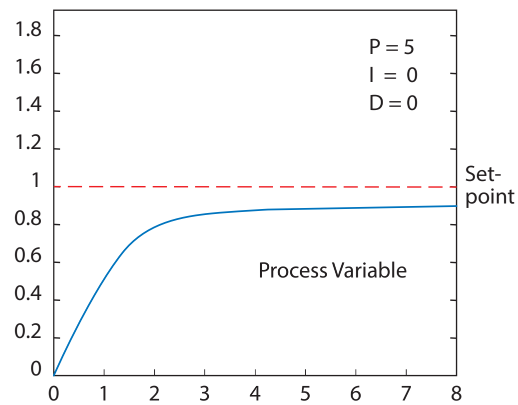
- *P = Proportional Gain = GS4 drive parameter P7.13,*
- *I = Integral Time = GS4 drive parameter P7.14,*
- *D = Derivative Value = GS4 drive parameter P7.15.*

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)

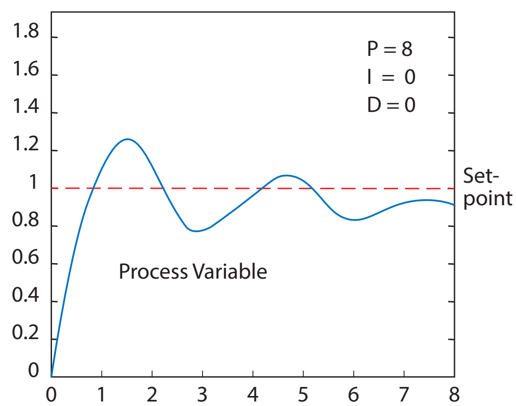
Sluggish PV response; process error



More practical PV response; process error



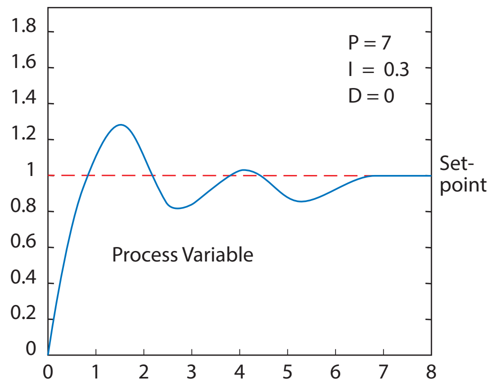
Overshoot & undershoot; process error

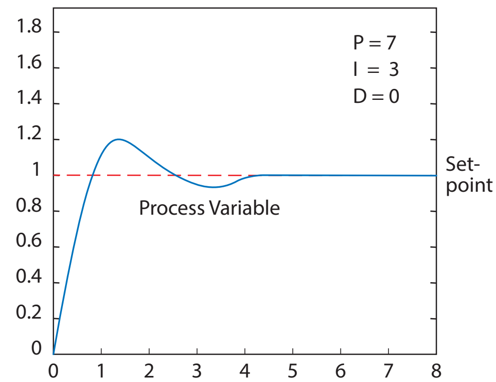


(Example continued next page)

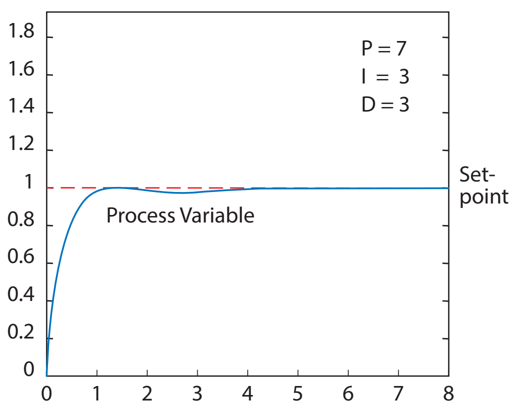
PID Tuning Example (continued)

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 GS4 and GS3 PID Parameter Comparisons

DURAPULSE GS4 & GS3 PID Parameter Comparisons – Summary			
GS4 PID Parameter		**GS3 PID Parameter**	
P7.00	PID Action/Mode	**P7.00**	Input Terminal for PID Feedback
P7.01	reserved	**P7.01**	PV 100% Value
P7.02	PID Setpoint Source (when PID enabled, this parameter data will be mapped from P4.00~P4.01 dependent upon whether in Remote=4.00 or Local=4.01)	**P7.02**	PID Setpoint Source
P7.03	PID Feedback Gain	**P7.03**	PID Feedback Gain
P7.04	PID Offset Value	**P7.04**	PID Setpoint Offset Polarity
		P7.05	PID Setpoint Offset
n/a	n/a	**P7.06**	PID Setpoint Gain
P7.05	Keypad PID Setpoint	**P7.10**	Keypad PID Setpoint
P7.06	PID Multi-Setpoint 1	**P7.11**	PID Multi-setpoint 1
P7.07	PID Multi-Setpoint 2	**P7.12**	PID Multi-setpoint 2
P7.08	PID Multi-Setpoint 3	**P7.13**	PID Multi-setpoint 3
P7.09	PID Multi-Setpoint 4	**P7.14**	PID Multi-setpoint 4
P7.10	PID Multi-Setpoint 5	**P7.15**	PID Multi-setpoint 5
P7.11	PID Multi-Setpoint 6	**P7.16**	PID Multi-setpoint 6
P7.12	PID Multi-Setpoint 7	**P7.17**	PID Multi-setpoint 7
P7.13	Proportional Gain	**P7.20**	Proportional Control
P7.14	Integral Time	**P7.21**	Integral Control
P7.15	Derivative Value	**P7.22**	Derivative Control
P7.16	Upper Limit for Integral Time	**P7.23**	Upper Bound for Integral Control
P7.17	Derivative Filter Time Constant	**P7.24**	Derivative Filter Time Constant
P7.18	PID Output Frequency Limit	**P7.25**	PID Output Frequency Limit
P7.19	PID Feedback Value	**n/a**	n/a
P7.20	Feedback Signal Detection Time	**P7.26**	Feedback Signal Detection Time
P7.21	PID Feedback Loss	**P7.27**	PID Feedback Loss
P7.22	PID Feedback Loss Speed Level Default	**P7.28**	PID Feedback Loss Preset Speed
P7.23	reserved	**n/a**	n/a
P7.24	PID Offset Selection		
P7.25	PID Mode Selection		
P7.26	PID Reverse Enable		
P7.27	Source of Sleep		
P7.28	Integral Limit During Sleep		
P7.29	Sleep Reference		
P7.30	Wake-up Reference		
P7.31	Sleep Time		
P7.32	Wake-up Delay Time		
P8.00	User Display (can be set to display PID values)	**P8.00**	User Defined Display Function
P8.01	Start-up Display Selection	**n/a**	n/a
P8.02	User Defined Format		
P8.03	User Defined Max		
P8.04	User Defined Setpoint		

GS4 Parameters Involved in PID Control – Summary

The following GS4 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 GS4 parameters, please refer to "Chapter 4: AC Drive Parameters."

***DURApulse* GS4 Parameters for PID Control – Summary**			
Parameter / Description			
P3.03	Multi-Function Input (DI1)	**P7.19**	PID Feedback Value
P3.04	Multi-Function Input (DI2)	**P7.20**	Feedback Signal Detection Time
P3.05	Multi-Function Input (DI3)	**P7.21**	PID Feedback Loss
P3.06	Multi-Function Input (DI4)	**P7.22**	PID Feedback Loss Speed Level Default
P3.07	Multi-Function Input (DI5)	**P7.23**	reserved
P3.08	Multi-Function Input (DI6)	**P7.24**	PID Offset Selection
P3.09	Multi-Function Input (DI7)	**P7.25**	PID Mode Selection
P3.10	Multi-Function Input (DI8)	**P7.26**	PID Reverse Enable
P3.11	Multi-Function Input (option card DI10 or PLC X12)	**P7.27**	Source of Sleep
P3.12	Multi-Function Input (option card DI11 or PLC X13)	**P7.28**	Integral Limit During Sleep
P3.13	Multi-Function Input (option card DI12 or PLC X14)	**P7.29**	Sleep Reference
P3.14	Multi-Function Input (option card DI13 or PLC X15)	**P7.30**	Wake-up Reference
P3.15	Multi-Function Input (option card DI14 or PLC X16)	**P7.31**	Sleep Time
P3.16	Multi-Function Input (option card DI15 or PLC X17)	**P7.32**	Wake-up Delay Time
P3.17	Multi-Function Output Terminal 1 (Relay 1)	**P8.00**	User Display
P3.36	PID Deviation Level		
P3.37	PID Deviation Time		
P3.57	AUTO to HAND Switching Behavior		
P4.00	1st Source of Frequency Command [Remote]		
P4.01	2nd Source of Frequency Command [Local]		
P4.02	Analog Input 1 (AI1) Function		
P4.03	Analog Input 2 (AI2) Function		
P4.04	Analog Input 3 (AI3) Function		
P6.25	Upper Limit of Output Frequency		
P6.26	Lower Limit of Output Frequency		
P7.00	PID Action/Mode		
P7.02	PID Setpoint Source		
P7.03	PID Feedback Gain		
P7.04	PID Offset Value		
P7.05	Keypad PID Setpoint	n/a	
P7.06	PID Multi-Setpoint 1		
P7.07	PID Multi-Setpoint 2		
P7.08	PID Multi-Setpoint 3		
P7.09	PID Multi-Setpoint 4		
P7.10	PID Multi-Setpoint 5		
P7.11	PID Multi-Setpoint 6		
P7.12	PID Multi-Setpoint 7		
P7.13	Proportional Gain		
P7.14	Integral Time		
P7.15	Derivative Value		
P7.16	Upper Limit for Integral Time		
P7.17	Derivative Filter Time Constant		
P7.18	PID Output Frequency Limit		

GS4 Parameters Involved in PID Control – Details

NOTE: The information provided herein is applicable only to the PID function. For fully detailed parameter information and for the complete set of GS4 parameters, please refer to "Chapter 4: AC Drive Parameters."

		Type	Hex Addr	Dec Addr
P3.03~P3.16	***Multi-Function Input Terminal Functions***	R/W	varies by parameter	
	Range/Units (ABBREVIATED LISTING; INCLUDES ONLY SETTINGS APPLICABLE TO PID)		Default	
	0~50		varies by parameter	

These parameters set the functions of the Multi-Function input terminals.

Multi-Function Input Terminal (P3.03~P3.16) Function Settings Applicable for PID Control						
Setting: Function	***Function Description***					
0: No function	Setting a Multi-Function Input to 0 will disable that input. The purpose of this function is to provide isolation for unused Multi-Function Input Terminals. ***Any unused terminals should be programmed to 0 to make sure they have no effect on drive operation.***					
1: Multi-Speed/PID Multi-Setpoint bit 1 2: Multi-Speed/PID Multi-Setpoint bit 2 3: Multi-Speed/PID Multi-Setpoint bit 3	When settings 1, 2, & 3 are selected and registers P7.06~P7.12 are populated, the Multi-Function Inputs refer to PID Multi-Setpoints. The SPs are determined by P7.06~P7.12. 1) In order to use the Multi-PID SPs, P7.06~P7.12 must be set, and P7.00≠0. 2) When all PID Multi-Setpoint inputs are off, the GS4 drive reverts to the PID Setpoint Source (P7.02).	***PID Setpoint***			***Selection***	
		Bit 3	***Bit 2***	***Bit 1***	***PID Setpoint***	
		OFF	OFF	OFF	P7.02: SP Source	
		OFF	OFF	ON	P7.06: Setpoint 1	
		OFF	ON	OFF	P7.07: Setpoint 2	
		OFF	ON	ON	P7.08: Setpoint 3	
		ON	OFF	OFF	P7.09: Setpoint 4	
		ON	OFF	ON	P7.10: Setpoint 5	
		ON	ON	OFF	P7.11: Setpoint 6	
		ON	ON	ON	P7.12: Setpoint 7	
21: PID function Disable	When the contact is activated, the PID function is disabled.					

		Type	Hex Addr	Dec Addr
P3.36	***PID Deviation Level***	♦R/W	0324	40805
	Range/Units	Default		
	1.0~50.0%	10.0		

If a Multi-Function Output terminal is set to PID Deviation Alarm (setting = 15), then the output will be activated when the amount of deviation between the SP (set point) and PV (process variable) in the PID loop exceeds the threshold set by this parameter for the period of time set by P3.37.

- *This parameter is used in conjunction with P3.37, PID Deviation Time.*

		Type	Hex Addr	Dec Addr
P3.37	***PID Deviation Time***	♦R/W	0325	40806
	Range/Units	Default		
	0.1~300.0 sec	5.0		

If a Multi-Function Output terminal is set to PID Deviation Alarm (setting = 15), then the output will be activated when the amount of deviation between the SP (set point) and PV (process variable) in the PID loop exceeds the threshold set by P3.36 for the period of time set by this parameter.

- *This parameter is used in conjunction with P3.36, PID Deviation Level.*

		Type	Hex Addr	Dec Addr
P3.57	***AUTO to HAND Switching Behavior***	♦R/W	0339	40826
	Range/Units (ABBREVIATED LISTING; INCLUDES ONLY SETTINGS APPLICABLE TO PID)	Default		
	0~Fh bit 2: PID control bit 0: Cancel PID control 1: PID control follows the setting of Auto mode (P8.02)	0		

		Type	Hex Addr	Dec Addr
P4.00	***1st Source of Frequency Command [Remote]***	♦R/W	0400	41025
P4.01	***2nd Source of Frequency Command [Local]***	♦R/W	0401	41026

Range/Units	Default
0: Digital Keypad 1: RS485 Communication (Modbus/BACnet) 2: Analog Input 3: External UP/DOWN Terminal 4: Comm Card	P4.00: 0 P4.01: 0

Parameters P4.00 & P4.01 establish the source of the master Frequency.

- *Parameter P4.00 selects the source of the Frequency Command in REMOTE mode.*
- *Parameter P4.01 selects the source of the Frequency Command in LOCAL mode.*

Related Parameters: PID parameters P7.00.

- *When PID is enabled (P7.00 > 0), the frequency command sources selected in P4.00 and P4.01 become the PID setpoint source. The selected PID setpoint source is mapped to P7.02, and can be read there.*

NOTE: GS4's output frequency can be affected by the Trim Function. If P4.08 Trim Function is set to a non-zero value, the drive's actual output frequency may not match the Local or Remote Command Frequency. See P4.08 for ways to add or subtract to the command frequency.

		Type	Hex Addr	Dec Addr
P4.02	***Analog Input 1 (AI1) Function***	♦R/W	0402	41027
P4.03	***Analog Input 2 (AI2) Function***	♦R/W	0403	41028
P4.04	***Analog Input 3 (AI3) Function***	♦R/W	0404	41029

Range/Units (ABBREVIATED LISTING; INCLUDES ONLY SETTINGS APPLICABLE TO PID)	Default
0: No Function	
1: Frequency Command/PID Setpoint REMOTE*	P4.02: 1
2: Frequency Command/PID Setpoint LOCAL*	P4.03: 0
3: Frequency Command/PID Setpoint REMOTE & LOCAL*	P4.04: 0
5: PID Feedback Signal*	

*(*1,2,3) Frequency Command: The analog value present on the selected input channel (0~10VDC / 4~20mA) corresponds to the drive output frequency from zero to maximum, as defined in parameter P0.04 (Drive Maximum Output Frequency).*

Frequency Command selection is a function of P4.00 or P4.01. If either parameter contains a value of 2 (Analog Input), then the corresponding Analog Input Function will be automatically set to 1, 2, or 3 (Frequency Command/PID Setpoint REMOTE, LOCAL, or REMOTE & LOCAL, respectively).

Example:

- *If P4.00 (1st Source of Frequency Command (Remote)) is configured to a value of 2 (Analog Input), and P4.04 (Analog Input 3) is set to a value of 1 (Remote Frequency Command/PID Set Point), then P7.02 (PID Setpoint Source) will be automatically updated to "Analog In3 (AI3)."*
- *The changes may not update until the drive enters RUN mode.*

*(*5) PID functions 5: Refer to Parameter Group 7 to define the analog inputs for PID Setpoint and Feedback use.*

		Type	Hex Addr	Dec Addr
P6.25	***Upper Limit of Output Frequency***	♦R/W	0619	41562
	Range/Units	*Default*		
	0.00~599.00 Hz	599.00		

		Type	Hex Addr	Dec Addr
P6.26	***Lower Limit of Output Frequency***	♦R/W	061A	41563
	Range/Units	*Default*		
	0.00~599.00 Hz	0.00		

The setting of output frequency upper/lower limit is used to prevent mis-operation, machine damage, overheating due to too low operation frequency, and damage due to too high speed.

P6.25 Output Frequency Upper Limit:

- *This setting limits the maximum output frequency of the drive. When the drive frequency command or feedback control frequency is higher than this setting, the drive output frequency will be limited by the upper limit of output frequency.*
- *This parameter must be equal to or greater than the Lower Limit of Output Frequency (P6.26).*
- *If the Upper Limit of Output Frequency is 50Hz and the Maximum Output Frequency is 60Hz, then any Command Frequency above 50Hz will generate a 50Hz output from the drive.*
- *If the frequency output upper limit is 60Hz and frequency command is also 60Hz, the drive won't exceed 60Hz even after slip compensation. If the output frequency needs to exceed 60Hz, then increase output frequency upper limit limit or max operation frequency.*
- *When the drive enters into the function of slip compensation (P2.01) or PID feedback control, the drive output frequency may exceed the frequency command but still be limited by this setting.*
- *The Output Frequency is also limited by the Motor Maximum RPM (P0.04).*

P6.26 Output Frequency Lower Limit:

- *This setting limits the minimum output frequency of the drive. When the drive frequency command or feedback control frequency is lower than this setting, the drive output frequency will be limited by the lower limit of output frequency.*
- *This parameter must be equal to or less than the Upper Limit of Output Frequency (P6.25).*
- *When the drive starts, it will operate from min output frequency (P2.08, 2.12) and accelerate to the setting frequency. The starting ramp won't be limited by this parameter setting; it will only limit the minimum setpoint frequency.*
- *If the Lower Limit of Output Frequency is 10Hz, and the Minimum Output Frequency (P2.08, P2.16) is set at 5.0Hz, then any Command Frequency between 5~10 Hz will generate a 10Hz output from the drive. A Command Frequency of less than 5Hz will not result in an output from the drive.*
- *When the drive enters into the function of slip compensation (P2.01) or PID feedback control, the drive output frequency may exceed the frequency command but still be limited by this setting.*

Related parameters: P0.04, P2.01, P2.08, P2.16, P6.25

		Type	Hex Addr	Dec Addr
P7.00	***PID Action/Mode***	♦R/W	0700	41793
	Range/Units	*Default*		
	0: PID Disabled 1: PID Reverse Local/Remote 2: PID Forward Local/Remote 3: PID Reverse Remote Only 4: PID Forward Remote Only 5: PID Reverse Local Only 6: PID Forward Local Only	0		

This parameter sets the input terminal to use for the process variable PID feedback.

		Type	Hex Addr	Dec Addr
P7.02	***PID Setpoint Source***	Read	0702	41795
	Range/Units	*Default*		
	00: Keypad 01: RS485 02: AI1 03: AI2 04: AI3 05: Ext Up/Down Key 06: Comm Card 07: Reserve (PID off)	7		

When PID is enabled (P7.00>0), P7.02 parameter data will be mapped from P4.00~P4.01 dependent upon whether in Remote (P4.00) or Local (P4.01).

This parameter indicates the source for the PID Setpoint, which is determined by setting of the appropriate parameter P4.00 (Remote) or P4.01 (Local).

The user can change the display to show the PID Setpoint by changing parameter P8.00 to 42, PID Reference.

		Type	Hex Addr	Dec Addr
P7.03	***PID Feedback Gain***	♦R/W	0703	41796
	Range/Units	*Default*		
	0.00~300.00%	100.00		

This parameter can be used to set a gain for the Process Variable feedback signal.

		Type	Hex Addr	Dec Addr
P7.04	***PID Offset Value***	♦R/W	0704	41797
	Range/Units	*Default*		
	-100.0% to +100.0%	0.0		

This parameter is for fine tuning a PID setting. You can input a PID offset to provide the desired operating condition. It functions similarly to parameters P4.10, P4.15, and P4.19.

		Type	Hex Addr	Dec Addr
P7.05	***Keypad PID Setpoint***	Read	0705	41798
	Range/Units	*Default*		
	0.00~100.00%	0.0		

This parameter is used for keypad and serial communication PID Setpoints.

If keypad is the source of Frequency Command when Lv or Fault occurs, the present Frequency Command will be saved in this parameter.

		Type	Hex Addr	Dec Addr
P7.06	**PID Multi-Setpoint 1**	♦R/W	0706	41799
P7.07	**PID Multi-Setpoint 2**	♦R/W	0707	41800
P7.08	**PID Multi-Setpoint 3**	♦R/W	0708	41801
P7.09	**PID Multi-Setpoint 4**	♦R/W	0709	41802
P7.10	**PID Multi-Setpoint 5**	♦R/W	070A	41803
P7.11	**PID Multi-Setpoint 6**	♦R/W	070B	41804
P7.12	**PID Multi-Setpoint 7**	♦R/W	070C	41805

Range/Units	Default
0.00~100.00%	0.00

Parameters P7.06~P7.12 are used to provide seven different PID Setpoints. Multi-Function Input Terminals DI1~DI15 are assigned in parameters P3.03~P3.16 to select which one of the PID Multi-Setpoints is to be used.

Multi-Function Input Terminal Function Settings (P3.03~P3.16) for Input Terminals DI1~DI16
(Abbreviated listing; includes only settings applicable to PID)

Setting: Function	Function Description
0: No function	Setting a Multi-Function Input to 0 will disable that input. The purpose of this function is to provide isolation for unused Multi-Function Input Terminals. ***Any unused terminals should be programmed to 0 to make sure they have no effect on drive operation.***
1: Multi-Speed/PID Multi-Setpoint bit 1 2: Multi-Speed/PID Multi-Setpoint bit 2 3: Multi-Speed/PID Multi-Setpoint bit 3	When settings 1, 2, & 3 are selected and registers P7.06~P7.12 are populated, the Multi-Function Inputs refer to PID Multi-Setpoints. The SPs are determined by P7.06~P7.12. 1) In order to use the Multi-PID SPs, P7.06~P7.12 must be set, and P7.00≠0. 2) When all PID Multi-Setpoint inputs are off, the GS4 drive reverts to the PID Setpoint Source (P7.02).

PID Setpoint			Selection
Bit 3	**Bit 2**	**Bit 1**	**PID Setpoint**
OFF	OFF	OFF	P7.02: SP Source
OFF	OFF	ON	P7.06: Setpoint 1
OFF	ON	OFF	P7.07: Setpoint 2
OFF	ON	ON	P7.08: Setpoint 3
ON	OFF	OFF	P7.09: Setpoint 4
ON	OFF	ON	P7.10: Setpoint 5
ON	ON	OFF	P7.11: Setpoint 6
ON	ON	ON	P7.12: Setpoint 7

		Type	Hex Addr	Dec Addr
P7.13	***Proportional Gain (P)***	♦R/W	070D	41806
	Range/Units	*Default*		
	0.0~100.0	1.0		

Proportional Gain is used to eliminate system error. It is most often used to decrease error and increase response speed. But a P7.13 setting value that is too large may cause system oscillation and instability.

If the other two controls (I and D) are set to zero, Proportional Gain is the only one effective in the PID loop.

		Type	Hex Addr	Dec Addr
P7.14	***Integral Time (I)***	♦R/W	070E	41807
	Range/Units	*Default*		
	0.00~100.00 sec	1.00		

This parameter is used to set the time of the Integral (I) controller. The integral controller is used to eliminate error in a stable system. The integral time of the PID controller is acted upon by the change in integral time. When the integral time is long, it will provide a small gain of integral control, a slower response, and lesser/sloppy external control. When the integral time is short, it will provide a large gain of Integral control, a faster response ,and more rapid external control. The Integral Time doesn't stop working until error is 0. The smaller integral time is set, the stronger integral action will be. It is helpful to reduce overshoot and oscillation to make a stable system. As it functions the decreasing error will be slowed. The Integral Time is often used with the other two controls to become PI controller or PID controller. Remember when the integral time is too small, it may cause system oscillation.

If the integral time is set as 0.00, P7.14 will be disabled.

		Type	Hex Addr	Dec Addr
P7.15	***Derivative Value (D)***	♦R/W	070F	41808
	Range/Units	*Default*		
	0.00~1.00 sec	0.00		

This parameter is used to set the value of the Derivative (or Rate) (D) controller to decide the response of error change. A suitable derivative time can reduce the overshoot of a P and I controller to decrease oscillation for a more stable system. The derivative controller is used to show the change of system error, is helpful to preview the change of error, and is used to eliminate error to improve a systems operating state. With a suitable derivative time, it can reduce overshoot and shorten adjustment time. However, the derivative operation does increase (because of its effect) noise interference. Please note that too large of a derivative can cause a large amount of noise interference. The derivative shows the change and the output of the derivative will be 0 when there is no change. Therefore, the derivative control can't be used independently. It needs to be used with the other two controllers to make a PD controller or PID controller. Too long a derivative time may cause system oscillation. The derivative controller acts to minimize the change of error and can't filter noise. It is not recommended to use this function in noisy or noise-prone applications.

NOTE: Derivative Control cannot be used independently. It needs to be used with the other PID controls to make a PD controller or PID controller.

		Type	Hex Addr	Dec Addr
P7.16	***Upper Limit for Integral Time***	♦R/W	0710	41809
	Range/Units	Default		
	0.0~100.0%	100.0		

This parameter defines an upper limit for the Integral Time (I), and therefore limits the Master Frequency.

- *Integral upper limit = Maximum Output Frequency (P0.04) x Upper Limit for Integral Time (P7.16).*

An integral value that is too high will slow the system response due to sudden load changes, and therefore may cause motor stall or machine damage. Therefore, use caution when setting this parameter.

		Type	Hex Addr	Dec Addr
P7.17	***Derivative Filter Time Constant***	♦R/W	0711	41810
	Range/Units	Default		
	0.0~2.5 sec	0.0		

To avoid amplification of measured noise in the controller output, a digital filter is inserted. This filter helps smooth oscillations. Larger values for P7.17 provide more smoothing.

		Type	Hex Addr	Dec Addr
P7.18	***PID Output Frequency Limit***	♦R/W	0712	41811
	Range/Units	Default		
	0.0~110.0%	100.0		

This parameter defines the percentage of output frequency limit during PID control.

- *Output frequency limit = Maximum Output Frequency (P0.04) x PID Output Frequency Limit (P7.18).*

		Type	Hex Addr	Dec Addr
P7.19	***PID Feedback Value***	Read	0713	41812
	Range/Units	Default		
	-200.00% to +200.00%	0.00		

This parameter shows the value of feedback signal under PID control.

		Type	Hex Addr	Dec Addr
P7.20	***Feedback Signal Detection Time***	♦R/W	0714	41813
	Range/Units	Default		
	0.0~3600.0 sec	0.0		

This parameter is valid only when the feedback signal is AI2 4~20mA.

This parameter defines the time during which the PID feedback must be abnormal before a warning is given. It also can be modified according to the system feedback signal time.

If this parameter is set to 0.0, the system would not detect any signal abnormality.

		Type	Hex Addr	Dec Addr
P7.21	**PID Feedback Loss**	R/W	0715	41814
	Range/Units	Default		
	0: Warn and Continue Operation 1: Warn (fault) and Ramp to Stop 2: Warn (fault) and Coast to Stop 3: Warn and Operate at Last Frequency 4: Warn and Run at P7.22	0		

Loss detected only if P7.20 (Loss Detect Time) > 0.

This parameter is valid only when the feedback signal is AI2 4~20mA.

GS4 AC drive acts when the feedback signals (analog PID feedback) are abnormal.

If the command frequency falls below the Sleep Reference frequency (P7.29), for the specified Sleep Time (P7.31), then the drive will shut off the output and wait until the command frequency rises above Wake-up Reference (P7.30).

Setting Explanations:

0: Drive goes to 0Hz, but does not fault (warning only). Drive will restart if signal returns.

1 & 2: AFE Fault (PID Feedback AI2 Loss). Requires reset.

3: Drive warns and runs at the last PID Feedback Frequency.

4: Drive warns and runs at setting of P7.22.

IF P7.21 = 0 OR 3 (KEEP RUNNING ON 4-20MA LOSS) AND P7.00 PID FEEDBACK IS SET FOR "FORWARD OPERATION" (P7.00 = 2, 4, OR 6), THE DRIVE WILL ACCELERATE TO P7.18 PID OUTPUT LIMIT IF THE ANALOG SIGNAL IS LOST.

		Type	Hex Addr	Dec Addr
P7.22	**PID Feedback Loss Speed Level Default Value**	♦R/W	0716	41815
	Range/Units	Default		
	0.00~400.00 Hz	0.00		

This parameter sets the speed of operation of the GS4 drive when there is a loss of the PID feedback signal, if P7.21 is set to 3.

		Type	Hex Addr	Dec Addr
P7.23	**reserved**	~	0717	41816

		Type	Hex Addr	Dec Addr
P7.24	**PID Offset Selection**	♦R/W	0718	41817
	Range/Units			Default
	0: Set by P7.04 1: Set by an Analog Input [AI1 (P4.02), AI2 (P4.03), or AI3 (P4.04) must be set to 7: PID Offset (Input)]			0

This parameter sets the source of the PID Offset.

		Type	Hex Addr	Dec Addr
P7.25	***PID Mode Selection***	R/W	0719	41818

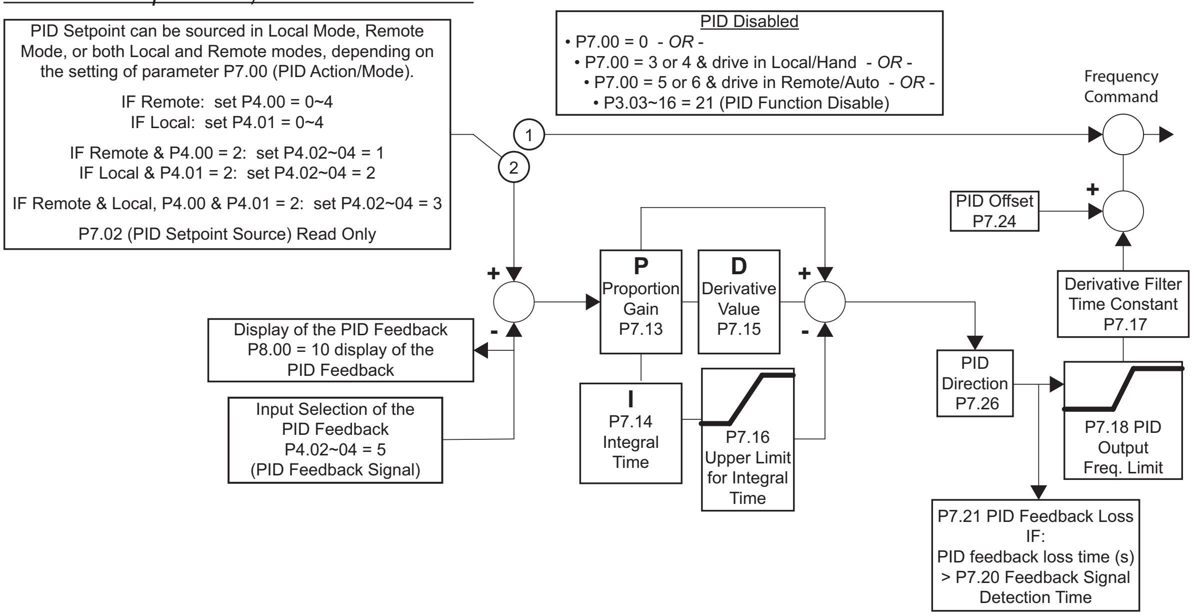
Range/Units — *Default*: 0

0: Old PID mode, Kp, Kp•Ki, Kp•Kd are dependent/serial
1: New PID mode, Kp, Ki, Kd are independent/parallel
NOTE: Refer to diagrams below for P7.25=0 and P7.25=1

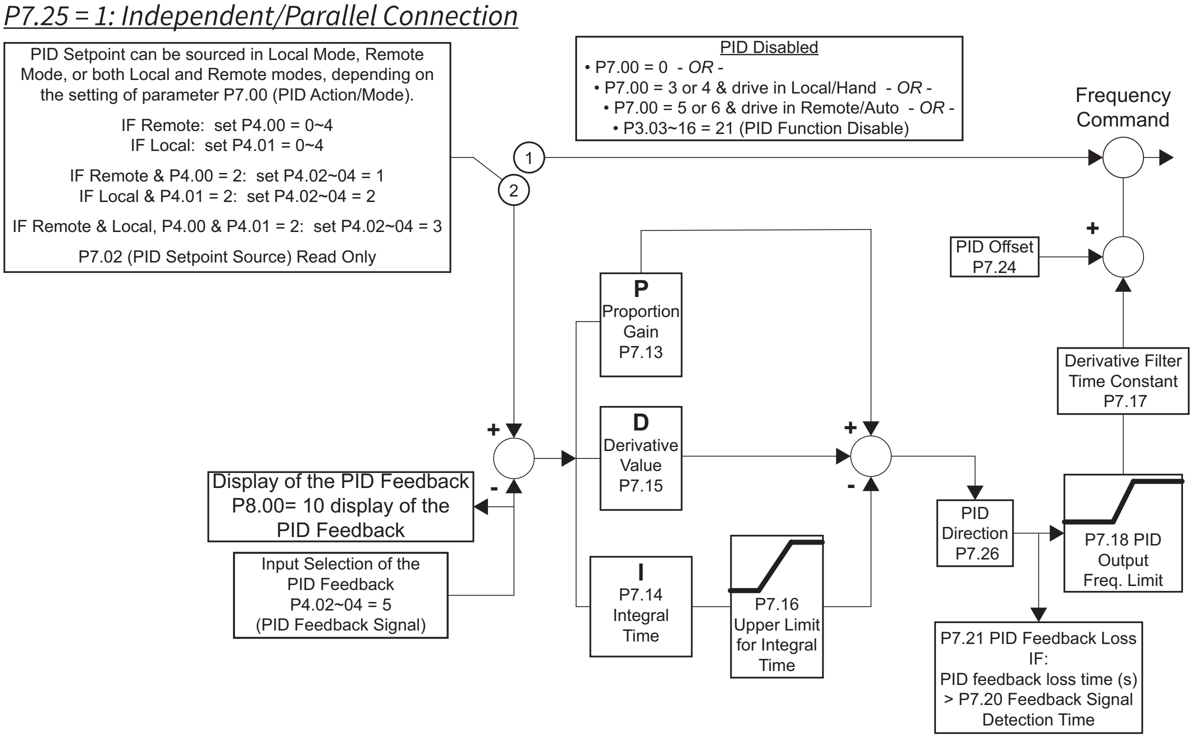
- *Kp = Proportional Gain/Control (P7.13)*
- *Ki = Integral Time/Control (P7.14)*
- *Kd = Derivative Value/Time (P7.15)*

The Serial or parallel connection PID mode selections are explained in the 2 graphics found in the detailed information found below.

P7.25 = 0: Dependent/Serial Connection



P7.25 = 1: Independent/Parallel Connection



		Type	Hex Addr	Dec Addr
P7.26	***PID Reverse Enable***	R/W	071A	41819
	Range/Units (Format: 16-bit binary)	*Default*		
	0: PID can't change command direction 1: PID can change command direction	0		

This parameter when engaged changes the ability of PID to change the direction of the drive.

- *When set to 0 it prevents PID from changing the direction of the output.*
- *When set to a 1 it enables the changing of direction by the level of PID.*

		Type	Hex Addr	Dec Addr
P7.27	***Source of Sleep***	R/W	071B	41820
	Range/Units (Format: 16-bit binary)	*Default*		
	0: Frequency/PID Command Frequency (CV) 1: Feedback	0		

This parameter selects how the Sleep Mode function will be actuated; either by the *Command Frequency (speed reference)* if the drive is operating with *PID disabled*, or by the *PID Command Frequency (CV)* if the *PID is enabled*.

In application, the trigger for sleep mode is the commanded frequency, (speed reference or PID, CV) and *NOT* the actual drive output frequency.

		Type	Hex Addr	Dec Addr
P7.28	***Integral Limit During Sleep***	R/W	071C	41821
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~200.0	50.0		

This upper integral limit of the drive is to avoid running at high speed right after the drive has been awakened.

		Type	Hex Addr	Dec Addr
P7.29	***Sleep Reference***	♦R/W	071D	41822
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P7.27=0: 0.0~599.00 Hz P7.27=1: 0.0~200.00%	0.00		

		Type	Hex Addr	Dec Addr
P7.30	***Wake-up Reference***	♦R/W	071E	41823
	Range/Units (Format: 16-bit unsigned)	*Default*		
	P7.27=0: 0.0~599.00 Hz P7.27=1: 0.0~200.00%	0.00		

		Type	Hex Addr	Dec Addr
P7.31	***Sleep Time***	♦R/W	071F	41824
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.0~6000.0 sec	0.0		

		Type	Hex Addr	Dec Addr
P7.32	***Wake-up Delay Time***	R/W	0720	41825
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0.00~600.00 sec	0.00		

Parameters P7.29, P7.30, P7.31, P7.32:

The Sleep Reference point (P7.29) provides the setpoint at which, should the drive reach or go below, causes the drive to go to sleep. When asleep the drive does nothing (its output being off) besides monitoring its operating point.

In order to Wake-up and again operate, it should reach the Wake-up Reference point (P7.30). If the Command Frequency falls below the Sleep Reference point (P7.29) for the Sleep Time specified in P7.31, then the drive will shut off the output and wait until the Command Frequency rises above what is set in Wake-Up Reference point (P7.30).

The Wake-up Delay Time (P7.32) delays the drive from Waking-Up once the Wake-Up Level has been exceeded by the amount of time set in this parameter.

The Wake-up Timer is not cumulative: the reference needs to stay above Wake-up Reference for the entire length of Wake-up Delay, otherwise the Delay timer will reset.

		Type	Hex Addr	Dec Addr
P8.00	***User Display***	♦ R/W	0800	42049

User Display (P8.00) Function Settings Applicable for PID Control — *Default*: 3

As Seen During Setup	*As Displayed During Operation*
10: PID Feedback %	b displayed value %
42: PID Reference	h. displayed value %
43: PID Offset	o. displayed value %
44: PID Output Hz	b. displayed value Hz

		Type	Hex Addr	Dec Addr
P8.01	***Start-up Display Selection***	♦ R/W	0801	42050

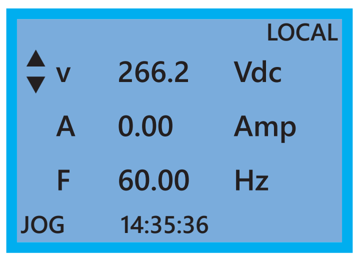
Range/Units (Format: 16-bit binary)

0: Freq Setpoint (F)
1: Output Hz (H)
2: User Display (U)
3: Output Amps (A)

Default: 0

This parameter determines the start-up display page after power is applied to the drive. The sequence does not change; the order of appearance is always (F), (H), (U), then (A). Only three parameters can be displayed on the keypad screen at a time. P8.01 specifies only which parameter appears on the top row when the drive is powered up. All four parameters can always be scrolled to using the keypad up and down arrows. User defined choice (U) displays values and units according to the setting in P8.00.

Example: If P8.00 = 3, the User Display shows DC Bus Voltage.
If P8.01 = 2, the User Display appears in the top row at power up.



		Type	Hex Addr	Dec Addr
P8.02	***User Defined Format***	R/W	0802	42051
	Range/Units (Format: 16-bit binary)	*Default*		

Bits 0~3:
User defined decimal place
0000b: no decimal place
0001b: one decimal place
0010b: two decimal place
0011b: three decimal place
Bits 4~9: 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: °C
014xh: °F
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: m^3/s
022xh: m^3/h
023xh: gpm
024xh: cfm

Default: 0

The user defined format sets the attributes (or units) that are enabled when P8.03 > 0. These settings allow the user to define a display field according to specific system processes. The frequency command signal will be scaled according to P0.04 (Max Output Freq) and P8.03 (User Coefficient Max)

Example:

- *P0.04 Max Output Freq = 60 Hz*
- *P8.00 User Display = 30 (User Defined)*
- *P8.02 User Defined Format = 0072h (unit = ppm, two decimal places)*
- *P8.03 User Defined Max = 115.00*

An analog frequency setting of 50% will result a 30Hz setting, but the keypad will display the user format 57.50ppm (50% x 115.00ppm). Likewise a commanded frequency input value of 100.00ppm will result in an output frequency of 52.17Hz = (100ppm/115ppm) x 60Hz.
Note: Running in forward or reverse will display a positive value.

		Type	Hex Addr	Dec Addr
P8.03	***User Defined Max***	R/W	0803	42052
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0: Disable 0~65535 (when P8.02 set to no decimal place) 0.0~6553.5 (when P8.02 set to 1 decimal place) 0.00~655.35 (when P8.02 set to 2 decimal place) 0.000~65.535 (when P8.02 set to 3 decimal place)	0		

User defined is enabled when P8.03 is not 0. The setting of P8.03 is linearly scaled to P0.04 (Max Output Frequency). *See example in P8.02 for further information*.

		Type	Hex Addr	Dec Addr
P8.04	***User Defined Setpoint***	Read	0804	42053
	Range/Units (Format: 16-bit unsigned)	*Default*		
	0~65535	0		

This parameter shows commanded frequency or user defined value when P8.03 is not set to 0.

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