



GS1 SERIES AC DRIVES USER MANUAL

GS1_UMW

GS1

AC DRIVE



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~ WARNING ~

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WARNINGS



WARNING: *READ THIS MANUAL THOROUGHLY BEFORE USING GSI 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 GSI 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 GSI 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.*



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USER MANUAL REVISION HISTORY



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

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ISSUE DATE: **03/25/2020**

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Issue	Date	Description of Changes
First Edition	06/07/2002	Original
Second Edition	07/06/2011	Numerous changes throughout; especially: Ch2 (Installation and Wiring) – storage conditions and circuit protection Ch4 (AC Drive Parameters) – parameter descriptions and explanations Ch5 (GS1 Modbus Communications) – PLC connections, programming, and communications delays Ch6 (Maintenance and Troubleshooting) – recharge capacitors AppxA (Accessories) – new accessories AppxB (Using GS1 AC Drives with AutomationDirect PLCs) – CLICK PLCs
Third Edition	11/09/2018	User manual reformatted, recreated, name changed (was GS1-M) Ch1: "Selecting the Proper Drive Rating," spec table symmetrical power note Ch2: Fusing, wiring, accessories, line reactor explanation Ch3: Notes re LED display and power cycling Ch4: Analog Input Examples, parameter explanations Ch5: Communications cables, numeric data formatting note AppxA: Fusing, output line reactor PWM carrier frequency note AppxB: DL05/06 F0 modules
3rd Ed., Rev. A	01/25/2019	AppxA: Single-phase 2-pole fuse block note and wiring diagram
3rd Ed., Rev. B	03/25/2020	AppxA: LR(2) line reactors, VTF drive output filters

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GETTING STARTED



CHAPTER

1

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MANUAL OVERVIEW

OVERVIEW OF THIS PUBLICATION

The GS1 AC Drive User Manual describes the installation, configuration, and methods of operation of the GS1 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 GS1 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:

**15 Inverness Way East
Englewood, CO 80112-5776
1-800-854-7179 (within the U.S.)
303-397-7956 (international)
www.global.ihs.com**

NEMA documents that might assist with your AC drive systems are:

- *Application Guide for AC Adjustable Speed Drive Systems*
- *Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.*

TECHNICAL SUPPORT

- *By Telephone: 770-844-4200
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- *On the Web: www.automationdirect.com*

Our technical support group is glad to work with you in answering your questions. If you cannot find the solution to your particular application, or, if for any reason you need additional technical assistance, please call technical support at 770-844-4200. We are available weekdays 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 technical and non-technical information about our products and our company. Visit us at www.automationdirect.com.

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).

GS1 AC DRIVE INTRODUCTION

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

A. 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.

B. 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.

C. INSTALLATION ALTITUDE

AC drives rely upon the cooling properties of air for cooling. As the altitude increases, the air becomes less dense, and this decrease 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 up to altitudes of 1000 meters. Above 1000m, the AC drive must be derated.

D. DETERMINE MAX ENCLOSURE INTERNAL TEMP

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.

E. CALCULATE REQUIRED OUTPUT AMPERAGE

Use the chart below to calculate the required FLA of the AC drive, as shown by the following examples. Select the rating that equals the motor’s voltage and equals or exceeds the calculated amperage.

- **Example 1 (GS1 or GS2 drive):**

Motor FLA = 6A; Overload = 200% @ 45s; Altitude = 800m; MEIT = 45°C

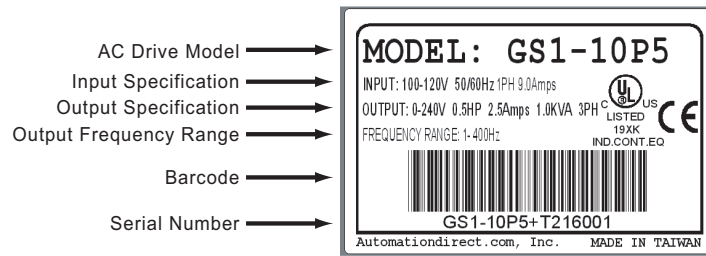
- **Example 2 (DURAPULSE GS3 drive):**

Motor FLA = 8A; Overload = 135% @ 75s; Altitude = 1100m; MEIT = 35°C

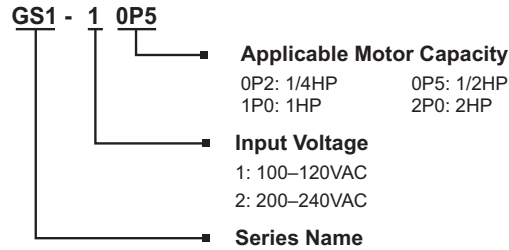
Calculating Required Drive Current				
If		Then Enter	Example 1 GS1 or GS2	Example 2 GS3 DURAPULSE
Overload Derate (overload %)				
If overload is < 150% and < 60 seconds		1	1.33	
If overload is > 150% and < 60 seconds		(overload / 150)%		
If overload is > 60 seconds		(overload / 100)%		
Overload Result	Multiply FLA x overload entry		8.0	10.8
Altitude Derate (meters)				
Altitude is < 1,000m		1	1	1.01
Altitude is > 1,000m and < 3,000m		1 + ((altitude - 1,000m) x 0.0001)		
Altitude Result	Multiply overload result x altitude entry		8.0	10.91
Ambient Temperature (°C)				
Maximum enclosure internal temperature (MEIT) is < 40°C		1	1	1
40°C < MEIT < 50° and GS1/2 AC drive up to 5hp		1		
40°C < MEIT < 50° and GS1/2 AC drive > 5hp or DURApulse AC drive		1.2		
Required Drive FLA	Multiply altitude result x MEIT entry		8.0	10.91

NAMEPLATE INFORMATION

Example of 0.5 hp 115 VAC drive



MODEL EXPLANATION



DRIVE PACKAGE CONTENTS

After receiving the AC motor drive, please check for the following:

- Make sure that the package includes an AC drive and the GS1 Series AC Drive Quick Reference.
- Inspect the unit to insure it was not damaged during shipment.
- Make sure that the part number indicated on the nameplate corresponds with the part number of your order.

EXTERNAL PARTS AND LABELS

- ① Digital Keypad
- ② Ventilation Slots
- ③ Mounting Screw Holes
- ④ Nameplate Label
- ⑤ Input Power Terminals
- ⑥ Control Input/Output Terminals
- ⑦ Output Power Terminals



GS1 AC DRIVE SPECIFICATIONS

GS1 MODEL-SPECIFIC SPECIFICATIONS

115V Class GS1 Specifications			
Model Name		GS1-10P2	GS1-10P5
Motor Rating	HP	1/4 hp	1/2 hp
	kW	0.2 kW	0.4 kW
Rated Input Voltage		Single-phase: 100–120 VAC ±10%, 50/60 Hz, ±5%	
Maximum Output Voltage		Three-phase: 200–240 VAC (x2 of input voltage)	
Rated Input Current (A)		6	9
Rated Output Current (A)		1.6	2.5
Short Circuit Withstand (A, rms symmetrical)		5kA @ 120 VAC	
Watt Loss 100% I (W)		19.2	19.2
Weight (lb)		2.16	2.24
Dimensions (HxWxD)		132.0 mm [5.20 in] x 68.0 mm [2.68 in] x 128.1 mm [5.04 in]	

230V Class GS1 Specifications					
Model Name		GS1-20P2	GS1-20P5	GS1-21P0	GS1-22P0
Motor Rating	HP	1/4 hp	1/2 hp	1 hp	2 hp
	kW	0.2 kW	0.4 kW	0.7 kW	1.5 kW
Rated Input Voltage *		Single/three-phase: 200–240 VAC ±10%, 50/60 Hz ±5%			Three-phase*: 200–240VAC ±10%, 50/60Hz ±5%
Maximum Output Voltage		Three-phase: 200–240VAC (proportional to input voltage)			
Rated Input Current (A)		4.9/1.9	6.5/2.7	9.7/5.1	9
Rated Output Current (A)		1.6	2.5	4.2	7.0
Short Circuit Withstand (A, rms symmetrical)		5kA @ 240 VAC			
Watt Loss 100% I (W)		18.4	26.8	44.6	73
Weight (lb)		2.06	2.2	2.26	2.2
Dimensions (HxWxD)		132.0 mm [5.20 in] x 68.0 mm [2.68 in] x 128.1 mm [5.04 in]			
* All 3-phase power sources must be symmetrical. Do NOT connect GS1 drives to grounded, center-tapped, delta transformers (which are typically used for lighting circuits).					

GS1 GENERAL SPECIFICATIONS

General Specifications			
Control Characteristics			
Control System		Sinusoidal Pulse Width Modulation, carrier frequency 3–10 kHz	
Rated Output Frequency		1.0 to 400.0 Hz	
Output Frequency Resolution		0.1 Hz	
Overload Capacity		150% of rated current for 1 minute	
Torque Characteristics		Includes auto-slip compensation and starting torque 150% @ 5.0 Hz	
DC Braking		Operation frequency: 0 to 60 Hz, 0–30% rated voltage. Start time 0.0–5.0 seconds. Stop time 0.0–25.0 seconds	
Acceleration/Deceleration Time		0.1 to 600 seconds (can be set individually)	
Voltage/Frequency Pattern		V/F pattern adjustable. Settings available for Constant Torque - low and high starting torque, Variable Torque - low and high starting torque, and user configured	
Stall Prevention Level		20 to 200% or rated current	
Operation Specifications			
Inputs	Frequency Setting	Keypad	Setting by <UP> or <DOWN> buttons or potentiometer
		External Signal	Potentiometer - 3 to 5kΩ, 0.5W; 0 to 10 VDC (input impedance 10 kΩ); 0 to 20 mA / 4 to 20 mA (input impedance 250Ω); Multi-function inputs 3 and 4 (3 steps, JOG, UP/DOWN command); RS-485 communication setting
	Operation Setting	Keypad	Setting by <RUN>, <STOP> buttons
		External Signal	DI1, DI2, DI3, DI4 can be combined to offer various modes of operation, RS-485 communication port
	Input Terminals	Digital	4 user-programmable: FWD/STOP, REV/STOP, RUN/STOP, REV/FWD, RUN momentary (N.O.), STOP momentary (N.C.), External Fault (N.O./N.C.), External Reset, Multi-Speed Bit (1and 2), Jog, External Base Block (N.O./N.C.), Second Accel/Decel Time, Speed Hold, Increase Speed, Decrease Speed, Reset Speed to Zero, Input Disable
		Analog	1 user-configurable, 10 bit resolution 0 to 10 VAC, (input impedance 10 kΩ), 0 to 20 mA, (input impedance 250Ω) 4 to 20 mA, (input impedance 250Ω)
Outputs	Output Terminals	Digital	1 user programmable: AC drive Running, AC drive Fault, At Speed, Zero Speed, Above Desired Frequency (P 3-16), Below Desired Frequency (P 3-16), At Maximum Speed, Over-torque Detected, Above Desired Current (P3-17), Below Desired Current (P 3-17)
	Operating Functions		Automatic voltage regulation, S-curve, Over-voltage stall prevention, DC braking, Fault records, Adjustable carried frequency, Starting frequency setting of DC braking, Over-current stall prevention, Momentary power loss restart, Reverse inhibition, Frequency limits, Parameter lock/reset
Protective Functions		Overcurrent, Overvoltage, Undervoltage, Electronic thermal motor overload, Overheating, Overload, Self testing	
Operator Interface	Operator Devices		5-key, 4-digit, 7-segment LED, 4 status LEDs, potentiometer
	Programming		Parameter values for setup and review, fault codes
	Status Display		Master Frequency, Output Frequency, Scaled Output Frequency, Output Voltage, DC Bus Voltage, Output Direction, Trip Event Monitor, Trip History Monitor
	Key Functions		RUN/STOP, DISPLAY/RESET, PROGRAM/ENTER, <UP>, <DOWN>
Environment	Enclosure Rating		Protected chassis, IP20
	Ambient Temperature		-10° to 40°C (14°F to 104°F) w/o derating
	Ambient Humidity		0 to 90% RH (non-condensing)
	Vibration		9.8 m/s ² (1G), less than 10 Hz; 5.88 m/s ² (0.6G) 20 to 50 Hz
	Installation Location		Altitude 1000m or lower above sea level, keep from corrosive gas, liquid and dust

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INSTALLATION AND WIRING



CHAPTER

2

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AMBIENT CONDITIONS

Ambient environmental conditions for use:

Ambient Conditions	
Ambient Temperature	-10° to 40°C (14°F to 104°F) w/o derating
Storage Temperature	-20° to 60° C (-4°F to 140°F) during short-term transportation period)
Relative Humidity	0 to 90% RH (non-condensing)
Atmosphere Pressure	86 kPA to 106 kPA
Vibration	9.8 m/s ² (1G) @ less than 10 Hz; 5.88 m/s ² (0.6G) @ 10 to 50 Hz
Installation Location	Altitude 1000m or lower above sea level, keep from corrosive gas, liquid and dust
Enclosure Rating	Protected chassis, IP20

STORAGE CONDITIONS

GS1 AC drives should be kept in their shipping carton or crate until they are installed. In order to retain their warranty coverage, they should be stored as described below if they are not to be installed and used within three months.

- Store in a clean and dry location free from direct sunlight and corrosive fumes.
- For storage of longer than 3 months, store within an ambient temperature range of -20°C to 30°C (-4°F to 86°F).
- For storage of 3 months or less, store within an ambient temperature range of -20°C to 60°C (-4°F to 140°F).
- Store within a relative humidity range of 0% to 90% and non-condensing environment.
- Store within an air pressure range of 86 kPA to 106 kPA.
- DO NOT store in an area with rapid changes in temperature. (It may cause condensation and frost.)
- DO NOT place directly on the ground.



NOTE: 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.)

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.

Improper installation of the AC drive will greatly reduce its life. Be sure to observe the following precautions when selecting a mounting location:

- 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.
- Mount the AC drive vertically and do not restrict the air flow to the heat sink fins.

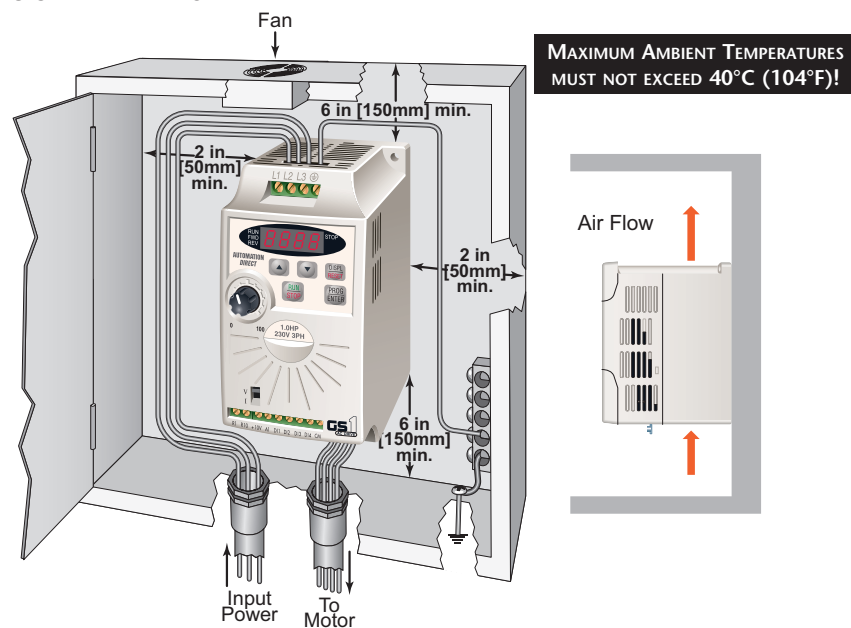


WARNING: FAILURE TO OBSERVE THESE PRECAUTIONS MAY DAMAGE THE DRIVE AND VOID THE WARRANTY!

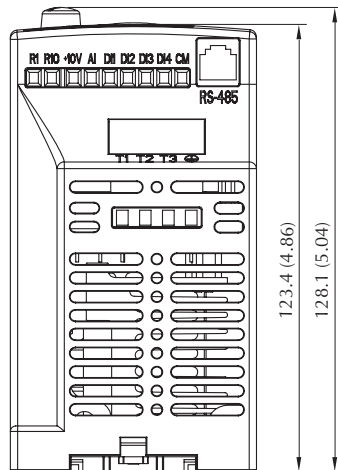
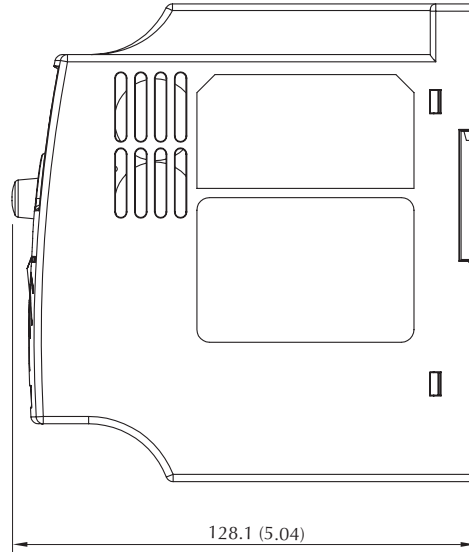
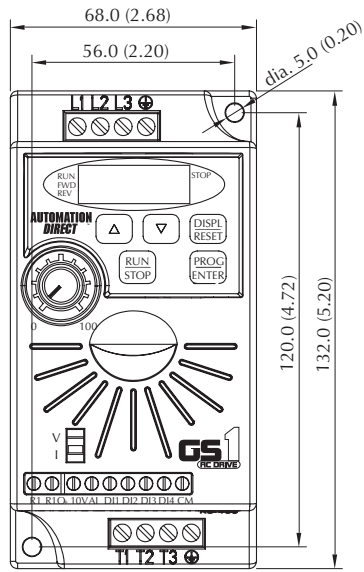


WARNING: AC DRIVES GENERATE A LARGE AMOUNT OF HEAT WHICH MAY DAMAGE THE AC DRIVE. AUXILIARY COOLING METHODS ARE TYPICALLY REQUIRED IN ORDER NOT TO EXCEED MAXIMUM AMBIENT TEMPERATURES.

MINIMUM CLEARANCES AND AIR FLOW



GS1 AC DRIVE DIMENSIONS



Unit: mm (in)

GS1 CIRCUIT CONNECTIONS

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 WITHOUT PRIOR WRITTEN CONSENT OF AUTOMATIONDIRECT.COM INC. WILL VOID ALL WARRANTIES, MAY RESULT IN A SAFETY HAZARD, AND MAY VOID THE UL LISTING.

WIRING NOTES: PLEASE READ PRIOR TO INSTALLATION.



WARNING: DO NOT CONNECT THE AC INPUT POWER TO THE T1, T2, AND T3 OUTPUT TERMINALS. THIS WILL DAMAGE THE AC DRIVE.



WARNING: TIGHTEN ALL SCREWS TO THE PROPER TORQUE RATING. SEE "MAIN CIRCUIT WIRING" LATER IN THIS CHAPTER.

- 1) During installation, follow all local electrical, construction, and safety codes for the country in which the AC drive is to be installed.
- 2) Make sure the appropriate protective devices (circuit breaker or fuses) are connected between the power supply and AC drive.
- 3) Make sure that the leads are connected correctly and the AC drive is properly grounded.
- 4) Use ground leads that comply with AWG/MCM standards, and keep them as short as possible.
- 5) The use of contactors or disconnect switches *for run/stop control* of the AC drive and motor *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.

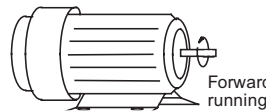
The installation of contactors or disconnects to isolate the motor during maintenance, though permissible, is not recommended. Opening contactors or disconnects while the drive is running will reduce the life cycle of the drive and may immediately damage the inverter section of the drive!

- 6) Multiple GS1 units can be installed in one location. All the units should be grounded directly to a common ground terminal. The GS1 ground terminals may also be connected in parallel, as shown in the figure below. Make sure there are no ground loops.

Correct



Incorrect



- 7) When the 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.
- 8) Make sure that the power source is capable of supplying the correct voltage and required current to the AC drive.
- 9) Do not attach or remove wiring when power is applied to the AC drive.
- 10) Do not monitor the signals on the circuit board while the AC drive is in operation.
- 11) For single-phase, 115V class AC drives, AC power must be connected to terminals L1 and L2. For the single-phase, 230V class AC drives, the AC power can be connected to any two of the three input terminals L1, L2, or L3.



NOTE: This AC drive is not intended for use with single-phase motors.

- 12) Route the power and control wires separately, or at 90 degree angle to each other.
- 13) When using a GFCI (Ground Fault Circuit Interrupt), select current sensor with sensitivity of 200mA, and not less than 0.1-second detection to avoid nuisance tripping.

MOTOR OPERATION PRECAUTIONS

- 1) When using the AC drive to operate a standard 3-phase induction motor, 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

Suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes.

- For all 115V models, the maximum is 120 Volts.
- For all 230V Models, the maximum is 240 Volts.

APPLICABLE CODES

All GS1 Series 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).

Installation 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 “Fuses and Fuse Kits” section in Appendix A lists the recommended fuse part number for each GS1 Series part number. These fuses (or equivalent) must be used on all installations where compliance with U.L. standards is required.

CIRCUIT PROTECTION DEVICES

Short-circuit and ground-fault protection devices are essential to prevent costly damage to your AC Drive. Fuse kits, which include fuses and fuse blocks, are available from AutomationDirect for the GS1 Series AC Drives.

MAXIMUM RECOMMENDED CIRCUIT PROTECTION DEVICES

The chart below gives the maximum recommended fuses and circuit breakers for short-circuit and ground-fault protection of GS1 Series AC Drives. Fuses and circuit breakers smaller than those shown are permitted.

Maximum Recommended Circuit Protection Devices					
Drive Part #	V/HP/kW	Input Phases	Input Current	Fuse	Inverse-Time Circuit Breaker
GS1-10P2	115 / 0.25 / 0.2	1	6A	20A type A3T (300V)	20A
GS1-10P5	115 / 0.5 / 0.4	1	9A	30A type A3T (300V)	30A
GS1-20P2	230 / 0.25 / 0.2	1	4.9A	15A type A3T (300V)	15A
		3	1.9A	10A type A3T (300V)	10A
GS1-20P5	230 / 0.5 / 0.4	1	6.5A	25A type A3T (300V)	25A
		3	2.7A	10A type A3T (300V)	10A
GS1-21P0	230 / 1 / 0.7	1	9.7A	45A type A3T (300V)	45A
		3	5.1A	20A type A3T (300V)	20A
GS1-22P0	230 / 2 / 1.5	3	9.0A	25A type A3T (300V)	25A

Recommended fuses are required for UL applications, and the specific fuses are available as shown in “Appendix A: Accessories”.

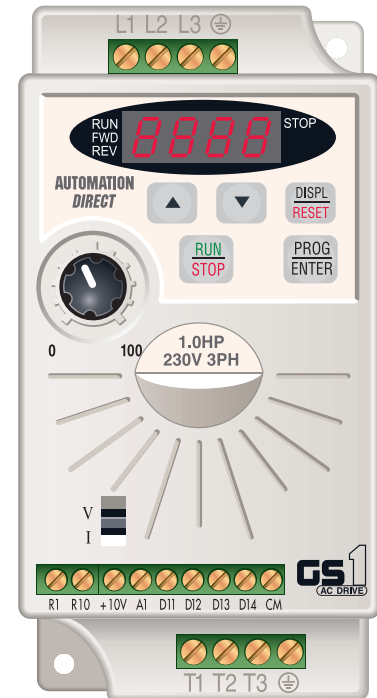
Recommended maximum fuses and circuit breakers are for protection of the AC drive. They may or may not also provide required motor branch circuit protection, depending upon the electrical code applicable to the installation.

MAIN CIRCUIT WIRING

Main Circuit Terminals	
Terminal	Description
L1, L2, L3	Input Power
T1, T2, T3	AC Drive Output
⊕	Ground

Main Circuit Wiring Specifications			
AC Drive Model	Max. Current (Input/Output)	Wire Gauge	Torque
GS1-10P2	6A / 1.6A	12–16 AWG	5.5 kgf·cm
GS1-10P5	9A / 2.5A		
GS1-20P2 (1-phase)	4.9A / 1.6A		
GS1-20P2 (3-phase)	1.9A / 1.6A	12–14 AWG	5.5 kgf·cm
GS1-20P5 (1-phase)	6.5A / 2.5A		
GS1-20P5 (3-phase)	2.7A / 2.5A		
GS1-21P0 (1-phase)	9.7A / 4.2A		
GS1-21P0 (3-phase)	5.1A / 4.2A		
GS1-22P0	9A / 7.0A		

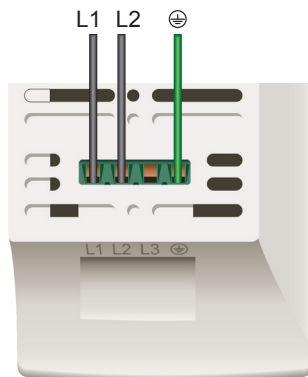
Wire Type: 75°C, copper only



INPUT POWER CONNECTIONS

1-PHASE INPUT POWER CONNECTIONS* **

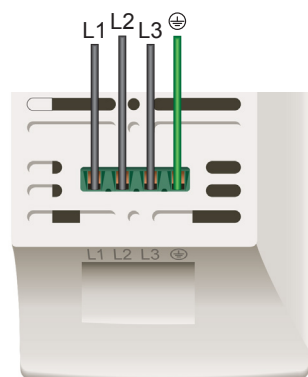
GS1 Top View (input power terminals)



1-Phase Input Power*	
115V Class**	Single-phase: 100–120VAC ± 10%, 50/60Hz, ± 5%
230V Class**	Single-phase: 200–240VAC ± 10%, 50/60Hz ± 5%
* Only models GS1-10P2, GS1-10P5, GS1-20P2, GS1-20P5, and GS1-21P0 are rated for single-phase input power.	
** For <u>115V</u> class single phase drives, AC power must be connected to terminals L1 and L2. For <u>230V</u> class single phase drives, AC power can be connected to any two of the three terminals L1, L2 or L3.	

3-PHASE INPUT POWER CONNECTIONS

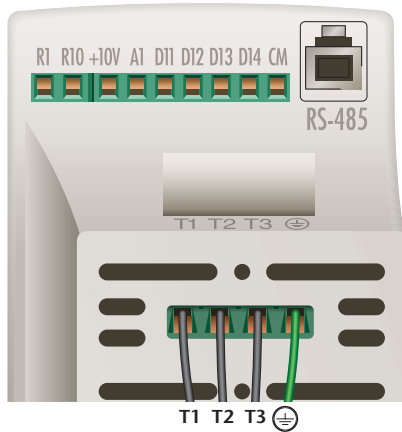
GS1 Top View (input power terminals)



3-Phase Input Power	
230V Class	Three-phase: 200–240VAC ± 10%, 50/60Hz ± 5%

OUTPUT POWER CONNECTIONS

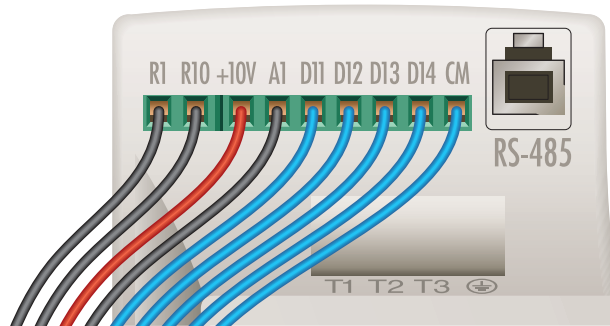
**GS1 Bottom View
(output power terminals)**



Output Power	
115V Class Max Output Voltage	Three phase 200–240VAC (input voltage x2)
230V Class Max Output Voltage	Three phase 200–240VAC (proportional to input voltage)

CONTROL TERMINAL WIRING

GS1 Bottom View (control terminals)



Control Circuit Terminals		
Terminal Symbol	Description	Remarks
R1	Relay Output Common	120VAC/24VDC @5A; 230VAC @2.5A
R10	Relay Output Normally Open	
+10V	Internal Power Supply	+10VDC (10mA maximum load)
AI	Analog Input	0 to +10 V (Max. Output Frequency) Input 0 to 20mA (Max. Output Frequency) Input 4 to 20mA (Max, Output Frequency) Input
DI1	Digital Input 1	Input voltage: Internally supplied (see Warning below) Maximum ON Voltage: 6V Minimum OFF Voltage: 11V Minimum ON Current: 2.5 mA Maximum OFF Current: 1mA (See "Basic Wiring Diagram" on next page.)
DI2	Digital Input 2	
DI3	Digital Input 3	
DI4	Digital Input 4	
CM	Common	
Control Terminal Wire Range: 24–12 AWG		
Control Terminal Tightening Torque: 5kgf·cm [4lbf·in]		



NOTE: Use twisted-shielded, twisted-pair or shielded-lead wires for the control signal wiring. Run all signal wiring in a separate steel conduit. The shield wire should only be connected at the AC drive. Do not connect shield wire on both ends.



WARNING:
Do NOT connect external voltage sources to the digital inputs. Permanent damage may result.

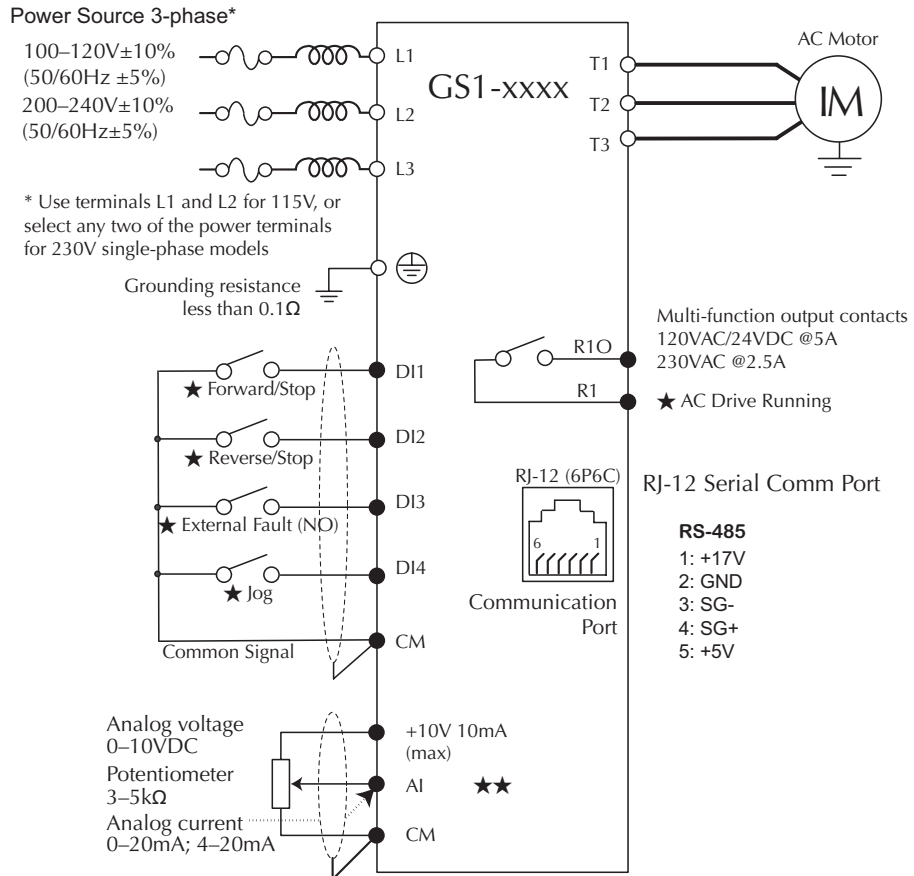
BASIC WIRING DIAGRAM



NOTE: Users must connect wiring according to the circuit diagram shown below.



WARNING: DO NOT PLUG A MODEM OR TELEPHONE INTO THE GS1 RJ-12 SERIAL COMM PORT, OR PERMANENT DAMAGE MAY RESULT. TERMINALS 1 AND 2 MUST NOT BE USED AS A POWER SOURCE FOR YOUR COMMUNICATION CONNECTION.



- ★ Factory default setting
- ★★ Factory default source of frequency command is via the keypad potentiometer
- Main circuit (power) terminals ● Control circuit terminal ⊕ Shielded leads

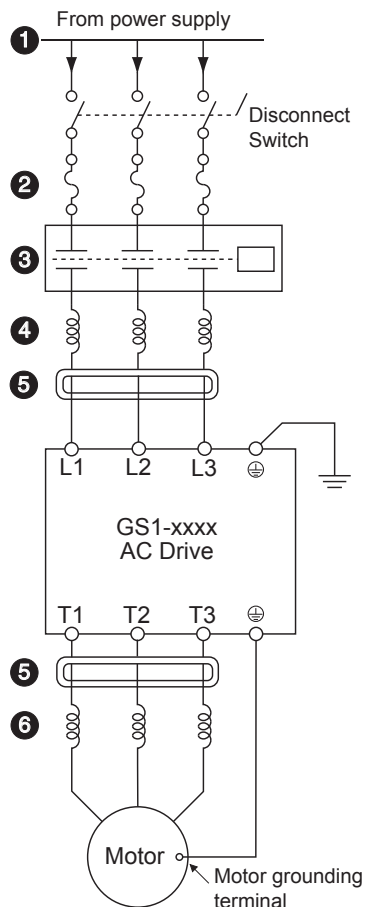
EXTERNAL WIRING AND ACCESSORIES



WARNING: THE INSTALLATION OF CONTACTORS OR DISCONNECTS TO ISOLATE THE MOTOR DURING MAINTENANCE, THOUGH PERMISSIBLE, IS **NOT** RECOMMENDED. OPENING CONTACTORS OR DISCONNECTS WHILE THE DRIVE IS RUNNING WILL REDUCE THE LIFE CYCLE OF THE DRIVE AND MAY IMMEDIATELY DAMAGE THE INVERTER SECTION OF THE DRIVE!



WARNING: WE STRONGLY RECOMMEND THAT YOU DO **NOT** USE A CONTACTOR BETWEEN THE AC DRIVE AND THE MOTOR, UNLESS THERE IS AN INTERLOCK TO OPEN THE CONTACTOR WHEN THE DRIVE IS NOT RUNNING.

**1 Power Supply**

Please follow the specific power supply requirements shown in Chapter 1.

2 Fuses

Input fuses protect the AC drive from excessive input current due to line surges, short circuits, and ground faults. They are recommended for all installations and may be required for UL-listed installations.

3 Contactor (Optional)

Do NOT use a contactor or disconnect switch for run/stop control of the 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.

4 AC Line Reactor – Input Side (Optional)

Input line reactors protect the AC drive from transient overvoltage conditions typically caused by utility capacitor switching. Input line reactors also reduce harmonics associated with AC drives, and are recommended for all installations.

5 RF Filter (Optional)

RF filters reduce the radio frequency interference or noise on the input or output side of the inverter.

6 AC Line Reactor – Output Side (Optional)

Output line (load) reactors protect the motor insulation against AC drive short circuits and IGBT reflective wave damage, and also “smooth” the motor current waveform, allowing the motor to run cooler. They are *recommended for operating “non-inverter-duty” motors, and when the length of wiring between the AC drive and motor exceeds 75ft.*



Please refer to Appendix A for specifications on GS1 AC Drive Accessories.

KEYPAD OPERATION AND QUICK-START

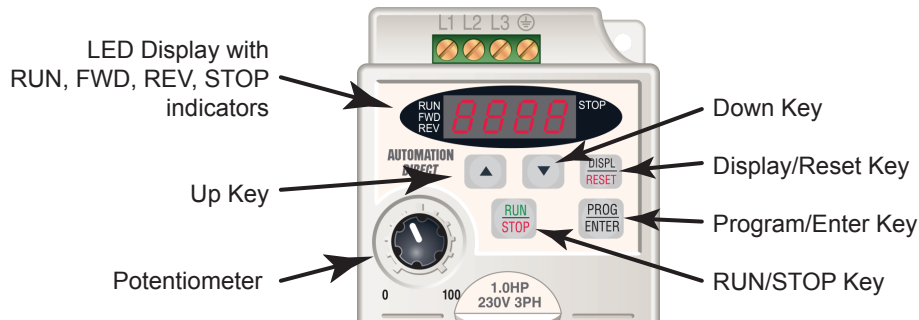


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THE GS1 DIGITAL KEYPAD

The digital keypad includes a 4-digit LED display, 4 LED indicators, 5 function keys, and a potentiometer. The diagram below shows all of the features of the digital keypad and an overview of their functions.



LED DISPLAY

The LED Display shows the operation values and parameter settings of the AC drive. The display also has four LED Indicators that show the RUN, STOP, FWD, and REV status of the AC drive.



A solid RUN LED and blinking STOP LED indicate an active RUN command with a speed reference of zero hertz.

FUNCTION KEYS



Program/Enter Key

Press the PROGRAM/ENTER key to view parameters and store parameter settings.



Display/Reset Key

Press the DISPL/RESET key to cycle through the operational values (Status Display) of the AC drive. This key will also reset the AC drive when a fault has occurred.



Run/Stop Key

Press the RUN/STOP key to start or stop the AC drive operation.



Up/Down Keys

Press the UP/DOWN keys to scroll through the parameter set or to change parameter settings. Press the “Up” or “Down” key momentarily to change the parameter settings in single-unit increments. To quickly run through the range of settings, press and hold the “Up” or “Down” key.

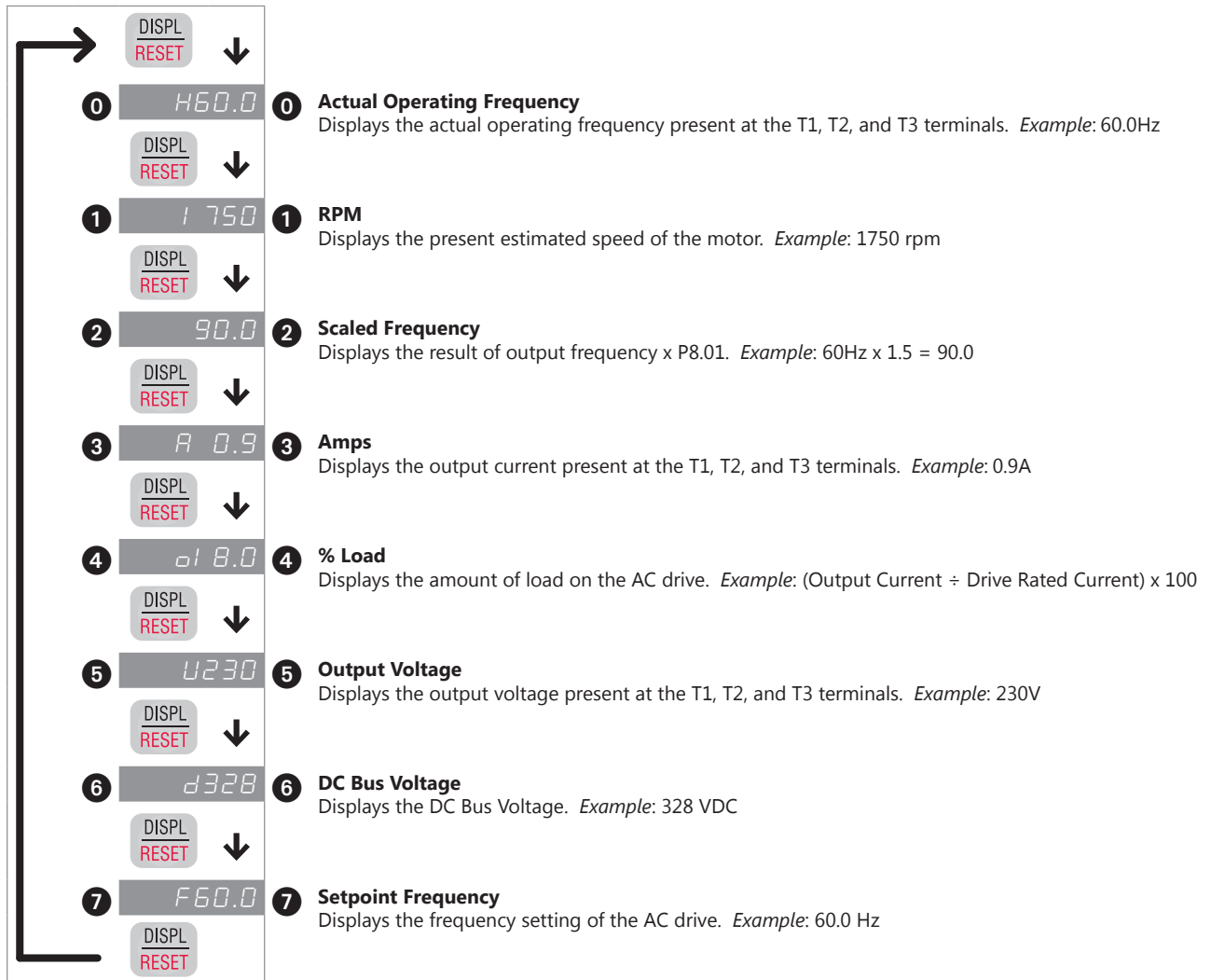


Potentiometer

The potentiometer is used to set the AC drive operation frequency.

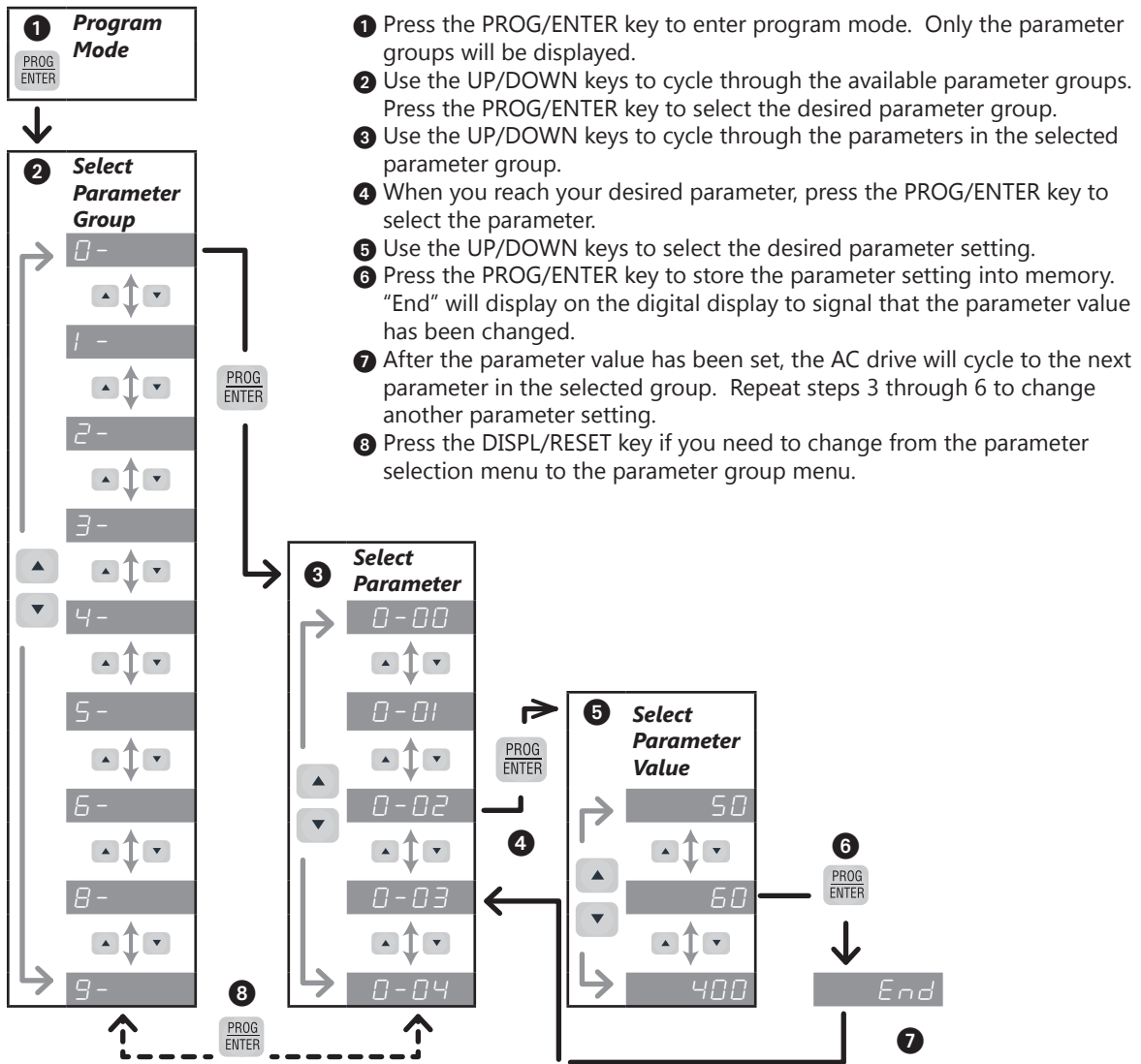
DISPLAYING THE STATUS OF THE GS1 AC DRIVE

Press the DISPL/RESET button on the keypad repeatedly to cycle through the status messages on the AC drive. The diagram below shows the order of the status messages and their definitions. The status of the AC drive can be shown in RUN or STOP mode.



PROGRAMMING THE GS1 AC DRIVE

The GS1 AC Drive parameters are organized into 10 different groups according to their functions. The illustration below shows you how to navigate through the parameter groups and parameter settings. For a complete list of parameters, see Chapter 4.



GS1 QUICKSTART

The following examples will help you quickly set up your GS1 AC Drive for two common applications. The first example applies to an application that requires constant torque, and the second example requires variable torque in its application.



For a complete list and description of the parameters for the GS1 Series AC drives, refer to Chapter 4, AC Drive Parameters.

EXAMPLE 1: CONSTANT TORQUE (E.G. CONVEYORS, COMPRESSORS, ETC.)

In this example, the AC drive needs to operate a motor that is connected to a conveyor. In order to decide which parameters need modifications, we will make a list of the needs for the application.

APPLICATION NEEDS

- The AC drive must control a 230V, 1hp motor. The AC drive model that we will use for this application is a GS1-21P0. An example of the motor nameplate is shown below.

INVERTER DUTY MOTOR							
HP	1	VOLTS	230	PHASE	3	TYPE	P
RPM	1725	AMPS	4.2	HZ	60	SF	1.15
DESIGN B			AMB	40°C		INSUL CLASS F	
DUTY	CONT		ENCL	TEFC		CODE	K

- The maximum speed for the motor is 2000 rpm.
- The motor should accelerate to maximum speed in 5 seconds.
- The motor should decelerate from maximum speed in 5 seconds.
- The motor will require a high torque when starting.
- The operation of the motor (start, stop, etc.) will be controlled by external control terminals. All keys on the GS1 keypad should be disabled.
- The frequency of the AC drive will be determined by a remote potentiometer that provides a 0 to +10V signal.
- The display of the AC drive should show the motor speed (rpm) when running.

PARAMETER SETUP (FOR EXAMPLE 1)

In order to meet the needs of this application, the parameters should be set as follows:

P0.00	Motor Nameplate Voltage	Setting: 230
	<i>Range:</i> 200V series: 200/208/220/230/240	<i>Default:</i> 240

This parameter setting is determined by the motor nameplate data.

P0.01	Motor Nameplate Amps	Setting: 4.2
	<i>Range:</i> Drive Rated Amps x 0.3 to Drive Rated Amps x 1.0	<i>Default:</i> Drive Rating (A)

This parameter setting is determined by the motor nameplate data.

P0.02	Motor Base Frequency	Setting: 60
	<i>Range:</i> 50/60/400	<i>Default:</i> 60

This parameter setting is determined by the motor nameplate data.

P0.03	Motor Base RPM	Setting: 1725
	<i>Range:</i> 375 to 9999 rpm	<i>Default:</i> 1750

This parameter setting is determined by the motor nameplate data.

P0.04	Motor Maximum RPM	Setting: 2000
	<i>Range:</i> P0.03 to 9999 rpm	<i>Default:</i> P0.03

This parameter setting is determined by the needs of the application.



WARNING: THE MOTOR MAXIMUM RPM 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.

P1.00	Stop Methods	Setting: 0
	<i>Range:</i> 0 – Ramp to Stop 1 – Coast to stop	<i>Default:</i> 0

The application requires that this parameter be set to Ramp to Stop because the motor needs to stop under power. If the AC drive was set for Coast to Stop, the AC drive would ignore the Deceleration Time setting.



WARNING: IF THE STOP METHOD FOR THE GSI AC DRIVE IS SET FOR COAST TO STOP, THE AC DRIVE WILL IGNORE ANY SETTING YOU HAVE FOR DECELERATION TIME (P1.02).

P1.01	Acceleration Time	Setting: 5.0
	<i>Range:</i> 0.1 to 600 sec	<i>Default:</i> 10 sec

The motor should accelerate from 0 rpm to Base RPM (P0.03) in 5 seconds.

P1.02	Deceleration Time	Setting: 5.0
	<i>Range:</i> 0.1 to 600 sec	<i>Default:</i> 30 sec

The motor should decelerate from Maximum RPM (P0.04) to 0 rpm in 5 seconds.

P2.00	Volts/Hertz Settings	Setting: 1
	<i>Settings:</i> 0 – General Purpose 1 – High Starting Torque 2 – Fans and Pumps 3 – Custom	<i>Default:</i> 0

The GS1 Series AC drive has some predefined torque settings that meet the needs of most applications. A custom setting is available if needed. In this example, the application requires a high starting torque.

P3.00 Source of Operation Command

Setting: 2

Settings:

Default: 0

- 0 – Operation Determined by Digital Keypad.
- 1 – Operation determined by external control terminals. Keypad STOP is enabled.
- 2 – Operation determined by external control terminals. Keypad STOP is disabled.
- 3 – Operation determined by RS-485 interface. Keypad STOP is enabled.
- 4 – Operation determined by RS-485 interface. Keypad STOP is disabled.

The AC drive operation will be determined by external control terminals and the keypad stop will be disabled.

P4.00 Source of Frequency Command

Setting: 2

Settings:

Default: 0

- 0 – Frequency determined by keypad potentiometer.
- 1 – Frequency determined by digital keypad up/down.
- 2 – Frequency determined by 0 to +10V input on AI terminal. AI switch must be set to "V"



← **AI switch must be set to "V" in order to use 0 to +10V input.**

- 3 – Frequency determined by 4 to 20mA input on AI terminal. AI switch must be set to "I."
- 4 – Frequency determined by 0 to 20mA input on AI terminal. AI switch must be set to "I."
- 5 – Frequency determined by RS-485 communication interface.

The frequency of the AC drive will be determined by an external potentiometer with a 0 to +10V signal.



When configured for "Frequency determined by digital keypad Up/Down, the drive will reset the commanded frequency to zero hertz on a power cycle. This happens only if the drive faults when it powers down (if its running when it loses power). If the drive is stopped when it loses power (and doesn't trigger a Low Voltage Fault), the drive will retain the last set speed when powered back up.

P8.00 User Defined Display Function

Setting: 1

Settings:

Default: 0

- 0 – Output Frequency (Hz)
- 1 – Motor Speed (rpm)
- 2 – Output Frequency x P8.01
- 3 – Output Current (A)
- 4 – Motor Output Current (%)
- 5 – Output Voltage (V)
- 6 – DC Bus Voltage (V)
- 9 – Frequency Setpoint

The AC drive display will show motor speed (rpm) when running.

EXAMPLE 2: VARIABLE TORQUE (E.G. FANS, CENTRIFUGAL PUMPS, ETC.)

In this example, the AC drive needs to operate a motor that is connected to a centrifugal pump. As in Example 1, we will make a list of the needs for the application in order to decide which parameters need modifications.

APPLICATION NEEDS

- The AC drive must control a 208V, 1/2hp motor. The AC drive model we will be use for this application is a GS1-20P5. An example of the motor nameplate is shown below.

INVERTER DUTY MOTOR							
HP	0.5	VOLTS	208	PHASE	3	TYPE	P
RPM	3525	AMPS	2.5	HZ	60	SF	1.15
DESIGN B			AMB	40°C		INSUL CLASS F	
DUTY	CONT		ENCL	TEFC		CODE	K

- The maximum speed for the motor is 3600 rpm.
- The motor should accelerate to maximum speed in 20 seconds.
- The motor should coast to stop when operation is terminated.
- The motor will be turning a centrifugal pump.
- The operation of the motor (start, stop, etc.) will be controlled by the GS1 digital keypad.
- The frequency of the AC drive will be determined by the GS1 keypad potentiometer.
- The display of the AC drive should show output current (A) when running.

PARAMETER SETUP (FOR EXAMPLE 2)

In order to meet the needs of this application, the parameters should be set as follows:

P0.00 Motor Nameplate Voltage **Setting: 208**
 Range: 200V series: 200/208/220/230/240 Default: 240
 This parameter setting is determined by the motor nameplate.

P0.01 Motor Nameplate Amps **Setting: 2.5**
 Range: Drive Rated Amps x 0.3 to Drive Rated Amps x 1.0 Default: Drive Rating (A)
 This parameter setting is determined by the motor nameplate.

P0.02 Motor Base Frequency **Setting: 60**
 Range: 50/60/400 Default: 60
 This parameter setting is determined by the motor nameplate data.

P0.03 Motor Base RPM **Setting: 3525**
 Range: 375 to 9999 rpm Default: 1750
 This parameter setting is determined by the motor nameplate data.

P0.04 Motor Maximum RPM **Setting: 3600**
 Range: P0.03 to 9999 rpm Default: P0.03
 This parameter setting is determined by the needs of the application.



WARNING: THE MOTOR MAXIMUM RPM 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.

P1.00 Stop Methods **Setting: 1**
 Settings: 0 – Ramp to Stop Default: 0
 1 – Coast to stop

The application requires that this parameter be set to Coast to Stop.



WARNING: IF THE STOP METHOD FOR THE GS1 AC DRIVE IS SET FOR COAST TO STOP, THE AC DRIVE WILL IGNORE ANY SETTING YOU HAVE FOR DECELERATION TIME (P1.02).

P1.01 Acceleration Time **Setting: 20.0**
Default: 10 sec
Range: 0.1 to 600 sec

The motor should accelerate from 0 rpm to Base RPM (P0.03) 20 seconds.

P2.00 Volts/Hertz Settings **Setting: 2**
Default: 0
Settings: 0 – General Purpose
 1 – High Starting Torque
 2 – Fans and Pumps
 3 – Custom

The GS1 Series AC drive has some predefined torque settings that meet the needs of most applications. A custom setting is available if needed. In this example, the motor will be running a pump.

P3.00 Source of Operation Command **Setting: 0**
Default: 0
Settings:
 0 – Operation Determined by Digital Keypad.
 1 – Operation determined by external control terminals. Keypad STOP is enabled.
 2 – Operation determined by external control terminals. Keypad STOP is disabled.
 3 – Operation determined by RS-485 interface. Keypad STOP is enabled.
 4 – Operation determined by RS-485 interface. Keypad STOP is disabled.

The AC drive operation will be determined by the digital keypad.

P4.00 Source of Frequency Command **Setting: 0**
Default: 0
Settings:
 0 – Frequency determined by keypad potentiometer.
 1 – Frequency determined by digital keypad up/down.
 2 – Frequency determined by 0 to +10V input on AI terminal. AI switch must be set to "V."
 3 – Frequency determined by 4 to 20mA input on AI terminal. AI switch must be set to "I."
 4 – Frequency determined by 0 to 20mA input on AI terminal. AI switch must be set to "I."
 5 – Frequency determined by RS-485 communication interface.

The frequency of the AC drive will be determined by the keypad potentiometer.



When configured for "Frequency determined by digital keypad Up/Down, the drive will reset the commanded frequency to zero hertz on a power cycle. This happens only if the drive faults when it powers down (if its running when it loses power). If the drive is stopped when it loses power (and doesn't trigger a Low Voltage Fault), the drive will retain the last set speed when powered back up.

P6.00 Electronic Thermal Overload Relay **Setting: 1**
Default: 0
Settings: 0 – Constant Torque
 1 – Variable Torque
 2 – Inactive

This function is used to limit the output power of the AC drive when powering a "self-cooled" motor at low speed.

P8.00 User Defined Display Function **Setting: 03**
Default: 00
Settings:
 00 – Output Frequency (Hz)
 01 – Motor Speed (rpm)
 02 – Output Frequency x P8.01
 03 – Output Current (A)
 04 – Motor Output Current (%)
 05 – Output Voltage (V)
 06 – DC Bus Voltage (V)
 09 – Frequency Setpoint

The AC drive display will show output current (A) when running.



For a complete list and description of the parameters for the GS1 Series AC drives, refer to Chapter 4, AC Drive Parameters.

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AC DRIVE PARAMETERS



CHAPTER

4

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GS1 PARAMETER SUMMARY

Parameter Summary – Motor Parameters (P0.xx)				
GS1 Parameter	Description	Range	Default Setting	User Setting
P0.00	Motor Nameplate Voltage	200/208/220/230/240	240	
P0.01	Motor Nameplate Amps	Drive Rated Amps x 0.3 to 1.0	Drive Rated Amps x 1.0	
P0.02	Motor Base Frequency	50/60/400	60	
P0.03	Motor Base RPM	375 to 9999 RPM	1750	
P0.04	Motor Maximum RPM	P0.03 to 9999 RPM	P0.03	

Parameter Summary – Ramp Parameters (P1.xx)				
GS1 Parameter	Description	Range	Default Setting	User Setting
P1.00	Stop Methods	0: Ramp to Stop 1: Coast to Stop	0	
◆ P1.01	Acceleration Time 1	0.1 to 600.0 sec	10.0	
◆ P1.02	Deceleration Time 1	0.1 to 600.0 sec	30.0	
P1.03	Accel S-curve	0 to 7	0	
P1.04	Decel S-curve	0 to 7	0	
◆ P1.05	Acceleration Time 2	0.1 to 600.0 sec	10.0	
◆ P1.06	Deceleration Time 2	0.1 to 600.0 sec	30.0	
P1.07	Select method to use 2nd Accel/Decel	0: RMP2 from terminal 1: Transition Frequencies P1.08 & P1.09	0	
P1.08	Accel 1 to Accel 2 frequency transition	0.0 to 400.0 Hz	0.0	
P1.09	Decel 1 to Decel 2 frequency transition	0.0 to 400.0 Hz	0.0	
P1.10	Skip Frequency 1	0.0 to 400.0 Hz	0.0	
P1.11	Skip Frequency 2	0.0 to 400.0 Hz	0.0	
P1.12	Skip Frequency 3	0.0 to 400.0 Hz	0.0	
P1.17	Skip Frequency Band	0.0 to 20.0 Hz	0.0	
P1.19	DC Injection Voltage Level	0 to 30%	0	
P1.20	DC Injection during Start-up	0.0 to 5.0 sec	0.0	
P1.21	DC Injection during Stopping	0.0 to 25.0 sec	0.0	
P1.22	Start-point for DC Injection	0.0 to 60.0 Hz	0.0	

◆ Parameter can be set during RUN Mode.

Parameter Summary – Volts/Hertz Parameters (P2.xx)				
GS1 Parameter	Description	Range	Default Setting	User Setting
P2.00	Volts/Hertz Settings	0: General Purpose 1: High Starting Torque 2: Fans and Pumps 3: Custom	0	
◆ P2.01	Slip Compensation	0.0 to 10.0	0.0	
◆ P2.03	Manual Torque Boost	0 to 10%	1	
P2.04	Mid-point Frequency	1.0 to 400 Hz	1.5	
P2.05	Mid-point Voltage	2.0 to 255V	10.0	
P2.06	Min. Output Frequency	1.0 to 20.0 Hz	1.5	
P2.07	Min. Output Voltage	2.0 to 50V	10.0	
P2.08	PWM Carrier Frequency	03 to 10 kHz	10	

◆ Parameter can be set during RUN Mode.

Parameter Summary – Digital Parameters (P3.xx)				
GS1 Parameter	Description	Range	Default Setting	User Setting
P3.00	Source of Operation Command	0: Operation determined by digital keypad 1: Operation determined by external control terminals, keypad STOP is enabled 2: Operation determined by external control terminals, keypad STOP is disabled 3: Operation determined by RS-485 interface, keypad STOP is enabled 4: Operation determined by RS-485 interface, keypad STOP is disabled	0	
P3.01	Multi-function Inputs 1 & 2 (DI1 & DI2)	0: DI1 - FWD / STOP, DI2 - REV / STOP 1: DI1 - RUN / STOP, DI2- REV / FWD 2: DI1 - RUN momentary (N.O.) DI2 - REV / FWD DI3 - STOP momentary (N.C.)	0	
P3.02	Multi-function Input 3 (DI3)	0: External Fault (N.O.)	0	
P3.03	Multi-function Input 4 (DI4)	1: External Fault (N.C.) 2: External Reset 3: Multi-Speed Bit 1 4: Multi-Speed Bit 2 9: Jog 10: External Base Block (N.O.) 11: External Base Block (N.C.) 12: Second Accel/Decel Time 13: Speed Hold 14: Increase Speed 15: Decrease Speed 16: Reset Speed to Zero 99: Input Disable	3	
P3.11	Multi-Function Output Terminal	0: AC Drive Running 1: AC Drive Fault 2: At Speed 3: Zero Speed 4: Above Desired Frequency (P3.16) 5: Below Desired Frequency (P3.16) 6: At Maximum Speed (P0.04) 7: Over torque detected 8: Above Desired Current (P3.17) 9: Below Desired Current (P3.17)	0	
◆ P3.16	Desired Frequency	0.0 to 400Hz	0.0	
◆ P3.17	Desired Current	0.0 to Drive Rated Amps	0.0	
◆ Parameter can be set during RUN Mode.				

Parameter Summary – Analog Parameters (P4.xx)				
GS1 Parameter	Description	Range	Default Setting	User Setting
P4.00	Source of Frequency Command	0: Frequency determined by keypad potentiometer 1: Frequency determined by digital keypad up/down 2: Frequency determined by 0 to +10V input on AI terminal (switch set to "V") 3: Frequency determined by 4 to 20mA input on AI terminal (switch set to "I") 4: Frequency determined by 0 to 20mA input on AI terminal (switch set to "I") 5: Frequency determined by RS-485 communication interface	0	
P4.01	Analog Input Offset Polarity	0: No Offset 1: Positive Offset 2: Negative Offset	0	
◆ P4.02	Analog Input Offset	0.0 to 100.0%	0.0	
◆ P4.03	Analog Input Gain	0.0 to 300.0%	100.0	
P4.04	Analog Input Reverse Motion Enable	0: Forward Motion Only 1: Reverse Motion Enable	0	
P4.05	Loss of ACI Signal (4–20mA)	0: Decelerate to 0Hz 1: Stop immediately and display error code "EF" 2: Continue operation by the last frequency command	0	
◆ Parameter can be set during RUN Mode.				

Parameter Summary – Presets Parameters (P5.xx)				
GS1 Parameter	Description	Range	Default Setting	User Setting
◆ P5.00	Jog	0.0 to 400Hz	6.0	
◆ P5.01	Multi-Speed 1	0.0 to 400Hz	0.0	
◆ P5.02	Multi-Speed 2	0.0 to 400Hz	0.0	
◆ P5.03	Multi-Speed 3	0.0 to 400Hz	0.0	
◆ Parameter can be set during RUN Mode.				

Parameter Summary – Protection Parameters (P6.xx)				
GS1 Parameter	Description	Range	Default Setting	User Setting
P6.00	Electronic Thermal Overload Relay	0: Constant Torque (inverter/vector duty motors) 1: Variable Torque (fan cooled standard motors) 2: Inactive	0	
P6.01	Auto Restart after Fault	0 to 10	0	
P6.02	Momentary Power Loss	0: Stop operation after momentary power loss 1: Continue operation after momentary power loss, speed search from Speed Reference 2: Continue operation after momentary power loss, speed search from Minimum Speed	0	
P6.03	Reverse Operation Inhibit	0: Enable Reverse Operation 1: Disable Reverse Operation	0	
P6.04	Auto Voltage Regulation	0: AVR enabled 1: AVR disabled 2: AVR disabled during decel 3: AVR disabled during stop	0	
P6.05	Over-Voltage Trip Prevention	0: Enable Over-voltage Trip Prevention 1: Disable Over-voltage Trip Prevention	0	
P6.06	Auto Adjustable Accel/Decel	0: Linear Accel/Decel 1: Auto Accel, Linear Decel 2: Linear Accel, Auto Decel 3: Auto Accel/Decel 4: Auto Accel/Decel Stall Prevention (limited by P1-01, P1-02, P1-05 and P1-06)	0	
P6.07	Over-Torque Detection Mode	0: Disabled 1: Enabled during constant speed operation 2: Enabled during acceleration	0	
P6.08	Over-Torque Detection Level	30 to 200%	150	
P6.09	Over-Torque Detection Time	0.1 to 10.0	0.1	
P6.10	Over-Current Stall Prevention during Acceleration	0 to 200% (0 = disable)	130	
P6.11	Over-Current Stall Prevention during Operation	0 to 200% (0 = disable)	130	
P6.12	Maximum Allowable Power Loss Time	0.3 to 5.0 sec	2.0	
P6.13	Base-Block Time for Speed Search	0.3 to 5.0 sec	0.5	
P6.14	Maximum Speed Search Current Level	30 to 200%	150	
P6.15	Upper Bound of Output Frequency	0.1 to 400.0Hz	400.0	
P6.16	Lower Bound of Output Frequency	0.0 to 400.0Hz	0.0	
P6.30 *	Line Start Lockout	00: Enable Line Start Lockout 01: Disable Line Start Lockout	00	
P6.31	Present Fault Record	0: No Fault occurred	00	
P6.32	Second Most Recent Fault Record	1: Over-current (oc)	00	
P6.33	Third Most Recent Fault Record	2: Over-voltage (ov)	00	
P6.34	Fourth Most Recent Fault Record	3: Overheat (oH)	00	
P6.35	Fifth Most Recent Fault Record	4: Overload (oL)	00	
P6.36	Sixth Most Recent Fault Record	5: Overload 1 (oL1) 6: Overload 2 (oL2) 7: External Fault (EF) 8: CPU failure 1 (CF1) 9: CPU failure 2 (CF2) 10: CPU failure 3 (CF3) 11: Hardware Protection Failure (HPF) 12: Over-current during accel (OCA) 13: Over-current during decel (OCd) 14: Over-current during steady state (OCn) 18: External Base-Block (bb) 19: Auto Adjust accel/decel failure (cFA) 20: Software protection code (codE)	00	


* This parameter is available only with AC drive firmware v1.07 or higher (refer to P9.39).

Parameter Summary – Display Parameters (P8.xx)				
GS1 Parameter	Description	Range	Default Setting	User Setting
◆ P8.00	User Defined Display Function	0: Output Frequency (Hz) 1: Motor Speed (RPM) 2: Output Freq. x P8.01 3: Output Current (A) 4: Motor Output Current (%) 5: Output Voltage (V) 6: DC Bus Voltage (V) 9: Frequency Setpoint	0	
◆ P8.01	Frequency Scale Factor	0.1 to 160.0	1.0	
◆ Parameter can be set during RUN Mode.				


Parameter Summary – Communications Parameters (P9.xx)				
GS1 Parameter	Description	Range	Default Setting	User Setting
P9.00	Communication Address	1 to 254	1	
P9.01	Transmission Speed	0: 4800 baud 1: 9600 baud 2: 19200 baud	1	
P9.02	Communication Protocol	0: MODBUS ASCII mode, 7 data bits, no parity, 2 stop bits 1: MODBUS ASCII mode, 7 data bits, even parity, 1 stop bit 2: MODBUS ASCII mode, 7 data bits, odd parity, 1 stop bit 3: MODBUS RTU mode, 8 data bits, no parity, 2 stop bits 4: MODBUS RTU mode, 8 data bits, even parity, 1 stop bit 5: MODBUS RTU mode, 8 data bits, odd parity, 1 stop bit	0	
P9.03	Transmission Fault Treatment	0: Display fault and continue operating 1: Display fault and RAMP to stop 2: Display fault and COAST to stop 3: No fault displayed and continue operating	0	
P9.04	Time Out Detection	0: Disable 1: Enable	0	
P9.05	Time Out Duration	0.1 to 60.0 seconds	0.5	
◆ P9.07	Parameter Lock	0: All parameters can be set and read 1: All parameters are read-only	0	
P9.08	Restore to Default	99: Restores all parameters to factory defaults	0	
◆ P9.11	Block Transfer Parameter 1	Parameters 0.00 to 8.01, 9.99	9.99	
◆ P9.12	Block Transfer Parameter 2	Parameters 0.00 to 8.01, 9.99	9.99	
◆ P9.13	Block Transfer Parameter 3	Parameters 0.00 to 8.01, 9.99	9.99	
◆ P9.14	Block Transfer Parameter 4	Parameters 0.00 to 8.01, 9.99	9.99	
◆ P9.15	Block Transfer Parameter 5	Parameters 0.00 to 8.01, 9.99	9.99	
◆ P9.16	Block Transfer Parameter 6	Parameters 0.00 to 8.01, 9.99	9.99	
◆ P9.17	Block Transfer Parameter 7	Parameters 0.00 to 8.01, 9.99	9.99	
◆ P9.18	Block Transfer Parameter 8	Parameters 0.00 to 8.01, 9.99	9.99	
◆ P9.19	Block Transfer Parameter 9	Parameters 0.00 to 8.01, 9.99	9.99	
◆ P9.20	Block Transfer Parameter 10	Parameters 0.00 to 8.01, 9.99	9.99	
◆ P9.26	Serial Comm Speed Reference	0.0 to 400.0 Hz	60.0	
◆ P9.27	Serial Comm RUN Command	0: Stop 1: Run	0	
◆ P9.28	Serial Comm Direction Command	0: Forward 1: Reverse	0	
◆ P9.29	Serial Comm External Fault	0: No fault 1: External fault	0	
◆ P9.30	Serial Comm Fault Reset	0: No action 1: Fault Reset	0	
◆ P9.31	Serial Comm JOG Command	0: Stop 1: Jog	0	
P9.39 *	Firmware Version	###	###	
P9.41	GS Series Number	1: GS1 2: GS2 3: GS3 4: GS4	##	
P9.42	Manufacturer Model Information	0: GS1-10P2 (120V, 1ph, 0.25HP) 1: GS1-10P5 (120V, 1ph, 0.5HP) 2: GS1-20P2 (230V, 1ph/3ph, 0.25HP) 3: GS1-20P5 (230V, 1ph/3ph, 0.5HP) 4: GS1-21P0 (230V, 1ph/3ph, 1HP) 5: GS1-22P0 (230V, 3ph, 2HP)	##	
* This parameter is available only with AC drive firmware v1.07 or higher.				
◆ Parameter can be set during RUN Mode.				

GS1 DETAILED PARAMETER LISTINGS

EXPLANATION OF PARAMETER DETAILS FORMAT

Px.xx	Parameter Name	Range: xxx	Default: xxx
	This parameter...		
	Where:		
	<ul style="list-style-type: none"> Px.xx = the parameter number Parameter Name = the descriptive name of the parameter 		
	 If the diamond symbol (◆) appears next to the parameter name, the parameter can be edited when the AC drive is in RUN Mode.		
	<ul style="list-style-type: none"> Range = the range or listing of the possible parameter settings Default = the factory default setting of the parameter This parameter... = an explanation of the parameter function 		

MOTOR PARAMETERS

P0.00	Motor Nameplate Voltage	Range: 115/230V series: 200/208/220/230/240	Default Setting: 240
	This parameter determines the Maximum Output Voltage of the AC 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. The setting value must be equal to or greater than the Mid-Point Voltage (P2.05).		
P0.01	Motor Nameplate Amps	Range: Drive Rated Amps x 0.3 to Drive Rated Amps x 1.0	Default Setting: Drive Rating (A)
	This parameter sets the output current to the motor. The value is determined by the value found on the motor nameplate.		
P0.02	Motor Base Frequency	Range: 50/60/400	Default Setting: 60
	This value should be set according to the base frequency of the motor as indicated on the motor nameplate. It sets the Maximum Voltage Frequency and determines the volts per hertz ratio.		
P0.03	Motor Base RPM	Range: 375 to 9999 rpm	Default Setting: 1750
	This value should be set according to rated Base RPM of the motor as indicated on the motor nameplate.		
P0.04	Motor Maximum RPM	Range: P0.03 to 9999 rpm	Default Setting: P0.03
	<ul style="list-style-type: none"> This value should be set according to the <u>desired</u> maximum speed of the motor. This value cannot be set lower than Motor Base RPM (P0.03). 		
	 WARNING: THE MOTOR MAXIMUM RPM PARAMETER (P0.04) SHOULD NEVER EXCEED THE MAXIMUM SAFE RPM RATING FOR THE MOTOR YOU ARE USING. IF THIS INFORMATION IS NOT READILY AVAILABLE, CONSULT YOUR MOTOR MANUFACTURER.		

This parameter, along with P 0.02 and P 0.03, determines the *desired* Maximum Output Frequency of the AC Drive. The Maximum Output Frequency can be calculated as follows:

- Max. Out. Freq. = (P0.04 Motor Max. RPM ÷ P0.03 Motor Base RPM) x (P0.02 Motor Base Freq.)

If an output limit based on Maximum Output Frequency is desired, use the following equation to determine the corresponding value for Motor Maximum RPM:

- P0.04 Motor Max. RPM = (Max. Out. Freq. ÷ P0.02 Motor Base Freq.) x (P0.03 Motor Base RPM)

RAMP PARAMETERS

P1.00 Stop Methods

Settings: 0 Ramp to Stop
1 Coast to stop

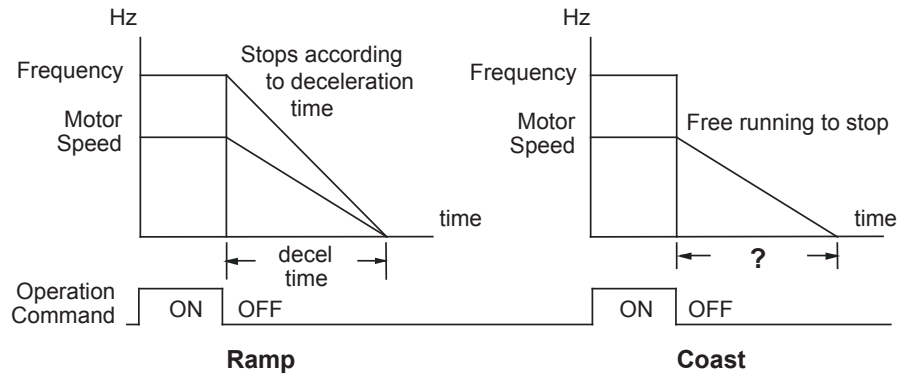
Default Setting: 0

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

- **Ramp:** The AC drive decelerates the motor to Minimum Output Frequency (P2.06) according to the deceleration time set in P1.02 or P1.06.
- **Coast:** The AC drive stops output instantly upon command, and the motor free runs until it comes to a complete stop.



The drive application or system requirements will determine which stop method is needed.



P1.01 Acceleration Time 1

Range: 0.1 to 600.0 sec

Default Setting: 10 sec

This parameter is used to determine the rate of acceleration for the AC drive to reach Maximum Motor RPM (P0.04). The rate is linear unless Accel S-Curve (P1.03) is "Enabled."

P1.02 Deceleration Time 1

Range: 0.1 to 600.0 sec

Default Setting: 30.0 sec

This parameter is used to determine the time required for the AC drive to decelerate from the Maximum Motor RPM (P0.04) down to 0Hz. The rate is linear unless Decel S-Curve (P1.04) is "Enabled."



Bus over-voltage trips may be caused by motor regeneration during rapid deceleration. If this tripping occurs, increase the deceleration time.

P1.03 Accel S-Curve

P1.04 Decel S-Curve

Range: 0 to 7

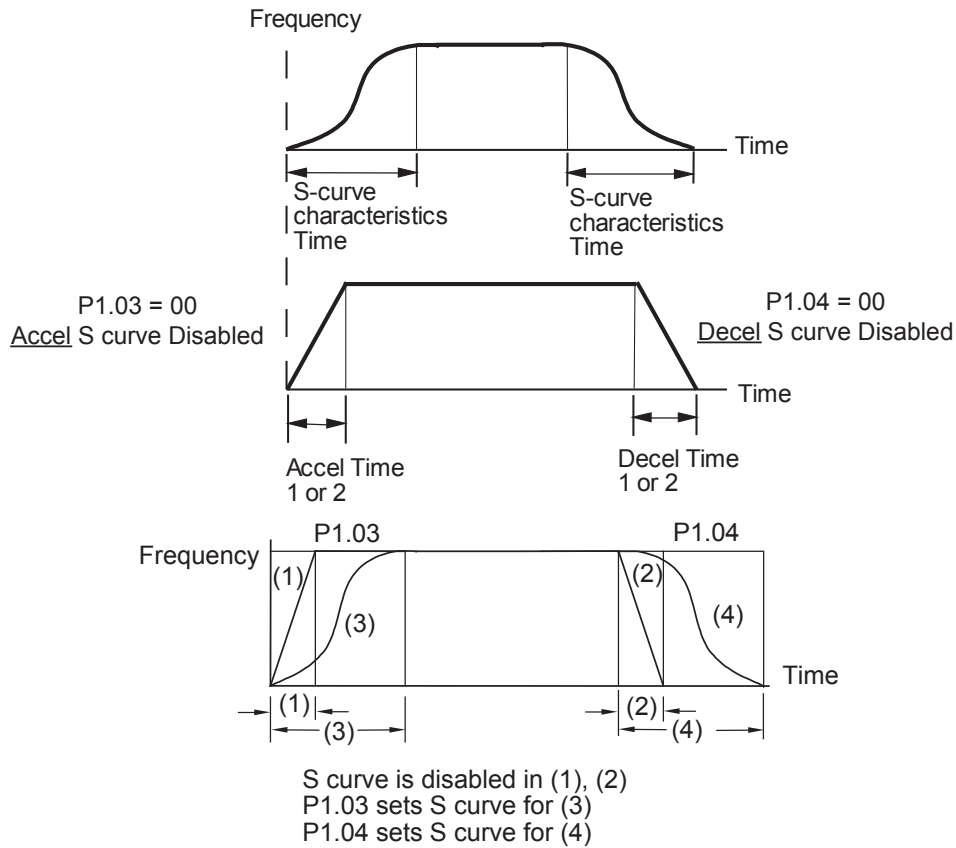
Default Setting: 0

Parameter P1.03 is used whenever the motor and load need to be accelerated more smoothly. The Accel S-Curve may be set from 0 to 7 to select the desired acceleration S Curve.

Parameter P1.04 is used whenever the motor and load need to be decelerated more smoothly. The Decel S-Curve may be set from 0 to 7 to select the desired deceleration S-Curve.



From the diagrams shown below, the original setting accel/decel time will be for reference when the function of the S-curve is enabled. The actual accel/decel time will be determined based on the S-curve selected (1 to 7).



P1.05 Acceleration Time 2

Range: 0.1 to 600.0 sec

Default Setting: 10.0

The Second Acceleration Time determines the time for the AC drive to accelerate from 0 rpm to Maximum Motor RPM (P0.04). Acceleration Time 2 (P1.05) can be selected using a multi-function input terminal or frequency transition (P1.07).

P1.06 Deceleration Time 2

Range: 0.1 to 600.0 sec

Default Setting: 30.0

The Second Deceleration Time determines the time for the AC drive to decelerate from Maximum Motor RPM (P0.04) to 0 rpm. Deceleration Time 2 (P1.06) can be selected using a multi-function input terminal or frequency transition (P1.07).

P1.07 Select method for 2nd Accel/Decel

Range: 0: Second Accel/Decel from terminal
1: Frequency Transition P1.08 & P1.09

Default Setting: 0

The second set of acceleration and deceleration times P1.05 and P1.06 can be selected either with a multi-function input terminal programmed to Second Accel/Decel, or by the values of the transition frequencies P1.08 and P1.09.

Refer to diagrams following P1.08 and P1.09.

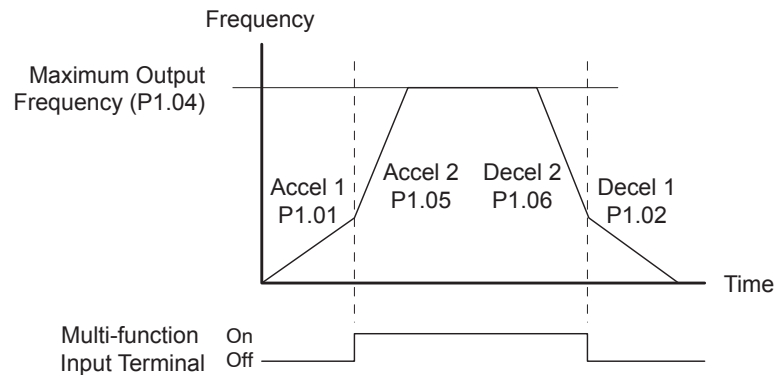
P1.08 Accel 1 to Accel 2 Frequency Transition

P1.09 Decel 1 to Decel 2 Frequency Transition

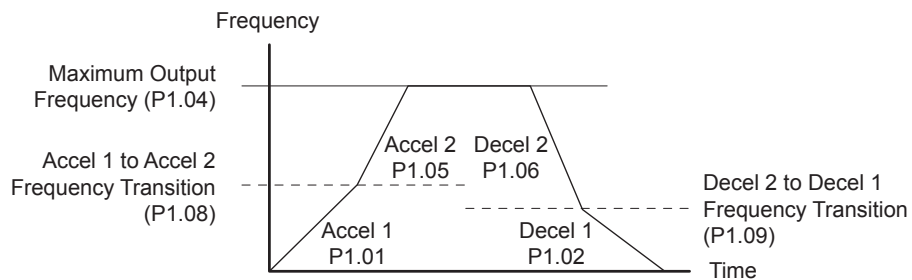
Range: 0.0 to 400.0 Hz

Default Setting: 0.0

Second Accel/Decel Times selected with Multi-Function Input Terminal



Second Accel/Decel Times selected with Frequency Transition



P1.10 Skip Frequency 1

P1.11 Skip Frequency 2

P1.12 Skip Frequency 3

Range: 0.0 to 400.0Hz

Default Setting: 0.0

P1.10, P1.11, and P1.12 determine the location of the frequency bands that will be skipped during AC drive operation.

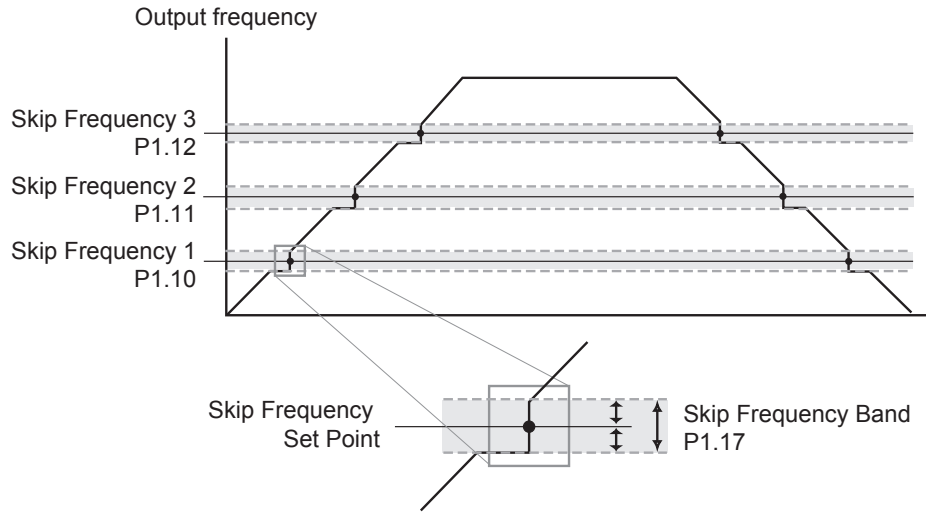
P1.17 Skip Frequency Band

Range: 0.0 to 20.0 Hz

Default Setting: 0.0

This parameter determines the frequency band for a given Skip Frequency (P1.10, P1.11, or P1.12). Half of the Skip Frequency Band is above the Skip Frequency and the other half is below.

Setting this parameter to 0.0 disables all skip frequencies.



P1.19 DC Injection Voltage Level

Range: 0 to 30%

Default Setting: 0

This parameter determines the amount of DC Braking Voltage applied to the motor during start-up and stopping. When setting DC Braking Voltage, please note that the setting is a percentage of the rated voltage of the drive. It is recommended to start with a low DC Braking Voltage Level and then increase until proper holding torque has been attained.

P1.20 DC Injection during Start-up

Range: 0.0 to 5.0 sec

Default Setting: 0.0

This parameter determines the duration of time that the DC Braking Voltage will be applied to the motor during the AC drive start-up. DC Braking will be applied for the time set in this parameter until the Minimum Frequency is reached during acceleration.

P1.21 DC Injection during Stopping

Range: 0.0 to 25.0 sec

Default Setting: 0.0

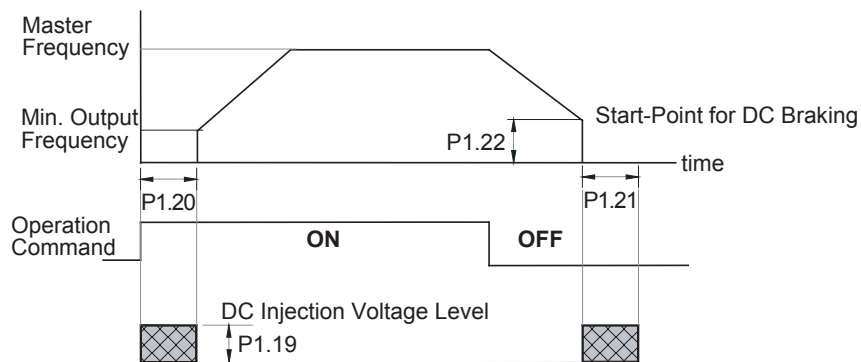
This parameter determines the duration of time that the DC braking voltage will be applied to the motor during stopping. If stopping with DC Braking is desired, then P1.00 must be set to Ramp to Stop (00).

P1.22 Start-point for DC Injection

Range: 0.0 to 60.0 Hz

Default Setting: 0.0

This parameter determines the frequency at which DC Braking will begin during deceleration.



VOLTS/HERTZ PARAMETERS

P2.00 Volts/Hertz Settings

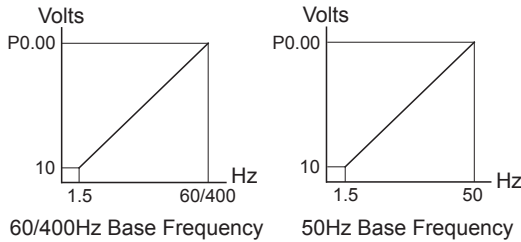
- Settings: 0 - General Purpose (constant torque)
 1 - High Starting Torque
 2 - Fans and Pumps (variable torque)
 3 - Custom

Default Setting: 0

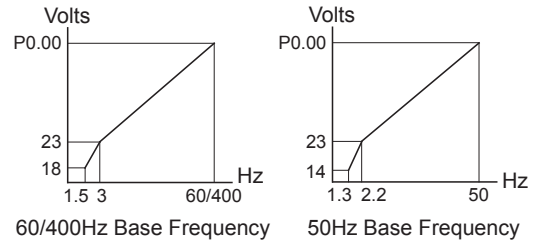


P2.04 through P2.07 are only used when the Volts/Hertz parameter (P2.00) is set to 3.

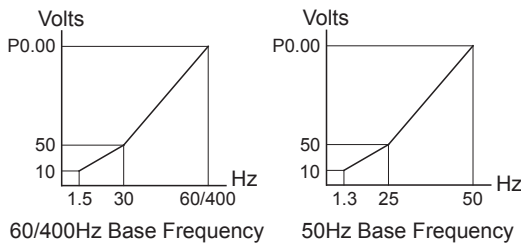
P2.00 = 0: General Purpose (constant torque)



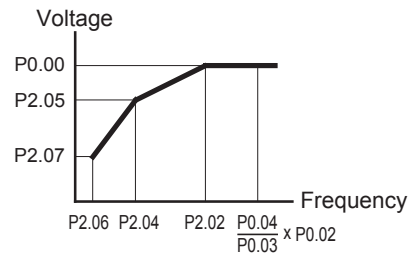
P2.00 = 1: High Starting Torque



P2.00 = 2: Fans and Pumps (variable torque)



P2.00 = 3: Custom



P2.01 ♦ Slip Compensation

Range: 0.0 to 10.0

Default Setting: 0.0

When controlling an asynchronous induction motor, an increase in load on the motor will result in an increase in slip within the motor. This parameter may be used to compensate the nominal slip within a range of 0 to 10. When the output current of the AC drive is greater than 40% of the Motor Nameplate Amps (P0.01), the AC drive will adjust its output frequency according to this parameter.

P2.03 ♦ Manual Torque Boost

Range: 0 to 10%

Default Setting: 1

This parameter provides a gain that increases the output voltage command to enhance output torque.



P2.04 through P2.07 are used only when the Volts/Hertz parameter (P2.00) is set to 3.

P2.04 Mid-point Frequency

Range: 1.0 to 400 Hz

Default Setting: 1.5

This parameter sets the Mid-Point Frequency of V/F curve. With this setting, the V/F ratio between Minimum Frequency and Mid-Point frequency can be determined.

- This parameter must be greater than or equal to the Minimum Output Frequency (P2.06), and less than or equal to the Maximum Voltage Frequency (P0.02).
- This parameter is active only if Volts/Hertz Settings (P2.00) is set to 3.

P2.05 Mid-point Voltage

Range: 2.0 to 255.0V

Default Setting: 10.0

This parameter sets the Mid-Point Voltage of any V/F curve. With this setting, the V/F ratio between Minimum Frequency and Mid-Point Frequency can be determined.

- This parameter must be equal to or greater than the Minimum Output Voltage (P2.07), and equal to or less than the Maximum Output Voltage (P0.00).
- This parameter is active only if Volts/Hertz Settings (P2.00) is set to 3.

P2.06 Minimum Output Frequency

Range: 1.0 to 20.0 Hz

Default Setting: 1.5

This parameter sets the Minimum Output Frequency of the AC drive.

- This parameter must be less than or equal to the Mid-Point Frequency (P2.04).
- This parameter is active only if Volts/Hertz Settings (P2.00) is set to 3.

P2.07 Minimum Output Voltage

Range: 2.0 to 50.0V

Default Setting: 10.0

This parameter sets the Minimum Output Voltage of the AC drive.

- This parameter must be equal to or less than Mid-Point Voltage (P2.05).
- This parameter is active only if Volts/Hertz Settings (P2.00) is set to 3.

P2.08 PWM Carrier Frequency

Range: 3 to 10 kHz

Default Setting: 10

This parameter sets the carrier frequency of PWM (Pulse-Width Modulated) output.

The table below shows that the carrier frequency of PWM output has a significant influence on the electromagnetic noise, leakage current, heat dissipation of the AC drive, and the acoustic noise to the motor.

Carrier Frequency	Acoustic Noise	Electromagnetic Noise, Leakage Current	Heat Dissipation
3kHz	significant	minimal	minimal
10kHz	minimal	moderate	moderate

DIGITAL PARAMETERS

P3.00 Source of Operation Command

Settings:

Default Setting: 0

- 0 – Operation Determined by Digital Keypad.
- 1 – Operation determined by external control terminals. Keypad STOP is enabled.
- 2 – Operation determined by external control terminals. Keypad STOP is disabled.
- 3 – Operation determined by RS-485 interface. Keypad STOP is enabled.
- 4 – Operation determined by RS-485 interface. Keypad STOP is disabled.

This parameter sets the input source for the AC drive operation commands.

- Refer to P3.01 and P3.03 for more details.

P3.01 Multi-function Inputs 1 & 2 (DI1-DI2)

Settings:

Default Setting: 0

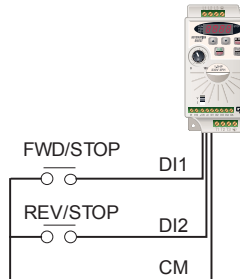
- 0 – DI1 = FWD/STOP
DI2 = REV/STOP
- 1 – DI1 = RUN/STOP
DI2 = REV/FWD
- 2 – DI1 = RUN (N.O. latching input)
DI2 = REV/FWD
DI3 = STOP (N.C. latching input)



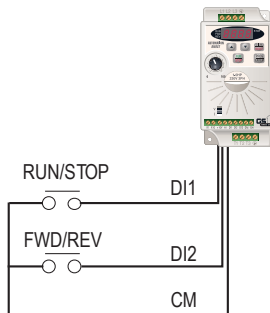
Multi-function Input Terminals DI1 and DI2 do not have separate parameter designations. DI1 and DI2 must be used in conjunction with each other to operate two and three wire control.

P3.01: Setting 0

DI1	DI2	Result
OFF	OFF	STOP
ON	OFF	FWD
OFF	ON	REV
ON	ON	STOP

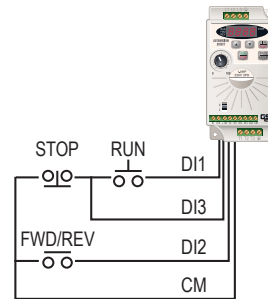


P3.01: Setting 1



DI1- RUN/STOP select
"Open" : Stop
"Close" : Run
DI2- FWD/REV select
"Open" : FWD
"Close" : REV

P3.01: Setting 2



DI1- RUN command
Latching input (N.O.)
Runs when closed
DI2- FWD/REV select
"Open" : FWD
"Close" : REV
DI3- STOP command
Latching input (N.C.)
Stops when open

The external STOP and RUN pushbuttons are momentary.
The circuit latches as does a typical 3-wire control circuit.

P3.02 Multi-Function Input 3 (DI3)

Default Setting: 0

P3.03 Multi-Function Input 4 (DI4)

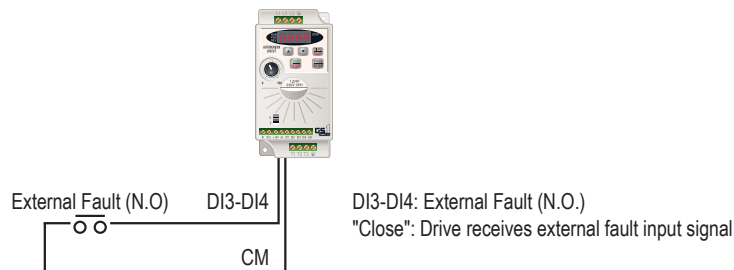
Default Setting: 3

- Settings:**
- 0 – External Fault (N.O.)
 - 1 – External Fault (N.C.)
 - 2 – External Reset
 - 3 – Multi-Speed Bit 1
 - 4 – Multi-Speed Bit 2
 - 9 – Jog
 - 10 – External Base Block (N.O.)
 - 11 – External Base Block (N.C.)
 - 12 – Second Accel/Decel Time
 - 13 – Speed Hold
 - 14 – Increase Speed (P4.00 must be set to 1)
 - 15 – Decrease Speed (P4.00 must be set to 1)
 - 16 – Reset Speed to Zero (P4.00 must be set to 1)
 - 99 – Input Disable

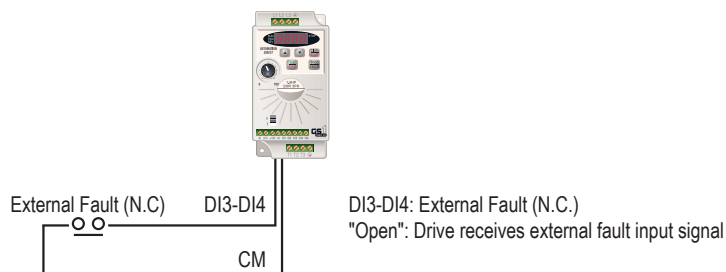
SETTING EXPLANATIONS FOR PARAMETERS P3.02 AND P3.03

Setting 0: External Fault (N.O.)

When an External Fault input signal is received, the AC drive output will turn off, the drive will display "EF" on the LED Display, and the motor will Coast to Stop. To resume normal operation, the external fault must be cleared, and the drive must be reset.

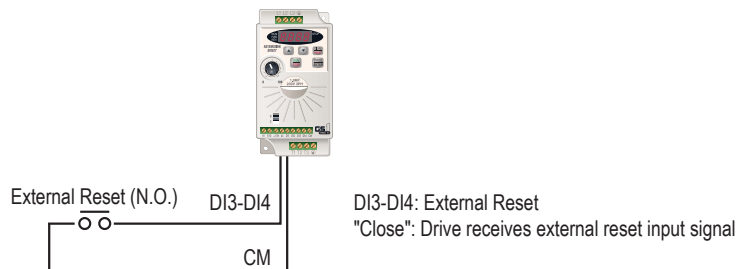


Setting 1: External Fault (N.C.)



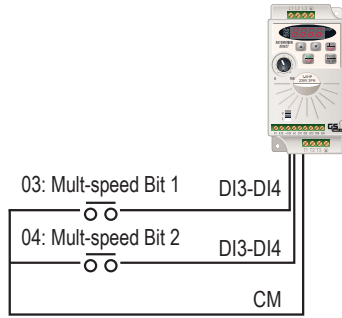
Setting 2: External Reset

An External Reset has the same function as the Reset key on the digital keypad. Use an External Reset to reset the drive after a fault.



Settings 3 and 4: Multi-Speed Bits 1 and 2

The three Multi-Speed Bits are used to select the multi-speed settings defined by parameters P5.01 to P5.03. (DI3 or DI4 can be assigned as Multi-Speed Bit 1 or as Multi-Speed Bit 2.)



Multi-Speed Bits		Speed Selection
Bit 2	Bit 1	
OFF	OFF	P4.00: Source of Frequency
OFF	ON	P5.01: Multi-Speed 1
ON	OFF	P5.02: Multi-Speed 2
ON	ON	P5.03: Multi-Speed 3



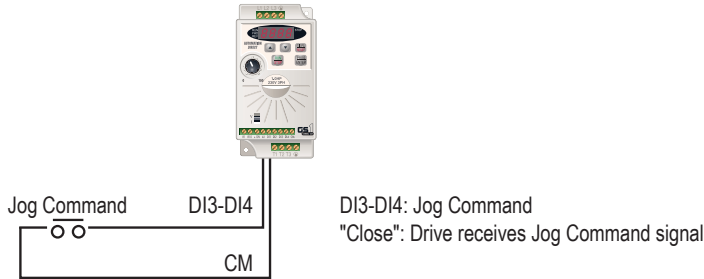
In order to use the Multi-Speed settings, parameters P5.01 to P5.03 must be set.



When all multi-speed inputs are off, the AC drive reverts back to the Command Frequency (P4.00).

Setting 9: Jog Command

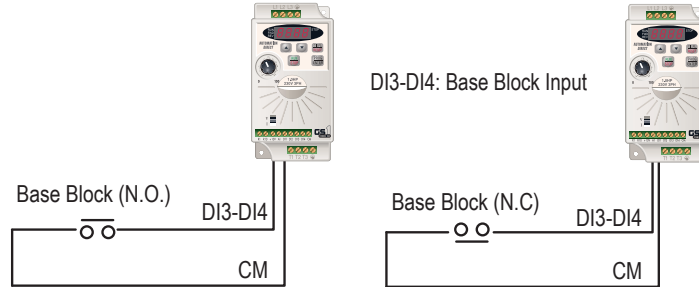
This setting configures a Multi-function Input Terminal to give the Jog Command when activated. P5.00 sets the Jog Speed.



The Jog Command cannot be used when the motor is running. The motor must be stopped to initiate this command.

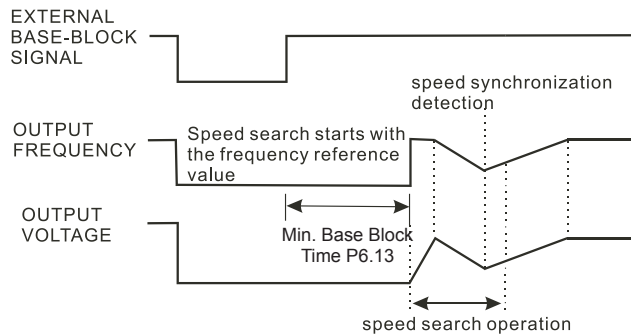
Setting 10 and 11: External Base Block (N.O.) and External Base Block (N.C.)

Value 10 is for a normally open (N.O) input and value 11 is for a normally closed (N.C.) input.



When an External Base Block is activated, the LED display shows "bb", the AC drive stops all output, and the motor will free run.

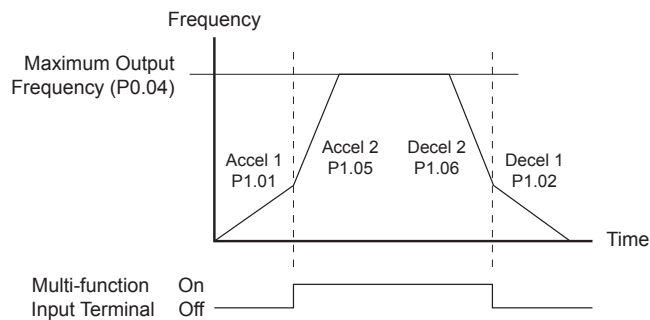
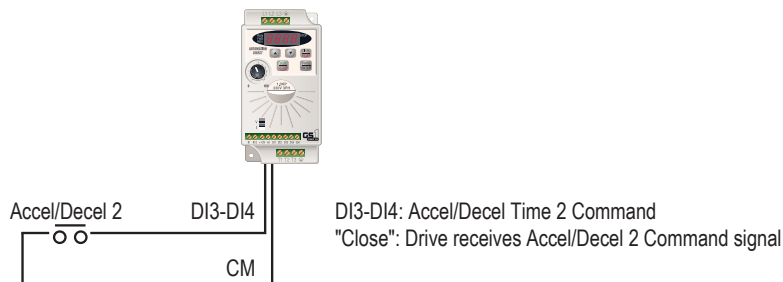
When the External Base Block is deactivated, the AC drive will start the speed search function and synchronize with the motor speed. The AC drive will then accelerate to the Master Frequency.



Refer also to P6.13 (Base-Block Time for Speed Search) and P6.14 (Maximum Speed Search Current Level).

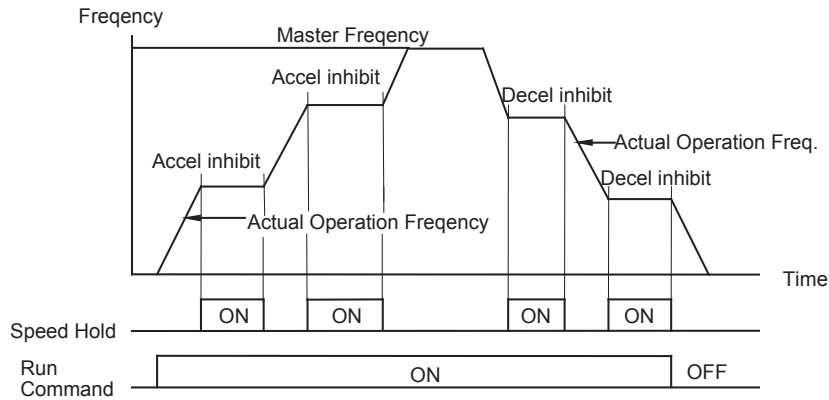
Setting 12: Second Accel/Decel Time

Multi-function Input Terminals DI3 and DI4 can be set to select between Accel/Decel times 1 and 2. Parameters 1.01 and 1.02 set times for Accel 1 and Decel 1, and parameters 1.05 and 1.06 set times for Accel 2 and Decel 2.



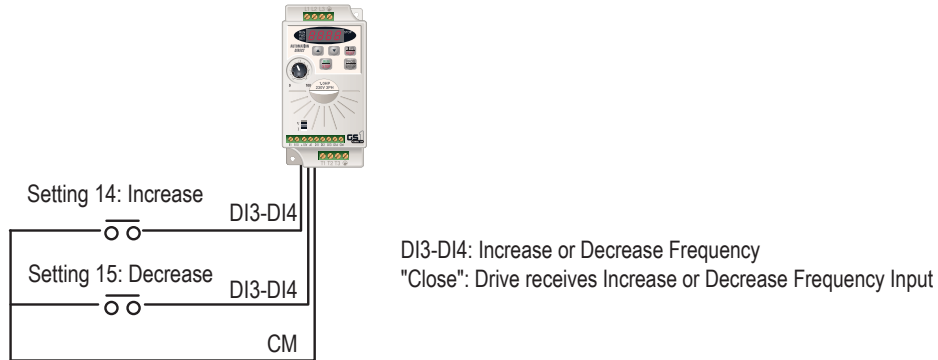
Setting 13: Speed Hold

When the Speed Hold command is received, the drive acceleration or deceleration is stopped and the drive maintains a constant speed.



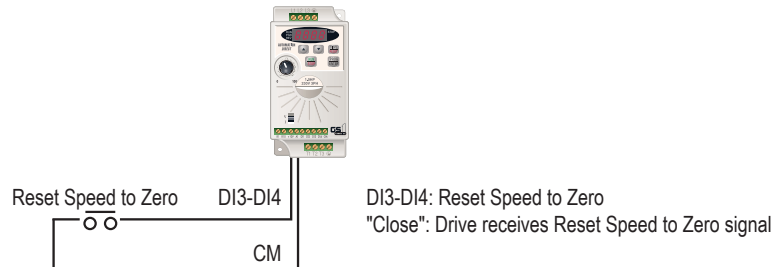
Settings 14 and 15: Increase and Decrease Speed (Electronic Motor Operated Potentiometer)

Settings 14 and 15 allow the Multi-function terminals to be used to increase or decrease speed incrementally. The Master Frequency will increase/decrease by one unit each time an increase/decrease speed input is received.



In order to use these settings, P4.00 must be set to 1.

Setting 16: Reset Speed to Zero



Setting 99: Multi-Function Input Disable

Setting a Multi-Function Input to 99 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 99 to make sure they have no effect on drive operation.



Any unused terminals should be programmed to 99 to make sure that they have no effect on drive operation.

P3.11 Multi-function Output Terminal

Settings:

Default Setting: 0

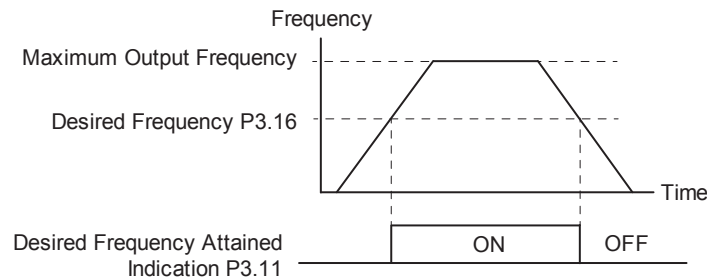
- 0: AC Drive Running
The terminal will be activated when there is an output from the drive.
- 1: AC Drive Fault
The terminal will be activated when one of the faults listed under parameters P6.31 through P6.36 occurs.
- 2: At Speed
The terminal will be activated when the AC drive attains the Command Frequency (P4.00).
- 3: Zero Speed
The output will be activated when Command Frequency (P4.00) is lower than the Minimum Output Frequency (P2.06).
- 4: Above Desired Frequency
The output will be activated when the AC drive is above the Desired Frequency (P3.16).
- 5: Below Desired Frequency
The output will be activated when the AC drive is below the Desired Frequency (P3.16).
- 6: At Maximum Speed
The output will be activated when the AC drive reaches Motor Maximum RPM (P0.04).
- 7: Over Torque Detected
The output will be activated when the AC drive reaches the Over-torque Detection Level (P6.08) and exceeds this level for a time greater than the Over-torque Detection Time (P6.09).
- 8: Above Desired Current
The output will be activated when the AC drive is above the Desired Current (P3.17).
- 9: Below Desired Current
The output will be activated when the AC drive is below the Desired Current (P3.17).

P3.16 ♦ Desired Frequency

Range: 0.0 to 400.0Hz

Default Setting: 0.0

If the Multi-function output terminal is set to function as Desired Frequency Attained (P3.11 = 04 or 05), then the output will be activated when the programmed frequency is attained.



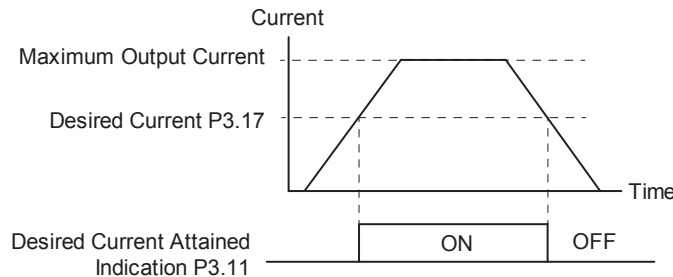
• $Max. Out. Freq. = (P0.04 Motor Max. RPM \div P0.03 Motor Base RPM) \times (P0.02 Motor Base Freq.)$

P3.17 ♦ Desired Current

Range: 0.0 to <Drive Rated Amps>

Default Setting: 0.0

If the Multi-function output terminal is set to function as Desired Current Attained (P3.11 = 08 or 09), then the output will be activated when the programmed current is attained.



ANALOG PARAMETERS**P4.00 Source of Frequency Command**Settings:Default Setting: 0

- 0 – Frequency determined by keypad potentiometer.
 1 – Frequency determined by digital keypad up/down.
 2 – Frequency determined by 0 to +10V input on AI terminal. (*Analog input switch must be set to "V."*)

← **AI switch must be set to "V" in order to use a 0 to +10V input.**

- 3 – Frequency determined by 4 to 20mA input on AI terminal. (*Analog input switch must be set to "I."*)

← **AI switch must be set to "I" in order to use a 4 to 20mA input.**

- 4 – Frequency determined by 0 to 20mA input on AI terminal. (*Analog input switch must be set to "I."*)

← **AI switch must be set to "I" in order to use a 0 to 20mA input.**

- 5 – Frequency determined by RS-485 communication interface.



When configured for "Frequency determined by digital keypad Up/Down, the drive will reset the commanded frequency to zero hertz on a power cycle. This happens only if the drive faults when it powers down (if its running when it loses power). If the drive is stopped when it loses power (and doesn't trigger a Low Voltage Fault), the drive will retain the last set speed when powered back up.



P4.01 to P4.04 are used when the source of frequency command is the analog signal (0 to +10VDC, 4 to 20mA, or 0 to 20mA). Refer to the Analog Input Examples later in this section.

P4.01 Analog Input Offset Polarity

Settings: 0 – Offset disabled
 1 – Positive Offset
 2 – Negative Offset

Default Setting: 0

This parameter sets the potentiometer Bias Frequency to be positive or negative.

- The Analog Input Offset calculation will also define the Offset Polarity. See the note after P4.02.
- P4.01 to P4.04 are used when the source of frequency command is the analog signal (0 to +10VDC, 4 to 20mA, or 0 to 20mA).

P4.02 Analog Input Offset

Range: 0.0 to 100%

Default Setting: 0.0

This parameter provides a frequency offset for an analog input.

Use the equation below to determine the Analog Input Offset. For this equation, you will need to know the necessary Minimum and Maximum Frequency References needed for your application.



The result of the Analog Input Offset calculation will also define the Analog Input Offset Polarity (P4.01). A positive answer means you should have a positive offset. A negative answer means you should have a negative offset.

- $\text{Analog Offset \%} = (\text{Min Frequency Reference} \div \text{Max Frequency Reference}) \times 100$
- P4.01 to P4.04 are used when the source of frequency command is the analog signal (0 to +10VDC, 4 to 20mA, or 0 to 20mA).

P4.03 Analog Input Gain

Range: 0.0 to 300.0%

Default Setting: 100.0

This parameter sets the ratio of analog input vs frequency output.

Use the equation below to calculate the Analog Input Gain. For this equation, you will need to know the minimum and maximum set-point frequencies needed for your application.

- $\text{Analog Gain \%} = ((\text{Max Frequency Ref} - \text{Min Frequency Ref}) \div \text{Max Output Frequency}) \times 100$
- P4.01 to P4.04 are used when the source of frequency command is the analog signal (0 to +10VDC, 4 to 20mA, or 0 to 20mA).

P4.04 Analog Input Reverse Motion Enable

Settings: 0 – Forward Motion Only
 1 – Reverse Motion Enable

Default Setting: 0

- P4.01 to P4.04 are used when the source of frequency command is the analog signal (0 to +10VDC, 4 to 20mA, or 0 to 20mA).

P4.05 Loss of ACI Signal (4–20mA)

Settings: 0 – Decelerate to 0Hz
 1 – Stop immediately and display “EF”
 2 – Continue operation by the last frequency command

Default Setting: 0

This parameter determines the operation of the drive when the ACI frequency command is lost.

ANALOG INPUT EXAMPLES

Use the equations below when calculating the values for the maximum output frequency, Analog Input Offset, Analog Input Gain, and the Mid-point frequency.

A) Max output frequency =
 $(P0.04 \text{ Motor Max RPM} \div P0.03 \text{ Motor Base RPM}) \times (P0.02 \text{ Motor Base Frequency})$



This maximum output frequency calculation is NOT a parameter setting, but is needed in order to calculate the Analog Gain. The default maximum output frequency for the GS1 drive is 60Hz. If parameters P0.02, P0.03, or P0.04 are changed, then the maximum output frequency will change accordingly.

B) $P4.02 \text{ Analog Offset \%} = (\text{min frequency reference} \div \text{max frequency reference}) \times 100$

C) $P4.03 \text{ Analog Gain \%} = ((\text{max frequency reference} - \text{min frequency ref}) \div \text{max output frequency}) \times 100$

D) $\text{Mid-point frequency} = ((\text{max frequency reference} - \text{min frequency ref}) \div 2) + \text{min frequency reference}$



This mid-point frequency calculation is NOT a parameter setting, but it shows the frequency reference of the drive when the potentiometer or other analog device is at its mid-point.

EXAMPLE 1: STANDARD OPERATION

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

- Minimum frequency reference = 0Hz
- Maximum frequency reference = 60Hz

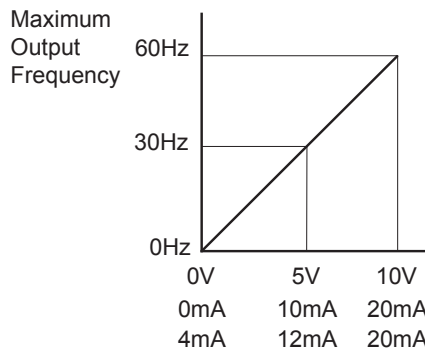
Calculations

- A) $\text{Max output frequency} = (1750\text{rpm} \div 1750\text{rpm}) \times (60\text{Hz}) = 60\text{Hz}$
- B) $P4.02 \text{ Analog Offset \%} = (0\text{Hz} \div 60\text{Hz}) \times 100 = 0\%$
- C) $P4.03 \text{ Analog Gain \%} = ((60\text{Hz} - 0\text{Hz}) \div 60\text{Hz}) \times 100 = 100\%$
- D) $\text{Mid-point frequency} = ((60\text{Hz} - 0\text{Hz}) \div 2) + 0\text{Hz} = 30\text{Hz}$

Parameter Settings

- P4.01: 00 (default) [Offset disabled]
- P4.02: 00 (default) [0% Analog Input Offset]
- P4.03: 100 (default) [100% Analog Input Gain]
- P4.04: 00 (default) [Forward Motion Only]

Results



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, Motor Maximum RPM. (Motors produce reduced output torque when running above their base speed.)



WARNING: THE MOTOR MAXIMUM RPM 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 P4.01 through P4.04 can remain defaulted, as determined by the analog input calculations shown below. The increased Maximum Output Frequency can be obtained regardless of whether the Source of Frequency Command 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
- P0.04 Motor Maximum RPM = 2042rpm

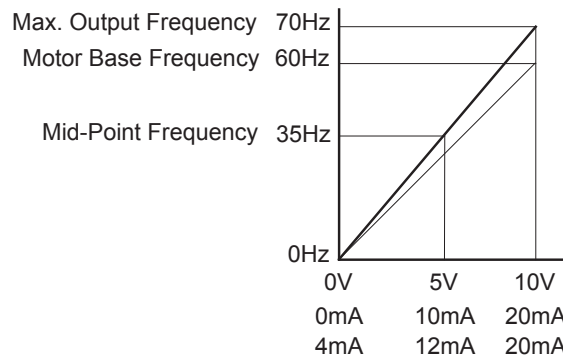
Calculations

- A) Max output frequency = $(2042\text{rpm} \div 1750\text{rpm}) \times (60\text{Hz}) = 70\text{Hz}$
- B) Analog Offset % = $(0\text{Hz} \div 70\text{Hz}) \times 100 = 0\%$
- C) Analog Gain % = $((70\text{Hz} - 0\text{Hz}) \div 70\text{Hz}) \times 100 = 100\%$
- D) Mid-point frequency = $((70\text{Hz} - 0\text{Hz}) \div 2) + 0\text{Hz} = 35\text{Hz}$

Parameter Settings

- P0.04: 2042 [2042rpm Motor Maximum RPM]
- P4.01: 00 (default) [Offset disabled]
- P4.02: 00 (default) [0% Analog Input Offset]
- P4.03: 100 (default) [100% Analog Input Gain]
- P4.04: 00 (default) [Forward Motion Only]

Results



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 (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

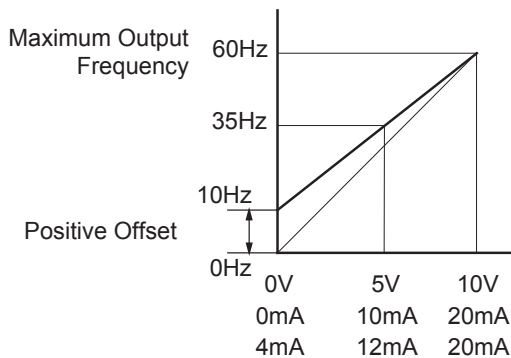
Calculations

- A) Max output frequency = (1750rpm ÷ 1750rpm) x (60Hz) = 60Hz
- B) Analog Offset % = (10Hz ÷ 60Hz) x 100 = 16.7%
- C) Analog Gain % = ((60Hz - 10Hz) ÷ 60Hz) x 100 = 83.3%
- D) Mid-point frequency = ((60Hz - 10Hz) ÷ 2) + 10Hz = 35Hz

Parameter Settings

- P4.01: 01 [Positive Input Offset Polarity]
- P4.02: 16.7 [16.7% Analog Input Offset]
- P4.03: 83.3 [83.3% Analog Input Gain]
- P4.04: 00 (default) [Forward Motion Only]

Results



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 P4.04 must be set to enable reverse motion.



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 = -60Hz (reverse)
- Maximum frequency reference = 60Hz

Calculations

- A) Max output frequency = (1750rpm ÷ 1750rpm) x (60Hz) = 60Hz
- B) Analog Offset % = (-60Hz ÷ 60Hz) x 100 = -100%



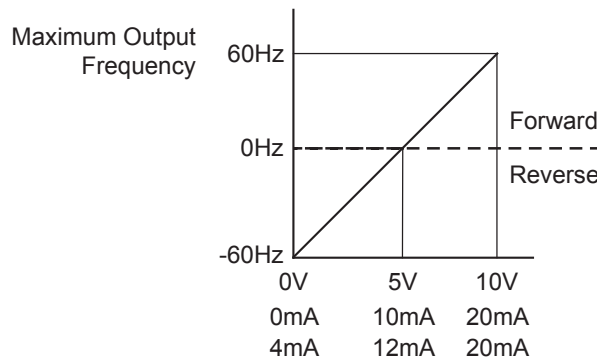
The negative (-) value for the Analog Offset % shows that a negative offset is needed for P4.01.

- C) Analog Gain % = ((60Hz - (-60Hz)) ÷ 60Hz) x 100 = 200%
- D) Mid-point frequency = ((60Hz - (-60Hz)) ÷ 2) + (-60Hz) = 0Hz

Parameter Settings

- P4.01: 02 [Negative Input Offset Polarity]
- P4.02: 100 [100% Analog Input Offset]
- P4.03: 200 [200% Analog Input Gain]
- P4.04: 01 [Reverse Motion Enable]

Results



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

Calculations

- A) Max output frequency = (1750rpm ÷ 1750rpm) x (60Hz) = 60Hz
- B) Analog Offset % = (-15Hz ÷ 60Hz) x 100 = -25%



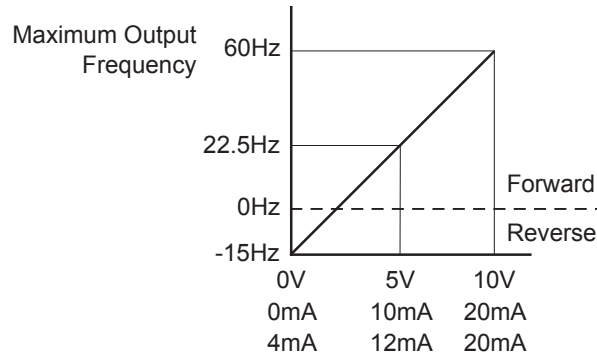
The negative (-) value for the Analog Offset % shows that a negative offset is needed for P4.01.

- C) Analog Gain % = ((60Hz - (-15Hz)) ÷ 60Hz) x 100 = 125%
- D) Mid-point frequency = ((60Hz - (-15Hz)) ÷ 2) + (-15Hz) = 22.5Hz

Parameter Settings

- P4.01: 02 [Negative Input Offset Polarity]
- P4.02: 25 [25% Analog Input Offset]
- P4.03: 125 [125% Analog Input Gain]
- P4.04: 01 [Reverse Motion Enable]

Results



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 Frequency Command. The Maximum Output Frequency 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*

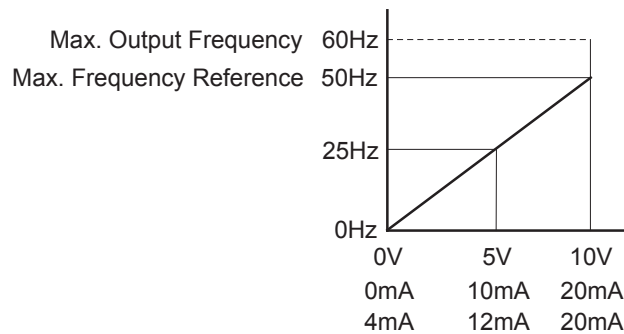
Calculations

- A) Max output frequency = (1750rpm ÷ 1750rpm) x (60Hz) = 60Hz
- B) Analog Offset % = (0Hz ÷ 50Hz) x 100 = 0%
- C) Analog Gain % = ((50Hz - 0Hz) ÷ 60Hz) x 100 = 83.3%
- D) Mid-point frequency = ((50Hz - 0Hz) ÷ 2) + (0Hz) = 25Hz

Parameter Settings

- *P4.01: 00 (default) [Negative Input Offset Polarity]*
- *P4.02: 00 (default) [0% Analog Input Offset]*
- *P4.03: 83.3 [83.3% Analog Input Gain]*
- *P4.04: 00 (default) [Forward Motion Only]*

Results



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

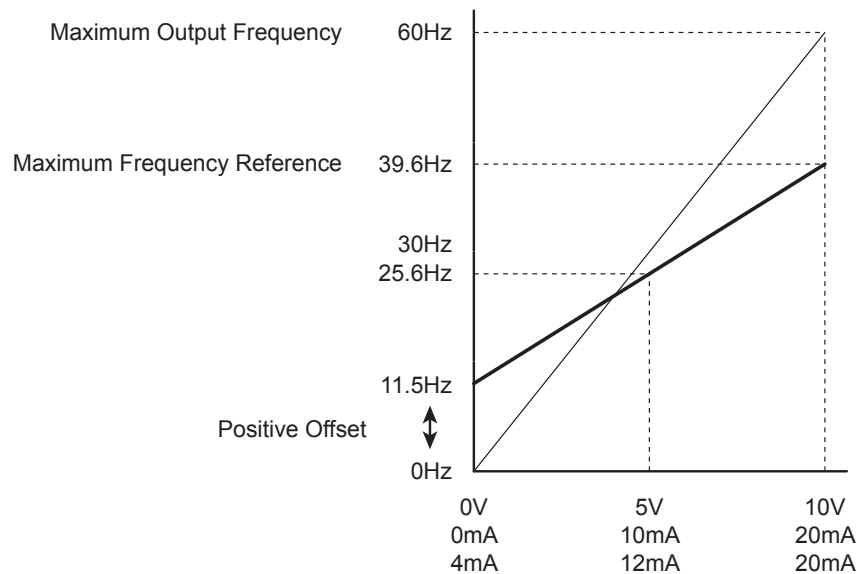
Calculations

- A) Max output frequency = (1750rpm ÷ 1750rpm) x (60Hz) = 60Hz
- B) Analog Offset % = (11.5Hz ÷ 60Hz) x 100 = 19.2%
- C) Analog Gain % = ((39.6Hz – 11.5Hz) ÷ 60Hz) x 100 = 46.8%
- D) Mid-point frequency = ((39.6Hz – 11.5Hz) ÷ 2) + (11.5Hz) = 25.6Hz

Parameter Settings

- P4.01: 01 [Positive Input Offset Polarity]
- P4.02: 19.2 [19.2% Analog Input Offset]
- P4.03: 46.8 [46.8% Analog Input Gain]
- P4.04: 00 (default) [Forward Motion Only]

Results



EXAMPLE 8: INVERT THE ANALOG INPUT SIGNAL

This example illustrates how to invert the analog input signal so that the drive is at 0Hz output at full analog signal, and full output at 0 analog signal.

Parameter Settings

- P4.01: 02 [Negative Input Offset Polarity]
- P4.02: 100.0 [100.0% Analog Input Offset]
- P4.03: 100.0 [100.0% Analog Input Gain]
- P4.04: 01 (default) [Forward Motion Only]



This change might require two of the motor leads to be swapped at the T terminals of the drive.

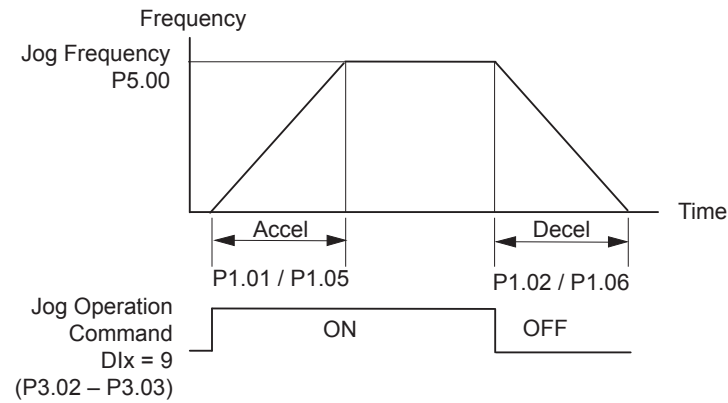
PRESETS PARAMETERS

P5.00 ♦ Jog

Range: 0.0 to 400.0 Hz

Default Setting: 6.0

The Jog Command is selected by a Multi-Function Input Terminal (P3.02 and P3.03) set to the Jog Function (9).



P5.01 ♦ Multi-Speed 1

P5.02 ♦ Multi-Speed 2

P5.03 ♦ Multi-Speed 3

Range: 0.0 to 400.0 Hz

Default Setting: 0.0

The Multi-Function Input Terminals are used to select one of the AC drive Multi-Step speeds. (DI3 or DI4 can be assigned as Multi-Speed Bit 1 or as Multi-Speed Bit 2; refer to P3.02 and P3.03)

The speeds (frequencies) are determined by P5.01 to P5.03.

Multi-Speed Bits		Speed Selection
Bit 2	Bit 1	
OFF	OFF	P4.00: Source of Frequency
OFF	ON	P5.01: Multi-Speed 1
ON	OFF	P5.02: Multi-Speed 2
ON	ON	P5.03: Multi-Speed 3



When all Multi-Speed Inputs are off, the AC drive reverts to the Command Frequency P4.00.

PROTECTION PARAMETERS

P6.00 Electronic Thermal Overload Relay

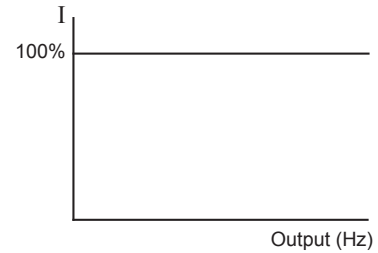
Settings: 00 – Constant Torque
01 – Variable Torque
02 – inactive

Default Setting: 00

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).

P6.00 = 00: Constant Torque (Recommended for inverter/vector duty motors)

Use this setting when using the drives 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.



P6.00 = 01: Variable Torque (Recommended for fan-cooled standard motors)

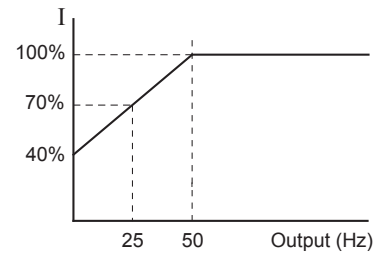
Use this setting when using the drives with motors which are NOT designed specifically for AC drive outputs. Motors with shaft mounted fans offer poor cooling at low speeds; therefore the output can be derated at lower output frequencies. This derated current is for protecting the motor at lower speeds.

The output current is derated as follows:

$$I_{output} (\%) = [f_{output} (\text{Hz}) \times 1.2 (\%/\text{Hz})] + 40\%$$

Example: If the rated motor current is 5A, and the output frequency is 25Hz, the derating will be 70%, and the overload will be 5.25A (150%) for one minute.

- $I_{output} (\%) = [(25\text{Hz}) (1.2 \%/\text{Hz})] + 40\% = 70\%$
- $5\text{A} \times 70\% = 3.5\text{A}$
- $3.5\text{A} \times 150\% = 5.25\text{A}$



P6.00 = 02: inactive

P6.01 Auto Restart after Fault

Range: 0 to 10

Default Setting: 0

After fault occurs (allowable faults: over-current OC, over-voltage OV), the AC drive can be reset/restarted automatically up to 10 times. Setting this parameter to 0 will disable the reset/restart operation after any fault has occurred. When enabled, the AC drive will restart with speed search, which starts at the previous frequency. To set the fault recovery time after a fault, please see (P6.13) base-block time for speed search.

P6.02 Momentary Power Loss

Settings:

Default Setting: 0

- 0 – Stop operation after momentary power loss.
- 1 – Continue operation after momentary power loss, speed search from Speed Reference.
- 2 – Continue operation after momentary power loss, speed search from Minimum Speed.



This parameter will only work if the Source of Operation (P3.00) is set to something other than 0 (Operation determined by digital keypad).

- Refer also to P6.12 (Maximum Allowable Power Loss Time).

P6.03 Reverse Operation Inhibit

Settings: 0 – Enable Reverse Operation
1 – Disable Reverse Operation

Default Setting: 0

This parameter determines whether or not the AC Motor Drive can operate in the reverse direction.

P6.04 Auto Voltage Regulation

Settings: 0 – AVR enabled
1 – AVR disabled
2 – AVR disabled during Decel
3 – AVR disabled during Stop

Default Setting: 0

AVR function automatically regulates the AC drive output voltage to the Maximum Output Voltage (P0.00). For instance, if P0.00 is set at 200VAC and the input voltage is at 200V to 264 VAC, then the Maximum Output Voltage will automatically be regulated to 200VAC.

Without AVR function, the Maximum Output Voltage may vary between 180V to 264 VAC, due to the input voltage varying between 180V to 264 VAC.

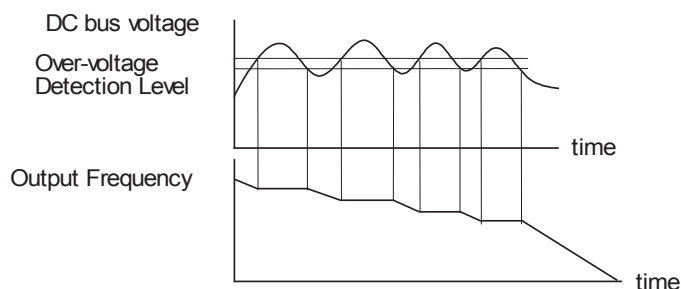
Selecting program value 2 enables the AVR function, but also disables the AVR function during deceleration. AVR improves regulation of the DC bus voltage. With lower DC bus voltage, regeneration and overvoltage faults are reduced, therefore allowing quicker deceleration.

P6.05 Over-Voltage Trip Prevention

Settings: 0 Enable Over-voltage Trip Prevention
1 Disable Over-voltage Trip Prevention

Default Setting: 0

During deceleration, the AC drive DC bus voltage may exceed its Maximum Allowable Value due to motor regeneration. When this function is enabled, the AC drive will stop decelerating, and maintain a constant output frequency. The drive will resume deceleration when the voltage drops below the factory-preset value.



With moderate inertial loads, over-voltage during deceleration will not occur. For applications with high inertia loads, the AC drive will automatically extend the deceleration time.

P6.06 Auto Adjustable Accel/Decel

Settings:

Default Setting: 0

- 0: Linear Accel/Decel – Linear Acceleration and deceleration (Operation by P1.01, P1.02 or P1.05, P1.06 acceleration/deceleration time).
- 1: Auto Accel, Linear Decel – Automatic acceleration, linear deceleration (Operation by automatic acceleration time; P1.02 or P1.06 deceleration time).
- 2: Linear Accel, Auto Decel – Linear acceleration and automatic deceleration (Operation by automatic deceleration time; P1.01 or P1.05 acceleration time).
- 3: Auto Accel/Decel – Automatic acceleration, deceleration (Operation by AC drive auto adjustable control).
- 4: Auto Accel/Decel Stall Prevention – Auto acceleration, deceleration. The auto accel/decel will not be quicker than the settings for acceleration (P1.01 or P1.05) or deceleration (P1.02 or P1.06). The operation is specific to preventing a stall.

If the Auto Accel/Decel is selected, the AC drive will accel/decel in the fastest and smoothest means possible by automatically adjusting the time of accel/decel.

P6.07 Over-Torque Detection Mode

Settings: 0 – Disabled

Default Setting: 0

- 1 – Enabled during constant speed operation
- 2 – Enabled during acceleration

P6.08 Over-Torque Detection Level

Range: 30 to 200%

Default Setting: 150

This parameter sets the Over-Torque Detection level in 1% increments. (The AC drive rated current is equal to 100%.)

- A setting of 100% is proportional to the Rated Output Current of the drive.

P6.09 Over-Torque Detection Time

Range: 0.1 to 10.0

Default Setting: 0.1

This parameter sets the Over-Torque Detection Time in units of 0.1 seconds.

P6.10 Over-current Stall Prevention during Acceleration

P6.11 Over-current Stall Prevention during Operation

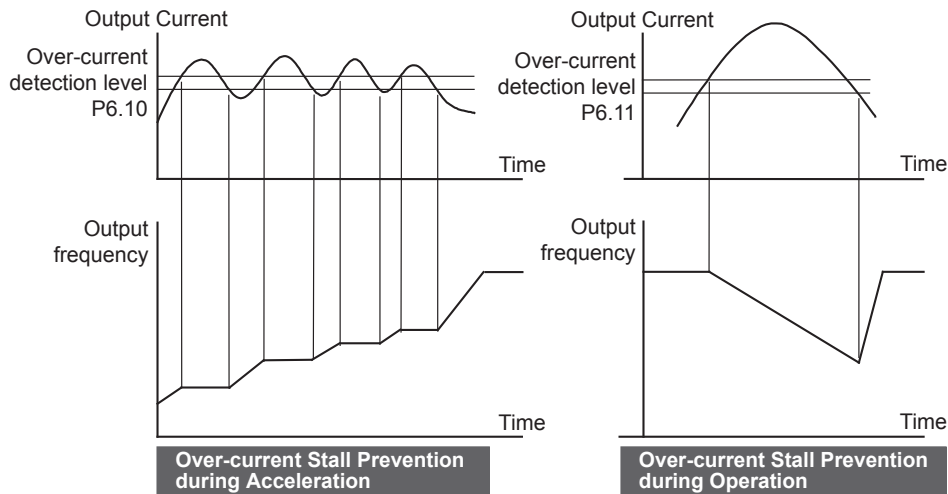
Range: 0 to 200%

Default Setting: 130

- A setting of 0% disables the functionality of this parameter.
- A setting of 100% is equal to the Rated Output Current of the drive.

P6.10: Under certain conditions, the AC drive output current may increase abruptly, and exceed the value specified by P6.10. This is commonly caused by rapid acceleration or excessive load on the motor. When this function is enabled, the AC drive will stop accelerating and maintain a constant output frequency. The AC drive will only resume acceleration when the current drops below the maximum value.

P6.11: During steady-state operation with motor load rapidly increasing, the AC drive output current may exceed the limit specified in P6.11. When this occurs, the output frequency will decrease to maintain a constant motor speed. The drive will accelerate to the steady-state output frequency only when the output current drops below the level specified by P6.11.



P6.12 Maximum Allowable Power Loss Time

Range: 0.3 to 5.0 sec

Default Setting: 2.0

During a power loss, if the power loss time is less than the time defined by this parameter, the AC drive will resume operation. If the Maximum Allowable Power Loss Time is exceeded, the AC drive output is turned off.

P6.13 Base-Block Time for Speed Search

Range: 0.3 to 5.0 sec

Default Setting: 0.5

When a momentary power loss is detected, the AC drive turns off for a specified time interval determined by P6.13 before resuming operation. This time interval is called Base-Block. This parameter should be set to a value where the residual output voltage due to regeneration is nearly zero, before the drive resumes operation.

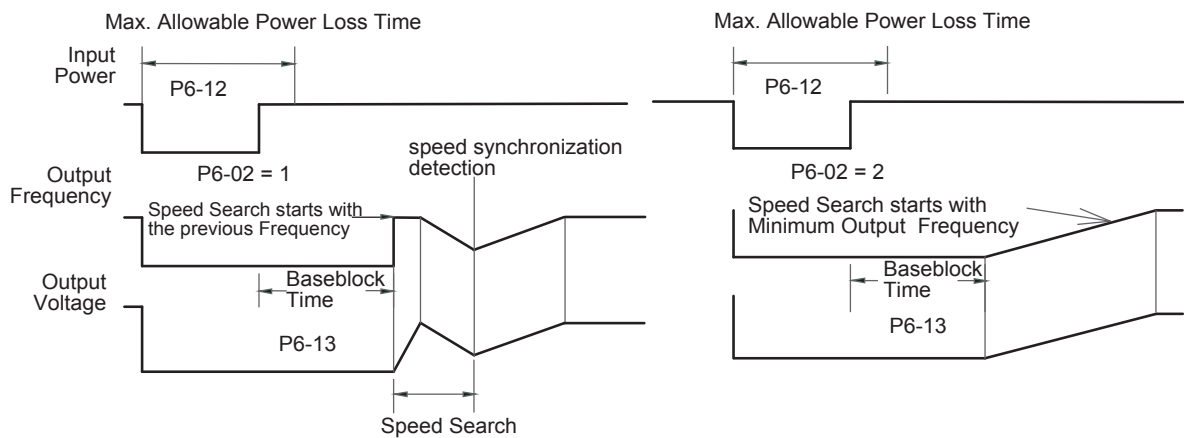
- This parameter also determines the searching time when performing external Base-Block and Fault Reset (P6.01).

P6.14 Maximum Speed Search Current Level

Range: 30 to 200%

Default Setting: 150

Following a power failure, the AC drive will start its speed search operation only if the output current is greater than the value determined by P6.14. When the output current is less than that of P6.14, the AC drive output frequency is at a “speed synchronization point.” The drive will start to accelerate or decelerate back to the operating frequency at which it was running prior to the power failure.



P6.15 Upper Bound of Output Frequency

Range: 0.1 to 400 Hz

Default Setting: 400.0

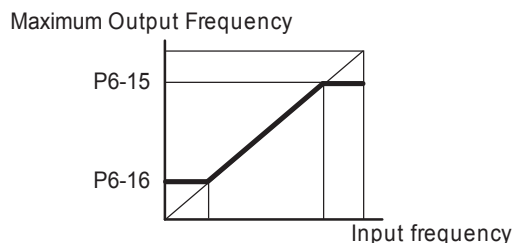
P6.16 Lower Bound of Output Frequency

Range: 0.0 to 400 Hz

Default Setting: 0.0

The Upper/Lower Bound is to prevent operation error and machine damage.

- The Upper Bound parameter (P6.15) must be greater than or equal to the Lower Bound of Output Frequency (P6.16).
- If the Upper Bound of Output Frequency is 50Hz and the Maximum Output Frequency is 60Hz, then any command frequency above 50 Hz will generate a 50Hz output from the drive.
- The Lower Bound parameter (P6.16) must be less than or equal to the Upper Bound of Output Frequency (P6.15).
- If the Lower Bound of Output Frequency is 10Hz, and the Minimum Output Frequency (P2.06) is set at 1.0Hz, then any Command Frequency between 1–10 Hz will generate a 10Hz output from the drive.
- The Output Frequency is also limited by the Motor Maximum RPM (P0.04).



P6.30 Line Start Lockout

Settings: 0 – Enable Line Start Lockout
1 – Disable Line Start Lockout

Default Setting: 0

When this parameter is enabled, the AC 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.

When this parameter is disabled, the AC Drive will start the motor when powered up with a RUN command already applied.

- *This parameter is available only with AC drive firmware v1.07 or higher. Refer to P9.39 to determine the drive's firmware version.*

P6.31 Present Fault Record**P6.32 Second Most Recent Fault Record****P6.33 Third Most Recent Fault Record****P6.34 Fourth Most Recent Fault Record****P6.35 Fifth Most Recent Fault Record****P6.36 Sixth Most Recent Fault Record**

Settings: 0 – No Fault occurred

Default Setting: 0

- 1 – Over-current (oc)
- 2 – Over-voltage (ov)
- 3 – Overheat (oH)
- 4 – Overload (oL)
- 5 – Overload 1 (oL1)
- 6 – Overload 2 (oL2)
- 7 – External Fault (EF)
- 8 – CPU failure 1 (CF1)
- 9 – CPU failure 2 (CF2)
- 10 – CPU failure 3 (CF3)
- 11 – Hardware Protection Failure (HPF)
- 12 – Over-current during accel (OCA)
- 13 – Over-current during decel (OCd)
- 14 – Over-current during steady state (OCn)
- 18 – External Base Block (bb)
- 19 – Auto Adjust Accel/decel failure (cFA)
- 20 – Software protection code (co)

DISPLAY PARAMETERS

P8.00 ♦ User Defined Display Function

Settings:

Default Setting: 0

- 0 – Output Frequency (Hz)
- 1 – Motor Speed (RPM)
- 2 – Output Frequency x P8.01
- 3 – Output Current (A)
- 4 – Motor Output Current (%)
- 5 – Output Voltage(V)
- 6 – DC Bus Voltage (V)
- 9 – Frequency Setpoint

P8.01 ♦ Frequency Scale Factor

Range: 0.1 to 160.0

Default Setting: 1.0

The coefficient K determines the multiplying factor for the user-defined unit.

The display value is calculated as follows:

- *Display value = output frequency x K*

The display window is only capable of showing four digits, but P8.01 can be used to create larger numbers.

The display window uses decimal points to signify numbers up to three digits as explained below:

<u>DISPLAY</u>	<u>NUMBER REPRESENTED</u>
9999	The absence of a decimal point indicates a four digit integer.
999.9	A single decimal point between the middle and the right-most numbers is a true decimal point; it separates ones and tenths as in "30.5 (thirty and one-half)."
9999.	A single decimal point after the right-most number is not a true decimal point; instead it indicates that a zero follows the right-most numbers. For example, the number 1230 would be displayed as "123."

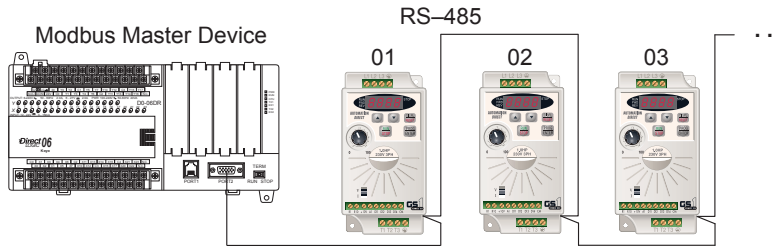
COMMUNICATIONS PARAMETERS

P9.00 Communication Address

Range: 1 to 254

Default Setting: 1

If the AC drive is controlled by RS-485 serial communication, the communication address must be set via this parameter.



P9.01 Transmission Speed

- Settings:
- 0 – 4800 baud data transmission speed
 - 1 – 9600 baud data transmission speed
 - 2 – 19200 baud data transmission speed

Default Setting: 1

Users can set parameters and control the operation of the AC drive via the RS-485 serial interface of a Modbus master. This parameter is used to set the transmission speed between the master and AC drive.

P9.02 Communication Protocol

- Settings:
- 0 – MODBUS ASCII mode <7 data bits, no parity, 2 stop bits>
 - 1 – MODBUS ASCII mode <7 data bits, even parity, 1 stop bit>
 - 2 – MODBUS ASCII mode <7 data bits, odd parity, 1 stop bit>
 - 3 – MODBUS RTU mode <8 data bits, no parity, 2 stop bits>
 - 4 – MODBUS RTU mode <8 data bits, even parity, 1 stop bit>
 - 5 – MODBUS RTU mode <8 data bits, odd parity, 1 stop bit>

Default Setting: 0

P9.03 Transmission Fault Treatment

- Settings:
- 0 – Display fault and continue operating
 - 1 – Display fault and RAMP to stop
 - 2 – Display fault and COAST to stop
 - 3 – No fault displayed and continue operating

Default Setting: 0

P9.04 Time Out Detection

- Settings:
- 0 – Disable
 - 1 – Enable

Default Setting: 0

When this parameter is set to 01, 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. The separation between characters within a message cannot exceed 500ms.

P9.05 Time Out Duration

Range: 0.1 to 60.0 seconds

Default Setting: 0.5

P9.07 ♦ Parameter Lock

- Settings:
- 0 – All parameters can be set and read
 - 1 – All parameters are read-only

Default Setting: 0

P9.08 Restore to Default

Range: 0 to 99

Default Setting: 0

•• Setting 99 restores all parameters to factory defaults. ••

- P9.11** ♦ **Block Transfer Parameter 1**
- P9.12** ♦ **Block Transfer Parameter 2**
- P9.13** ♦ **Block Transfer Parameter 3**
- P9.14** ♦ **Block Transfer Parameter 4**
- P9.15** ♦ **Block Transfer Parameter 5**
- P9.16** ♦ **Block Transfer Parameter 6**
- P9.17** ♦ **Block Transfer Parameter 7**
- P9.18** ♦ **Block Transfer Parameter 8**
- P9.19** ♦ **Block Transfer Parameter 9**
- P9.20** ♦ **Block Transfer Parameter 10**

Range: P0.00 to P8.01, and 9.99

Default Setting: 9.99

Range: Default Setting:

- Setting 9.99 disables this parameter.

The block transfer parameters (P9.11~P9.20) are used to read and write to and from non-consecutive drive addresses via Modbus.

For writing to any of the parameters from P0.00 to P8.01, a group of 10 block transfer parameters (P9.11 to P9.20) is available in the GS1 AC drive. This sequential block of parameters can be used to “group” various miscellaneous non-sequential parameters, so that you can update the parameters in one programming write block instead of having to use multiple write commands.

For example, it would typically take three different write commands to change the three non-sequential parameters Accel Time 1 (P1.01), Accel S-curve (P1.03), and Multi-speed 1 (P5.01).

However, you could make the same three changes using one write command by setting P9.11 to P1.01, P9.12 to P1.03, and P9.13 to P5.01, so that the parameters become sequential.

P9.26 ♦ **Serial Comm Speed Reference**

Range: 0.0 to 400.0 Hz

Default Setting: 60.0

This parameter is used to set the Master Frequency when the AC drive is controlled by communication interface.



In order for this parameter to function, the Source of Frequency Command (P4.00) must be set to 5.

P9.27 ♦ **Serial Comm RUN Command**

Settings: 0 – Stop
1 – Run

Default Setting: 0

- Do not attempt to both Run and Jog (P9.27 & P9.31) in one Modbus write command.

P9.28 ♦ **Serial Comm Direction Command**

Settings: 0 – Forward
1 – Reverse

Default Setting: 0

P9.29 ♦ **Serial Comm External Fault**

Settings: 0 – No fault
1 – External fault

Default Setting: 0

P9.30 ♦ **Serial Comm Fault Reset**

Settings: 0 – No action
1 – Fault Reset

Default Setting: 0

P9.31 ♦ **Serial Comm JOG Command**

Settings: 0 – Stop
1 – Jog

Default Setting: 0

- Do not attempt to both Run and Jog (P9.27 & P9.31) in one Modbus write command.

P9.39 Firmware Version

Settings: Read Only

Default Setting: Factory Set

- This parameter is available only with AC drive firmware v1.07 or higher.

P9.41 GS Series Number

Settings: 1 – GS1
2 – GS2
3 – GS3
4 – GS4

Default Setting: ##

P9.42 Manufacturer Model Information

Settings: 0 – GS1-10P2 (115V, 1ph, 0.25hp)
1 – GS1-10P5 (115V, 1ph, 0.5hp)
2 – GS1-20P2 (230V, 1ph/3ph, 0.25hp)
3 – GS1-20P5 (230V, 1ph/3ph, 0.5hp)
4 – GS1-21P0 (230V, 1ph/3ph, 1hp)
5 – GS1-22P0 (230V, 3ph, 2hp)

Default Setting: ##

GS1 MODBUS COMMUNICATIONS



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Unless otherwise stated, numeric data is in the unsigned decimal data format.

COMMUNICATIONS PARAMETERS SUMMARY (P9.xx)

A summary of the GS1 Communications Parameters is listed below. For a complete listing of the GS1 Parameters, refer to Chapter 4.

GS1 Parameter Summary – Communications Parameters (P9.xx)			
Parameter	Description	Range	Default
P9.00	Communication Address	1 to 254	1
P9.01	Transmission Speed	0: 4800 baud 1: 9600 baud 2: 19200 baud	1
P9.02	Communication Protocol	0: MODBUS ASCII mode, 7 data bits, no parity, 2 stop bits 1: MODBUS ASCII mode, 7 data bits, even parity, 1 stop bit 2: MODBUS ASCII mode, 7 data bits, odd parity, 1 stop bit 3: MODBUS RTU mode, 8 data bits, no parity, 2 stop bits 4: MODBUS RTU mode, 8 data bits, even parity, 1 stop bit 5: MODBUS RTU mode, 8 data bits, odd parity, 1 stop bit	0
P9.03	Transmission Fault Treatment	0: Display fault and continue operating 1: Display fault and RAMP to stop 2: Display fault and COAST to stop 3: No fault displayed and continue operating	0
P9.04	Time Out Detection	0: Disable 1: Enable	0
P9.05	Time Out Duration	0.1 to 60.0 seconds	0.5
◆ P9.07	Parameter Lock	0: All parameters can be set and read 1: All parameters are read-only	0
P9.08	Restore to Default	99: Restores all parameters to factory defaults	0
◆ P9.11	Block Transfer Parameter 1	Parameters 0.00 to 8.01, 9.99	9.99
◆ P9.12	Block Transfer Parameter 2	Parameters 0.00 to 8.01, 9.99	9.99
◆ P9.13	Block Transfer Parameter 3	Parameters 0.00 to 8.01, 9.99	9.99
◆ P9.14	Block Transfer Parameter 4	Parameters 0.00 to 8.01, 9.99	9.99
◆ P9.15	Block Transfer Parameter 5	Parameters 0.00 to 8.01, 9.99	9.99
◆ P9.16	Block Transfer Parameter 6	Parameters 0.00 to 8.01, 9.99	9.99
◆ P9.17	Block Transfer Parameter 7	Parameters 0.00 to 8.01, 9.99	9.99
◆ P9.18	Block Transfer Parameter 8	Parameters 0.00 to 8.01, 9.99	9.99
◆ P9.19	Block Transfer Parameter 9	Parameters 0.00 to 8.01, 9.99	9.99
◆ P9.20	Block Transfer Parameter 10	Parameters 0.00 to 8.01, 9.99	9.99
◆ P9.26	Serial Comm Speed Reference	0.0 to 400.0 Hz	60.0
◆ P9.27	Serial Comm RUN Command	0: Stop 1: Run	0
◆ P9.28	Serial Comm Direction Command	0: Forward 1: Reverse	0
◆ P9.29	Serial Comm External Fault	0: No fault 1: External fault	0
◆ P9.30	Serial Comm Fault Reset	0: No action 1: Fault Reset	0
◆ P9.31	Serial Comm JOG Command	0: Stop 1: Jog	0
P9.39 *	Firmware Version	###	###
P9.41	GS Series Number	1: GS1 2: GS2 3: GS3 4: GS4	##
P9.42	Manufacturer Model Information	0: GS1-10P2 (120V, 1ph, 0.25HP) 1: GS1-10P5 (120V, 1ph, 0.5HP) 2: GS1-20P2 (230V, 1ph/3ph, 0.25HP) 3: GS1-20P5 (230V, 1ph/3ph, 0.5HP) 4: GS1-21P0 (230V, 1ph/3ph, 1HP) 5: GS1-22P0 (230V, 3ph, 2HP)	##

* This parameter is available only with AC drive firmware v1.07 or higher.
◆ Parameter can be set during RUN Mode.

GS1 PARAMETER MEMORY ADDRESSES



The octal address also can be used in the WX / RX instruction of the DL-250-1, DL-450, and DL05.

Parameter Memory Addresses – Motor Parameters (P0.xx)				
GS1 Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
P0.00	Motor Nameplate Voltage	0000	40001	0
P0.01	Motor Nameplate Amps	0001	40002	1
P0.02	Motor Base Frequency	0002	40003	2
P0.03	Motor Base RPM	0003	40004	3
P0.04	Motor Maximum RPM	0004	40005	4

* For Modbus Decimal addresses used with CLICK PLCs, insert another zero as the next-to-most-significant digit, e.g., 402333 instead of 42333.

Parameter Memory Addresses – Ramp Parameters (P1.xx)				
GS1 Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
P1.00	Stop Methods	0100	40257	400
◆ P1.01	Acceleration Time 1	0101	40258	401
◆ P1.02	Deceleration Time 1	0102	40259	402
P1.03	Accel S-curve	0103	40260	403
P1.04	Decel S-curve	0104	40261	404
◆ P1.05	Acceleration Time 2	0105	40262	405
◆ P1.06	Deceleration Time 2	0106	40263	406
P1.07	Select method to use 2nd Accel/Decel	0107	40264	407
P1.08	Accel 1 to Accel 2 frequency transition	0108	40265	410
P1.09	Decel 1 to Decel 2 frequency transition	0109	40266	411
P1.10	Skip Frequency 1	010A	40267	412
P1.11	Skip Frequency 2	010B	40268	413
P1.12	Skip Frequency 3	010C	40269	414
P1.17	Skip Frequency Band	0111	40274	421
P1.19	DC Injection Voltage Level	0113	40276	423
P1.20	DC Injection during Start-up	0114	40277	424
P1.21	DC Injection during Stopping	0115	40278	425
P1.22	Start-point for DC Injection	0116	40279	426

◆ Parameter can be set during RUN Mode.

* For Modbus Decimal addresses used with CLICK PLCs, insert another zero as the next-to-most-significant digit, e.g., 402333 instead of 42333.

Parameter Memory Addresses – Volts/Hertz Parameters (P2.xx)				
GS1 Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
P2.00	Volts/Hertz Settings	0200	40513	1000
◆ P2.01	Slip Compensation	0201	40514	1001
◆ P2.03	Manual Torque Boost	0203	40516	1003
P2.04	Mid-point Frequency	0204	40517	1004
P2.05	Mid-point Voltage	0205	40518	1005
P2.06	Min. Output Frequency	0206	40519	1006
P2.07	Min. Output Voltage	0207	40520	1007
P2.08	PWM Carrier Frequency	0208	40521	1010

◆ Parameter can be set during RUN Mode.

* For Modbus Decimal addresses used with CLICK PLCs, insert another zero as the next-to-most-significant digit, e.g., 402333 instead of 42333.

Parameter Memory Addresses – Digital Parameters (P3.xx)				
GS1 Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
P3.00	Source of Operation Command	0300	40769	1400
P3.01	Multi-function Inputs 1 & 2 (DI1 & DI2)	0301	40770	1401
P3.02	Multi-function Input 3 (DI3)	0302	40771	1402
P3.03	Multi-function Input 4 (DI4)	0303	40772	1403
P3.11	Multi-Function Output Terminal	030B	40780	1413
◆ P3.16	Desired Frequency	0310	40785	1420
◆ P3.17	Desired Current	0311	40786	1421
◆ Parameter can be set during RUN Mode.				
* For Modbus Decimal addresses used with CLICK PLCs, insert another zero as the next-to-most-significant digit, e.g., 402333 instead of 42333.				

Parameter Memory Addresses – Analog Parameters (P4.xx)				
GS1 Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
P4.00	Source of Frequency Command	0400	41025	2000
P4.01	Analog Input Offset Polarity	0401	41026	2001
◆ P4.02	Analog Input Offset	0402	41027	2002
◆ P4.03	Analog Input Gain	0403	41028	2003
P4.04	Analog Input Reverse Motion Enable	0404	41029	2004
P4.05	Loss of ACI Signal (4–20mA)	0405	41030	2005
◆ Parameter can be set during RUN Mode.				
* For Modbus Decimal addresses used with CLICK PLCs, insert another zero as the next-to-most-significant digit, e.g., 402333 instead of 42333.				

Parameter Memory Addresses – Presets Parameters (P5.xx)				
GS1 Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
◆ P5.00	Jog	0500	41281	2400
◆ P5.01	Multi-Speed 1	0501	41282	2401
◆ P5.02	Multi-Speed 2	0502	41283	2402
◆ P5.03	Multi-Speed 3	0503	41284	2403
◆ Parameter can be set during RUN Mode.				
* For Modbus Decimal addresses used with CLICK PLCs, insert another zero as the next-to-most-significant digit, e.g., 402333 instead of 42333.				

Parameter Memory Addresses – Protection Parameters (P6.xx)				
GS1 Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
P6.00	Electronic Thermal Overload Relay	0600	41537	3000
P6.01	Auto Restart after Fault	0601	41538	3001
P6.02	Momentary Power Loss	0602	41539	3002
P6.03	Reverse Operation Inhibit	0603	41540	3003
P6.04	Auto Voltage Regulation	0604	41541	3004
P6.05	Over-Voltage Trip Prevention	0605	41542	3005
P6.06	Auto Adjustable Accel/Decel	0606	41543	3006
P6.07	Over-Torque Detection Mode	0607	41544	3007
P6.08	Over-Torque Detection Level	0608	41545	3010
P6.09	Over-Torque Detection Time	0609	41546	3011
P6.10	Over-Current Stall Prevention during Acceleration	060A	41547	3012
P6.11	Over-Current Stall Prevention during Operation	060B	41548	3013
P6.12	Maximum Allowable Power Loss Time	060C	41549	3014
P6.13	Base-Block Time for Speed Search	060D	41550	3015
P6.14	Maximum Speed Search Current Level	060E	41551	3016
P6.15	Upper Bound of Output Frequency	060F	41552	3017
P6.16	Lower Bound of Output Frequency	0610	41553	3020
P6.30 **	Line Start Lockout	061E	41567	3036
P6.31	Present Fault Record	061F	41568	3037
P6.32	Second Most Recent Fault Record	0620	41569	3040
P6.33	Third Most Recent Fault Record	0621	41570	3041
P6.34	Fourth Most Recent Fault Record	0622	41571	3042
P6.35	Fifth Most Recent Fault Record	0623	41572	3043
P6.36	Sixth Most Recent Fault Record	0624	41573	3044
<p>◆ Parameter can be set during RUN Mode.</p> <p>* For Modbus Decimal addresses used with CLICK PLCs, insert another zero as the next-to-most-significant digit, e.g., 402333 instead of 42333.</p> <p>** This parameter is available only with AC drive firmware v1.07 or higher (refer to P9.39 for firmware version).</p>				

Parameter Memory Addresses – Display Parameters (P8.xx)				
GS1 Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
◆ P8.00	User Defined Display Function	0800	42049	4000
◆ P8.01	Frequency Scale Factor	0801	42050	4001
<p>◆ Parameter can be set during RUN Mode.</p> <p>* For Modbus Decimal addresses used with CLICK PLCs, insert another zero as the next-to-most-significant digit, e.g., 402333 instead of 42333.</p>				

Parameter Memory Addresses – Communications Parameters (P9.xx)				
GS1 Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
P9.00	Communication Address	0900	42305	4400
P9.01	Transmission Speed	0901	42306	4401
P9.02	Communication Protocol	0902	42307	4402
P9.03	Transmission Fault Treatment	0903	42308	4403
P9.04	Time Out Detection	0904	42309	4404
P9.05	Time Out Duration	0905	42310	4405
◆ P9.07	Parameter Lock	0907	42312	4407
P9.08	Restore to Default	0908	42313	4410
◆ P9.11	Block Transfer Parameter 1	090B	42316	4413
◆ P9.12	Block Transfer Parameter 2	090C	42317	4414
◆ P9.13	Block Transfer Parameter 3	090D	42318	4415
◆ P9.14	Block Transfer Parameter 4	090E	42319	4416
◆ P9.15	Block Transfer Parameter 5	090F	42320	4417
◆ P9.16	Block Transfer Parameter 6	0910	42321	4420
◆ P9.17	Block Transfer Parameter 7	0911	42322	4421
◆ P9.18	Block Transfer Parameter 8	0912	42323	4422
◆ P9.19	Block Transfer Parameter 9	0913	42324	4423
◆ P9.20	Block Transfer Parameter 10	0914	42325	4424
◆ P9.26	Serial Comm Speed Reference	091A	42331	4432
◆ P9.27	Serial Comm RUN Command	091B	42332	4433
◆ P9.28	Serial Comm Direction Command	091C	42333	4434
◆ P9.29	Serial Comm External Fault	091D	42334	4435
◆ P9.30	Serial Comm Fault Reset	091E	42335	4436
◆ P9.31	Serial Comm JOG Command	091F	42336	4437
P9.39 **	Firmware Version	0927	42344	4447
P9.41	GS Series Number	0929	42346	4451
P9.42	Manufacturer Model Information	092A	42347	4452
◆ Parameter can be set during RUN Mode.				
* For Modbus Decimal addresses used with CLICK PLCs, insert another zero as the next-to-most-significant digit, e.g., 402333 instead of 42333.				
** This parameter is available only with AC drive firmware v1.07 or higher.				

GS1 STATUS ADDRESSES

The GS1 Series AC drive has status memory addresses that are used to monitor the AC drive. The status addresses and value definitions are listed below.

STATUS ADDRESSES (READ ONLY)

GS1 Status Addresses			
Description	Hexadecimal	Modbus Decimal	Octal
Status Monitor 1	2100	48449	20400
Status Monitor 2	2101	48450	20401
Frequency Command F	2102	48451	20402
Output Frequency H	2103	48452	20403
Output Current A	2104	48453	20404
DC Bus Voltage d	2105	48454	20405
Output Voltage U	2106	48455	20406
Motor RPM	2107	48456	20407
Scale Frequency (Low Word)	2108	48457	20410
Scale Frequency (High Word)	2109	48458	20411
% Load	210B	48460	20413
Firmware Version	2110	48465	20420

Status Monitor 1 – Error Codes h2100

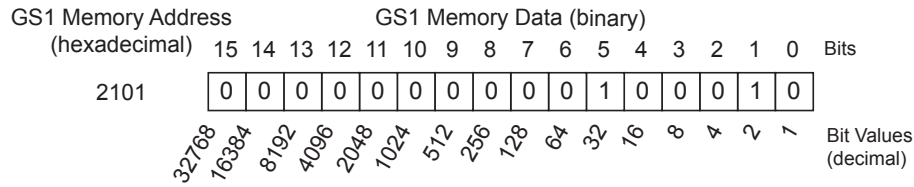
- | | |
|-------------------------|--|
| 00: No fault occurred | 11: Hardware Protection Failure (HPF) |
| 01: Over-current(oc) | 12: Over-current during accel (ocA) |
| 02: Over-voltage(ov) | 13: Over-current during decel (ocd) |
| 03: Overheat (oH) | 14: Over-current during steady state (ocn) |
| 04: Overload (oL) | 16: Low Voltage (Lv) |
| 05: Overload 1 (oL1) | 18: External Base-Block (bb) |
| 06: Overload 2 (oL2) | 19: Auto Adjust accel/decel Failure (cFA) |
| 07: External Fault (EF) | 20: Software Protection Code (codE) |
| 08: CPU Failure 1 (cF1) | |
| 09: CPU Failure 2 (cF2) | |
| 10: CPU Failure 3 (cF3) | |



Some error codes will not display under status address if only a warning message. The drive must have a hard trip. To manually check this, set "External Fault" to Terminal Control, and trip. This will simulate the result of a hard trip.

Status Monitor 2

h2101



ADDRESS BIT(s)	BIT(s) VALUE BINARY (DECIMAL)	AC DRIVE STATUS
0 and 1	00 (0)	Drive operation stopped (STOP)
	01 (1)	Run to Stop transition
	10 (2)	Standby
	11 (3)	Drive operation running (RUN)
2	1 (4)	JOG active
3 and 4	00 (0)	Rotational direction forward (FWD)
	01 (8)	REV to FWD transition
	10 (16)	FWD to REV transition
	11 (24)	Rotational direction reverse (REV)
5	1 (32)	Source of frequency determined by serial comm interface (P4.00 = 5)
6	1 (64)	Source of frequency determined by AI terminal (P4.00 = 2, 3, or 4)
7	1 (128)	Source of operation determined by serial comm interface (P3.00 = 3 or 4)
8	1 (256)	Parameters have been locked (P9.07 = 1)
9 ~ 15	N/A	Reserved

Frequency Command F (xxx.x)

h2102

Status location for the frequency setting of the AC drive.

Output Frequency H (xxx.x)

h2103

Status location for the actual operating frequency present at terminals T1, T2, and T3.

Output Current A (xxx.x)

h2104

Status location for the output current present at terminals T1, T2, and T3.

DC BUS Voltage d (xxx.x)

h2105

Status location for the DC Bus Voltage.

Output Voltage U (xxx.x)

h2106

Status location for the output voltage present at terminals T1, T2, and T3. (This is the RMS voltage between phases.)

Motor RPM

h2107

Status location for the present estimated speed of the motor.

Scale Frequency (Low word)

h2108

Status location for result of output frequency x P8.01 (low word).

Scale Frequency (High word)

h2109

Status location for result of output frequency x P8.01 (high word).

% Load

h210B

Status location for the amount of load on the AC drive. (Output Current ÷ Drive Rated Current) x 100.

Firmware Version

h2110

Status location for firmware version of the AC drive.

BLOCK TRANSFER PARAMETERS FOR MODBUS PROGRAMS

For writing to any of the parameters from P0.00 to P8.01, a group of 10 block transfer parameters (P9.11 to P9.20) is available in the GS1 AC drive. This sequential block of parameters can be used to “group” various miscellaneous non-sequential parameters, so that you can update the parameters in one programming write block instead of having to use multiple write commands.

For example, it would typically take three different write commands to change the three non-sequential parameters Accel Time 1 (P1.01), Accel S-curve (P1.03), and Multi-speed 1 (P5.01).

However, you could make the same three changes using one write command by setting P9.11 to P1.01, P9.12 to P1.03, and P9.13 to P5.01, so that the parameters become sequential.

COMMUNICATING WITH AUTOMATIONDIRECT PLCs

The following steps explain how to connect and communicate with GS1 AC drives using AutomationDirect PLCs.



GS1 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, P9.04, and P9.05.

STEP 1: CHOOSE THE APPROPRIATE CPU

The GS1 AC drives will communicate with the following AutomationDirect PLCs using Modbus communications.

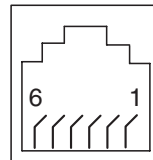
- Modbus control is easier to accomplish from a DirectLOGIC PLC with an RS-485 port and MRX/MWX, or from a CLICK PLC using Send/Receive instructions.

Choose Your CPU	
Primary Choices	CLICK Analog CPU with Send/Receive instructions & RS-485 comm port D2-260 or DL06 with MRX / MWX instructions & RS-485 comm port
Secondary Choices	CLICK Basic CPU with Send/Receive instructions & RS-232 comm port DL05, D2-250(-1), or D4-450 with RX / WX instructions & RS-232 comm port

STEP 2: MAKE THE CONNECTIONS

GS1 RS-485 SERIAL COMM PORT

**GS1 Serial Comm Port
RS-485 Interface
RJ12 (6P4C)**



- 1: +17V
- 2: GND
- 3: SG-
- 4: SG+
- 5: nc
- 6: reserved

The GS1 Comm Port requires an RS-485 input. RS-232 signals can be converted to RS-485 by using a separate converter.

PLC Connections for RS-485 Modbus RTU Control of GS1 Drive					
Drive	PLC *	PLC Port *	Communication	Direct Cable	Length
GS1	CLICK	3	RS-485	ZL-RJ12-CBL-2P ***	2m [6.6 ft] ***
	DL05	2 **	RS-232 – RS-485 **	N/A **	
	DL06 D0-DCM	2	RS-485	GS-485HD15-CBL-2 ***	2m [6.6 ft] ***
	D2-DCM D2-250(-1)	2 **	RS-232 – RS-485 **	N/A **	
	D2-260	2	RS-485	GS-485HD15-CBL-2 ***	2m [6.6 ft] ***
	D4-450	3 **	RS-232 – RS-485 **	N/A **	

* If a PLC type or port is not listed in this chart, it cannot function as a Modbus RTU master.
 ** Requires RS-232–RS-485 converter & generic cabling options described later in this chapter.
 *** Termination resistors not required due to short cable length.

RS-485 CONNECTIONS FOR MULTIPLE DRIVES

ZIPLink™ RS-485 communication boards (ZL-CDM-RJ12X4 or ZL-CDM-RJ12X10) provide an easy means to break out the RS-485 signal to several drives at one location, which creates a star configuration. However, the transmission errors are negligible, so this configuration is acceptable for proper operation of the VFDs.

RS-485 DIRECT CONNECTIONS

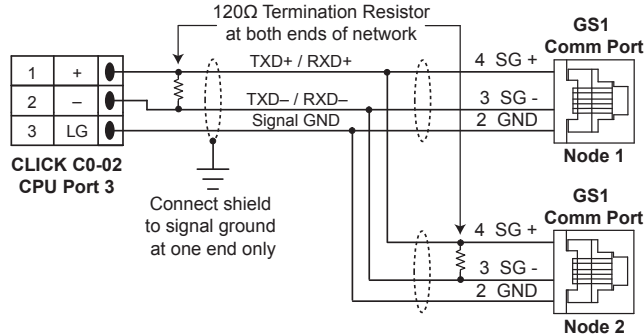


Termination Resistors are required on both ends of RS-485 networks; especially on long runs. Select resistors that match the impedance rating of the cable (between 100 and 500W).

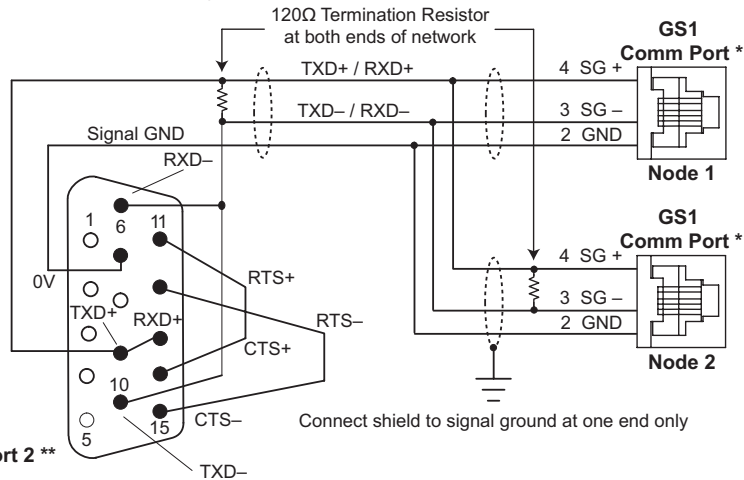


Recommended RS-485 cable: Belden 9842 or equivalent.

CLICK C0-02: RS-485 Connection Wiring



D0-DCM/DL06/DL260: RS-485 Connection Wiring



D0-DCM/DL06/DL260 Port 2 **

* Consider using ZIPLink RJ12 Feedthrough Modules [ZL-RTB-RJ12](#) for easy wiring termination.
 ** Consider using ZIPLink 15-pin high-density Comm Port Adapter, [ZL-CMA15](#) or [ZL-CMA15L](#), for easy wiring termination.

For Single Cable Runs of 2m (6.6 ft) or less to only one AC Drive: Use pre-terminated cable [GS-485HD15-CBL-2](#) for easy wiring.

RS-232C TO RS-485 CONVERSION

An RS-485 network cable can span up to 1000 meters (4000 feet). However, most DirectLOGIC PLCs have only RS-232C communication ports, and require an FA-ISOCOCON (RS-232C to RS-422/485 network adapter) in order to make an RS-485 connection.

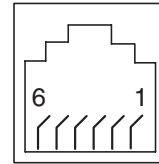


If an FA-ISOCOCON module is used, set the module DIP switches as required. Refer to the FA-ISOCOCON manual for more detailed information.

FA-ISOCOCON 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)

FA-ISOCOCON 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

Use the following wiring diagrams to connect DirectLOGIC RS-232C PLCs to a GS1 Series AC drive with an FA-ISOCOCON network adapter module:

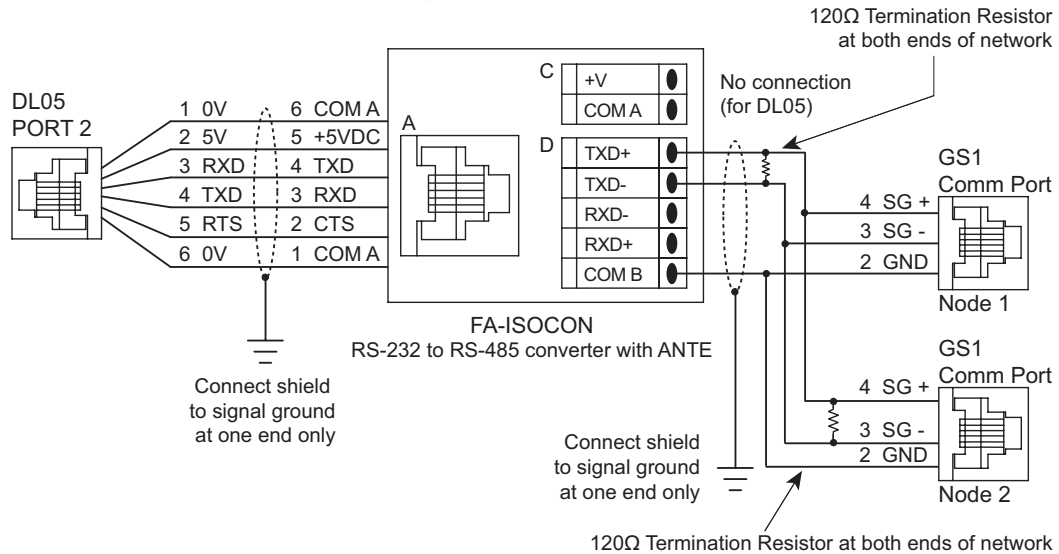


Recommended cable for RS-232: Belden 8102 or equivalent.

Recommended cable for RS-485: Belden 9842 or equivalent.

Various pre-terminated cables for specific wiring connections are available from AutomationDirect, as listed in applicable individual wiring sections of this chapter.

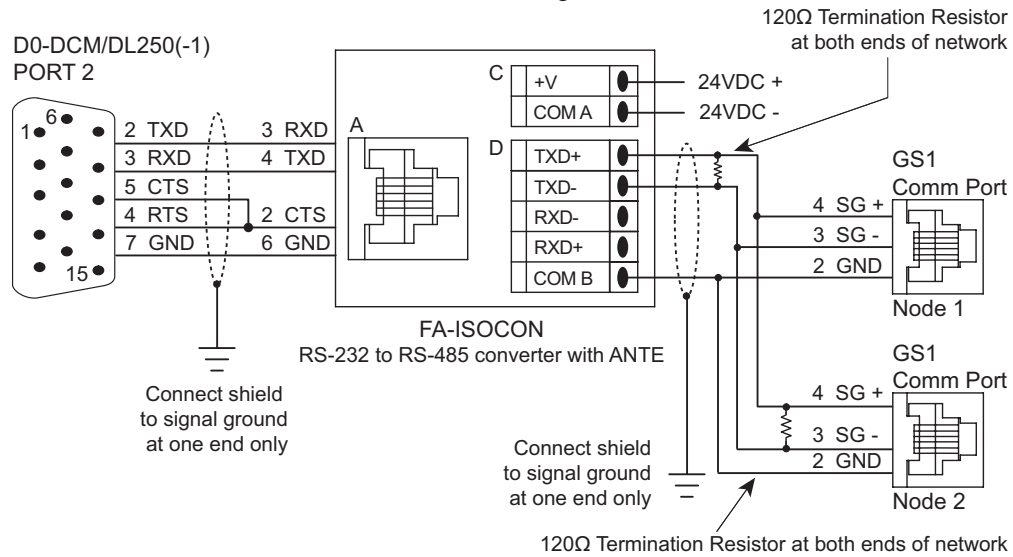
DL05: RS-232C to RS-485 Connection Wiring



Cable D0-DSCBL (12ft; 3.7m) is available for connecting the DL05 to the FA-ISOCOCON.

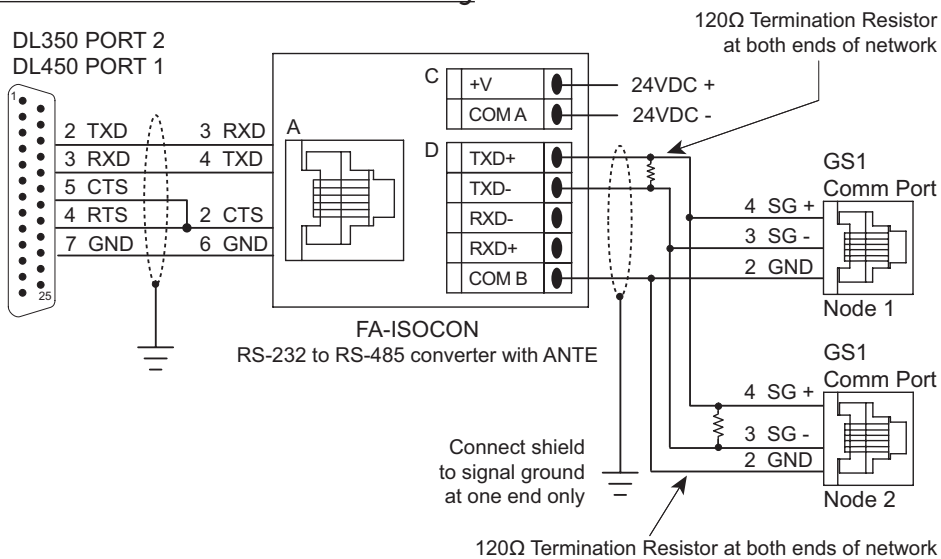
For a single run to only one AC Drive, cable GS-ISOCOCON-CBL-2 (2m; 6.6ft) is available for directly connecting the FA-ISOCOCON to the GS1 Com Port.

D0-DCM/DL250(-1): RS-232C to RS-485 Connection Wiring



A cable that will connect the D0-DCM or DL250(-1) to the FA-ISOCON can be constructed using the FA-15HD adapter and the D0-CBL cable. A cable can also be constructed using the FA-15HD adapter and RJ12-6P6C cable from the FA-CABKIT.

DL350/DL450: RS-232C to RS-485 Connection Wiring



A cable that will connect the DL450 to the FA-ISOCON can be constructed using the DB25-pin-male-to-RJ12 adapter and the RJ12-6P6C cable from the FA-CABKIT.

ETHERNET CONNECTION USING GS-EDRV(100)

The GS-EDRV(100) provides an Ethernet link between a control system and a GS1 AC drive. It mounts on DIN rail and connects a drive to an Ethernet hub/switch or PC. The GS-EDRV(100) processes signals to and from the drive. It formats the signals to conform with the Ethernet standard to the H2-ERM(100) or H4-ERM(100), KEPdirect EBC I/O server, or independent controller with a MODBUS TCP/IP driver. This Ethernet interface allows for great connectivity to many control system architectures. An additional feature is the built-in web browser which allows users to configure and control the drive from any web browser via the IP address of the GS-EDRV(100) card.

STEP 3: SET AC DRIVE PARAMETERS

The following parameters need to be set as shown in order to communicate properly.

- P3.00: 03 or 04 Operation Determined by RS-485 interface. Keypad STOP is enabled (03) or disabled (04).
- P4.00: 05 Frequency determined by RS-485 communication interface.
- P9.00: xx Communication address 1-254 (unique for each device, see P9.00).
- P9.01: 01 9600 baud data transmission speed (higher baud rate setting may be required with FA-ISOCAN network adapter; set adapter DIP switches accordingly).
- P9.02: 05 MODBUS RTU mode <8 data bits, odd parity, 1 stop bit>.



This list of parameter settings is the minimum required to communicate with a DirectLOGIC PLC. There may be other parameters that need to be set to meet the needs of your particular application.

STEP 4: CONFIGURE THE PLC CPU

The PLC CPUs must be configured to communicate with the GS1 AC drives. This configuration includes setting up the communication port and adding instructions to your logic program.

The set up for all of the AutomationDirect PLC CPUs is very similar, although there are some subtle differences between CPUs. Refer to the appropriate CPU User Manual for the specifics on your specific PLC CPU if more details are needed.



For instructions on Modbus Configuration for your specific PLC CPU, refer to the appropriate PLC User Manual.

CONFIGURE THE CLICK PLC

Configure the CLICK CPU communication port before writing communication instructions into your logic program.



For more detailed instructions on Modbus Configuration for your CLICK, refer to the CLICK PLC Hardware User Manual, CO-USER-M, or to the CLICK software help file.

CLICK Port 3 MODBUS Configuration for RS-485

The following configuration example is specific for CLICK PLC CPUs.

- Configure the communication port before writing communication instructions into the logic program.
- In CLICK programming software, open the "Comm Port Details Setup" dialog box by choosing the Setup menu, then Comm Port Setup, then Port 2 Setup.
- From the "Port:" list box, choose "**Port 3.**"
- For the "Protocol:" list box, select "**Modbus.**"
- Set the "Node Address" to "**1**" to make the CLICK PLC a MODBUS master.
- Set the "Baud Rate" to "**19200.**"
- Set the "Parity" to "**Odd.**"
- Set the "Stop Bit" to "**1.**"
- Set the "Time-out Setting" to "**500ms.**"
- Set the "Response Delay Time" to "**0ms.**"



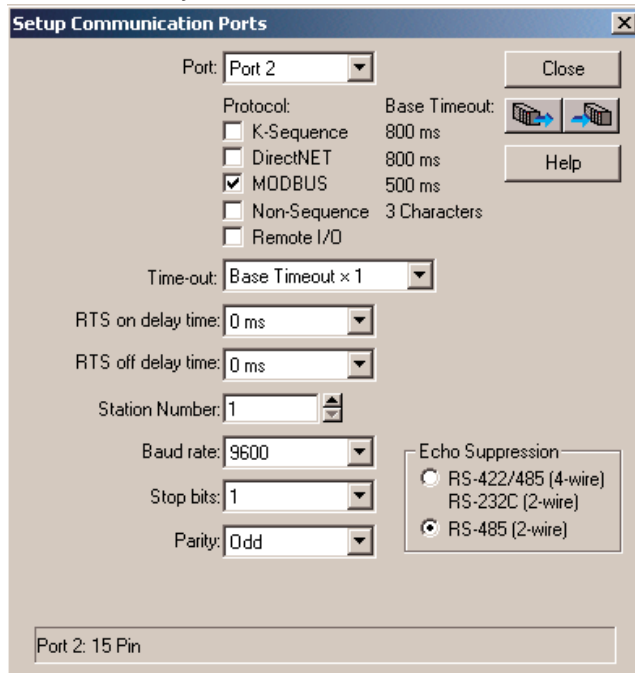
The communication port settings are saved in the project file. The project must be transferred to the CLICK PLC in order for any port setting changes to take effect.

CONFIGURE THE DIRECTLOGIC CPUs

DirectLOGIC MODBUS Port Configuration for D2-260 and DL06

The following configuration example is specific to the D2-260 and DL06. Refer to the appropriate CPU User Manual for the specifics on your DirectLOGIC CPU.

- In DirectSOFT, choose the PLC menu, then Setup, then **“Secondary Comm Port.”**
- From the Port number list box at the top, choose **“Port 2.”**
- For the Protocol, select ONLY **“MODBUS.”** (Do not select multiple protocols.)
- Response Delay Time should be **“0ms.”** Both RTS on and off delay times must be set to 0ms.
- The Station Number should be set to **“1”** to make the D2-260 or DL06 CPU a MODBUS master.
- The Baud Rate should be set at **“9600.”**
- In the Stop Bits list box, Choose **“1.”**
- In the Parity list box, choose **“Odd.”**



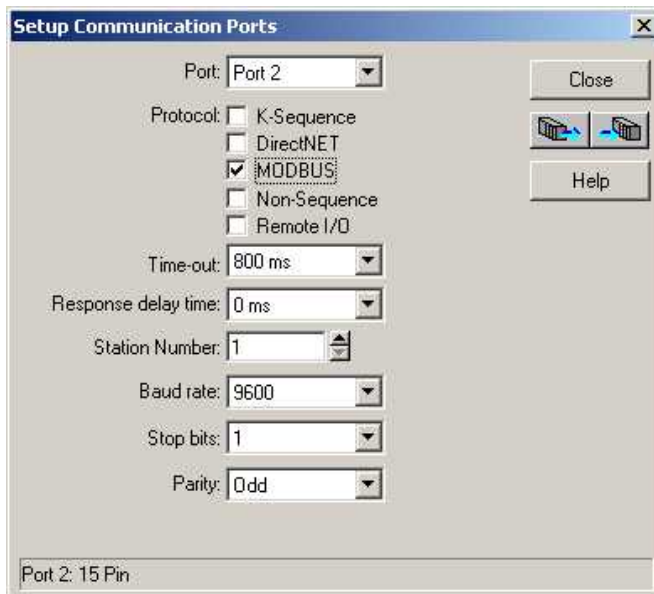
CONFIGURE THE DIRECTLOGIC CPUs (CONTINUED)***DirectLOGIC MODBUS Port Configuration for DL05, D2-250(-1), and D4-450***

The following configuration example is specific to the D2-250(-1) and DL05. Refer to the appropriate CPU User Manual for the specifics on your DirectLogic CPU.

- In DirectSOFT, choose the PLC menu, then Setup, then **"Secondary Comm Port."**
- From the Port list box, choose **"Port 2."**
- For the Protocol, select ONLY **"MODBUS."** (Do not select multiple protocols.)
- In the Timeout list box, select **"800ms."**
- Response Delay Time should be **"0ms."**
- The Station Number should be set to **"1"** to make the D2-250(-1) or DL05 CPU a MODBUS Master.
- The Baud Rate should be set at **"9600"** (or higher, if using an FA-ISOCON network adapter module).
- In the Stop Bits list box, choose **"1."**
- In the Parity list box, choose **"Odd."**



The DL250 network instructions used in Master mode will access only slaves 1 to 90. Each slave must have a unique number.



CLICK MODBUS LADDER PROGRAMMING

The set up for all of the CLICK CPUs is very similar. However, there may be some subtle differences between CPUs, or for the requirements of your particular program. Refer to the CLICK programming software internal help file for more information regarding CLICK programming.

The following ladder program shows some examples of how to control the GS1 AC drive through Modbus RTU. The drive should be set up and tested for communications before it is connected to a load.



WARNING: *A DRIVE SHOULD NEVER BE CONNECTED TO A LOAD UNTIL ANY APPLICABLE COMMUNICATION PROGRAMS HAVE BEEN PROVEN.*



WARNING: *WRITE PROGRAMS IN SUCH A WAY THAT THE PROGRAM DOES NOT ERRONEOUSLY OVERWRITE A REMOTE STOP COMMAND WITH A RUN COMMAND, SUCH AS WHEN P3.00 IS SET TO 03. THIS EXAMPLE PROGRAM PREVENTS SUCH AN ACCIDENTAL OVERWRITE.*



These programs are for illustrational purposes only, and are not intended for a true application.

SEPARATE RUN COMMAND WRITE INSTRUCTION

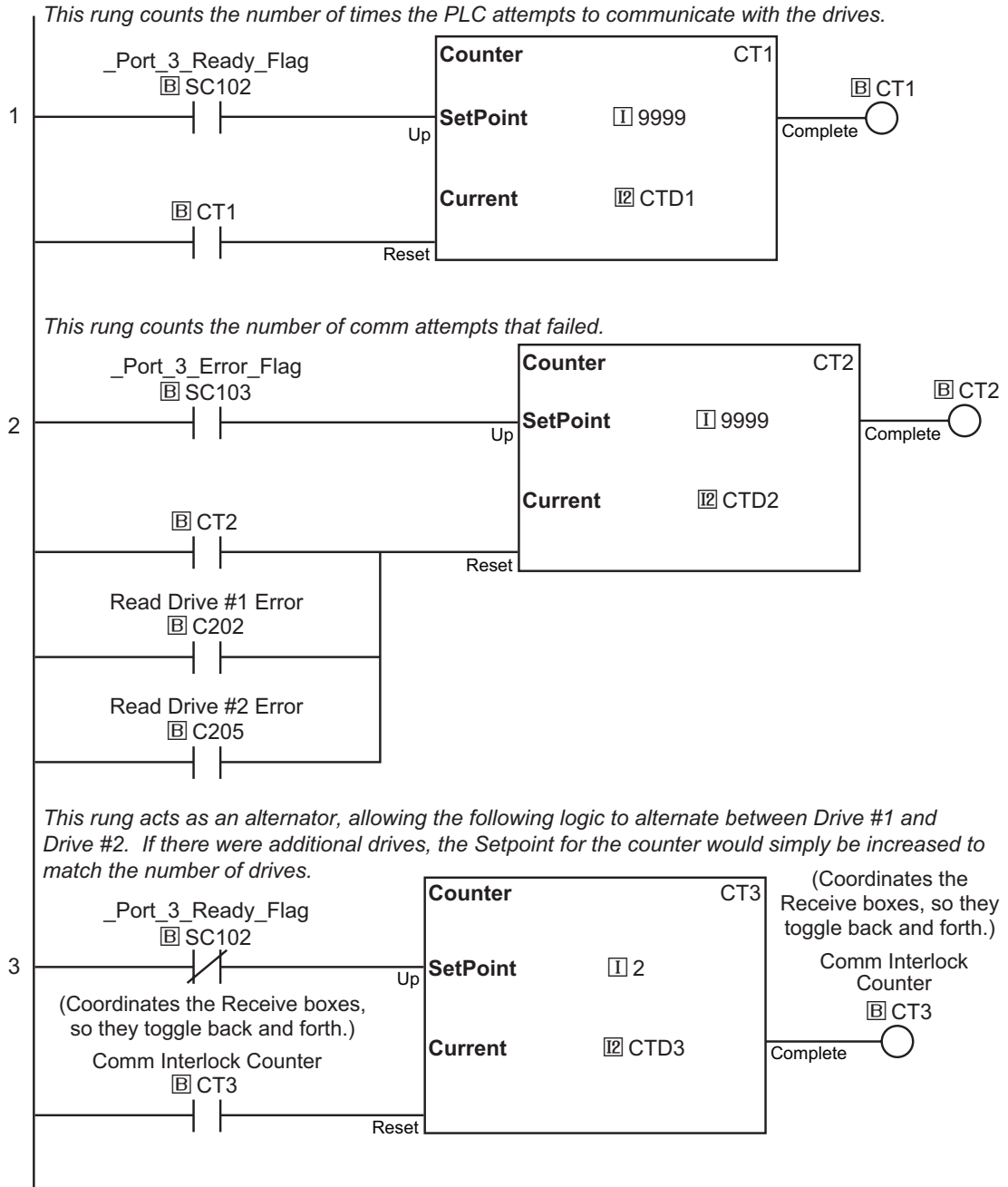
Why do we write the Run Command with a separate write instruction? If we write the Run Command to the drive along with the Speed Reference, Direction, External Fault, and Fault Reset Commands, we can keep the parameter addresses in sequence, and we can update all five of the commands with one write instruction. This method is valid only if we disable the drive's keypad STOP button (P3.00 = 04).

Typically, the keypad STOP button will be enabled (P3.00 = 03), and we need to prevent a change in one of the other commands from overriding a keypad Stop Command by causing a previous Run Command to be rewritten to the drive. By using a separate Run Command write instruction, only a deliberate Run Command change by the program will run the drive again after a stop.

CLICK COMMUNICATION PROGRAM EXAMPLE – (FOR CLICK PLCs)



This program is for illustrational purposes only, and is not intended for a true application.

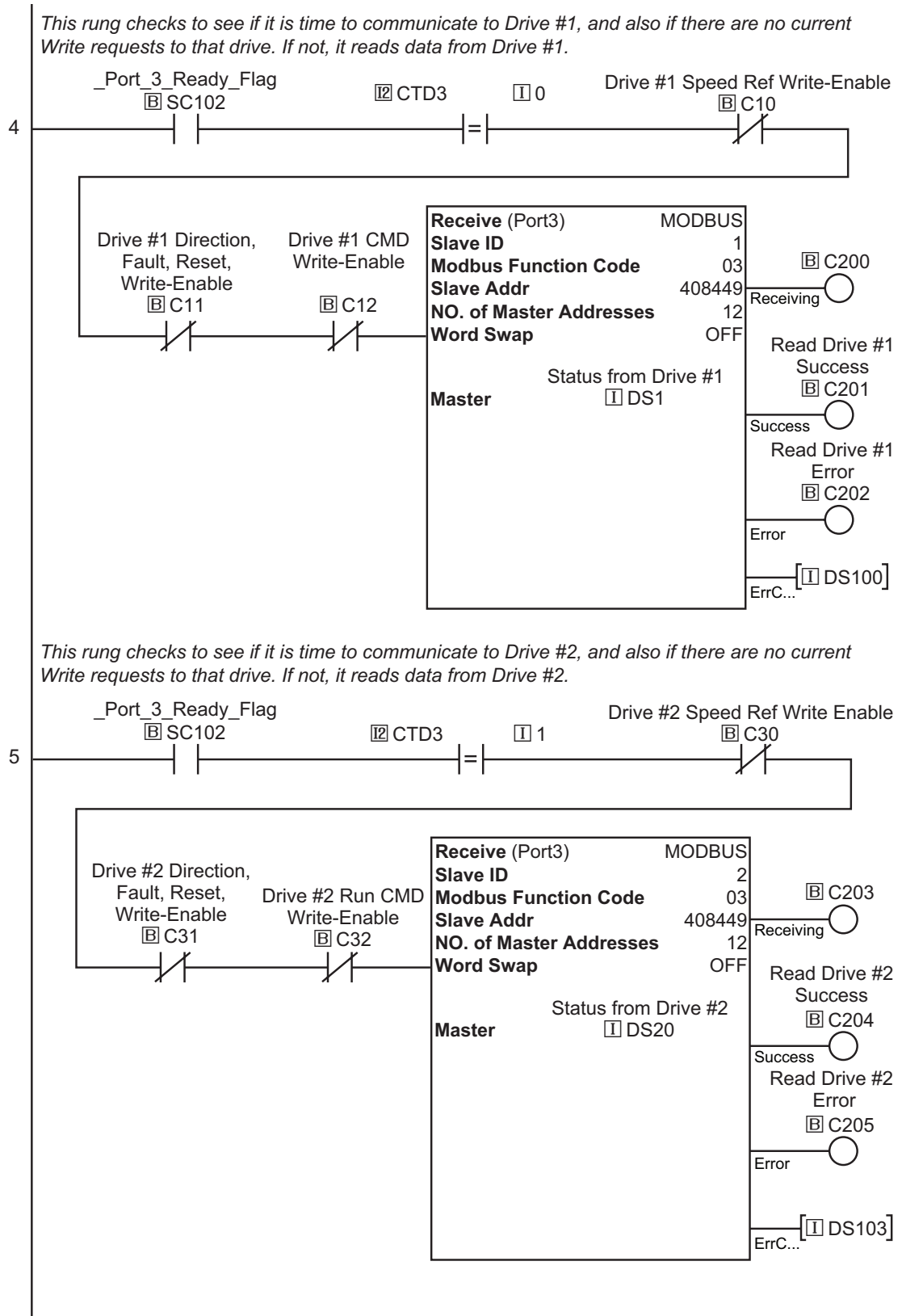


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This program is for illustrational purposes only, and is not intended for a true application.

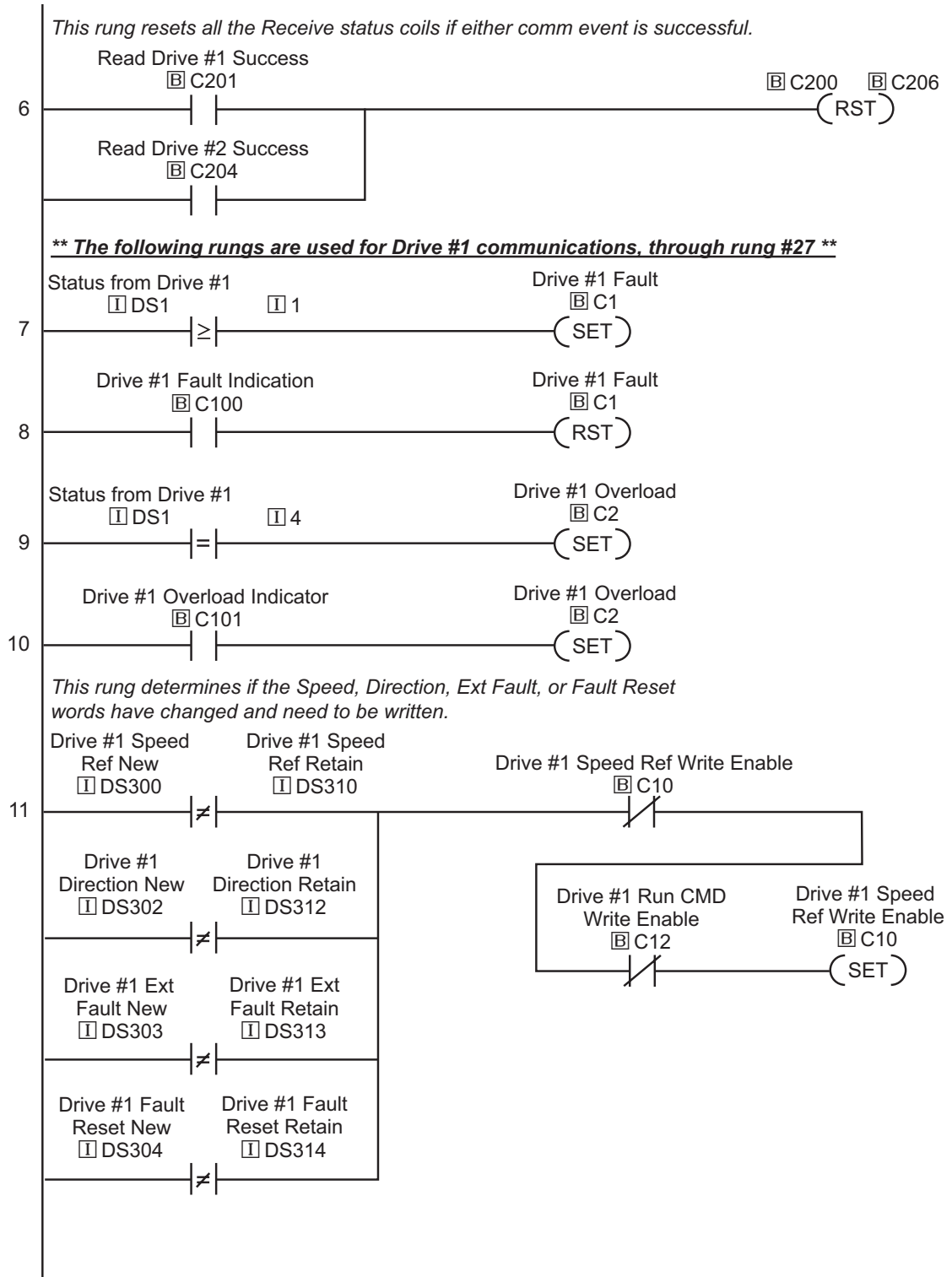


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This program is for illustrational purposes only, and is not intended for a true application.

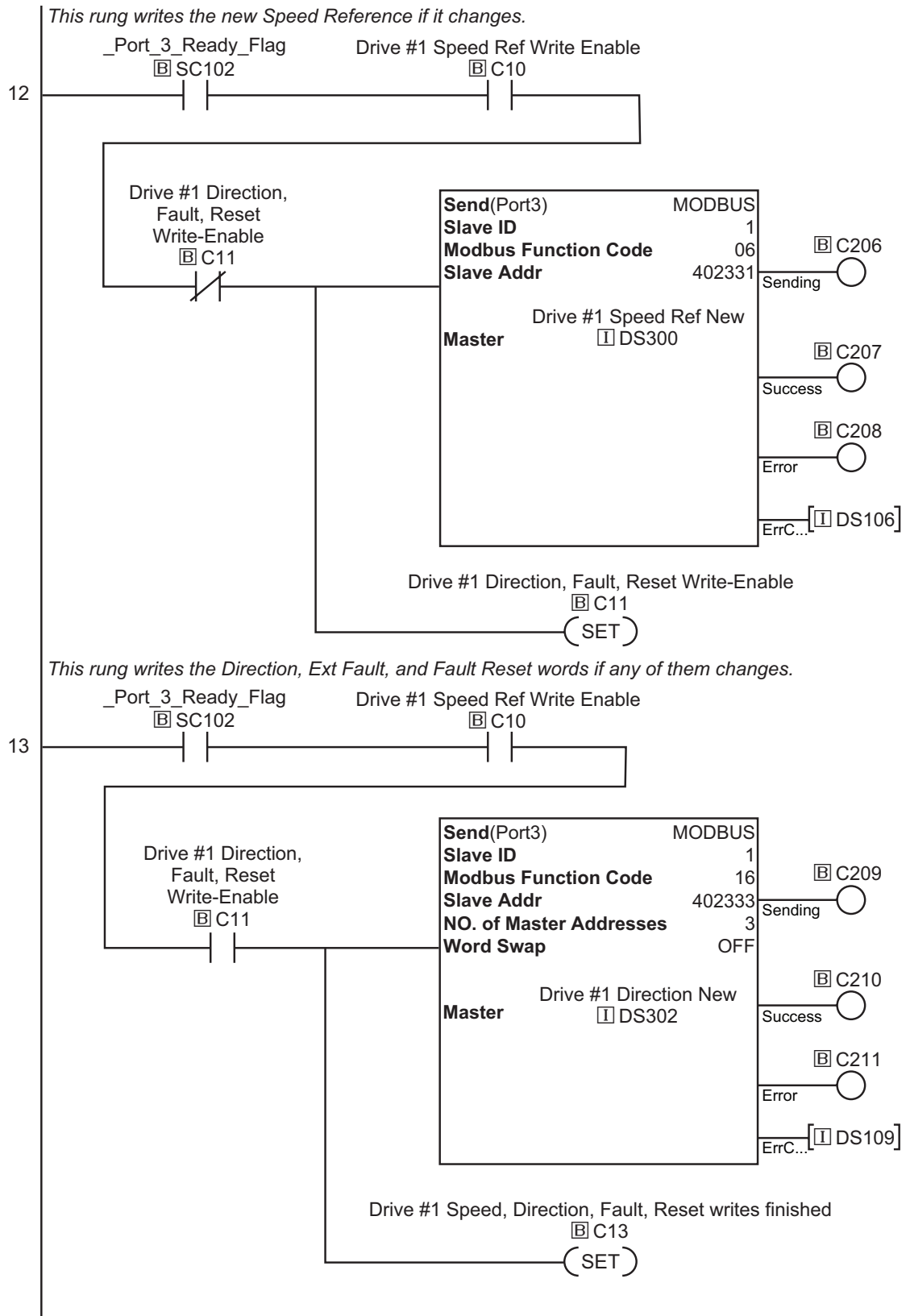


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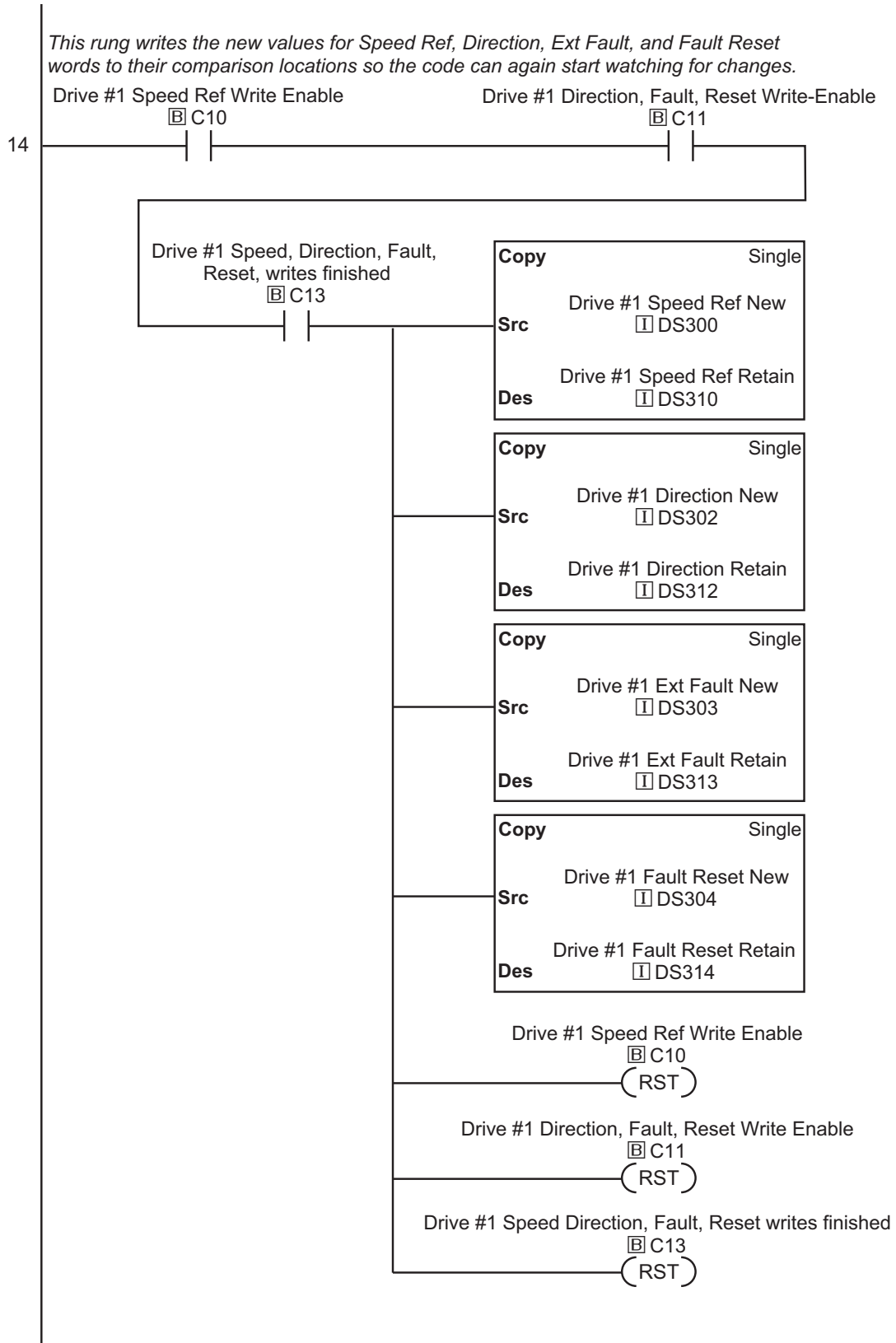


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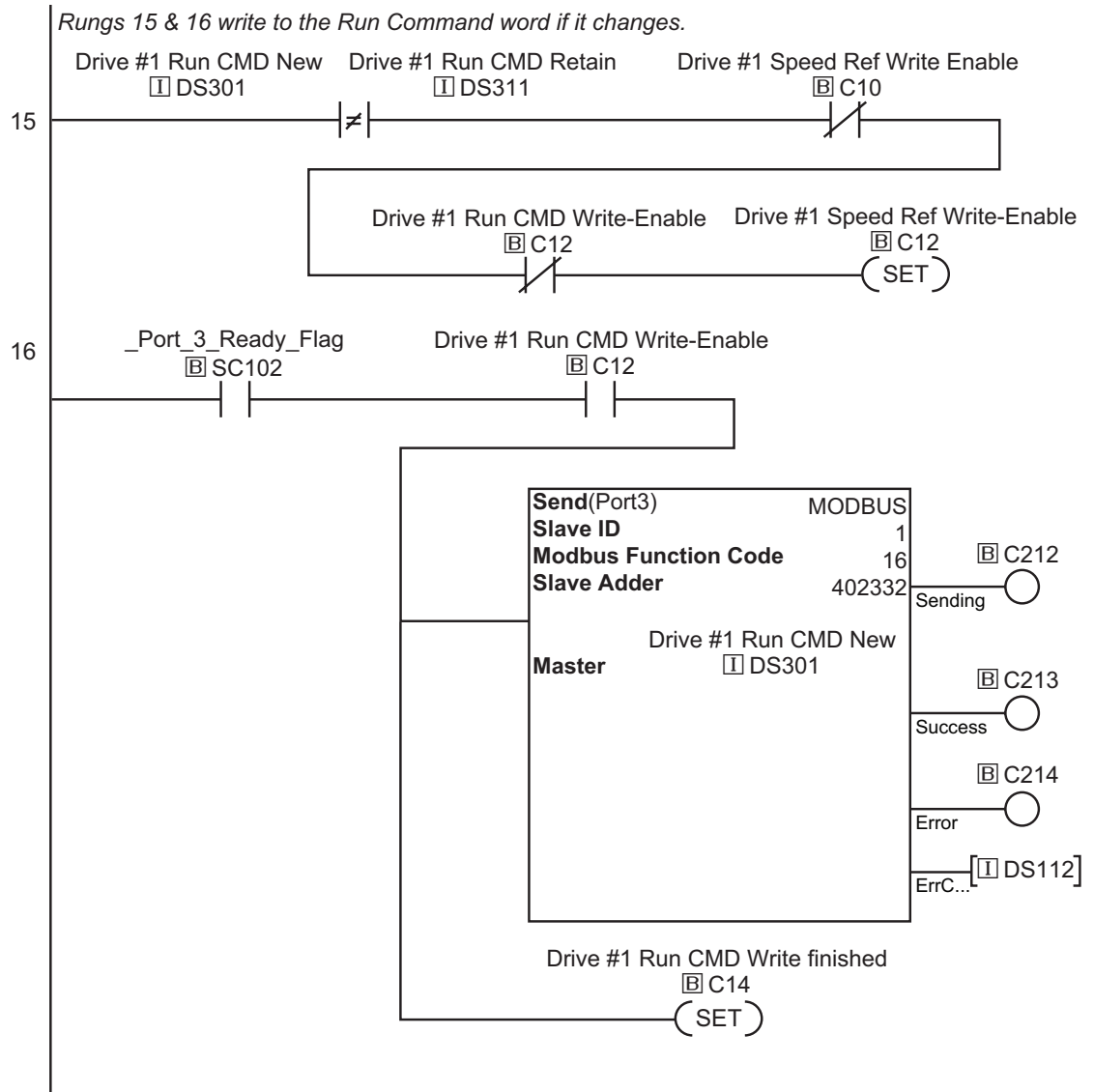


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This program is for illustrational purposes only, and is not intended for a true application.

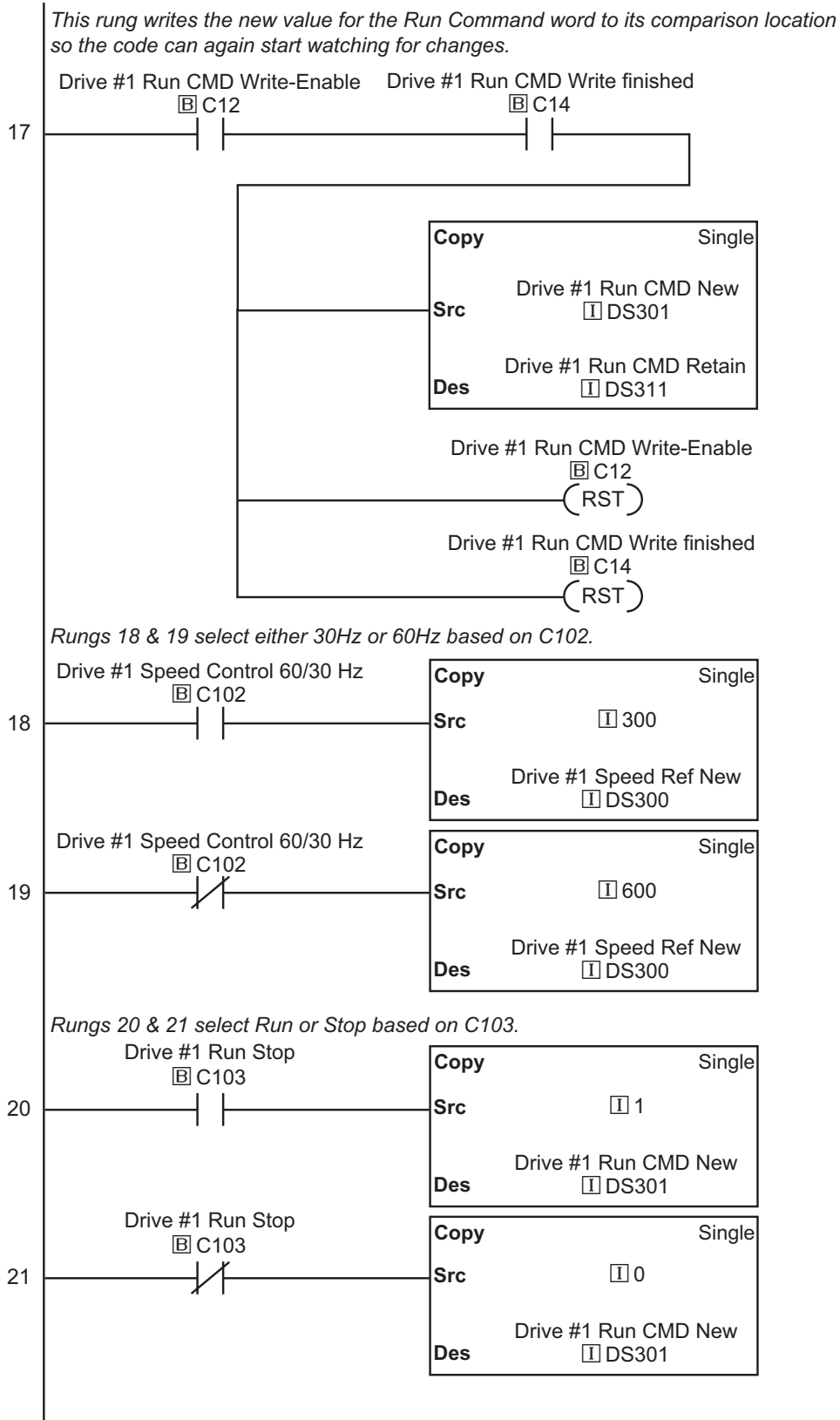


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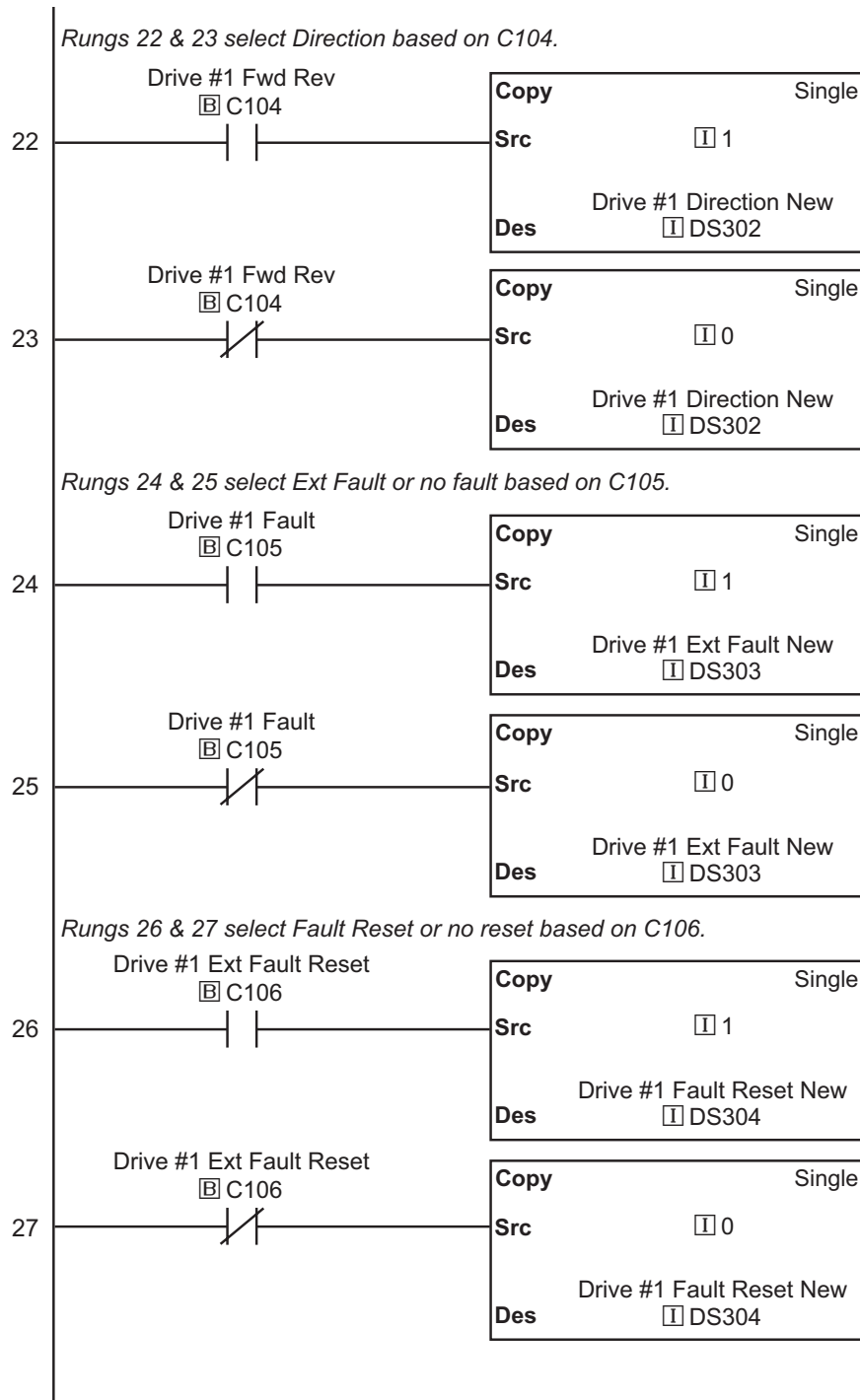


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This program is for illustrational purposes only, and is not intended for a true application.

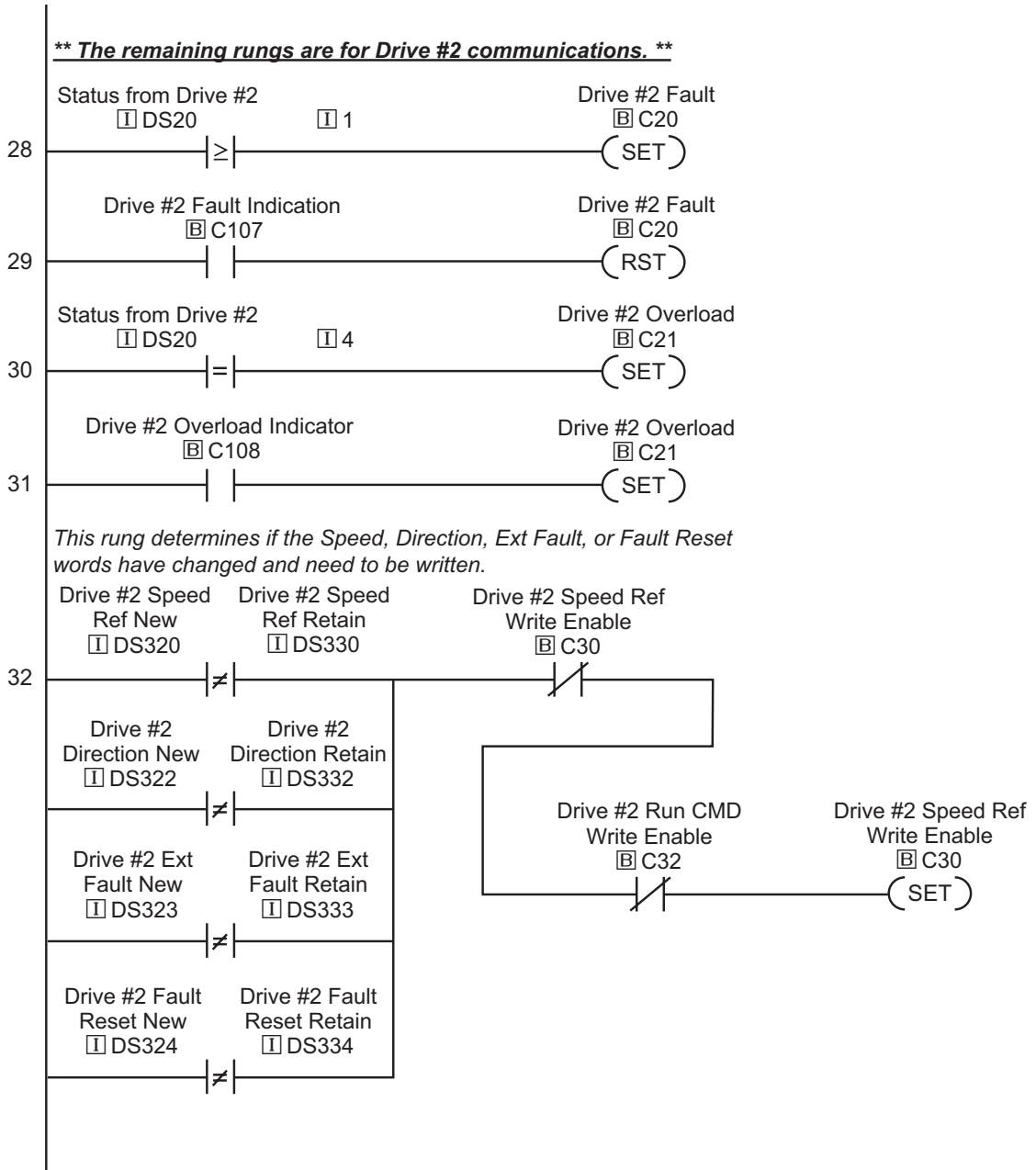


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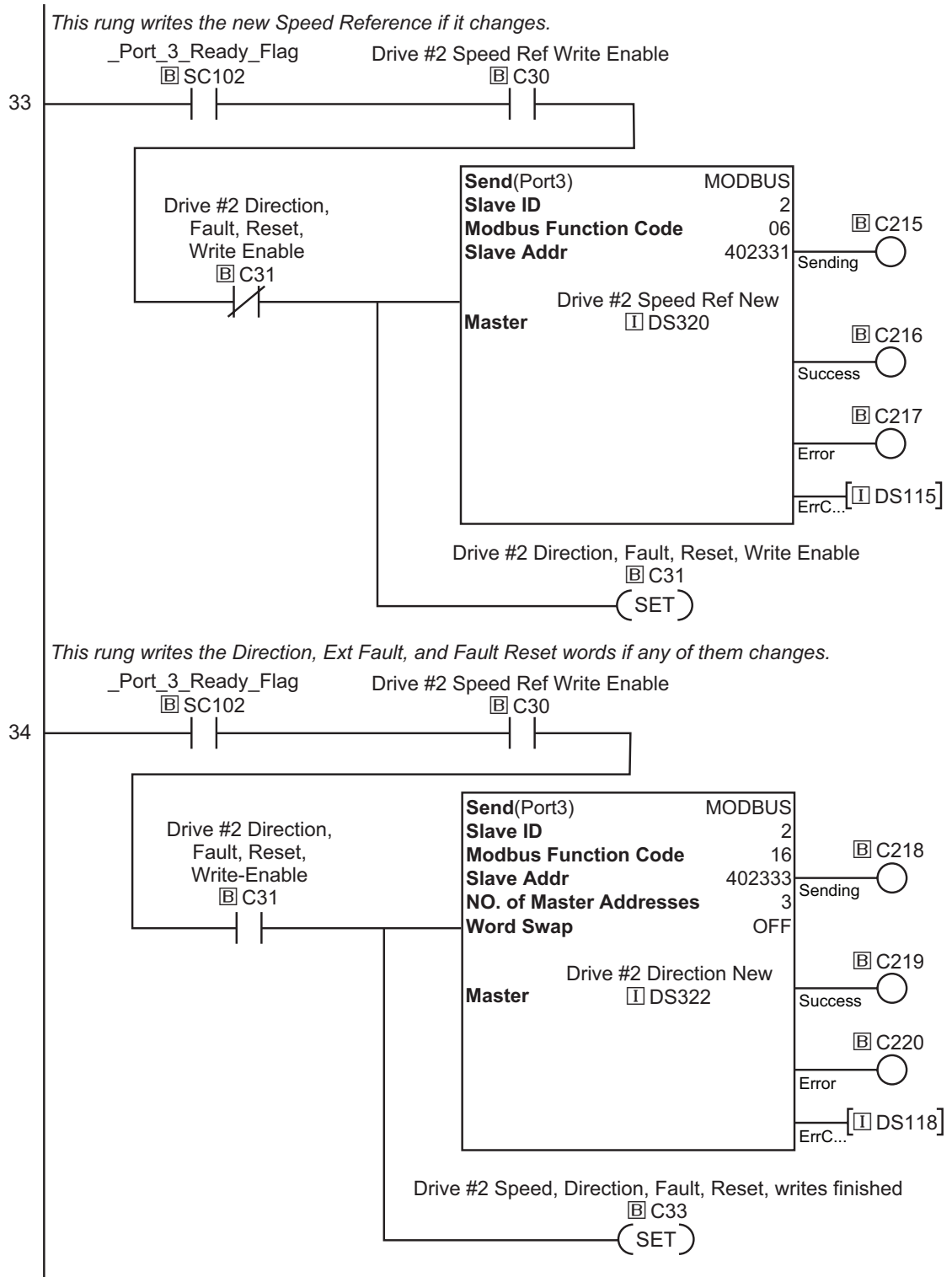


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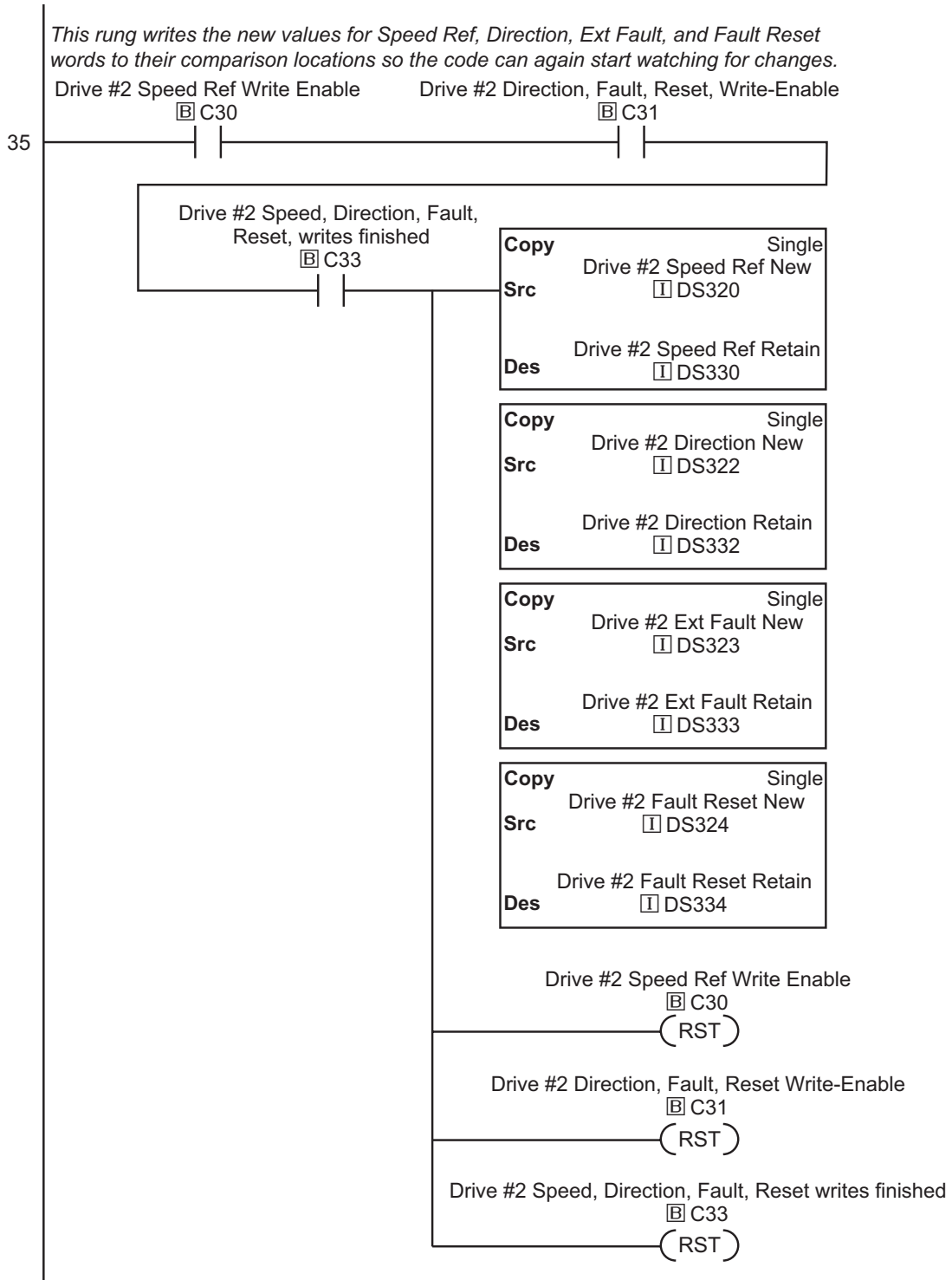


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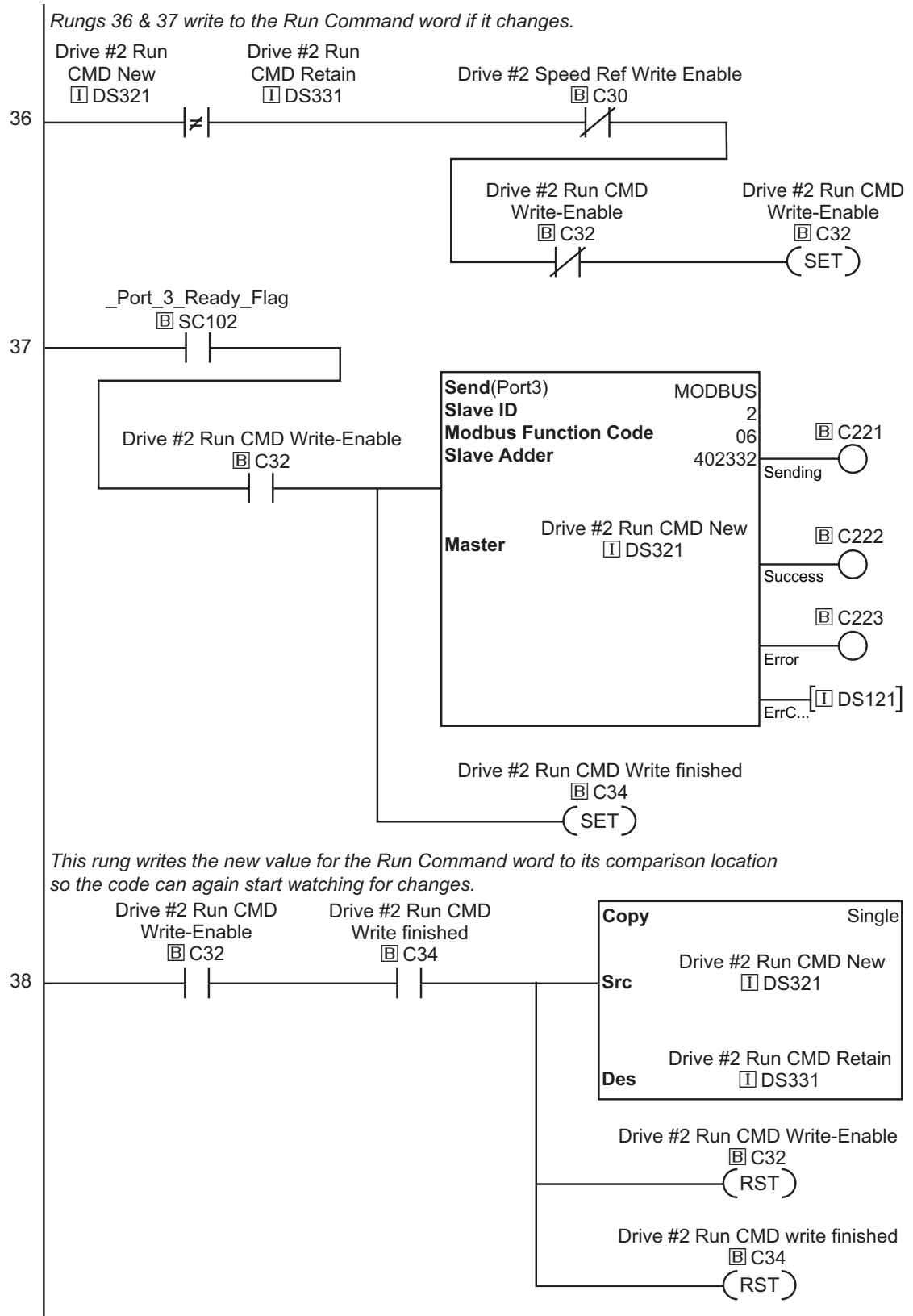


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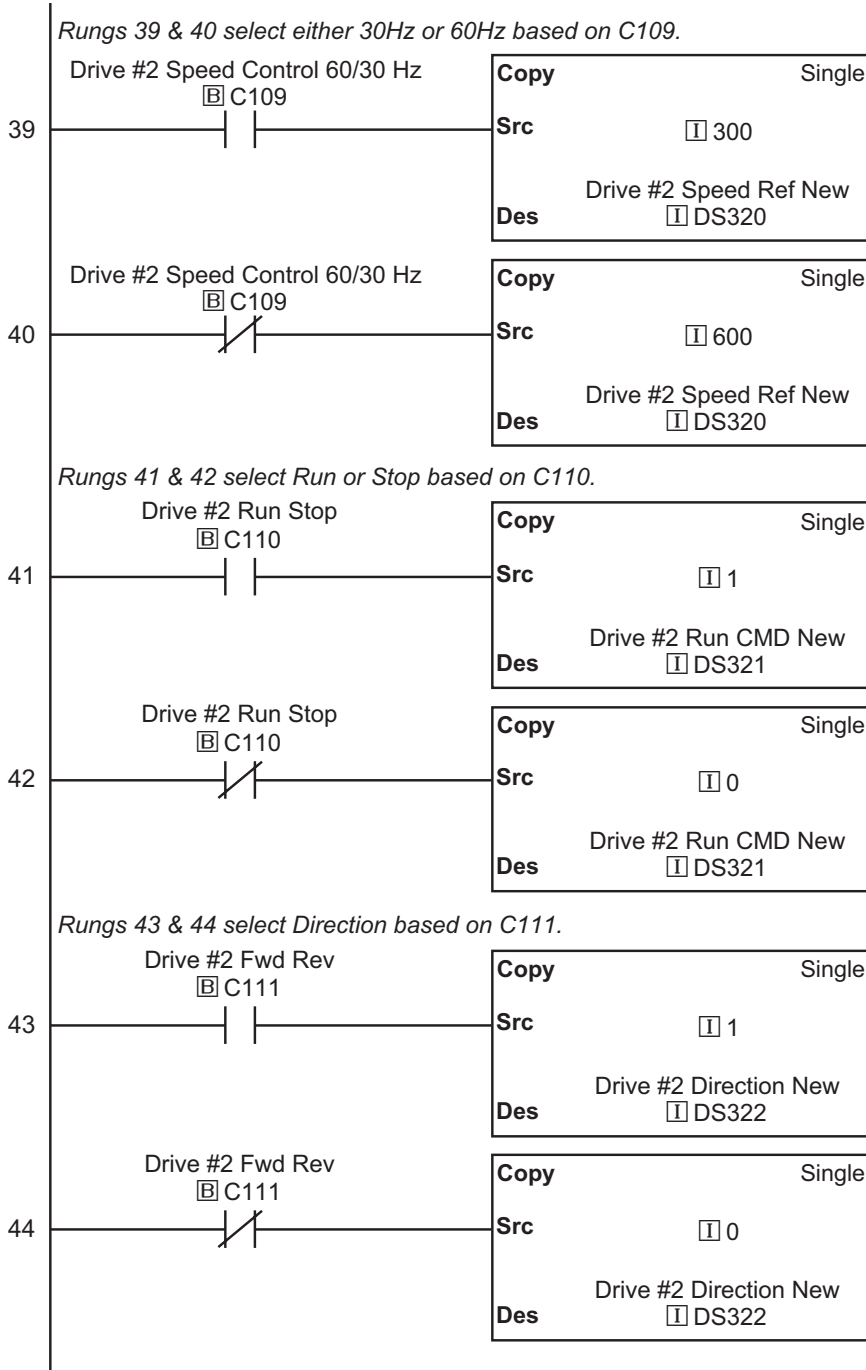


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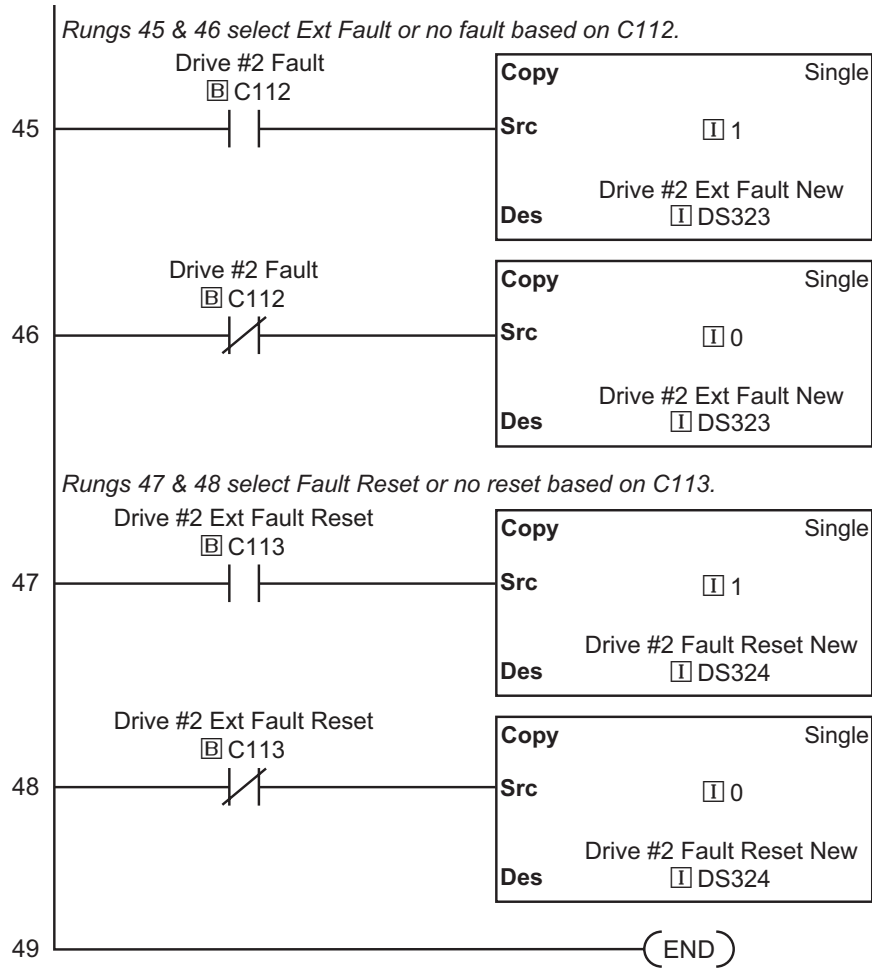


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DIRECTLOGIC MODBUS LADDER PROGRAMMING

The set up for all of the *Direct*LOGIC CPUs is very similar. However, there may be some subtle differences between CPUs. Refer to the appropriate CPU User Manual for the specifics on your *Direct*LOGIC CPU.

The following ladder program shows some examples of how to control the GS1 AC drive through Modbus RTU. The drive should be setup and tested for communications before it is connected to a load.



WARNING: *A DRIVE SHOULD NEVER BE CONNECTED TO A LOAD UNTIL ANY APPLICABLE COMMUNICATION PROGRAMS HAVE BEEN PROVEN.*



WARNING: *WRITE PROGRAMS IN SUCH A WAY THAT THE PROGRAM DOES NOT ERRONEOUSLY OVERWRITE A REMOTE STOP COMMAND WITH A RUN COMMAND, SUCH AS WHEN P3.00 IS SET TO 03. THIS EXAMPLE PROGRAM PREVENTS SUCH AN ACCIDENTAL OVERWRITE.*



These programs are for illustrational purposes only, and are not intended for a true application.

SEPARATE RUN COMMAND WRITE INSTRUCTION

Why do we write the Run Command with a separate write instruction? If we write the Run Command to the drive along with the Speed Reference, Direction, External Fault, and Fault Reset Commands, we can keep the parameter addresses in sequence, and we can update all five of the commands with one write instruction. This method is valid only if we disable the drive's keypad STOP button (P3.00 = 04).

Typically, the keypad STOP button will be enabled (P3.00 = 03), and we need to prevent a change in one of the other commands from overriding a keypad Stop Command by causing a previous Run Command to be rewritten to the drive. By using a separate Run Command write instruction, only a deliberate Run Command change by the program will run the drive again after a stop.

BLOCK TRANSFER PARAMETERS FOR MODBUS PROGRAMS

For writing to any of the parameters from P0.00 to P8.01, a group of 10 block transfer parameters (P9.11 to P9.20) is available in the GS1 AC drive. This sequential block of parameters can be used to “group” various miscellaneous non-sequential parameters, so that you can update the parameters in one programming write block instead of having to use multiple write commands.

For example, it would typically take three different write commands to change the three non-sequential parameters Accel Time 1 (P1.01), Accel S-curve (P1.03), and Multi-speed 1 (P5.01).

However, you could make the same three changes using one write command by setting P9.11 to P1.01, P9.12 to P1.03, and P9.13 to P5.01, so that the parameters become sequential.

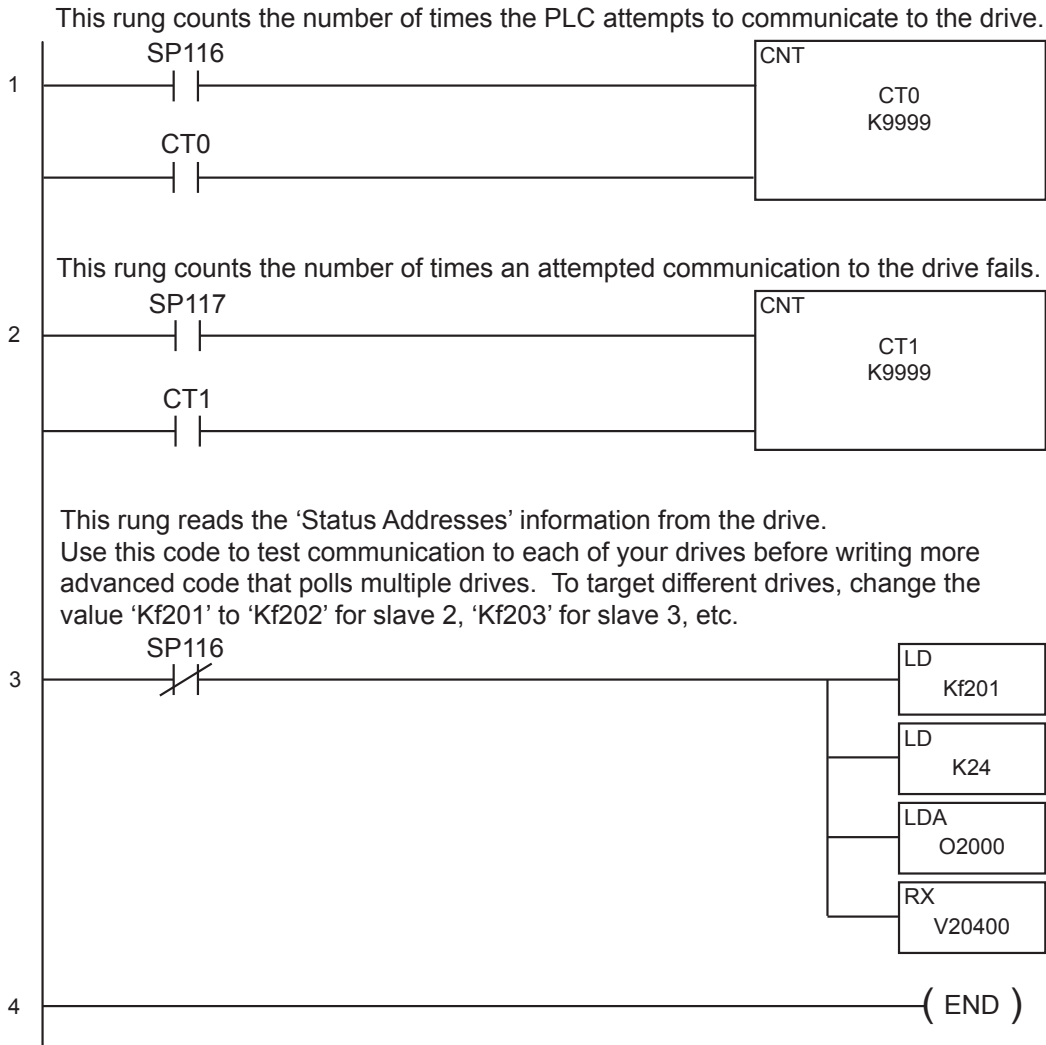
DIRECTLOGIC BASIC COMMUNICATION PROGRAM – START WITH THIS CODE

We recommend starting with the following program code, and using it to test communication to each of your drives before adding more advanced code for your application.

To target different drives, change the value Kf201 to Kf202 for slave 2, Kf203 for slave 3, etc.



This program is for illustrational purposes only, and is not intended for a true application.



SP116 is a special relay in the DirectLOGIC CPUs that monitors the PLC's communications. SP116 is on when Port 2 is communicating with another device.



SP117 is a special relay in the DirectLOGIC CPUs that monitors the PLC's communications. SP117 is on when Port 2 has encountered a communication error.

PROGRAMMING DIFFERENCES FOR DIRECTLOGIC PLCs

Different types of DirectLOGIC PLCs can be programmed differently, depending upon the types of network read and write instructions they can perform. There are two different types of these instructions, and this User Manual shows programming examples of both types.

RX/WX INSTRUCTIONS FOR DL05, D2-250(-1), D4-450

PLCs with DL05, D2-250, D2-250-1, and D4-450 CPUs can read from and write to networks using RX (Read from Network) and WX (Write to Network) programming instructions.

MRX/MWX INSTRUCTIONS FOR DL06, D2-260

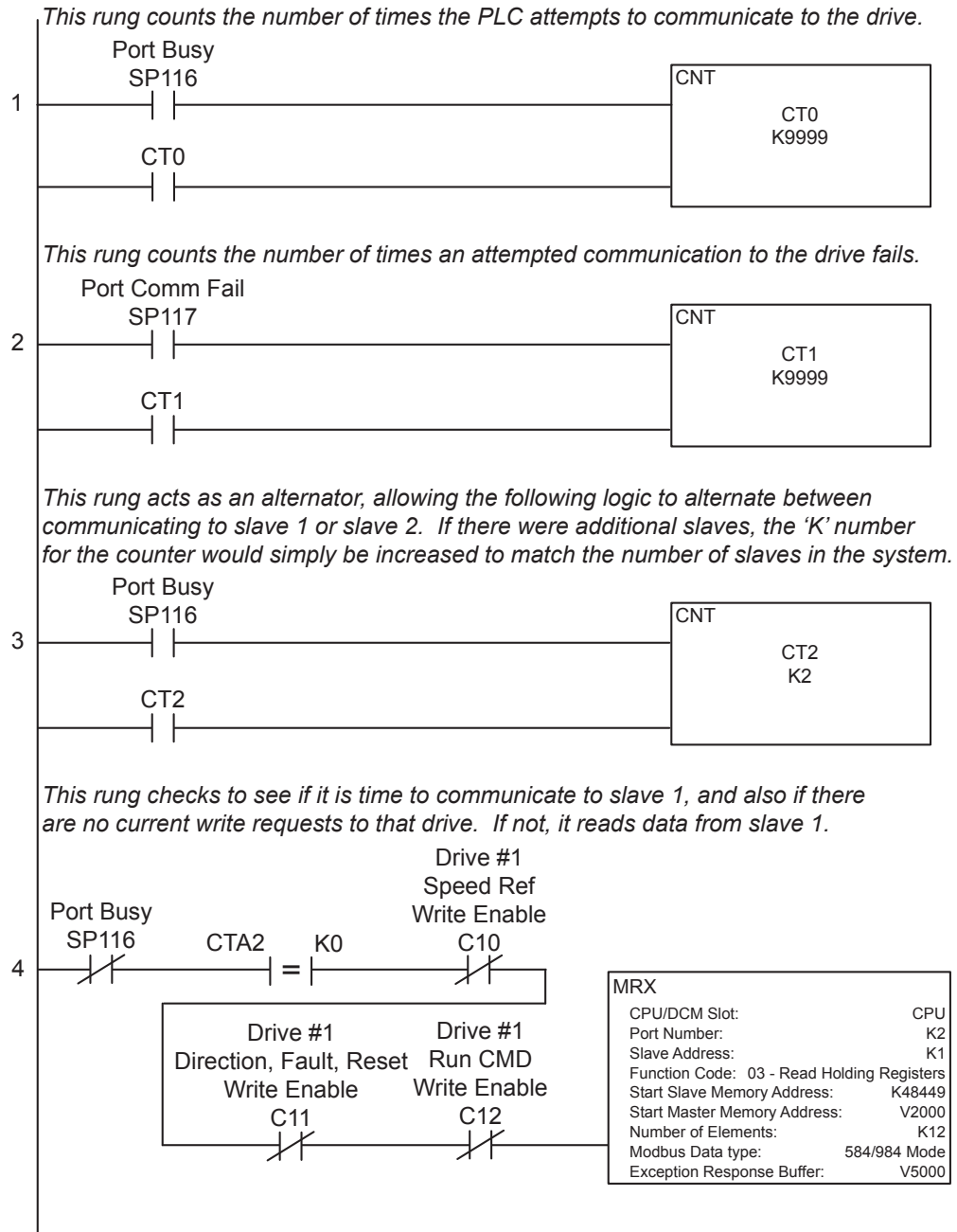
In addition to the RX and WX instructions listed above, PLCs with DL06 and D2-260 CPUs can also read from and write to networks using MRX (Modbus Read from Network) and MWX (Modbus Write to Network) programming instructions.

The MRX and MWX instructions are simpler and easier to use than are the RX and WX instructions. Therefore, we recommend that you use DL06 or D2-260 with MRX and MWX instructions if you have a choice.

DL MRX/MWX COMMUNICATION PROGRAM – FOR DL06 & D2-260 PLCs



This program is for illustrational purposes only, and is not intended for a true application.

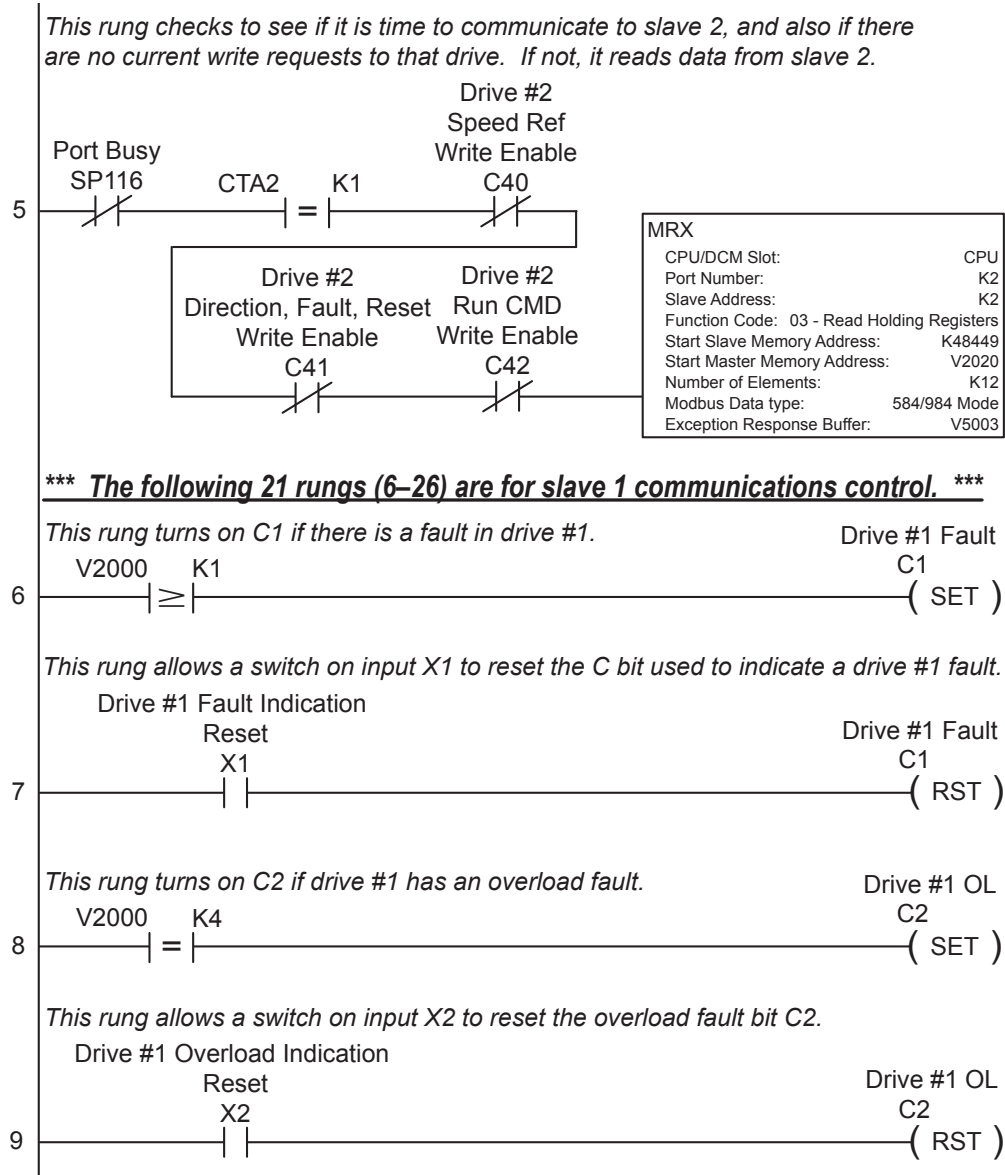


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This program is for illustrational purposes only, and is not intended for a true application.

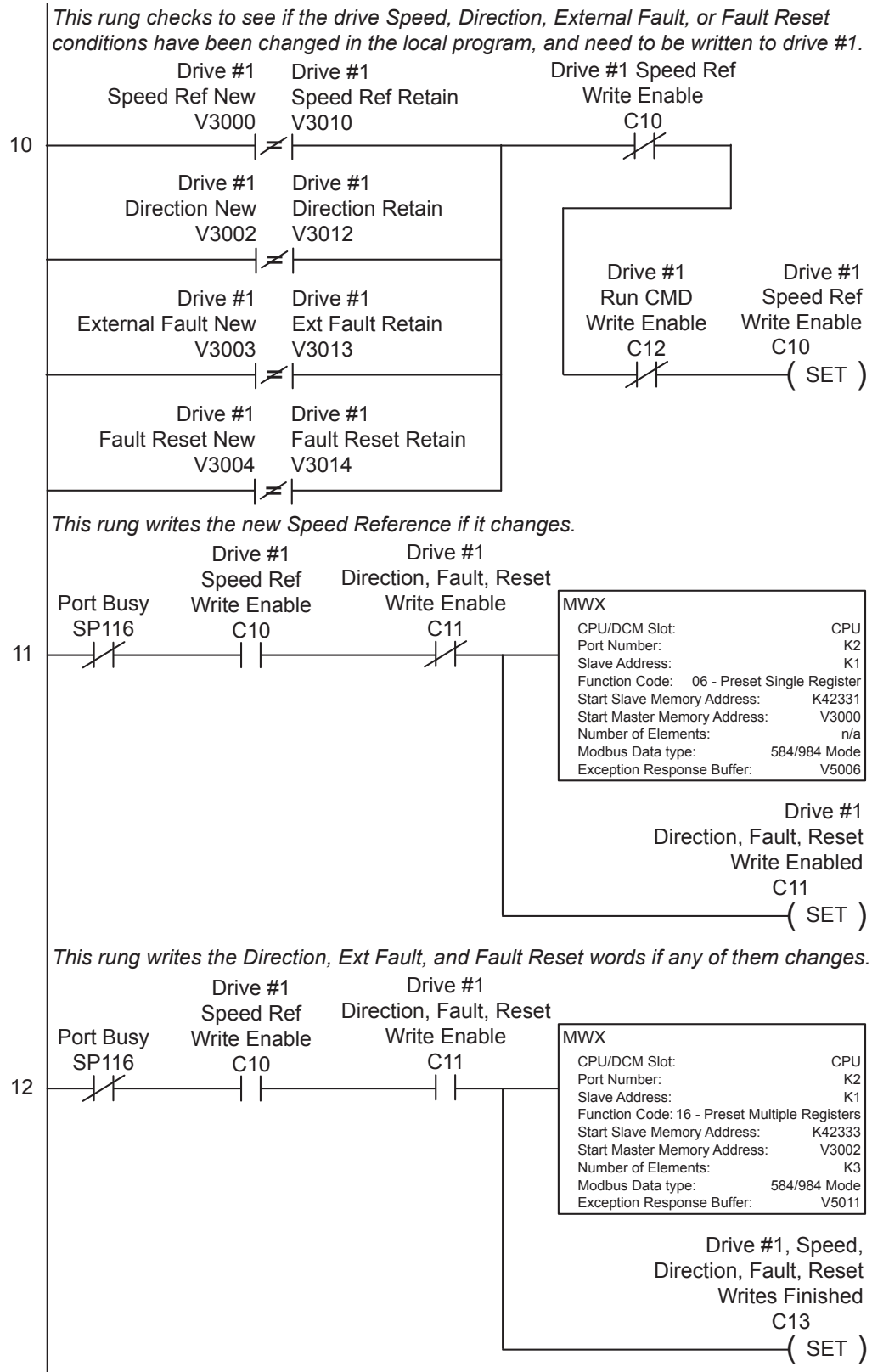


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This program is for illustrational purposes only, and is not intended for a true application.

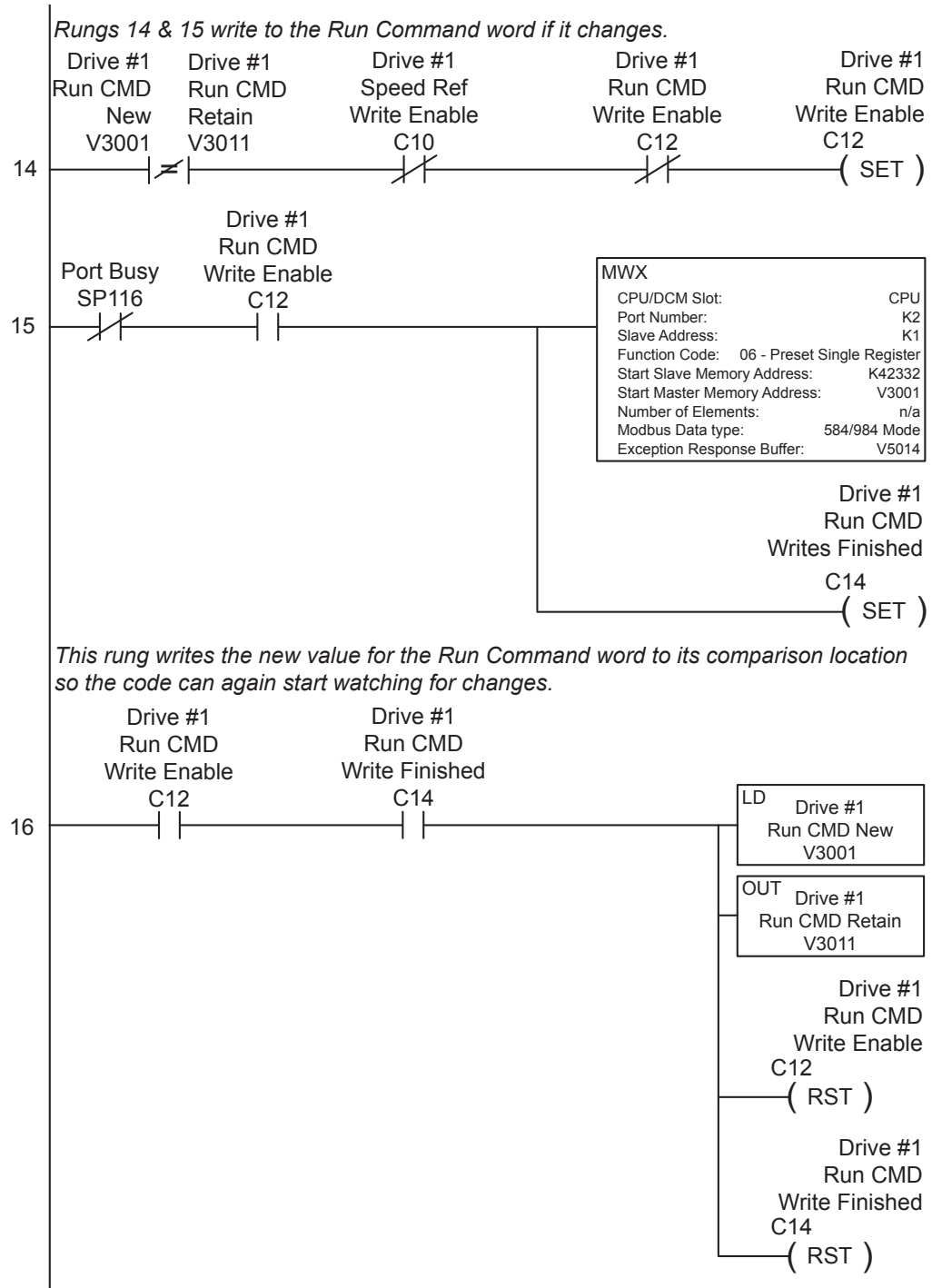


(continued next page – DL MRX/MWX communication program example for DL06 & D2-260 PLCs)

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This program is for illustrational purposes only, and is not intended for a true application.

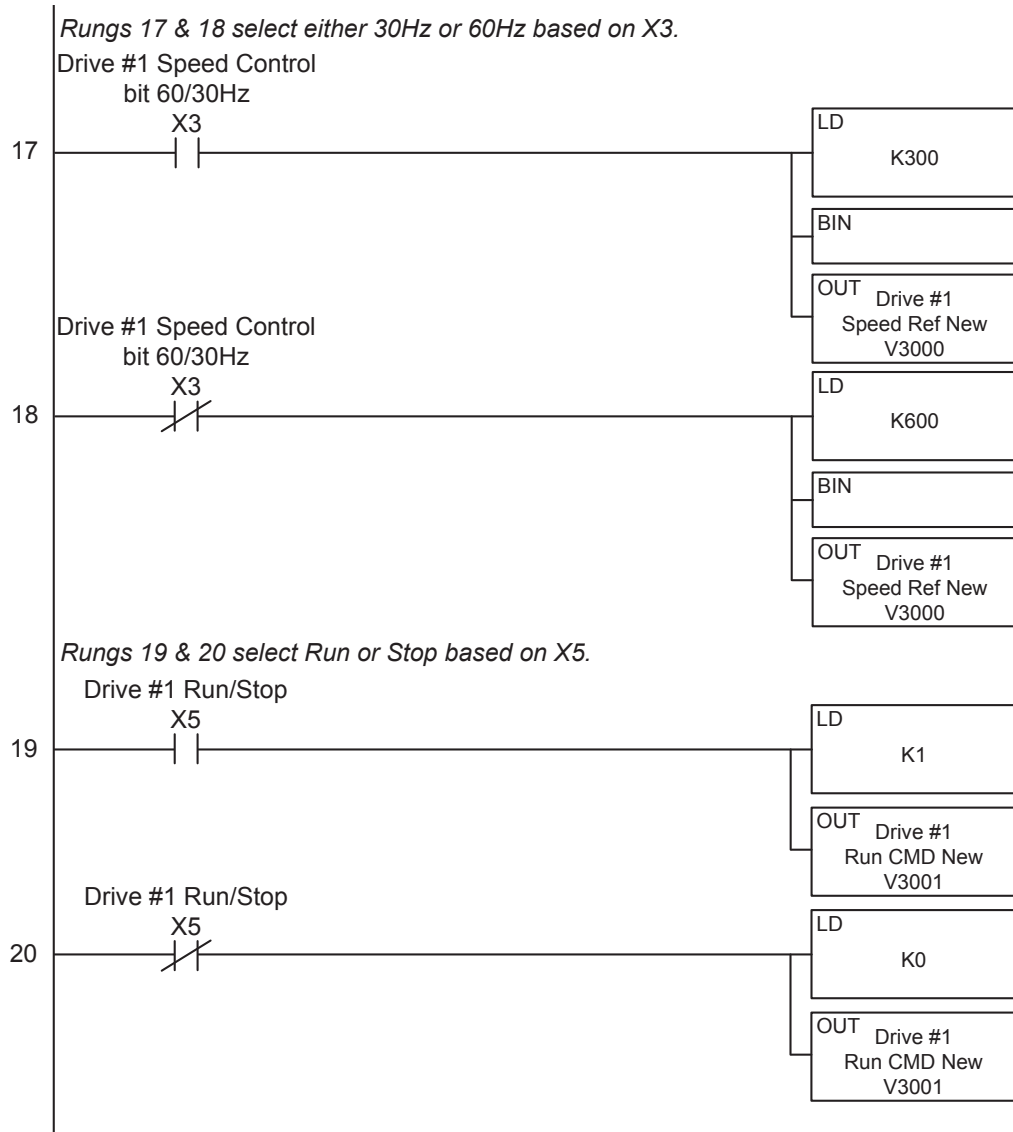


(continued next page – DL MRX/MWX communication program example for DL06 & D2-260 PLCs)

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This program is for illustrational purposes only, and is not intended for a true application.

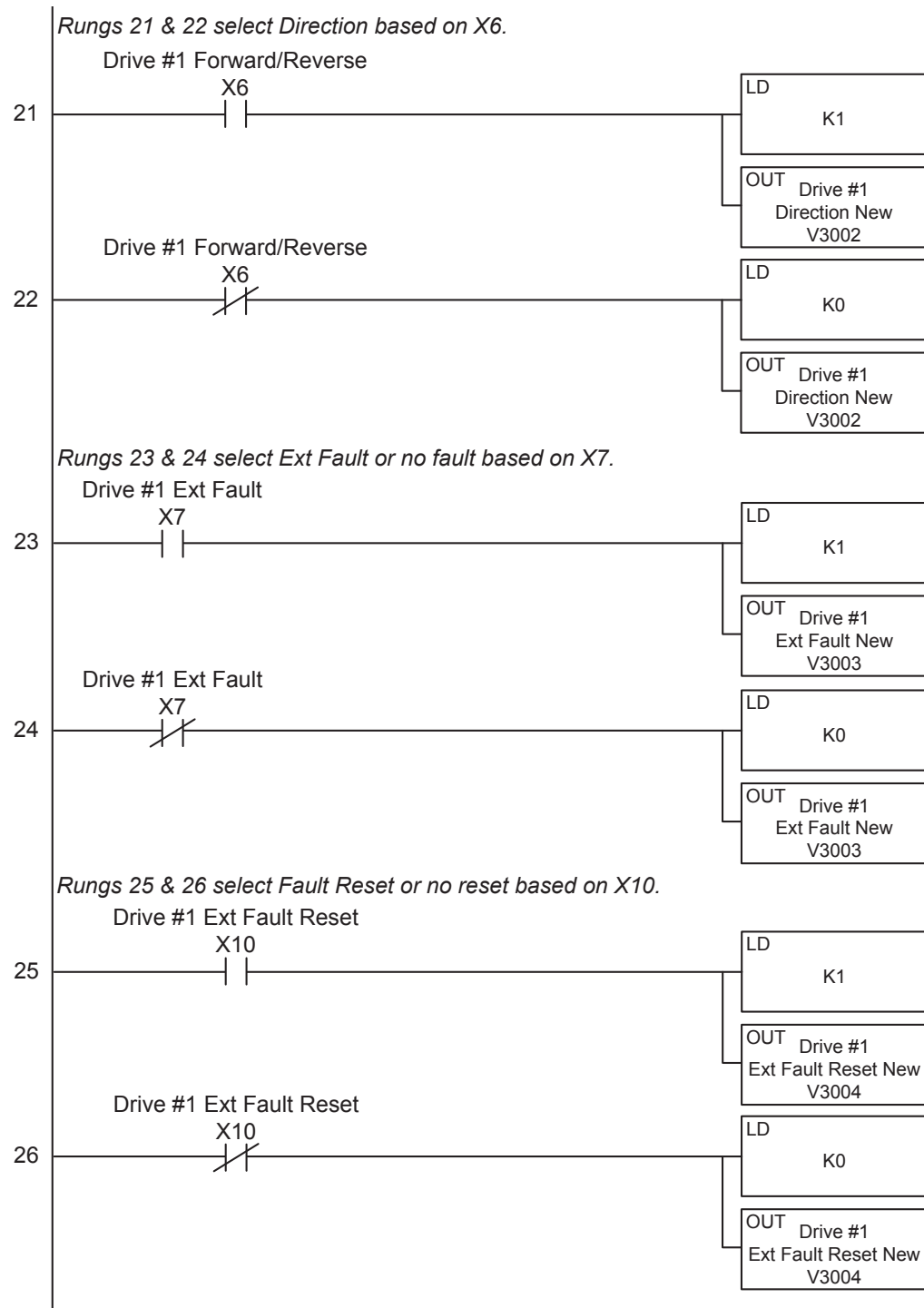


(continued next page – DL MRX/MWX communication program example for DL06 & D2-260 PLCs)

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This program is for illustrational purposes only, and is not intended for a true application.

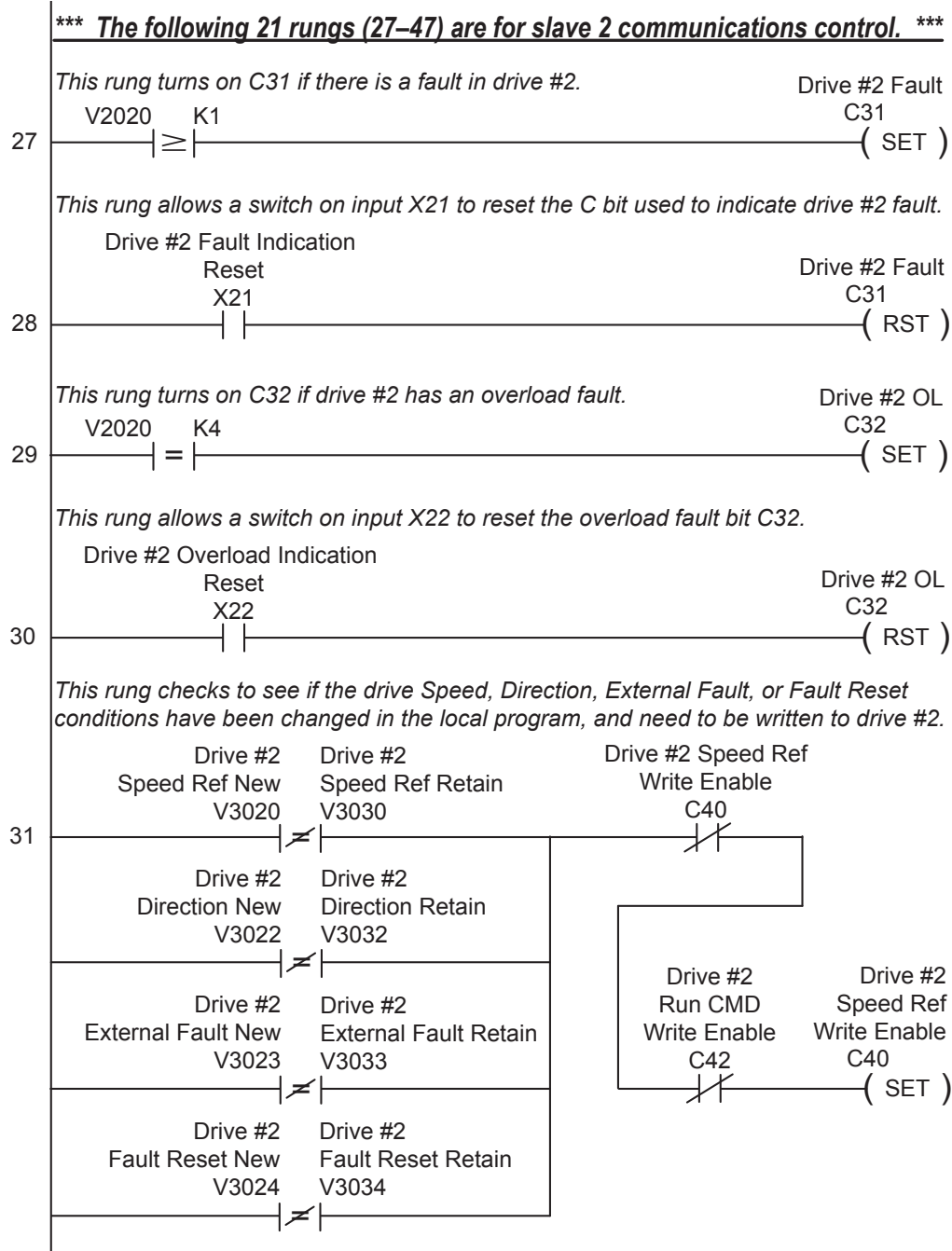


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This program is for illustrational purposes only, and is not intended for a true application.

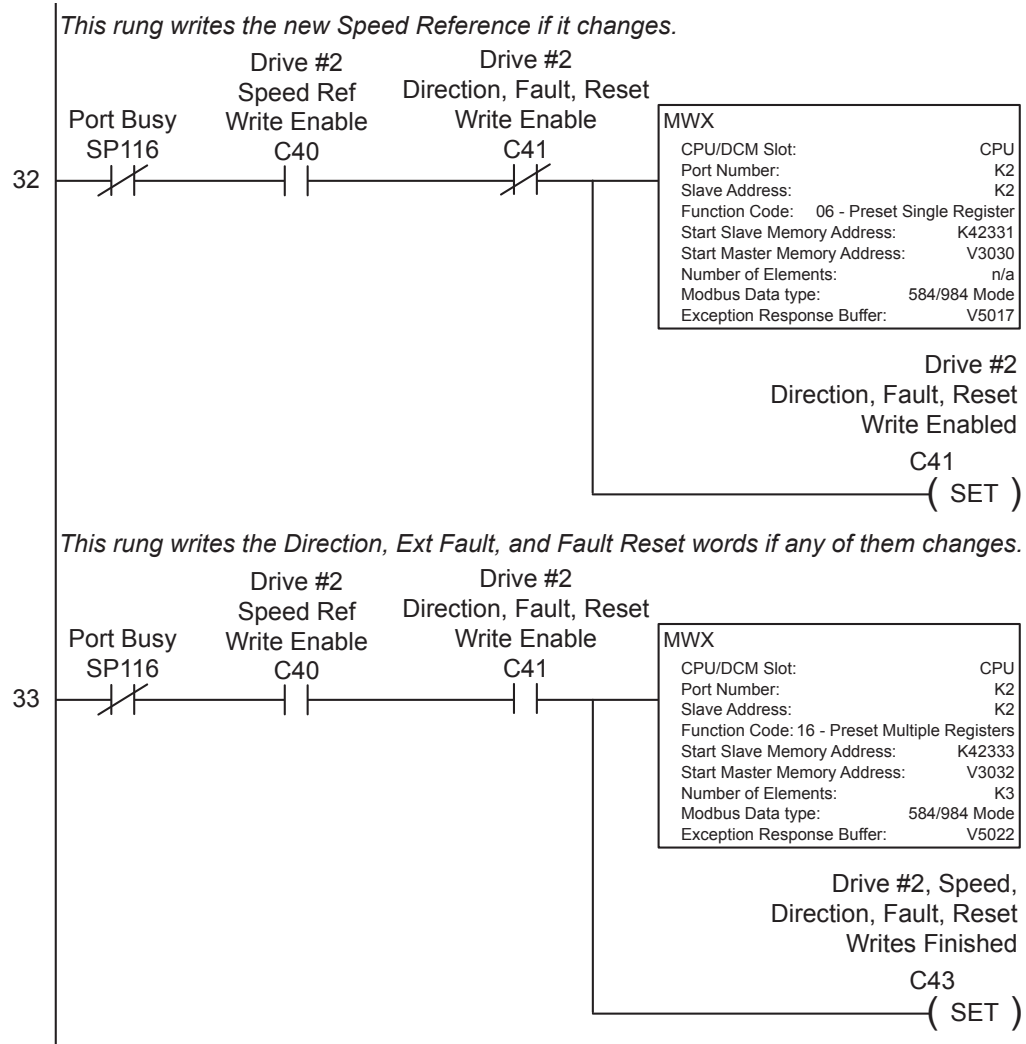


(continued next page – DL MRX/MWX communication program example for DL06 & D2-260 PLCs)

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This program is for illustrational purposes only, and is not intended for a true application.

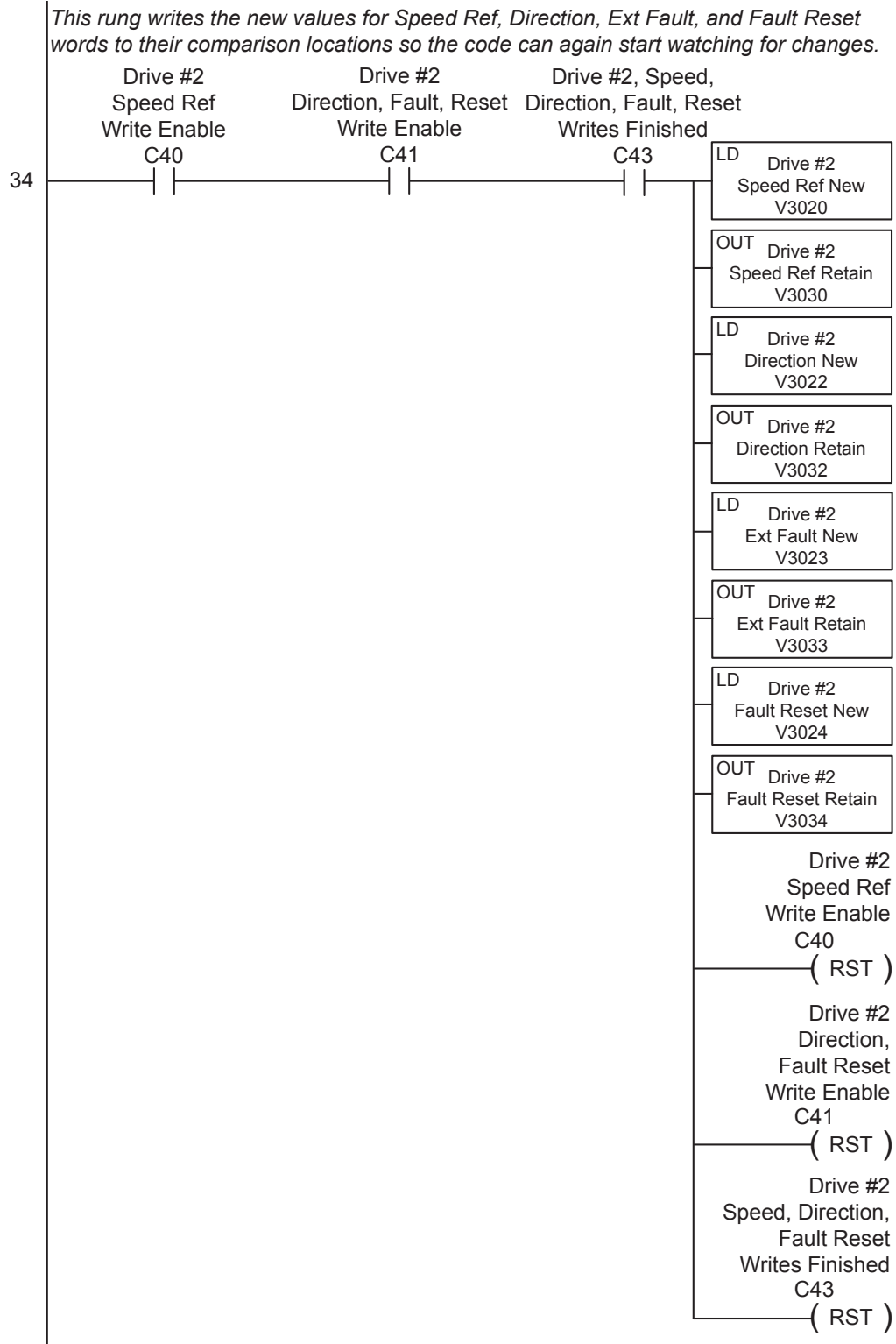


(continued next page – DL MRX/MWX communication program example for DL06 & D2-260 PLCs)

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This program is for illustrational purposes only, and is not intended for a true application.

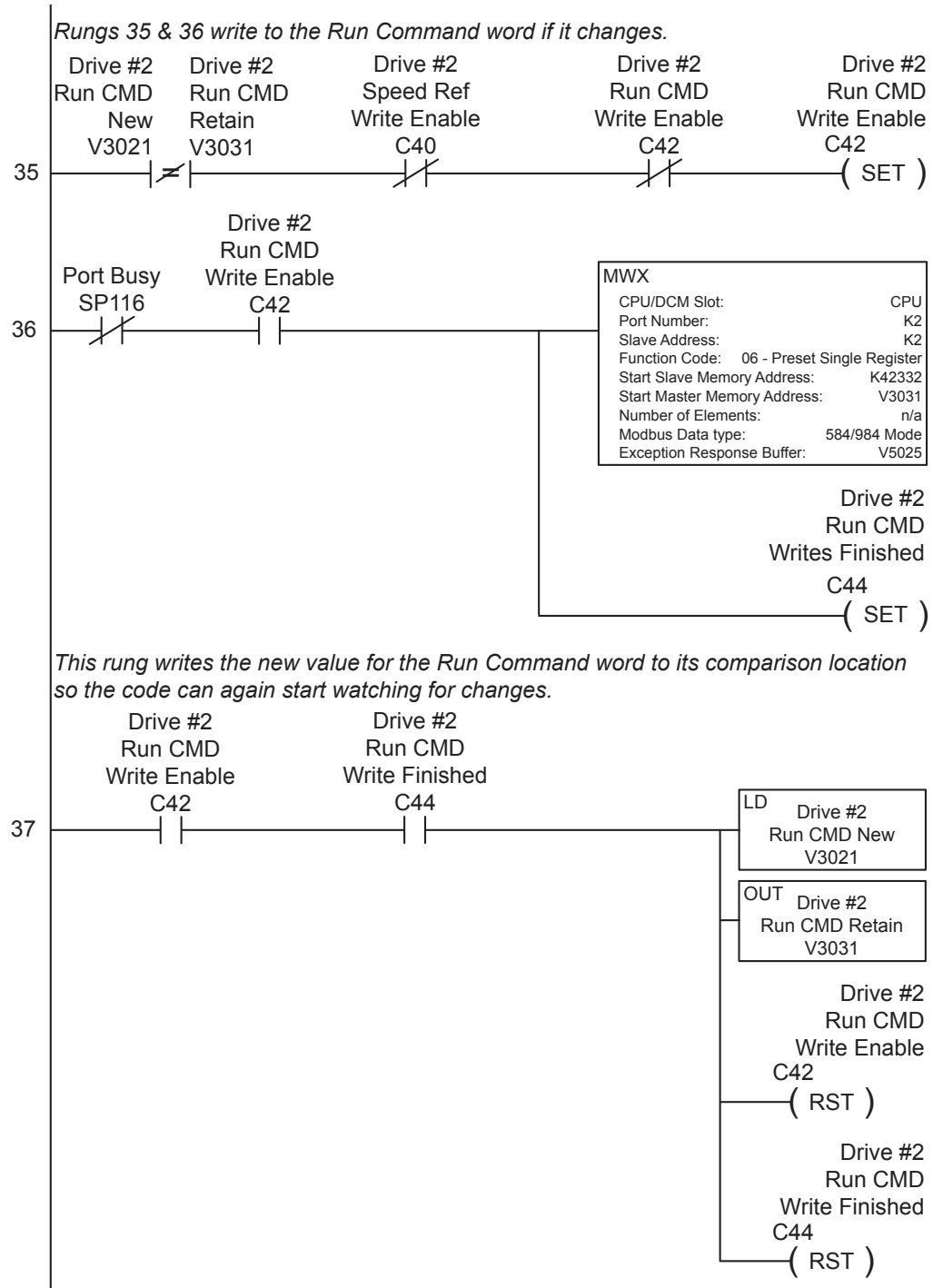


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This program is for illustrational purposes only, and is not intended for a true application.

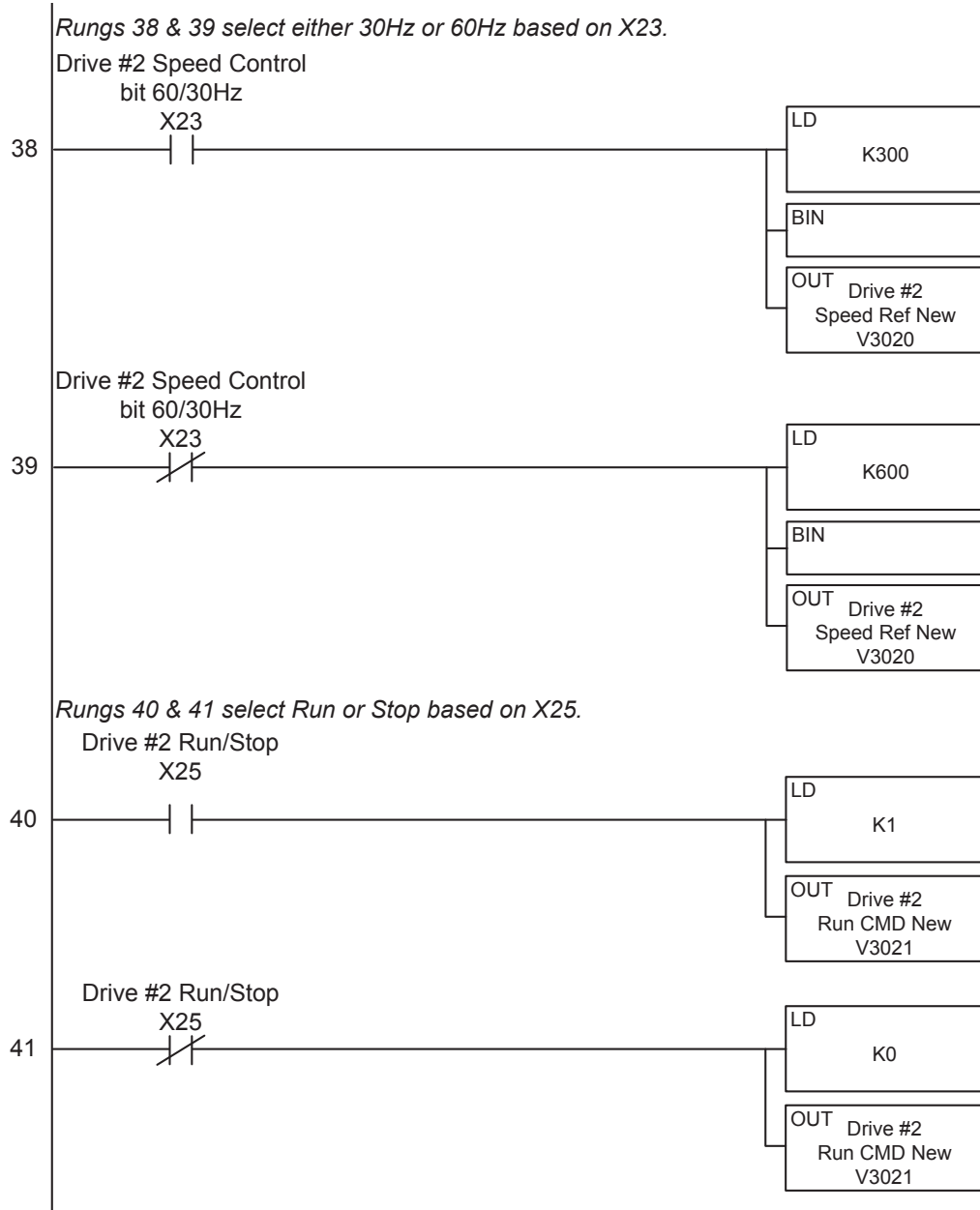


(continued next page – DL MRX/MWX communication program example for DL06 & D2-260 PLCs)

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This program is for illustrational purposes only, and is not intended for a true application.

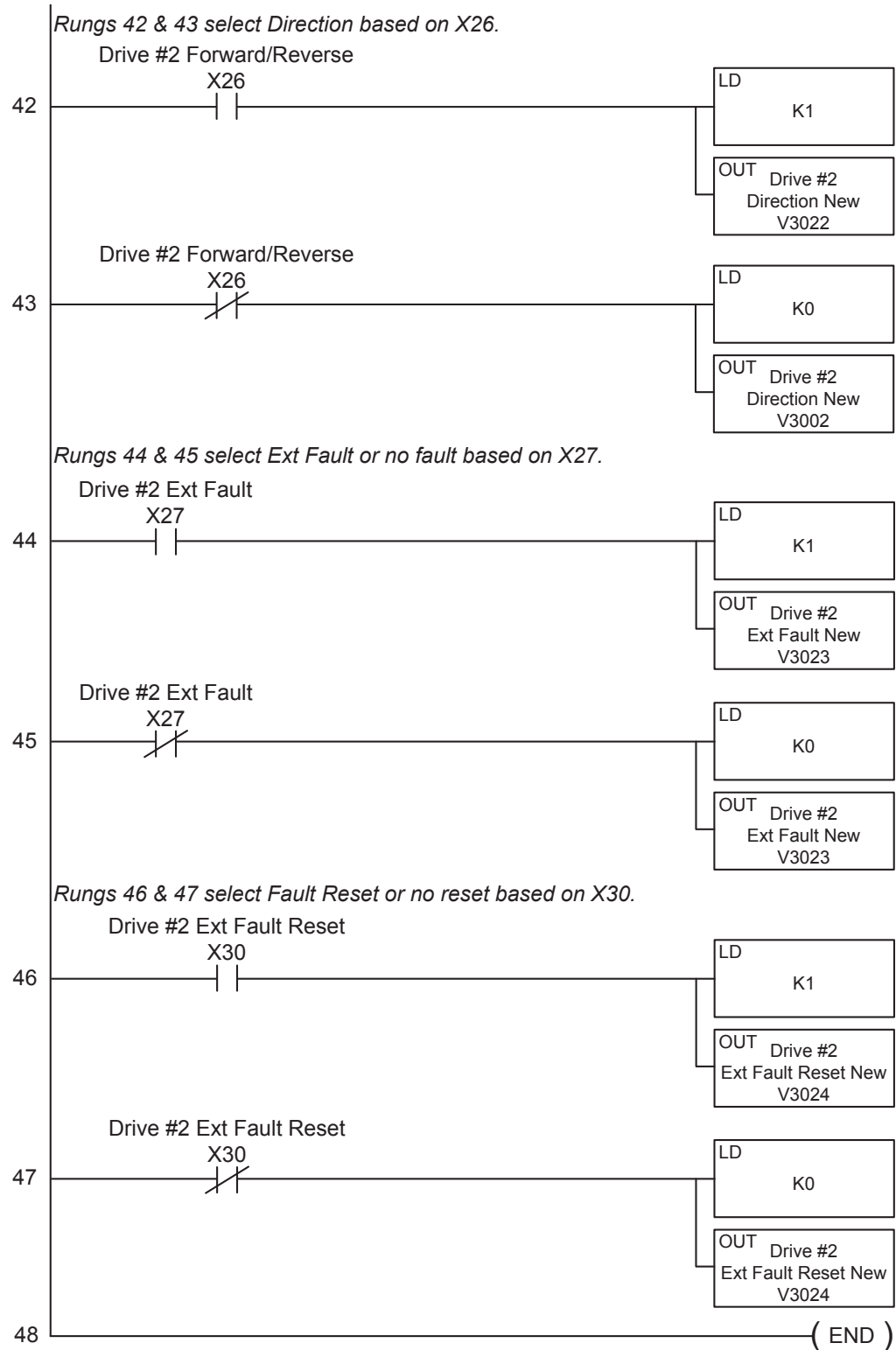


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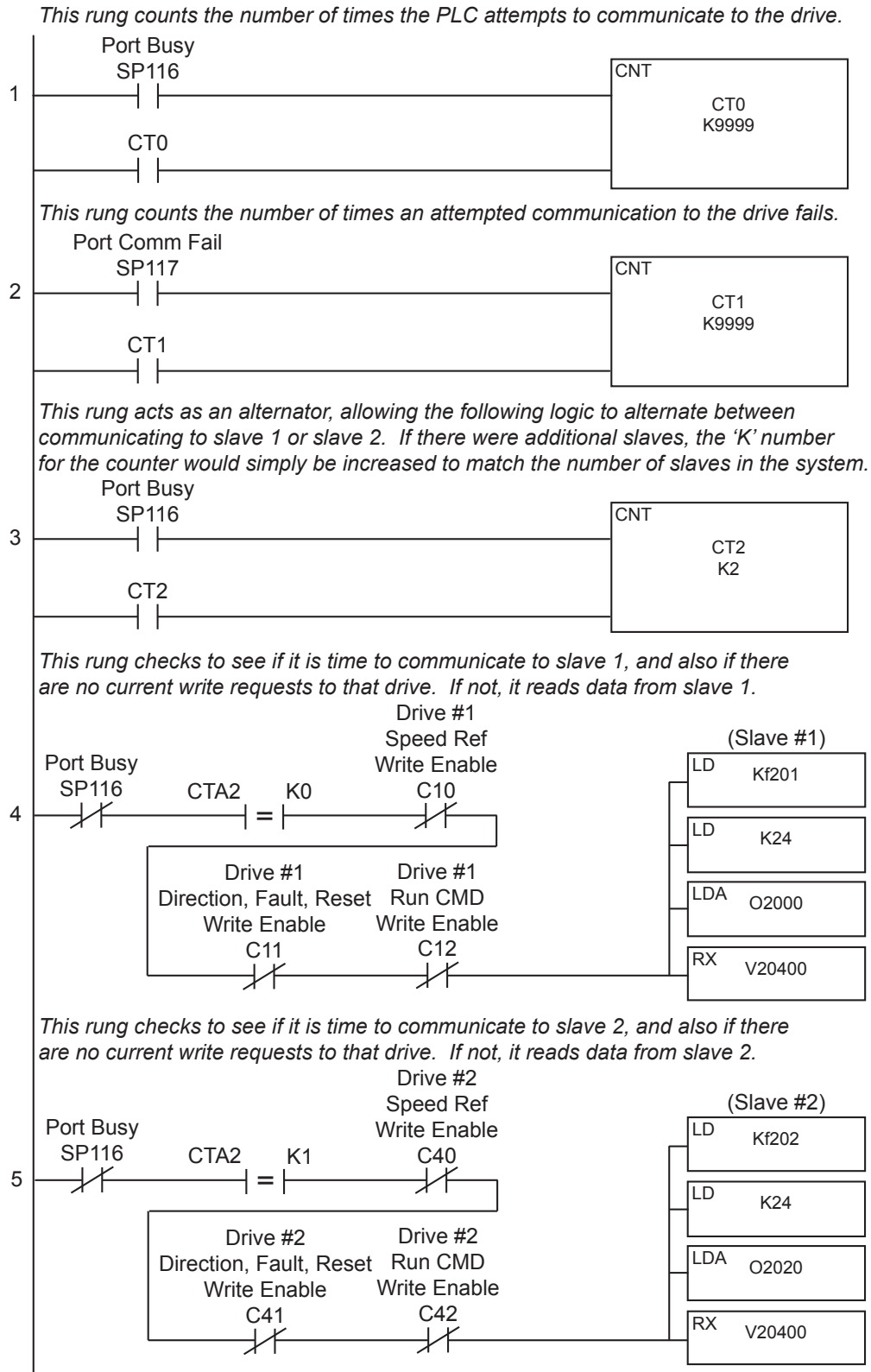
This program is for illustrational purposes only, and is not intended for a true application.



DL RX/WX COMMUNICATION PROGRAM – FOR DL05, D2-250(-1), D4-450 PLCs



This program is for illustrational purposes only, and is not intended for a true application.

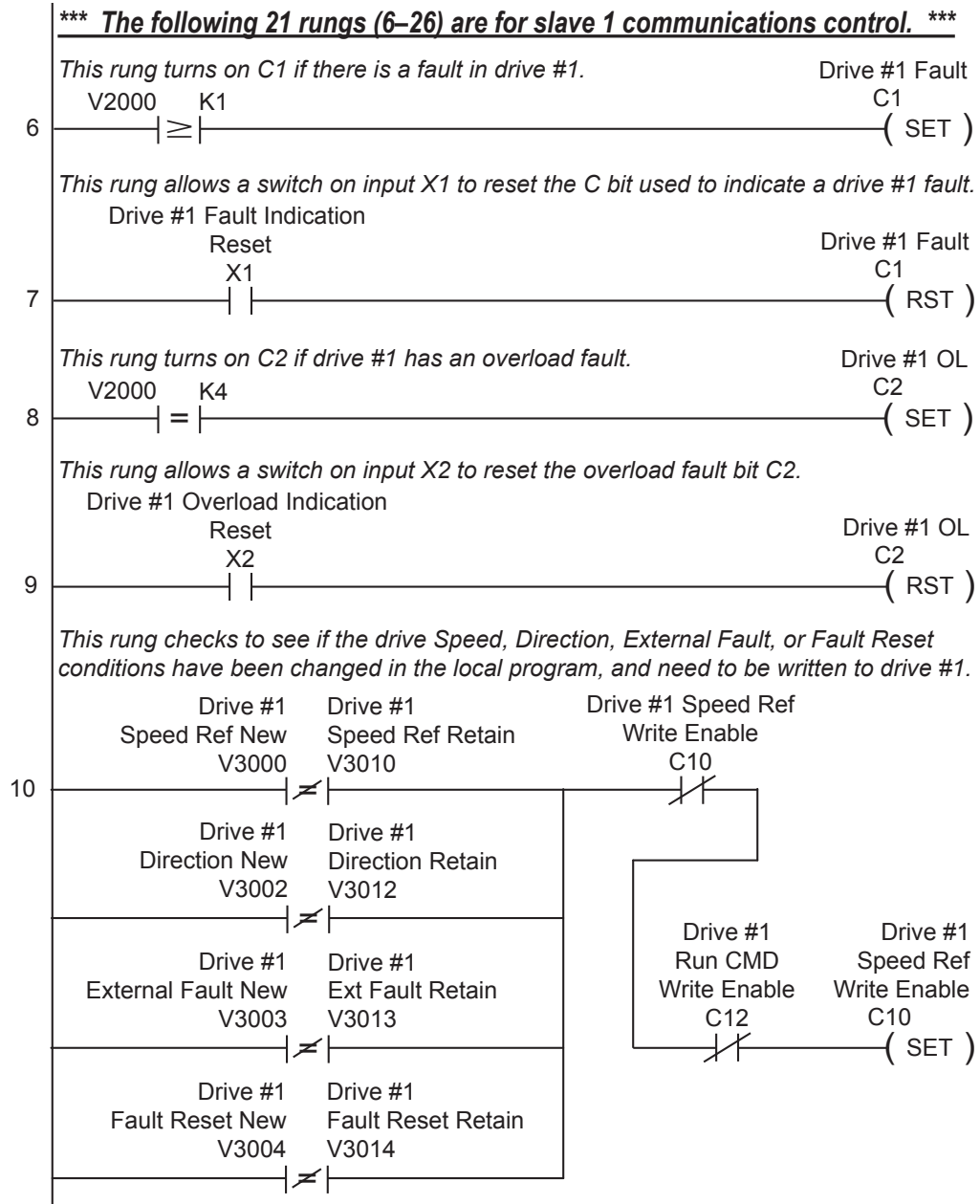


(continued next page – DL RX/WX Communication Program example for DL05, D2-250(-1), D4-450 PLCs)

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This program is for illustrational purposes only, and is not intended for a true application.

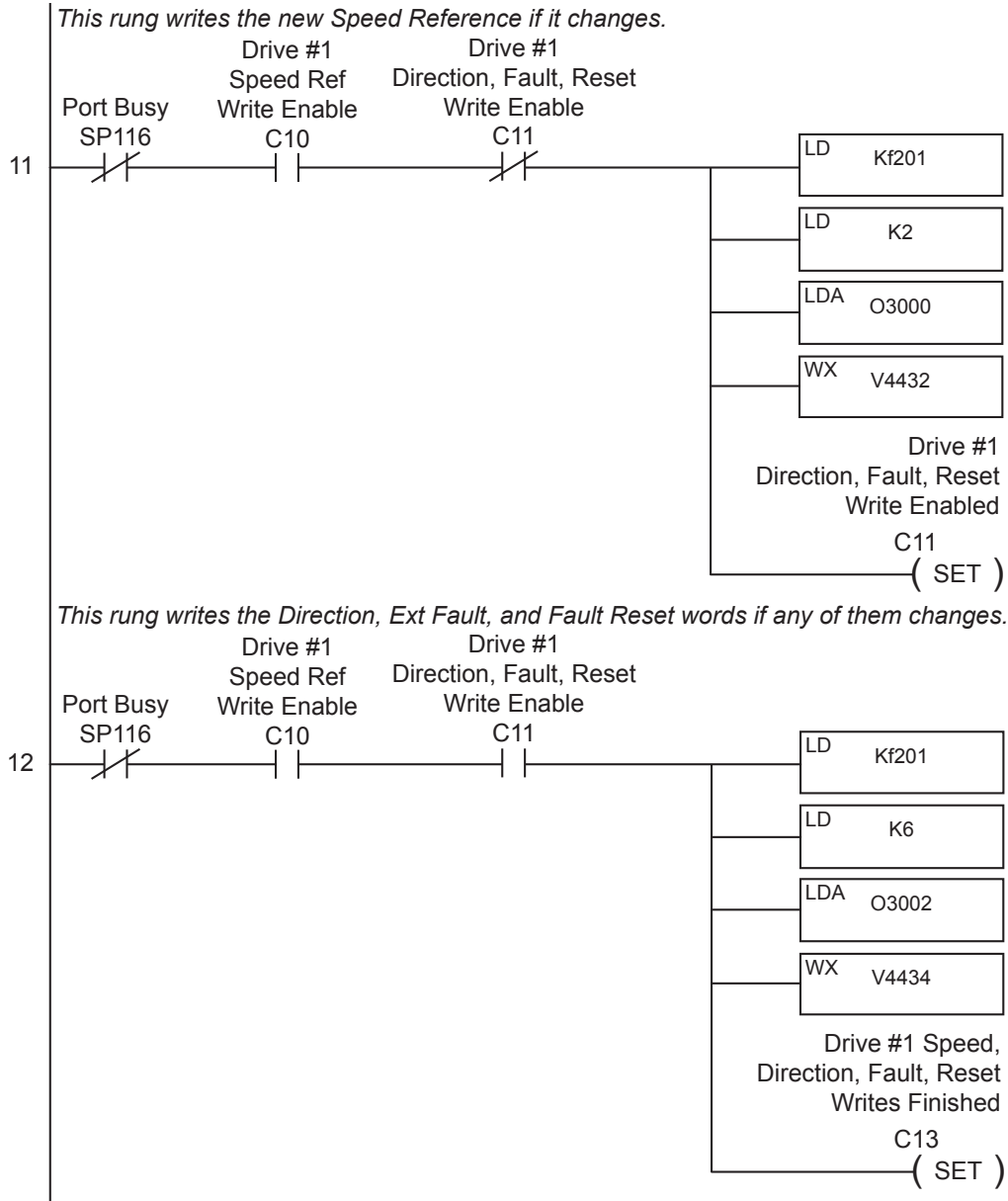


(continued next page – DL RX/WX Communication Program example for DL05, D2-250(-1), D4-450 PLCs)

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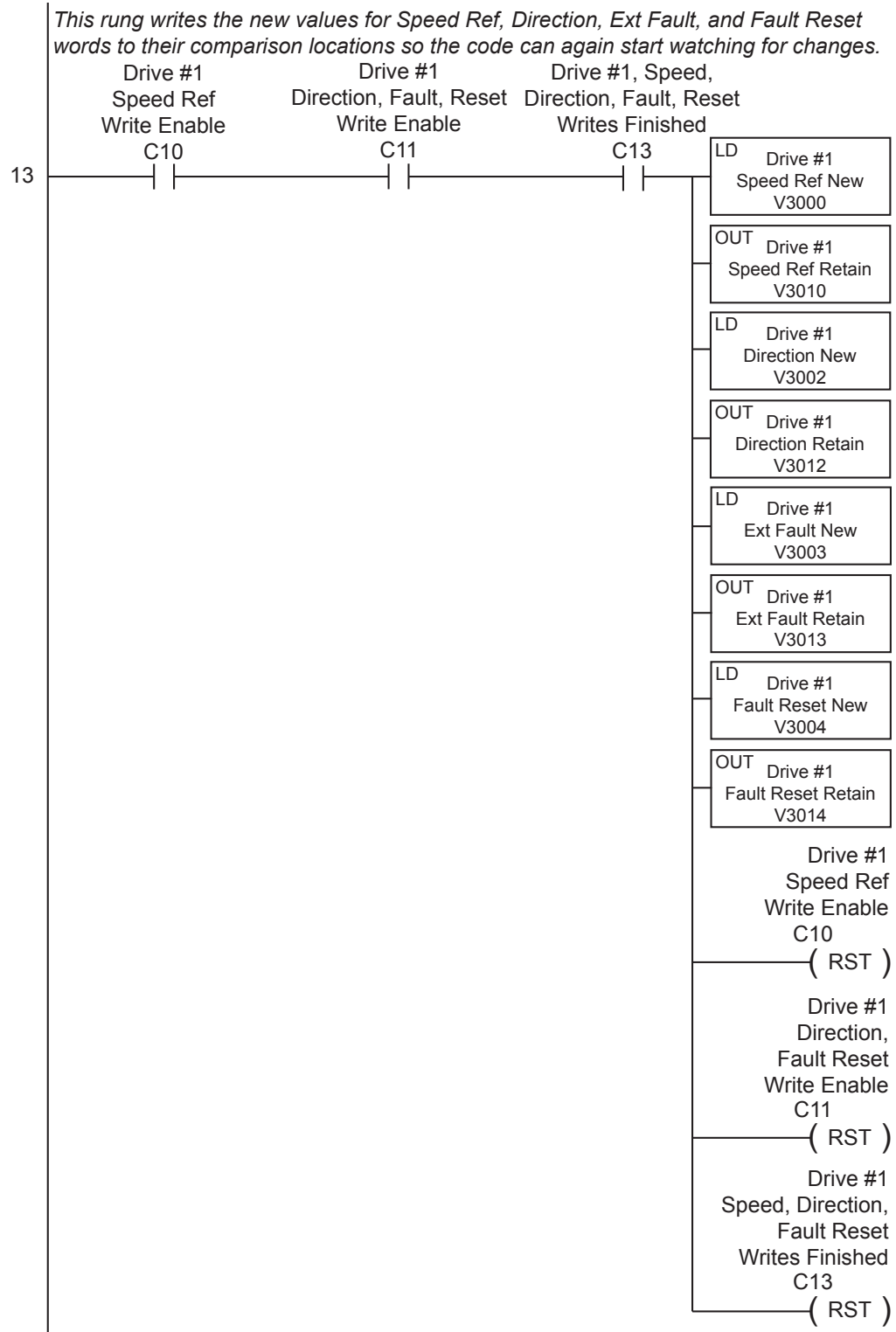


(continued next page – DL RX/WX Communication Program example for DL05, D2-250(-1), D4-450 PLCs)

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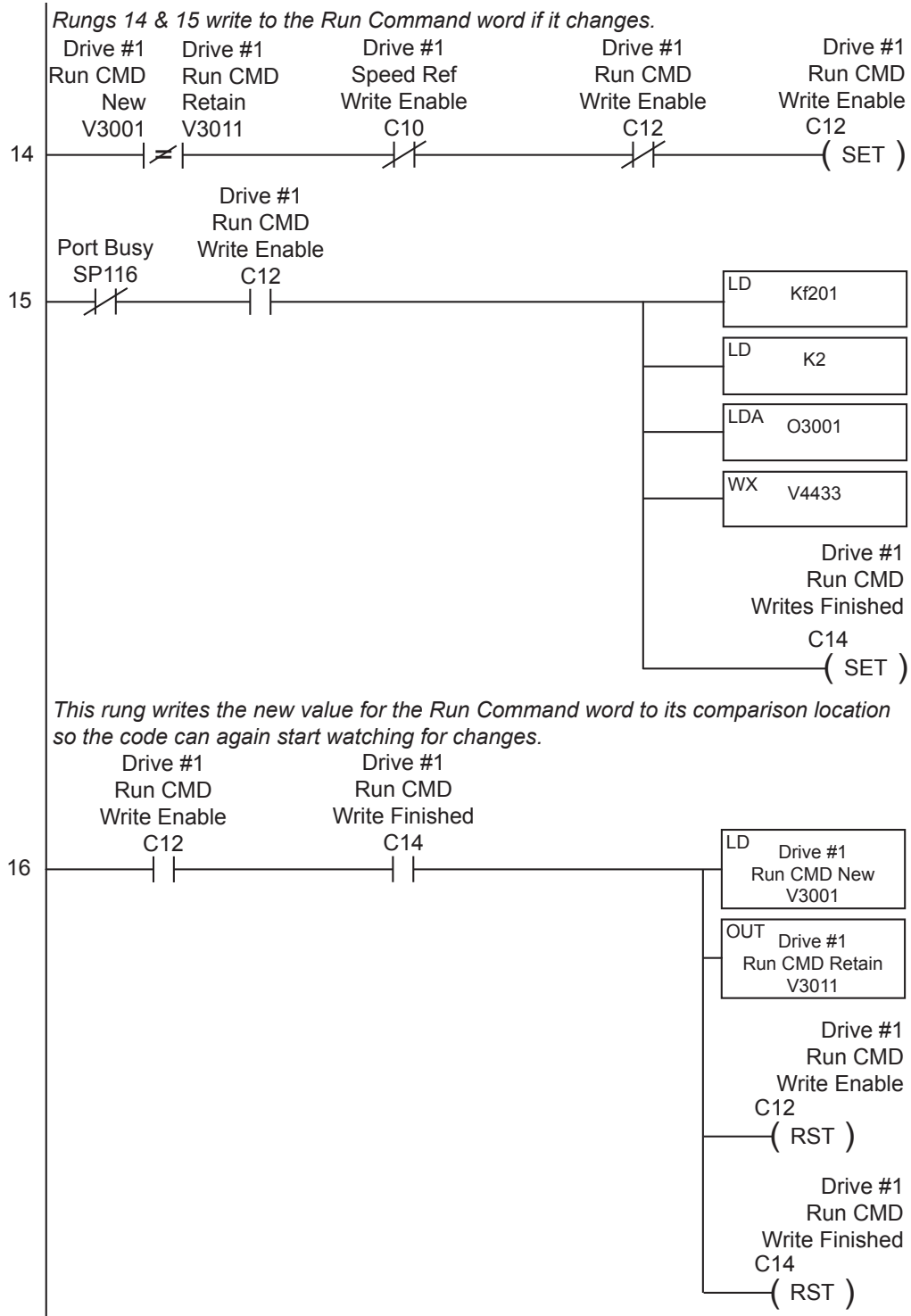


(continued next page – DL RX/WX Communication Program example for DL05, D2-250(-1), D4-450 PLCs)

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This program is for illustrational purposes only, and is not intended for a true application.

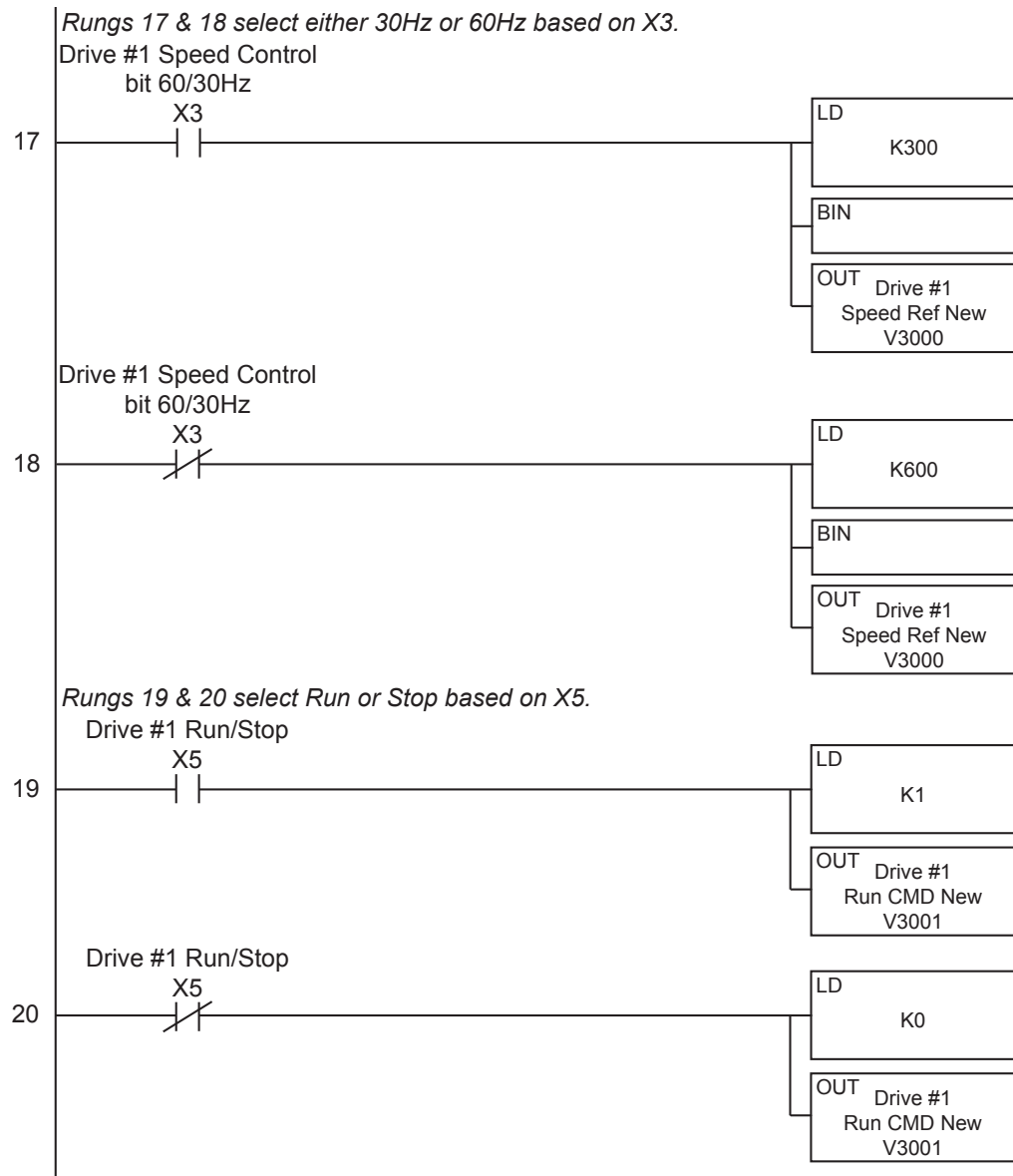


(continued next page – DL RX/WX Communication Program example for DL05, D2-250(-1), D4-450 PLCs)

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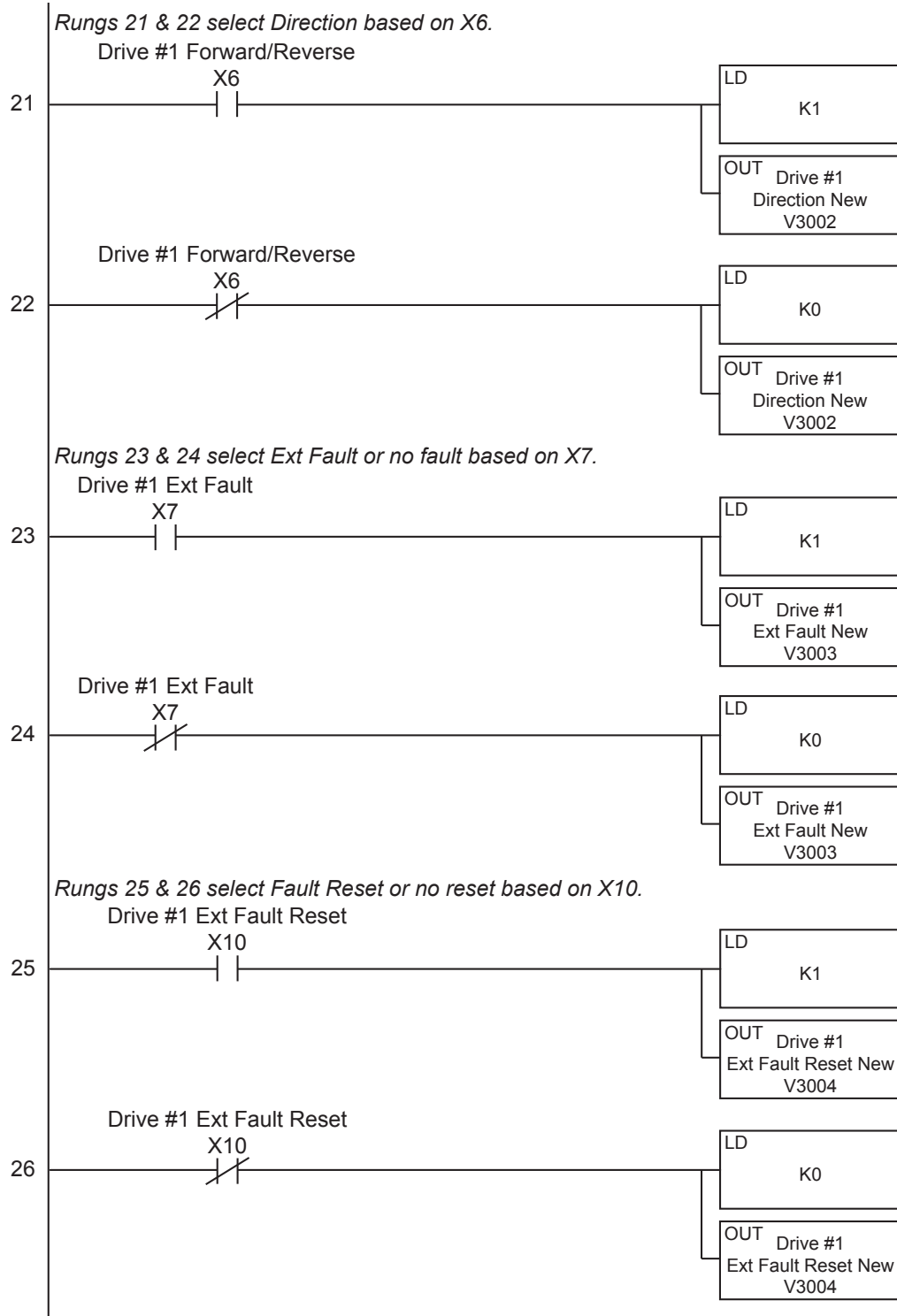


(continued next page – DL RX/WX Communication Program example for DL05, D2-250(-1), D4-450 PLCs)

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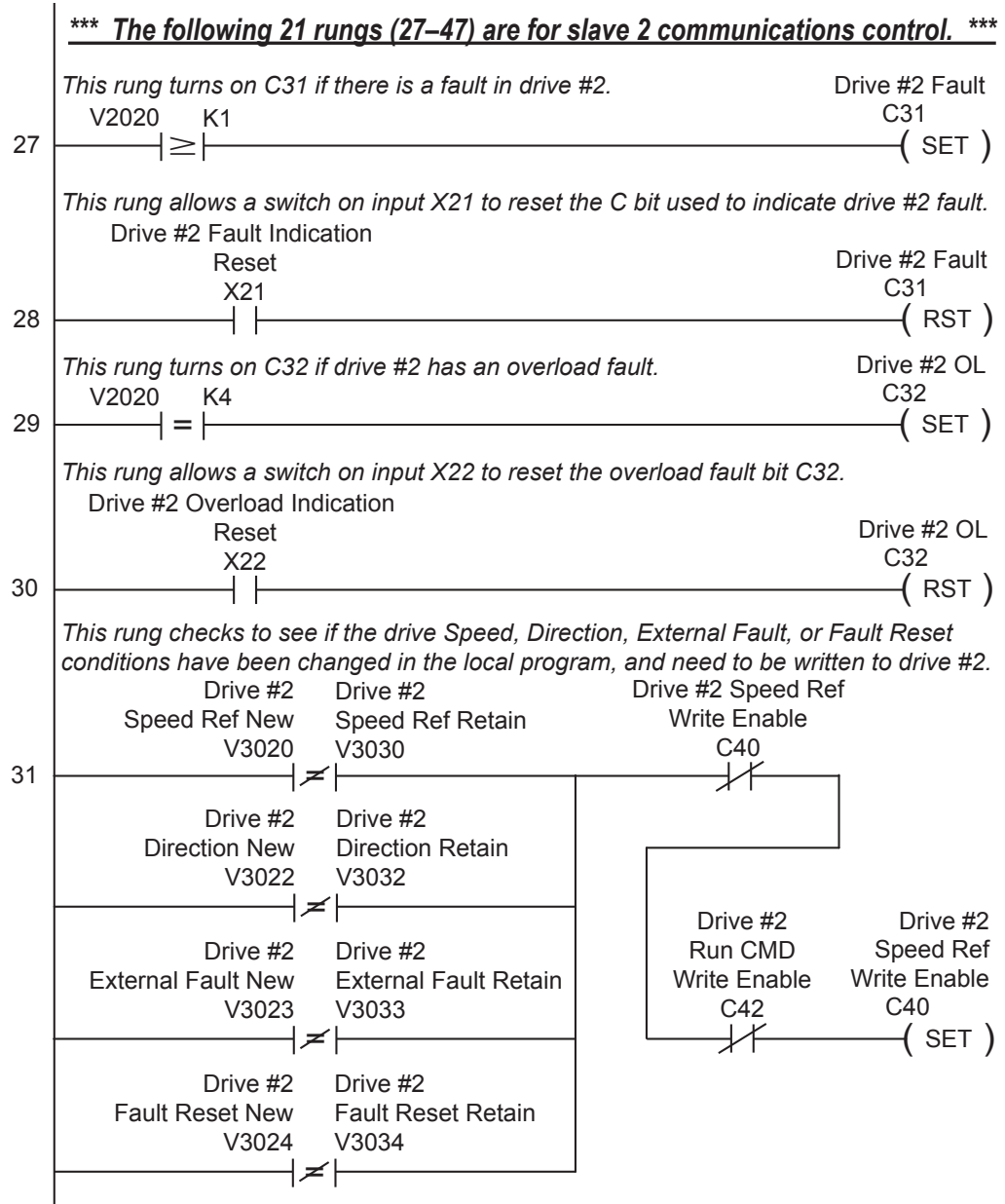


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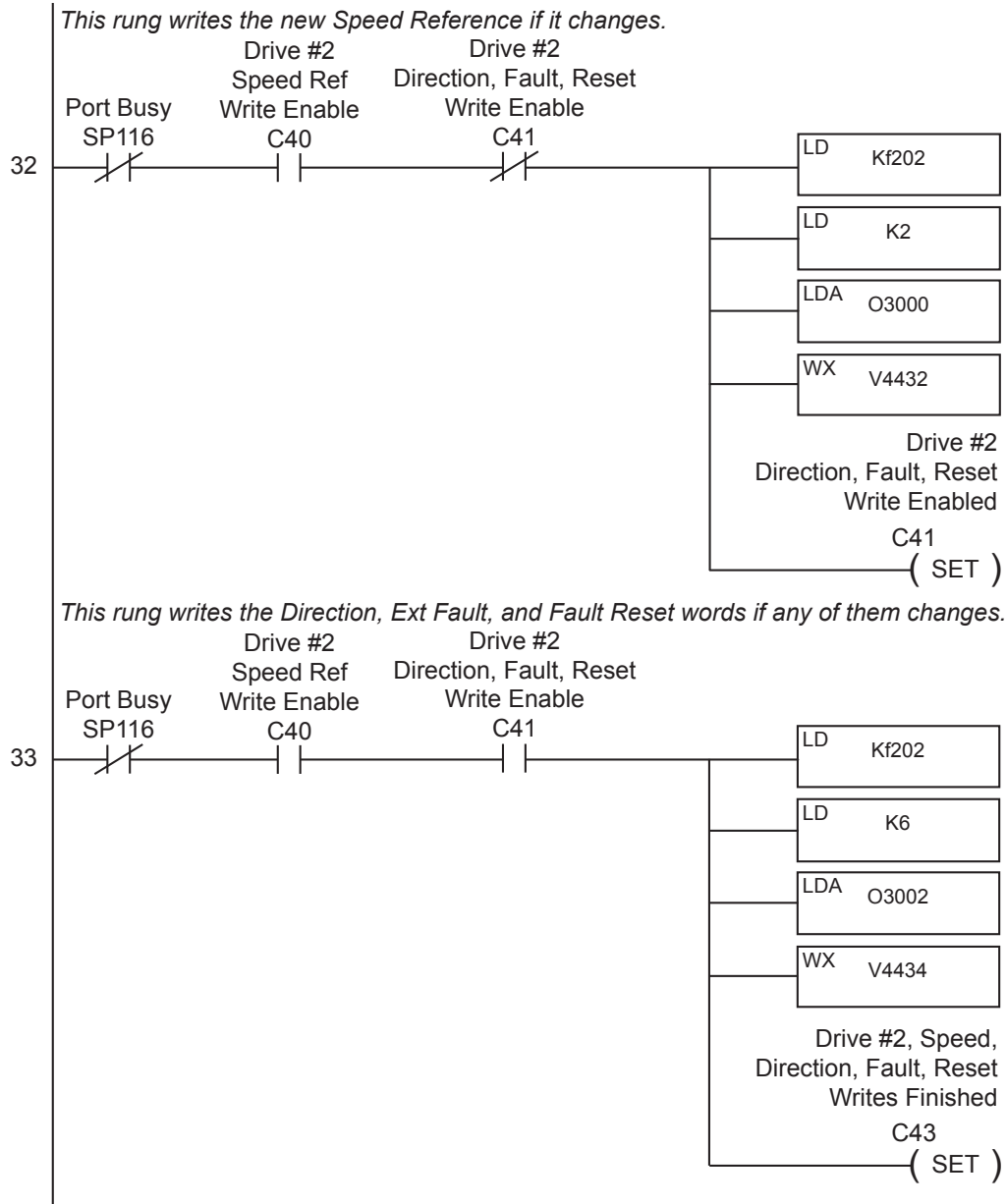


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This program is for illustrational purposes only, and is not intended for a true application.

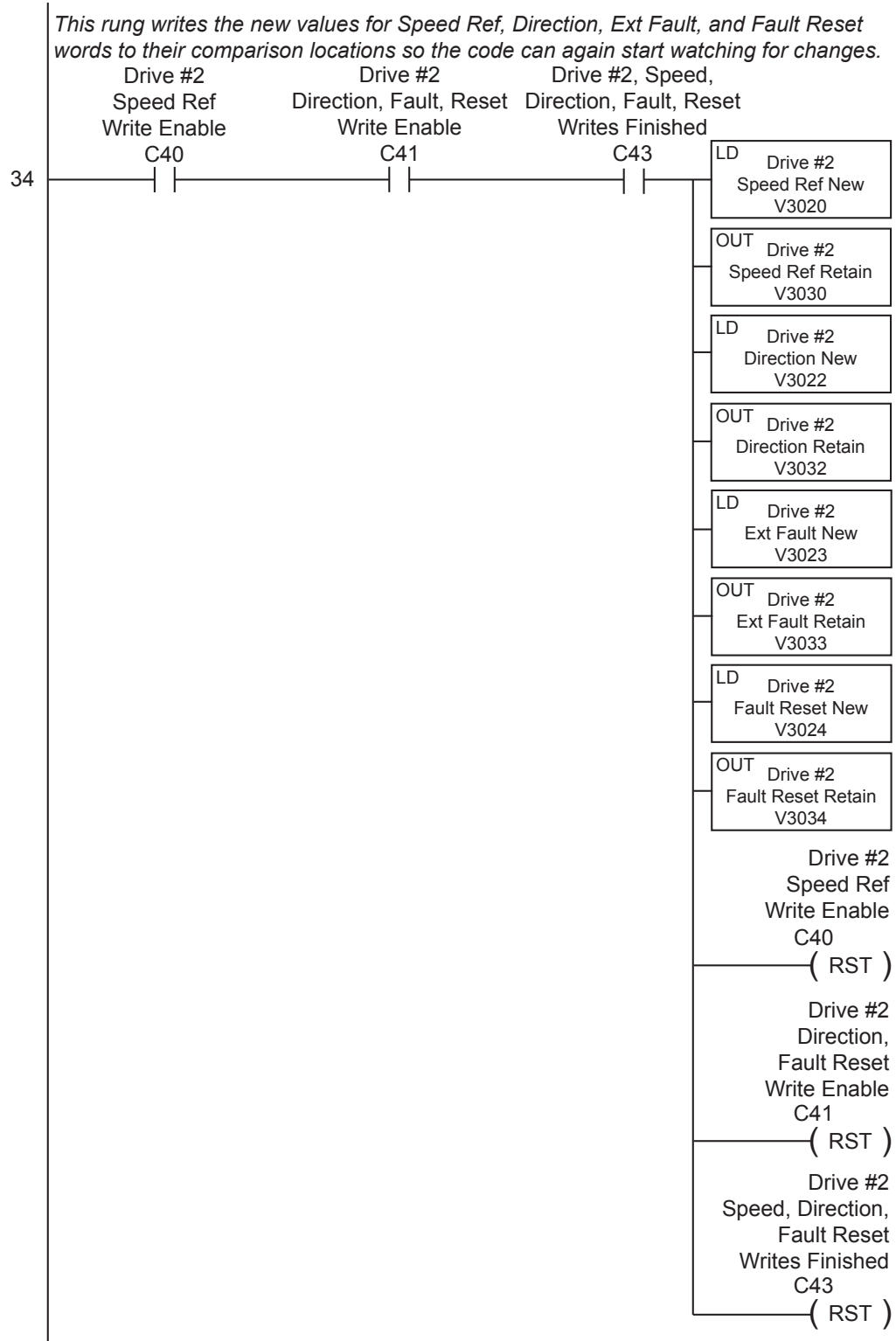


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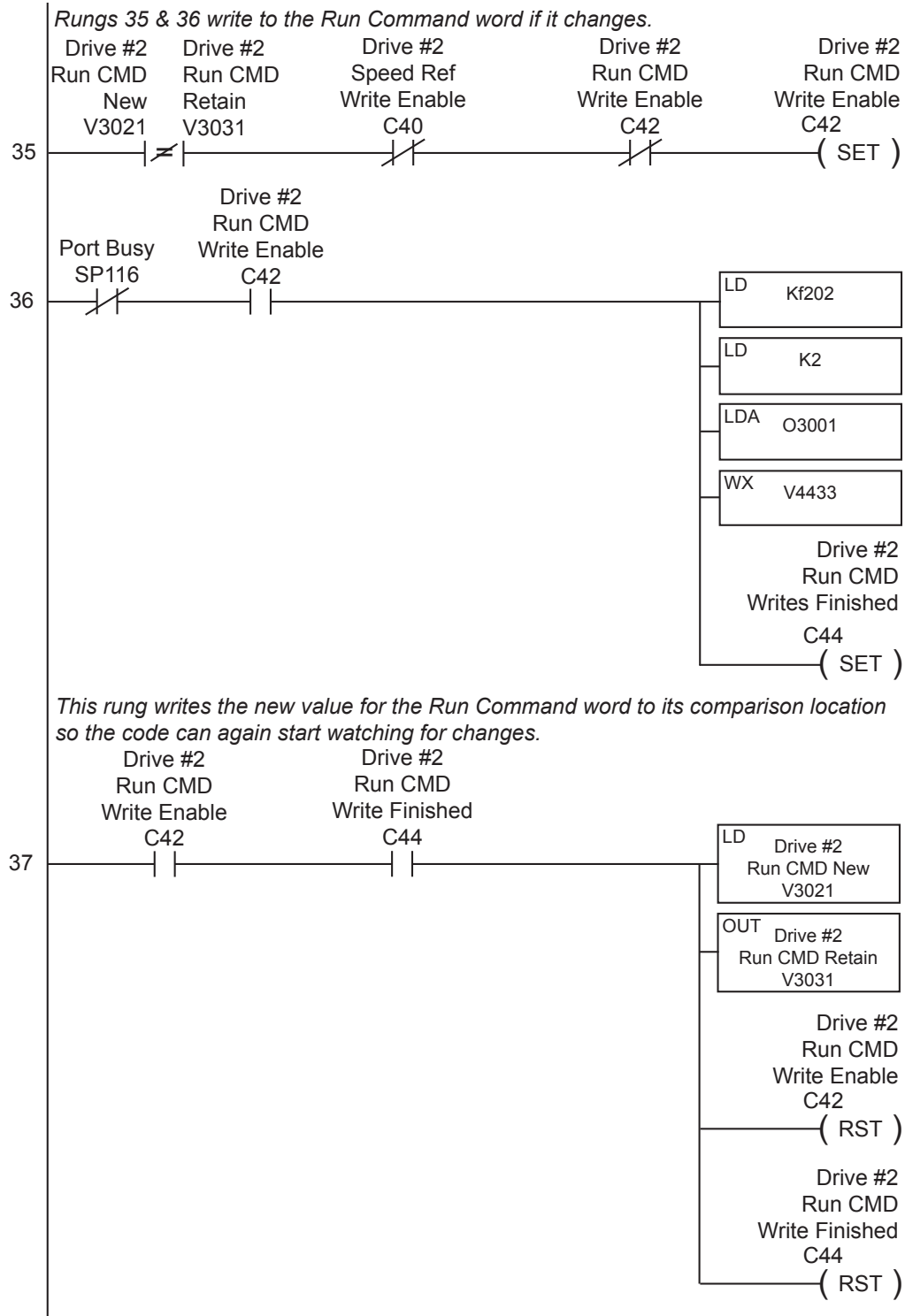


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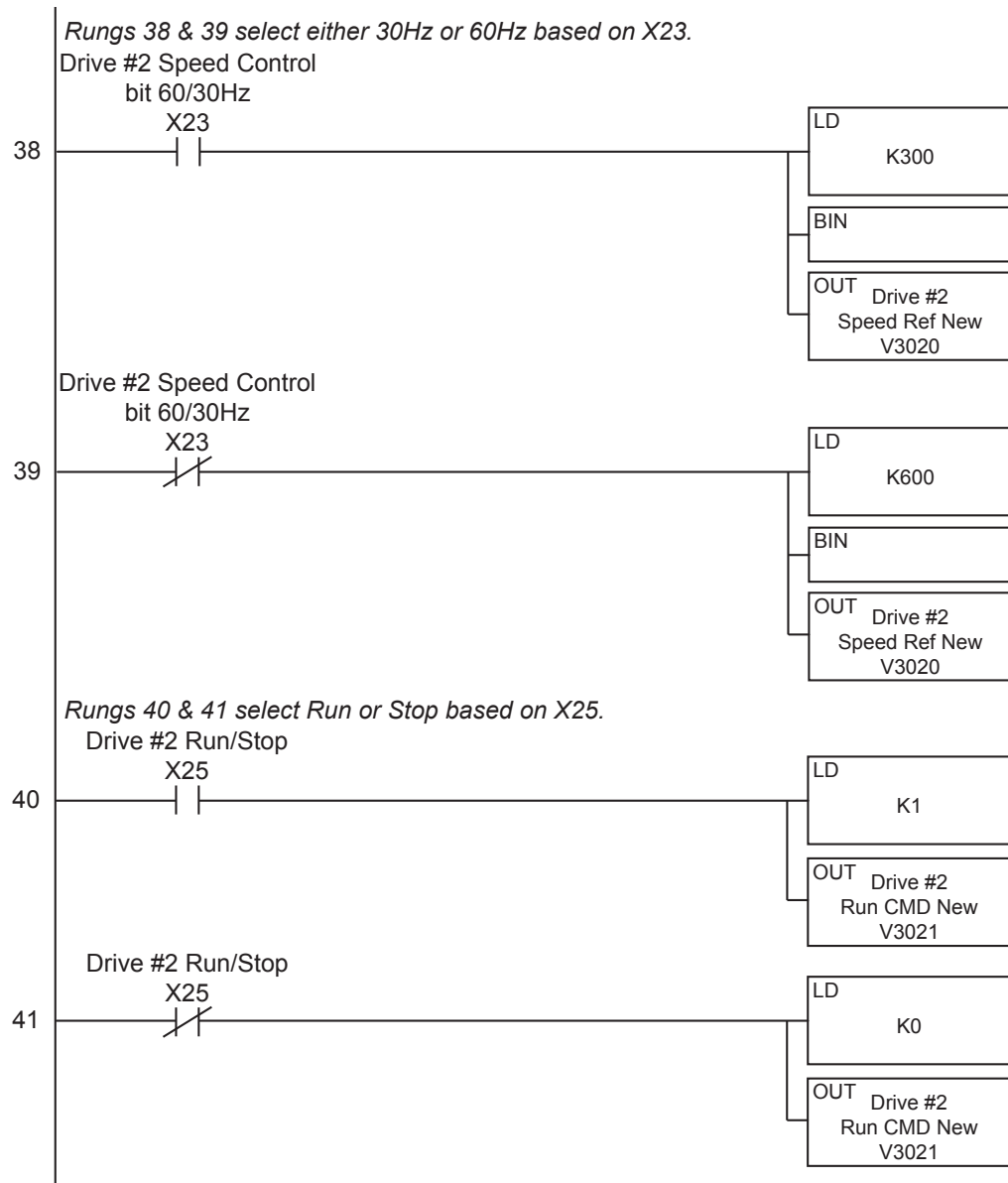


(continued next page – DL RX/WX Communication Program example for DL05, D2-250(-1), D4-450 PLCs)

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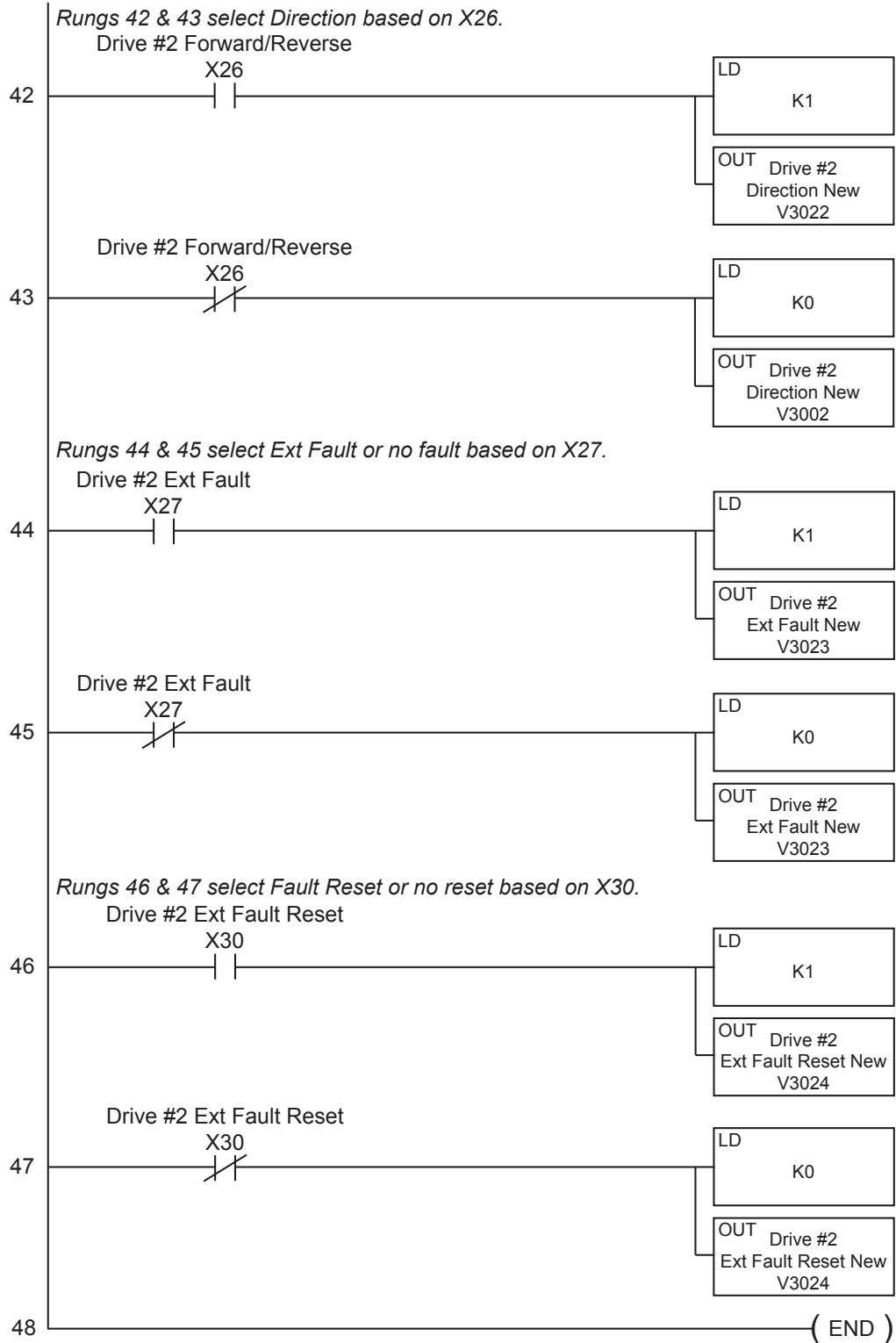


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This program is for illustrational purposes only, and is not intended for a true application.



COMMUNICATING WITH THIRD-PARTY DEVICES

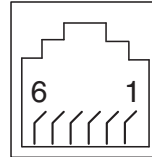
The GS1 Serial Comm Port will accommodate an RS-485 connection.

An RS-485 network cable can span up to 1000 meters (3280 feet). The GS1 AC drive communication address is specified by P9.00. The third party device then controls each AC drive according to its communication address.

The GS1 series AC drive can be set up to communicate on standard MODBUS networks using the following transmission modes: ASCII or RTU. Using the Communication Protocol parameter (P9.02), you can select the desired mode, data bits, parity, and stop bits. The mode and serial parameters must be the same for all devices on a MODBUS network.

GS1 RS-485 Serial Comm Port

**GS1 Serial Comm Port
RS-485 Interface
RJ12 (6P4C)**



- 1: +17V
- 2: GND
- 3: SG-
- 4: SG+
- 5: nc
- 6: reserved



GS1 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, P9.04, and P9.05.

COMMON THIRD-PARTY MODBUS RTU MASTERS

- MODSCAN from www.wintech.com
- KEPSERVER EX 4.0 from www.kepware.com
- Entivity Studio 7.2
- Think & Do Live 5.5.1

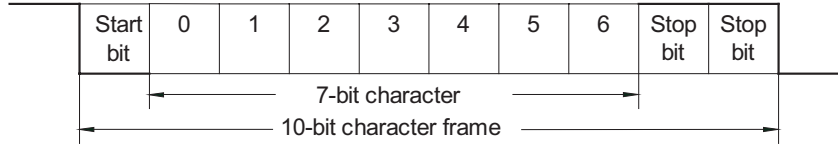
For additional technical assistance, go to our Technical support home page at: <http://support.automationdirect.com/technotes.html>

USING MODBUS ASCII

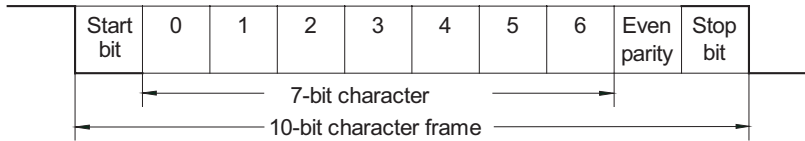
DATA FORMAT

ASCII Mode: 10-bit character frame (For 7-bit character):

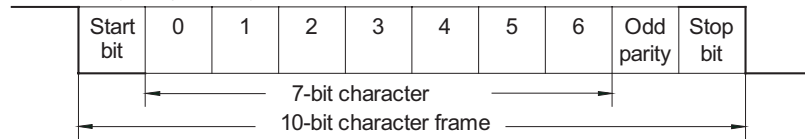
P9.02 = 00 (7 data bits, no parity, 2 stop bits)



P9.02 = 01 (7 data bits, even parity, 1 stop bit)

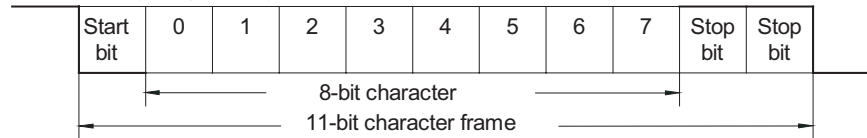


P9.02 = 02 (7 data bits, odd parity, 1 stop bit)

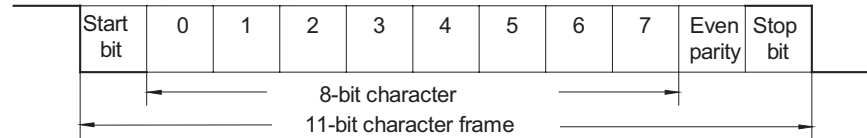


RTU Mode: 11-bit character frame (For 8-bit character):

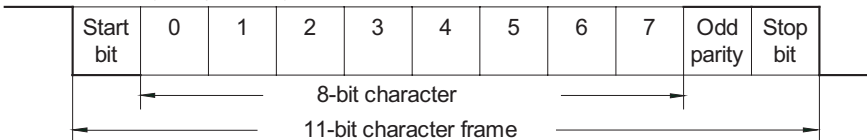
P9.02 = 03 (8 data bits, no parity, 2 stop bits)



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 reply any message to 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 follows: 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		Response Message	
STX	'0'	STX '0'	'0'
ADR 1	'0'	ADR 1	'0'
ADR 0	'1'	ADR 0	'1'
CMD 1	'0'	CMD 1	'0'
CMD 0	'3'	CMD 0	'3'
Starting data address	'2'	Number of data (Count by byte)	'0'
	'1'		'4'
	'0'	Content of starting data address 2102H	'1'
	'2'		'7'
'0'	'7'		
Number of data (Count by word)	'0'	Content data address 2103H	'0'
	'0'		'0'
	'0'		'0'
	'2'		
LRC CHK 1	'D'	LRC CHK 1	'7'
LRC CHK 0	'7'		LRC CHK 0
END 1	CR	END 1	CR
END 0	LF		END 0

RTU mode:

Command Message		Response Message	
ADR	01H	ADR	01H
CMD	03H	CMD	03H
Starting data address	21H	Number of data (Count by byte)	04H
	02H		'0'
Number of data (Count by word)	00H	Content of data address 2102H	17H
	02H		70H
CRC CHK Low CRC CHK High	6FH	Content of data address 2103H	00H
	F7H		02H
		CRC CHK Low CRC CHK High	FEH
			5CH

Command code: 06H, write 1 word

For example, writing 6000(1770H) to address 0100H of the AC drive with address 01H.

ASCII mode:

Command Message		Response Message	
STX	'.'	STX	'.'
ADR 1	'0'	ADR 1	'0'
ADR 0	'1'	ADR 0	'1'
CMD 1	'0'	CMD 1	'0'
CMD 0	'6'	CMD 0	'6'
Data Address	'0'	Data Address	'0'
	'1'		'1'
	'0'		'0'
	'0'	Data Content	'1'
	'1'		'7'
	'7'		'7'
	'7'		'0'
'0'	LRC CHK 1	'7'	
'1'		LRC CHK 0	'1'
END 1	CR	END 1	CR
END 0	LF	END 0	LF

RTU mode:

This is an example of using function code 16 for writing to multiple registers.

Command Message		Response Message	
ADR	01H	ADR	01H
CMD	10H	CMD	10H
Starting data address	20H	Starting data address	20H
	00H		00H
Number of registers	00H	Number of data (Count by word)	00H
	02H		02H
Byte count	04H	CRC CHK Low	4AH
Content of data address 2000H	00H	CRC CHK High	08H
	02H		
Content of data address 2001H	02H		
	58H		
CRC CHK Low CRC CHK High	CBH		
	34H		

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.

COMM DELAY – OPTIMIZING COMMUNICATIONS

OPTIMIZING COMMUNICATIONS TO GS DRIVES



In most cases, optimizing communications to GS Drives MAY NOT BE NECESSARY.

If you are only communicating to one or two drives and reading or writing only a few parameters, the communication speed will most likely be sufficient for your application.

However, in the case that the communication speed (reaction time from reading or writing an event to a given drive) is too slow, you may need to take a more detailed look at how your code is designed to communicate to the GS Drives in your application.

To properly design the system, it is necessary to understand all of the propagation delays that are incurred when triggering the event to send a Modbus message to the point of receiving the data or status of the reply into the PLC or Modbus master.

To determine the time necessary to transmit a message from the Master to the Slave and vice versa, we must first determine the “Bit Time” and the “Character Time”. This is calculated by using the following formulas:

- **Bit Time:**
The value one divided by the baud rate. A baud rate of 19,200 equals a bit rate of 0.0000528 (1/19200) or 52 μs (microseconds).
- **Character Time:**
Bit Time multiplied by the number of bits. With Modbus this is typically 10–12 bits per character [1 start bit (fixed), 1 or 2 stop bits (usually configurable), 0 or 1 parity bit (Odd & Even = 1 bit; None = 0), & 8 data bits]. For a setting of Odd parity and 1 Stop bit, this would be 11 bits. So at 19200, Odd parity and 1 stop bit, a character time would be 0.000573 or 573 μs (0.0000528 · 11).

Now that we know the byte time, we can multiply that time by the number of characters in each message.

TYPES OF MESSAGES SENT TO GS DRIVES

There are three different types of messages typically be sent to GS Drives:

- 1) Read Registers (Function Code 3).
- 2) Write Multiple Registers (Function Code 16).
- 3) Write Single Register (Function Code 6).

FORMAT OF "READ REGISTERS" MESSAGES:

<p><u>Request:</u> XX = Node Address (1 Char) 03 = Function Code (1 Char) XXXX = Starting Address to read (2 Chars) XXXX = Number of Registers to read (2 Chars) XXXX = 16 Bit CRC (2 Chars)</p>	<p><u>Reply:</u> XX = Node Address (1 Char) 03 = Function Code (1 Char) XX = Byte count of data being sent from Slave (1 Char) XXXX... = Depends upon Request (2 Chars per Register requested) XXXX = 16 Bit CRC (2 Chars)</p>
---	---

FORMAT OF "WRITE MULTIPLE REGISTERS" MESSAGES:

<p><u>Request:</u> XX = Node Address (1 Char) 10 = Function Code (Hex format) (1 Char) XXXX = Starting Address to write to (2 Chars) XXXX = Number of Registers to write to (2 Chars) XX = Number of bytes of data to write (1 Char) XXXX... = Depends upon Request (2 Chars per Register requested) XXXX = 16 Bit CRC (2 Chars)</p>	<p><u>Reply:</u> XX = Node Address (1 Char) 10 = Function Code (Hex format)(1 Char) XXXX = Starting Address to write to (2 Chars) XXXX = Number of Registers to write to (2 Chars) XXXX = 16 Bit CRC (2 Chars)</p>
---	---

FORMAT OF "WRITE SINGLE REGISTER" MESSAGES:

<p><u>Request:</u> XX = Node Address (1 Char) 06 = Function Code (1 Char) XXXX = Register to Write to (2 Chars) XXXX = Data to Write (2 Chars) XXXX = 16 Bit CRC (2 Chars)</p>	<p><u>Reply:</u> XX = Node Address (1 Char) 06 = Function Code (1 Char) XXXX = Register to Write to (2 Chars) XXXX = Data to Write (2 Chars) XXXX = 16 Bit CRC (2 Chars)</p>
---	---

EXAMPLE MESSAGE:

Write a value of 60Hz to P9.26 and a value of 1 to P9.27 = **01 10 09 1b 00 02 04 02 58 00 01 5a 66**

We receive a good reply = **01 10 09 1b 00 02 a3 9f**

Sending message (13 characters from above) = **7.4 ms (0.00744796)**

Reply message (8 characters from above) = **4.6 ms (0.004583)**



For more specific information on how Modbus messages are formed, refer to the Modbus specifications found at www.modbus.org.

ADDITIONAL MESSAGE DELAY TIMES

So we have the total transmission time for sending a message and receiving a reply but this does not include all of the delays for a given message. The receiving device must have time to process the receipt of a message and formulate a reply. The amount of time that the receiving device needs will vary greatly depending upon the hardware platform and other processes that the device is running.

For the previous example message, the GS Drive responds in 4ms when the drive is stopped and will respond in 5ms when the drive is running. This may vary somewhat depending upon the specific parameter values and the size of the request.

MODBUS-SPECIFIED DELAYS BETWEEN MESSAGES

There is one additional time delay required in the Modbus protocol. The protocol specifies at least a 3.5 character delay between messages. For the settings above, a 3.5 character time in our example would be about 2ms.

So the total time required for the message sent above would be:

7.4 ms	(Transmission time for sending message)
5.0 ms	(response delay from GS Drive when drive running)
4.6 ms	(Transmission time for reply message)
+ 2.0 ms	(Modbus message wait delay)
19.0 ms	(approximately)

Remember, from our description, that this is purely the time from when the message leaves the serial port to when the reply is received back in to the serial port.

OTHER DELAYS

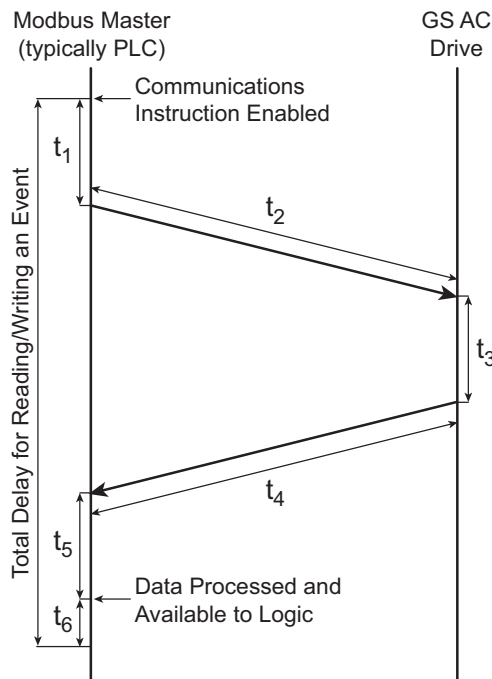
Depending upon the master device, there may be additional delays. For example:

In the DirectLogic PLC, the serial communications are serviced in the housekeeping portion of the PLC scan. So if the communications instruction is in rung #1 of a ladder program, the serial communications message does not get sent until the end of the total PLC scan. Likewise, if the reply message was received into the serial port at the beginning of the PLC scan, it would not be serviced until the end of the PLC scan.

So you would need to add an additional possible two PLC scan times to the number above to truly calculate the time necessary to read or write an event to the GS drive.

These delays are shown in the following Communication Delay Timing Diagram.

COMMUNICATION DELAY TIMING DIAGRAM



- t_1 = Scan delay from the point of turning on a communications instruction to when it actually goes out of the serial port.
- t_2 = Transmission time to send Message request (read or write).
- t_3 = Response delay from GS drive to receive the reply and formulate the response.
- t_4 = Transmission time to send Reply message.
- t_5 = Scan delay from the point of receiving reply, processing it and placing in PLC memory for Logic usage.
- t_6 = Wait time required by Modbus spec (3.5 byte times). This may or may not be present depending upon the Scan delay, but safer to factor in.

COMMUNICATION DELAY SUMMARY

Now that you know how to calculate the time required for one message to one GS drive, you would simply multiply this value per message to each GS drive on the network, since only one message can be sent at a time.

As you can deduce from the statement above, the more messages being sent to GS drives, the longer it takes to communicate to an individual drive as each message has to take its turn.

So how do you optimize your communications to get messages faster to your GS drives?

There is no way to make a message go faster than what is specified above, but what you can affect is the amount of messages being sent to any given GS drive in two ways.

- 1) Group together messages into Block requests whenever possible. For example, if you wanted to read Status Monitor 1 and the Output Frequency status register from the drive, read the two together as a block (Status Monitor 1, Status Monitor 2, Frequency Command and Output Frequency), and ignore the other two status registers that you don't need instead of sending two separate read commands. If you do the calculations above, you will see that is much faster to take the additional hit from four extra bytes in the reply message than it would be to send a separate message. NOTE that you cannot read across non-contiguous Modbus addresses, so this typically only works when reading within the Status registers or in a Parameter category (P9.xx, P1.xx, etc...).
- 2) Only send a write message when the value changes in the Master device. It is simpler to setup your communications instructions to read and write all the time, but it wastes precious network time to write the same value to the GS drive over and over if that value is not changing. Write some simple logic that only triggers a write command when the value to be sent has changed.

For more specific instructions on how to configure and/or interlock, in detail, the individual communications instructions, consult your PLC or Modbus Master Device user manual. If using DirectLogic PLCs as the Modbus Master, consult the Dx-USER-M manuals for specifics on configuring the individual communications instructions and look at the Hx-ECOM-M manual for information on interlocking communications instructions.

MAINTENANCE AND TROUBLESHOOTING



CHAPTER

6

CONTENTS OF THIS CHAPTER

<i>Maintenance and Inspection</i>	6-2
<i>Monthly Inspection:</i>	6-2
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<i>Recharge Capacitors (for unused drives)</i>	6-2
<i>Troubleshooting</i>	6-3
<i>Fault Codes.</i>	6-3
<i>Warning Messages</i>	6-4

MAINTENANCE AND INSPECTION

Modern AC drives are based on solid state electronics technology. Preventive maintenance is required to operate the AC drive in its optimal condition, and to ensure a long life. We recommend that a qualified technician perform a regular inspection of the AC drive. Some items should be checked once a month, and some items should be checked yearly. Before the inspection, always turn off the AC input power to the unit, and wait at least two minutes after all display lamps have turned off.



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.



WARNING! *DISCONNECT AC POWER AND ENSURE THAT THE INTERNAL CAPACITORS HAVE FULLY DISCHARGED BEFORE INSPECTING THE AC DRIVE!*

MONTHLY INSPECTION:

Check the following items at least once a month.

- 1) Make sure the motors are operating as expected.
- 2) Make sure the installation environment is normal.
- 3) Make sure the cooling system is 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 of the AC 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) Tighten and reinforce the screws of the AC drive 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 the insulation with a mega-ohmmeter.
- 4) Check the capacitors and relays, and replace if necessary.
- 5) 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.
- 6) Recharge the capacitors of any drive that is in storage or is otherwise unused.

RECHARGE CAPACITORS (FOR UNUSED DRIVES)

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.

TROUBLESHOOTING

FAULT CODES

The AC drive has a comprehensive fault diagnostic system that includes several different alarms and fault messages. Once a fault is detected, the corresponding protective functions will be activated. The fault codes are then displayed on the digital keypad display. The six most recent faults can be read on the digital keypad display by viewing P6-31 to P6-36.



NOTE: Faults can be cleared by a reset from the keypad or input terminal.

Fault Codes		
Fault Name	Fault Description	Corrective Actions
OC	The AC drive detects an abnormal increase in current.	<ol style="list-style-type: none"> 1) Check whether the motor's horsepower corresponds to the AC drive output power. 2) Check the wiring connections between the AC drive and motor for possible short circuits. 3) Increase the Acceleration time (P1-01 or P1-05). 4) Check for possible excessive loading conditions at the motor. 5) If there are any abnormal conditions when operating the AC drive after short-circuit is removed, the AC drive should be sent back to the manufacturer.
OU	The AC drive detects that the DC bus voltage has exceeded its maximum allowable value.	<ol style="list-style-type: none"> 1) Check whether the input voltage falls within the rated AC drive input voltage. 2) Check for possible voltage transients. 3) Bus over-voltage may also be caused by motor regeneration. Increase the decel time. 4) Check whether the required braking power is within the specified limits.
OH	The AC drive temperature sensor detects excessive heat.	<ol style="list-style-type: none"> 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 on the heat sinks and check for possible dirty heat sink fins. 4) Provide enough spacing for adequate ventilation.
LU	The AC drive detects that the DC bus voltage has fallen below its minimum value.	Check whether the input voltage falls within the AC drive's rated input voltage.
OL	The AC drive detects excessive drive output current. <i>Note:</i> The AC drive can withstand up to 150% of the rated current for a maximum of 60 seconds.	<ol style="list-style-type: none"> 1) Check whether the motor is overloaded. 2) Reduce torque compensation setting as set in P2-03. 3) Increase the AC drive's output capacity.
OLI	Internal electronic overload trip	<ol style="list-style-type: none"> 1) Check for possible motor overload. 2) Check electronic thermal overload setting. 3) Increase motor capacity. 4) Reduce the current level so that the AC drive output current does not exceed the value set by the Motor Rated Current P0-01.
OL2	Motor overload. Check the parameter settings (P6-07 to P6-09)	<ol style="list-style-type: none"> 1) Reduce the motor load. 2) Adjust the over-torque detection setting to an appropriate level.
OCRA	Over-current during acceleration: <ol style="list-style-type: none"> 1) Short-circuit at motor output. 2) Torque boost too high. 3) Acceleration time too short. 4) AC drive output capacity is too small. 	<ol style="list-style-type: none"> 1) Check for possible poor insulation at the output line. 2) Decrease the torque boost setting in P2-03. 3) Increase the acceleration time. 4) Replace the AC drive with one that has a higher output capacity (next HP size).
OCRD	Over-current during deceleration: <ol style="list-style-type: none"> 1) Short-circuit at motor output. 2) Deceleration time too short. 3) AC drive output capacity is too small. 	<ol style="list-style-type: none"> 1) Check for possible poor insulation at the output line. 2) Increase the deceleration time. 3) Replace the AC drive with one that has a higher output capacity (next HP size).
OCRN	Over-current during steady state operation: <ol style="list-style-type: none"> 1) Short-circuit at motor output. 2) Sudden increase in motor loading. 3) AC drive output capacity is too small. 	<ol style="list-style-type: none"> 1) Check for possible poor insulation at the output line. 2) Check for possible motor stall. 3) Replace the AC drive with one that has a higher output capacity (next HP size).

(table continued next page)

Fault Codes (continued)		
Fault Name	Fault Description	Corrective Actions
<i>cF1</i>	Internal memory IC cannot be programmed.	1) Switch off power supply. 2) Check whether the input voltage falls within the AC drive's rated input voltage. 3) Switch the AC drive back on.
<i>cF2</i>	Internal memory IC can not be read.	1) Check the connections between the main control board and the power board. 2) Reset drive to factory defaults.
<i>HPF</i>	Hardware protection failure	Return to the factory.
<i>codE</i>	Software protection failure	Return to the factory.
<i>cF3</i>	AC Drive's internal circuitry abnormal.	1) Switch off power supply. 2) Check whether the input voltage falls within the rated AC drive input voltage. Switch on the AC drive.
<i>EF</i>	The external terminal EF-CM goes from OFF to ON.	When external terminal EF-CM is closed, the output will be turned off (under N.O. E.F.).
<i>cFR</i>	Auto accel/decel failure	Don't use the function of auto acceleration/deceleration.
<i>bb</i>	External Base Block: AC drive output is turned off.	1) When the external input terminal (base-block) is active, the AC drive output will be turned off. 2) Disable this connection and the AC drive will begin to work again.

WARNING MESSAGES

There are several Warning Messages that the GS1 AC Drive may give. The GS1 AC Drive allows you to decide how it should respond to these messages. The descriptions of the Warning Messages are listed below.

Warning Messages		
Warning Name	Warning Description	Corrective Actions
<i>CEED1</i>	<u>Communications Warning:</u> Illegal command code - The command code received in the command message is not available for the AC drive.	The corrective action can be set with the Transmission Fault Treatment parameter (P9-03). The available settings are: 0 - Display fault and continue operating 1 - Display fault and RAMP to stop 2 - Display fault and COAST to stop 3 - No fault displayed and continue operating The default setting is 0.
<i>CEED2</i>	<u>Communications Warning:</u> Illegal data address - The data address received in the command message is not available for the AC drive.	
<i>CEED3</i>	<u>Communications Warning:</u> Illegal data value - The data value received in the command message is not available for the AC drive.	
<i>CEED4</i>	<u>Communications Warning:</u> Slave device failure - The AC drive is unable to perform the requested action.	
<i>CE10</i>	<u>Communications Warning:</u> Communication Time Out	

ACCESSORIES



APPENDIX

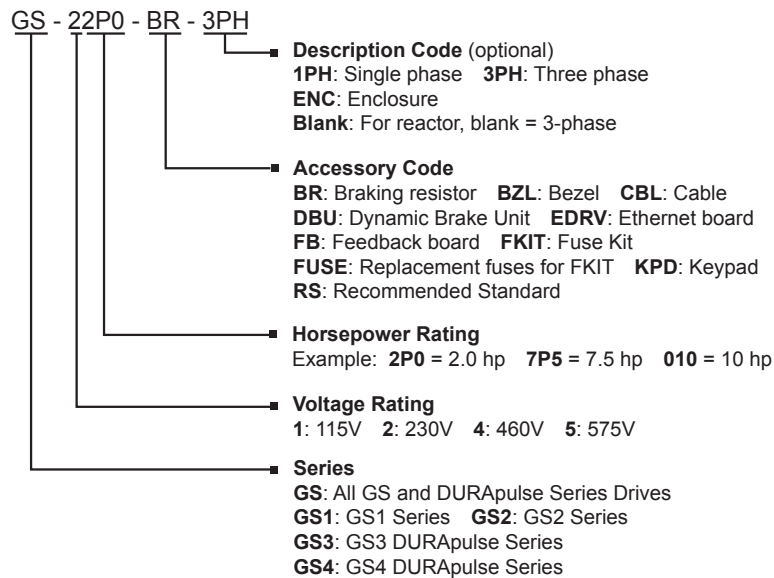
A

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ACCESSORIES PART NUMBERING

With the exception of EMI filters, RF filters, and LR series line reactors, each accessory part number begins with GS, followed by the AC Drive rating, and then the relevant accessory code. Following the accessory code, you will find a description code when applicable. The diagram below shows the accessory part numbering system.



LINE REACTORS

Input line reactors protect the AC drive from transient overvoltage conditions typically caused by utility capacitor switching. Input line reactors also reduce the harmonics associated with AC drives, and are recommended for all installations.

Output line (load) reactors 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.

There are two types of AutomationDirect line reactors that can be used with GS1 AC Drives:

- 1) the original GS series reactors (legacy),
- 2) and the newer LR(2) series reactors.

LR(2) series reactors have differing mounting options depending on the model. Some have universal mounting feet with multiple slots, while others have direct bolt on or optional accessories for mounting. Review the specific mounting for each model.

LINE REACTOR SPECIFICATIONS – LR(2) SERIES

Line Reactors – LR(2) Series									
Part Number	Dimension Drawing #	Rated Amps	Imped -ance	Watt Loss	System Voltage ⁽¹⁾	Phase – Use ⁽¹⁾	GS1 Drive Model	Drive HP	
LR-10P2-1PH ⁽²⁾⁽³⁾	1	5.8	3%	8.0	120	1 – In	GS1-10P2	0.25	
LR2-10P2-1PH ⁽²⁾	13	10		21					
LR-10P5-1PH ⁽²⁾⁽³⁾	1	9.8		11.7	240	1 – In	GS1-10P5	0.5	
LR2-10P5-1PH ⁽²⁾	13	12		29					
LR-20P5-1PH ⁽²⁾⁽³⁾	1	4.9		11.2	208/240	1 – In	GS1-20P2	0.25	
LR2-20P5-1PH ^{(2) (4)}	17	7.6		39					
LR-20P5 ⁽³⁾	3	2.4		7	240	3 – Out	GS1-10P2	0.25	
	16	5		30.6					
LR2-20P5 ⁽⁴⁾	3	2.4		7	208/240	3 – I/O	GS1-10P5	0.5	
LR-21P0-1PH ⁽²⁾	1	8		15.9	240	1 – In	GS1-21P0	1	
LR-22P0-1PH ⁽²⁾	2	12		24.3	240	1 – In	GS1-22P0	2	

- 1) Use (side of drive): In = input only; Out = output only; I/O = input or output.
 GS1-1xxx drives require 115V class input line reactors and 230V class output line reactors.
 2) Single-phase line reactors are used only on the input side of GS1-1xxx drives. Single-phase line reactors should NOT be installed on the output side of AC drives.
 3) This reactor is recommended for existing installations only; product will be discontinued after existing stock is depleted.
 4) Optional mounting accessories are available for these models. See "LR2 Series Line Reactor Mounting Adapters" (below).

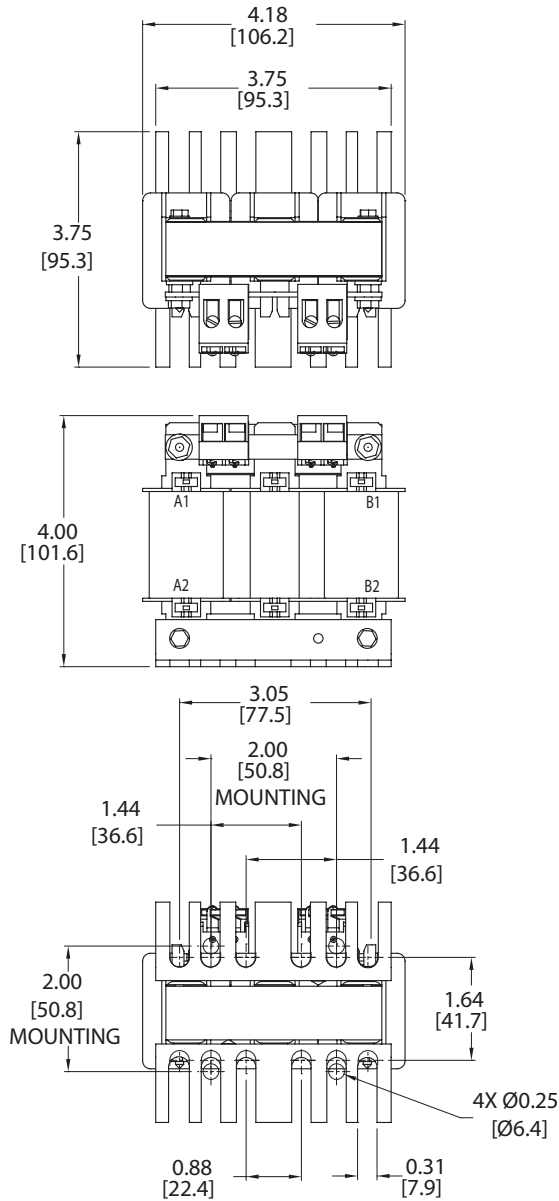
Part Number (repeated)	Wire Range (AWG)	Terminal Torque (lb·in)	Fasteners	Temperature Range		Environment
				Operating	Storage	
LR-10P2-1PH	18-12	10	#6-32x5/16in flathead screw	-40 – 104 °F [-40 – 40 °C]	-40 – 149 °F [-40 – 65 °C]	NEMA: open IP00 no corrosive gases
LR-10P5-1PH			#6-32x5/16in flathead screw			
LR-20P5-1PH						
LR-20P5						
LR-21P0-1PH						
LR-21P0		20				
LR-22P0-1PH		10				
LR2-10P2-1PH	18-12	10	6/40 x 5/16 flathead	104° [40°C] max		
LR2-10P5-1PH						
LR2-20P5-1PH						
LR2-20P5	22-12	9	n/a - captive	122°F [50°C] max		
LR2-21P0						
LR2-22P0						

LR2 Series Line Reactor Mounting Adapters		
Part Number	Description	Dimension Drawing
LR2-AP1	Adapter Plate Kit; includes 2 flange nuts (10-32); Dimensions 4.45" x 2.63"	16a
LR2-AP2	Adapter Plate Kit; includes 2 flange nuts (10-32); Dimensions 4.45" x 3.51"	16b
LR2-DR1	DIN Rail Mounting Clips and Hardware Kit; includes 2 screws (M5-0.8 x 8mm), 2 washers, 2 clips	16c
LR2-DR2	DIN Rail Mounting Plate and Hardware Kit; includes 4 bolts (0.25-20 x 0.50) and 4 flange nuts	17a

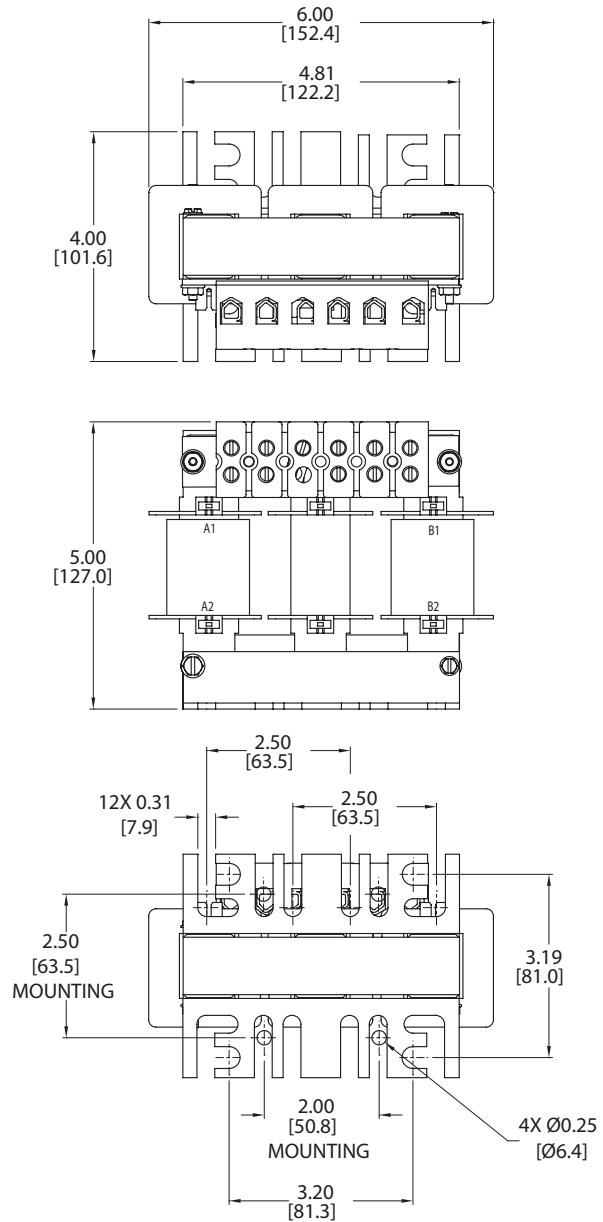
LINE REACTOR DIMENSIONS – LR(2) SERIES

(UNITS = IN [MM]) SEE OUR WEBSITE: WWW.AUTOMATIONDIRECT.COM FOR COMPLETE ENGINEERING DRAWINGS

1) LR(2) Line Reactors Dimension Drawing #1
 LR-10P2-1PH, LR-10P5-1PH, LR-20P5-1PH, LR-21P0-1PH



2) LR(2) Line Reactors Dimension Drawing #2
 LR-22P0-1PH



LINE REACTOR DIMENSIONS – LR(2) SERIES

(UNITS = IN [MM])

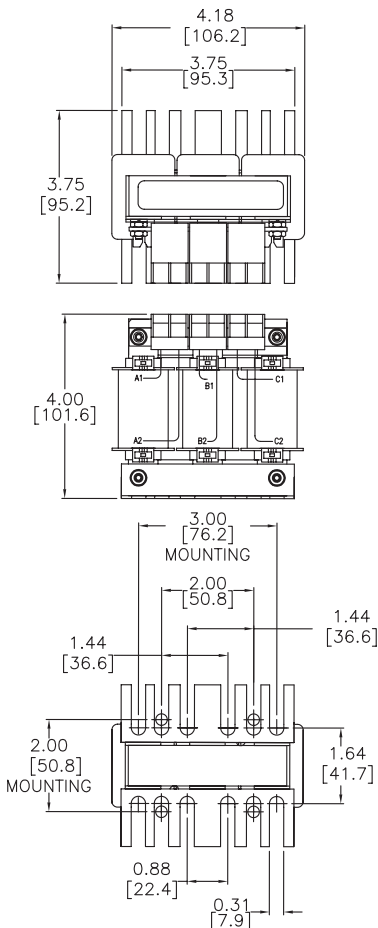
SEE OUR WEBSITE: WWW.AUTOMATIONDIRECT.COM FOR COMPLETE ENGINEERING DRAWINGS

4) LR(2) Line Reactors Dimension Drawing #4 through
12) LR(2) Line Reactors Dimension Drawing #12

not applicable for GS1 AC Drives

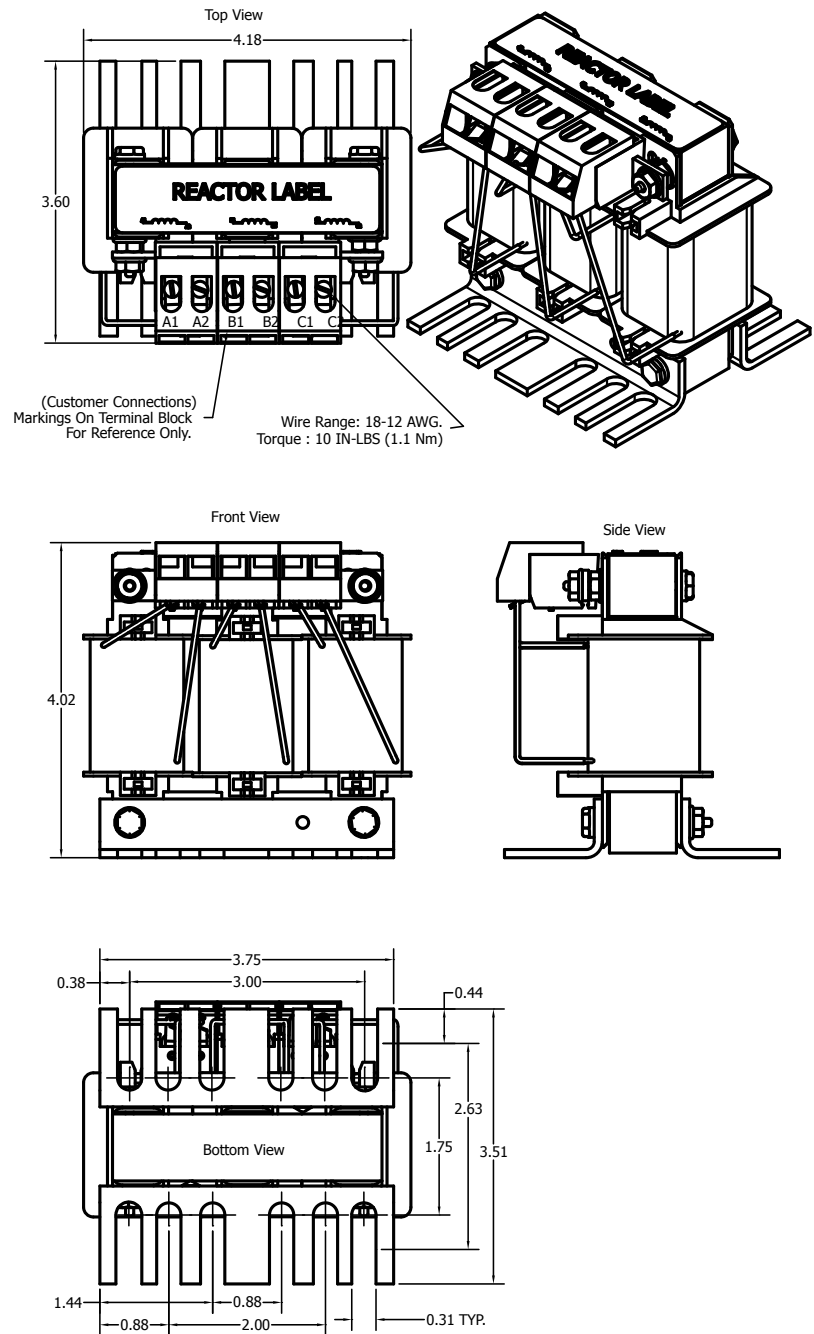
3) LR(2) Line Reactors Dimension Drawing #3

LR-20P5, LR-21P0, LR-22P0



13) LR(2) Line Reactors Dimension Drawing #13

LR2-10P2-1PH, LR2-10P5-1PH

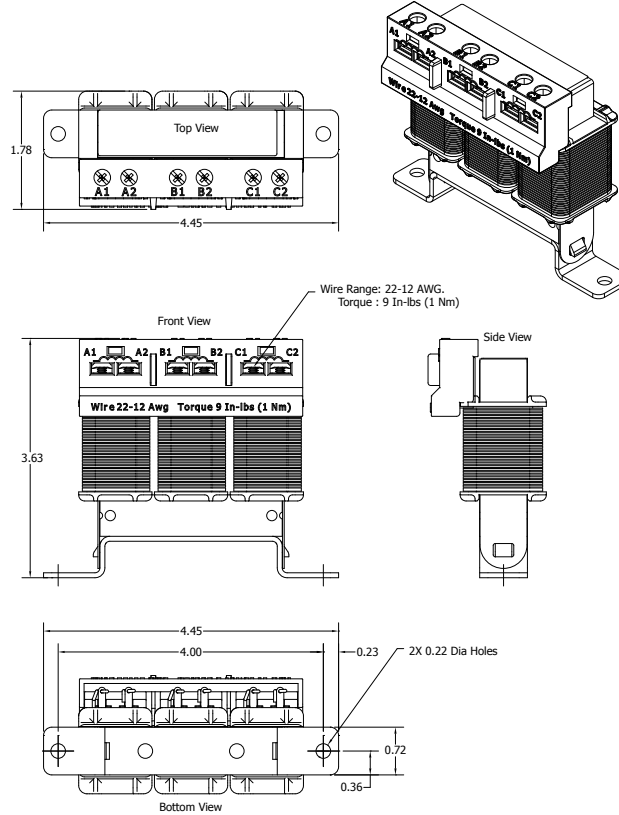


LINE REACTOR DIMENSIONS – LR(2) SERIES

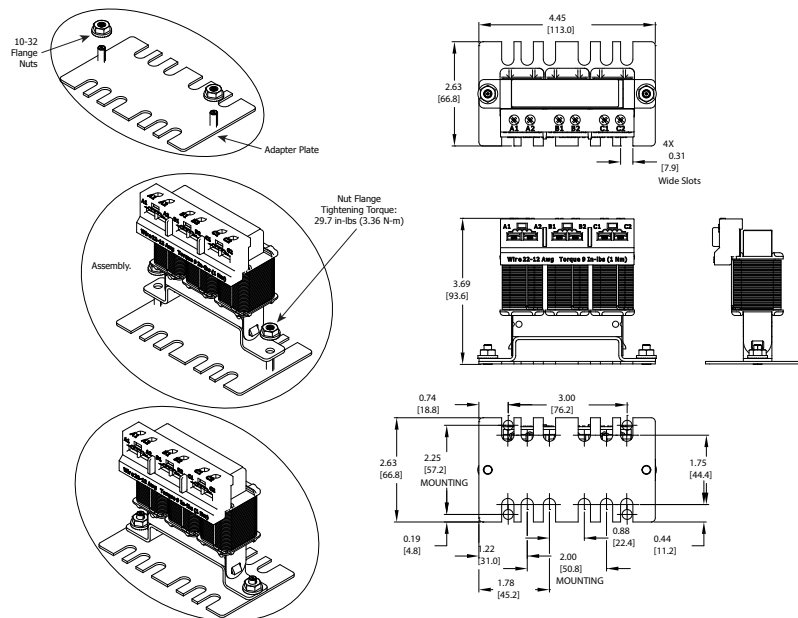
(UNITS = IN [MM]) SEE OUR WEBSITE: WWW.AUTOMATIONDIRECT.COM FOR COMPLETE ENGINEERING DRAWINGS

- 14) LR(2) Line Reactors Dimension Drawing #14 through
- 15) LR(2) Line Reactors Dimension Drawing #15 not applicable for GS1 AC Drives

16) LR(2) Line Reactors Dimension Drawing #16
LR2-52P0



16a) LR(2) Line Reactors Dimension Drawing #16a
LR2-AP1 Adapter Plate for Universal Mounting for: LR2-20P5

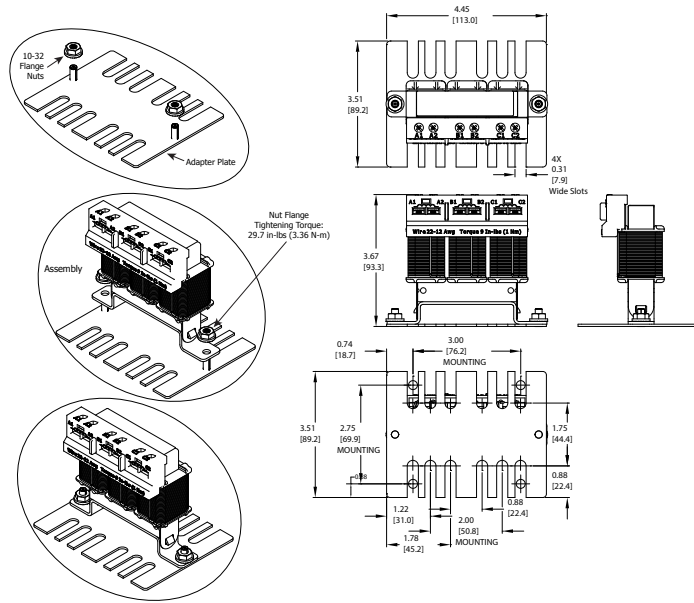


LINE REACTOR DIMENSIONS – LR(2) SERIES

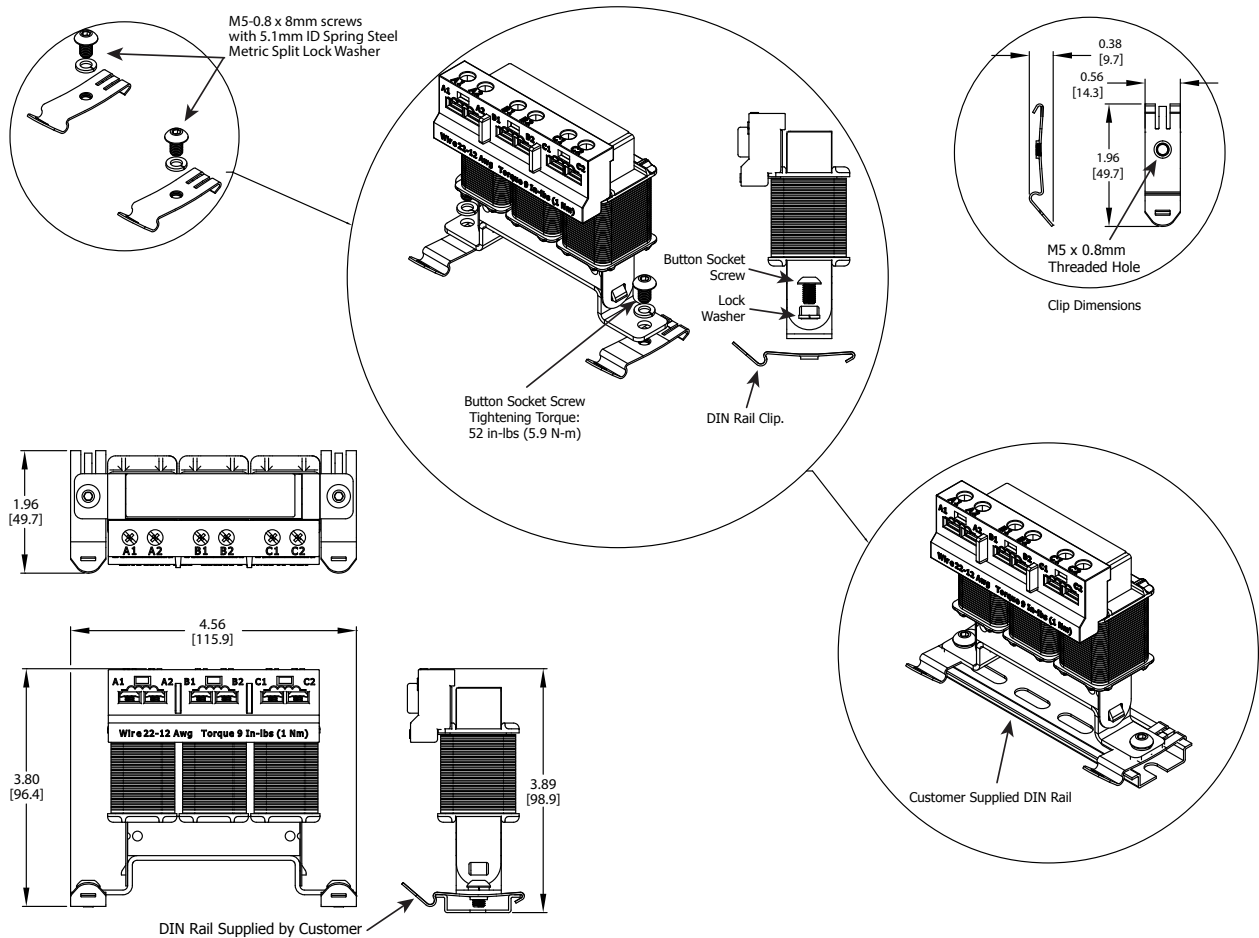
(UNITS = IN [MM])

SEE OUR WEBSITE: WWW.AUTOMATIONDIRECT.COM FOR COMPLETE ENGINEERING DRAWINGS

16b) LR(2) Line Reactors Dimension Drawing # 16b
LR2-AP2 Adapter Plate for Universal Mounting for: LR2-20P5



16c) LR(2) Line Reactors Dimension Drawing #16c
LR2-DR1 Hardware Kit for DIN Rail Mounting for: LR2-20P5



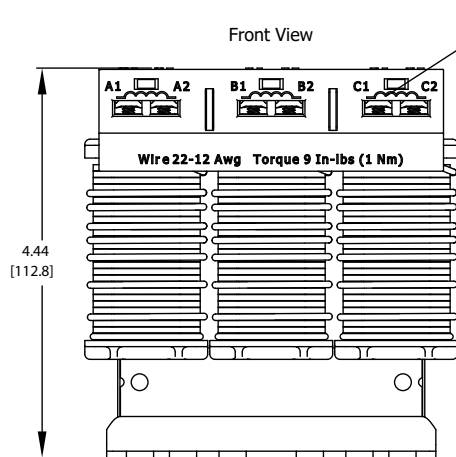
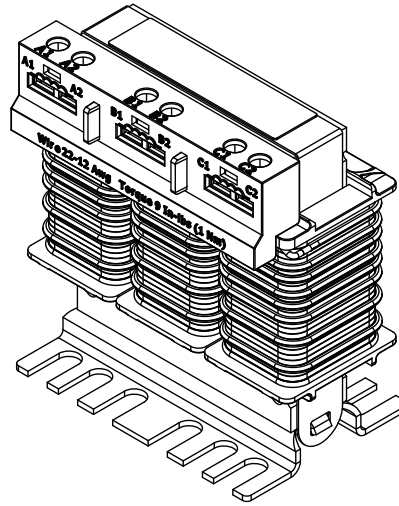
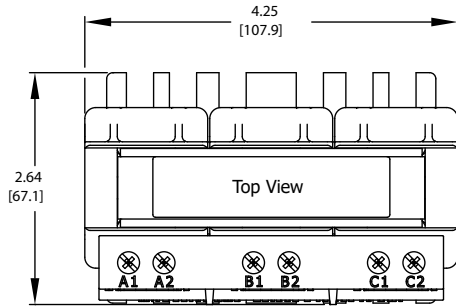
LINE REACTOR DIMENSIONS – LR(2) SERIES

(UNITS = IN [MM])

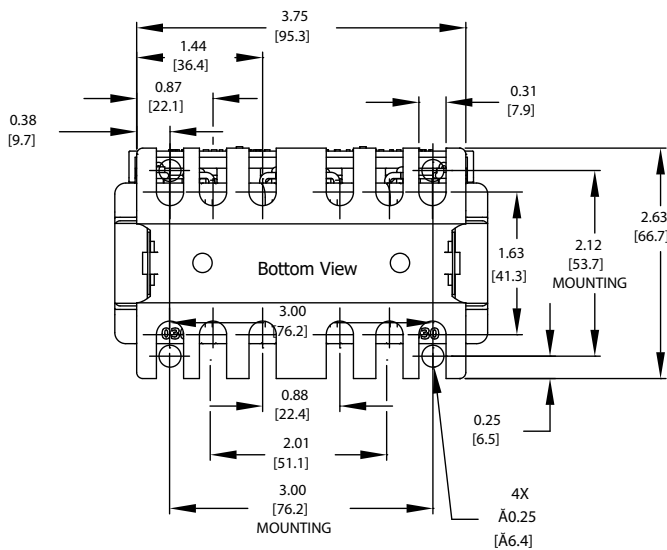
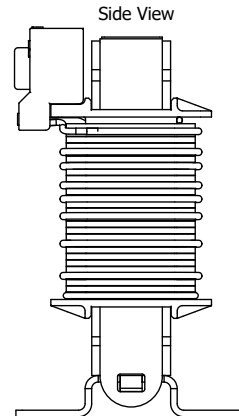
SEE OUR WEBSITE: WWW.AUTOMATIONDIRECT.COM FOR COMPLETE ENGINEERING DRAWINGS

17) LR(2) Line Reactors Dimension Drawing #17

LR2-20P5-1PH, LR2-21P0, LR2-22P0



Wire Range: 22-12 AWG.
Torque : 9 In-lbs (1 Nm)

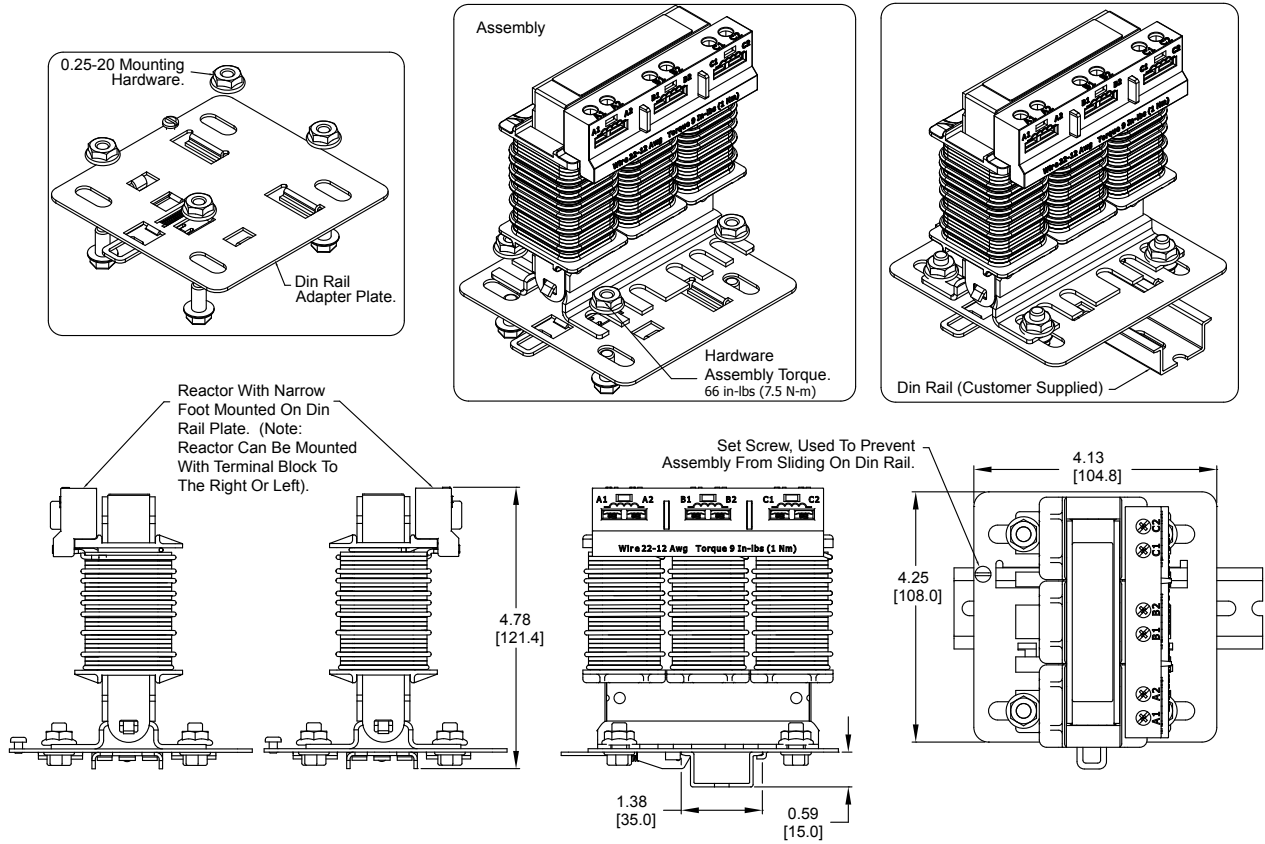


LINE REACTOR DIMENSIONS – LR(2) SERIES

(UNITS = IN [MM]) SEE OUR WEBSITE: WWW.AUTOMATIONDIRECT.COM FOR COMPLETE ENGINEERING DRAWINGS

17a) LR(2) Line Reactors Dimension Drawing #17a

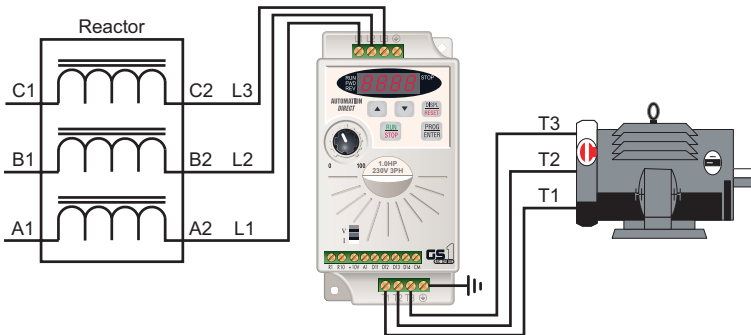
LR2-DR2 Hardware Kit for DIN Rail Mounting for: LR2-20P5-1PH, LR2-21P0, LR2-22P0



LINE REACTOR APPLICATIONS AND CONNECTIONS

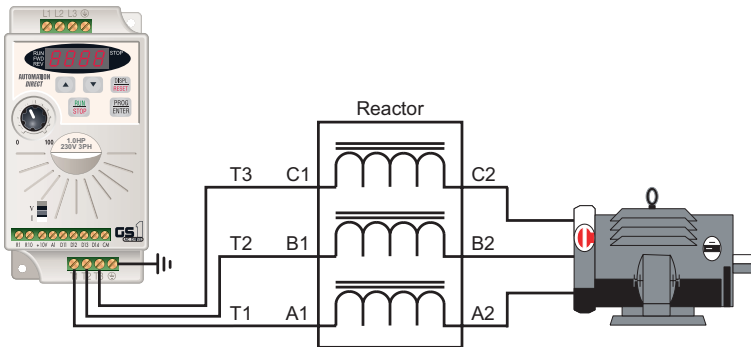
INPUT SIDE OF AC DRIVE

When installed on the input side of the AC Drive, line reactors will reduce line notching, and limit current and voltage spikes and surges from the incoming line. The line reactors will also reduce harmonic distortion from the AC Drive onto the line. Units are installed in front of the AC Drive as shown.



OUTPUT SIDE OF AC DRIVE

When installed on the output side of the AC Drive, line (load) reactors protect the drive from short circuits at the load. Voltage and current waveforms from the drive are enhanced, reducing motor overheating and noise emissions.



Single-phase line reactors should NOT be installed on the output of the AC Drive. Use only three-phase reactors on drive outputs, and only for three-phase motors.

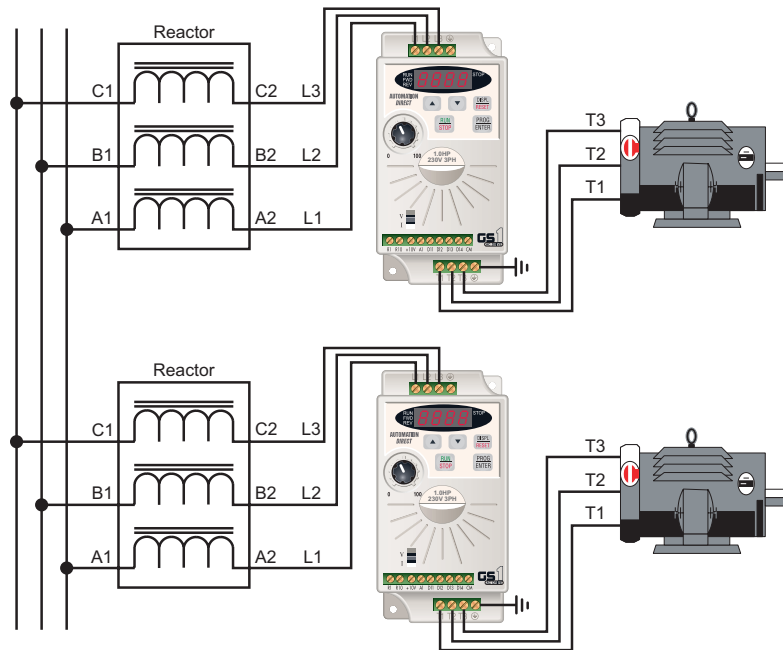


If installing a line reactor on the output side of the drive, especially with motor lead lengths in excess of 75 feet, lower the drive PWM output carrier frequency to 4kHz in order to protect the line reactor from excess heating and possible damage.

LINE REACTOR APPLICATIONS AND CONNECTIONS (CONTINUED)

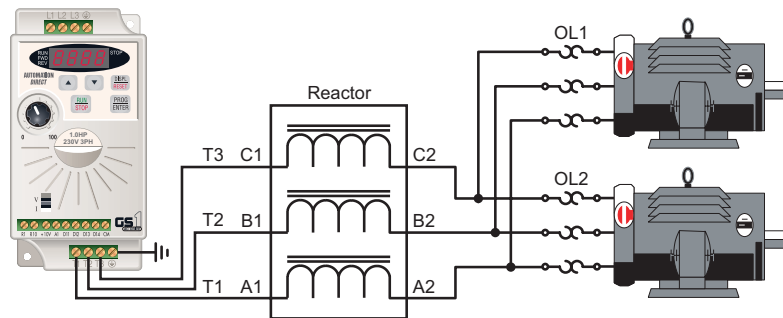
MULTIPLE AC DRIVES

Individual line reactors are recommended when installing multiple AC Drives on the same power line. Individual line reactors eliminate cross-talk between multiple drives, and provide isolated protection for each drive for its own specific load.



MULTIPLE MOTORS

A single output (load) reactor can be used for multiple motors on the same AC 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 recommended for use in multi-motor applications.

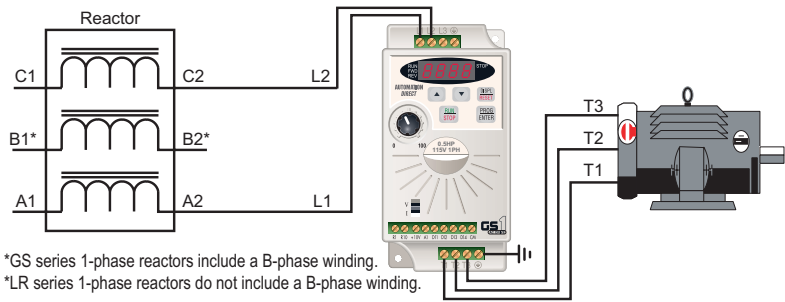


A single reactor should be used with multiple motors ONLY when the motors will operate simultaneously from a single AC drive. OVERLOAD RELAYS are recommended for use in multiple motor applications.

LINE REACTOR APPLICATIONS AND CONNECTIONS (CONTINUED)

SINGLE-PHASE APPLICATIONS

Some of the 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.



*GS series 1-phase reactors include a B-phase winding.
 *LR series 1-phase reactors do not include a B-phase winding.



WARNING: ENSURE THAT YOU PROPERLY INSULATE TERMINALS B1 AND B2 BEFORE MAKING ANY CONNECTIONS TO SINGLE-PHASE POWER.

DRIVE OUTPUT FILTER

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.



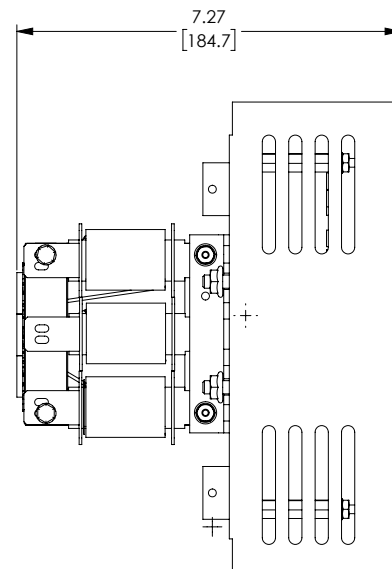
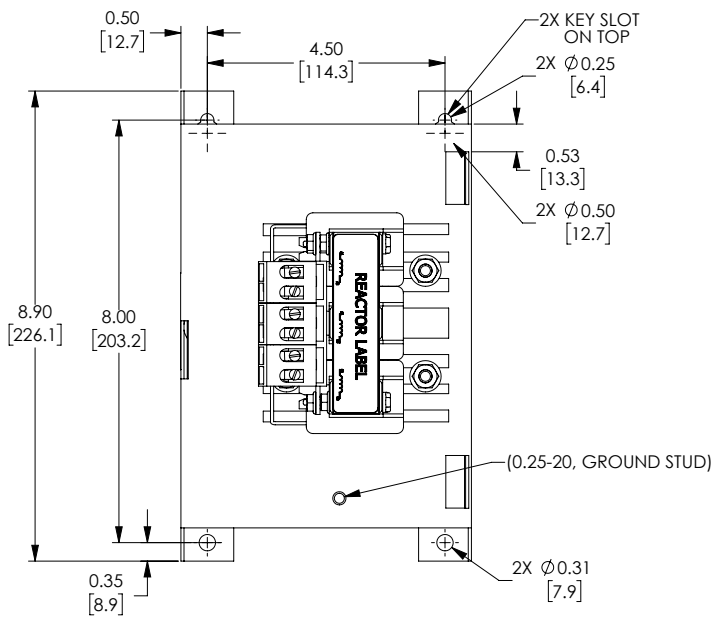
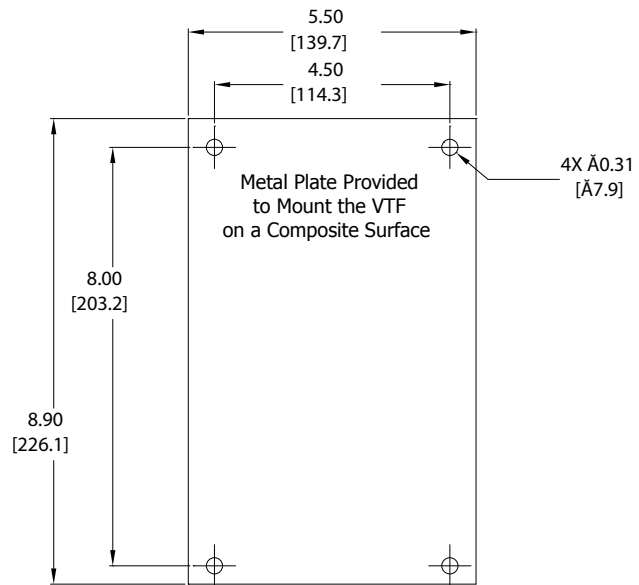
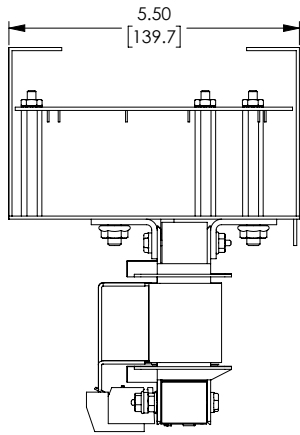
NOTE: Install Drive Output Filters on the output side of the AC Drive.

Drive Output Filters – VTF Series									
Part Number	Rated HP			Max Rated Amps	Max Rated Voltage	Phases	GSI Drive		Drive HP
	230V	460V	575V				w 1Ø Input	w 3Ø Input	
VTF-46-DE	–	0.75	1	2	600	3	GSI-10P2	–	0.25
							GSI-20P2	GSI-20P2	0.25
VTF-246-CFG	0.5	1.5	2	3			GSI-10P5	–	0.5
							GSI-20P5	GSI-20P5	0.5
VTF-24-FH	1.5	3	–	6			GSI-21P0	GSI-21P0	1
VTF-246-GJJ	2	5	5	8	–	GSI-22P0	2		
Part Number (repeated)	Wire Range (AWG)		Terminal Torque (lb-in)		Fasteners		Weight (lb)		
VTF-46-DE	14–12		10		6/40 x 5/16 flathead		8		
VTF-246-CFG									
VTF-24-FH									
VTF-246-GJJ									

DRIVE OUTPUT FILTER DIMENSIONS – VTF SERIES

(Units = in [mm]) See our website: www.AutomationDirect.com for complete engineering drawings

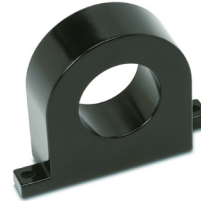
VTF-46-DE, VTF-246-CFG, VTF-24-FH, VTF-246-GJJ



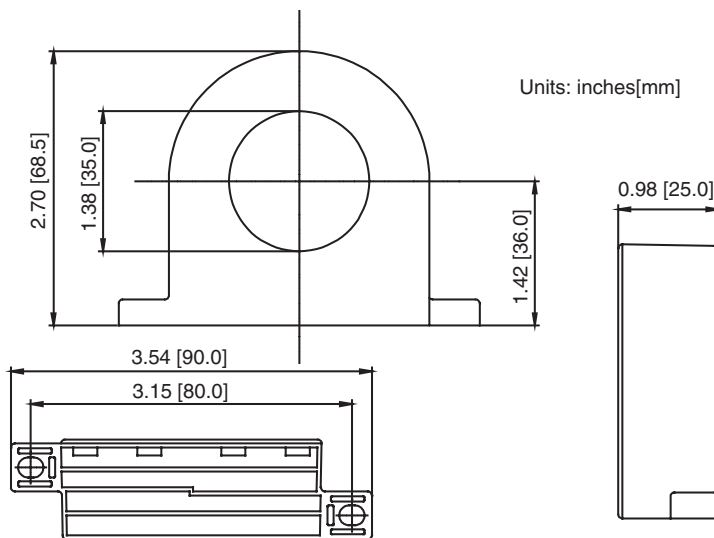
RF FILTER

RF Filter Part #: RF220X00A

RF Filters are used to reduce the radio frequency interference or noise on the input or output side of the drive. RF Filter RF220X00A can be used with all GS model drives.

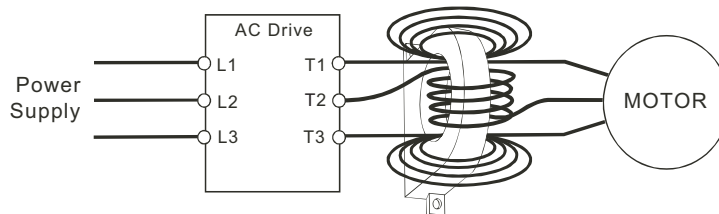


RF FILTER DIMENSIONS



RF FILTER WIRING

Wind each wire four times around the core. The RF filter should be located as close as possible to the output side of the drive.



FUSES AND FUSE KITS

Short-circuit and ground fault protection devices are essential to prevent costly damage to your AC Drive application equipment. Fuse kits are available from AutomationDirect for 115V and 230V GS1 AC Drives.



WARNING: THE FUSE KITS PROVIDE PROTECTION ONLY FOR THE SEMICONDUCTOR COMPONENTS INSIDE THE AC DRIVE. MOTOR BRANCH CIRCUIT OVERCURRENT PROTECTION SHOULD BE SEPARATELY PROVIDED PER APPLICABLE LOCAL CODES.

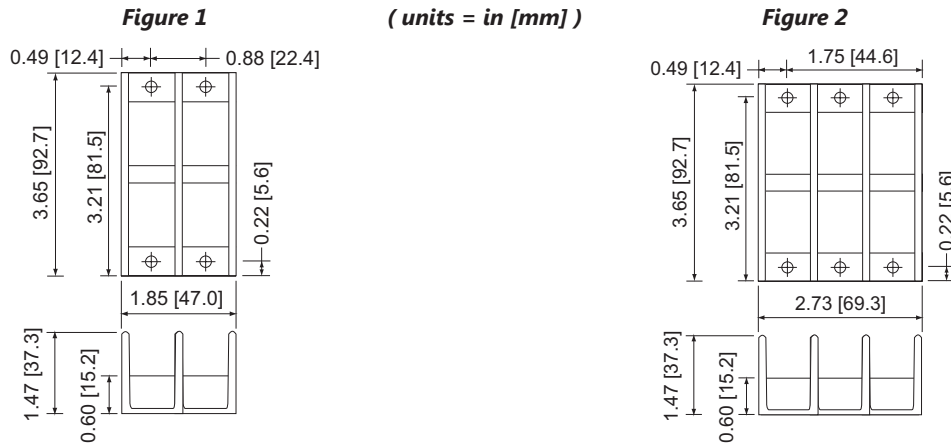
The following fuse kits consist of one fuse block and fuses sized to match each GS1 Series AC Drive. Replacement fuses are also available, and their part numbers are listed in the table below.

Fuse Kit Specifications (for 115V & 230V GS1 drive models)								
Part Number	Drive Model / Phase	Fuse Block	Wire Size	Wire Connector Torque	Fuse Type	Dimensions	Fuse Rating	Replacement Fuses
GS-10P2-FKIT-1P*	GS1-10P2 / 1	2 pole	Al/Cu #2-14	20 lb-in	A3T	Figure 1	300V@20A	GS-10P2-FUSE-1P
GS-10P5-FKIT-1P*	GS1-10P5 / 1	2 pole				Figure 1	300V@30A	GS-10P5-FUSE-1P
GS-20P2-FKIT-1P	GS1-20P2 / 1	2 pole				Figure 1	300V@15A	GS-20P2-FUSE-1P
GS-20P2-FKIT-3P	GS1-20P2 / 3	3 pole				Figure 2	300V@10A	GS-20P2-FUSE-3P
GS-20P5-FKIT-1P	GS1-20P5 / 1	2 pole				Figure 1	300V@20A	GS-20P5-FUSE-1P
GS-20P5-FKIT-3P	GS1-20P5 / 3	3 pole				Figure 2	300V@10A	GS-20P5-FUSE-3P
GS-21P0-FKIT-1P	GS1-21P0 / 1	2 pole				Figure 1	300V@30A	GS-21P0-FUSE-1P
GS-21P0-FKIT-3P	GS1-21P0 / 3	3 pole				Figure 2	300V@20A	GS-21P0-FUSE-3P
GS-22P0-FKIT-3P	GS1-22P0 / 3	3 pole				Figure 2	300V@25A	GS-22P0-FUSE-3P

Short Circuit Current Rating (SCCR) = 200 kA

* Single-phase fuse kits contain a 2-pole fuseblock. Per NEC 240.22, fusing is correct only for the hot leg of a source; not for an intentionally grounded source conductor. The hot leg of a grounded 115VAC supply is the only supply line that should be fused.

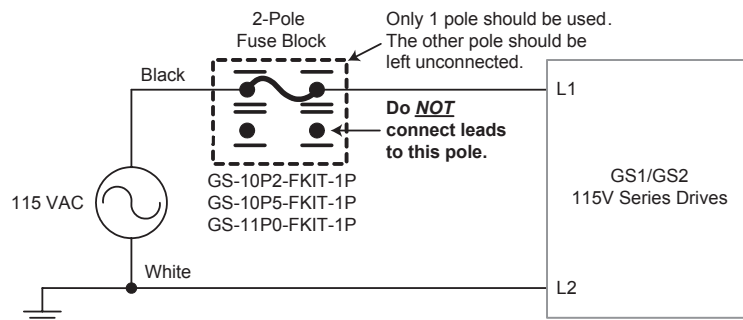
FUSE BLOCK DIMENSIONS



FUSE BLOCK SINGLE-PHASE 115VAC WIRING



WARNING: THE SINGLE-PHASE FUSE KITS CONTAIN A 2-POLE FUSE BLOCK. PER NEC 240.22, FUSING IS CORRECT ONLY FOR THE HOT LEG OF A SOURCE; NOT FOR AN INTENTIONALLY GROUNDED SOURCE CONDUCTOR. THE HOT LEG OF A GROUNDED 115VAC SUPPLY IS THE ONLY SUPPLY LINE THAT SHOULD BE FUSED.



ETHERNET INTERFACE

GS-EDRV(XXX) Specifications			
Part Number	Input Voltage	Input Current	Ethernet Communication
GS-EDRV	10-33 VDC	90-135 mA	10BaseT
GS-EDRV100	10-36 VDC	50-220 mA	10/100Mbps
<i>Can be used with all GS and DURAPULSE AC drives.</i>			

GS-EDRV(XXX) Ethernet Interfaces provide low-cost, high-performance Ethernet links between control systems and any GS/DURAPULSE series AC Drives. With the appropriate cable connections and, if needed, Ethernet switches or hubs, the GS-EDRV(XXX) allows you to communicate with your AC drives over qualified Ethernet networks.

The control systems can be any of the following:

- DL205 CPU, DL405 CPU, or a WinPLC, with the appropriate Ethernet Remote Master module (H2-ERM or H4-ERM).
- Productivity CPUs with Remote I/O Ethernet port.
- A PC running Entivity's ThinkDo software, a PC using a custom device driver that was developed using our Ethernet SDK, or a PC running KEPDirect EBC or OPC Server.
- Any independent I/O controller with a Modbus TCP/IP driver.

The control function is performed by one of the control systems mentioned above. The I/O mapping function is performed by an H2(4)-ERM module (purchased separately). The H2(4)-ERM module is configured with the ERM Workbench Utility which is part of the DirectSOFT PLC programming software.

The functions of the GS-EDRV(XXX) interface are as follows:

- process input signals from the AC drive
- format these signals to conform to the Ethernet standard
- transmit converted signals to the control system
- receive and translate output signals from the control system
- distribute the output signals to the appropriate drive
- DIN-rail mounting
- built-in web browser allows users to configure and control the drive from any web browser via the IP address of the GS-EDRV(XXX).



The GS-EDRV(XXX) requires an external 24 VDC power supply.



The GS series drives have a provision for shutting down control or power to the drive in the event of a communications time-out. This function can be set up through the drive parameter group 9.

Refer to the "GS Series AC Drive Ethernet Interface User Manual" or www.AutomationDirect.com for detailed information.

ZIPLINK™ CABLES FOR RS-485 MODBUS RTU

ZIPLink communication cables make it very easy to set up RS-485 Modbus RTU control of a single GS1 AC drive from a DirectLOGIC DL06 or D2-260 PLC.



GS-485HD15-CBL-2

PLC Connections for RS-485 Modbus RTU Control of GS1 Drive					
Drive	PLC *	PLC Port *	Communication	Direct Cable	Length
GS1	CLICK	3	RS-485	ZL-RJ12-CBL-2P ***	2m [6.6 ft] ***
	DL05	2 **	RS-232 – RS-485 **	N/A **	
	DL06 D0-DCM	2	RS-485	GS-485HD15-CBL-2 ***	2m [6.6 ft] ***
	D2-DCM D2-250(-1)	2 **	RS-232 – RS-485 **	N/A **	
	D2-260	2	RS-485	GS-485HD15-CBL-2 ***	2m [6.6 ft] ***
	D4-450	3 **	RS-232 – RS-485 **	N/A **	

* If a PLC type or port is not listed in this chart, it cannot function as a Modbus RTU master.
 ** Requires RS-232–RS-485 converter & generic cabling options described later in this chapter.
 *** Termination resistors not required due to short cable length.



In addition to these GS-specific cables, the ZIPLink product line also includes other components which can be useful for Modbus wiring. Refer to Ch5 “GS1 Modbus Communications” for more information.

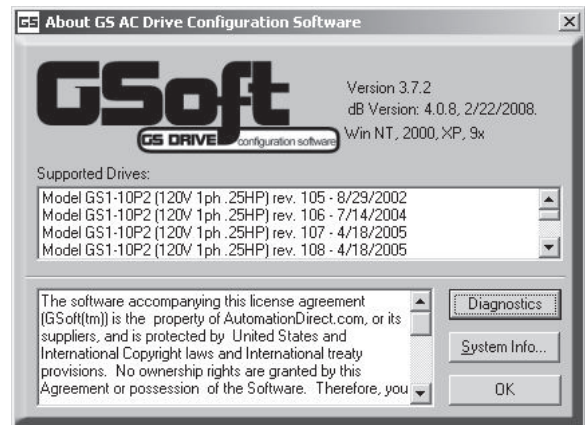
GS DRIVE CONFIGURATION SOFTWARE

SOFTWARE FUNCTIONS

GSoft is the optional configuration software for the AutomationDirect GS family of drives. It allows you to connect a personal computer to GS1 drives via RS-485, and perform a variety of functions:

- Upload/download drive configurations
- Create new drive configurations using Quick Start, Detailed, or Schematic Views
- Edit drive configurations
- Archive/store multiple drive configurations on your PC
- Trend drive operation parameters
- Tune the drive PID loop (PID not applicable for GS1 drives)
- View real time key operating parameters
- Start/Stop drive and switch directions, provided drive is set up for remote operation
- View drive faults
- Print a schematic representation of the drive configuration
- Print a tabular report of the current drive configuration.

GS Series AC Drive Software	
Part Number	Description
GSOFT	GS drives configuration software
GS-232CBL	GSOFT programming cable (3m [9.8 ft])



GSoft includes an integral help file with software instructions.

SYSTEM REQUIREMENTS

GSoft will run on PCs that meet the following requirements:

- Windows 95, 98, Me, NT, 2000, XP, Vista (32-bit), and 7 (32-bit)
- Internet Explorer 4.0 or higher (for HTML help support)
- 24 MB of available memory
- 8MB hard drive space
- Available RS-232 serial port

CONFIGURATION CABLE

USB-485M serial adapter cable (sold separately)

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USING GS1 AC DRIVES WITH AUTOMATIONDIRECT PLCs



APPENDIX

B

CONTENTS OF THIS CHAPTER

<i>Compatible AutomationDirect PLCs and Modules</i>	<i>.B-2</i>
<i>Typical PLC Connections to GS1 Series AC Drives</i>	<i>.B-6</i>
<i>CLICK CPU and DC Output Modules (Sinking)</i>	<i>B-6</i>
<i>CLICK CPU Modules with Non-isolated Analog Outputs.</i>	<i>B-7</i>
<i>DirectLOGIC DC Output Modules (Sinking)</i>	<i>B-8</i>
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<i>DirectLOGIC Non-isolated Voltage or Sourcing Current Analog Output Modules.</i>	<i>.B-10</i>

COMPATIBLE AUTOMATIONDIRECT PLCs AND MODULES

The following tables show which AutomationDirect PLCs and modules can be used with the GS1 Series AC Drive.

AutomationDirect PLC Modules for Use with GS1 AC Drives	
CLICK PLCs *	
C0-00DD1-D	CLICK CPU, 8 DC in / 6 sinking DC out; 24 VDC power supply; RS-232C Modbus/ASCII comm port. Discrete <u>Inputs</u> : 8 DC inputs, 24 VDC sink/source, 2 isolated commons. Discrete <u>Outputs</u> : 6 DC outputs, 5–27 VDC sinking, 0.1A/pt, 2 isolated commons. Removable I/O terminal block.
C0-02DD1-D	CLICK CPU, 4 DC in / 4 sinking DC out; 2 channels analog in / 2 channels analog out (current/voltage selectable); 24 VDC power supply; RS-232C Modbus/ASCII comm port, 3-wire RS-485 Modbus/ASCII comm port. Discrete <u>Inputs</u> : 4 DC inputs, 5–27 VDC sink/source, 1 common. Discrete <u>Outputs</u> : 4 DC outputs, 24 VDC sinking, 0.1A/point, 1 common. Analog <u>Inputs</u> : 2 channels 4–20 mA or 0–5 VDC. Analog <u>Outputs</u> : 2 channels 4–20 mA or 0–5 VDC. Removable I/O terminal block.
C0-02DD2-D	CLICK PLC CPU, 4 DC in / 4 sourcing DC out, 2 channels analog in / 2 channels analog out (current / voltage selectable); 24 VDC power supply; RS-232C Modbus/ASCII comm port, 3-wire RS-485 Modbus/ASCII comm port. Discrete <u>Inputs</u> : 4 DC inputs, 24 VDC sink/source, 1 common. Discrete <u>Outputs</u> : 4 DC outputs, 24 VDC sourcing, 0.1A/point, 1 common. Analog <u>Inputs</u> : 2 channels 4–20 mA or 0–5 VDC. Analog <u>Outputs</u> : 2 channels 4–20 mA or 0–5 VDC. Removable I/O terminal block.
C0-02DR-D	CLICK PLC CPU, 4 DC in / 4 relay out, 2 channels analog in / 2 channels analog out (current / voltage selectable); 24 VDC power supply; RS-232C Modbus/ASCII comm port, 3-wire RS-485 Modbus/ASCII comm port. Discrete <u>Inputs</u> : 4 DC inputs, 24 VDC sink/source, 1 common. Discrete <u>Outputs</u> : 4 relay outputs, 6–240 VAC / 6–27 VDC Form A (SPST) relays, 1.0A/point, 1 common. Analog <u>Inputs</u> : 2 channels 4–20 mA or 0–5 VDC. Analog <u>Outputs</u> : 2 channels 4–20 mA or 0–5 VDC. Removable I/O terminal block.
* "Brick" PLCs may contain some I/O that are not compatible with GS1 drives. Refer to "Typical PLC Connections to GS1 Series AC Drives" (page B-6) to determine specifically which I/O are compatible.	
CLICK DC Output Modules	
C0-08TD1	8-pt. 3.3–27 VDC current sinking <u>output</u> , 2 isolated commons, 0.3A/pt., removable terminals.
C0-16TD1	16-pt. 5–27 VDC current sinking <u>output</u> , 2 isolated commons, 0.1A/pt., removable terminals.
DL05 PLCs *	
D0-05AR	DL05 CPU, 8 AC in / 6 Relay out, 110/220VAC Power Supply. <u>Inputs</u> : 8 AC inputs, 90–120 VAC, 2 isolated commons. <u>Outputs</u> : 6 Relay outputs, 6–27 VDC, 6–240 VAC, 2A/pt. max., 2 isolated commons.
D0-05DD	DL05 CPU, 8 DC in / 6 DC out, 110/220VAC Power Supply. <u>Inputs</u> : 8 DC inputs, 12–24 VDC current sinking/sourcing, 2 isolated commons. <u>Outputs</u> : 6 DC outputs, 6–27 VDC current sinking, 1.0A/pt. max.
D0-05DD-D	DL05 CPU, 8 DC in / 6 DC out, 12/24VDC Power Supply. <u>Inputs</u> : 8 DC inputs, 12–24 VDC current sinking/sourcing, 2 isolated commons. <u>Outputs</u> : 6 DC outputs, 6–27 VDC current sinking, 1.0A/pt. max.
D0-05DR	DL05 CPU, 8 DC in / 6 Relay out, 110/220VAC Power Supply. <u>Inputs</u> : 8 DC inputs, 12–24 VDC current sinking/sourcing, 2 isolated commons. <u>Outputs</u> : 6 Relay outputs, 6–27 VDC, 6–240 VAC, 2A/pt. max., 2 isolated commons.
D0-05DR-D	DL05 CPU, 8 DC in / 6 Relay out, 12/24VDC Power Supply. <u>Inputs</u> : 8 DC inputs, 12–24 VDC current sinking/sourcing, 2 isolated commons. <u>Outputs</u> : 6 Relay outputs, 6–27 VDC, 6–240 VAC, 2A/pt. max., 2 isolated commons.
* "Brick" PLCs may contain some I/O that are not compatible with GS1 drives. Refer to "Typical PLC Connections to GS1 Series AC Drives" (page B-6) to determine specifically which I/O are compatible.	
(table continued next page)	

AutomationDirect PLC Modules for Use with GS1 AC Drives (continued)	
DL06 PLCs *	
D0-06AR	DL06 CPU, 16 AC in / 20 Relay out, 110/220VAC power supply, with 0.3A 24VDC auxiliary device power supply. <u>Inputs</u> : 20 AC inputs, 90–120 VAC, 5 isolated commons (4 inputs per common). <u>Outputs</u> : 16 Relay outputs, 6–27 VDC, 6–240 VAC, 2A/pt. max., 4 isolated commons (4 pt/common).
D0-06DD1	DL06 CPU, 20 DC in / 16 DC out, 110/220VAC Power Supply, with 0.3A 24VDC Auxiliary Device Power Supply. <u>Inputs</u> : 20 DC inputs, 12–24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). <u>Outputs</u> : 16 DC outputs, 12–24 VDC current sinking, 1.0A/pt. max., 4 commons non-isolated (4 pt/common).
D0-06DD1-D	DL06 CPU, 20 DC in / 16 DC out, 12/24VDC Power Supply. <u>Inputs</u> : 20 DC inputs, 12–24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). <u>Outputs</u> : 16 DC outputs, 12–24 VDC current sinking, 1.0A/pt. max., 4 commons non-isolated (4 pt/common).
D0-06DR	DL06 CPU, 20 DC in / 16 Relay out, 110/220VAC Power Supply, with 0.3A 24VDC Auxiliary Device Power Supply. <u>Inputs</u> : 20 DC inputs, 12–24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). <u>Outputs</u> : 16 Relay outputs, 6–27 VDC, 6–240 VAC, 2A/pt. max., 4 isolated commons (4 pt/common).
D0-06DR-D	DL06 CPU, 20 DC in / 16 Relay out, 110/220VAC Power Supply. <u>Inputs</u> : 20 DC inputs, 12–24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). <u>Outputs</u> : 16 Relay outputs, 6–27 VDC, 6–240 VAC, 2A/pt. max., 4 isolated commons (4 points per common).
* "Brick" PLCs may contain some I/O that are not compatible with GS1 drives. Refer to "Typical PLC Connections to GS1 Series AC Drives" (page B-6) to determine specifically which I/O are compatible.	
DL05/DL06 DC Input/Output Modules	
D0-08CDD1	4-pt. 12–24VDC current sinking/sourcing <u>input</u> , 1 common, 4-pt. 12–24VDC sinking <u>output</u> , 0.3A/point, 1.2A/module, removable terminal, no fuse.
DL05/DL06 DC Output Modules	
D0-10TD1	10-pt. 12–24 VDC current sinking <u>output</u> module, 2 commons non-isolated (5 pts. per common), 0.3A/point, 1.5A/common, removable terminal, no fuse.
D0-16TD1	16-pt. 12–24 VDC current sinking <u>output</u> module, 2 commons non-isolated (5 pts. per common), 0.3A/point, 1.5A/common, removable terminal, no fuse.
DL05/DL06 Analog Modules	
F0-04DAH-1	4-channel current analog <u>output</u> module; 4–20 mA; 16-bit resolution.
F0-04DAH-2	4-channel voltage analog <u>output</u> module; 0–10V; 16-bit resolution.
F0-08DAH-1	8-channel current analog <u>output</u> module; 4–20 mA; 16-bit resolution.
F0-08DAH-2	8-channel voltage analog <u>output</u> module; 0–10V; 16-bit resolution.
F0-2AD2DA-2	2-channel <u>in</u> , 2-channel <u>output</u> voltage analog option card; 0–5V, 0–10V.
F0-4AD2DA-1	4-channel <u>in</u> , 2-channel sourcing <u>output</u> current analog option card; 4–20mA.
F0-4AD2DA-2	4-channel <u>in</u> , 2-channel <u>output</u> voltage analog option card; 0–5V, 0–10V.
DL105 PLCs *	
F1-130DD	DL130 CPU, 10 DC in / 8 DC out, 110/220VAC Power Supply. <u>Inputs</u> : 10 DC inputs, 12–24 VDC current sinking/sourcing, 3 isolated commons. <u>Outputs</u> : 8 DC outputs, 5–30VDC current sinking, 0.5A/pt. max, 3 internally connected commons.
F1-130DR	DL06 CPU, 20 DC in / 16 DC out, 110/220VAC Power Supply, with 0.3A 24VDC Auxiliary Device Power Supply. <u>Inputs</u> : 20 DC inputs, 12–24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). <u>Outputs</u> : 16 DC outputs, 12–24 VDC current sinking, 1.0A/pt. max., 4 commons non-isolated (4 points per common).
F1-130DD-D	DL130 CPU, 10 DC in / 8 DC out, 12/24VDC Power Supply. <u>Inputs</u> : 10 DC inputs, 12–24 VDC current sinking/sourcing, 3 isolated commons. <u>Outputs</u> : 8 DC outputs, 5–30VDC current sinking, 0.5A/pt. max, 3 internally connected commons.
F1-130DR-D	DL130 CPU, 10 DC in / 8 Relay out, 12/24VDC Power Supply. <u>Inputs</u> : 10 DC inputs, 12–24 VDC current sinking/sourcing, 3 isolated commons. <u>Outputs</u> : 8 relay outputs, 12–30 VDC, 12–250VAC, 7A/pt. max., 4 isolated commons.
* "Brick" PLCs may contain some I/O that are not compatible with GS1 drives. Refer to "Typical PLC Connections to GS1 Series AC Drives" (page B-6) to determine specifically which I/O are compatible.	
DL205 DC Output Module	
D2-16TD1-2	16-pt. 12–24 VDC current sinking <u>output</u> module, 1 common (2 common terminals), 0.1A/point, 1.6A/module, no fuse, European type removable terminal.
D2-32TD1	32-pt. 12–24 VDC current sinking <u>output</u> module. 1 common (4 common terminals), 0.1A/point, 3.2A/module, no fuse.
(table continued next page)	

AutomationDirect PLC Modules for Use with GS1 AC Drives (continued)	
DL205 Relay Output Modules	
D2-04TRS	4-pt. 5–30 VDC or 5–240 VAC isolated relay <u>output</u> module, 4 Form A (SPST) relays, 4 commons, 4A/point, 8.0A/module, replaceable fuse, removable terminal.
D2-08TR	8-pt. 5–30 VDC or 5–240 VAC <u>output</u> module, 8 Form A (SPST) relays, 1 common (2 common terminals), 1A/point, 4.0A/module, replaceable fuse, removable terminal.
F2-08TR	8-pt relay <u>output</u> , 10A/common, 5–30VDC or 5–240VAC.
F2-08TRS	8-pt. 12–28 VDC or 12–240 VAC <u>output</u> module, 5 Form A (SPST) relays, 3 Form C (SPDT) relays, 8 isolated commons, 7A/point max., no fuses, removable terminal.
D2-12TR	12-pt. 5–30 VDC or 5–240 VAC relay <u>output</u> module, 12 Form A (SPST) relays, 2 commons, 1.5A/point max., 3.0A/common, 2 replaceable fuses, removable terminal.
DL205 DC Input/Output Modules	
D2-08CDR	4-pt. 24VDC sinking/sourcing <u>input</u> , 1 common, 4 pt. relay <u>output</u> , 1A/pt., 4A/module, 1 common, replaceable fuse.
DL205 Analog Output Module	
F2-02DA-2	2-channel analog <u>output</u> module; 12 bit resolution, ranges: 0–5V, 0–10V, -5 to +5V, -10 to +10V. Designed to operate with 24 VDC user-supplied power supply.
F2-02DAS-1	2 channel, analog <u>output</u> module; 16-bit resolution, Isolated 4–20mA sourcing (2 isolated commons). Designed to operate with 24 VDC user-supplied power supply.
F2-02DAS-2	2-channel analog <u>output</u> module; 16 bit resolution, isolated, range: 0–5V, 0–10V (2 isolated commons). Designed to operate with 24 VDC user-supplied power supply.
F2-08DA-1	8-channel analog <u>output</u> module; 12 bit resolution, range: 4–20mA, sink or source output configurable. Designed to operate with 24 VDC user-supplied power supply.
F2-08DA-2	8-channel analog <u>output</u> module; 12 bit resolution, ranges: 0–5V, 0–10V. Designed to operate with 24 VDC user-supplied power supply.
DL305 Relay Output Modules	
D3-08TR	8-pt. 5–30 VDC or 5–220 VAC <u>output</u> module, 5A/point DC or 4A/point AC, 8 Form A relays (SPST), 2 commons (isolated), non-removable terminal, 2 user replaceable fuses.
D3-16TR	16-pt. 5–30 VDC or 5–220 VAC <u>output</u> module, 2A/point, 16 Form A relays (SPST), 2 commons (isolated), removable terminal, no internal fuses.
DL305 Analog Output Modules	
F3-04DAS	4-channel isolated analog <u>output</u> module, 12 bit resolution, ranges: 0 to 5V, 0 to 10V, -5 to +5V, -10 to +10V, 4 to 20mA, 0 to 20mA. Channel to channel isolation -750 to +750 VDC.
DL405 DC Output Modules	
D4-08TD1	8-pt. 12–24 VDC current sinking <u>output</u> module, 2 commons (internally connected), 2A/point, 5A/common, removable terminal
D4-16TD1	16-pt. 5–24 VDC current sinking <u>output</u> module, 2 commons (internally connected), 0.5A/point, 3A/common, removable terminal
D4-32TD1	32-pt. 5–24 VDC current sinking <u>output</u> module, 4 commons (isolated), 0.2A/point, 1.6A/common. Requires one connector, sold separately.
DL405 Relay Output Modules	
D4-08TR	8-pt. 5–30 VDC or 5–250 VAC <u>output</u> module, 8 Form A (SPST) relays, 2 commons (isolated), 2A/point, 5A/common, removable terminal
F4-08TRS-1	8-pt. 12–30 VDC or 12–250 VAC isolated <u>output</u> module, 4 Form A (SPST) and 4 Form C (SPDT) relays, 8 commons (isolated), 10A/point, 40A/module, removable terminal.
F4-08TRS-2	8-pt. 12–30 VDC or 12–250 VAC isolated <u>output</u> module, 4 Form A (SPST) relays and 4 Form C (SPDT) relays, 8 commons (isolated), 5A/point, 40A/module, replaceable fuses, removable terminals.
D4-16TR	16-pt. 5–30 VDC or 5–250 VAC <u>output</u> module, 8 Form A (SPST) relays, 2 commons (isolated), 1A/point, 5A/common, removable terminals.
DL405 Analog Output Modules	
F4-04DAS-1	4-channel analog <u>output</u> module, 16 bit resolution, isolated, range: 4 to 20mA current sourcing.
F4-04DAS-2	4-channel analog <u>output</u> module, 16 bit resolution, isolated, range: 0–5V, 0–10V.
F4-08DA-2	8-channel analog <u>output</u> module, 12 bit resolution, range: 0–5V or 0–10V.
F4-16DA-2	16-channel analog <u>output</u> module, 12 bit resolution, range: 0–5V or 0–10V.

(table continued next page)

AutomationDirect PLC Modules for Use with GS1 AC Drives (continued)	
Terminator I/O DC Output Modules	
T1K-08TD1	8-pt. 12–24 VDC current sinking <u>output</u> module, 4 points per common, 1.0A/point, 2 replaceable fuses (T1K-FUSE-1). (use with T1K-08B or T1K-08B-1 terminal base)
T1K-16TD1	16-pt. 12–24 VDC current sinking <u>output</u> module, 4 points per common, 1.0A/point, 4 replaceable fuses (T1K-FUSE-1). (use with T1K-16B or T1K-16B-1 terminal base)
Terminator I/O Relay Output Modules	
T1K-08TR	8-pt. 5–30 VDC or 5–240 VAC <u>output</u> module, 8 Form A (SPST) relays, 4 points per common, 2.0A/point max., 2 replaceable fuses (T1K-FUSE-2). (use with T1K-08B or T1K-08B-1 terminal base)
T1K-16TR	16-pt. 5–30 VDC or 5–240 VAC <u>output</u> module, 16 Form A (SPST) relays, 4 points per common, 2.0A/point max., 4 replaceable fuses (T1K-FUSE-2). (use with T1K-16B or T1K-16B-1 terminal base)
T1K-08TRS	8-pt. 5–30 VDC or 5–240 VAC isolated relay <u>output</u> module, 8 Form A (SPST) relays, 1 point per common, 7.0A/point max., 8 replaceable fuses (T1K-FUSE-3). (isolation requires use of T1K-16B or T1K-16B-1 terminal base)
Terminator I/O Analog Output Modules	
T1F-08DA-2	8-channel analog <u>output</u> , 12 bit resolution, range: 0–5VDC, 0–10VDC, +/-5VDC, +/-10VDC. (use with T1K-08B or T1K-08B-1 terminal base)
T1F-16DA-2	16-channel analog <u>output</u> , 12 bit resolution, range: 1–5VDC, 1–10VDC, +/-5VDC, +/-10VDC. (use with T1K-16B or T1K-16B-1 terminal base)

TYPICAL PLC CONNECTIONS TO GS1 SERIES AC DRIVES

The following drawings show some typical connections between the GS1 Series AC Drive and AutomationDirect PLCs and modules.

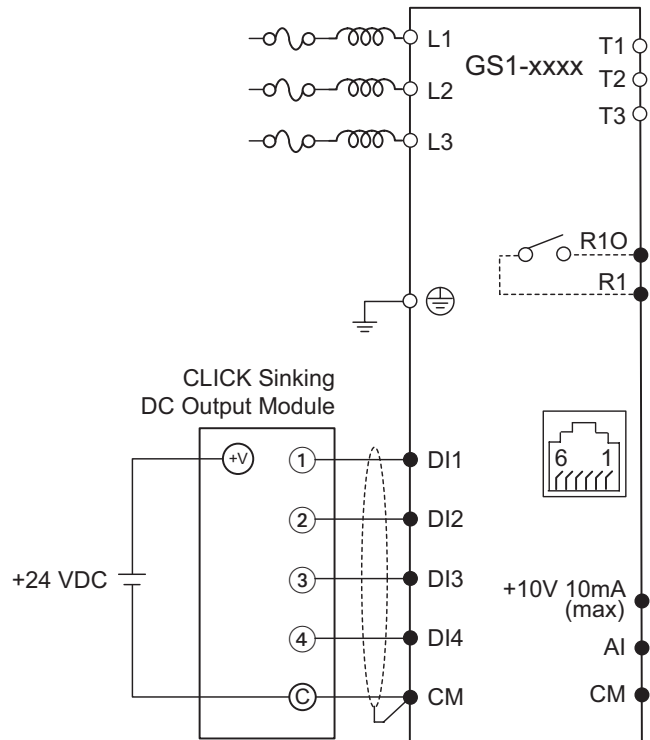
CLICK CPU AND DC OUTPUT MODULES (SINKING)

• C0-00-DD1-D

• C0-02-DD1-D

• C0-08-TD1

• C0-16-TD1



○ Main circuit (power) terminals ● Control circuit terminals ⊕ Shielded leads

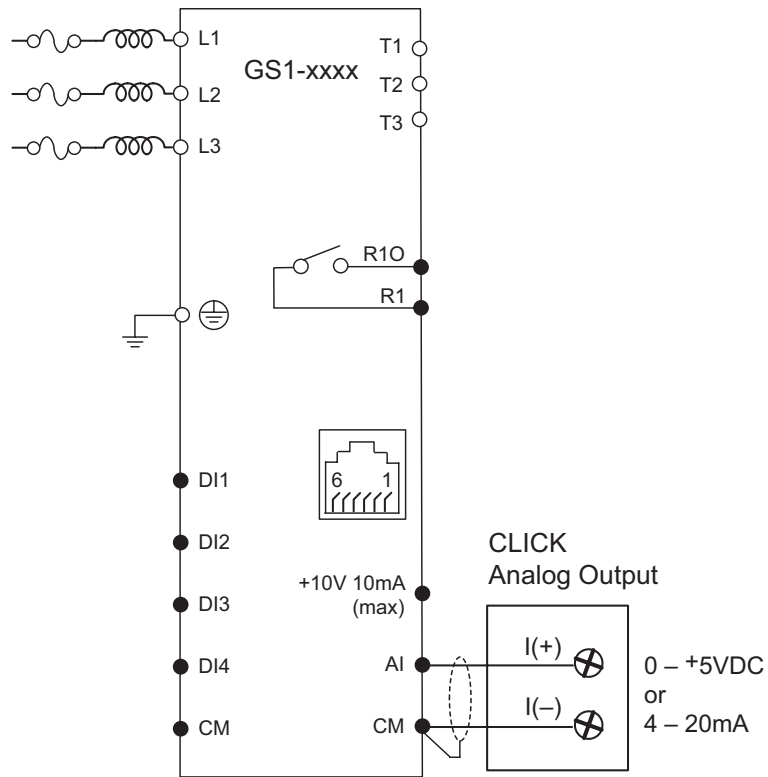
TYPICAL PLC CONNECTIONS TO GS1 SERIES AC DRIVES (CONTINUED)

CLICK CPU MODULES WITH NON-ISOLATED ANALOG OUTPUTS

• C0-02DD1-D

• C0-02DD2-D

• C0-02DR-D



○ Main circuit (power) terminals ● Control circuit terminal ⊕ Shielded leads

TYPICAL PLC CONNECTIONS TO GS1 SERIES AC DRIVES (CONTINUED)

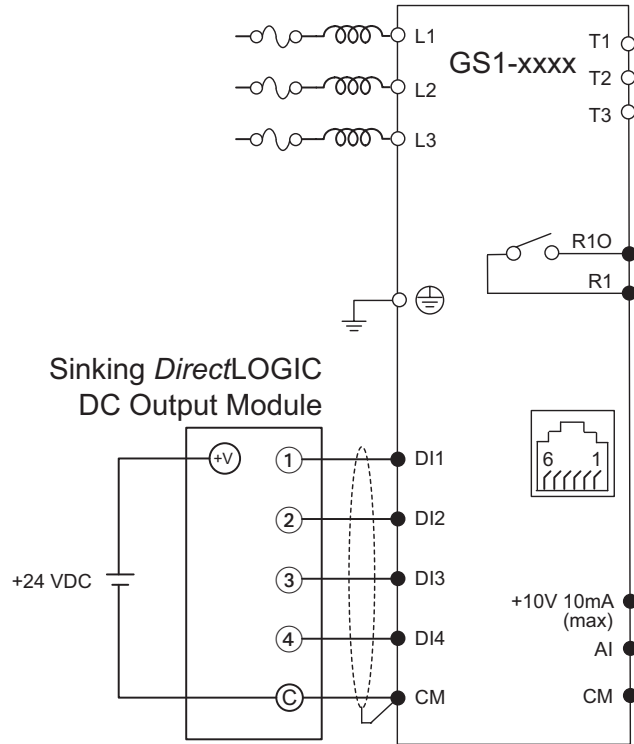
DIRECTLOGIC DC OUTPUT MODULES (SINKING)

- D0-05DD
- D0-05DD-D
- D0-06DD1
- D0-06DD1-D

- D0-10TD1
- D0-16TD1
- D2-16TD1-2

- D2-32TD1
- D4-08TD1
- D4-16TD1

- D4-32TD1
- T1K-08TD1
- T1K-16TD1



○ Main circuit (power) terminals ● Control circuit terminals ⏏ Shielded leads

TYPICAL PLC CONNECTIONS TO GS1 SERIES AC DRIVES (CONTINUED)

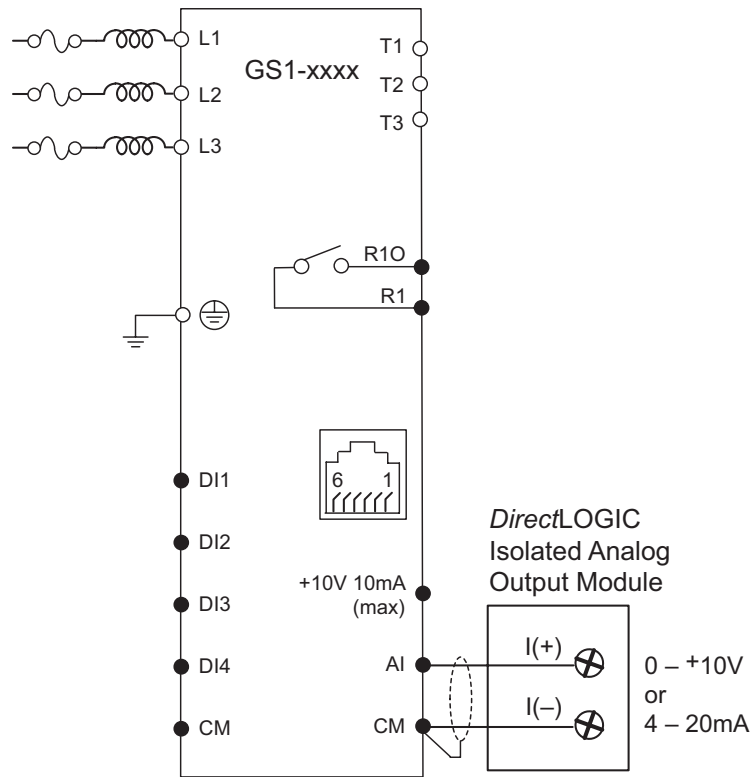
DIRECTLOGIC ISOLATED ANALOG OUTPUT MODULES

• F2-02DAS-1

• F2-02DAS-2

• F4-04DAS-1

• F4-04DAS-2



○ Main circuit (power) terminals ● Control circuit terminal ⊕ Shielded leads

TYPICAL PLC CONNECTIONS TO GS1 SERIES AC DRIVES (CONTINUED)

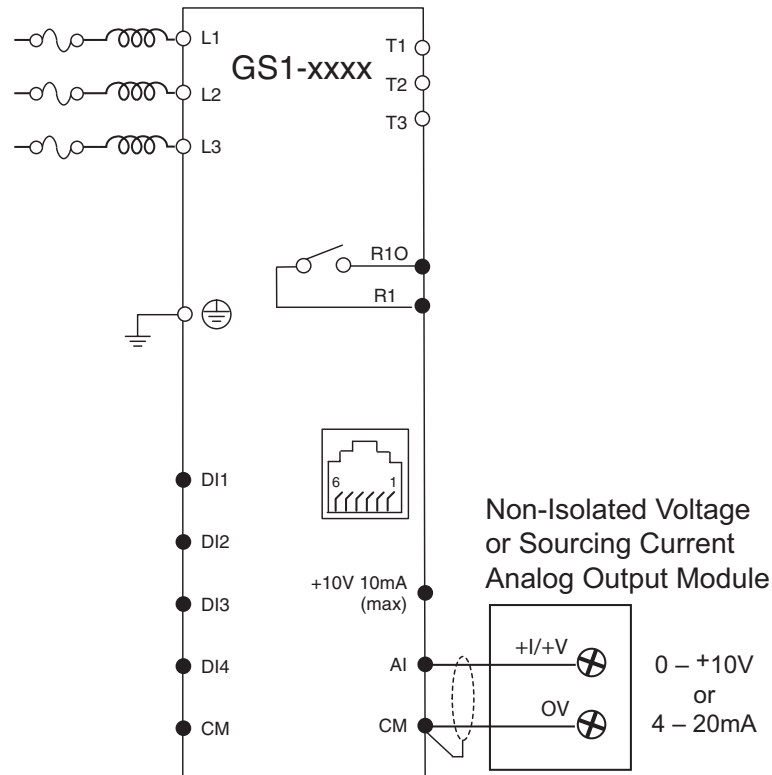
DIRECTLOGIC NON-ISOLATED VOLTAGE OR SOURCING CURRENT ANALOG OUTPUT MODULES

- F0-04DAH-1
- F0-04DAH-2
- F0-08DAH-1
- F0-08DAH-2

- F0-02AD2DA-2
- F0-04AD2DA-1
- F0-04AD2DA-2

- F2-08DA-1
- F2-02DA-2
- F2-08DA-2
- F4-08DA-2
- F4-16DA-2

- T1F-08DA-2
- T1F-16DA-2
- T1F-8AD4DA-1
- T1F-8AD4DA-2



○ Main circuit (power) terminals ● Control circuit terminal ⊕ Shielded leads

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