



DURAPULSE GS3 SERIES AC DRIVES USER MANUAL

GS3_UMW

DURA PULSE



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~ WARNING ~

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WARNINGS



WARNING: READ THIS MANUAL THOROUGHLY BEFORE USING DURAPULSE GS3 SERIES AC MOTOR DRIVES.



WARNING: AC INPUT POWER MUST BE DISCONNECTED BEFORE PERFORMING ANY MAINTENANCE. DO NOT CONNECT OR DISCONNECT WIRES OR CONNECTORS WHILE POWER IS APPLIED TO THE CIRCUIT. MAINTENANCE MUST BE PERFORMED ONLY BY A QUALIFIED TECHNICIAN.



WARNING: THERE ARE HIGHLY SENSITIVE MOS COMPONENTS ON THE PRINTED CIRCUIT BOARDS, AND THESE COMPONENTS ARE ESPECIALLY SENSITIVE TO STATIC ELECTRICITY. TO AVOID DAMAGE TO THESE COMPONENTS, DO NOT TOUCH THESE COMPONENTS OR THE CIRCUIT BOARDS WITH METAL OBJECTS OR YOUR BARE HANDS.



WARNING: A CHARGE MAY STILL REMAIN IN THE DC-LINK CAPACITOR WITH HAZARDOUS VOLTAGES, EVEN IF THE POWER HAS BEEN TURNED OFF. TO AVOID PERSONAL INJURY, DO NOT REMOVE THE COVER OF THE AC DRIVE UNTIL ALL "DISPLAY LED" LIGHTS ON THE DIGITAL KEYPAD ARE OFF. PLEASE NOTE THAT THERE ARE LIVE COMPONENTS EXPOSED WITHIN THE AC DRIVE. DO NOT TOUCH THESE LIVE PARTS.



WARNING: GROUND THE DURAPULSE GS3 AC DRIVE USING THE GROUND TERMINAL. THE GROUNDING METHOD MUST COMPLY WITH THE LAWS OF THE COUNTRY WHERE THE AC DRIVE IS TO BE INSTALLED. REFER TO "BASIC WIRING DIAGRAM" IN CHAPTER 2.



WARNING: THE MOUNTING ENCLOSURE OF THE AC DRIVE MUST COMPLY WITH EN50178. LIVE PARTS SHALL BE ARRANGED IN ENCLOSURES OR LOCATED BEHIND BARRIERS THAT MEET AT LEAST THE REQUIREMENTS OF THE PROTECTIVE TYPE IP20. THE TOP SURFACE OF THE ENCLOSURES OR BARRIER THAT IS EASILY ACCESSIBLE SHALL MEET AT LEAST THE REQUIREMENTS OF THE PROTECTIVE TYPE IP40. USERS MUST PROVIDE THIS ENVIRONMENT FOR DURAPULSE GS3 SERIES AC DRIVE.



WARNING: THE AC DRIVE MAY BE DESTROYED BEYOND REPAIR IF INCORRECT CABLES ARE CONNECTED TO THE INPUT/ OUTPUT TERMINALS. NEVER CONNECT THE AC DRIVE OUTPUT TERMINALS T1, T2, AND T3 DIRECTLY TO THE AC MAIN CIRCUIT POWER SUPPLY.



All DURAPULSE GS3 drives require a symmetrical 3-phase power source. Do not connect them to grounded, center-tapped delta transformers of the type typically used for lighting circuits.



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USER MANUAL REVISION HISTORY



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

MANUAL NUMBER: GS3_UMW
ISSUE: SECOND EDITION
ISSUE DATE: 06/2020

Publication History		
Issue	Date	Description of Changes
First Edition	12/08/2003	Original issue
First Edition, Revision A	2/26/2004	Ch1 – Corrected Watt loss information. Minor changes, corrections, and addtn'l information throughout.
First Edition, Revision B	06/2007	Minor changes and corrections throughout; Ch4 – New parameters & revised parameter explanations; Ch5 – New PLC program.
First Edition, Revision C	06/24/2011	Minor changes and corrections throughout. Ch2 – Wiring diagram & terminal spec modifications. Ch4 – Parameter description modifications (P2.10, P3.11-3.14, P6.00, P6.18, P9.04). Ch5 – PLC communication cable notes. AppxA – New accessories: LR-xxxx line reactors; 1-phase EMI filters; 1-phase fuses & blocks; GS-EDRV100; GS replacement cooling fans. AppxB – CLICK PLCs & connections.
First Edition, Revision D	05/2013	Minor changes and corrections throughout. Ch1 – New info for “Selecting the Proper Drive Rating.” Ch2 – Storage conditions, capacitor recharge, and short-circuit information. Ch3 – Clarification of P4.00 in examples. Ch4 – New parameter info, especially for firmware v1.05; new analog input example. Ch5 – New and revised info regarding parameters, wiring and cabling, and CLICK and DirectLOGIC PLC programming. Ch6 – Storage conditions; capacitor recharge info. AppxA – Fusing and SCCR specs; ZIPLink™ GS cables. AppxB – New PLC components.
Second Edition	06/2020	Update to more modern ADC manual standard. Variety of error fixes throughout manual content.

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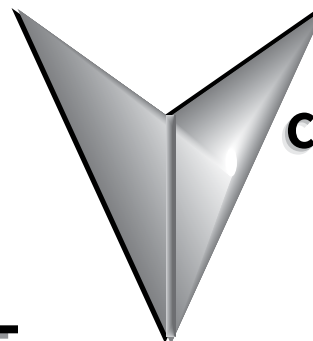
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GETTING STARTED



CHAPTER

1

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MANUAL OVERVIEW

OVERVIEW OF THIS PUBLICATION

The *DURAPULSE* AC Drive User Manual describes the installation, configuration, and methods of operation of the *DURAPULSE* 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 *DURAPULSE* GS3 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.*

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- *On the Web: www.automationdirect.com*

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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



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



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).

DURAPULSE GS3 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.

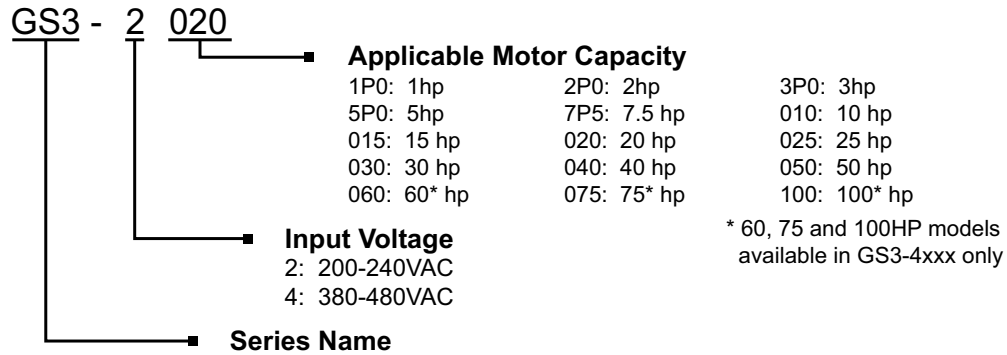
AC drives function by converting incoming AC power to DC, which is then synthesized back into three phase output power. The voltage and frequency of this synthesized output power is directly varied by the drive, where the frequency determines the speed of the three phase AC induction motor.

SELECTING THE PROPER DRIVE RATING

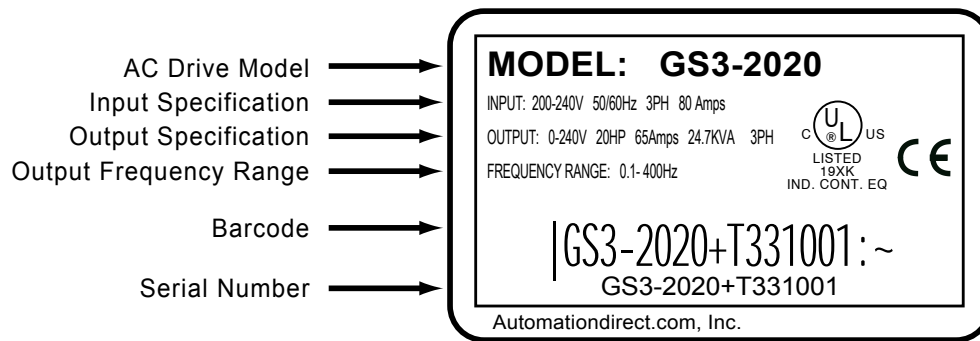
- A) Determine motor full-load amperage (FLA)
 Motor FLA is located on the nameplate of the motor.
 Note: FLA of motors that have been rewound may be higher than stated.
- B) Determine motor overload requirements
 Many applications experience temporary overload conditions due to starting requirements 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 GS3DURAPULSE
Overload Derate (overload %)				
If overload is < 150% and < 60 seconds		1	1.33	1.35
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 GS3 AC drive		1.2		
Required Drive FLA	Multiply altitude result x MEIT entry		8.0	10.91

MODEL NUMBER EXPLANATION



NAMEPLATE INFORMATION



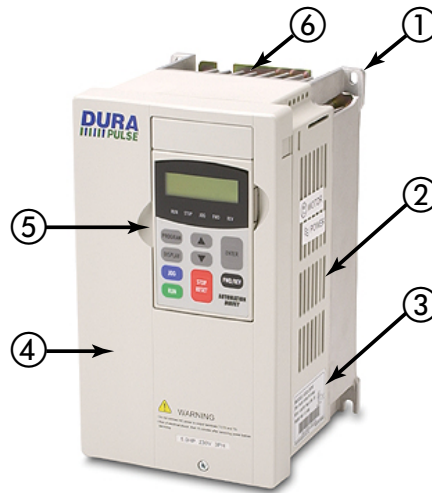
DRIVE PACKAGE CONTENTS

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

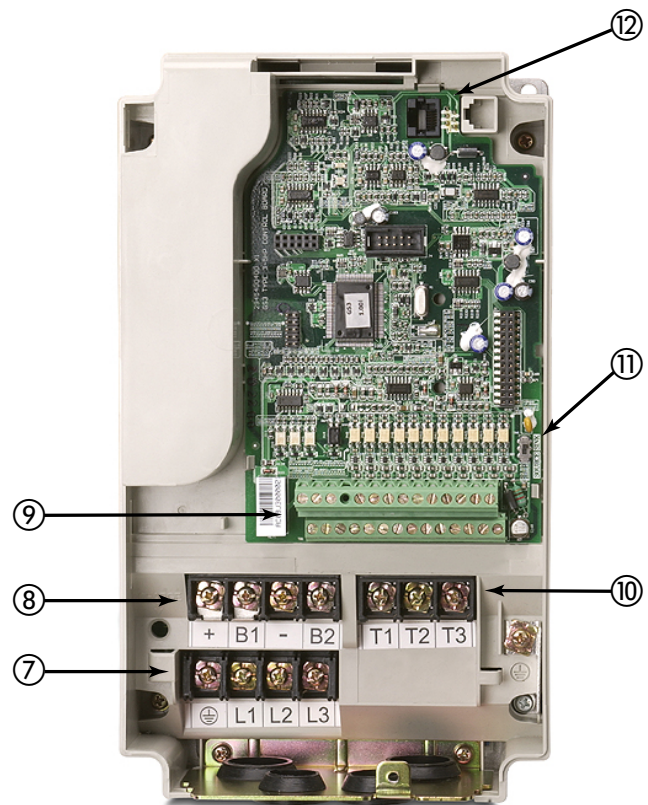
- Make sure that the package includes an AC drive and the DURAPULSE GS3 AC Drive Quick Reference.
- Inspect the unit to insure it was not damaged during shipment.
- Make sure that the part number indicated on the nameplate corresponds with the part number of your order.

EXTERNAL PARTS AND LABELS

GS3-25P0 shown



- ① Mounting Screw Holes
- ② Ventilation Slots
- ③ Nameplate Label
- ④ Cover
- ⑤ Digital Keypad
- ⑥ Heat Sink Fins
- ⑦ Input Power Terminals
- ⑧ Braking Terminals
- ⑨ Control Terminals
- ⑩ Output Power Terminals
- ⑪ Input Mode Switch (Sink/Source)
- ⑫ Serial Communication Port



DURAPULSE GS3 AC DRIVE SPECIFICATIONS**230V CLASS SPECIFICATIONS**

230V Class							
Model Name: GS3-xxxx		21P0	22P0	23P0	25P0	27P5	
Output Rating	Maximum Motor Output	hp	1.0	2.0	3.0	5.0	7.5
		kW	0.75	1.5	2.2	3.7	5.5
	Rated Output Current (A)		5	7	11	17	25
	Maximum Output Voltage		Three-phase 200 to 240V (proportional to input voltage)				
	Rated frequency		0.1 to 400 Hz				
Input * Rating	Rated Voltage/Frequency		Single/Three-phase; 50/60 Hz; 200/208/220/230/240 VAC			Three-phase; 50/60 Hz; 200/208/220/230/240 VAC	
	Rated Input Current (A)		11.9 / 5.7	15.3 / 7.6	22 / 15.5	20.6	26
	Voltage/Frequency Tolerance		Voltage: ± 10% Frequency: ± 5%				
	Short Circuit Withstand (SCCR) (A, rms symmetrical)		5kA @ 240 VAC				
Watt Loss 100% I (W)		60	82	130	194	301	
Weight (lb [kg])		4.5 [2.03]	4.5 [2.03]	9.4 [4.24]	9.4 [4.24]	13.3 [6.03]	

* All 3-phase power sources must be symmetrical. Do not connect DURApulse GS3 drives to grounded, center-tapped delta transformers (which are typically used for lighting circuits).

230V Class (continued)									
Model Name: GS3-xxxx		2010	2015	2020	2025	2030	2040	2050	
Output Rating	Maximum Motor Output	hp	10	15	20	25	30	40	50
		kW	7.5	11	15	18.5	22	30	37
	Rated Output Current (A)		33	49	65	75	90	120	145
	Maximum Output Voltage		Three-phase 200 to 240V (proportional to input voltage)						
	Rated frequency		0.1 to 400 Hz						
Input * Rating	Rated Voltage/Frequency		Three-phase; 200/208/220/230/240 VAC; 50/60 Hz						
	Rated Input Current (A)		34	50	60	75	90	110	142
	Voltage/Frequency Tolerance		Voltage: ± 10% Frequency: ± 5%						
	Short Circuit Withstand (SCCR) (A, rms symmetrical)		5kA @ 240 VAC						
Watt Loss 100% I (W)		380	660	750	920	1300	1340	1430	
Weight (lb [kg])		13.3 [6.03]	14.3 [6.49]	26.5 [12]	26.5 [12]	26.5 [12]	77.2 [35]	77.2 [35]	

* All 3-phase power sources must be symmetrical. Do not connect DURApulse GS3 drives to grounded, center-tapped delta transformers (which are typically used for lighting circuits).

460V CLASS SPECIFICATIONS

460V Class – Three Phase										
Model Name: GS3-xxxx			41P0	42P0	43P0	45P0	47P5	4010	4015	
Output Rating	Maximum Motor Output	HP	1	2	3	5	7.5	10	15	
		kW	0.75	1.5	2.2	3.7	5.5	7.5	11	
	Rated Output Current (A)		2.7	4.2	5.5	8.5	13	18	24	
	Maximum Output Voltage		Three-phase 380 to 480V (proportional to input voltage)							
Rated frequency		0.1 to 400 Hz								
Input * Rating	Rated Voltage/Frequency		Three-phase; 380/400/415/440/460/480VAC; 50/60 Hz							
	Rated Input Current (A)		3.2	4.3	5.9	11.2	14	19	25	
	Voltage/Frequency Tolerance		Voltage: ± 10% Frequency: ± 5%							
	Short Circuit Withstand (SCCR) (A, rms symmetrical)		5kA @ 480 VAC							
Watt Loss 100% I (W)			70	102	132	176	250	345	445	
Weight (lb [kg])			3.9 [1.76]	4.4 [1.99]	4.1 [1.86]	9.4 [4.24]	13.2 [6.00]	13.5 [6.11]	14.4 [6.53]	
* All 3-phase power sources must be symmetrical. Do not connect DURApulse GS3 drives to grounded, center-tapped delta transformers (which are typically used for lighting circuits).										

460V Class – Three Phase (continued)										
Model Name: GS3-xxxx			4020	4025	4030	4040	4050	4060	4075	4100
Output Rating	Maximum Motor Output	HP	20	25	30	40	50	60	75	100
		kW	15	18.5	22	30	37	45	55	75
	Rated Output Current (A)		32	38	45	60	73	91	110	150
	Maximum Output Voltage		Three-phase 380 to 480V (proportional to input voltage)							
Rated frequency		0.1 to 400 Hz								
Input * Rating	Rated Voltage/Frequency		Three-phase; 380/400/415/440/460/480; 50/60 Hz							
	Rated Input Current (A)		32	39	49	60	63	90	130	160
	Voltage/Frequency Tolerance		Voltage: ± 10% Frequency: ± 5%							
	Short Circuit Withstand (SCCR) (A, rms symmetrical)		5kA @ 480 VAC					10 kA @ 480 VAC		
Watt Loss 100% I (W)			620	788	1290	1420	1680	2020	2910	3840
Weight (lb [kg])			26.5 [12]	26.5 [12]	26.5 [12]	77.2 [35]	77.2 [35]	77.2 [35]	116.8 [53]	116.8 [53]
* All 3-phase power sources must be symmetrical. Do not connect DURApulse drives to grounded, center-tapped delta transformers (which are typically used for lighting circuits).										

GENERAL SPECIFICATIONS

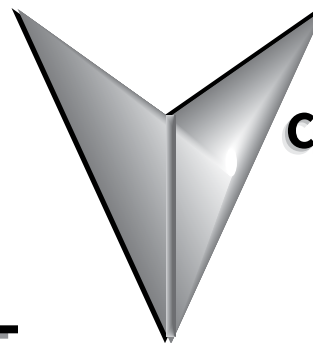
General Specifications			
Control Characteristics			
Control System	Pulse Width Modulation, Carrier frequency 1-15 kHz, adjustable, depending on the model. This system determines the control methods of the AC drive: 00: V/Hz open loop control, 01: V/Hz closed loop control, 02: Sensorless Vector, 03: Sensorless Vector with external feedback		
Rated Output Frequency	0.1 to 400.0 Hz		
Output Frequency Resolution	0.1 Hz		
Overload Capacity	150% of rated current for 1 minute		
Torque Characteristics	Includes auto-torque boost, auto-slip compensation, starting torque 125% @ 0.5 Hz / 150% @ 1.0 Hz		
Braking Torque	20% without dynamic braking, 125% with optional braking resistor (braking circuit built-in only for units under 20 hp)		
DC Braking	Operation frequency 60-0 Hz, 0-100% rated current, Start time 0.0-5.0 seconds, Stop time 0.0-5.0 seconds		
Acceleration/Deceleration Time	0.1 to 600 seconds (linear or non-linear acceleration/deceleration), second acceleration/deceleration available		
Voltage/Frequency Pattern	Settings available for Constant Torque - low & high starting torque, Variable Torque - low & high starting torque, and user configured		
Stall Prevention Level	20 to 200% of rated current		
Operation Specification			
Inputs	Frequency Setting	Keypad	Setting by <UP> or <DOWN> buttons
		External Signal	Potentiometer - 3-5 kΩ, 0 to 10 VDC (input impedance 10 kΩ), 0 to 20 mA / 4 to 20 mA (input impedance 250Ω). Multi-Speed Inputs 1 to 4, RS-232C/RS-485 communication interface
	Operation Setting	Keypad	Setting by <RUN>, <STOP>, <JOG> buttons
		External Signal	Forward/Stop, Reverse/Stop (run/stop, fwd/rev), 3-wire control, Serial Communication RS-232C & RS-485 (Modbus RTU)
	Input Terminals	Digital Sink/Source Selectable	11 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 (1-4), Manual Keyboard Control, Jog, External Base Block (N.O./N.C.), Second Accel/Decel Time, Speed Hold, Increase Speed, Decrease Speed, Reset Speed to Zero, PID Disable (N.O.), PID Disable (N.C.), Input Disable
		Analog	3 user-configurable, 0 to 10 VDC (input impedance 10 kΩ), 0 to 20mA / 4 to 20mA (input impedance 250Ω), 10 bit resolution; -10V to +10V, 10 bit resolution
Outputs	Output Terminals	Digital 3 transistors 1 relay	4 user-programmable: Inverter Running, Inverter Fault, At Speed, Zero Speed, Above Desired Frequency, Below Desired Frequency, At Maximum Speed, Over Torque Detected, Above Desired Current, Below Desired Current, PID Deviation Alarm, Heatsink Overheat Warning (OH), Soft Braking Signal, Above desired Frequency 2, Below desired Frequency 2, Encoder Loss
		Analog	1 user-programmable, 0 to 10 VDC, 8 bit resolution frequency, current, process variable PV
	Operating Functions	Automatic voltage regulation, voltage/frequency characteristics selection, non-linear acceleration/deceleration, upper and lower frequency limiters, 15-stage speed operation, adjustable carrier frequency (1 to 15 kHz), PID control, 5 skip frequencies, analog gain & bias adjustment, jog, electronic thermal relay, automatic torque boost, trip history, software protection	
Protective Functions			
Electronic Thermal, Overload Relay, Auto Restart after Fault, Momentary Power Loss, Reverse Operation Inhibit, Auto Voltage Regulation, Over-Voltage Stall Prevention, Auto Adjustable Accel/Decel, Over-Torque Detection Mode, Over-Torque Detection Level, Over-Torque Detection Time, Over-Current Stall Prevention during Acceleration, Over-Current Stall Prevention during Operation			

(table continued next page)

General Specifications (cont.)		
Operator Interface	Operator Devices	9-key, 2 line x 16 character LCD display, 5 status LEDs
	Programming	Parameter values for setup and review, fault codes
	Status Display	Output Frequency, Motor Speed, Scaled Frequency, Output Current, Motor Load, Output Voltage, DC Bus Voltage, PID Setpoint, PID Feedback, Frequency Setpoint
	Key Functions	RUN, STOP/RESET, FWD/REV, PROGRAM, DISPLAY, <UP>, <DOWN>, ENTER
Environment	Enclosure Rating	Protected Chassis, IP20
	Ambient Temperature	-10°C to 40°C (14°F to 104°F)
	Ambient Humidity	20 to 90% RH (non-condensing)
	Vibration	9.8 m/s ² (1G) less than 10 Hz, 5.9 m/s ² (0.6G) 10 to 60 Hz
	Installation Location	Altitude 1000m or lower above sea level, keep from corrosive gas, liquid and dust
Options		Noise filter, input AC reactor, output AC reactor, cable for remote operator, programming software, Dynamic braking resistor, input fuses

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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°C to 40°C (14°F to 104°F)
Relative Humidity	0 to 90% (non-condensing)
Atmosphere Pressure	86 kPa to 106 kPa
Vibration	9.8 m/s ² (1G) less than 10 Hz, 5.9 m/s ² (0.6G) 10 to 60 Hz
Installation Location	Altitude 1000m or lower above sea level, keep from corrosive gas, liquid and dust
Enclosure Rating	IP20: Protection against contact by fingers. Protection against medium-size foreign objects

STORAGE CONDITIONS

The AC drives should be kept in their shipping cartons or crates 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.



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.



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

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

- Do not mount the AC drive near heat-radiating elements or in direct sunlight.
- Do not install the AC drive in a place subjected to high temperature, high humidity, excessive vibration, corrosive gases or liquids, or airborne dust or metallic particles.
- Mount the AC drive securely on a flat, rigid, non-flammable surface.
- Mount the AC drive vertically and do not restrict the air flow to the heat sink fins.

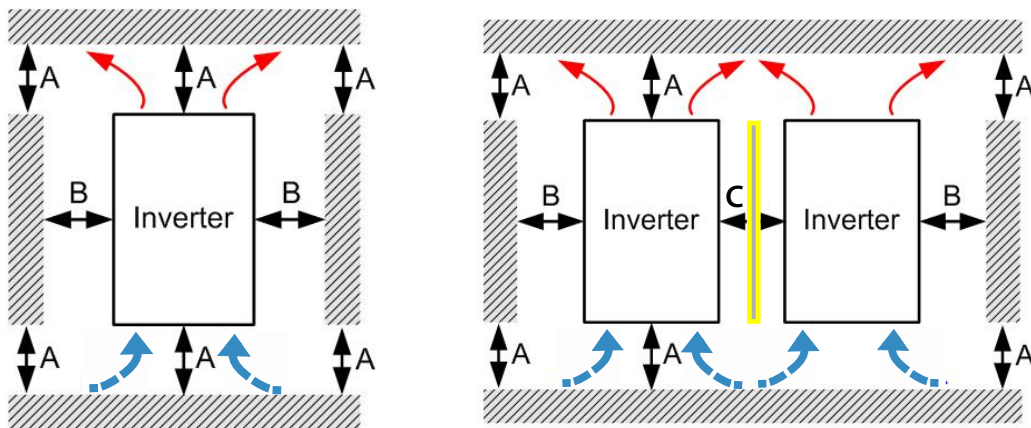


WARNING: AC DRIVES GENERATE A LARGE AMOUNT OF HEAT WHICH MAY DAMAGE THEM. AUXILIARY COOLING METHODS ARE TYPICALLY REQUIRED IN ORDER NOT TO EXCEED MAXIMUM AMBIENT TEMPERATURES.

MINIMUM CLEARANCES AND AIR FLOW

DIAGRAM DIRECTIONAL ARROWS

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



WARNING: MAXIMUM AMBIENT TEMPERATURES MUST NOT EXCEED 40°C (104°F)!

Minimum Clearances				
Installation Method	HP	A [mm]	B [mm]	C [mm]
Single drive installation	1-5	150	50	-
	7.5-20	175	75	-
	25-75	200	75	-
	100	150	75	-
Side-by-side horizontal installation	1-5	150	50	50
	7.5-20	175	75	75
	25-75	200	75	75
	100	150	75	100*

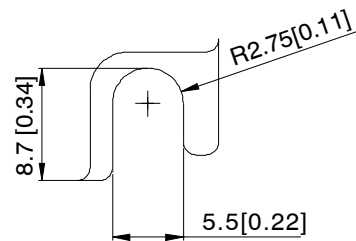
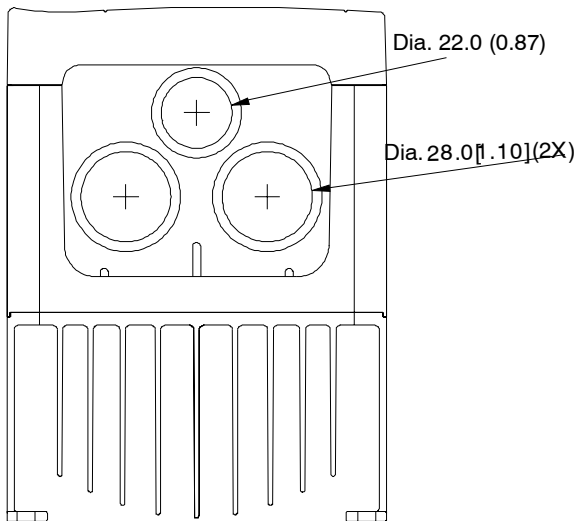
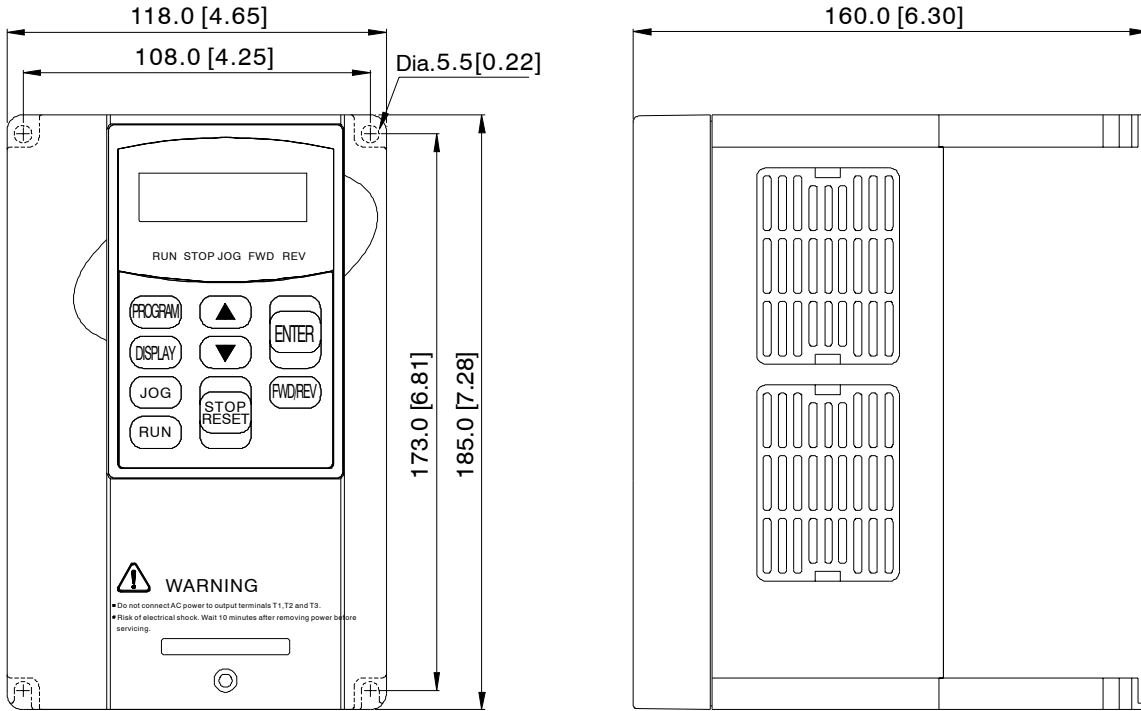
* Add divider plate of equal height and depth of drives between each drive, as highlighted above at C. This is to prevent air from blowing directly from one drive into the other.

DIMENSIONS

UNITS = MM [IN]

FRAME A

Part Numbers: *GS3-21P0, GS3-22P0, GS3-41P0, GS3-42P0*

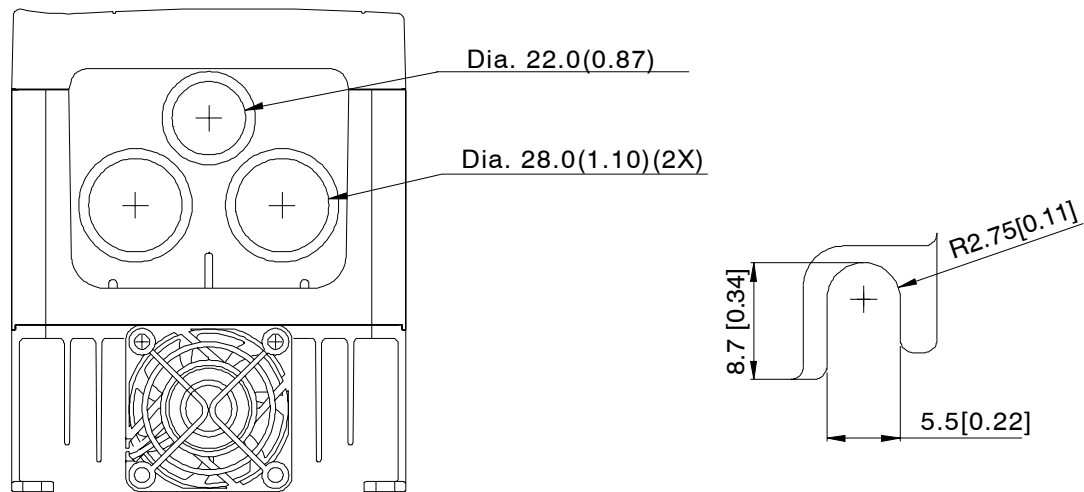
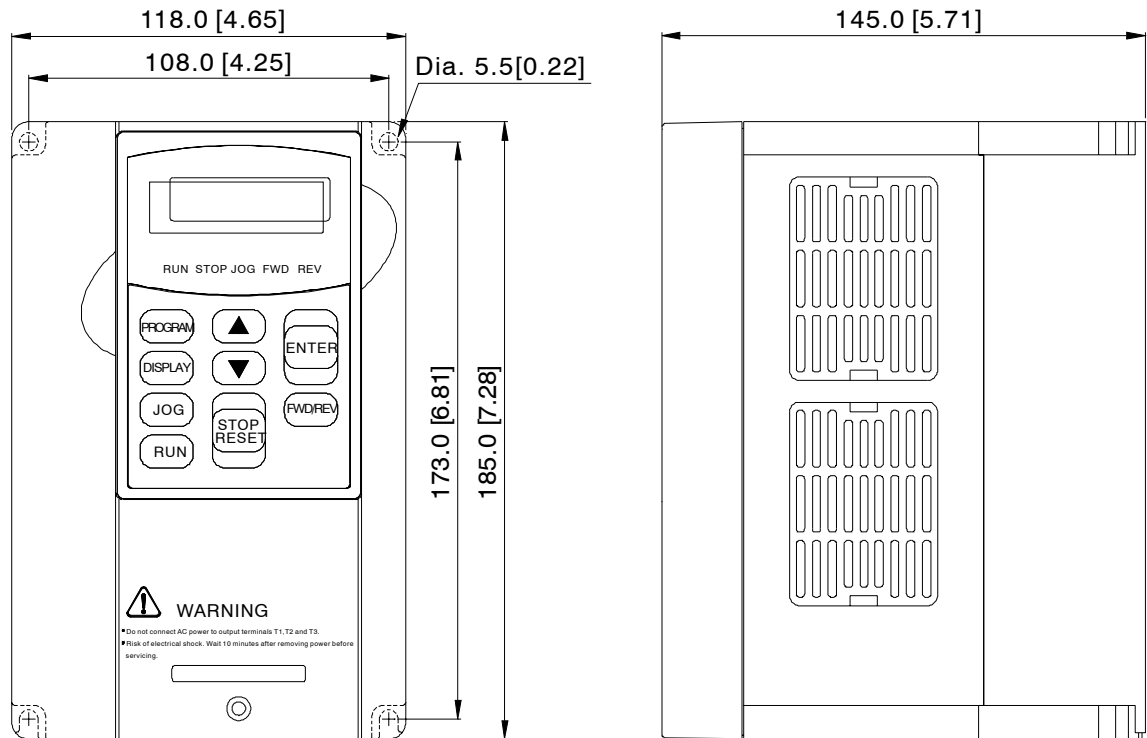


DIMENSIONS (CONTINUED)

UNITS = MM [IN]

FRAME A WITH FAN

Part Numbers: GS3-43P0

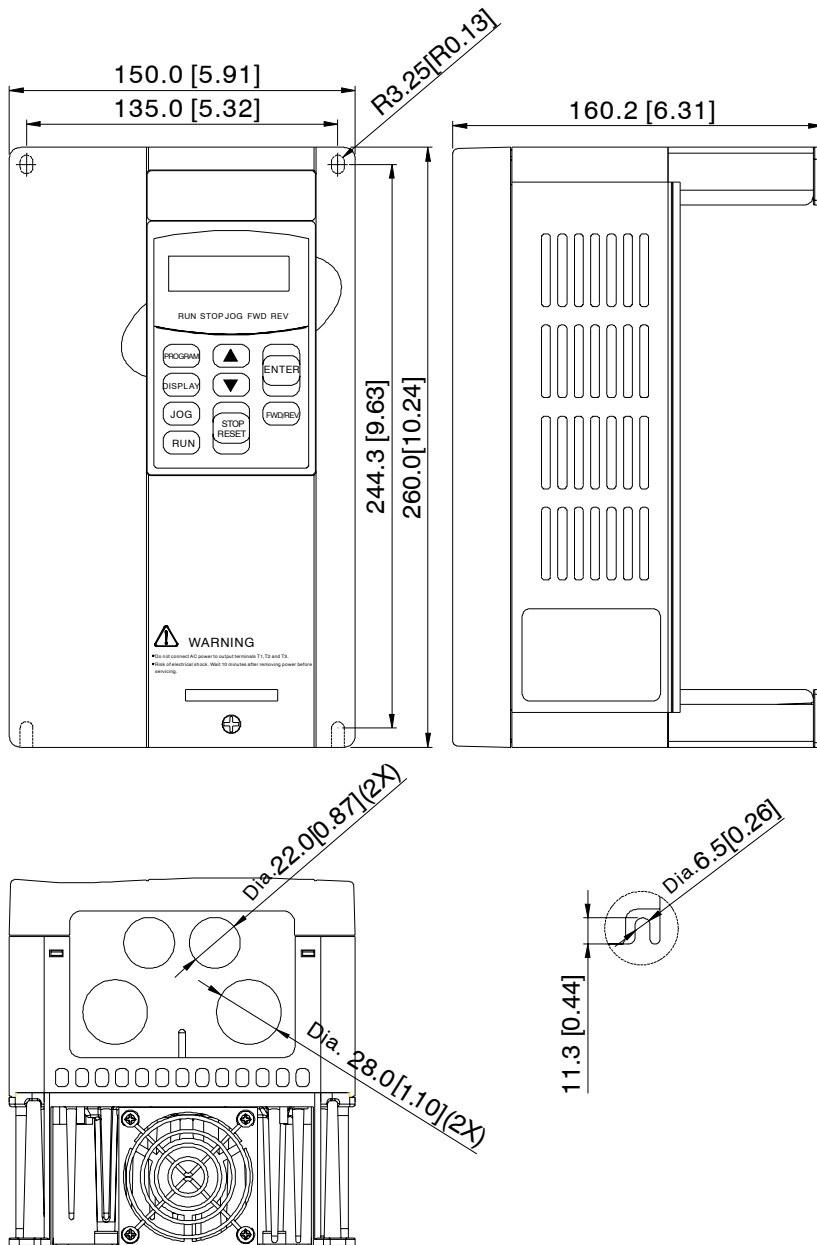


DIMENSIONS (CONTINUED)

UNITS = MM [IN]

FRAME B

Part Numbers: GS3-23P0, GS3-25P0, GS3-45P0

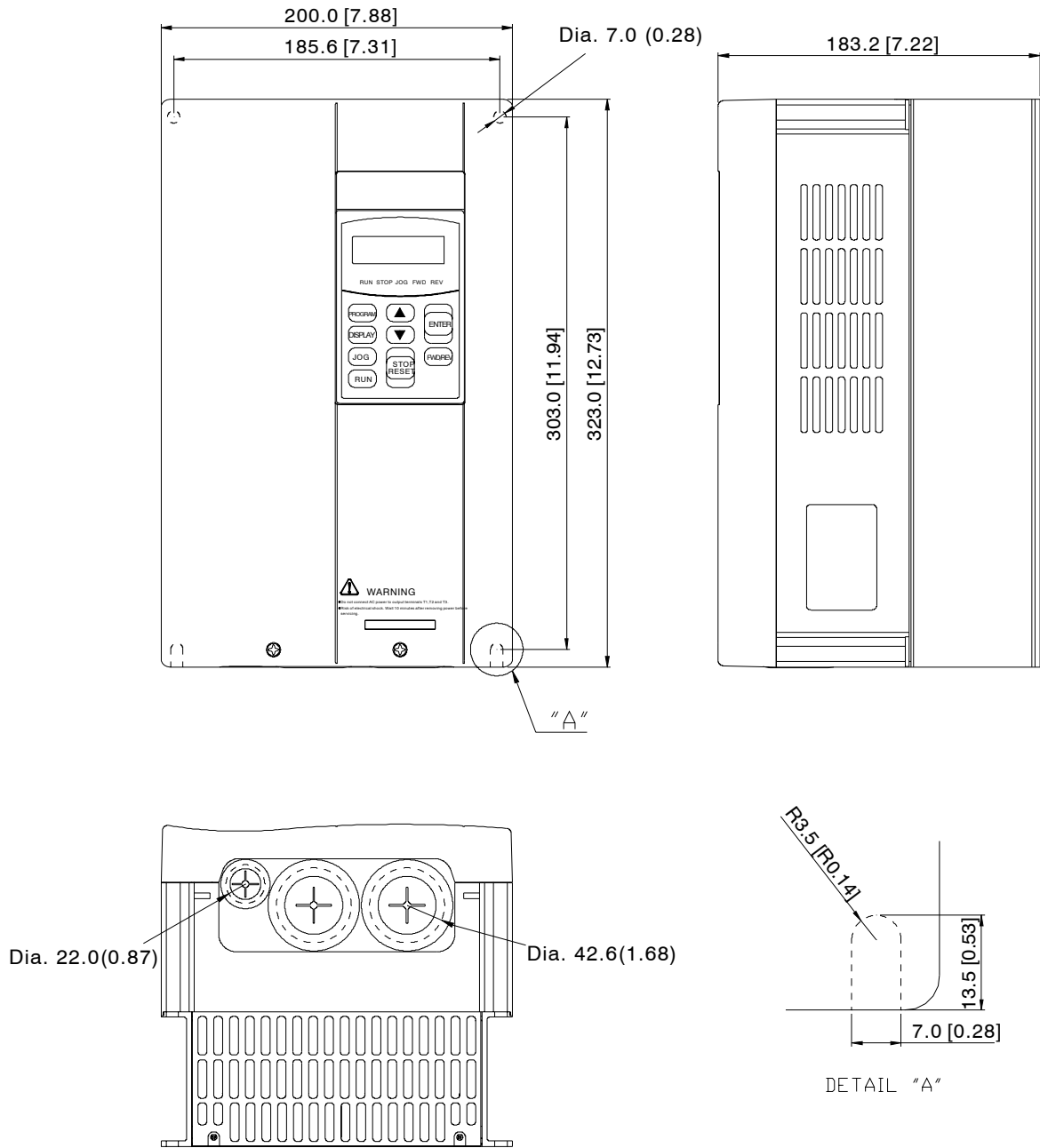


DIMENSIONS (CONTINUED)

UNITS = MM [IN]

FRAME C

Part Numbers: GS3-27P5, GS3-2010, GS3-2015, GS3-47P5, GS3-4010, GS3-4015

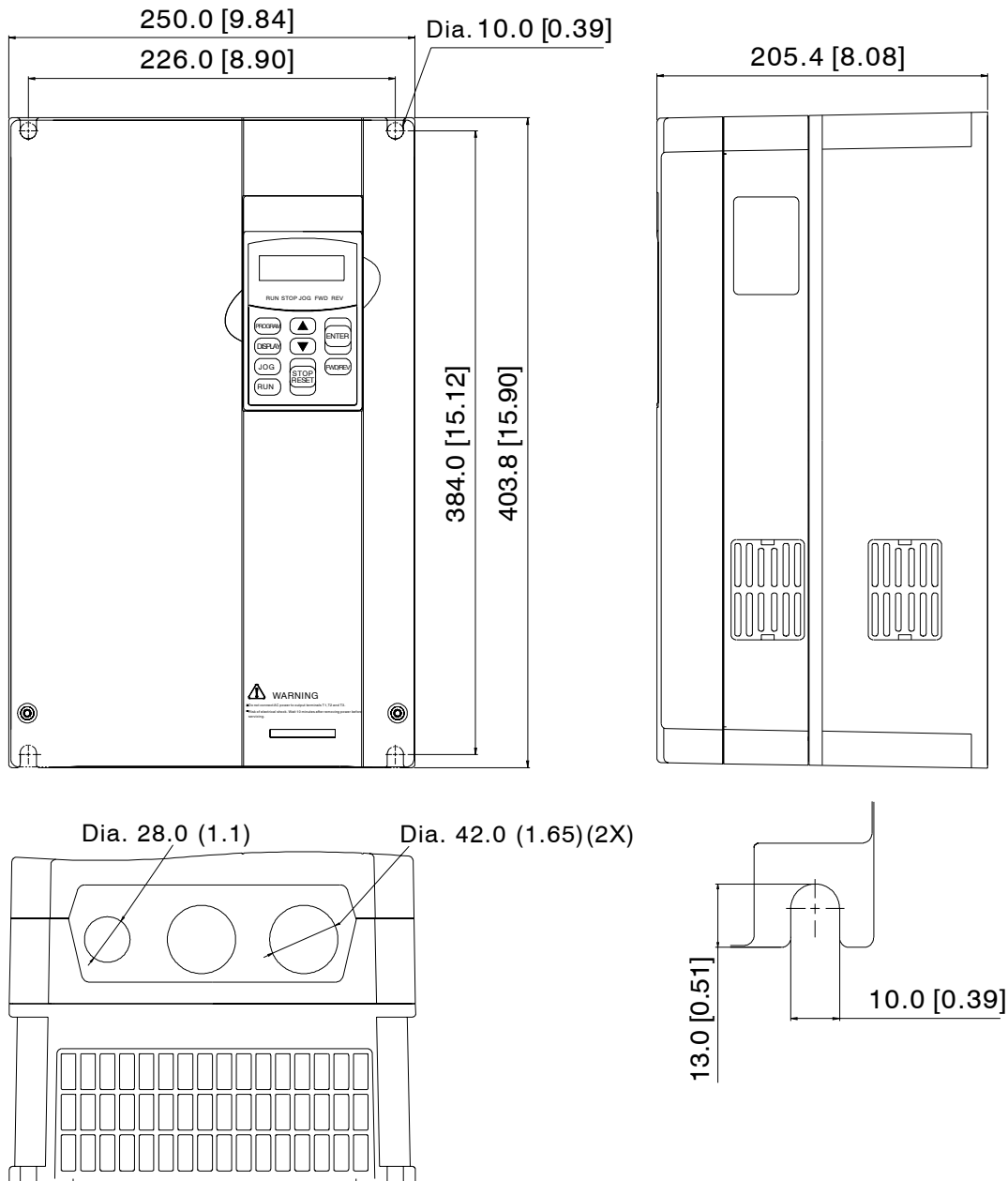


DIMENSIONS (CONTINUED)

UNITS = MM [IN]

FRAME D

Part Numbers: GS3-2020, GS3-2025, GS3-2030, GS3-4020, GS3-4025, GS3-4030

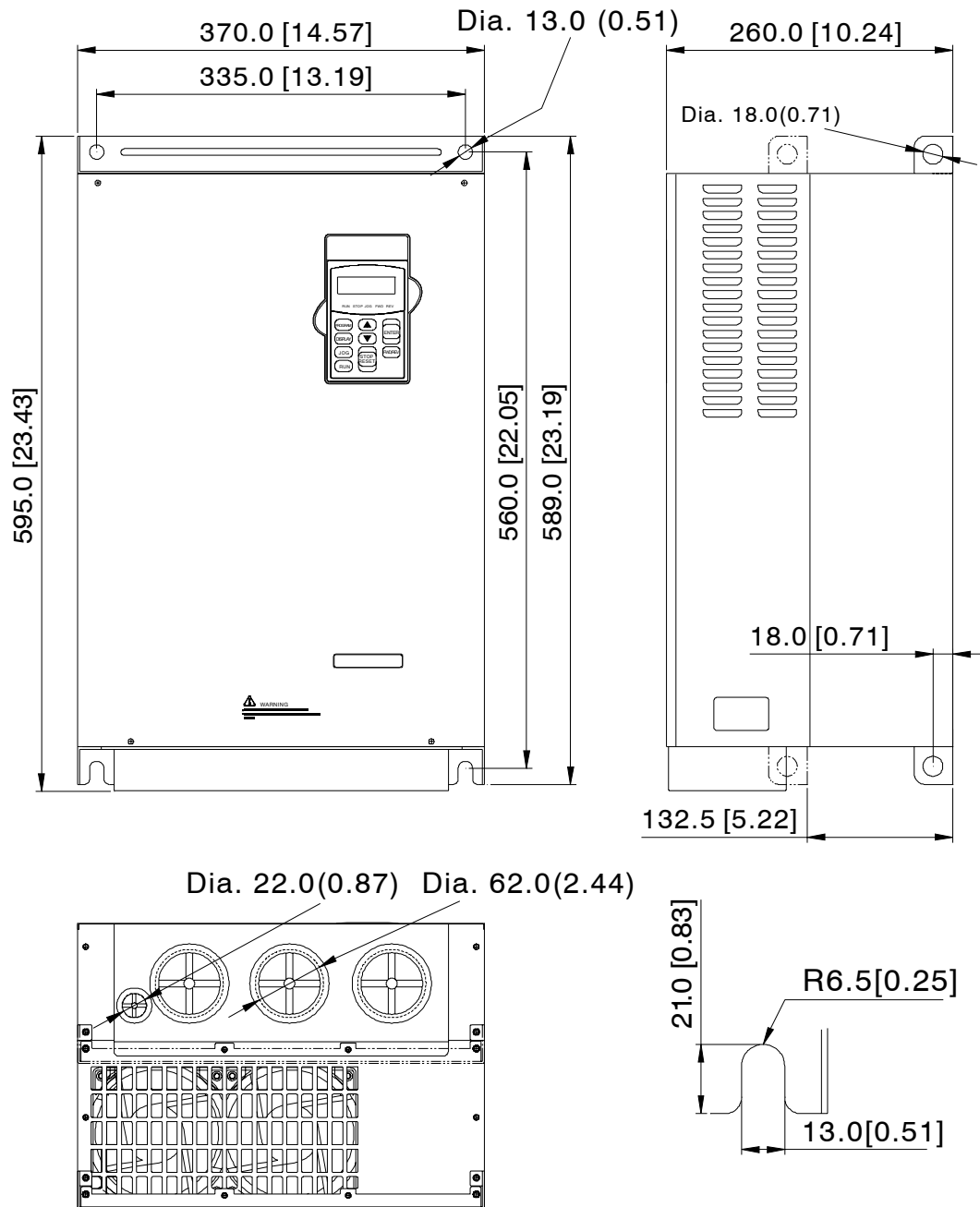


DIMENSIONS (CONTINUED)

UNITS = MM [IN]

FRAME E

Part Numbers: GS3-2040, GS3-2050, GS3-4040, GS3-4050, GS3-4060

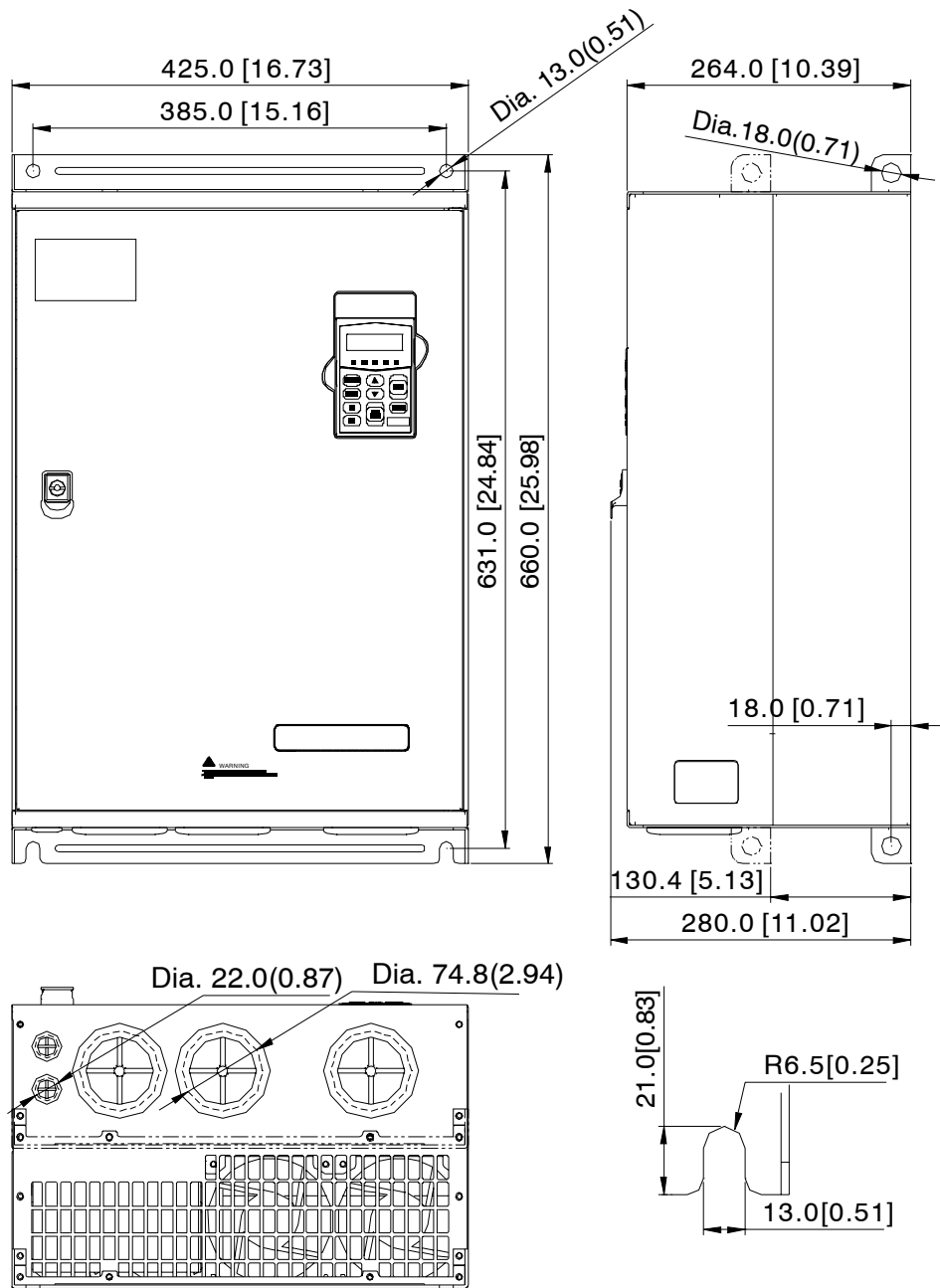


DIMENSIONS (CONTINUED)

UNITS = MM [IN]

FRAME F

Part Numbers: GS3-4075, GS3-4100



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.



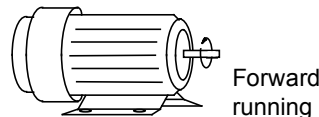
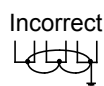
WARNING: DO NOT CONNECT THE AC INPUT POWER TO THE T1, T2, AND T3 OUTPUT TERMINALS. DOING THIS WILL DAMAGE THE AC DRIVE.



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

WIRING NOTES: PLEASE READ PRIOR TO INSTALLATION:

- 1) During installation, follow all local electrical, construction, and safety codes for the country in which the AC drive is to be installed.
- 2) 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. (Ground resistance should not exceed 0.1Ω.)
- 4) Use ground leads that comply with AWG/MCM standards and keep them as short as possible.
- 5) Do not use a power circuit 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.
- 6) Multiple DURAPULSE GS3 units can be installed in one location. All of the units should be grounded directly to a common ground terminal. The DURAPULSE GS3 ground terminals may also be connected in parallel, as shown in the figure below. Make sure there are no ground loops.



- 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 inspect components unless inside "POWER" lamp is turned off.
- 11) Do not monitor the signals on the circuit board while the AC drive is in operation.
- 12) GS3 series DURAPULSE drives **cannot be used with single-phase motors.**
- 13) Route the power and control wires separately, or at 90 degree angle to each other.
- 14) If a filter is required for reducing EMI (Electro Magnetic Interference), install it as close as possible to the AC drive. EMI can also be reduced by lowering the Carrier Frequency.
- 15) If the AC drive is installed in a place where a load reactor is needed, install the filter close to the T1, T2, and T3 side of AC drive. Do not use a Capacitor, L-C Filter (Inductance-Capacitance), or R-C Filter (Resistance-Capacitance), unless approved by AutomationDirect.
- 16) 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, notice that the energy loss is greater than for an inverter duty motor.
- 2) Avoid running a standard induction motor at low speed, which may cause the motor temperature to exceed the motor rating due to limited airflow produced by the motor's fan.
- 3) When the standard motor operates at low speed, the output load must be decreased.
- 4) If **100% output torque** is desired at **low speed**, it may be necessary to use a special **“inverter-duty” rated motor**.

SHORT CIRCUIT WITHSTAND (SCCR)

Models through 50 hp are suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes; 10,000A for models 60 hp through 100 hp. The maximum voltage is 240V for all 230V models, and 480V for all 460V models.

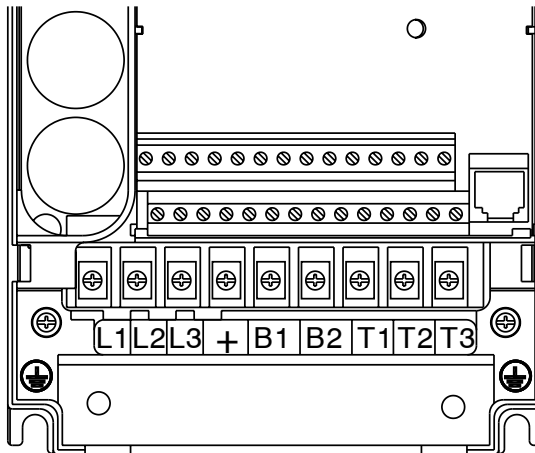
APPLICABLE CODES

All *DURAPULSE* GS3 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).

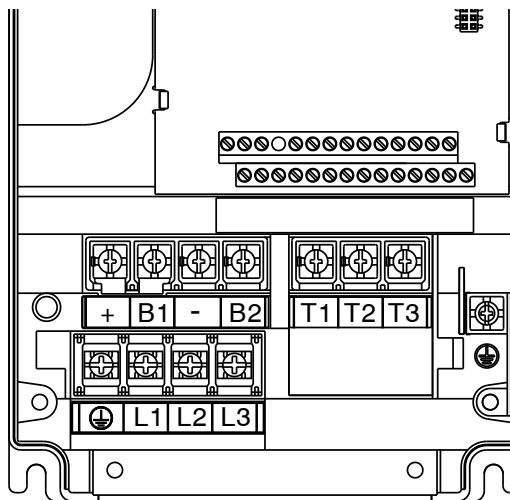
Installation intended to meet the UL and cUL requirements must follow the instructions provided in “Wiring Notes” as a minimum standard. Follow all local codes that exceed UL and cUL requirements. Refer to the technical data label affixed to the AC drive and the motor nameplate for electrical data. The “Circuit Protection Devices” section in Appendix A, lists the recommended fuse part number for each *DURAPULSE* GS3 part number. These fuses (or equivalent) must be used on all installations where compliance with U.L. standards is required.

TERMINAL WIRING DIAGRAMS

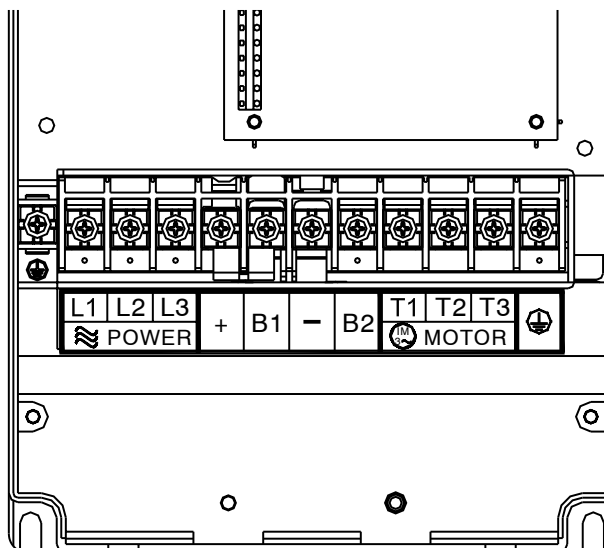
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GS3-23P0, GS3-25P0, GS3-45P0

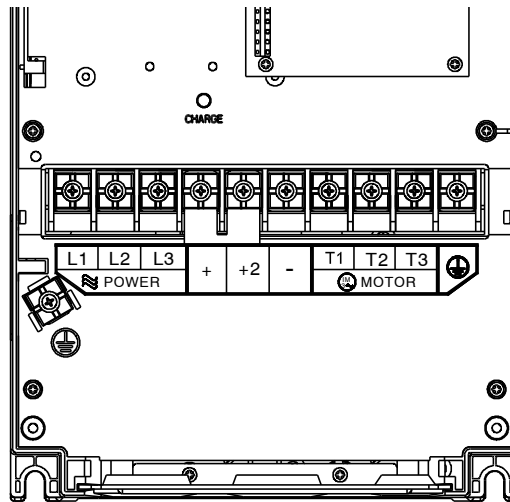


GS3-27P5, GS3-47P5, GS3-2010, GS3-4010, GS3-2015, GS3-4015

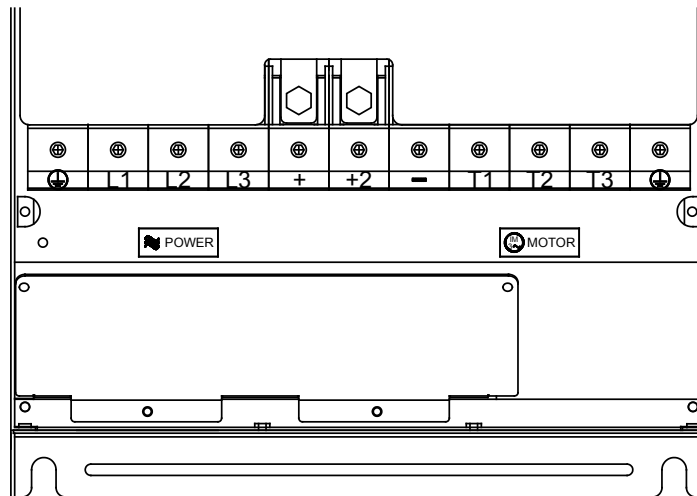


TERMINAL WIRING DIAGRAMS (CONTINUED)

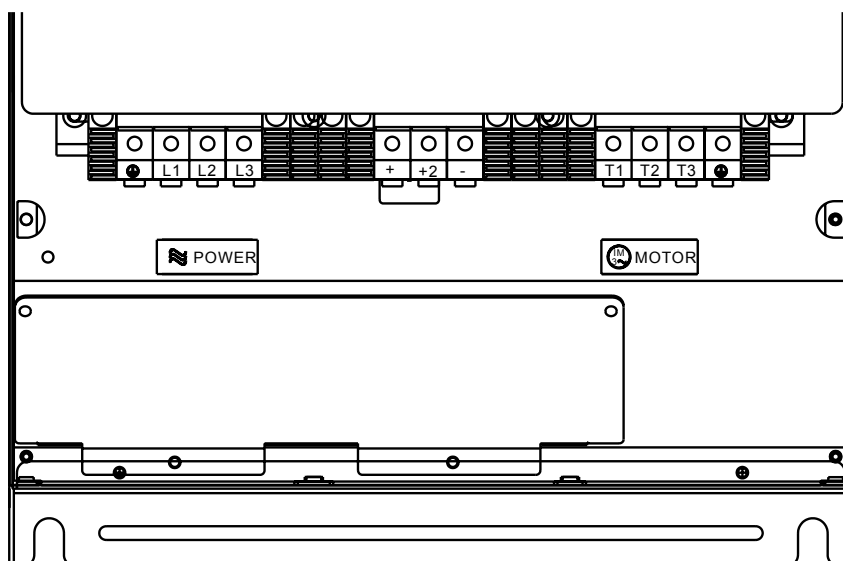
GS3-2020, GS3-4020, GS3-2025, GS3-4025, GS3-2030, GS3-4030



GS3-2040, GS3-2050

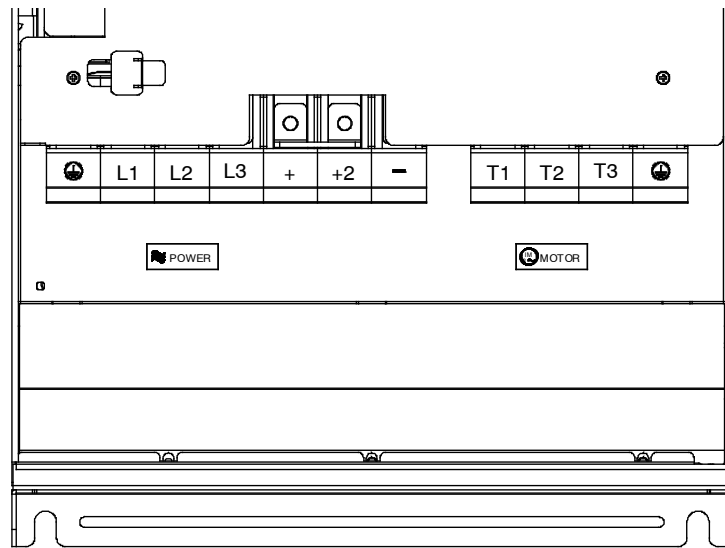


GS3-4040, GS3-4050, GS3-4060




TERMINAL WIRING DIAGRAMS (CONTINUED)

GS3-4075, GS3-4100



MAIN CIRCUIT WIRING

Main Circuit Terminals	
Terminal	Description
L1, L2, L3	Input Power
T1, T2, T3	AC Drive Output
B1, B2	Braking Resistor Connection (Under 20HP)
+2, - (negative)	External Dynamic Brake Unit (20HP & Over)
	Ground

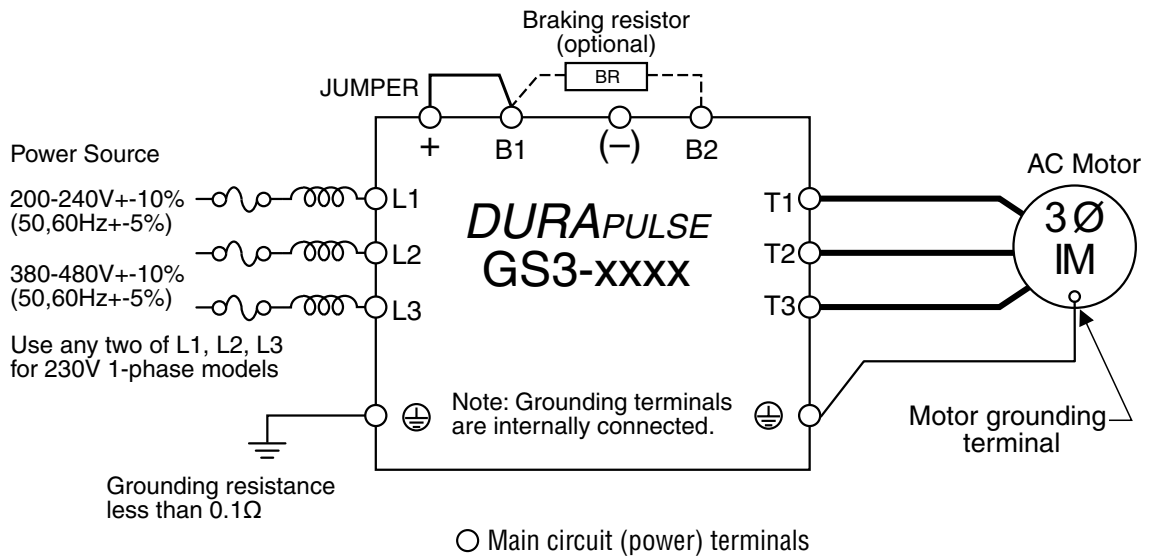
Main Circuit Wiring Specifications				
AC Drive Model	Input Current (A)	Output Current (A)	Wire Range (AWG)	Terminal Tightening Torque (kgf-cm)
GS3-21P0	5.7	5	10-18	18
GS3-22P0	7.6	7		
GS3-23P0	15.5	10		
GS3-25P0	20.6	17		
GS3-27P5	26	25	8-12	30
GS3-2010	34	33		
GS3-2015	50	49	2-8	40
GS3-2020	60	65		
GS3-2025	75	75		
GS3-2030	90	90		
GS3-2040	110	120	2/0-3/0	200
GS3-2050	142	145		
GS3-41P0	3.2	2.7	10-18	18
GS3-42P0	4.3	4.2		
GS3-43P0	5.9	5.5		
GS3-45P0	11.2	8.5		
GS3-47P5	14	13	8-12	30
GS3-4010	19	18		
GS3-4015	25	24		
GS3-4020	32	32	2-8	40
GS3-4025	39	38		
GS3-4030	49	45		
GS3-4040	60	60	2-4	57
GS3-4050	63	73		
GS3-4060	90	91		
GS3-4075	130	110	2/0-3/0	200
GS3-4100	160	150		

POWER WIRING DIAGRAMS

DRIVES UNDER 20HP



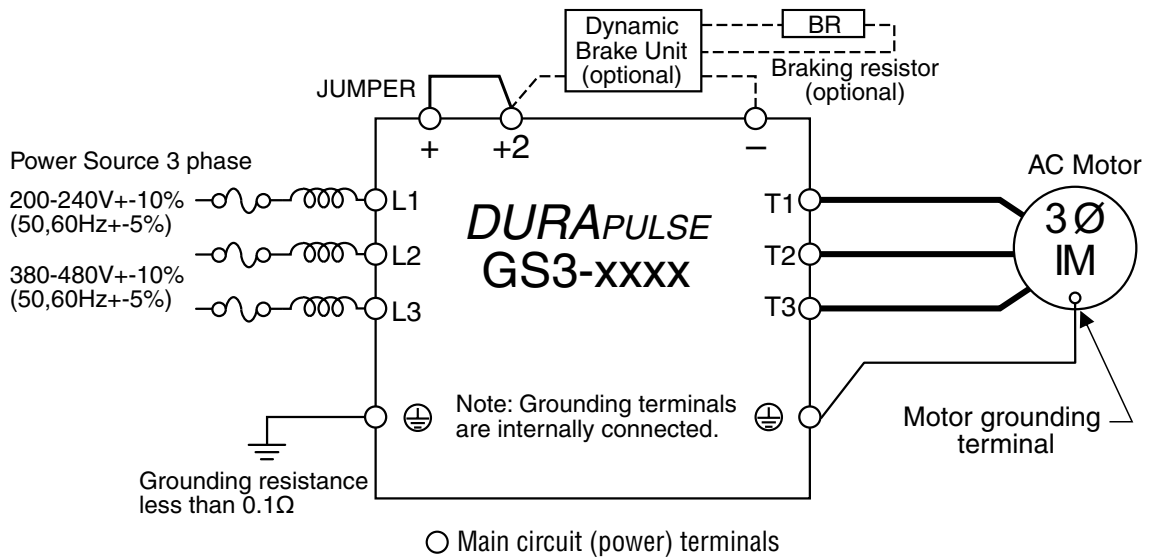
Users must connect wiring according to the circuit diagram shown below.



DRIVES 20–30HP (230VAC) & 20–60HP (460VAC)



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

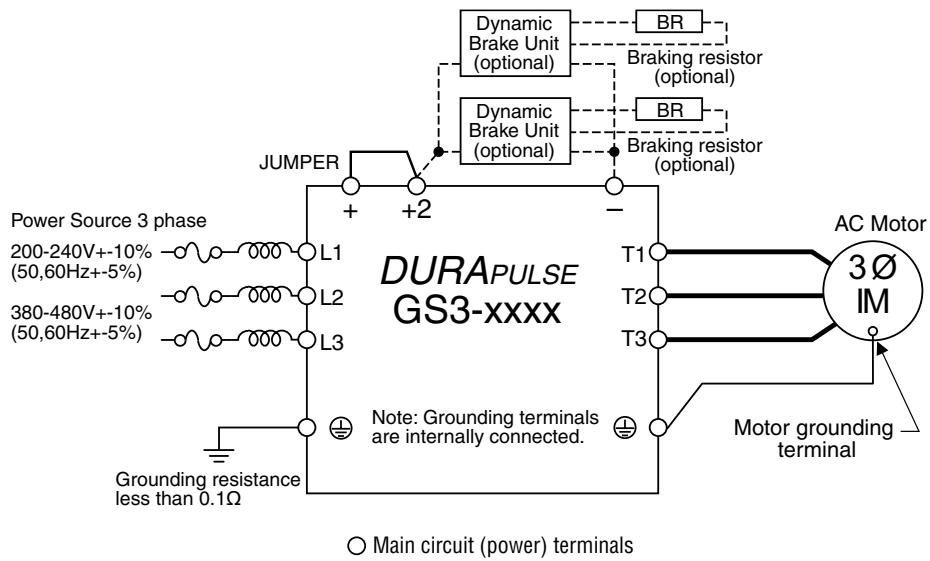


POWER WIRING DIAGRAMS (CONTINUED)

DRIVES 40–50HP (230VAC) & 75–100HP (460VAC)



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



CONTROL TERMINAL DESIGNATIONS

Control Circuit Terminals		
Terminal Symbol	Description	Remarks
+24V	DC Voltage Source	(+24V, 20mA), used only for AC drive digital inputs wired for source mode operation
DI1	Digital Input 1	Input Voltage: Internally Supplied (see Warning below) Sink Mode: Low active, V_{inL} Min = 0V, V_{inL} Max = 15V; I_{in} Min = 2.1mA, I_{in} Max = 7.0mA Source Mode: High active, V_{inH} Min = 8.5V, V_{inH} Max = 24V; I_{in} Min = 2.1mA, I_{in} Max = 7.0mA Input response: 12–15 ms Also see "Basic Wiring Diagram" on the next pages.
DI2	Digital Input 2	
DI3	Digital Input 3	
DI4	Digital Input 4	
DI5	Digital Input 5	
DI6	Digital Input 6	
DI7	Digital Input 7	
DI8	Digital Input 8	
DI9	Digital Input 9	
DI10	Digital Input 10	
DI11	Digital Input 11	
DCM	Digital Common	
+10V	Internal Power Supply	+10VDC (10mA maximum load)
AI1	Analog Input	0 to +10 V input only
AI2	Analog Input	0 to 20 mA / 4 to 20 mA input
AI3	Analog Input	-10 to +10 V input only
ACM	Analog Common	
R1O	Relay Output 1 Normally Open	Resistive Load: 240VAC – 5A (N.O) / 3A (N.C.); 24VDC – 5A (N.O.) / 3A (N.C.) Inductive Load: 240VAC – 1.5A (N.O) / 0.5A (N.C); 24VDC – 1.5A (N.O) / 0.5A (N.C)
R1C	Relay Output 1 Normally Closed	
R1	Relay Output 1 Common	
DO1	Photocoupled digital output	12–48 VDC, 50 mA
DO2	Photocoupled digital output	
DO3	Photocoupled digital output	
DOC	Digital Output Common	
FO	Digital Frequency Output	Maximum 50mA @ 48VDC, Scalable squarewave, 50% duty cycle output
AO	Analog Output	0 to +10V, 2mA Output
Control Terminal Wire Range: 24–12 AWG		
Control Terminal Tightening Torque: 5kgf·cm [4lbf·in]		



WARNING: *DO NOT CONNECT EXTERNAL VOLTAGE SOURCES TO THE DIGITAL INPUTS. PERMANENT DAMAGE MAY RESULT.*



Use twisted-shielded, twisted-pair or shielded-lead wires for the control signal wiring. It is recommended to 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.

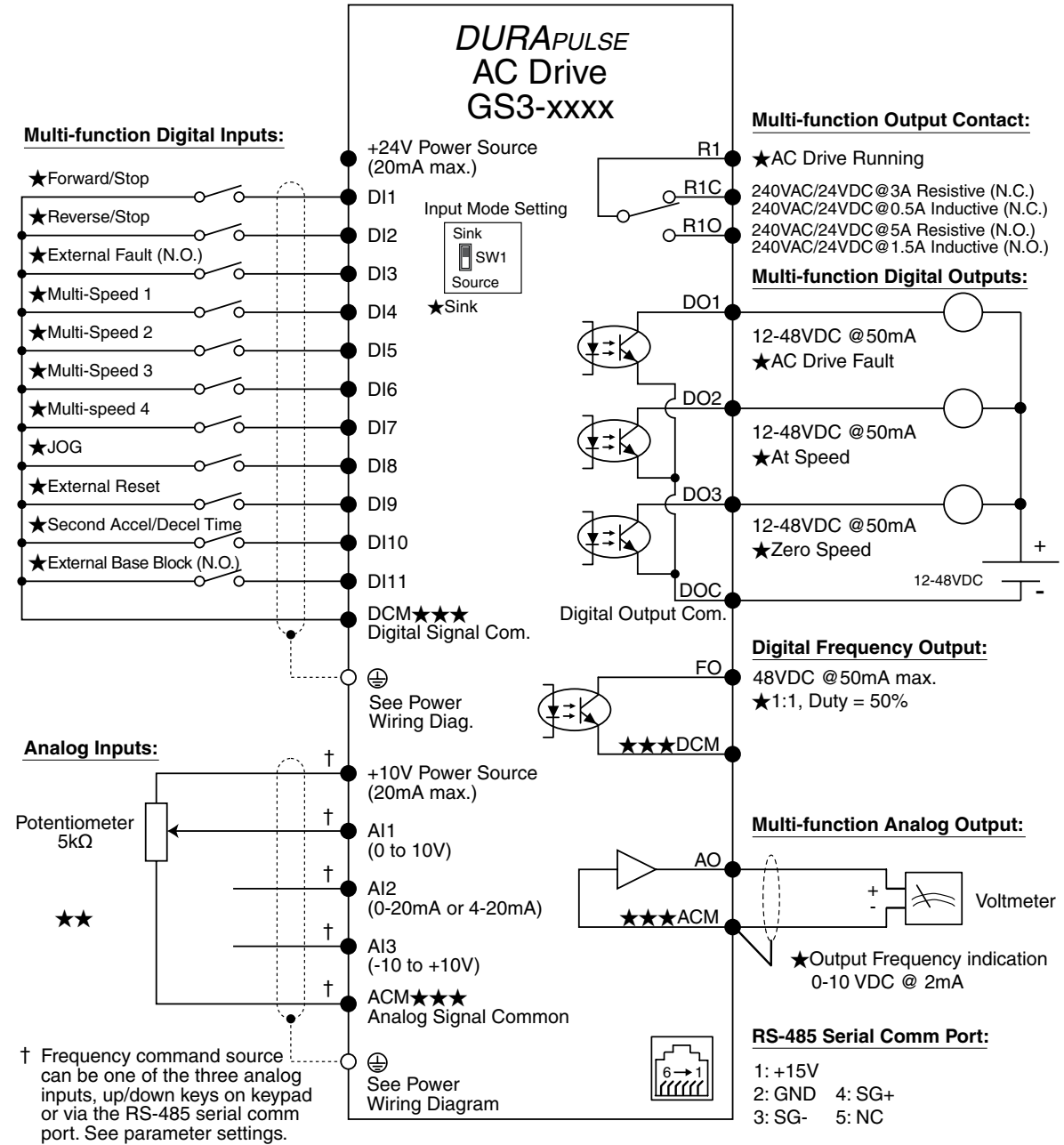
CONTROL WIRING DIAGRAM – SINKING INPUTS



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



WARNING: DO NOT PLUG A MODEM OR TELEPHONE INTO THE DURAPULSE GS3 RJ-12 SERIAL COMM PORT, OR PERMANENT DAMAGE MAY RESULT.



- ★ Factory default setting
- ★★ Factory default source of frequency command is via the keypad up/down keys
- ★★★ ACM and DCM are isolated from each other
- Main circuit (power) terminals ● Control circuit terminal Ⓢ Shielded leads

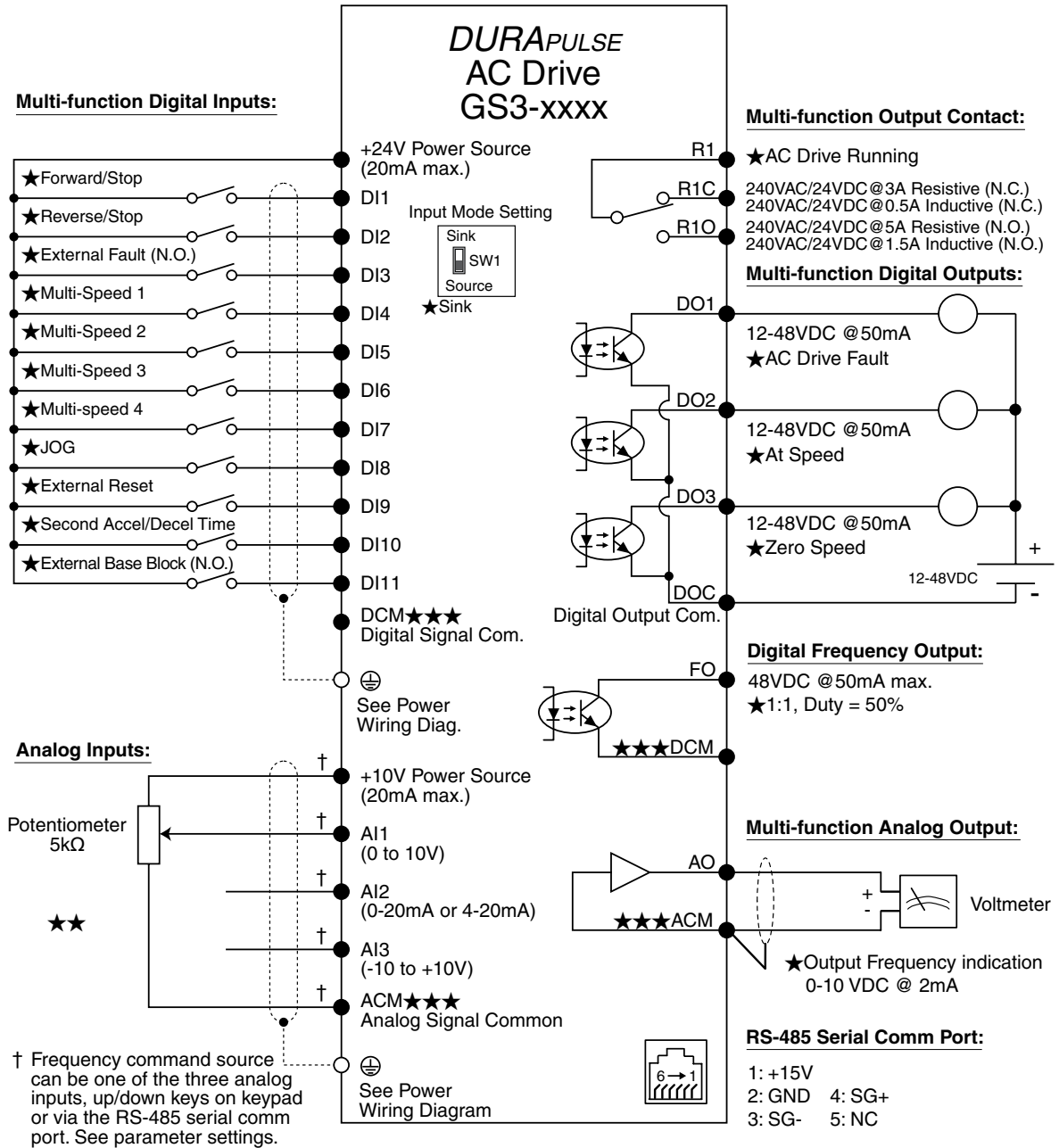
CONTROL WIRING DIAGRAM – SOURCING INPUTS



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

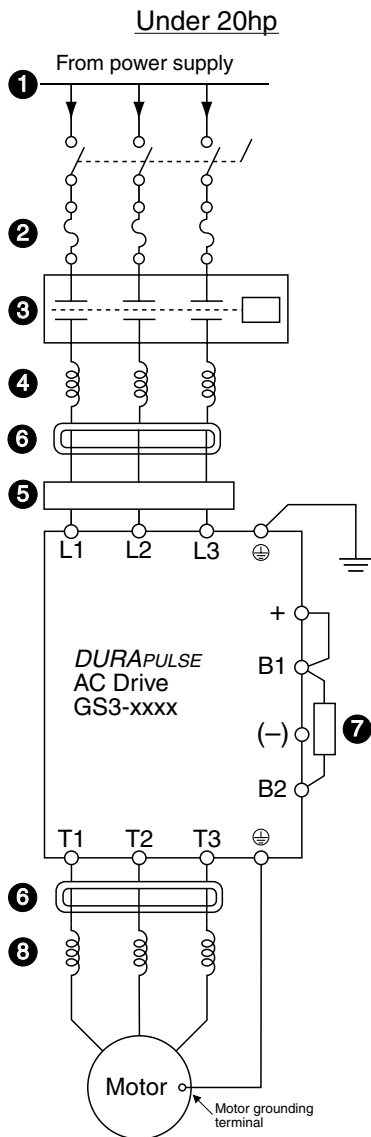


WARNING: DO NOT PLUG A MODEM OR TELEPHONE INTO THE DURAPULSE GS3 RJ-12 SERIAL COMM PORT, OR PERMANENT DAMAGE MAY RESULT.



- ★ Factory default setting
- ★★ Factory default source of frequency command is via the keypad up/down keys
- ★★★ ACM and DCM are isolated from each other
- Main circuit (power) terminals ● Control circuit terminal Ⓢ Shielded leads

EXTERNAL ACCESSORIES

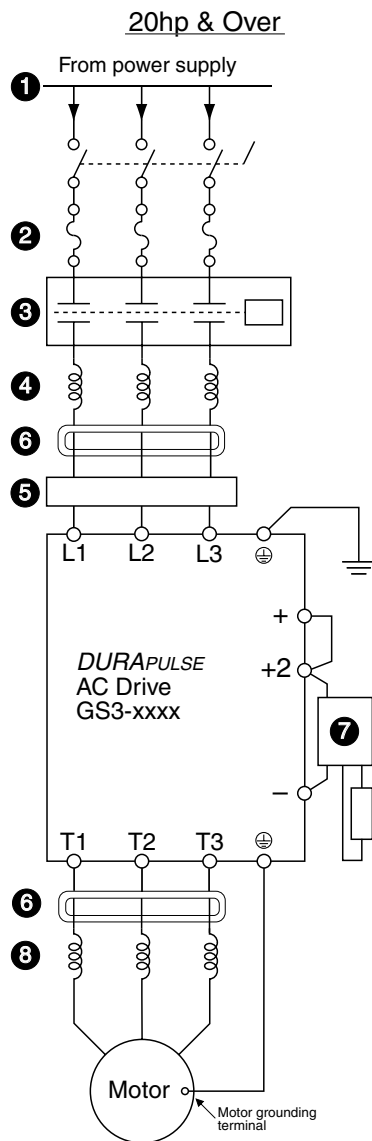


- 1 Power Supply**
Please follow the specific power supply requirements shown in Chapter 1.
- 2 Fuses**
Input fuses protect the AC drive from excessive input current due to line surges, short circuits, and ground faults. They are recommended for all installations and may be required for UL-listed installations.
- 3 Contactor (Optional)**
Do NOT use a power circuit 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 (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 EMI filter (Optional)**
Input EMI filters reduce electromagnetic interference or noise on the input side of the AC drive. They are required for CE compliance and recommended for installations prone to or sensitive to electromagnetic interference.
- 6 RF filter (Optional)**
RF filters reduce the radio frequency interference or noise on the input or output side of the inverter.
- 7 Braking Resistor (Optional)**
Dynamic braking allows the AC drive to produce additional braking (stopping) torque. AC drives can typically produce between 15% & 20% braking torque without the addition of any external components. Optional braking may be required for applications that have high inertia loads or require rapid deceleration.
- 8 AC Line Reactor/Output Filter (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 is less than 100 feet. Use Output filters if wiring exceeds 100 feet up to 1000 feet (max).



Please refer to Appendix A for specifications on DURApulse GS3 AC Drive Accessories.

EXTERNAL ACCESSORIES (CONTINUED)



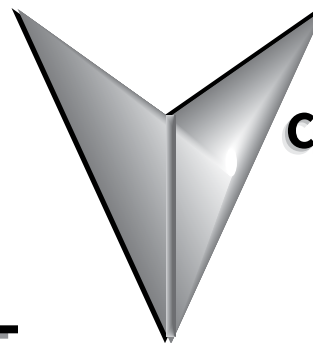
- 1 Power Supply**
Please follow the specific power supply requirements shown in Chapter 1.
- 2 Fuses**
Input fuses protect the AC drive from excessive input current due to line surges, short circuits, and ground faults. They are recommended for all installations and may be required for UL-listed installations.
- 3 Contactor (Optional)**
Do NOT use a power circuit 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 (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 EMI filter (Optional)**
Input EMI filters reduce electromagnetic interference or noise on the input side of the AC drive. They are required for CE compliance and recommended for installations prone to or sensitive to electromagnetic interference.
- 6 RF filter (Optional)**
RF filters reduce the radio frequency interference or noise on the input or output side of the inverter.
- 7 Braking Unit and Braking Resistor (Optional)**
Dynamic braking allows the AC drive to produce additional braking (stopping) torque. AC drives can typically produce between 15% & 20% braking torque without the addition of any external components. Optional braking may be required for applications that have high inertia loads or require rapid deceleration.
- 8 AC Line Reactor/Output Filter (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 is less than 100 feet. Use Output filters if wiring exceeds 100 feet up to 1000 feet (max).



Please refer to Appendix A for specifications on DURApulse GS3 AC Drive Accessories.

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KEYPAD OPERATION AND QUICK-START



CHAPTER

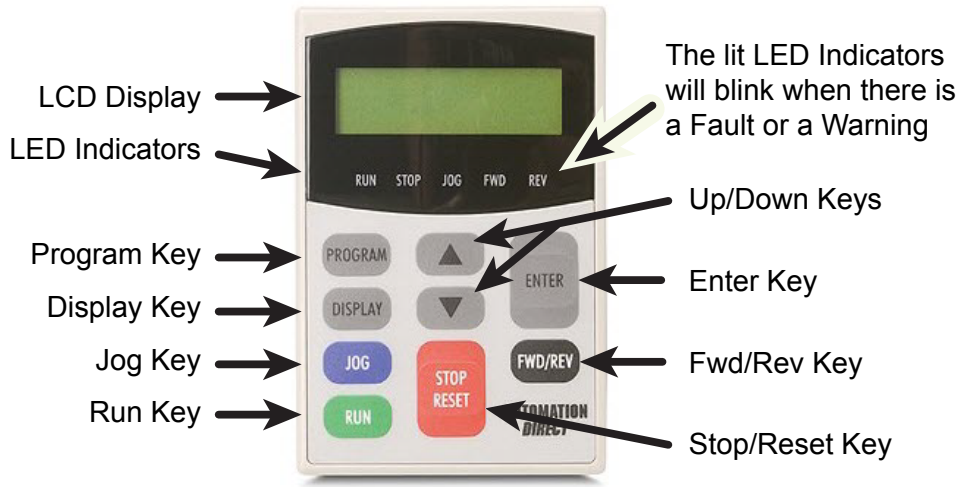
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THE DURAPULSE GS3 DIGITAL KEYPAD

The digital keypad includes a 2-line x 16-character LCD display, 5 status LED Indicators, and 9 function keys. The diagram below shows all of the features of the digital keypad and an overview of their functions.



LCD DISPLAY

The LCD Display shows the operation values and parameter settings of the AC drive.

LED INDICATORS

The combination of solid RUN and flashing STOP LEDs indicates that the drive has an active RUN command, but has a zero speed reference.

RUN	The RUN LED indicates the AC drive is in Run Mode.
STOP	The STOP LED indicates the AC drive is <u>not</u> in Run Mode.
FWD	The FWD LED indicates the AC drive is running the motor in the forward direction.
REV	The REV LED indicates the AC drive is running the motor in the reverse direction.
JOG	The JOG LED indicates the AC drive is in the Jog Mode.



If the STOP key on the keypad is active and the keypad is removed, the drive will stop.

FUNCTION KEYS**PROGRAM KEY**

Pressing the PROGRAM key will display the parameter groups. Use the UP/DOWN or PROGRAM keys to cycle through the parameter groups. The LCD display will show which parameter group is currently selected.

DISPLAY KEY

Pressing the DISPLAY key on the keypad repeatedly will cycle through the status messages on the AC drive.

FWD/REV KEY

Pressing the FWD/REV key changes the direction in which the motor operates.

RUN

Pressing the RUN key starts the AC drive operation. This key has no function if the AC drive is controlled by the external control terminals.

UP/DOWN KEYS

The UP/DOWN keys are used to scroll through the parameter groups, the various parameters in each group and also change the parameter settings in single-unit increments. To quickly run through the range of settings, press and hold the UP or DOWN key.

ENTER KEY

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

STOP/RESET KEY

Used to stop AC drive operation. If the AC drive has stopped due to a fault, clear the fault first, then press this key to reset the AC drive.

JOG KEY

Pressing the JOG key controls the jog function.



After a one (1) minute key inactivity, the keypad LCD display will automatically revert to the display mode and display the user defined display function selected in parameter P8.00.

ADJUST FREQUENCY SETPOINT

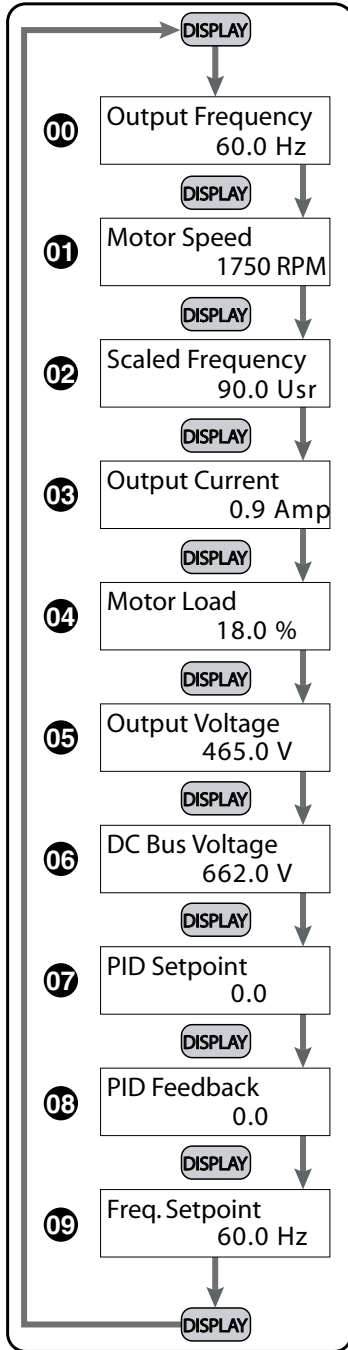
If the UP and DOWN keys are pressed when the LCD is in DISPLAY mode and the AC drive frequency is being controlled by the keypad (P4.00=1), then the keypad will display the frequency setpoint and have the ability to adjust the frequency setpoint with the UP/DOWN keys accordingly. The frequency setpoint will be stored even if the drive is powered off.

ADJUST PID SETPOINT

The ability to adjust the PID setpoint with the UP and DOWN keys will be true if parameter P7.00 is set to a value of 01, 02, 03, or 04, parameter P7.02 = 00 and the LCD display shows the PID setpoint.

DISPLAYING THE STATUS OF THE DURAPULSE GS3 AC DRIVE

Press the DISPLAY key on the keypad repeatedly to cycle through the status messages on the AC drive. The diagram below shows the order of the status messages as you cycle through them and shows the definition of the status messages. The status of the AC drive can be shown in RUN or STOP mode.

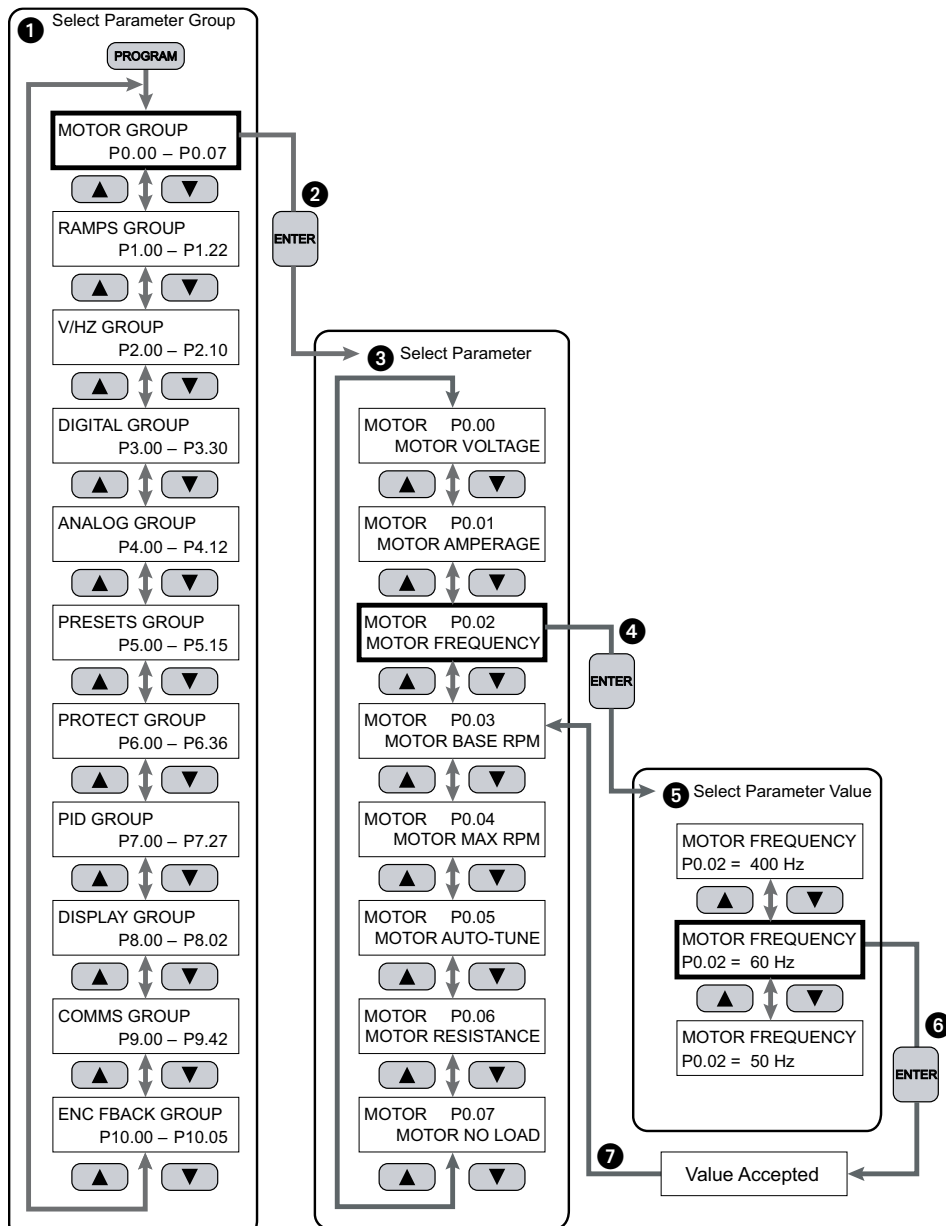


- 00 Actual Operating Frequency**
Displays the actual operating frequency present at the T1, T2, and T3 terminals. *Example: 60.0Hz*
- 01 RPM**
Displays the present estimated speed of the motor.
Example: 1750 RPM
- 02 Scaled Frequency**
Displays the result of output frequency x parameter P8.01.
Example: 60Hz x 1.5 = 90.0
- 03 Amps**
Displays the output current present at the T1, T2, and T3 terminals. *Example: 0.9A*
- 04 % Motor Load**
Displays the amount of load on the AC drive.
Example: (Output Current v Drive Rated Current) x 100
- 05 Output Voltage**
Displays the output voltage present at the T1, T2, and T3 terminals. *Example: 465V*
- 06 DC Bus Voltage**
Displays the DC Bus Voltage. *Example: 662 VDC*
- 07 PID Setpoint**
Displays the PID setpoint. *Note: It is possible to change the PID setpoint with the ▲ and ▼ keys when the PID setpoint value is displayed on the keypad. The PID function (P7.00) must be enabled, and the PID Setpoint source (P7.02) must be set to keypad (00).*
- 08 PID Feedback Signal (PV)**
Displays the PID feed-back signal.
- 09 Frequency Setpoint**
Displays the frequency setting of the AC drive. *Example: 60.0Hz*

PROGRAMMING THE DURAPULSE GS3 AC DRIVE

The *DURAPULSE* GS3 AC Drive parameters are organized into eleven (11) different groups according to their functions, plus a special “Copy Keypad” function for storing up to four (4) different sets of program parameters into the keypad. The illustration below shows you how to navigate through the parameter groups and parameter settings. For a complete list of parameters, see Chapter 4.

- 1) Press the PROGRAM key and then use the UP/DOWN or PROGRAM keys to cycle through the parameter groups. The LCD display will show the parameter group that is currently selected.
- 2) Press the ENTER key to display the various parameters for the selected group and use the UP/DOWN keys to view each one.
- 3) (same as #2)
- 4) When the desired parameter is shown, press the ENTER key to select.
- 5) Use the UP/DOWN keys to cycle through the available settings.
- 6) Press the ENTER key to select the setting. The phrase “Value Accepted” will be displayed for a moment to show that the parameter value has been changed.
- 7) After the parameter value has been set, the LCD display will cycle to the next parameter in the selected group.



DURAPULSE GS3 QUICKSTART

The following examples will help you quickly set up your DURApulse 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 DURApulse AC drives, see Chapter 4.

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 460V, 1hp inverter duty motor. We will use a model GS3-41P0 AC drive for this application. An example of the motor nameplate is shown below.

INVERTER DUTY MOTOR							
HP	1	VOLTS	460	PHASE	3	TYPE	P
RPM	1725	AMPS	2.6	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. (Applications with high starting torque requirements and/or high inertia loads may require optional braking resistors.)
- The motor will require a high torque when starting.
- The operation of the motor (start, stop, etc.) will be controlled by remote control terminals. All keys on the DURAPULSE GS3 keypad should be disabled.
- The frequency of the AC drive will be determined by remote potentiometer that has a 0 to +10V signal.
- The display of the AC drive should default to the motor speed (rpm) when running.

PARAMETER SETUP

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

P0.00 Motor Nameplate Voltage **Setting: 460**
Settings: 230V series: 200/208/220/230/240 Default Setting: 240
 460V series: 380/400/415/440/460/480 Default Setting: 480

This parameter setting is determined by the motor nameplate.

P0.01 Motor Nameplate AMPS **Setting: 2.6**
Range: Drive Rated Amps x 0.4 to Drive Rated Amps x 1.0 Default Setting: Drive Rating (A)

This parameter setting is determined by the motor nameplate.

P0.02 Motor Base Frequency **Setting: 60**
Range: 50/60/400 Default Setting: Drive Rating 60

This parameter setting is determined by the motor nameplate.

P0.03 Motor Base RPM **Setting: 1725**
Range: 375 to 24,000 RPM Default Setting: 1750

This parameter setting is determined by the motor nameplate.

P0.04 Motor Maximum RPM **Setting: 2000**
Range: P0.03 to 24,000 RPM Default Setting: 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 THAT YOU ARE USING. IF THIS INFORMATION IS NOT READILY AVAILABLE, CONSULT YOUR MOTOR MANUFACTURER.

P1.00 Stop Methods **Setting: 00**
Settings: 00 Ramp to Stop Default Setting: 00
 01 Coast to stop

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



WARNING: IF THE STOP METHOD FOR THE DURAPULSE GS3 AC DRIVE IS SET FOR COAST TO STOP, THE AC DRIVE WILL IGNORE THE (P1.02) SETTING FOR DECELERATION TIME.

P1.01 Acceleration Time **Setting: 5.0**
Range: 0.1 to 600 sec *Default Setting:* 10

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

P1.02 Deceleration Time **Setting: 5.0**
Range: 0.1 to 600 sec *Default Setting:* 30

The motor should decelerate from 2000 rpm; Maximum Motor RPM (P0.04) to 0 RPM in 5 seconds.

P2.00 Volts/Hertz Settings **Setting: 01**
Settings: 00 - General Purpose *Default Setting:* 00
 01 - High Starting Torque
 02 - Fans and Pumps
 03 - Custom

The DURAPULSE GS3 AC drive has some predefined torque settings that meet the needs of most applications. A custom setting is available if needed. In this particular example, the application requires a high starting torque.

P3.00 Source of Operation Command **Setting: 02**
Settings: *Default Setting:* 00

- 00 - Operation Determined by Digital Keypad.
- 01 - Operation determined by external control terminals. Keypad STOP is enabled.
- 02 - Operation determined by external control terminals. Keypad STOP is disabled.
- 03 - Operation determined by RS-485 interface. Keypad STOP is enabled.
- 04 - 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.



If parameter P3.00 = 00, 01, or 03, enabling the keypad STOP key, the drive will stop if the keypad is removed from the drive.

P4.00 Source of Frequency Command

Setting: 02

- Settings: 01 - Frequency determined by digital keypad up/down
 02* - Frequency determined by 0 to +10V input on AI1 terminal
 03 - Frequency determined by 4 to 20 mA input on AI2 terminal
 04 - Frequency determined by 0 to 20 mA input on AI2 terminal
 05 - Frequency determined by RS-485 communication interface
 06 - Frequency determined by -10V~+10V input on AI3 terminal

Default Setting: 01

* In order to set P4.00 = 02, you must first change the value of P4.13 to some value other than two (02) in order to avoid the "Error: Duplicate Function" error message. (P4.13 default value is 02)



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: 00

- Settings: 00 - Constant Torque (inverter/vector duty motor)
 01 - Variable Torque (fan-cooled standard motor)
 02 - Inactive

Default Setting: 00

This function setting 00 is the standard overload protection curve used to protect inverter/vector duty motors.

P8.00 User Defined Display Function

Setting: 01

- Settings: 00 - Output Frequency (Hz)
 01 - Motor Speed (RPM)
 02 - Scaled Frequency
 03 - Output Current (A)
 04 - Motor Load (%)
 05 - Output Voltage(V)
 06 - DC Bus Voltage (V)
 07 - PID Setpoint
 08 - PID Feedback (PV)
 09 - Frequency Setpoint

Default Setting: 00

The AC drive display will default to 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, 3hp fan-cooled standard duty motor. The AC drive model we will be using for this application is a GS3-23P0. An example of the motor nameplate is shown below.

STANDARD DUTY MOTOR							
HP	3	VOLTS	208	PHASE	3	TYPE	P
RPM	3525	AMPS	9.2	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 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 DURAPULSE GS3 digital keypad.
- The frequency of the AC drive will be determined by the DURAPULSE GS3 keypad potentiometer.
- The display of the AC drive should default to output current (A) when running.

PARAMETER SETUP

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

P0.00	Motor Nameplate Voltage	Setting: 208
	<i>Settings:</i> 230V series: 200/208/220/230/240 460V series: 380/400/415/440/460/480	<i>Default Setting:</i> 240 <i>Default Setting:</i> 480

This parameter setting is determined by the motor nameplate.

P0.01	Motor Nameplate AMPS	Setting: 9.2
	<i>Range:</i> Drive Rated Amps x 0.4 to Drive Rated Amps x 1.0	<i>Default Setting:</i> Drive Rating (A)

This parameter setting is determined by the motor nameplate.

P0.02 Motor Base Frequency **Setting: 60**
Range: 50/60/400 *Default Setting:* Drive Rating 60

This parameter setting is determined by the motor nameplate.

P0.03 Motor Base RPM **Setting: 3525**
Range: 375 to 24,000 RPM *Default Setting:* 1750

This parameter setting is determined by the motor nameplate.

P0.04 Motor Maximum RPM **Setting: 3600**
Range: P0.03 to 24,000 RPM *Default Setting:* 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 THAT YOU ARE USING. IF THIS INFORMATION IS NOT READILY AVAILABLE, CONSULT YOUR MOTOR MANUFACTURER.

P1.00 Stop Methods **Setting: 01**
Settings: 00 Ramp to Stop *Default Setting:* 00
 01 Coast to stop

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



WARNING: IF THE STOP METHOD FOR THE DURAPULSE GS3 AC DRIVE IS SET FOR COAST TO STOP, THE AC DRIVE WILL IGNORE THE (P1.02) SETTING FOR DECELERATION TIME.

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

The motor should accelerate from 0 RPM to Maximum Motor RPM (P0.04) in 20 seconds.

P2.00 Volts/Hertz Settings**Setting: 02**

Settings: 00 - General Purpose
01 - High Starting Torque
02 - Fans and Pumps
03 - Custom

Default Setting: 00

The DURAPULSE GS3 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.



In some applications it is perfectly acceptable to leave this parameter set for "00" - General Purpose.

P3.00 Source of Operation Command**Setting: 00**

Settings:
00 - Operation Determined by Digital Keypad.
01 - Operation determined by external control terminals. Keypad STOP is enabled.
02 - Operation determined by external control terminals. Keypad STOP is disabled.
03 - Operation determined by RS-485 interface. Keypad STOP is enabled.
04 - Operation determined by RS-485 interface. Keypad STOP is disabled.

Default Setting: 00

The AC drive operation will be determined by the Digital Keypad.



If parameter P3.00 = 00, 01, or 03, enabling the keypad STOP key, the drive will stop if the keypad is removed from the drive.

P4.00 Source of Frequency Command

Setting: 00

- Settings: 01 - Frequency determined by digital keypad up/down
 02* - Frequency determined by 0 to +10V input on AI1 terminal
 03 - Frequency determined by 4 to 20 mA input on AI2 terminal
 04 - Frequency determined by 0 to 20 mA input on AI2 terminal
 05 - Frequency determined by RS-485 communication interface
 06 - Frequency determined by -10V~+10V input on AI3 terminal

Default Setting: 01

* In order to set P4.00 = 02, you must first change the value of P4.13 to some value other than two (02) in order to avoid the "Error: Duplicate Function" error message. (P4.13 default value is 02)



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: 01

- Settings: 00 - Constant Torque (inverter/vector duty motor)
 01 - Variable Torque (fan-cooled standard motor)
 02 - Inactive

Default Setting: 00

This function setting 01 is used to derate the AC drive output current overload protection to protect a fan-cooled standard motor running at low speeds.

P8.00 User Defined Display Function

Setting: 03

- Settings: 00 - Output Frequency (Hz)
 01 - Motor Speed (RPM)
 02 - Scaled Frequency
 03 - Output Current (A)
 04 - Motor Load (%)
 05 - Output Voltage(V)
 06 - DC Bus Voltage (V)
 07 - PID Setpoint
 08 - PID Feedback (PV)
 09 - Frequency Setpoint

Default Setting: 00

The AC drive display will default to indicate Output Current (A) when running.



For a complete list and description of the parameters for the DURAPULSE GS3 AC drives, see Chapter 4.

AUTO-TUNE PROCEDURE

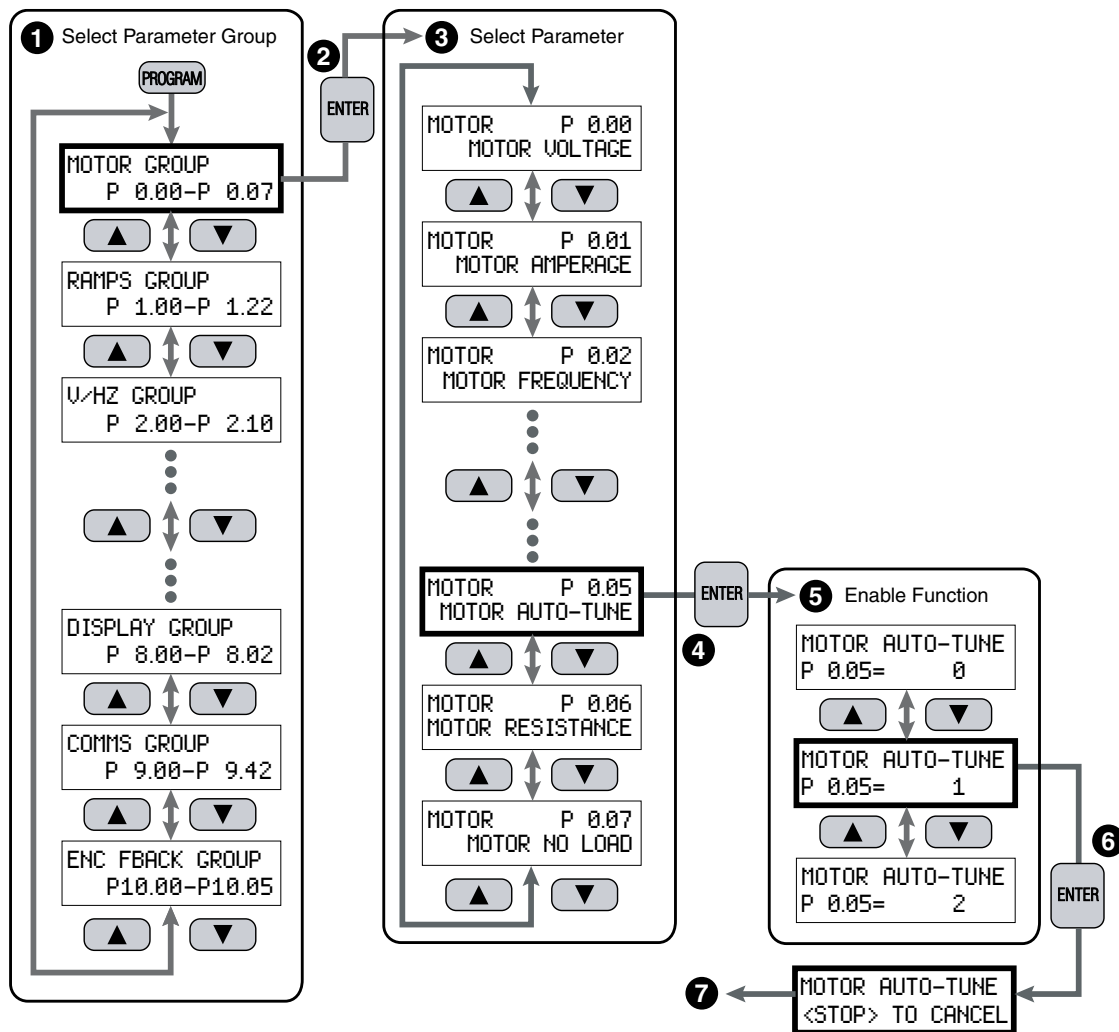
Auto-tuning is required only for Sensorless Vector Control Modes (P2.10 = 02, 03, 05).



WARNING: THE MOTOR WILL ROTATE WHEN EXECUTING THE AUTO-TUNING PROCEDURE. IT IS ALSO VERY IMPORTANT THAT NO LOAD BE CONNECTED TO THE MOTOR OUTPUT SHAFT AT THE TIME THE AUTO-TUNE PROCEDURE IS PERFORMED.

The DURAPULSE GS3 AC drive is capable of performing an auto-tune procedure when a motor is connected to the AC drive. It is also very important for safety and functional reasons that *no load* be physically connected to the motor output shaft *during auto-tuning*. The auto-tune will begin when the RUN key is pressed on the AC drive keypad. To enable the Auto-Tune procedure, do the following:

- 8) Press the PROGRAM key repeatedly until the MOTOR GROUP, P0.00–P0.07, is displayed on the keypad LCD display.
- 9) Press the ENTER key to display the various parameters for this group.
- 10) Use the UP/DOWN keys to display parameter P0.05, MOTOR AUTO-TUNE.
- 11) Press the ENTER key to display the current value for this parameter.
- 12) Use the UP/DOWN keys to change the value in this parameter to either a “1” to have the drive determine only the motor line to line resistance R1 (P0.06) or “2” to determine R1 (P0.06) and motor no-load current (P0.07).
- 13) Press the ENTER key to accept this value and enable the AUTO-TUNE function. The LCD display will indicate with “MOTOR AUTO-TUNE, <STOP> TO CANCEL” message for 3 seconds.
- 14) Proceed to the next page for steps to initiate the auto-tune procedure.



The "MOTOR AUTO-TUNE" display text flashes during this step.



It is not necessary to set up the encoder and control mode before performing the auto-tuning function. (Auto-tuning is required only for the sensorless vector control modes.)



*Do NOT set auto-tuning without a motor connected to the drive.
Do NOT set auto-tuning with any mechanical load connected to the motor output shaft.*



P3.00 must be set to zero (0) before auto-tuning; failure to do so will result in an ---ERR--- indication.

AUTO-TUNE INSTRUCTIONS

If the drive is set to auto-tune with no motor connected, the drive will go into an infinite auto-tune loop without access to the parameter groups. To correct this situation, simply power down the unit, connect the motor, complete auto-tuning (even if incorrect), reset factory default (9.08 = 99), and then start over.

- 1) Make sure all wiring is correctly connected to the AC drive and motor.
- 2) Make sure there is no load connected to the motor's output shaft, including any belts or gear boxes.
- 3) Program parameters P0.00, P0.01, P0.02, P0.03 and P0.04 with the correct values for the motor being used.
- 4) After enabling the Auto-Tune parameter P0.05 as shown on the previous page for either a "1" to have the AC drive determine only the motor line to line resistance R1 (P0.06), or a "2" to determine R1 (P0.06) and the motor's no-load current (P0.07), the message MOTOR AUTO-TUNE (flashing), <STOP> TO CANCEL will appear on the keypad LCD display for a 3 second period. If the STOP key is pressed during this time, the Auto-Tune procedure will terminate, the value in parameter P0.05 will reset to "0" and the LCD display will return to the display mode.
- 5) After the confirmation message is shown, (the AC drive is ready to perform an Auto-Tune), the keypad LCD will display the message PRESS <RUN>, TO CONTINUE for 60 seconds. Once the RUN key is pressed, the display will show DETECTING MOTOR (flashing), <STOP> TO CANCEL. If the STOP key is pressed, the Auto-Tune procedure will terminate, the keypad LCD display will show either a "R1 Detect Error" or "No Load Error" warning message, and the value in parameter P0.05 will reset to "0." Use the STOP/RESET key to clear the warning message and return the drive to the display mode. Then repeat the procedure.
- 6) The Auto-Tune procedure will take approximately 15 seconds to execute, plus the acceleration and deceleration times in parameters P1.01 and P1.02. (The greater the horsepower of the AC drive and motor, the more acceleration and deceleration time will be required.)
- 7) Upon completion of the Auto-Tune procedure, the display will show the message TUNING COMPLETE, PRESS <ENTER>. At this time, the determined values for parameters P0.06 and P0.07 will be filled in automatically. Please check these parameters to make sure a value was determined. If no value was determined, then repeat the procedure.
- 8) If the STOP/RESET key on the keypad is pressed during auto-tuning, or if the RUN key is not pressed within 60 seconds once the message PRESS <RUN>, TO CONTINUE is displayed, the Auto-Tune procedure will terminate and the value in parameter P0.05 will reset to "0." The DURAPULSE GS3 AC drive will return to the normal display mode.

COPY KEYPAD FUNCTION

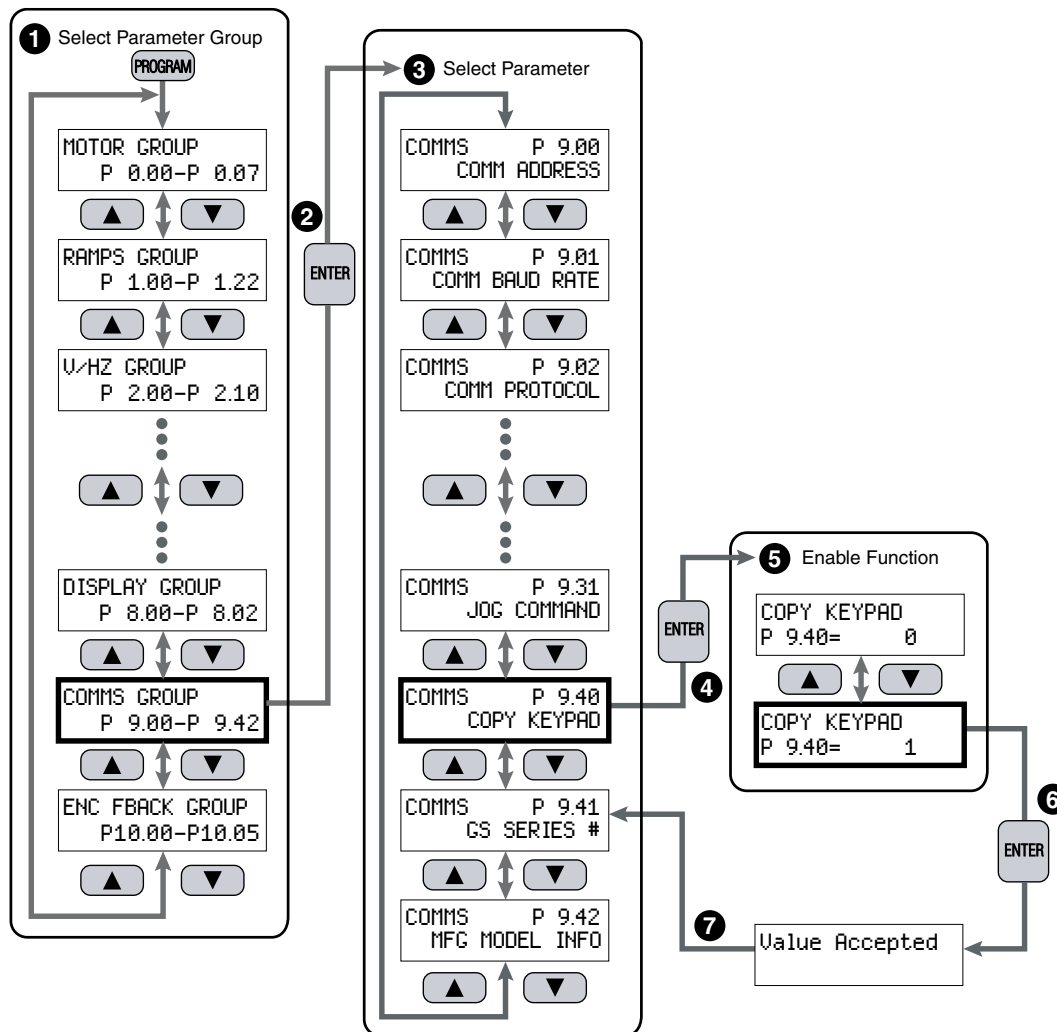
The COPY KEYPAD function has the ability to permanently store up to four (4) different program parameter settings within the keypad device. The stored parameter settings can be for any of the DURApulse AC Drives. This allows the parameter settings to be backed-up and readily available for either duplicating the same multiple AC drives or for maintenance use if a drive needs to be replaced.



It is recommended that once the application has been programmed, the parameter settings be backed-up in the keypad for future use and maintenance.

ENABLE COPY KEYPAD FUNCTION

- 1) Press the PROGRAM key repeatedly until the COMMS GROUP, P9.00 – P9.42, is displayed on the keypad LCD display.
- 2) Press the ENTER key to display the various parameters for this group.
- 3) Use the UP/DOWN keys to display parameter P9.40, the COPY KEYPAD function.
- 4) Press the ENTER key to display the current value for this parameter.
- 5) Use the UP/DOWN keys to change the value in this parameter to a “1.” A value of “1” is used to enable the COPY KEYPAD function.
- 6) Press the ENTER key to accept this value and enable the COPY KEYPAD function. The LCD display will indicate “Value Accepted” for a moment.
- 7) The LCD display will automatically increment to the next parameter in the group.

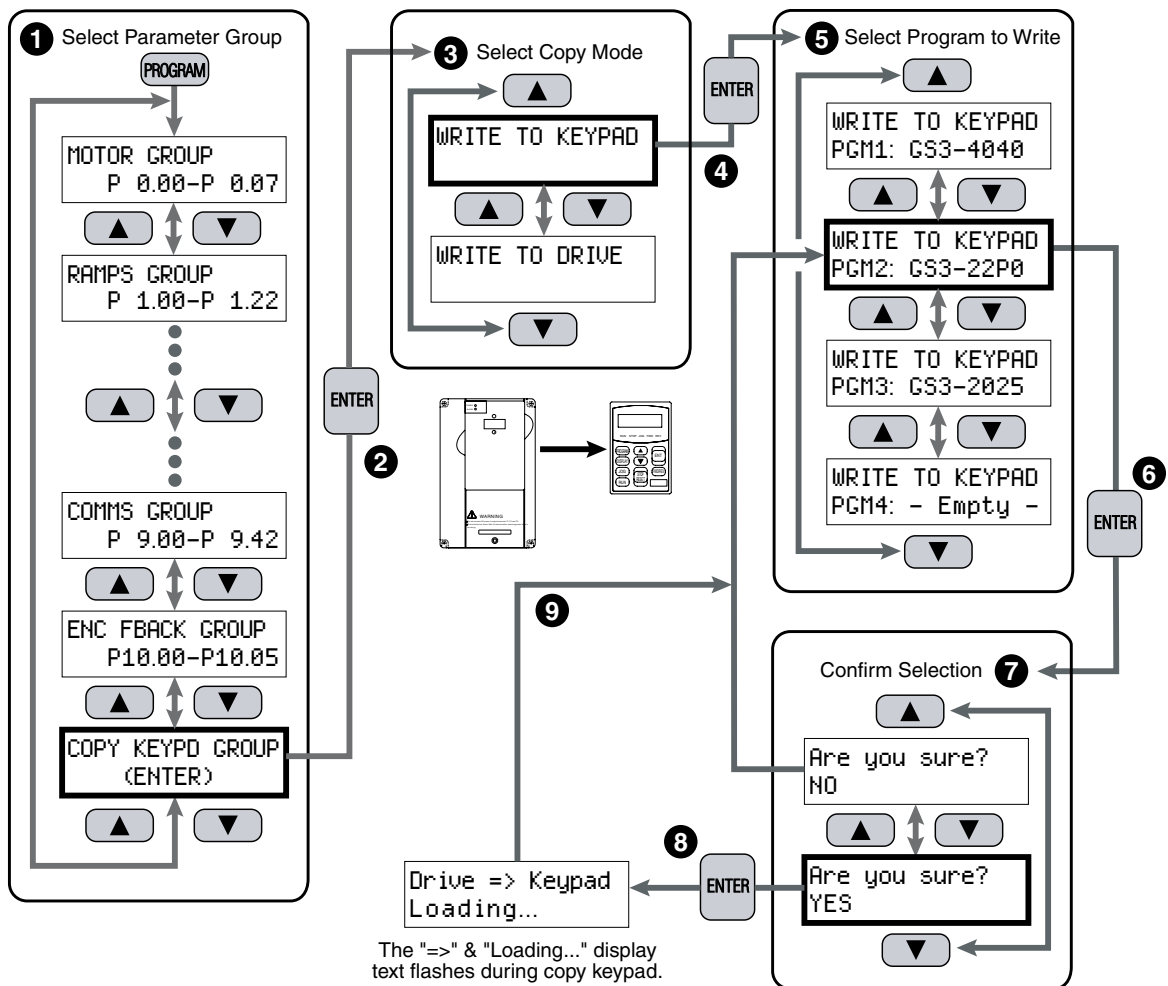


WRITE PARAMETER SETTINGS TO KEYPAD



WARNING: DO NOT REMOVE THE KEYPAD DURING TRANSFER OF PROGRAM PARAMETER SETTINGS TO OR FROM THE AC DRIVE.

- 1) After P9.40 COPY KEYPAD is enabled, the LCD display will show an additional group called COPY KEYPD GROUP. Press the PROGRAM key and then the UP/DOWN or PROGRAM keys until this new group is displayed.
- 2) Press the ENTER key to display the copy mode selections.
- 3) Select the WRITE TO KEYPAD mode using the UP/DOWN keys.
- 4) Press the ENTER key to display the four (4) available program numbers to write from the AC drive to the keypad. The program name will automatically be named the part number of the AC drive, for example: GS3-22P0.
- 5) Use the UP/DOWN keys to select the desired program number; PGM1 thru PGM4 and press the ENTER key.
- 6) (same as #5)
- 7) Use the UP/DOWN keys to select “Yes” to confirm and press the ENTER key.
- 8) (same as #7)
- 9) The LCD display will show the message “Drive => Keypad, Loading...” while the parameters are being copied and return to the program selection when finished.
(Does not restore P9.40 back to Disable Copy Keypad Function.)

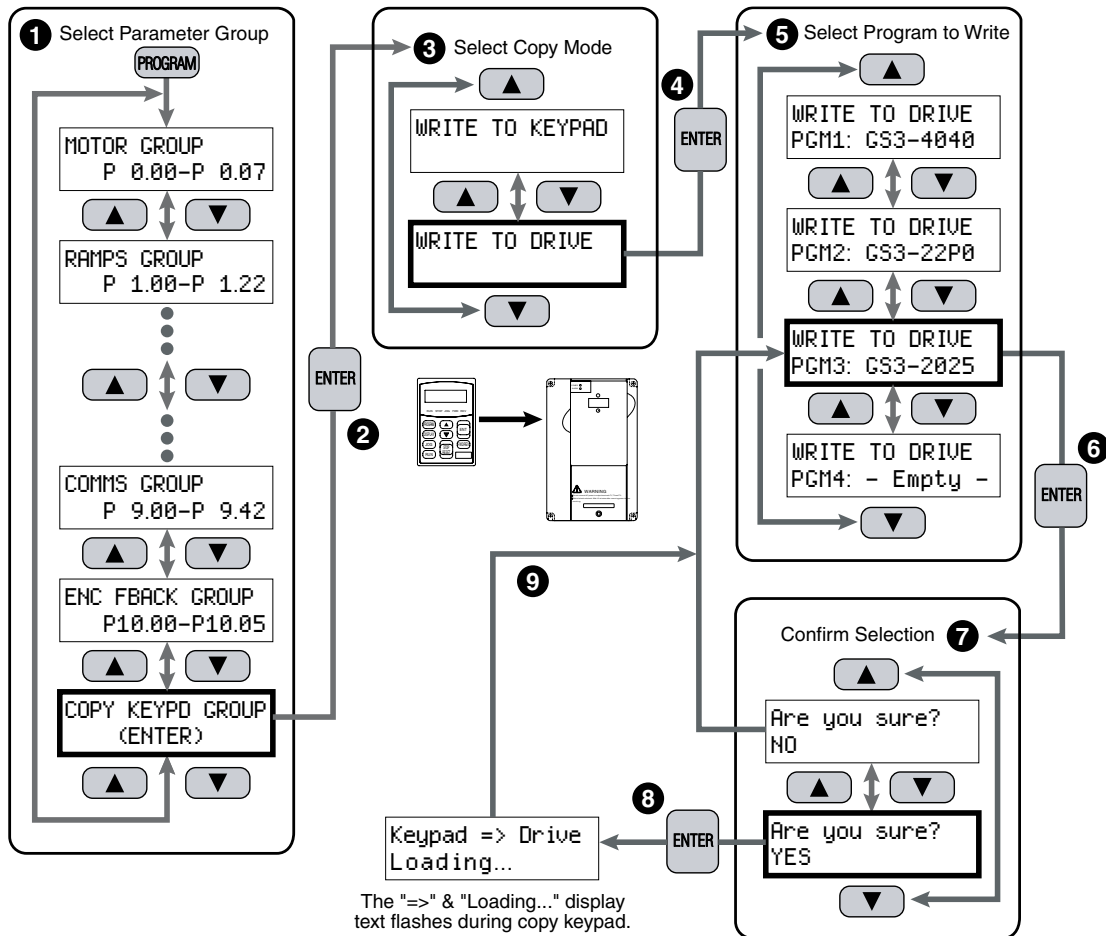


WRITE PARAMETER SETTINGS TO DRIVE



WARNING: DO NOT REMOVE THE KEYPAD DURING TRANSFER OF PROGRAM PARAMETER SETTINGS TO OR FROM THE AC DRIVE.

- 1) After the COPY KEYPAD parameter is enabled, the LCD display will show an additional group called COPY KEYPD GROUP. Press the PROGRAM key and then the UP/DOWN or PROGRAM keys until this new group is displayed.
- 2) Press the ENTER key to display the copy mode selections.
- 3) Select the WRITE TO DRIVE mode using the UP/DOWN keys.
- 4) Press the ENTER key to display the four (4) available program numbers to write from the keypad to the AC drive. The program name must match the part number of the AC drive being programmed; for example: GS3-2025.
- 5) Use the UP/DOWN keys to select the desired program number; PGM1 thru PGM4 and press the ENTER key.
- 6) (same as #5)
- 7) Use the UP/DOWN keys to select “Yes” to confirm and press the ENTER key.
- 8) (same as #7)
- 9) The LCD display will show the message “Keypad => Drive, Loading...” while the parameters are being copied and return to the program selection when finished.



Use the PROGRAM key to back out of the various menu selections without saving changes.



The warning message RATING MISMATCH will be displayed on the LCD display if trying to do a WRITE TO DRIVE copy mode and selecting an existing program that does not match the drive being used.

AC DRIVE PARAMETERS



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DURAPULSE GS3 PARAMETER SUMMARY

PARAMETERS AVAILABLE ONLY IN LATER FIRMWARE VERSIONS OF DURAPULSE GS3 AC DRIVES



Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 AC drives. Check parameter P9.39 to determine the firmware version of your DURAPULSE GS3 drive.

PARAMETERS AND SETTINGS AVAILABLE ONLY WITH FIRMWARE V1.02 AND HIGHER:

- P6.30
- P9.39

PARAMETERS AND SETTINGS AVAILABLE ONLY WITH FIRMWARE V1.04 AND HIGHER:

- P3.02~P3.10 settings 19, 20
- P3.11~P3.14 setting 16
- P3.31
- P4.13
- P4.14
- P4.15
- P4.16
- P4.17
- P4.18
- P7.27 settings 02, 03
- P7.28

PARAMETERS AND SETTINGS AVAILABLE ONLY WITH FIRMWARE V1.05 AND HIGHER:

- P2.09
- P2.10 settings 04, 05
- P4.13 default = 06
- P6.37

PARAMETER SUMMARY LISTING

Parameter Summary				
Motor Parameters (P0.##)				
Parameter*	Description	Range*	Default Setting	User Setting
P0.00	Motor Nameplate Voltage	230V class: 200/208/220/230/240 460V class: 380/400/415/440/460/480	240 480	
P0.01	Motor Nameplate Amps	Drive Rated Amps x 0.4 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 24,000 rpm	1750	
P0.04	Motor Maximum RPM (Max operation Freq., AI1 and AI2 100% value)	P0.03 to 24,000 rpm	P0.03	
P0.05	Motor Auto Tune	00 Disable 01 Enable P0.06 only 02 Enable P0.06 and P0.07	00	
P0.06	Motor Line to Line Resistance R1	00 to 65535 mΩ	00	
P0.07	Motor No-Load Current	Drive Rated Amps x 0.0 to 0.9 (Amps)	Drive Rated Amps x 0.4	

* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions..." (page 4-2) for more information.
 ♦ Parameter can be set during RUN Mode.

Parameter Summary				
Ramp Parameters (P1.##)				
Parameter*	Description	Range*	Default Setting	User Setting
P1.00	Stop Methods	00: Ramp to Stop 01: Coast to Stop	00	
◆ P1.01	Acceleration Time 1	0.1 to 600.0s (must be > 1s to be effective)	10.0	
◆ P1.02	Deceleration Time 1	0.1 to 600.0s (must be > 1s to be effective)	30.0	
P1.03	Accel S-curve	0 to 7	00	
P1.04	Decel S-curve	0 to 7	00	
◆ P1.05	Acceleration Time 2	0.1 to 600.0s (must be > 1s to be effective)	10.0	
◆ P1.06	Deceleration Time 2	0.1 to 600.0s (must be > 1s to be effective)	30.0	
P1.07	Select method to use 2nd Accel/Decel	00: RMP2 from DI terminal 01: Transition Frequencies P1.08 & P1.09	00	
P1.08	Accel 1 to Accel 2 frequency transition	0.0 to 400.0 Hz	0.0	
P1.09	Decel 2 to Decel 1 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	
P1.13	Skip Frequency 4	0.0 to 400.0 Hz	0.0	
P1.14	Skip Frequency 5	0.0 to 400.0 Hz	0.0	
P1.17	Skip Frequency Band	0.0 to 20.0 Hz	0.0	
P1.18	DC Injection Current Level	00 to 100 %	00	
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	
<p>* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions..." (page 4-2) for more information.</p> <p>◆ Parameter can be set during RUN Mode.</p>				

Parameter Summary				
Volts/Hertz Parameters (P2.##)				
Parameter*	Description	Range*	Default Setting	User Setting
P2.00	Volts/Hertz Settings	00: General Purpose 01: High Starting Torque 02: Fans and Pumps 03: Custom	00	
◆ P2.01	Slip Compensation	0.0 to 10.0	0.0 (V/Hz mode) 1.0 (Vector mode)	
◆ P2.02	Auto-torque Boost	00 to 10	00	
◆ P2.03	Torque Compensation Time Constant	00 to 10 sec	0.05	
P2.04	Mid-point Frequency	0.1 to 400 Hz	0.5	
P2.05	Mid-point Voltage	230V class: 0.1 to 240V 460V class: 0.1 to 480V	5.0 10.0	
P2.06	Min. Output Frequency	0.1 to 20.0 Hz	0.5	
P2.07	Min. Output Voltage	230V class: 0.1 to 50V 460V class: 0.1 to 100V	5.0 10.0	
P2.08	PWM Carrier Frequency	01 to 15 kHz 01 to 15 kHz 01 to 09 kHz 01 to 06 kHz	1-5hp = 15 7.5-25hp = 9 30-60hp = 6 75-100hp = 6	
◆ P2.09	Slip Compensation Time Constant	0.05 to 10.00 sec	0.10	
P2.10	Control Mode	00: V/Hz without encoder feedback 01: V/Hz with encoder feedback 02: Sensorless Vector without encoder feedback 03: Sensorless Vector with encoder feedback 04: V/Hz with encoder feedback & high-speed regulation 05: Sensorless Vector with encoder feedback & high-speed regulation	00	

* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions..." (page 4-2) for more information.
 ◆ Parameter can be set during RUN Mode.

Parameter Summary				
Digital Parameters (P3.##)				
Parameter*	Description	Range*	Default Setting	User Setting
P3.00	Source of Operation Command	00: Operation determined by digital keypad 01: Operation determined by external control terminals; keypad STOP is enabled 02: Operation determined by external control terminals; keypad STOP is disabled 03: Operation determined by RS-485 interface; keypad STOP is enabled 04: Operation determined by RS-485 interface; keypad STOP is disabled	00	
P3.01	Multi-function Input Terminals (DI1 - DI2)	00: DI1 - FWD / STOP, DI2 - REV / STOP 01: DI1 - RUN / STOP, DI2 - REV / FWD 02: DI1 - RUN momentary (N.O.) DI2 - REV / FWD DI3 - STOP momentary (N.C.)	00	
P3.02	Multi-function Input DI3	00: External Fault (N.O.)	00	
P3.03	Multi-function Input DI4	01: External Fault (N.C.)	03	
P3.04	Multi-function Input DI5	02: External Reset	04	
P3.05	Multi-function Input DI6	03: Multi-Speed Bit 1	05	
P3.06	Multi-function Input DI7	04: Multi-Speed Bit 2	06	
P3.07	Multi-function Input DI8	05: Multi-Speed Bit 3	09	
P3.08	Multi-function Input DI9	06: Multi-Speed Bit 4	02	
P3.09	Multi-function Input DI10	07: Manual Keyboard Control 08: Reserved 09: Jog 10: External Base Block (N.O.)	12	
P3.10	Multi-function Input DI11	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 17: PID Disable (N.O.) 18: PID Disable (N.C.) 19: 1st/2nd Source Select (N.O.) 20: 1st/2nd Source Select (N.C.) 99: Input Disable	10	
P3.11	Multi-Function Output Terminal 1 (Relay Output)	00: AC Drive Running 01: AC Drive Fault 02: At Speed 03: Zero Speed	00	
P3.12	Multi-Function Output Terminal 2 (DO1)	04: Above Desired Frequency (P3.16) 05: Below Desired Frequency (P3.16) 06: At Maximum Speed (P0.04)	01	
P3.13	Multi-Function Output Terminal 3 (DO2)	07: Over Torque detected (P6.08) 08: Above Desired Current (P3.17) 09: Below Desired Current (P3.17)	02	
P3.14	Multi-Function Output Terminal 4 (DO3)	10: PID Deviation Alarm 11: Heatsink Overheat Warning (OH1) 12: Soft Braking Signal 13: Above Desired Frequency 2 (P3.20) 14: Below Desired Frequency 2 (P3.20) 15: Encoder Loss 16: PID Feedback Loss Warning	03	
* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions..." (page 4-2) for more information.				
◆ Parameter can be set during RUN Mode.				
Table continued next page				

Parameter Summary – Digital Parameters (continued)				
Parameter*	Description	Range*	Default Setting	User Setting
◆ P3.16	Desired Frequency	0.0 to 400.0 Hz	0.0	
◆ P3.17	Desired Current	0.0 to <Drive Rated Amps>	0.0	
◆ P3.18	PID Deviation Level	1.0 to 50.0 %	10.0	
◆ P3.19	PID Deviation Time	0.1 to 300.0 sec	5.0	
◆ P3.20	Desired Frequency 2	0.0 to 400.0 Hz	0.0	
◆ P3.30	Frequency Output (FO) Scaling Factor	1 to 20	1	
P3.31	2nd Source of Operation Command	00: Operation determined by digital keypad 01: Operation determined by external control terminals; keypad STOP is enabled 02: Operation determined by external control terminals; keypad STOP is disabled 03: Operation determined by RS-485 interface; keypad STOP is enabled 04: Operation determined by RS-485 interface; keypad STOP is disabled	0	
<p>* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions..." (page 4-2) for more information.</p> <p>◆ Parameter can be set during RUN Mode.</p>				

Parameter Summary				
Analog Parameters (P4.##)				
Parameter*	Description	Range*	Default Setting	User Setting
P4.00	Source of Frequency Command	01: Frequency determined by digital keypad up/down 02: Frequency determined by 0 to +10V input on AI1 terminal 03: Frequency determined by 4 to 20 mA input on AI2 terminal 04: Frequency determined by 0 to 20 mA input on AI2 terminal 05: Frequency determined by RS-485 communication interface 06: Frequency determined by -10V to +10V input on (AI3) terminal	01	
◆ P4.01	Analog Input Offset Polarity	00: No Offset 01: Positive Offset 02: Negative Offset	00	
◆ 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	00: Forward Motion Only 01: Reverse Motion Enable	00	
P4.05	Loss of AI2 Signal (4-20 mA)	00: Decelerate to 0Hz 01: Stop immediately and display error code "External Fault" 02: Continue operation by the last frequency command	00	
◆ P4.11	Analog Output Signal	00: Frequency Hz 01: Current A 02: PV	00	
◆ P4.12	Analog Output Gain	00 to 200%	100	
P4.13	2nd Source of Frequency Command	same settings as for P4.00	06	
◆ P4.14	2nd Analog Input Offset Polarity	same settings as for P4.01	00	
◆ P4.15	2nd Analog Input Offset	0.0 to 100.0%	0.0 (float)	
◆ P4.16	2nd Analog Input Gain	0.0 to 300.0%	100.0 (float)	
◆ P4.17	Trim Frequency Reference	0.0 to 400.0 Hz	0.0 (float)	
◆ P4.18	Trim Mode Select	00: Disable Trim function 01: 1st source frequency + 2nd source freq 02: 1st source frequency - 2nd source freq 03: Speed Command + Trim Frequency Reference (P4.17) 04: Speed Command - Trim Frequency Reference (P4.17)	00	

* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions..." (page 4-2) for more information.
◆ Parameter can be set during RUN Mode.

Parameter Summary				
Presets Parameters (P5.##)				
Parameter*	Description	Range*	Default Setting	User Setting
◆ P5.00	Jog Speed	0.0 to 400.0 Hz	6.0	
◆ P5.01	Multi-Speed 1	0.0 to 400.0 Hz	0.0	
◆ P5.02	Multi-Speed 2	0.0 to 400.0 Hz	0.0	
◆ P5.03	Multi-Speed 3	0.0 to 400.0 Hz	0.0	
◆ P5.04	Multi-Speed 4	0.0 to 400.0 Hz	0.0	
◆ P5.05	Multi-Speed 5	0.0 to 400.0 Hz	0.0	
◆ P5.06	Multi-Speed 6	0.0 to 400.0 Hz	0.0	
◆ P5.07	Multi-Speed 7	0.0 to 400.0 Hz	0.0	
◆ P5.08	Multi-Speed 8	0.0 to 400.0 Hz	0.0	
◆ P5.09	Multi-Speed 9	0.0 to 400.0 Hz	0.0	
◆ P5.10	Multi-Speed 10	0.0 to 400.0 Hz	0.0	
◆ P5.11	Multi-Speed 11	0.0 to 400.0 Hz	0.0	
◆ P5.12	Multi-Speed 12	0.0 to 400.0 Hz	0.0	
◆ P5.13	Multi-Speed 13	0.0 to 400.0 Hz	0.0	
◆ P5.14	Multi-Speed 14	0.0 to 400.0 Hz	0.0	
◆ P5.15	Multi-Speed 15	0.0 to 400.0 Hz	0.0	
<p>* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions..." (page 4-2) for more information.</p> <p>◆ Parameter can be set during RUN Mode.</p>				

Parameter Summary				
Protection Parameters (P6.##)				
Parameter*	Description	Range*	Default Setting	User Setting
P6.00	Electronic Thermal Overload Relay	00: Inverter/Vector Duty Motors 01: Fan Cooled Standard Motors 02: Inactive	00	
P6.01	Auto Restart after Fault	00 to 10	00	
P6.02	Momentary Power Loss	00: Stop operation after momentary power loss 01: Continue operation after momentary power loss, speed search from Speed Reference 02: Continue operation after momentary power loss, speed search from Minimum Speed	00	
P6.03	Reverse Operation Inhibit	00: Enable Reverse Operation 01: Disable Reverse Operation	00	
P6.04	Auto Voltage Regulation	00: AVR enabled 01: AVR disabled 02: AVR disabled during decel 03: AVR disabled during stop	00	
P6.05	Over-Voltage Stall Prevention	00: Enable Over-voltage Stall Prevention 01: Disable Over-voltage Stall Prevention	00	
P6.06	Auto Adjustable Accel/Decel	00: Linear Accel/Decel 01: Auto Accel, Linear Decel 02: Linear Accel, Auto Decel 03: Auto Accel/Decel 04: Auto Accel/Decel Stall Prevention (limited by P1.01, P1.02, P1.05 and P1.06)	00	
P6.07	Over-Torque Detection Mode	00: Disabled 01: Enabled during constant speed operation 02: Enabled during acceleration	00	
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	20 to 200% [0 = disable]	150	
P6.11	Over-Current Stall Prevention during Operation	20 to 200% [0 = disable]	150	
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 Hz	400	
P6.16	Lower Bound of Output Frequency	0.0 to 400 Hz	0.0	
P6.17	Over-Voltage Stall Prevention Level	230V series - 330.0V to 450.0V 460V series - 600.0V to 900.0V	390.0 780.0	
P6.18	Braking Voltage Level	230V series - 370.0V to 450.0V 460V series - 740.0V to 900.0V	380.0 760.0	
P6.30	Line Start Lockout	00: Enable Line Start Lockout 01: Disable Line Start Lockout	00	
<p>* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions.." (page 4-2) for more information. ♦ Parameter can be set during RUN Mode.</p>				
(table continued next page)				

Parameter Summary – Protection Parameters (continued)				
Parameter*	Description	Range*	Default Setting	User Setting
P6.31	Present Fault Record	00: No Fault occurred	00	
P6.32	Second Most Recent Fault Record	01: Over-current (oc) 02: Over-voltage (ov)	00	
P6.33	Third Most Recent Fault Record	03: Over-temperature	00	
P6.34	Fourth Most Recent Fault Record	04: Overload (oL)	00	
P6.35	Fifth Most Recent Fault Record	05: Thermal Overload (oL1) 06: Over-Torque (oL2)	00	
P6.36	Sixth Most Recent Fault Record	07: External Fault (EF) 08: CPU failure 1 (CF1) 09: 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) 15: Ground fault or fuse failure (GFF) 17: Input power 3-phase loss 19: Auto Ramp Fault 20: Parameters Locked 21: PID Feedback loss (FbE) 22: Encoder Feedback Loss 23: Output Shorted (OCC) 24: Momentary Power Loss	00	
◆ P6.37	Hunting Gain	0 to 1000	0	
<p>* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions..." (page 4–2) for more information.</p> <p>◆ Parameter can be set during RUN Mode.</p>				

Parameter Summary				
PID Parameters				
Parameter*	Description	Range*	Default Setting	User Setting
P7.00	Input Terminal for PID Feedback	00: Inhibit PID operation 01: Forward-acting (heating loop) PID feedback, PV from AI1 (0 to + 10V) 02: Forward-acting (heating loop) PID feedback, PV from AI2 (4 to 20 mA) 03: Reverse-acting (cooling loop) PID feedback, PV from AI1 (0 to +10V) 04: Reverse-acting (cooling loop) PID feedback, PV from AI2 (4 to 20 mA)	00	
P7.01	PV 100% Value	0.0 to 999	100.0	
P7.02	PID Setpoint Source	00: Keypad 01: Serial Communications 02: AI1 (0 to +10V) 03: AI2 (4 to 20mA)	02	
◆ P7.03	PID Feedback Gain	00 to 300.0%	100	
◆ P7.04	PID Setpoint Offset Polarity	00: No Offset 01: Positive Offset 02: Negative Offset	00	
◆ P7.05	PID Setpoint Offset	0.0 to 100.0%	0.0	
◆ P7.06	PID Setpoint Gain	0.0 to 300.0%	100	
◆ P7.10	Keypad PID Setpoint	0.0 to 999	0.0	
◆ P7.11	PID Multi-setpoint 1	0.0 to 999	0.0	
◆ P7.12	PID Multi-setpoint 2	0.0 to 999	0.0	
◆ P7.13	PID Multi-setpoint 3	0.0 to 999	0.0	
◆ P7.14	PID Multi-setpoint 4	0.0 to 999	0.0	
◆ P7.15	PID Multi-setpoint 5	0.0 to 999	0.0	
◆ P7.16	PID Multi-setpoint 6	0.0 to 999	0.0	
◆ P7.17	PID Multi-setpoint 7	0.0 to 999	0.0	
◆ P7.20	Proportional Control	0.0 to 10.0	1.0	
◆ P7.21	Integral Control	0.00 to 100.0 sec	1.00	
◆ P7.22	Derivative Control	0.00 to 1.00 sec	0.00	
P7.23	Upper Bound for Integral Control	00 to 100%	100	
P7.24	Derivative Filter Time Constant	0.0 to 2.5 sec	0.0	
P7.25	PID Output Frequency Limit	00 to 110%	100	
P7.26	Feedback Signal Detection Time	0.0 to 3600 sec.	60	
P7.27	PID Feedback Loss	00: Warn and AC Drive Stop 01: Warn and continue operation 02: Warn and continue at last frequency 03: Warn and continue at Preset Speed (P7.28)	00	
◆ P7.28	PID Feedback Loss Preset Speed	0.0 to 400.0 Hz	0.0	

* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions..." (page 4-2) for more information.
 ◆ Parameter can be set during RUN Mode.

Parameter Summary				
Display Parameters (P8.##)				
Parameter*	Description	Range*	Default Setting	User Setting
◆ P8.00	User Defined Display Function	00: Output Frequency (Hz) 01: Motor Speed (rpm) 02: Scaled Frequency 03: Output Current (A) 04: Motor Load (%) 05: Output Voltage (V) 06: DC Bus Voltage (V) 07: PID Setpoint 08: PID Feedback (PV) 09: Frequency Setpoint	00	
◆ P8.01	Frequency Scale Factor	0.01 to 160.0	1.0	
◆ P8.02	Backlight Timer	00: Timer Enable (1 min light off) 01: Timer Disable	00	
<p>* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions..." (page 4-2) for more information.</p> <p>◆ Parameter can be set during RUN Mode.</p>				

Parameter Summary				
Communications Parameters (P9.##)				
Parameter*	Description	Range*	Default Setting	User Setting
P9.00	Communication Address	01 to 254	01	
P9.01	Transmission Speed	00: 4800 baud 01: 9600 baud 02: 19200 baud 03: 38400 baud	01	
P9.02	Communication Protocol	00: MODBUS ASCII mode 7 data bits, no parity, 2 stop bits 01: MODBUS ASCII mode 7 data bits, even parity, 1 stop bit 02: MODBUS ASCII mode 7 data bits, odd parity, 1 stop bit 03: MODBUS RTU mode 8 data bits, no parity, 2 stop bits 04: MODBUS RTU mode 8 data bits, even parity, 1 stop bit 05: MODBUS RTU mode 8 data bits, odd parity, 1 stop bit	00	
P9.03	Transmission Fault Treatment	00: Display fault and continue operating 01: Display fault and RAMP to stop 02: Display fault and COAST to stop 03: No fault displayed and continue operating	00	
P9.04	Time Out Detection	00: Disable 01: Enable	00	
P9.05	Time Out Duration	0.1 to 60.0 seconds	0.5	
◆ P9.07	Parameter Lock	00: All parameters can be set and read 01: All parameters are read-only	00	
P9.08	Restore to Default	99: Restores all parameters to factory defaults	00	
◆ P9.11	Block Transfer Parameter 1	P0.00 to P8.02, P9.99	P9.99	
◆ P9.12	Block Transfer Parameter 2	P0.00 to P8.02, P9.99	P9.99	
◆ P9.13	Block Transfer Parameter 3	P0.00 to P8.02, P9.99	P9.99	
◆ P9.14	Block Transfer Parameter 4	P0.00 to P8.02, P9.99	P9.99	
◆ P9.15	Block Transfer Parameter 5	P0.00 to P8.02, P9.99	P9.99	
◆ P9.16	Block Transfer Parameter 6	P0.00 to P8.02, P9.99	P9.99	
<p>* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions..." (page 4-2) for more information.</p> <p>◆ Parameter can be set during RUN Mode.</p>				
(table continued next page)				

Parameter Summary – Communications Parameters (continued)				
Parameter*	Description	Range*	Default Setting	User Setting
◆ P9.17	Block Transfer Parameter 7	P0.00 to P8.02, P9.99	P9.99	
◆ P9.18	Block Transfer Parameter 8	P0.00 to P8.02, P9.99	P9.99	
◆ P9.19	Block Transfer Parameter 9	P0.00 to P8.02, P9.99	P9.99	
◆ P9.20	Block Transfer Parameter 10	P0.00 to P8.02, P9.99	P9.99	
◆ P9.21	Block Transfer Parameter 11	P0.00 to P8.02, P9.99	P9.99	
◆ P9.22	Block Transfer Parameter 12	P0.00 to P8.02, P9.99	P9.99	
◆ P9.23	Block Transfer Parameter 13	P0.00 to P8.02, P9.99	P9.99	
◆ P9.24	Block Transfer Parameter 14	P0.00 to P8.02, P9.99	P9.99	
◆ P9.25	Block Transfer Parameter 15	P0.00 to P8.02, P9.99	P9.99	
◆ P9.26	Serial Comm Speed Reference	0.0 to 400.0 Hz	60.0	
◆ P9.27	Serial Comm RUN Command	00: Stop 01: Run	00	
◆ P9.28	Serial Comm Direction Command	00: Forward 01: Reverse	00	
◆ P9.29	Serial Comm External Fault	00: No fault 01: External fault	00	
◆ P9.30	Serial Comm Fault Reset	00: No action 01: Fault Reset	00	
◆ P9.31	Serial Comm JOG Command	00: Stop 01: Jog	00	
P9.39	Firmware Version	###	###	
◆ P9.40	Parameter Copy	00: Disable Copy Keypad Function 01: Enable Copy Keypad Function	00	
P9.41	GS Series Number	01: GS1 02: GS2 03: GS3 04: GS4	##	N/A
P9.42	Manufacturer Model Information	00: GS3-21P0 (230V 3ph 1.0hp) 01: GS3-22P0 (230V 3ph 2.0hp) 02: GS3-23P0 (230V 3ph 3.0hp) 03: GS3-25P0 (230V 3ph 5.0hp) 04: GS3-27P5 (230V 3ph 7.5hp) 05: GS3-2010 (230V 3ph 10hp) 06: GS3-2015 (230V 3ph 15hp) 07: GS3-2020 (230V 3ph 20hp) 08: GS3-2025 (230V 3ph 25hp) 09: GS3-2030 (230V 3ph 30hp) 10: GS3-2040 (230V 3ph 40hp) 11: GS3-2050 (230V 3ph 50hp) 12: GS3-41P0 (460V 3ph 1.0hp) 13: GS3-42P0 (460V 3ph 2.0hp) 14: GS3-43P0 (460V 3ph 3.0hp) 15: GS3-45P0 (460V 3ph 5.0hp) 16: GS3-47P5 (460V 3ph 7.5hp) 17: GS3-4010 (460V 3ph 10hp) 18: GS3-4015 (460V 3ph 15hp) 19: GS3-4020 (460V 3ph 20hp) 20: GS3-4025 (460V 3ph 25hp) 21: GS3-4030 (460V 3ph 30hp) 22: GS3-4040 (460V 3ph 40hp) 23: GS3-4050 (460V 3ph 50hp) 24: GS3-4060 (460V 3ph 60hp) 25: GS3-4075 (460V 3ph 75hp) 26: GS3-4100 (460V 3ph 100hp)	##	N/A
<p>* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions..." (page 4-2) for more information.</p> <p>◆ Parameter can be set during RUN Mode.</p>				

Parameter Summary				
<i>Encoder Feedback Parameters (P10.##)</i>				
Parameter*	Description	Range*	Default Setting	User Setting
P10.00	Encoder Pulses per Revolution	01 to 20000	1024	
P10.01	Encoder Type Input	00: Disable 01: Single Phase 02: Quadrature, FWD - CCW 03: Quadrature, FWD - CW	00	
◆ P10.02	Proportional Control	0.0 to 10.0	1.0	
◆ P10.03	Integral Control	0.00 to 100.00 sec	1.00	
P10.04	Encoder Control Output Limit	0.0 to 20.0%	7.5	
P10.05	Encoder Loss Detection	00: Warn and continue operation 01: Warn and RAMP to stop 02: Warn and COAST to stop	00	
<p>* Some parameters and settings are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "Parameters available only in later firmware versions..." (page 4-2) for more information.</p> <p>◆ Parameter can be set during RUN Mode.</p>				

DETAILED PARAMETER LISTINGS

EXPLANATION OF PARAMETER DETAILS FORMAT

Px.xx **Parameter Name**
Range: xxx Default: xxx

This parameter...

Where:

- **Px.xx** = the parameter number
- **Parameter Name** = the descriptive name of the parameter



If the solid diamond symbol (◆) appears next to the parameter name, that parameter can be edited when the AC drive is in RUN Mode.

- 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:
 230V series: 200/208/220/230/240 Default Setting:
 460V series: 380/400/415/440/460/480 230V series: 240
460V series: 480

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 0.4 to Drive Rated Amps x 1.0 Default Setting: Drive Rating (A)

This parameter sets the output current to the motor, and is used by the drive to set the motor overload protection. Set this parameter value to the full load current listed on the motor nameplate. (Also refer to P6.00 to set overload current type.)

P0.02 **Motor Base Frequency**
Range: 50/60/400 Default Setting: 60

This value should be set 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 24,000 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 24,000 rpm*Default Setting:* P0.03

- This value should be set according to the desired maximum speed of the motor.
- This value should not exceed the motor's maximum rated speed.



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 value cannot be set lower than Motor Base RPM (P0.03).

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:

- $\text{Max Out Freq} = (P0.04 \text{ Motor Max RPM} \div P0.03 \text{ Motor Base RPM}) \times (P0.02 \text{ Motor Base Freq})$

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

- $P0.04 \text{ Motor Max RPM} = (\text{Max Out Freq} \div P0.02 \text{ Motor Base Freq}) \times (P0.03 \text{ Motor Base RPM})$

P0.05 Motor Auto Tune*Settings:* 00 Disable*Default Setting:* 00

01 Enable P0.06 only (R1)

02 Enable P0.06 and P0.07 (R1 + No-load Test)

- Auto-tuning is required only for Sensorless Vector Control Modes (P2.10 = 02, 03, 05).
- Do NOT set auto-tuning without a motor connected.
- Do NOT set auto-tuning with any mechanical load connected to the motor output shaft.

The unit will auto detect when you press the RUN key after this parameter is set to 01 or 02.

- When set to 01, the unit will auto detect only the motor R1 line to line resistance value (P0.06); manually enter the motor no-load current in P0.07.
- When set to 02, the values of both P0.06 and P0.07 will be filled in automatically.

Refer to the "Auto-Tune Procedure" subsection of chapter 3 for step-by-step auto-tuning instructions.

P0.06 Motor Line-to-Line Resistance R1*Range:* 00 to 65535 mΩ (*milliohm*)*Default Setting:* 00

The motor auto detection feature will set this parameter. The user may also set this parameter without using P0.05. Some motor manufacturers list this value on the motor nameplate.

P0.07 Motor No-Load Current*Range:* Drive Rated Amps x 0.0 to 0.9 (Amps)*Default Setting:* Drive Rated Amps x 0.4

The rated current of the AC drive is regarded as 100%. The setting of the motor no-load current will affect the slip compensation.

- The setting value must be less than the Motor Rated Current (P0.01).

RAMP PARAMETERS

P1.00 Stop Methods

Settings: 00 Ramp to Stop
01 Coast to stop

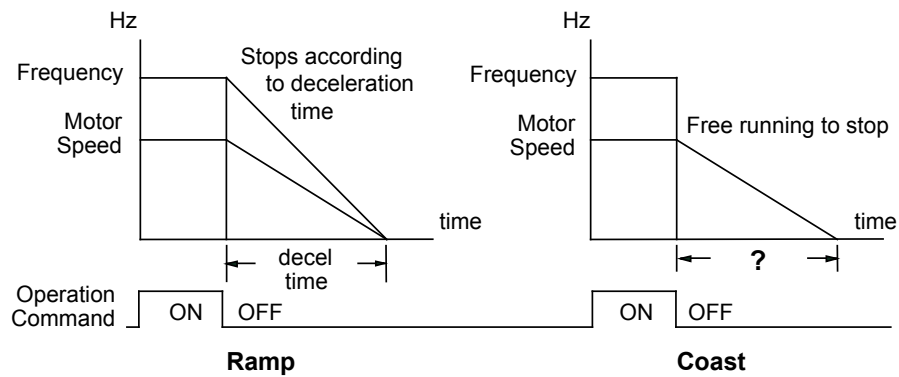
Default Setting: 00

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) and then stops 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 ramp from zero speed to Maximum Motor RPM (P0.04). The rate is linear unless Accel S-Curve is “Enabled” (P1.03 > 0).

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 zero speed. The rate is linear unless Decel S-Curve is “Enabled” (P1.04 > 0).

P1.03 Accel S-Curve

P1.04 Decel S-Curve

Range: 00 to 07

Default Setting: 00

Parameter P1.03 is used whenever the motor and load need to be accelerated more smoothly. The Accel S-Curve may be set from 00 to 07 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 00 to 07 to select the desired deceleration S-Curve.



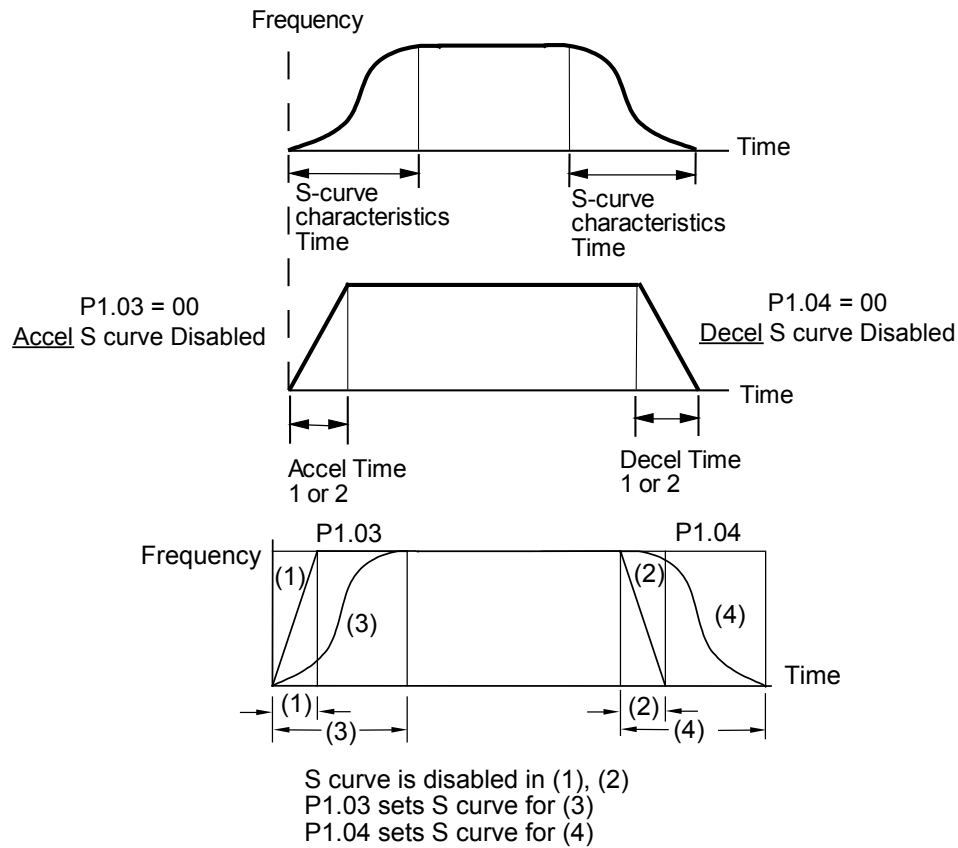
S-curves can only be seen when the motor is loaded. Static testing will result in no noticeable change on tuning software (i.e. GSoft).



Accel / Decel times 1 and 2 are applied to S-curve calculations.



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 (01 to 07).



P1.05 ♦ Acceleration Time 2

Range: 0.1 to 600.0 sec

Default Setting: 10 sec

The second Acceleration Time determines the time for the AC drive to accelerate from zero speed 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 sec

The second Deceleration Time determines the time required for the AC drive to decelerate from the Maximum Motor RPM (P0.04) to zero speed. 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

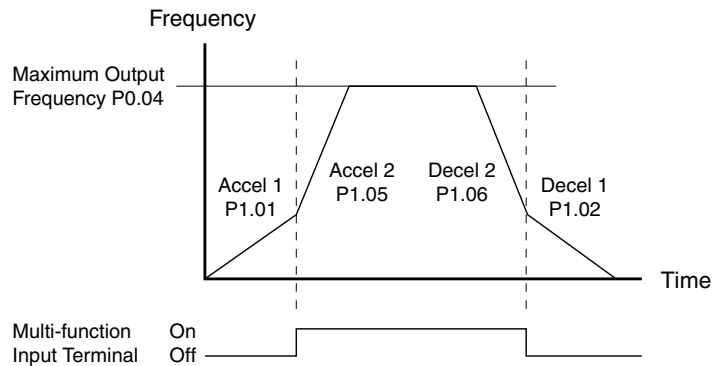
Settings: 00: Second Accel/Decel from terminal

Default Setting: 00

01: Frequency Transitions P1.08 & P1.09

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.

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



P1.08 Accel 1 to Accel 2 Frequency Transition

P1.09 Decel 2 to Decel 1 Frequency Transition

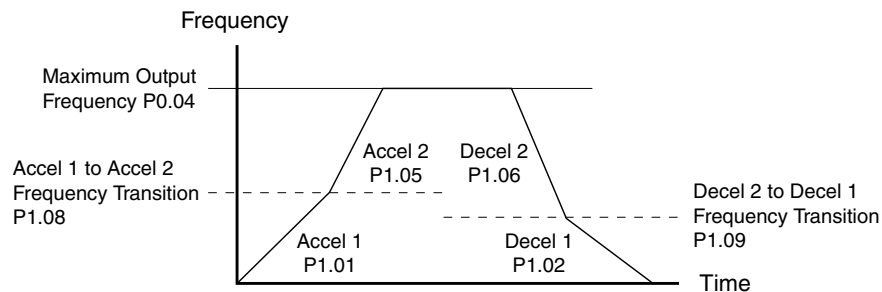
Range: 0.0 to 400.0 Hz

Default Setting: 0.0

Parameter P1.08 sets the frequency at which the AC drive changes acceleration rate from Acceleration Time 1 (P1.01) to Acceleration Time 2 (P1.05).

Parameter P1.09 sets the frequency at which the AC drive changes deceleration rate from Deceleration Time 2 (P1.06) to Deceleration Time 1 (P1.02).

Second Accel/Decel Times selected with Frequency Transition



P1.10 Skip Frequency 1

P1.11 Skip Frequency 2

P1.12 Skip Frequency 3

P1.13 Skip Frequency 4

P1.14 Skip Frequency 5

Range: 0.0 to 400.00 Hz

Default Setting: 0.0

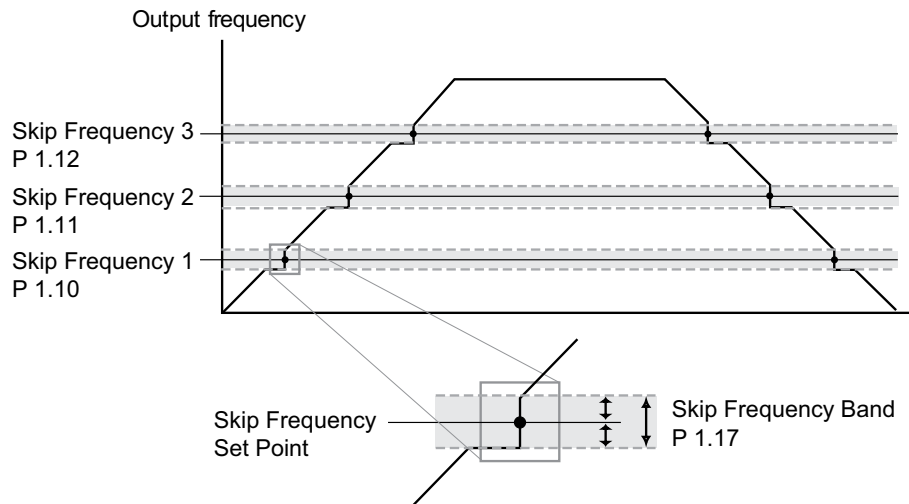
- P1.10, P1.11, and P1.12 determine the location of the frequency bands that will be skipped during AC drive operation.

P1.17 Skip Frequency Band

Range: 0.0 to 20.00 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. Programming this parameter to 0.0 disables all skip frequencies.



P1.18 DC Injection Current Level

Range: 00 to 100%

Default Setting: 00

This parameter determines the amount of DC Braking Current applied to the motor during start-up and stopping. When setting DC Braking Current, please note that 100% is equal to the rated current of the drive. It is recommended to start with a low DC Braking Current 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 Current 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

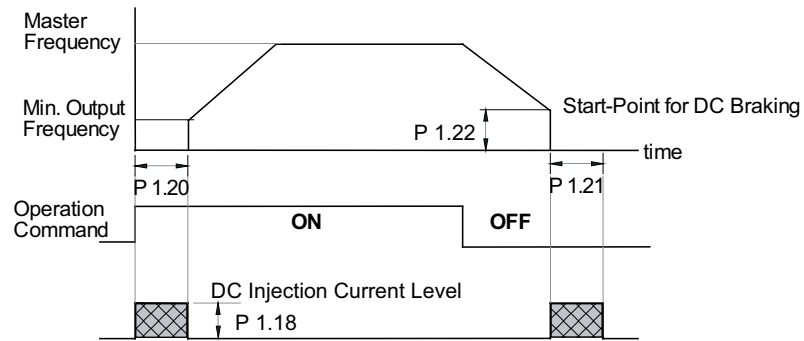
This parameter determines the duration of time that the DC braking voltage will be applied to the motor during stopping. If stopping with DC Braking is desired, then P1.00 must be set to Ramp to Stop (00).

P1.22 Start-point for DC Injection

Range: 0.0 to 60.0 Hz

Default Setting: 0.0

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



VOLTS/HERTZ PARAMETERS

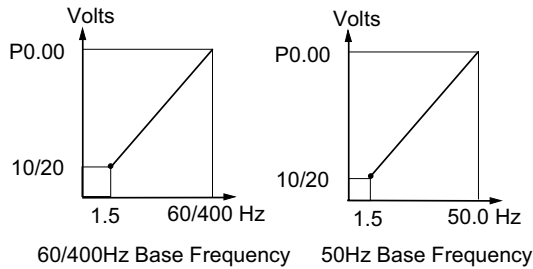
P2.00 Volts/Hertz Settings

- Settings: 00: General Purpose (constant torque) Default Setting: 00
 01: High Starting Torque
 02: Fans and Pumps (variable torque)
 03: Custom

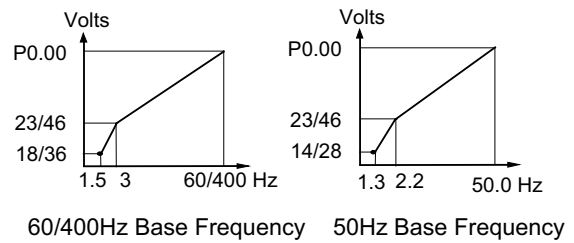


P2.04 through P2.07 are used only when the Volts/Hertz parameter (P2.00) is set to 03.

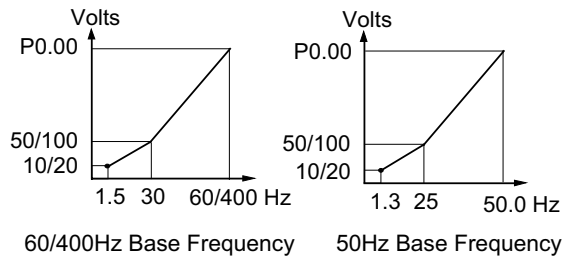
00: General Purpose



01: High Starting Torque



02: Fans and Pumps



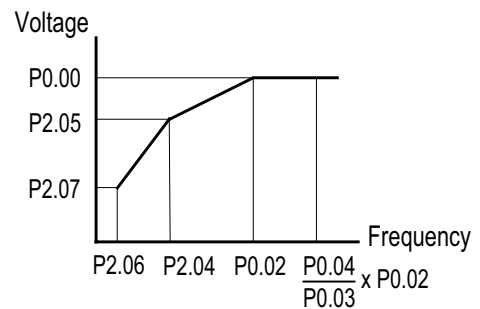
03: Custom

A custom curve can be applied for nonstandard motors.

Example:

These settings keep the V/Hz ratio at 380/300 for a motor rated 380V, 18000 rpm, 300 Hz:

- P0.00 = 460V or 400V
- P0.02 = 400 Hz
- P2.00 = 03
- P2.04 = 300 Hz
- P2.05 = 380V
- P2.06 = 1.5 Hz
- P2.07 = 20V
- P6.15 = 300 Hz



P2.01 ♦ **Slip Compensation***Range:* 0.0 to 10.0*Default Setting:* V/Hz mode: 0.0*Default Setting:* Vector mode: 1.0

This parameter can be used to partially compensate for the slip inherent in asynchronous three phase AC induction motors. An increase in load on the motor will result in an increase in slip within the motor. When this parameter is set above zero, the drive automatically increases the output frequency as the load increases. The higher the parameter setting, the more aggressively the drive increases the output frequency. The drive compares the actual output current to the values of P0.01 (Motor Nameplate Amps) and P0.07 (Motor No-Load Current) in order to determine the required output frequency increase.

The proper setting for P2.01 is determined by trial and error. Correct settings of P0.01, P0.07, and P2.09 (if applicable) are important for proper operation of this slip compensation feature.

P2.02 ♦ **Auto-torque Boost***Range:* 00 to 10*Default Setting:* 00

This parameter functions similarly to the High Starting Torque setting of the V/Hz Settings parameter (P2.00 = 01), except that this parameter (P2.02) uses less current. The High Starting Torque setting of P2.00 boosts starting torque by increasing current at every start beyond what is required to move the load. However, P2.02 Auto-torque Boost increases the current only as required to move the load. The proper setting for P2.02 is determined by trial and error.

- This parameter only applies in V/Hz mode.

P2.03 **Torque Compensation Time Constant***Range:* 00 to 10 sec*Default Setting:* 0.05

This parameter is essentially a low-pass filter which affects how Auto-Torque Boost (P2.02) is applied. When this parameter is set to zero, Auto-Torque Boost is applied instantaneously. When this parameter is set greater than zero, Auto-Torque Boost is applied gradually over the time period set by this parameter.



P2.04 through P2.07 are used only when the Volts/Hertz parameter (P2.00) is set to 03. If trying to set when P2.00 is not 03, "ERR" will result.

P2.04 **Mid-point Frequency***Range:* 0.1 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 used only when the Volts/Hertz Settings parameter (P2.00) is set to 03, custom.

P2.05 **Mid-point Voltage***Range:* 230V class: 0.1 to 240V*Default Setting:* 230V class: 10.0

460V class: 0.1 to 480V

Default Setting: 460V class: 20.0

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 used only when the Volts/Hertz Settings parameter (P2.00) is set to 03, custom.

P2.06 **Minimum Output Frequency***Range:* 0.1 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 used only when the Volts/Hertz Settings parameter (P2.00) is set to 03, custom.

P2.07 Minimum Output Voltage

Range: 230V class: 0.1 to 50V
460V class: 0.1 to 100V

Default Setting: 230V class: 10.0
460V class: 20.0

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 used only when the Volts/Hertz Settings parameter (P2.00) is set to 03, custom.

P2.08 PWM Carrier Frequency

Range: 1 to 5 hp: 01 to 15 kHz
7.5 to 25 hp: 01 to 15 kHz
30 to 60 hp: 01 to 09 kHz
75 to 100 hp: 01 to 06 kHz

Default Setting: 1 to 5 hp: 15
7.5 to 25 hp: 09
30 to 60 hp: 06
75 to 100 hp: 06

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

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

Carrier Frequency	Acoustic Noise	Electromagnetic Noise, Leakage Current	Heat Dissipation
1kHz	significant	minimal	minimal
15kHz	minimal	moderate	moderate

P2.09 Slip Compensation Time Constant

Range: 0.05 to 10.00 sec

Default Setting: 0.10

This parameter is usually applied to heavy-load applications in which the motor speed is changed frequently. It acts as a damper for P2.01, Slip Compensation, which changes the output frequency to compensate for motor slip due to heavy loads. Frequent speed changes can cause system vibration, and P2.09 can be adjusted while monitoring drive/motor operation to reduce that vibration.

Increasing P2.09 slows the Slip Compensation response (loosens speed regulation).

Decreasing P2.09 speeds the Slip Compensation response (tightens speed regulation).

- This parameter is enabled only in the “high-speed regulation” control modes; (P2.10 = 04 or 05).
- This parameter is available only with AC drive firmware v1.05 or higher. Refer to P9.39 to determine the drive’s firmware version.

P2.10 Control Mode

Settings: 00: V/Hz without encoder feedback
01: V/Hz with encoder feedback
02: Sensorless Vector without encoder feedback
03: Sensorless Vector with encoder feedback
04: V/Hz with encoder feedback and high-speed regulation
05: Sensorless Vector with encoder feedback and high-speed regulation

Default Setting: 00

This parameter determines the control method of the AC drive.

The V/Hz modes (00, 01, & 04) are the basic control modes.

The Sensorless Vector modes (02, 03, & 05) allow improved torque performance at very low speeds and improved speed regulation. These modes require Auto-Tuning per P0.05 in order to match the characteristics of the particular motor being used.

The encoder feedback settings (01, 03, 04, & 05) require the installation of an optional GS3-FB feedback card in order for the drive to read the encoder signal from the motor. (Refer to Appendix A of this manual for more information regarding the GS3-FB.)

The high-speed regulation settings (04 & 05) enable two other parameters which can be used to reduce system vibration:

- Slip Compensation Time Constant (P2.09)
- Hunting Gain (P6.37)

DIGITAL PARAMETERS

P3.00 Source of Operation Command

Settings:

Default Setting: 00

- 00: Operation Determined by Digital Keypad
- 01: Operation determined by external control terminals. Keypad STOP is enabled.
- 02: Operation determined by external control terminals. Keypad STOP is disabled.
- 03: Operation determined by communication interface. Keypad STOP is enabled.
- 04: Operation determined by communication interface. Keypad STOP is disabled.

This parameter sets the input source for the AC drive operation commands. Refer to P3.01 to P3.10 for more details.

P3.01 Multi-Function Input Terminals (DI1-DI2)

Settings:

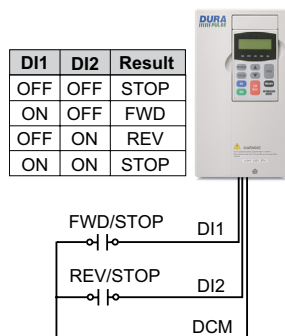
Default Setting: 00

- 00: DI1 – FWD/STOP
DI2 – REV/STOP
- 01: DI1 – RUN/STOP
DI2 – REV/FWD
- 02: DI1 – RUN (used with momentary N.O. contact)
DI2 – REV/FWD
DI3 – STOP (used with momentary N.C. contact)

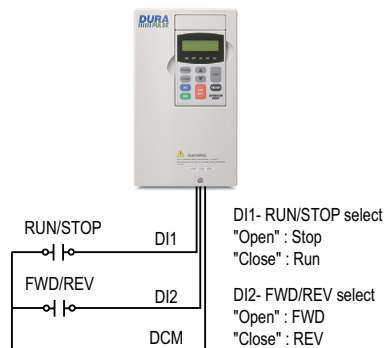


Multi-function Input Terminals DI1 and DI2 do not have separate parameter designations. DI1 and DI2 must be used in conjunction with each other to operate two and three wire control.

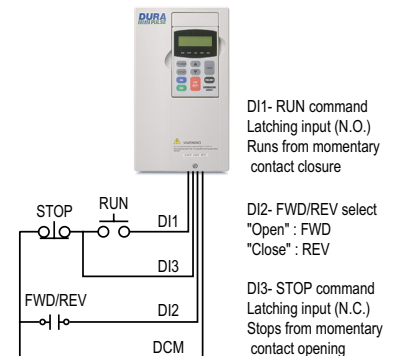
P3.01: Setting 00



P3.01: Setting 01



P3.01: Setting 02



<u>P3.02</u>	Multi-Function Input (DI3)	<i>Default Setting:</i> 00
<u>P3.03</u>	Multi-Function Input (DI4)	<i>Default Setting:</i> 03
<u>P3.04</u>	Multi-Function Input (DI5)	<i>Default Setting:</i> 04
<u>P3.05</u>	Multi-Function Input (DI6)	<i>Default Setting:</i> 05
<u>P3.06</u>	Multi-Function Input (DI7)	<i>Default Setting:</i> 06
<u>P3.07</u>	Multi-Function Input (DI8)	<i>Default Setting:</i> 09
<u>P3.08</u>	Multi-Function Input (DI9)	<i>Default Setting:</i> 02
<u>P3.09</u>	Multi-Function Input (DI10)	<i>Default Setting:</i> 12
<u>P3.10</u>	Multi-Function Input (DI11)	<i>Default Setting:</i> 10

Settings for P3.02~P3.10:

00*	External Fault (N.O.)
01*	External Fault (N.C.)
02	External Reset
03	Multi-Speed Bit 1 / PID Setpoint Bit 1
04	Multi-Speed Bit 2 / PID Setpoint Bit 2
05	Multi-Speed Bit 3 / PID Setpoint Bit 3
06	Multi-Speed Bit 4
07	Manual Keypad Control
08	Reserved
09	Jog
10	External Base Block (N.O.)
11	External Base Block (N.C.)
12	Second Accel/Decel Time
13	Speed Hold (P4.00 must be set to 01.)
14**	Increase Speed (P4.00 must be set to 01.)
15**	Decrease Speed (P4.00 must be set to 01.)
16	Reset Speed to Zero (P4.00 must be set to 01.)
17	PID Disable (N.O.)
18	PID Disable (N.C.)
19***	1st/2nd Source Select (N.O.)
20***	1st/2nd Source Select (N.C.)
99	Input Disable

* Use either setting 00 or 01, but not both. Use interposing relays if more contacts are needed.

** Accel / Decel times must be more than one second in order for Increase Speed (14) and Decrease Speed (15) settings to work efficiently.

*** Parameter settings 19 and 20 are available only with firmware v1.04 or higher (refer to P9.39).

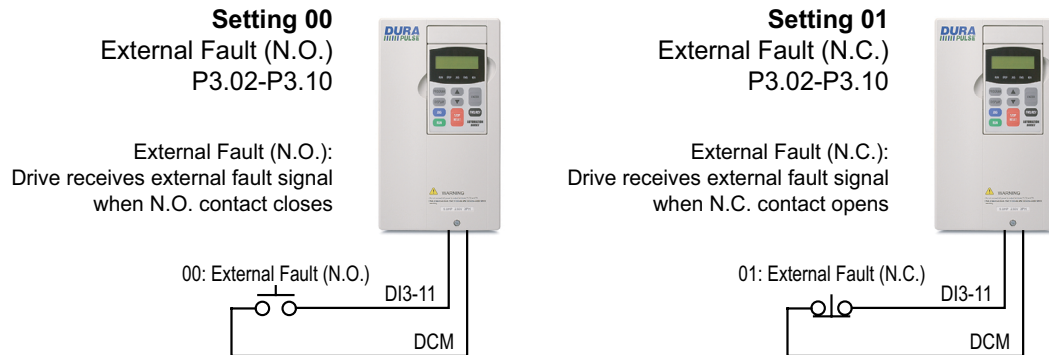
NOTE: If using 1st/2nd Source Selection, the GS3 drive will continue to operate in the last commanded state when switched from 1st to 2nd source, or from 2nd to 1st source. If stopped when switched, the GS3 drive will remain stopped. If running when switched, the GS3 drive will continue to run.

The feature 1st/2nd Source Select is available in the GS3 drive by configuring one of the digital inputs (DI3 thru DI11), to a value of 19 or 20. If used, 1st/2nd Source Select affects the following parameters: P3.00 – Source of Operation Command, P3.31 – 2nd Source of Operation Command, P4.00 – Source of Frequency Command, P4.13 – 2nd Source of Frequency Command.

SETTING EXPLANATIONS FOR PARAMETERS P3.02 THROUGH P3.10

SETTINGS 00 AND 01: EXTERNAL FAULT (N.O. & N.C.)

When an External Fault input signal is received, the AC drive output will turn off, the drive will display the words “External Fault” 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. (The drive can be reset from the STOP/RESET key on the keypad, or from a contact wired to a digital input set for function 02, External Reset.)



- Use either setting 00 or 01, but not both. Use interposing relays if more contacts are needed.

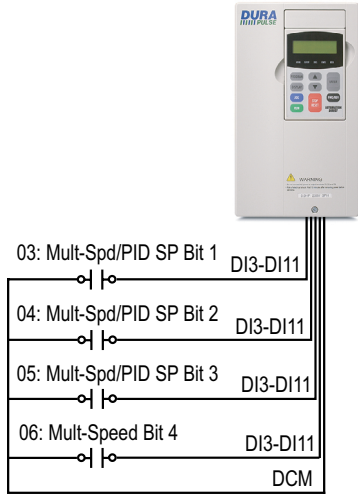
SETTING 02: EXTERNAL RESET

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

SETTINGS 03, 04, AND 05: PID SETPOINT BITS 1, 2, 3

SETTINGS 03, 04, 05 AND 06: MULTI-SPEED BITS 1, 2, 3 AND 4

The four Multi-Speed Bits are used to select the multi-speed settings defined by parameters P5.01 to P5.15. The first three of these bits can also be used to select a PID setpoint, if PID is enabled (P7.00 ≠ 0.)



Multi-Speed / PID SP				Speed Selection	PID SP Selection
Bit 4	Bit 3	Bit 2	Bit 1		
OFF	OFF	OFF	OFF	P4.00	P7.02
OFF	OFF	OFF	ON	P5.01: Spd 1	P7.11: SP 1
OFF	OFF	ON	OFF	P5.02: Spd 2	P7.12: SP 2
OFF	OFF	ON	ON	P5.03: Spd 3	P7.13: SP 3
OFF	ON	OFF	OFF	P5.04: Spd 4	P7.14: SP 4
OFF	ON	OFF	ON	P5.05: Spd 5	P7.15: SP 5
OFF	ON	ON	OFF	P5.06: Spd 6	P7.16: SP 6
OFF	ON	ON	ON	P5.07: Spd 7	P7.17: SP 7
ON	OFF	OFF	OFF	P5.08: Spd 8	-
ON	OFF	OFF	ON	P5.09: Spd 9	-
ON	OFF	ON	OFF	P5.10: Spd 10	-
ON	OFF	ON	ON	P5.11: Spd 11	-
ON	ON	OFF	OFF	P5.12: Spd 12	-
ON	ON	OFF	ON	P5.13: Spd 13	-
ON	ON	ON	OFF	P5.14: Spd 14	-
ON	ON	ON	ON	P5.15: Spd 15	-



In order to use the Multi-Speed settings, P5.01 - P5.15 must be set. In order to use the Multi-PID SPs, P7.11 - P7.17 must be set, and P7.00 ≠ 0.



When all Multi-Speed inputs are off, the AC drive reverts back to the Command Frequency (P4.00). When all PID Multi-Setpoint inputs are off, the AC drive reverts back to the PID Setpoint Source (P7.02).

SETTING 07

This setting is used to temporarily switch to the keypad RUN and STOP buttons as the source of the operation command for run and stop functions. It does NOT change the source of the frequency command for the speed reference. Useful for troubleshooting.

SETTING 09: JOG COMMAND

This setting configures a Multi-function Input Terminal to run the motor at a preset speed only while the Jog Input is activated. Set the Jog Speed in P5.00. The Jog function can be used in combination with a FWD/REV signal (P3.01 = 01 or 02) to Jog in forward or reverse directions.



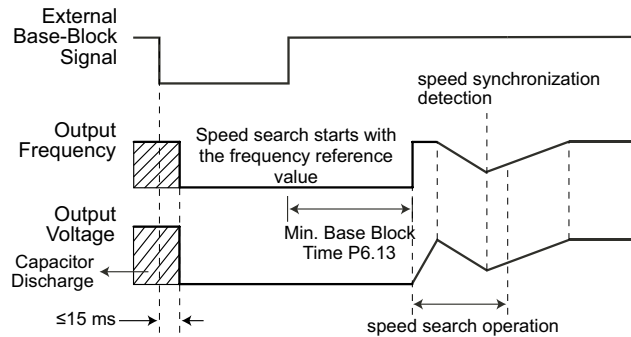
NO The drive must be stopped to initiate this command. The Jog Command cannot be used simultaneously with an active FWD/STOP, REV/STOP, or RUN/STOP command. TE: (table)

SETTING 10: EXTERNAL BASE BLOCK (N.O.)

SETTING 11: EXTERNAL BASE BLOCK (N.C.)

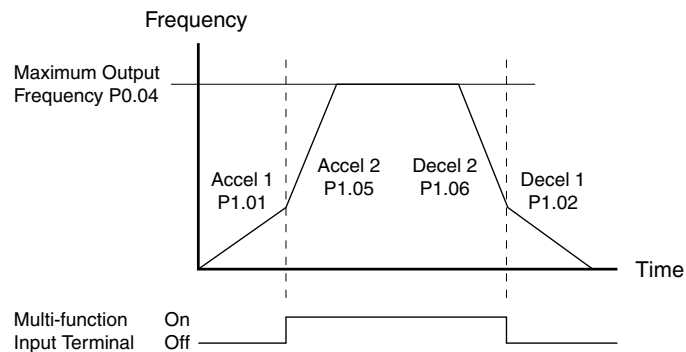
- Value 10 is for a normally open (N.O) input.
- Value 11 is for a normally closed (N.C.) input.

When an External Base Block is activated, the LCD display reads "EXT.BASE-BLOCK," 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.



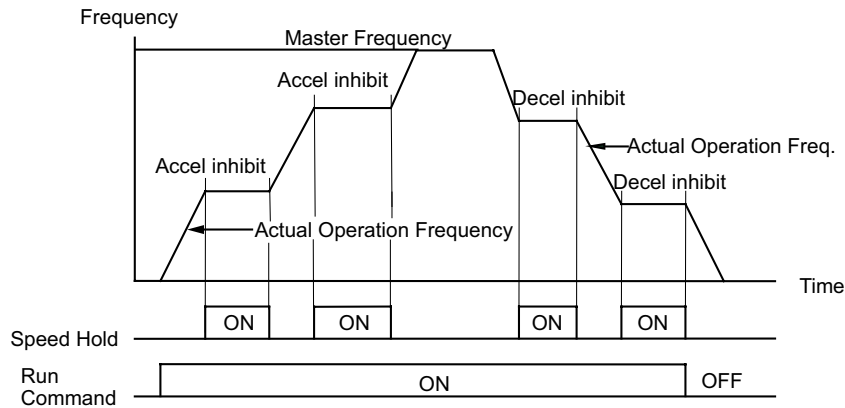
SETTING 12: SECOND ACCEL/DECCEL TIME

Multi-function Input Terminals DI3~DI11 can be set to select between Accel/Decel times 1 and 2. Parameters P1.01 and P1.02 set Accel 1 and Decel 1 times. Parameters P1.05 and P1.06 set Accel 2 and Decel 2 times.



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.

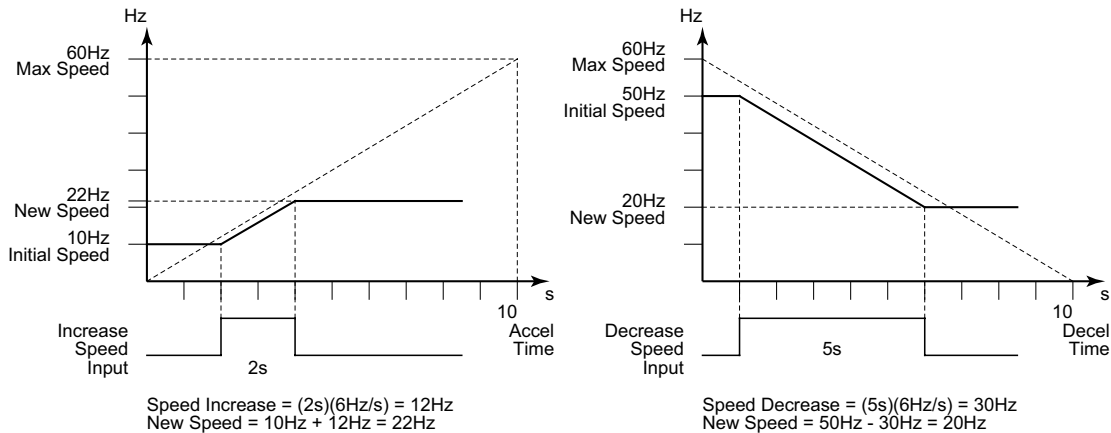


SETTINGS 14 AND 15: INCREASE AND DECREASE SPEED (ELECTRONIC MOTOR OPERATED POTENTIOMETER)

Settings 14 and 15 allow the Multi-function terminals to be used to increase or decrease speed. As long as the DI terminal is activated, the speed reference will continuously increase or decrease using the acceleration and deceleration ramp settings.

- Increase Speed rate of change = $P0.04(\text{Hz}) / P1.01(\text{s})$
- Decrease Speed rate of change = $P0.04(\text{Hz}) / P1.02(\text{s})$

Example: For $P0.04 = 60\text{Hz}$; $P1.01 = P1.02 = 10\text{s}$; rate of change = $60\text{Hz}/10\text{s} = 6\text{Hz/s}$



- In order to use these settings, P4.00 must be set to 01.
- Accel / Decel times must be more than one second to work efficiently.

SETTING 16: RESET SPEED TO ZERO

This setting allows a Multi-function input terminal to reset the drive output frequency to zero.

SETTING 17: PID DISABLE (N.O)

SETTING 18: PID DISABLE (N.C.)

Settings 17 and 18 set the Multi-function terminals to disable PID operation.

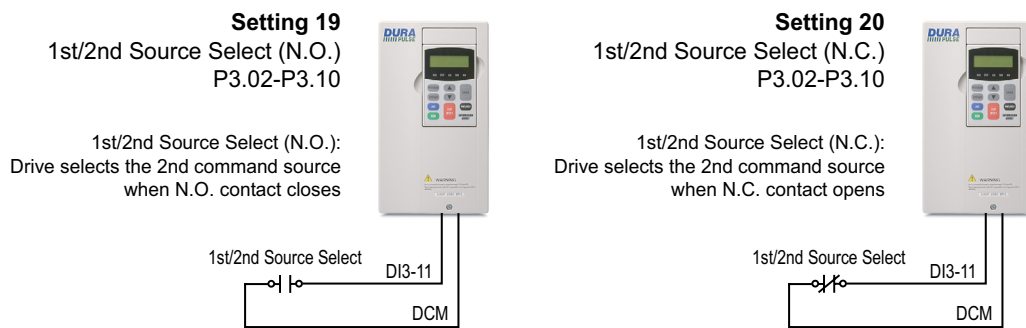
SETTING 19: 1ST/2ND SOURCE SELECT (N.O.)

SETTING 20: 1ST/2ND SOURCE SELECT (N.C.)

The AC drive runs from the (1st) Source of Operation Command (P3.00) and the (1st) Source of Frequency Command (P4.00) if the 1st/2nd Source Select signal is inactive.

The AC drive runs from the 2nd Source of Operation Command (P3.31) and the 2nd Source of Frequency Command (P4.13) if the 1st/2nd Source Select signal is active.

- Among other uses, these two settings allow the drive operation to be switched back and forth between local and remote control.
- Parameter settings 19 and 20 are available only with firmware v1.04 or higher (refer to P9.39).



NOTE: If using 1st/2nd Source Selection, the GS3 drive will continue to operate in the last commanded state when switched from 1st to 2nd source, or from 2nd to 1st source. If stopped when switched, the GS3 drive will remain stopped. If running when switched, the GS3 drive will continue to run. The feature 1st/2nd Source Select is available in the GS3 drive by configuring one of the digital inputs (DI3 thru DI11), to a value of 19 or 20. If used, 1st/2nd Source Select affects the following parameters: P3.00 - Source of Operation Command, P3.31 - 2nd Source of Operation Command, P4.00 - Source of Frequency Command, P4.13 - 2nd Source of Frequency Command.



EXAMPLE: Digital input DI11 is configured for 1st/2nd Source Select N.O. (P3.10 = 19):

- The 1st source of operation is the digital keypad (P3.00 = 0) and the 2nd source of operation is the external control terminals DI1, DI2, DI3, (P3.31 = 01 or 02). If the GS3 drive is running from the digital keypad (1st source) and is switched to the external control terminals DI1, DI2, DI3, (2nd source), the GS3 drive will continue to run, even if the external control terminals DI1, DI2, DI3 are off (drive stop). Following a transition of the 2nd source of operation external terminals DI1, DI2, DI3, the GS3 drive will then operate based on that control state.



WARNING: IT IS ADVISABLE TO INSURE THAT THE GS3 DRIVE IS STOPPED, BEFORE SWITCHING FROM ONE OPERATION COMMAND SOURCE TO THE OTHER.

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 they have no effect on drive operation.

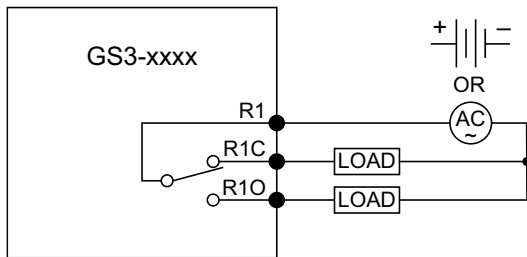
<u>P3.11</u> Multi-Function Output Terminal 1 (Relay Output)	<i>Default Setting:</i> 00
<u>P3.12</u> Multi-Function Output Terminal 2 (DO1)	<i>Default Setting:</i> 01
<u>P3.13</u> Multi-Function Output Terminal 3 (DO2)	<i>Default Setting:</i> 02
<u>P3.14</u> Multi-Function Output Terminal 4 (DO3)	<i>Default Setting:</i> 03

Settings for P3.11~P3.14:

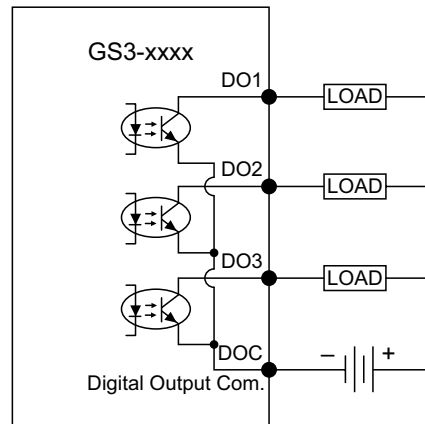
- 00 AC Drive Running
- 01 AC Drive Fault
- 02 At Speed
- 03 Zero Speed
- 04 Above Desired Frequency (P3.16)
- 05 Below Desired Frequency (P3.16)
- 06 At Maximum Speed (P0.02)
- 07 Over Torque Detected
- 08 Above Desired Current (P3.17)
- 09 Below Desired Current (P3.17)
- 10 PID Deviation Alarm (P3.18 and P3.19)
- 11 Heatsink Overheat Warning (OH)
- 12 Soft Braking Signal
- 13 Above Desired Frequency 2 (P3.20)
- 14 Below Desired Frequency 2 (P3.20)
- 15 Encoder Loss
- 16* PID Feedback Loss Warning

* Parameter setting available only with firmware v1.04 or higher (refer to P9.39)

Wiring Diagram for
R1, R1C, R1O
(Relay Output)



Wiring Diagram for
DO1, DO2, DO3, DO4
(Digital Outputs)



SETTING EXPLANATIONS FOR PARAMETERS P3.11 THROUGH P3.14

- Setting 00: AC Drive Running — The terminal will be activated when there is an output from the drive.
- Setting 01: AC Drive Fault — The terminal will be activated when one of the faults listed under parameters P6.31 through P6.36 occurs.
- Setting 02: At Speed — The terminal will be activated when the AC drive attains the Command Frequency (P4.00).
- Setting 03: Zero Speed — The output will be activated when Command Frequency (P4.00) is lower than the Minimum Output Frequency (P2.06).
- Setting 04: Above Desired Frequency — The output will be activated when the AC drive is above the Desired Frequency (P3.16).
- Setting 05: Below Desired Frequency — The output will be activated when the AC drive is below the Desired Frequency (P3.16).
- Setting 06: At Maximum Speed — The output will be activated when the AC drive reaches Motor Maximum RPM (P0.04).
- Setting 07: 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).
- Setting 08: Above Desired Current — The output will be activated when the AC drive is above the Desired Current (P3.17).
- Setting 09: Below Desired Current — The output will be activated when the AC drive is below the Desired Current (P3.17).
- Setting 10: PID Deviation Alarm — The output will be activated when the AC drive exceeds the PID Deviation Level (P3.18) for longer than the PID Deviation Time (P3.19).
- Setting 11: Heatsink Overheat Warning (OH) — The output will be activated when the heatsink overheats. The function will be activated as follows: Temperature range: 1 ~ 15HP, >90°C (194°F) ON; <90°C (194°F) OFF.
Above 15HP: >80°C (176°F) ON; <80°C (176°F) OFF
- Setting 12: Soft Braking Signal — If DC Bus voltage is greater than the braking voltage level set in parameter P6.18 (Braking Voltage level), then any output configured for function 12 will change state.
- Setting 13: Above Desired Frequency 2 — The output will be activated when the AC drive is above the Desired Frequency. (P3.20)
- Setting 14: Below Desired Frequency — The output will be activated when the AC drive is below the Desired Frequency. (P3.20)
- Setting 15: Encoder Loss — The output will be activated when the AC drive experiences loss of the encoder signal.
- Setting 16*: PID Feedback Loss Warning — The output will be activated when the AC drive experiences loss of a 4 to 20 mA PID Feedback signal.

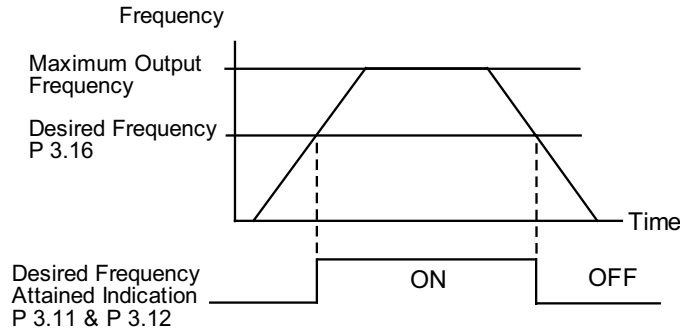
* - Parameter setting available only with firmware v1.04 or higher (refer to P9.39)

P3.16 ♦ Desired Frequency

Range: 0.0 to 400.0 Hz

Default Setting: 0.0

If a Multi-Function output terminal is set to function as Desired Frequency Attained (P3.11 or P3.12 = 04 or 05), then the output will be activated when the programmed frequency is attained.



P3.17 ♦ Desired Current

Range: 0.0 to <Drive Rated Amps>

Default Setting: 0.0

P3.18 ♦ PID Deviation Level

Range: 1.0 to 50.0%

Default Setting: 10.0

If a Multi-Function Output terminal is set to PID Deviation Alarm (RO, DO1-DO3 setting = 10), then the output will be activated when the amount of deviation between the SP (set point) and PV (process variable) in the PID loop constantly exceeds the threshold set by this parameter for the period of time set by P3.19. This is defined in percentage of PV Value (see P7.01).

- This parameter is used in conjunction with P3.19, PID Deviation Time.

P3.19 ♦ PID Deviation Time

Range: 0.1 to 300.0 sec

Default Setting: 5.0

If a Multi-Function Output terminal is set to PID Deviation Alarm (RO, DO1-DO3 setting = 10), then the output will be activated when the amount of deviation between the SP (set point) and PV (process variable) in the PID loop constantly exceeds the threshold set by P3.18 for the period of time set by this parameter.

- This parameter is used in conjunction with P3.18, PID Deviation Level.

P3.20 ♦ Desired Frequency 2

Range: 0.0 to 400.0 Hz

Default Setting: 0.0

P3.30 ♦ Frequency Output (FO) Scaling Factor

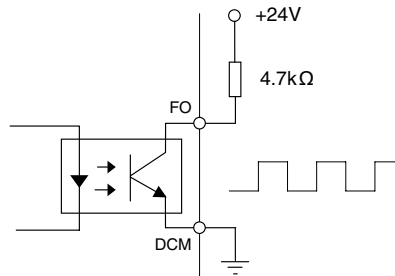
Range: 01 to 20

Default: 01

This parameter determines the scaling factor that is used to scale the frequency at the Digital Frequency Output terminals (FO-DCM). The number of output pulses per second is equal to the AC drive output frequency multiplied by P3.30. (*Pulse per second = actual output frequency x P3.30*).

- Example 1: When drive frequency is 60.0 Hz and P3.30 = 10;
60.0 Hz x 10 = 600.0 Hz;
Frequency of FO's outputted square wave is 600.0 Hz
- Example 2: When drive output frequency = 400.0 Hz and P3.30 = 20
400.0Hz x 20 = 8kHz;
FO's output frequency is 8kHz.

FO is an open collector circuit. Square wave is generated, for example, by sending +24V through a 4.7kΩ resistor as shown in the diagram below.



P3.31 2nd Source of Operation Command

Settings:

Default: 00

- 00 Operation Determined by Digital Keypad
- 01 Operation determined by external control terminals. Keypad STOP is **enabled**.
- 02 Operation determined by external control terminals. Keypad STOP is **disabled**.
- 03 Operation determined by RS-485 communication interface. Keypad STOP is **enabled**.
- 04 Operation determined by RS-485 communication interface. Keypad STOP is **disabled**.

This parameter sets the second input source for the AC drive operation command.

- Select the 1st or 2nd sources with a Digital Input and the appropriate parameter settings for P3.02 through P3.10.
- This parameter is available only with AC drive firmware v1.04 or higher.
Refer to P9.39 to determine the drive's firmware version.

NOTE: If using 1st/2nd Source Selection, the GS3 drive will continue to operate in the last commanded state when switched from 1st to 2nd source, or from 2nd to 1st source. If stopped when switched, the GS3 drive will remain stopped. If running when switched, the GS3 drive will continue to run.



The feature 1st/2nd Source Select is available in the GS3 drive by configuring one of the digital inputs (DI3 thru DI11), to a value of 19 or 20. If used, 1st/2nd Source Select affects the following parameters: P3.00 - Source of Operation Command, P3.31 - 2nd Source of Operation Command, P4.00 - Source of Frequency Command, P4.13 - 2nd Source of Frequency Command.

EXAMPLE: Digital input DI11 is configured for 1st/2nd Source Select N.O. (P3.10 = 19):

- The 1st source of operation is the digital keypad (P3.00 = 0) and the 2nd source of operation is the external control terminals DI1, DI2, DI3, (P3.31 = 01 or 02). If the GS3 drive is running from the digital keypad (1st source) and is switched to the external control terminals DI1, DI2, DI3, (2nd source), the GS3 drive will continue to run, even if the external control terminals DI1, DI2, DI3 are off (drive stop). Following a transition of the 2nd source of operation external terminals DI1, DI2, DI3, the GS3 drive will then operate based on that control state.



WARNING: IT IS ADVISABLE TO INSURE THAT THE GS3 DRIVE IS STOPPED, BEFORE SWITCHING FROM ONE OPERATION COMMAND SOURCE TO THE OTHER.

ANALOG PARAMETERS**P4.00 Source of Frequency Command**Settings:Default: 01

- 01 Frequency determined by digital keypad up/down.
- 02* Frequency determined by 0 to +10V input (including remote potentiometer) on AI1 terminal.
- 03 Frequency determined by 4 to 20 mA input on AI2 terminal.
- 04 Frequency determined by 0 to 20 mA input on AI2 terminal.
- 05 Frequency determined by RS-485 communication interface.
- 06 Frequency determined by -10V to +10V input on AI3 terminal.

* In order to set P4.00 = 02, you must first change the value of P4.13 to some value other than two (02) in order to avoid the "Error: Duplicate Function" error message. (P4.13 default value is 02)

This parameter sets the input source for the AC drive frequency command.



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 Analog Input Offset PolaritySettings:Default: 00

- 00 Offset disabled
- 01 Positive Offset
- 02 Negative Offset

This parameter sets the analog input bias frequency to be positive or negative.

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

P4.02 Analog Input OffsetRange: 0.0 to 100%Default: 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 Frequency References and Maximum Output Frequency needed for your application.

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



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.

P4.03 ♦ Analog Input Gain

Range: 0.0 to 300.0%

Default: 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.

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

P4.04 Analog Input Reverse Motion Enable

Settings: 00 Forward Motion Only
01 Reverse Motion Enable

Default: 00

This parameter enables analog input reverse motion.

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

P4.05 Loss of AI2 Signal (4-20mA)

Settings: 00 Decelerate to 0Hz
01 Stop immediately and display "EF"
02 Continue operation by the last frequency command

Default: 00

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

P4.11 ♦ Analog Output Signal

Settings: 00 Frequency Hz
01 Current A
02 PV

Default: 00

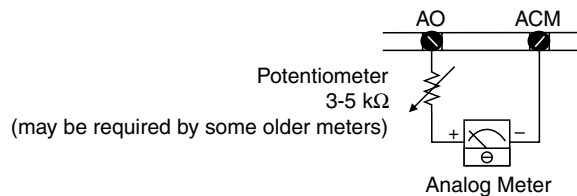
This parameter configures the 0–10V AO output to indicate either output Frequency, output Current, or the PID Process Variable.

P4.12 ♦ Analog Output Gain

Range:

Default: 100

This parameter sets the voltage range of the analog output signal on output terminal AO.



- When P4.11 is set to 00, the analog output voltage is directly proportional to the output frequency of the AC drive. With the factory setting of 100%, the Maximum Output Frequency of the AC drive corresponds to +10VDC analog voltage output. (The actual voltage is about +10VDC, and can be adjusted by P4.12)
- When P4.11 is set to 01, the analog output voltage is directly proportional to the output current of the AC drive. With the factory setting of 100%, the 2.5 times rated current of the AC drive corresponds to +10 VDC analog voltage output. (The actual voltage is about +10 VDC, and can be adjusted by P4.12).

Note: Any type of voltmeter can be used. If the meter reads full scale at a voltage less than 10 volts, then P4.12 should be set by the following formula:

- $P4.12 = (meter\ full\ scale\ voltage \div 10) \times 100\%$

For Example: When using the meter with full scale of 5 Volts, adjust P4.12 to 50%.

P4.13 2nd Source of Frequency CommandSettings:Default: 06

- 01* Frequency determined by digital keypad up/down.
- 02 Frequency determined by 0 to +10V input on AI1 terminal.
- 03 Frequency determined by 4 to 20 mA input on AI2 terminal.
- 04 Frequency determined by 0 to 20 mA input on AI2 terminal.
- 05 Frequency determined by RS-485 communication interface.
- 06 Frequency determined by -10V ~ +10V input on AI3 terminal.

* **In order to set P4.13 = 01, you must first change the value of P4.00 to some value other than one (01) in order to avoid the "Error: Duplicate Function" error message. (P4.00 default value is 01)**

This parameter sets the second input source for the AC drive frequency command.

- Select the 1st or 2nd sources with a Digital Input and the appropriate parameter settings for P3.02 through P3.10.
- This parameter is available only with AC drive firmware v1.04 or higher.
Default setting = 02 for firmware v1.04.
Default setting = 06 for firmware v1.05 and higher.
Refer to P9.39 to determine the drive's firmware version.

NOTE: If using 1st/2nd Source Selection, the GS3 drive will continue to operate in the last commanded state when switched from 1st to 2nd source, or from 2nd to 1st source. If stopped when switched, the GS3 drive will remain stopped. If running when switched, the GS3 drive will continue to run.



The feature 1st/2nd Source Select is available in the GS3 drive by configuring one of the digital inputs (DI3 thru DI11), to a value of 19 or 20. If used, 1st/2nd Source Select affects the following parameters: P3.00 - Source of Operation Command, P3.31 - 2nd Source of Operation Command, P4.00 - Source of Frequency Command, P4.13 - 2nd Source of Frequency Command.

EXAMPLE: Digital input DI11 is configured for 1st/2nd Source Select N.O. (P3.10 = 19):

- The 1st source of operation is the digital keypad (P3.00 = 0) and the 2nd source of operation is the external control terminals DI1, DI2, DI3, (P3.31 = 01 or 02). If the GS3 drive is running from the digital keypad (1st source) and is switched to the external control terminals DI1, DI2, DI3, (2nd source), the GS3 drive will continue to run, even if the external control terminals DI1, DI2, DI3 are off (drive stop). Following a transition of the 2nd source of operation external terminals DI1, DI2, DI3, the GS3 drive will then operate based on that control state.



WARNING: IT IS ADVISABLE TO ENSURE THAT THE GS3 DRIVE IS STOPPED BEFORE SWITCHING FROM ONE OPERATION COMMAND SOURCE TO THE OTHER.

P4.14 ♦ 2nd Analog Input Offset Polarity

Settings:

Default: 00

- 00 Offset disabled
- 01 Positive Offset
- 02 Negative Offset

This parameter sets the analog input 2nd bias frequency to be positive or negative.

- Select the 1st or 2nd sources with a Digital Input and the appropriate parameter settings for P3.02 through P3.10.
- The 2nd Analog Input Offset calculation will also define the 2nd Analog Input Offset Polarity. Refer to the note following P4.15.
- This parameter is available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version

P4.15 ♦ 2nd Analog Input Offset

Range: 0.0 to 100%

Default: 0.0

This parameter provides a frequency offset for a second analog input.

- Select the 1st or 2nd sources with a Digital Input and the appropriate parameter settings for P3.02 through P3.10.

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

- $Analog\ Offset\ \% = (Min\ Frequency\ Reference \div Max\ Output\ Frequency) \times 100$



The result of the 2nd Analog Input Offset calculation will also define the Analog 2nd Input Offset Polarity (P4.14). A positive answer means you should have a positive offset. A negative answer means you should have a negative offset.

- This parameter is available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version.

P4.16 ♦ 2nd Analog Input Gain

Range: 0.0 to 300.0%

Default: 100.0

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

- Select the 1st or 2nd sources with a Digital Input and the appropriate parameter settings for P3.02 through P3.10.

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.

- $Analog\ Gain\ \% = ((Max\ Frequency\ Ref - Min\ Frequency\ Ref) \div Max\ Output\ Frequency) \times 100$
- This parameter is available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version.

P4.17 ♦ **Trim Reference Frequency**

Range: 0.0 to 400.0 Hz

Default: 0.0

This parameter determines a set frequency to add to or subtract from the selected Frequency Command (P4.00 or P4.13) to produce a modified actual frequency command. The setting of P4.18 determines whether P4.17 adds to or subtracts from the Frequency Command.

- This parameter is active only if P4.18 is set to 03 or 04.
- This parameter is available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version.

Effects of P4.17 on Actual Frequency Command		
Source of Frequency Command	Trim Mode Select P4.18 Setting	Actual Frequency Command
P4.00	03	P4.00 + P4.17
	04	P4.00 - P4.17
P4.13	03	P4.13 + P4.17
	04	P4.13 - P4.17

P4.18 ♦ **Trim Mode Select**

Settings:

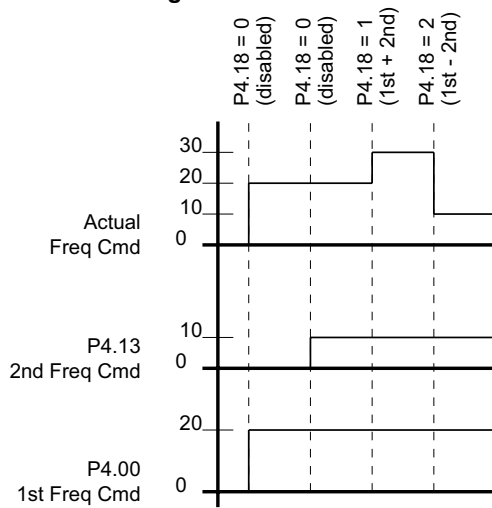
Default: 00

- 00 Disable Trim Function
- 01 1st Frequency Command (P4.00) + 2nd Frequency Command (P4.13)
- 02 1st Frequency Command (P4.00) - 2nd Frequency Command (P4.13)
- 03 Frequency Command (P4.00 or P4.13) + Trim Ref Frequency (P4.17)
- 04 Frequency Command (P4.00 or P4.13) - Trim Ref Frequency (P4.17)

This parameter determines how the Frequency Command is modified by the Trim Frequency to produce the modified actual frequency command.

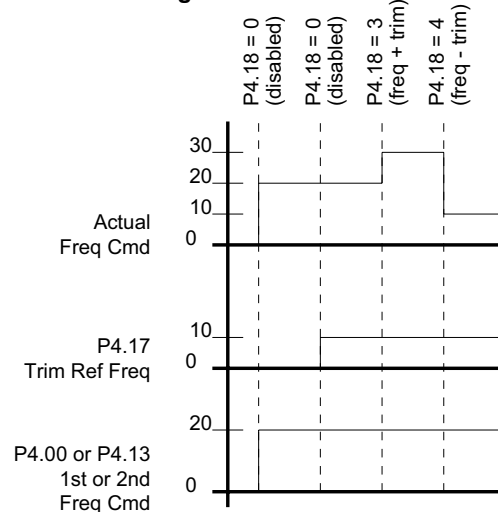
- For parameter settings 03 and 04, the Trim Frequency modifies whichever primary Frequency Command is selected as active by the digital input controlled by P3.02~P3.10 settings 19 or 20.
- This parameter is available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version.

P4.18 - Settings 01 & 02



NOTE: P4.00 & P4.13 values shown also include any effects of P4.01~P4.04 and P4.14~P4.16. These seven additional parameters affect frequency commands only from the analog inputs. They do not affect keypad or RS-485 frequency commands.

P4.18 - Settings 03 & 04



NOTE: P4.00 & P4.13 values shown also include any effects of P4.01~P4.04 and P4.14~P4.16. These seven additional parameters affect frequency commands only from the analog inputs. They do not affect keypad or RS-485 frequency commands.

ANALOG INPUT PARAMETER EXAMPLES

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

Use the equations below when calculating the values for the Maximum Output Frequency, Analog Input Offset, Analog Input Gain, and the Mid-point Frequency.

- A) Maximum output frequency =
(P0.04 Maximum Speed ÷ P0.03 Base Speed) x P0.02 Base Frequency



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

- B) Analog Offset % = (minimum frequency reference ÷ maximum output frequency) x 100
C) Analog Gain % = ((max freq reference - min freq reference) ÷ max output frequency) x 100
D) Mid-point Frequency = ((max freq reference - min freq reference) ÷ 2) + min freq reference



The mid-point frequency calculation shows the frequency reference of the drive when the potentiometer or other analog input device is at its mid-point.

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

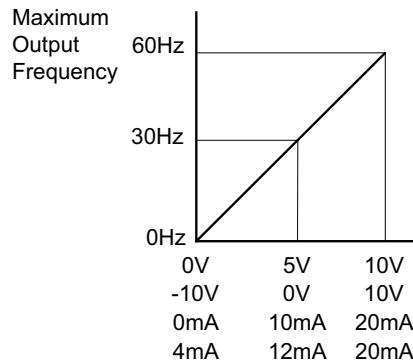
Calculations

- A) Max output frequency = (1750rpm ÷ 1750rpm) x (60Hz) = 60Hz
- B) P4.02 Analog Offset % = (0Hz ÷ 60Hz) x 100 = 0%
- C) P4.03 Analog Gain % = ((60Hz - 0Hz) ÷ 60Hz) x 100 = 100%
- D) Mid-point frequency = ((60Hz - 0Hz) ÷ 2) + 0Hz = 30Hz

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 = 70 Hz
- P0.04 Motor Maximum RPM = 2042 rpm

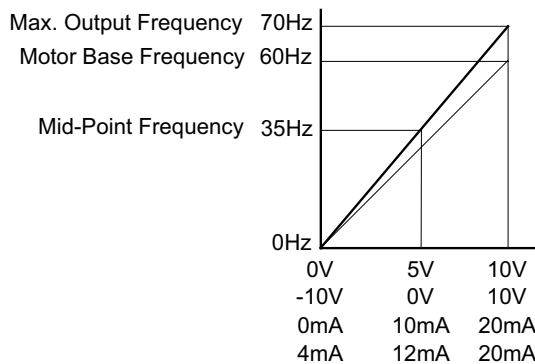
Calculations

- A) Max output frequency = (2042 rpm / 1750 rpm) x 60 Hz = 70 Hz
- B) Analog Offset % = (0Hz / 70 Hz) x 100 = 0%
- C) Analog Gain % = ((70 Hz - 0Hz) / 70 Hz) x 100 = 100%
- D) Mid-point frequency = ((70 Hz - 0Hz) / 2) + 0Hz = 35 Hz

Parameter Settings

- P0.04: 2042 [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 60 Hz.

- Minimum Frequency Reference = 10 Hz
- Maximum Frequency Reference = 60 Hz

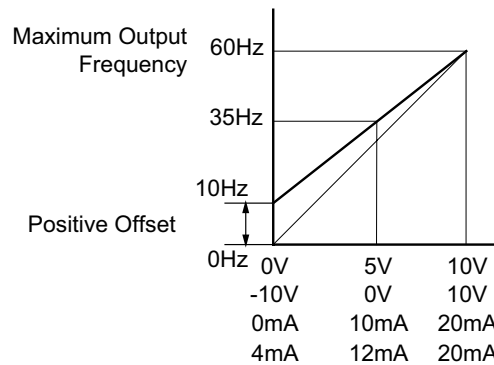
Calculations

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

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 = -60 Hz (reverse)
- Maximum Frequency Reference = 60 Hz

Calculations

- A) Max Output Frequency = (1750 rpm / 1750 rpm) x 60 Hz = 60 Hz
- B) Analog Offset % = (-60 Hz / 60 Hz) x 100 = -100%
- C) Analog Gain % = ((60 Hz - (-60 Hz)) / 60 Hz) x 100 = 200%
- D) Mid-point Frequency = ((60 Hz - (-60 Hz)) / 2) + (-60 Hz) = 0Hz

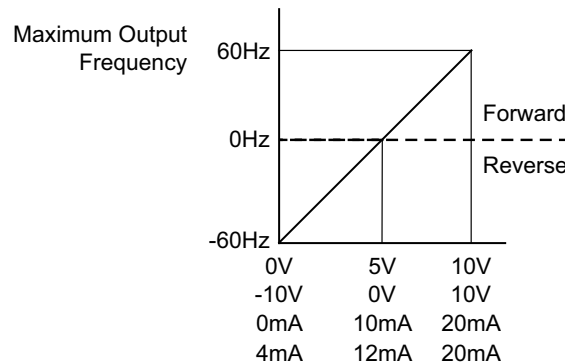


The negative (-) value for the Analog Offset % shows that a negative offset is needed for P4.01.

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 = -15 Hz (reverse)
- Maximum Frequency Reference = 60 Hz

Calculations

- A) Max Output Frequency = (1750 rpm / 1750 rpm) x 60 Hz = 60 Hz
- B) Analog Offset % = (-15 Hz / 60 Hz) x 100 = -25%
- C) Analog Gain % = ((60 Hz - 15 Hz) / 60 Hz) x 100 = 125%
- D) Mid-point Frequency = ((60 Hz - (-15 Hz)) / 2) + (-15 Hz) = 22.5 Hz

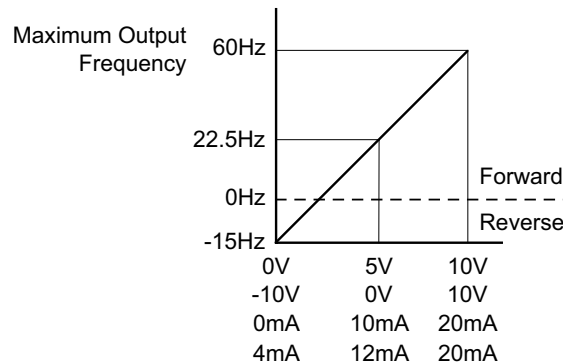


The negative (-) value for the Analog Offset % shows that a negative offset is needed for P4.01.

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 60 Hz if controlled from the Keypad, RS-485 interface, Jog Command, or Multi-Speed settings.

- Minimum Frequency Reference = 0Hz
- Maximum Frequency Reference = 50 Hz

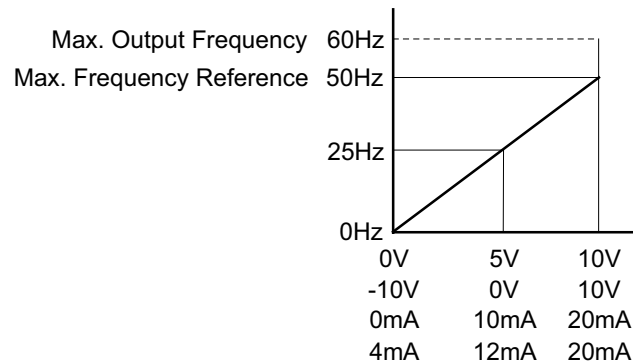
Calculations

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

Parameter Settings

- P4.01: 00 (default) – Offset disabled
- P4.02: 00 (default) – 0% Analog Input Offset
- P4.03: 71.4 – 71.4% 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 = 11.5 Hz
- Maximum Frequency Reference = 39.6 Hz

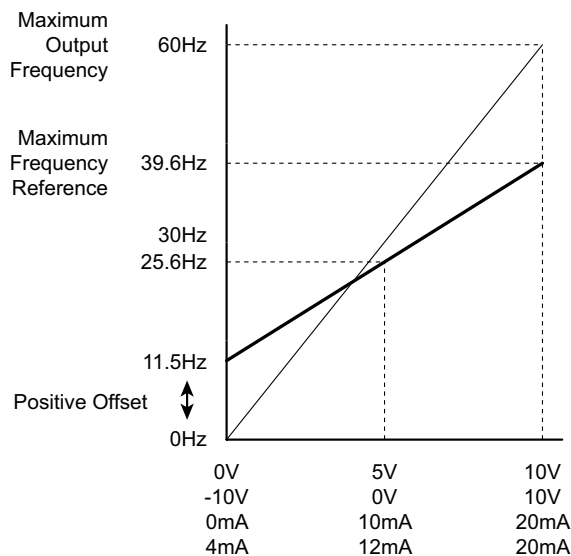
Calculations

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

Parameter Settings

- P4.01: 01 – Positive Analog 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: TRIM MODE

This example illustrates using the drive in Trim Mode with a Trim Reference Frequency

- Minimum Frequency Reference = 0Hz
- Maximum Frequency Reference = 45Hz
- Output Frequency = Frequency Command - Trim Reference Frequency

Calculations

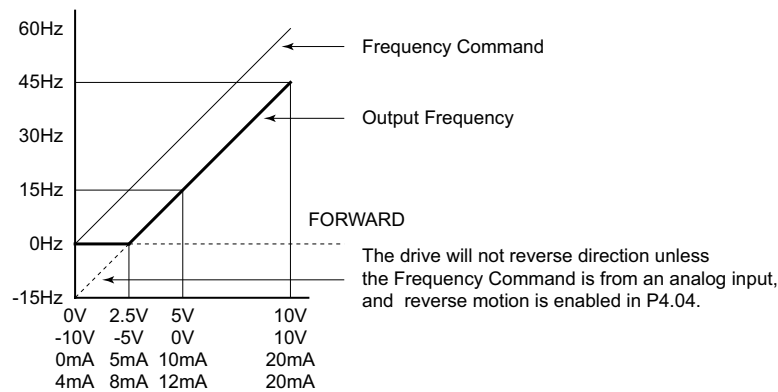
- A) Max Output Frequency = (1750 rpm / 1750 rpm) x 60Hz = 60Hz
- B) Analog Offset % = (0Hz / 60 Hz) x 100 = 0%
- C) Analog Gain % = ((60 Hz - 0Hz) / 60 Hz) x 100 = 100%
- D) Mid-point Frequency = ((60 Hz - 0Hz) / 2) + 0Hz = 30Hz

NOTE: Actual Output Frequency_{P4.18=04} = Freq Command – Trim Ref Freq

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
- P4.17: 15 – Trim Reference Frequency = 15 Hz
- P4.18: 04 – Output Frequency = Frequency Command - Trim Reference Frequency

Results



EXAMPLE 9: 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

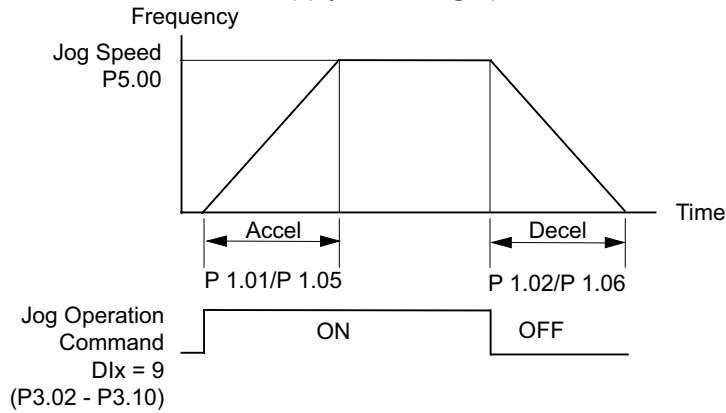
P5.00 ♦ Jog Speed

Range: 0.0 to 400.0 Hz

Default: 6.0

This parameter sets the speed for the Jog Command.

- The Jog Command is selected by a Multi-Function Input Terminal (P3.02 to P3.10) set to the Jog Command function (09).
- Acceleration and deceleration times apply to the Jog Speed



The Jog function can be used in conjunction with the direction signal (FWD/REV; P3.01 = 01 or 02) to Jog in forward and reverse directions.



The drive must be stopped to initiate this command. The Jog command cannot be used simultaneously with an active FWD/STOP, REV/STOP, or RUN/STOP command.

<u>P5.01</u> ♦ Multi-Speed 1	<i>Default Setting:</i> 0.0
<u>P5.02</u> ♦ Multi-Speed 2	<i>Default Setting:</i> 0.0
<u>P5.03</u> ♦ Multi-Speed 3	<i>Default Setting:</i> 0.0
<u>P5.04</u> ♦ Multi-Speed 4	<i>Default Setting:</i> 0.0
<u>P5.05</u> ♦ Multi-Speed 5	<i>Default Setting:</i> 0.0
<u>P5.06</u> ♦ Multi-Speed 6	<i>Default Setting:</i> 0.0
<u>P5.07</u> ♦ Multi-Speed 7	<i>Default Setting:</i> 0.0
<u>P5.08</u> ♦ Multi-Speed 8	<i>Default Setting:</i> 0.0
<u>P5.09</u> ♦ Multi-Speed 9	<i>Default Setting:</i> 0.0
<u>P5.10</u> ♦ Multi-Speed 10	<i>Default Setting:</i> 0.0
<u>P5.11</u> ♦ Multi-Speed 11	<i>Default Setting:</i> 0.0
<u>P5.12</u> ♦ Multi-Speed 12	<i>Default Setting:</i> 0.0
<u>P5.13</u> ♦ Multi-Speed 13	<i>Default Setting:</i> 0.0
<u>P5.14</u> ♦ Multi-Speed 14	<i>Default Setting:</i> 0.0
<u>P5.15</u> ♦ Multi-Speed 15	<i>Default Setting:</i> 0.0

Range for P5.01~P5.15: 0.0 to 400.0 Hz

The Multi-Function Input Terminals (refer to P3.02 to P3.10) are used to select one of the AC drive preset Multi-speeds. The speeds (frequencies) are determined by the settings of P5.01 to P5.15.



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

Multi-Speed Bits				Speed Selection
Bit 4	Bit 3	Bit 2	Bit 1	
OFF	OFF	OFF	OFF	P4.00: Source of Frequency
OFF	OFF	OFF	ON	P5.01: Multi-Speed 1
OFF	OFF	ON	OFF	P5.02: Multi-Speed 2
OFF	OFF	ON	ON	P5.03: Multi-Speed 3
OFF	ON	OFF	OFF	P5.04: Multi-Speed 4
OFF	ON	OFF	ON	P5.05: Multi-Speed 5
OFF	ON	ON	OFF	P5.06: Multi-Speed 6
OFF	ON	ON	ON	P5.07: Multi-Speed 7

Multi-Speed Bits				Speed Selection
Bit 4	Bit 3	Bit 2	Bit 1	
ON	OFF	OFF	OFF	P5.08: Multi-Speed 8
ON	OFF	OFF	ON	P5.09: Multi-Speed 9
ON	OFF	ON	OFF	P5.10: Multi-Speed 10
ON	OFF	ON	ON	P5.11: Multi-Speed 11
ON	ON	OFF	OFF	P5.12: Multi-Speed 12
ON	ON	OFF	ON	P5.13: Multi-Speed 13
ON	ON	ON	OFF	P5.14: Multi-Speed 14
ON	ON	ON	ON	P5.15: Multi-Speed 15

PROTECTION PARAMETERS

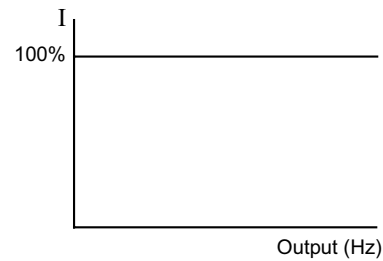
P6.00 Electronic Thermal Overload Relay

Default: 00

Settings:

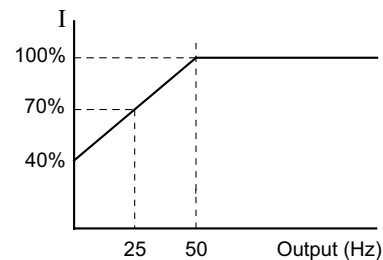
00 Constant Torque (Recommended for inverter/vector duty motors)

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.



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:

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

Example:

If the rated motor current is 10A, and the output frequency is 25Hz, the derating will be 70%, and the overload will be 10.5A (150%) for one minute.

- $I_{\text{output}} (\%) = [(25\text{Hz}) (1.2 \text{ \%/Hz})] + 40\% = 70\%$
- $10\text{A} \times 70\% = 7\text{A}$
- $7\text{A} \times 150\% = 10.5\text{A}$

02 Inactive

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).

P6.01 Auto Restart after Fault

Range: 00 to 10

Default Setting: 00

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: 00

- 00 Stop operation after momentary power loss.
- 01 Continue operation after momentary power loss; speed search from Speed Reference.
- 02 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 00 (Operation determined by digital keypad).

P6.03 Reverse Operation Inhibit

Settings:

Default Setting: 00

- 00 Enable Reverse Operation
- 01 Disable Reverse Operation

This parameter determines whether the AC Motor Drive can operate in the reverse direction.

P6.04 Auto Voltage Regulation

Settings:

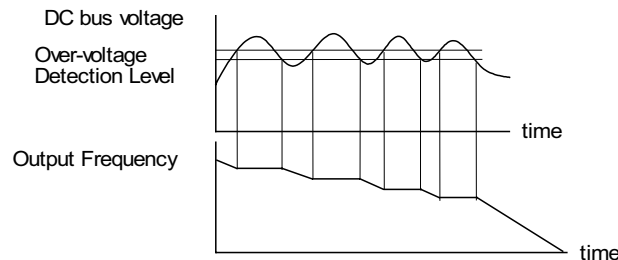
Default Setting: 00

- 00 AVR enabled
 - 01 AVR disabled
 - 02 AVR disabled during decel
 - 03 AVR disabled during stop
- AVR function automatically regulates the AC drive output voltage to the Maximum Output Voltage (P0.00). For instance, if P0.00 is set at 200 VAC and the input voltage is at 200V to 264VAC, then the Maximum Output Voltage will automatically be regulated to 200 VAC.
 - Without AVR function, the Maximum Output Voltage may vary between 180V to 264VAC, due to the input voltage varying between 180V to 264 VAC.
 - Selecting program value 2 enables the AVR function and also disables the AVR function during deceleration. This offers a quicker deceleration.

P6.05 Over-Voltage Stall PreventionSettings:Default Setting: 00

- 00 Enable Over-voltage Stall Prevention
- 01 Disable Over-voltage Stall Prevention

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. If deceleration time is critical for the application, a dynamic braking resistor should be used. Set this parameter to **01 (disable)** when using a dynamic braking resistor.*

P6.06 Auto Adjustable Accel/DecelSettings:Default Setting: 00

- 00 Linear Accel/Decel
- 01 Auto Accel, Linear Decel
- 02 Linear Accel, Auto Decel
- 03 Auto Accel/Decel
- 04 Auto Accel/Decel Stall Prevention

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.

This parameter provides five modes to choose:

- 00 Linear Acceleration and deceleration (operation by P1.01, P1.02 or P1.05, P1.06 acceleration/deceleration time).
- 01 Automatic acceleration, linear deceleration (Operation by automatic acceleration time, P1.02 or P1.06 deceleration time).
- 02 Linear acceleration and automatic deceleration (Operation by automatic acceleration time, P1.01 or P1.05 acceleration time).
- 03 Automatic acceleration, deceleration (Operation by AC drive auto adjustable control).
- 04 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.

P6.07 Over-Torque Detection ModeSettings:Default Setting: 00

- 00 Disabled
- 01 Enabled during constant speed operation
- 02 Enabled during acceleration

P6.08 Over-Torque Detection Level

Range:
30–200%

Default Setting: 150

- A setting of 100% is proportional to the Rated Output Current of the drive.
- This parameter sets the Over-Torque Detection level in 1% increments (the AC drive rated current is equal to 100%).

P6.09 Over-Torque Detection Time

Range:
0.1 to 10.0

Default Setting: 0.1

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

P6.10 Over-current Stall Prevention during Acceleration

Range:
20 to 200% [a setting of 0 disables this parameter]

Default Setting: 150

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

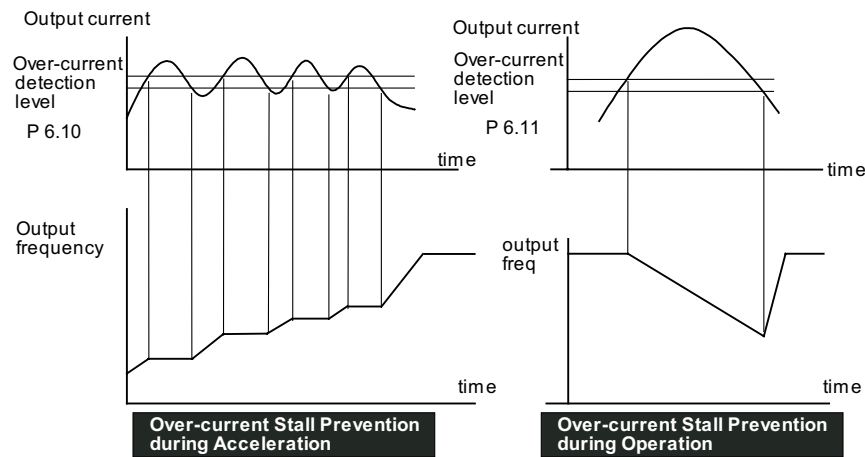
Under certain conditions, the AC drive output current may increase abruptly, and exceed the value specified by P6.10. This is commonly caused by rapid acceleration or excessive load on the motor. When this function is enabled, the AC drive will stop accelerating and maintain a constant output frequency.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

P6.11 Over-current Stall Prevention during Operation

Range:
20 to 200% [a setting of 0 disables this parameter]

Default Setting: 150

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

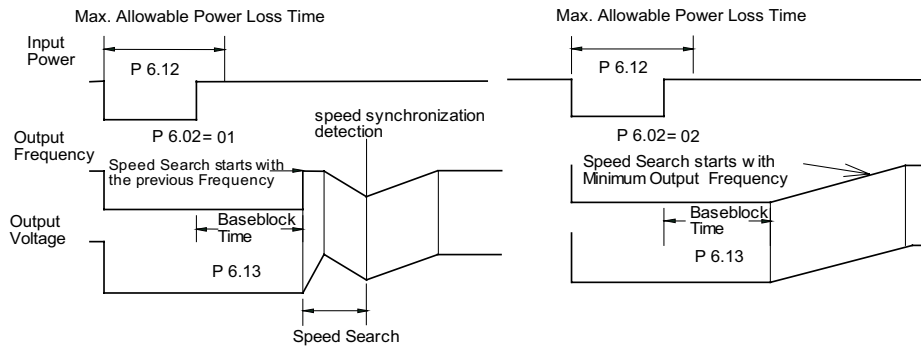
- When a momentary power loss is detected, the AC drive turns off for a specified time interval determined by P6.13 before resuming operation. This time interval is called Base-Block. This parameter should be set to a value where the residual output voltage due to regeneration is nearly zero, before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

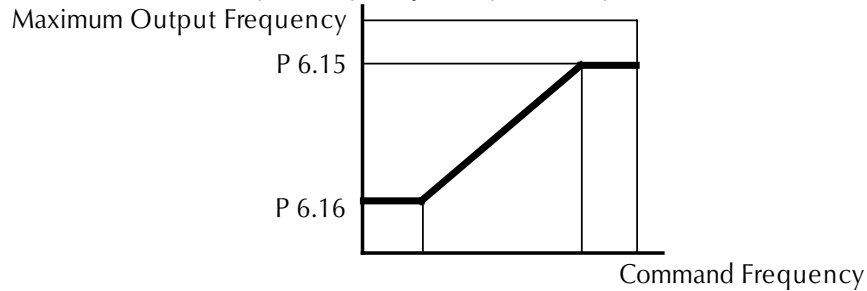
- The Upper/Lower Bound of Output Frequency is to prevent operation error and machine damage.
- This parameter must be equal to or greater than the Lower Bound of Output Frequency (P6.16).
- If the Upper Bound of Output Frequency is 50Hz and the Maximum Output Frequency is 60 Hz, then any Command Frequency above 50 Hz will generate a 50 Hz output from the drive.
- The Output Frequency is also limited by the Motor Maximum RPM (P0.04).

P6.16 Lower Bound of Output Frequency

Range:
0.0 to 400 Hz

Default Setting: 0.0

- The Upper/Lower Bound of Output Frequency is to prevent operation error and machine damage.
- This parameter must be equal to or less than the Upper Bound of Output Frequency (P6.15).
- If the Lower Bound of Output Frequency is 10 Hz, and the Minimum Output Frequency (P2.06) is set at 1.0 Hz, then any Command Frequency between 1-10 Hz will generate a 10 Hz output from the drive.
- The Upper/Lower Bound of Output Frequency is to prevent operation error and machine damage.



If the reference frequency is less than 0.5 Hz, then this parameter setting is disabled.

P6.17 Over-Voltage Stall Prevention Level

Range:
230V Series - 330.0V to 450.0V
460V Series - 600.0V to 900.0V

Default Setting:
Default 230V series = 390.0V
Default 460V series = 780.0V

When drive is running, if the DC bus voltage exceeds Over-Voltage Stall level (P6.17), the AC drive will start over-voltage stall prevention.

P6.18 Braking Voltage Level

Range:
230V Series - 370.0V to 450.0V
460V Series - 740.0V to 900.0V

Default Setting:
Default 230V series = 380.0V
Default 460V series = 760.0V

This parameter establishes the Dynamic Braking Voltage level threshold based on the DC Bus voltage. With the drive running and with DC Bus voltage above the braking level threshold, the braking transistor internal to the drive is gated ON, connecting the external braking resistor across the DC Bus to dissipate the excess voltage as heat.

P6.30 Line Start Lockout

Settings
00 Enable Line Start Lockout
01 Disable Line Start Lockout

Default Setting: 00

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 v1.02 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**

SettingsDefault Setting: 00

- 00 No Fault occurred
- 01 Over-current (oc)
- 02 Over-voltage (ov)
- 03 Over-temperature (oH)
- 04 Overload (oL)
- 05 Thermal Overload (oL1)
- 06 Over-Torque (oL2)
- 07 External Fault (EF)
- 08 CPU failure 1 (CF1)
- 09 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)
- 15 Ground fault or fuse failure (GFF)
- 17 Input Power 3 phase loss
- 19 Auto Ramp Fault
- 20 Parameters Locked
- 21 PID Feedback Loss
- 22 Encoder Feedback Loss
- 23 Output Shorted(OCC)
- 24 Momentary Power Loss

P6.37 Hunting GainRange:Default Setting: 0

0 to 1000

This parameter can help control frequency oscillation of motors (if needed). If system vibration is encountered due to drive frequency hunting, reduce the vibration by adjusting this parameter while monitoring drive/motor operation.

- This parameter is enabled only in the “high-speed regulation” control modes; (P2.10 = 04 or 05).
- This parameter is available only with AC drive firmware v1.05 or higher. Refer to P9.39 to determine the drive’s firmware version.

PID PARAMETERS

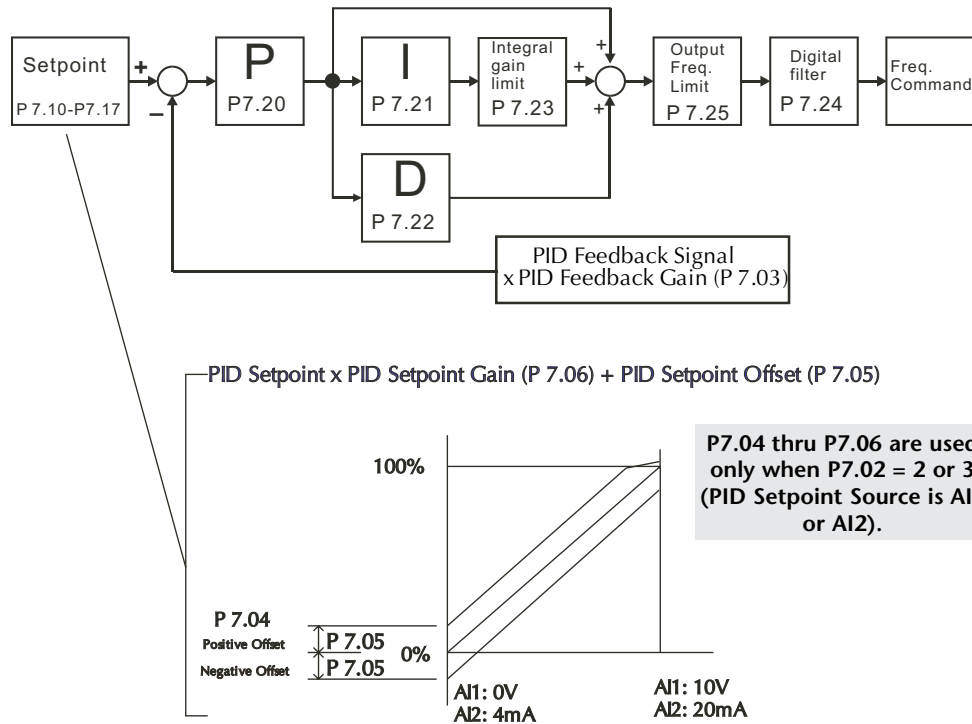
P7.00 Input Terminal for PID Feedback

Settings

Default Setting: 00

- 00 Inhibit PID operation.
- 01 Forward-acting (heating loop) PID feedback, PV from AI1 (0 to +10V)
- 02 Forward-acting (heating loop) PID feedback, PV from AI2 (4 to 20 mA)
- 03 Reverse-acting (cooling loop) PID feedback, PV from AI1 (0 to +10V)
- 04 Reverse-acting (cooling loop) PID feedback, PV from AI2 (4 to 20 mA)

Basic PID Loop Diagram:



P7.01 PV 100% Value

Range:

Default Setting: 100.0

0.0 to 999

This parameter should be set to the value corresponding to the 100% value of the process variable (PV). The setting for P7.01 cannot be less than any setting for P7.10 to P7.17.



The setting for PV 100% value (P7.01) cannot be set less than any value set for P7.10 to P7.17. If you are unable to reduce P7.01 to the desired value, check parameters P7.10 to P7.17, and reduce these values accordingly.

P7.02 PID Setpoint Source

Settings:

Default Setting: 02

- 00 Keypad
- 01 Serial Communications*
- 02 AI1 (0 to 10V)
- 03 AI2 (4 to 20mA)

The user may change the display to PID setpoint by changing P8.00 to 07 on the keypad.



NOTE: (Serial communication PID setpoint uses P7.10 memory address: Hexadecimal - 070A; MODBUS Decimal - 41803; Octal - V3412. table)*

P7.03 ♦ PID Feedback Gain

Range:
00 to 300.0%

Default Setting: 100

P7.04 ♦ PID Setpoint Offset Polarity

Settings:
00 No Offset
01 Positive Offset
02 Negative Offset

Default Setting: 00

This parameter functions similarly to P4.01, Analog Input Offset Polarity.

- This parameter only affects analog inputs AI1 and AI2. It does not affect AI3.

P7.05 ♦ PID Setpoint Offset

Range:
0.0 to 100.0%

Default Setting: 0.0

This parameter functions similarly to P4.02, Analog Input Offset.

- This parameter only affects analog inputs AI1 and AI2. It does not affect AI3.

P7.06 ♦ PID Setpoint Gain

Range:
0.0 to 300.0%

Default Setting: 100

This parameter functions similarly to P4.03, Analog Input Gain.

- This parameter only affects analog inputs AI1 and AI2. It does not affect AI3.

P7.10 ♦ Keypad PID Setpoint

Range:
0.0 to 999

Default Setting: 0.0

This parameter is used for serial communication PID setpoints.



Serial communication PID setpoint uses P7.10 memory address:
Hexadecimal - 070A, MODBUS Decimal - 41803, Octal - V3412



The Setting for P7.10 cannot exceed the setting for P7.01.



The setting for PV 100% value (P7.01) cannot be set less than any value set for P7.10 to P7.17. If you are unable to reduce P7.01 to the desired value, check parameters P7.10 to P7.17, and reduce these values accordingly.

- P7.11** ◆PID Multi-setpoint 1
- P7.12** ◆PID Multi-setpoint 2
- P7.13** ◆PID Multi-setpoint 3
- P7.14** ◆PID Multi-setpoint 4
- P7.15** ◆PID Multi-setpoint 5
- P7.16** ◆PID Multi-setpoint 6
- P7.17** ◆PID Multi-setpoint 7

Range:
0.0 to 999

Default Setting: 0.0

The Multi-Function Input Terminals DI3 to DI11 (P3.02 to P3.10) are used to select one of the PID Multi-Setpoints. The SPs are determined by P7.11 to P7.17



- 1) In order to use the Multi-PID SPs, P7.11 - P7.17 must be set, and P7.00 ≠ 0.
- 2) The settings for P7.11 through P7.17 cannot exceed the setting for P7.01
- 3) When all PID Multi-Setpoint inputs are off, the AC drive reverts to the PID Setpoint Source (P7.02).

Multi-PID SP Bits			PID SP Selection
Bit 3	Bit 2	Bit 1	
OFF	OFF	OFF	P7.02
OFF	OFF	ON	P7.11: SP 1
OFF	ON	OFF	P7.12: SP 2
OFF	ON	ON	P7.13: SP 3
ON	OFF	OFF	P7.14: SP 4
ON	OFF	ON	P7.15: SP 5
ON	ON	OFF	P7.16: SP 6
ON	ON	ON	P7.17: SP 7

P7.20 ◆ **Proportional Control (P)**

Range:
0.0 to 10.0

Default Setting: 1.0

The first parameter of PID control is Proportional Control (P). For a given process, if the Proportional Value is set too low, the control action will be too sluggish. If the Proportional value is set too high, the control action will be unstable (erratic).

Set the Integral Control (I) and Derivative Control (D) to zero (0). Begin tuning the process with a low Proportional Value, and increase the Proportional value until the system goes unstable (erratic). When instability is reached, reduce the Proportional Value slightly until the system becomes stable (smaller values reduce system Gain). Stability can be tested by moving between two wide-spread setpoint values.

With 10% deviation and P=1, then PX 10% = Control Output. For example, if the speed of a motor is dragged down 10% due to a load increase, a corrective speed signal increase of 10% is generated. In a perfect world, this increase in speed command should bring the motor speed back to normal.

P7.21 ◆ **Integral Control (I)**

Range:
0.0 to 100.0 sec (0.00 disable)

Default Setting: 1.00

Using only the Proportional Control, the corrective action may not increase fast enough or the setpoint may never be reached because of system losses. The Integral Control is used to generate additional corrective action.

When tuning, begin with a large Integral value and reduce the value until the system goes unstable (erratic). When instability is reached, increase the Integral value slightly until the system becomes stable and the desired setpoint value is reached.

P7.22 ♦ **Derivative Control (D)**

Range:
0.0 to 1.00 sec

Default Setting: 0.00

If the control output is too sluggish after the Proportional Control (P) and Integral Control (I) values are set, Derivative Control (D) may be required. Begin with a high Derivative value and reduce the value to the point of system instability. Then increase the Derivative value until the control output regains stability. Stability can be tested by moving between two wide-spread setpoint values.

P7.23 **Upper Bound for Integral Control**

Range:
00 to 100%

Default Setting: 100

This parameter defines an upper boundary or limit for the integral gain (I) and therefore limits the Master Frequency. Use the formula below to calculate the Integral upper limit.

The formula is: Integral upper limit = (Maximum Output Frequency) x P7.23. This parameter can limit the Maximum Output Frequency.

$$\text{Max. Output Frequency} = \left(\frac{\text{Maximum Speed (P 0.04)}}{\text{Base Speed (P 0.03)}} \right) \times \text{Base Frequency (P 0.02)}$$

P7.24 **Derivative Filter Time Constant**

Range:
0.0 to 2.5 sec

Default Setting: 0.0

To avoid amplification of measured noise in the controller output, a derivative digital filter is inserted. This filter helps smooth oscillations. Larger values for P7.24 provide more smoothing.

P7.25 **PID Output Frequency Limit**

Range:
00 to 110%

Default Setting: 100

This parameter defines the percentage of output frequency limit during the PID control. The formula is Output Frequency Limit = (Maximum Output Frequency) x P7.25. This parameter will limit the Maximum Output Frequency.

$$\text{Max. Output Frequency} = \left(\frac{\text{Maximum Speed (P 0.04)}}{\text{Base Speed (P 0.03)}} \right) \times \text{Base Frequency (P 0.02)}$$

P7.26 **Feedback Signal Loss Detection Time**

Range:
0.0 to 3600 sec

Default Setting: 60

This parameter defines how long the PID Feedback signal is lost before an error is generated. Setting this parameter to 0.0 disables the PID Feedback loss timer. When the feedback signal is lost, the PID Feedback loss timer starts timing. When the timer value is greater than the setting value of P7.26, the PID Feedback Loss warning will activate as set in P7.27. The display shows "PID FBACK LOSS", meaning a feedback abnormality is detected. When the signal is corrected, the warning message "PID FBACK LOSS" will automatically be corrected if a PV signal is still present. If no signal is present, then the screen must be manually reset.

P7.27 **PID Feedback Loss Operation**

Settings:
00 Warn and AC Drive Stop
01 Warn and Continue Operation
*02 Warn and Continue at Last Frequency
*03 Warn and Continue Preset Speed set in P7.28

Default Setting: 00

* - Parameter setting available only with firmware v1.04 or higher (refer to P9.39)

This parameter sets the operation of the drive when there is a loss of the PID feedback signal.

P7.28 PID Feedback Loss Preset Speed

Range:
0 to 400.0 Hz

Default Setting: 0.0

This parameter sets the speed of operation of the drive when there is a loss of the PID feedback signal, and P7.27 is set to 03.

- *This parameter is available only with AC drive firmware v1.04 or higher. Refer to P9.39 to determine the drive's firmware version.*

DISPLAY PARAMETERS

P8.00 ♦ User Defined Display Function

Settings:

Default Setting: 00

- 00 Output Frequency (Hz)
- 01 Motor Speed (rpm)
- 02 Scaled Frequency
- 03 Output Current (A)
- 04 Motor Load (%)
- 05 Output Voltage (V)
- 06 DC Bus Voltage (V)
- 07 PID Setpoint
- 08 PID Feedback (PV)
- 09 Frequency Setpoint

P8.01 ♦ Frequency Scale Factor

Range:

Default Setting: 1.0

0.01 to 160.0

This parameter can be used to multiply the display unit by a scaling factor so that the display will represent some other user desired unit. For example, the user may want to scale the drive display to represent ft/min for a motor that is driving a conveyor.

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

- The display value is calculated as follows:

$$\text{Display value} = \text{output frequency} \times K$$

- 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 five digits as explained below:

Display	Number Represented
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 "300.5 (three hundred 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 12340 would be displayed as "1234."

P8.02 ♦ Backlight Timer

Settings:

Default Setting: 00

- 00 Timer Enable (1 min light off)
- 01 Timer Disable

This parameter is used to enable or disable the backlight timer.

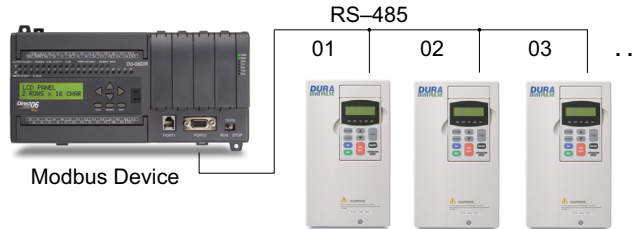
COMMUNICATIONS PARAMETERS

P9.00 Communication Address

Range:
01 to 254

Default Setting: 01

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



P9.01 Transmission Speed

Settings:
00 4800 baud data transmission speed
01 9600 baud data transmission speed
02 19200 baud data transmission speed
03 38400 baud data transmission speed

Default Setting: 01

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

P9.02 Communication Protocol

Settings:
00 MODBUS ASCII mode, 7 data bits, no parity, 2 stop bits
01 MODBUS ASCII mode, 7 data bits, even parity, 1 stop bit
02 MODBUS ASCII mode, 7 data bits, odd parity, 1 stop bit
03 MODBUS RTU mode, 8 data bits, no parity, 2 stop bits
04 MODBUS RTU mode, 8 data bits, even parity, 1 stop bit
05 MODBUS RTU mode, 8 data bits, odd parity, 1 stop bit

Default Setting: 00

Each DURAPULSE AC drive has a pre-assigned communication address specified by P9.00. The master computer or PLC then controls each AC drive according to its communication address. DURAPULSE drives can be set up to communicate on Modbus networks using one of the following modes: ASCII (American Standard Code for Information Interchange), or RTU (Remote Terminal Unit). Users can select the desired mode along with the serial port communications protocol using the settings above.

P9.03 Transmission Fault Treatment

Settings:
00 Display fault and continue operating
01 Display fault and RAMP to stop
02 Display fault and COAST to stop
03 No fault displayed and continue operating

Default Setting: 00

This parameter is used to detect an error and take appropriate action.

P9.04 Time Out Detection

Settings:
00: Disable
01: Enable

Default Setting: 00

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:
00 All parameters can be set and read
01 All parameters are read only

Default Setting: 00

P9.08 Restore to Default

Settings:
00 Default
99 Restore all parameters to factory defaults

Default Setting: 00

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

P9.11 ♦ Block Transfer Parameter 1**P9.12 ♦ Block Transfer Parameter 1****P9.13 ♦ Block Transfer Parameter 1****P9.14 ♦ Block Transfer Parameter 1****P9.15 ♦ Block Transfer Parameter 1****P9.16 ♦ Block Transfer Parameter 1****P9.17 ♦ Block Transfer Parameter 1****P9.18 ♦ Block Transfer Parameter 1****P9.19 ♦ Block Transfer Parameter 1****P9.20 ♦ Block Transfer Parameter 1****P9.21 ♦ Block Transfer Parameter 1****P9.22 ♦ Block Transfer Parameter 1****P9.23 ♦ Block Transfer Parameter 1****P9.24 ♦ Block Transfer Parameter 1****P9.25 ♦ Block Transfer Parameter 1**

Range:
P0.00 to P8.02, P9.99

Default Setting: P9.99

The sequential block transfer parameters (P9.11 through P9.25) allow you to “group” various miscellaneous non-sequential parameters, so that only one PLC programming write instruction is required to update those parameters, instead of three separate write instructions.

- Example:
Writing directly to three non-sequential parameters P1.00, P1.02, and P1.04 requires three separate write instructions from the PLC. However, those drive parameters can be updated with only one PLC write instruction to the sequential transfer blocks P9.11 through P9.13; if P9.11 is set to P1.00, P9.12 is set to P1.02, and P9.13 is set to P1.04.
- Setting P9.99 (default) disables the Block Transfer Parameter.

P9.26 ♦ Serial Comm Speed Reference

Range:
0.0 to 400.0 Hz [16-bit binary (HEX) format]

Default Setting: 60.0

This parameter is used to set the Frequency Command 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 05.

P9.27 ♦ Serial Comm RUN Command

Settings: Default Setting: 00
 00 Stop
 01 Run

- Do not write both RUN (P9.27) & JOG (P9.31) Commands in the same write instruction. Use separate write instructions from the master computer or PLC.



In order for this parameter to function, the Source of Operation Command (P3.00) must be set to 03 or 04.

P9.28 ♦ Serial Comm Direction Command

Settings: Default Setting: 00
 00 Forward
 01 Reverse

P9.29 ♦ Serial Comm External Fault

Settings: Default Setting: 00
 00 No action
 01 External fault

P9.30 ♦ Serial Comm Fault Reset

Settings: Default Setting: 00
 00 No action
 01 Fault Reset

P9.31 ♦ Serial Comm JOG Command

Settings: Default Setting: 00
 00 Stop
 01 Jog

- Do not write both RUN (P9.27) & JOG (P9.31) Commands in the same write instruction. Use separate write instructions from the master computer or PLC.

P9.39 Firmware Version

Settings: Default Setting: ##
 Factory set, read only

- This parameter is available only with AC drive firmware v1.02 or higher.

P9.40 ♦ Parameter Copy

Settings: Default Setting: 00
 00 DISABLE Copy Keypad Function
 01 ENABLE Copy Keypad Function

This parameter is used to upload or download information to the drive.

P9.41 GS Series Number

Settings: Default Setting: ##
 01 GS1
 02 GS3
 03 GS3
 04 GS4

P9.42 Manufacturer Model InformationSettings:Default Setting: ##

- 00 GS3-21P0 (230V / 3ph / 1.0 hp)
- 01 GS3-22P0 (230V / 3ph / 2.0 hp)
- 02 GS3-23P0 (230V / 3ph / 3.0 hp)
- 03 GS3-25P0 (230V / 3ph / 5.0 hp)
- 04 GS3-27P5 (230V / 3ph / 7.5 hp)
- 05 GS3-2010 (230V / 3ph / 10 hp)
- 06 GS3-2015 (230V / 3ph / 15 hp)
- 07 GS3-2020 (230V / 3ph / 20 hp)
- 08 GS3-2025 (230V / 3ph / 25 hp)
- 09 GS3-2030 (230V / 3ph / 30 hp)
- 10 GS3-2040 (230V / 3ph / 40 hp)
- 11 GS3-2050 (230V / 3ph / 50 hp)
- 12 GS3-41P0 (460V / 3ph / 1.0 hp)
- 13 GS3-42P0 (460V / 3ph / 2.0 hp)
- 14 GS3-43P0 (460V / 3ph / 3.0 hp)
- 15 GS3-45P0 (460V / 3ph / 5.0 hp)
- 16 GS3-47P5 (460V / 3ph / 7.5 hp)
- 17 GS3-4010 (460V / 3ph / 10 hp)
- 18 GS3-4015 (460V / 3ph / 15 hp)
- 19 GS3-4020 (460V / 3ph / 20 hp)
- 20 GS3-4025 (460V / 3ph / 25 hp)
- 21 GS3-4030 (460V / 3ph / 30 hp)
- 22 GS3-4040 (460V / 3ph / 40 hp)
- 23 GS3-4050 (460V / 3ph / 50 hp)
- 24 GS3-4060 (460V / 3ph / 60 hp)
- 25 GS3-4075 (460V / 3ph / 75 hp)
- 26 GS3-4100 (460V / 3ph / 100 hp)

ENCODER FEEDBACK PARAMETERS**P10.00 Encoder Pulses Per Revolution**

Range:
01 to 20000

Default Setting: 1024

An encoder is used as a transducer to feed back the motor speed, and this parameter defines the number of pulses for each cycle of the PI control.

P10.01 Encoder Type Input

Settings:
00 Disable
01 Single Phase
02 Quadrature, FWD - CCW
03 Quadrature, FWD - CW

Default Setting: 00

This parameter is used to specify encoder signal type. Settings 02 and 03 are used to distinguish motor rotation in relation to the quadrature type encoder signal. Error message “ENC SIGNAL ERROR” will come up if motor rotation does not match quadrature settings.



The diagram on the following page shows the output control relationship of P10.02, P10.03, and P10.04.

P10.02 ♦ Proportional Control

Range:
0.0 to 10.0

Default Setting: 1.0

This parameter specifies proportional control and associated gain (I) used for vector control with encoder feedback (P2.10 = 03). As part of the drive’s control algorithm, the most recent feedback signal is multiplied on each scan by the scaling factor set by this parameter.

P10.03 ♦ Integral Control

Range:
0.00 to 100.00 sec

Default Setting: 1.00

This parameter specifies integral control and associated gain (I) used for vector control with encoder feedback (P2.10 = 03). The drive calculates a running integral, or summation, of the feedback signal over the time period set by this parameter. This summation, rather than the most recent feedback signal, is used in the control algorithm. Integral control “smoothes” the effect of radical changes in the feedback signal.

P10.04 Encoder Control Output Limit

Range:
0.0 to 20.0%

Default Setting: 7.5

This parameter limits the amount of correction by the encoder proportional and integral controls (P10.02 & P10.03) on the output frequency when controlling speed. It can limit the maximum output frequency, and is defined in percent of maximum output frequency.

P10.05 Encoder Loss Detection

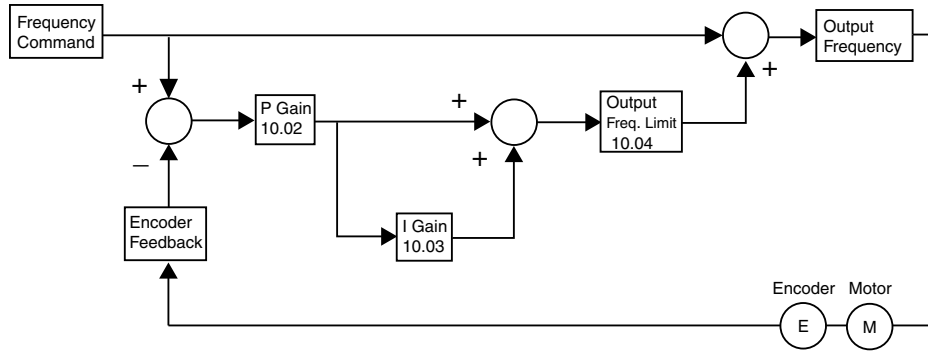
Settings:

Default Setting: 00

- 00 Warn and continue operation
- 01 Warn and RAMP to stop
- 02 Warn and COAST to stop

This parameter governs the response of the drive to the feedback signals, such as the analog or encoder pulse signals, when they are performing abnormally.

Closed Loop Tuning Diagram (P10.02, P10.03, P10.04)



GS3 MODBUS COMMUNICATIONS



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

COMMUNICATIONS PARAMETERS SUMMARY

A summary of the DURApulse GS3 Communications Parameters is listed below. For a complete listing of the DURA GS3 Parameters, refer to Chapter 4.

Communications Parameters Summary			
Parameter	Description	Range	Default
♦ Parameter can be set during RUN Mode.			
** Some parameters are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "GS3 Parameter Summary" in Chapter 4 (AC Drive Parameters) for more information.			
P9.02	Communication Protocol	00: MODBUS ASCII mode 7 data bits, no parity, 2 stop bits 01: MODBUS ASCII mode 7 data bits, even parity, 1 stop bit 02: MODBUS ASCII mode 7 data bits, odd parity, 1 stop bit 03: MODBUS RTU mode 8 data bits, no parity, 2 stop bits 04: MODBUS RTU mode 8 data bits, even parity, 1 stop bit 05: MODBUS RTU mode 8 data bits, odd parity, 1 stop bit	00
P9.03	Transmission Fault Treatment	00: Display fault and continue operating 01: Display fault and RAMP to stop 02: Display fault and COAST to stop 03: No fault displayed and continue operating	00
P9.04	Time Out Detection	00: Disable 01: Enable	00
P9.05	Time Out Duration	0.1 to 60.0 seconds	0.5
♦ P9.07	Parameter Lock	00: All parameters can be read and set 01: All parameters are read-only	00
P9.08	Restore to Default	99: Restores all parameters to factory defaults	00
♦ P9.11	Block Transfer Parameter 1	P0.00 to P8.02, P9.99	P9.99
♦ P9.12	Block Transfer Parameter 2	P0.00 to P8.02, P9.99	P9.99
♦ P9.13	Block Transfer Parameter 3	P0.00 to P8.02, P9.99	P9.99
♦ P9.14	Block Transfer Parameter 4	P0.00 to P8.02, P9.99	P9.99
♦ P9.15	Block Transfer Parameter 5	P0.00 to P8.02, P9.99	P9.99
♦ P9.16	Block Transfer Parameter 6	P0.00 to P8.02, P9.99	P9.99
♦ P9.17	Block Transfer Parameter 7	P0.00 to P8.02, P9.99	P9.99
♦ P9.18	Block Transfer Parameter 8	P0.00 to P8.02, P9.99	P9.99
♦ P9.19	Block Transfer Parameter 9	P0.00 to P8.02, P9.99	P9.99
♦ P9.20	Block Transfer Parameter 10	P0.00 to P8.02, P9.99	P9.99
♦ P9.21	Block Transfer Parameter 11	P0.00 to P8.02, P9.99	P9.99
♦ P9.22	Block Transfer Parameter 12	P0.00 to P8.02, P9.99	P9.99
♦ P9.23	Block Transfer Parameter 13	P0.00 to P8.02, P9.99	P9.99
♦ P9.24	Block Transfer Parameter 14	P0.00 to P8.02, P9.99	P9.99
♦ P9.25	Block Transfer Parameter 15	P0.00 to P8.02, P9.99	P9.99
♦ P9.26	Serial Comm (RS485) Speed Reference	0.0 to 400.0 Hz	60.0
♦ P9.27	Serial Comm RUN Command	00: Stop 01: Run	00
♦ P9.28	Serial Comm Direction Command	00: Forward 01: Reverse	00
♦ P9.29	Serial Comm External Fault	00: No fault 01: External fault	00
♦ P9.30	Serial Comm Fault Reset	00: No action 01: Fault Reset	00

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Communications Parameters Summary (continued from previous page)			
Parameter	Description	Range	Default
♦ Parameter can be set during RUN Mode. ** Some parameters are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "GS3 Parameter Summary" in Chapter 4 (AC Drive Parameters) for more information.			
♦ P9.31	Serial Comm JOG Command	00: Stop 01: Jog	00
P9.39**	Firmware Version	###	###
♦ P9.40	Parameter Copy	00: Disable Copy Keypad Function 01: Enable Copy Keypad Function	00
P9.41	GS Series Number	01: GS1 02: GS2 03: GS3 04: GS4	##
P 9.42	Manufacturer Model Information	00: GS3-21P0 (230V 3ph 1.0hp) 01: GS3-22P0 (230V 3ph 2.0hp) 02: GS3-23P0 (230V 3ph 3.0hp) 03: GS3-25P0 (230V 3ph 5.0hp) 04: GS3-27P5 (230V 3ph 7.5hp) 05: GS3-2010 (230V 3ph 10hp) 06: GS3-2015 (230V 3ph 15hp) 07: GS3-2020 (230V 3ph 20hp) 08: GS3-2025 (230V 3ph 25hp) 09: GS3-2030 (230V 3ph 30hp) 10: GS3-2040 (230V 3ph 40hp) 11: GS3-2050 (230V 3ph 50hp) 12: GS3-41P0 (460V 3ph 1.0hp) 13: GS3-42P0 (460V 3ph 2.0hp) 14: GS3-43P0 (460V 3ph 3.0hp) 15: GS3-45P0 (460V 3ph 5.0hp) 16: GS3-47P5 (460V 3ph 7.5hp) 17: GS3-4010 (460V 3ph 10hp) 18: GS3-4015 (460V 3ph 15hp) 19: GS3-4020 (460V 3ph 20hp) 20: GS3-4025 (460V 3ph 25hp) 21: GS3-4030 (460V 3ph 30hp) 22: GS3-4040 (460V 3ph 40hp) 23: GS3-4050 (460V 3ph 50hp) 24: GS3-4060 (460V 3ph 60hp) 25: GS3-4075 (460V 3ph 75hp) 26: GS3-4100 (460V 3ph 100hp)	##

DURAPULSE GS3 PARAMETER MEMORY ADDRESSES



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

Parameter Memory Addresses				
Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
♦ 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.				
** Some parameters are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "GS3 Parameter Summary" in Chapter 4 (AC Drive Parameters) for more information.				
Motor Parameters				
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
P0.05	Motor Auto Tune	0005	40006	5
P0.06	Motor Line to Line Resistance R1	0006	40007	6
P0.07	Motor No-Load Current	0007	40008	7
Ramp Parameters				
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 2 to Decel 1 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
P1.13	Skip Frequency 4	010D	40270	415
P1.14	Skip Frequency 5	010E	40271	416
P1.17	Skip Frequency Band	0111	40274	421
P1.18	DC Injection Current Level	0112	40275	422
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
Volts/Hertz Parameters				
P2.00	Volts/Hertz Settings	0200	40513	1000
♦ P2.01	Slip Compensation	0201	40514	1001
♦ P2.02	Auto-torque Boost	0202	40515	1002
♦ P2.03	Torque Compensation Time Constant	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
♦ P2.09**	Slip Compensation Time Constant	0209	40522	1011
P2.10	Control Mode	020A	40523	1012

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Parameter Memory Addresses (continued from previous page)				
Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
♦ 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.				
** Some parameters are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "GS3 Parameter Summary" in Chapter 4 (AC Drive Parameters) for more information.				
Digital Parameters				
P3.00	Source of Operation Command	0300	40769	1400
P3.01	Multi-function Input Terminals (DI1 - DI2)	0301	40770	1401
P3.02	Multi-function Input Terminal 3 (DI3)	0302	40771	1402
P3.03	Multi-function Input Terminal 4 (DI4)	0303	40772	1403
P3.04	Multi-function Input Terminal 5 (DI5)	0304	40773	1404
P3.05	Multi-function Input Terminal 6 (DI6)	0305	40774	1405
P3.06	Multi-function Input Terminal 7 (DI7)	0306	40775	1406
P3.07	Multi-function Input Terminal 8 (DI8)	0307	40776	1407
P3.08	Multi-function Input Terminal 9 (DI9)	0308	40777	1410
P3.09	Multi-function Input Terminal 10 (DI10)	0309	40778	1411
P3.10	Multi-function Input Terminal 11 (DI11)	030A	40779	1412
P3.11	Multi-Function Output Terminal 1 (Relay Output)	030B	40780	1413
P3.12	Multi-Function Output Terminal 2 (DO1)	030C	40781	1414
P3.13	Multi-Function Output Terminal 3 (DO2)	030D	40782	1415
P3.14	Multi-Function Output Terminal 4 (DO3)	030E	40783	1416
♦ P3.16	Desired Frequency	0310	40785	1420
♦ P3.17	Desired Current	0311	40786	1421
♦ P3.18	PID Deviation Level	0312	40787	1422
♦ P3.19	PID Deviation Time	0313	40788	1423
♦ P3.20	Desired Frequency 2	0314	40789	1424
♦ P3.30	Frequency Output (FO) Scaling Factor	031E	40799	1436
P3.31**	2nd Source of Operation Command	031F	40800	1437
Analog Parameters				
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 AI2 Signal (4-20 mA)	0405	41030	2005
♦ P4.11	Analog Output Signal	040B	41036	2013
♦ P4.12	Analog Output Gain	040C	41037	2014
P4.13**	2nd Source of Frequency Command	040D	41038	2015
♦ P4.14**	2nd Frequency Command Offset Polarity	040E	41039	2016
♦ P4.15**	2nd Frequency Command Offset	040F	41040	2017
♦ P4.16**	2nd Frequency Command Gain	0410	41041	2020
♦ P4.17**	Trim Frequency Reference	0411	41042	2021
♦ P4.18**	Trim Mode Select	0412	41043	2022

table continued next page

Parameter Memory Addresses (continued from previous page)				
Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
♦ 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.				
** Some parameters are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "GS3 Parameter Summary" in Chapter 4 (AC Drive Parameters) for more information.				
Presets Parameters				
♦ 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
♦ P5.04	Multi-Speed 4	0504	41285	2404
♦ P5.05	Multi-Speed 5	0505	41286	2405
♦ P5.06	Multi-Speed 6	0506	41287	2406
♦ P5.07	Multi-Speed 7	0507	41288	2407
♦ P5.08	Multi-Speed 8	0508	41289	2410
♦ P5.09	Multi-Speed 9	0509	41290	2411
♦ P5.10	Multi-Speed 10	050A	41291	2412
♦ P5.11	Multi-Speed 11	050B	41292	2413
♦ P5.12	Multi-Speed 12	050C	41293	2414
♦ P5.13	Multi-Speed 13	050D	41294	2415
♦ P5.14	Multi-Speed 14	050E	41295	2416
♦ P5.15	Multi-Speed 15	050F	41296	2417
Protection Parameters				
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 Stall Protection	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
P6.17	Over-Voltage Stall Prevention Level	0611	41554	3021
P6.18	Braking Voltage Level	0612	41555	3022
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
♦ P6.37**	Hunting Gain	0625	41574	3045

table continued next page

Parameter Memory Addresses (continued from previous page)				
Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
♦ 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.				
** Some parameters are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "GS3 Parameter Summary" in Chapter 4 (AC Drive Parameters) for more information.				
PID Parameters				
P7.00	Input Terminal for PID Feedback	0700	41793	3400
P7.01	PV 100% Value	0701	41794	3401
P7.02	PID Setpoint Source	0702	41795	3402
♦ P7.03	PID Feedback Gain	0703	41796	3403
♦ P7.04	PID Setpoint Offset Polarity	0704	41797	3404
♦ P7.05	PID Setpoint Offset	0705	41798	3405
♦ P7.06	PID Setpoint Gain	0706	41799	3406
♦ P7.10	Keypad & Serial PID Setpoint	070A	41803	3412
♦ P7.11	PID Multi-setpoint 1	070B	41804	3413
♦ P7.12	PID Multi-setpoint 2	070C	41805	3414
♦ P7.13	PID Multi-setpoint 3	070D	41806	3415
♦ P7.14	PID Multi-setpoint 4	070E	41807	3416
♦ P7.15	PID Multi-setpoint 5	070F	41808	3417
♦ P7.16	PID Multi-setpoint 6	0710	41809	3420
♦ P7.17	PID Multi-setpoint 7	0711	41810	3421
♦ P7.20	Proportional Control	0714	41813	3424
♦ P7.21	Integral Control	0715	41814	3425
♦ P7.22	Derivative Control	0716	41815	3426
P7.23	Upper Bound for Integral Control	0717	41816	3427
P7.24	Derivative Filter Time Constant	0718	41817	3430
P7.25	PID Output Frequency Limit	0719	41818	3431
P7.26	Feedback Signal Detection Time	071A	41819	3432
P7.27	PID Feedback Loss	071B	41820	3433
♦ P7.28**	PID Feedback Loss Preset Speed	071C	41821	3434
Display Parameters				
♦ P8.00	User Defined Display Function	0800	42049	4000
♦ P8.01	Frequency Scale Factor	0801	42050	4001
♦ P8.02	Backlight Timer	0802	42051	4002
<i>table continued next page</i>				

Parameter Memory Addresses (continued from previous page)				
Parameter	Description	Hexadecimal	Modbus Decimal *	Octal
♦ 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.				
** Some parameters are available only in later firmware versions of DURAPULSE GS3 drives. Refer to "GS3 Parameter Summary" in Chapter 4 (AC Drive Parameters) for more information.				
Communications Parameters				
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
♦ P9.21	Block Transfer Parameter 11	0915	42326	4425
♦ P9.22	Block Transfer Parameter 12	0916	42327	4426
♦ P9.23	Block Transfer Parameter 13	0917	42328	4427
♦ P9.24	Block Transfer Parameter 14	0918	42329	4430
♦ P9.25	Block Transfer Parameter 15	0919	42330	4431
♦ P9.26	Serial Comm (RS-485) 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
♦ P9.40	Parameter Copy	0928	42345	4450
P9.41	GS Series Number	0929	42346	4451
P9.42	Manufacturer Model Information	092A	42347	4452
Encoder Feedback Parameters				
P10.00	Encoder Pulse per Revolution	0A00	42561	5000
P10.01	Encoder type Input	0A01	42562	5001
♦ P10.02	Proportional Control	0A02	42563	5002
♦ P10.03	Integral Control	0A03	42564	5003
P10.04	Speed Control Output Speed Limit	0A04	42565	5004
P10.05	Encoder Loss Detection	0A05	42566	5005

DURAPULSE GS3 STATUS ADDRESSES

The DURA GS3 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)

DURAPULSE GS3 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
Power Factor Angle	210A	48459	20412
% Load	210B	48460	20413
PID Setpoint	210C	48461	20414
PID Feedback Signal (PV)	210D	48462	20415
Firmware Version	2110	48465	20420

Status Monitor 1

h2100

Error Codes:

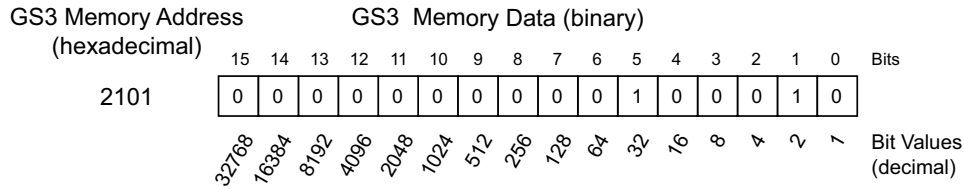
00: No fault occurred	13: Over-current during decel (ocd)
01: Over-current(oc)	14: Over-current during steady state (ocn)
02: Over-voltage(ov)	15: Ground Fault or Fuse Failure (GFF)
03: Overheat (oH)	16: Low Voltage (Lv)
04: Overload (oL)	17: Input Power 3-phase Loss (PHL)
05: Thermal Overload 1 (oL1)	18: External Base-Block (bb)
06: Over-torque (oL2)	19: Auto Adjust accel/decel Failure (cFA)
07: External Fault (EF)	20: Software Protection Code (codE)
08: CPU Failure 1 (cF1)	21: PID Feedback Loss (FbE)
09: CPU Failure 2 (cF2)	22: Encoder Feedback Loss (ENCODER LOSS)
10: CPU Failure 3 (cF3)	23: Output Shorted (occ)
11: Hardware Protection Failure (HPF)	24: Momentary Power Loss (MOM POWER LOSS)
12: Over-current during accel (ocA)	



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



Status Monitor 2 - Memory Address h2101		
Address Bit(s)	Bit(s) Value Binary (Decimal)	AC Drive Status
0 and 1	00 (0)	(Stop state): driver Stop command state; drive has <u>no</u> output.
	01 (1)	(Stopping): driver Stop command state and Frequency deceleration (by Stop methods set Ramp stop mode); drive has an output.
	10 (2)	(Standby state): driver Run command state and frequency command is 0 Hz; drive has <u>no</u> output.
	11 (3)	(Running): driver Run command state and the frequency command is not zero; drive has an output.
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 ~ 7	N/A	Reserved
8	1 (256)	Source of frequency determined by serial comm interface (P4.00 = 5)
9	1 (512)	Source of frequency determined by AI terminal (P4.00 = 2, 3, 4 or 6)
10	1 (1024)	Source of operation determined by serial comm interface (P3.00 = 3 or 4)
11	1 (2048)	Parameters have been locked (P9.07 = 1)
12	N/A	Copy command enable

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 the T1, T2, and T3 terminal.

Output Current A h2104

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

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 the T1, T2, and T3 terminals.	
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 P 8.01 (low word).	
Scale Frequency (High Word)	h2109
Status location for result of output frequency x P 8.01 (high word).	
Power Factor Angle	h210A
Status location for the power factor angle.	
% Load	h210B
Status location for the amount of load on the AC drive. $(\text{Output Current} \div \text{Drive Rated Current}) \times 100$.	
PID Setpoint	h210C
Status location for the PID setpoint.	
PID Feedback Signal (Process Variable)	h210D
Status location for PID process variable feedback signal.	
Firmware Version	h2110
Status location for the firmware version of the AC drive.	

COMMUNICATING WITH AUTOMATIONDIRECT PLCs

The following steps explain how to connect and communicate with the DURA GS3 AC drives using AutomationDirect PLCs.



GS3 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 GS3 AC drives will communicate with the following AutomationDirect PLCs using Modbus communications.

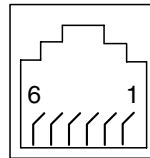
- Modbus control is easier to accomplish from a DirectLOGIC PLC with an RS-485 port and MRX/MWX, or from a CLICK PLC using Send/Receive instructions.

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

GS3 RS-485 Serial Comm Port

**GS3 Serial Comm Port
RS-485 Interface
RJ12 (6P6C)**



- 1: +15V
- 2: GND
- 3: SG-
- 4: SG+
- 5: nc
- 6: reserved

The GS3 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 DURAPULSE GS3 AC Drive					
Drive	PLC *	PLC Port *	Communication	Direct Cable	Length
DURAPULSE (GS3)	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.

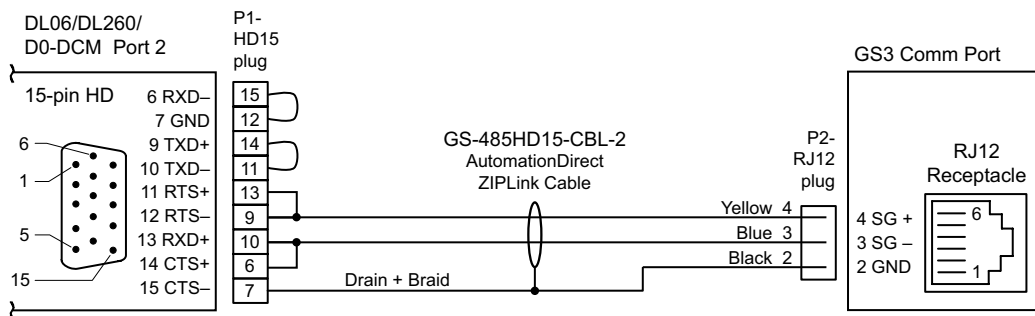
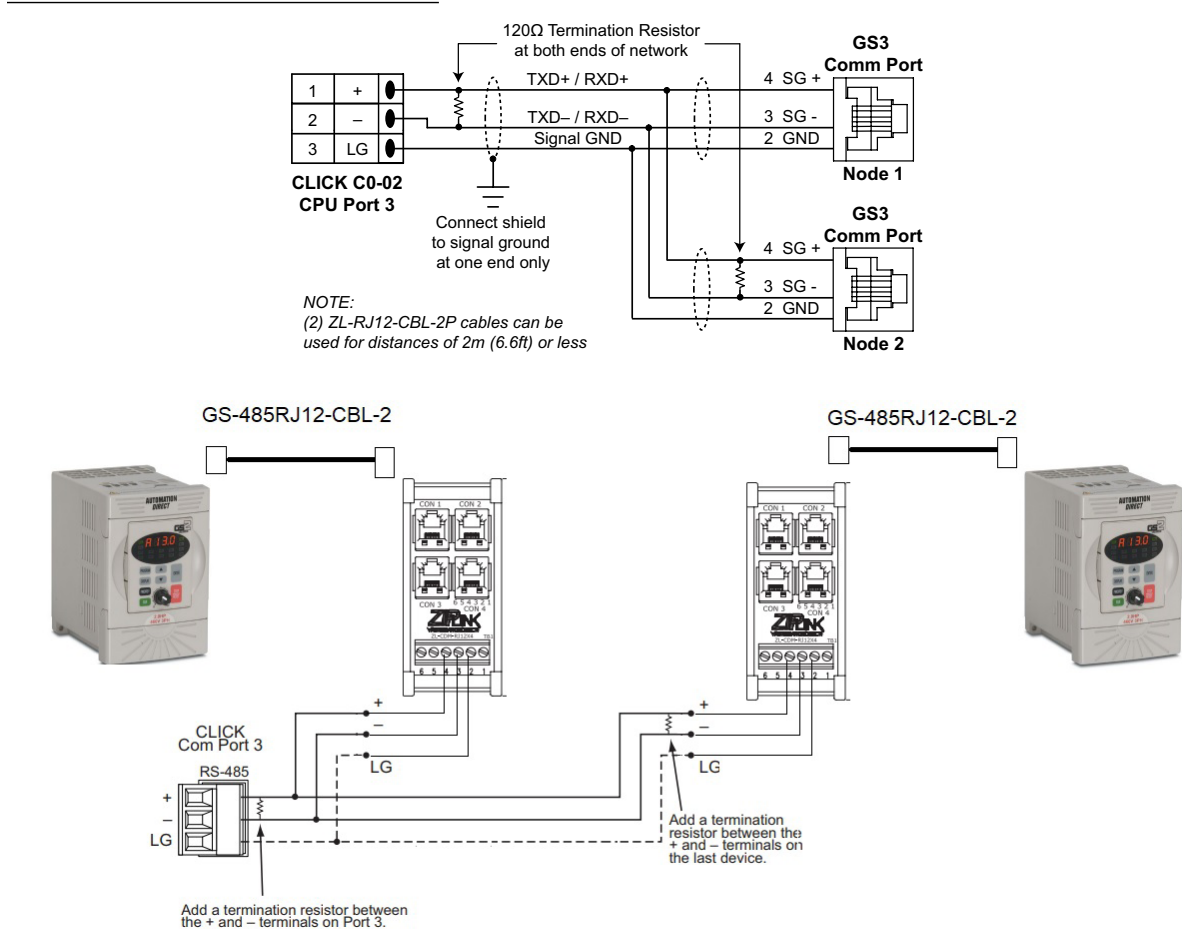
RS-485 DIRECT CONNECTIONS

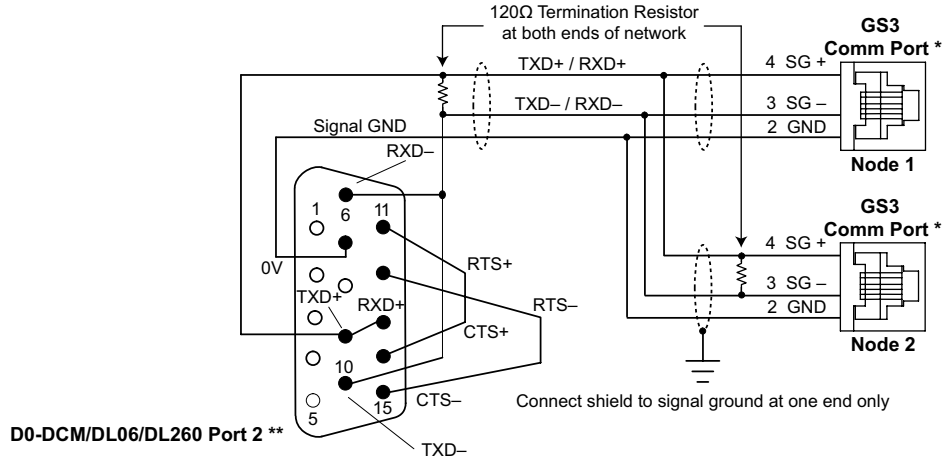


Termination Resistors are required on both ends of RS-485 networks; especially on long runs. Select resistors that match the impedance rating of the cable (between 100 and 500Ω).



Recommended RS-485 cable: Belden 9842 or equivalent.





* 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

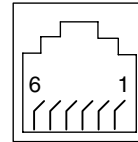
An RS-485 network cable can span up to 1000 meters (4000 feet). However, many AutomationDirect PLCs have only RS-232C communication ports, and require an FA-ISOCAN (RS-232C to RS-422/485 network adapter) in order to make an RS-485 connection.



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

- 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-ISOCAN 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

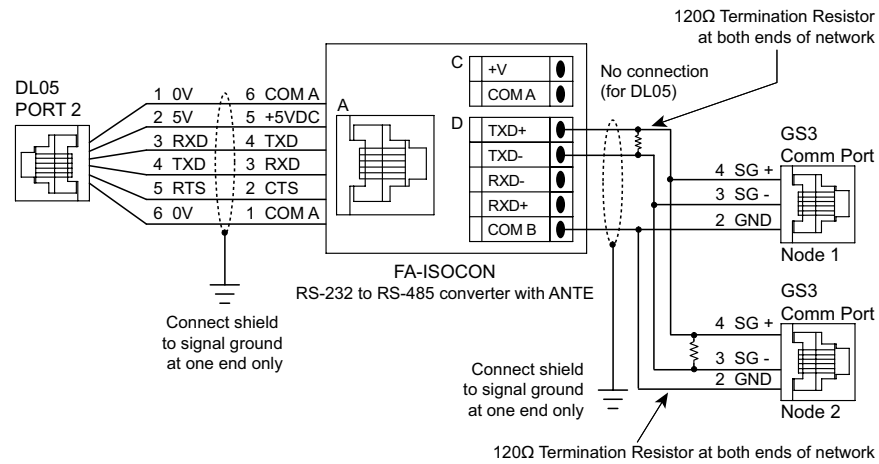


*Recommended cable for RS-232: Belden 8102 or equivalent.
 Recommended cable for RS-485: Belden 9842 or equivalent.
 Various pre-terminated cables for specific wiring connections are available from AutomationDirect, as listed in applicable individual wiring sections of this chapter.*

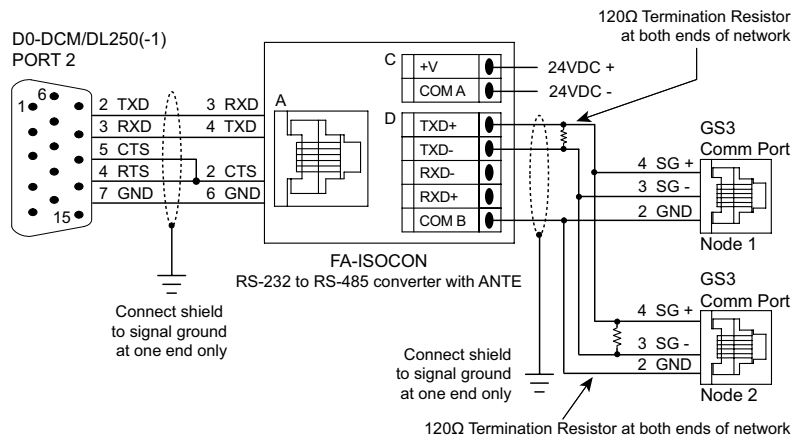
RS-232C TO RS-485 CONVERSION (CONTINUED)

Use the following wiring diagrams to connect DirectLOGIC RS-232C PLCs to a DURA GS3 AC drive with an FA-ISOCOM network adapter module:

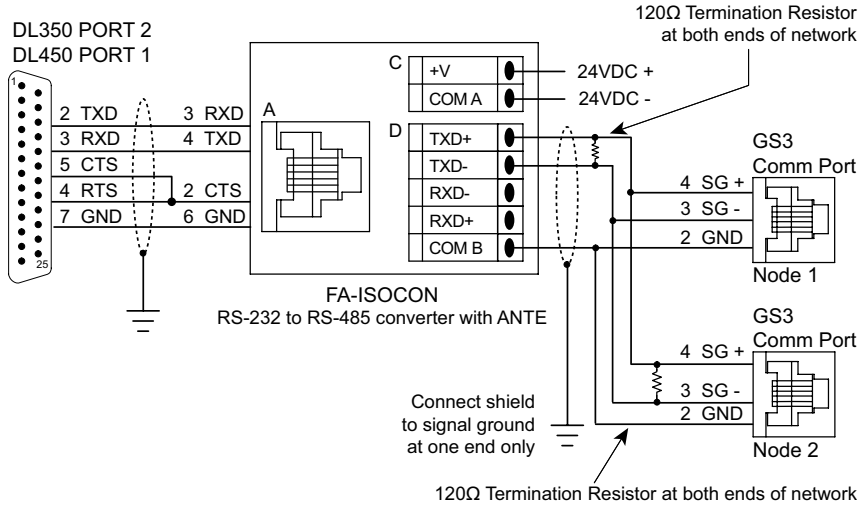
DL05: RS-232C to RS-485 Connection Wiring



Cable D0-DSCBL (12ft; 3.7m) is available for connecting the DL05 to the FA-ISOCOM. For a single run to only one AC Drive, cable GS-ISOCOM-CBL-2 (2m; 6.6ft) is available for directly connecting the FA-ISOCOM to the GS3 Com Port.



A cable that will connect the D0-DCM or DL250(-1) to the FA-ISOCOM 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.



A cable that will connect the DL450 to the FA-ISOCOCON 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 a high-performance Ethernet link between a control system and a GS3 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-ISOCOCON 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 DURApulse 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 Setup Details" 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."



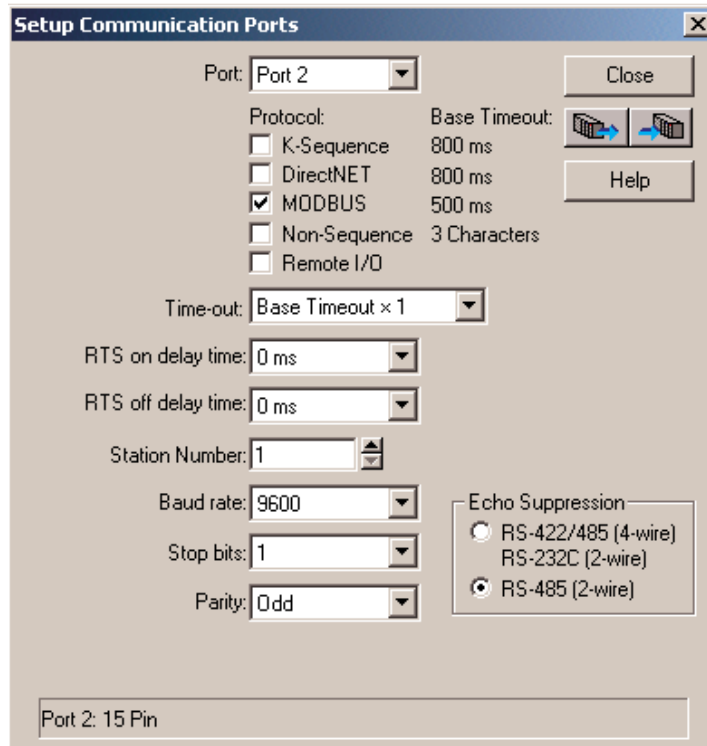
The communication port settings are saved in the project file. The project must be transferred to the CLICK PLC in order for any port setting changes to take effect.

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 "MODBUS."
- 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" (or higher, if using an FA-ISOCAN network adapter module).
- In the Stop Bits list box, Choose "1."
- In the Parity list box, choose "Odd."



CONFIGURE THE DIRECTLOGIC CPUs (CONTINUED)

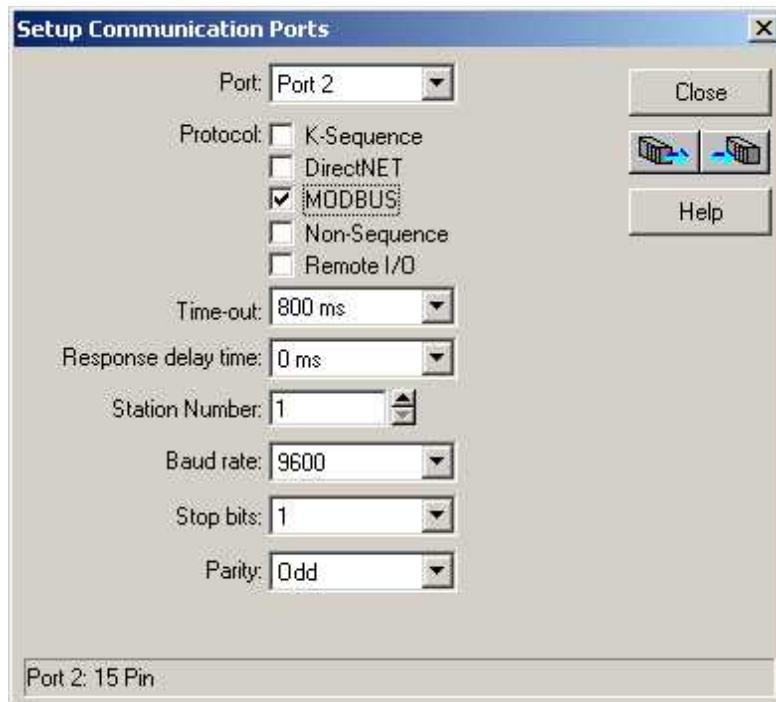
DirectLOGIC MODBUS Port Configuration for DL05, D2-250(-1), or D4-450

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 "MODBUS."
- In the Timeout list box, select "800 ms."
- 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-ISOCAN 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 GS3 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.

BLOCK TRANSFER PARAMETERS FOR MODBUS PROGRAMS

For writing to any of the parameters from P0.00 to P8.02, a group of 15 block transfer parameters (P9.11 to P9.25) is available in the GS3 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).

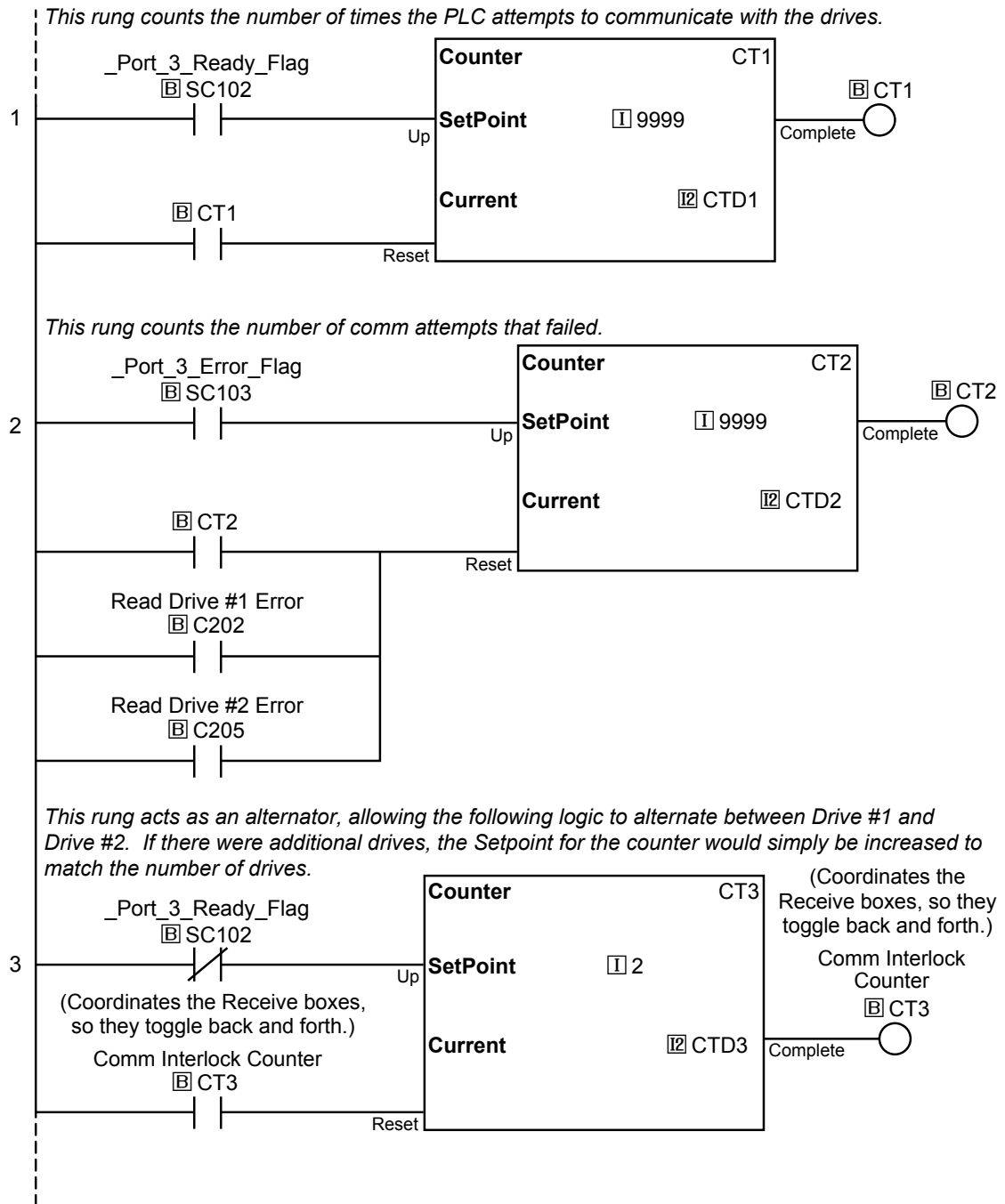
However, you could make the same three changes using one write command by setting P9.11 to P1.01, P9.12 to P1.03, and P9.13 to P5.01, so that the parameters become sequential.

CLICK COMMUNICATION PROGRAM – (FOR CLICK PLCs)



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

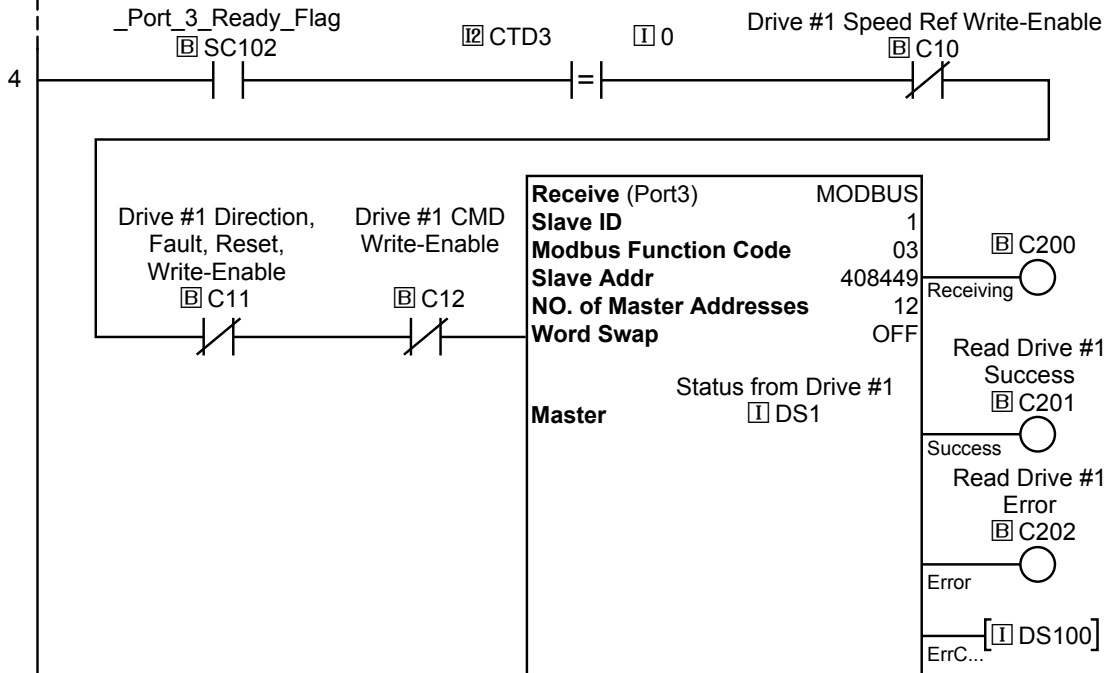
CLICK PLC Program Example



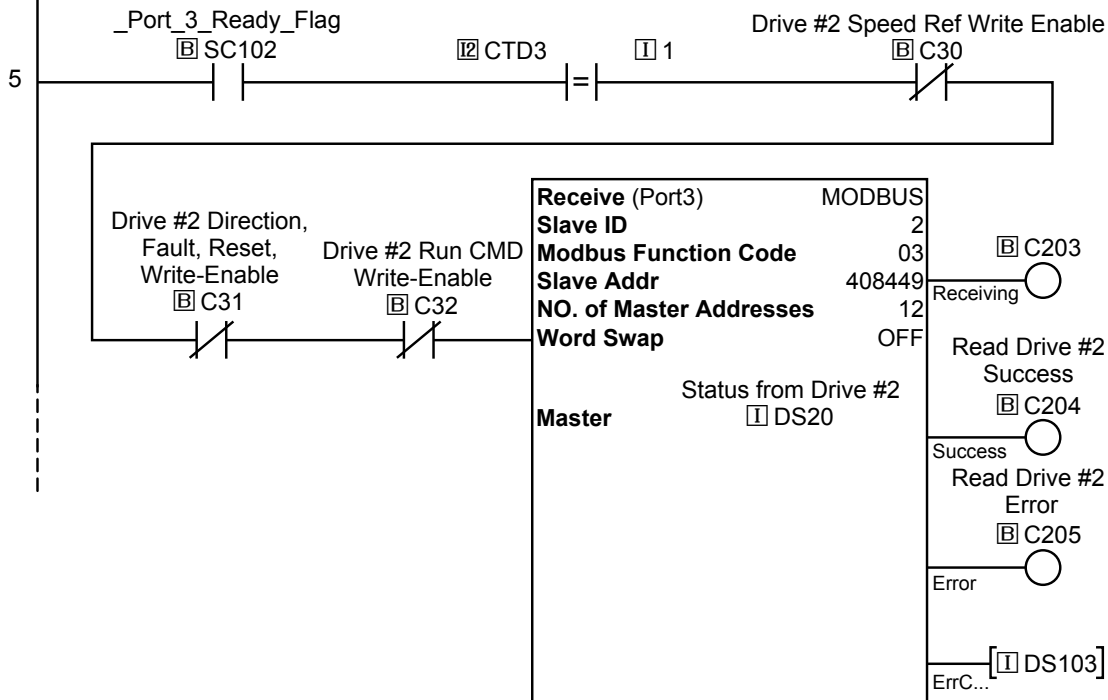
(PLC program continued on next page)

(CLICK PLC program continued from previous page)

This rung checks to see if it is time to communicate to Drive #1, and also if there are no current Write requests to that drive. If not, it reads data from Drive #1.

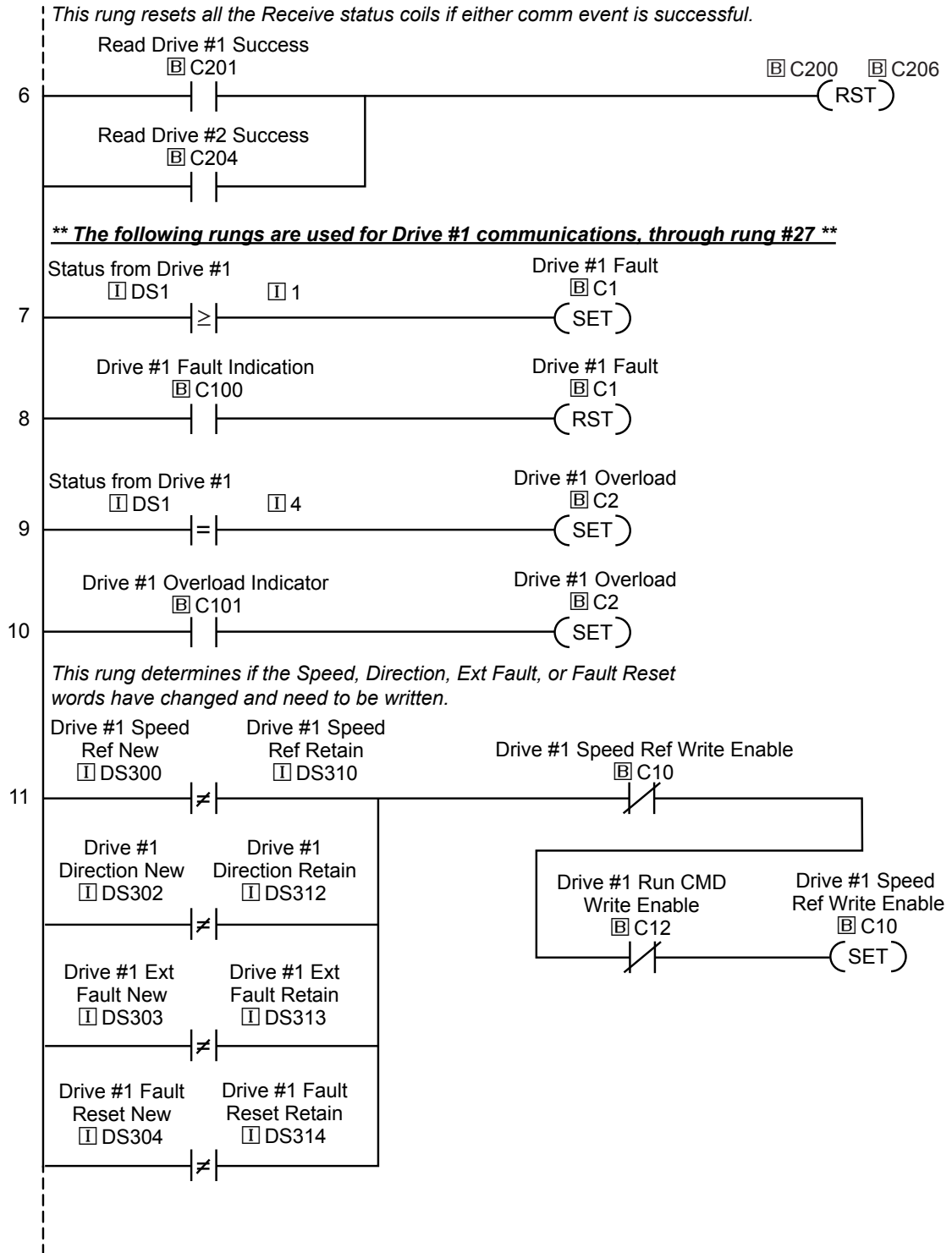


This rung checks to see if it is time to communicate to Drive #2, and also if there are no current Write requests to that drive. If not, it reads data from Drive #2.



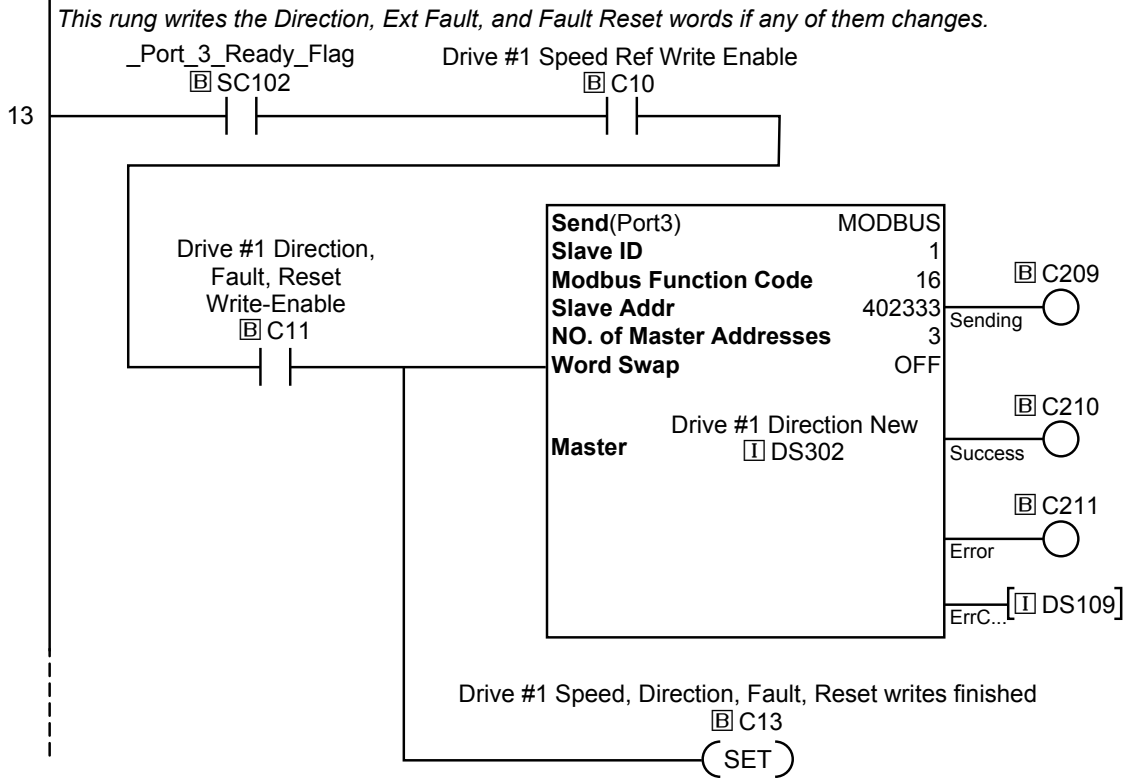
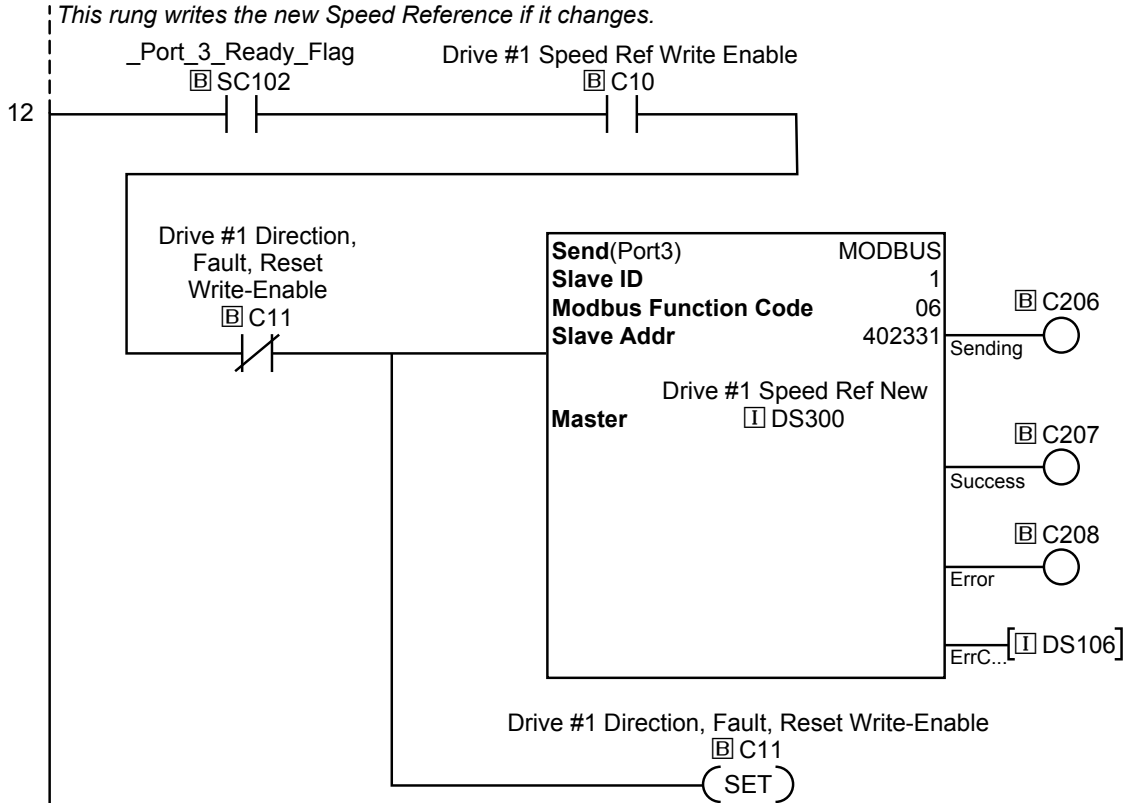
(PLC program continued on next page)

(CLICK PLC program continued from previous page)



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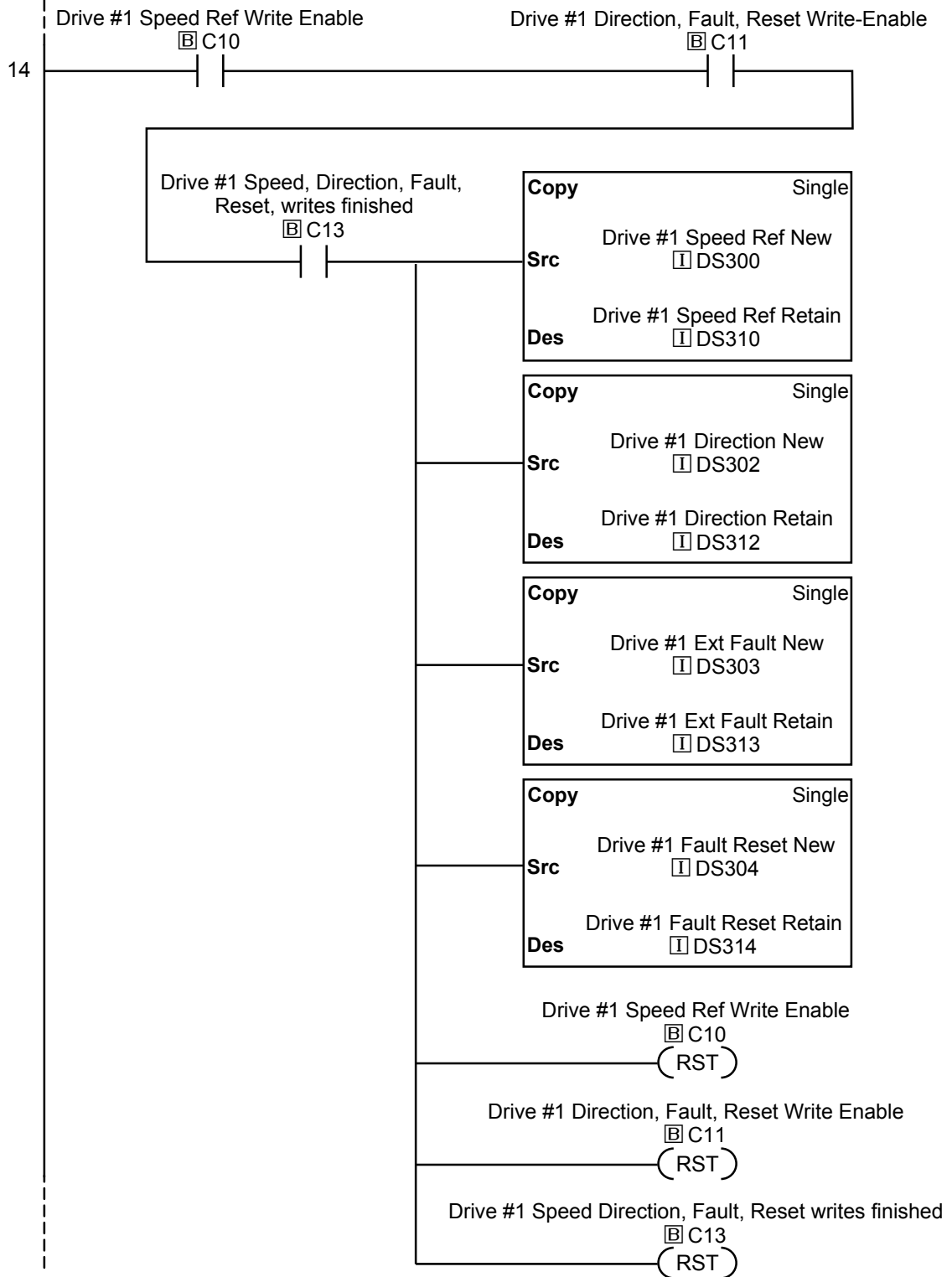
(CLICK PLC program continued from previous page)



(PLC program continued on next page)

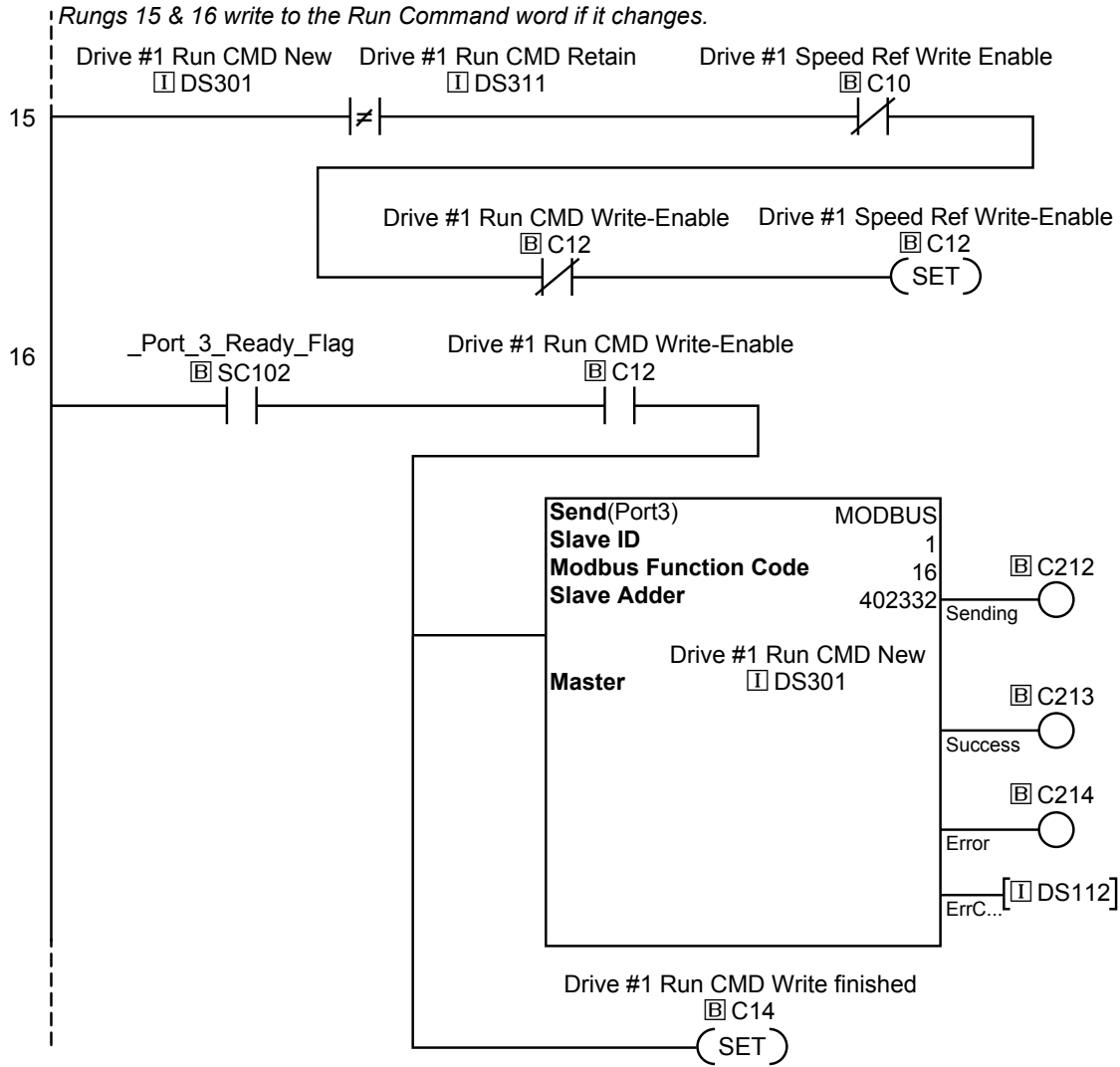
(CLICK PLC program continued from previous page)

This rung writes the new values for Speed Ref, Direction, Ext Fault, and Fault Reset words to their comparison locations so the code can again start watching for changes.



(PLC program continued on next page)

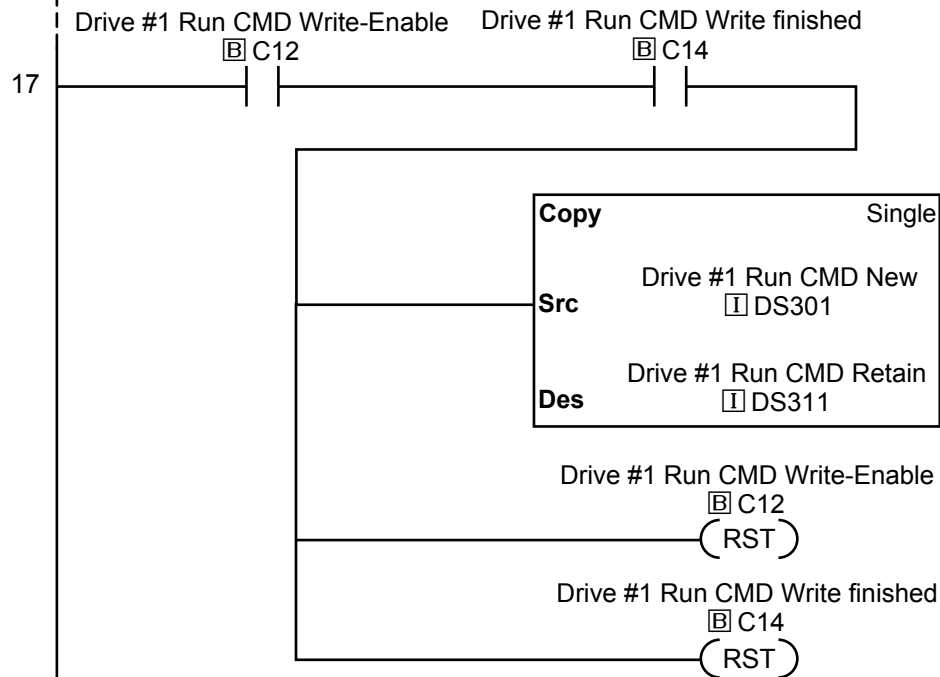
(CLICK PLC program continued from previous page)



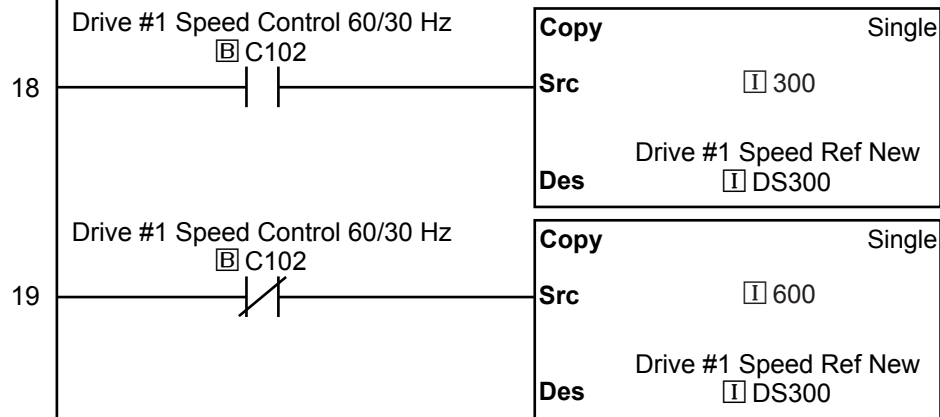
(PLC program continued on next page)

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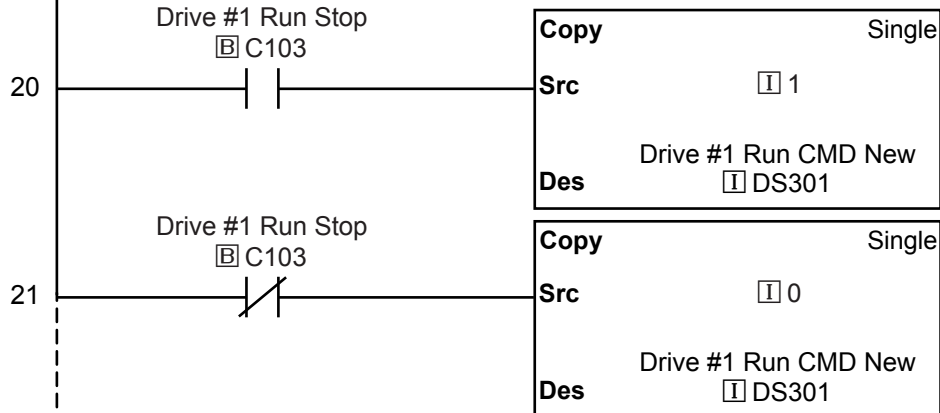
This rung writes the new value for the Run Command word to its comparison location so the code can again start watching for changes.



Rungs 18 & 19 select either 30Hz or 60Hz based on C102.

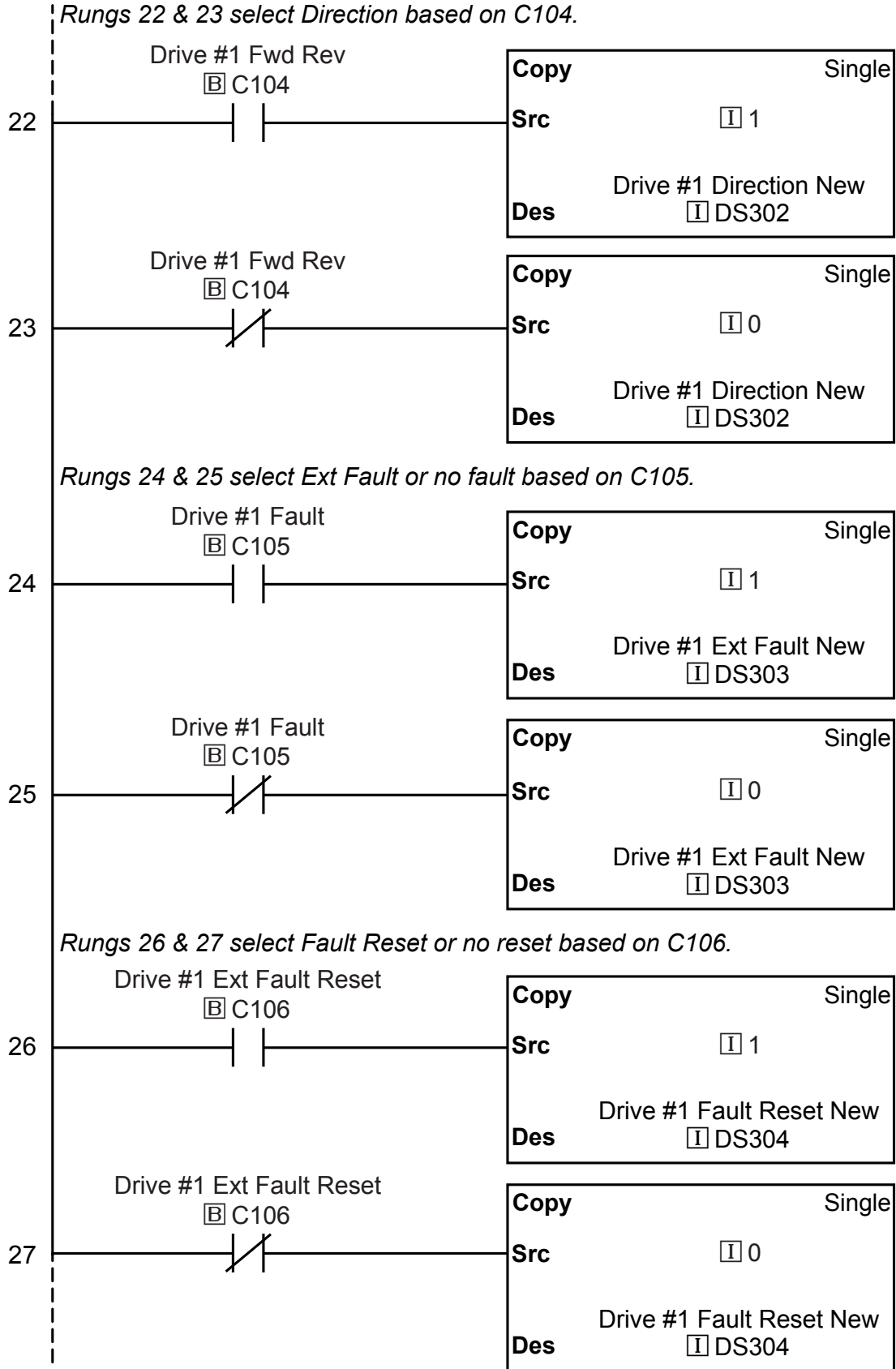


Rungs 20 & 21 select Run or Stop based on C103.



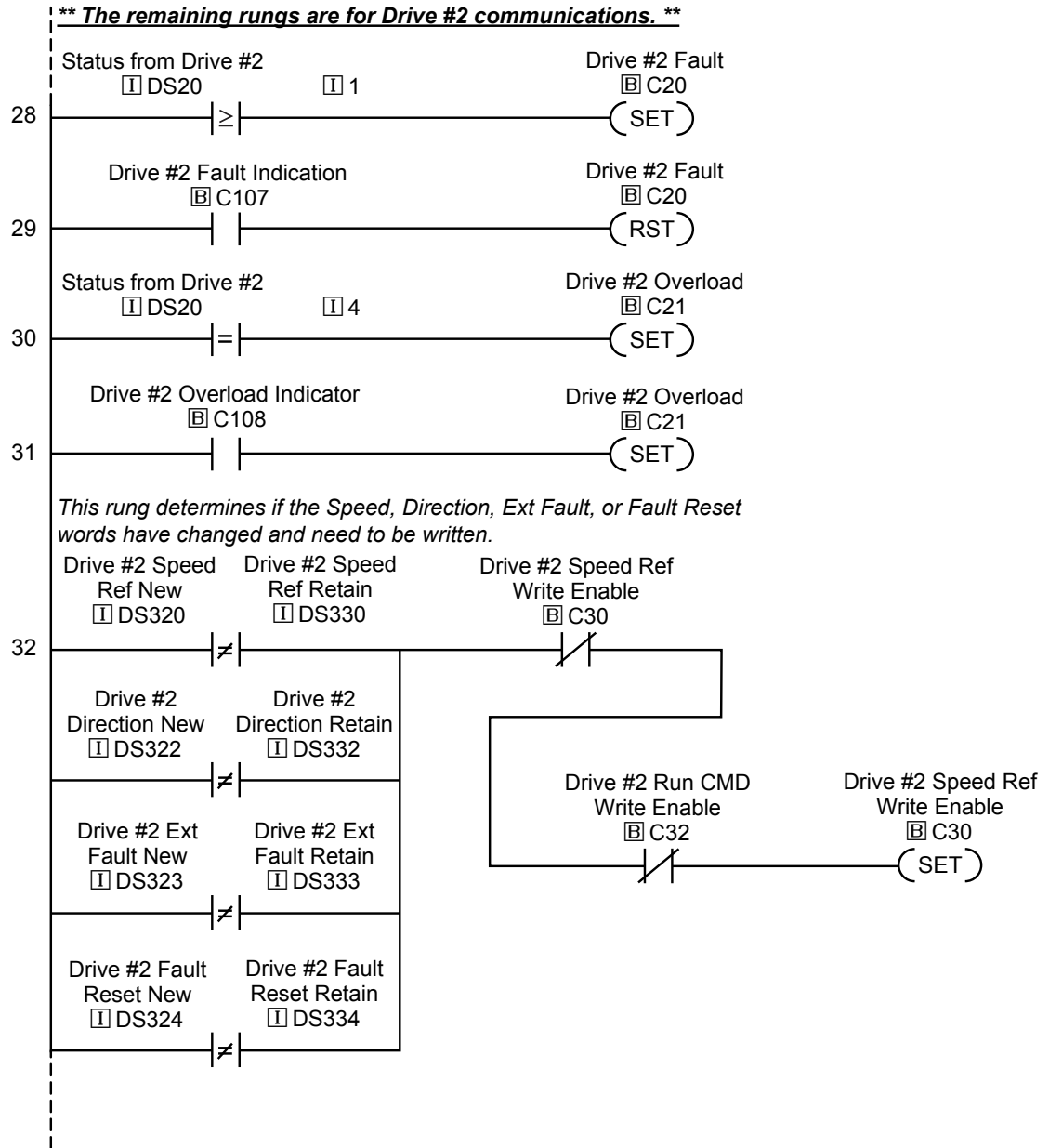
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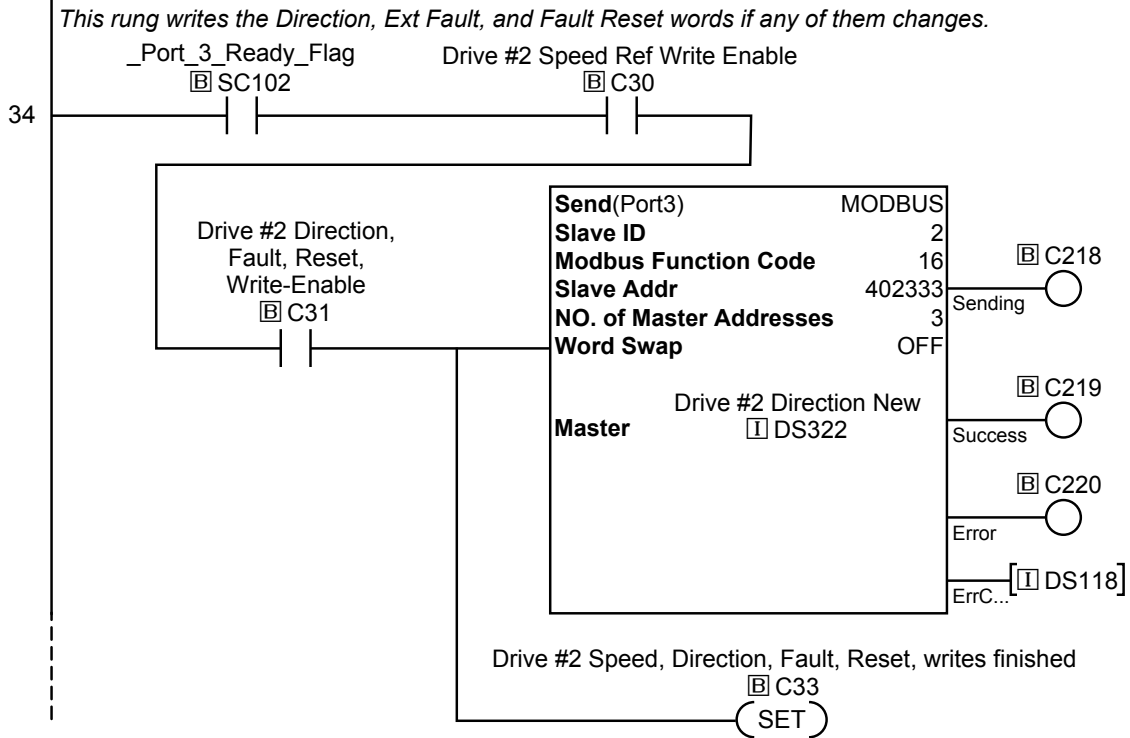
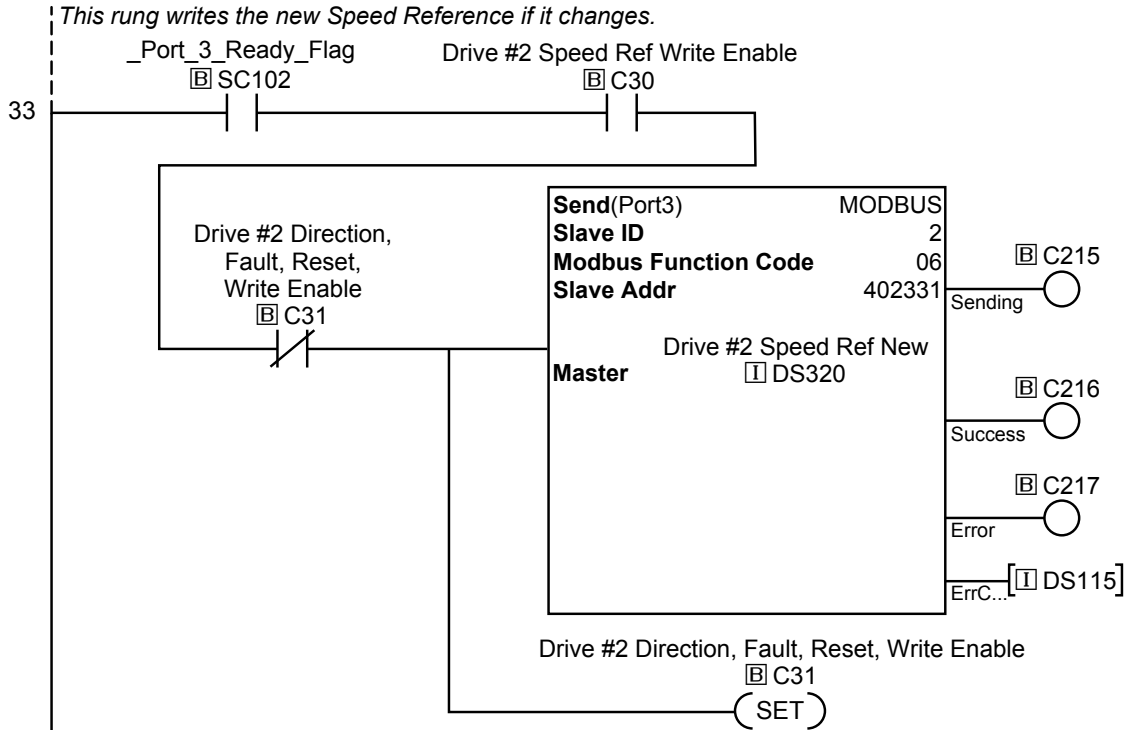
(PLC program continued on next page)

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(PLC program continued on next page)

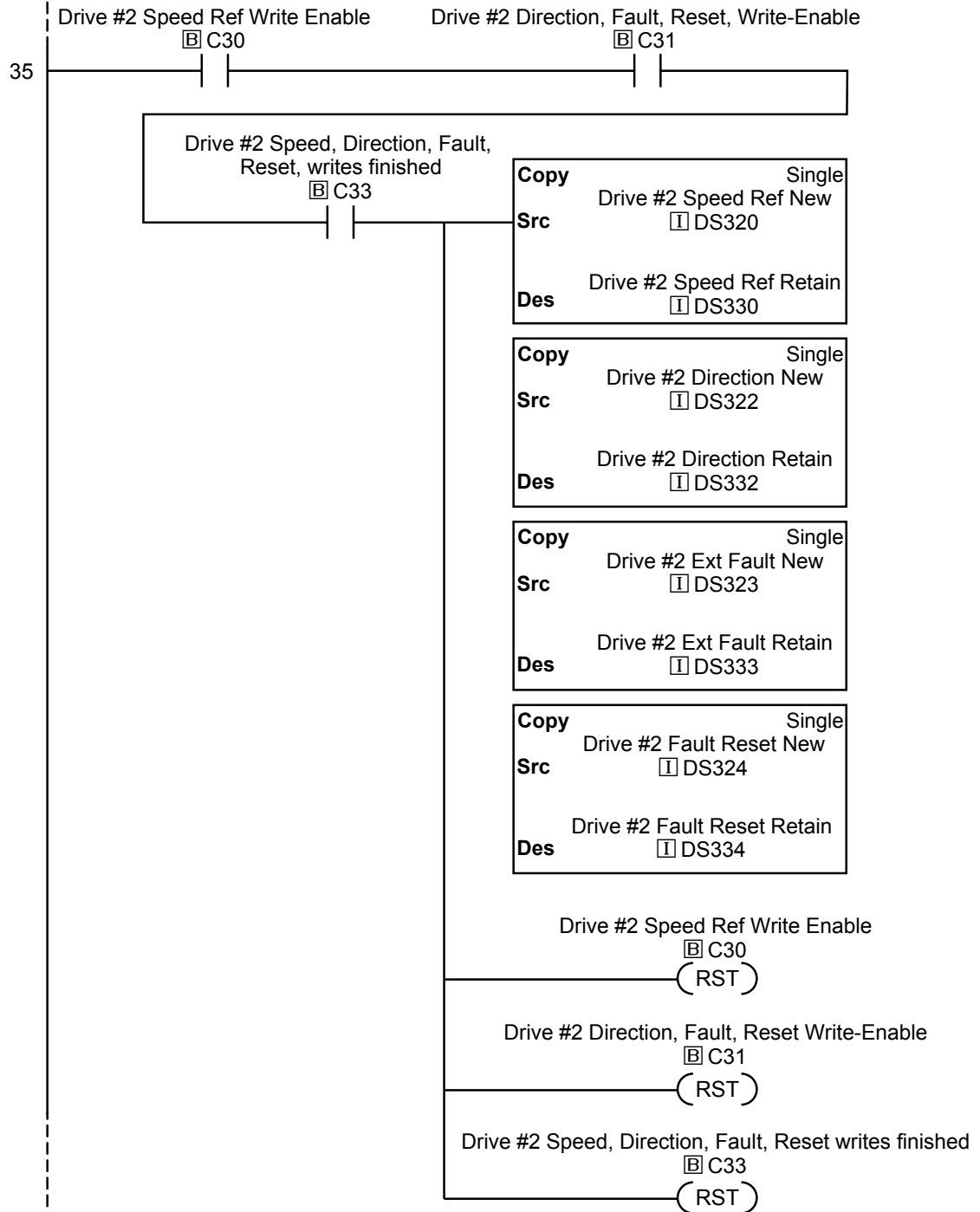
(CLICK PLC program continued from previous page)



(PLC program continued on next page)

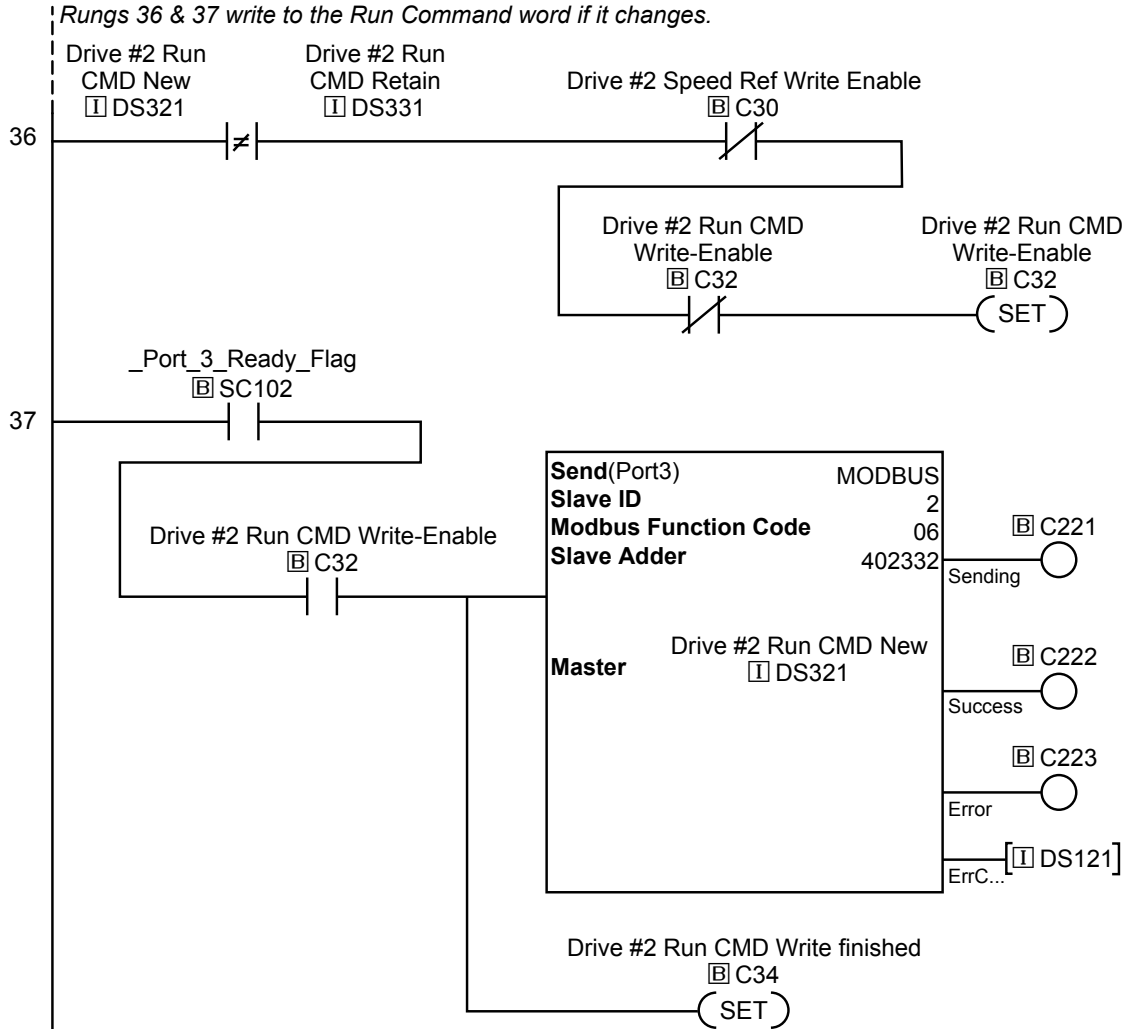
(CLICK PLC program continued from previous page)

This rung writes the new values for Speed Ref, Direction, Ext Fault, and Fault Reset words to their comparison locations so the code can again start watching for changes.

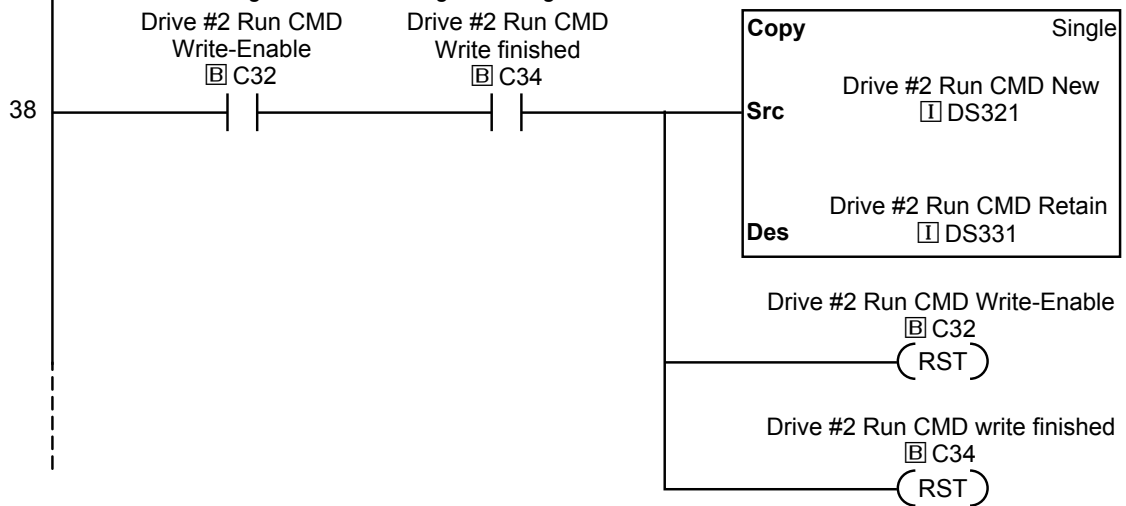


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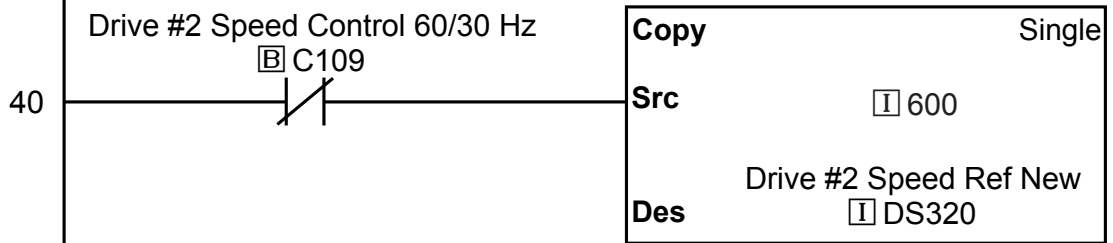
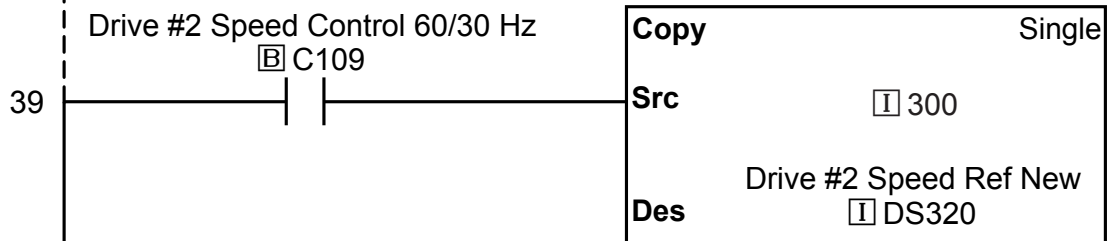
This rung writes the new value for the Run Command word to its comparison location so the code can again start watching for changes.



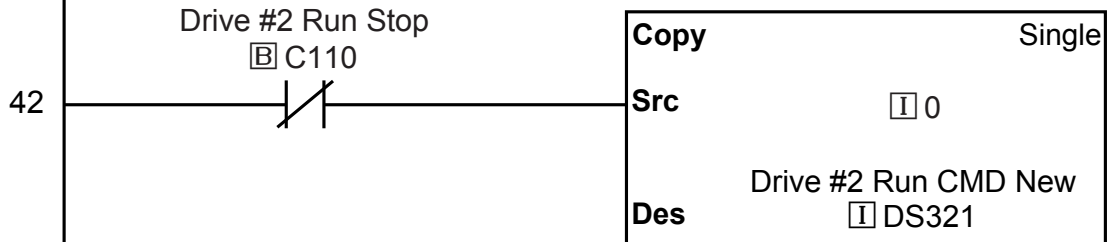
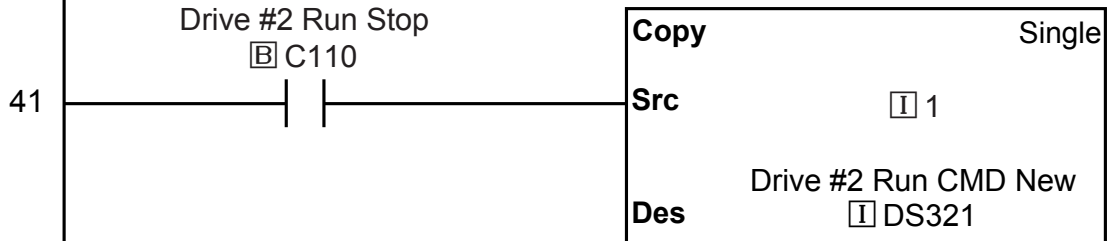
(PLC program continued on next page)

(CLICK PLC program continued from previous page)

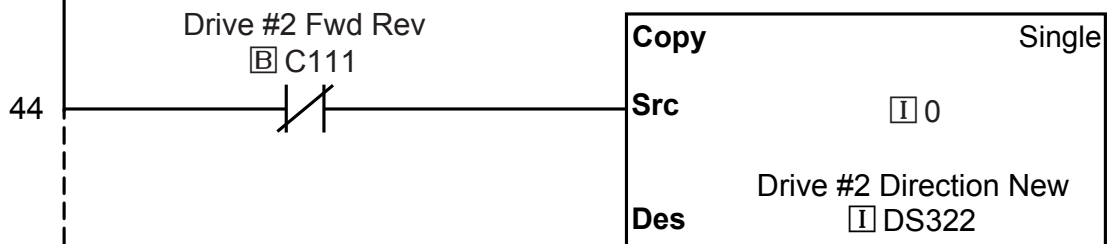
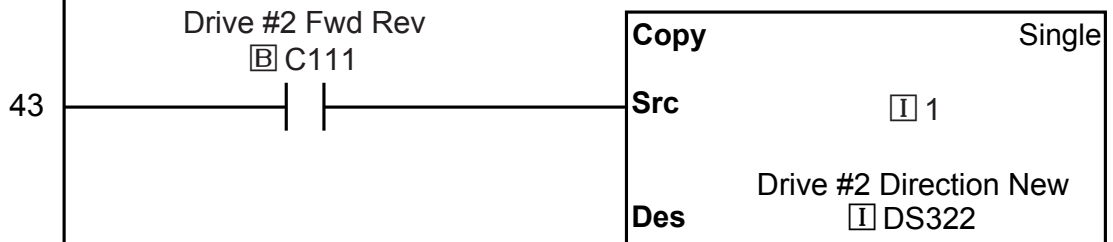
Rungs 39 & 40 select either 30Hz or 60Hz based on C109.



Rungs 41 & 42 select Run or Stop based on C110.

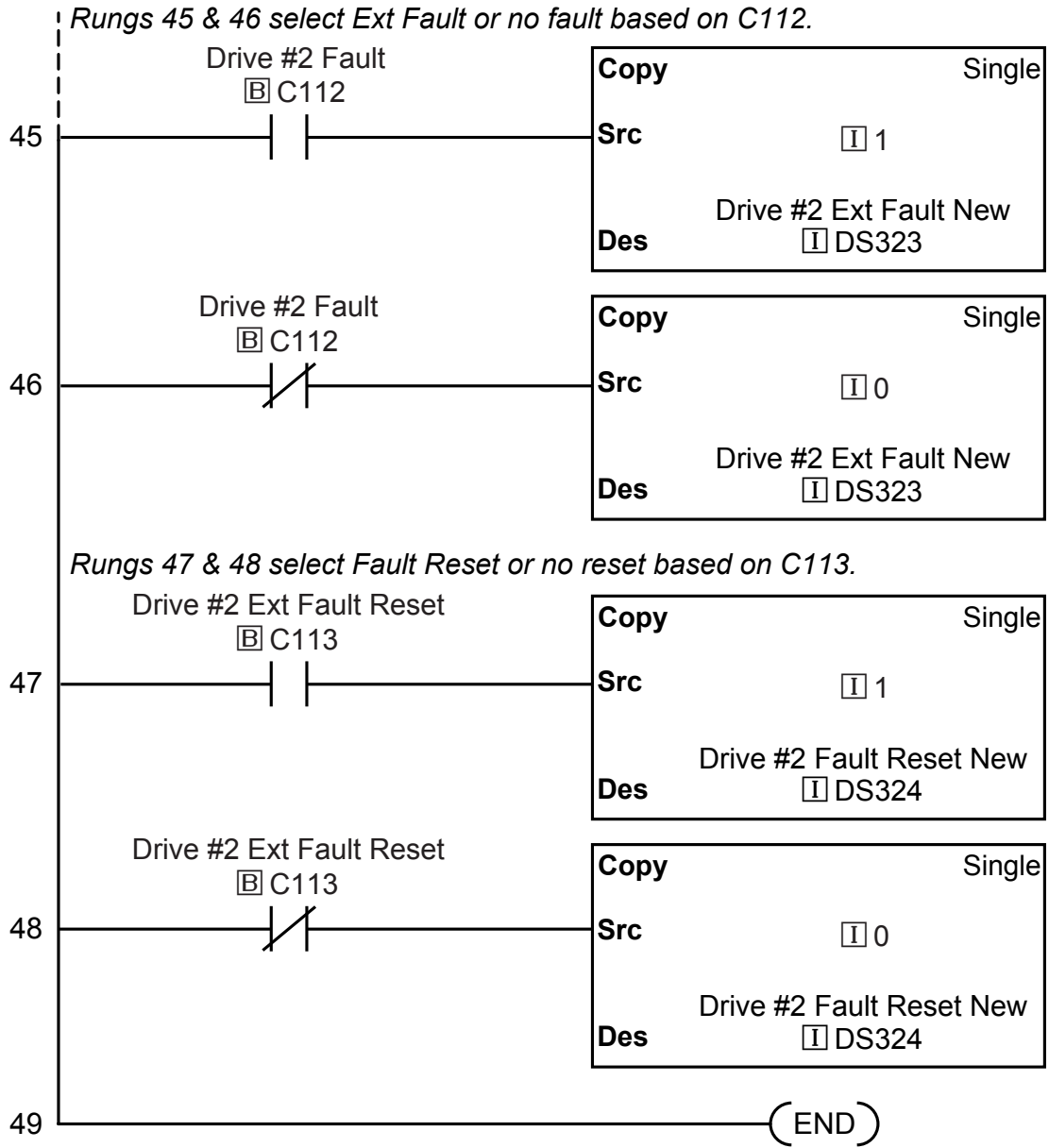


Rungs 43 & 44 select Direction based on C111.



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DIRECTLOGIC MODBUS LADDER PROGRAMMING

The set up for all of the DirectLogic 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 DirectLogic CPU.

The following ladder program shows some examples of how to control the *DURAPULSE* GS3 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 P8.02, a group of 15 block transfer parameters (P9.11 to P9.25) is available in the GS3 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

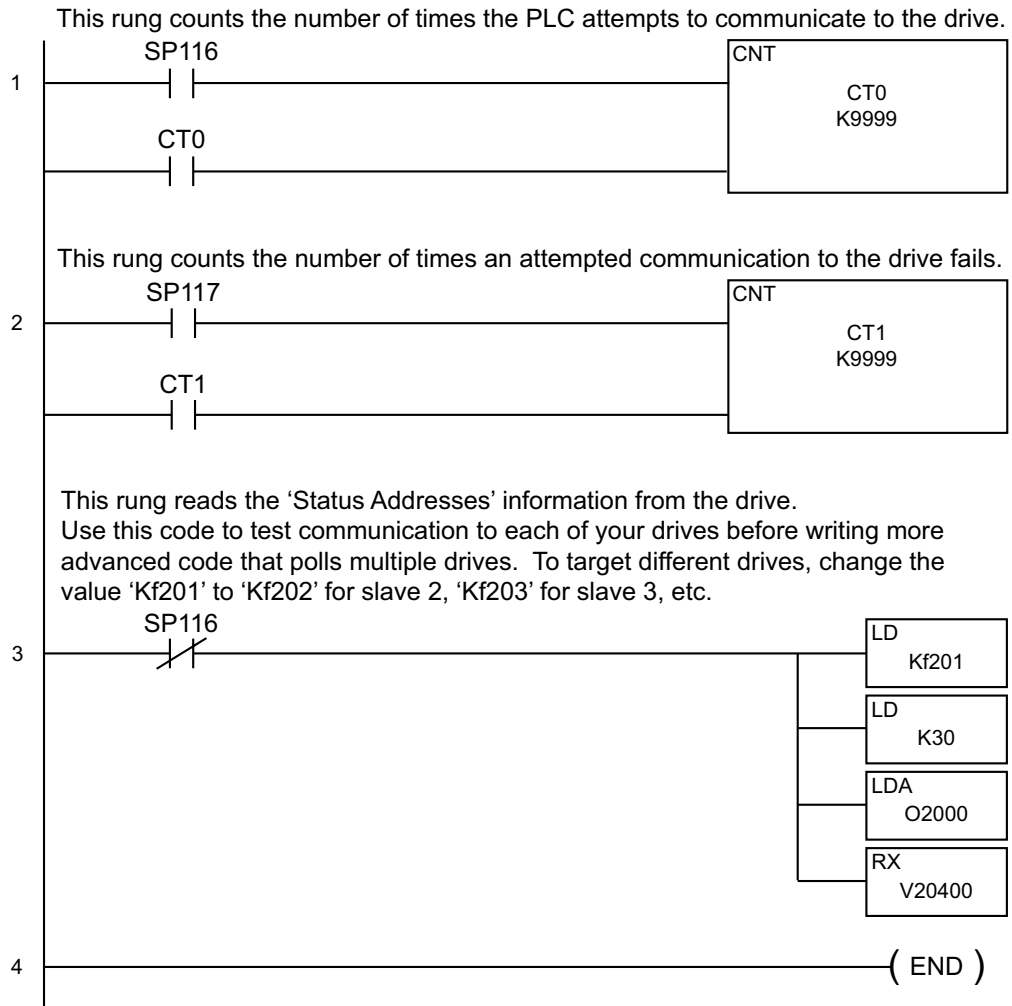
We recommend starting with the following program code, and using it to test communication to each of your drives before adding more advanced code for your application.

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.

DirectLOGIC Basic Communication Program Example – start with this code



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.

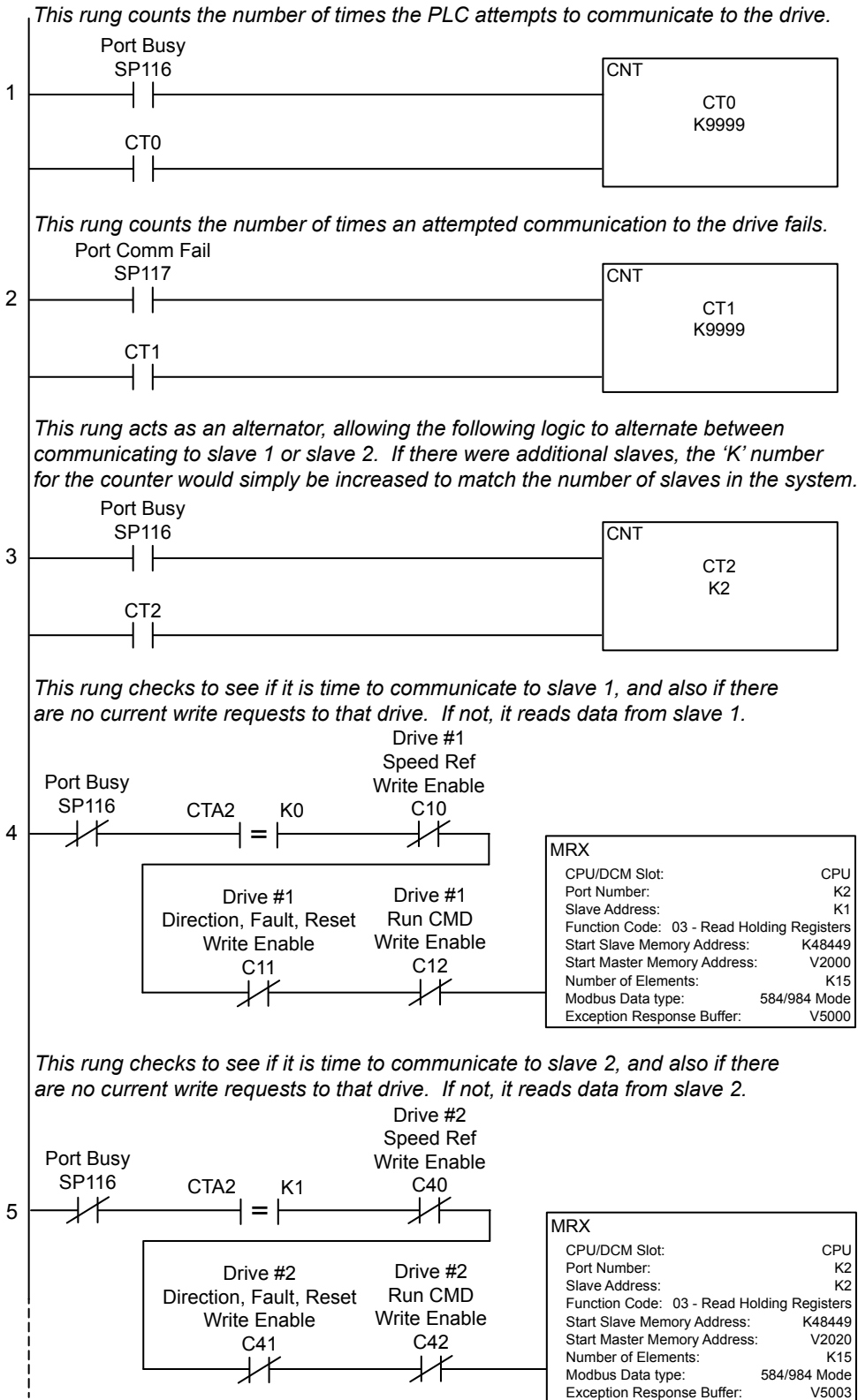
The MRX and MWX instructions are simpler and easier to use than are the RX and WX instructions. Therefore, we recommend that you use DL06 or D2-260 with MRX and MWX instructions if you have a choice.

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



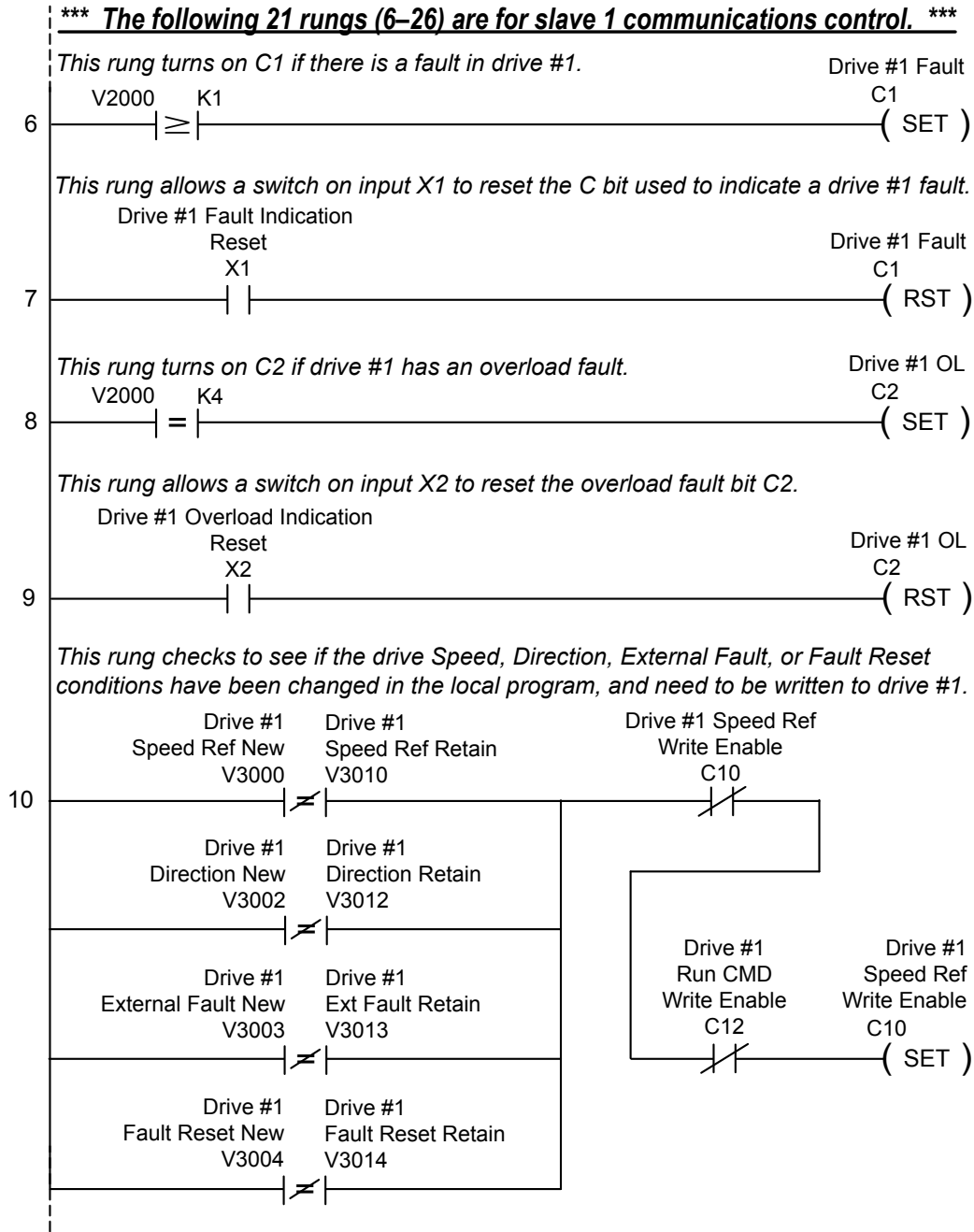
This program is for illustrational purposes only, and is not intended for a true application.

DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs



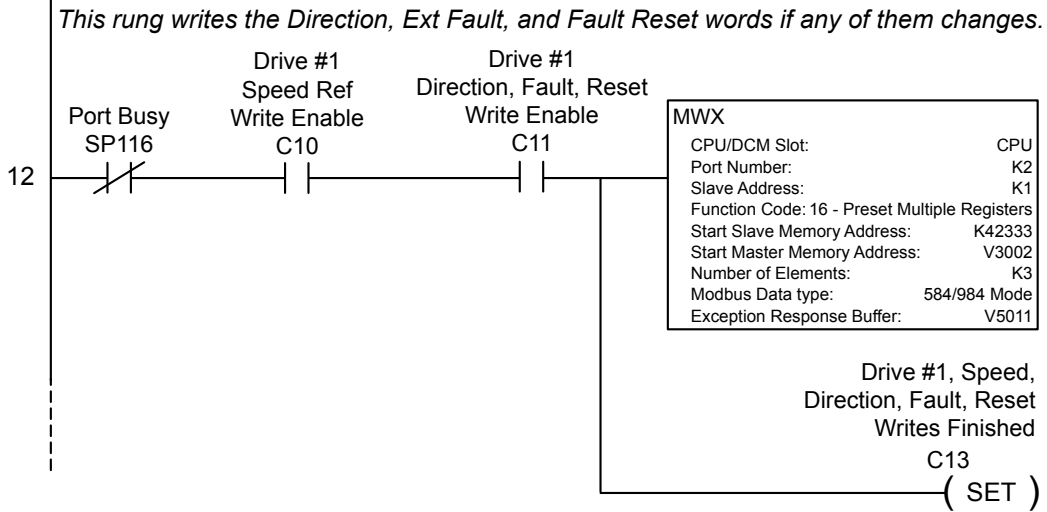
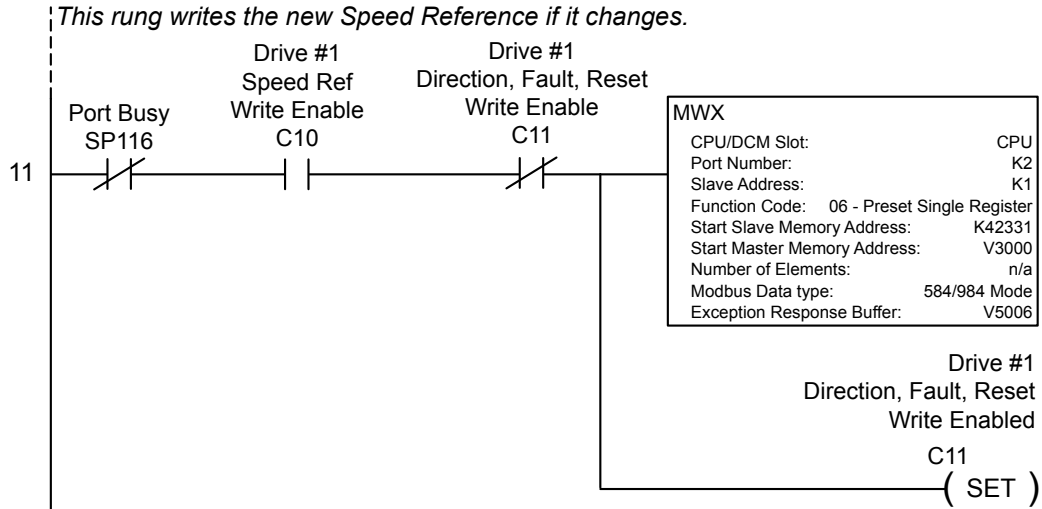
(PLC program continued on next page)

(DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs – continued from previous page)



(PLC program continued on next page)

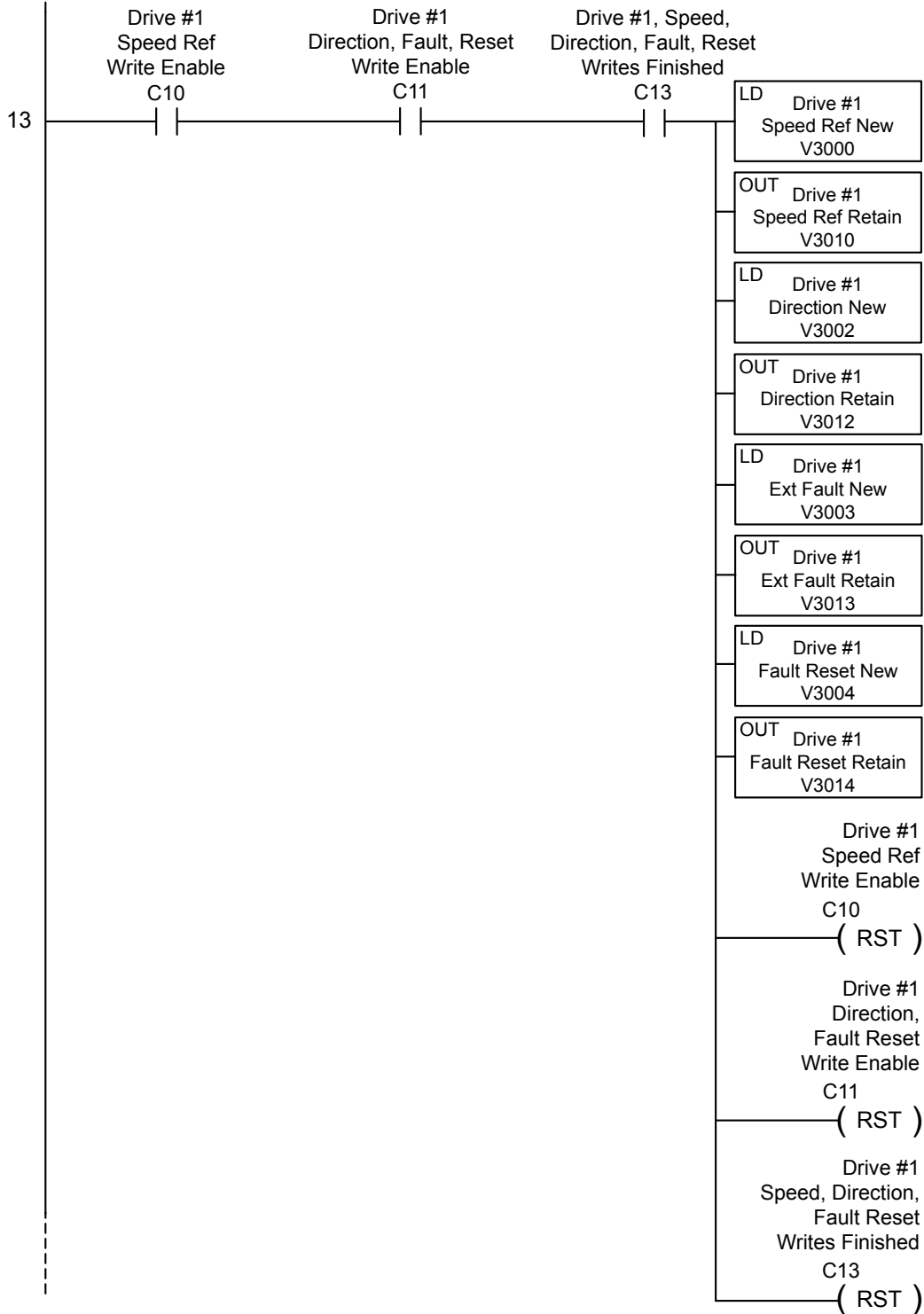
(DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs – continued from previous page)



(PLC program continued on next page)

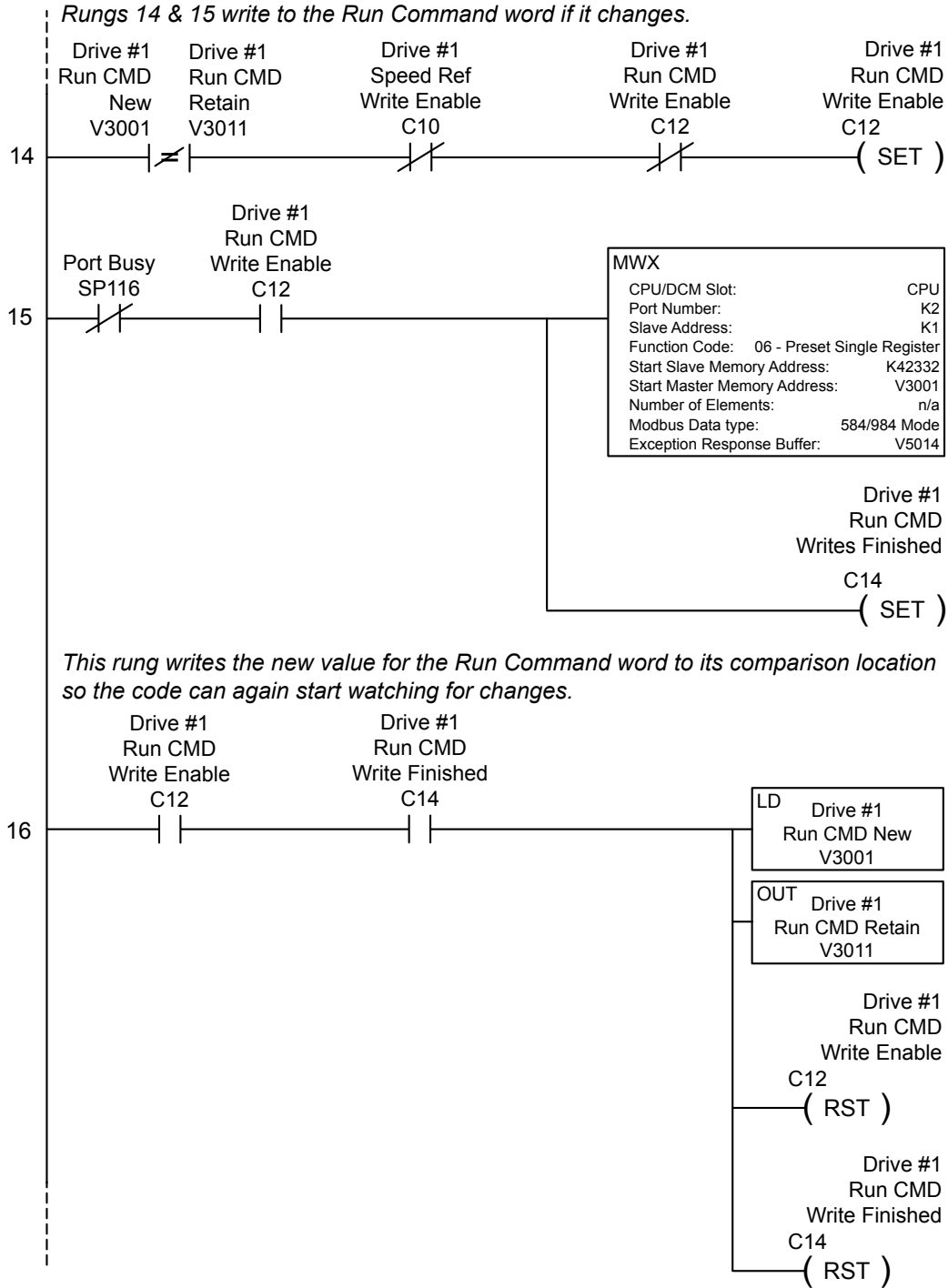
(DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs – continued from previous page)

This rung writes the new values for Speed Ref, Direction, Ext Fault, and Fault Reset words to their comparison locations so the code can again start watching for changes.



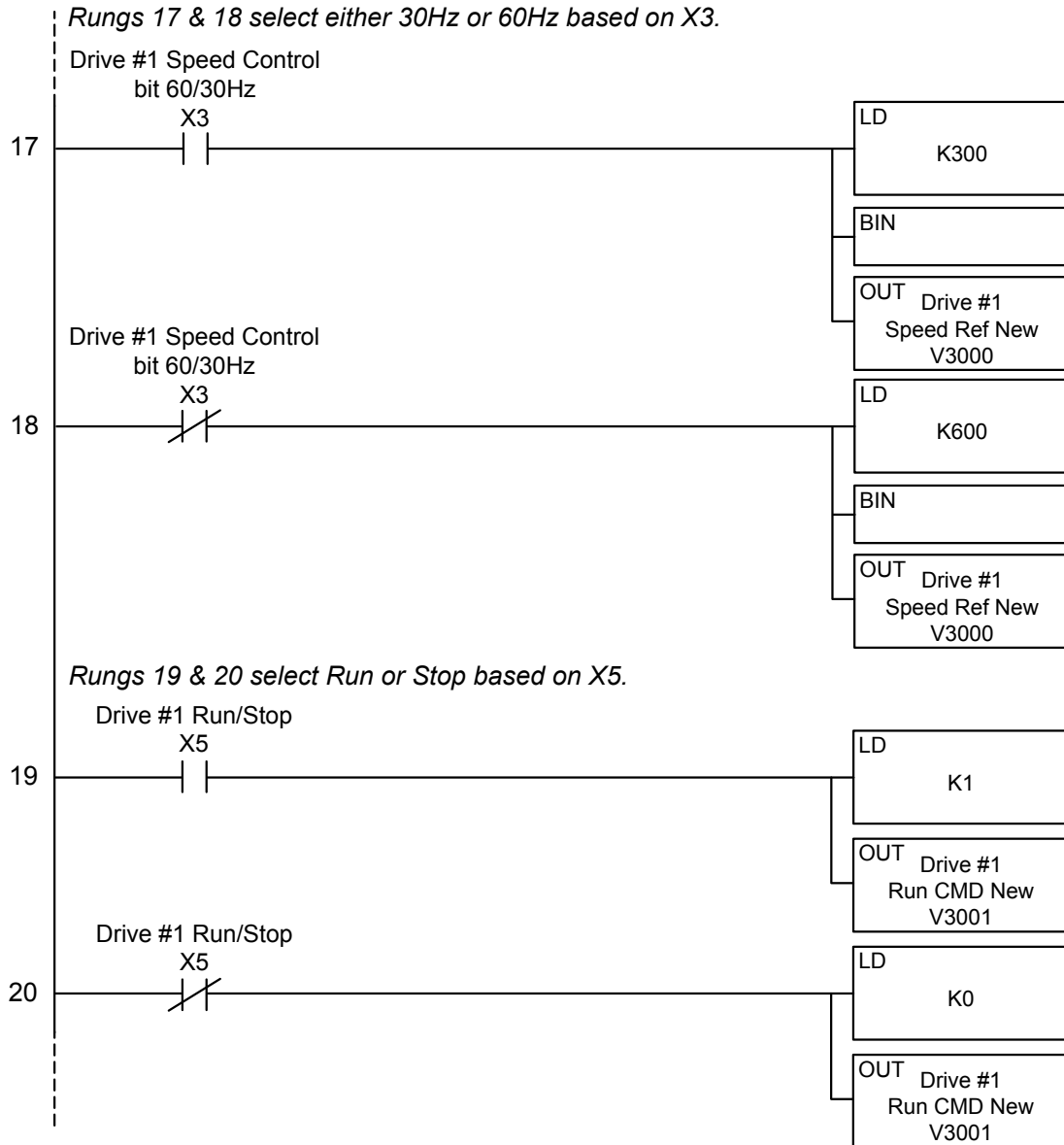
(PLC program continued on next page)

(DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs – continued from previous page)



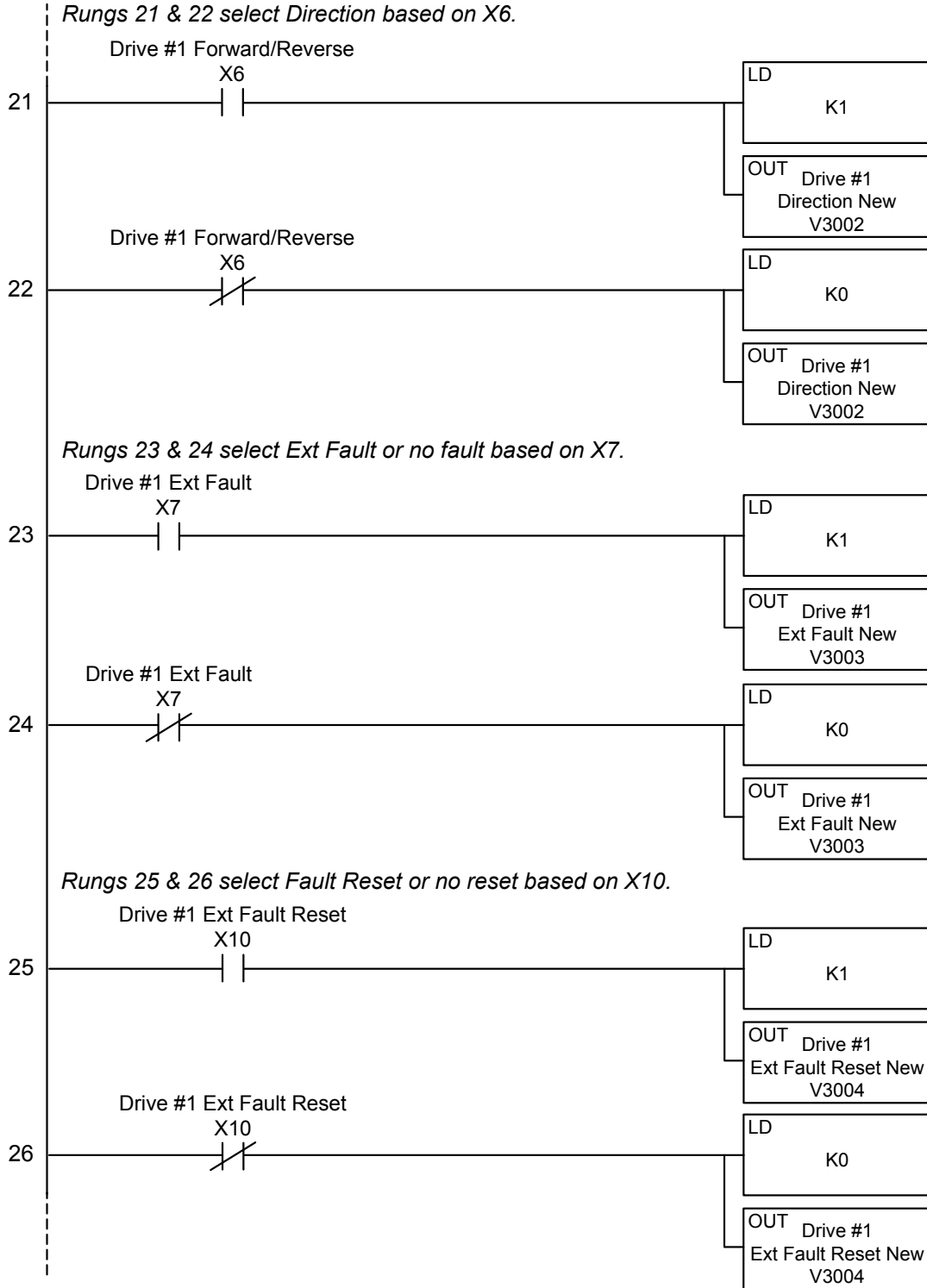
(PLC program continued on next page)

(DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs – continued from previous page)



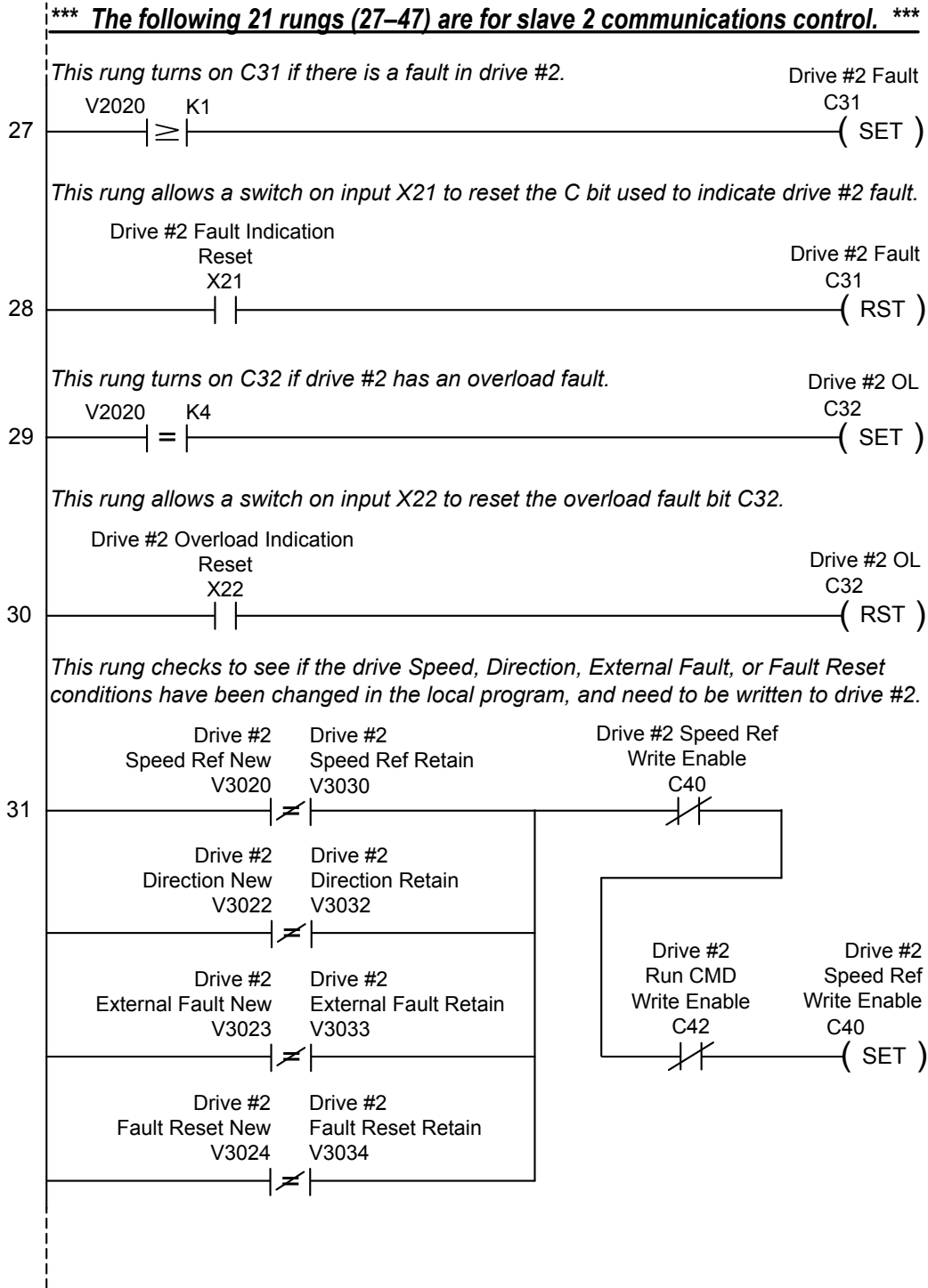
(PLC program continued on next page)

(DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs – continued from previous page)



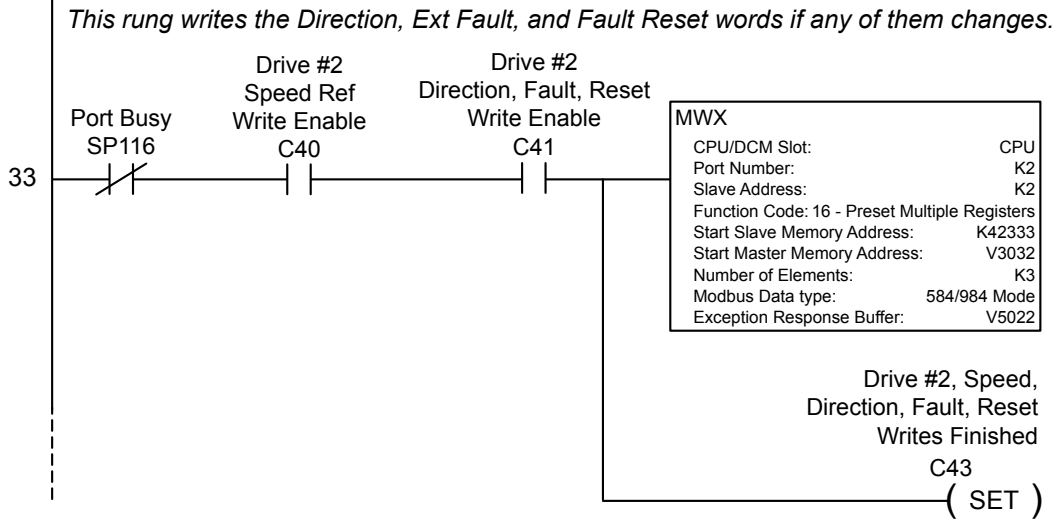
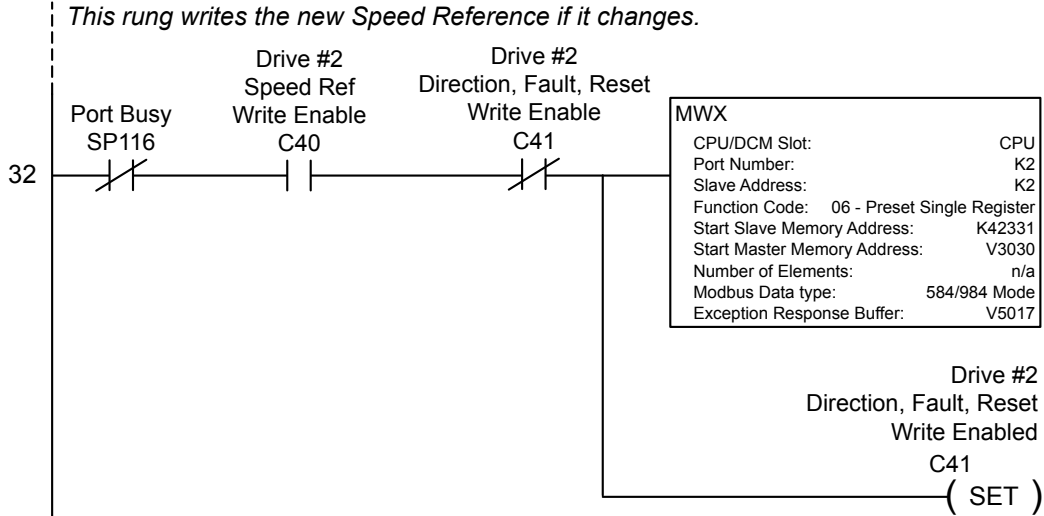
(PLC program continued on next page)

(DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs – continued from previous page)



(PLC program continued on next page)

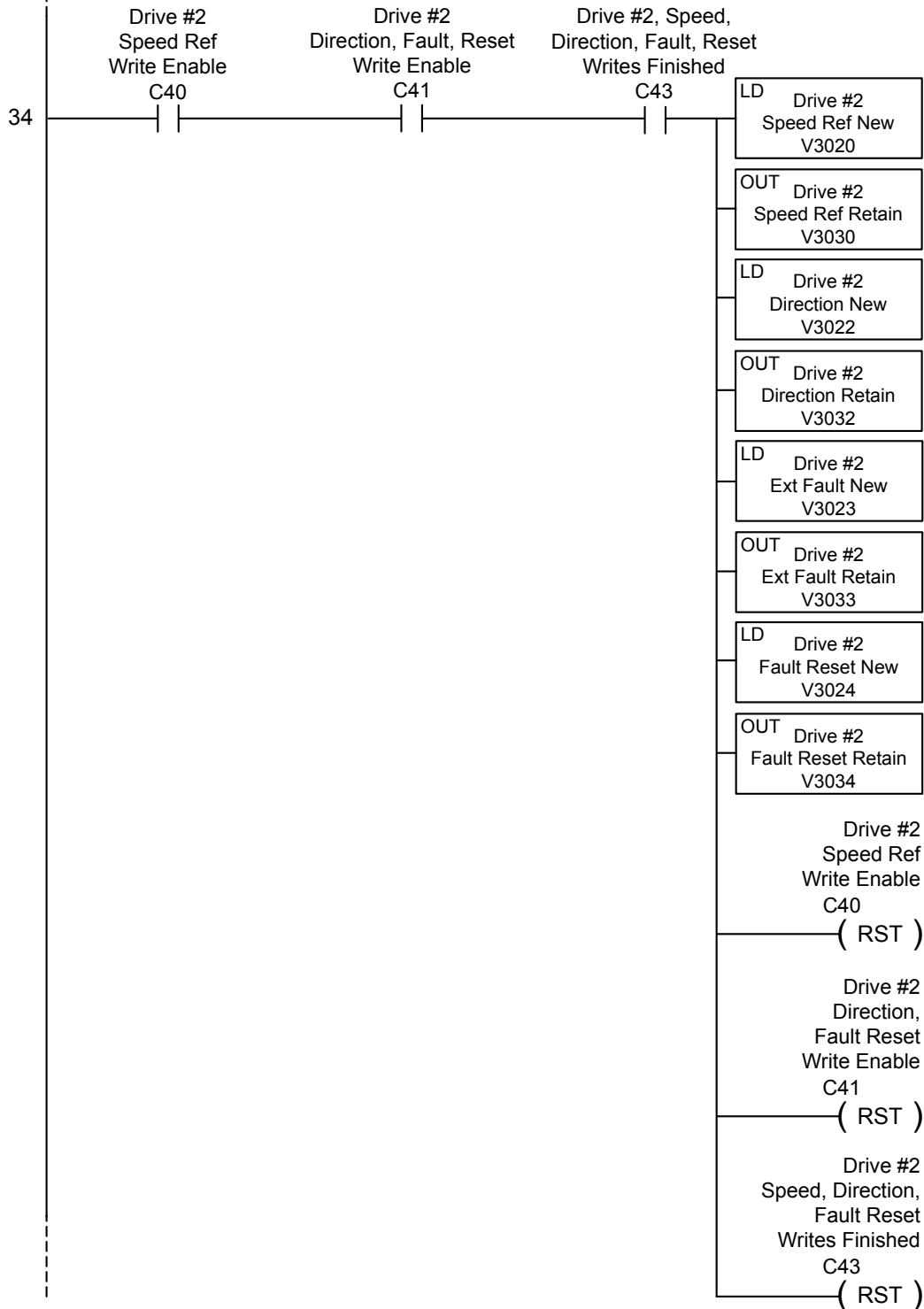
(DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs – continued from previous page)



(PLC program continued on next page)

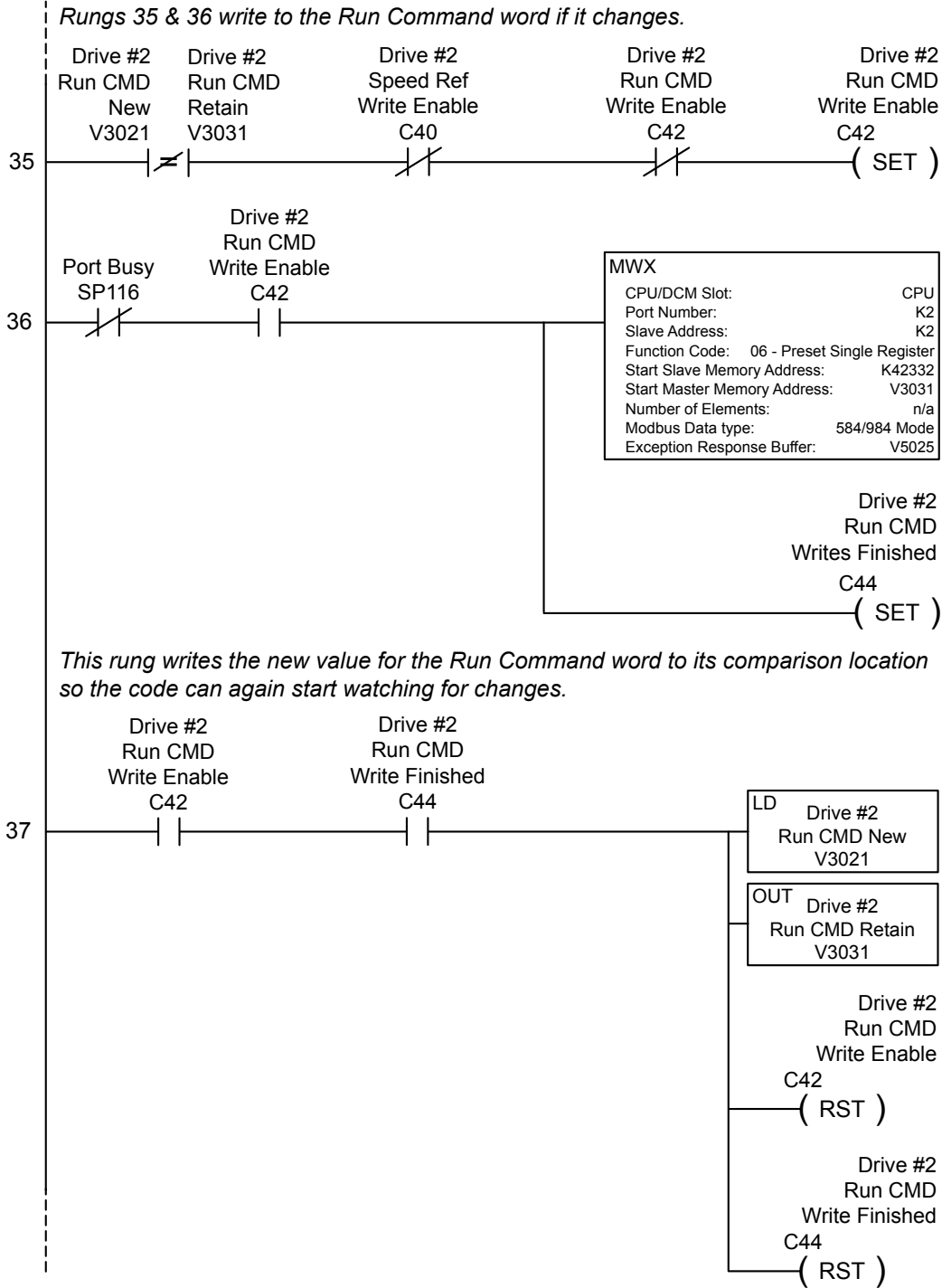
(DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs – continued from previous page)

This rung writes the new values for Speed Ref, Direction, Ext Fault, and Fault Reset words to their comparison locations so the code can again start watching for changes.



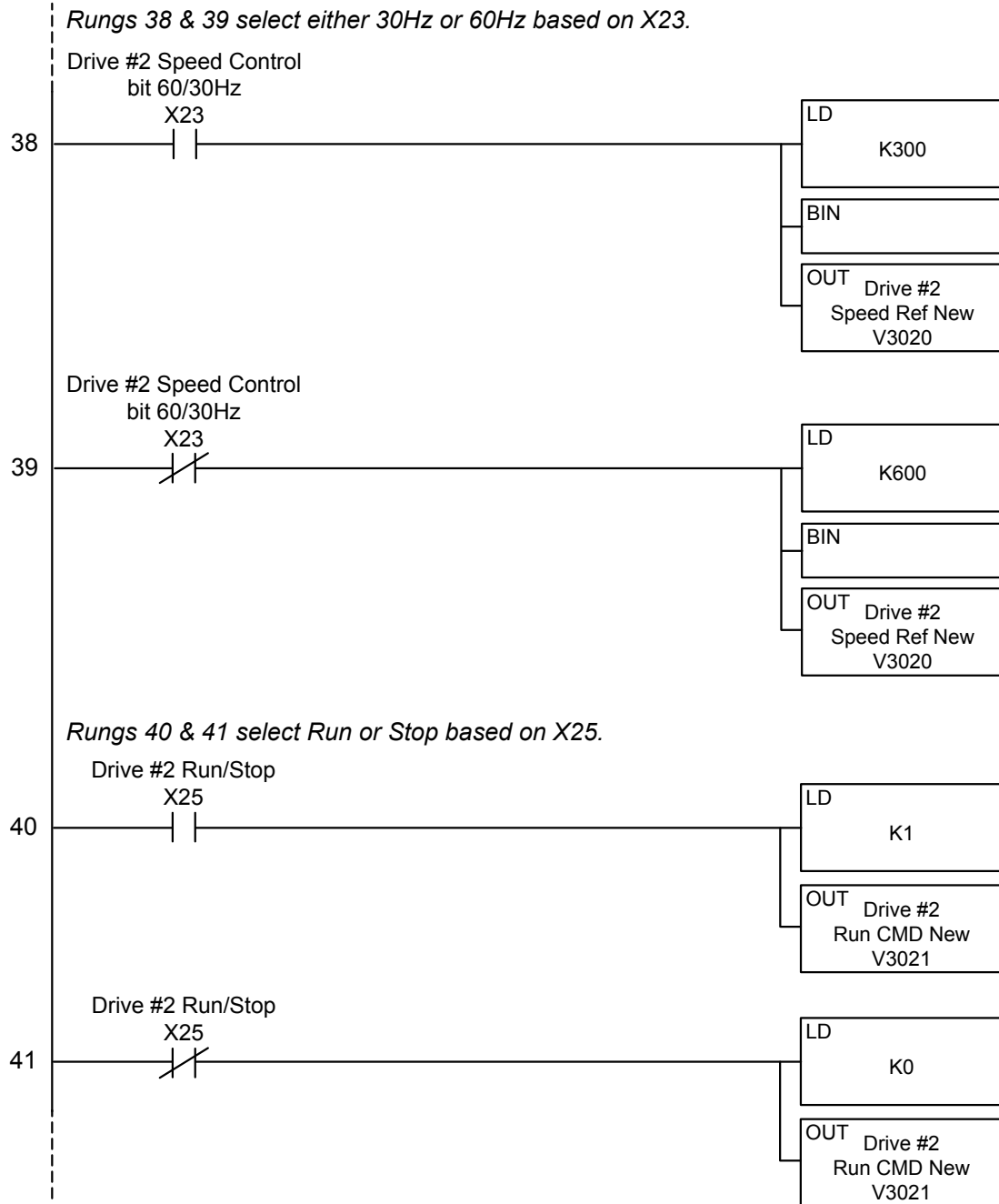
(PLC program continued on next page)

(DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs – continued from previous page)



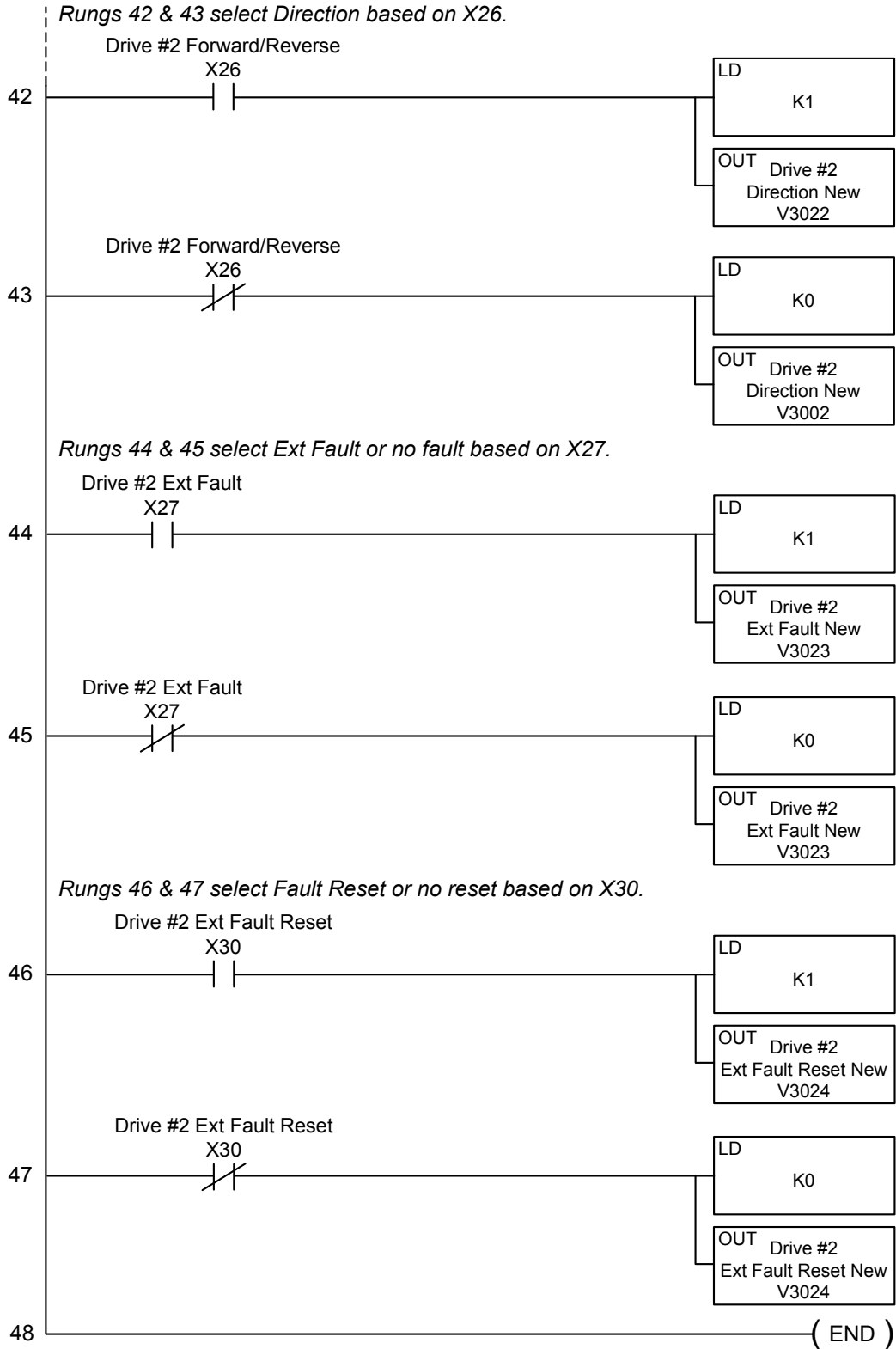
(PLC program continued on next page)

(DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs – continued from previous page)



(PLC program continued on next page)

(DL MRX/MWX Communication Program Example – for DL06 & D2-260 PLCs – continued from previous page)

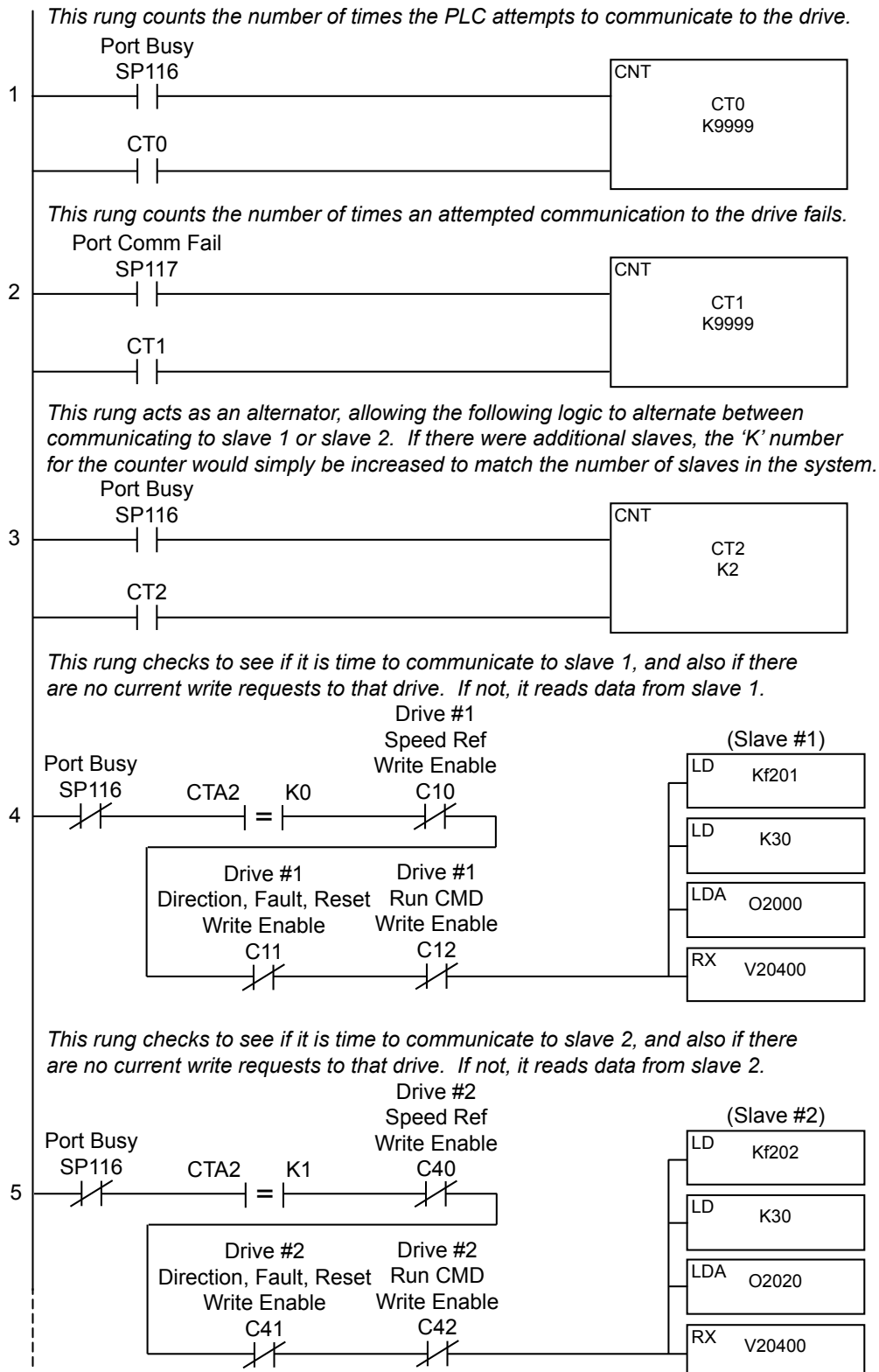


DL RX/WX COMMUNICATION PROGRAM – FOR DL05, D2-250(-1), & D4-450 PLCs



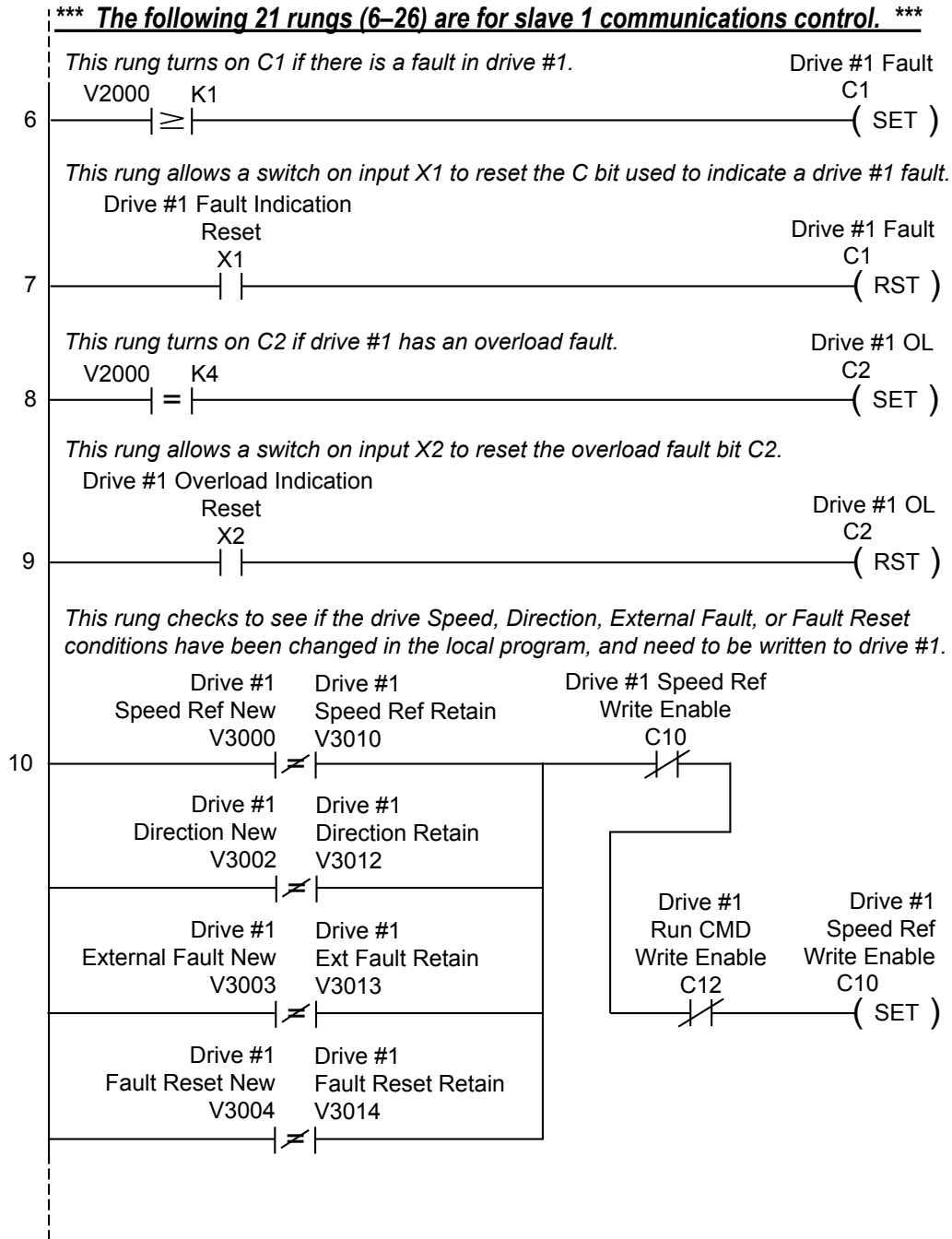
This program is for illustrational purposes only, and is not intended for a true application.

DL RX/WX Communication Program Example – for DL05, D2-250(-1), D4-450 PLCs



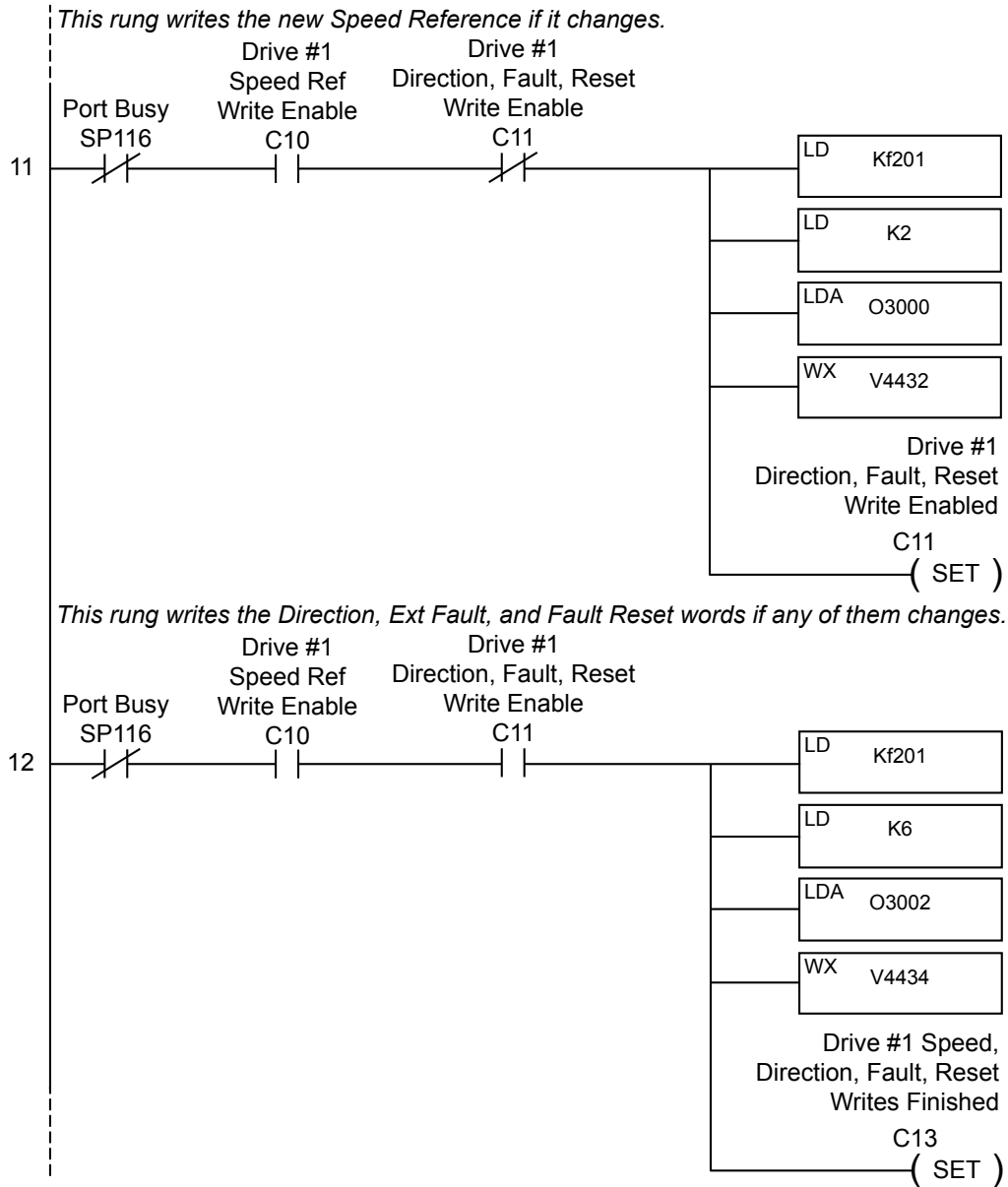
(PLC program continued next page)

(DL RX/WX Communication Program Example – for DL05, D2-250(-1), D4-450 – continued from previous page)



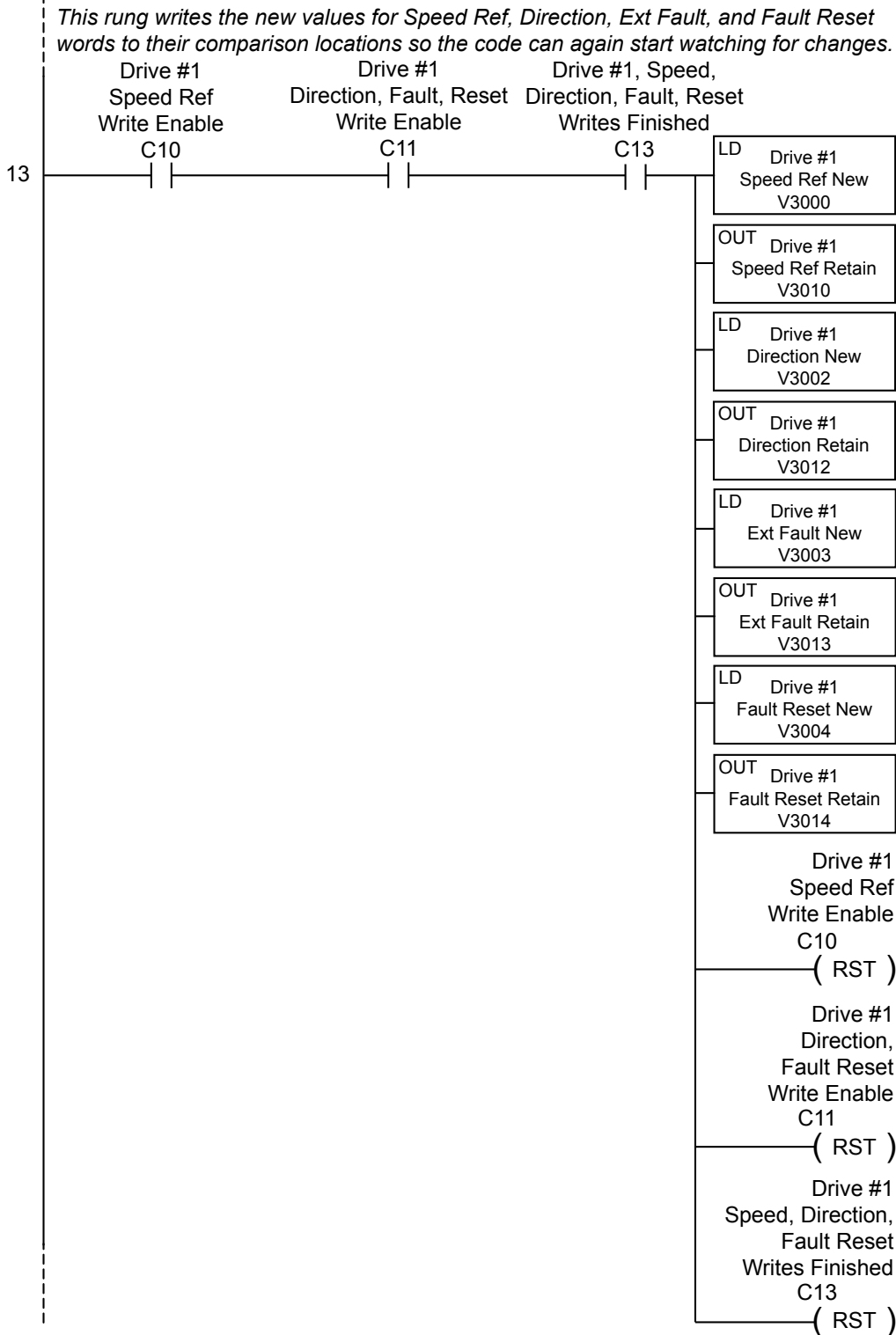
(PLC program continued next page)

(DL RX/WX Communication Program Example – for DL05, D2-250(-1), D4-450 – continued from previous page)



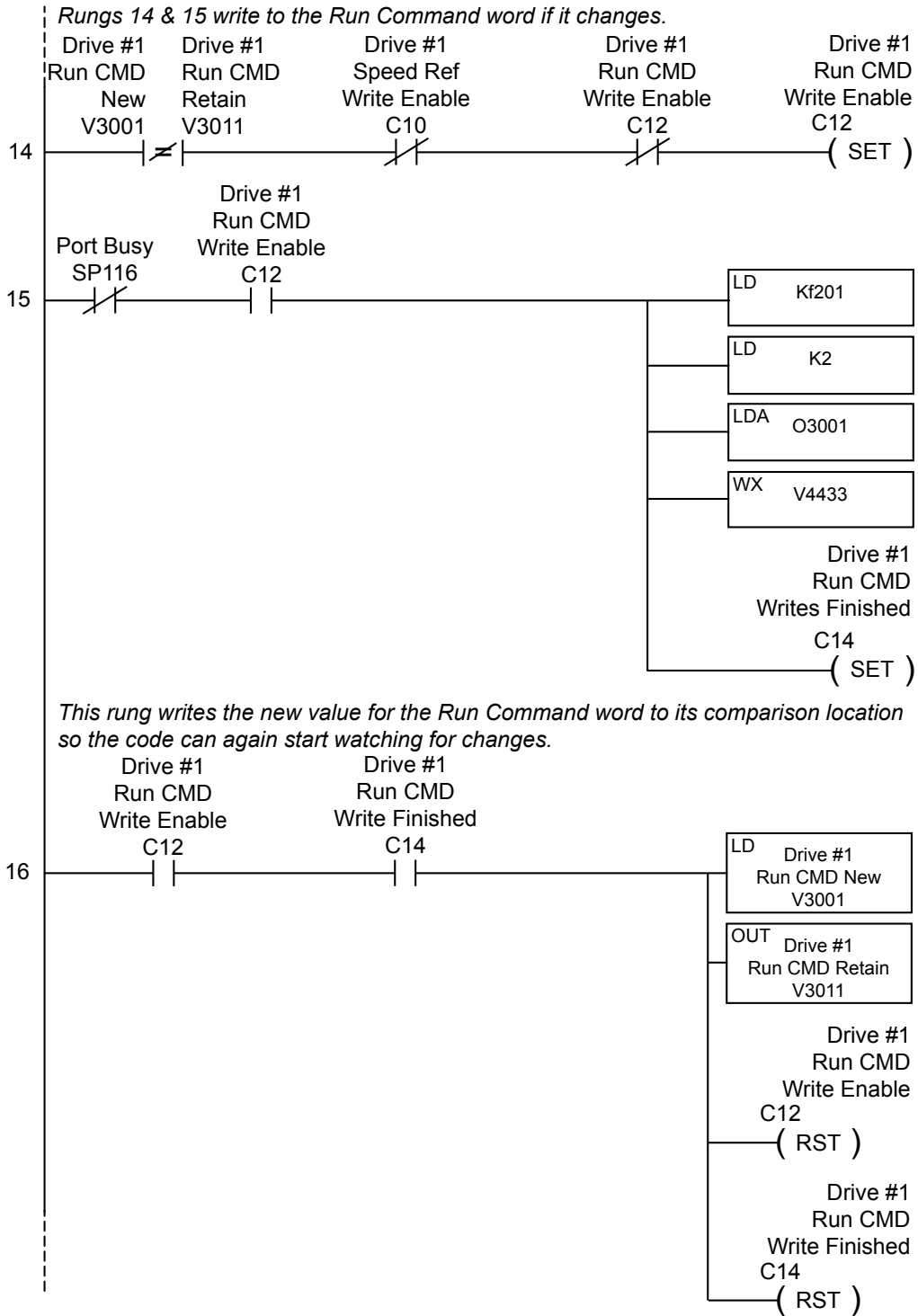
(PLC program continued next page)

(DL RX/WX Communication Program Example – for DL05, D2-250(-1), D4-450 – continued from previous page)



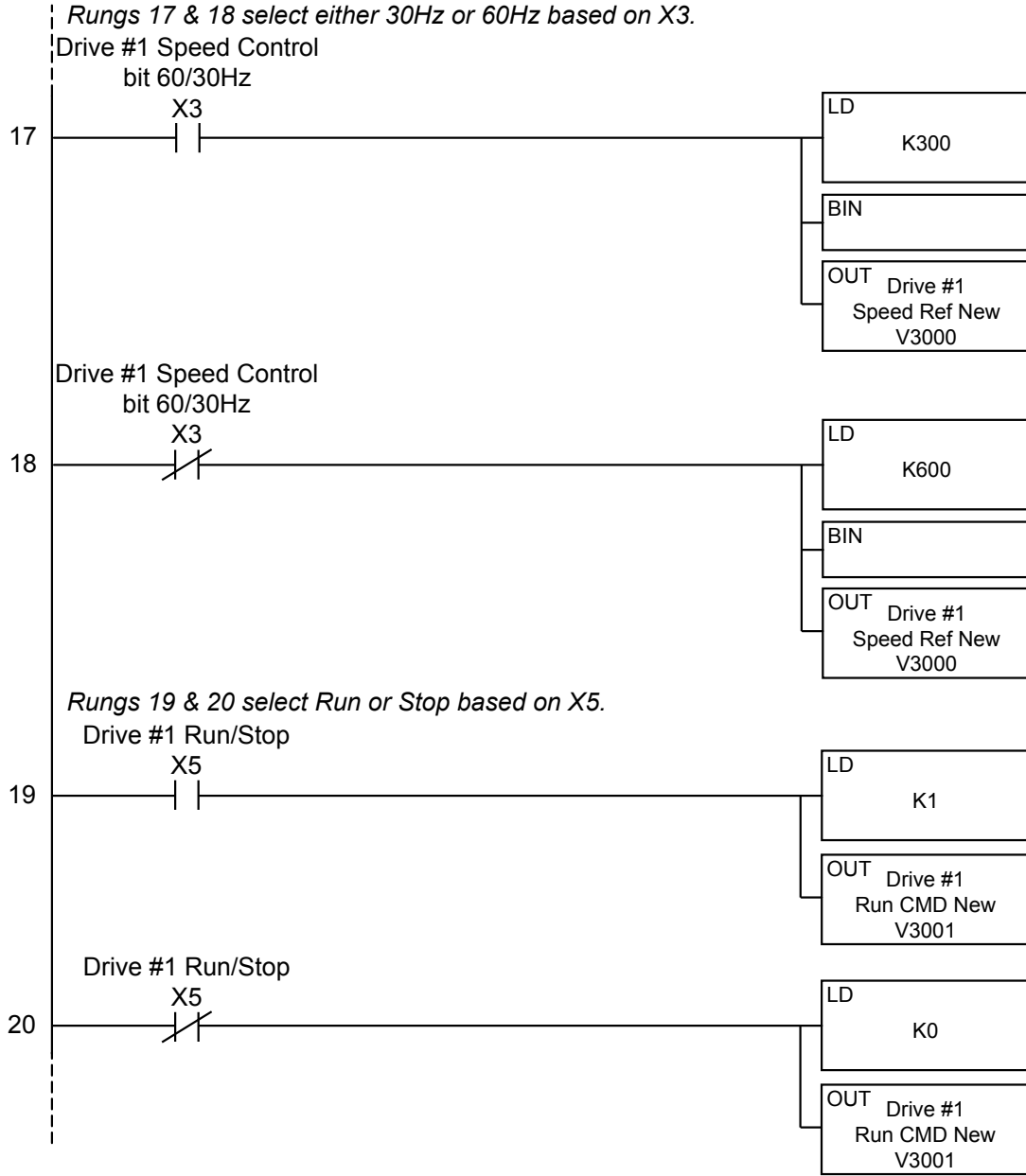
(PLC program continued next page)

(DL RX/WX Communication Program Example – for DL05, D2-250(-1), D4-450 – continued from previous page)



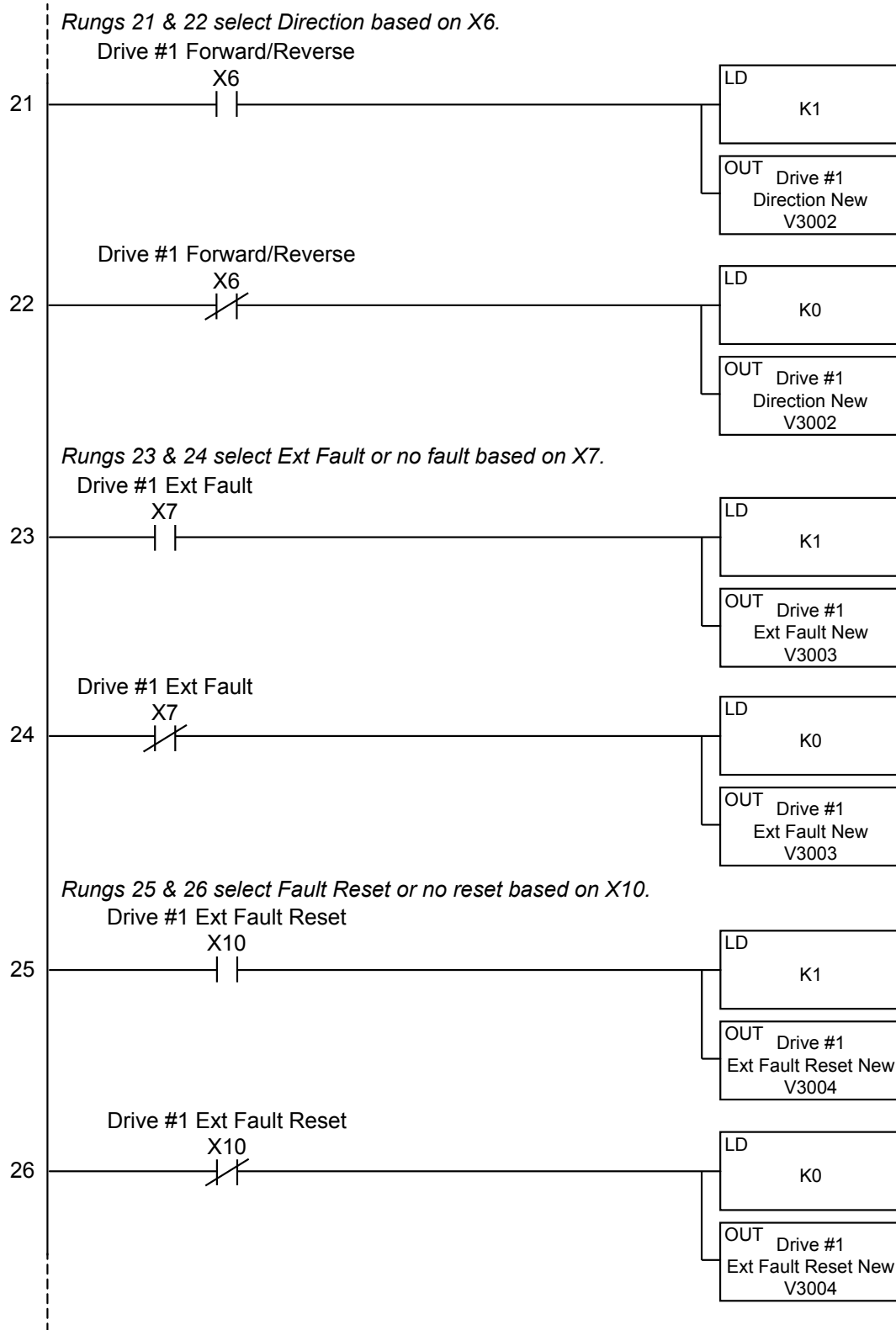
(PLC program continued next page)

(DL RX/WX Communication Program Example – for DL05, D2-250(-1), D4-450 – continued from previous page)



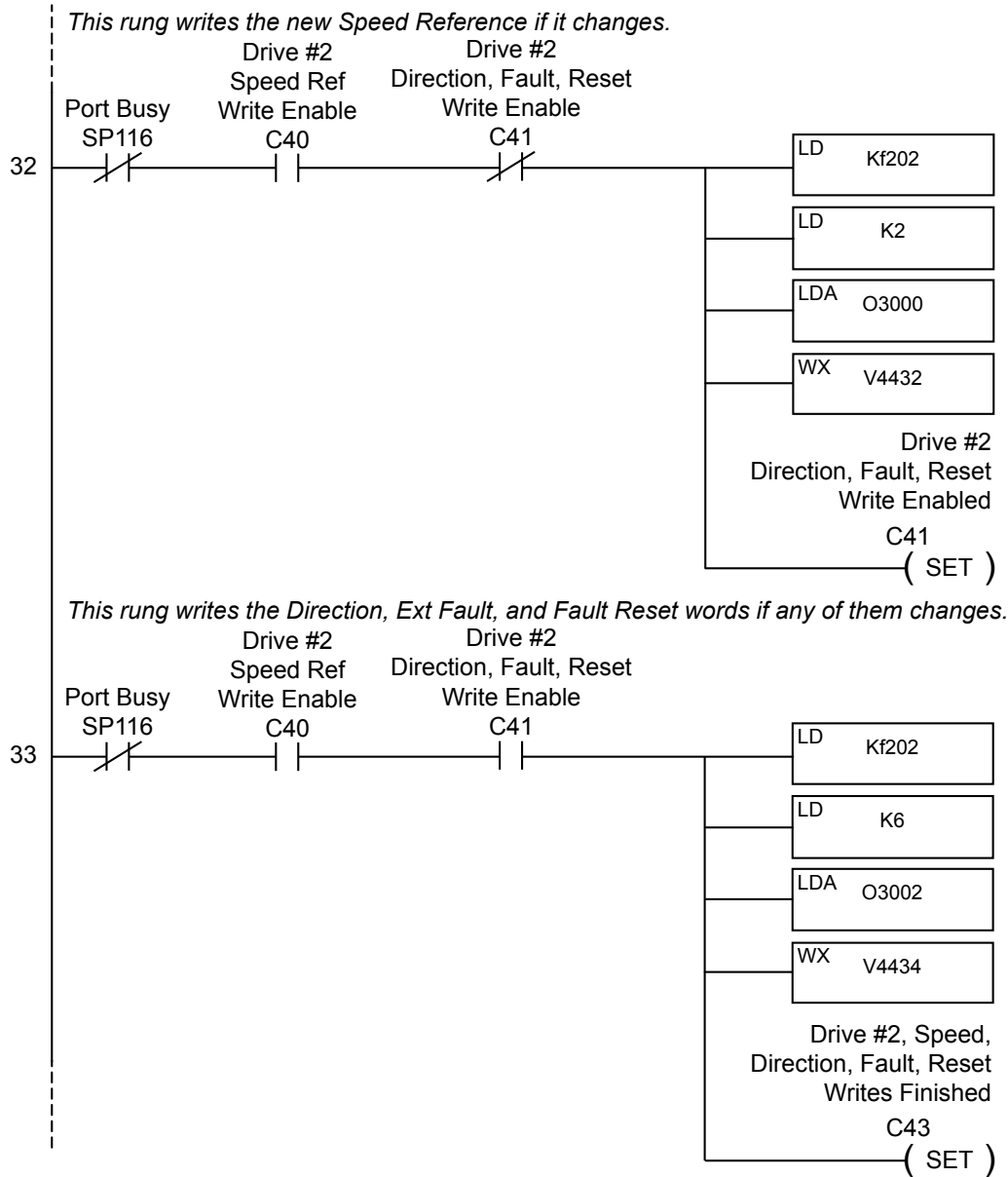
(PLC program continued next page)

(DL RX/WX Communication Program Example – for DL05, D2-250(-1), D4-450 – continued from previous page)



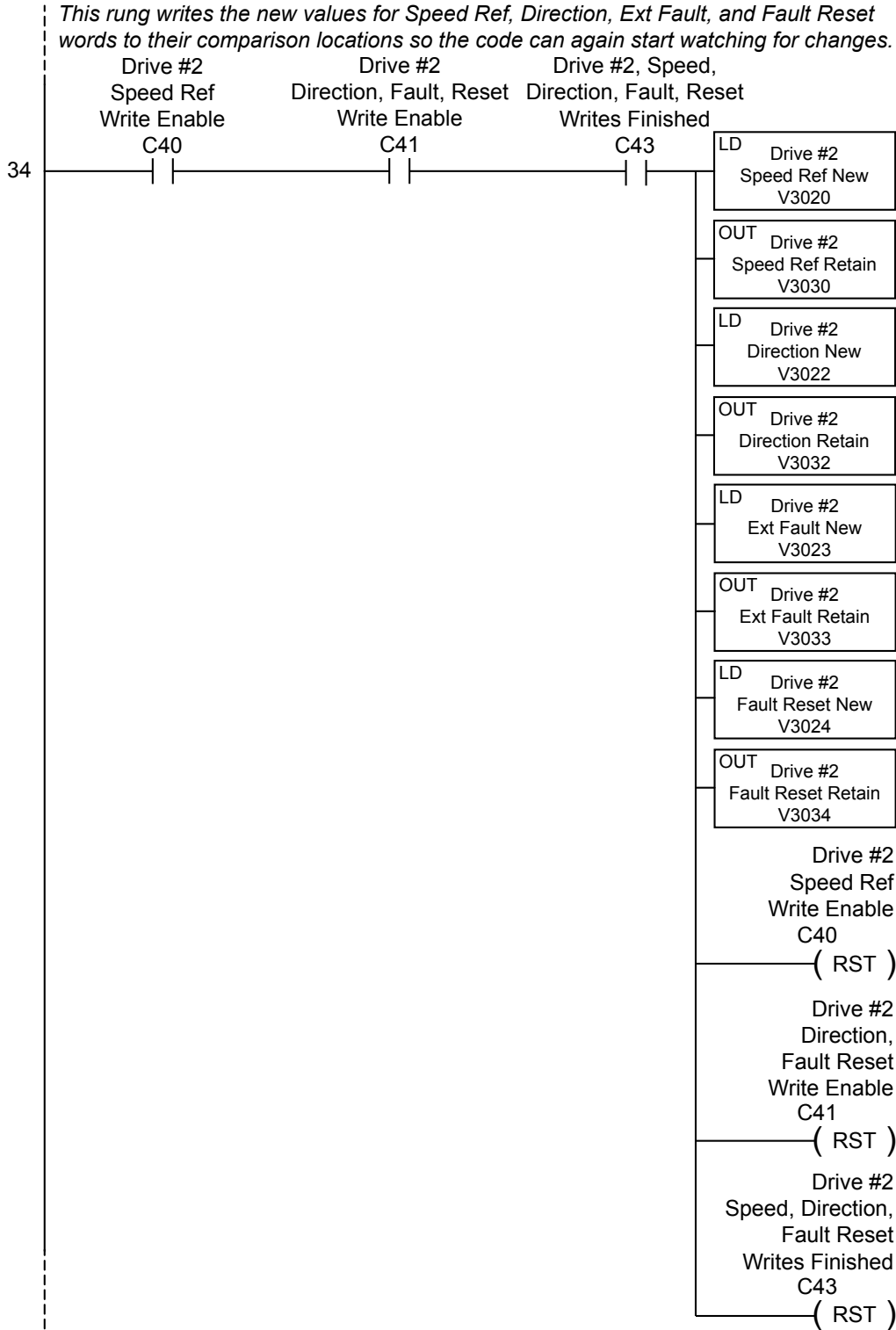
(PLC program continued next page)

(DL RX/WX Communication Program Example – for DL05, D2-250(-1), D4-450 – continued from previous page)



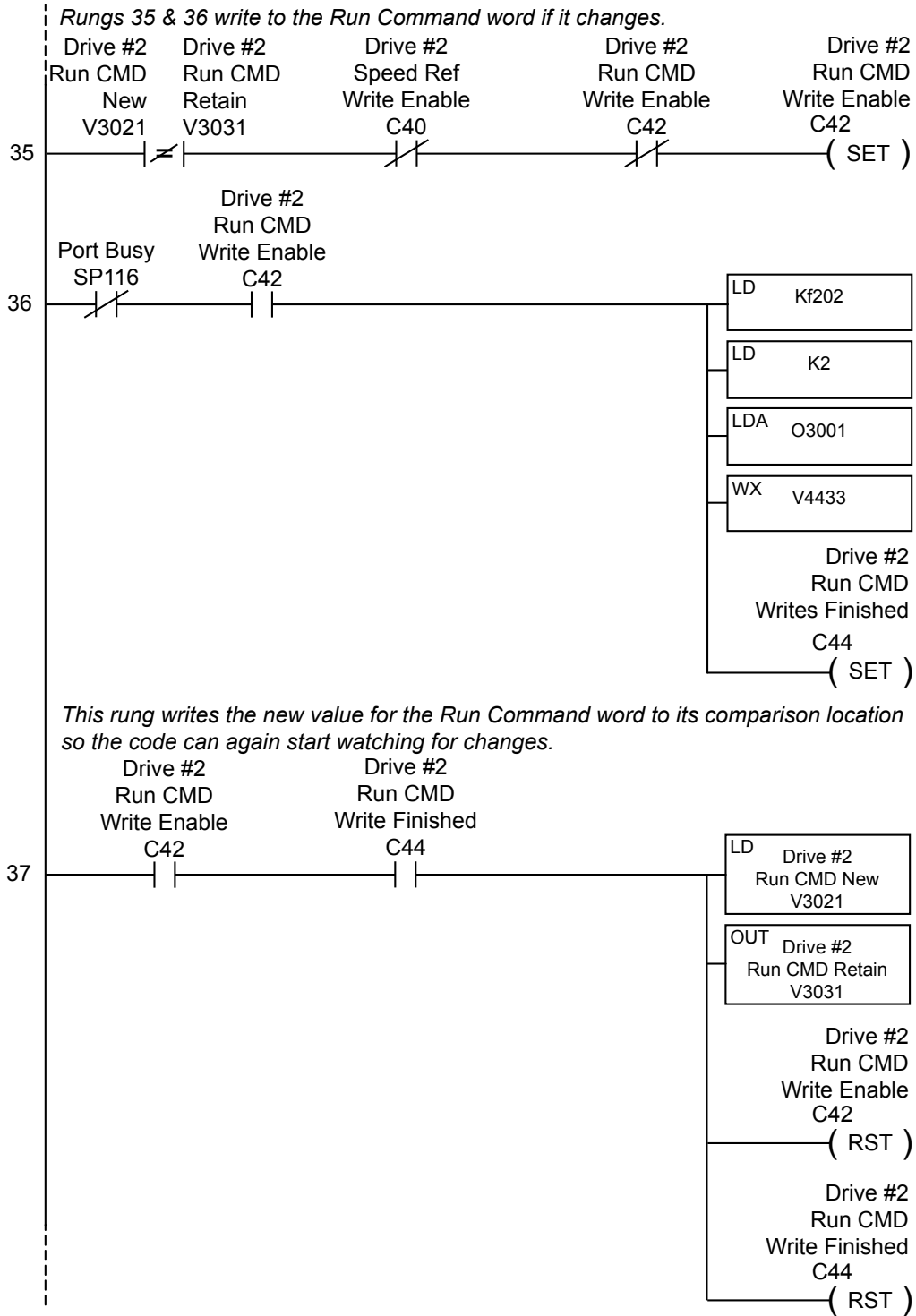
(PLC program continued next page)

(DL RX/WX Communication Program Example – for DL05, D2-250(-1), D4-450 – continued from previous page)



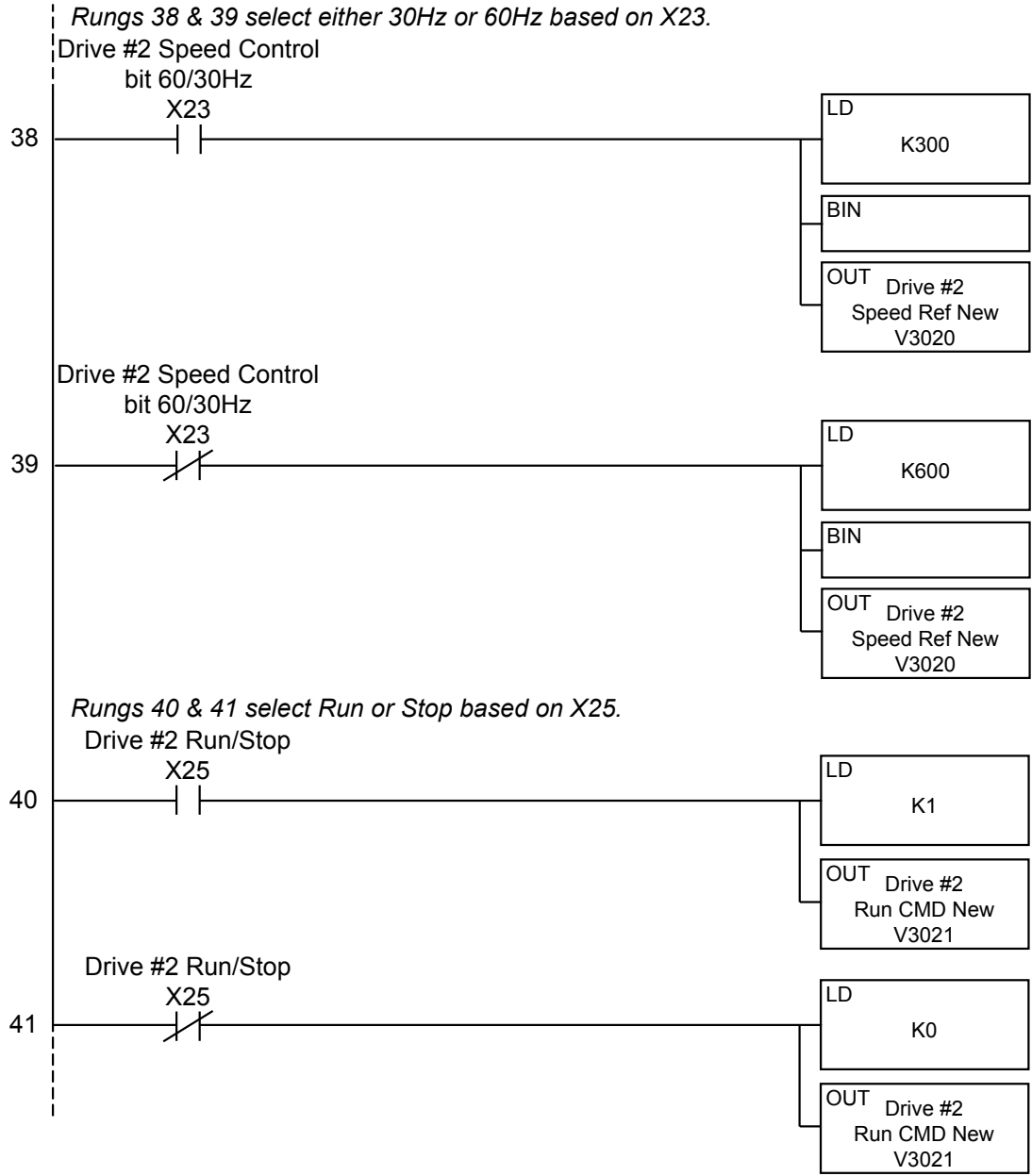
(PLC program continued next page)

(DL RX/WX Communication Program Example – for DL05, D2-250(-1), D4-450 – continued from previous page)



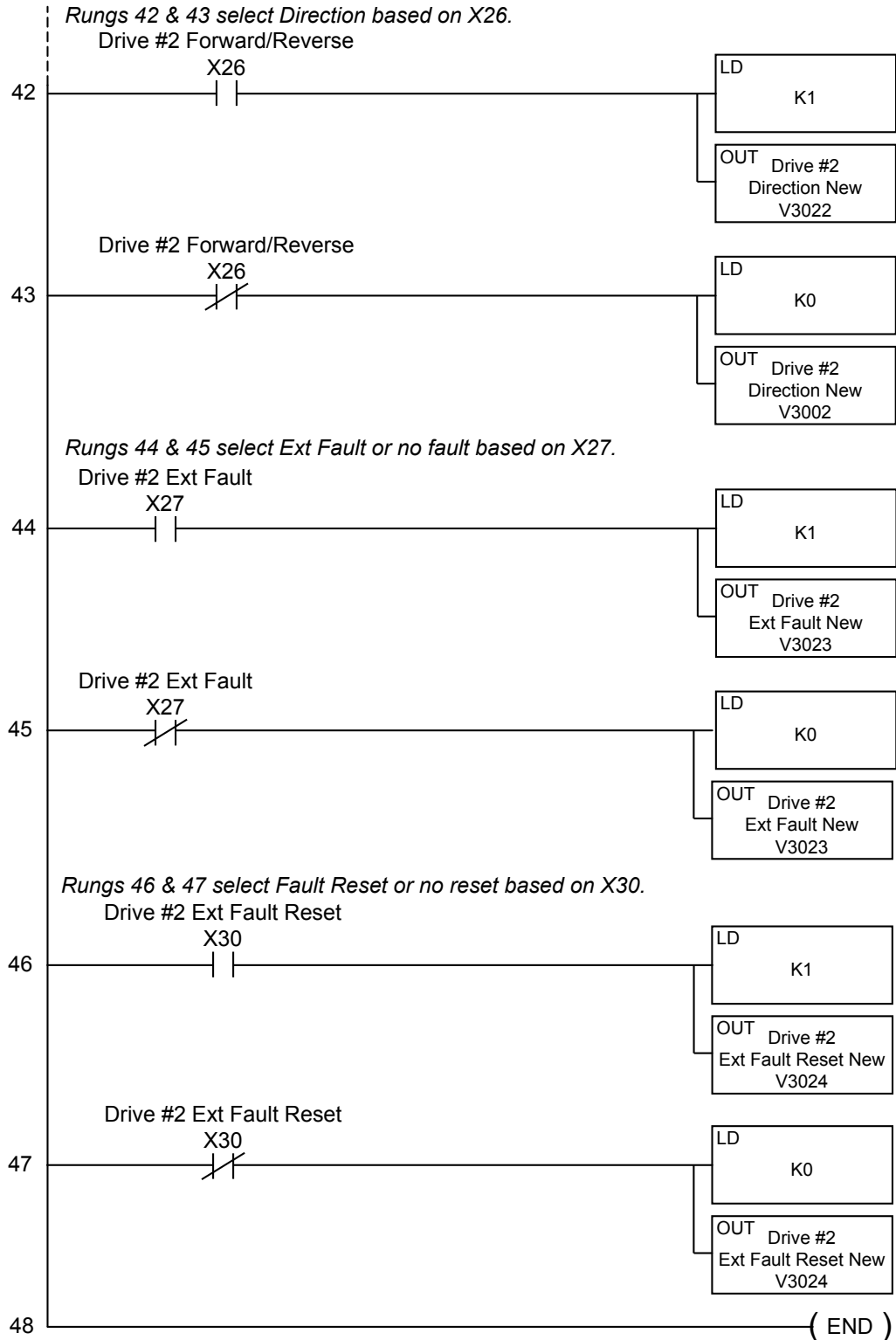
(PLC program continued next page)

(DL RX/WX Communication Program Example – for DL05, D2-250(-1), D4-450 – continued from previous page)



(PLC program continued next page)

(DL RX/WX Communication Program Example – for DL05, D2-250(-1), D4-450 – continued from previous page)



COMMUNICATING WITH THIRD-PARTY DEVICES

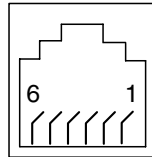
The *DURAPULSE* GS3 RJ-12 Serial Comm Port will accommodate an RS-485 connection.

An RS-485 network cable can span up to 1000 meters (4000 feet). The *DURAPULSE* GS3 AC drive communication address is specified by P9.00. The third party device then controls each AC drive according to its communication address.

The *DURAPULSE* GS3 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.

DURAPULSE GS3 RS-485 Serial Comm Port

**GS3 Serial Comm Port
RS-485 Interface
RJ12 (6P6C)**



1: +15V
2: GND
3: SG-
4: SG+
5: nc
6: reserved



DURAPULSE GS3 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

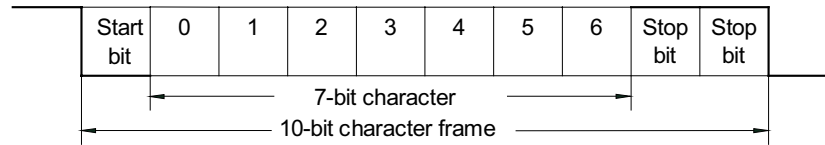
- MODSCAN from www.wintech.com
- KEPSERVER EX 4.0 from www.kepware.com
- Entivity Studio 7.2
- Think & Do Live 5.5.1

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

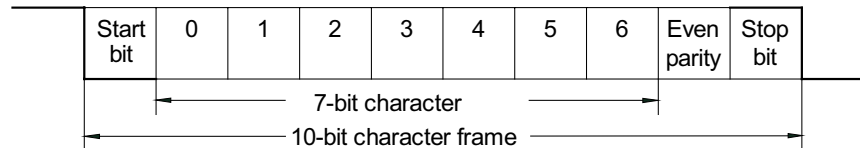
DATA FORMAT

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

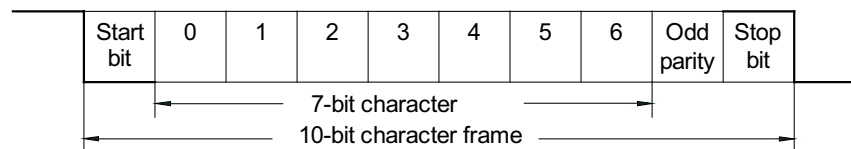
P9.02 = 00 (7 data bits, no parity, 2 stop bits)



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

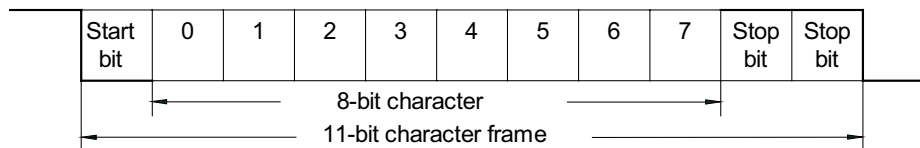


P9.02 = 02 (7 data bits, odd parity, 1 stop bit)

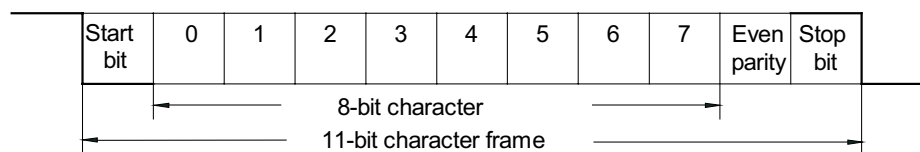


RTU Mode: 11-bit character frame (For 8-bit character):

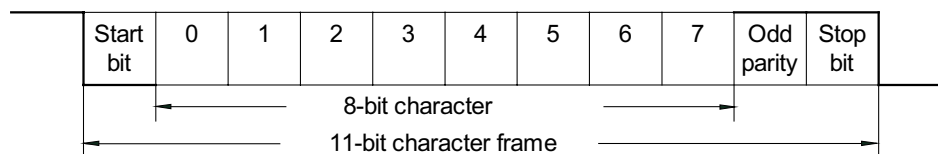
P9.02 = 03 (8 data bits, no parity, 2 stop bits)



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 followed: Command code: 03H, read N words. The maximum value of N is 12. For example, reading continuous 2 words from starting address 2102H of the AC drive with address 01H.

ASCII mode:

Command Message		Response Message	
STX	'.'	STX	'.'
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'
Number of data (Count by word)	'0'	Content data address 2103H	'7'
	'0'		'0'
	'0'	'0'	'0'
	'2'	'0'	'0'
LRC CHK 1	'D'	LRC CHK 1 LRC CHK 0	'7'
LRC CHK 0	'7'		'1'
END 1	CR	END 1	CR
END 0	LF	END 0	LF

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'		'0'
	'1'	Data Content	'1'
	'7'		'7'
	'7'		'7'
	'0'		'0'
LRC CHK 1	'7'	LRC CHK 1	'7'
LRC CHK 0	'1'	LRC CHK 0	'1'
END 1	CR	END 1	CR
END 0	LF	END 0	LF

RTU mode:

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

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

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:

- Step 1: Load a 16-bit register (called CRC register) with FFFFH.
- Step 2: Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.
- Step 3: Shift the CRC register one bit to the right with MSB zero filling. Extract and examine the LSB.
- Step 4: If the LSB of CRC register is 0, repeat step 3; else Exclusive or the CRC register with the polynomial value A001H.
- Step 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.
- Step 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 μ s (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 μ s (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:Request:

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)

Reply:

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)

FORMAT OF "WRITE MULTIPLE REGISTERS" MESSAGES:Request:

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)

Reply:

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)

FORMAT OF "WRITE SINGLE REGISTER" MESSAGES:Request:

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)

Reply:

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)

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, 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

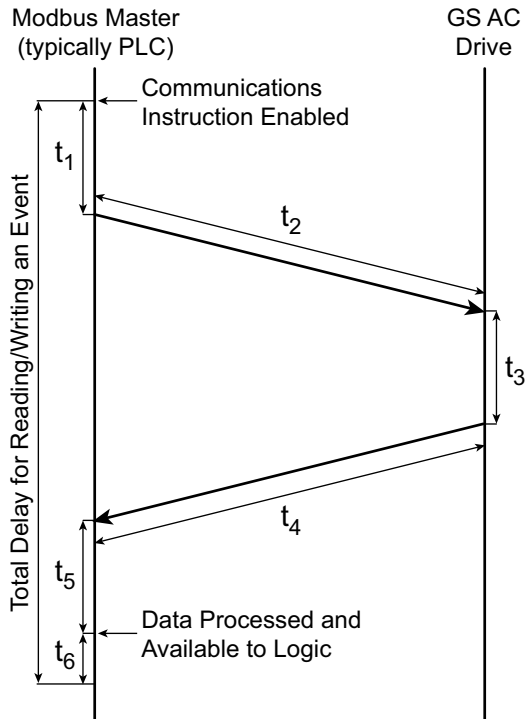
Depending upon the master device, there may be additional delays. For example:

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



- t₁ = Scan delay from the point of turning on a communications instruction to when it actually goes out of the serial port.
- t₂ = Transmission time to send Message request (read or write).
- t₃ = Response delay from GS drive to receive the reply and formulate the response.
- t₄ = Transmission time to send Reply message.
- t₅ = Scan delay from the point of receiving reply, processing it and placing in PLC memory for Logic usage.
- t₆ = 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?

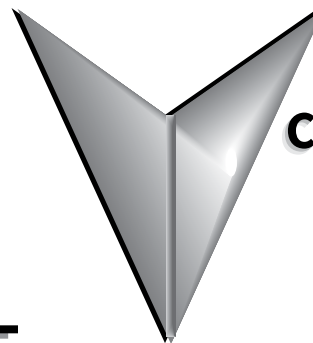
There is no way to make a message go faster than what is specified above, but what you can affect is the amount of messages being sent to any given GS drive in two ways.

- 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.

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MAINTENANCE AND TROUBLESHOOTING



CHAPTER

6

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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.



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! WAIT AT LEAST TWO MINUTES AFTER ALL DISPLAY LAMPS HAVE TURNED OFF.*

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 megohmmeter.
- 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 MESSAGES

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 messages are then displayed on the digital keypad LCD display. The six most recent faults can be read on the digital keypad display by viewing parameters P06.31 to P06.36.



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

Fault Messages	
Fault Name/Description	Corrective Actions
<p>OVER-CURRENT</p> <p>The AC drive detects an abnormal increase in current.</p>	<ol style="list-style-type: none"> 1. Check whether the motor's horsepower is equal to or less than 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, or fault does not clear, call ADC Support for assistance.
<p>OVER-VOLTAGE</p> <p>The AC drive detects that the DC bus voltage has exceeded its maximum allowable value.</p>	<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. Either increase the decel time or add an optional braking resistor. 4. Check whether the required braking power is within the specified limits. 5. Check braking resistor on drives under 20hp and dynamic brake unit & braking resistor on drives 20hp and above.
<p>OVER-TEMPERATURE</p> <p>The AC drive temperature sensor detects excessive heat.</p>	<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.
<p>UNDER-VOLTAGE</p> <p>The AC drive detects that the DC bus voltage has fallen below its minimum allowable value.</p>	<p>Check whether the input voltage falls within the rated AC drive input voltage.</p>
<p>OVERLOAD</p> <p>The AC drive detects excessive drive output current.</p>	<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. <p><i>Note: The AC drive can withstand up to 150% of the rated current for a maximum of 60 seconds.</i></p>
<p>THERMAL OVERLOAD</p> <p>Parameter settings (P6.07 to P6.09) An external condition has occurred to cause an internal electronic or motor thermal overload fault</p>	<p>If P6.07 is set to '1' to enable during steady state:</p> <ol style="list-style-type: none"> 1. Check for possible motor overload. 2. Check electronic thermal overload relay setting (P6.00). 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.
<p>OVER-TORQUE</p> <p>Parameter settings (P6.07 to P6.09) An external condition has occurred to cause an over-torque fault.</p>	<p>If P6.07 is set to '2' to enable detection during accel/decel:</p> <ol style="list-style-type: none"> 1. Reduce the motor overload. 2. Adjust the over-torque detection setting to an appropriate level.
(table continued next page)	

Fault Messages (continued from previous page)	
Fault Name/Description	Corrective Actions
<p>OVER-CURRENT ACC</p> <p>Over-current during acceleration:</p> <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 P2.02. 3. Increase the acceleration time P1.01 and P1.05. 4. Replace the AC drive with one that has a higher output capacity.
<p>OVER-CURRENT DEC</p> <p>Over-current during deceleration:</p> <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 P1.02 and P1.06. 3. Replace the AC drive with one that has a higher output capacity.
<p>OVER-CURRENT STD</p> <p>Over-current during steady state operation</p> <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.
<p>CPU FAILURE 1</p> <p>Internal memory IC cannot be programmed</p>	<ol style="list-style-type: none"> 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. If fault does not clear, contact ADC Support for assistance.
<p>CPU FAILURE 2</p> <p>Internal memory IC cannot be read.</p>	<ol style="list-style-type: none"> 1. Reset drive to factory defaults P9.08 to 99. 2. Switch off power supply 3. Switch the AC drive back on. If fault does not clear, contact ADC Support for assistance.
<p>CPU FAILURE 3</p> <p>Internal memory IC failed to receive output status</p>	<ol style="list-style-type: none"> 1. Check all connections at L1, L2 and L3. 2. Verify correct voltage at L1, L2, and L3. 3. Contact ADC Support for assistance.
<p>HARDWARE FAILURE</p> <p>Hardware protection failure</p>	<ol style="list-style-type: none"> 1. Check all connections at L1, L2 and L3. 2. Verify correct voltage at L1, L2, and L3. 3. Contact ADC Support for assistance.
<p>MOM POWER LOSS</p> <p>Input power has been lost</p>	<p>Check line power to drive</p>
<p>EXTERNAL FAULT</p> <p>The external terminal EF-CM goes from OFF to ON</p>	<p>When external terminal EF-CM is closed, the output will be turned off (under Normally Open. External Fault.).</p>
<p>AUTO RAMP FAULT</p> <p>Auto accel/decel failure</p>	<p>Refer to Over-current or Over-voltage error</p>
<p>GROUND FAULT</p> <ol style="list-style-type: none"> 1. Possible unbalanced load 2. Possible current leakage 	<ol style="list-style-type: none"> 1. Check the motor for possible insulation damage. 2. Check for possible poor insulation at the output line.
<p>EXT. BASE-BLOCK</p> <p>AC drive output is turned off.</p>	<ol style="list-style-type: none"> 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.

(table continued next page)

Fault Messages (continued from previous page)	
Fault Name/Description	Corrective Actions
<p>INPUT POWER LOSS</p> <p>One phase of the input power is lost</p>	<ol style="list-style-type: none"> 1. Check for possible poor connection on the input power line. 2. Check for possible loss of phase on input power line.
<p>OUTPUT SHORTED</p> <p>IGBT Short Circuit</p>	<p>Contact ADC Support for assistance.</p>
<p>PID FBACK LOSS</p> <ol style="list-style-type: none"> 1. If P7.27 = 0, (<i>warn and AC drive stop</i>), PID feedback loss recorded. 2. If P7.27 = 1, (<i>warn and continue operation</i>), PID feedback loss not recorded. 	<p>PID Warning: PID Feedback Loss - The 4-20mA PID signal has been lost. The corrective action can be set with the PID Feedback Loss parameter (P7.27). The available settings are: 00 - Warn and AC Drive Stop 01 - Warn and Continue The default setting is 00.</p>
<p>ENCODER LOSS</p> <ol style="list-style-type: none"> 1. If P10.05 = 1 or 2 (<i>warn and AC drive stop</i>), Encoder feedback loss would be recorded. 2. If P10.05 = 0 (<i>warn and continue operation</i>), Encoder feedback loss would not be recorded. 	<ol style="list-style-type: none"> 1. Verify that the encoder board has power. 2. Check to be sure it is not mis-wired. 3. Check for incorrect voltage or encoder set-up. 4. Check both the mechanical and electrical integrity of the encoder.
<p>ENC SIGNAL ERROR</p> <p>Encoder A/B phase signal is in error when the control mode is from the encoder</p>	<ol style="list-style-type: none"> 1. Verify power to the encoder feedback card. 2. Verify encoder and feedback card wiring. 3. Check encoder feedback card dip switch settings and encoder voltage requirements

WARNING MESSAGES: SERIAL COMMUNICATION AND KEYPAD ERRORS

There are several Warning Messages that a DURAPULSE GS3 AC Drive may give. The DURAPULSE GS3 AC Drive allows you to decide its response to these messages. The descriptions of the Warning Messages are listed below.

Warning Messages	
Error/Warning Name/Description	Corrective Actions
<input type="text"/> No display shown on the keypad	<ol style="list-style-type: none"> 1. The Keypad LCD display has failed. 2. Check input power. 3. Make sure the keypad is tightly connected to the drive.
<input type="text"/> Invalid Cmd Code	Invalid Command Code when communicating
<input type="text"/> Invalid Address	Invalid Address when communicating
<input type="text"/> Invalid Data	Invalid Data when communicating
<input type="text"/> Slave Comm Fault	Slave Comm Fault device failure
<input type="text"/> Comm Time-Out	Communication Time Out
<input type="text"/> Drive Error	Drive model doesn't match keypad
<input type="text"/> EEPROM Fault	When the copy function is enabled (P9.40), there is a Read/Write EEPROM Fault.
<input type="text"/> Rating Mismatch	Data range doesn't match
<input type="text"/> Group# Overflow	When the copy function is enabled (P9.40), keypad's group number data is more than the drive's.
<input type="text"/> No Space	When the copy function is enabled (P9.40), EEPROM data block in the keypad is full.
<input type="text"/> Delete Failure	When the copy function is enabled (P9.40), delete EEPROM block fails.
<input type="text"/> No Data	When the copy function is enabled (P9.40), EEPROM data block is null.
<input type="text"/> R1 Detect Error Failure to detect motor resistance during Auto-tune procedure	<ol style="list-style-type: none"> 1. Check to make sure the motor is connected to the drive correctly. 2. Check line power to drive. 3. STOP key was pressed during Auto-Tune procedure.
<input type="text"/> No Load Error Failure to detect any motor load during Auto-tune procedure	<ol style="list-style-type: none"> 1. Check to make sure the motor is connected to the drive correctly. 2. Check line power to drive. 3. STOP key was pressed during Auto-Tune procedure.
<input type="text"/> Copy Error-COMMS Communications error during Copy Keypad function	<ol style="list-style-type: none"> 1. Check connection between the keypad and drive and make sure it is not loose. 2. Check communications protocol for correct settings.
<input type="text"/> Copy Error-Data Data error during Copy Keypad function	<ol style="list-style-type: none"> 1. Check connection between the keypad and drive and make sure it is not loose. 2. Check communications protocol for correct settings.

(table continued next page)

Warning Messages (continued from previous page)	
Error/Warning Name/Description	Corrective Actions
<p>Overheat Warning</p> <p>The AC drive temperature has exceeded 85% of the Over-temperature condition.</p>	<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.
<p>Write Failure</p>	<p>When the copy function is enabled (P9.40), Write to EEPROM fails.</p>
<p>Parameter Locked</p>	<p>Parameters have been locked: read only – cannot be set / cannot write.</p>
<p>--- ERR ---</p>	<p>Error: The configuration is not accepted, or the parameter is locked.</p>
<p>Value Accepted</p>	<p>Value Accepted.</p>
<p>Error: Duplicate Function</p>	<p>This occurs when attempting to set two mutually exclusive parameters to the same value. This is most commonly seen when P4.00 and P4.13 are both set to the same value. (Firmware version 1.04 or higher only.)</p>

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ACCESSORIES



APPENDIX

A

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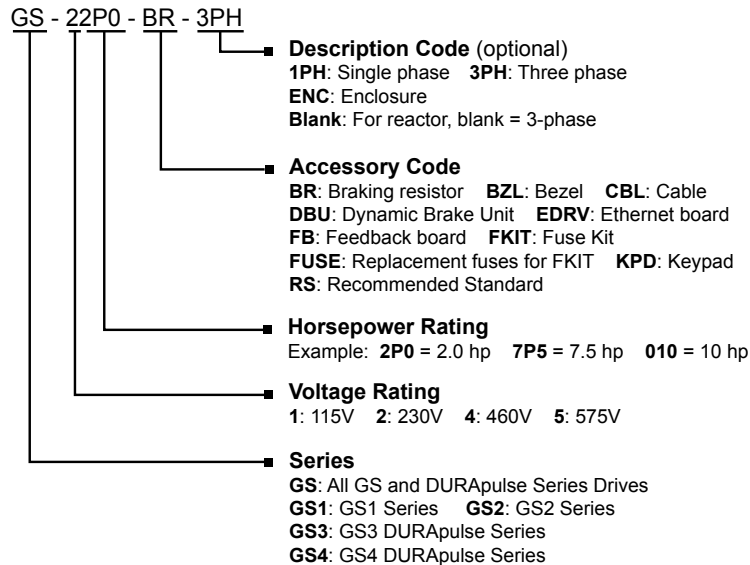
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ACCESSORIES PART NUMBERING

With the exception of EMI filters, RF filters, and LR(2) 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.

GS SERIES-SPECIFIC PART NUMBER EXPLANATION



LINE/LOAD REACTORS

Input line reactors protect the AC drive from transient overvoltage conditions typically caused by large motor load applications, short circuit incidents, utility capacitor switching, etc. 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 DURAPULSE GS3 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 REACTORS – LR(2) SERIES

SELECTION AND ELECTRICAL SPECIFICATIONS

Line Reactors – LR(2) Series – Selection & Electrical Specifications									
Part Number	Dimension Drawing #	Rated Amps	Impedance	Watt Loss	System Voltage	Phase – Use ⁽¹⁾	GS3 Drive Model	Drive HP	
LR-21P0-1PH ⁽²⁾	1	8	3%	15.9	240	1 – In	GS3-21P0	1	
LR-22P0-1PH ⁽²⁾	2	12		24.3			GS3-22P0	2	
LR-23P0-1PH ⁽²⁾	2	17		27.3			GS3-23P0	3	
LR-21P0 ⁽³⁾	3	4.6		11	208/240	3 – I/O	GS3-21P0	1	
LR2-21P0 *	17	11.6		64	240		GS3-22P0	2	
LR-22P0 ⁽³⁾	3	7.5		21	208/240		GS3-23P0	3	
LR2-22P0 *	17	11.6		64	240		GS3-25P0	5	
LR-23P0	3	10.6		38	208/240		GS3-27P5	7.5	
LR-25P0	4	16.7		48			GS3-2010	10	
LR-27P5	4	24.2		65			GS3-2015	15	
LR-2010	5	30.8		96			GS3-2020	20	
LR-2015	5	46.2		64			GS3-2025	25	
LR-2020	5	59.4		85			GS3-2030	30	
LR-2025	6	74.8		94			GS3-2040	40	
LR-2030	7	88		135			GS3-2050	50	
LR-2040	7	114		149			480	GS3-41P0	1
LR-2050	8	143		154				GS3-42P0	2
LR-41P0 ⁽³⁾	3	2.1		10.4	3 – I/O			GS3-43P0	3
LR2-41P0 *	16	2.3		25.2		GS3-45P0		5	
LR-42P0 ⁽³⁾	3	3.4		19		GS3-47P5		7.5	
LR2-42P0 *	16	4.2		23.5		GS3-4010		10	
LR-43P0 ⁽³⁾	3	4.8		23		GS3-4015		15	
LR2-43P0 *	16	5		30.6		GS3-4020		20	
LR-45P0 ⁽³⁾	3	7.6		49		GS3-4025		25	
LR2-45P0 *	17	8.2		49		GS3-4030		30	
LR-47P5 ⁽³⁾	3	11		40		GS3-4040	40		
LR2-47P5 *	17	11.6		64		GS3-4050	50		
LR-4010	3	14		64	GS3-4060	60			
LR-4015	4	21		65	GS3-4075	75			
LR-4020	4	27		79	GS3-4100	100			
LR-4025	5	34	96						
LR-4030	5	40	105						
LR-4040	6	52	114						
LR-4050	9	65	114						
LR-4060	9	77	169						
LR-4075	7	96	193						
LR-4100	10	124	225						

1) Use (side of drive): In = input only; Out = output only; I/O = input or output.
 2) Single-phase line reactors are used only on the input side of GS3-xxxx drives with single-phase input power. 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.
 * Optional mounting accessories are available for these models. See dimensions section for details.

LINE REACTORS – LR(2) SERIES (CONTINUED) – ADDITIONAL SPECIFICATIONS

Line Reactors – LR(2) Series – Additional Specifications						
Part Number	Wire Range	Terminal Torque (lb-in)	Fasteners	Temperature Range		Environment
				Operating	Storage	
LR-21P0-1PH	18–12 AWG	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-22P0-1PH	18–12 AWG	20	#6-32x5/16in flathead screw	-40 – 104 °F [-40 – 40 °C]		
LR-23P0-1PH	18–12 AWG	20	1/4in-28x3/8in set screw	-40 – 104 °F [-40 – 40 °C]		
LR-21P0	18–12 AWG	10	#6-32x5/16in flathead screw	-40 – 104 °F [-40 – 40 °C]		
LR2-21P0 *	22–12 AWG	9	n/a - captive	122°F [50°C] max		
LR-22P0	18–12 AWG	10	n/a - captive	-40 – 104 °F [-40 – 40 °C]		
LR2-22P0 *	22–12 AWG	9	1/4-28 x 3/8 set screw	122°F [50°C] max		
LR-23P0	18–12 AWG	10	#6-32x5/16in flathead screw	-40 – 104 °F [-40 – 40 °C]		
LR-25P0	18–4 AWG	20	1/4in-28x3/8in set screw			
LR-27P5						
LR-2010						
LR-2015						
LR-2020						
LR-2025	18–4 AWG	18–16 AWG: 25 14–6 AWG: 30 4 AWG: 35	n/a - captive			
LR-2030	2/0 – #6AWG (AL or CU)	120	7/16in-20x5/8in set screw			
LR-2040						
LR-2050	250kcmil – #6AWG (AL or CU)	275				
LR-41P0	18–12 AWG	10	#6-32x5/16in flathead screw			
LR2-41P0 *	22–12 AWG	9	n/a - captive	122°F [50°C] max		
LR-42P0	18–12 AWG	10	#6-32x5/16in flathead screw	-40 – 104 °F [-40 – 40 °C]		
LR2-42P0 *	22–12 AWG	9	n/a - captive	122°F [50°C] max		
LR-43P0	18–12 AWG	10	#6-32x5/16in flathead screw	-40 – 104 °F [-40 – 40 °C]		
LR2-43P0 *	22–12 AWG	9	n/a - captive	122°F [50°C] max		
LR-45P0	18–12 AWG	10	#6-32x5/16in flathead screw	-40 – 104 °F [-40 – 40 °C]		
LR2-45P0 *	22–12 AWG	9	n/a - captive	122°F [50°C] max		
LR-47P5	18–12 AWG	10	#6-32x5/16in flathead screw	-40 – 104 °F [-40 – 40 °C]		
LR2-47P5 *	22–12 AWG	9	n/a - captive	122°F [50°C] max		
LR-4010	18–12 AWG	10	#6-32x5/16in flathead screw	-40 – 104 °F [-40 – 40 °C]		
LR-4015	18–4 AWG	20	1/4in-28x3/8in set screw			
LR-4020						
LR-4025						
LR-4030						
LR-4040						
LR-4050	22–4 AWG	18–16 AWG: 25 14–6 AWG: 30 4 AWG: 35	n/a - captive			
LR-4060						
LR-4075	2/0 – #6AWG (AL or CU)	120	7/16in-20x5/8in set screw			
LR-4100	250kcmil – #6AWG (AL or CU)	275	5/8in-18x7/8in set screw			

* Optional mounting accessories are available for these models. See dimensions section for details.

LINE REACTOR DIMENSIONS – LR(2) SERIES

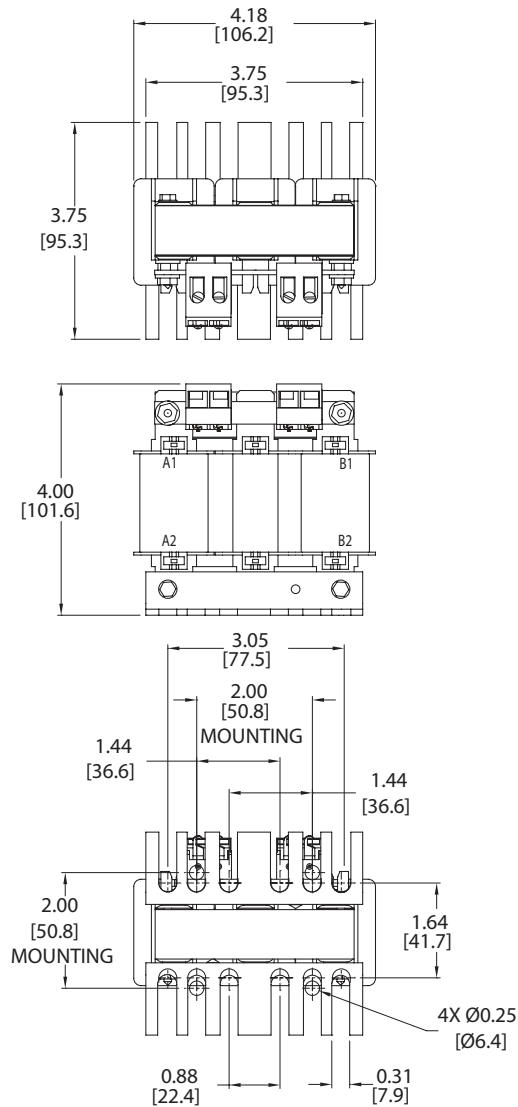
1) LR(2) DIMENSION DRAWING #1

LR-21P0-1PH

Mounting feet with multiple mounting slots allow replacement of most other reactors using existing mounting holes. Use four bolts to mount the LR reactors.

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

(Units = inches [mm])



LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

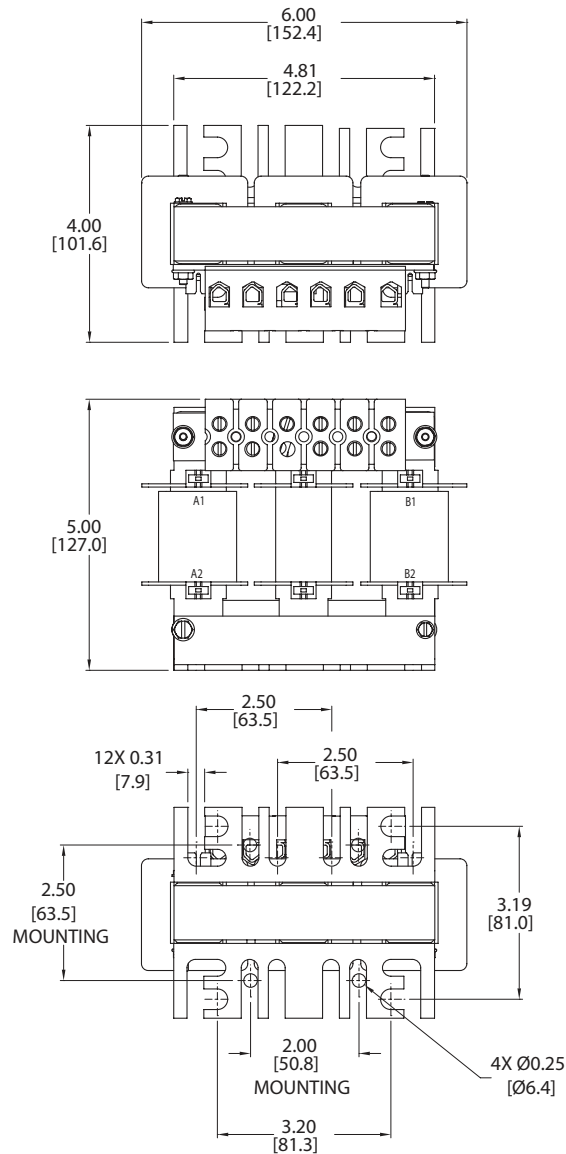
2) LR(2) DIMENSION DRAWING #2

LR-22P0-1PH, LR-23P0-1PH

Mounting feet with multiple mounting slots allow replacement of most other reactors using existing mounting holes. Use four bolts to mount the LR reactors.

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

(Units = inches [mm])



LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

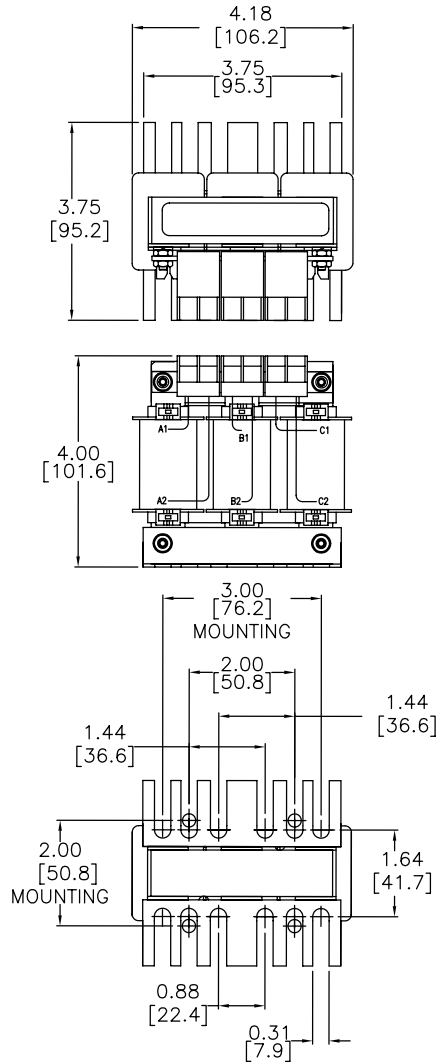
3) LR(2) DIMENSION DRAWING #3

LR-21P0, LR-22P0, LR-23P0, LR-41P0, LR-42P0, LR-43P0, LR-45P0, LR-47P5, LR-4010

Mounting feet with multiple mounting slots allow replacement of most other reactors using existing mounting holes. Use four bolts to mount the LR reactors.

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

(Units = inches [mm])



LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

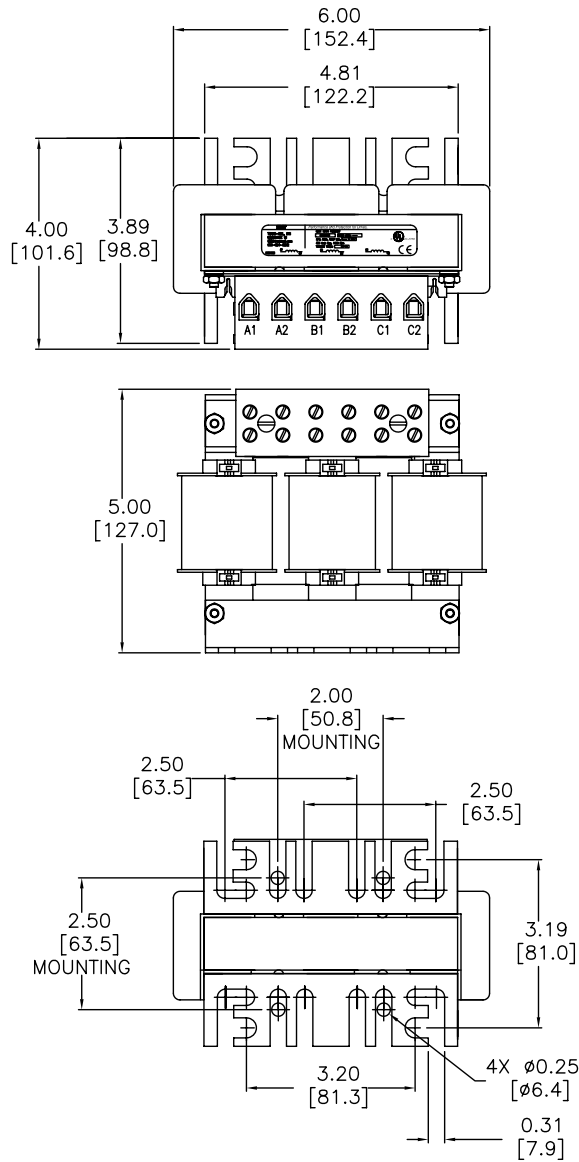
4) LR(2) DIMENSION DRAWING #4

LR-25P0, LR-27P5, LR-4015, LR-4020

Mounting feet with multiple mounting slots allow replacement of most other reactors using existing mounting holes. Use four bolts to mount the LR reactors.

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

(Units = inches [mm])



LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

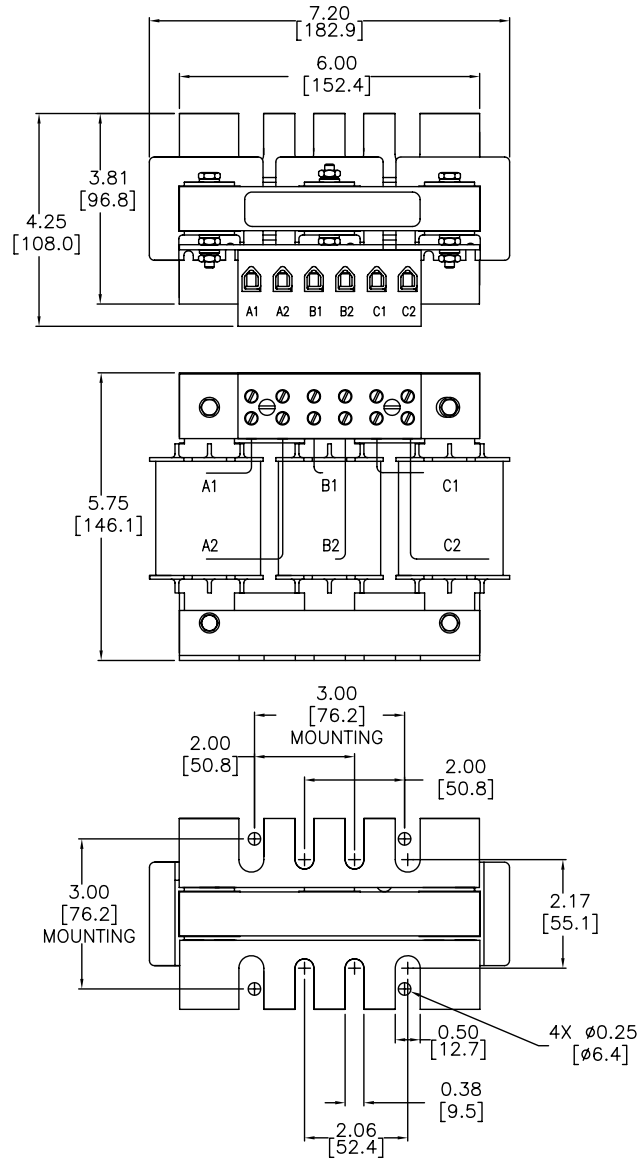
5) LR(2) DIMENSION DRAWING #5

LR-2010, LR-2015, LR-2020, LR-4025, LR-4030

Mounting feet with multiple mounting slots allow replacement of most other reactors using existing mounting holes. Use four bolts to mount the LR reactors.

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

(Units = inches [mm])



LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

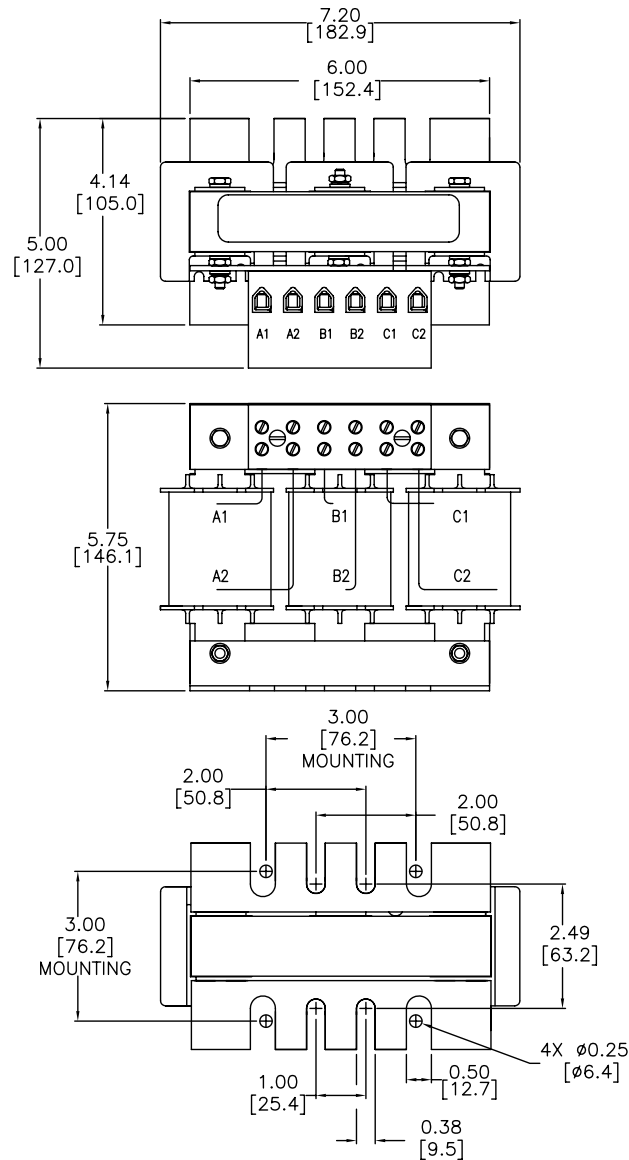
6) LR(2) DIMENSION DRAWING #6

LR-2025, LR-4040

Mounting feet with multiple mounting slots allow replacement of most other reactors using existing mounting holes. Use four bolts to mount the LR reactors.

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

(Units = inches [mm])



LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

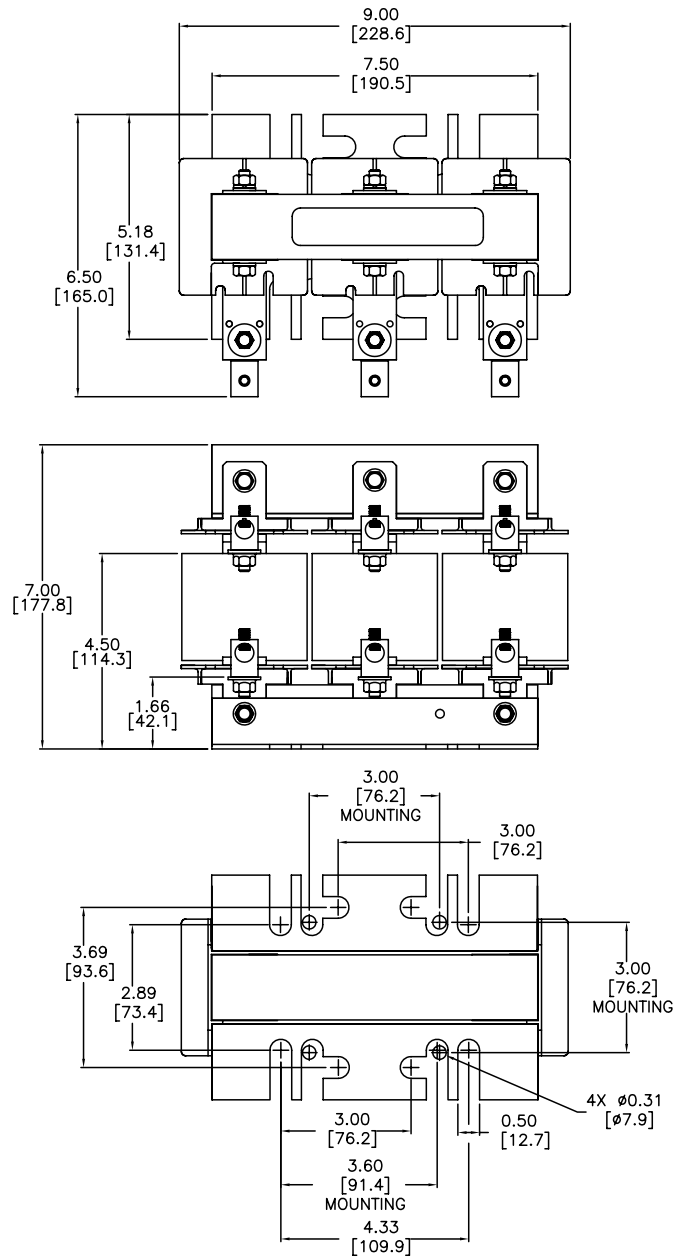
7) LR(2) DIMENSION DRAWING #7

LR-2030, LR-2040, LR-4075

Mounting feet with multiple mounting slots allow replacement of most other reactors using existing mounting holes. Use four bolts to mount the LR reactors.

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

(Units = inches [mm])



LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

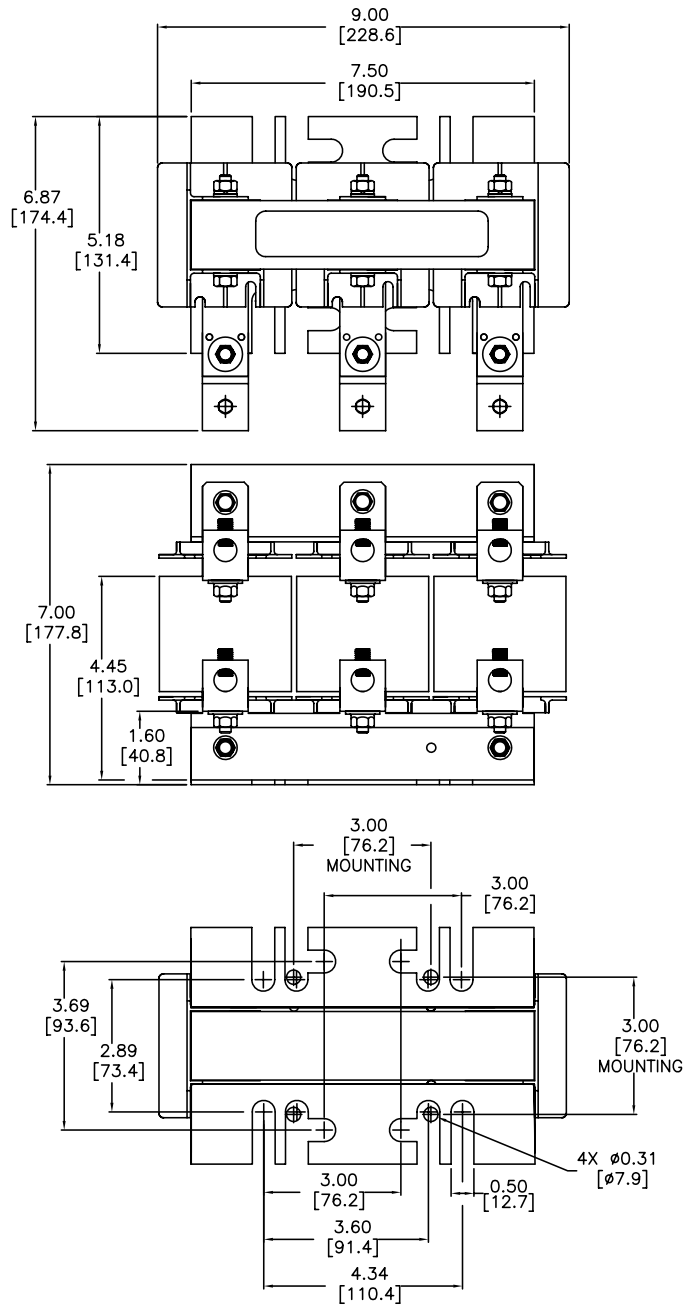
8) LR(2) DIMENSION DRAWING #8

LR-2050

Mounting feet with multiple mounting slots allow replacement of most other reactors using existing mounting holes. Use four bolts to mount the LR reactors.

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

(Units = inches [mm])



LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

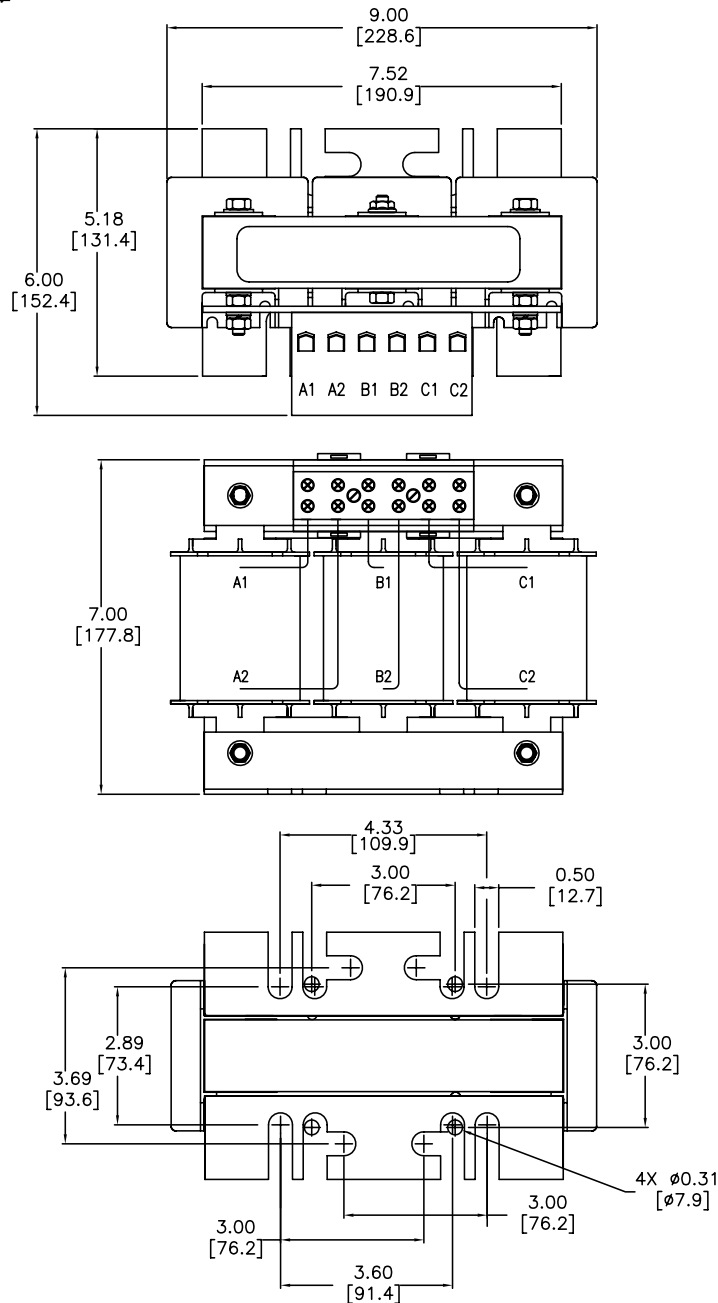
9) LR(2) DIMENSION DRAWING #9

LR-4050, LR-4060

Mounting feet with multiple mounting slots allow replacement of most other reactors using existing mounting holes. Use four bolts to mount the LR reactors.

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

(Units = inches [mm])



LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

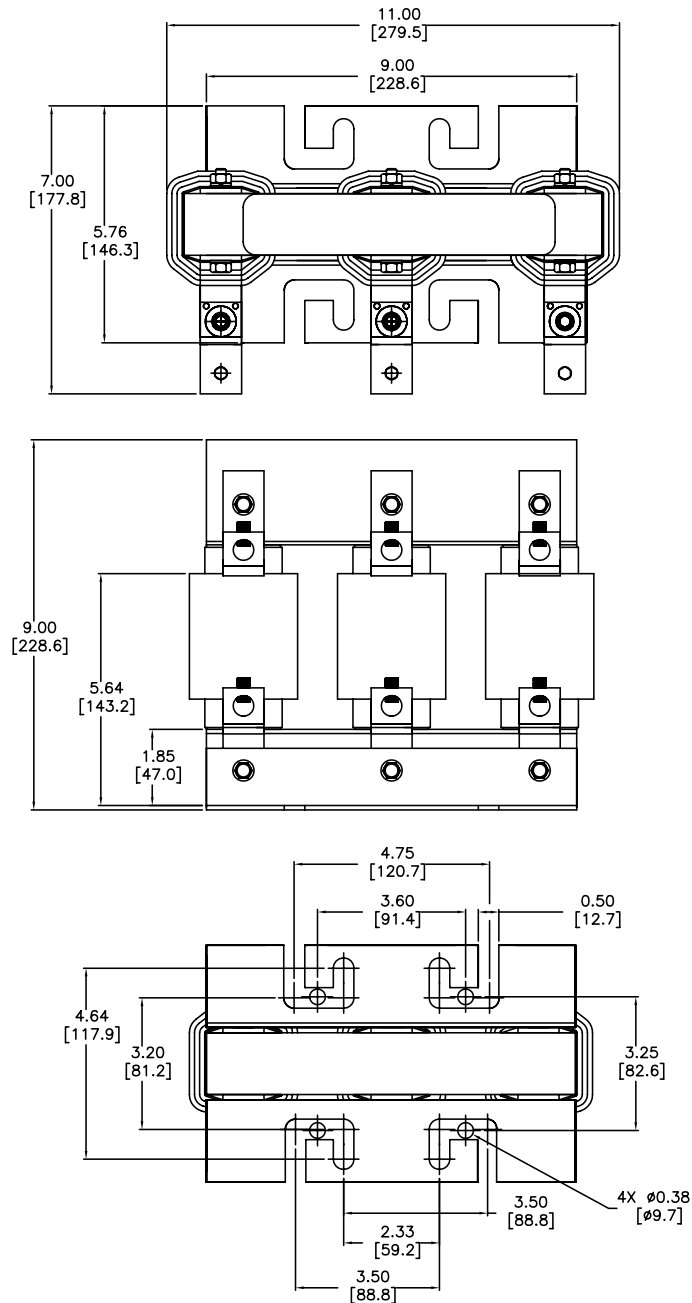
10) LR(2) DIMENSION DRAWING #10

LR-4100

Mounting feet with multiple mounting slots allow replacement of most other reactors using existing mounting holes. Use four bolts to mount the LR reactors.

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

(Units = inches [mm])



LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

11) – 15) DIMENSION DRAWINGS #11 THROUGH #15 NOT APPLICABLE FOR GS3 AC DRIVES

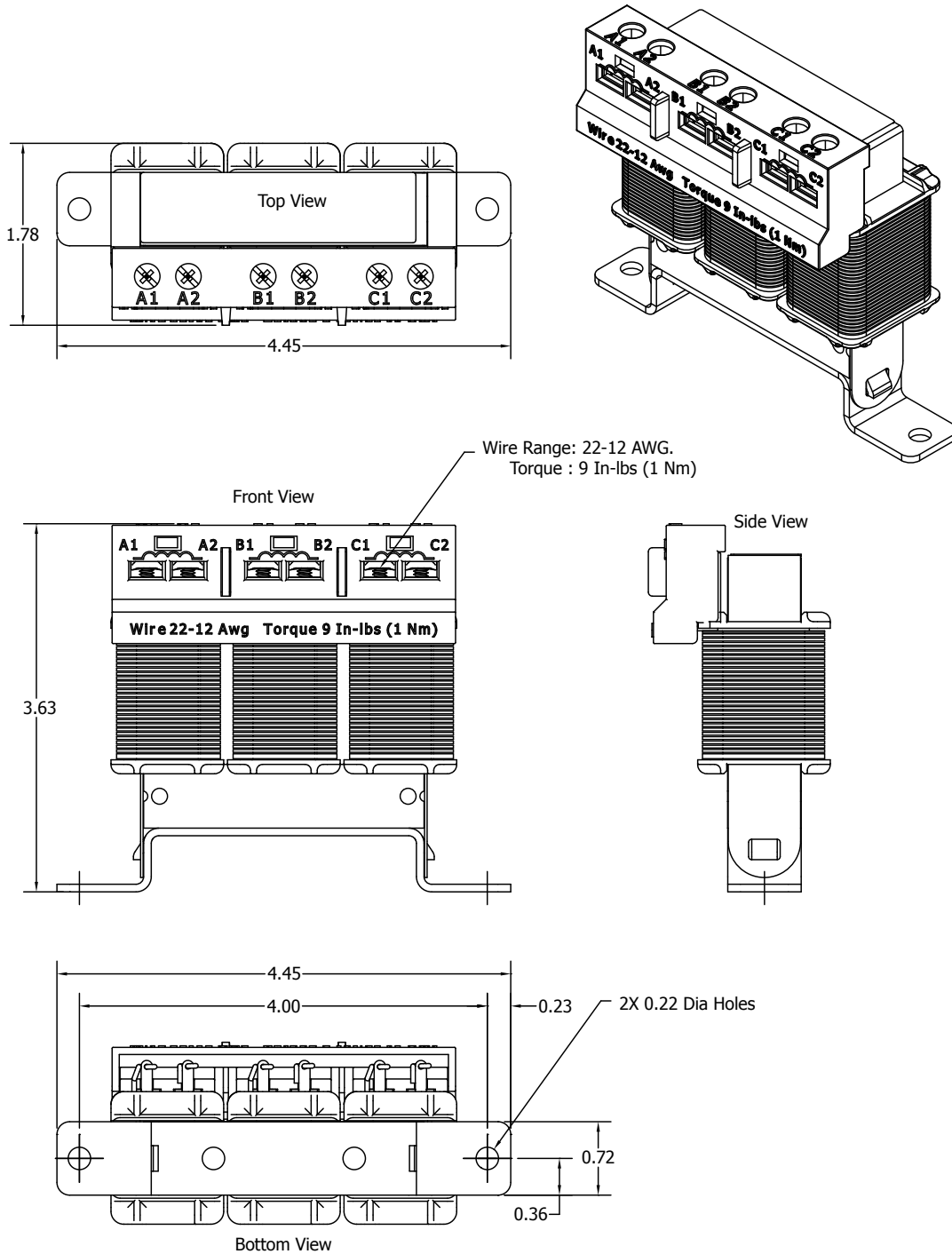
16) LR(2) DIMENSION DRAWING #16

LR2-41P0, LR2-42P0, LR2-43P0

Adapter Plate Kits AP1 and AP2 allow for universal panel mounting with these models. DIN Rail mount kit DR1 allows DIN rail mounting with these models. See accessory dimensions below.

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

(Units = inches)



(drawings continued next page for optional mounting accessories)

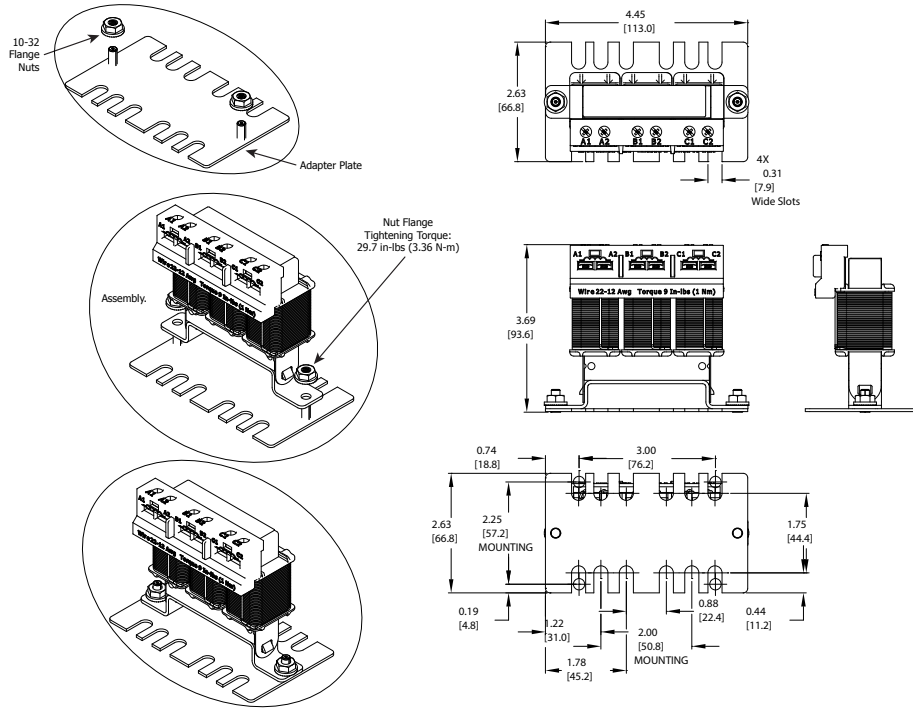
LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

16) LR(2) DIMENSION DRAWING #16 (CONTINUED FROM PREVIOUS PAGE)

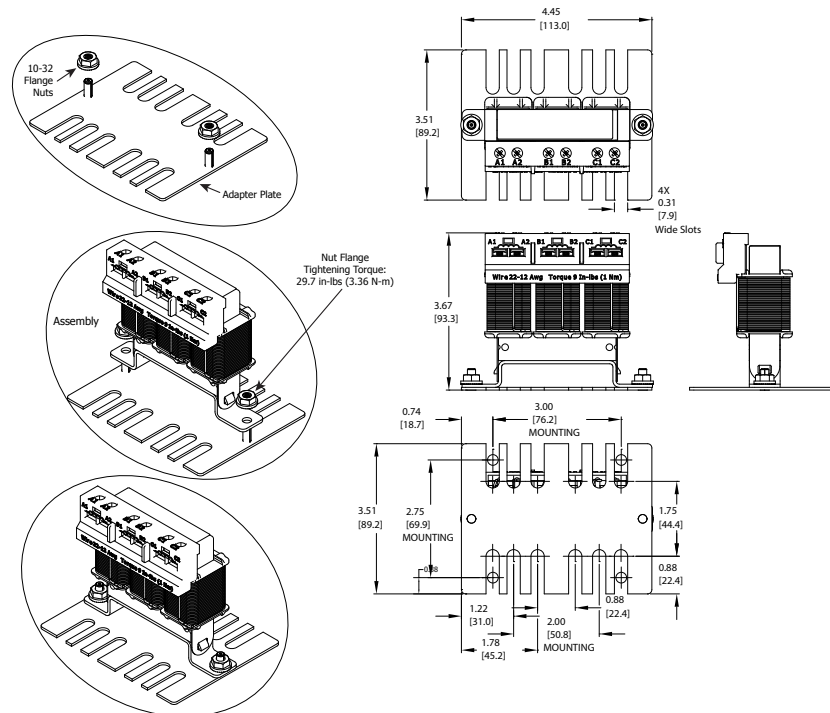
See our website: www.AutomationDirect.com for complete engineering drawings.

(Units = inches [mm])

16A) LR2-AP1 ADAPTER PLATE FOR UNIVERSAL MOUNTING



16B) LR2-AP2 ADAPTER PLATE FOR UNIVERSAL MOUNTING



(drawings continued next page for optional mounting accessories)

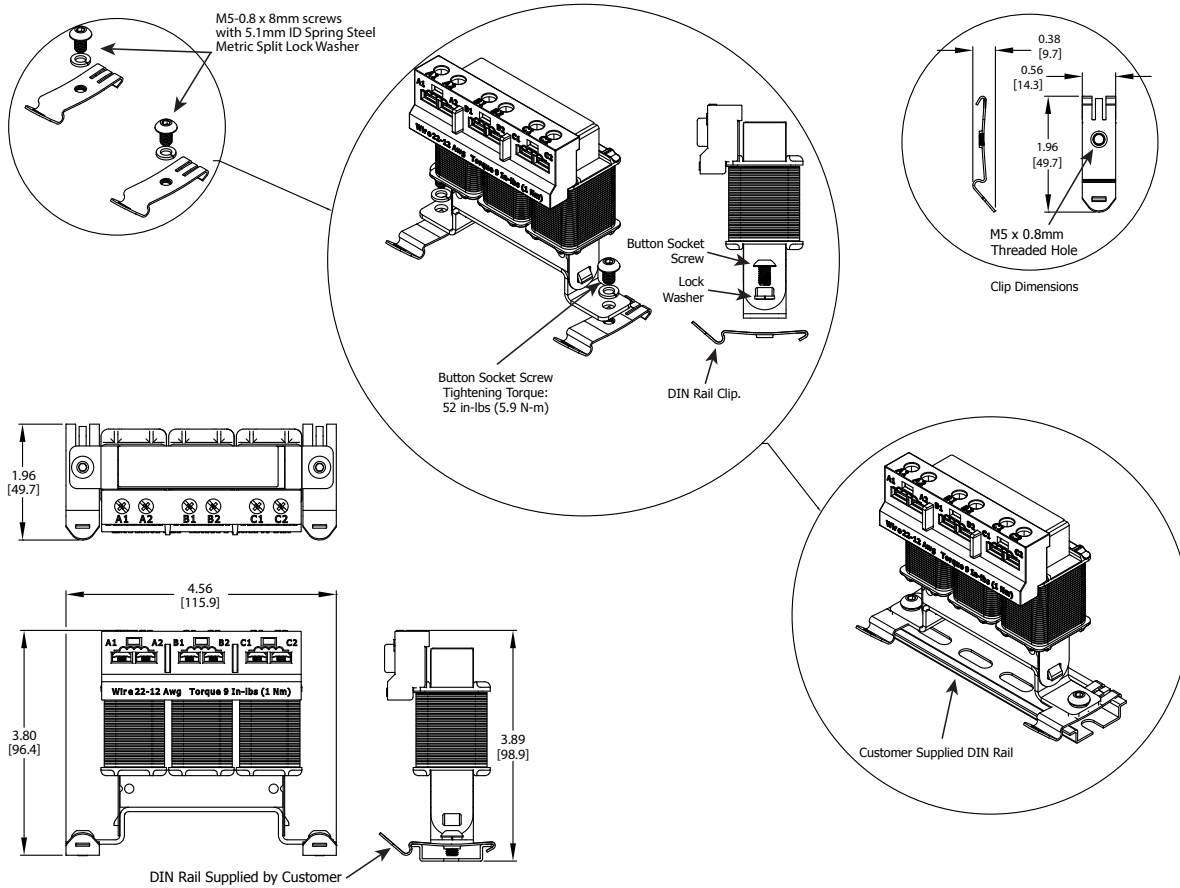
LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

16) LR(2) DIMENSION DRAWING #16 (CONTINUED FROM PREVIOUS PAGE)

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

16c) LR2-DR1 HARDWARE KIT FOR DIN RAIL MOUNTING

(Units = inches [mm])



LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

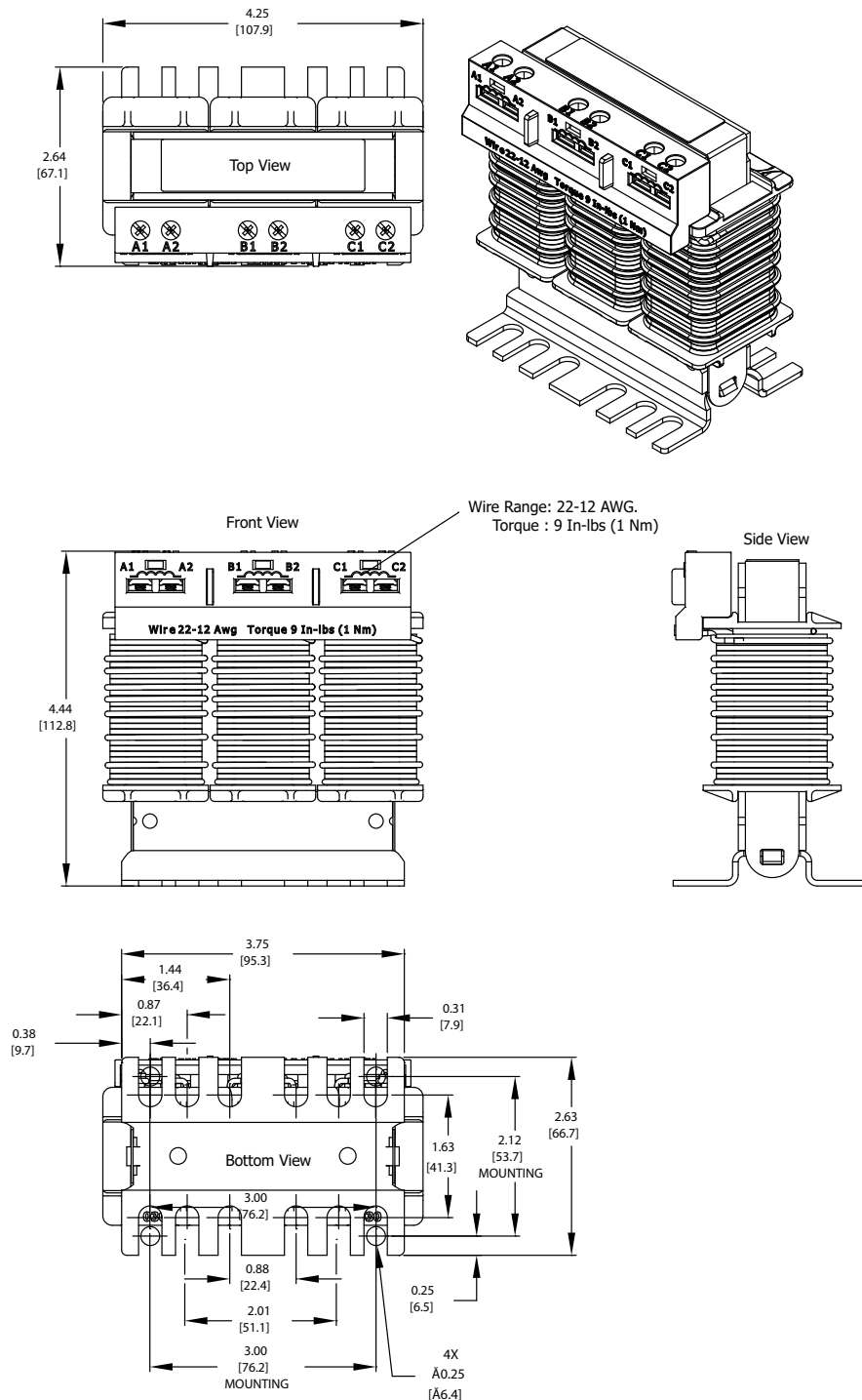
17) LR(2) DIMENSION DRAWINGS #17

LR2-21P0, LR2-22P0, LR2-45P0, LR2-47P5

Mounting feet with multiple mounting slots allow replacement of most other reactors using existing mounting holes. Use four bolts to mount the LR reactors. For Din Rail mounting, use accessory LR2-DR2.

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

(Units = inches [mm])



(drawings continued next page for optional mounting accessory)

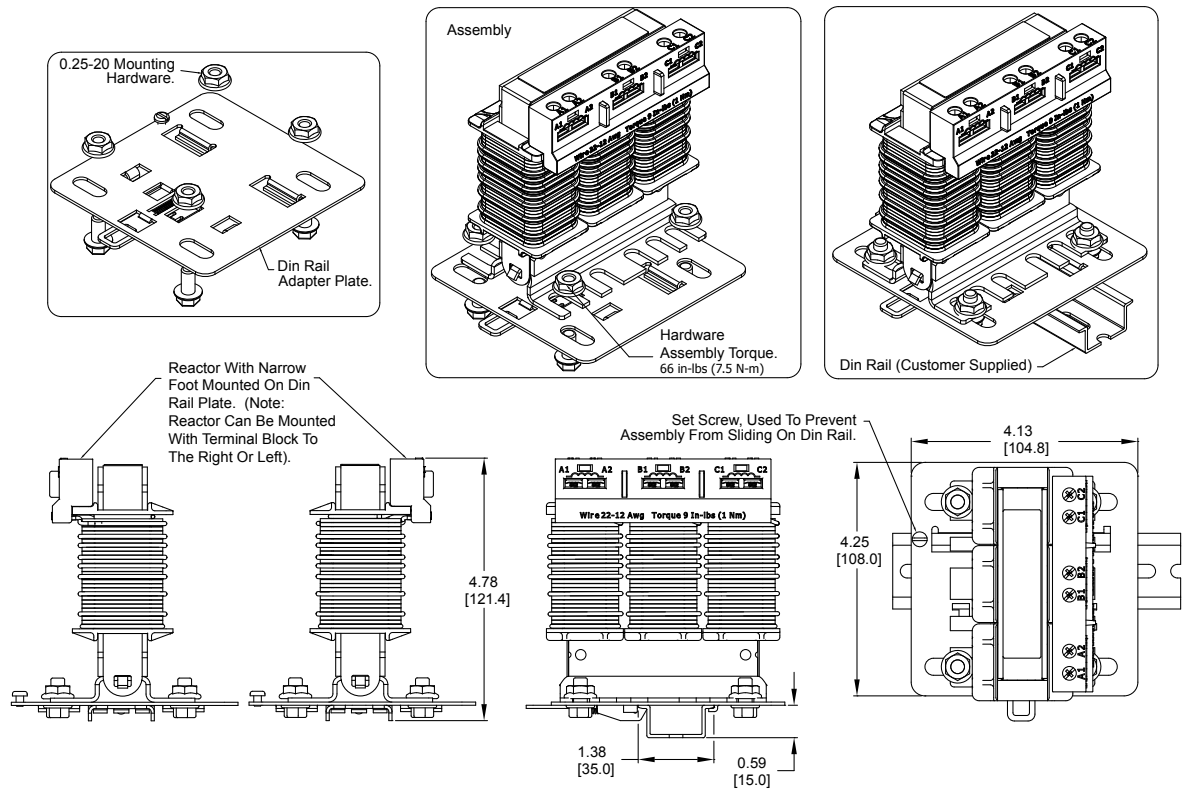
LINE REACTOR DIMENSIONS – LR(2) SERIES (CONTINUED)

17) LR(2) DIMENSION DRAWINGS #17 (CONTINUED FROM PREVIOUS PAGE)

17A) LR2-DR2 HARDWARE KIT FOR DIN RAIL MOUNTING

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

(Units = inches [mm])

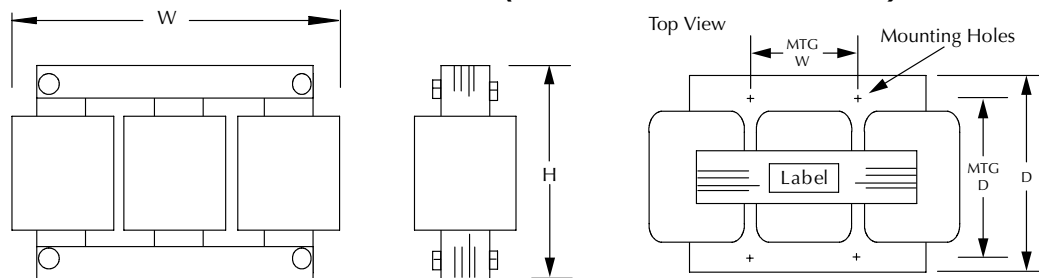


LINE REACTORS – LEGACY GS SERIES (DO NOT USE FOR NEW INSTALLATIONS)

Line Reactors – GS Series					
230 VOLT Class – Three Phase					
Part Number	Rated HP	Rated Amps	Impedance	Inductance	Watts Loss
GS-21P0-LR-3PH	1	5	3%	3.00 mH	7
GS-22P0-LR-3PH	2	7	3%	1.50 mH	11
GS-23P0-LR-3PH	3	11	3%	1.30 mH	23
GS-25P0-LR	5	17	3%	0.80 mH	19
GS-27P5-LR	7.5	25	3%	0.50 mH	23
GS-2010-LR	10	33	3%	0.40 mH	36
GS-2015-LR	15	49	3%	0.30 mH	33
GS-2020-LR	20	65	3%	0.25 mH	39
GS-2025-LR	25	75	3%	0.20 mH	88
GS-2030-LR	30	90	3%	0.20 mH	88
GS-2040-LR	40	120	3%	0.10 mH	95
GS-2050-LR	50	145	3%	0.10 mH	95

Line Reactors – GS Series					
460 VOLT Class – Three Phase					
Part Number	Rated HP	Rated Amps	Impedance	Inductance	Watts Loss
GS-41P0-LR	1	2	3%	12.0 mH	7
GS-42P0-LR	2	4	3%	6.50 mH	13
GS-43P0-LR	3	8	3%	5.00 mH	31
GS-45P0-LR	5	8	3%	3.00 mH	25
GS-47P5-LR	7.5	12	3%	2.50 mH	26
GS-4010-LR	10	18	3%	1.50 mH	29
GS-4015-LR	15	24	3%	1.20 mH	44
GS-4020-LR	22	32	3%	0.80 mH	51
GS-4025-LR	25	38	3%	0.80 mH	51
GS-4030-LR	30	45	3%	0.70 mH	64
GS-4040-LR	40	60	3%	0.50 mH	75
GS-4050-LR	50	73	3%	0.40 mH	138
GS-4060-LR	60	91	3%	0.40 mH	138
GS-4075-LR	75	105	3%	0.30 mH	123
GS-4100-LR	100	145	3%	0.20 mH	115

LINE REACTOR DIMENSIONS – LEGACY GS SERIES (NOT FOR NEW INSTALLATIONS)



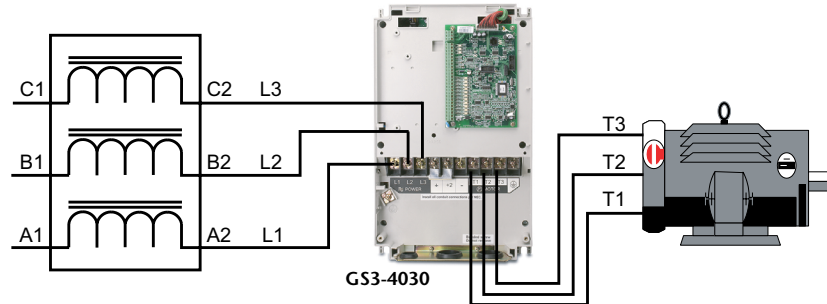
AC Line Reactor Dimensions

AC Line Reactor Dimensions – GS Series (inches)							
Part Number	H	W	D	Mtg D	Mtg W	Mtg Slot Hole Size	Weight (lb)
GS-21P0-LR-1PH	3.40	4.40	2.83	1.77	1.44	0.28 x 0.63	2.80
GS-21P0-LR-3PH	3.40	4.40	2.83	1.77	1.44	0.28 x 0.63	2.30
GS-22P0-LR-1PH	4.80	6.00	3.30	2.09	2.00	0.28 x 0.63	7.10
GS-22P0-LR-3PH	3.40	4.40	2.83	1.77	2.00	0.28 x 0.63	2.80
GS-23P0-LR-1PH	4.80	6.00	3.30	2.09	2.00	0.28 x 0.63	7.50
GS-23P0-LR-3PH	3.40	4.40	2.83	1.77	2.00	0.28 x 0.63	2.90
GS-25P0-LR	4.80	6.00	3.30	2.09	2.00	0.28 x 0.63	7.10
GS-27P5-LR	5.70	6.00	3.09	2.09	3.00	0.28 x 0.63	7.00
GS-2010-LR	5.70	6.00	3.34	2.34	3.00	0.28 x 0.63	9.00
GS-2015-LR	5.70	6.00	3.84	2.84	3.00	0.28 x 0.63	13.0
GS-2020-LR	5.70	6.00	3.84	2.84	3.00	0.28 x 0.63	12.0
GS-2025-LR	6.88	8.50	4.37	3.12	3.60	0.44 x 1.00	26.0
GS-2030-LR	6.88	8.50	4.37	3.12	3.60	0.44 x 1.00	26.0
GS-2040-LR	6.88	8.50	4.37	3.12	3.00	0.44 x 1.00	27.0
GS-2050-LR	6.88	8.50	4.37	3.12	3.00	0.44 x 1.00	27.0
GS-41P0-LR	3.40	4.40	2.83	1.77	1.44	0.28 x 0.63	2.30
GS-42P0-LR	3.40	4.40	2.83	1.77	1.44	0.28 x 0.63	2.80
GS-43P0-LR	3.40	4.40	3.39	2.39	2.00	0.28 x 0.63	4.30
GS-45P0-LR	3.40	4.40	2.83	1.77	2.00	0.28 x 0.63	3.10
GS-47P5-LR	4.80	6.00	3.30	2.09	2.00	0.28 x 0.63	7.50
GS-4010-LR	4.80	6.30	3.55	2.34	2.00	0.28 x 0.63	9.10
GS-4015-LR	5.70	6.00	3.34	2.34	3.00	0.28 x 0.63	10.0
GS-4020-LR	5.61	6.90	3.95	2.75	3.00	0.38 x 0.63	17.0
GS-4025-LR	5.61	6.90	3.95	2.75	3.00	0.38 x 0.63	17.0
GS-4030-LR	5.61	6.90	4.45	3.25	3.00	0.38 x 0.63	22.0
GS-4040-LR	6.88	8.50	4.37	3.12	3.00	0.44 x 1.00	26.0
GS-4050-LR	6.88	8.50	4.87	3.62	3.60	0.44 x 1.00	36.0
GS-4060-LR	6.88	8.50	4.87	3.62	3.60	0.44 x 1.00	36.0
GS-4075-LR	8.29	10.50	5.35	3.73	3.60	0.44 x 1.00	52.0
GS-4100-LR	8.29	10.50	5.35	3.73	3.60	0.44 x 1.00	41.0

LINE REACTOR APPLICATIONS AND WIRING CONNECTIONS

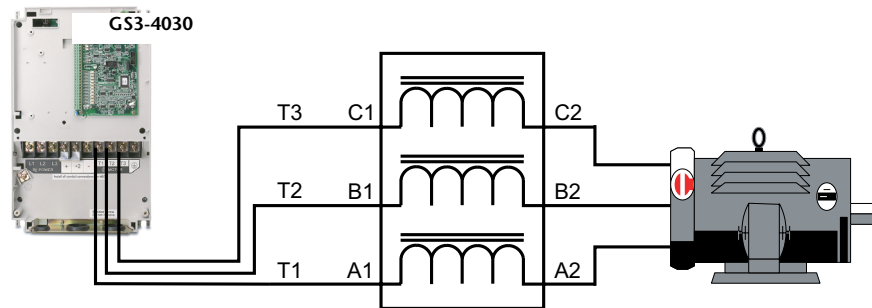
INPUT SIDE OF AC DRIVE

When installed on the input side of the AC Drive, line reactors will reduce line notching, limit current and voltage spikes and surges from the incoming line, and reduce the available short circuit current. 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 AC Drive from short circuits at the load. Voltage and current waveforms from the AC Drive are enhanced, reducing motor overheating and noise emissions.



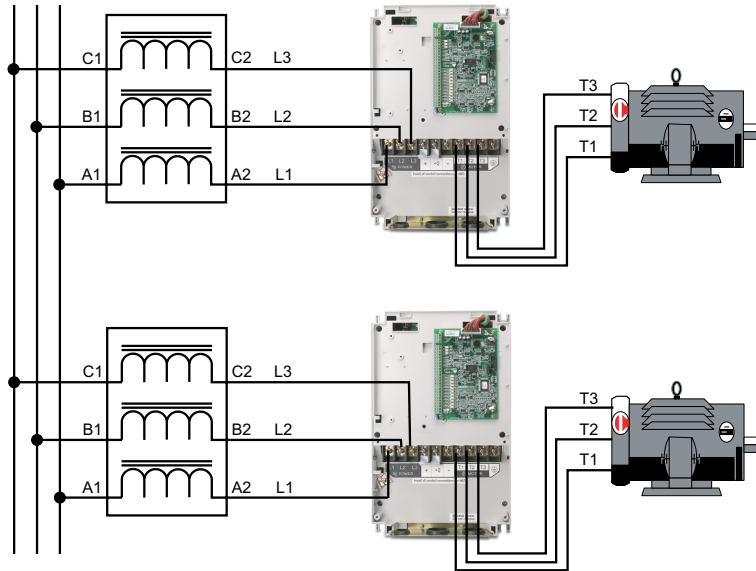
Single phase line reactors should NOT be installed on the output side of an AC Drive. Use only three-phase reactors on drive outputs, and only for three-phase motors.



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.

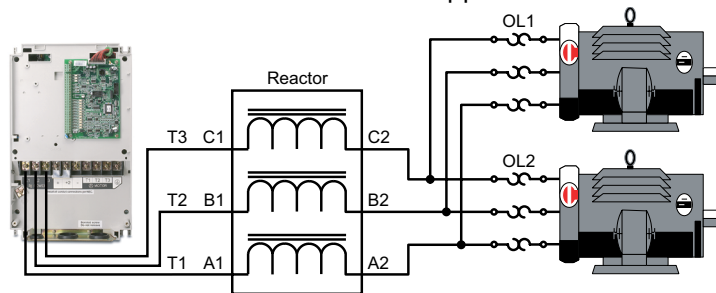
MULTIPLE AC DRIVES

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



MULTIPLE MOTORS

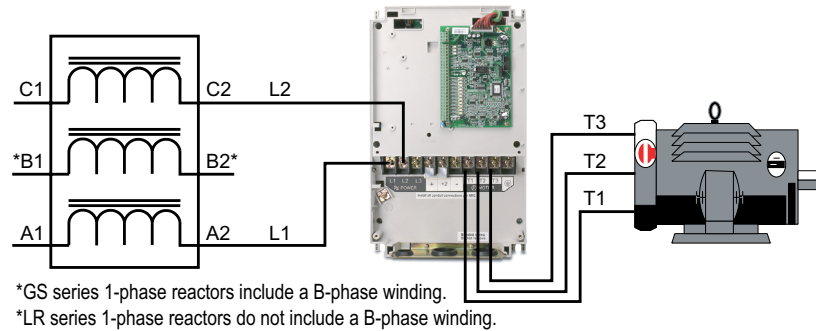
A single output (load) reactor can be used for multiple motors on the same AC Drive, but only if the motors operate simultaneously. Size the reactor based upon the total horsepower of all the motors, and select a reactor with a current rating greater than the sum of the motor full-load currents. Overload 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.

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.



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

DRIVE OUTPUT FILTERS

Extend the life of your motors and cables by reducing the harmful effects of voltage spikes due to voltage wave reflection. Voltage wave reflection is a function of the voltage rise time (dV/dT) and the length of the motor cables.

AutomationDirect VTF series drive output filters protect motors and cables by combining a patented dampening circuit with a low pass filter to increase the voltage rise time (dT out of dV/dT), thereby preventing voltage spikes from exceeding 1,000V.

- Protect cable runs and reduce motor heating, noise, and vibration.
- Prevent motor failure with protection against motor insulation breakdown.
- Reduce Common Mode by a minimum of 30%.
- Improve system productivity and increase bearing life and up-time.
- Protect long lead lengths up to 1,000 feet.



NOTE: Install Drive Output Filters on the output side of the AC Drive only. The Output Filters are to provide a dV/dT solution for leads up to 1,000 ft. For lengths in excess of 1000 feet, please consult technical support.

VTF PART NUMBER EXPLANATION

VTF	-	xxx	-	xxx
<p>HP @ corresponding Voltage: A = 0.25 B = 0.33 C = 0.5 D = 0.75 E = 1 F = 1.5 G = 2 H = 3 J = 5 K = 7.5 L = 10 M = 15 N = 20 P = 25 Q = 30 R = 40 S = 50 T = 60 U = 75 V = 100 W = 125</p>				
<p>VOLTAGE: 2 = 220/230/240 VAC 4 = 440/460/480 VAC 6 = 575/600 VAC</p>				
<p>SERIES NAME: VTF = Voltage Time Filter</p>				

For example:

Model VTF-246-SVW is a Voltage Time Filter for a 230V/50hp, or 460V/100hp, or 575V/125hp AC Drive

VTF SPECIFICATIONS

ELECTRICAL SPECIFICATIONS & DRIVE COMPATIBILITY

VTF Series Drive Output Filters – Electrical Specifications & Drive Compatibility									
Part Number	Rated HP			Max Rated Amps	Max Rated Voltage	Phases	GS3 Drive *		Drive HP
	230V	460V	575V				w 1Ø Input	w 3Ø Input	
VTF-46-DE	–	0.75	1	2	600	3	–	–	–
VTF-246-CFG	0.5	1.5	2	3			–	GS3-41P0	1
VTF-246-DGH	0.75	2	3	4			–	GS3-42P0	2
VTF-24-FH	1.5	3	–	6			GS3-21P0	GS3-21P0	1
							–	GS3-43P0	3
VTF-246-GJJ	2	5	5	8			GS3-22P0	GS3-22P0	2
VTF-246-HKL	3	7.5	10	12			GS3-23P0	GS3-23P0	3
							–	GS3-45P0	5
VTF-24-JL	5	10	–	16			–	GS3-47P5	7.5
VTF-46-LM	–	10	15	18			–	GS3-25P0	5
							–	GS3-4010	10
VTF-4-M	–	15	–	21			–	GS3-4015	15
VTF-246-KMN	7.5	15	20	25			–	GS3-27P5	7.5
VTF-46-NP	–	20	25	27			–	–	–
VTF-246-LPQ	10	25	30	35			–	GS3-2010	10
							–	GS3-4020	20
VTF-246-MQR	15	30	40	45			–	GS3-4025	25
							–	GS3-4030	30
VTF-246-NRS	20	40	50	55			–	GS3-2015	15
							–	GS3-4040	40
VTF-246-PSU	30	60	75	80	–	GS3-2020	20		
					–	GS3-2025	25		
					–	GS3-4050	50		
					–	GS3-4060	60		
VTF-246-RUV	40	75	100	110	–	GS3-2030	30		
					–	GS3-4075	75		
VTF-246-SVW	50	100	125	130	–	GS3-2040	40		

* VTF drive output filters are not available for GS3-2050 & GS3-4100.

ELECTRICAL SPECIFICATIONS & DRIVE COMPATIBILITY

VTF Series Drive Output Filters – Additional Specifications									
Part Number	Wire Range (AWG)	Terminal Torque (lb-in)	Fasteners	Weight (lb)	Dimension Drawing #				
VTF-46-DE	12-14	10	6/40 x 5/16 flathead	8	1				
VTF-246-CFG									
VTF-246-DGH									
VTF-24-FH									
VTF-246-GJJ									
VTF-246-HKL									
VTF-24-JL	4-12	20	1/4-28 x 3/8	12	2				
VTF-46-LM	4-10								
VTF-4-M									
VTF-246-KMN	4-8								
VTF-46-NP									
VTF-246-LPQ	6-8								
VTF-246-MQR	6	35	n/a (captive)	17	3				
VTF-246-NRS	1-4								
VTF-246-PSU	1-3								
VTF-246-RUV	2/0 - 1/0					50	7/16-20 x 9/16	40	5
VTF-246-SVW	2/0								

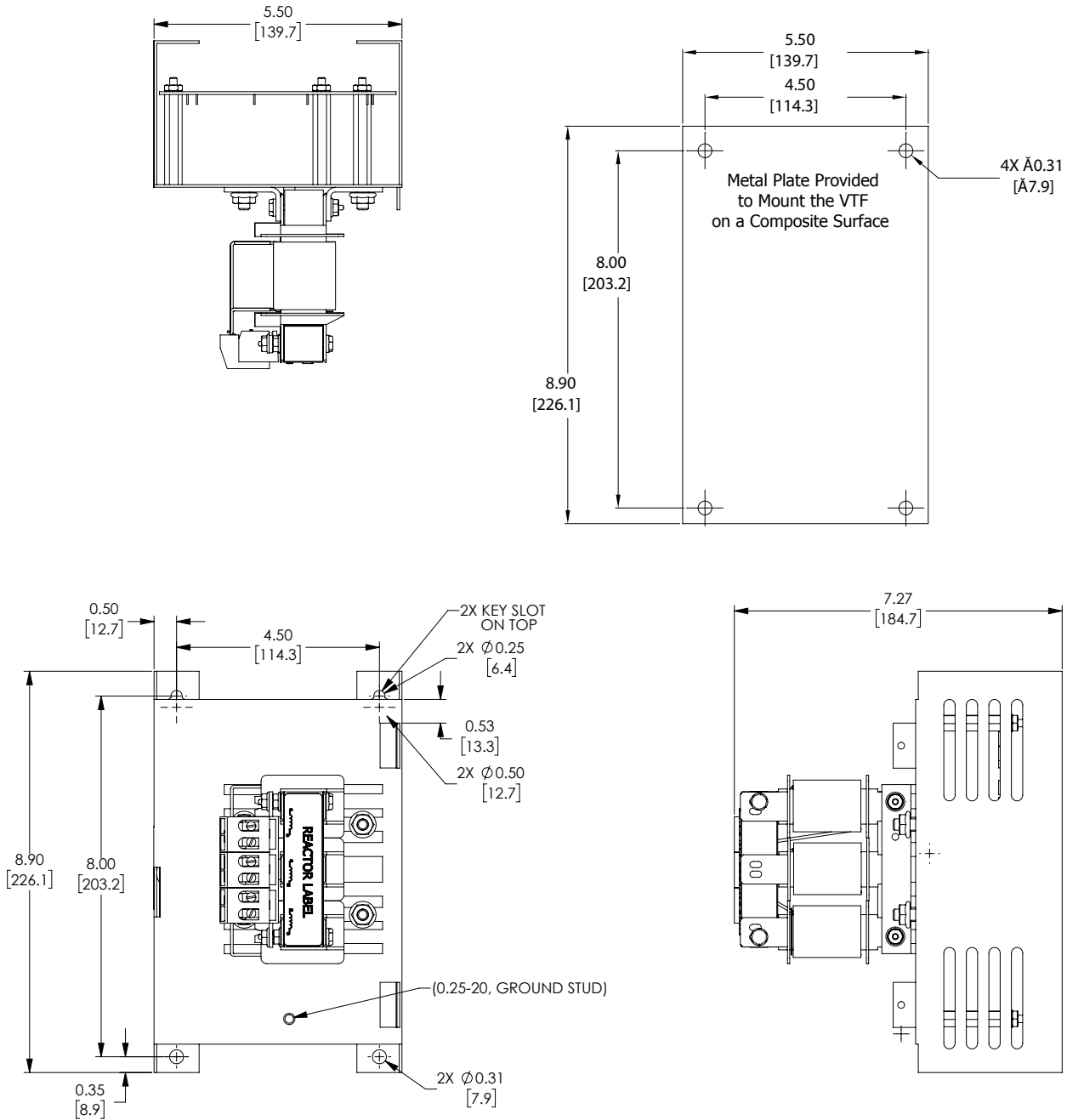
OUTPUT FILTER DIMENSIONS – VTF SERIES

1) VTF FILTERS DIMENSION DRAWING #1

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

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

(Units = inches [mm])

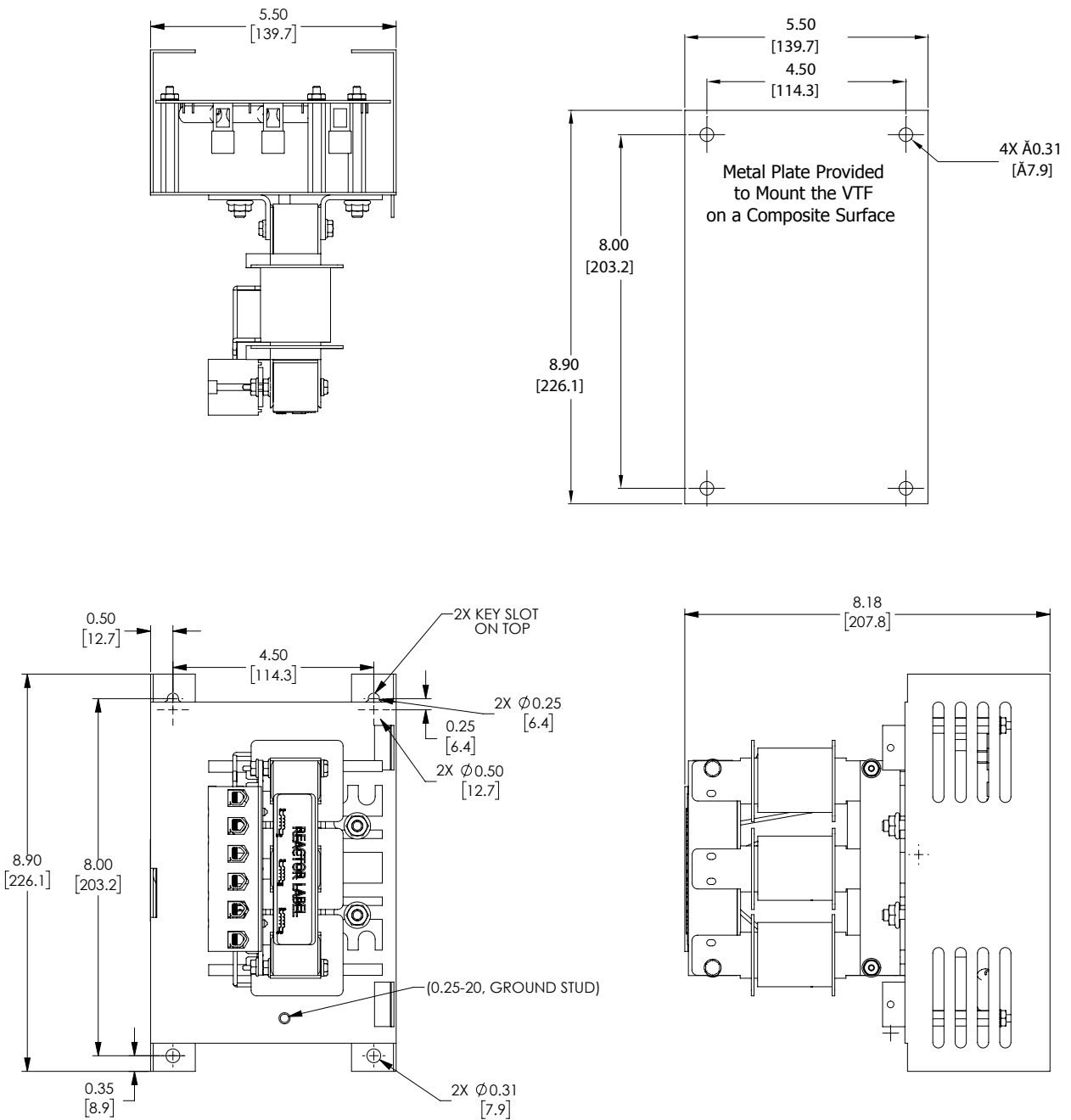


2) VTF FILTERS DIMENSION DRAWING #2

VTF-24-JL, VTF-246-KMN, VTF-46-LM, VTF-4-M, VTF-46-NP

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

(Units = inches [mm])

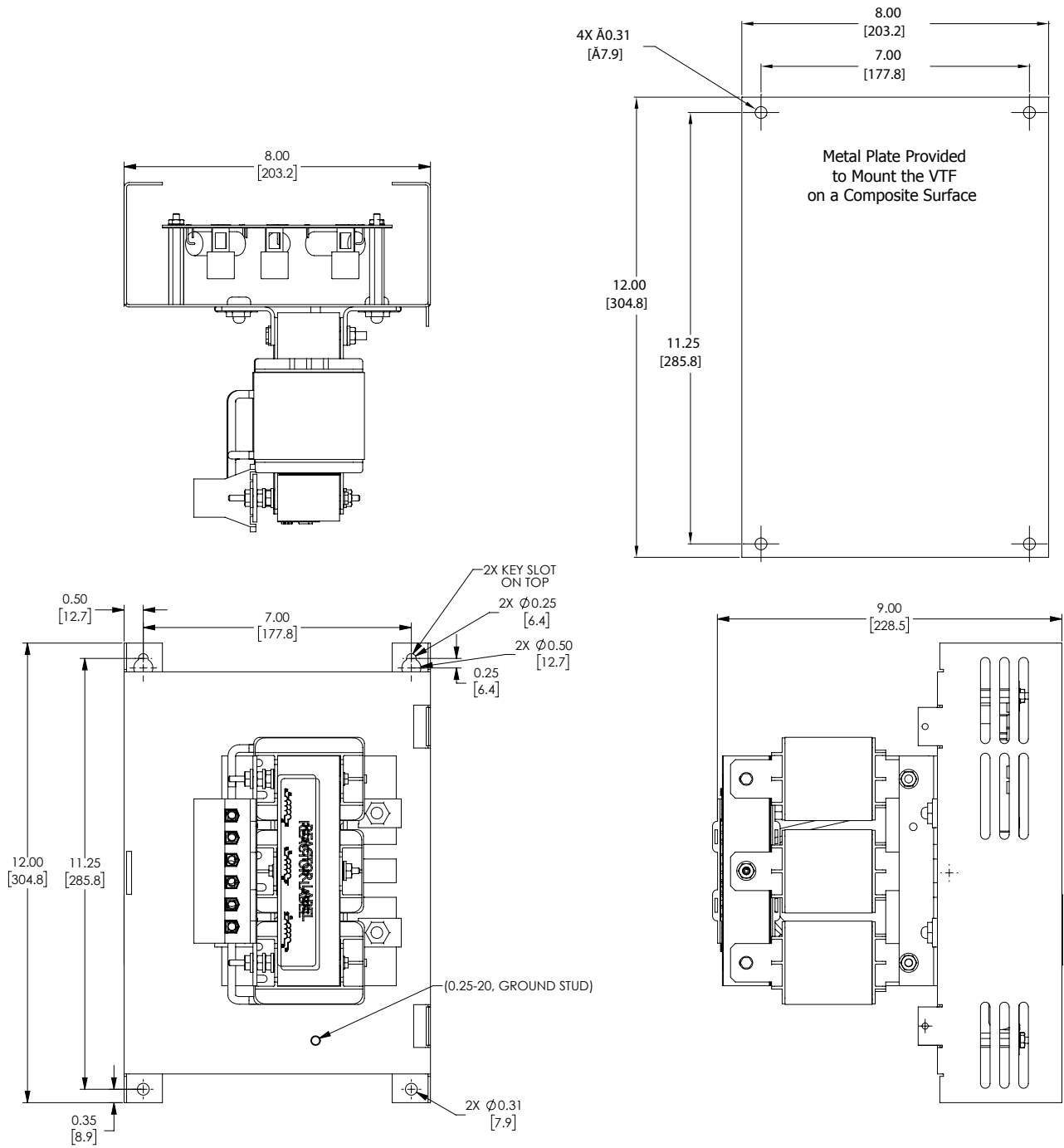


3) VTF FILTERS DIMENSION DRAWING #3

VTF-246-LPQ, VTF-246-MQR, VTF-246-NRS

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

(Units = inches [mm])

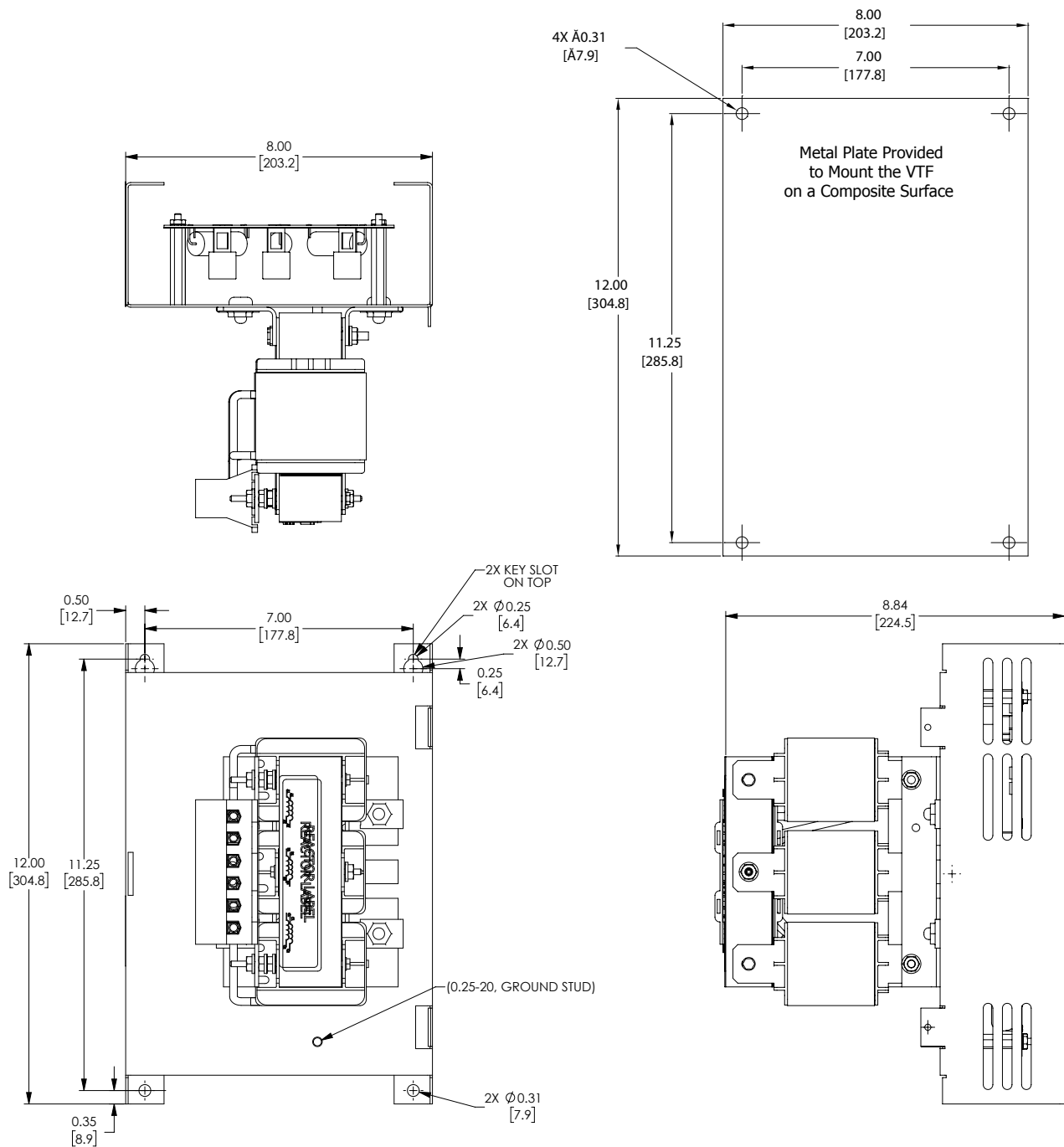


4) VTF FILTERS DIMENSION DRAWING #4

VTF-246-PSU

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

(Units = inches [mm])

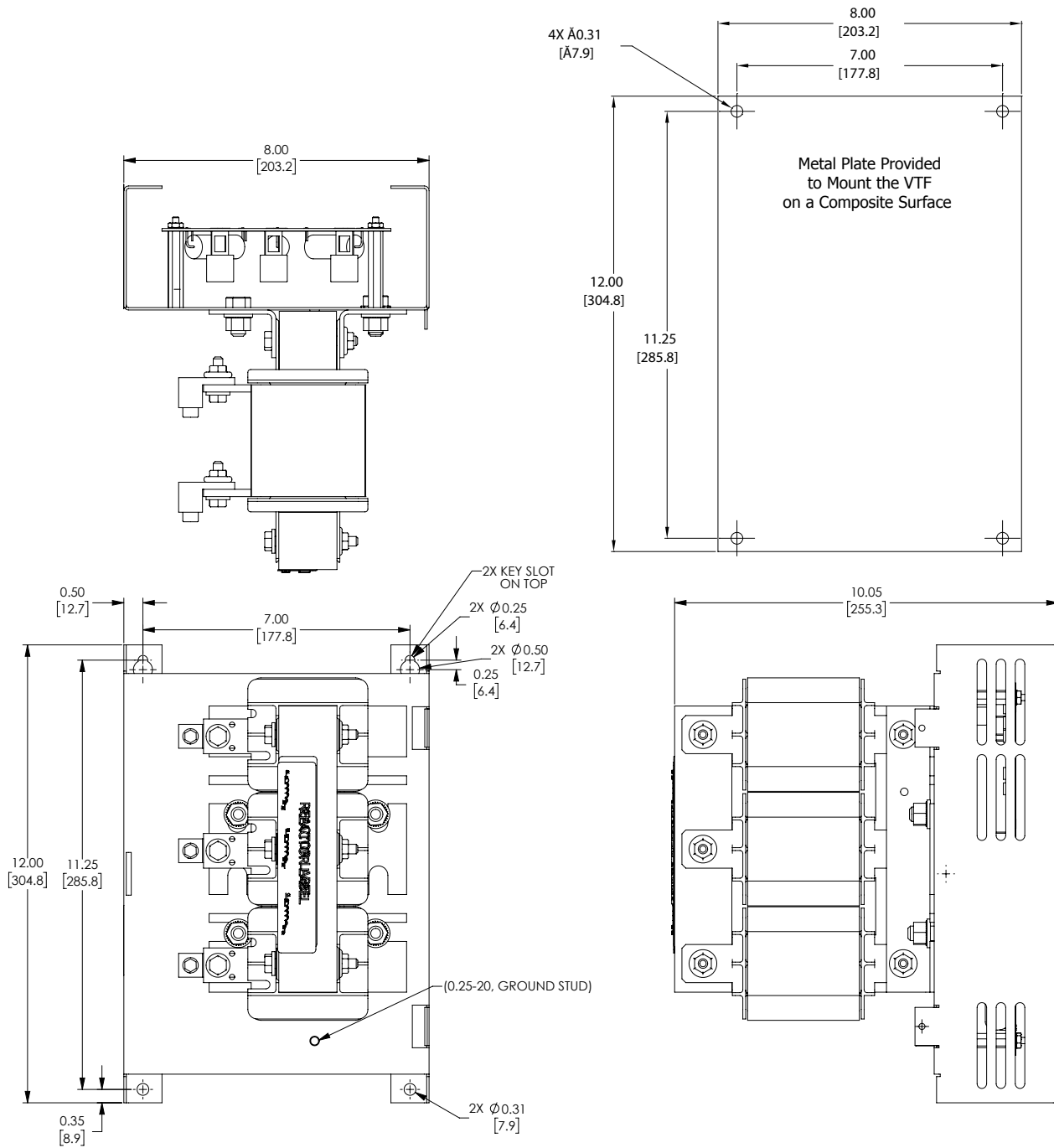


5) VTF FILTERS DIMENSION DRAWING #5

VTF-246-RUV

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

(Units = inches [mm])

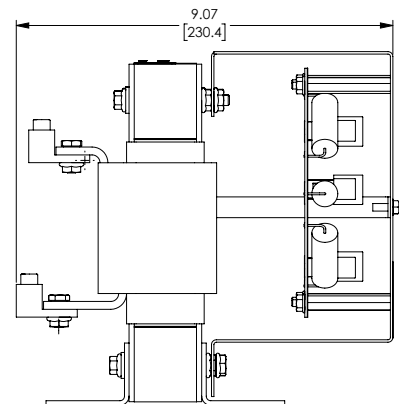
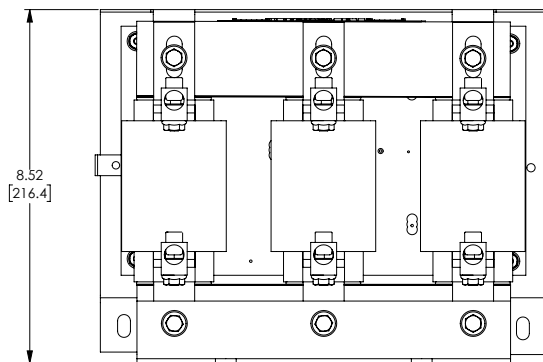
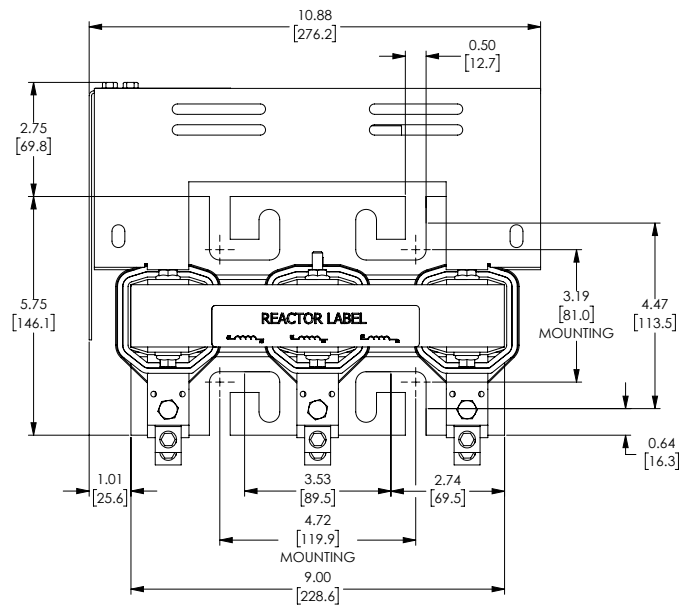


6) VTF FILTERS DIMENSION DRAWING #6

VTF-246-SVW

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

(Units = inches [mm])



BRAKING UNITS AND BRAKING RESISTORS

Braking units are used to absorb the motor regeneration energy when the motor stops by deceleration. With the braking unit, the regeneration energy is dissipated by braking resistors. Our braking units are suitable for 230V and 460V DURAPULSE GS3 drives, and must be used in conjunction with GS series braking resistors to provide the best braking results.



WARNING:

TO AVOID POSSIBLE INJURY, PLEASE REFER TO THE DYNAMIC BRAKING MANUAL, GS-DB_UMW, BEFORE WIRING.

BRAKING UNITS

AC Drive		Brake Unit		Braking Resistor			Torque	O/L
Voltage Class	AC Drive Part No.	Qty	Brake Unit Part No.	Qty	Resistor Part No.	Resistor Specification for Each Braking Unit	Braking Torque 10% Duty Cycle	Typical Thermal Overload Relay Value
230V	GS3-2020	1	GS-2DBU	1	GS-2020-BR-ENC	3000W 10Ω	125%	30A
	GS3-2025	1		1	GS-2025-BR-ENC	4800W 8Ω	125%	35A
	GS3-2030	1		1	GS-2030-BR-ENC	4800W 6.8Ω	125%	40A
	GS3-2040	2		2	GS-2040-BR-ENC	3000W 10Ω	125%	30A
	GS3-2050	2		2	GS-2050-BR-ENC	4800W 8Ω	125%	30A
460V	GS3-4020	1	GS-4DBU	1	GS-4020-BR-ENC	1500W 40Ω	125%	15A
	GS3-4025	1		1	GS-4025-BR-ENC	4800W 32Ω	125%	15A
	GS3-4030	1		1	GS-4030-BR-ENC	4800W 27.2Ω	125%	20A
	GS3-4040	1		1	GS-4040-BR-ENC	6000W 20Ω	125%	30A
	GS3-4050	1		1	GS-4050-BR-ENC	9600W 16Ω	125%	40A
	GS3-4060	1		1	GS-4060-BR-ENC	9600W 13.6Ω	125%	50A
	GS3-4075	2		2	GS-4075-BR-ENC	6000W 20Ω	125%	30A
	GS3-4100	2		2	GS-410 0-BR-ENC	9600W 13.6Ω	125%	50A

DYNAMIC BRAKE UNIT TERMINAL SPECIFICATIONS

Dynamic Brake Unit Terminal Specifications				
Circuit	Terminal Mark	Wire Gauge AWG/mm ²	Terminal	Torque
Power Input Circuit	+ (P), - (N)	10~12AWG / 3.5~5.5mm ²	M4 Screw	18 kg-cm
Braking Resistor	B1, B2			
Slave and Fault Circuit	M1, M2	20~18AWG / 0.25~0.75mm ² M1, M2, S1, S2 with shielded wires	M2 Screw	4 kg-cm
	S1, S2			
	RA, RB, RC			

DYNAMIC BRAKE UNIT GENERAL SPECIFICATIONS

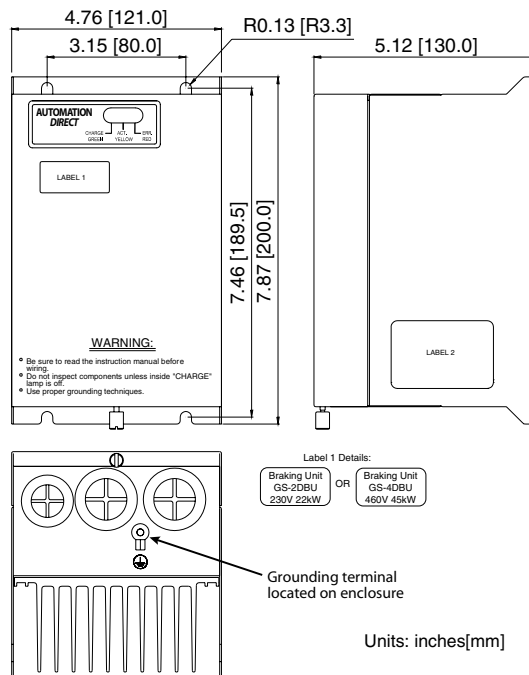
Dynamic Brake Unit Specifications		
Model	230V Class	460V Class
Part Number	GS-2DBU	GS-4DBU
Max. Motor Capacity HP (KW)	30 (22)	60 (45)
Output Rating	Max. Peak Discharge Current (A) 10% ED (Duty Cycle)	60
	Continuous Discharge Current (A)	20
	Braking Start-up Voltage (DC)	330/345/360/380/400/415 ±3V
	Maximum On-Time	60 seconds
Input Rating	DC Voltage	200~400 VDC
		400~800 VDC
Protection	Heat Sink Overheat	Temperature over +95 °C (203 °F)
	Alarm Output	Relay contact 5A @ 120VAC/28VDC (RA, RB, RC)
	Power CHARGE LED (Green)	ON until the bus (P-N) voltage is below 50VDC
	Braking ACT LED (Yellow)	ON during braking
	Fault ERR LED (Red)	ON if a fault has occurred
Usage Environment	Installation Location	Indoor (no corrosive gases, metallic dust)
	Operating Temperature	-10 °C to +50 °C (14 °F to 122 °F)
	Storage Temperature	-20 °C to +60 °C (-4 °F to 140 °F)
	Humidity	90% Non-condensing
	Vibration	9.8m/s ² (1G) under 20 2m/s ² (0.2G) @ 20~50Hz
Mechanical Configuration	Wall-mounted enclosed type IP50	

BRAKING UNIT WIRING

For information on braking unit wiring, refer to the power wiring diagrams in “Chapter 2: Installation and Wiring” of this manual, and to the DURAPULSE Dynamic Braking Units User Manual GS-DB_UMW.

BRAKING UNIT DIMENSIONS

Part Numbers: GS-2DBU, GS-4DBU



For more information regarding brake units, please refer to the brake unit user manual GS-DB_UMW.

BRAKING RESISTORS

Braking resistors are used to increase the control torque of the AC Drive, for frequently repeated ON-OFF cycles of the AC Drive, or for decelerating a load with large inertia.

BRAKING RESISTOR SPECIFICATIONS

Braking Resistor Specifications								
Voltage Class	AC Drive Model	Qty	Braking Resistor Part Number	Motor HP	Braking Torque ED 10%	Type (Ω)	Power (W)	Duty Cycle
230V	GS3-21P0	1	GS-21P0-BR	1	125%	200	80	10%
	GS3-22P0	1	GS-22P0-BR	2	125%	100	300	10%
	GS3-23P0	1	GS-23P0-BR	3	125%	70	300	10%
	GS3-25P0	1	GS-25P0-BR	5	125%	40	400	10%
	GS3-27P5	1	GS-27P5-BR	7.5	125%	30	500	10%
	GS3-2010	1	GS-2010-BR-ENC	10	125%	20	1000	10%
	GS3-2015	1	GS-2015-BR-ENC	15	125%	13.6	2400	10%
	GS3-2020	1	GS-2020-BR-ENC	20	125%	10	3000	10%
	GS3-2025	1	GS-2025-BR-ENC	25	125%	8	4800	10%
	GS3-2030	1	GS-2030-BR-ENC	30	125%	6.8	4800	10%
	GS3-2040	2	GS-2040-BR-ENC	40	125%	10	3000	10%
	GS3-2050	2	GS-2050-BR-ENC	50	125%	8	4800	10%
460V	GS3-41P0	1	GS-41P0-BR	1	125%	750	80	10%
	GS3-42P0	1	GS-42P0-BR	2	125%	400	300	10%
	GS3-43P0	1	GS-43P0-BR	3	125%	250	300	10%
	GS3-45P0	1	GS-45P0-BR	5	125%	150	400	10%
	GS3-47P5	1	GS-47P5-BR	7.5	125%	100	500	10%
	GS3-4010	1	GS-4010-BR	10	125%	75	1000	10%
	GS3-4015	1	GS-4015-BR-ENC	15	125%	50	1000	10%
	GS3-4020	1	GS-4020-BR-ENC	20	125%	40	1500	10%
	GS3-4025	1	GS-4025-BR-ENC	25	125%	32	4800	10%
	GS3-4030	1	GS-4030-BR-ENC	30	125%	27.2	4800	10%
	GS3-4040	1	GS-4040-BR-ENC	40	125%	20	6000	10%
	GS3-4050	1	GS-4050-BR-ENC	50	125%	16	9600	10%
	GS3-4060	1	GS-4060-BR-ENC	60	125%	13.6	9600	10%
	GS3-4075	2	GS-4075-BR-ENC	75	125%	20	6000	10%
GS3-4100	2	GS-4100-BR-ENC	100	125%	13.6	9600	10%	



For DURAPULSE GS3 drive models 20 hp and above, a dynamic braking unit must be used in conjunction with the braking resistor, as shown in the Braking Units and Braking Resistors table earlier in this chapter. For additional information, please refer to the dynamic braking manual, GS-DB_UMW.

BRAKING RESISTOR WIRING

For information on braking resistor wiring, refer to the power wiring diagrams in “Chapter 2: Installation and Wiring”.

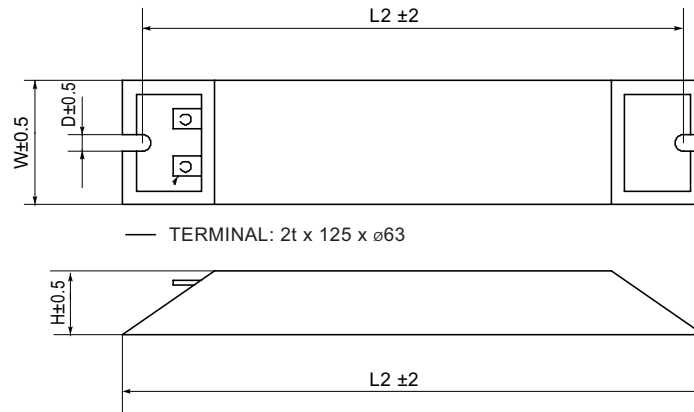
BRAKING RESISTOR DIMENSIONS

Braking Resistor Dimensions				
Voltage Class	AC Drive Model	Braking Resistor Part Number	Enclosure Type	Dimensions
230V	GS3-21P0	GS-21P0-BR	none	Figure 1
	GS3-22P0	GS-22P0-BR		
	GS3-23P0	GS-23P0-BR		
	GS3-25P0	GS-25P0-BR		
	GS3-27P5	GS-27P5-BR	none	Figure 2
	GS3-2010	GS-2010-BR-ENC	GCE3	Figure 3
	GS3-2015	GS-2015-BR-ENC	GCE6	Figure 4
	GS3-2020	GS-2020-BR-ENC		
	GS3-2025	GS-2025-BR-ENC	GCE9	Figure 5
	GS3-2030	GS-2030-BR-ENC		
	GS3-2040	GS-2040-BR-ENC	(2) x GCE6	(2) x Figure 4
	GS3-2050	GS-2050-BR-ENC	(2) x GCE9	(2) x Figure 5
460V	GS3-41P0	GS-41P0-BR	none	Figure 1
	GS3-42P0	GS-42P0-BR		
	GS3-43P0	GS-43P0-BR		
	GS3-45P0	GS-45P0-BR		
	GS3-47P5	GS-47P5-BR	none	Figure 2
	GS3-4010	GS-4010-BR		
	GS3-4015	GS-4015-BR-ENC	GCE3	Figure 3
	GS3-4020	GS-4020-BR-ENC	GCE4	Figure 6
	GS3-4025	GS-4025-BR-ENC	GCE12	Figure 7
	GS3-4030	GS-4030-BR-ENC		
	GS3-4040	GS-4040-BR-ENC		
	GS3-4050	GS-4050-BR-ENC	GCE15	Figure 8
	GS3-4060	GS-4060-BR-ENC		
	GS3-4075	GS-4075-BR-ENC		
GS3-4100	GS-4100-BR-ENC	(2) x GCE12	(2) x Figure 7	
		(2) x GCE15	(2) x Figure 8	

BRAKING RESISTOR DIMENSIONS (CONTINUED)

Figure 1

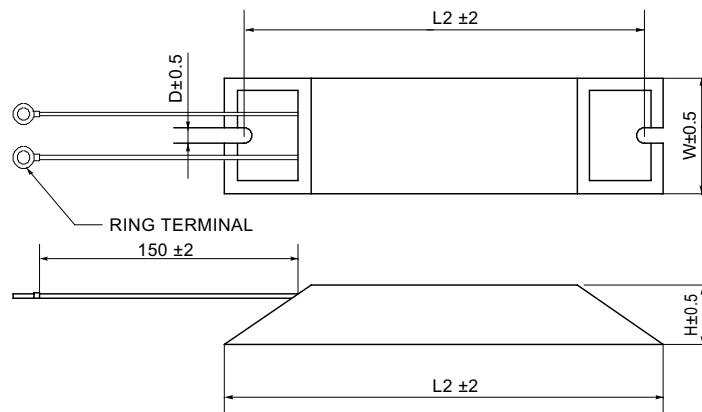
- GS-21P0-BR**
- GS-22P0-BR**
- GS-23P0-BR**
- GS-25P0-BR**
- GS-41P0-BR**
- GS-42P0-BR**
- GS-43P0-BR**
- GS-45P0-BR**



Resistor Part Number	L1 (mm)	L2 (mm)	H (mm)	D (mm)	W (mm)
GS-21P0-BR	140	125	20	5.3	60
GS-22P0-BR	215	200	30	5.3	60
GS-23P0-BR	215	200	30	5.3	60
GS-25P0-BR	265	250	30	5.3	60
GS-41P0-BR	140	125	20	5.3	60
GS-42P0-BR	215	200	30	5.3	60
GS-43P0-BR	215	200	30	5.3	60
GS-45P0-BR	265	250	30	5.3	60

Figure 2

- GS-27P5-BR**
- GS-47P5-BR**
- GS-4010-BR**



Resistor Part Number	L1 (mm)	L2 (mm)	H (mm)	D (mm)	W (mm)
GS-27P5-BR	335	320	30	5.3	60
GS-47P5-BR	335	320	30	5.3	60
GS-4010-BR	400	385	50	5.3	100

BRAKING RESISTOR DIMENSIONS (CONTINUED)

Figure 3
GS-2010-BR-ENC
GS-4015-BR-ENC

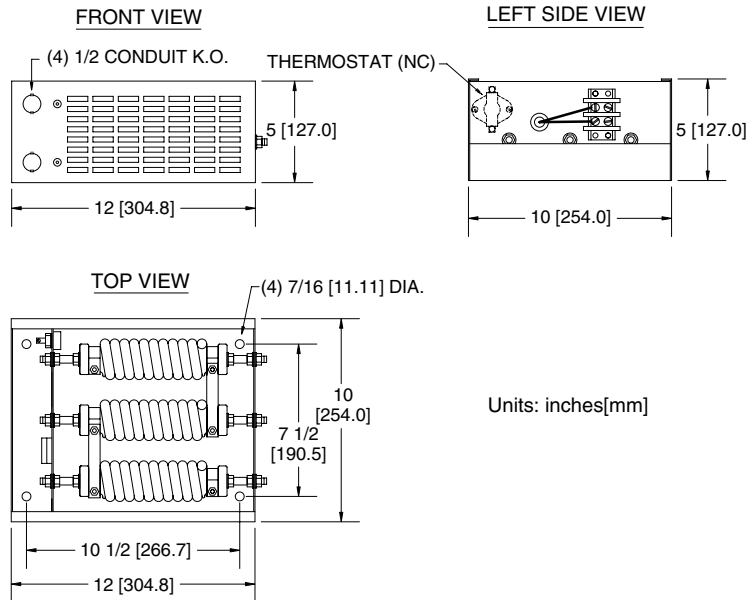
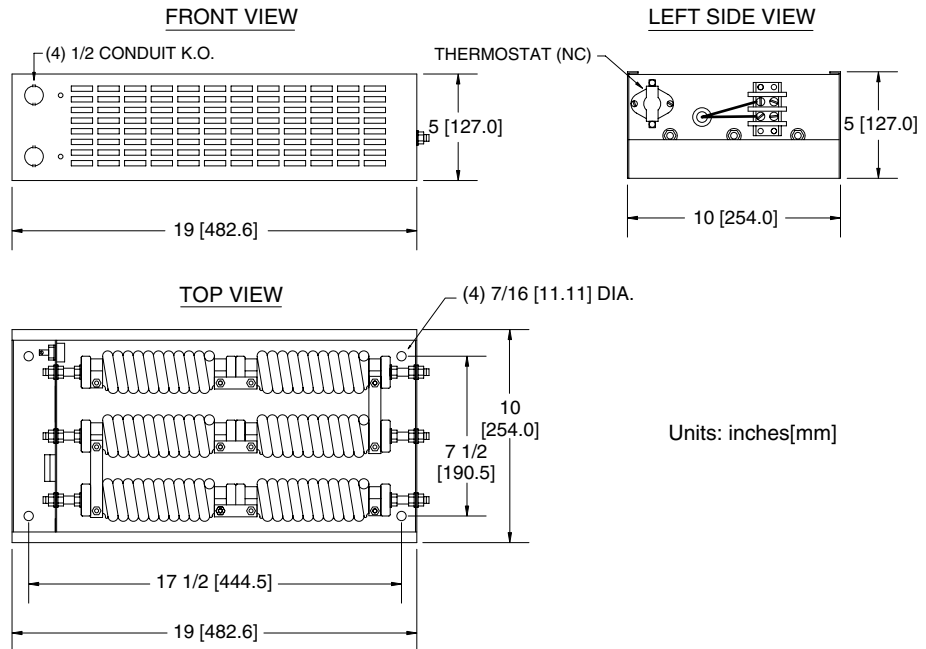


Figure 4
GS-2015-BR-ENC
GS-2020-BR-ENC
GS-2040-BR-ENC*
 *(2) units required



BRAKING RESISTOR DIMENSIONS (CONTINUED)

Figure 5

GS-2025-BR-ENC

GS-2030-BR-ENC

GS-2050-BR-ENC*

* (2) units required

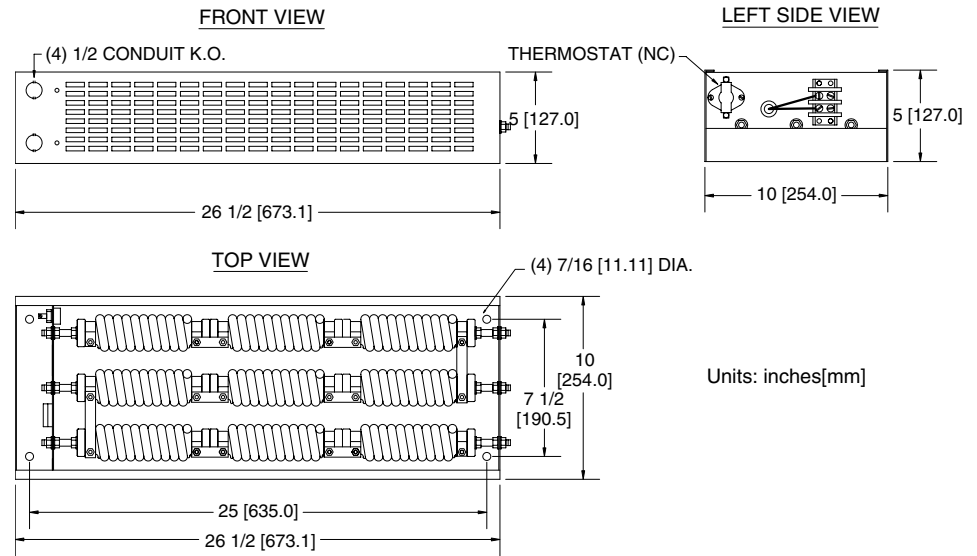
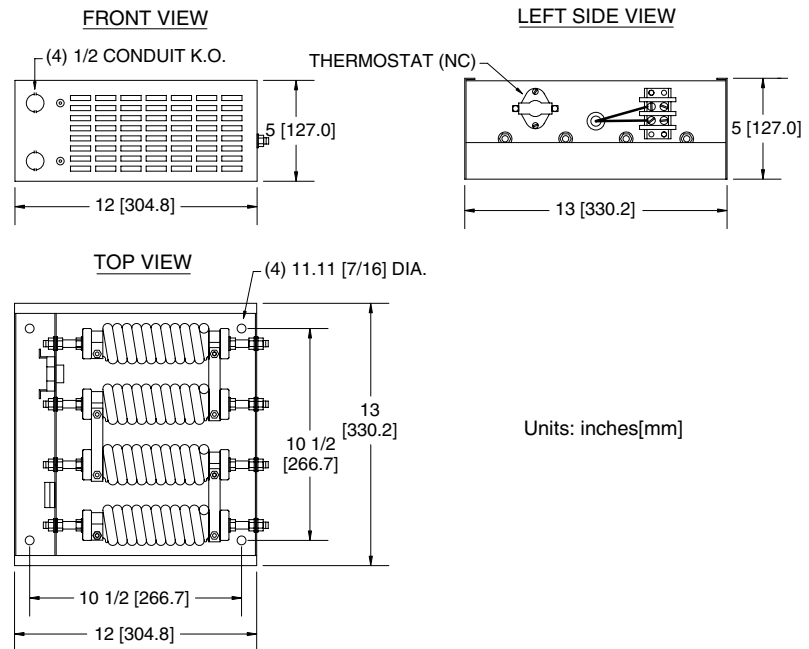


Figure 6

GS-4020-BR-ENC



BRAKING RESISTOR DIMENSIONS (CONTINUED)

Figure 7

GS-4025-BR-ENC
GS-4030-BR-ENC
GS-4040-BR-ENC
GS-4075-BR-ENC*
 * (2) units required

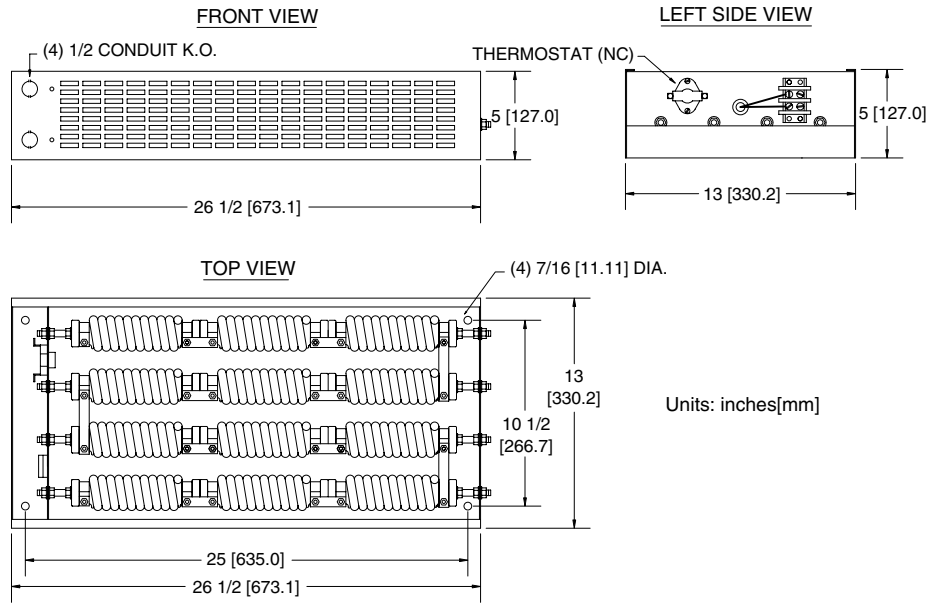
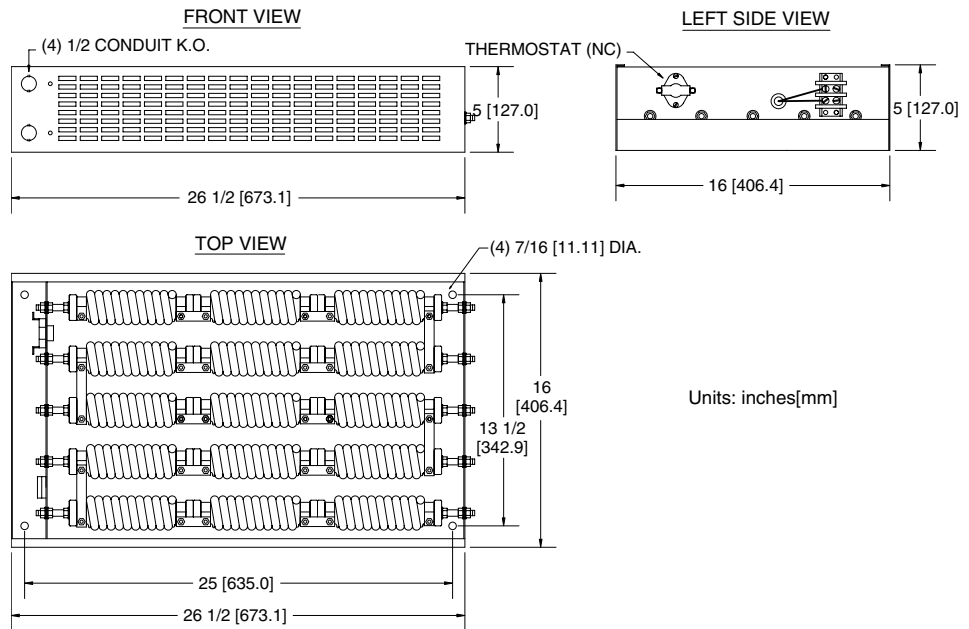


Figure 8

GS-4050-BR-ENC
GS-4060-BR-ENC
GS-4100-BR-ENC*
 * (2) units required



EMI INPUT FILTERS

The EC Declaration of Conformity for the DURAPULSE GS3 AC Drives was completed in conjunction with EMI Filters listed below. Use the following table to specify the corresponding EMI Filter for each AC Drive model.



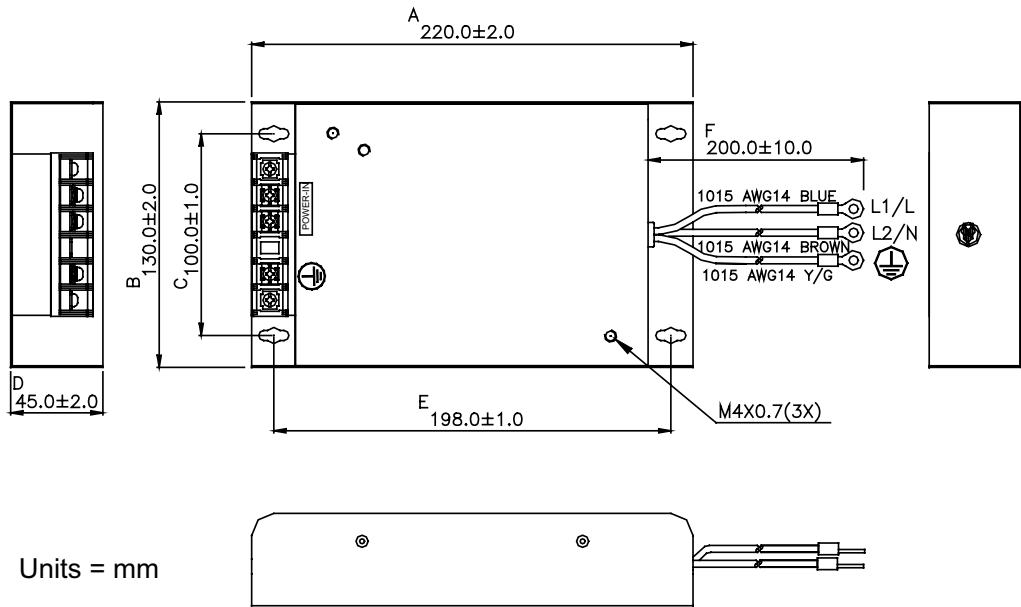
CE compliance requires the use of EMI filters.

EMI INPUT FILTER SPECIFICATIONS

EMI Input Filter Specifications					
AC Drive Model / Input Phase		EMI Filter	Input Power Max Rating	Dimension Drawing	Terminal Screw Max Torque
230V	460V				kg-cm [lb-in]
GS3-21P0 / 1ph GS3-22P0 / 1ph	–	20DRT1W3S	250V, 1-phase, 20A	Figure 1-1	18 [16]
GS3-23P0 / 1ph	–	32DRT1W3C	250V, 1-phase, 32A	Figure 1-2	
GS3-21P0 / 3ph GS3-22P0 / 3ph	–	10TDT1W4C	250V, 3-phase, 10A	Figure 3-1	
GS3-23P0 / 3ph GS3-25P0 / 3ph	–	26TDT1W4C	250V, 3-phase, 26A	Figure 3-2	
GS3-27P5 / 3ph GS3-2010 / 3ph	GS3-4020 / 3ph GS3-4025 / 3ph	50TDS4W4C	250/480V, 3-phase, 50A	Figure 3-3	30 [26]
GS3-2015 / 3ph GS3-2020 / 3ph	GS3-4030 / 3ph GS3-4040 / 3ph GS3-4050 / 3ph	100TDS84C	250/480V, 3-phase, 100A	Figure 3-4	65 [56]
GS3-2025 / 3ph GS3-2030 / 3ph GS3-2040 / 3ph	GS3-4060 / 3ph	150TDS84C	250/480V, 3-phase, 150A	Figure 3-5	
GS3-2050 / 3ph	–	180TDS84C	250V, 3-phase, 180A	Figure 3-6	
–	GS3-41P0 / 3ph GS3-42P0 / 3ph GS3-43P0 / 3ph	RF022B43AA	480V, 3-phase, 5.9A	Figure 3-7	n/a
–	GS3-45P0 / 3ph	RF037B43BA	480V, 3-phase, 11.2A	Figure 3-8	
–	GS3-47P5 / 3ph GS3-4010 / 3ph GS3-4015 / 3ph	RF110B43CA	480V, 3-phase, 25A	Figure 3-9	
–	GS3-4075 / 3ph GS3-4100 / 3ph	200TDDS84C	480V, 3-phase, 200A	Figure 3-10	65 [56]

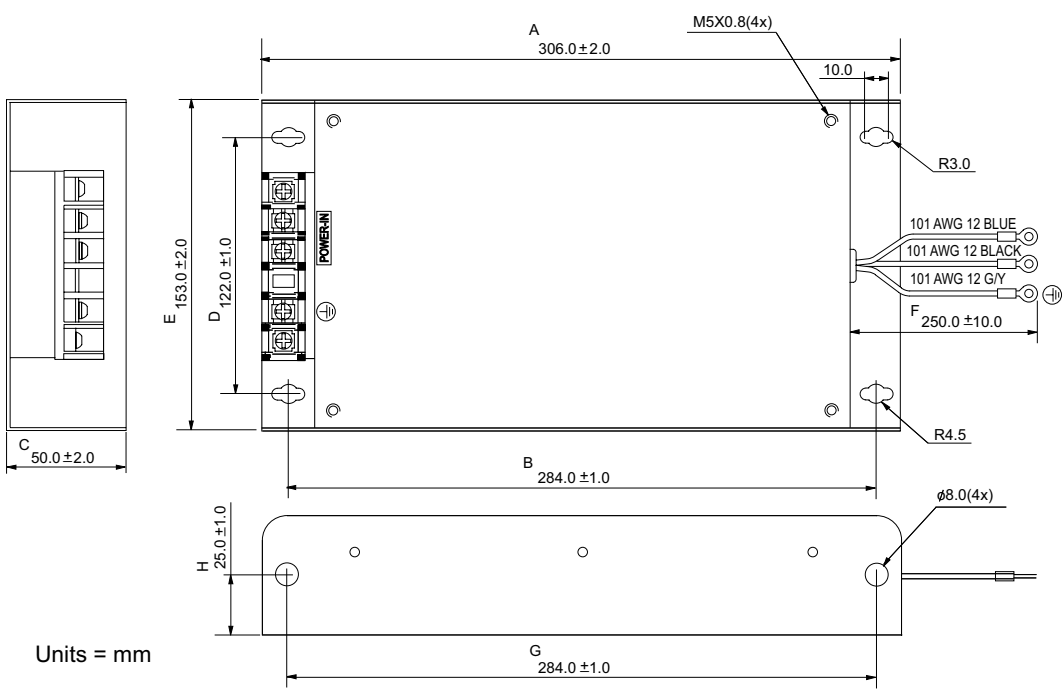
EMI FILTER DIMENSIONS

Figure 1-1
[units = mm]
20DRT1W3S



Units = mm

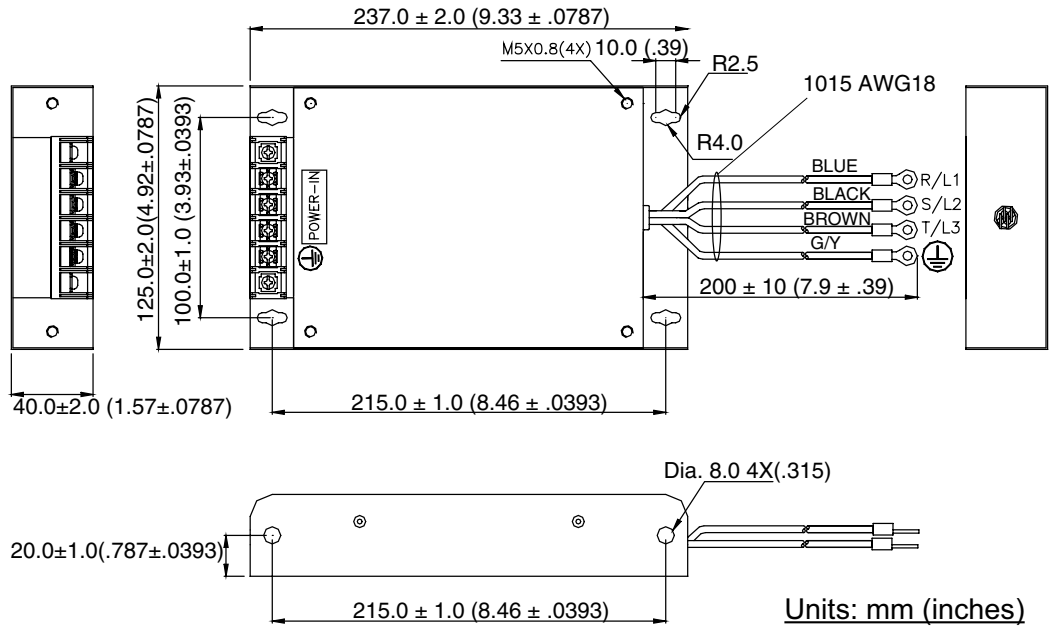
Figure 1-2
[units = mm]
32DRT1W3C



Units = mm

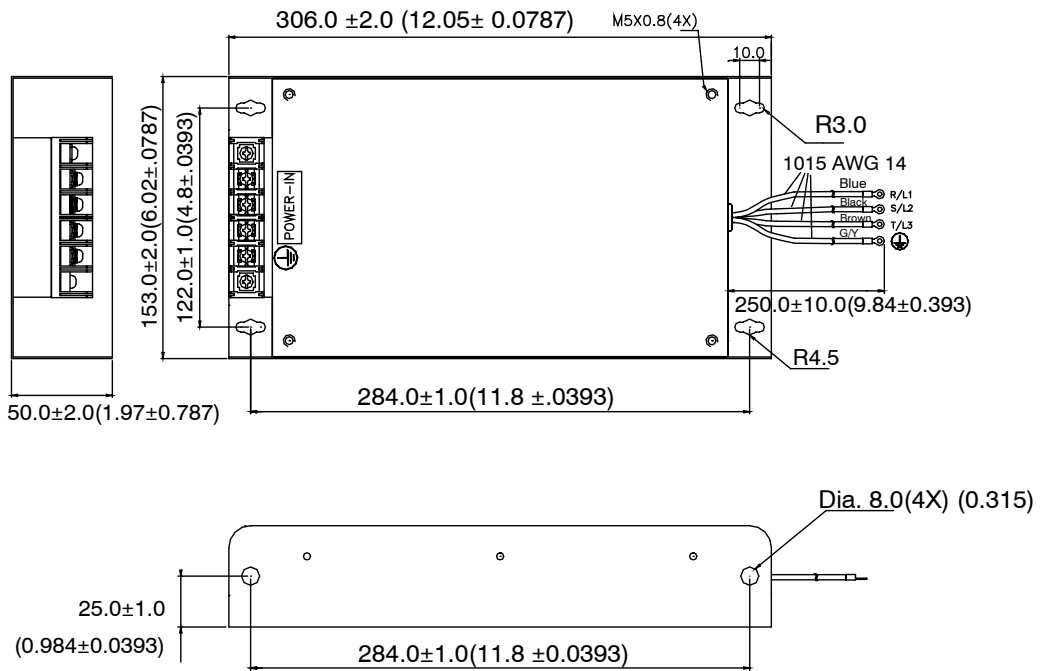
EMI FILTER DIMENSIONS (CONTINUED)

Figure 3-1
[units = mm (in)]
10TDT1W4C



Units: mm (inches)

Figure 3-2
[units = mm (in)]
26TDT1W4C



EMI FILTER DIMENSIONS (CONTINUED)

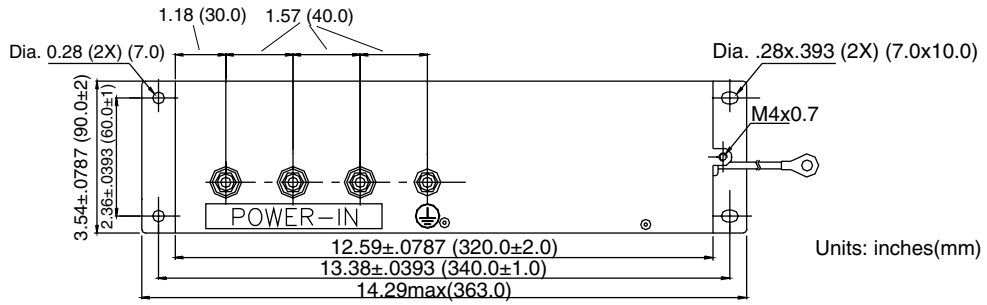


Figure 3-3
[units = in (mm)]
50TDS4W4C

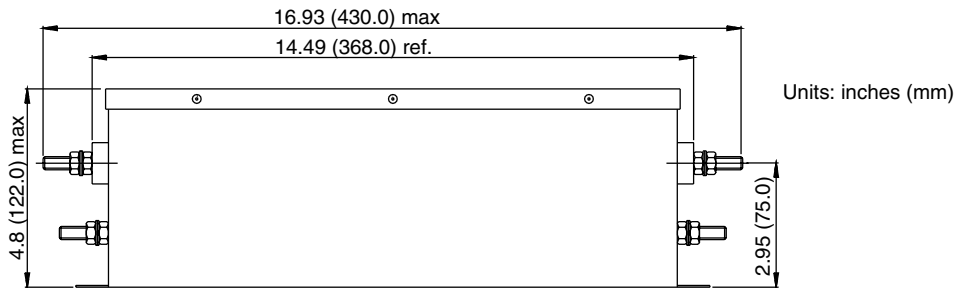
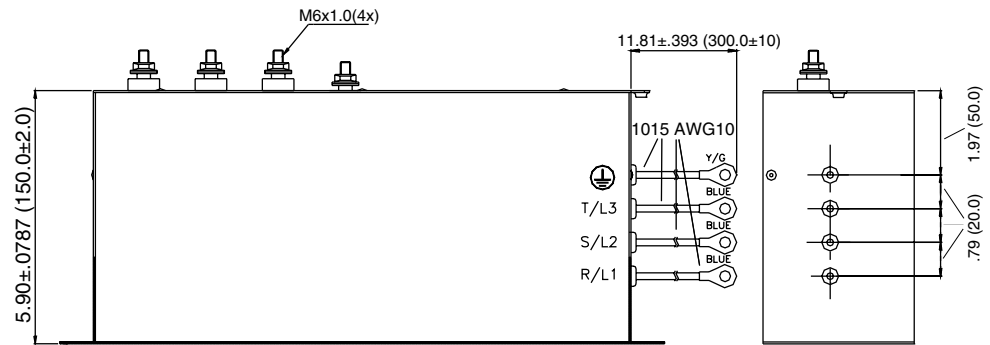
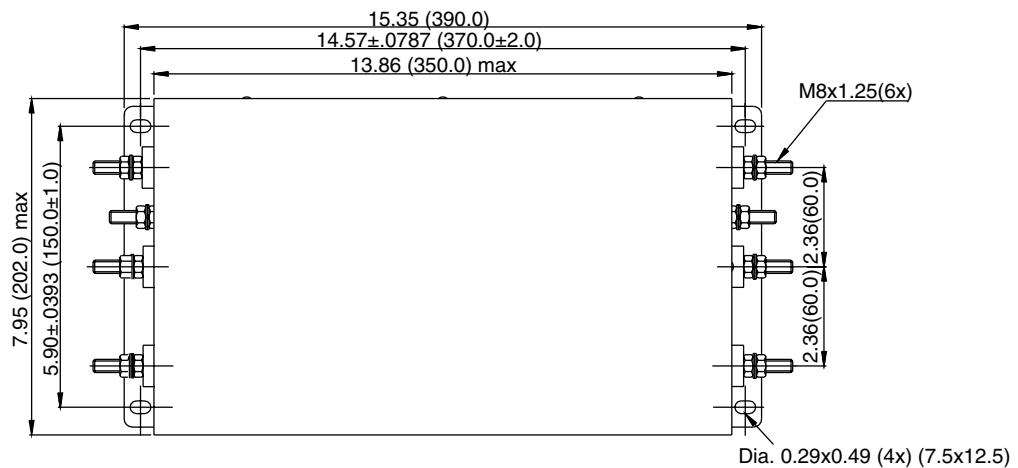


Figure 3-4
[units = in (mm)]
100TDS84C



EMI FILTER DIMENSIONS (CONTINUED)

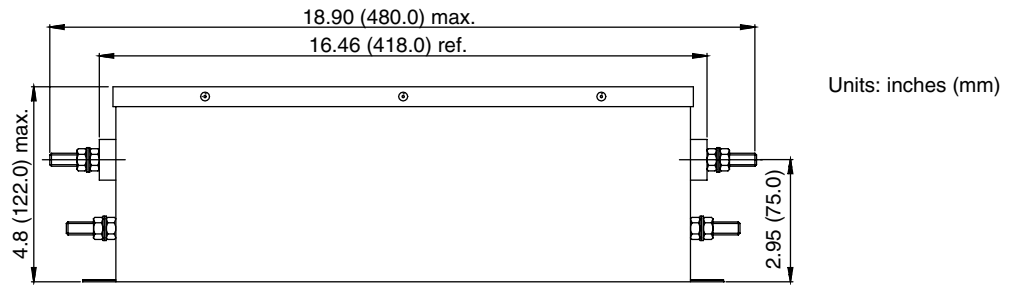


Figure 3-5
[units = in (mm)]
150TDS84C

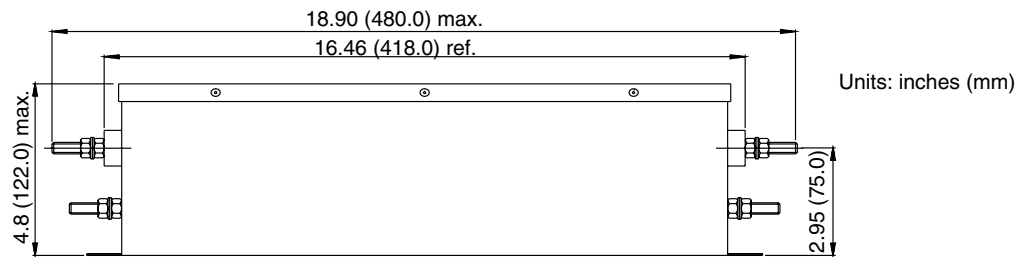
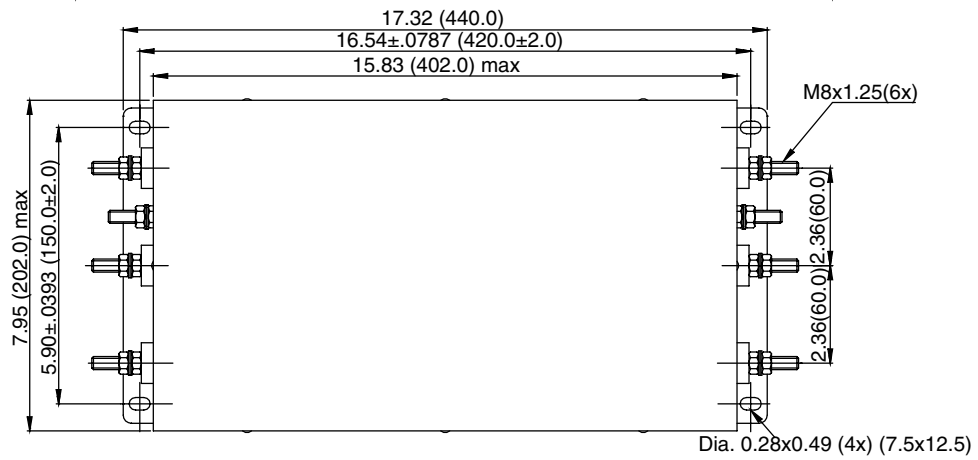
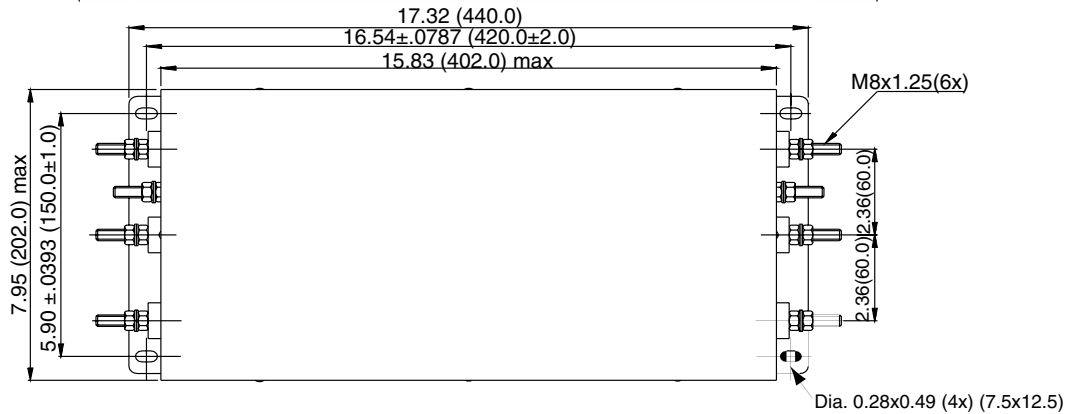


Figure 3-6
[units = in (mm)]
180TDS84C



EMI FILTER DIMENSIONS (CONTINUED)

Figure 3-7
[units = in (mm)]
RF022B43AA

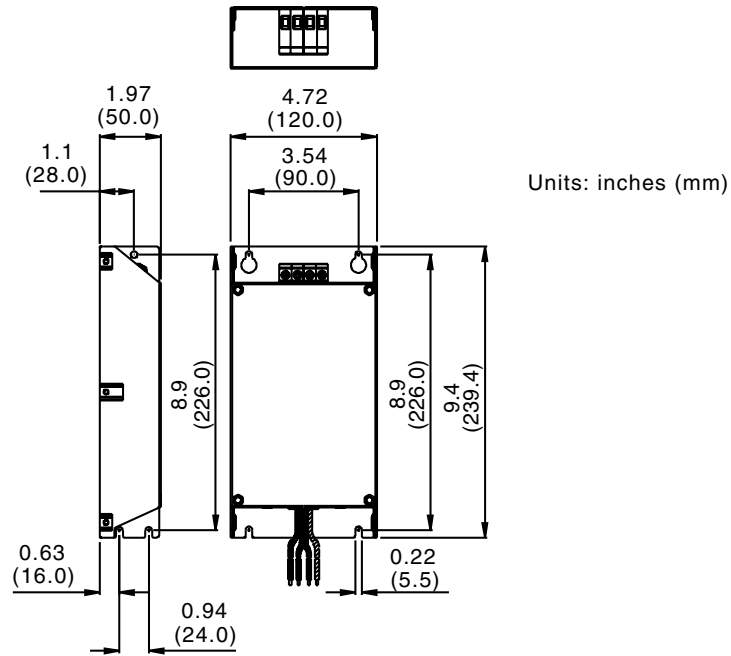
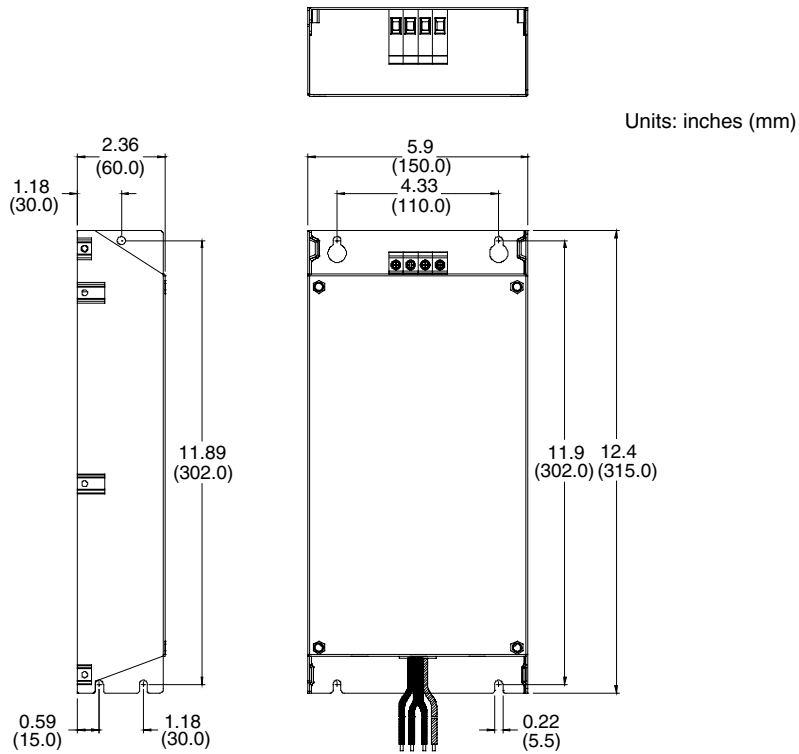


Figure 3-8
[units = in (mm)]
RF037B43AA



EMI FILTER DIMENSIONS (CONTINUED)

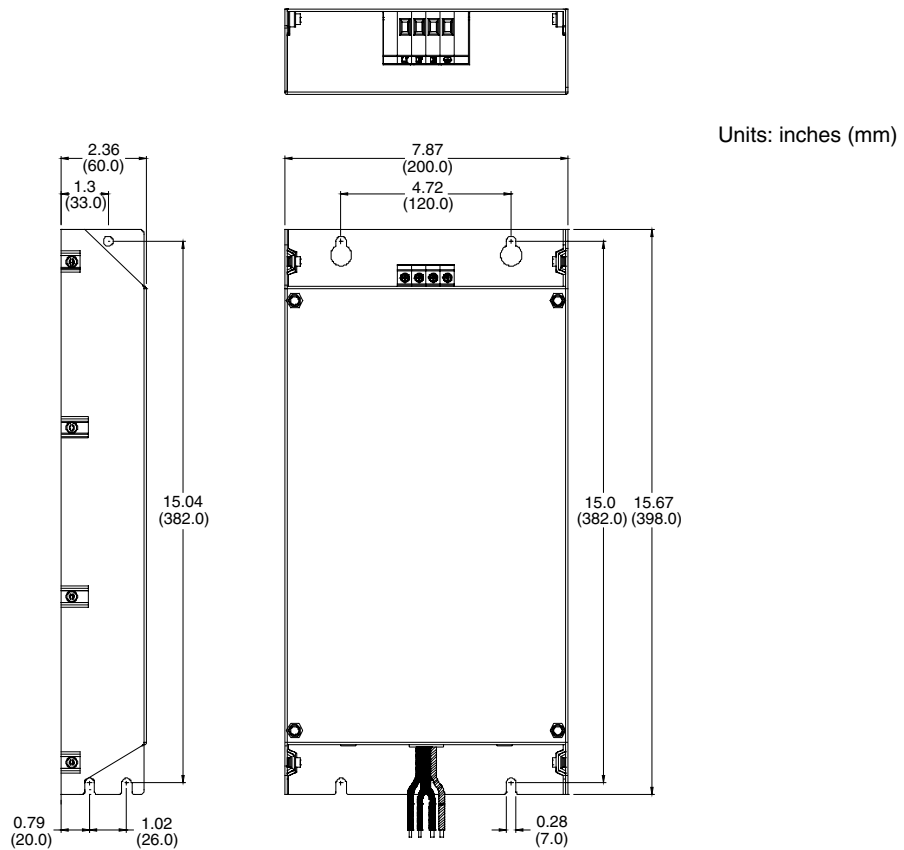


Figure 3-9
[units = in (mm)]
RF110B43CA

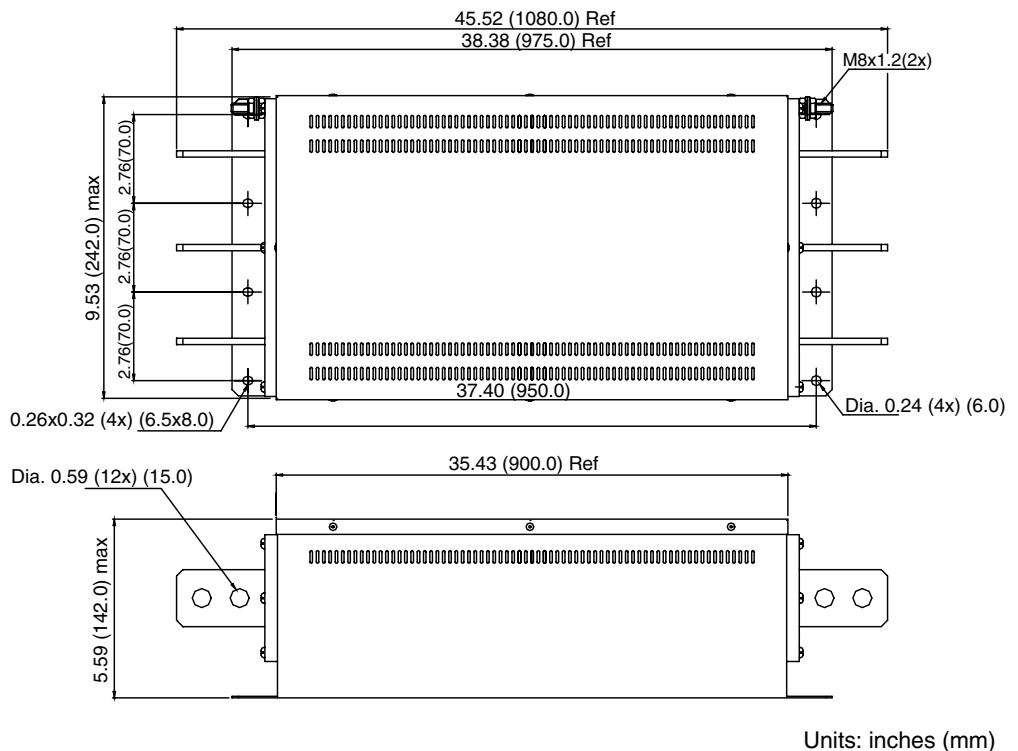
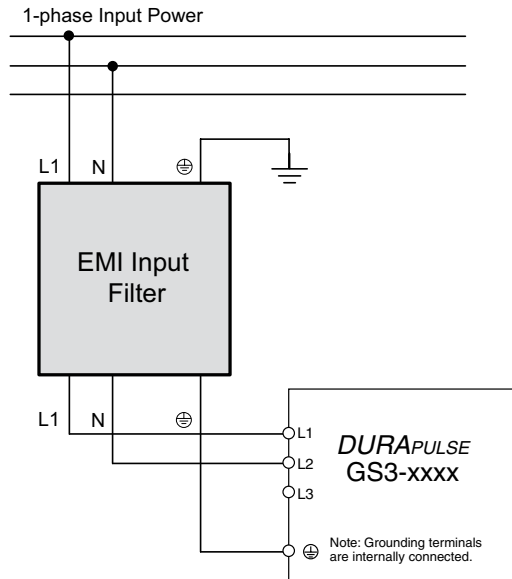


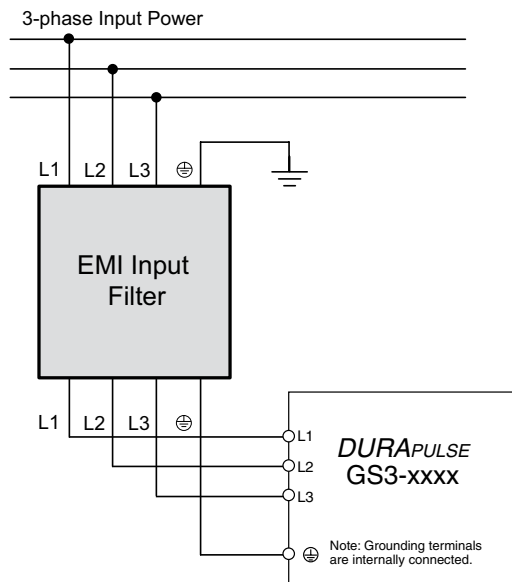
Figure 3-10
[units = in (mm)]
200TDDS84C

EMI FILTER WIRING CONNECTIONS

SINGLE-PHASE INPUT CONNECTIONS



TRIPLE-PHASE INPUT CONNECTIONS



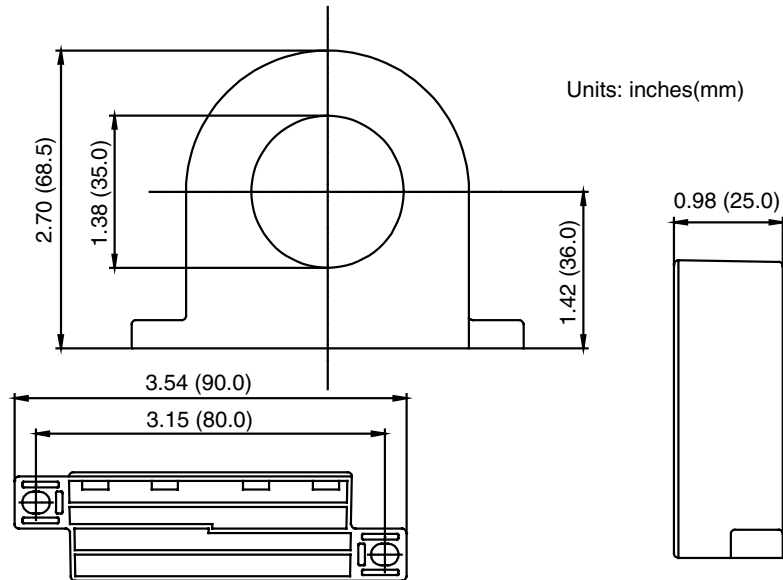
Distance of wires from filter to drive should be as short as possible.

RF FILTER

RF FILTER PART #: RF220X00A

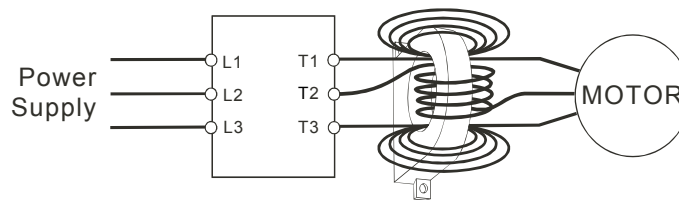
RF Filters are used to reduce the radio frequency interference or noise on the input or output side of the inverter. RF220X00A can be used with all GS model drives.

RF FILTER DIMENSIONS

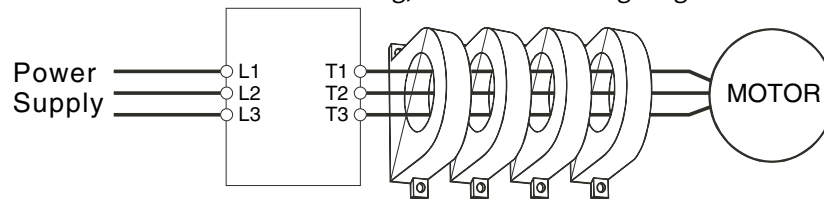


RF FILTER WIRING

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



If you are unable to wire as shown above due to wire size, or another aspect of your application, put all wires through four cores in series without winding, as in the following diagram.



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 the GS3 DURAPULSE GS3 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 USING APPLICABLE LOCAL CODES.

The following fuse kits consist of one fuse block and fuses sized to match each GS3 DURApulse GS3 AC Drive. Replacement fuses are also available, as shown below.

Fuse Kit Specifications for GS3 AC Drives													
Part Number	Drive Model / Phase	Fuse Block Type	Fuse Type	Fuse Rating	Fuse Block Dimensions	Wire Connector Torque (lb-in)	Fuse Bolt Torque (lb-in)	Wire Range	Replacement Fuses				
GS-21P0-FKIT-1P*	GS3-21P0 / 1	2-pole		300V @ 30A	Figure 1	20	spring clips	Al/Cu #2-14	GS-21P0-FUSE-1P				
GS-22P0-FKIT-1P*	GS3-22P0 / 1			300V @ 45A		45			GS-22P0-FUSE-1P				
GS-23P0-FKIT-1P*	GS3-23P0 / 1			300V @ 60A		45			GS-23P0-FUSE-1P				
GS-21P0-FKIT-3P	GS3-21P0 / 3	A3T		300V @ 20A	Figure 2	20	Al/Cu #2-14	GS-21P0-FUSE-3P					
GS-22P0-FKIT-3P	GS3-22P0 / 3			300V @ 25A		20		GS-22P0-FUSE-3P					
GS-23P0-FKIT-3P	GS3-23P0 / 3			300V @ 40A		45		GS-23P0-FUSE-3P					
GS-25P0-FKIT	GS3-25P0 / 3			300V @ 60A	45	GS-25P0-FUSE							
GS-27P5-FKIT	GS3-27P5 / 3			300V @ 100A	Figure 3	50		72	GS-27P5-FUSE				
GS-2010-FKIT**	GS3-2010 / 3			300V @ 125A					GS-2010-FUSE				
GS-2015-FKIT**	GS3-2015 / 3			300V @ 175A					GS-2015-FUSE				
GS-2020-FKIT	GS3-2020 / 3			Figure 5	300V @ 250A	600		228	Al/Cu 2/0-#6	GS-2020-FUSE			
GS-2025-FKIT	GS3-2025 / 3									300V @ 300A	600	228	GS-2025-FUSE
GS-2030-FKIT	GS3-2030 / 3									300V @ 350A	600	228	GS-2030-FUSE
GS-2040-FKIT***	GS3-2040 / 3			Figure 6	300V @ 450A	600		360	Al/Cu 2/0-#6	GS-2040-FUSE			
GS-2050-FKIT***	GS3-2050 / 3									300V @ 500A	600	360	GS-2050-FUSE
GS-41P0-FKIT	GS3-41P0 / 3	3-pole		600V @ 10A	Figure 7	20	Al/Cu #2-14	GS-41P0-FUSE					
GS-42P0-FKIT	GS3-42P0 / 3			600V @ 15A		20		GS-42P0-FUSE					
GS-43P0-FKIT	GS3-43P0 / 3			600V @ 20A		20		GS-43P0-FUSE					
GS-45P0-FKIT	GS3-45P0 / 3			600V @ 30A		20		GS-45P0-FUSE					
GS-47P5-FKIT	GS3-47P5 / 3			600V @ 50A	Figure 8	45		GS-47P5-FUSE					
GS-4010-FKIT	GS3-4010 / 3			Figure 9	600V @ 70A	120		72	Cu 2/0-#12	GS-4010-FUSE			
GS-4015-FKIT	GS3-4015 / 3									600V @ 90A	120	72	GS-4015-FUSE
GS-4020-FKIT	GS3-4020 / 3			Figure 10	600V @ 125A	275		132	Al/Cu 2/0-#6	GS-4020-FUSE			
GS-4025-FKIT	GS3-4025 / 3									600V @ 150A	275	132	GS-4025-FUSE
GS-4030-FKIT	GS3-4030 / 3									600V @ 175A	275	132	GS-4030-FUSE
GS-4040-FKIT***	GS3-4040 / 3			Figure 11	600V @ 225A	600		228	Al/Cu 2/0-#6	GS-4040-FUSE			
GS-4050-FKIT***	GS3-4050 / 3									600V @ 250A	600	228	GS-4050-FUSE
GS-4060-FKIT***	GS3-4060 / 3	600V @ 350A	600				228			GS-4060-FUSE			
GS-4075-FKIT***	GS3-4075 / 3	600V @ 400A	600				228			GS-4075-FUSE			
GS-4100-FKIT***	GS3-4100 / 3	600V @ 600A	Figure 12				600			360	GS-4100-FUSE		

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.

** GS-2010-FKIT and GS-2015-FKIT are no longer available. Please use GS-27P5-FKIT instead.

*** Three units required.

FUSE BLOCK DIMENSIONS

[Units = inches]

Figure 1

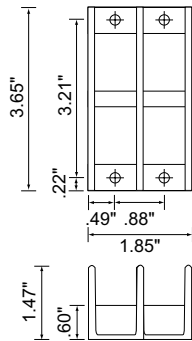


Figure 2

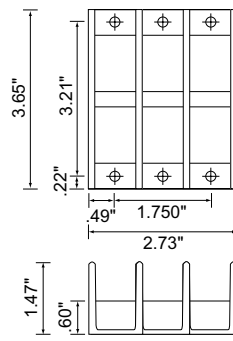


Figure 3

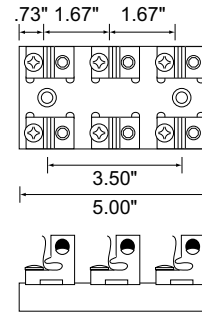


Figure 4

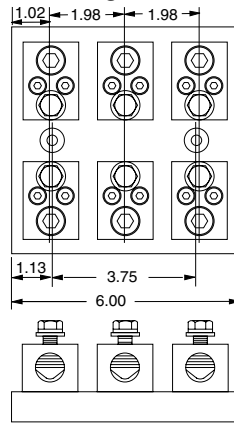


Figure 5

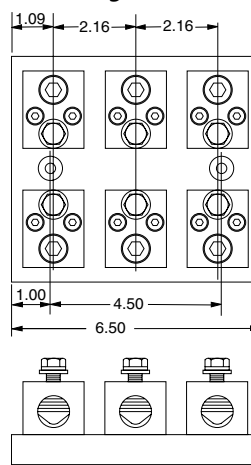
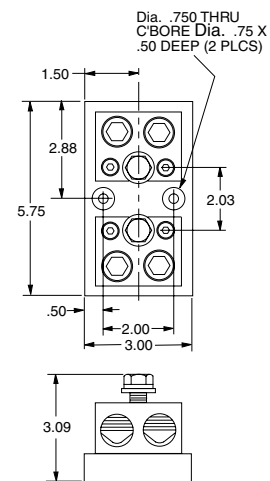


Figure 6



FUSE BLOCK DIMENSIONS (CONTINUED)

[Units = inches]

Figure 7

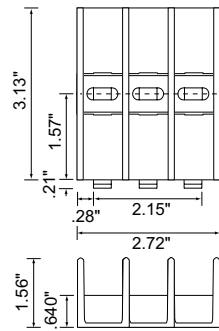


Figure 8

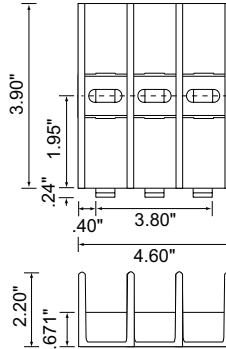


Figure 9

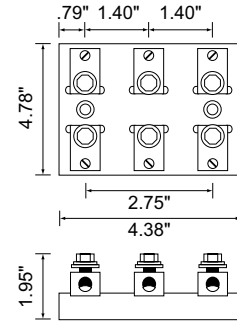


Figure 10

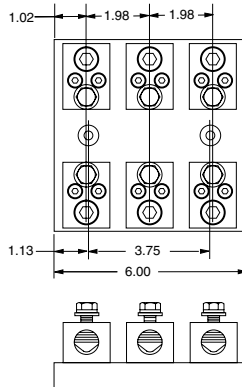


Figure 11

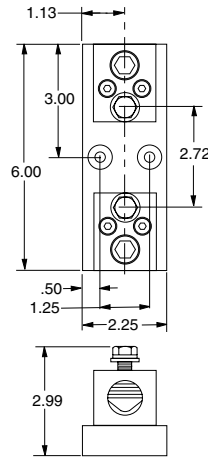
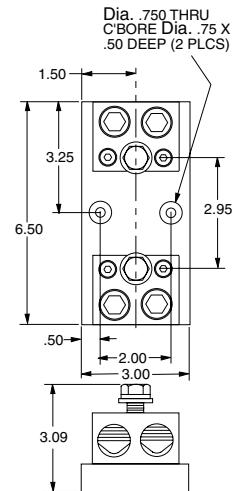


Figure 12

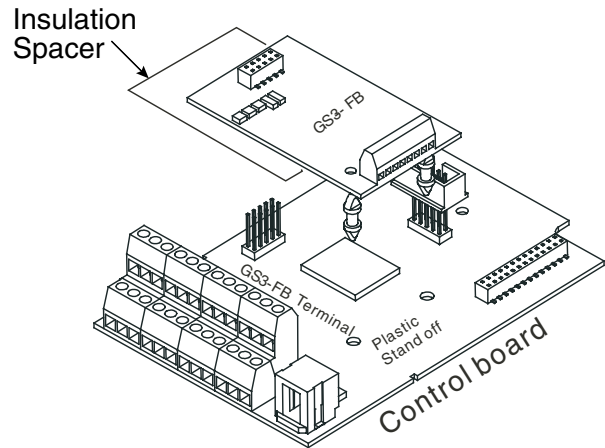


GS3-FB FEEDBACK CARD

1 to 2HP (0.75kW to 1.5kW)

INSTALLATION

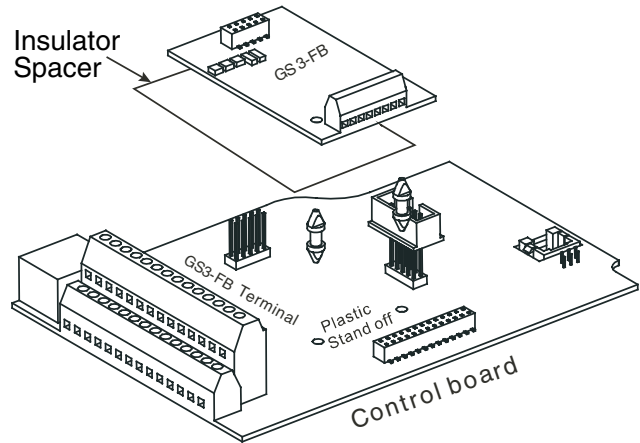
For **1 to 2hp** (0.75kW to 1.5kW) drives



3 to 5HP (2.2kW to 3.7kW)

INSTALLATION

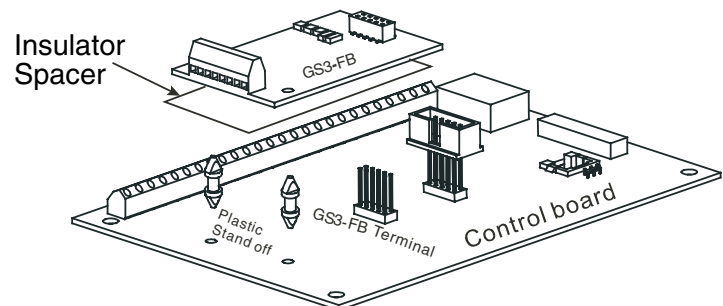
For **3 to 5hp** (2.2kW to 3.7kW) drives



7.5HP (5.5kW) and above

INSTALLATION

For drives **7.5hp (5.5kW) and above**



Make sure GS3-FB card snaps firmly into board. If it is not properly installed, LEDs will not light upon power-up.

GS3-FB TERMINAL DESCRIPTIONS WIRING NOTES

Terminal Symbols	Descriptions
VP	Power source of GS3-FB (SW1 can be switched to 12V or 5V) Output Voltage: (+12VDC ±5% 200mA) or (+5VDC ±2% 400mA)
DCM	Power source (VP) and input signal (A, B) common
A, NOT A, B, NOT B	Input signal from Encoder; Input type is selected by SW2; Maximum 500kP/Sec
A/O, B/O	GS3-FB output signal for use with RPM Meter (Open Collector) Maximum DC24V 100mA
COM	GS3-FB output signal (A/O, B/O) common
PG	Pulse generator or Encoder
IM 3~	3-Phase motor

The control, power supply and motor leads must be laid separately. They must not be fed through the same cable conduit / trunking.

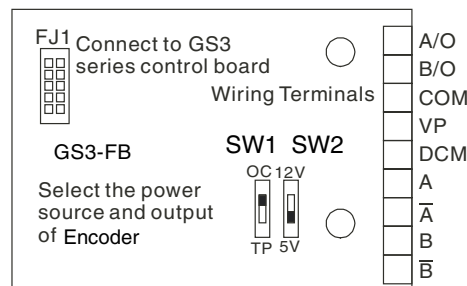
- 1) Please use a shield cable to prevent interference. Do not run control wire parallel to any high voltage AC power line (220V and up).
- 2) Connect shielded wire to Ground only.
- 3) Recommended wire size for shielded cable: AWG24 to AWG18 (0.21 to 0.81mm²)
- 4) Wire length:

Types of Encoders	Maximum Wire Length	Wire Gauge at Maximum Wire Length
Output Voltage	165 ft (50m)	AWG16 (1.25mm ²) or larger
Open Collector	165 ft (50m)	
Line Driver	1000 ft (300m)	
Complimentary	230 ft (70m)	

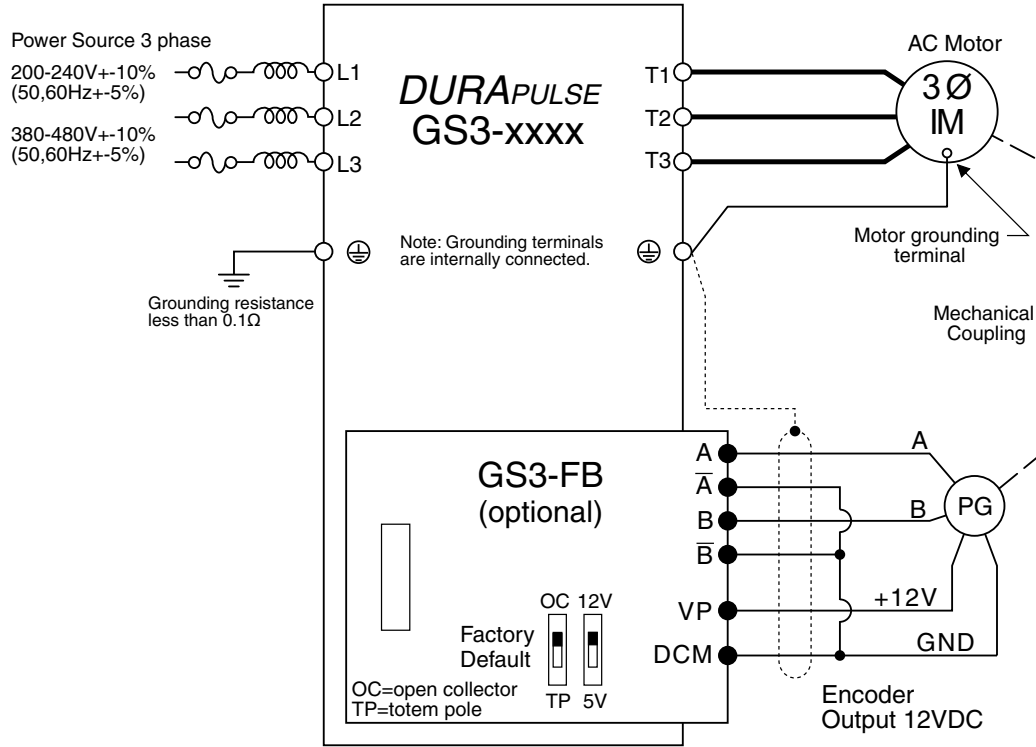


Please refer to instructions supplied with product for additional installation information.

CONTROL TERMINALS BLOCK DESIGNATIONS

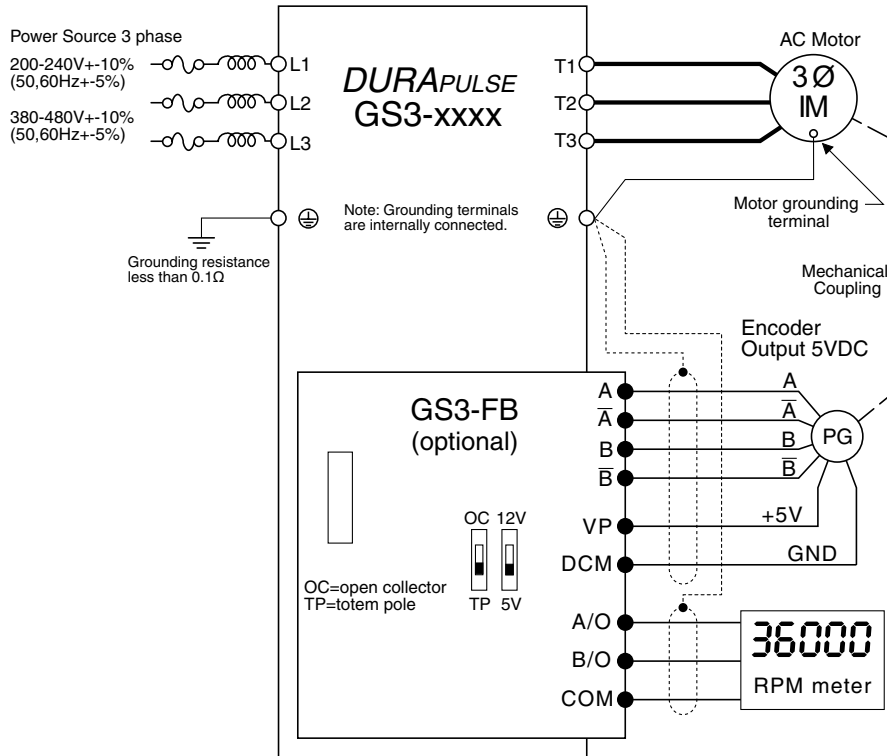


GS3-FB BASIC WIRING DIAGRAM – OPEN COLLECTOR TYPE ENCODER



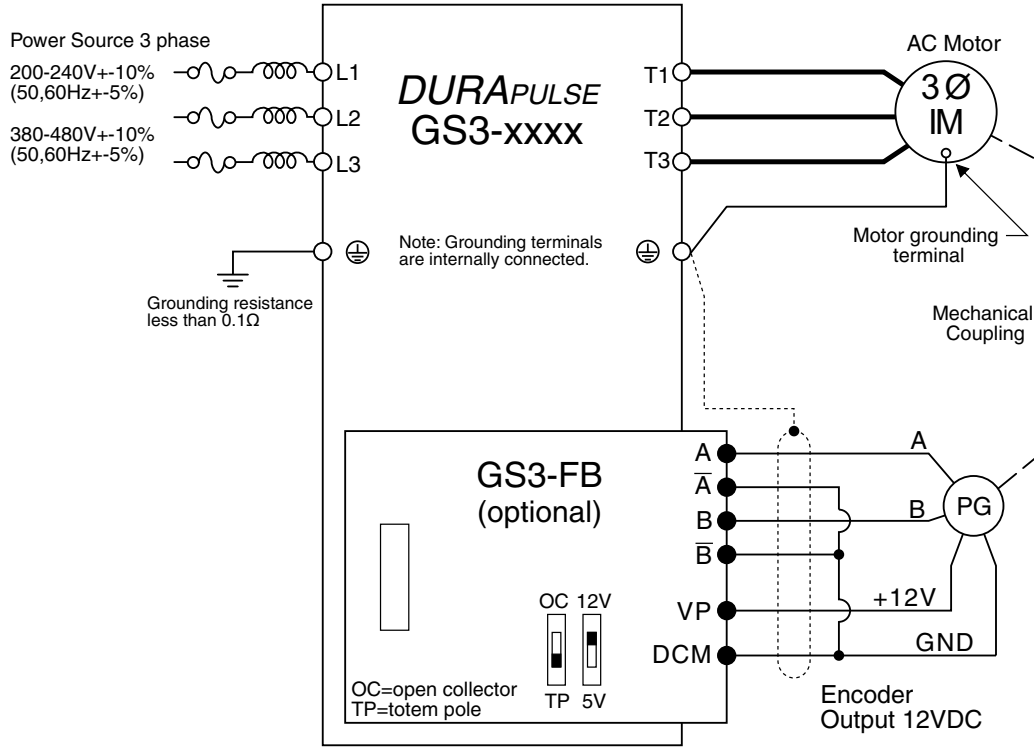
○ Main circuit (power) terminals ● Control circuit terminal ⊕ Shielded leads

GS3-FB BASIC WIRING DIAGRAM – LINE DRIVER TYPE ENCODER WITH RPM METER



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

GS3-FB BASIC WIRING DIAGRAM – OUTPUT VOLTAGE OR COMPLEMENTARY TYPE ENCODER



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

TYPES OF ENCODERS AND DIP SWITCH SETTINGS

Types of Encoders		Switches SW1 and SW2	
		5V	12V
Output Voltage		OC 12V TP 5V	OC 12V TP 5V
Open Collector		OC 12V TP 5V	OC 12V TP 5V
Line Driver		OC 12V TP 5V	OC 12V TP 5V
Complementary		OC 12V TP 5V	OC 12V TP 5V

ETHERNET INTERFACE GS-EDRV(xxx)

GS-EDRV(xxx) Specifications			
Part Number	Input Voltage	Input Current	Ethernet Communiation
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 DURAPULSE and other GS AC drives.</i>			

GS-EDRV(xxx) Ethernet Interfaces provide low-cost, high-performance Ethernet links between control systems and any DURApulse or other GS-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 ThinknDo 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 DURAPULSE GS3 AC drive from a DirectLOGIC DL06 or D2-260 PLC.

GS-485HD15-CBL-2



PLC Connections for RS-485 Modbus RTU Control of DURAPULSE GS3 Drives					
Drive	PLC * or Device	PLC Port *	Communication	Direct Cable	Length
DURAPULSE (GS3)	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 **	
	FA-ISOCON		RS-485	GS-ISOCON-CBL-2	2m [6.6 ft] ***
	GS-EDRV100		RS-485	GS-EDRV-CBL-2	2m [6.6 ft] ***
	ZL-CDM-RJ12Xxx		RS-485	GS-485RJ12-CBL-2	2m [6.6 ft] ***

* 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 in Ch5 “Modbus Communications”.
 *** 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, including distribution modules for wiring connections to multiple drives. For more information, refer to Ch5 “Modbus Communications” or to www.automationdirect.com/static/specs/fzipselection.pdf.

GS DRIVE CONFIGURATION SOFTWARE

GSoft is the configuration software for the Automation Direct GS family of drives. It is designed to allow you to connect a personal computer to drives in the GS family, 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
- 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.

GSoft includes an integral help file with software instructions.

SYSTEM REQUIREMENTS

GSoft will run on PCs that meet the following requirements:

- Windows 7 (32-bit, 64-bit), 8 (32-bit, 64-bit), 8.1 (32-bit, 64-bit), 10
- Internet Explorer 4.0 or higher (for HTML help support)
- 24 Mb of available memory
- 8Mb hard drive space
- Available RS-232 serial port



GSoft requires use of a configuration cable, GS-232CBL, which is sold separately.

RS-485 communication from an RS-232 PC port requires an FA-ISOCAN or compatible converter, which is sold separately.



MISCELLANEOUS ACCESSORIES

CONFIGURATION CABLE

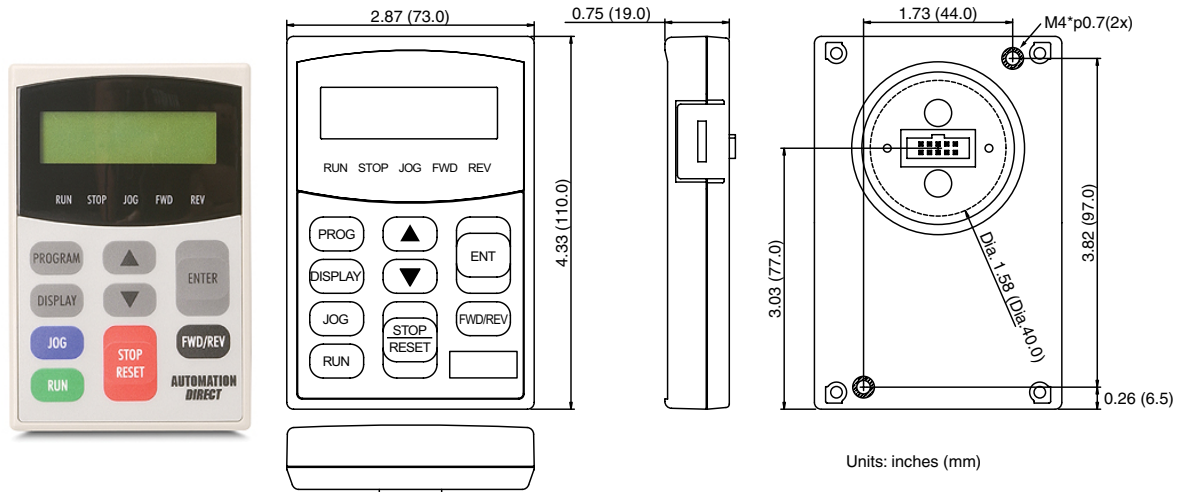
GS-232CBL

Required programming cable for GSOFT software.

SPARE KEYPAD

GS3-KPD

Spare or replacement keypad for *DURAPULSE* GS3 AC drives.



KEYPAD CABLES

GS-CBL2-1L, GS-CBL2-3L, GS-CBL2-5L

GS-CBL2-1L

1 meter keypad cable
(installation screws included)



GS-CBL2-3L

3 meter keypad cable
(installation screws included)



GS-CBL2-5L

5 meter keypad cable
(installation screws included)

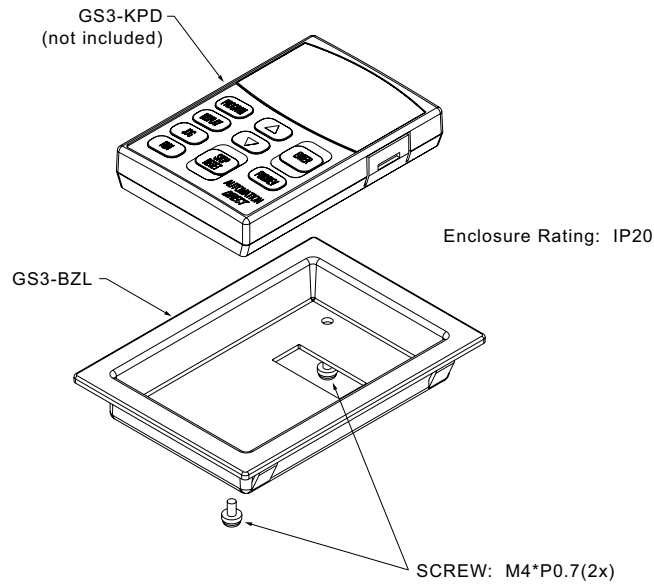


REMOTE PANEL ADAPTER

GS3-BZL

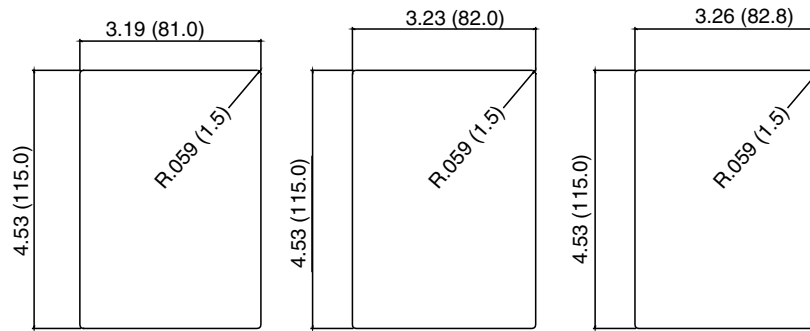
For remote mounting of DURAPULSE GS3 removable keypad.

Mounting Instructions



The thickness of the panel will determine required screw hole dimensions:

t = .0393 (1.0) - .0551 (1.4) t = .629 (1.6) - .0787 (2.0) t = .0866 (2.2) - .1181 (3.0)

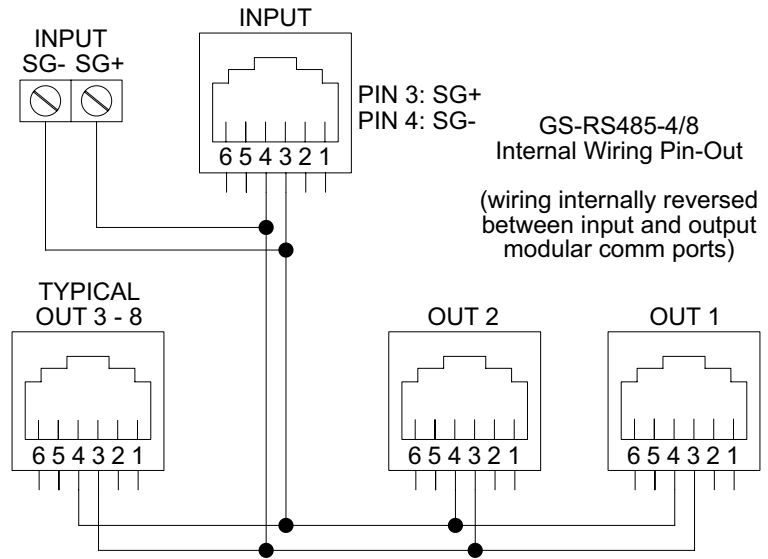


Units: inches(mm)

COMMUNICATION DISTRIBUTION BLOCKS – LEGACY GS SERIES

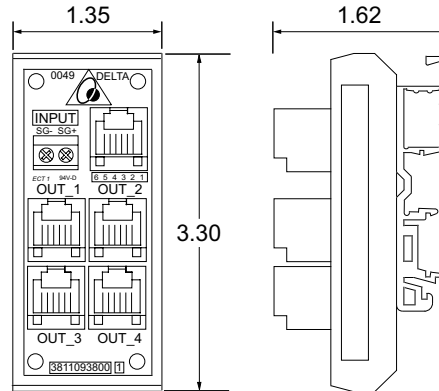
(Do not use for new installations. For new installations, please consider AutomationDirect ZIPLink ZL-CDM-RJ12Xxx distribution modules.)

Using the RS-485 communication board (GS-RS485-4 or GS-RS485-8) provides an easy means to break out the RS-485 signal to several drives at one location. This is a star configuration, but the transmission errors are negligible, so this configuration is acceptable for proper operation of the VFDs.



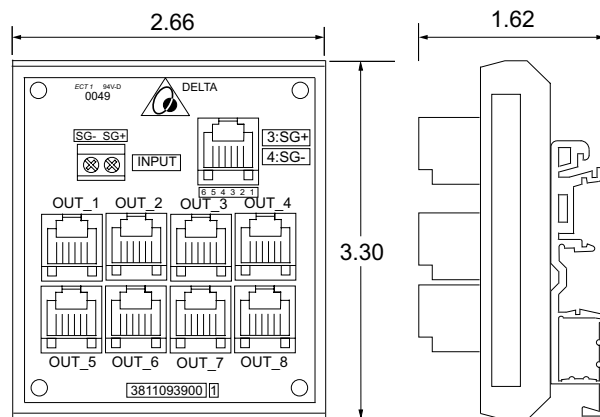
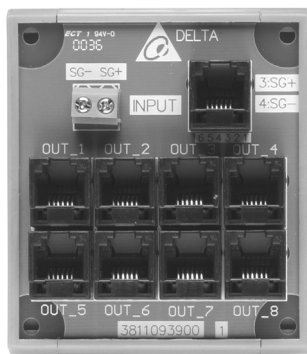
GS-RS485-4

4-port RS485 Communication Distribution Board



GS-RS485-8

8-port RS485 Communication Distribution Board



REPLACEMENT ACCESSORIES – COOLING FANS

All DURAPULSE GS3 AC drives have built-in cooling fans, and replacement fans are also available. These fans are direct replacements for the internal factory-installed fans.



Installation instructions are included with the fans.



FAN REPLACEMENT SHOULD ONLY BE PERFORMED BY PERSONNEL SKILLED IN THE DISASSEMBLY AND REPAIR OF VARIABLE FREQUENCY AC DRIVES.

Replacement Fans for DURAPULSE (GS3 Series) AC Drives				
Part Number ⁽¹⁾	Specifications ⁽²⁾	Fans / Drive ⁽³⁾	GS3 Drive Model ⁽⁴⁾	Drive V / HP
GS-FAN-1	50 mm, 12 VDC, 0.25A	1	GS3-43P0	460 / 3
GS-FAN-2	60 mm, 12 VDC, 0.25A	1	GS3-23P0 GS3-25P0 GS3-45P0	230 / 3 230 / 5 460 / 5
GS-FAN-3	80 mm, 12 VDC, 0.42A	2	GS3-27P5 GS3-2010 GS3-2015 GS3-47P5 GS3-4010 GS3-4015	230 / 7.5 230 / 10 230 / 15 460 / 7.5 460 / 10 460 / 15
GS-FAN-4	92 mm, 24 VDC, 0.30A	2	GS3-2020 GS3-2025 GS3-2030 GS3-4020 GS3-4025 GS3-4030	230 / 20 230 / 25 230 / 30 460 / 20 460 / 25 460 / 30
GS-FAN-5	120 mm, 24 VDC, 1.2A	2	GS3-2040 GS3-2050 GS3-4040 GS3-4050 GS3-4060 GS3-4075 GS3-4100	230 / 40 230 / 50 460 / 40 460 / 50 460 / 60 460 / 75 460 / 100
<p>1) One fan per part number. Includes connectorized electrical cable and installation instructions.</p> <p>2) Fans are replacements for the internal fans in GS3 drives, are dimensionally and electrically equivalent to the originals, and are not intended for other use. Fan electrical loading is included in the input amperage ratings of the drives, and DC voltage is internally provided by the drives.</p> <p>3) Some drives require multiple fans.</p> <p>4) Can be used only with applicable DURAPULSE GS3 AC Drive.</p>				

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USING DURAPULSE GS3 AC DRIVES WITH AUTOMATIONDIRECT PLCs



APPENDIX

B

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COMPATIBLE AUTOMATIONDIRECT PLCs AND MODULES

The following tables show which AutomationDirect PLCs and modules can be used with the GS3-Series DURAPULSE AC Drive.

AutomationDirect PLC Modules for Use with DURAPULSE GS3 AC Drives	
CLICK PLCs *	
C0-00DD1-D	CLICK CPU, 8 <u>DC in</u> / 6 <u>sinking DC out</u> ; requires 24 VDC power supply; RS-232C Modbus/ASCII comm port. Discrete Inputs: 8 DC inputs, 24 VDC sink/source, 2 isolated commons. Discrete Outputs: 6 DC outputs, 5-27 VDC sinking, 0.1A/pt, 2 isolated commons.
C0-00DD2-D	CLICK PLC CPU, 8 <u>DC in</u> / 6 <u>sourcing DC out</u> ; requires 24 VDC power supply; RS-232C Modbus/ASCII comm port, 3-wire RS-485 Modbus/ASCII comm port. Discrete Inputs: 8 DC inputs, 24 VDC sink/source, 2 common. Discrete Outputs: 6 DC outputs, 24 VDC sourcing, 0.1A/point, 2 common.
C0-00DR-D	CLICK PLC CPU, 8 <u>DC in</u> / 6 <u>relay out</u> ; requires 24VDC power supply; 8k steps program memory; 6.4k words data memory; RS-232C Modbus/ASCII comm port. Discrete Inputs: 8 DC inputs, 24VDC sink/source, 2 common. Discrete Outputs: 6 relay outputs, 6-240 VAC / 6-27 VDC Form A (SPST) relays, 1.0A/point, 1 common.
C0-02DD1-D	CLICK CPU, 4 <u>DC in</u> / 4 <u>sinking DC out</u> ; 2 channels <u>analog in</u> / 2 channels <u>analog out</u> (current/voltage selectable); requires 24 VDC power supply; RS-232C Modbus/ASCII comm port, 3-wire RS-485 Modbus/ASCII comm port. Discrete Inputs: 4 DC inputs, 5-27 VDC sink/source, 1 common. Discrete Outputs: 4 DC outputs, 24 VDC sinking, 0.1A/point, 1 common. Analog Inputs: 2 channels 4-20 mA or 0-5 VDC. Analog Outputs: 2 channels 4-20 mA or 0-5 VDC.
C0-02DD2-D	CLICK PLC CPU, 4 <u>DC in</u> / 4 <u>sourcing DC out</u> , 2 channels <u>analog in</u> / 2 channels <u>analog out</u> (current / voltage selectable); requires 24 VDC power supply; RS-232C Modbus/ASCII comm port, 3-wire RS-485 Modbus/ASCII comm port. Discrete Inputs: 4 DC inputs, 24 VDC sink/source, 1 common. Discrete Outputs: 4 DC outputs, 24 VDC sourcing, 0.1A/point, 1 common. Analog Inputs: 2 channels 4-20 mA or 0-5 VDC. Analog Outputs: 2 channels 4-20 mA or 0-5 VDC.
C0-02DR-D	CLICK PLC CPU, 4 <u>DC in</u> / 4 <u>relay out</u> , 2 channels <u>analog in</u> / 2 channels <u>analog out</u> (current / voltage selectable); requires 24 VDC power supply; RS-232C Modbus/ASCII comm port, 3-wire RS-485 Modbus/ASCII comm port. Discrete Inputs: 4 DC inputs, 24 VDC sink/source, 1 common. Discrete Outputs: 4 relay outputs, 6-240 VAC / 6-27 VDC Form A (SPST) relays, 1.0A/point, 1 common. Analog Inputs: 2 channels 4-20 mA or 0-5 VDC. Analog Outputs: 2 channels 4-20 mA or 0-5 VDC.
CLICK DC Input Modules	
C0-08ND3	8-point 12-24 VDC current sinking/sourcing <u>input</u> module; 2 isolated commons.
C0-16ND3	16-point 24VDC current sinking/sourcing <u>input</u> module; 4 isolated commons.
CLICK DC Output Modules	
C0-08TD1	8-point 3.3-27 VDC current <u>sinking output</u> module, 2 isolated commons, 0.3A/point.
C0-08TD2	8-point 12-24 VDC current <u>sourcing output</u> module; 1 isolated common, 0.3A/point.
C0-16TD1	16-point 5-27 VDC current <u>sinking output</u> module, 2 isolated commons, 0.1A/point.
C0-16TD2	16-point 12-24 VDC current <u>sourcing output</u> module; 2 isolated commons, 0.1A/point.
DL05 PLCs *	
D0-05AR	DL05 CPU, 8 AC in / 6 Relay out, 110/220VAC Power Supply. Inputs: 8 AC inputs, 90-120 VAC, 2 isolated commons. Outputs: 6 Relay outputs, 6-27 VDC, 6-240 VAC, 2A/pt. max., 2 isolated commons
D0-05DR	DL05 CPU, 8 DC in / 6 Relay out, 110/220VAC Power Supply. Inputs: 8 DC inputs, 12-24 VDC current sinking/sourcing, 2 isolated commons. Outputs: 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. Inputs: 8 DC inputs, 12-24 VDC current sinking/sourcing, 2 isolated commons. Outputs: 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. Inputs: 8 DC inputs, 12-24 VDC current sinking/sourcing, 2 isolated commons. Outputs: 6 DC outputs, 6-27 VDC current sinking, 1.0A/pt. max.
D0-05DR-D	DL05 CPU, 8 DC in / 6 Relay out, 12/24VDC Power Supply. Inputs: 8 DC inputs, 12-24 VDC current sinking/sourcing, 2 isolated commons. Outputs: 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 GS3/DURApulse drives. Refer to "Typical Connections..." section to determine specifically which I/O are compatible.	
(table continued next page)	

AutomationDirect PLC Modules for Use with DURAPULSE GS3 AC Drives (continued from previous page)	
DL06 PLCs *	
D0-06DD1	DL06 CPU, 20 DC in / 16 DC out, 110/220VAC Power Supply, with 0.3A 24VDC Auxiliary Device Power Supply. Inputs: 20 DC inputs, 12-24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). Outputs: 16 DC outputs, 12-24 VDC current sinking, 1.0A/pt. max., 4 commons non-isolated (4 points per common)
D0-06DD2	DL06 CPU, 20 DC in / 16 DC out, 110/220VAC power supply, with 0.3A 24VDC auxiliary device power supply. Inputs: 20 DC inputs, 12-24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). Outputs: 16 DC outputs, 12-24 VDC current sourcing 1.0A/pt. max., 4 commons non-isolated (4 points per common).
D0-06DR	DL06 CPU, 20 DC in / 16 Relay out, 110/220VAC Power Supply, with 0.3A 24VDC Auxiliary Device Power Supply. Inputs: 20 DC inputs, 12-24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). Outputs: 16 Relay outputs, 6-27 VDC, 6-240 VAC, 2A/pt. max., 4 isolated commons (4 points per common)
D0-06AR	DL06 CPU, 16 AC in / 20 Relay out, 110/220VAC power supply, with 0.3A 24VDC auxiliary device power supply. Inputs: 20 AC inputs, 90-120 VAC, 5 isolated commons (4 inputs per common). Outputs: 16 Relay outputs, 6-27 VDC, 6-240 VAC, 2A/pt. max., 4 isolated commons (4 points per common)
D0-06DD1-D	DL06 CPU, 20 DC in / 16 DC out, 12/24VDC Power Supply. Inputs: 20 DC inputs, 12-24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). Outputs: 16 DC outputs, 12-24 VDC current sinking, 1.0A/pt. max., 4 commons non-isolated (4 points per common).
D0-06DD2-D	DL06 CPU, 20 DC in / 16 DC out, 12/24VDC power supply. Inputs: 20 DC inputs, 12-24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). Outputs: 16 DC outputs, 12-24 VDC current sourcing, 1.0A/pt. max., 4 commons non-isolated (4 points per common).
D0-06DR-D	DL06 CPU, 20 DC in / 16 Relay out, 110/220VAC Power Supply. Inputs: 20 DC inputs, 12-24 VDC current sinking/sourcing, 5 isolated commons (4 inputs per common). Outputs: 16 Relay outputs, 6-27 VDC, 6-240 VAC, 2A/pt. max., 4 isolated commons (4 points per common)
DL05/DL06 DC Input/Output Modules	
D0-08CDD1	4 pt. 12-24VDC current sinking/sourcing input, 1 common, 4 pt. 12-24VDC sinking output, 0.3A/point, 1.2A/module, removable terminal, no fuse
DL05/DL06 DC Output Modules	
D0-10TD1	10 pt. 12-24 VDC current sinking output module, 2 commons non-isolated (5 pts. per common), 0.3A/point, 1.5A/common, removable terminal, no fuse
D0-10TD2	10 pt. 12-24 VDC current sourcing output 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 output module, 2 commons non-isolated (5 pts. per common), 0.3A/point, 1.5A/common, removable terminal, no fuse
D0-16TD2	16 pt. 12-24 VDC current sourcing output module, 2 commons non-isolated (5 pts. per common), 0.3A/point, 1.5A/common, removable terminal, no fuse. One pre-wired Ziplink cable (0.5 meter) and terminal block connector module required for this I/O module
DL05/DL06 Analog Modules	
F0-04DAH-1	4 channel current analog output module; 4-20 mA; 16-bit resolution
F0-04DAH-2	4 channel voltage analog output module; 0-10V; 16-bit resolution
F0-08DAH-1	8 channel current analog output module; 4-20 mA; 16-bit resolution
F0-08DAH-2	8 channel voltage analog output module; 0-10V; 16-bit resolution
F0-2AD2DA-2	2 channel in, 2 channel out voltage analog option card; 0-5V, 0-10V
F0-4AD2DA-1	4 channel in, 2 channel sourcing out current analog option card; 4-20mA
F0-4AD2DA-2	4 channel in, 2 channel out voltage analog option card; 0-5V, 0-10V
* "Brick" PLCs may contain some I/O that are not compatible with GS3/DURApulse drives. Refer to "Typical Connections..." section to determine specifically which I/O are compatible.	
(table continued next page)	

AutomationDirect PLC Modules for Use with DURAPULSE GS3 AC Drives (continued from previous page)	
DL105 PLCs *	
F1-130DR	DL130 CPU, 10 DC in / 8 Relay out, 110/220VAC Power Supply. Inputs: 10 DC inputs, 12-24 VDC current sinking/sourcing, 3 isolated commons. Outputs: 8 relay outputs, 12-30 VDC, 12-250VAC, 7A/pt. max., 4 isolated commons
F1-130DD	DL130 CPU, 10 DC in / 8 DC out, 110/220VAC Power Supply. Inputs: 10 DC inputs, 12-24 VDC current sinking/sourcing, 3 isolated commons. Outputs: 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. Inputs: 10 DC inputs, 12-24 VDC current sinking/sourcing, 3 isolated commons. Outputs: 8 relay outputs, 12-30 VDC, 12-250VAC, 7A/pt. max., 4 isolated commons
F1-130DD-D	DL130 CPU, 10 DC in / 8 DC out, 12/24VDC Power Supply. Inputs: 10 DC inputs, 12-24 VDC current sinking/sourcing, 3 isolated commons. Outputs: 8 DC outputs, 5-30VDC current sinking, 0.5A/pt. max, 3 internally connected commons
DL205 DC Input/Output Modules	
D2-08CDR	4 pt. 24VDC sinking/sourcing input, 1 common, 4 pt. relay output, 1A/pt., 4A/module, 1 common, replaceable fuse
DL205 DC Output Modules	
D2-08TD1	8 pt. 12-24 VDC current sinking output module, 1 common (2 common terminals), 0.3A/point, 2.4A/module, fused per common (non-replaceable), removable terminal
D2-08TD2	8 pt. 12-24 VDC current sourcing output module, 1 common (2 common terminals), 0.3A/point, 2.4A/module, fused per common (non-replaceable), removable terminal
D2-16TD1-2	16 pt. 12-24 VDC current sinking output module, 1 common (2 common terminals), 0.1A/point, 1.6A/module, no fuse, European type removable terminal
D2-16TD2-2	16 pt. 12-24 VDC current sourcing output 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 output module. 1 common (4 common terminals), 0.1A/point, 3.2A/module, no fuse
D2-32TD2	32 pt. 12-24 VDC current sourcing output module, 4 commons (isolated), 0.1A/point, 3.2A/module, no fuse. Requires one connector, sold separately. NOTE: Recommended pre-wired Ziplink connector cable for this I/O Module is part number ZL-4CBL4#; where # designates either 0.5, 1, or 2 meter cable lengths. Accessory cable connector module for ZL-4CBL4# cable is part number ZL-CM40. (Or build a custom cable with D4-IO3264R, D4-IO3264S or D4-IOCBL-1.)
DL205 Relay Output Modules	
D2-04TRS	4-pt. 5-30 VDC or 5-240 VAC isolated relay output 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 output 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 output, 10A/common, 5-30VDC or 5-240VAC
F2-08TRS	8-pt. 12-28 VDC or 12-240 VAC output 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 output module, 12 Form A (SPST) relays, 2 commons, 1.5A/point max., 3.0A/common, 2 replaceable fuses, removable terminal
DL205 Analog Output Module	
F2-02DAS-1	2 channel, 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 output, 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 output module, 12 bit resolution, range: 4-20mA, sink or source output configurable. Designed to operate with 24 VDC user-supplied power supply.
F2-02DA-2	2 channel analog output 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.
F2-08DA-2	8 channel analog output module, 12 bit resolution, ranges: 0-5V, 0-10V. Designed to operate with 24 VDC user-supplied power supply.
* "Brick" PLCs may contain some I/O that are not compatible with GS3/DURApulse drives. Refer to "Typical Connections..." section to determine specifically which I/O are compatible.	
(table continued next page)	

AutomationDirect PLC Modules for Use with DURAPULSE GS3 AC Drives (continued from previous page)	
DL205 Analog Input Modules	
F2-04AD-2	4 channel, 12-bit, 0-5V, 0-10V, -5 to +5V, -10 to +10V. Designed to operate with a 24VDC user supplied power supply
F2-08AD-2	8 channel, 12-bit, 0-5V, 0-10V, -5 to +5V, -10 to +10V. Designed to operate with a 24VDC user supplied power supply
DL205 Analog Combination Modules	
F2-8AD4DA-1	8 channel, 16-bit, 0-20mA in; 4 channel, 16-bit, 4-20mA out. Designed to operate with a 24VDC user supplied power supply.
F2-8AD4DA-2	8 channel, 16-bit, 0-5V, 0-10V in; 4 channel, 16-bit, 0-5V, 0-10V out. Designed to operate with a 24VDC user supplied power supply.
DL305 Relay Output Modules	
D3-08TR	8-pt. 5-30VDC or 5-220VAC output 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. 5-30VDC or 5-220VAC output module, 2A/point, 16 Form A relays (SPST), 2 commons (isolated), removable terminal, no internal fuses
DL305 Analog Input Modules	
F3-04ADS	4-channel isolated analog input module, 12-bit resolution, ranges: 0-5V, 0-10V, 1-5V, -5V to +5V, -10V to +10V, 0-20mA, 4-20mA. -750 to +750 VDC channel-to-channel isolation.
F3-16AD	16-channel analog input module, 12-bit resolution, ranges: -5 to +5V, -10 to +10V, 0 to 10V, 0 to 20mA. Each point can be either a voltage or current input.
DL305 Analog Output Modules	
F3-04DAS	4-channel isolated analog output module, 12-bit resolution, ranges: 0-5V, 0-10V, -5 to +5V, -10 to +10V, 4-20mA, 0-20mA. -750 to +750 VDC channel-to-channel isolation.
DL405 DC Output Modules	
D4-08TD1	8-pt. 12-24VDC current sinking output module, 2 commons (internally connected), 2A/point, 5A/common, removable terminal
D4-16TD1	16-pt. 5-24VDC current sinking output module, 2 commons (internally connected), 0.5A/point, 3A/common, removable terminal
D4-16TD2	16-pt. 12-24VDC current sourcing output module, 2 commons (isolated), 0.5A/point, 3A/common, removable terminal
D4-32TD1	32-pt. 5-24VDC current sinking output module, 4 commons (isolated), 0.2A/point, 1.6A/common. Requires one connector, sold separately.
D4-32TD2	32-pt. 12-24VDC current sourcing output module, 4 commons (isolated), 0.2A/point, 1A/common. Requires one connector, sold separately.
DL405 Relay Output Modules	
D4-08TR	8-pt. 5-30VDC or 5-250VAC output module, 8 Form A (SPST) relays, 2 commons (isolated), 2A/point, 5A/common, removable terminal
F4-08TRS-1	8-pt. 12-30VDC or 12-250VAC isolated output 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. 12-30VDC or 12-250VAC isolated output 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. 5-30VDC or 5-250VAC output module, 8 Form A (SPST) relays, 2 commons (isolated), 1A/point, 5A/common, removable terminals
DL405 Analog Input Modules	
F4-04ADS	4-channel isolated analog input module, 12-bit resolution, ranges: 0-5V, 0-10V, 1-5V, -5V to +5V, -10V to +10V, 0-20mA, 4-20mA
F4-08AD	8-channel analog input module, 12-bit resolution, ranges: 4 to 20mA, 1 to 5V, 0 to 20mA, 0 to 5V, 0 to 10V, -5V to +5V, -10V to +10V
F4-16AD-2	16-channel analog input module, 12-bit resolution, ranges: 0-5V, 0-10V
DL405 Analog Output Modules	
F4-04DAS-1	4-channel analog output module, 16-bit resolution, isolated, range: 4 to 20mA current sourcing
F4-04DAS-2	4-channel analog output module, 16-bit resolution, isolated, range: 0-5V, 0-10V
F4-08DA-2	8-channel analog output module, 12-bit resolution, range: 0-5V or 0-10V
F4-16DA-2	16-channel analog output module, 12-bit resolution, range: 0-5V or 0-10V
* "Brick" PLCs may contain some I/O that are not compatible with GS3/DURApulse drives. Refer to "Typical Connections..." section to determine specifically which I/O are compatible.	
(table continued next page)	

AutomationDirect PLC Modules for Use with DURAPULSE GS3 AC Drives (continued from previous page)	
Terminator I/O DC Output Modules	
T1K-08TD1	8 pt. 12-24 VDC current sinking output 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-08TD2-1	8 pt. 12-24 VDC current sourcing output module, 4pts/common, 1.0A/point, 2 replaceable fuses. (Use with T1K-08B or T1K-08B1 terminal base.)
T1K-16TD1	16 pt. 12-24 VDC current sinking output module, 4 points per common, 1.0A/point, 4 replaceable fuses (T1K-FUSE-1). (Use with T1K-16B or T1K-16B-1 terminal base.)
T1K-16TD2-1	16 pt. 12-24 VDC current sourcing output module, 4pts/common, 1.0A/point, 4 replaceable fuses. (Use with T1K-16B or T1K-16B-1 terminal base.) Note: Replaces T1K-16TD2 with improved derating. Not a direct replacement; simple device wiring change if used as replacement part for T1K-16TD2.
Terminator I/O Relay Output Modules	
T1K-08TR	8 pt. 5-30 VDC or 5-240 VAC output 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 output 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 output 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 Input Modules	
T1F-08AD-2	8 channel analog input module, 14 bit resolution (13 bit plus sign bit), range: 0-5VDC, 0-10VDC, +/-5VDC, +/-10VDC. (Use with T1K-08B or T1K-08B-1 terminal base.)
T1F-16AD-2	16 channel analog input module, 14 bit resolution (13 bit plus sign bit), range: 0-5VDC, 0-10VDC, +/-5VDC, +/-10VDC. (Use with T1K-16B or T1K-16B-1 terminal base.)
Terminator I/O Analog Output Modules	
T1F-08DA-1	8 channel analog output, 12 bit resolution, range: 0-20mA, 4-20mA. (Use with T1K-08B or T1K-08B-1 terminal base.)
T1F-08DA-2	8 channel analog output, 12 bit resolution, range: 0-5VDC, 0-10VDC, +/-5VDC, +/-10VDC. (Use with T1K-08B or T1K-08B-1 terminal base.)
T1F-16DA-1	16 channel analog output, 12 bit resolution, range: 0-20mA, 4-20mA. (Use with T1K-16B or T1K-16B-1 terminal base.)
T1F-16DA-2	16 channel analog output, 12 bit resolution, range: 1-5VDC, 1-10VDC, +/-5VDC, +/-10VDC. (Use with T1K-16B or T1K-16B-1 terminal base.)
Terminator I/O Analog Input/Output Modules	
T1F-8AD4DA-1	8 channel analog input module and 4 channel analog output module. Inputs: 14 bit resolution (13 bit plus sign bit), range: -20 to 20mA, 0-20mA, 4-20mA. Outputs: 12 bit resolution, range: 4-20mA, sinking or sourcing compatible. (Use with T1K-08B or T1K-08B-1 terminal base.)
T1F-8AD4DA-2	8 channel analog input module and 4 channel analog output module. Inputs: 14 bit resolution (13 bit plus sign bit), range: 0-5VDC, 0-10VDC, +/-5VDC, +/-10VDC. Outputs: 12 bit resolution, range: 0-5VDC, 0-10VDC, +/-5VDC, +/-10VDC. (Use with T1K-08B or T1K-08B-1 terminal base.)

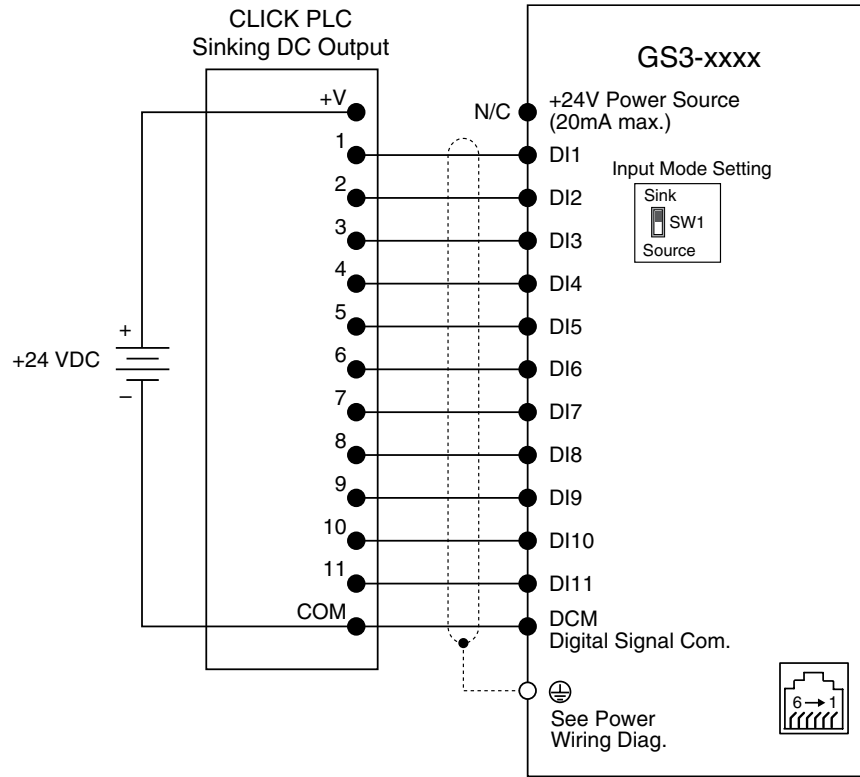
TYPICAL PLC CONNECTIONS TO DURAPULSE GS3 AC DRIVES

The following drawings show some typical connections between DURAPULSE GS3 AC Drives and AutomationDirect PLCs and modules.

CLICK PLC AND SINKING DC OUTPUT MODULES

- C0-00-DD1-D
- C0-02-DD1-D
- C0-08-TD1
- C0-16-TD1

DC VOLTAGE SUPPLIED FROM PLC OR EXTERNAL SOURCE:



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



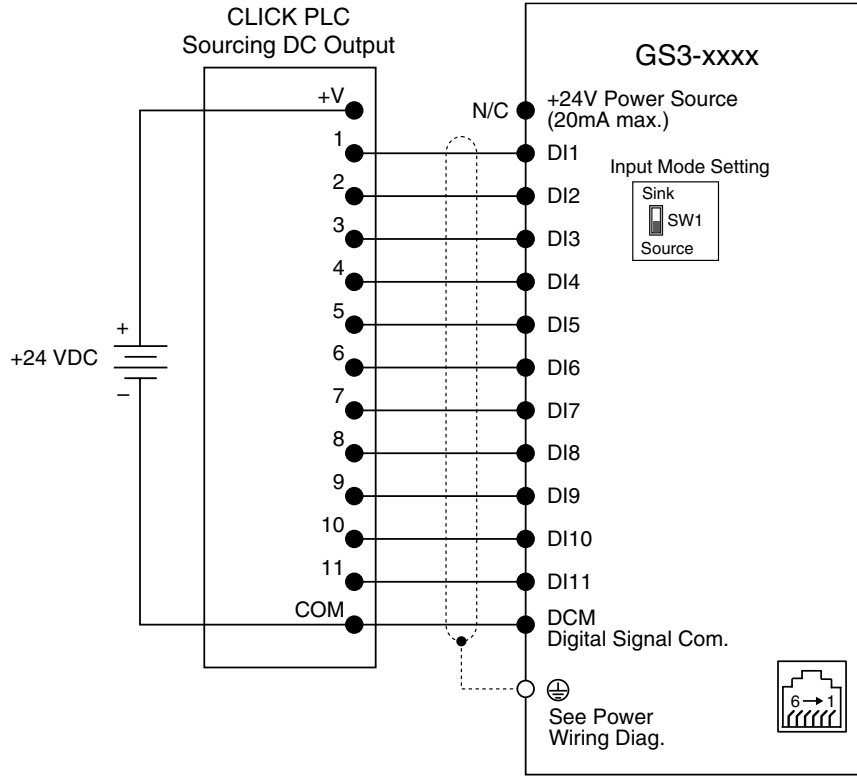
Mode switch SW1 needs to be set to the "Sink" position when connecting to a "sinking" output module.

TYPICAL PLC CONNECTIONS TO DURAPULSE GS3 AC DRIVES (CONTINUED FROM PREVIOUS PAGE)

CLICK PLC AND SOURCING DC OUTPUT MODULES

- C0-00DD2-D
- C0-02DD2-D
- C0-08TD2
- C0-16TD2

DC VOLTAGE SUPPLIED FROM PLC OR EXTERNAL SOURCE:



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

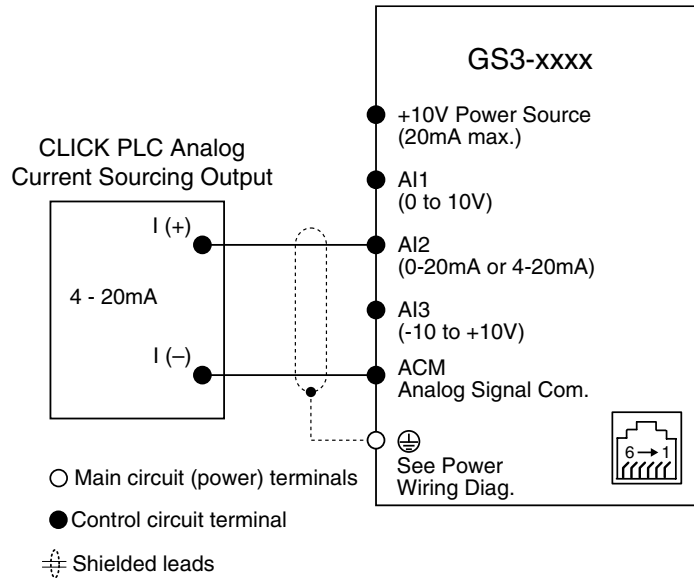


Mode switch SW1 needs to be set to the “Source” position when connecting to a “sourcing” output module.

TYPICAL PLC CONNECTIONS TO DURAPULSE GS3 AC DRIVES (CONTINUED FROM PREVIOUS PAGE)

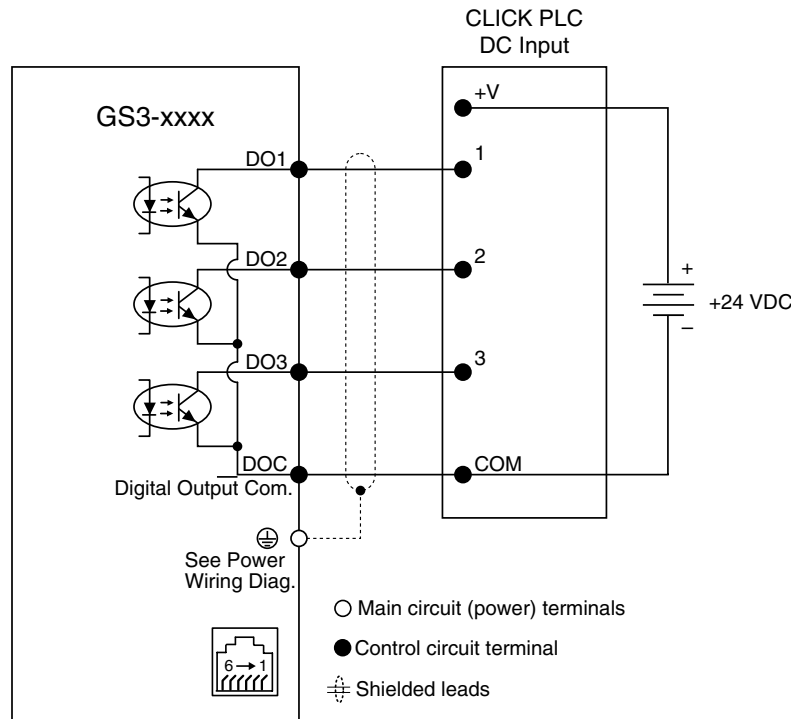
CLICK PLC SOURCING ANALOG CURRENT OUTPUT MODULES

- C0-02DD1-D
- C0-02DD2-D
- C0-02DR-D



CLICK PLC DC INPUT MODULES

- C0-00DD1-D
- C0-02DD1-D
- C0-08ND3
- C0-00DD2-D
- C0-02DD2-D
- C0-16ND3
- C0-00DR-D
- C0-02DR-D



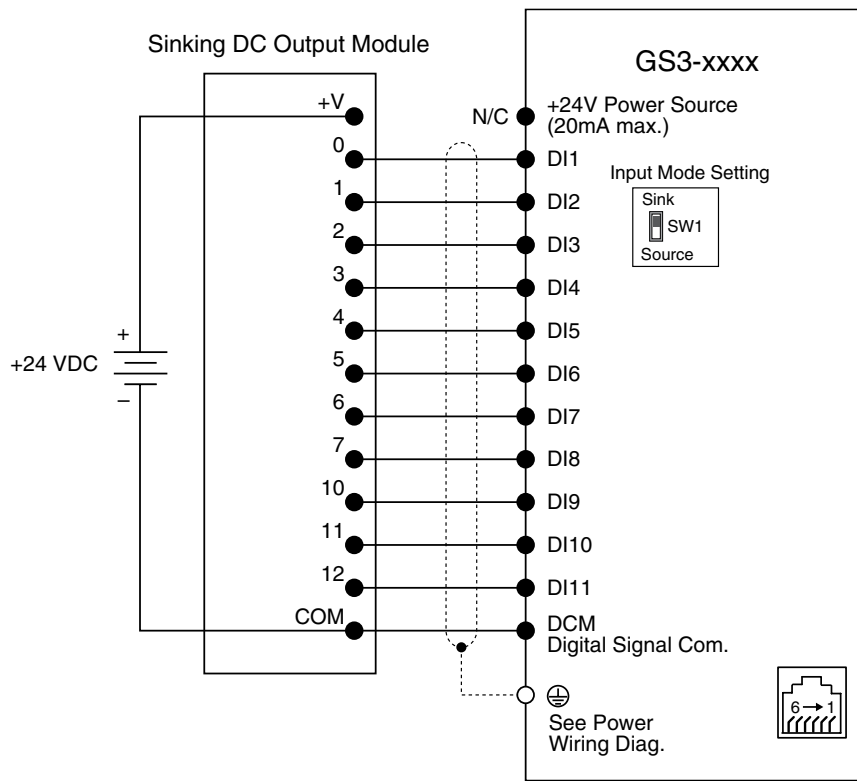
TYPICAL PLC CONNECTIONS TO DURAPULSE GS3 AC DRIVES (CONTINUED FROM PREVIOUS PAGE)

The following drawings show some typical connections between DURAPULSE GS3 AC Drives and DirectLOGIC PLCs and modules.

DIRECTLOGIC SINKING DC OUTPUT MODULES

- D0-05DD
- D0-05DD-D
- D0-06DD1
- D0-06DD1-D
- D0-08CDD1
- D0-10TD1
- D0-16TD1
- F1-130DD
- F1-130DD-D
- D2-08TD1
- D2-16TD1-2
- D2-32TD1
- D4-08TD1
- D4-16TD1
- D4-32TD1
- T1K-08TD1
- T1K-16TD1

DC VOLTAGE SUPPLIED FROM PLC OR EXTERNAL SOURCE:



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



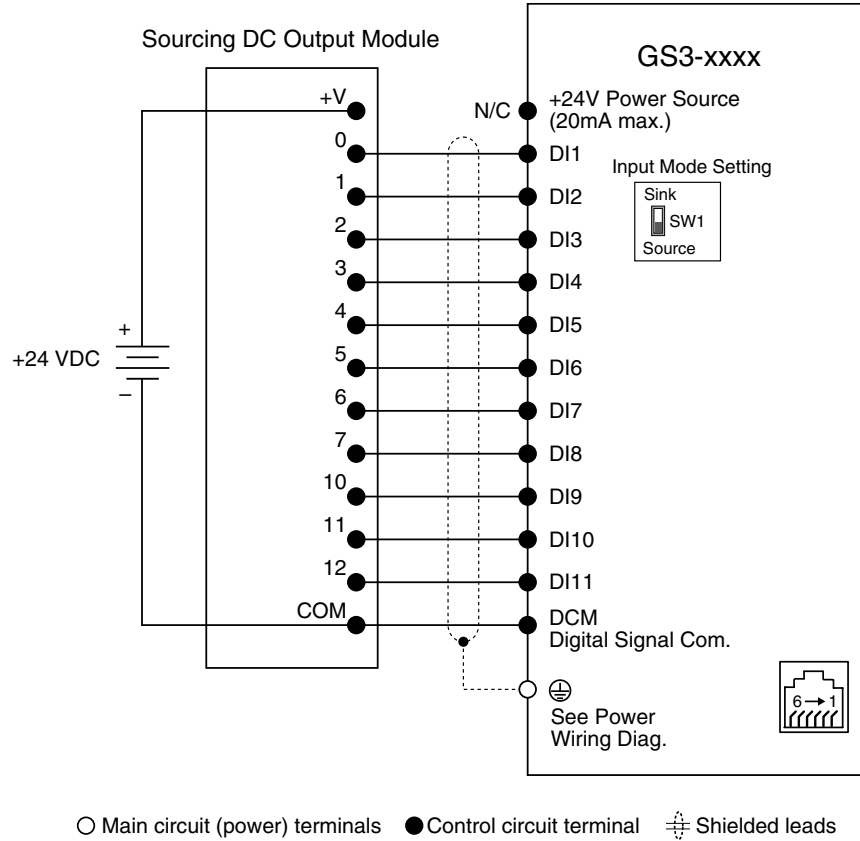
Mode switch SW1 needs to be set to the “Sink” position when connecting to a “sinking” output module.

TYPICAL PLC CONNECTIONS TO DURAPULSE GS3 AC DRIVES (CONTINUED FROM PREVIOUS PAGE)

DIRECTLOGIC SOURCING DC OUTPUT MODULES

- D0-06DD2
- D0-06DD2-D
- D0-10TD2
- D0-16TD2
- D2-08TD2
- D2-16TD2-2
- D2-32TD2
- D4-08TD2
- D4-16TD2
- D4-32TD2
- T1K-08TD2-1
- T1K-16TD2-1

DC VOLTAGE SUPPLIED FROM PLC OR EXTERNAL SOURCE:



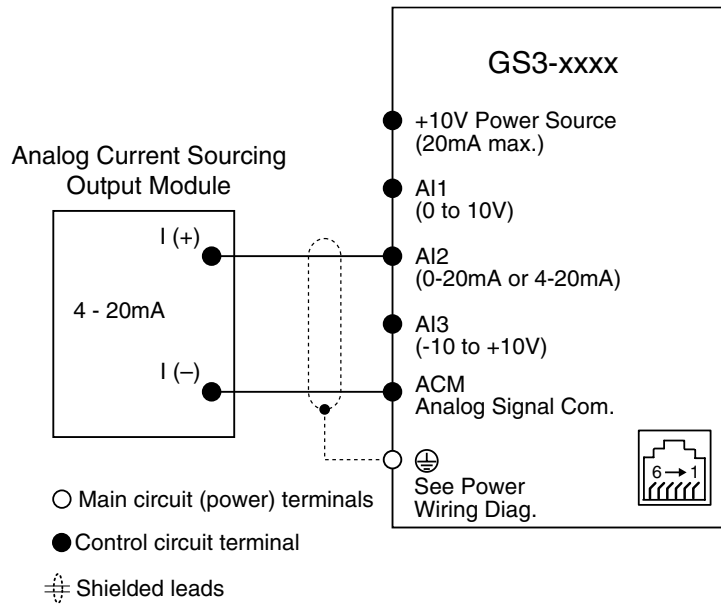
Mode switch SW1 needs to be set to the “Source” position when connecting to a “sourcing” output module.

TYPICAL PLC CONNECTIONS TO DURAPULSE GS3 AC DRIVES (CONTINUED FROM PREVIOUS PAGE)

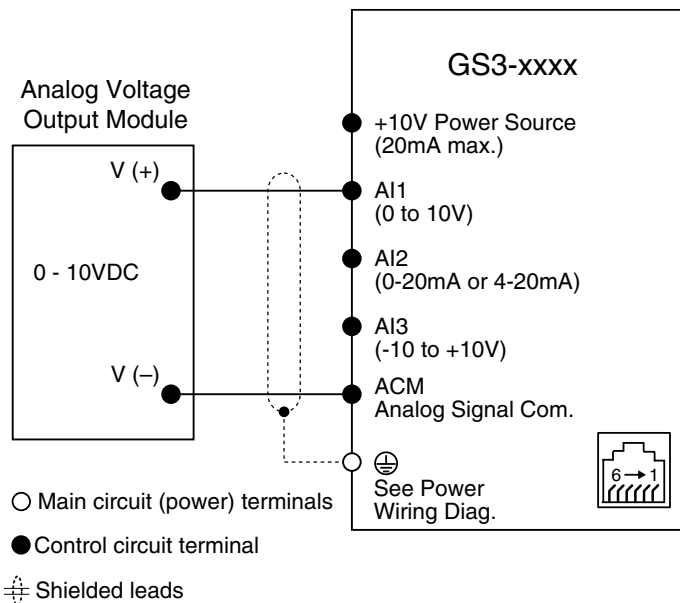
DIRECTLOGIC VOLTAGE OR CURRENT SOURCING ANALOG OUTPUT MODULES

- F0-04DAH-1
- F0-04DAH-2
- F0-08DAH-1
- F0-08DAH-2
- F0-2AD2DA-2
- F0-4AD2DA-1
- F0-4AD2DA-2
- F2-02DAS-1
- F2-02DAS-2
- F2-08DA-1
- F2-02DA-2
- F2-08DA-2
- F2-8AD4DA-1
- F2-8AD4DA-2
- F4-08DA-2
- F4-16DA-2
- F4-04DAS-1
- F4-04DAS-2
- T1F-08DA-2
- T1F-16DA-2
- T1F-8AD4DA-1
- T1F-8AD4DA-2

ANALOG CURRENT SOURCING OUTPUT MODULE

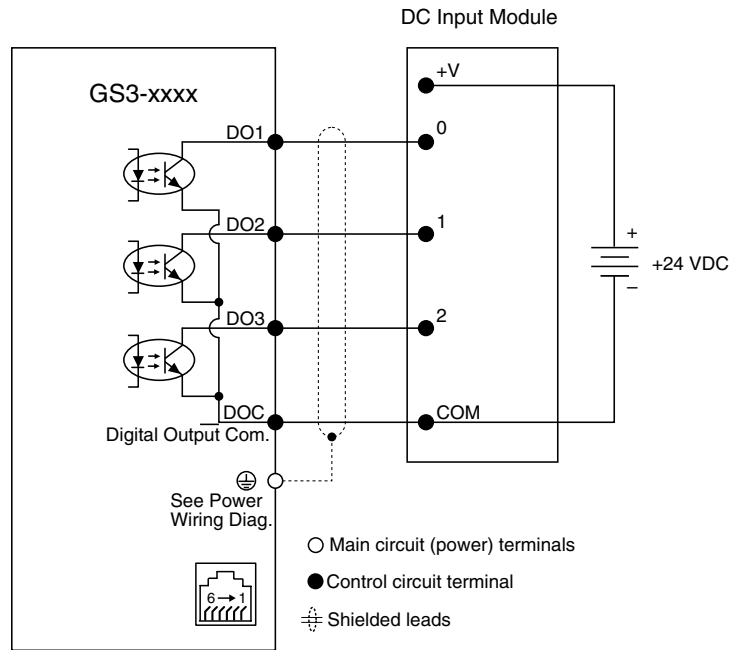


ANALOG VOLTAGE OUTPUT MODULE

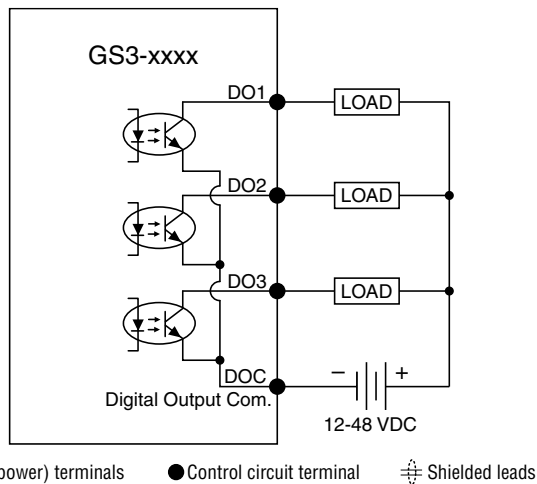


TYPICAL PLC CONNECTIONS TO DURAPULSE GS3 AC DRIVES (CONTINUED FROM PREVIOUS PAGE)

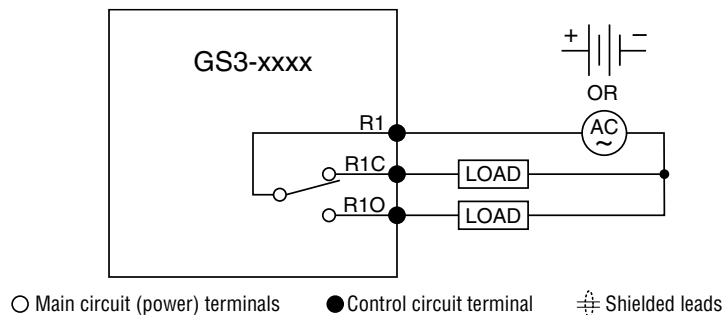
DIRECTLOGIC PLC DC INPUT MODULES



DIGITAL OUTPUT TERMINAL WIRING



RELAY CONTACT OUTPUT TERMINAL WIRING



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