GS series and *DURA*PULSE AC Drives

Section 13
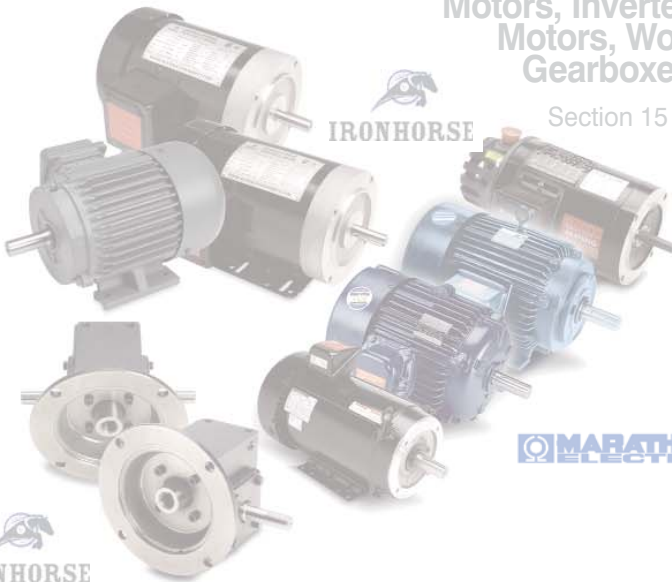
Hitachi AC Drives

Section 14

General Purpose Motors, Inverter Duty Motors, Worm Gearboxes
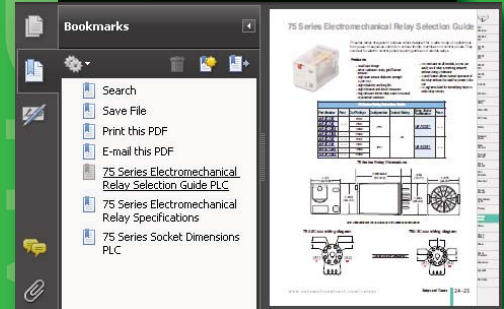
Section 15

IRONHORSE

MARATHON ELECTRIC

IRONHORSE

Steppers and Servos

Section 16

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Order Today, Get it Tomorrow

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GS Series AC Drives

GS1 AC minidrive

¼ and ½ hp, 115 VAC single-phase
¼, ½ and 1 hp, 230 VAC single-phase/3-phase
2 hp, 230 VAC 3-phase

- Simple Volts/Hertz control
- 130% starting torque at 5 Hz
- Electronic overload protection
- Use of integrated potentiometer or keypad for local speed setting
- External analog input (0-10V, 0-20 mA or 4-20 mA)
- Three preset speeds

- Four programmable digital inputs
- One programmable relay output
- RS485 Modbus communications up to 19.2K
- Optional Ethernet communications DIN-rail mountable
- Two-year replacement warranty*
- UL, CUL,CE-listed

GS2 AC microdrive

¼ hp to 1 hp, 115 VAC single-phase
½ hp to 7.5 hp, 230 VAC
1 to 10 hp, 460 VAC
1 to 10 hp, 575 VAC

GSoft configuration software available

http://support.automationdirect.com/products/gsoft.html

- Simple Volts/Hertz control
- 150% starting torque
- Dynamic braking circuit
- Electronic overload protection
- Use of integrated potentiometer or keypad for local speed setting
- External analog input (0-10V, 0-20 mA or 4-20 mA)
- Removable keypad
- Seven preset speeds

- CE Listed (except 575V model)
- Six programmable digital inputs
- Two programmable relay outputs
- PID control
- RS-232/RS-485 Modbus communications up to 38.4K
- Optional Ethernet communications
- Two-year replacement warranty*
- UL, CUL

DuraPulse® Series AC Drives

DURAPULSE AC sensorless vector drives

1 hp to 50 hp, 230 VAC, 3-phase only
1 hp to 100 hp, 460 VAC

The *DURAPULSE* seres is a line of autotuning and sensorless vector control AC drives. All parameters are programmable via a removable keypad that will store up to four different application programs. The PWM output of the drive is controlled by a 16-bit microprocessor with an output frequency from 0.1 to 400 Hz.

- V/Hz or sensorless vector control modes
- 150% starting torque
- Removable keypad
- Three analog inputs - (0-10V, -10 to +10 VDC or 4-20 mA/0 - 20 mA)
- 16 preset speeds
- 11 programmable digital inputs
- Four programmable outputs

- Optional encoder feedback card
- RS-485 Modbus communications up to 38.4K
- Optional Ethernet communications
- Two-year replacement warranty*
- UL, CE listed

*Failures due to misuse or mis-application are not covered.

Hitachi® SJ300 AC flux vector drives

½ hp to 30 hp, 230/460 VAC

- Closed-loop vector**, sensorless vector, or Volts/Hertz control
- 200% starting torque
- Auto-tuning of motor constants
- Dynamic braking circuit -15 hp and smaller
- Electronic overload protection
- Integral speed potentiometer
- External analog input (0-10V, ±10V or 4-20 mA)
  16-stage multispeed presets
- PID control

- Remote keypad operation available
- Electronic line shaft (electronic gearing) with ratio control available**
- RS-232/RS-485 communication with optional SC-OPE3I card

**Requires SJ-FB option card

IronHorse® AC Motors up to 300 hp

High-quality general purpose motors

IRONHORSE

You asked for general purpose motors, so we sourced this high-quality motor line from a manufacturer who has over three decades of solid experience and reliability in the North American motor market.

Choose from 56C, T, and TC-frame motors in a variety of sizes and speed ratings, including 1200, 1800 and 3600 RPM. Complete your motor installation with an IronHorse worm gearbox and STABLE motor base. And all these components are in stock and ready to ship.

Marathon Electric® AC Motors up to 100 hp

Inverter-duty motors matched with drives

MARATHON ELECTRIC

Marathon Electric has over 20 years experience in the design, manufacturing and application of AC variable speed motors, and well over 15,000 hours of laboratory testing in their state-of-the -art facilities. Their expertise in the application of AC drives with induction motors is unsurpassed.

The Marathon Electric motor lines have been carefully selected to be performance-matched with the *DURA*pulse and GS series AC drives. The offering includes models ranging from ¼ hp to 100 hp, that feature dual 230/460 VAC voltages and a base speed of 1,200 or 1,800 RPM.

Worm Gearboxes and Motor Bases for IronHorse and Marathon motors

*Sure*Step®
Stepping Systems

High-performance microstepping drives and high-torque stepping motors

The *Sure*Step™ stepping family features nine standard "high-torque" motors that employ the latest technology to achieve the best torque-to-volume ratio, and therefore handle a wide range of automation applications. Frame sizes include NEMA 17, 23, and 34, with holding torque ranges from 61 oz-in to 1,291 oz-in. New advanced microstepping drives are software configurable and feature an internal indexer.

*Sure*Servo®
Servo Systems

100W to 3 kW systems with flexible features

The *Sure*Servo family of brushless servo systems from AutomationDirect is fully digital and offers a rich set of features at dynamite prices. Choose from eight standard servo motors (100W to 3 kW) that can be used with one of three standard servo drives. For configuration, tuning and diagnostics, use the drives' integrated keypad/display or take advantage of the free *Sure*Servo Pro™ PC-based software, which can be downloaded online at http://support.automationdirect.com/products/sureservo.html·

Tune the system easily with adaptive auto-tuning selections or a manual mode. Adapt to diverse applications with configurable I/O, including 8 digital inputs, 5 digital outputs, 2 analog monitors and a scalable encoder output.

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GSoft Configuration Software

GSoft configuration software is a Windows-based package that allows connection from a PC to any GS or *DURAPULSE* drive for easy configuration and tuning. You can create new drive configurations, upload and download archived configurations, and tune the drive's PID loop with intuitive screens.

GSoft configuration software available

http://support.automationdirect.com/products/gsoft.html
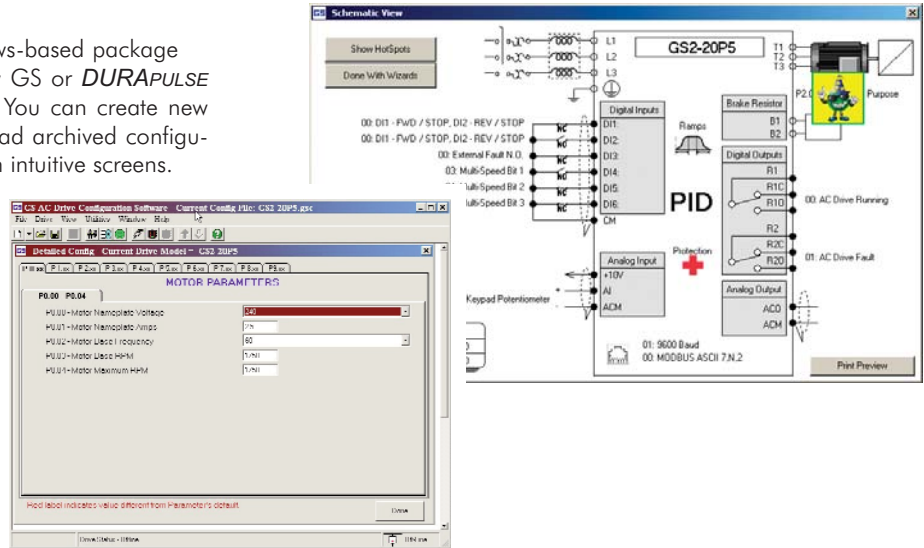
Networking AC Drives with Built-in Modbus Communications

AUTOMATIONDIRECT's AC drives offer "out-of-the-box" RS-485 and RS-232 (GS2 series only) serial connectivity. Modbus RTU is the onboard standard protocol used for control and monitoring. This can be used to connect several Modbus masters like AUTOMATIONDIRECT's family of *Direct*LOGIC PLCs, Think & Do Studio or Live!, and any OPC server that has a Modbus driver such as Kepware or Software Toolbox.

Imagine getting all the parameter settings and control functionality on one cable, even when the information is not readily available by any other means. This flexibility offers cost savings, standardization, smaller PLC usage, and less development time.

RS-485 Modbus Network

Add Ethernet Connectivity for Advanced Functionality

Add Ethernet connectivity and open up the path to the most advanced functionality today.

The GS-EDRV provides a high-performance Ethernet link between a control system and a *DURAPULSE* or GS drive. It mounts on DIN rail and connects a drive to an Ethernet hub or PC. The GS-EDRV processes signals to and from the drive and formats them to conform with the Ethernet standard to the H2-ERM or H4-ERM, KEP*Direct* EBC I/O server (as shown below), or independent controller with the Modbus TCP/IP driver. This allows for greater connectivity to many control system architectures.

An additional feature is the built-in Web server, which allows users to configure and control the drive from any web browser via the IP address of the GS-EDRV card. The *DURAPULSE* and GS series drives have a provision for shutting down control or power to the inverter in the event of a communications timeout. This function can be set up through the drive parameter group 9 on all the drive platforms.

The KEP*Direct* EBC I/O server software is a 32-bit application that provides a way to connect your favorite Windows client software to AUTOMATIONDIRECT Ethernet I/O through our Ethernet base controllers. It provides GS series drive support via the GS-EDRV Ethernet interface, as shown in the diagram below. KEP*Direct* allows the user a direct line into the drive parameter group just like an Ethernet field I/O drop. The user can control or monitor from any OPC/DDE compliant third party software. For a complete description of KEP*Direct* software features, go to the Software section of this catalog. Several application notes specific to the versatility of this software can be found on our web site at www.automationdirect.com.
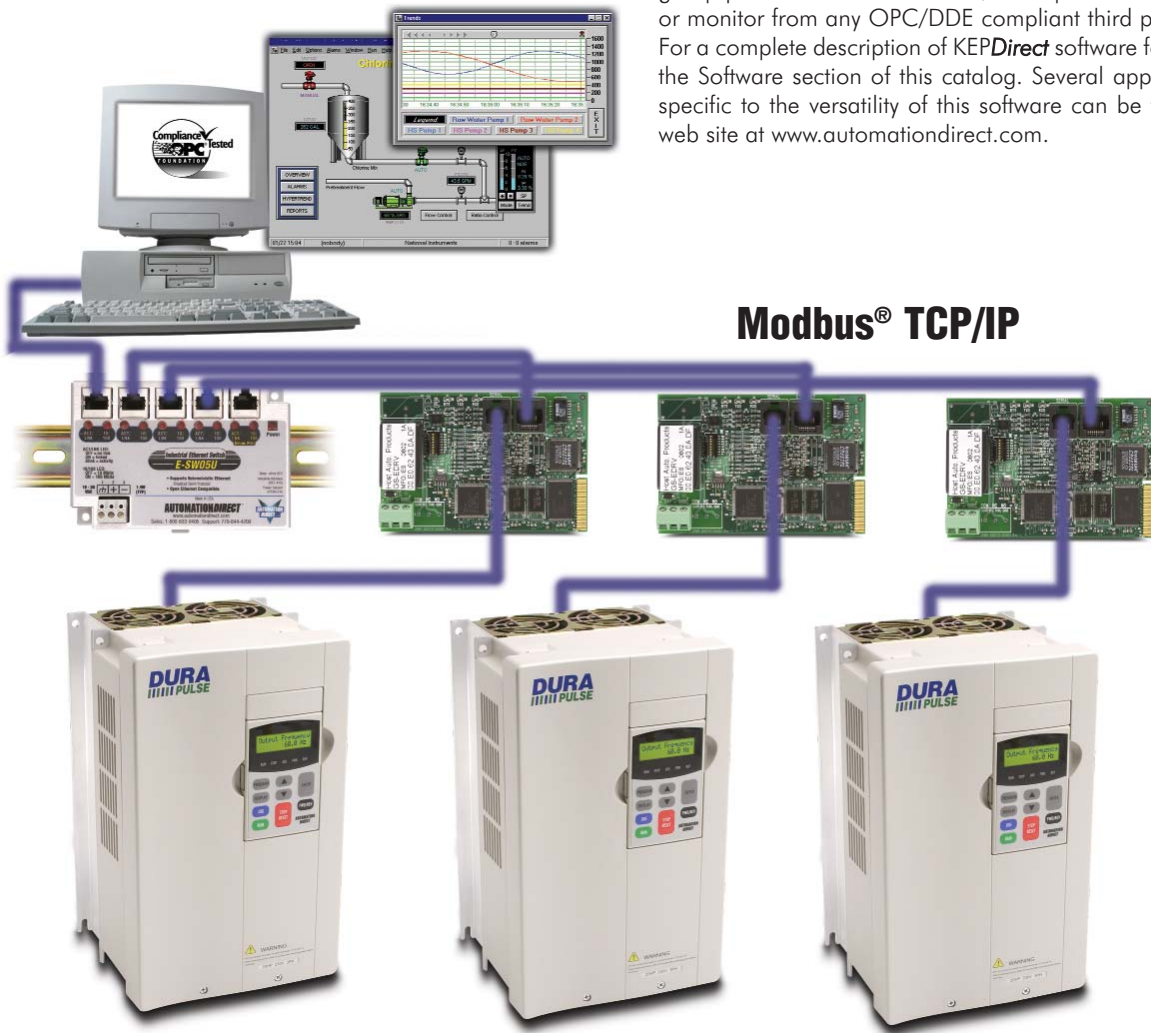
Modbus® TCP/IP

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3 Steps to Selecting the Right AC Drive

STEP 1 - Select The Right Model

A. Determine motor voltage, horsepower and full-load amperage

	AC drive models			
	GS1	**GS2**	**DURApulse**	**SJ300**
Horsepower	1/4 - 2	1/4 - 10*	1 - 100**	1/2 - 30
Input voltage	115/230 VAC	115/230/460 VAC	230/460 VAC	230/460 VAC
Motor voltage	230 VAC	230/460 VAC	230/460 VAC	230/460 VAC

* 230V up to 7.5 hp
460V up to 10 hp
575V up to 10 hp

** 230V up to 50 hp
460V up to 100 hp

Check the nameplate on the motor for specs needed:

Motor horsepower →

Motor voltage →

Motor amperage →

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		

Motor voltage, horsepower, and amperage can be found on the motor's nameplate.

Note: Most motors can be connected for multiple voltages and will have multiple amperages listed.

In the example to the left the motor can be connected for 460V only. The 460V amperage is 2.6.

B. Select your application and/or control mode

	AC Drive Models			
	GS1	**GS2**	**DURApulse**	**SJ300**
Volts/Hertz Control	✔	✔	✔	✔
Sensorless Vector Control			✔	✔
Closed Loop Control			Optional	Optional
Encoder Feedback			Optional	Optional
Integral PID Control		✔	✔	✔
Integral Dynamic Braking Unit		✔	15 HP*	15 HP*
	Conveyor	Conveyor	Conveyor	Conveyor
	Pump	Pump	Pump	Pump
	Fan	Fan	Fan	Fan
	Shop tools	Material handling	Material handling	Material handling
		HVAC	HVAC	HVAC
		Mixing	Mixing	Mixing
		Compressor	Compressor	Compressor
		Shop tools	Shop tools	Extruding
				Grinders
				Web handling
				Spindle

Either choose your application from those listed or select the control mode that meets your application's requirements. For applications not listed, either select the control mode that offers the same or higher level of performance as the existing control, or call us and ask for assistance.

Control Mode			
	Volts/Hertz	**Sensorless Vector**	**Closed-Loop Control**
Complexity	Low	Moderate	Complex
Performance	Good	Good	High
1 min. Overload	150%	150%	150%
Starting Torque	175%	200%	200%
Speed Regulation	+/- 2%	+/- 1%	+/- 0.2%

>15 hp requires external braking units

STEP 1 HERE · STEP 2 · STEP 3

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C. Determine the I/O requirements of the AC drive

	AC Drive Models			
	GS1	GS2	DURAPULSE	SJ300
Digital Inputs	4	6	11	8
Digital Outputs - Transistor	0	0	3	5
Digital Outputs - Relay	1	2	1	1
Digital Output - Frequency pulse			1	
Analog Input - 0-10VDC/4-20mA	1	1	3	2
Analog Output - 0 - 10 VDC	0	1	1	Optional

Digital inputs are used to interface the AC drive with devices such as pushbuttons, selector switches and PLC digital output modules, either DC or relay. These signals are typically used for functions such as Start/Stop, Forward/Reverse, External Fault, Preset Speed selection, Fault Reset, etc.

Digital outputs are typically used to connect the AC drive to devices such as pilot lights, alarms, auxiliary relays, solenoids, and PLC digital input modules. Relay outputs are rated for both AC and DC voltages. Transistor outputs are rated for only DC voltages.

The analog input is used to interface the AC drive with an external 0-10 VDC or 4-20 mA signal. This signal can represent either a speed setpoint or if available, PID feedback.

D. Determine location of AC drive's keypad

	AC Drive Models			
	GS1	GS2	DURAPULSE	SJ300
Removable Keypad		✔	✔	✔

The keypad of the GS2, DURApulse and SJ300 are removable and can be remotely mounted. If the AC drive is installed in a location that the operator cannot easily access, its keypad could be relocated to a more suitable location. Remote mounting would require the purchase of the appropriate cable. Also available for the DURApulse drives is a remote, panel-mount bezel.

E. Determine communications requirements

	AC Drive Models			
	GS1	GS2	DURAPULSE	SJ300
MODBUS Communications	✔	✔	✔	Optional
Ethernet Communications	Optional	Optional	Optional	N/A

A serial communication interface can be used to connect the AC drive to other devices that have the capability to function as a master device. The master device can control the AC drive with this interface instead of using the digital and analog I/O. The master can also use this interface to monitor the status of various AC drive parameters, speed, current, fault status, etc.

The GS1, GS2 and DURApulse AC drives have a standard Modbus RS-485 interface. The SJ300 requires an optional SC-OPE31 interface for the Modbus interface.

The GS1, GS2, and DURApulse drives also have the optional capability to communicate through an Ethernet interface. Please refer to the technical section of each model to determine the required Ethernet interface adapter and compatible Ethernet devices.

F. Select the proper series

After you have selected the AC drive series that meets your requirements, you need to determine the correct rating. Turn the page and proceed to Step two.

STEP 2 - Select the Proper 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 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. 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 m. Above 1000 m, 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 degrees F (40 degrees C). Enclosure ventilation and/or cooling may be required to maintain a maximum internal temperature of 104 degrees F (40 degrees C) or less. Ambient temperature measurements/calculations should be made for the maximum expected temperature. (SJ300 AC drives may also require a reduction in carrier frequency.)
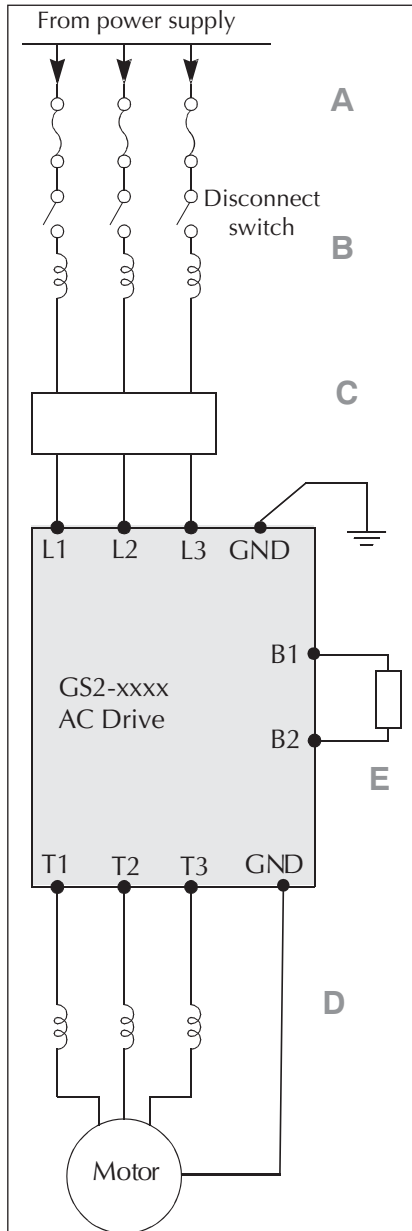
E. Calculate required output amperage

Use the chart below to calculate the required FLA of the AC drive. Select the rating that equals the motor's voltage and equals or exceeds the calculated amperage.

Example 1: Motor FLA=6, Overload=200%@45 secs, Altitude=800m, MEIT=45° C, **GS Series**
Example 2: Motor FLA=8, Overload=135%@75 secs, Altitude=1100m, MEIT=35° C, **DURAPULSE**

	Example 1 GS Series	Example 2 DURAPULSE
ENTER Motor FLA	6	8
Overload Derate (overload %)		
If Overload is less than 150% and less than 60 seconds, Then ENTER 1		
If Overload is greater than 150% and less than 60 seconds, Then ENTER (overload/150%)	1.333	
If Overload is greater than 60 seconds, Then ENTER (overload/100%)		1.35
Multiply FLA x overload entry (This entry is the overload result)	8	10.8
Altitude Derate (meters)		
If Altitude is less than 1000m Then ENTER 1	1	
If Altitude is more than 1000m and less than 3000m Then ENTER 1+ ((altitude-1000) x 0.0001)		1.01
Multiply overload result x altitude entry (This entry is the altitude result)	8	10.91
Ambient Temperature (°Celsius)		
If Max enclosure internal temperature (MEIT) is less than 40°C Then ENTER 1		1
If 40°C < MEIT< 50°C and GS series AC drive up to 5 hp Then ENTER 1	1	
If 40°C < MEIT< 50°C and GS Series >5 hp or DURAPULSE series AC drive Then ENTER 1.2		
Multiply altitude result x MEIT entry (This result is the required drive FLA)	8	10.91

STEP 3 - Options, Options, and more Options

From power supply

A

Disconnect switch

B

C

L1   L2   L3   GND

GS2-xxxx AC Drive

B1

B2

E

T1   T2   T3   GND

D

Motor

A. Input 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. Input fuse kits and replacement fuses are available for GS series and *DURAPULSE* AC drives.

B. Input line reactor

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

C. Input EMI filter

Input EMI filters reduce electromagnetic interference or noise on the input side of the inverter. They are required for CE compliance and recommended for installations prone to or sensitive to electromagnetic interference.

D. Output line reactor

Output line reactors protect the motor insulation against drive short circuits and IGBT reflective wave damage. Output line reactors also "smooth" the motor current waveform, allowing the motor to run cooler. The line reactor can be used for either input or output applications.

Output line reactors are recommended for operating "noninverter-duty" motors and when the length of wiring between the AC drive and motor is langer thant the recommended max lenght of a given motor model. Inverter-duty rated motors support longer lead length than do non-inverter duty motors.

E. Dynamic braking

Dynamic braking allows the AC drive to produce additional braking (stopping) torque. AC drives can typically produce between 15% and 20% braking torque without the addition of any external components. The GS2, *DURAPULSE*, and SJ300 AC drives have built-in braking circuits on all units below 15 hp. These drives still require the addition of a braking resistor to increase their braking torque capability. Ratings larger than 15 hp require separate braking units in addition to the braking resistors to increase their braking torque capability.

Dynamic braking may be required for applications requiring rapid deceleration or high inertia loads.

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GS1 Series Introduction

GS1 Series Drives					
Motor Rating	**Hp**	**.25**	**.5**	**1**	**2**
	kW	**0.2**	**0.4**	**0.75**	**1.5**
115 Volt Single-Phase Input/230 Volt Three-Phase Output		✔	✔		
230 Volt Single-Phase Input/230 Volt Three-Phase Output		✔	✔	✔	
230 Volt Three-Phase Input/Output					✔

Overview

The GS1 series of AC drives is our most affordable and compact inverter, offering V/Hz control with general purpose application features. These drives can be configured using the built-in digital keypad (which also allows you to set the drive speed, start and stop, and monitor specific parameters) or with the standard RS-485 serial communications port. Standard GS1 features include one analog input, four programmable digital inputs and one programmable normally open relay output.

Features

- Simple Volts/Hertz control
- Pulse Width Modulation (PWM)
- 3 - 10 kHz carrier frequency
- IGBT technology
- 130% starting torque at 5Hz
- 150% rated current for one minute
- Electronic overload protection
- Stall prevention
- Adjustable accel and decel ramps
- S-curve settings for acceleration and deceleration
- Automatic torque compensation
- Automatic slip compensation
- DC braking
- Built-in EMI filter
- Three skip frequencies
- Trip history
- Integral keypad and speed potentiometer
- Programmable jog speed
- Three programmable preset speeds
- Four programmable digital inputs
- One programmable analog input
- One programmable relay output
- RS-485 Modbus communications up to 19.2K
- Optional Ethernet communications
- UL/cUL/CE listed

Accessories

- AC line reactors
- RF filter
- Ethernet interface
- Four and eight port RS-485 multi-drop termination board
- KEP**Direct** I/O Server
- GSoft drive configuration software
- GS-485HD15-CBL - **ZIP**Link RS485 Communication cable for connection to the DL06 and D2-260 15-pin ports.
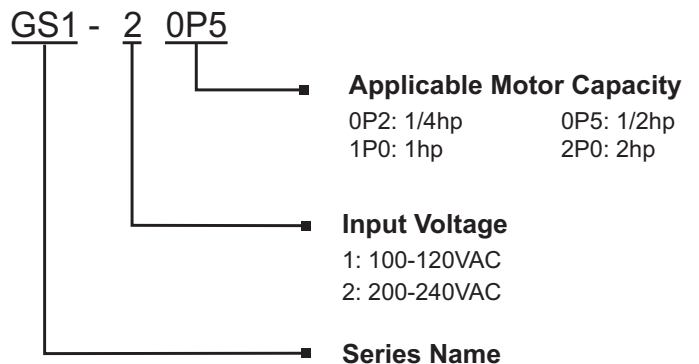
Detailed descriptions and specifications for the accessories are available in the "GS/DURAPULSE Accessories" section.

Typical Applications

- Conveyors
- Fans
- Pumps
- Shop tools

GS1 series part numbering system

GS1 - 2 0P5

Applicable Motor Capacity
0P2: 1/4hp   0P5: 1/2hp
1P0: 1hp   2P0: 2hp

Input Voltage
1: 100-120VAC
2: 200-240VAC

Series Name

GS1 Series Specifications

115V/230V CLASS GS1 Series							
Model		GS1-10P2	GS1-10P5	GS1-20P2	GS1-20P5	GS1-21P0	GS1-22P0
Price		<--->	<--->	<--->	<--->	<--->	<--->
Motor Rating	HP	1/4 hp	1/2 hp	1/4 hp	1/2 hp	1hp	2hp
	kW	0.2 kW	0.4 kW	0.2 kW	0.4 kW	0.7 kW	1.5 kW
Rated Output Capacity (200V) kVA		0.6	1.0	0.6	1.0	1.6	2.7
Rated Input Voltage		Single-phase 100-120 VAC ±10%, 50/60 Hz ±5%		Single/three-phase: 200-240 VAC±10%, 50/60 Hz ±5%			Three-phase: 200-240 VAC±10%, 50/60 Hz ±5%
Rated Output Voltage		Three-phase corresponds to double the input voltage		Three-phase corresponds to the input voltage			
Rated Input Current (A)		6	9	4.9/1.9	6.5/2.7	9.7/5.1	9
Rated Output Current (A)		1.6	2.5	1.6	2.5	4.2	7.0
Watt Loss @ 100% I (W)		19.2	19.2	18.4	26.8	44.6	73
Weight: kg (lb)		2.10	2.20	2.20	2.20	2.20	2.20
Dimensions (HxWxD) (mm [in])		132.0 x 68.0 x128.1 [5.20 x 2.68 x 5.04]					
Accessories							
Ethernet Communications module for GS Series Drives (DIN rail mounted)		GS-EDRV					
Four port RS-485 multi-drop termination board		GS-RS485-4					
Eight port RS-485 multi-drop termination board		GS-RS485-8					
Software		GSoft / KEP*Direct*					
OPC Server		KEP*Direct*					

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GS1 General Specifications

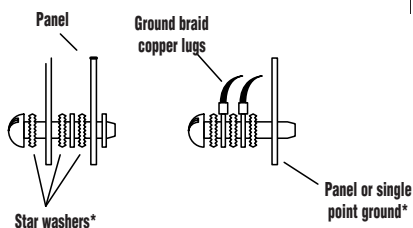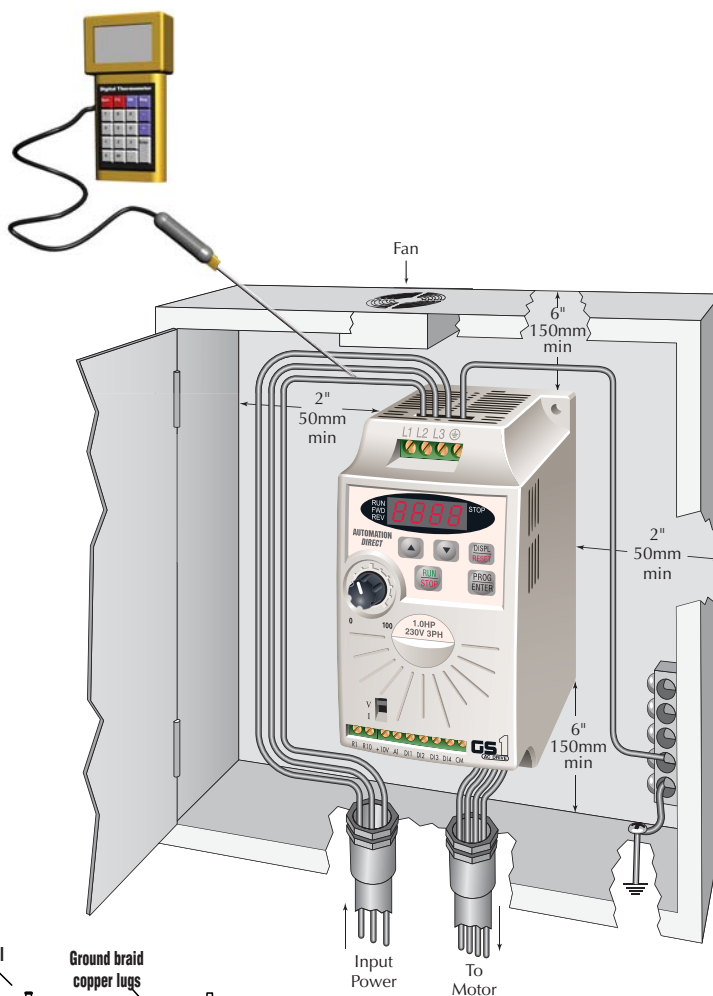| General Specifications			
Control Characteristics			
Control System			Sinusoidal Pulse Width Modulation, carrier frequency 3kHz - 10kHz
Rated Output Frequency			1.0 to 400.0 Hz limited to 9999 motor rpm
Output Frequency Resolution			0.1 Hz
Overload Capacity			150% of rated current for 1 minute
Torque Characteristics			Includes auto-torque, auto-slip compensation, starting torque 130% @ 5.0Hz
DC Braking			Operation frequency 60-0Hz, 0-30% rated voltage. Start time 0.0-5.0 seconds. Stop time 0.0-25.0 seconds
Acceleration/Deceleration Time			0.1 to 600 seconds (can be set individually)
Voltage/Frequency Pattern			V/F pattern adjustable. Settings available for Constant Torque - low and high starting torque, Variable Torque - low and high starting torque, and user configured
Stall Prevention Level			20 to 200% or rated current
Operation Specification			
Inputs	**Frequency Setting**	**Keypad**	Setting by <UP> or <DOWN> buttons or potentiometer
		External Signal	Potentiometer - 5kΩ 0.5W, 0 to 10 VDC (input impedance 47kΩ), 0 to 20 mA / 4 to 20 mA (input impedance 250Ω), Multi-function inputs 1 to 3 (3 steps, JOG, UP/DOWN command), RS485 communication setting
	Operation Setting	**Keypad**	Setting by <RUN>, <STOP> buttons
		External Signal	DI1, DI2, DI3, DI4 can be combined to offer various modes of operation, RS485 communication port
Outputs	**Multi-Function Input Signal**		Multi-step selection 0 to 3, Jog, Accel/decel inhibit, First/second accel/decel switch, Counter, PLC operation, External base block (N.C., N.O.) selection
	Multi-Function Output Signal		AC drive operating, Frequency attained, Non zero speed, Base Block, Fault indication, Local/remote indication, PLC operation indication
	Operating Functions		Automatic voltage regulation, S-curve, Over-voltage stall prevention, DC braking, Fault records, Adjustable carried frequency, Starting frequency setting of DC braking, Over-current stall prevention, Momentary power loss restart, Reverse inhibition, Frequency limits, Parameter lock/reset
Protective Functions			Overcurrent, overvoltage, undervoltage, electronic thermal motor overload, Overheating, Overload, Self testing
Operator Interface	**Operator Devices**		5-key, 4-digit, 7-segment LED, 3 status LEDs, potentiometer
	Programming		Parameter values for setup and review, fault codes
	Parameter Monitor		Master Frequency, Output Frequency, Scaled Output Frequency, Output Voltage, DC Bus Voltage, Output Direction, Trip Event Monitor, Trip History Monitor
	Key Functions		RUN/STOP, DISPLAY/RESET, PROGRAM/ENTER, <UP>, <DOWN>
Environment	**Enclosure Rating**		Protected chassis, IP20
	Ambient Operating Temperature		-10° to 40°C (14°F to 104°F) w/o derating
	Storage Temperature		-20° to 60 °C (-4°F to 140°F) during short-term transportation period)
	Ambient Humidity		0 to 90% RH (non-condensing)
	Vibration		9.8 m/s^2(1G), less than 10Hz. 5.88 m/s^2 (0.6G) 20 to 50 Hz
	Installation Location		Altitude 1000m or lower above sea level, keep from corrosive gas, liquid and dust
Options			Programming Software (GSOFT)

GS1 Specifications - Installation

Understanding the installation requirements for your GS1 drive will help to ensure that it will operate within its environmental and electrical limits.

NOTE:
Never use only this catalog for installation instructions or operation of equipment; refer to the user manual, GS1-M.

Environmental Specifications	
Protective Structure	IP20
Ambient Operating Temperature [2]	-10 to 40°C
Storage Temperature [3]	-20 to 60°C
Humidity	to 90% (no condensation)
Vibration [4]	5.9 m/s² (0.6g), 10 to 55 Hz
Location	Altitude 1,000 m or less, indoors (no corrosive gases or dust)

1: Protective structure is based upon EN60529

2: The ambient temperature must be in the range of -10° to 40° C. If the range will be up to 50° C, you will need to set the carrier frequency to 2.1 kHz or less and derate the output current to 80% or less. See our Web site for derating curves.

3: The storage temperature refers to the short-term temperature during transport.

4: Conforms to the test method specified in JIS CO911 (1984)

Watt-loss Chart	
GS1 Drive Model	**At full load**
GS1-10P2	19.2
GS1-10P5	19.2
GS1-20P2	18.4
GS1-20P5	26.8
GS1-21P0	44.6
GS1-22P0	73

Fan

2"
50mm
min

6"
150mm
min

2"
50mm
min

6"
150mm
min

1.0HP
230V 3PH

Panel

Ground braid copper lugs

Star washers*

Panel or single point ground*

Input Power

To Motor

* FOR PAINTED SUB-PANELS, SCRAPE THE PAINT FROM UNDERNEATH THE STAR WASHERS BEFORE TIGHTENING THEM.

Air Flow

Warning: AC drives generate a large amount of heat, which may damage the AC drive. Auxiliary cooling methods are typically required in order to not exceed maximum ambient temperatures.

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PLCs

Field I/O

Software

C-more & other HMI

AC Drives

AC Motors

Power Transmiss.

Steppers/ Servos

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Proximity Sensors

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Pressure Sensors

Temp. Sensors

Pushbuttons/ Lights

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GS1 Specifications - Terminals

Main Circuit Wiring	
Terminal	**Description**
L1, L2, L3	Input power
T1, T2, T3	AC drive output
⏚	Ground
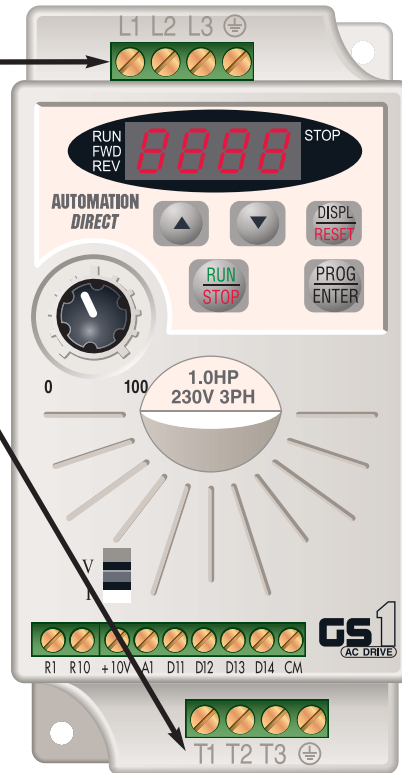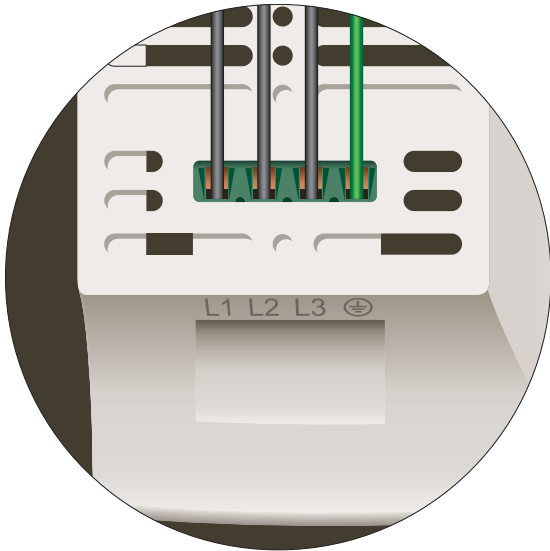
Control Circuit Terminals	
Terminal Symbol	**Description**
R1O	Relay output 1 normally open
R1	Relay output 1 common
DI1	Digital input 1
DI2	Digital input 2
DI3	Digital input 3
DI4	Digital input 4
AI [1]	Analog input
+10V	Internal power supply (10 mA @ 10 VDC)
CM	Common

[1] *0 to +10 VDC, 0 to 20 mA, or 4 to 20 mA input represents zero to maximum output frequency.*

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

GS1 Specifications - Basic Wiring Diagram

Company Info.

PLCs

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Note: Users MUST connect wiring according to the circuit diagram shown below. (Refer to user manual GS1-M for additional specific wiring information.)

Note: Refer to the following pages for explanations and information regarding line reactors and RF filters: 13–50, 13–67.
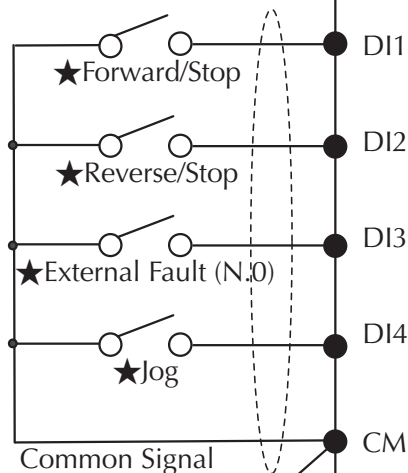
Power Source 3-phase*

100-120V±10% (50/60Hz ±5%)

200-240V±10% (50/60Hz±5%)
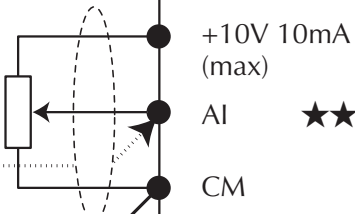
L1

L2

L3

GS1-xxxx

AC Motor

IM

T1

T2

T3
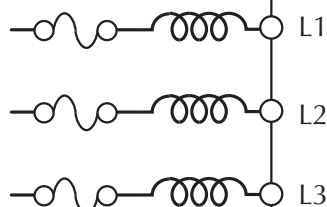
* Use terminals L1 and L2 for 120V, or select any two of the power terminals for 240V single-phase models

Grounding resistance less than 0.1Ω

★Forward/Stop   DI1

★Reverse/Stop   DI2

★External Fault (N.O)   DI3

★Jog   DI4

Common Signal   CM

Multi-function output contacts 120VAC/24VDC @5A 230VAC @2.5A

R1O

R1
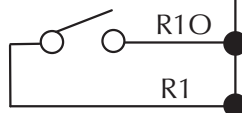
★Fault Indication

RJ-12 (6P4C)

6   1

Communication Port
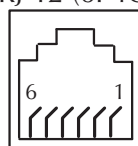
RJ-12 Serial Comm Port* Interface (See Warning)

RS-485
2: GND
3: SG-
4: SG+
5: +5V

*Optional ZIPLink RS485 Communication cable GS-485HD15-CBL available for connection to the DL06 and D2-260 15-pin ports. See page 12-75.

Analog voltage 0-10VDC

Potentiometer 3~5kΩ

Analog current 0-20mA; 4-20mA

+10V 10mA (max)

AI   ★★

CM

★Factory default setting

★★Factory default source of frequency command is via the keypad potentiometer

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

WARNING: Do not plug a modem or telephone into the GS1 RJ-12 Serial Comm Port, or permanent damage may result. Terminals 2 and 5 should not be used as a power source for your communication connection.

GS1 Specifications - Dimensions

68.0 (2.68)

56.0 (2.20)

dia. 5.0 (0.20)

L1 L2 L3 ⏚

RUN
FWD
REV

STOP

AUTOMATION
DIRECT

△ ▽ DISPL
RESET

RUN
STOP

PROG
ENTER

0   100

V
I

GS1
AC DRIVE

R1 R1O +10V AI DI1 DI2 DI3 DI4 CM

RS-485

T1 T2 T3 ⏚

120.0 (4.72)

132.0 (5.20)

128.1 (5.04)

R1 R1O +10V AI DI1 DI2 DI3 DI4 CM

RS-485

T1 T2 T3 ⏚

123.4 (4.86)

128.1 (5.04)

Unit: mm (in)

Company Info.

PLCs

Field I/O

Software

C-more & other HMI

AC Drives

AC Motors

Power Transmiss.

Steppers/ Servos

Motor Controls

Proximity Sensors

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GS2 Series - Introduction

		GS2 Series Drives							
Motor Rating	**Hp**	.25	.5	1	2	3	5	7.5	10
	kW	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5
Single-Phase 115 Volt Class		✔	✔	✔					
Single/Three-Phase 230 Volt Class			✔	✔	✔	✔			
Three-Phase 230 Volt Class							✔	✔	
Three-Phase 460 Volt Class				✔	✔	✔	✔	✔	✔
Three-Phase 575 Volt Class				✔	✔	✔	✔	✔	✔

Overview

The GS2 series of AC drives offers all of the features of our GS1 drive plus dynamic braking, PID and a removable keypad. The drive can be configured using the built-in digital keypad or with the standard RS-232/RS-485 serial communications port. The standard keypad allows you to configure the drive, set the speed, start and stop the drive, command forward and reverse direction of motor shaft, and monitor specific parameters during operation. Each GS2 features one analog and six programmable digital inputs, and one analog and two programmable relay outputs.

Features

- Simple Volts/Hertz control
- Sinusoidal Pulse Width Modulation (PWM)
- 1-12 kHz carrier frequency
- IGBT technology
- Starting torque: 125% at 0.5 Hz/150% at 5 Hz
- 150% rated current for one minute
- Electronic overload protection
- Stall prevention
- Adjustable accel and decel ramps
- S-curve settings for acceleration and deceleration
- Automatic torque compensation
- Automatic slip compensation
- Dynamic braking circuit
- DC braking
- Three skip frequencies
- Trip history
- Programmable jog speed
- Integral PID control
- Removable keypad with speed potentiometer
- Programmable analog input
- Programmable analog output
- Six programmable digital inputs
- Two programmable relay outputs
- RS-232/485 Modbus communications up to 38.4 Kbps.
- Optional Ethernet communications
- UL/cUL/CE* listed
  * GS2-5xxx 575V drives NOT CE compliant

Accessories

- AC line reactors
- EMI filters
- RF filters
- Braking resistors
- Fuse kits and replacement fuses
- Ethernet interface
- Replacement keypads
- Keypad cables in 1, 3, and 5 meter lengths
- Four and eight-port serial communication breakout boards
- KEP*Direct* I/O Server
- GSoft drive configuration software
- GS-485HD15-CBL /GS-RJ12-CBL-2 *ZIP*Link RS232 and RS485 Communication cables for connection to the DL05, DL06, D2-250-1 and D2-260 ports.

Detailed descriptions and specifications for the accessories are available in the "GS/DURAPULSE Accessories" section.

Typical Applications

- Conveyors
- Fans
- Pumps
- Compressors
- HVAC
- Material handling
- Mixing
- Shop tools

GS2 series part numbering system

GS2- 4 7P5

Applicable Motor Capacity
0P2: 0.25HP   0P5: 0.5HP
1P0: 1.0HP   2P0: 2.0HP
3P0: 3.0HP   5P0: 5.0HP
7P5: 7.5HP   010: 10HP

Input Voltage
1: 100-120VAC
2: 200-240VAC
4: 380-480VAC
5: 500-600VAC

Series Name

GS2 Series Specifications

115V CLASS GS2 SERIES				
Model		GS2-10P2	GS2-10P5	GS2-11P0
Price		<--->	<--->	<--->
Motor Rating	**HP**	1/4hp	1/2hp	1hp
	kW	0.2kW	0.4kW	0.75kW
Rated Output Capacity (kVA)		0.6	1.0	1.6
Rated Input Voltage		Single-phase : 100 to 120 VAC ±10% 50/60 Hz ±5%		
Rated Output Voltage		Three-phase, two times proportion to input voltage		
Rated Input Current (A)		6	9	16
Rated Output Current (A)		1.6	2.5	4.2
DC Braking		Frequency 60-0 Hz, 0-100% rated current, start time 0.0-5.0 seconds, Stop Time 0.0-25.0 seconds		
Protective Structure		Protected chassis IP20		
Ambient Operating Temperature		-10°C to 50°C (14°F to 122°F) without derating		
Storage Temperature		-20° to 60°C (-4° to 140°F) during short term transportation period		
Humidity		20 to 90% Humidity (no condensation)		
Vibration		9.8 m/s^2 (1G) at less than 10 Hz; 5.9 m/s^2 (0.6G) 10 to 60 Hz		
Location		Altitude 1,000m or less, Keep from corrosive gases liquids or dust		
Watt Loss @ 100% I (W)		24	34	46
Weight (lb)		3.5	3.6	3.7
Dimensions* (HxWxD) (mm [in])**		151.0 x 100.0 x 140.5 [5.94 x 3.94 x 5.53]		
Accessories				
Line Reactor	**Input side of drive (1 Phase)***	GS-10P2-LR	GS-10P5-LR	GS-11P0-LR
	Output side of drive (3 Phase)*	GS-20P5-LR-3PH	GS-20P5-LR-3PH	GS-21P0-LR-3PH
Braking Resistor		GS-20P5-BR	GS-20P5-BR	GS-21P0-BR
EMI Filter		20DRT1W3S		
Fuse Kit	**Single Phase****	GS-10P2-FKIT-1P	GS-10P5-FKIT-1P	GS-11P0-FKIT-1P
Replacement Fuses	**Single Phase****	GS-10P2-FUSE-1P	GS-10P5-FUSE-1P	GS-11P0-FUSE-1P
Spare Keypad, GS2 Series Drive		GS2-KPD		
Keypad Cable, GS2 Series, 1 meter		GS-CBL2-1L		
Keypad Cable, GS2 Series, 3 meter		GS-CBL2-3L		
Keypad Cable, GS2 Series, 5 meter		GS-CBL2-5L		
Ethernet Communications module for GS2 Series Drives (DIN rail mounted)		GS-EDRV		
Four port RS-485 multi-drop termination board		GS-RS485-4		
Eight port RS-485 multi-drop termination board		GS-RS485-8		
Software		GSoft / KEP*Direct*		
OPC Server		KEP*Direct*		

Note: GS2-1xxx drives require 115V class input line reactors and 230V class output line reactors.

**Note: Single phase fuse kits and fuses are used only with GS2-1xxx drives.*

***Note: Height dimension does not include external ground terminal, which adds 10 to 15 mm. Refer to dimensional drawings for details.*

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Field I/O

Software

C-more & other HMI

AC Drives

AC Motors

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Steppers/ Servos

Motor Controls

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Photo Sensors

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GS2 Series Specifications

230V CLASS GS2 SERIES							
Model		GS2-20P5	GS2-21P0	GS2-22P0	GS2-23P0	GS2-25P0	GS2-27P5
Price		<--->	<--->	<--->	<--->	<--->	<--->
Motor Rating	*HP*	1/2hp	1hp	2hp	3hp	5hp	7.5hp
	kW	0.4kW	0.75kW	1.5kW	2.2kW	3.7kW	5.5kW
Rated Output Capacity (kVA)		1.0	1.9	2.7	3.8	6.5	9.5
Rated Input Voltage		Single/Three-phase : 200/208/220/230/240 VAC ±10%, 50/6 0Hz ±5%				Three-phase : 200/208/220/230/240 VAC ±10%, 50/60 Hz ±5%	
Rated Output Voltage		Three-phase : Corresponds to input voltage					
Rated Input Current (A)		6.3/2.9	11.5/6.3	15.7/8.8	27.0/12.5	19.6	28
Rated Output Current (A)		2.5	5.0	7.0	10	17	25
DC Braking		Frequency 60-0 Hz, 0-100% rated current, start time 0.0-5.0 seconds, Stop Time 0.0-25.0 seconds					
Protective Structure		Protected chassis IP20					
Ambient Operating Temperature		-10°C to 50°C (14°F to 122°F) without derating				-10°C to 40°C (14°F to 104°F) without derating	
Storage Temperature		-20° to 60°C (-4° to 140°F) during short term transportation period					
Humidity		20 to 90% Humidity (no condensation)					
Vibration		9.8 m/s² (1G) at less than 10 Hz; 5.9 m/s² (0.6G) 10 to 60 Hz					
Location		Altitude 1,000m or less, Keep from corrosive gases liquids or dust					
Watt Loss @ 100% I (W)		34	57	77	111	185	255
Weight (lb)		3.5	3.6	3.7	8.5	8.5	8.5
Dimensions* (HxWxD) (mm [in])		151.0 x 100.0 x 140.5 [5.94 x 3.94 x 5.53]			220.0 x 125.0 x 189.5 [8.66 x 4.92 x 7.46]		
Accessories							
Line Reactor	*Single-Phase*	GS-20P5-LR-1PH	GS-21P0-LR-1PH	GS-22P0-LR-1PH	GS-23P0-LR-1PH	N/A	N/A
	Three-Phase	GS-20P5-LR-3PH	GS-21P0-LR-3PH	GS-22P0-LR-3PH	GS-23P0-LR-3PH	GS-25P0-LR	GS-27P5-LR
Braking Resistor		GS-20P5-BR	GS-21P0-BR	GS-22P0-BR	GS-23P0-BR	GS-25P0-BR	GS-27P5-BR
EMI Filter (single phase input)		20DRT1W3S			32DRT1W3C	40TDS4W4B	
Fuse Kit	*Single-Phase*	GS-20P5-FKIT-1P	GS-21P0-FKIT-1P	GS-22P0-FKIT-1P	GS-23P0-FKIT-1P	N/A	N/A
	Three-Phase	GS-20P5-FKIT-3P	GS-21P0-FKIT-3P	GS-22P0-FKIT-3P	GS-23P0-FKIT-3P	GS-25P0-FKIT-3P	GS-27P5-FKIT
Replacement Fuses	*Single-Phase*	GS-20P5-FUSE-1P	GS-21P0-FUSE-1P	GS-22P0-FUSE-1P	GS-23P0-FUSE-1P	N/A	N/A
	Three-Phase	GS-20P5-FUSE-3P	GS-21P0-FUSE-3P	GS-22P0-FUSE-3P	GS-23P0-FUSE-3P	GS-25P0-FUSE	GS-27P5-FUSE
Spare Keypad, GS2 Series Drive		GS2-KPD					
Keypad Cable, GS2 Series, 1 meter		GS-CBL2-1L					
Keypad Cable, GS2 Series, 3 meter		GS-CBL2-3L					
Keypad Cable, GS2 Series, 5 meter		GS-CBL2-5L					
Ethernet Communications module for GS2 Series Drives (DIN rail mounted)		GS-EDRV					
Four port RS-485 multi-drop terminaton board		GS-RS485-4					
Eight port RS-485 multi-drop terminaton board		GS-RS485-8					
Software		GSoft / KEP*Direct*					
OPC Server		KEP*Direct*					

Note: Height dimension does not include external ground terminal, which adds 10 to 15 mm. Refer to dimensional drawings for details.

GS2 Series Specifications

460V CLASS GS2 SERIES							
Model		GS2-41P0	GS2-42P0	GS2-43P0	GS2-45P0	GS2-47P5	GS2-4010
Price		<--->	<--->	<--->	<--->	<--->	<--->
Motor Rating	**HP**	1hp	2hp	3hp	5hp	7.5hp	10hp
	kW	0.8kW	1.5kW	2.2kW	4kW	5.5kW	7.5kW
Rated Output Capacity (kVA)		2.3	3.1	3.8	6.2	9.9	13.7
Rated Input Voltage		Three-phase: 380/400/415/440/460/480 VAC ±10%, 50/60 Hz ±5%					
Rated Output Voltage		Corresponds to input voltage					
Rated Input Current (A)		4.2	5.7	6.0	8.5	14	23
Rated Output Current (A)		3.0	4.0	5.0	8.2	13	18
DC Braking		Frequency 60-0 Hz, 0-100% rated current, Start Time 0.0-5.0 seconds, Stop Time 0.0-25.0 seconds					
Protective Structure		Protected chassis IP20					
Ambient Operating Temperature		-10°C to 50°C (14°F to122°F)				-10°C to 40°C(14°F to 104°F)	
Storage Temperature		-20°C to 60°C (-4°F to 140°F) during short term transportation period					
Humidity		20 to 90% Humidity (no condensation)					
Vibration		9.8 m/s^2 (1G) at less than 10Hz, 5.9 m/s^2 (0.6G)10 to 60 Hz					
Location		Altitude 1,000m or less, Keep from corrosive gases liquids or dust					
Watt Loss @ 100% I (W)		73	86	102	170	240	255
Weight (lb)		3.5	3.6	3.7	8.5	8.5	8.5
Dimensions* (HxWxD) (mm [in])		151.0 x 100.0 x 140.5 [5.94 x 3.94 x 5.53]			220.0 x 125.0 x 189.5 [8.66 x 4.92 x 7.46]		
Accessories							
Line Reactor		GS-41P0-LR	GS-42P0-LR	GS-43P0-LR	GS-45P0-LR	GS-47P5-LR	GS-4010-LR
Braking Resistor		GS-41P0-BR	GS-42P0-BR	GS-43P0-BR	GS-45P0-BR	GS-47P5-BR	GS-4010-BR
EMI Filter		11TDT1W4S			17TDT1W44		26TDT1W4B4
Fuse Kit		GS-41P0-FKIT	GS-42P0-FKIT	GS-43P0-FKIT	GS-45P0-FKIT	GS-47P5-FKIT	GS-4010-FKIT
Replacement Fuses		GS-41P0-FUSE	GS-42P0-FUSE	GS-43P0-FUSE	GS-45P0-FUSE	GS-47P5-FUSE	GS-4010-FUSE
Spare Keypad, GS2 Series Microdrive		GS2-KPD					
Keypad Cable, GS2 Series, 1 meter		GS-CBL2-1L					
Keypad Cable, GS2 Series, 3 meter		GS-CBL2-3L					
Keypad Cable, GS2 Series, 5 meter		GS-CBL2-5L					
Ethernet Communications Module for GS Series Drives (DIN rail mounted)		GS-EDRV					
Four port RS-485 multi-drop terminaton board		GS-RS485-4					
Eight port RS-485 multi-drop terminaton board		GS-RS485-8					
Software		GSoft / KEP*Direct*					
OPC Server		KEP*Direct*					

*Note: Height dimension does not include external ground terminal, which adds 10 to 15 mm. Refer to dimensional drawings for details.

Company Info.

PLCs

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Software

C-more & other HMI

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GS2 Series Specifications

575V CLASS GS2 SERIES							
Model		GS2-51P0	GS2-52P0	GS2-53P0	GS2-55P0	GS2-57P5	GS2-5010
Price		<--->	<--->	<--->	<--->	<--->	<--->
Motor Rating	**HP**	1hp	2hp	3hp	5hp	7.5hp	10hp
	kW	0.75kW	1.5kW	2.2kW	3.7kW	5.5kW	7.5kW
Rated Output Capacity (kVA)		1.7	3.0	4.2	6.6	9.9	12.2
Rated Input Voltage		Three-phase: 500 to 600 VAC -15/+10%, 50/60 Hz ±5%					
Rated Output Voltage		Corresponds to input voltage					
Rated Input Current (A)		2.4	4.2	5.9	7.0	10.5	12.9
Rated Output Current (A)		1.7	3.0	4.2	6.6	9.9	12.2
DC Braking		Frequency 60-0 Hz, 0-100% rated current, Start Time 0.0-5.0 seconds, Stop Time 0.0-25.0 seconds					
Protective Structure		Protected chassis IP20					
Ambient Operating Temperature		-10°C to 50°C (14°F to122°F)				-10°C to 40°C(14°F to 104°F)	
Storage Temperature		-20°C to 60°C (-4°F to 140°F) during short term transportation period					
Humidity		20 to 90% Humidity (no condensation)					
Vibration		9.8 m/s^2 (1G) at less than 10Hz, 5.9 m/s^2 (0.6G)10 to 60 Hz					
Location		Altitude 1,000m or less, Keep from corrosive gases liquids or dust					
Watt Loss @ 100% I (W)		30	58	83	132	191	211
Weight (lb)		3.3	3.3	4.4	7.0	7.0	7.3
Dimensions* (HxWxD) (mm [in])		151.0 x 100.0 x 140.5 [5.94 x 3.94 x 5.53]			220.0 x 125.0 x 189.5 [8.66 x 4.92 x 7.46]		
Accessories							
Line Reactor		GS-51P0-LR	GS-52P0-LR	GS-42P0-LR	GS-43P0-LR	GS-47P5-LR	
Braking Resistor		GS-42P0-BR		GS-42P0-BR x (2) in parallel		GS-4010-BR x (2) in series	
EMI Filter		not available					
Fuse Block (Edison 3-pole part #)		BC6033PQ or CHCC3D or CHCC3DI					
Replacement Fuses (Edison Fuse part #)		HCLR6 (10 fuses per pack)	HCLR10 (10 fuses per pack)	HCLR15 (10 fuses per pack)		HCLR20 (10 fuses per pack)	HCLR30 (10 fuses per pack)
Spare Keypad, GS2 Series Microdrive		GS2-KPD					
Keypad Cable, GS2 Series, 1 meter		GS-CBL2-1L					
Keypad Cable, GS2 Series, 3 meter		GS-CBL2-3L					
Keypad Cable, GS2 Series, 5 meter		GS-CBL2-5L					
Ethernet Communications Module for GS Series Drives (DIN rail mounted)		GS-EDRV					
Four port RS-485 multi-drop terminaton board		GS-RS485-4					
Eight port RS-485 multi-drop terminaton board		GS-RS485-8					
Software		GSoft / KEP*Direct*					
OPC Server		KEP*Direct*					

Note: Height dimension does not include external ground terminal, which adds 10 to 15 mm. Refer to dimensional drawings for details.

GS2 Series — General Specifications

General Specifications			
Control Characteristics			
Control System	Sinusoidal Pulse Width Modulation, carrier frequency 1kHz - 12kHz		
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% @ 0.5Hz/150% @ 5.0Hz		
Braking Torque	20% without dynamic braking resistor, 125% with optional braking resistor		
DC Braking	Operation frequency 60-0Hz, 0-100% rated current. Start time 0.0-5.0 seconds. Stop time 0.0-0 25.0 seconds		
Acceleration/Deceleration Time	0.1 to 600 seconds (linear or non-linear acceleration/deceleration), second acceleration/deceleration available		
Voltage/Frequency Pattern	V/F pattern adjustable. Settings available for Constant Torque - low and high starting torque, Variable Torque - low and high starting torque, and user configured		
Stall Prevention Level	20 to 200% or rated current		
Operation Specifications			
Inputs	**Frequency Setting**	Keypad	Setting by <UP> or <DOWN> buttons or potentiometer
		External Signal	Potentiometer - 3k to 5kΩ/2W, 0 to 10VDC (input impedance 10kΩ), 0 to 20mA / 4 to 20 mA (input impedance 250Ω), Multi-speed inputs 1 to 3, Serial Communication RS232 and RS485 (Modbus RTU)
	Operation Setting	Keypad	Setting by <RUN>, <STOP> buttons
		External Signal	Forward/Stop, Reverse/Stop (run/stop, fwd/rev), 3-wire control, Serial Communication RS232 and RS485 (Modbus RTU)
	Input Terminals	Digital	6 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 (1-3), 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	1 user-configurable, 0 to 10VDC (input impedance 10k Ω) or 0 to 20mA / 4 to 20mA (input impedance 250Ω), 10 bit resolution Frequency setpoint or PID process variable PV
Outputs	**Output Terminals**	Digital	2 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
		Analog	1 user-programmable: 0 to 10VDC (max load 2mA), 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, 7-stage speed operation, adjustable carrier frequency (1 to 12 kHz), PID control, 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 Trip 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		
Operator Interface	**Operator Devices**		8-key, 4-digit, 7-segment LED, 14 status LEDs, potentiometer
	Programming		Parameter values for setup and review, fault codes
	Status Display		Actual Operating Frequency, RPM, Scaled Frequency, Amps, % Load, Output Voltage, DC Bus Voltage, Process Variable, Set-point Frequency
	Key Functions		RUN, STOP/RESET, FWD/REV, PROGRAM, DISPLAY, <UP>, <DOWN>, ENTER
Environment	**Enclosure Rating**		Protected chassis, IP20
	Ambient Temperature		-10° to 50°C (14°F to 122°F) -10° to 40°C (14°F to 104°F) For models 7.5Hp (5.5kW) and higher
	Storage Temperature		-20° to 60 °C (-4°F to 140°F) - during short-term transportation period
	Ambient Humidity		20 to 90% RH (non-condensing)
	Vibration		9.8 m/s²(1G), less than 10Hz,. 5.9 m/s² (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 (GSOFT), Dynamic braking resistor, input fuses, ethernet interface (GS-EDRV), EMI filters		

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GS2 Specifications — Installation

Understanding the installation requirements for your GS2 drive will help to ensure that it operates within its environmental and electrical limits.

Note: Never use only this catalog for installation instructions or operation of equipment; refer to the user manual, GS2-M.
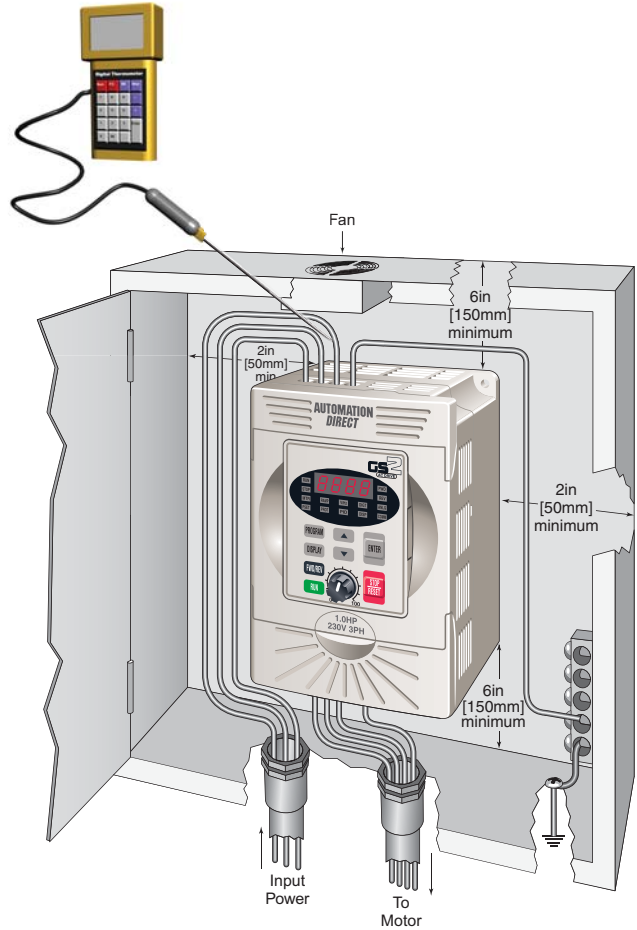
Environmental Specifications	
Protective Structure [1]	IP20
Ambient Operating Temperature [2]	-10 to 50°C (14°F to 122°F) -10 to 40°C (14°F to 104°F) for models 7.5HP and higher
Storage Temperature [3]	-20 to 60°C (-4°F to 140°F)
Humidity	To 90% (no condensation)
Vibration [4]	5.9 m/s^2 (0.6g), 10 to 55 Hz
Location	Altitude 1,000 m or less, indoors (no corrosive gases or dust)

1: Protective structure is based upon EN60529

2: The ambient temperature must be in the range of -10° to 40° C. If the range will be up to 50° C, you will need to set the carrier frequency to 2.1 kHz or less and derate the output current to 80% or less. See our Web site for derating curves.

3: The storage temperature refers to the short-term temperature during transport.

4: Conforms to the test method specified in JIS CO911 (1984)

Watt-loss Chart	
GS2 Drive Model	**At full load**
GS2-10P2	24
GS2-10P5	34
GS2-11P0	46
GS2-20P5	34
GS2-21P0	57
GS2-22P0	77
GS2-23P0	111
GS2-25P0	185
GS2-27P5	255
GS2-41P0	73
GS2-42P0	86
GS2-43P0	102
GS2-45P0	170
GS2-47P5	240
GS2-4010	255
GS2-51P0	30
GS2-52P0	58
GS2-53P0	83
GS2-55P0	132
GS2-57P5	191
GS2-5010	211

Fan

6in [150mm] minimum

2in [50mm] min.

2in [50mm] minimum

6in [150mm] minimum

Input Power

To Motor

⚠ **Warning: Maximum ambient temperatures must not exceed 50°C (122°F), or 40°C (104°F) for models 7.5 hp (5.5 kW) and higher!**

Air Flow

⚠ **Warning: AC drives generate a large amount of heat which may damage the AC drive. Auxiliary cooling methods are typically required in order not to exceed maximum ambient temperatures.**

Panel

Ground braid copper lugs

Star washers*

Panel or single point ground*
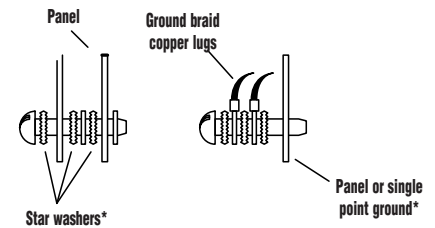
FOR PAINTED SUB-PANELS, SCRAPE THE PAINT FROM UNDERNEATH THE STAR WASHERS BEFORE TIGHTENING THEM.

GS2 Specifications — Terminals

Main Circuit Wiring

Terminal	Description
L1, L2, L3	Input power
T1, T2, T3	AC drive output
B1, B2	DB resistor input
⏚	Ground

WARNING: • Do not connect AC power to output terminals (T1, T2, T3).
• Do not inspect components until LEDs are turned off for at least 1 min.

WARNING: • Do not connect AC power to output terminals (T1, T2, T3).
• Do not inspect components until LEDs are turned off for at least 1 min.

Control Circuit Terminals

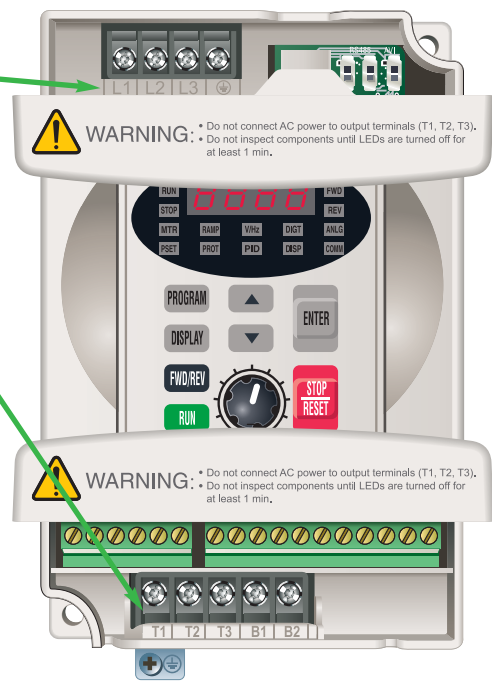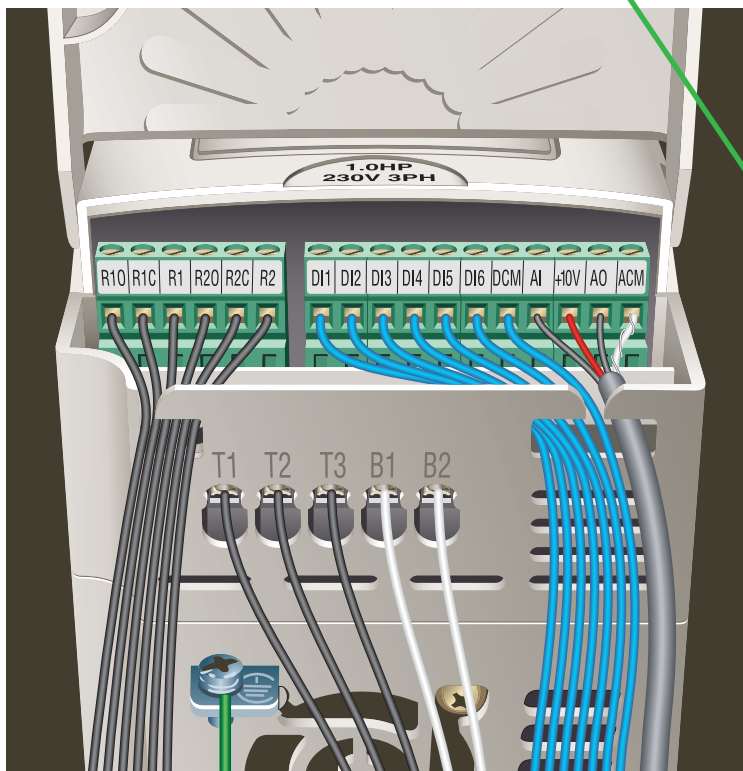| Terminal Symbol	Description
R1O	Relay output 1 normally open
R1C	Relay output 1 normally closed
R1	Relay output 1 common
R2O	Relay output 2 normally open
R2C	Relay output 2 normally closed
R2	Relay output 2 common
DI1	Digital input 1
DI2	Digital input 2
DI3	Digital input 3
DI4	Digital input 4
DI5	Digital input 5
DI6	Digital input 6
DCM	Digital common
AI	Analog input
+10V	Internal power supply (DC 10V) @ 10 mA
AO	Analog output
ACM	Analog common

Note: 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 drive. Do not connect shield wire on both ends.

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GS2 Specifications — Basic Wiring Diagram

Note: Users MUST connect wiring according to the circuit diagram shown below. (Refer to user manual GS2-M for additional specific wiring information.)

Note: Refer to the following pages for explanations and information regarding line reactors, braking resistors, EMI and RF filters, and fuses:
13–50, 13–56, 13–61, 13–67, 13–68.

Power Source*

100-120V ±10%
200-240V ±10%
380-480V ±10%
500-600V -15%;+10%

(50,60Hz ±5%)

* Use terminals L1, L2 for 115V 1-phase models; use any two of L1, L2, L3 for 230V 1-phase models.
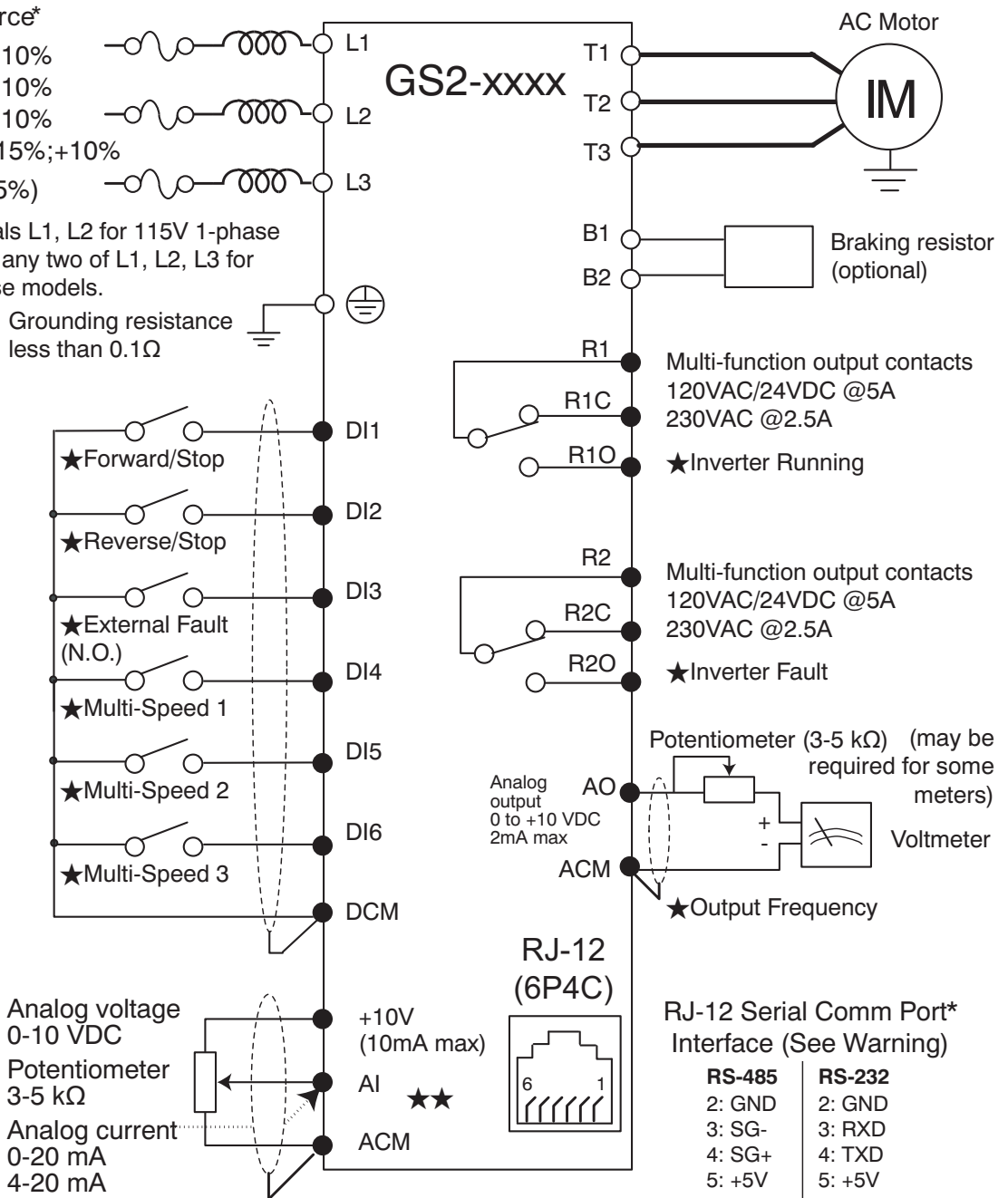
Grounding resistance less than 0.1Ω

L1
L2
L3

GS2-xxxx

T1
T2
T3

AC Motor

IM

B1
B2

Braking resistor (optional)

R1
R1C
R1O

Multi-function output contacts
120VAC/24VDC @5A
230VAC @2.5A
★Inverter Running

DI1
★Forward/Stop

DI2
★Reverse/Stop

DI3
★External Fault (N.O.)

DI4
★Multi-Speed 1

DI5
★Multi-Speed 2

DI6
★Multi-Speed 3

DCM

R2
R2C
R2O

Multi-function output contacts
120VAC/24VDC @5A
230VAC @2.5A
★Inverter Fault

AO

Analog output
0 to +10 VDC
2mA max

ACM

Potentiometer (3-5 kΩ)   (may be required for some meters)

+ -

Voltmeter

★Output Frequency

Analog voltage
0-10 VDC

Potentiometer
3-5 kΩ

Analog current
0-20 mA
4-20 mA

+10V
(10mA max)

AI ★★

ACM

RJ-12
(6P4C)

6   1

RJ-12 Serial Comm Port*
Interface (See Warning)

RS-485	RS-232
2: GND	2: GND
3: SG-	3: RXD
4: SG+	4: TXD
5: +5V	5: +5V

*Optional ZIPLink RS232 Communication cable GS-RJ12-CBL-2 and RS485 Communication cable GS-485HD15-CBL are available for connection to the DL05, DL06, D2-250-1 and D2-260 ports. See page 12-75.

★Factory default setting

★★Factory default source of frequency command is via the keypad potentiometer

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

WARNING: Do not plug a modem or telephone into the GS2 RJ-12 Serial Comm Port, or permanent damage may result. Terminals 2 and 5 should not be used as a power source for your communication connection.

GS2 Specifications — Dimensions

GS2-10P2, GS2-10P5, GS2-11P0; GS2-20P5, GS2-21P0, GS2-22P0;
GS2-41P0, GS2-42P0, GS2-43P0; GS2-51P0, GS2-52P0, GS2-53P0
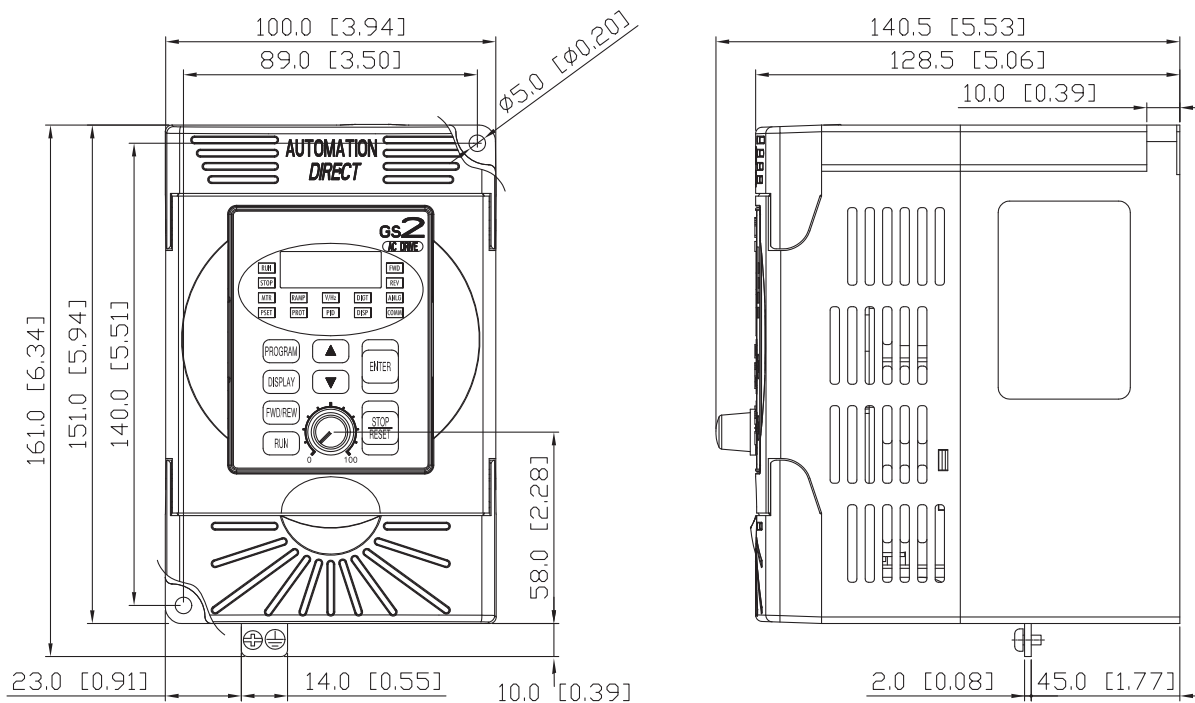
GS2-23P0, GS2-25P0, GS2-27P5;
GS2-45P0, GS2-47P5, GS2-4010; GS2-55P0, GS2-57P5, GS2-5010
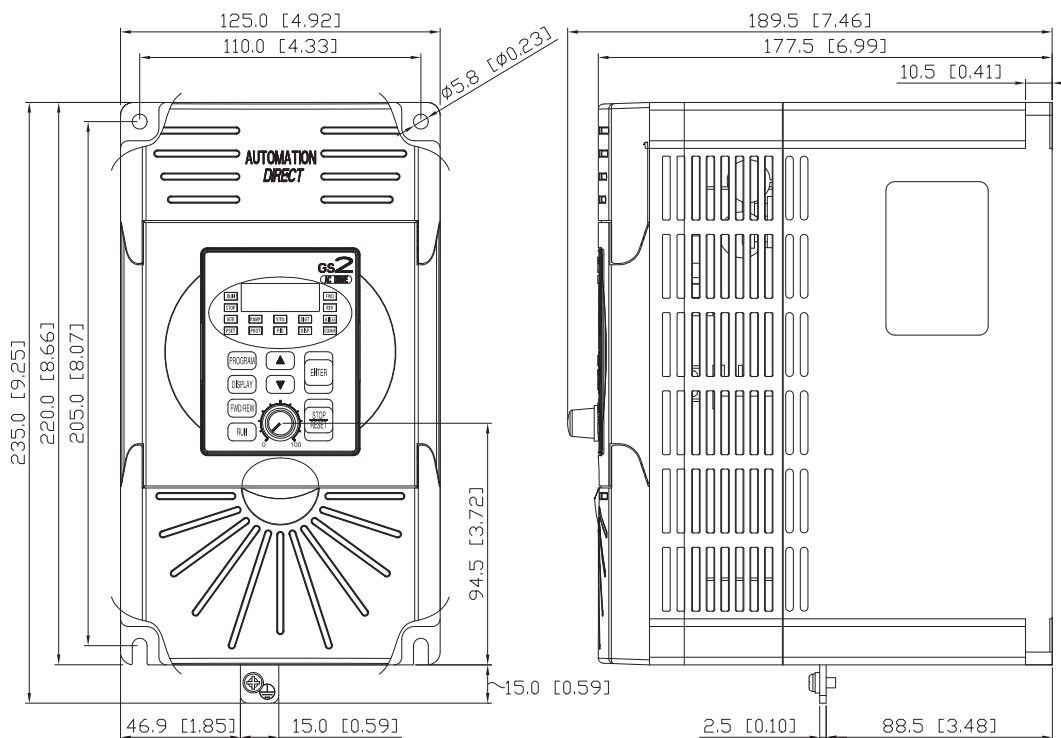
Company Info.

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DURAPULSE AC Drives – Introduction

DURApulse Drives																
Motor Rating	**Hp**	1	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100
	kW	.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Single/Three-Phase 230 Volt		✔	✔	✔												
Three-Phase 230 Volt Class					✔	✔	✔	✔	✔	✔	✔	✔	✔			
Three-Phase 460 Volt Class		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

Overview

The *DURAPULSE* series of AC drives offers all of the features of our GS2 series of drives including dynamic braking, PID, removable keypad and RS-485 Modbus communication. The *DURAPULSE* AC drive also offers sensorless vector control with the option of encoder feedback for enhanced speed control. The standard **smart** keypad (aka HIM or Human Interface Module) is designed with defaults for the North American customer and allows you to configure the drive, set the speed, start and stop the drive, and monitor critical parameters for your application. In addition, this keypad has internal memory that allows **four** complete programs to be stored and transferred to any *DURAPULSE* drive. The *DURAPULSE* series offers three analog inputs, eleven digital inputs, and one SPDT relay output.

Features

- Simple Volts/Hertz control
- Sensorless vector control with autotune
- Sensorless vector control with optional encoder feedback card, for better speed control
- Sinusoidal pulse width modulation (PWM)
- Variable carrier frequency, depending on model
- IGBT technology
- Starting torque: 125% @ 0.5 Hz/150% @ 1Hz
- 150% rated current for one minute
- Electronic overload protection
- Stall prevention
- Adjustable accel and decel ramps with linear and S-curve settings
- Automatic torque and slip compensation
- Internal dynamic braking circuit for models under 20 hp; optional baking units available for models 20 hp and above
- DC braking
- Five skip frequencies
- Trip history
- Programmable jog speed
- Integral PID control
- Removable **smart** keypad with parameter upload/download
- **HIM** Keypad with memory to store up to four programs of any *DURAPULSE* drive

- Eleven programmable digital inputs
- Three programmable analog inputs
- Three digital and one SPDT relay programmable outputs
- One programmable analog output
- One digital frequency output
- RS-485 Modbus communications
- Ethernet communication optional
- UL/cUL/CE listed

Accessories

- AC line reactors
- EMI filters
- RF filters
- Braking resistors
- Braking units (for models 20 hp and above)
- Fuse kits and replacement fuses
- Ethernet interface
- Replacement keypad
- Remote panel adapter
- Keypad cables in 1, 3, and 5 meter lengths
- Four and eight port RS-485 multi-drop termination boards
- KEP*Direct* I/O Server
- GSoft drive configuration software
- GS3-FB feedback card
- GS-485HD15-CBL *ZIP*Link RS485 Communication cable for connection to the DL06 and D2-260 15-pin ports

Detailed descriptions and specifications for the accessories are available in the "GS/DURAPULSE Accessories" section.

Typical Applications
- Conveyors
- Fans
- Pumps
- Compressors
- HVAC
- Material handling
- Mixing
- Shop tools
- Extruding
- Grinding

DURAPULSE part numbering system

GS3 - 2 020

Applicable Motor Capacity

1P0: 1HP	2P0: 2HP
3P0: 3HP	5P0: 5HP
7P5: 7.5HP	010: 10HP
015: 15HP	020: 20HP
025: 25HP	030: 30HP
040: 40HP	050: 50HP
060: 60HP*	075: 75HP*
100: 100HP*	

* 60, 75 and 100HP models available in GS3-4xxx only

Input Voltage
2: 200-240VAC
4: 380-480VAC

Series Name

DURA*PULSE* AC Drives Specifications

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230V Class

Model Name: GS3-xxx			21P0	22P0	23P0	25P0	27P5	2010	2015	2020	2025	2030	2040	2050
Price			<--->	<--->	<--->	<--->	<--->	<--->	<--->	<--->	<--->	<--->	<--->	<--->
Output Rating	Maximum Motor Output	HP	1.0	2.0	3.0	5.0	7.5	10	15	20	25	30	40	50
		kW	.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37
	Rated Output Current (A)		5	7	11	17	25	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		Single/Three-phase			Three-phase								
			200/208/220/230/240 VAC, 50/60Hz											
	Rated Input Current (A)		11.9 / 5.7	15.3 / 7.6	22 / 15.5	20.6	26	34	50	60	75	90	110	142
Voltage/Frequency Tolerance			Voltage: ± 10% Frequency: ± 5%											
Watt Loss @ 100% I (W)			60	82	130	194	301	380	660	750	920	1300	1340	1430
Weight (lb [kg])			4.5 [2.034]	4.5 [2.034]	9.4 [4.24]	9.4 [4.24]	13.3 [6.031]	13.3 [6.031]	14.3 [6.487]	26.5 [12]	26.5 [12]	26.5 [12]	77.2 [35]	77.2 [35]

* All DURApulse drives require a symmetrical 3-phase power source.
  Do not connect any DURApulse drives to grounded, center-tapped delta transformers (which are typically used for lighting circuits).

460V Class – Three-Phase

Model Name: GS3-xxx			41P0	42P0	43P0	45P0	47P5	4010	4015	4020	4025	4030	4040	4050	4060	4075	4100
Price			<--->	<--->	<--->	<--->	<--->	<--->	<--->	<--->	<--->	<--->	<--->	<--->	<--->	<--->	<--->
Output Rating	Maximum Motor Output	HP	1	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100
		kW	.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75
	Rated Output Current (A)		2.7	4.2	5.5	8.5	13	18	24	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, 380/400/415/440/460/480VAC, 50/60Hz														
	Rated Input Current (A)		3.2	4.3	5.9	11.2	14	19	25	32	39	49	60	63	90	130	160
Voltage/Frequency Tolerance			Voltage: ± 10% Frequency: ± 5%														
Watt Loss @ 100% I (W)			70	102	132	176	250	345	445	620	788	1290	1420	1680	2020	2910	3840
Weight (lb [kg])			3.9 [1.759]	4.4 [1.994]	4.1 [1.857]	9.4 [4.24]	13.2 [6.002]	13.5 [6.106]	14.4 [6.525]	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 DURApulse drives require a symmetrical 3-phase power source.
  Do not connect any DURApulse drives to grounded, center-tapped delta transformers (which are typically used for lighting circuits).

*DURA*PULSE AC Drives General Specifications

General Specifications			
Control Characteristics			
Control System			Pulse Width Modulation, Carrier frequency adjustable from 1k - 15kHz 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 braking resistor, 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 - 25.0 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 to 5 kΩ, 0 to 10 VDC (input impedance 10 kΩ), -10 to +10 VDC, 4 to 20 mA (input impedance 250Ω), 0 to 20 mA; Multi-Speed Inputs 1 to 4, RS-232C/RS-485 communication interface
	Operation Setting	**Keypad**	Setting by <RUN>, <STOP>, <JOG>, <FWD>, <REV> 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 10V (input impedance 10 kΩ), 0 to 20 mA, 4 to 20 mA (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
		Digital Square Wave	One digital square wave output representing drive frequency
		Analog	1 user-programmable, 0 to 10V, 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
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)
	Storage Temperature		-20°C to 60°C (-4°F to 140°F) – during short term transportation period
	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, dynamic braking unit; RF filter; remote panel adapter; Ethernet interface; four and eight port RS-485 multi-drop termination boards, replacement keypads, fuse kits and replacement fuses

DURA*PULSE* Drives Specifications – Installation

Understanding the installation requirements for your *DURAPULSE* AC drive will help to ensure that it operates within its environmental and electrical limits.

Note: Never use only this catalog for installation instructions or operation of equipment; refer to the user manual, GS3-M.

Environmental Specifications

| Environmental Specifications	
Protective Structure [1]	IP20
Ambient Operating Temperature [2]	-10 to 40°C (14°F to 104°F) f
Storage Temperature [3]	-20 to 60°C (-4°F to 140°F)
Humidity	To 90% (no condensation)
Vibration [4]	9.8 m/s² (1g), less than 10 Hz 5.9 m/s² (0.6g),10 to 60 Hz
Location	Altitude 1,000 m or less, indoors (no corrosive gases, liquids or dust)

1: Protective structure is based upon EN60529

2: The ambient temperature must be in the range of -10° to 40°C. If the range will be up to 50°C, you will need to set the carrier frequency to 2.1 kHz or less and derate the output current to 80% or less.

3: The storage temperature refers to the short-term temperature during transport.

4: Conforms to the test method specified in JIS CO911 (1984)

Watt-loss Chart

GS3 Drive Model	At full load
GS3-21P0	60
GS3-22P0	82
GS3-23P0	130
GS3-25P0	194
GS3-27P5	301
GS3-2010	380
GS3-2015	660
GS3-2020	750
GS3-2025	920
GS3-2030	1300
GS3-2040	1340
GS3-2050	1430
GS3-41P0	70
GS3-42P0	102
GS3-43P0	132
GS3-45P0	176
GS3-47P5	250
GS3-4010	345
GS3-4015	445
GS3-4020	620
GS3-4025	788
GS3-4030	1290
GS3-4040	1420
GS3-4050	1680
GS3-4060	2020
GS3-4075	2910
GS3-4100	3840
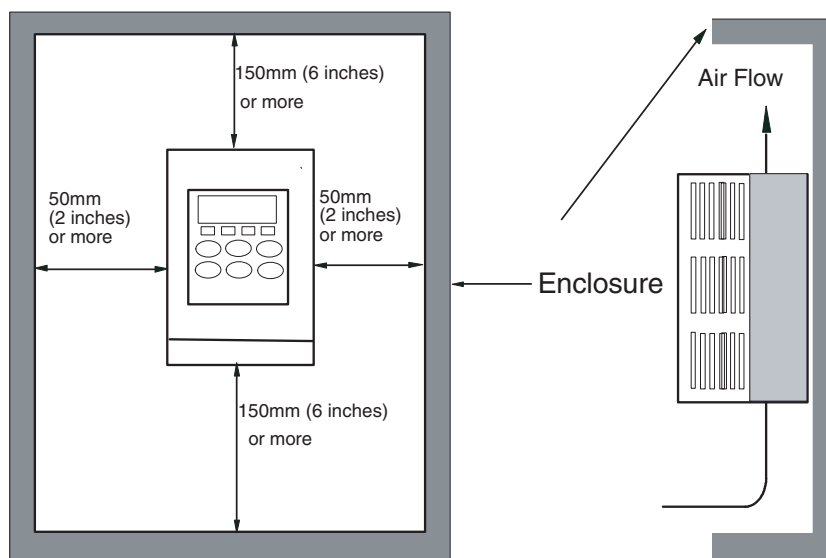
Minimum Clearances and Air Flow

⚠ **Warning: AC drives generate a large amount of heat which may damage the AC drive. Auxiliary cooling methods are typically required in order not to exceed maximum ambient temperatures.**

⚠ **Warning: Maximum ambient temperatures must not exceed 50°C (122°F), or 40°C (104°F) for models 7.5 hp (5.5 kW) and higher!**

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Software

C-more & other HMI

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AC Motors

Power Transmiss.

Steppers/ Servos

Motor Controls

Proximity Sensors

Photo Sensors

Limit Switches

Encoders

Current Sensors

Pressure Sensors

Temp. Sensors

Pushbuttons/ Lights

Process

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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

GS3-4030 shown

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	
DI2	Digital Input 2	
DI3	Digital Input 3	
DI4	Digital Input 4	Input Voltage: Internally Supplied (see Warning below)
DI5	Digital Input 5	Sink Mode: Low active, VinL Min = 0V, VinL Max = 15V,
DI6	Digital Input 6	Iin Min = 2.1mA, Iin Max = 7.0mA
DI7	Digital Input 7	Source Mode: High active, VinH Min = 8.5V, VinH Max = 24V, Iin Min = 2.1mA, Iin Max = 7.0mA
DI8	Digital Input 8	Input response: 12 - 15 msec
DI9	Digital Input 9	Also see "Basic Wiring Diagram" on the next pages.
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 20mA / 4 to 20mA input
AI3	Analog Input	-10 to +10 V input only
ACM	Analog Common	
R1O	Relay Output 1 Normally Open	Resistor Load: 240VAC - 5A (N.O) / 3A (N.C.)
R1C	Relay Output 1 Normally Closed	24VDC - 5A (N.O.) / 3A (N.C.) Inductive Load:
R1	Relay Output 1 Common	240VAC - 1.5A (N.O) / 0.5A (N.C) 24VDC - 1.5A (N.O) / 0.5A (N.C) See P 3.01 to P 3.03
DO1	Photocoupled digital output	
DO2	Photocoupled digital output	Maximum 48VDC, 50mA
DO3	Photocoupled digital output	
DOC	Digital Output Common	
AO	Analog Output	0 to +10 V 2mA Output
FO	Digital Frequency Output	Square wave pulse train output

⚠ **WARNING: Do NOT connect external voltage sources to the digital inputs. Permanent damage may result.**
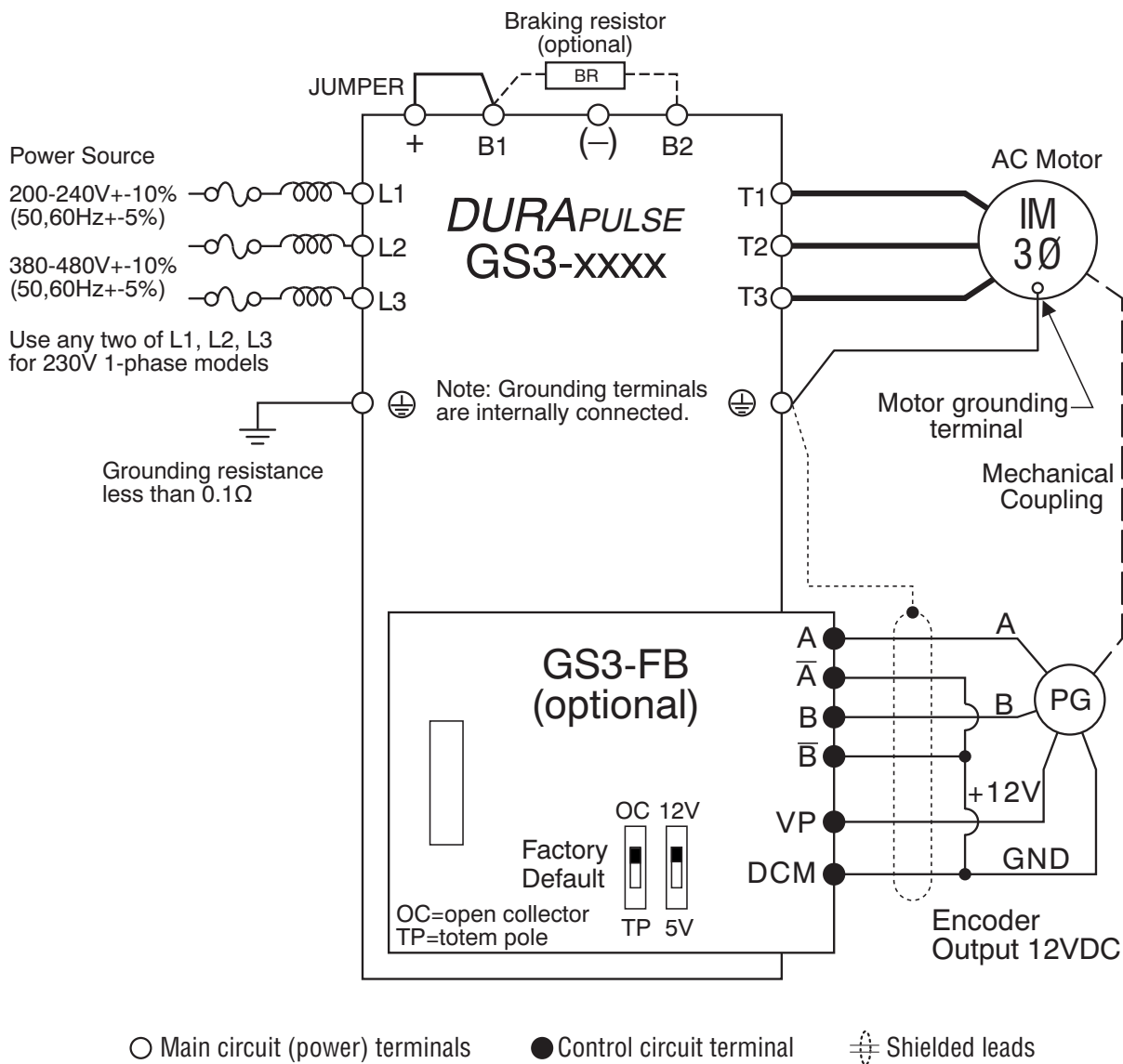
📝 *NOTE: USE TWISTED-SHIELDED, TWISTED-PAIR OR SHIELDED-LEAD WIRES FOR THE CONTROL SIGNAL WIRING. IT IS RECOMMENDED TO RUN ALL SIGNAL WIRING IN A SEPARATE STEEL CONDUIT. THE SHIELD WIRE SHOULD ONLY BE CONNECTED AT THE AC DRIVE. DO NOT CONNECT SHIELD WIRE ON BOTH ENDS.*

DURA*PULSE* AC Drives – Basic Wiring Diagram

Power Wiring Diagram - drives under 20 hp

Note: Users MUST connect wiring according to the circuit diagram shown below. (Refer to user manual GS3-M for additional specific wiring information.)

Note: Refer to the following pages for explanations and information regarding feedback cards, line reactors, braking resistors, EMI and RF filters, and fuses: 13–48, 13–50, 13–56, 13–61, 13–67, 13–68.

Braking resistor (optional)

JUMPER

Power Source

200-240V+-10%
(50,60Hz+-5%)

380-480V+-10%
(50,60Hz+-5%)

Use any two of L1, L2, L3
for 230V 1-phase models

Grounding resistance
less than 0.1Ω

DURA*PULSE*
GS3-xxxx

AC Motor

IM
3∅

Note: Grounding terminals
are internally connected.

Motor grounding
terminal

Mechanical
Coupling

GS3-FB
(optional)

Factory
Default

OC=open collector
TP=totem pole

PG

Encoder
Output 12VDC

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

WARNING: Do not plug a modem or telephone into the GS3/DURA*PULSE* RJ-12 Serial Comm Port, or permanent damage may result. Terminals 2 and 5 should not be used as a power source for your communication connection.

Company Info.

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DURAPULSE AC Drives – Basic Wiring Diagram

Power Wiring Diagram – 20 to 30 hp (230 VAC) & 20 to 60 hp (460 VAC)

Note: *Users MUST connect wiring according to the circuit diagram shown below. (Refer to user manual GS3-M for additional specific wiring information.)*

Note: *Refer to the following pages for explanations and information regarding feedback cards, line reactors, braking units and resistors, EMI and RF filters, and fuses:*
13–48, 13–50, 13–54, 13–56, 13–61, 13–67, 13–68.

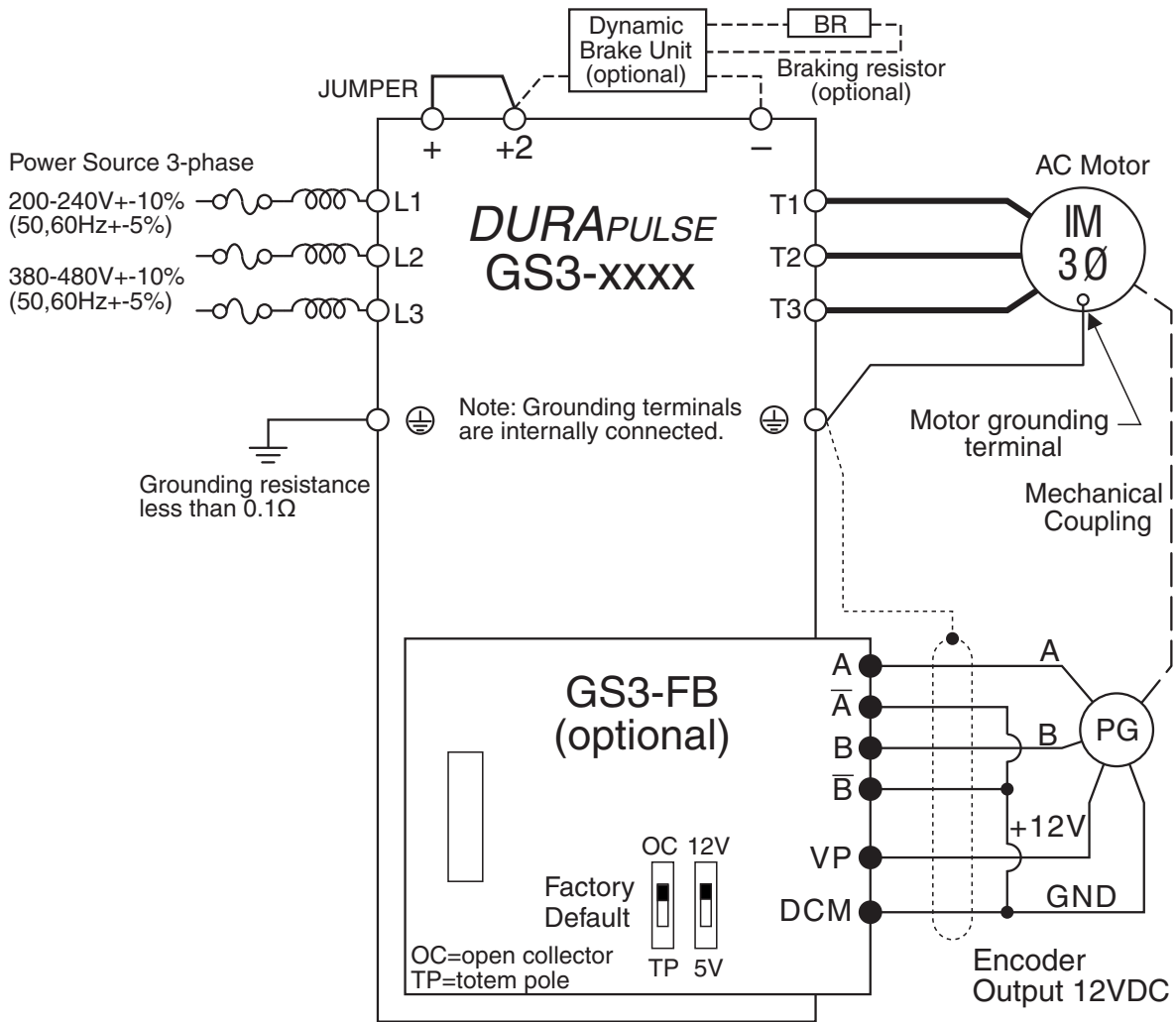○ Main circuit (power) terminals   ● Control circuit terminal   Shielded leads

WARNING: **Do not plug a modem or telephone into the GS3/*DURAPULSE* RJ-12 Serial Comm Port, or permanent damage may result. Terminals 2 and 5 should not be used as a power source for your communication connection.**

*DURA*PULSE AC Drives – Basic Wiring Diagram

Power Wiring Diagram - 40 to 50 hp (230 VAC) & 75 to 100 hp (460 VAC)

Note: Users MUST connect wiring according to the circuit diagram shown below. (Refer to user manual GS3-M for additional specific wiring information.)

Note: Refer to the following pages for explanations and information regarding feedback cards, line reactors, braking units and resistors, EMI and RF filters, and fuses:
13–48, 13–50, 13–54, 13–56, 13–61, 13–67, 13–68.

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

⚠ **WARNING:** Do not plug a modem or telephone into the GS3/*DURA*PULSE RJ-12 Serial Comm Port, or permanent damage may result. Terminals 2 and 5 should not be used as a power source for your communication connection.
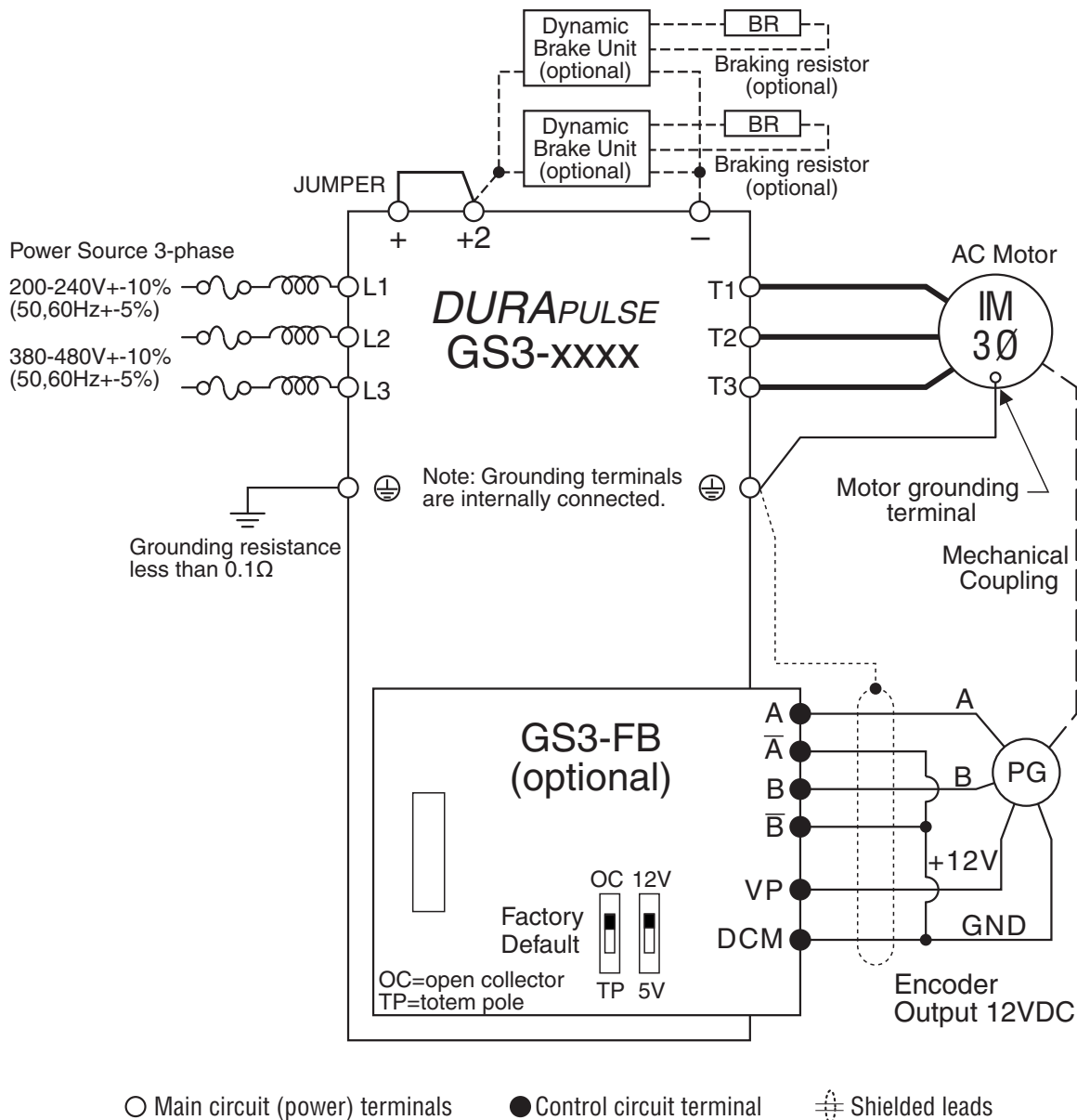
Automation Direct

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Control Wiring Diagram - Digital Input Connections to Sinking Output Devices

NOTE: USERS MUST CONNECT WIRING ACCORDING TO THE CIRCUIT DIAGRAM SHOWN BELOW.

*DURA*PULSE
AC Drive
GS3-xxxx

Multi-function Digital Inputs:

★Forward/Stop — DI1
★Reverse/Stop — DI2
★External Fault (N.O.) — DI3
★Multi-Speed 1 — DI4
★Multi-Speed 2 — DI5
★Multi-Speed 3 — DI6
★Multi-speed 4 — DI7
★JOG — DI8
★External Reset — DI9
★Second Accel/Decel Time — DI10
★External Base Block (N.O.) — DI11

+24V Power Source (20mA max.)

Input Mode Setting
Sink
SW1
Source
★Sink

DCM Digital Signal Com.

See Power Wiring Diag.

Analog Inputs:

Potentiometer 5kΩ

★★

† +10V Power Source (20mA max.)
† AI1 (0 to 10V)
† AI2 (0-20mA or 4-20mA)
† AI3 (-10 to +10V)
† ACM Analog Signal Common

† Frequency command source can be one of the three analog inputs, up/down keys on keypad or via the RS-485 serial comm port. See parameter settings.

See Power Wiring Diagram

Multi-function Output Contact:

R1
R1C
R1O

120VAC/24VDC @5A
230VAC @2.5A
★AC Drive Running

Multi-function Digital Outputs:

DO1
48VDC @50mA max.
★AC Drive Fault

DO2
48VDC @50mA max.
★At Speed

DO3
48VDC @50mA max.
★Zero Speed

DOC
Digital Output Com.

Digital Frequency Output:

FO

★1:1, Duty = 50%

DCM

Multi-function Analog Output:

AO

Potentiometer (3-5 kΩ)

ACM

★Indicates Output Frequency Hz.

0-10VDC @ 2mA

RJ-12 Serial Comm Port*
Interface (See Warning)
RS-485
1: +15V
2: GND
3: SG-
4: SG+
5: NC

6 → 1

Optional ZIPLink RS485 Communication cable GS-485HD15-CBL available for connection to the DL06 and D2-260 15-pin ports. See page 12-75.

★Factory default setting

★★Factory default source of frequency command is via the keypad up/down keys
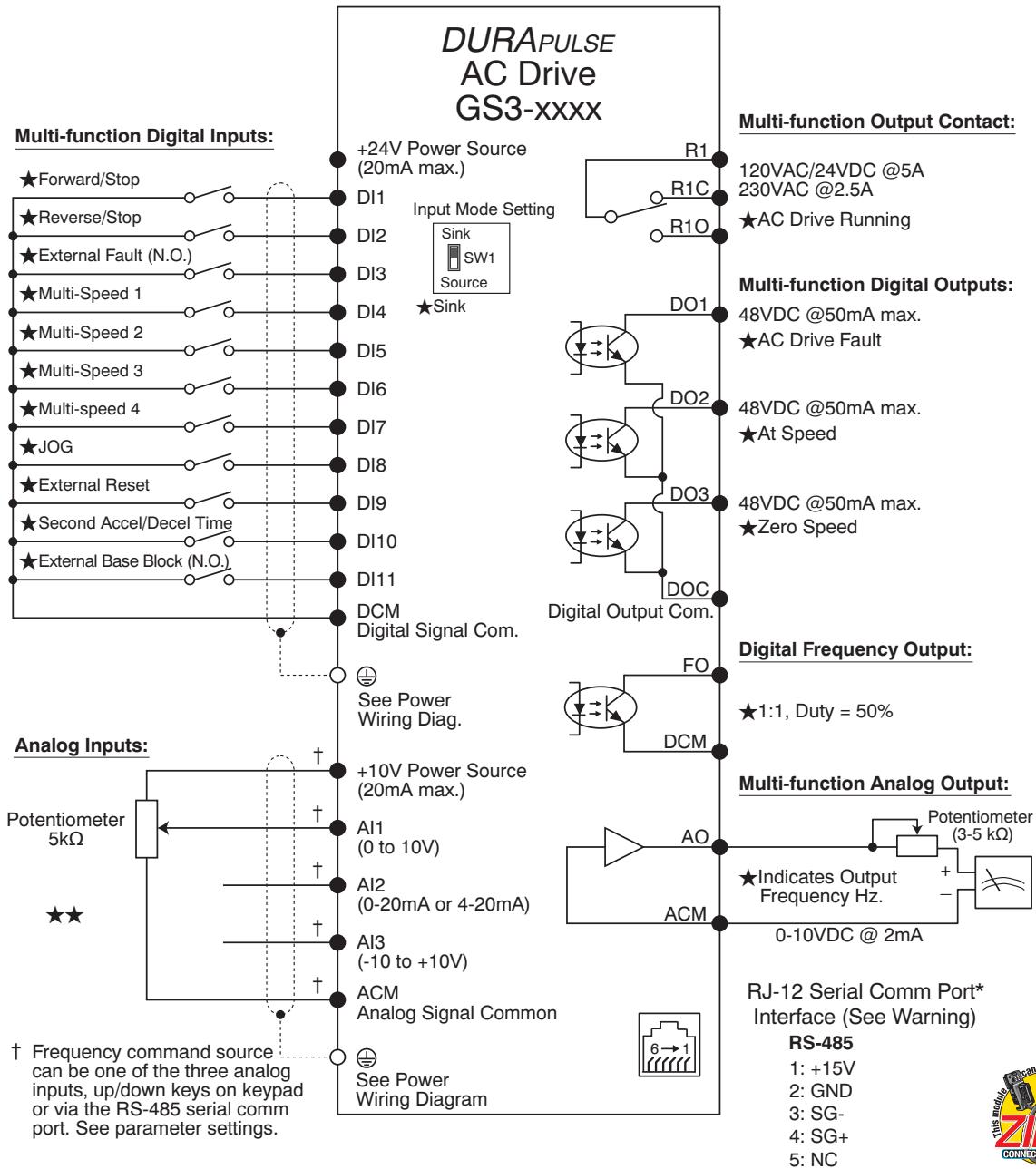
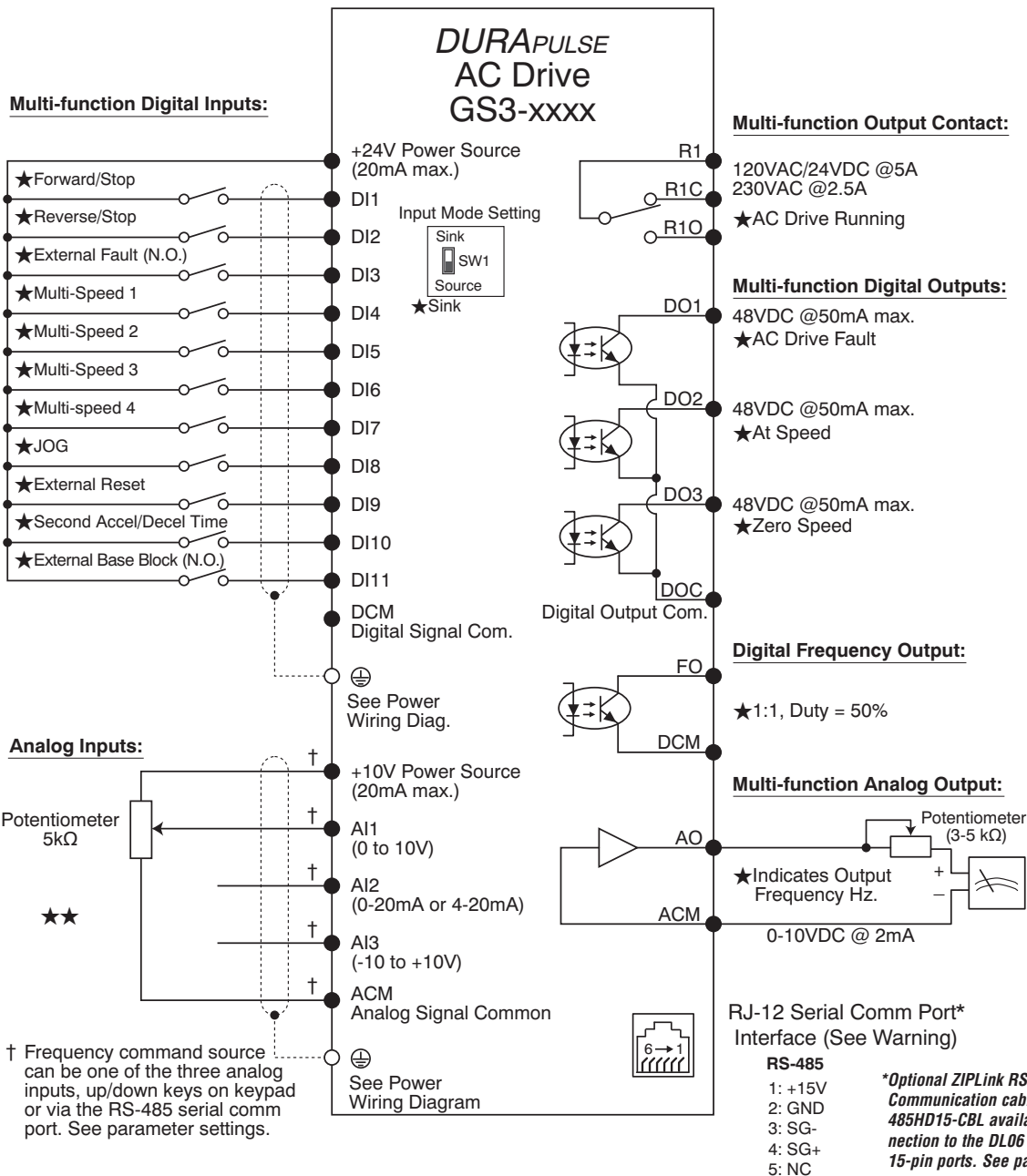○ Main circuit (power) terminals   ● Control circuit terminal   ⏚ Shielded leads
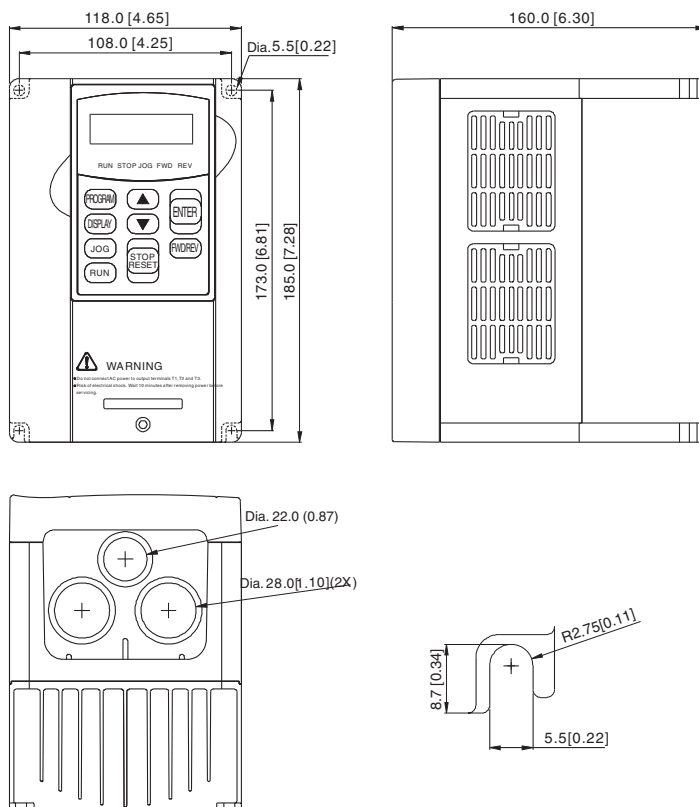
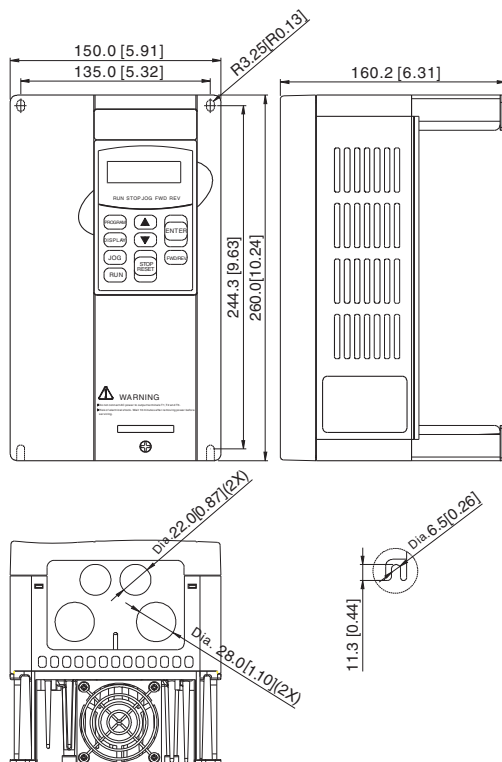WARNING: Do not plug a modem or telephone into the *DURAPULSE* RJ-12 Serial Comm Port, or permanent damage may result.

DURA*PULSE* AC Drives – Control Wiring Diagram – DI Connections to Sourcing Outputs

Control Wiring Diagram - Digital Input Connections to Sourcing Output Devices

NOTE: USERS MUST CONNECT WIRING ACCORDING TO THE CIRCUIT DIAGRAM SHOWN BELOW.

DURA*PULSE* AC Drive GS3-xxxx

Multi-function Digital Inputs:

- ★Forward/Stop — DI1
- ★Reverse/Stop — DI2
- ★External Fault (N.O.) — DI3
- ★Multi-Speed 1 — DI4
- ★Multi-Speed 2 — DI5
- ★Multi-Speed 3 — DI6
- ★Multi-speed 4 — DI7
- ★JOG — DI8
- ★External Reset — DI9
- ★Second Accel/Decel Time — DI10
- ★External Base Block (N.O.) — DI11

+24V Power Source (20mA max.)

Input Mode Setting
Sink
SW1
Source
★Sink

DCM Digital Signal Com.

See Power Wiring Diag.

Analog Inputs:

Potentiometer 5kΩ

★★

+10V Power Source (20mA max.) †

AI1 (0 to 10V) †

AI2 (0-20mA or 4-20mA) †

AI3 (-10 to +10V) †

ACM Analog Signal Common †

See Power Wiring Diagram

† Frequency command source can be one of the three analog inputs, up/down keys on keypad or via the RS-485 serial comm port. See parameter settings.

Multi-function Output Contact:

R1
R1C
R1O

120VAC/24VDC @5A
230VAC @2.5A
★AC Drive Running

Multi-function Digital Outputs:

DO1
48VDC @50mA max.
★AC Drive Fault

DO2
48VDC @50mA max.
★At Speed

DO3
48VDC @50mA max.
★Zero Speed

DOC
Digital Output Com.

Digital Frequency Output:

FO

DCM

★1:1, Duty = 50%

Multi-function Analog Output:

AO

ACM

Potentiometer (3-5 kΩ)

★Indicates Output Frequency Hz.

0-10VDC @ 2mA

+
–

RJ-12 Serial Comm Port* Interface (See Warning)

6 → 1

RS-485
1: +15V
2: GND
3: SG-
4: SG+
5: NC

*Optional ZIPLink RS485 Communication cable GS-485HD15-CBL available for connection to the DL06 and D2-260 15-pin ports. See page 12-75.

★Factory default setting

★★Factory default source of frequency command is via the keypad up/down keys

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

WARNING: Do not plug a modem or telephone into the DURA*PULSE* RJ-12 Serial Comm Port, or permanent damage may result.

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C-more & other HMI
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Power Transmiss.
Steppers/ Servos
Motor Controls
Proximity Sensors
Photo Sensors
Limit Switches
Encoders
Current Sensors
Pressure Sensors
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DURAPULSE AC Drives — Dimensions

GS3-21P0, GS3-22P0, GS3-41P0, GS3-42P0

118.0 [4.65]
108.0 [4.25]
Dia.5.5[0.22]
160.0 [6.30]
173.0 [6.81]
185.0 [7.28]

RUN STOP JOG FWD REV

PROGRAM
DISPLAY
JOG
RUN
▲
▼
STOP
RESET
ENTER
FWD/REV

⚠ WARNING

Dia. 22.0 (0.87)
Dia. 28.0[1.10](2X)

R2.75[0.11]
8.7 [0.34]
5.5[0.22]

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

150.0 [5.91]
135.0 [5.32]
R3.25[R0.13]
160.2 [6.31]
244.3 [9.63]
260.0[10.24]

RUN STOP JOG FWD REV

PROGRAM
DISPLAY
JOG
RUN
▲
▼
STOP
RESET
ENTER
FWD/REV

⚠ WARNING

Dia.22.0[0.87](2X)
Dia. 28.0[1.10](2X)
Dia.6.5[0.26]
11.3 [0.44]

unit: mm(in)

DURAPULSE AC Drives — Dimensions

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

200.0 [7.88]
185.6 [7.31]
Dia. 7.0 (0.28)
183.2 [7.22]
303.0 [11.94]
323.0 [12.73]

"A"

Dia. 22.0(0.87)   Dia. 42.6(1.68)

R3.5 [R0.14]
13.5 [0.53]
7.0 [0.28]
DETAIL "A"
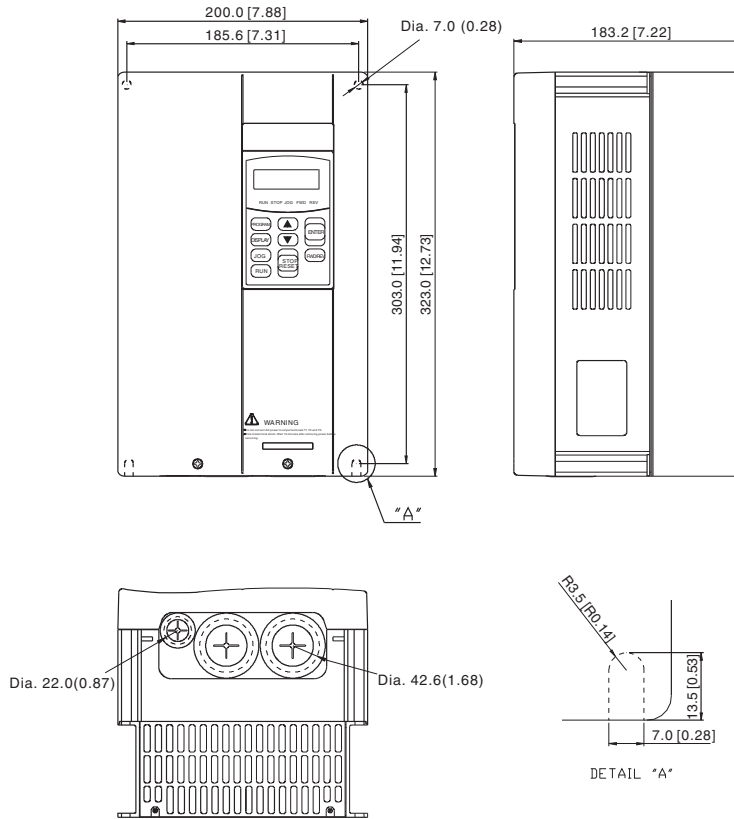
GS3-2020, GS3-2025, GS3-2030, GS3-4020, GS3-4025, GS3-4030

250.0 [9.84]
226.0 [8.90]
Dia. 10.0 [0.39]
205.4 [8.08]
384.0 [15.12]
403.8 [15.90]

Dia. 28.0 (1.1)   Dia. 42.0 (1.65)(2X)

13.0 [0.51]   10.0 [0.39]

unit: mm(in)

Automation Direct

Company Info.

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DURAPULSE AC Drives — Dimensions

GS3-2040, GS3-2050, GS3-4040, GS3-4050, GS3-4060
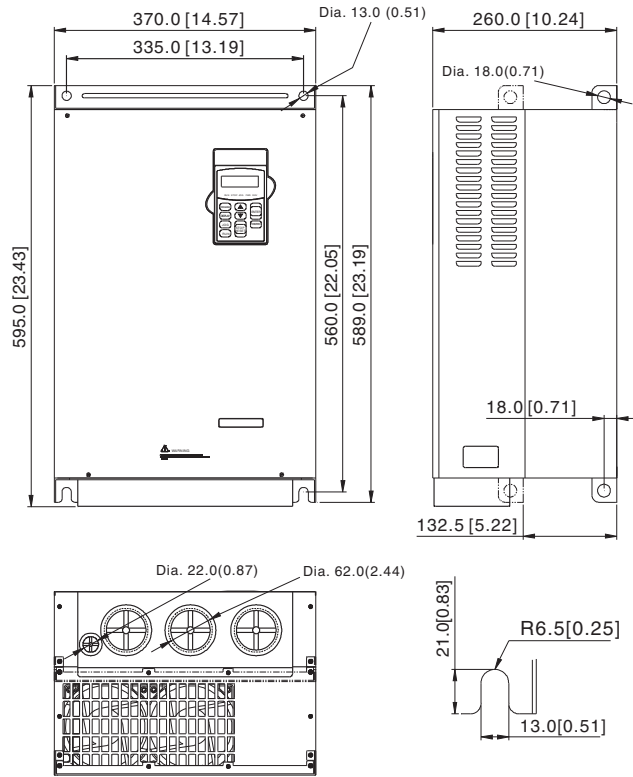
GS3-43P0
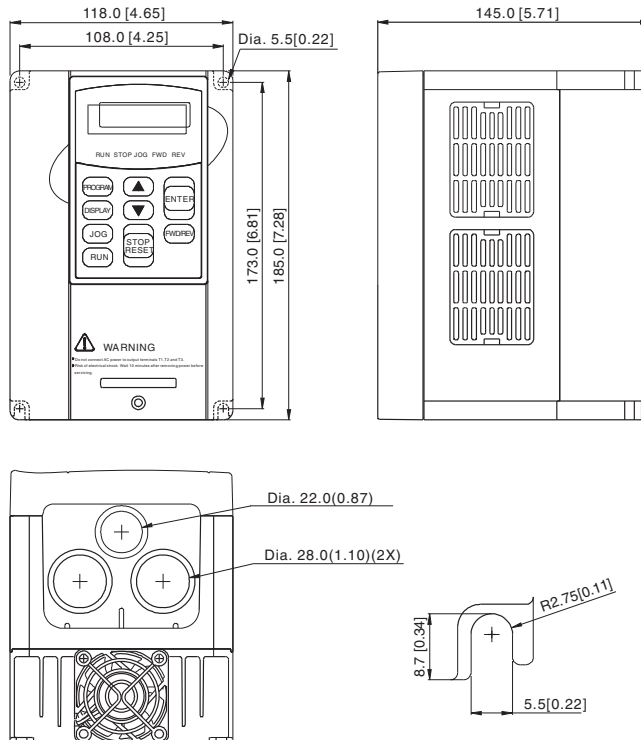
unit: mm(in)

DURAPULSE AC Drives — Dimensions

GS3-4075, GS3-4100

425.0 [16.73]
385.0 [15.16]
Dia. 13.0(0.51)
631.0 [24.84]
660.0 [25.98]

264.0 [10.39]
Dia.18.0(0.71)
18.0 [0.71]
130.4 [5.13]
280.0 [11.02]

Dia. 22.0(0.87)   Dia. 74.8(2.94)

21.0[0.83]
R6.5[0.25]
13.0[0.51]

unit: mm(in)

Company Info.

PLCs

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Part Index

GS/*DURAPULSE* Accessories – Overview

Accessories part numbering system

Note: With the exception of the EMI filters and RF filters, 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 at right shows the accessory part numbering system.

GS - 23P0 - LR - 3PH

Description Code (optional)
1PH: Single-phase   **3PH**: Three-phase   **ENC**: Enclosure
Blank: For reactor, check specific part # to determine phase

Accessory Code
BR: Braking resistor   **FKIT**: Fuse Kit
FUSE: Replacement fuses for FKIT   **LR**: Line reactor

Drive Rating (See Drive P/N description)
BZL: Bezel   **CBL**: Cable   **DBU**: Dynamic Brake Unit
EDRV: Ethernet board   **FB**: Feedback board
KPD: Keypad   **RS**: Recommended Standard

Drive Series
GS: All GS and DURApulse Series Drives
GS1: GS1 Series   **GS2**: GS2 Series
GS3: DURApulse Series

Under 20hp

❶ Power Supply

Please follow the specific power supply requirements shown in Chapter 1 and the Warning section of the applicable GS or *DURAPULSE* AC Drives User Manual.

❷ Fuses (Refer to page 13–68.)

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. *(AutomationDirect fuses are not available for GS1 drives.)*

❸ Contactor (Optional) (Refer to the Motor Controls section.)

Do not use a contactor or disconnect switch for run/stop control of the AC drive and motor. This will reduce the operating life cycle of the AC drive. Cycling a power circuit switching device while the AC drive is in run mode should be done only in emergency situations.

❹ Input Line Reactor (Optional) (Refer to page 13–50.)

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

❺ EMI filter (Optional) (Refer to page 13–61.)

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. *(Separate EMI filters are not neccessary for GS1 drives.)*

❻ RF filter (Optional) (Refer to page 13–67.)

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

❼ Braking Resistor (Optional) (Refer to page 13–56.)

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. The addition of optional braking may be required for applications that require rapid deceleration or high inertia loads. *(Braking resistors are not available for GS1 drives.)*
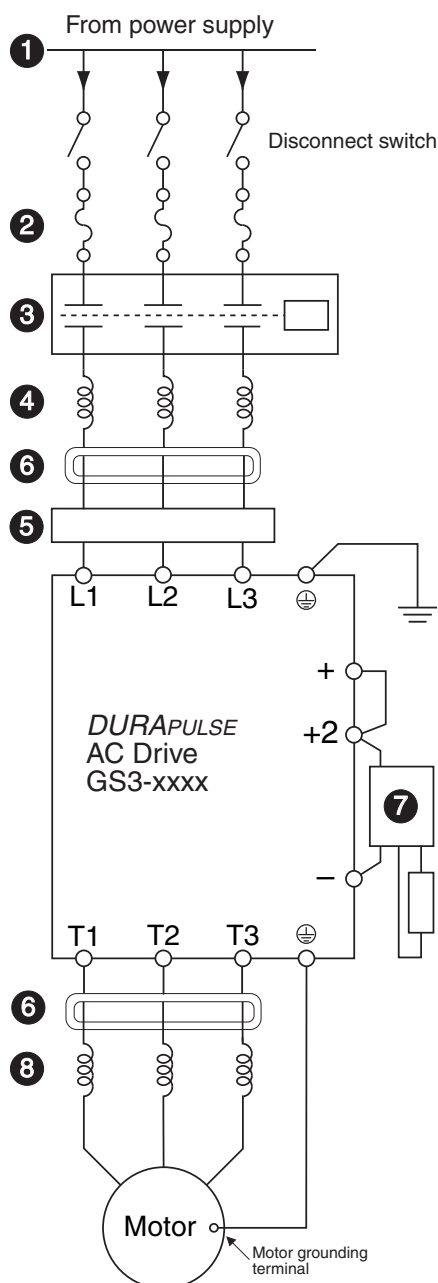
❽ Output Line Reactor (Optional) (Refer to page 13–50.)

Output line reactors protect the motor insulation against AC drive short circuits and IGBT reflective wave damage, and also "smooth" the motor current waveform, allowing the motor to run cooler. They are **recommended for operating "non-inverter-duty" motors** and when the **length of wiring between the AC drive and motor exceeds 75 feet**.
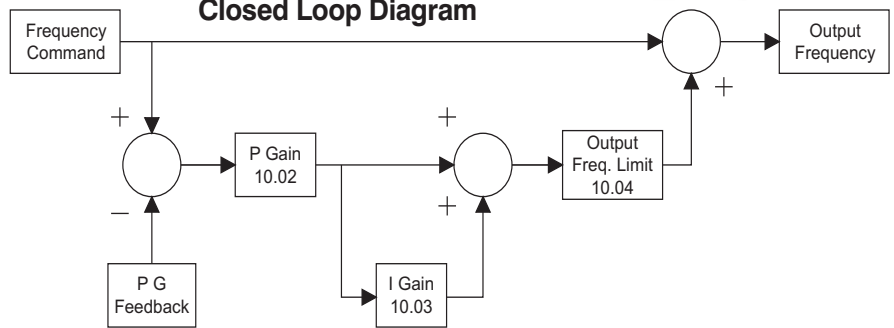
GS/*DURA*PULSE Accessories – Overview

20hp & Over
(*DURA*PULSE only)

From power supply

1

Disconnect switch

2

3

4

6

5

L1   L2   L3   ⏚

+
+2

7

−

*DURA*PULSE
AC Drive
GS3-xxxx

T1   T2   T3   ⏚

6

8

Motor

Motor grounding terminal

❶ Power Supply

Please follow the specific power supply requirements shown in Chapter 1 of the *DURA*PULSE AC Drives User Manual.

❷ Fuses (Refer to page 13–68.)

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.

❸ Contactor (Optional) (Refer to the Motor Controls section.)

Do not use a contactor or disconnect switch for run/stop control of the AC drive and motor. This will reduce the operating life cycle of the AC drive. Cycling a power circuit switching device while the AC drive is in run mode should be done only in emergency situations.

❹ Input Line Reactor (Optional) (Refer to page 13–50.)

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

❺ EMI filter (Optional) (Refer to page 13–61.)

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.

❻ RF filter (Optional) (Refer to page 13–67.)

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

❼ Braking Unit & Braking Resistor (Optional) (pg 13–54)

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. The addition of optional braking may be required for applications that require rapid deceleration or high inertia loads.

❽ Output Line Reactor (Optional) (Refer to page 13–50.)

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

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Limit Switches
Encoders
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Pressure Sensors
Temp. Sensors
Pushbuttons/ Lights
Process
Relays/ Timers
Comm.
Terminal Blocks & Wiring
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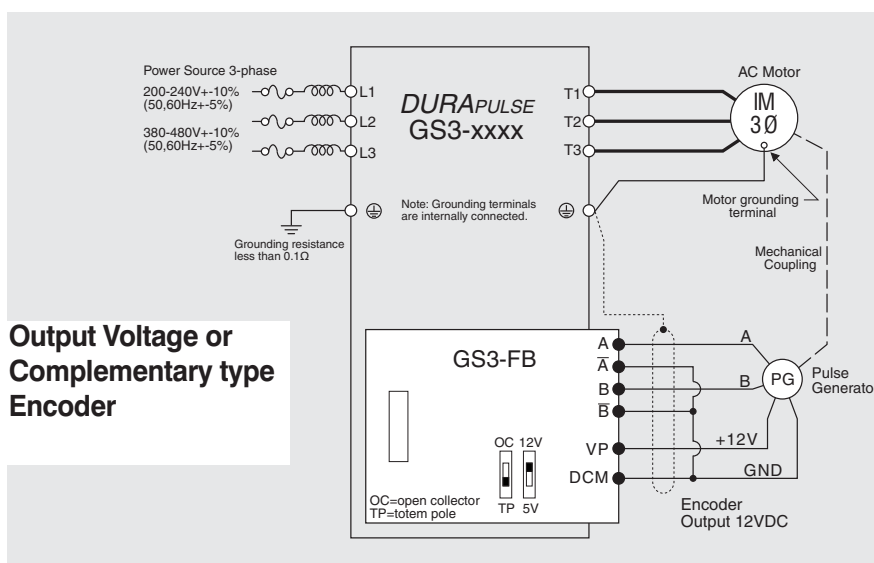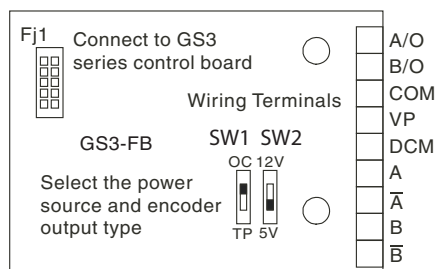# GS/*DURAPULSE* Accessories – Feedback Card

Description

The GS3-FB card is used to add another layer of precision control to the already precise control algorithm utilized in the *DURAPULSE* drive series. This added control is activated by selecting control modes V/Hz closed loop control or sensor-less vector with external feedback. The feedback mechanism uses pulses generated by an external encoder or pulse generator. Unlike other feedback types, the GS3-FB accommodates the four most common encoder signal types: output voltage, open collector, line driver, and complimentary.

Closed Loop Diagram

Types of Encoders		SW1 and SW2 switches	
		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
Complimentary		OC 12V / TP 5V	OC 12V / TP 5V

GS/*DURAPULSE* Accessories – Feedback Card

Wiring Diagrams

Automation Direct

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Power Transmiss.

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Proximity Sensors

Photo Sensors

Limit Switches

Encoders

Current Sensors

Pressure Sensors

Temp. Sensors

Pushbuttons/ Lights

Process

Relays/ Timers

Comm.

Terminal Blocks & Wiring

Power

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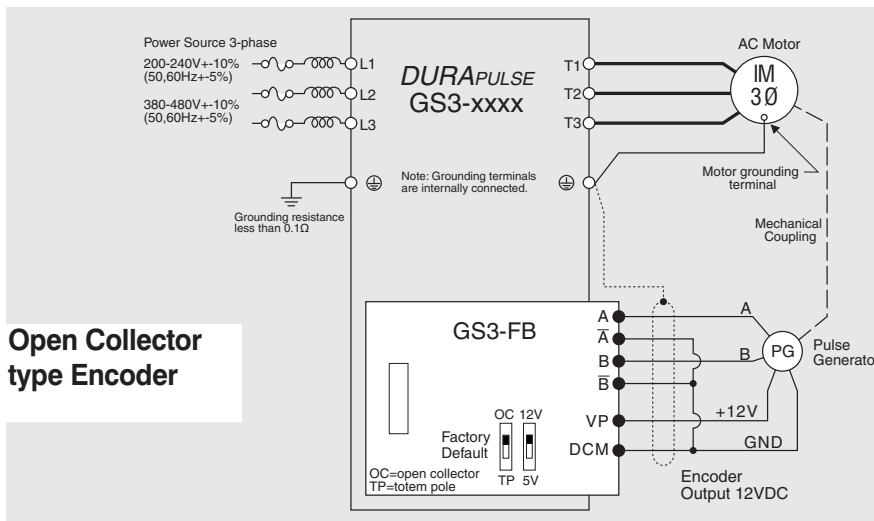
Open Collector type Encoder

Power Source 3-phase
200-240V+-10% (50,60Hz+-5%)
380-480V+-10% (50,60Hz+-5%)

L1
L2
L3

DURAPULSE GS3-xxxx

T1
T2
T3

AC Motor IM 3Ø

Note: Grounding terminals are internally connected.

Grounding resistance less than 0.1Ω

Motor grounding terminal

Mechanical Coupling

GS3-FB

A
Ā
B
B̄
VP
DCM

A
B
+12V
GND

PG Pulse Generator

Factory Default

OC 12V

OC=open collector
TP=totem pole

TP 5V

Encoder Output 12VDC

Terminal Symbols	Description
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
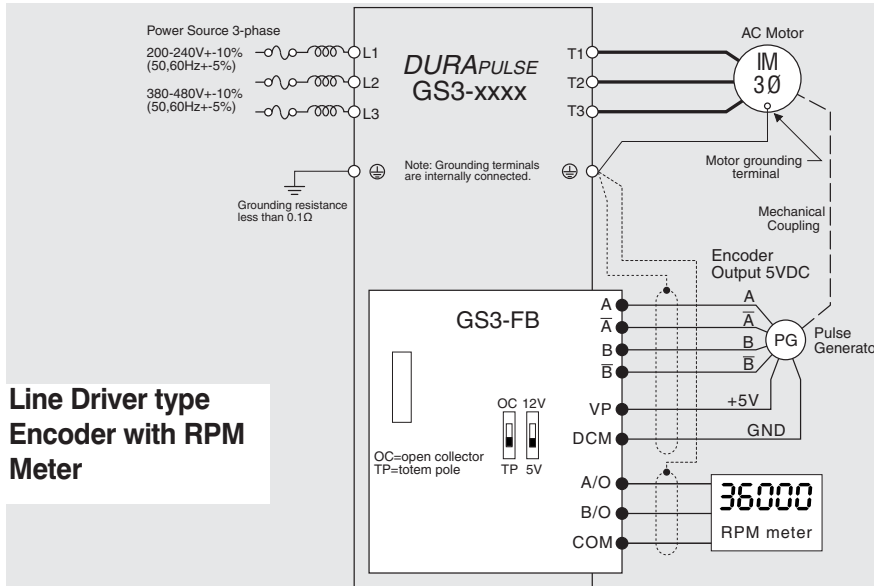
Line Driver type Encoder with RPM Meter

Power Source 3-phase
200-240V+-10% (50,60Hz+-5%)
380-480V+-10% (50,60Hz+-5%)

L1
L2
L3

DURAPULSE GS3-xxxx

T1
T2
T3

AC Motor IM 3Ø

Note: Grounding terminals are internally connected.

Grounding resistance less than 0.1Ω

Motor grounding terminal

Mechanical Coupling

Encoder Output 5VDC

GS3-FB

A
Ā
B
B̄
VP
DCM
A/O
B/O
COM

A
Ā
B
B̄
+5V
GND

PG Pulse Generator

OC 12V

OC=open collector
TP=totem pole

TP 5V

36000 RPM meter

Control Terminals Block Designations

Fj1

Connect to GS3 series control board

Wiring Terminals

GS3-FB

SW1 SW2

Select the power source and encoder output type

OC 12V

TP 5V

A/O
B/O
COM
VP
DCM
A
Ā
B
B̄

Output Voltage or Complementary type Encoder

Power Source 3-phase
200-240V+-10% (50,60Hz+-5%)
380-480V+-10% (50,60Hz+-5%)

L1
L2
L3

DURAPULSE GS3-xxxx

T1
T2
T3

AC Motor IM 3Ø

Note: Grounding terminals are internally connected.

Grounding resistance less than 0.1Ω

Motor grounding terminal

Mechanical Coupling

GS3-FB

A
Ā
B
B̄
VP
DCM

A
B
+12V
GND

PG Pulse Generator

OC 12V

OC=open collector
TP=totem pole

TP 5V

Encoder Output 12VDC

GS/*DURAPULSE* Drives Accessories – Line Reactors

Input side of the drive

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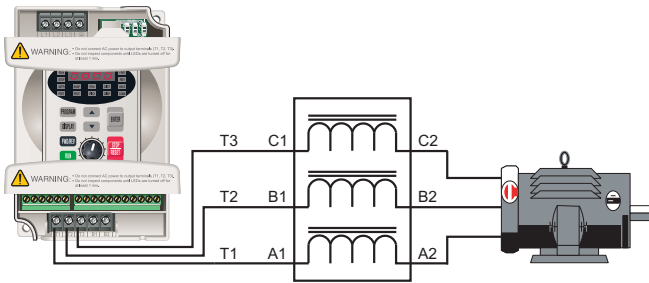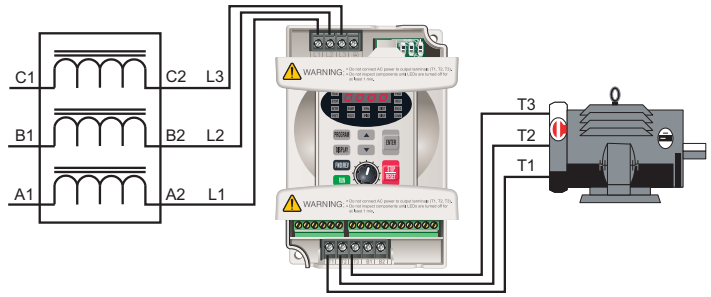
Output side of the drive

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

Note: Single phase line reactors should not be installed on the output of the AC Drive. Use three-phase only.

Multiple drives

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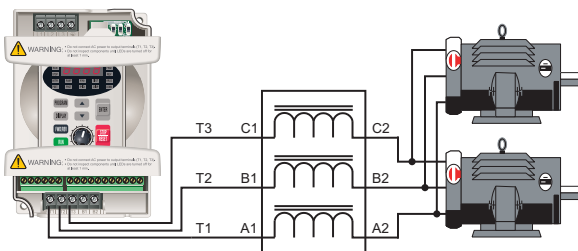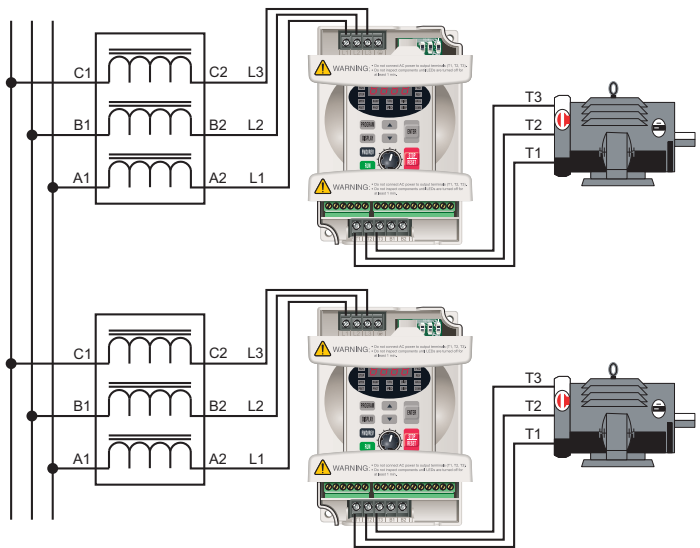
Multiple motors

A single reactor can be used when the application calls for multiple motors on the same drive. The reactor is sized based upon the total horsepower of all the motors. **Overload relays** (not shown) **are recommended** for use in multi-motor applications.

Note: A single reactor should only be used with multiple motors when the motors will always operate simultaneously.

Single phase applications

Some of the line reactors are listed for use with single-phase input power. Follow the connection diagram to the left. Make sure that terminals B1 and B2 are properly insulated before any connections are made.

⚠ **WARNING: Please ensure that terminals B1 and B2 are properly insulated before making any connections to single-phase power.**

GS/*DURAPULSE* Drives Accessories – Line Reactors

115 Volt Single-Phase Input Reactors

NOTE: Single phase line reactors should not be installed on the output of the AC Drive.

Part Number	Price	Rated Amps	Impedance	Inductance	Watt Loss	Drive Model and Side / Phase / Volts	Drive hp
GS-10P2-LR	<--->	18	3%	0.80 mH	19	GS1-10P2 (input) / 1ph / 115V GS2-10P2 (input) / 1ph / 115V	0.25
GS-10P5-LR	<--->	25	3%	0.50 mH	23	GS1-10P5 (input) / 1ph / 115V GS2-10P5 (input) / 1ph / 115V	0.5
GS-11P0-LR	<--->	35	3%	0.40 mH	36	GS2-11P0 (input) / 1ph / 115V	1

230 Volt Single-Phase Input Reactors

NOTE: Single phase line reactors should not be installed on the output of the AC Drive.

Part Number	Price	Rated Amps	Impedance	Inductance	Watt Loss	Drive Model and Side / Phase / Volts	Drive hp
GS-20P5-LR-1PH	<--->	8	3%	6.50 mH	13	GS1-20P5 (input) / 1ph / 230V GS2-20P5 (input) / 1ph / 230V	0.5
GS-21P0-LR-1PH	<--->	12	3%	6.50 mH	13	GS1-21P0 (input) / 1ph / 230V GS2-21P0 (input) / 1ph / 230V GS3-21P0 (input) / 1ph / 230V	1
GS-22P0-LR-1PH	<--->	18	3%	3.00 mH	25	GS2-22P0 (input) / 1ph / 230V GS3-22P0 (input) / 1ph / 230V	2
GS-23P0-LR-1PH	<--->	35	3%	2.50 mH	26	GS2-23P0 (input) / 1ph / 230V GS3-23P0 (input) / 1ph / 230V	3

230 Volt Three-Phase Input / Output Reactors

Part Number	Price	Rated Amps	Impedance	Inductance	Watt Loss	Drive Model and Side / Phase / Volts	Drive hp
GS-20P5-LR-3PH	<--->	4	3%	6.50 mH	13	GS1-10P5 (output) / 3ph / 230V GS1-20P5 (in/out) / 3ph / 230V GS2-20P5 (in/out) / 3ph / 230V	0.5
GS-21P0-LR-3PH	<--->	4	3%	3.00 mH	7	GS1-21P0 (in/out) / 3ph / 230V GS2-21P0 (in/out) / 3ph / 230V GS3-21P0 (in/out) / 3ph / 230V	1
GS-22P0-LR-3PH	<--->	8	3%	1.50mH	11	GS1-22P0 (in/out) / 3ph / 230V GS2-22P0 (in/out) / 3ph / 230V GS3-22P0 (in/out) / 3ph / 230V	2
GS-23P0-LR-3PH	<--->	12	3%	1.30mH	23	GS2-23P0 (in/out) / 3ph / 230V GS3-23P0 (in/out) / 3ph / 230V	3
GS-25P0-LR	<--->	18	3%	0.80mH	19	GS2-25P0 (in/out) / 3ph / 230V GS3-25P0 (in/out) / 3ph / 230V	5
GS-27P5-LR	<--->	25	3%	0.50mH	23	GS2-27P5 (in/out) / 3ph / 230V GS3-27P5 (in/out) / 3ph / 230V	7.5
GS-2010-LR	<--->	35	3%	0.40mH	36	GS3-2010 (in/out) / 3ph / 230V	10
GS-2015-LR	<--->	45	3%	0.30mH	33	GS3-2015 (in/out) / 3ph / 230V	15
GS-2020-LR	<--->	55	3%	0.25mH	39	GS3-2020 (in/out) / 3ph / 230V	20
GS-2025-LR	<--->	80	3%	0.20mH	88	GS3-2025 (in/out) / 3ph / 230V	25
GS-2030-LR	<--->	80	3%	0.20mH	88	GS3-2030 (in/out) / 3ph / 230V	30
GS-2040-LR	<--->	130	3%	0.10mH	95	GS3-2040 (in/out) / 3ph / 230V	40
GS-2050-LR	<--->	130	3%	0.10mH	95	GS3-2050 (in/out) / 3ph / 230V	50

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Pressure Sensors
Temp. Sensors
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Process
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Terminal Blocks & Wiring
Power
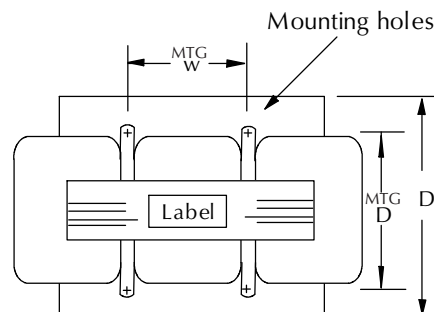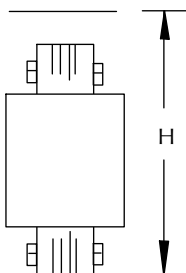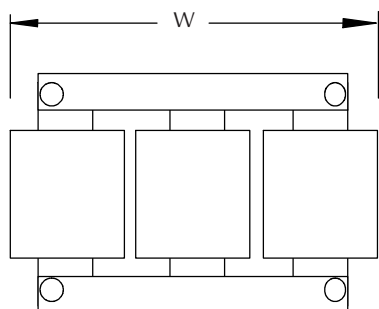Circuit Protection
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GS/*DURAPULSE* Drives Accessories – Line Reactors

460 & 575 Volt Three-Phase Input / Output Reactors							
Part Number	**Price**	**Rated Amps**	**Impedance**	**Inductance**	**Watt Loss**	**Drive Model and Side / Phase / Volts**	**Drive hp**
GS-41P0-LR	<--->	2	3%	12.0 mH	7	GS2-41P0 (in/out) / 3ph / 460V GS3-41P0 (in/out) / 3ph / 460V	1
GS-42P0-LR	<--->	4	3%	6.50 mH	13	GS2-42P0 (in/out) / 3ph / 460V GS2-53P0 (in/out) / 3ph / 575V GS3-42P0 (in/out) / 3ph / 460V	2 3 2
GS-43P0-LR	<--->	8	3%	5.00 mH	31	GS2-43P0 (in/out) / 3ph / 460V GS2-55P0 (in/out) / 3ph / 575V GS3-43P0 (in/out) / 3ph / 460V	3 5 3
GS-45P0-LR	<--->	8	3%	3.00 mH	25	GS2-45P0 (in/out) / 3ph / 460V GS3-45P0 (in/out) / 3ph / 460V	5
GS-47P5-LR	<--->	12	3%	2.50 mH	26	GS2-47P5 (in/out) / 3ph / 460V GS2-57P5 (in/out) / 3ph / 575V GS2-5010 (in/out) / 3ph / 575V GS3-47P5 (in/out) / 3ph / 460V	7.5 7.5 10 7.5
GS-4010-LR	<--->	18	3%	1.50 mH	29	GS2-4010 (in/out) / 3ph / 460V GS3-4010 (in/out) / 3ph / 460V	10
GS-4015-LR	<--->	25	3%	1.20 mH	44	GS3-4015 (in/out) / 3ph / 460V	15
GS-4020-LR	<--->	35	3%	0.80 mH	51	GS3-4020 (in/out) / 3ph / 460V	20
GS-4025-LR	<--->	35	3%	0.80 mH	51	GS3-4025 (in/out) / 3ph / 460V	25
GS-4030-LR	<--->	45	3%	0.70 mH	64	GS3-4030 (in/out) / 3ph / 460V	30
GS-4040-LR	<--->	55	3%	0.50 mH	75	GS3-4040 (in/out) / 3ph / 460V	40
GS-4050-LR	<--->	80	3%	0.40 mH	138	GS3-4050 (in/out) / 3ph / 460V	50
GS-4060-LR	<--->	80	3%	0.40 mH	138	GS3-4060 (in/out) / 3ph / 460V	60
GS-4075-LR	<--->	110	3%	0.30 mH	123	GS3-4075 (in/out) / 3ph / 460V	75
GS-4100-LR	<--->	130	3%	0.20 mH	115	GS3-4100 (in/out) / 3ph / 460V	100
GS-51P0-LR	<--->	2	3%	20.0 mH	9	GS2-51P0 (in/out) / 3ph / 575V	1
GS-52P0-LR	<--->	4	3%	9.10 mH	15	GS2-52P0 (in/out) / 3ph / 575V	2

GS/DURAPULSE Drives Accessories – Line Reactors

AC Line Reactor Dimensions (inches)							
Part Number	H	W	D	Mtg D	Mtg W	Mtg Slot Hole Size	Weight (lbs)
GS-10P2-LR	4.80	6.00	3.30	2.09	2.00	0.28 x 0.63	7.10
GS-10P5-LR	5.7	6.00	3.09	2.09	3.00	0.28 x 0.63	7.00
GS-11P0-LR	5.7	6.00	3.34	2.34	3.00	0.28 x 0.63	8.90
GS-20P5-LR-1PH	3.40	4.40	2.83	1.77	1.44	0.28 x 0.63	2.80
GS-20P5-LR-3PH	3.40	4.40	2.83	1.77	1.44	0.28 x 0.63	2.80
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 1.25	52.0
GS-4100-LR	8.29	10.50	5.35	3.73	3.60	0.44 x 1.25	41.0
GS-51P0-LR	3.40	4.40	2.83	1.77	1.44	0.28 x 0.63	3
GS-52P0-LR	3.40	4.40	2.83	1.77	1.44	0.28 x 0.63	3

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GS/*DURAPULSE* Drives Accessories – Braking Units

Overview

📝 *BRAKING UNITS ARE AVAILABLE ONLY FOR DURAPULSE DRIVES.*

Braking units are applied to absorb the motor regeneration energy when the three-phase induction motor stops by deceleration.

GS-2DBU and GS-4DBU, used with GS series braking resistors, provide optimum braking performance.

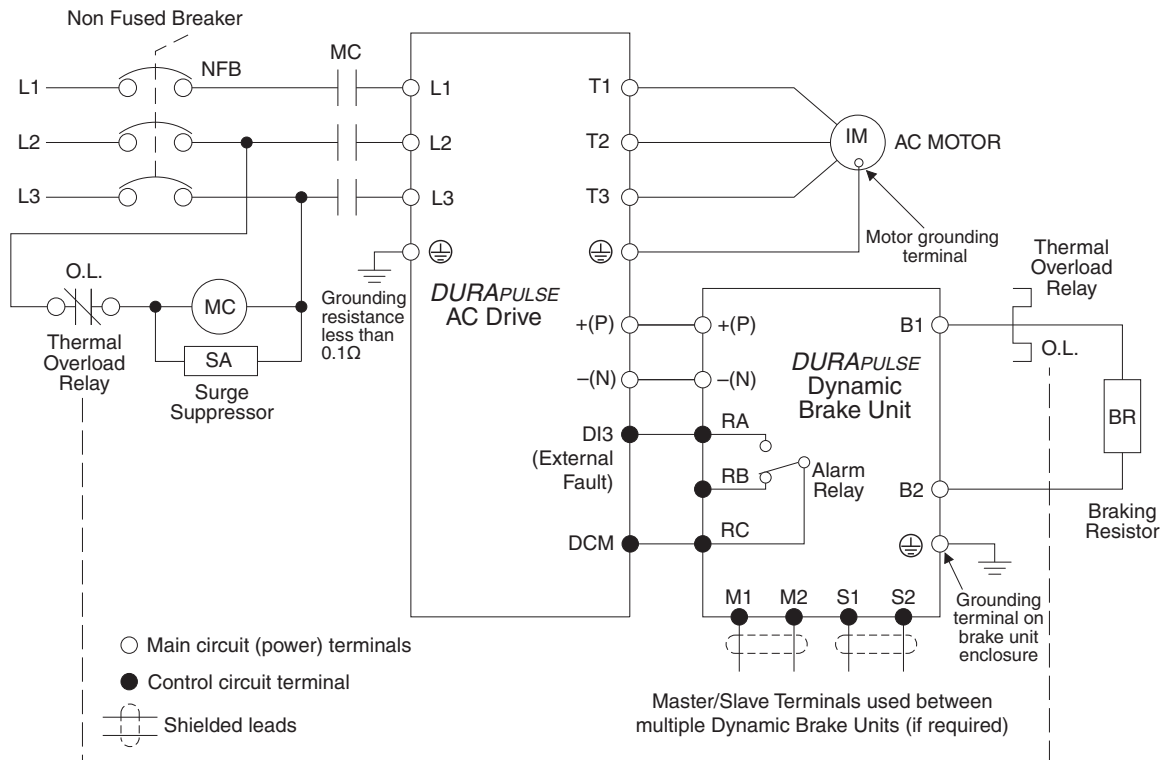⚠ **To avoid injury or mechanical damage, please refer to user manual GS3-DB-M before wiring.**

DURApulse AC Drive Braking Units									
AC Drive		**Brake Unit**			**Braking Resistor**			**Braking Torque 10% Duty Cycle**	**Typical Thermal Overload Relay Value**
Voltage	**AC Drive Part No.**	**QTY**	**Brake Unit Part No.**	**Price**	**QTY**	**Resistor Part No.**	**Resistor Specification for Each Braking Unit**		
230V	GS3-2020	1	**GS-2DBU**	<--->	1	GS-2020-BR-ENC	3000 W / 10Ω	125%	30A
	GS3-2025	1			1	GS-2025-BR-ENC	4800 W / 8Ω	125%	35A
	GS3-2030	1			1	GS-2030-BR-ENC	4800 W / 6.8Ω	125%	40A
	GS3-2040	2			2	GS-2040-BR-ENC	3000 W / 10Ω	125%	30A
	GS3-2050	2			2	GS-2050-BR-ENC	3000 W / 10Ω	100%	30A
460V	GS3-4020	1	**GS-4DBU**	<--->	1	GS-4020-BR-ENC	1500 W / 40Ω	125%	15A
	GS3-4025	1			1	GS-4025-BR-ENC	4800 W / 32Ω	125%	15A
	GS3-4030	1			1	GS-4030-BR-ENC	4800 W / 27.2Ω	125%	20A
	GS3-4040	1			1	GS-4040-BR-ENC	6000 W / 20Ω	125%	30A
	GS3-4050	1			1	GS-4050-BR-ENC	9600 W / 16Ω	125%	40A
	GS3-4060	1			1	GS-4060-BR-ENC	9600 W / 13.6Ω	125%	50A
	GS3-4075	2			2	GS-4075-BR-ENC	6000 W / 20Ω	125%	30A
	GS3-4100	2			2	GS-4100-BR-ENC	9600 W / 13.6Ω	125%	50A

GS/*DURAPULSE* Drives Accessories – Braking Units

Wiring Diagram (*DURApulse* only)

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

Master/Slave Terminals used between multiple Dynamic Brake Units (if required)

Dimensions

121.0 [4.76]
80.0 [3.15]
R3.3 [R0.13]
130.0 [5.12]
189.5 [7.46]
200.0 [7.87]

AUTOMATION DIRECT
CHARGE ACT. ERR.
GREEN YELLOW RED

LABEL 1

WARNING:
° Be sure to read the instruction manual before wiring.
° Do not inspect components unless inside "CHARGE" lamp is off.
° Use proper grounding techniques.

LABEL 2

Label 1 Details:

Braking Unit GS-2DBU 230V 22kW	OR	Braking Unit GS-4DBU 460V 45kW

Grounding terminal located on enclosure

units: mm(in)

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GS/*DURAPULSE* Accessories – Braking Resistors

Overview

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.

FOR DURAPULSE DRIVE MODELS 20 HP AND ABOVE, A DYNAMIC BRAKING UNIT MUST BE USED IN CONJUNCTION WITH THE BRAKING RESISTOR, AS SHOWN IN THE DURAPULSE AC DRIVE BRAKING UNITS TABLE.

For additional information, please refer to the dynamic braking manual, GS3-DB-M.

GS-25P0-BR

GS-27P5-BR

GS-2020-BR-ENC

GS-2020-BR-ENC without Cover
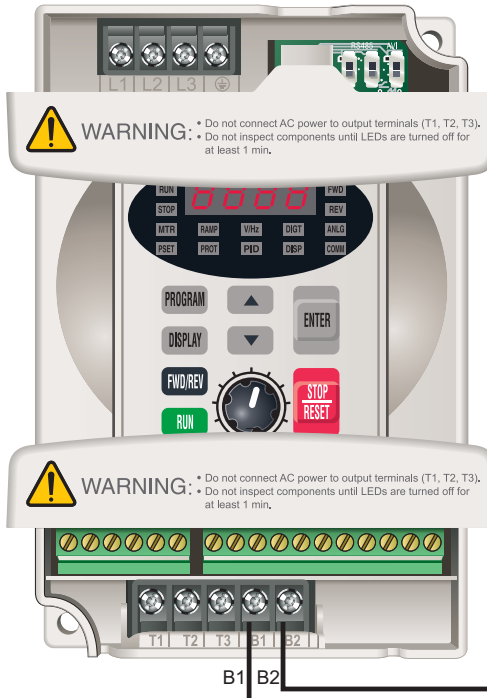
GS2 braking resistor connection;

Refer to user manuals GS3-M and GS3-DB-M for *DURAPULSE* resistor connection information.

Braking Resistor

GS/*DURAPULSE* Accessories – Braking Resistors

Dynamic Braking Resistors								
Part Number	Quantity Required and Wiring	Price Each	Drive Model	Motor V / hp	Braking Torque ED 10%	Resistance (Ω)	Power (W)	Duty Cycle
GS-20P5-BR	1	<--->	GS2-10P2 GS2-10P5 GS2-20P5	115 / 0.25 115 / 0.5 230 / 0.5	270%	200Ω	80	10%
GS-21P0-BR	1	<--->	GS2-11P0 GS2/3-21P0	115 / 1 230 / 1	125%	200Ω	80	10%
GS-22P0-BR	1	<--->	GS2/3-22P0	230 / 2	125%	100Ω	300	10%
GS-23P0-BR	1	<--->	GS2/3-23P0	230 / 3	125%	70Ω	300	10%
GS-25P0-BR	1	<--->	GS2/3-25P0	230 / 5	125%	40Ω	400	10%
GS-27P5-BR	1	<--->	GS2/3-27P5	230 / 7.5	125%	30Ω	500	10%
GS-2010-BR-ENC	1	<--->	GS3-2010	230 / 10	125%	20Ω	1000	10%
GS-2015-BR-ENC	1	<--->	GS3-2015	230 / 15	125%	13.6Ω	2400	10%
GS-2020-BR-ENC	1	<--->	GS3-2020	230 / 20	125%	10Ω	3000	10%
GS-2025-BR-ENC	1	<--->	GS3-2025	230 / 25	125%	8Ω	4800	10%
GS-2030-BR-ENC	1	<--->	GS3-2030	230 / 30	125%	6.8Ω	4800	10%
GS-2040-BR-ENC	2 (also 2 DBU)	<--->	GS3-2040	230 / 40	125%	10Ω x 2	3000 x 2	10%
GS-2050-BR-ENC	2 (also 2 DBU)	<--->	GS3-2050	230 / 50	125%	8Ω x 2	4800 x 2	10%
GS-41P0-BR	1	<--->	GS2/3-41P0	460 / 1	125%	750Ω	80	10%
GS-42P0-BR	1	<--->	GS2/3-42P0 GS2-51P0 GS2-52P0	460 / 2 575 / 1 575 / 2	125%	400Ω	300	10%
	2 / parallel		GS2-53P0 GS2-55P0 GS2-57P5	575 / 3 575 / 5 575 / 7.5				
GS-43P0-BR	1	<--->	GS2/3-43P0	460 / 3	125%	250Ω	300	10%
GS-45P0-BR	1	<--->	GS2/3-45P0	460 / 5	125%	150Ω	400	10%
GS-47P5-BR	1	<--->	GS2/3-47P5	460 / 7.5	125%	100Ω	500	10%
GS-4010-BR	1	<--->	GS2/3-4010	460 / 10	125%	75Ω	1000	10%
	2 / series		GS2-5010	575 / 10				
GS-4015-BR-ENC	1	<--->	GS3-4015	460 / 15	125%	50Ω	1000	10%
GS-4020-BR-ENC	1	<--->	GS3-4020	460 / 20	125%	40Ω	1500	10%
GS-4025-BR-ENC	1	<--->	GS3-4025	460 / 25	125%	32Ω	4800	10%
GS-4030-BR-ENC	1	<--->	GS3-4030	460 / 30	125%	27.2Ω	4800	10%
GS-4040-BR-ENC	1	<--->	GS3-4040	460 / 40	125%	20Ω	6000	10%
GS-4050-BR-ENC	1	<--->	GS3-4050	460 / 50	125%	16Ω	9600	10%
GS-4060-BR-ENC	1	<--->	GS3-4060	460 / 60	125%	13.6Ω	9600	10%
GS-4075-BR-ENC	2 (also 2 DBU)	<--->	GS3-4075	460 / 75	125%	20Ω x 2	6000 x 2	10%
GS-4100-BR-ENC	2 (also 2 DBU)	<--->	GS3-4100	460 / 100	125%	13.6Ω x 2	9600 x 2	10%

NOTE: Dynamic braking resistors not available for GS1 series AC drives.

NOTE: The use of dynamic braking resistors with GS2 series AC drives requires no parameter setup. The AC drive will automatically sense the presence of a braking resistor.

NOTE: For DURAPULSE GS3 series AC drives 20 hp and above, dynamic braking units must be used in conjunction with braking resistors.

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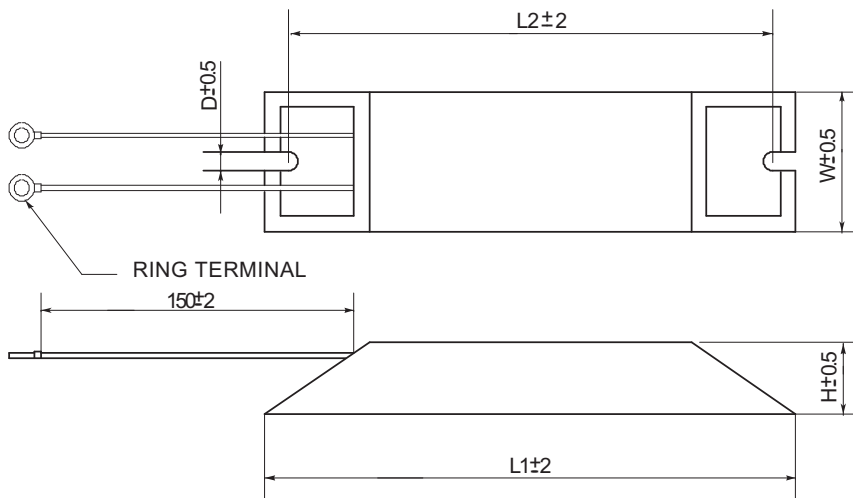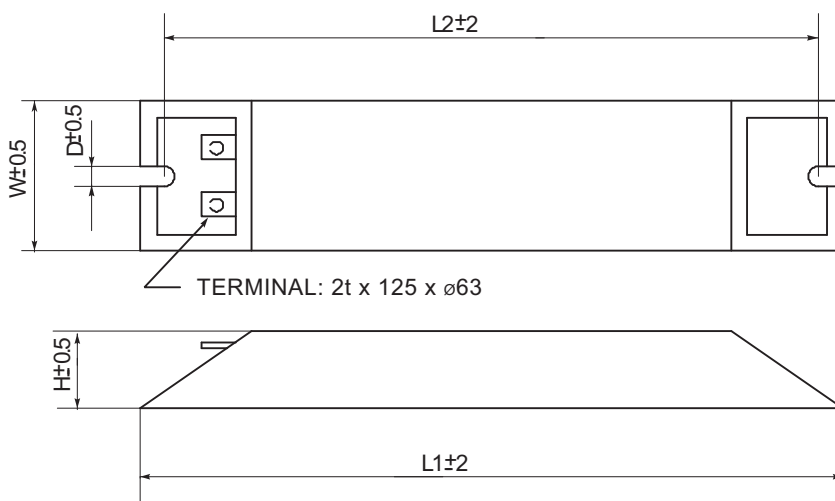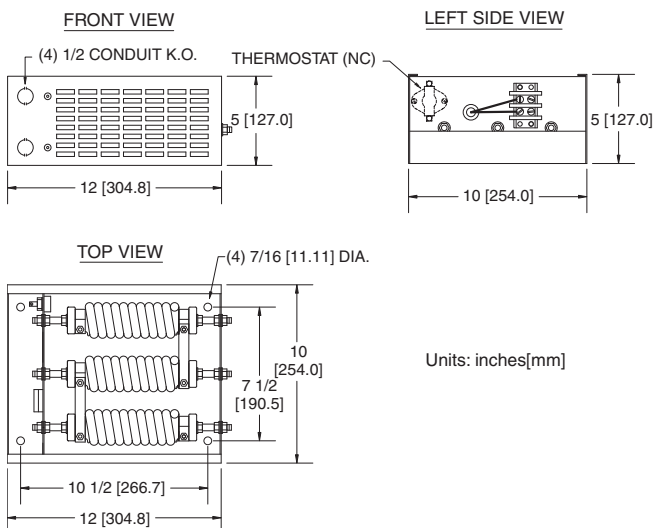
GS/*DURAPULSE* Accessories – Braking Resistors

Dimensions

Braking Resistors Dimensions								
Part Number	*Enclosure*	*Figure*	*Weight (g)*	*L1 (mm)*	*L2 (mm)*	*H (mm)*	*D (mm)*	*W (mm)*
GS-20P5-BR	none	1	160	140	125	20	5.3	60
GS-21P0-BR			160	140	125	20	5.3	60
GS-22P0-BR			750	215	200	30	5.3	60
GS-23P0-BR			750	215	200	30	5.3	60
GS-25P0-BR			930	265	250	30	5.3	60
GS-27P5-BR		2	1100	335	320	30	53	60
GS-2010-BR-ENC	GCE3	3	dimensions shown in diagram					
GS-2015-BR-ENC	GCE6	4						
GS-2020-BR-ENC								
GS-2025-BR-ENC	GCE9	5						
GS-2030-BR-ENC								
GS-2040-BR-ENC	GCE6	4						
GS-2050-BR-ENC	GCE9	5						
GS-41P0-BR	none	1	160	140	125	20	5.3	60
GS-42P0-BR			750	215	200	30	5.3	60
GS-43P0-BR			750	215	200	30	5.3	60
GS-45P0-BR			930	265	250	30	5.3	60
GS-47P5-BR		2	1100	335	320	30	5.3	60
GS-4010-BR			2800	400	385	50	5.3	100
GS-4015-BR-ENC	GCE3	3	dimensions shown in diagram					
GS-4020-BR-ENC	GCE4	6						
GS-4025-BR-ENC	GCE12	7						
GS-4030-BR-ENC								
GS-4040-BR-ENC								
GS-4050-BR-ENC	GCE15	8						
GS-4060-BR-ENC								
GS-4075-BR-ENC	GCE12	7						
GS-4100-BR-ENC	GCE15	8						

Note: For DURAPULSE drive models 20HP and above, a dynamic braking unit must be used in conjunction with the braking resistor, as shown in the Braking Units and Braking Resistors tables. For additional information, refer to the dynamic braking manual, GS3-DB-M.

GS/*DURAPULSE* Accessories – Braking Resistors

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Figure 1

RING TERMINAL

150±2

Figure 2

TERMINAL: 2t x 125 x ⌀63

Figure 3

FRONT VIEW

(4) 1/2 CONDUIT K.O.

THERMOSTAT (NC)

LEFT SIDE VIEW

5 [127.0]

12 [304.8]

10 [254.0]

TOP VIEW

(4) 7/16 [11.11] DIA.

10 [254.0]

7 1/2 [190.5]

10 1/2 [266.7]

12 [304.8]

Units: inches[mm]

Figure 4

FRONT VIEW

(4) 1/2 CONDUIT K.O.

THERMOSTAT (NC)

LEFT SIDE VIEW

5 [127.0]

19 [482.6]

10 [254.0]

TOP VIEW

(4) 7/16 [11.11] DIA.

10 [254.0]

7 1/2 [190.5]

17 1/2 [444.5]

19 [482.6]

Units: inches[mm]
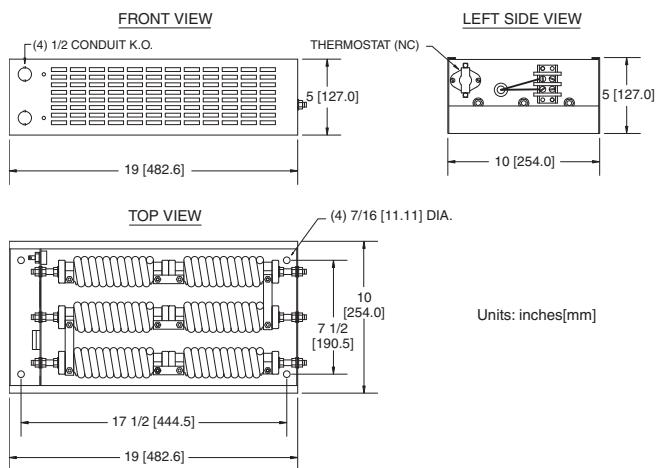
GS/*DURAPULSE* Accessories – Braking Resistors

Figure 5

FRONT VIEW
(4) 1/2 CONDUIT K.O.
THERMOSTAT (NC)
5 [127.0]
26 1/2 [673.1]

LEFT SIDE VIEW
5 [127.0]
10 [254.0]

TOP VIEW
(4) 7/16 [11.11] DIA.
10 [254.0]
7 1/2 [190.5]
25 [635.0]
26 1/2 [673.1]

Units: inches[mm]

Figure 6

FRONT VIEW
(4) 1/2 CONDUIT K.O.
THERMOSTAT (NC)
5 [127.0]
12 [304.8]

LEFT SIDE VIEW
5 [127.0]
13 [330.2]

TOP VIEW
(4) 11.11 [7/16] DIA.
13 [330.2]
10 1/2 [266.7]
10 1/2 [266.7]
12 [304.8]

Units: inches[mm]

Figure 7

FRONT VIEW
(4) 1/2 CONDUIT K.O.
THERMOSTAT (NC)
5 [127.0]
26 1/2 [673.1]

LEFT SIDE VIEW
5 [127.0]
13 [330.2]

TOP VIEW
(4) 7/16 [11.11] DIA.
13 [330.2]
10 1/2 [266.7]
25 [635.0]
26 1/2 [673.1]

Units: inches[mm]

Figure 8

FRONT VIEW
(4) 1/2 CONDUIT K.O.
THERMOSTAT (NC)
5 [127.0]
26 1/2 [673.1]

LEFT SIDE VIEW
5 [127.0]
16 [406.4]

TOP VIEW
(4) 7/16 [11.11] DIA.
16 [406.4]
13 1/2 [342.9]
25 [635.0]
26 1/2 [673.1]

Units: inches[mm]

GS/*DURAPULSE* Accessories – EMI Filters

Overview

The CE Declaration of Conformity for the GS2 and *DURAPULSE* AC drives was completed in conjunction with the EMI filters listed. Use the following table to specify the corresponding EMI filter for each AC drive model.

CE compliance requires the use of EMI filters for GS2 and *DURAPULSE* AC drives. GS1 AC drives have internal EMI filtering, and do not require separate filters.

3-phase Input Power
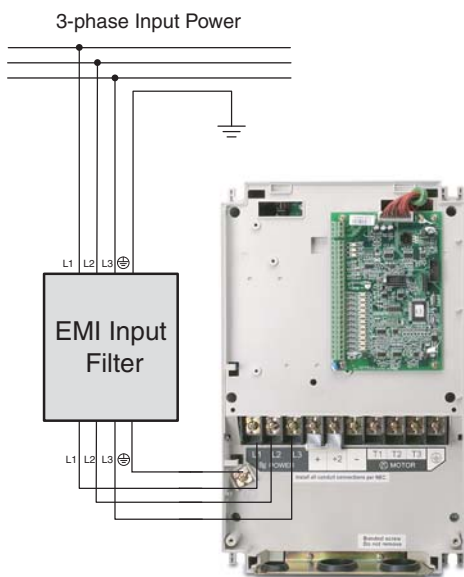
EMI Input Filter

GS3-4030 shown

EMI Input Filter Specifications					
AC Drive 115V / 230V	AC Drive 460V / 575V	EMI Filter	Price	Input Power	Dimensions
GS2-1xxx	-	*20DRT1W3S*	<--->	1-phase, 20A	Figure 1
GS2-20P5 (1-ph)					
GS2-21P0 (1-ph)					
GS2-22P0 (1-ph)					
GS3-21P0 (1-ph)					
GS3-22P0 (1-ph)					
GS2-23P0 (1-ph)	-	*32DRT1W3C*	<--->	1-phase, 32A	Figure 2
GS3-23P0 (1-ph)					
GS2-25P0	-	*40TDS4W4B*	<--->	3-phase, 40A	Figure 3
GS2-27P5					
-	GS2-41P0	*11TDT1W4S*	<--->	3-phase, 11A	Figure 4
	GS2-42P0				
	GS2-43P0				
-	GS2-45P0	*17TDT1W44*	<--->	3-phase, 17A	Figure 5
	GS2-47P5				
-	GS2-4010	*26TDT1W4B4*	<--->	3-phase, 26A	Figure 6
GS2-20P5 (3-ph)	GS2-5xxx	*not available*		n/a	
GS2-21P0 (3-ph) (note 1)	-	*10TDT1W4C*	<--->	3-phase, 10A	Figure 7
GS2-22P0 (3-ph) (note 1)					
GS3-21P0					
GS3-22P0					
GS2-23P0 (3-ph) (note 1)	-	*26TDT1W4C*	<--->	3-phase, 26A	Figure 8
GS3-23P0					
GS3-25P0					
GS3-27P5	GS3-4020	*50TDS4W4C*	<--->	3-phase, 50A	Figure 9
GS3-2010	GS3-4025				
GS3-2015	GS3-4030	*100TDS84C*	<--->	3-phase, 100A	Figure 10
GS3-2020	GS3-4040				
-	GS3-4050				
GS3-2025	GS3-4060	*150TDS84C*	<--->	3-phase, 150A	Figure 11
GS3-2030	-				
GS3-2040					
GS3-2050	-	*180TDS84C*	<--->	3-phase, 180A	Figure 12
-	GS3-41P0	*RF022B43AA*	<--->	3-phase, 5.9A	Figure 13
	GS3-42P0				
	GS3-43P0				
-	GS3-45P0	*RF037B43BA*	<--->	3-phase, 11.2A	Figure 14
-	GS3-47P5	*RF110B43CA*	<--->	3-phase, 25A	Figure 15
	GS3-4010				
	GS3-4015				
-	GS3-4075	*200TDDS84C*	<--->	3-phase, 200A	Figure 16
	GS3-4100				

Note 1: EMI filters 10TDT1W4C and 26TDT1W4C mount underneath DURApulse, but do NOT mount underneath GS2 drives.

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GS/*DURAPULSE* Accessories – EMI Filters

Dimensions

Figure 1 [units = mm]
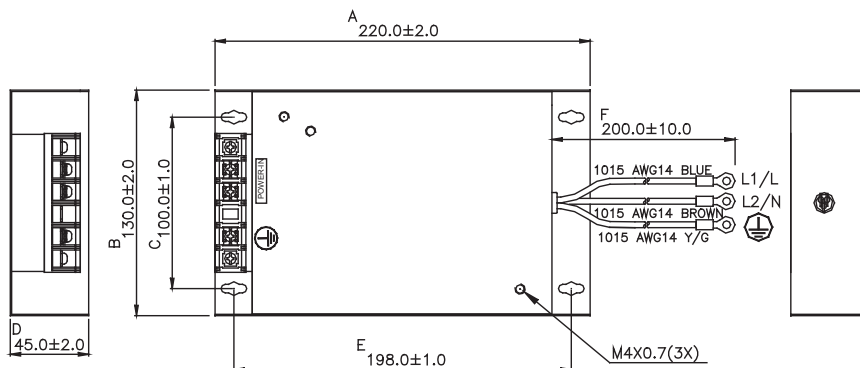
20DRT1W3S
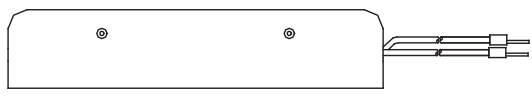
Figure 2 [units = mm]
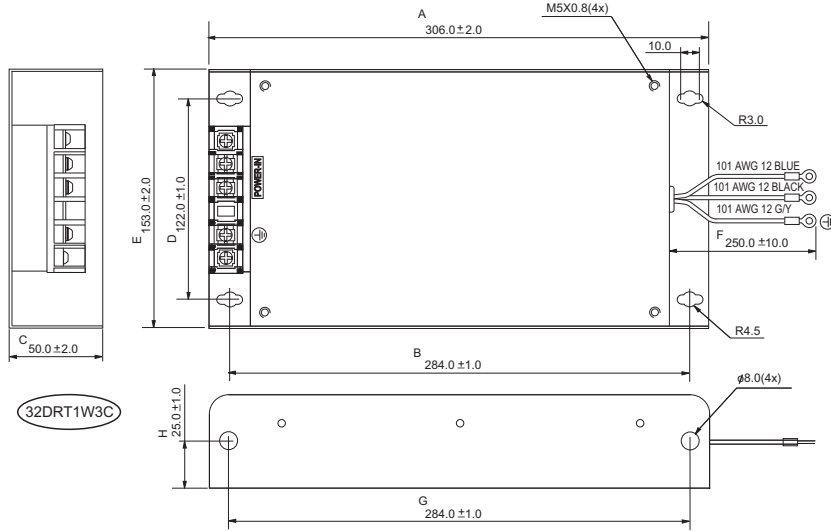
32DRT1W3C

Figure 3 [units = mm]
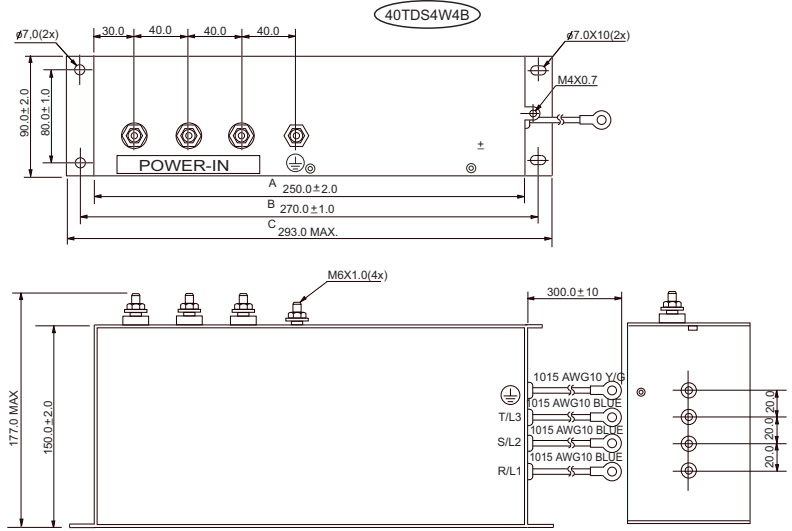
40TDS4W4B

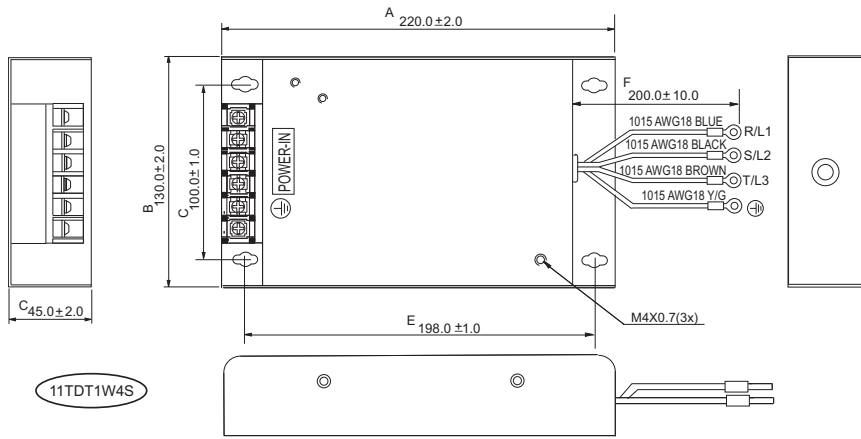# GS/*DURAPULSE* Accessories – EMI Filters

Figure 4 [units = mm]

11TDT1W4S
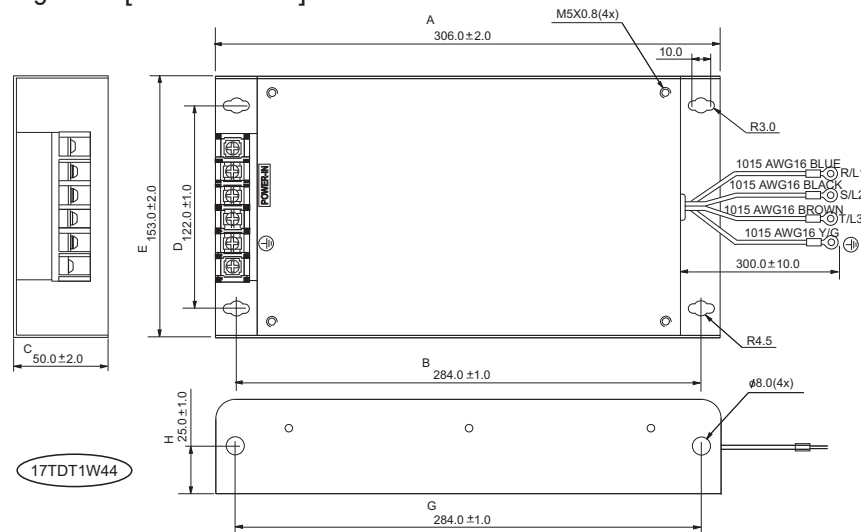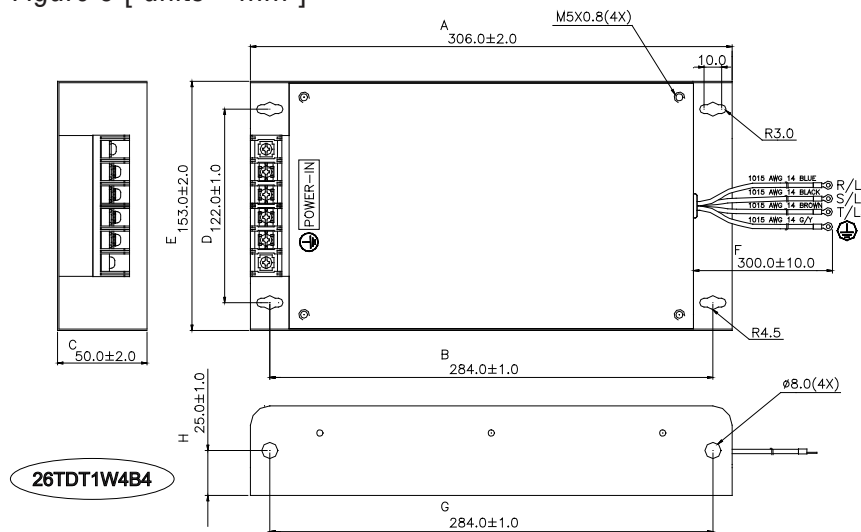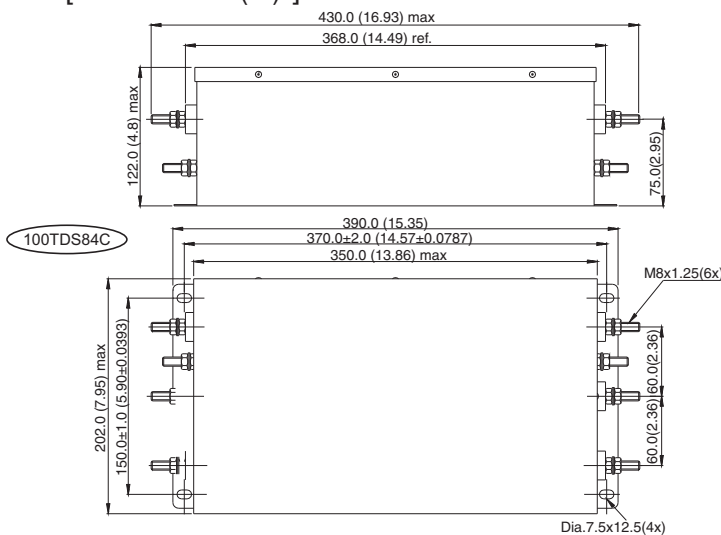
Figure 5 [units = mm]

17TDT1W44

Figure 6 [units = mm]

26TDT1W4B4

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Figure 7 [units = mm (in)]
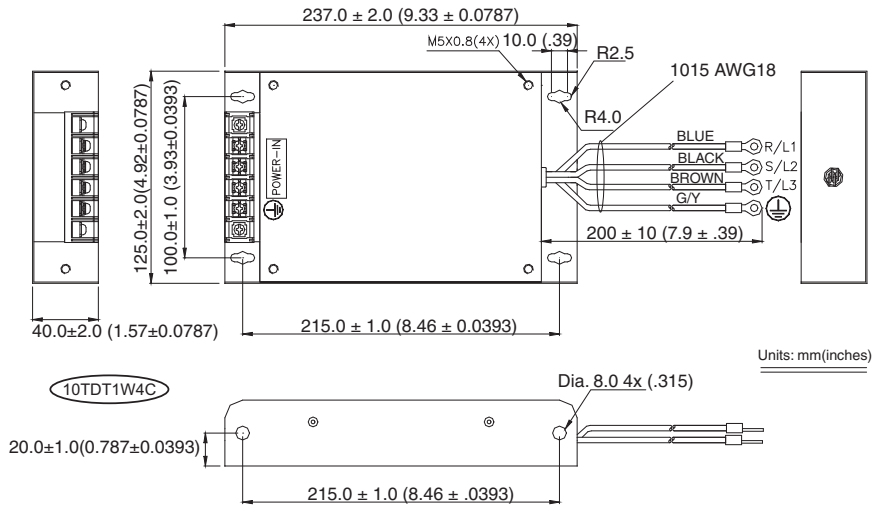
10TDT1W4C

Figure 8 [units = mm (in)]
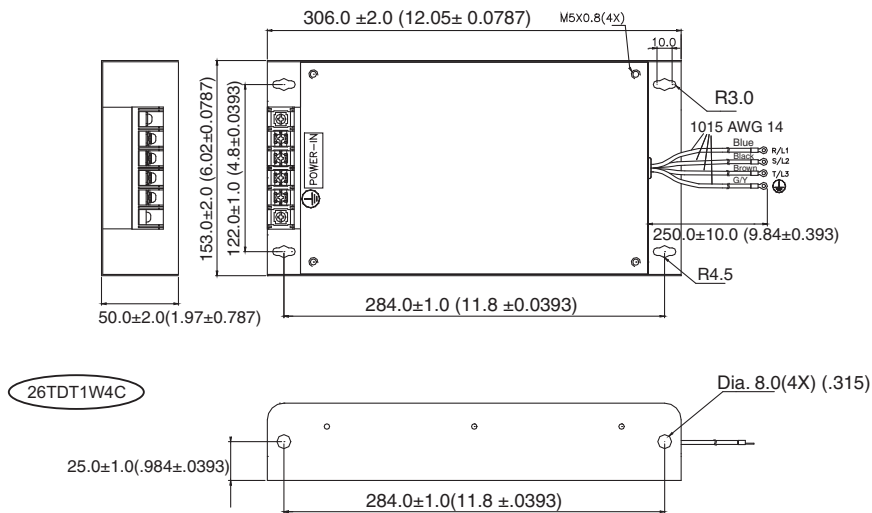
26TDT1W4C

Figure 9 [units = mm (in)]
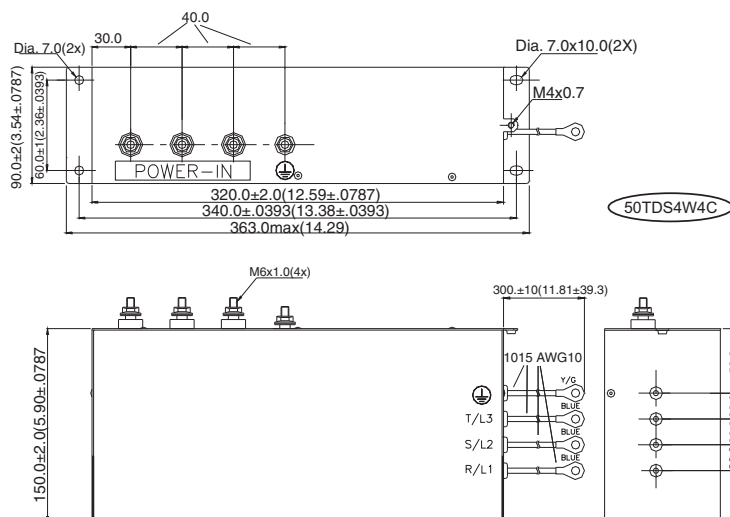
50TDS4W4C

GS/*DURAPULSE* Accessories – EMI Filters

Figure 10 [units = mm (in)]

100TDS84C

Figure 11 [units = mm (in)]

150TDS84C
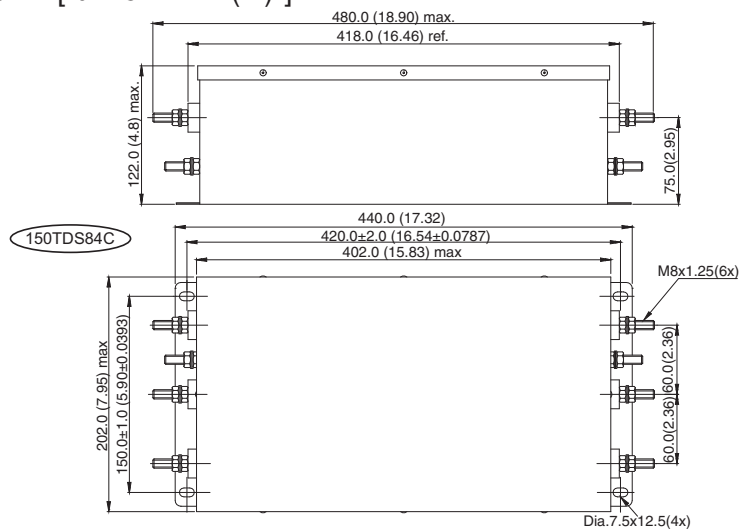
Figure 12 [units = mm (in)]

180TDS84C
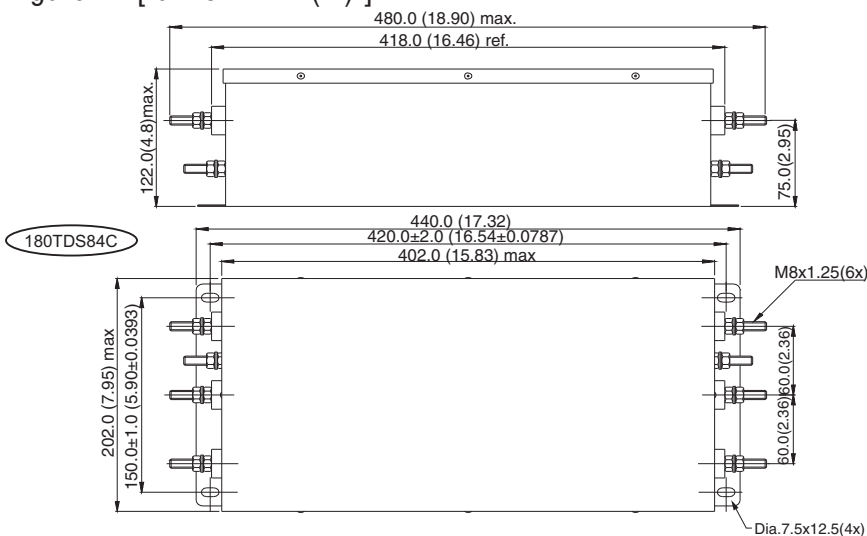
GS/*DURAPULSE* Accessories – EMI Filters

Figure 13 [units = mm (in)]

RF022B43AA

Filter Mounting screw
M5x0.8(#10-24)
torque: 1.56~1.96N·m
(14~17lb·in)

Drive Mounting screw
M5x0.8x15-20mm
torque: 1.56~1.96N·m
(14~17lb·in)
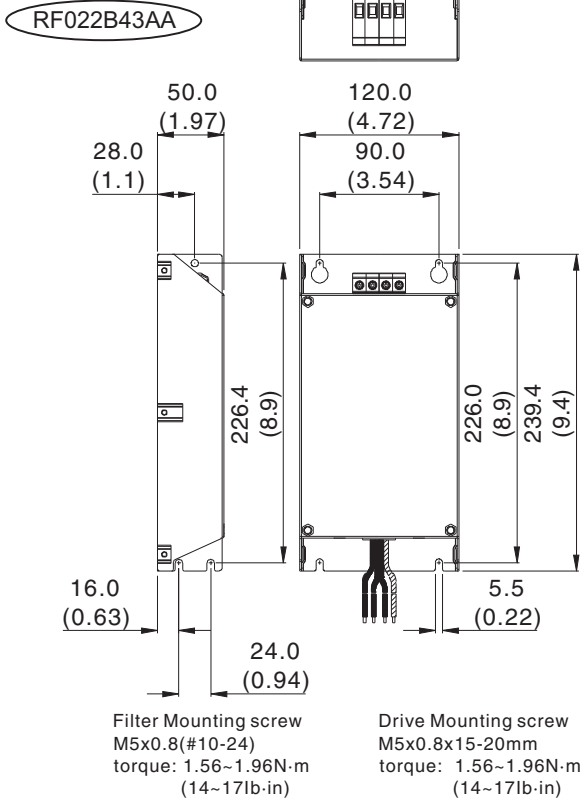
Figure 14 [units = mm (in)]

RF037B43BA
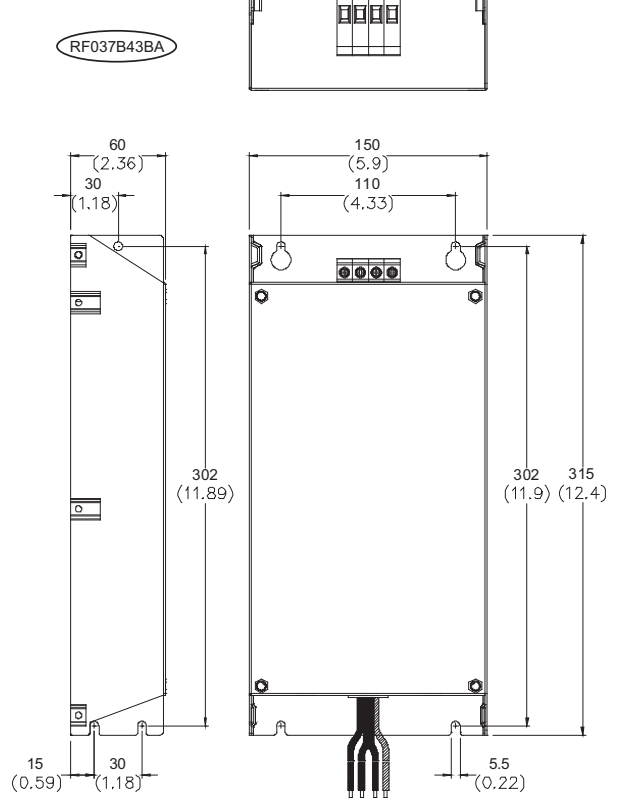
Figure 15 [units = mm (in)]

RF110B43CA
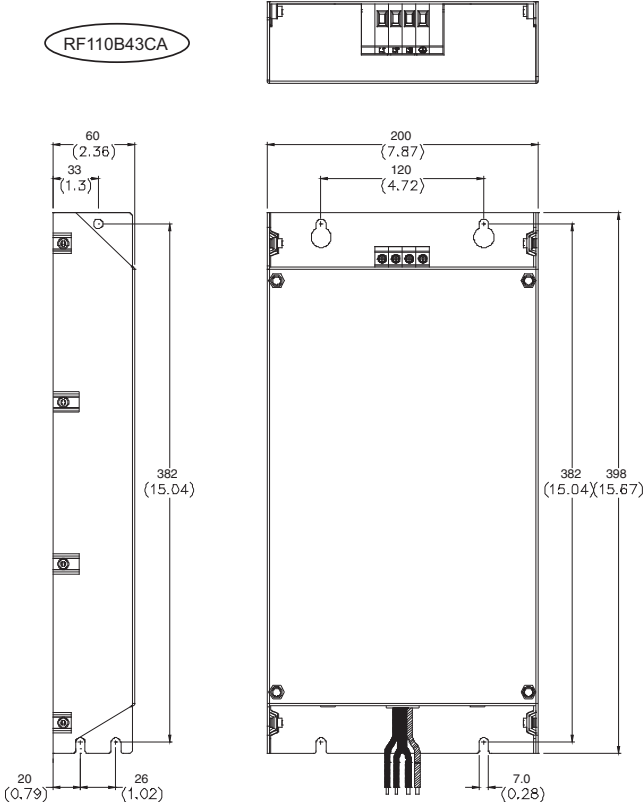
Figure 16 [units = mm (in)]

200TDDS84C
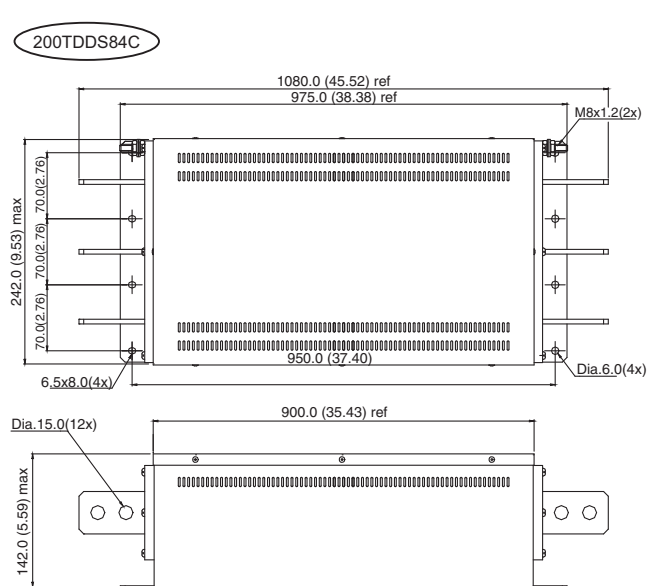
GS/*DURAPULSE* Accessories – RF Filter

RF Filter for GS/*DURAPULSE* AC Drives

Part Number	Price	Drive Model
RF220X00A	<-->	GSx-xxxx
Can be used with all series GS/DURAPULSE AC drives		

Description

Zero phase reactors, (aka RF noise filters) help reduce radiated noise from the inverter wiring. The wiring must go through the opening to reduce the RF component of the electrical noise. Loop the wires three times (four turns) to attain the full RF filtering effect. For larger wire sizes, place multiple zero-phase reactors (up to four) side by side for a greater filtering effect. These are effective for noise reduction on both the input and output sides of the inverter. Attenuation quality is good in a wide range from AM band to 10 Mhz.

Wiring Method

Wind each wire four times around the core, as shown in diagram A to the right. The reactor must be put at inverter side as closely as possible.

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

68.5 (2.70)   35 (1.38)   36 (1.42)   25 (0.98)

90 (3.54)

80 (3.15)

UNITS: mm (in)

TOP VIEW

A

Line Power — L1 L2 L3 — T1 T2 T3 — MOTOR

B

Line Power — L1 L2 L3 — T1 T2 T3 — MOTOR

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Motor Controls

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Current Sensors

Pressure Sensors

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GS/*DURAPULSE* Accessories – Fusing

Fusing Overview

Circuit protection devices are essential to prevent costly damage to your AC drive application equipment. Fuses and fuse kits are available from AUTOMATIONDIRECT for the GS2 and *DURAPULSE* AC drives. (AutomationDirect GS style fuses and fuse kits are NOT available for GS1 drives at this time.)

The fuse specifications are shown in the table below. Each fuse kit consists of one fuse block and fuses sized to handle the inrush current while providing superior protection for the corresponding GS2 or *DURAPULSE* AC drive. The larger drives in the *DURAPULSE* family require three fuse kits (one per phase). Their part numbers are marked in the table with a double asterisk.

Replacement fuses are also available, and listed in the table next to their companion fuse kits.

Fuse Kit Specifications for GS2 and *DURAPULSE* 115~460V Drives								
Fuse Kit *	Price	Fuse Block Type	Wire Range	Fuse Type	Fuse Block Dimensions	Fuse Rating	Replacement Fuses (5 fuses per package)	Price
GS-10P2-FKIT-1P**	<--->	Two-pole	AI/Cu #2-14	A3T	Figure 1	300V@20A	GS-10P2-FUSE-1P	<--->
GS-10P5-FKIT-1P**	<--->					300V@20A	GS-10P5-FUSE-1P	<--->
GS-11P0-FKIT-1P**	<--->					300V@20A	GS-11P0-FUSE-1P	<--->
GS-20P5-FKIT-1P	<--->					300V@20A	GS-20P5-FUSE-1P	<--->
GS-20P5-FKIT-3P	<--->	Three-pole			Figure 2	300V@10A	GS-20P5-FUSE-3P	<--->
GS-21P0-FKIT-1P	<--->	Two-pole			Figure 1	300V@30A	GS-21P0-FUSE-1P	<--->
GS-21P0-FKIT-3P	<--->	Three-pole			Figure 2	300V@20A	GS-21P0-FUSE-3P	<--->
GS-22P0-FKIT-1P	<--->	Two-pole			Figure 1	300V@45A	GS-22P0-FUSE-1P	<--->
GS-22P0-FKIT-3P	<--->	Three-pole			Figure 2	300V@25A	GS-22P0-FUSE-3P	<--->
GS-23P0-FKIT-1P	<--->	Two-pole			Figure 1	300V@60A	GS-23P0-FUSE-1P	<--->
GS-23P0-FKIT-3P	<--->	Three-pole			Figure 2	300V@40A	GS-23P0-FUSE-3P	<--->
GS-25P0-FKIT	<--->		AI/Cu 2/0-#6			300V@60A	GS-25P0-FUSE	<--->
GS-27P5-FKIT	<--->				Figure 9	300V@100A	GS-27P5-FUSE	<--->
GS-2010-FKIT	<--->				Figure 4	300V@125A	GS-2010-FUSE	<--->
GS-2015-FKIT	<--->					300V@175A	GS-2015-FUSE	<--->
GS-2020-FKIT	<--->				Figure 5	300V@250A	GS-2020-FUSE	<--->
GS-2025-FKIT	<--->					300V@300A	GS-2025-FUSE	<--->
GS-2030-FKIT	<--->					300V@350A	GS-2030-FUSE	<--->
GS-2040-FKIT***	<--->	One-pole			Figure 6 ***	300V@450A	GS-2040-FUSE	<--->
GS-2050-FKIT***	<--->	One-pole				300V@500A	GS-2050-FUSE	<--->
GS-41P0-FKIT	<--->		AI/Cu #2-14	A6T	Figure 7	600V@10A	GS-41P0-FUSE	<--->
GS-42P0-FKIT	<--->					600V@15A	GS-42P0-FUSE	<--->
GS-43P0-FKIT	<--->					600V@20A	GS-43P0-FUSE	<--->
GS-45P0-FKIT	<--->					600V@30A	GS-45P0-FUSE	<--->
GS-47P5-FKIT	<--->	Three-pole			Figure 8	600V@50A	GS-47P5-FUSE	<--->
GS-4010-FKIT	<--->				Figure 9	600V@70A	GS-4010-FUSE	<--->
GS-4015-FKIT	<--->					600V@90A	GS-4015-FUSE	<--->
GS-4020-FKIT	<--->				Figure 10	600V@125A	GS-4020-FUSE	<--->
GS-4025-FKIT	<--->					600V@150A	GS-4025-FUSE	<--->
GS-4030-FKIT	<--->		AI/Cu 2/0-#6			600V@175A	GS-4030-FUSE	<--->
GS-4040-FKIT***	<--->				Figure 11 ***	600V@225A	GS-4040-FUSE	<--->
GS-4050-FKIT***	<--->					600V@250A	GS-4050-FUSE	<--->
GS-4060-FKIT***	<--->	One-pole				600V@350A	GS-4060-FUSE	<--->
GS-4075-FKIT***	<--->					600V@400A	GS-4075-FUSE	<--->
GS-4100-FKIT***	<--->				Figure 12 ***	600V@600A	GS-4100-FUSE	<--->

NOTES:

* - AutomationDirect GS style fuses and fuse kits are NOT available at this time for GS1 drives.
** - Single phase 115V fuse kits are for use only with GS2 drives.
*** - Kit includes three single-pole fuse blocks and three fuses.

GS/*DURAPULSE* Accessories – Fusing

Fuse Specifications for GS2 575V Drives					
GS2 Drive Model	**Edison Fuse Block**	**Fuse Block Type**	**Fuse Class**	**Fuse Rating**	**Edison Fuses (10 fuses per pack)**
GS2-51P0	**BC6033PQ or CHCC3D or CHCC3DI**	3-pole or 3-pole modular or 3-pole modular indicating	CC	6A@600V	**HCLR6**
GS2-52P0				10A@600V	**HCLR10**
GS2-53P0				15A@600V	**HCLR15**
GS2-55P0					
GS2-57P5				20A@600V	**HCLR20**
GS2-5010				30A@600V	**HCLR30**

NOTE:
Refer to the Edison Fuses section of this catalog for pricing, specifications, and dimensions.

Fuse Block Dimensions

Units = inches

Figure 1

Figure 2

Dia. 0.20" x 0.10" DP TYPICAL

Figure 3

Dia. 0.25 THRU C'BORE Dia. 0.50 x 0.50 DEEP (2 PLCS)

Figure 4

Dia. 0.28 THRU C'BORE Dia. 0.62 x 0.50 DEEP (2 PLCS)

Figure 5

Dia. 0.28 THRU C'BORE Dia. 0.62 x 0.50 DEEP (2 PLCS)

Figure 6

Dia. 0.28 THRU C'BORE Dia. 0.62 x 0.50 DEEP (2 PLCS)

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C-more & other HMI

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Power Transmiss.

Steppers/ Servos

Motor Controls

Proximity Sensors

Photo Sensors

Limit Switches

Encoders

Current Sensors

Pressure Sensors

Temp. Sensors

Pushbuttons/ Lights

Process

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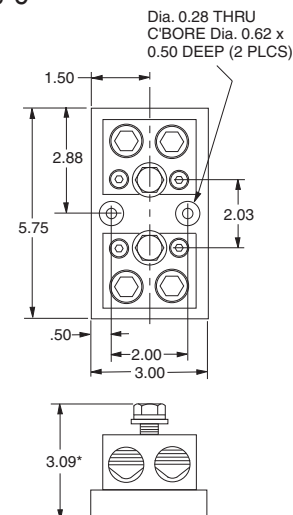
GS/*DURAPULSE* Accessories – Fusing

Fuse Block Dimensions
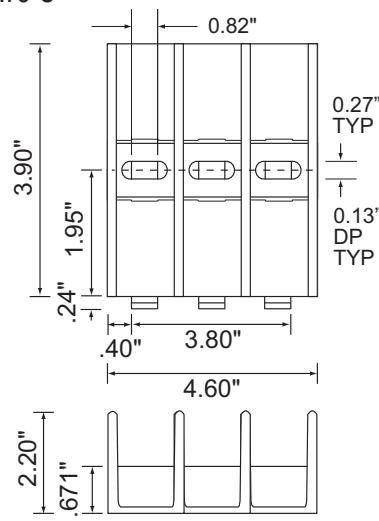
Figure 7

Figure 8

Figure 9

Dia. 0.25 THRU
C'BORE Dia. 0.50 x
0.50 DEEP (2 PLCS)

Figure 10

Dia. 0.28 THRU
C'BORE Dia. 0.62 x
0.50 DEEP (2 PLCS)

Figure 11

Dia. 0.28 THRU
C'BORE Dia. 0.62 x
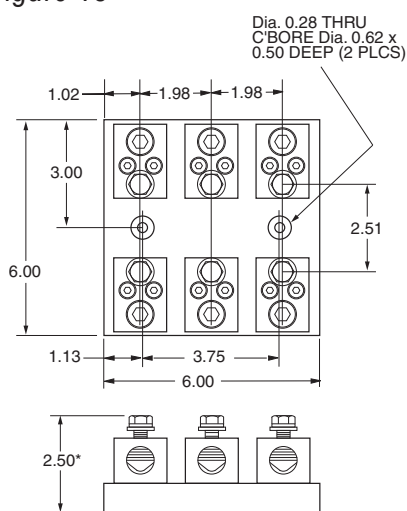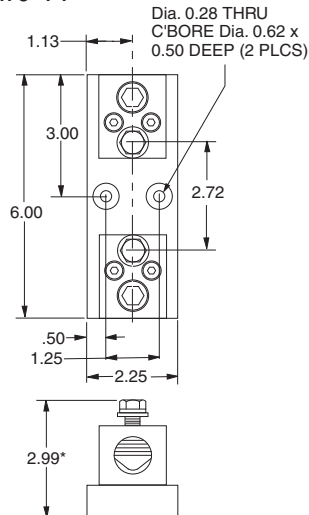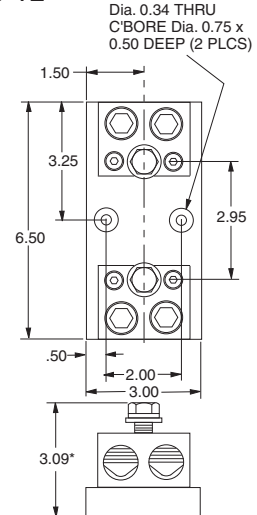0.50 DEEP (2 PLCS)

Figure 12

Dia. 0.34 THRU
C'BORE Dia. 0.75 x
0.50 DEEP (2 PLCS)
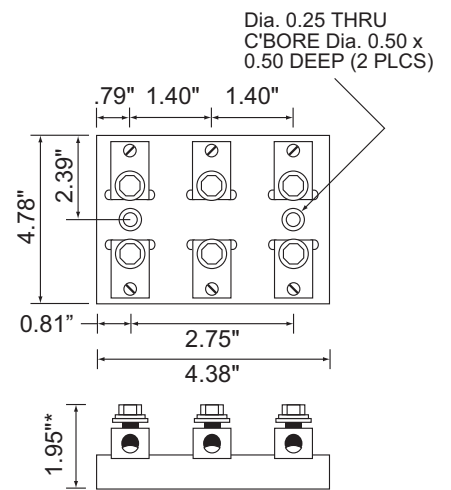
* Height includes nominal fuse blade thickness.

GS/*DURAPULSE* Accessories – Ethernet Interface

Overview

The GS-EDRV Ethernet interface provides a high-performance Ethernet link between a control system and any GS or *DURAPULSE* AC drive. The GS-EDRV processes signals to and from the drive, mounts on a DIN rail, and connects the drive to an Ethernet hub or PC. It formats signals to conform with the Ethernet standard to the H2-ERM or H4-ERM, KEP*Direct* EBC I/O server (as shown on the following page), or independent controller with a Modbus TCP/IP driver. This allows for greater 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 card.
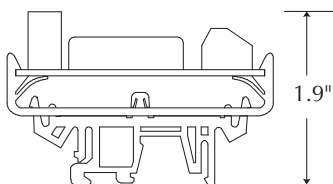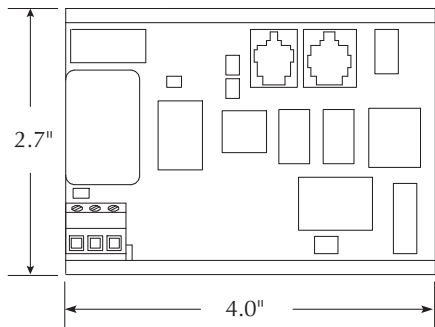
Note: The GS-EDRV requires an external 24 VDC power supply.
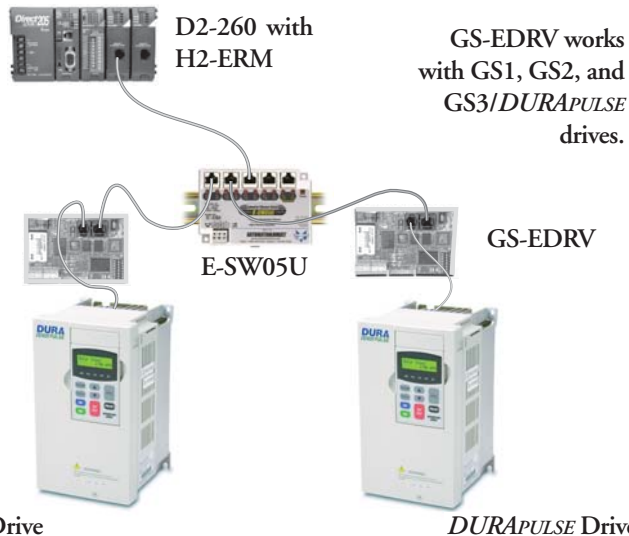
Automatic power shut-down

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

D2-260 with H2-ERM

GS-EDRV works with GS1, GS2, and GS3/*DURAPULSE* drives.

GS-EDRV   **E-SW05U**   **GS-EDRV**

DURAPULSE **Drive**   *DURAPULSE* **Drive**

Dip Switches   **Communication Ports**
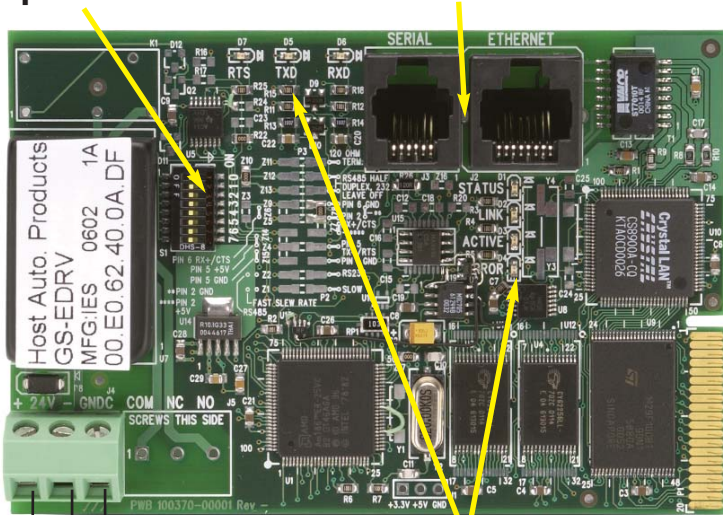
LED Indicators

Power Terminals
Chassis or system ground connection
Negative connection (-) or 0VDC
Positive connection (+) or +24 VDC

Specifications	
Part Number	*GS-EDRV*
Price	<--->
Input Voltage	10-33 VDC
Input Current	90-135 mA
Can be used with all series GS/DURAPULSE AC drives	

Dimensions

2.7"

4.0"

1.9"

units: inches

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PLCs

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C-more & other HMI

AC Drives

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Power Transmiss.

Steppers/ Servos

Motor Controls

Proximity Sensors

Photo Sensors

Limit Switches

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GS/*DURAPULSE* Accessories – Software

KEP*Direct* I/O Server Overview

The KEP*Direct* EBC I/O server software is a 32-bit application that provides a way to connect your favorite Windows client software to AUTOMATIONDIRECT Ethernet I/O through our Ethernet base controllers. It provides GS/*DURAPULSE* series drive support via the GS-EDRV Ethernet interface, as shown in the diagram below. KEP*Direct* allows the user a direct line into the drive parameter group just like an Ethernet field I/O drop. The user can control or monitor from any OPC/DDE compliant third party software. For a complete description of KEP*Direct* software features, go to the Software section of this catalog. *Several application notes specific to the versatility of this software can be found on our web site at www.automationdirect.com.*

KEP*Direct* I/O Server Software

Part Number	Description	Price
PC-KEPEBC-3	Supports up to three GS-EDRV or EBC nodes	<--->
PC-KEPEBC-7	Supports up to seven GS-EDRV or EBC nodes	<--->
PC-KEPEBC-8P	Supports eight or more GS-EDRV or EBC nodes	<--->
PC-KEPEBC-UPG	Upgrade to next larger package	<--->

Can be used with all series GS/DURAPULSE AC drives; Requires GS-EDRV Ethernet interface.

CMMS and Condition Monitoring of Drives and Hardware Applications

Condition monitoring is usually the last part of CMMS (Computer Maintenance Management Software) implementation to be explored. It is expensive and difficult to use. Traditionally, the CMMS companies have used custom built data acquisition (DAQ) boards to monitor systems for values like vibration or temperature.

New technologies like KEP*Direct*, GS/*DURAPULSE* drives, and Terminator field I/O are perfect matches to allow the user to dispose of expensive proprietary DAQ boards. In addition to the cost savings, the intuitive set-up will reduce implementation.

These will become the standard tools that monitor control loop performance on-line and in real time. These tools enable continuous monitoring of control loops, and instant notification of operational deviations as they occur. Using OPC to tie these systems into CMMS provides tracking and automatic evaluation of your soft and hard assets. It also enables easy tracking of true operational and maintenance costs associated with those assets. Personnel can focus on fixing the cause of the problem, and not just the symptom.

Larger Scale Asset Management Applications

On a larger scale, such as Asset Management Software, there is too much information to directly link to the software (many of them are OPC/DDE compliant). There must be a buffer of some type. Usually this buffer is a SCADA type package that handles distribution of information gathered by condition monitoring field devices. KEP*Direct* and Terminator field I/O can connect as easily to the SCADA software as to any OPC compliant software.
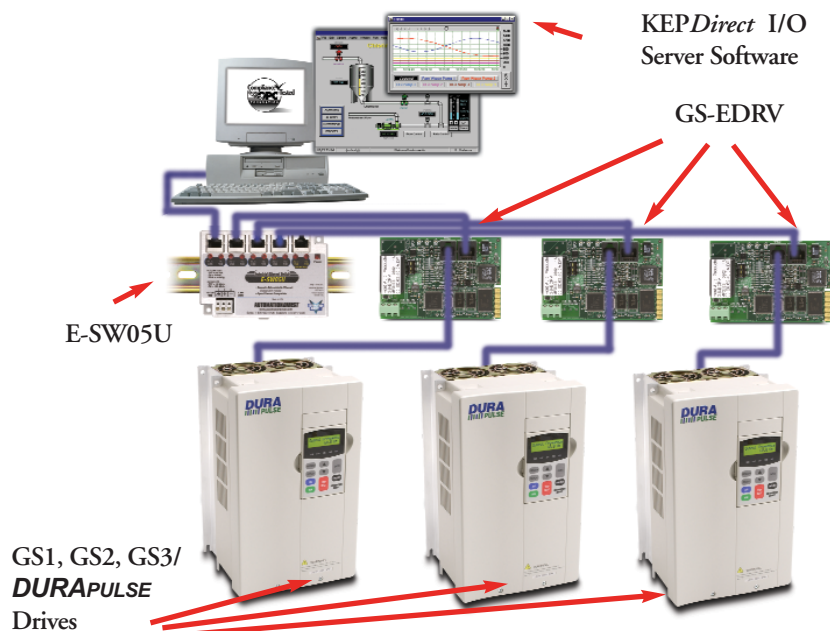
Major OPC Clients supported

- Rockwell Software RSView32®
- GE's Cimplicity®
- Iconics' Genesis32®
- Cutler Hammer's PanelMate PC Pro
- Think & Do Live!
- Think & Do Studio
- Wonderware's In Touch® and OPCLink®
- Intellution's Fix Dynamics® and OPC Power Tool®
- Siemen's WinCC®
- Kepware's OPC QuickClient
- BizWareDirect's DataNet OPC

System Requirements

To run KEP*Direct* I/O Server, your PC must meet the following requirements:

- Pentium CPU, 400 Mhz clock speed
- Windows 98, NT 4.0 SP5, 2000 or XP
- 64 MB free RAM and 10 MB free hard disk space

KEP*Direct* I/O Server Software

GS-EDRV

E-SW05U

GS1, GS2, GS3/ *DURAPULSE* Drives

GS/*DURAPULSE* Accessories – Software

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Overview

GSoft, the configuration software for the GS/*DURAPULSE* drives, allows a personal computer to be directly connected to the drives via RS-232 or RS-485 (RS-485 requires FA-ISOCON or user supplied converter). You can perform a variety of functions to allow easy, intuitive, and secure set-up of any application that is required using GSoft.

System Requirements

To run GSoft, your PC must meet the following requirements:

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

Features

- Create new drive configurations using one of three views:
  - Quick Start - Allows for just the basic set-up to get quick and simple applications up and running ASAP.
  - Detailed - The complete set-up of all parameters in the drive.
  - Schematic Views - Set up the drive using the interactive schematic view. Create a printable cad-like drawing at the same time for future documentation and maintenance-friendly activities.

- Upload/download drive configurations.
- Edit drive configuration .
- Archive/store multiple drive configurations on your PC .
- Trend drive operation parameters in real time.
- Maintenance keypad will allow the user to commission the drive from the PC, check rotation, and run a basic cycle.
- Live PID tuning with active tuning control. Take the difficulty out of PID tuning with a real time trend.
- View drive faults.
- OPC client with KEP*Direct* EBC I/O server over the Ethernet with the GS-EDRV option card
- Have a large system with KEP*Direct* already being used to supply information to your SCADA system? Now program online with drive changes.

GS/*DURAPULSE* AC Drive Software

Part Number	Price	Description
GSOFT	<--->	configuration software
GS-232CBL	<--->	RS-232 cable
FA-ISOCON	<--->	RS-232 to RS-422/485 converter with ANTE

Can be used with all series GS/DURAPULSE drives; FA-ISOCON required for GS1 and DURAPULSE drives.

## GSoft offers three software configuration methods

Detailed Configuration

The Detailed Configuration method provides AC drive parameter access in a tabbed dialog format. Detailed Configuration can be used for new or existing configurations.
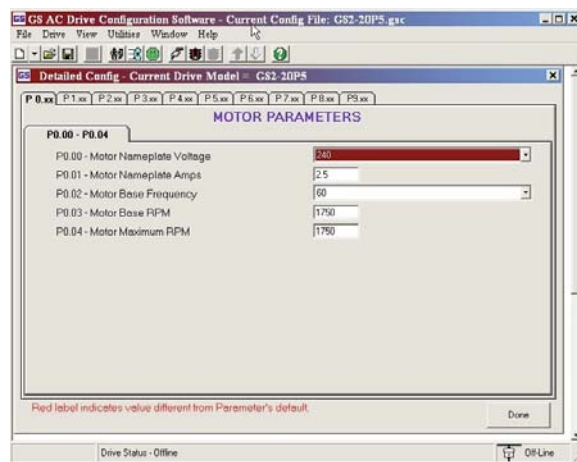

Schematic View Configuration

The Schematic View Configuration method uses a schematic picture of the AC drive and external connections to guide you through the setup of the AC drive. The Schematic View method can be used for new or existing configurations.
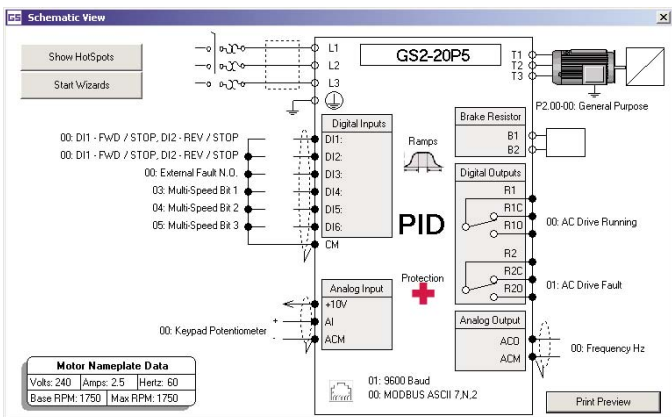
Quick Start Configuration

The Quick Start Configuration method guides you through the most commonly used AC drive parameters. Quick Start Configuration may ONLY be used to *create* a new configuration. Once created and saved, subsequent editing is done using the Detailed or Schematic View methods.
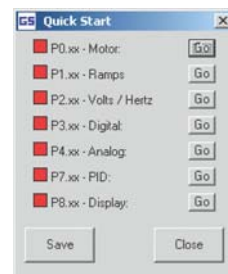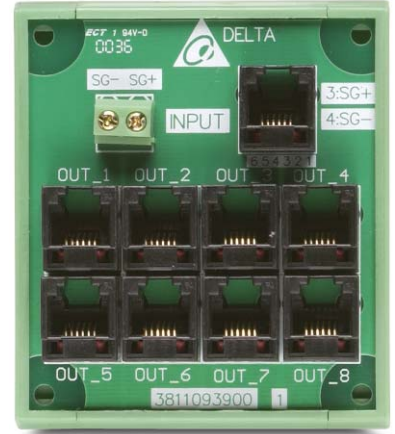
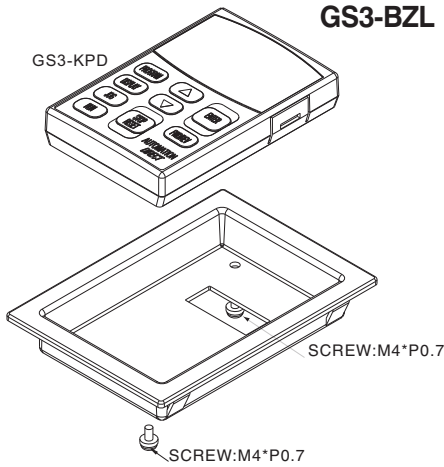# GS/*DURAPULSE* Accessories – Miscellaneous

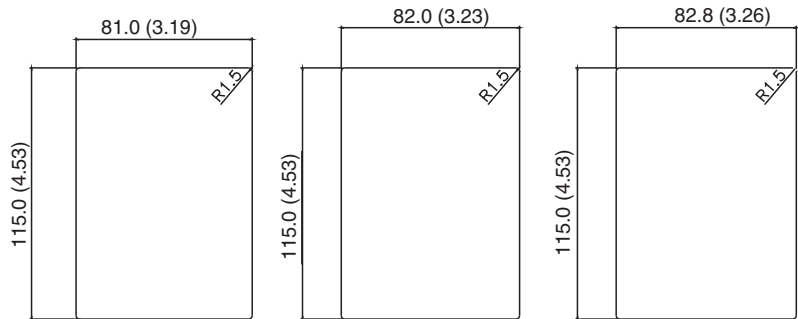**GS3-KPD**

GS2-KPD

GS-RS485-4

GS-RS485-8

GS3-KPD

SCREW:M4*P0.7

SCREW:M4*P0.7

GS3-BZL

The GS3-BZL Flush Mount Bezel Kit allows remote mounting of the *DURAPULSE* removable keypad. The Bezel Kit has a Protected Chassis, IP20 enclosure rating. The thickness of the panel will determine required hole dimensions:

t = 1.0 (.0393) - 1.4 (.0551)   t = 1.6 (.629) - 2.0 (.0787)   t = 2.2 (.0866) - 3.0 (.1181)

81.0 (3.19)   82.0 (3.23)   82.8 (3.26)

R1.5   R1.5   R1.5

115.0 (4.53)   115.0 (4.53)   115.0 (4.53)

GS-CBL2-1L

GS-CBL2-3L

GS-CBL2-5L

GS/*DURAPULSE* Drives Miscellaneous Accessories			
Part Number	**Drive Model**	**Description**	**Price**
GS-232CBL	GS1, GS2, GS3/DURApulse	Configuration Cable required for GSoft configuration software	<--->
GS-CBL2-1L	GS2, GS3/DURApulse	One meter keypad cable (installation screws included)	<--->
GS-CBL2-3L	GS2, GS3/DURApulse	Three meter keypad cable (installation screws included)	<--->
GS-CBL2-5L	GS2, GS3/DURApulse	Five meter keypad cable (installation screws included)	<--->
GS2-KPD	GS2	Spare or replacement keypad for GS2 AC drives	<--->
GS3-KPD	GS3/DURApulse	Spare or replacement keypad for DURApulse AC drives; great for maintenance or back-up programs	<--->
GS3-BZL	GS3/DURApulse	Flush Mount Bezel Kit for remote mounting of the DURApulse removable keypad	<--->
GS-RS485-4	GS1, GS2, GS3/DURApulse	4-port RS-485 multi-drop termination board	<--->
GS-RS485-8	GS1, GS2, GS3/DURApulse	8-port RS-485multi-drop termination board	<--->

![ZIPLink AutomationDirect logo]

GS and DuraPulse Drive Wiring Solutions

It is easier than you think to control the GS series and *DURA*PULSE drives from a *Direct*LOGIC or CLICK PLC when using Modbus RTU serial communications.

Step 1: Select a Drive

Using the chart below select the drive that fits your application needs.

Step 2: Select the Network/Protocol

Select the Network/Protocol that the drive uses.

Step 3: Select the PLC and Communication Port

Select the PLC and Communication port that works with the drive selected.

Step 4: Select a Cable

Select the cable (and adapter if needed) listed in the chart.

Note: If a PLC type or PLC port is not listed in the selection charts, it does not support Modbus RTU.

Step1	Step 3	CLICK	DL05	DL06	
		Port 2	Port 2	Port 1	Port 2
GS1	Step 2	Step 4			
	RS485 Modbus RTU	Not Possible	Not Possible	Not Possible	GS-485HD15-CBL
GS2	RS232 Modbus RTU	Not Possible	GS-RJ12-CBL-2	Not Possible	FA-15HD + GS-RJ12-CBL-2
	RS485 Modbus RTU	Not Possible	Not Possible	Not Possible	GS-485HD15-CBL
DuraPulse	RS485 Modbus RTU	Not Possible	Not Possible	Not Possible	GS-485HD15-CBL

Step1	Step 3	D2-250-1	D2-260		D4-450
		Port 2	Port 1	Port 2	Port 1
GS1	Step 2	Step 4			
	RS485 Modbus RTU	Not Possible	Not Possible	GS-485HD15-CBL-2	Not Possible
GS2	RS232 Modbus RTU	FA-15HD + GS-RJ12-CBL-2	Not Possible	FA-15HD + GS-RJ12-CBL-2	FA-CABKIT + GS-RJ12-CBL-2
	RS485 Modbus RTU	Not Possible	Not Possible	GS-485HD15-CBL-2	Not Possible
DuraPulse	RS485 Modbus RTU	Not Possible	Not Possible	GS-485HD15-CBL-2	Not Possible

ZIPLinks Connector Modules specifications begin on page 26-56
ZIPLinks Cables specifications begin on page 26-74

GS-RJ12-CBL-2

GS-485HD15-CBL-2

FA-15HD

Company Info.

PLCs

Field I/O

Software

C-more & other HMI

AC Drives

AC Motors

Power Transmiss.

Steppers/ Servos

Motor Controls

Proximity Sensors

Photo Sensors

Limit Switches

Encoders

Current Sensors

Pressure Sensors

Temp. Sensors

Pushbuttons/ Lights

Process

Relays/ Timers

Comm.

Terminal Blocks & Wiring

Power

Circuit Protection

Enclosures

Tools

Pneumatics

Appendix

Part Index