



Legal Department

September 24, 2018

Chairman Asim Z. Haque  
Public Utilities Commission of Ohio  
180 East Broad Street  
Columbus, OH 43215-3793

Re: **In the Matter of the Application of** )  
**D S Brown Company** )  
**and Ohio Power Company** ) **Case No. 18-0891-EL-EEC**  
**for Approval of a Special Arrangement** )  
**Agreement with a Mercantile Customer** )

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Dear Chairman Haque,

Attached please find the Joint Application of Ohio Power Company (AEP Ohio) and the above-referenced mercantile customer for approval of a Special Arrangement of the commitment of energy efficiency/peak demand reduction (EE/PDR) resources toward compliance with the statutory benchmarks for 2018 (hereinafter "Joint Application").

Amended Substitute Senate Bill 221, codified at R.C. 4928.66, sets forth EE/PDR benchmarks that electric distribution utilities are required to meet or exceed. The statute allows utilities to include EE/PDR resources committed by mercantile customers for integration into the utilities' programs to be counted toward compliance with a utility's EE/PDR benchmarks. The statute also enables the Commission to approve special arrangements for mercantile customers that commit EE/PDR resources to be counted toward compliance with EE/PDR benchmarks.

The Commission's Order in Case No. 10-834-EL-EEC established a streamlined process to expedite review of these special arrangements by developing a sample application process for parties to follow for consideration of such programs implemented during the prior three calendar years. The attached Joint Application and affidavit conforms with AEP Ohio's version of the streamlined sample application. As requested by Commission Staff, any confidential information referenced in the Joint Application has been provided confidentially to Commission Staff for filing in Commission Docket 10-1599-EL-EEC and subject to the confidentially protections of R.C. 4901.16 and OAC 4901-1-24(E). AEP Ohio respectfully requests that the Commission treat the two cases as associated dockets and that any confidential information provided to Staff for filing in connection with the Joint Application be subject to the protective order requested in Docket 10-1599-EL-EEC.

Cordially,

/s/ Tanner Wolffram  
Tanner Wolffram

Attachments

**Case No.:** 18-0891-EL-EEC

**Mercantile Customer:** D S BROWN COMPANY

**Electric Utility:** Ohio Power

**Program Title or Description:** AEP Ohio Business Incentives for Energy Efficiency: Self Direct Program

Rule 4901:1-39-05(F), Ohio Administrative Code (O.A.C.), permits a mercantile customer to file, either individually or jointly with an electric utility, an application to commit the customer's existing demand reduction, demand response, and energy efficiency programs for integration with the electric utility's programs. The following application form is to be used by mercantile customers, either individually or jointly with their electric utility, to apply for commitment of such programs in accordance with the Commission's pilot program established in Case No. [10-834-EL-POR](#)

Completed applications requesting the cash rebate reasonable arrangement option (Option 1) in lieu of an exemption from the electric utility's energy efficiency and demand reduction (EEDR) rider will be automatically approved on the sixty-first calendar day after filing, unless the Commission, or an attorney examiner, suspends or denies the application prior to that time. Completed applications requesting the exemption from the EEDR rider (Option 2) will also qualify for the 60-day automatic approval so long as the exemption period does not exceed 24 months. Rider exemptions for periods of more than 24 months will be reviewed by the Commission Staff and are only approved up the issuance of a Commission order.

Complete a separate application for each customer program. Projects undertaken by a customer as a single program at a single location or at various locations within the same service territory should be submitted together as a single program filing, when possible. Check all boxes that are applicable to your program. For each box checked, be sure to complete all subparts of the question, and provide all requested additional information. Submittal of incomplete applications may result in a suspension of the automatic approval process or denial of the application. Any confidential or trade secret information may be submitted to Staff on disc or via email at [ee-pdr@puc.state.oh.us](mailto:ee-pdr@puc.state.oh.us).

## Section 1: Company Information

Name: D S BROWN COMPANY

Principal address: 300 East Cherry St., North Baltimore, Oh 45872

Address of facility for which this energy efficiency program applies: 300 E Cherry St, N Baltimore, Oh 45872-1227

Name and telephone number for responses to questions:

Steve Mathey, D S Brown Company, (419) 257-3561

Electricity use by the customer (check the box(es) that apply):

- ☒ The customer uses more than seven hundred thousand kilowatt hours per year at our facility. (Please attach documentation.)

See Confidential and Proprietary Attachment 4 – Calculation of Rider Exemption and UCT which provides the facility consumption for the last three years, benchmark kWh, and the last 12 months usage.

- ☐ The customer is part of a national account involving multiple facilities in one or more states. (Please attach documentation.) When checked, see Attachment 6 – Supporting Documentation for a listing of the customer's name and service addresses of other accounts in the AEP Ohio service territory.

## Section 2: Application Information

A) The customer is filing this application (choose which applies):

- ☐ Individually, on our own.
- ☒ Jointly with our electric utility.

B) Our electric utility is: Ohio Power Company

The application to participate in the electric utility energy efficiency program is  
"Confidential and Proprietary Attachment 3 – Self Direct Program Project  
Completed Application."

C) The customer is offering to commit (choose which applies):

- ☐ Energy savings from our energy efficiency program. (Complete Sections 3, 5, 6, and 7.)
- ☐ Capacity savings from the customer's demand response/ demand reduction program. (Complete Sections 4, 5, 6, and 7.)
- ☒ Both the energy savings and the demand reduction from the customer's energy efficiency program. (Complete all sections of the Application.)

### Section 3: Energy Efficiency Programs

A) The customer's energy efficiency program involves (choose whichever applies):

- ☒ Early replacement of fully functioning equipment with new equipment. (Provide the date on which the customer replaced fully functioning equipment, 4/28/2017 and the date on which the customer would have replaced your equipment if you had not replaced it early. Please include a brief explanation for how the customer determined this future replacement date (or, if not known, please explain why this is not known)).

The remaining life of the equipment varies and is not known with certainty. The future replacement date is unknown and has historically been at the end of equipment life. Replacement was completed early to achieve energy savings and to reduce future maintenance costs.

- ☐ Installation of new equipment to replace equipment that needed to be replaced. The customer installed new equipment on the following date(s):
- ☐ Installation of new equipment for new construction or facility expansion. The customer installed new equipment on the following date(s):
- ☐ Behavioral or operational improvement.

B) Energy savings achieved/to be achieved by your energy efficiency program:

- 1) If you checked the box indicating that your project involves the early replacement of fully functioning equipment replaced with new equipment, then calculate the annual savings [(kWh used by the original equipment) - (kWh used by new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Unit Quantity (watts) = Existing (watts x units) - Installed (watts x units)

kWh Reduction (Annual Savings) = Unit Quantity x (Deemed kWh/Unit)

Annual savings: 9,009 kWh

See Confidential and Proprietary Attachment 5 - Self Direct Program Project Calculation for annual energy savings calculations and 10-1599-EL-EEC for the work papers that provide all methodologies, protocols, and practices used in this application for prescriptive measures, as needed.

- 2) If you checked the box indicating that you installed new equipment to replace equipment that needed to be replaced, then calculate the annual savings [(kWh used by less efficient new equipment) – (kWh used by the higher efficiency new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Annual savings: kWh

Please describe the less efficient new equipment that you rejected in favor of the more efficient new equipment.

- 3) If you checked the box indicating that your project involves equipment for new construction or facility expansion, then calculate the annual savings [(kWh used by less efficient new equipment) – (kWh used by higher efficiency new equipment) = (kWh per year saved)]. Please attach your calculations and record the results below:

Annual savings: kWh

Please describe the less efficient new equipment that you rejected in favor of the more efficient new equipment.

- 4) If you checked the box indicating that the project involves behavioral or operational improvements, provide a description of how the annual savings were determined.

#### Section 4: Demand Reduction/Demand Response Programs

A) The customer's program involves (check the one that applies):

- ☒ Coincident peak-demand savings from the customer's energy efficiency program.
- ☐ Actual peak-demand reduction. (Attach a description and documentation of the peak-demand reduction.)
- ☐ Potential peak-demand reduction check the one that applies):

➤ Choose one or more of the following that applies:

- ☐ The customer's peak-demand reduction program meets the requirements to be counted as a capacity resource under a tariff of a regional transmission organization (RTO) approved by the Federal Energy Regulatory Commission.
- ☐ The customer's peak-demand reduction program meets the requirements to be counted as a capacity resource under a program that is equivalent to an RTO program, which has been approved by the Public Utilities Commission of Ohio.

B) On what date did the customer initiate its demand reduction program?

The coincident peak-demand savings are permanent installations that reduce demand through energy efficiency and were installed on the date specified in Section 3 A above.

C) What is the peak demand reduction achieved or capable of being achieved (show calculations through which this was determined):

Unit Quantity (watts) = Existing (watts x units) - Installed (watts x units)

KW Demand Reduction = Unit Quantity (watts) x (Deemed KW/Unit (watts))

1.7 kW

See Confidential and Proprietary Attachment 5 - Self Direct Program Project Calculation for peak demand reduction calculation, and 10-1599-EL-EEC for the work papers that provide all methodologies, protocols, and practices used in this application for prescriptive measures, as needed.

### Section 5: Request for Cash Rebate Reasonable Arrangement (Option 1) or Exemption from Rider (Option 2)

Under this section, check the box that applies and fill in all blanks relating to that choice.

Note: If Option 2 is selected, the application will not qualify for the 60-day automatic approval. All applications, however, will be considered on a timely basis by the Commission.

A) The customer is applying for:

☒ Option 1: A cash rebate reasonable arrangement.

OR

☐ Option 2: An exemption from the cost recovery mechanism implemented by the electric utility.

OR

☐ Commitment payment

B) The value of the option that the customer is seeking is:

Option 1: A cash rebate reasonable arrangement, which is the lesser of (show both amounts):

☐ A cash rebate of \$\_\_\_\_\_. (Rebate shall not exceed 50% project cost. Attach documentation showing the methodology used to determine the cash rebate value and calculations showing how this payment amount was determined.)

OR

☒ A cash rebate valued at no more than 50% of the total project cost, which is equal to \$ 411.94. (Attach documentation and calculations showing how this payment amount was determined.)

See Confidential and Proprietary Attachment 5 – Self Direct Program Project Calculation for incentive calculations for this mercantile program.

Option 2: An exemption from payment of the electric utility's energy efficiency/peak demand reduction rider.



- ☐ An exemption from payment of the electric utility's energy efficiency/peak demand reduction rider for \_\_\_\_ months (not to exceed 24 months). (Attach calculations showing how this time period was determined.)

OR

- ☐ A commitment payment valued at no more than \$\_\_\_\_\_. (Attach documentation and calculations showing how this payment amount was determined.)

OR

- ☐ Ongoing exemption from payment of the electric utility's energy efficiency/peak demand reduction rider for an initial period of 24 months because this program is part of an ongoing efficiency program that is practiced by our organization. (Attach documentation that establishes your organization's ongoing efficiency program. In order to continue the exemption beyond the initial 24 month period your organization will need to provide a future application establishing additional energy savings and the continuance of the organization's energy efficiency program.)

## Section 6: Cost Effectiveness

The program is cost effective because it has a benefit/cost ratio greater than 1 using the (choose which applies):

- ☐ Total Resource Cost (TRC) Test. The calculated TRC value is: \_\_\_\_\_  
(Continue to Subsection 1, then skip Subsection 2)
- ☒ Utility Cost Test (UCT) . The calculated UCT value is: 6.32 (Skip to Subsection 2.)

### Subsection 1: TRC Test Used (please fill in all blanks).

The TRC value of the program is calculated by dividing the value of our avoided supply costs (generation capacity, energy, and any transmission or distribution) by the sum of our program overhead and installation costs and any incremental measure costs paid by either the customer or the electric utility.

The electric utility's avoided supply costs were \_\_\_\_\_.

Our program costs were \_\_\_\_\_.

The utility's incremental measure costs were \_\_\_\_\_.

### Subsection 2: UCT Used (please fill in all blanks).

We calculated the UCT value of our program by dividing the value of our avoided supply costs (capacity and energy) by the costs to our electric utility (including administrative costs and incentives paid or rider exemption costs) to obtain our commitment.

Our avoided supply costs were \$ 2,947.15

The utility's program costs were \$ 54.05

The utility's incentive costs/rebate costs were \$ 411.94.

## Section 7: Additional Information

Please attach the following supporting documentation to this application:

- Narrative description of your program including, but not limited to, make, model, and year of any installed and replaced equipment.

See Attachment 1 - Self Direct Project Overview and Commitment for a description of the project. See Attachment 6 - Supporting Documentation, for the specifications of the replacement equipment 10-1599-EL-EEC for the work papers that provide all methodologies, protocols, and practices used in this application for prescriptive measures, as needed. Due to the length of time since the equipment replacement, the make, model and year of the replaced equipment is not available.

- A copy of the formal declaration or agreement that commits your program to the electric utility, including:

- 1) any confidentiality requirements associated with the agreement;

See Attachment 2 - Self Direct Program Project Blank Application including Rules and Requirements. All confidentiality requirements are pursuant to the Retrospective Projects/Rules and Requirements that are part of the signed application which is provided as Confidential and Proprietary Attachment 3 - Self Direct Program Project Completed Application.)

- 2) a description of any consequences of noncompliance with the terms of the commitment;

See Attachment 2 - Self Direct Program Project Blank Application including Rules and Requirements. All consequences of noncompliance are pursuant to the Retrospective Projects/Rules and Requirements that are part of the signed application which is provided as Confidential and Proprietary Attachment 3 - Self Direct Program Project Completed Application.

- 3) a description of coordination requirements between the customer and the electric utility with regard to peak demand reduction;

None required because the resources committed are permanent installations that reduce demand through increased efficiency during the Company's peak summer demand period generally defined as May through September and do not require specific coordination and communication to provide demand reduction capabilities to the Company.

- 4) permission by the customer to the electric utility and Commission staff and consultants to measure and verify energy savings and/or peak-demand reductions resulting from your program; and,

See Attachment 2 – Self Direct Program Blank Application including Rules and Requirements granting such permission pursuant to the Retrospective Projects/Rules and Requirements that are part of the signed application which is provided as Confidential and Proprietary Attachment 3 – Self Direct Program Project Completed Application.

- 5) a commitment by you to provide an annual report on your energy savings and electric utility peak-demand reductions achieved.

See Attachment 1 - Self Direct Project Overview and Commitment for the commitment to comply with any information and compliance reporting requirements imposed by rule or as part of the approval of this arrangement by the Public Utilities Commission of Ohio.

- A description of all methodologies, protocols, and practices used or proposed to be used in measuring and verifying program results. Additionally, identify and explain all deviations from any program measurement and verification guidelines that may be published by the Commission.

The Company applies the same methodologies, protocols, and practices to Self Direct Program retrospective projects that are screened and submitted for approval as it does to prospective projects submitted through its Prescriptive and Custom Programs. The Commission has not published a technical reference manual for use by the Company so deviations can not be identified. The project submitted is a prescriptive project and energy savings are determined as described in Confidential and Proprietary Attachment 5 - Self Direct Program Project Calculation, and 10-1599-EL-EEC for the work papers that provide all methodologies, protocols, and practices used in this application for prescriptive measures, as needed.



# Public Utilities Commission

Project # 17-20440

Docket # 18-0891

## Application to Commit Energy Efficiency/Peak Demand Reduction Programs (Mercantile Customers Only)

Case No.: 18-0891-EL-EEC

State of Ohio :

Nigma Mustafa, Affiant, being duly sworn according to law, deposes and says that:

1. I am the duly authorized representative of:  
  
DNV GL Energy Services USA Inc. agent of Ohio Power
2. I have personally examined all the information contained in the foregoing application, including any exhibits and attachments. Based upon my examination and inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete.

Nigma Mustafa Engineer  
Signature of Affiant & Title

Sworn and subscribed before me this 9th day of August, 2018 Month/Year

Linda M. Schmidt  
Signature of official administering oath

LINDA M. SCHMIDT  
Print Name and Title  
Admin Assistant

My commission expires on 7/31/2022



LINDA M. SCHMIDT  
Notary Public, State of Ohio  
My Commission Expires 7-31-2022



### Self Direct Project Overview & Commitment

The Public Utility Commission of Ohio (PUCO) will soon review your application for participation in AEP Ohio's Energy Efficiency/Peak Demand Response program. Based on your submitted project, please select by initialing one of the two options below, sign and fax to 877-607-0740.

<b>Customer Name</b>	D S BROWN COMPANY	
<b>Project Number</b>	AEP-17-20440	
<b>Customer Premise Address</b>	300 E CHERRY ST, N BALTIMORE, OH 45872-1227	
<b>Customer Mailing Address</b>	300 East Cherry St., North Baltimore, OH 45872	
<b>Date Received</b>	4/18/2018	
<b>Project Installation Date</b>	4/28/2017	
<b>Annual kWh Reduction</b>	9,009	
<b>Total Project Cost</b>	\$1,098.50	
<b>Unadjusted Energy Efficiency Credit (EEC) Calculation</b>	\$549.25	
<b>Simple Payback (yrs)</b>	1.7	
<b>Utility Cost Test (UCT) for EEC</b>	6.32	
<b>Utility Cost Test (UCT) for Exemption</b>	0.03	
<i>Please Choose One Option Below and Initial</i>		
<b>Self Direct EEC: 75%</b>	<b>\$411.94</b>	<input checked="" type="checkbox"/> <b>Initial: SM</b>
<b>EE/PDR Rider Exemption</b>	<b>2 Months (After PUCO Approval)</b>	<input type="checkbox"/> <b>Initial:</b>

*Note: This is a one time selection. By selecting EEC, the customer will receive payment in the amount stated above. Selection of EE/PDR rider exemption, will result in the customer not being eligible to participate in any other energy efficiency programs offered by AEP Ohio during the period of exemption. In addition, the term of EE/PDR rider exemption is subject to ongoing review for compliance and could be changed by the PUCO.*

If EEC has been selected, will the Energy Efficiency Funds selected help you move forward with other energy efficiency projects?

☒ YES ☐ NO

*Note: Exemptions for periods beyond 24 months are subject to look-back or true-up adjustments every year to ensure that the exemption accurately reflects the EEDR savings. Applicants must file for renewal for any exemption beyond 12 months.*

#### Project Overview:

The Self Direct (Prescriptive and Custom) project that the above has completed and applied is as follows.  
Install VFD on cooling tower fan

The documentation that was included with the application proved that the energy measures applied for were purchased and installed.

*By signing this document, the Mercantile customer affirms its intention to commit and integrate the above listed energy efficiency resources into the utility's peak demand reduction, demand response, and energy efficiency programs. By signing, the Mercantile customer also agrees to serve as a joint applicant in any filings necessary to secure approval of this arrangement by the Public Utilities Commission of Ohio, and comply with any information and compliance reporting requirements imposed by rule or as part of that approval.*

Ohio Power Company

By: 

Title: Manager

Date: 6/4/2018

D S BROWN COMPANY

By: 

Title: Manager, Maintenance and Facilities

Date: 2018-06-4





## CHECKLIST OF REQUIRED ATTACHMENTS

### PRE-APPROVAL

- ☐ Completed Applicant Information Form
- ☐ Estimated Total Project Cost
- ☐ Estimated Completion Date
- ☐ Completed Incentives Requested Section of Application
- ☐ Applicable Incentive Worksheets
- ☐ Completed Third-Party Payment Release Authorization Section with W9 (optional)
- ☐ Signed Customer Agreement Form
- ☐ Equipment Specifications
- ☐ Proposed Scope of Work
- ☐ W-9 (Customer's W-9 or 3rd party W-9, if applicable)

### FINAL APPLICATION ONLY (NO PRE APP SUBMITTED)

- ☐ Completed Applicant Information Form
- ☐ Completed Incentives Requested Section of Application
- ☐ Applicable Incentive Worksheets
- ☐ Total Project Cost
- ☐ Completion date
- ☐ Completed and Signed Final Payment Agreement and Customer Agreement Forms
- ☐ Completed Third-Party Payment Release Authorization Section with W9 (optional))
- ☐ Itemized Invoices
- ☐ Equipment Specifications
- ☐ Scope of Work
- ☐ W-9 (Customer's W-9 or 3rd party W-9, if applicable)

### FINAL APPLICATION (IF PRE APP HAS BEEN SUBMITTED)

- ☐ Completed Applicant Information Form (optional)
- ☐ Assigned Project Number on Signature Page
- ☐ Total Project Cost
- ☐ Project Completion Date
- ☐ Completed and Signed Final Payment Agreement and Customer Agreement Forms
- ☐ Completed Third-Party Payment Release Authorization Section (optional)
- ☐ Itemized Invoices
- ☐ Updated Scope of Work (if there were changes from pre)
- ☐ Applicable Incentive Worksheets (if there were changes from pre)

#### AEP Ohio Business Incentives Program

445 Hutchinson Avenue, Suite 300  
Columbus, Ohio 43235  
877-541-3048 | [aepohiosolutions@clearesult.com](mailto:aepohiosolutions@clearesult.com)  
Visit our website at [AEPohio.com/solutions](http://AEPohio.com/solutions)

#### Revised Submittal

Please complete below if this is a revised submittal.

Submittal date \_\_\_\_\_

AEP Project Number (if known) AEP - \_ \_ - \_ \_ \_ \_ \_







## APPLICANT INFORMATION

### Solution Provider/Contractor Information (If project is not self-performed by customer)

Contracting Company Name \_\_\_\_\_

Contact Name \_\_\_\_\_ Title of Contact \_\_\_\_\_

Mailing Address \_\_\_\_\_ City \_\_\_\_\_ State OH Zip \_\_\_\_\_

Phone \_\_\_\_\_ Ext. \_\_\_\_\_ Contact Email \_\_\_\_\_

Who should we contact with questions about the application? ☐ Customer ☐ Contractor

### Primary Contact Information

Contact Name \_\_\_\_\_ Title of Contact \_\_\_\_\_

Phone \_\_\_\_\_ Ext. \_\_\_\_\_ Contact Email \_\_\_\_\_

## INCENTIVE SUMMARY TABLE (THIS TABLE SELF-POPULATES FROM WORKSHEETS)

Incentive Category	Applied for Incentives	Applicable Self- Direct Incentives
Lighting		
HVAC		
Motors		
Motor Rewind		
Drives		
Compressed Air		
Refrigeration/Food Service		
Agriculture		
Miscellaneous		
Process Efficiency		
NC Lighting (SD Only)		
Total		

AEP Application Number AEP - \_ \_ \_ - \_ \_ \_ \_



## CUSTOMER AGREEMENT

### Application Agreement

I agree to the Terms and Conditions for the applicable program and Final Application Agreement. As an eligible customer, I verify the information is correct and request consideration for participation under this program. Furthermore, I concur that I meet all eligibility criteria in order to receive payment under this program.

[Link to Efficient Products for Business/Process Efficiency Terms and Conditions, and Final Application Agreement](#)  
[Link to Self-Direct Terms and Conditions, and Final Application Agreement](#)

Pre-Application	Final-Application
Project Completion Year (Select One) _____	Self-Direct _____
Project Completion Date _____	Total Project Cost _____
Date _____	Total Applied for Incentive _____
Total Requested Incentive <sup>1</sup> _____	Total Self-Direct Requested Incentive <sup>2</sup> _____
Print Name _____	AEP Ohio Customer Signature _____

### Third Party Payment Release Authorization (Optional, NOT APPLICABLE TO Self-Direct)

Complete this section ONLY if incentive payment is to be paid to an entity other than the AEP Ohio customer.

Make checks payable to: Company/Individual \_\_\_\_\_

Mailing Address \_\_\_\_\_ City \_\_\_\_\_ State OH Zip \_\_\_\_\_

Phone \_\_\_\_\_ Ext. \_\_\_\_\_

Taxpayer ID of 3rd Party \_\_\_\_\_ - \_\_\_\_\_ W-9 Tax Status \_\_\_\_\_

By signing this document, I authorize the payment of the incentive to the third party named above and understand that I will not receive the incentive payment from AEP Ohio. I also understand that my release of the payment to a third party does not exempt me from the Terms and Conditions, and Final Application Agreement.

Print Name _____	Date _____	Customer Signature (AEP Ohio Customer) _____
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SUBMIT VIA EMAIL

PRINT APPLICATION

<sup>1</sup>Incentives have a threshold of 50% of the project cost and total incentives paid to a threshold of \$25,000 and Bid4Efficiency above that.

<sup>2</sup>Self-Direct incentives are 75% of Total Requested Incentive, after 50% of the project cost threshold and tiering is applied.

Prices as of April 15, 2015. Check Web site for most current prices.

# DURAPULSE AC Drives – Introduction



## 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 (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.

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 Input 230V		✓	✓	✓												
Three-Phase 230V Class					✓	✓	✓	✓	✓	✓	✓	✓	✓			
Three-Phase 460V Class		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

## 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 braking 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
- 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
- Two-year warranty
- UL/cUL/CE listed

## Accessories

- AC line reactors
- EMI filters
- RF filter
- Braking resistors
- Braking units (for models 20 hp and above)
- Fuse kits and replacement fuses
- Replacement cooling fans
- Remote panel adapter
- Replacement keypad
- Keypad cables in 1, 3, and 5-meter lengths
- Ethernet interface
- Four and eight-port RS-485 multi-drop termination boards
- KEPDirect I/O or OPC Server
- GSoft drive configuration software
- GS3-FB – feedback card
- GS-485HD15-CBL – ZIPLink RS485 communication cable for connection to the DL06 and D2-260 15-pin ports
- USB-485M – USB to RS-485 PC adapter (see "Communications Products" chapter for detailed information)

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

## DURAPULSE part numbering system

GS3 - 2 020

### Applicable Motor Capacity

1P0 1HP	2P0 2HP
3P0 3HP	5P0 5HP
7P5 7.5HP	10 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

## Typical Applications

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





# DURAPULSE AC Drives Specifications

230V Class														
Model Name: GS3-xxx			21P0	22P0	23P0	25P0	27P5	2010	2015	2020	2025	2030	2040	2050
Price			\$242.00	\$293.00	\$347.00	\$400.00	\$549.00	\$698.00	\$889.00	\$1,104.00	\$1,298.00	\$1,486.00	\$2,177.00	\$2,637.00
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 3-phase power sources must be symmetrical. 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		\$323.00	\$360.00	\$385.00	\$427.00	\$613.00	\$734.00	\$957.00	\$1,165.00	\$1,383.00	\$1,570.00	\$2,001.00	\$2,436.00	\$2,788.00	\$3,130.00	\$3,498.00	
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 3-phase power sources must be symmetrical. Do not connect any DURApulse drives to grounded, center-tapped delta transformers (which are typically used for lighting circuits).																	

Prices as of April 15, 2015. Check Web site for most current prices.

# DURAPULSE 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 Specifications			
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 <sup>2</sup> (1G) less than 10 Hz; 5.9 m/s <sup>2</sup> (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	



# DURAPULSE Drives Specifications – Installation

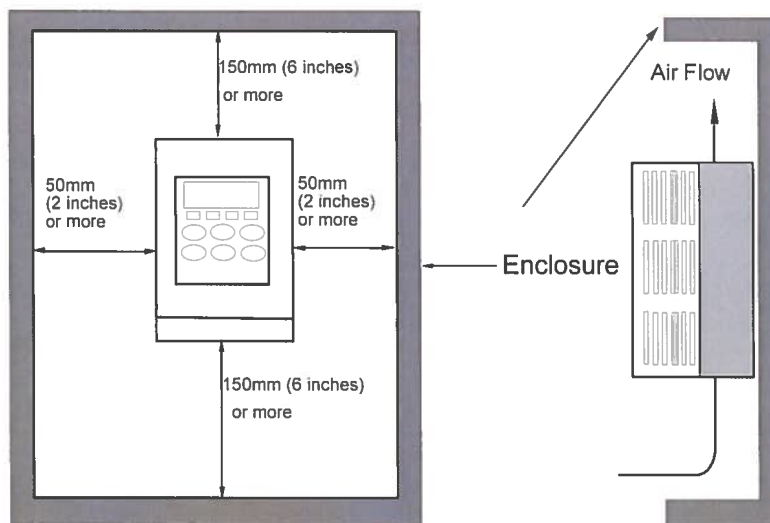
Understanding the installation requirements for your DURAPULSE AC drive will help to ensure that it operates within its environmental and electrical limits.

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

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

Environmental Specifications	
<b>Protective Structure <sup>1</sup></b>	IP20
<b>Ambient Operating Temperature <sup>2</sup></b>	-10 to 40°C (14°F to 104°F) I
<b>Storage Temperature <sup>3</sup></b>	-20 to 60°C (-4°F to 140°F)
<b>Humidity</b>	To 90% (no condensation)
<b>Vibration <sup>4</sup></b>	9.8 m/s <sup>2</sup> (1g), less than 10 Hz 5.9 m/s <sup>2</sup> (0.6g), 10 to 60 Hz
<b>Location</b>	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 C0911 (1984)



## 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!

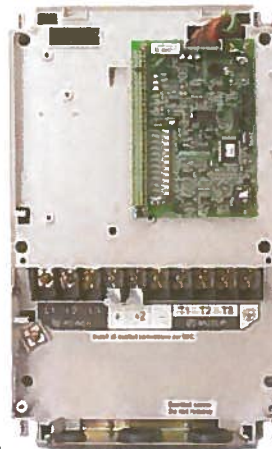


Prices as of April 15, 2015. Check Web site for most current prices.

# DURAPULSE AC Drives Specifications

## — Terminals

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



GS3-4030 shown

Control Circuit Terminals		
Terminal Symbol	Description	Remarks
<b>+24V</b>	DC Voltage Source	(+24V, 20mA), used only for AC drive digital inputs wired for source mode operation
<b>DI1</b>	Digital Input 1	Input Voltage: Internally Supplied (see Warning below) Sink Mode: Low active, $V_{inL}$ Min = 0V, $V_{inL}$ Max = 15V, $I_{in}$ Min = 2.1mA, $I_{in}$ Max = 7.0mA Source Mode: High active, $V_{inH}$ Min = 8.5V, $V_{inH}$ Max = 24V, $I_{in}$ Min = 2.1mA, $I_{in}$ Max = 7.0mA Input response: 12–15 msec Also see "Basic Wiring Diagram" on the next pages.
<b>DI2</b>	Digital Input 2	
<b>DI3</b>	Digital Input 3	
<b>DI4</b>	Digital Input 4	
<b>DI5</b>	Digital Input 5	
<b>DI6</b>	Digital Input 6	
<b>DI7</b>	Digital Input 7	
<b>DI8</b>	Digital Input 8	
<b>DI9</b>	Digital Input 9	
<b>DI10</b>	Digital Input 10	
<b>DI11</b>	Digital Input 11	
<b>DCM</b>	Digital Common	
<b>+10V</b>	Internal Power Supply	+10VDC (10mA maximum load)
<b>AI1</b>	Analog Input	0 to +10 V input only
<b>AI2</b>	Analog Input	0 to 20mA / 4 to 20mA input
<b>AI3</b>	Analog Input	-10 to +10 V input only
<b>ACM</b>	Analog Common	
<b>R10</b>	Relay Output 1 Normally Open	Resistor Load: 240VAC - 5A (N.O.) / 3A (N.C.) 24VDC - 5A (N.O.) / 3A (N.C.)
<b>R1C</b>	Relay Output 1 Normally Closed	Inductive Load: 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
<b>R1</b>	Relay Output 1 Common	
<b>DO1</b>	Photocoupled digital output	Maximum 48VDC, 50mA
<b>DO2</b>	Photocoupled digital output	
<b>DO3</b>	Photocoupled digital output	
<b>DOC</b>	Digital Output Common	
<b>AO</b>	Analog Output	0 to +10 V 2mA Output
<b>FO</b>	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.

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Motion: Servos and Steppers
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Sensors: Proximity
Sensors: Photoelectric
Sensors: Encoders
Sensors: Limit Switches
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Pneumatics: Directional Control Valves
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Pneumatics: Tubing
Pneumatics: Air Fittings
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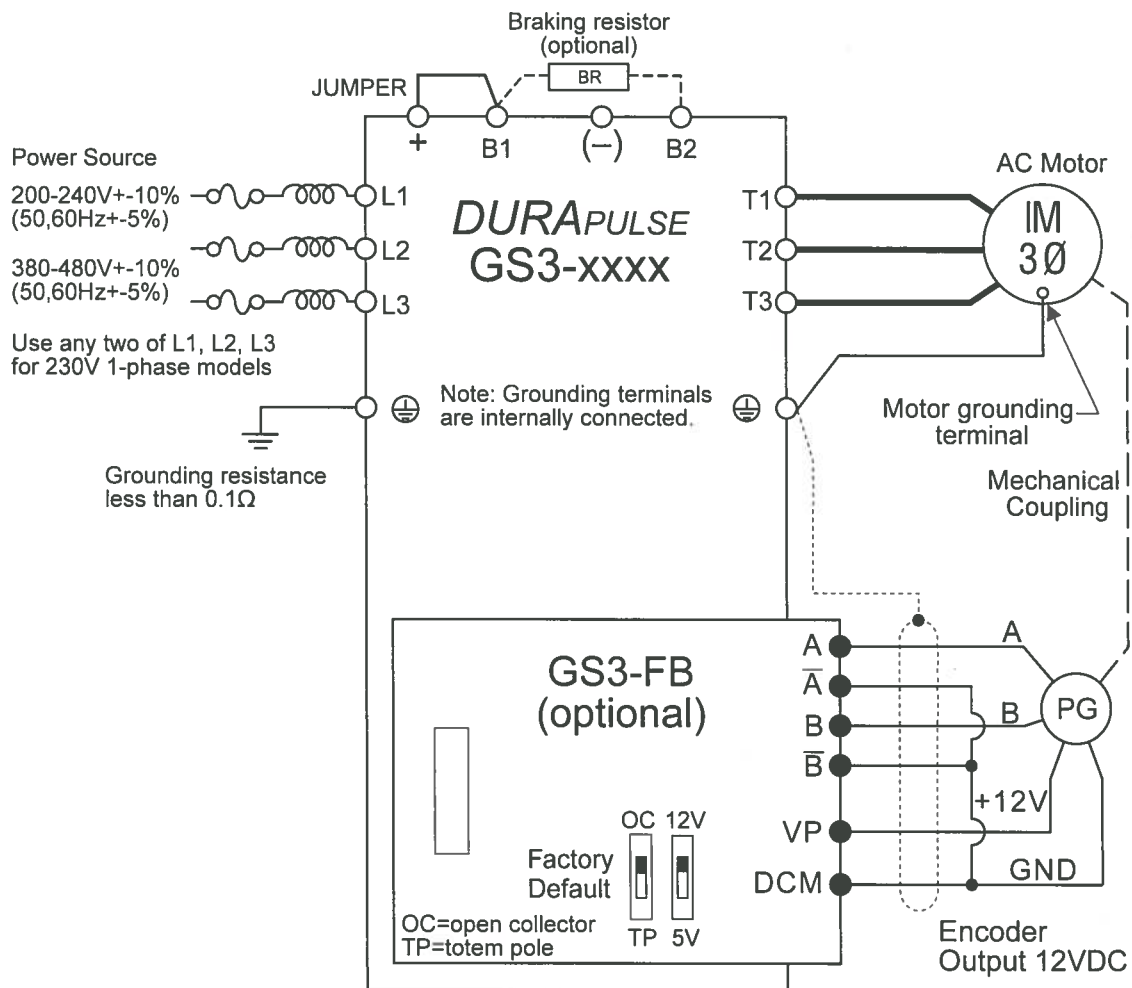


# DURAPULSE AC Drives – Basic Wiring Diagram

## 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: Please refer to the following catalog pages in the Drives section\* of our catalog for explanations and information regarding feedback cards, line reactors, braking resistors, EMI and RF filters, and fuses: 47, 49, 68, 73, 79, 80.**



○ 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.

\*The Drives section is in Book 2 of current version of our catalog, or you can download PDF of section here.

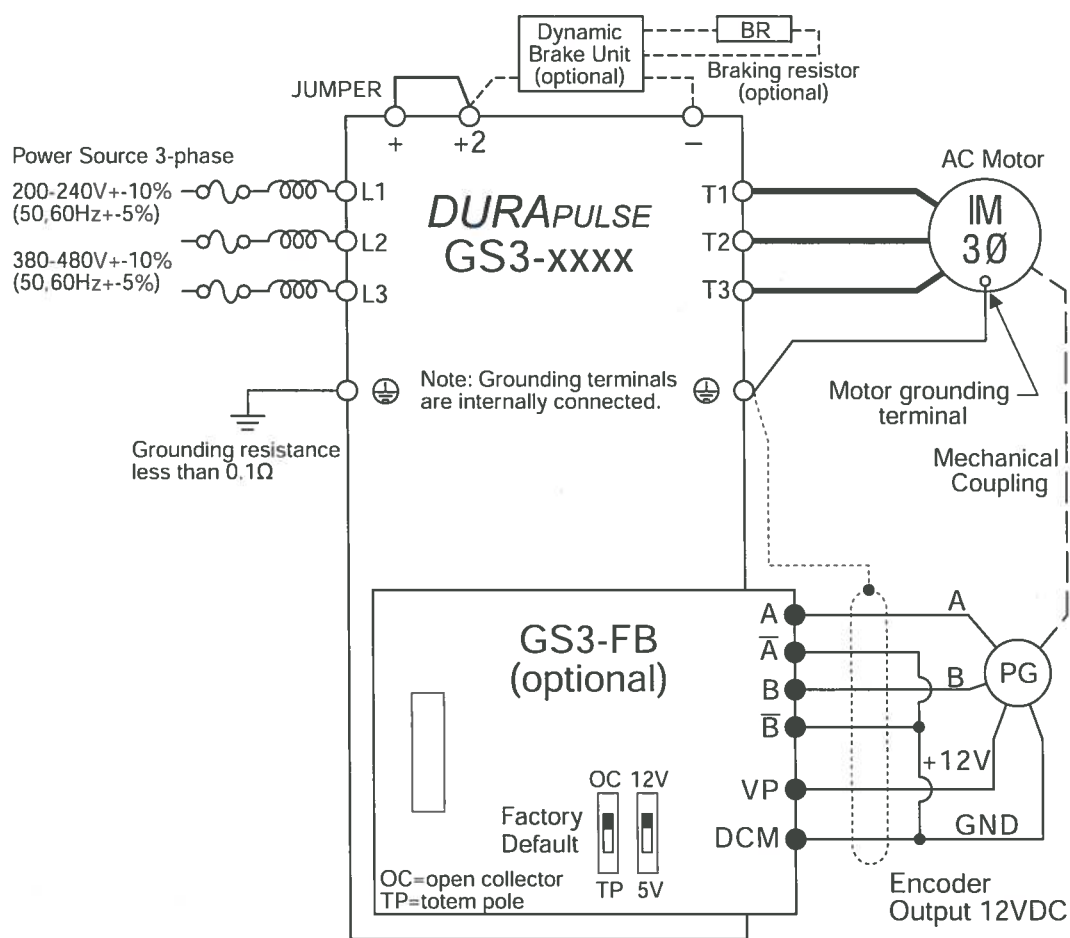
Prices as of April 15, 2015. Check Web site for most current prices.

# 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: Please refer to the following catalog pages in the Drives section\* of our catalog for explanations and information regarding feedback cards, line reactors, braking units and resistors, EMI and RF filters, and fuses: 47, 49, 66, 68, 73, 79, 80.**



○ 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.**

\*The Drives section is in Book 2 of current version of our catalog, or you can download PDF of section here.

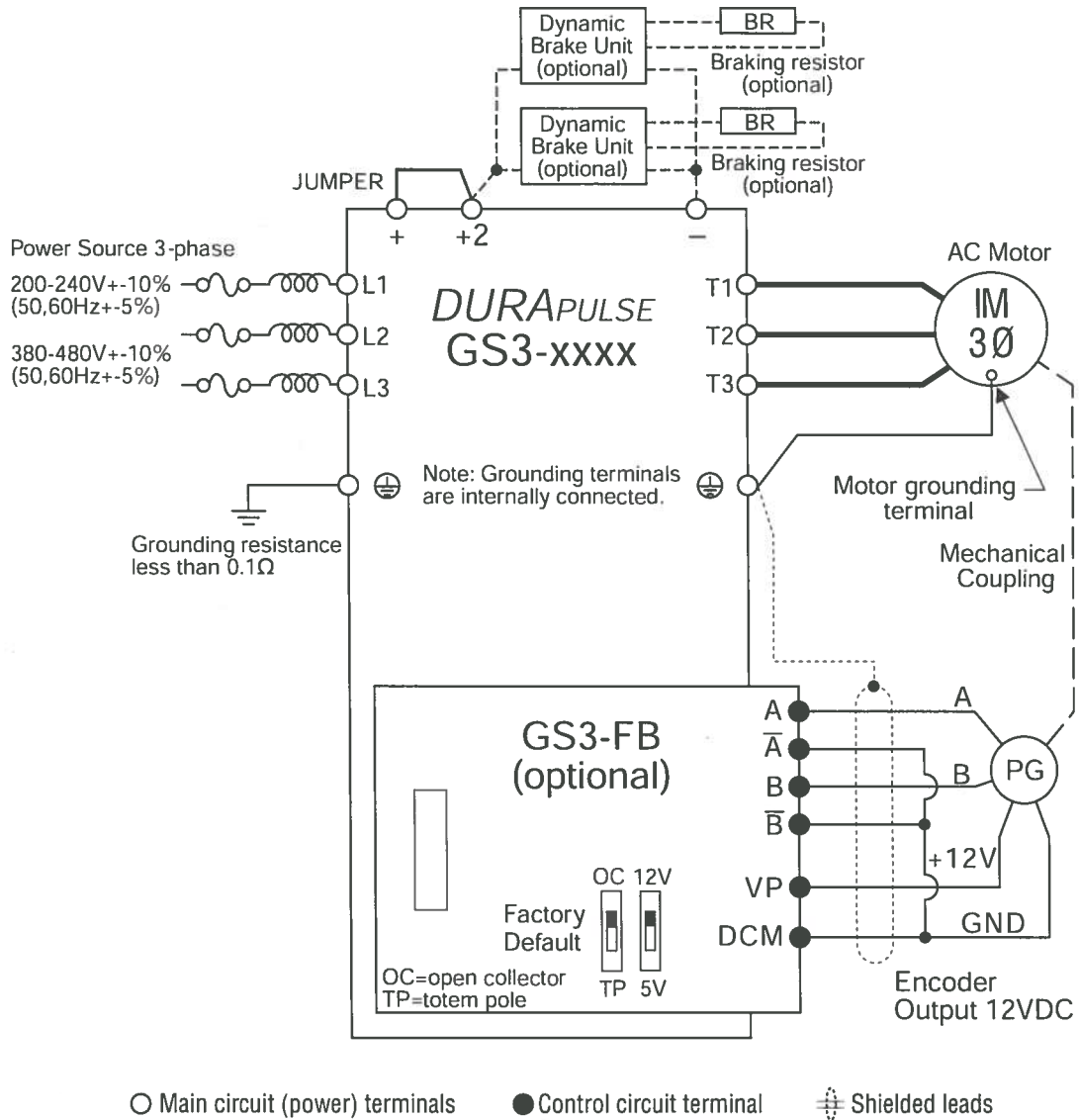
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Sensors: Encoders
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Relays and Timers
Pneumatics: Air Prep
Pneumatics: Directional Control Valves
Pneumatics: Cylinders
Pneumatics: Tubing
Pneumatics: Air Fittings
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# DURAPULSE 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: Please refer to the following catalog pages in the Drives section\* of our catalog for explanations and information regarding feedback cards, line reactors, braking units and resistors, EMI and RF filters, and fuses: 47, 49, 66, 68, 73, 79, 80.**



**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.

\*The Drives section is in Book 2 of current version of our catalog, or you can download PDF of section here.

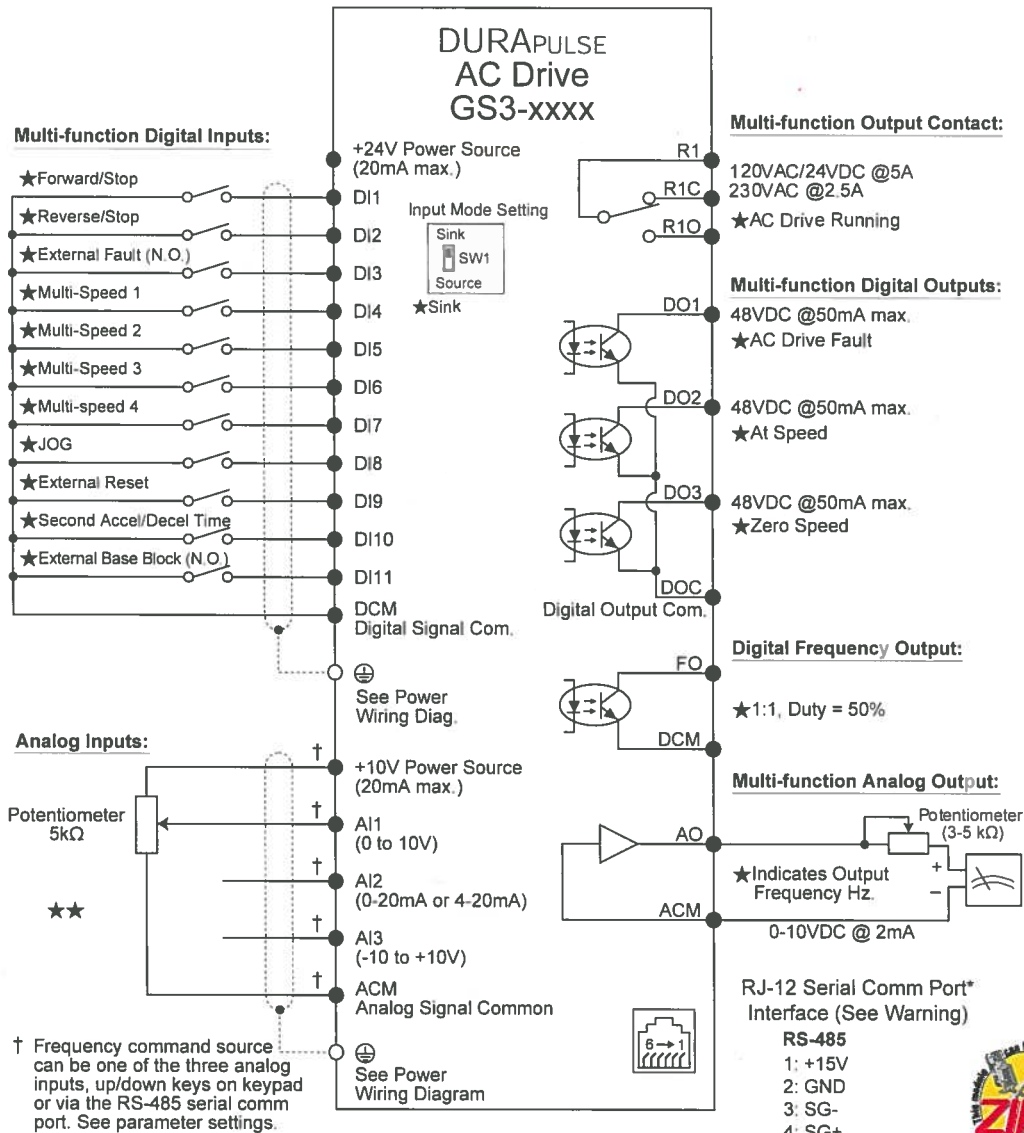
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# DURAPULSE AC Drives – Control Wiring Diagram – DI Connection to Sinking Outputs

## Control Wiring Diagram - Digital Input Connections to Sinking Output Devices



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



★ 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.**

**\*Optional ZIPLink serial communication cables available for plug and play connectivity to AutomationDirect PLCs. See the comm cable selection matrix on page 92.**



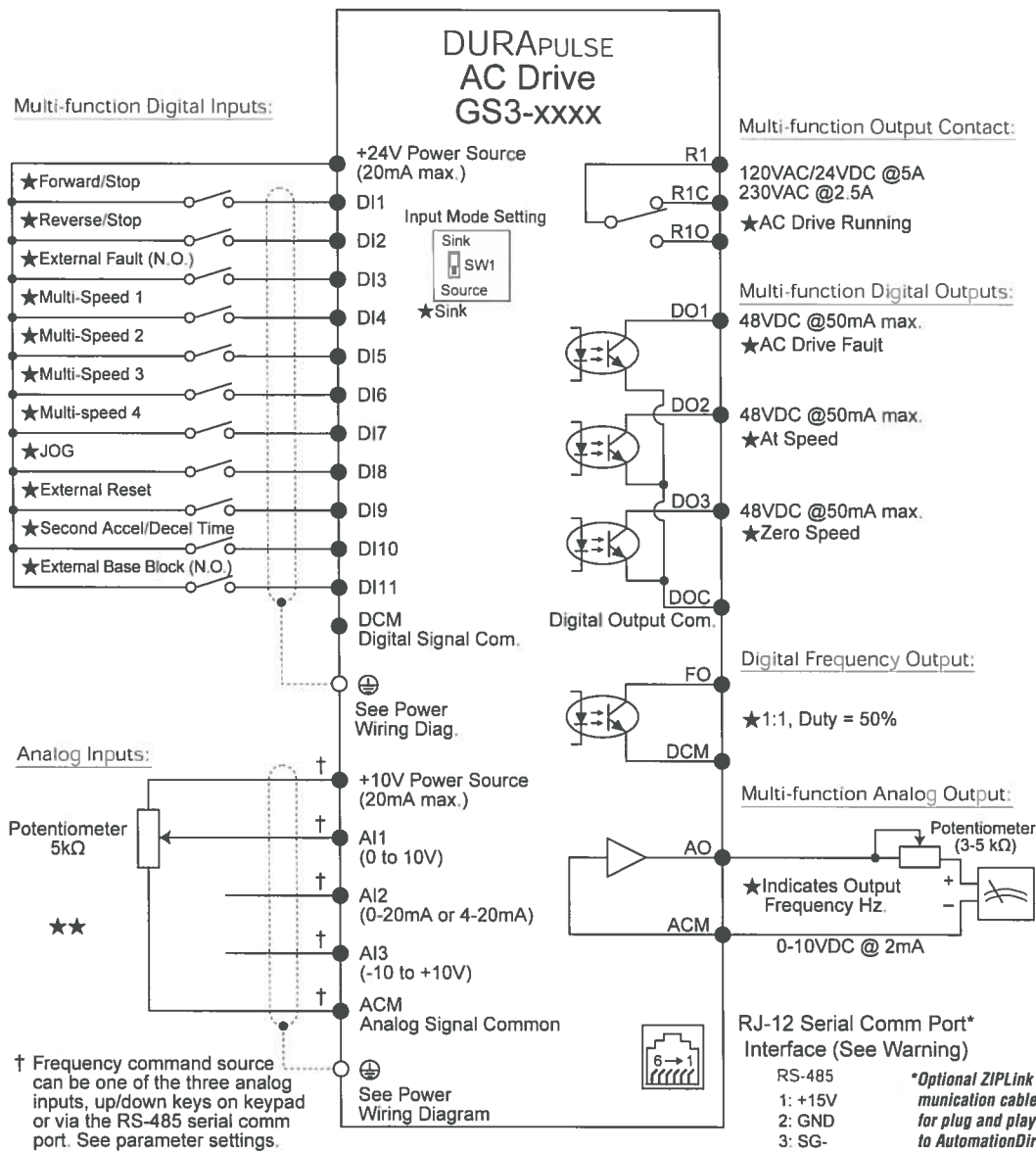
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# DURAPULSE AC Drives – Control Wiring Diagram – DI Connections to Sourcing Outputs

## Control Wiring Diagram - Digital Input Connections to Sourcing Output Devices



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



**\*Optional ZIPLink serial communication cables available for plug and play connectivity to AutomationDirect PLCs. See the comm cable selection matrix on page 92.**



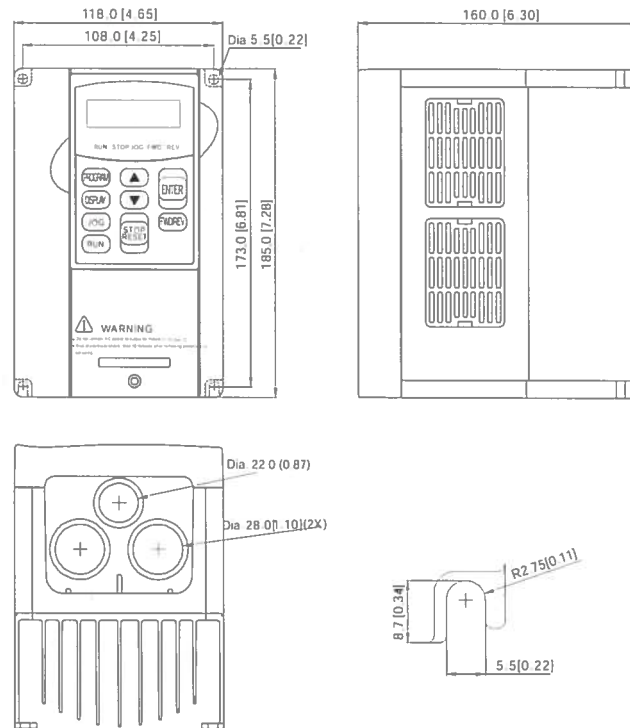
**WARNING: Do not plug a modem or telephone into the DURAPULSE RJ-12 Serial Comm Port, or permanent damage may result.**



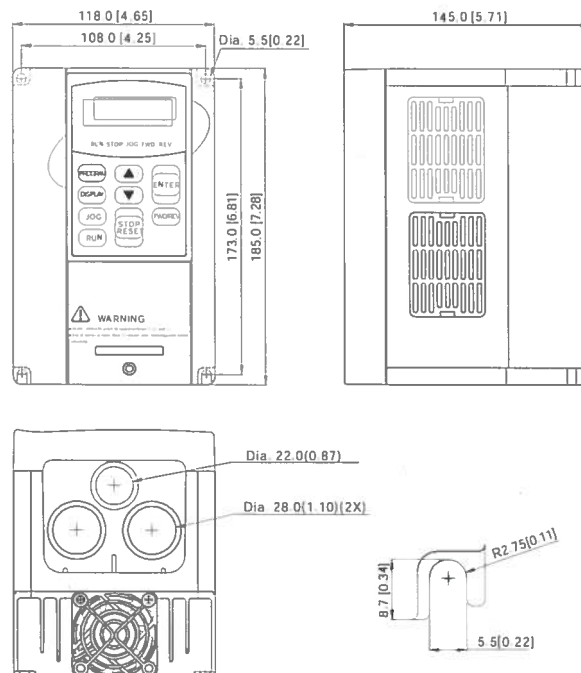
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# DURAPULSE AC Drives — Dimensions

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



## GS3-43P0

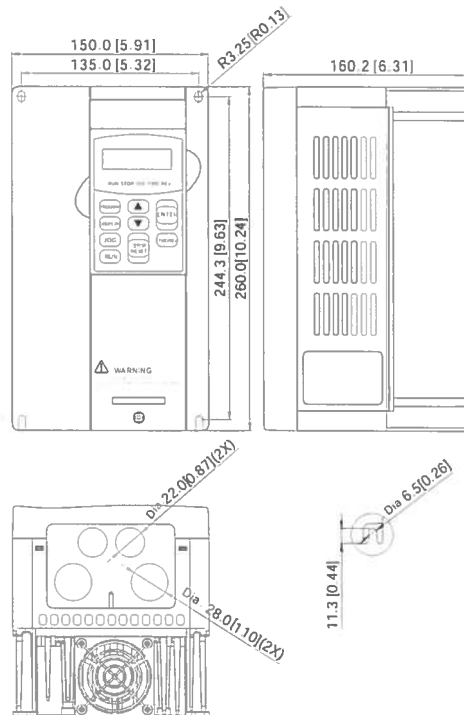


unit: mm(in)

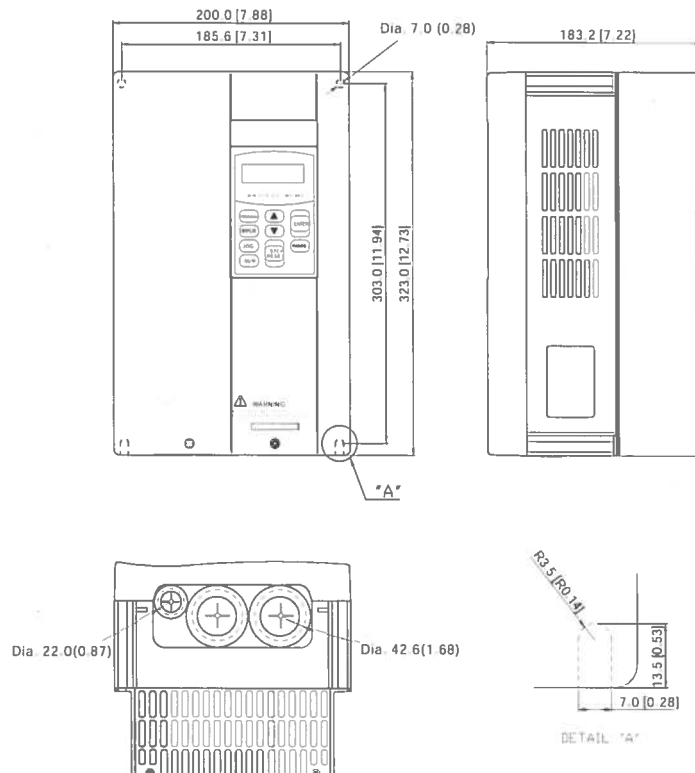


# DURAPULSE AC Drives — Dimensions

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



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

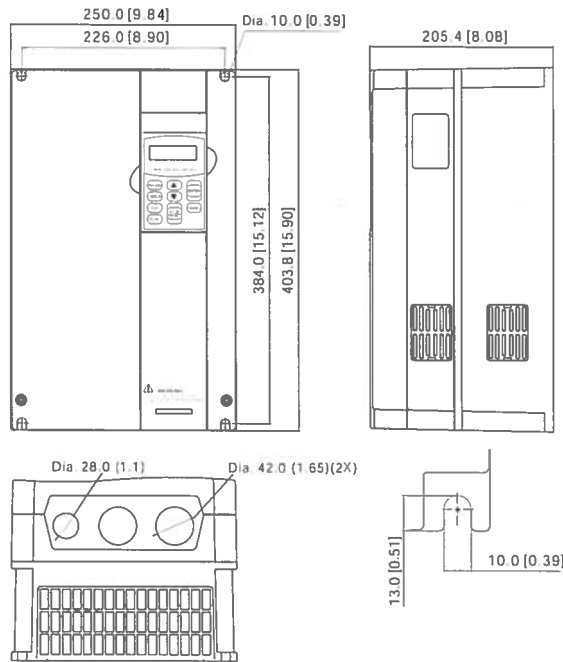


unit: mm(in)

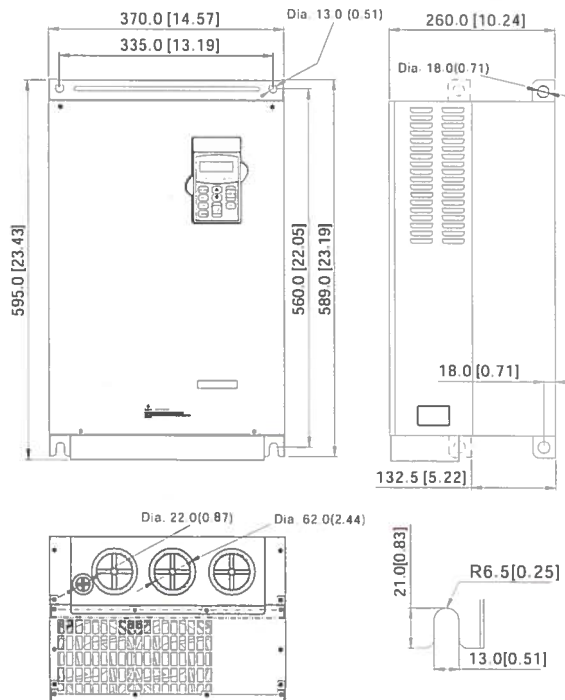
Prices as of April 15, 2015. Check Web site for most current prices.

# DURAPULSE AC Drives — Dimensions

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



GS3-2040, GS3-2050, GS3-4040, GS3-4050, GS3-4060



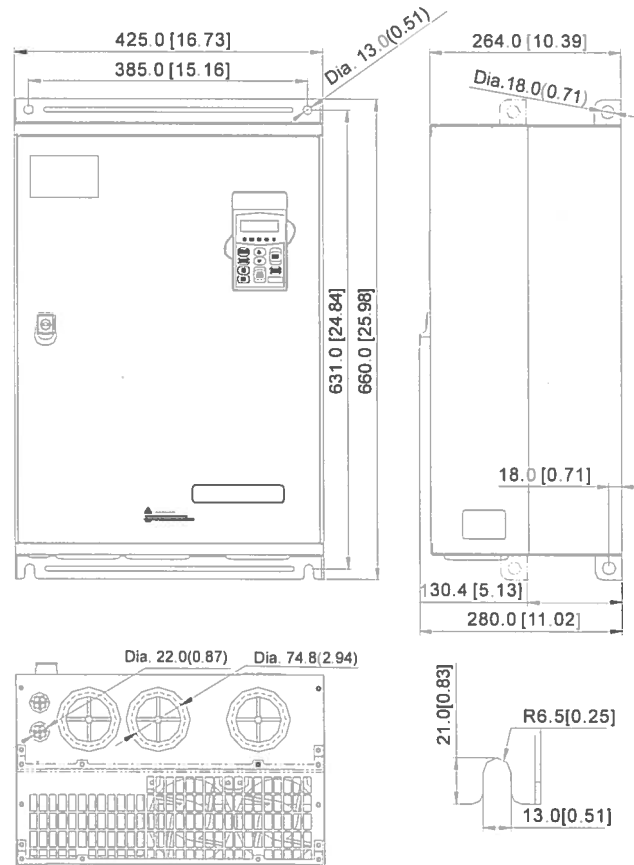
unit: mm(in)

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# DURAPULSE AC Drives — Dimensions

GS3-4075, GS3-4100



unit: mm(in)

Prices as of April 15, 2015. Check Web site for most current prices.

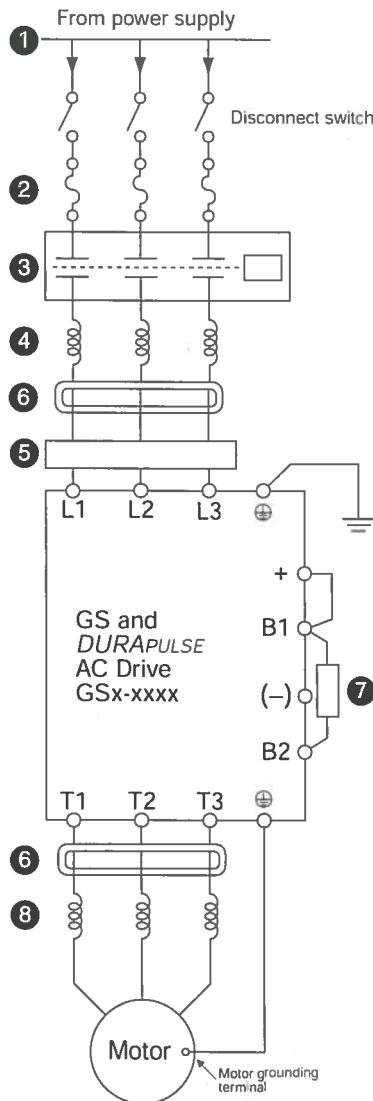
# GS/DURAPULSE Accessories – Overview

## Accessories – Part numbering system

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

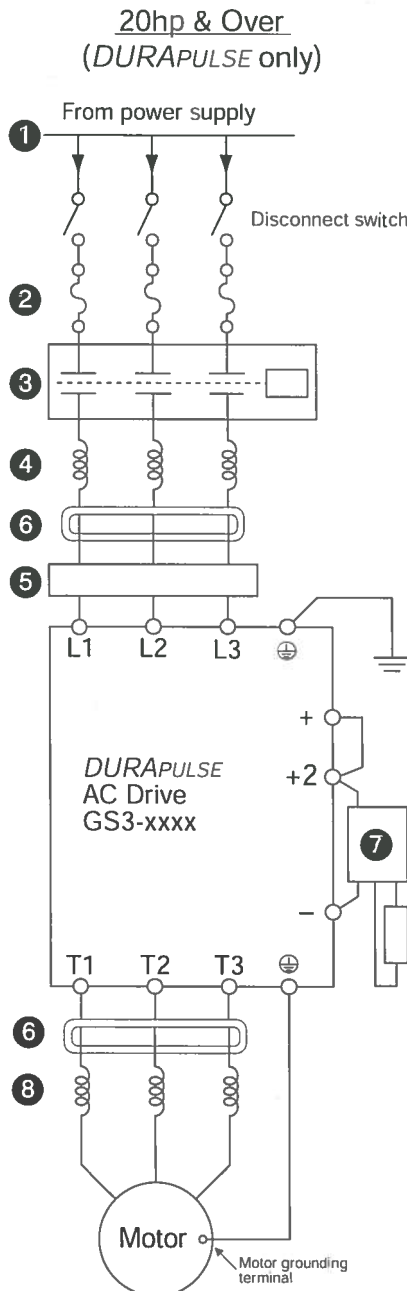
GS - 22P0 - LR - 3PH	<b>Description Code</b> (optional) 1PH: Single phase 3PH: Three phase ENC: Enclosure Blank: For reactor, blank = 3-phase
	<b>Accessory Code</b> BR: Braking resistor BZL: Bezel CBL: Cable DBU: Dynamic Brake Unit EDRV: Ethernet board FB: Feedback board FKIT: Fuse Kit FUSE: Replacement fuses for FKIT KPD: Keypad LR: Line reactor (legacy) RS: Recommended Standard
	<b>Horsepower Rating</b> Example: 2P0 = 2.0 hp 7P5 = 7.5 hp 010 = 10 hp
	<b>Voltage Rating</b> 1: 115V 2: 230V 4: 460V 5: 575V
	<b>Series</b> GS: All GS and DURApulse Series Drives GS1: GS1 Series GS2: GS2 Series GS3: DURApulse Series LR: Newer line reactor series

### Under 20hp



Automation Direct
Company Information
Drives
Soft Starters
Motors
Power Transmission
Motor, Servos and Steppers
Motor Controls
Sensors: Proximity
Sensors: Photoelectric
Sensors: Encoders
Sensors: Limit Switches
Sensors: Current
Sensors: Pressure
Sensors: Temperature
Sensors: Level
Sensors: Flow
Pushbuttons and Lights
Stacklights
Signal Devices
Process
Relays and Timers
Pneumatics: Air Prep
Pneumatics: Directional Control Valves
Pneumatics: Cylinders
Pneumatics: Tubing
Pneumatics: Air Fittings
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# GS/DURAPULSE Accessories – Overview



## 1 Power Supply

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

## 2 Fuses (Please refer to catalog page 80 in the Drives section\* of our catalog.)

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

## 3 Contactor (Optional) (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.

## 4 Input Line Reactor (Optional)

(Please refer to catalog page 49 in the Drives section\* of our catalog.)

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.

## 5 EMI filter (Optional)

(Please refer to catalog page 73 in the Drives section\* of our catalog.)

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

## 6 RF filter (Optional)

(Please refer to catalog page 79 in the Drives section\* of our catalog.)

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

## 7 Braking Unit & Braking Resistor (Optional)

(Please refer to catalog page 66 in the Drives section\* of our catalog.)

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.

## 8 Output Line Reactor (Optional)

(Please refer to catalog page 49 in the Drives section\* of our catalog.)

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.

\*The Drives section is in Book 2 of current version of our catalog, or you can download PDF of section [here](#).

Prices as of April 15, 2015. Check Web site for most current prices.

# GS/DURAPULSE Accessories – Feedback Card

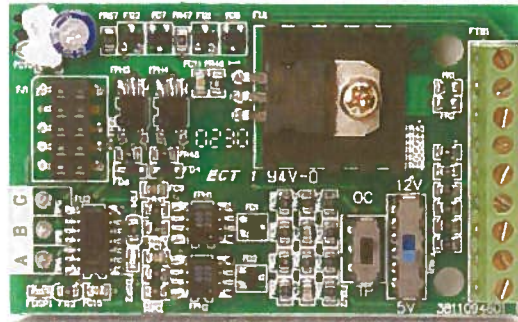
## Feedback Card for DURAPULSE AC Drives

Part Number	Price	Drive Model
<b>GS3-FB</b>	\$58.00	GS3-xxxx

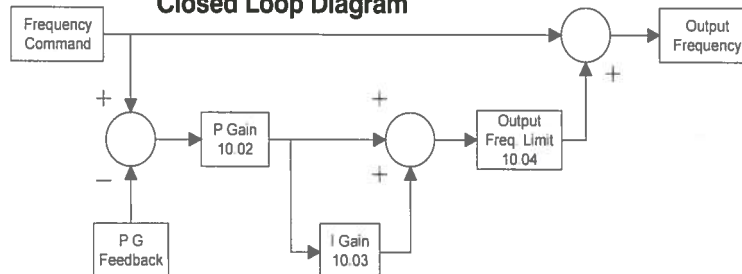
The GS3-FB feedback card is for use only with DURAPULSE AC drives.

## 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 sensorless 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

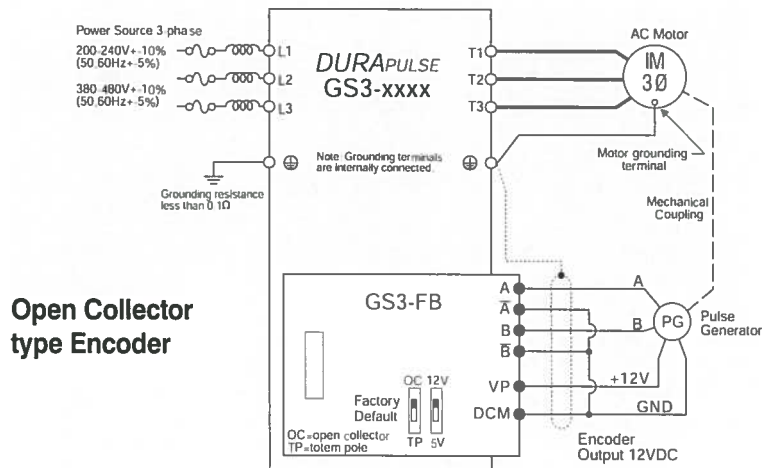


Types of Encoders		SW1 and SW2 switches	
		5V	12V
Output Voltage			
Open collector			
Line driver			
Complimentary			

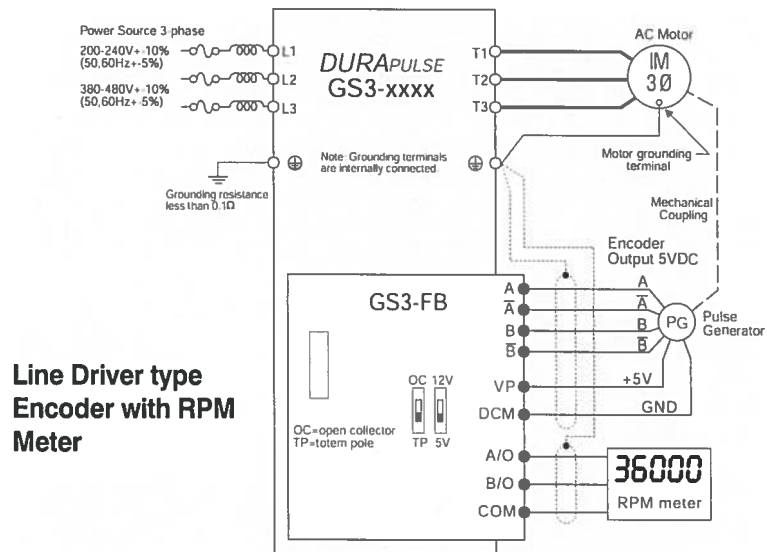
Automation Direct
Company Information
Drives
Soft Starters
Motors
Power Transmission
Motion Servos and Steppers
Motor Controls
Sensors Proximity
Sensors Photoelectric
Sensors Encoders
Sensors Limit Switches
Sensors Current
Sensors Pressure
Sensors Temperature
Sensors Level
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Pushbuttons and Lights
Stacklights
Signal Devices
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Relays and Timers
Pneumatics Air Prep
Pneumatics Directional Control Valves
Pneumatics Cylinders
Pneumatics Tubing
Pneumatics Air Fittings
Appendix Book 2
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# GS/DURAPULSE Accessories – Feedback Card

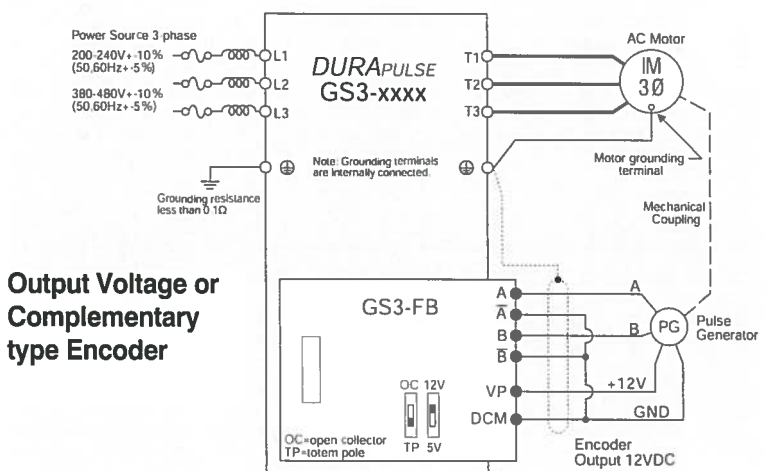
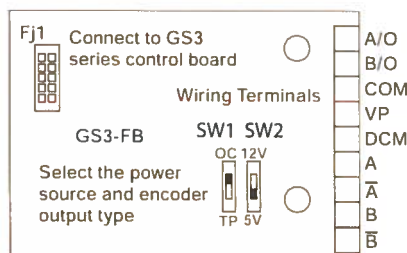
## Wiring Diagrams



Terminal Symbols	Description
<b>VP</b>	Power source of GS3-FB (SW1 can be switched to 12V or 5V) Output Voltage: (+12VDC $\pm 5\%$ 200mA) or (+5VDC $\pm 2\%$ 400mA)
<b>DCM</b>	Power source (VP) and input signal (A, B) common
<b>A, NOT A, B, NOT B</b>	Input signal from Encoder. Input type is selected by SW2; Maximum 500kp/sec
<b>A/O, B/O</b>	GS3-FB output signal for use with RPM Meter. (Open Collector) Maximum DC24V 100mA
<b>COM</b>	GS3-FB output signal (A/O, B/O) common



## Control Terminals Block Designations







## Wiring Solutions

### Wiring Solutions using the **ZIPLink** Wiring System

**ZIPLink**s eliminate the normally tedious process of wiring between devices by utilizing prewired cables and DIN rail mount connector modules. It's as simple as plugging in a cable connector at either end or terminating wires at only one end. Prewired cables keep installation clean and efficient, using half the space at a fraction of the cost of standard terminal blocks. There are several wiring solutions available when using the **ZIPLink** System ranging from

PLC I/O-to-**ZIPLink** Connector Modules that are ready for field termination, options for connecting to third party devices, GS, DuraPulse and SureServo Drives, and specialty relay, transorb and communications modules. Pre-printed I/O-specific adhesive label strips for quick marking of **ZIPLink** modules are provided with **ZIPLink** cables. See the following solutions to help determine the best **ZIPLink** system for your application.

#### **Solution 1: DirectLOGIC, CLICK and Productivity3000 I/O Modules to ZIPLink Connector Modules**

When looking for quick and easy I/O-to-field termination, a **ZIPLink** connector module used in conjunction with a prewired **ZIPLink** cable, consisting of an I/O terminal block at one end and a multi-pin connector at the other end, is the best solution.

Using the PLC I/O Modules to **ZIPLink** Connector Modules selector tables located in this section,

1. Locate your I/O module/PLC.
2. Select a **ZIPLink** Module.
3. Select a corresponding **ZIPLink** Cable.



#### **Solution 2: DirectLOGIC, CLICK and Productivity3000 I/O Modules to 3rd Party Devices**

When wanting to connect I/O to another device within close proximity of the I/O modules, no extra terminal blocks are necessary when using the **ZIPLink** Pigtail Cables. **ZIPLink** Pigtail Cables are prewired to an I/O terminal block with color-coded pigtail with soldered-tip wires on the other end.

Using the I/O Modules to 3rd Party Devices selector tables located in this section,

1. Locate your PLC I/O module.
2. Select a **ZIPLink** Pigtail Cable that is compatible with your 3rd party device.



#### **Solution 3: GS Series and DURAPULSE Drives Communication Cables**

Need to communicate via Modbus RTU to a drive or a network of drives?

**ZIPLink** cables are available in a wide range of configurations for connecting to PLCs and SureServo, SureStep, Stellar Soft Starter and AC drives. Add a **ZIPLink** communications module to quickly and easily set up a multi-device network.

Using the Drives Communication selector tables located in this section,

1. Locate your Drive and type of communications.
2. Select a **ZIPLink** cable and other associated hardware.



Prices as of April 15, 2015. Check Web site for most current prices.



## Wiring Solutions

### Solution 4: Serial Communications Cables

ZIPLink offers communications cables for use with *Direct*LOGIC, CLICK, and Productivity3000 CPUs, that can also be used with other communications devices. Connections include a 6-pin RJ12 or 9-pin, 15-pin and 25-pin D-sub connectors which can be used in conjunction with the RJ12 or D-Sub Feedthrough modules.

Using the Serial Communications Cables selector table located in this section,

1. Locate your connector type
2. Select a cable.



### Solution 5: Specialty ZIPLink Modules

For additional application solutions, ZIPLink modules are available in a variety of configurations including stand-alone relays, 24VDC and 120VAC transorb modules, D-sub and RJ12 feedthrough modules, communication port adapter and distribution modules, and SureServo 50-pin I/O interface connection.

Using the ZIPLink Specialty Modules selector table located in this section,

1. Locate the type of application.
2. Select a ZIPLink module.



### Solution 6: ZIPLink Connector Modules to 3rd Party Devices

If you need a way to connect your device to terminal blocks without all that wiring time, then our pigtail cables with color-coded soldered-tip wires are a good solution. Used in conjunction with any compatible ZIPLink Connector Modules, a pigtail cable keeps wiring clean and easy and reduces troubleshooting time.

Using the Universal Connector Modules and Pigtail Cables table located in this section,

1. Select module type.
2. Select the number of pins.
3. Select cable.



Automation Direct
Company Information
Drives
Soft Starters
Motors
Power Transmission
Motion: Servos and Steppers
Motor Controls
Sensors: Proximity
Sensors: Photoelectric
Sensors: Encoders
Sensors: Limit Switches
Sensors: Current
Sensors: Pressure
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Stacklights
Signal Devices
Process
Relays and Timers
Pneumatics: Air Prep
Pneumatics: Directional Control Valves
Pneumatics: Cylinders
Pneumatics: Tubing
Pneumatics: Air Fittings
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# Motor Controller Communication

Drive / Motor Controller (GS/DURAPulse/SureServo/SureStep/Stellar) ZIPLink Selector							
Drive / Motor Controller		Communications			ZIPLink Cable		
Controller	Comm Port Type	Network/Protocol	Connects to	Comm Port Type	Cable (2 meter length)	Cable Connectors	Other Hardware Required
GS1	RJ12	RS-485 Modbus RTU	DL06 PLCs	Port 2 (HD15)	GS-485HD15-CBL-2	RJ12 to HD15	—
			D2-260 CPU				—
			GS-EDRV100	RJ12	GS-EDRV-CBL-2	RJ12 to RJ12	—
			ZL-CDM-RJ12Xxx*	RJ12	GS-485RJ12-CBL-2	RJ12 to RJ12	—
			FA-ISOCOCON	5-pin Connector	GS-ISOCOCON-CBL-2	RJ12 to 5-pin plug	—
GS2	RJ12	RS-232 Modbus RTU	CLICK PLCs	Port 2 (RJ12)			—
			DL05 PLCs				—
			DL06 PLCs				—
			D2-250-1 CPU	Port 2 (HD15)	GS-RJ12-CBL-2	RJ12 to RJ12	FA-15HD
			D2-260 CPU				
			D4-450 CPU	Port 3 (25-pin)			FA-CABKIT
			P3-550 CPU	Port 2 (RJ12)			—
		RS-485 Modbus RTU	DL06 PLCs	Port 2 (HD15)	GS-485HD15-CBL-2	RJ12 to HD15	—
			D2-260 CPU				—
			GS-EDRV100	RJ12	GS-EDRV-CBL-2	RJ12 to RJ12	—
			ZL-CDM-RJ12Xxx*	RJ12	GS-485RJ12-CBL-2	RJ12 to RJ12	—
DuraPulse (GS3)	RJ12	RS-485 Modbus RTU	FA-ISOCOCON	5-pin Connector	GS-ISOCOCON-CBL-2	RJ12 to 5-pin plug	—
			DL06 PLCs	Port 2 (HD15)	GS-485HD15-CBL-2	RJ12 to HD15	—
			D2-260 CPU				—
			GS-EDRV100	RJ12	GS-EDRV-CBL-2	RJ12 to RJ12	—
			ZL-CDM-RJ12Xxx*	RJ12	GS-485RJ12-CBL-2	RJ12 to RJ12	—
Stellar (Soft Starter) SR44 Series	RJ45**	RS-485 Modbus RTU	FA-ISOCOCON	5-pin Connector	GS-ISOCOCON-CBL-2	RJ12 to 5-pin plug	—
			DL06 PLCs	Port 2 (HD15)	GS-485HD15-CBL-2	RJ45 to HD15	SR44-RS485**
			D2-250-1 CPU				
			D2-260 CPU				
SureServo	IEEE1394 (CN3)	RS-232 Modbus RTU	ZL-CDM-RJ12Xxx*	RJ12	SR44-485RJ45-CBL-2	RJ45 to RJ12	—
			CLICK PLCs	Port 2 (RJ12)			—
			DL05 PLCs				—
			DL06 PLCs				—
			D2-250-1 CPU	Port 2 (HD15)	SVC-232RJ12-CBL-2	6-pin IEEE to RJ12	FA-15HD
			D2-260 CPU				
			D4-450 CPU	Port 3 (25-pin)			FA-CABKIT
			P3-550 CPU	Port 2 (RJ12)			—
		RS-485 Modbus RTU	DL06 PLCs	Port 2 (HD15)	SVC-485HD15-CBL-2	6-pin IEEE to HD15	—
			D2-260 CPU				—
			ZL-CDM-RJ12Xxx*	RJ12	SVC-485RJ12-CBL-2	6-pin IEEE to RJ12	—
			USB-485M	RJ45	SVC-485CFG-CBL-2	6-pin IEEE to RJ45	—
SureStep	RJ12	RS-232 ASCII	DL06 PLCs	Port 2 (HD15)	STP-232HD15-CBL-2	HD15-pin to RJ12	—
			D2-250-1 CPU				—
			D2-260 CPU (Port2)				—
			DL05 PLCs	RJ12			—
			CLICK PLCs				—
			Do-more PLC	Port 2 (Serial)	STP-232RJ12-CBL-2	RJ12 to RJ12	—
			Productivity Series	RS-232 Serial			—
							—

\* When using the ZL-CDM-RJ12Xxx ZIPLink Communication Distribution Module, replace the lowercase "xx" with the number of RJ12 ports, i.e. "4" for four ports, or "10" for ten ports. (ex: ZL-CDM-RJ12X4 or ZL-CDM-RJ12X10)

\*\* The SR44-RS485 Communications Adapter must be installed for RS-485 communications with the Stellar soft starters.



Prices as of April 15, 2015. Check Web site for most current prices.

# Hitachi Drives Cross References

To find a suitable replacement for an SJ300 Hitachi drive, use the chart to the right to determine control mode(s) required, and the tables below to determine possible replacement part numbers. Suggested replacements do not necessarily have all control modes of the original, so appropriate drives will be application-dependent. Please call Tech Support if there are any replacement questions.

Drive Series	Volts/Hz	PID	Sensorless Vector	Full Flux Vector
L100	✓	✓		
SJ100	✓	✓	✓	
GS1	✓			
GS2	✓	✓		
DURAPulse (GS3)	✓	✓	✓	
SJ300	✓	✓	✓	✓

## Hitachi SJ300 Cross Reference

Hitachi SJ300 AC Drives			Possible Replacements					
	Part No.	Horsepower	GS1	Price	GS2	Price	DURAPulse (GS3)	Price
230V	SJ300-004LFU	0.5 hp	GS1-20P5	\$117.00	GS2-20P5	\$158.00	GS3-21P0 **	\$242.00
	SJ300-007LFU	1.0 hp	GS1-21P0	\$134.00	GS2-21P0	\$177.00	GS3-21P0	\$242.00
	SJ300-015LFU	2.0 hp	GS1-22P0 *	\$164.00	GS2-22P0	\$251.00	GS3-22P0	\$293.00
	SJ300-022LFU	3.0 hp	—	—	GS2-23P0	\$309.00	GS3-23P0	\$347.00
	SJ300-037LFU	5.0 hp	—	—	GS2-25P0 *	\$363.00	GS3-25P0 *	\$400.00
	SJ300-055LFU	7.5 hp	—	—	GS2-27P5 *	\$465.00	GS3-27P5 *	\$549.00
	SJ300-075LFU	10 hp	—	—	—	—	GS3-2010 *	\$698.00
	SJ300-110LFU	15 hp	—	—	—	—	GS3-2015 *	\$889.00
	SJ300-150LFU	20 hp	—	—	—	—	GS3-2020 *	\$1,104.00
	SJ300-185LFU	25 hp	—	—	—	—	GS3-2025 *	\$1,298.00
	SJ300-220LFU	30 hp	—	—	—	—	GS3-2030 *	\$1,486.00
460V	SJ300-007HFU	1.0 hp	—	—	GS2-41P0 *	\$261.00	GS3-41P0 *	\$323.00
	SJ300-015HFU	2.0 hp	—	—	GS2-42P0 *	\$303.00	GS3-42P0 *	\$360.00
	SJ300-022HFU	3.0 hp	—	—	GS2-43P0 *	\$357.00	GS3-43P0 *	\$385.00
	SJ300-040HFU	5.0 hp	—	—	GS2-45P0 *	\$410.00	GS3-45P0 *	\$427.00
	SJ300-055HFU	7.5 hp	—	—	GS2-47P5 *	\$586.00	GS3-47P5 *	\$613.00
	SJ300-075HFU	10 hp	—	—	GS2-4010 *	\$725.00	GS3-4010 *	\$734.00
	SJ300-110HFU	15 hp	—	—	—	—	GS3-4015 *	\$957.00
	SJ300-150HFU	20 hp	—	—	—	—	GS3-4020 *	\$1,165.00
	SJ300-185HFU	25 hp	—	—	—	—	GS3-4025 *	\$1,383.00
	SJ300-220HFU	30 hp	—	—	—	—	GS3-4030 *	\$1,570.00

Notes: Replacement drives do not necessarily have the same physical dimensions, mounting hole patterns or wiring terminal arrangements.

\* All SJ300 drives are specified for use with 3-phase power (but can be installed in single-phase applications). Replacement drive requires 3-phase power. Ensure that the existing SJ application uses 3-phase input power, or that 3-phase power is available.

\*\* Replacement drive is higher horsepower than existing drive. Output power of new drive can be parameter-limited to the smaller horsepower.



Company Information

Drives

Soft Starters

Motors

Power Transmission

Motion: Servos and Steppers

Motor Controls

Sensors: Proximity

Sensors: Photoelectric

Sensors: Encoders

Sensors: Limit Switches

Sensors: Current

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Pneumatics: Tubing

Pneumatics: Air Fittings

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# Hitachi Drives Cross References

To find a suitable replacement for an L100 or SJ100 Hitachi drive, use the chart to the right to determine control mode(s) required, and the tables below to determine possible replacement part numbers. Suggested replacements do not necessarily have all control modes of the original, so appropriate drives will be application-dependent. Please call Tech Support if there are any replacement questions.

Drive Series	Volts/Hz	PID	Sensorless Vector	Full Flux Vector
L100	✓	✓		
SJ100	✓	✓	✓	
GS1	✓			
GS2	✓	✓		
DURAPULSE	✓	✓	✓	
SJ300	✓	✓	✓	✓

## Hitachi L100 Cross Reference

Hitachi L100 AC Drives			Possible Replacements					
	Part No.	Horsepower	GS1	Price	GS2	Price	DURAPULSE	Price
230V	L100-002NFU	0.25 hp	GS1-20P2	\$113.00	GS2-20P5 **	\$158.00	GS3-21P0 **	\$242.00
	L100-004NFU	0.5 hp	GS1-20P5	\$117.00	GS2-20P5	\$158.00	GS3-21P0 **	\$242.00
	L100-007NFU	1.0 hp	GS1-21P0	\$134.00	GS2-21P0	\$177.00	GS3-21P0	\$242.00
	L100-015NFU	2.0 hp	GS1-22P0 *	\$164.00	GS2-22P0	\$251.00	GS3-22P0	\$293.00
	L100-022NFU	3.0 hp	—	—	GS2-23P0	\$309.00	GS3-23P0	\$347.00
	L100-037LFU	5.0 hp	—	—	GS2-25P0 *	\$363.00	GS3-25P0 *	\$400.00
	L100-055LFU	7.5 hp	—	—	GS2-27P5 *	\$465.00	GS3-27P5 *	\$549.00
	L100-075LFU	10 hp	—	—	—	—	GS3-2010 *	\$698.00
460V	L100-004HFU	0.5 hp	—	—	GS2-41P0 * **	\$261.00	GS3-41P0 * **	\$323.00
	L100-007HFU	1.0 hp	—	—	GS2-41P0 *	\$261.00	GS3-41P0 *	\$323.00
	L100-015HFU	2.0 hp	—	—	GS2-42P0 *	\$303.00	GS3-42P0 *	\$360.00
	L100-022HFU	3.0 hp	—	—	GS2-43P0 *	\$357.00	GS3-43P0 *	\$385.00
	L100-040HFU	5.0 hp	—	—	GS2-45P0 *	\$410.00	GS3-45P0 *	\$427.00
	L100-055HFU	7.5 hp	—	—	GS2-47P5 *	\$586.00	GS3-47P5 *	\$613.00
	L100-075HFU	10 hp	—	—	GS2-4010 *	\$725.00	GS3-4010 *	\$734.00

Notes: Replacement drives do not necessarily have the same physical dimensions, mounting hole patterns or wiring terminal arrangements.  
 \* = Replacement drive requires 3-phase input power. Ensure that the existing application uses 3-phase input power, or that 3-phase power is available.  
 \*\* = Replacement drive is higher horsepower than existing drive. Output power of new drive can be parameter-limited to the smaller horsepower.

## Hitachi SJ100 Cross Reference

Hitachi SJ100 AC Drives			Possible Replacements					
	Part No.	Horsepower	GS1	Price	GS2	Price	DURAPULSE	Price
230V	SJ100-002NFU	0.25 hp	GS1-20P2	\$113.00	GS2-20P5 **	\$158.00	GS3-21P0 **	\$242.00
	SJ100-004NFU	0.5 hp	GS1-20P5	\$117.00	GS2-20P5	\$158.00	GS3-21P0 **	\$242.00
	SJ100-007NFU	1.0 hp	GS1-21P0	\$134.00	GS2-21P0	\$177.00	GS3-21P0	\$242.00
	SJ100-015NFU	2.0 hp	GS1-22P0 *	\$164.00	GS2-22P0	\$251.00	GS3-22P0	\$293.00
	SJ100-022NFU	3.0 hp	—	—	GS2-23P0	\$309.00	GS3-23P0	\$347.00
	SJ100-037LFU	5.0 hp	—	—	GS2-25P0 *	\$363.00	GS3-25P0 *	\$400.00
	SJ100-055LFU	7.5 hp	—	—	GS2-27P5 *	\$465.00	GS3-27P5 *	\$549.00
	SJ100-075LFU	10 hp	—	—	—	—	GS3-2010 *	\$698.00
460V	SJ100-004HFU	0.5 hp	—	—	GS2-41P0 * **	\$261.00	GS3-41P0 * **	\$323.00
	SJ100-007HFU	1.0 hp	—	—	GS2-41P0 *	\$261.00	GS3-41P0 *	\$323.00
	SJ100-015HFU	2.0 hp	—	—	GS2-42P0 *	\$303.00	GS3-42P0 *	\$360.00
	SJ100-022HFU	3.0 hp	—	—	GS2-43P0 *	\$357.00	GS3-43P0 *	\$385.00
	SJ100-040HFU	5.0 hp	—	—	GS2-45P0 *	\$410.00	GS3-45P0 *	\$427.00
	SJ100-055HFU	7.5 hp	—	—	GS2-47P5 *	\$586.00	GS3-47P5 *	\$613.00
	SJ100-075HFU	10 hp	—	—	GS2-4010 *	\$725.00	GS3-4010 *	\$734.00

Notes: Replacement drives do not necessarily have the same physical dimensions, mounting hole patterns or wiring terminal arrangements.  
 \* = Replacement drive requires 3-phase input power. Ensure that the existing application uses 3-phase input power, or that 3-phase power is available.  
 \*\* = Replacement drive is higher horsepower than existing drive. Output power of new drive can be parameter-limited to the smaller horsepower.

**This foregoing document was electronically filed with the Public Utilities**

**Commission of Ohio Docketing Information System on**

**9/24/2018 1:17:33 PM**

**in**

**Case No(s). 18-0891-EL-EEC**

Summary: Application - D S Brown Company and Ohio Power Company for approval of a special arrangement agreement with a mercantile customer electronically filed by Mr. Steven T Nourse on behalf of Ohio Power Company