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Allen-Bradley

PowerFlex® 40P

Adjustable Frequency AC Drive

FRN 1.xx - 2.xx

User Manual

Rockwell Automation

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Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at **http://www.rockwellautomation.com/literature**) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary we use notes to make you aware of safety considerations.



WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

Important: Identifies information that is critical for successful application and understanding of the product.



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you:

- identify a hazard
- avoid the hazard
- recognize the consequences



Shock Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that dangerous voltage may be present.



Burn Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that surfaces may be at dangerous temperatures.

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Manual Updates

The information below summarizes the changes to the PowerFlex 40P User Manual since the March 2006 release.

Description of New or Updated Information	See Page(s)
Voltage Range DIP Switch location and note added	1-15, 1-16
I/O Terminal 03 default value is Not Active	1-17
Catalog Number for Encoder Terminal Cover corrected	1-19
DriveGuard Safe-Off Option (Series B) *User Manual* publication number corrected to PFLEX-UM003	P-1, 1-21, 1-29
Display resolution corrected to 0.01 for b001 [Output Freq]	3-3
Display resolution corrected to 0.01 for b002 [Commanded Freq]	3-3
Description of I/O Terminal 03 function added to options 1, 2, 3 & 4	3-10
Position Source added to table for A070-A077 [Preset Freq x], when P038 [Speed Reference] = 9 “Positioning”	3-25
Important statement about saving parameter settings to drive non-volatile memory added at E207 [Comm Write Mode]	3-52
E248 [Enh Control Word] descriptions for options 7 & 8 clarified	3-60
Corrective Action added for an F91 Encoder Loss fault when in Positioning mode	4-5
RS485 (DSI) Network Wiring practices clarified	C-1
Logic Command Word and Logic Status Word now have selectable Velocity and Position Bit definitions	C-4…C-6
Positioning Mode option 1 “Preset Input” description clarified	F-5

Parameter Updates

The following parameters have been added or updated with Firmware Revision Number (FRN) 2.xx.

Parameter	Number	Description	Page
Cmd Stat Select	E249	New Parameter	3-61
Drive Status 2	d301	Bit 0 renamed “Dir Positive”	3-62

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Overview

The purpose of this manual is to provide you with the basic information needed to install, start-up and troubleshoot the PowerFlex 40P Adjustable Frequency AC Drive.

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Reference Materials	P-1
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Who Should Use this Manual?

This manual is intended for qualified personnel. You must be able to program and operate Adjustable Frequency AC Drive devices. In addition, you must have an understanding of the parameter settings and functions.

Reference Materials

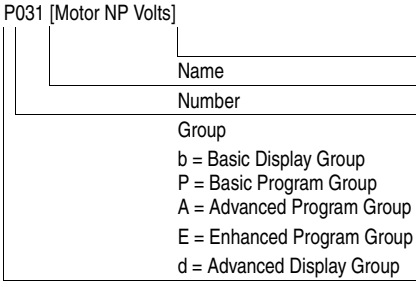
The following manuals are recommended for general drive information:

Title	Publication	Available Online at ...
Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives	DRIVES-IN001...	www.rockwellautomation.com/literature
Preventive Maintenance of Industrial Control and Drive System Equipment	DRIVES-TD001...	
Safety Guidelines for the Application, Installation and Maintenance of Solid State Control	SGI-1.1	
A Global Reference Guide for Reading Schematic Diagrams	100-2.10	
Guarding Against Electrostatic Damage	8000-4.5.2	
DriveGuard® Safe-Off Option (Series B) for PowerFlex AC Drives	PFLEX-UM003...	

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Manual Conventions

- In this manual we refer to the PowerFlex 40P Adjustable Frequency AC Drive as; drive, PowerFlex 40P or PowerFlex 40P Drive.
- Parameter numbers and names are shown in this format:



- The following words are used throughout the manual to describe an action:

Word	Meaning
Can	Possible, able to do something
Cannot	Not possible, not able to do something
May	Permitted, allowed
Must	Unavoidable, you must do this
Shall	Required and necessary
Should	Recommended
Should Not	Not Recommended

Drive Frame Sizes

Similar PowerFlex 40P drive sizes are grouped into frame sizes to simplify spare parts ordering, dimensioning, etc. A cross reference of drive catalog numbers and their respective frame sizes is provided in Appendix B.

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General Precautions



ATTENTION: The drive contains high voltage capacitors which take time to discharge after removal of mains supply. Before working on drive, ensure isolation of mains supply from line inputs [R, S, T (L1, L2, L3)]. Wait three minutes for capacitors to discharge to safe voltage levels. Failure to do so may result in personal injury or death.

Darkened display LEDs is not an indication that capacitors have discharged to safe voltage levels.

ATTENTION: Only qualified personnel familiar with adjustable frequency AC drives and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

ATTENTION: This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference A-B publication 8000-4.5.2, “Guarding Against Electrostatic Damage” or any other applicable ESD protection handbook.

ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.

ATTENTION: The bus regulator function is extremely useful for preventing nuisance overvoltage faults resulting from aggressive decelerations, overhauling loads, and eccentric loads. However, it can also cause either of the following two conditions to occur.
1. Fast positive changes in input voltage or imbalanced input voltages can cause uncommanded positive speed changes;
2. Actual deceleration times can be longer than commanded deceleration times
However, a “Stall Fault” is generated if the drive remains in this state for 1 minute. If this condition is unacceptable, the bus regulator must be disabled (see parameter A117). In addition, installing a properly sized dynamic brake resistor will provide equal or better performance in most cases.

ATTENTION: Risk of injury or equipment damage exists. Drive does not contain user-serviceable components. Do not disassemble drive chassis.

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Catalog Number Explanation

1-3	4	5	6-8	9	10	11	12	13-14
22D	**-**	**B**	**2P3**	**N**	**1**	**0**	**4**	**AA**
Drive	Dash	Voltage Rating	Rating	Enclosure	HIM	Emission Class	Version	Optional

Code	
22D	PowerFlex 40P

Code	Version
4	Standard

Code	EMC Filter
0	Not Filter

Code	Voltage	Ph.
B	240V AC	3
D	480V AC	3
E	600V AC	3

Code	HIM Version
1	Display/Fault Reset Only
2	Display/Fault Reset Only (Plate Drive)

Code	Purpose
AA thru ZZ	Reserved for custom firmware

Code	Enclosure
N	Panel Mount - IP 20 (NEMA Type Open)
F	Flange Mount - IP 20 (NEMA Type Open)
H	Plate Drive - IP 20 (NEMA Type Open)

Output Current @ 200-240V Input

Code	Amps	kW (HP)
2P3	2.3	0.4 (0.5)
5P0	5.0	0.75 (1.0)
8P0	8.0	1.5 (2.0)
012	12	2.2 (3.0)
017	17.5	3.7 (5.0)
024	24	5.5 (7.5)
033	33	7.5 (10)

Output Current @ 380-480V Input

Code	Amps	kW (HP)
1P4	1.4	0.4 (0.5)
2P3	2.3	0.75 (1.0)
4P0	4.0	1.5 (2.0)
6P0	6.0	2.2 (3.0)
010	10.5	4.0 (5.0)
012	12	5.5 (7.5)
017	17	7.5 (10)
024	24	11 (15)

Output Current @ 460-600V Input

Code	Amps	kW (HP)
1P7	1.7	0.75 (1.0)
3P0	3.0	1.5 (2.0)
4P2	4.2	2.2 (3.0)
6P6	6.6	4.0 (5.0)
9P9	9.9	5.5 (7.5)
012	12	7.5 (10)
019	19	11 (15)

Additional accessories, options and adapters are available. See Appendix B for details.

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Installation/Wiring

This chapter provides information on mounting and wiring the PowerFlex 40P Drive.

For information on...	See page
Opening the Cover	1-1
Mounting Considerations	1-2
AC Supply Source Considerations	1-4
General Grounding Requirements	1-6

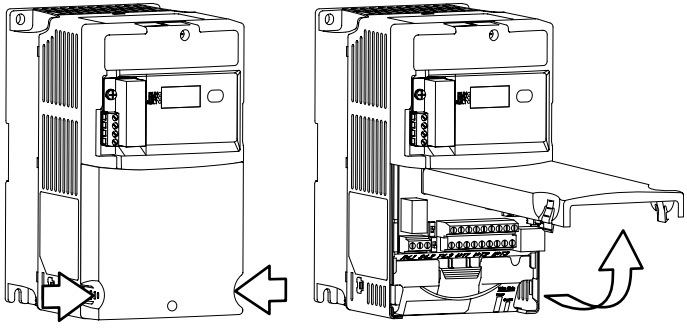
For information on...	See page
Fuses and Circuit Breakers	1-7
Power Wiring	1-9
I/O Wiring Recommendations	1-13
EMC Instructions	1-29

Most start-up difficulties are the result of incorrect wiring. Every precaution must be taken to assure that the wiring is done as instructed. All items must be read and understood before the actual installation begins.

ATTENTION: The following information is merely a guide for proper installation. Rockwell Automation, Inc. cannot assume responsibility for the compliance or the noncompliance to any code, national, local or otherwise for the proper installation of this drive or associated equipment. A hazard of personal injury and/or equipment damage exists if codes are ignored during installation.

Opening the Cover

1. Press and hold in the tabs on each side of the cover.
2. Pull the cover out and up to release.



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Mounting Considerations

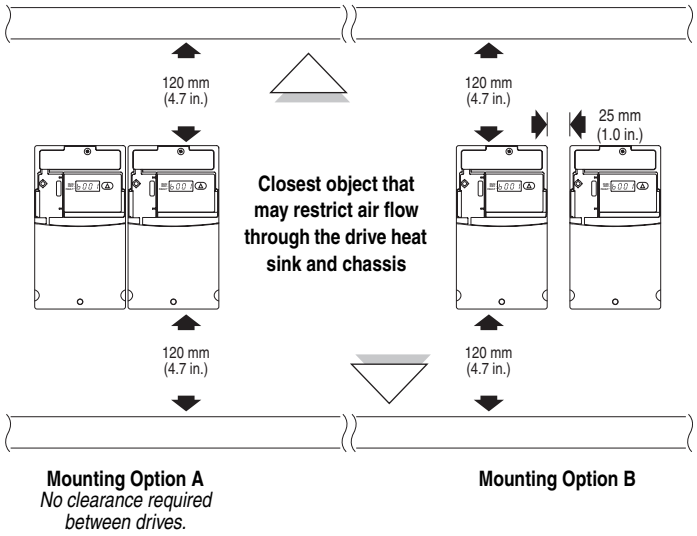
- Mount the drive upright on a flat, vertical and level surface.

Frame	Screw Size	Screw Torque	DIN Rail
B	M4 (#8-32)	1.56-1.96 N-m (14-17 lb.-in.)	35 mm
C	M5 (#10-24)	2.45-2.94 N-m (22-26 lb.-in.)	–

- Protect the cooling fan by avoiding dust or metallic particles.
- Do not expose to a corrosive atmosphere.
- Protect from moisture and direct sunlight.

Minimum Mounting Clearances

Refer to Appendix B for mounting dimensions.



Ambient Operating Temperatures

Table 1.A Enclosure and Clearance Requirements

Ambient Temperature		Enclosure Rating	Minimum Mounting Clearances
Minimum	Maximum		
-10°C (14°F)	40°C (104°F)	IP 20/Open Type	Use Mounting Option A
		IP 30/NEMA 1/UL Type 1 (1)	Use Mounting Option B
	50°C (122°F)	IP 20/Open Type	Use Mounting Option B

(1) Rating requires installation of the PowerFlex 40P IP 30/NEMA 1/UL Type 1 option kit.

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Debris Protection

A plastic top panel is included with the drive. Install the panel to prevent debris from falling through the vents of the drive housing during installation. Remove the panel for IP 20/Open Type applications.

Storage

- Store within an ambient temperature range of -40° to +85°C.
- Store within a relative humidity range of 0% to 95%, non-condensing.
- Do not expose to a corrosive atmosphere.

Plate Drive Installation

For Plate drive installation instructions, refer to Appendix H.

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AC Supply Source Considerations

Ungrounded Distribution Systems

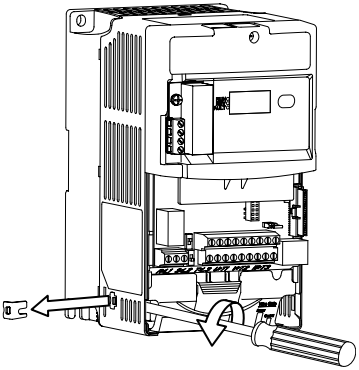
ATTENTION: PowerFlex 40P drives contain protective MOVs that are referenced to ground. These devices must be disconnected if the drive is installed on an ungrounded or resistive grounded distribution system.

Disconnecting MOVs

To prevent drive damage, the MOVs connected to ground shall be disconnected if the drive is installed on an ungrounded distribution system where the line-to-ground voltages on any phase could exceed 125% of the nominal line-to-line voltage. To disconnect these devices, remove the jumper shown in the Figures 1.1 and 1.2.

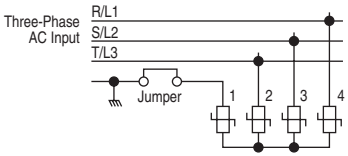
1. Turn the screw counterclockwise to loosen.
2. Pull the jumper completely out of the drive chassis.
3. Tighten the screw to keep it in place.

Figure 1.1 Jumper Location (Typical)



Important:
Tighten screw after jumper removal.

Figure 1.2 Phase to Ground MOV Removal



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Input Power Conditioning

The drive is suitable for direct connection to input power within the rated voltage of the drive (see Appendix A). Listed in Table 1.B are certain input power conditions which may cause component damage or reduction in product life. If any of the conditions exist, as described in Table 1.B, install one of the devices listed under the heading *Corrective Action* on the line side of the drive.

Important: Only one device per branch circuit is required. It should be mounted closest to the branch and sized to handle the total current of the branch circuit.

Table 1.B Input Power Conditions

Input Power Condition	Corrective Action
Low Line Impedance (less than 1% line reactance)	• Install Line Reactor(2) • or Isolation Transformer • or Bus Inductor – 5.5 & 11 kW (7.5 & 15 HP) drives only
Greater than 120 kVA supply transformer	
Line has power factor correction capacitors	• Install Line Reactor • or Isolation Transformer
Line has frequent power interruptions	
Line has intermittent noise spikes in excess of 6000V (lightning)	
Phase to ground voltage exceeds 125% of normal line to line voltage	• Remove MOV jumper to ground. • or Install Isolation Transformer with grounded secondary if necessary.
Ungrounded distribution system	
240V open delta configuration (stinger leg)(1)	• Install Line Reactor

(1) For drives applied on an open delta with a middle phase grounded neutral system, the phase opposite the phase that is tapped in the middle to the neutral or earth is referred to as the “stinger leg,” “high leg,” “red leg,” etc. This leg should be identified throughout the system with red or orange tape on the wire at each connection point. The stinger leg should be connected to the center Phase B on the reactor. Refer to Table B.D for specific line reactor part numbers.

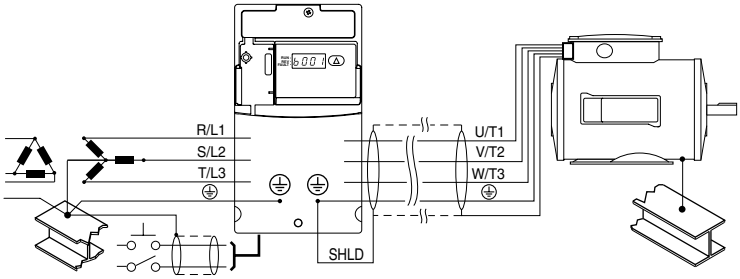
(2) Refer to Appendix B for accessory ordering information.

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General Grounding Requirements

The drive Safety Ground - ⏚ (PE) must be connected to system ground. Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. The integrity of all ground connections should be periodically checked.

Figure 1.3 Typical Grounding



Ground Fault Monitoring

If a system ground fault monitor (RCD) is to be used, only Type B (adjustable) devices should be used to avoid nuisance tripping.

Safety Ground - ⏚ (PE)

This is the safety ground for the drive that is required by code. One of these points must be connected to adjacent building steel (girder, joist), a floor ground rod or bus bar. Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

Motor Ground

The motor ground must be connected to one of the ground terminals on the drive.

Shield Termination - SHLD

Either of the safety ground terminals located on the power terminal block provides a grounding point for the motor cable shield. The **motor cable** shield connected to one of these terminals (drive end) should also be connected to the motor frame (motor end). Use a shield terminating or EMI clamp to connect the shield to the safety ground terminal. The conduit box option may be used with a cable clamp for a grounding point for the cable shield.

When shielded cable is used for **control and signal wiring**, the shield should be grounded at the source end only, not at the drive end.

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RFI Filter Grounding

Using an external filter with any drive rating, may result in relatively high ground leakage currents. Therefore, the **filter must only be used in installations with grounded AC supply systems and be permanently installed and solidly grounded** (bonded) to the building power distribution ground. Ensure that the incoming supply neutral is solidly connected (bonded) to the same building power distribution ground. Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection. Some local codes may require redundant ground connections. The integrity of all connections should be periodically checked.

Fuses and Circuit Breakers

The PowerFlex 40P does not provide branch short circuit protection. This product should be installed with either input fuses or an input circuit breaker. National and local industrial safety regulations and/or electrical codes may determine additional requirements for these installations.

Fusing

The ratings in the table that follows are the recommended values for use with each drive rating. The devices listed in this table are provided to serve as a guide.

Bulletin 140M (Self-Protected Combination Controller)/UL489 Circuit Breakers

When using Bulletin 140M or UL489 rated circuit breakers, the guidelines listed below must be followed in order to meet the NEC requirements for branch circuit protection.

- Bulletin 140M can be used in single and group motor applications.
- Bulletin 140M can be used up stream from the drive **without** the need for fuses.

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Table 1.C Recommended Branch Circuit Protective Devices

Voltage Rating	**Drive Rating** *kW (HP)*	**Fuse Rating**(1) *Amps*	**140M Motor Protectors** *Catalog No.*	**Recommended MCS Contactors** *Catalog No.*
240V AC – 3-Phase	0.4 (0.5)	6	140M-C2E-B40	100-C07
	0.75 (1.0)	10	140M-C2E-C10	100-C09
	1.5 (2.0)	15	140M-C2E-C16	100-C12
	2.2 (3.0)	25	140M-C2E-C16	100-C23
	3.7 (5.0)	30	140M-F8E-C25	100-C23
	5.5 (7.5)	40	140M-F8E-C32	100-C37
	7.5 (10.0)	60	140M-G8E-C45	100-C60
480V AC – 3-Phase	0.4 (0.5)	3	140M-C2E-B25	100-C07
	0.75 (1.0)	6	140M-C2E-B40	100-C07
	1.5 (2.0)	10	140M-C2E-B63	100-C09
	2.2 (3.0)	15	140M-C2E-C10	100-C09
	4.0 (5.0)	20	140M-C2E-C16	100-C23
	5.5 (7.5)	25	140M-D8E-C20	100-C23
	7.5 (10.0)	30	140M-D8E-C20	100-C23
	11 (15)	50	140M-F8E-C32	100-C43
600V AC – 3-Phase	0.75 (1.0)	6	140M-C2E-B25	100-C09
	1.5 (2.0)	6	140M-C2E-B40	100-C09
	2.2 (3.0)	10	140M-C2E-B63	100-C09
	4.0 (5.0)	15	140M-C2E-C10	100-C09
	5.5 (7.5)	20	140M-C2E-C16	100-C16
	7.5 (10.0)	25	140M-C2E-C16	100-C23
	11 (15)	40	140M-D8E-C25	100-C30

(1) Recommended Fuse Type: UL Class J, CC, T or Type BS88; 600V (550V) or equivalent.

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Power Wiring



ATTENTION: National Codes and standards (NEC, VDE, BSI, etc.) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.



ATTENTION: To avoid a possible shock hazard caused by induced voltages, unused wires in the conduit must be grounded at both ends. For the same reason, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled. This will help minimize the possible shock hazard from “cross coupled” power leads.

Motor Cable Types Acceptable for 200-600 Volt Installations

A variety of cable types are acceptable for drive installations. For many installations, unshielded cable is adequate, provided it can be separated from sensitive circuits. As an approximate guide, allow a spacing of 0.3 meters (1 foot) for every 10 meters (32.8 feet) of length. In all cases, long parallel runs must be avoided. Do not use cable with an insulation thickness less than 15 mils (0.4 mm/0.015 in.). Do not route more than three sets of motor leads in a single conduit to minimize “cross talk”. If more than three drive/motor connections per conduit are required, shielded cable must be used.
UL installations in 50°C ambient must use 600V, 75°C or 90°C wire.
UL installations in 40°C ambient should use 600V, 75°C or 90°C wire.
Use copper wire only. Wire gauge requirements and recommendations are based on 75 degree C. Do not reduce wire gauge when using higher temperature wire.

Unshielded

THHN, THWN or similar wire is acceptable for drive installation in dry environments provided adequate free air space and/or conduit fill rates limits are provided. **Do not use THHN or similarly coated wire in wet areas**. Any wire chosen must have a minimum insulation thickness of 15 mils and should not have large variations in insulation concentricity.

Shielded/Armored Cable

Shielded cable contains all of the general benefits of multi-conductor cable with the added benefit of a copper braided shield that can contain much of the noise generated by a typical AC Drive. Strong consideration for shielded cable should be given in installations with sensitive equipment such as weigh scales, capacitive proximity switches and other devices that may be affected by electrical noise in the distribution system. Applications with large numbers of drives in a similar location, imposed EMC regulations or a high degree of communications / networking are also good candidates for shielded cable.

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Shielded cable may also help reduce shaft voltage and induced bearing currents for some applications. In addition, the increased impedance of shielded cable may help extend the distance that the motor can be located from the drive without the addition of motor protective devices such as terminator networks. Refer to Reflected Wave in "Wiring and Grounding Guidelines for PWM AC Drives," publication DRIVES-IN001A-EN-P.

Consideration should be given to all of the general specifications dictated by the environment of the installation, including temperature, flexibility, moisture characteristics and chemical resistance. In addition, a braided shield should be included and be specified by the cable manufacturer as having coverage of at least 75%. An additional foil shield can greatly improve noise containment.

A good example of recommended cable is Belden® 295xx (xx determines gauge). This cable has four (4) XLPE insulated conductors with a 100% coverage foil and an 85% coverage copper braided shield (with drain wire) surrounded by a PVC jacket.

Other types of shielded cable are available, but the selection of these types may limit the allowable cable length. Particularly, some of the newer cables twist 4 conductors of THHN wire and wrap them tightly with a foil shield. This construction can greatly increase the cable charging current required and reduce the overall drive performance. Unless specified in the individual distance tables as tested with the drive, these cables are not recommended and their performance against the lead length limits supplied is not known.

Recommended Shielded Wire

Location	Rating/Type	Description
Standard (Option 1)	600V, 90°C (194°F) XHHW2/RHW-2 Anixter B209500-B209507, Belden 29501-29507, or equivalent	• Four tinned copper conductors with XLPE insulation. • Copper braid/aluminum foil combination shield and tinned copper drain wire. • PVC jacket.
Standard (Option 2)	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter OLF-7xxxxx or equivalent	• Three tinned copper conductors with XLPE insulation. • 5 mil single helical copper tape (25% overlap min.) with three bare copper grounds in contact with shield. • PVC jacket.
Class I & II; Division I & II	Tray rated 600V, 90°C (194°F) RHH/RHW-2 Anixter 7V-7xxxx-3G or equivalent	• Three bare copper conductors with XLPE insulation and impervious corrugated continuously welded aluminum armor. • Black sunlight resistant PVC jacket overall. • Three copper grounds on #10 AWG and smaller.

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Reflected Wave Protection

The drive should be installed as close to the motor as possible. Installations with long motor cables may require the addition of external devices to limit voltage reflections at the motor (reflected wave phenomena). See Table 1.D for recommendations.

The reflected wave data applies to all frequencies 2 to 16 kHz.

For 240V ratings, reflected wave effects do not need to be considered.

Table 1.D Maximum Cable Length Recommendations

Reflected Wave		
380-480V Ratings	**Motor Insulation Rating**	**Motor Cable Only**(1)
	1000 Vp-p	15 meters (49 feet)
	1200 Vp-p	40 meters (131 feet)
	1600 Vp-p	170 meters (558 feet)

(1) Longer cable lengths can be achieved by installing devices on the output of the drive. Consult factory for recommendations.

Output Disconnect

The drive is intended to be commanded by control input signals that will start and stop the motor. A device that routinely disconnects then reapplies output power to the motor for the purpose of starting and stopping the motor should not be used. If it is necessary to disconnect power to the motor with the drive outputting power, an auxiliary contact should be used to simultaneously disable drive control run commands.

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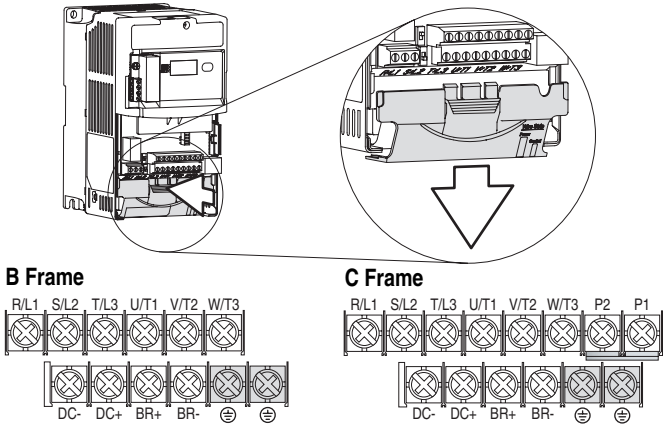
Power Terminal Block

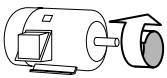
The power terminal block is covered by a finger guard. To remove:

1. Press in and hold the locking tab.
2. Slide finger guard down and out.

Replace the finger guard when wiring is complete.

Figure 1.4 Power Terminal Block (Typical)



Terminal[1]	Description
R/L1, S/L2	1-Phase Input[2]
R/L1, S/L2, T/L3	3-Phase Input
U/T1	To Motor U/T1
V/T2	To Motor V/T2 =  Switch any two motor leads to change forward direction.
W/T3	To Motor W/T3
P2, P1	DC Bus Inductor Connection (C Frame drives only.) The C Frame drive is shipped with a jumper between Terminals P2 and P1. Remove this jumper only when a DC Bus Inductor will be connected. Drive will not power up without a jumper or inductor connected. 
DC+, DC-	DC Bus Connection
BR+, BR-	Dynamic Brake Resistor Connection
⏚	Safety Ground - PE

(1) **Important:** Terminal screws may become loose during shipment. Ensure that all terminal screws are tightened to the recommended torque before applying power to the drive.

(2) Single-phase operation requires a 65% derate of drive rated current.

Table 1.E Power Terminal Block Specifications

Frame	Maximum Wire Size[1]	Minimum Wire Size[1]	Torque
B	5.3 mm^2 (10 AWG)	1.3 mm^2 (16 AWG)	1.7-2.2 N-m (16-19 lb.-in.)
C	8.4 mm^2 (8 AWG)	1.3 mm^2 (16 AWG)	2.9-3.7 N-m (26-33 lb.-in.)

(1) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

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Common Bus/Precharge Notes

If drives with internal precharge are used with a disconnect switch to the common bus, then an auxiliary contact on the disconnect must be connected to a digital input of the drive. The corresponding input (parameter A051-A054) must be set to option 29, “Precharge Enable.” This provides the proper precharge interlock, guarding against possible damage to the drive when connected to a common DC bus.

I/O Wiring Recommendations

Motor Start/Stop Precautions



ATTENTION: A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that will start and stop the motor. If used, the input device must not exceed one operation per minute or drive damage can occur.



ATTENTION: The drive start/stop control circuitry includes solid-state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove the AC line to the drive. When the AC line is removed, there will be a loss of any inherent regenerative braking effect that might be present - the motor will coast to a stop. An auxiliary braking method may be required.

Important points to remember about I/O wiring:

- Always use copper wire.
- Wire with an insulation rating of 600V or greater is recommended.
- Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

Important: I/O terminals labeled “Common” are not referenced to the safety ground (PE) terminal and are designed to greatly reduce common mode interference.



ATTENTION: Driving the 4-20mA analog input from a voltage source could cause component damage. Verify proper configuration prior to applying input signals.

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Signal and Control Wire Types

Table 1.F Recommended Signal Wire

Signal Type/ Where Used	Belden Wire Type(s)[1] *(or equivalent)*	Description	Min. Insulation Rating
Analog I/O & PTC	8760/9460	0.750 mm^2 (18 AWG), twisted pair, 100% shield with drain[3]	300V, 75-90° C (167-194° F)
Remote Pot	8770	0.750 mm^2 (18 AWG), 3 cond., shielded	
Encoder/Pulse I/O	89730[2]	0.196 mm^2 (24 AWG), individually shielded pairs	

(1) Stranded or solid wire.

(2) 9728 or 9730 are equivalent and may be used but may not fit in the drive wire channel.

(3) If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

Table 1.G Recommended Control Wire for Digital I/O

Type	Wire Type(s)	Description	Minimum Insulation Rating
Unshielded	Per US NEC or applicable national or local code	–	300V, 60 degrees C (140 degrees F)
Shielded	Multi-conductor shielded cable such as Belden 8770 (or equiv.)	0.750 mm^2 (18 AWG), 3 conductor, shielded.	

I/O Terminal Block

Table 1.H I/O Terminal Block Specifications

Frame	Maximum Wire Size [1]	Minimum Wire Size [1]	Torque
B & C	1.3 mm^2 (16 AWG)	0.2 mm^2 (24 AWG)	0.5-0.8 N-m (4.4-7 lb.-in.)

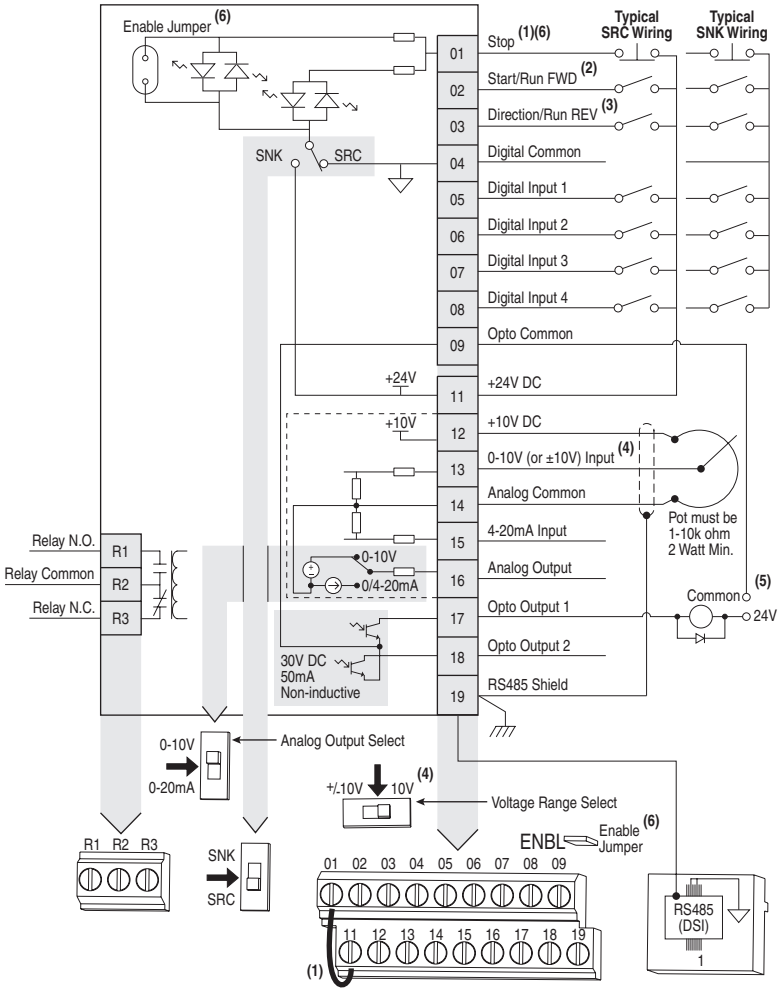
(1) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

Maximum Control Wire Recommendations

Do not exceed control wiring length of 30 meters (100 feet). Control signal cable length is highly dependent on electrical environment and installation practices. To improve noise immunity, the I/O terminal block Common may be connected to ground terminal/protective earth. If using the RS485 (DSI) port, I/O Terminal 19 should also be connected to ground terminal/protective earth.

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Figure 1.5 Control Wiring Block Diagram



	30V DC	125V AC	240V AC
Resistive	3.0A	3.0A	3.0A
Inductive	0.5A	0.5A	0.5A

See Control Wiring Block Diagram Notes on next page.

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Control Wiring Block Diagram Notes

(1) **Important:** I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set to "3-Wire", "2-W Lvl Sens" or "Momt FWD/REV" control. In three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode]. All other stop sources are controlled by P037 [Stop Mode].

P036 [Start Source]	Stop	I/O Terminal 01 Stop
3-Wire	Per P037	Per P037(6)
2-Wire	Per P037	Coast
2-W Lvl Sens	Per P037	Per P037(6)
2-W Hi Speed	Per P037	Coast
RS485 Port	Per P037	Coast
Momt FWD/REV	Per P037	Per P037(6)

Important: The drive is shipped with a jumper installed between I/O Terminals 01 and 11. Remove this jumper when using I/O Terminal 01 as a stop or enable input.

(2) Two wire control shown. For three wire control use a momentary input  on I/O Terminal 02 to command a start. Use a maintained input  for I/O Terminal 03 to change direction.

(3) The function of I/O Terminal 03 is fully programmable. Program with E202 [Digital Term 3].

(4) Match the Voltage Range Select DIP Switch setting with the control scheme for proper Uni-Polar or Bipolar analog input operation.

(5) When using an opto output with an inductive load such as a relay, install a recovery diode parallel to the relay as shown, to prevent damage to the output.

(6) When the ENBL enable jumper is removed, I/O Terminal 01 will always act as a hardware enable, causing a coast to stop without software interpretation.

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Table 1.I Control I/O Terminal Designations

No.	Signal	Default	Description	Param.
R1	Relay N.O.	Fault	Normally open contact for output relay.	A055
R2	Relay Common	–	Common for output relay.	
R3	Relay N.C.	Fault	Normally closed contact for output relay.	A055
Analog Output Select DIP Switch		0-10V	Sets analog output to either voltage or current. Setting must match A065 [Analog Out Sel].	
Sink/Source DIP Switch		Source (SRC)	Inputs can be wired as Sink (SNK) or Source (SRC) via DIP Switch setting.	
01	Stop (1)	Coast	The factory installed jumper or a normally closed input must be present for the drive to start.	P036 (1)
02	Start/Run FWD	Not Active	I/O Terminal 03 is fully programmable. Program with E202 [Digital Term 3]. To disable reverse operation, see A095 [Reverse Disable].	P036, P037
03	Digital Term 3	Not Active		P036, P037, A095, E202
04	Digital Common	–	For digital inputs. Electronically isolated with digital inputs from analog I/O and opto outputs.	
05	Digital Input 1	Preset Freq	Program with A051 [Digital In1 Sel].	A051
06	Digital Input 2	Preset Freq	Program with A052 [Digital In2 Sel].	A052
07	Digital Input 3	Local	Program with A053 [Digital In3 Sel].	A053
08	Digital Input 4	Jog Forward	Program with A054 [Digital In4 Sel].	A054
09	Opto Common	–	For opto-coupled outputs. Electronically isolated with opto outputs from analog I/O and digital inputs.	
11	+24V DC	–	Referenced to Digital Common. Drive supplied power for digital inputs. Maximum output current is 100mA.	
12	+10V DC	–	Referenced to Analog Common. Drive supplied power for 0-10V external potentiometer. Maximum output current is 15mA.	P038
13	±10V In (2)	Not Active	For external 0-10V (unipolar) or ±10V (bipolar) input supply (input impedance = 100k ohm) or potentiometer wiper.	P038, A051-A054, A123, A132
14	Analog Common	–	For 0-10V In or 4-20mA In. Electronically isolated with analog inputs and outputs from digital I/O and opto outputs.	
15	4-20mA In (2)	Not Active	For external 4-20mA input supply (input impedance = 250 ohm).	P038, A051-A054, A132
16	Analog Output	OutFreq 0-10	The default analog output is 0-10V. To covert to a current value, change the Analog Output Select DIP Switch to 0-20mA. Program with A065 [Analog Out Sel]. Max analog value can be scaled with A066 [Analog Out High]. Maximum Load: 4-20mA = 525 ohm (10.5V) 0-10V = 1k ohm (10mA)	A065, A066
17	Opto Output 1	MotorRunning	Program with A058 [Opto Out1 Sel]	A058, A059, A064
18	Opto Output 2	At Frequency	Program with A061 [Opto Out2 Sel]	A061, A062, A064
19	RS485 (DSI) Shield	–	Terminal should be connected to safety ground - PE when using the RS485 (DSI) communications port.	

(1) See Footnotes (1) and (6) on page 1-16.

(2) 0-10V In and 4-20mA In are distinct input channels and may be connected simultaneously. Inputs may be used independently for speed control or jointly when operating in PID mode.

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Encoder Interface

The PowerFlex 40P Encoder Interface can source 5 or12 volt power and accept 5, 12 or 24 volt single ended or differential inputs.

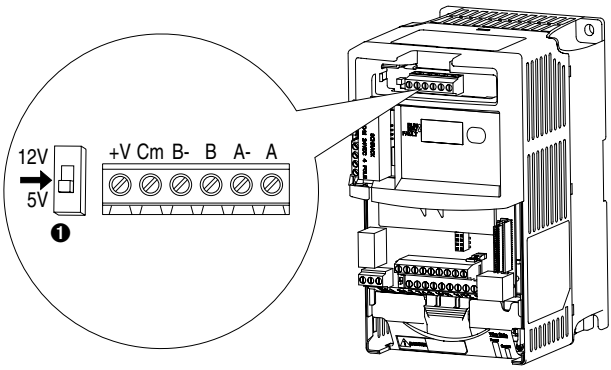


Table 1.J Terminal Description

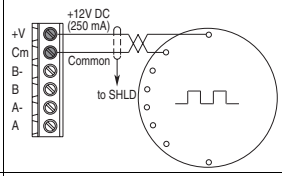
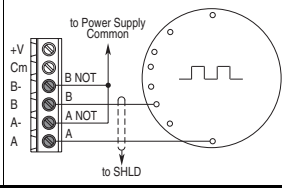
No.	Signal	Description
+V	5V-12V Power (1)	Internal power source 250 mA (isolated).
Cm	Power Return	
B-	Encoder B (NOT)	Quadrature B input.
B	Encoder B	
A-	Encoder A (NOT)	Single channel, pulse train, or quadrature A input.
A	Encoder A	
❶	Output	DIP switch selects 12 or 5 volt power supplied at terminals "+V" and "Cm" for the encoder.

(1) When using 12V Encoder power, 24V I/O power, maximum output current at I/O Terminal 11 is 50 mA.

Important: A quadrature encoder provides rotor speed and direction. Therefore, the encoder must be wired such that the forward direction matches the motor forward direction. If the drive is reading encoder speed but the position regulator or other encoder function is not working properly, remove power to the drive and swap the A and B encoder channels or swap any two motor leads. Drives using FRN 2.xx and greater will fault when an encoder is incorrectly wired and E216 [Motor Fdbk Type] is set to option 5 "Quad Check".

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Figure 1.6 Sample Encoder Wiring

I/O	Connection Example
Encoder Power – Internal Drive Power Internal (drive) 12V DC, 250mA	
Encoder Signal – Single-Ended, Dual Channel	

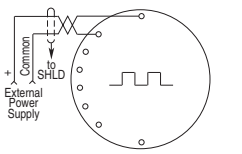
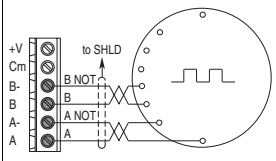
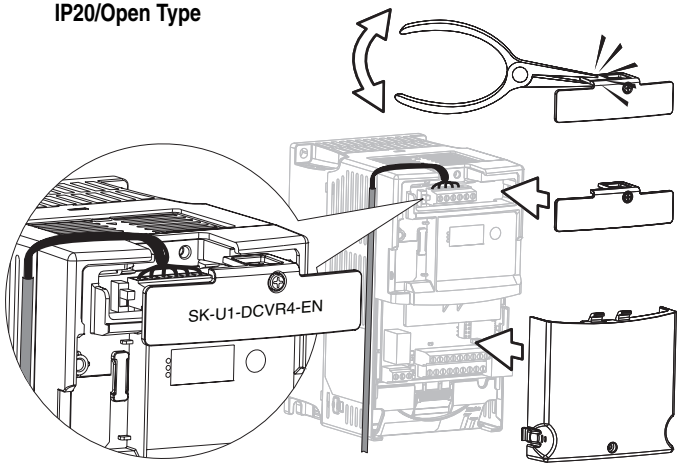
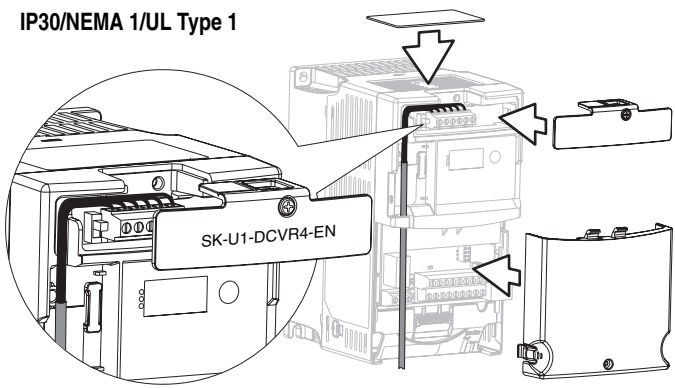
I/O	Connection Example
Encoder Power – External Power Source	
Encoder Signal – Differential, Dual Channel	

Figure 1.7 Encoder Wire Routing Options

IP20/Open Type



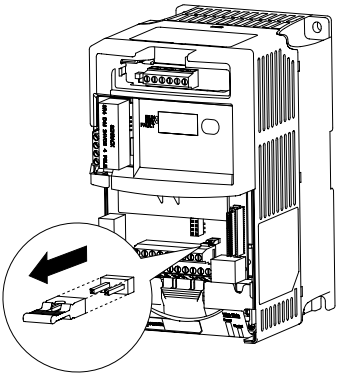
IP30/NEMA 1/UL Type 1



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Hardware Enable Circuitry

I/O Terminal 01 is always a stop input. The status of this input is *interpreted by drive software*. If the application requires the drive to be disabled *without* software interpretation, a hardware enable configuration can be utilized. This is done by removing the ENBL enable jumper and wiring the enable input to I/O Terminal 1 (see below).



1. Remove drive cover as described on page 1-1.

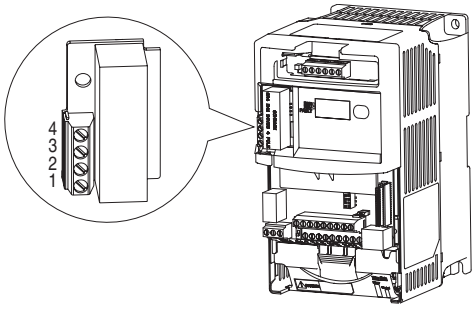
2. Locate and remove the Enable Jumper on the Main Control Board (see diagram).

3. Wire Enable to I/O Terminal 1 (see Table 1.I). The drive will always coast to a stop regardless of the settings of P036 [Start Source] and P037 [Stop Mode].

4. If I/O Terminal 01 is used as hardware enable and 3-wire control is needed, program one of the digital inputs for the desired stop mode.

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User Installed DriveGuard Safe-Off Option (Series B)



The DriveGuard Safe-Off Option (Series B) board, when used with suitable safety components, provides protection according to EN 954-1:1997; Category 3 for safe off and protection against restart. The PowerFlex safe off option is just one safety control system. All components in the system must be chosen and applied correctly to achieve the desired level of operator safeguarding. Refer to the DriveGuard Safe-Off Option (Series B) *User Manual*, publication PFLEX-UM003… for detailed installation information.

ATTENTION: Hazard of injury exists due to electric shock. Only install a Series B or greater DriveGuard Safe-Off Option in a PowerFlex 40P Drive.

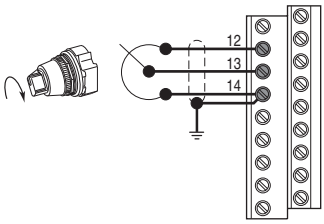
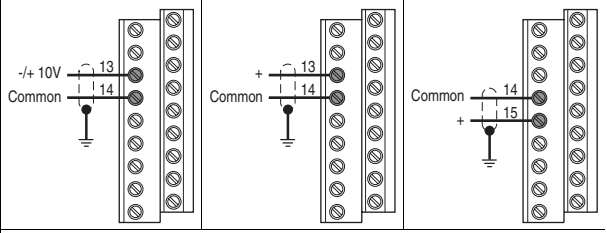
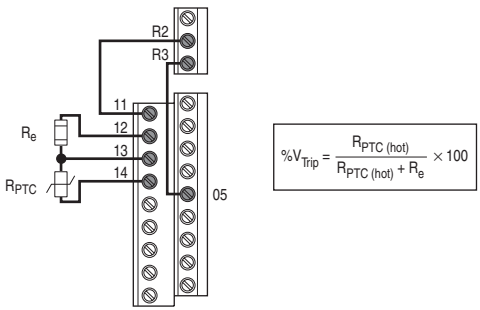
Important: When using the DriveGuard Safe-Off Option (Series B) with the drive in an IP30/NEMA 1/UL Type 1 installation, only use low voltage Class 2 circuits.

Table 1.K Safe-Off Option Terminal Description

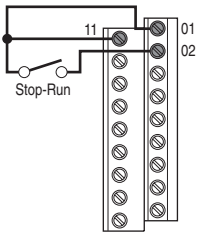
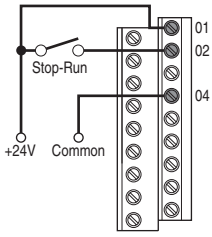
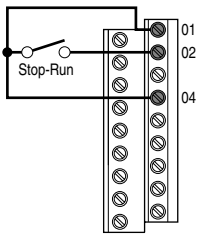
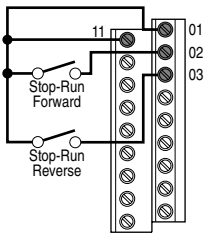
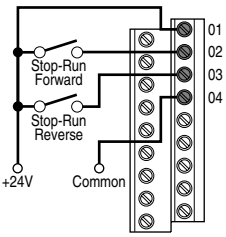
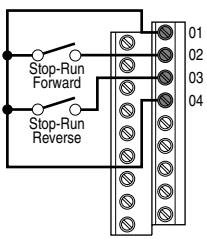
No.	Signal	Description
4	24V Common	Connections for user supplied power to energize coil.
3	+24V DC	
2	Common - N.C.	Normally closed contacts for monitoring relay status. Maximum Resistive Load: 250V AC / 30V DC / 50 VA / 60 Watts Maximum Inductive Load: 250V AC / 30V DC / 25 VA / 30 Watts
1	Monitor - N.C.	

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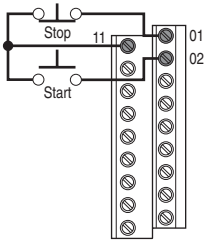
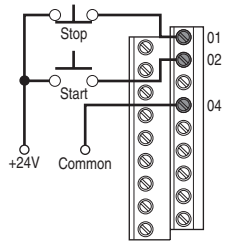
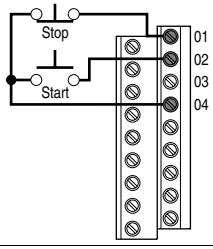
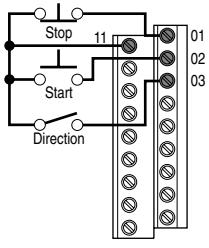
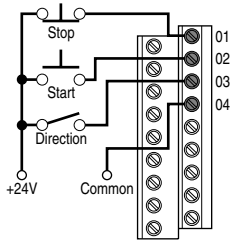
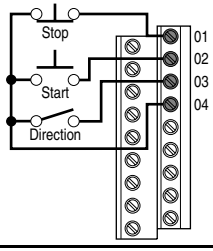
I/O Wiring Examples

<table>
<tr><th>Input/Output</th><th colspan="3">Connection Example</th></tr>
<tr><td>Potentiometer
1-10k Ohm Pot.
Recommended
(2 Watt minimum)</td><td colspan="3">P038 [Speed Reference] = 2 “0-10V Input”

</td></tr>
<tr><td rowspan="2">Analog Input
0 to +10V, 100k ohm impedance
4-20 mA, 250 ohm impedance</td><td>Bipolar
P038 [Speed Reference] = 2 “0-10V Input” and A123 [10V Bipolar Enbl] = 1 “Bi-Polar In”</td><td>Unipolar (Voltage)
P038 [Speed Reference] = 2 “0-10V Input”</td><td>Unipolar (Current)
P038 [Speed Reference] = 3 “4-20mA Input”</td></tr>
<tr><td>
</td></tr>
<tr><td>Analog Input, PTC
For Drive Fault</td><td colspan="3">Wire the PTC and External Resistor (typically matched to the PTC Hot Resistance) to I/O Terminals 12, 13, 14.
Wire R2/R3 Relay Output (SRC) to I/O Terminals 5 & 11.
A051 [Digital In1 Sel] = 3 “Aux Fault”
A055 [Relay Out Sel] = 10 “Above Anlg V”
A056 [Relay Out Level] = % Voltage Trip

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

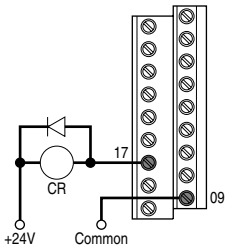
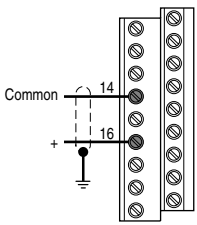
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Input/Output	Connection Example	
2 Wire SRC Control - Non-Reversing P036 [Start Source] = 2, 3 or 4 Input must be active for the drive to run. When input is opened, the drive will stop as specified by P037 [Stop Mode]. If desired, a User Supplied 24V DC power source can be used. Refer to the "External Supply (SRC)" example.	Internal Supply (SRC)	External Supply (SRC)
		 Each digital input draws 6 mA.
2 Wire SNK Control - Non-Reversing	Internal Supply (SNK)	
		
2 Wire SRC Control - Run FWD/Run REV P036 [Start Source] = 2, 3 or 4 Input must be active for the drive to run. When input is opened, the drive will stop as specified by P037 [Stop Mode]. If both Run Forward and Run Reverse inputs are closed at the same time, an undetermined state could occur.	Internal Supply (SRC)	External Supply (SRC)
		 Each digital input draws 6 mA.
2 Wire SNK Control - Run FWD/Run REV	Internal Supply (SNK)	
		

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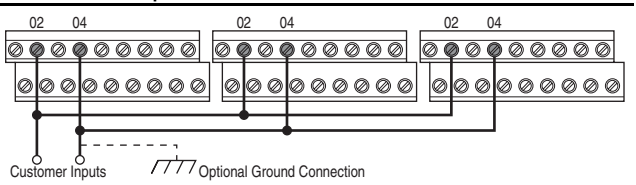
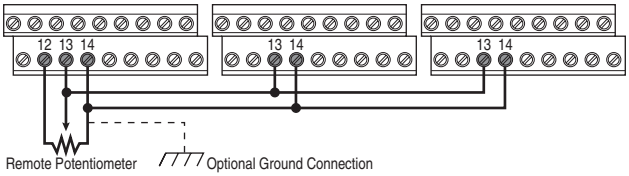
Input/Output	Connection Example	
3 Wire SRC Control - Non-Reversing P036 [Start Source] = 1 A momentary input will start the drive. A stop input to I/O Terminal 01 will stop the drive as specified by P037 [Stop Mode].	Internal Supply (SRC)	External Supply (SRC)
		 Each digital input draws 6 mA.
3 Wire SNK Control - Non-Reversing	Internal Supply (SNK)	
		
3 Wire SRC Control - Reversing P036 [Start Source] = 1 A momentary input will start the drive. A stop input to I/O Terminal 01 will stop the drive as specified by P037 [Stop Mode]. I/O Terminal 03 determines direction.	Internal Supply (SRC)	External Supply (SRC)
		 Each digital input draws 6 mA.
3 Wire SNK Control - Reversing	Internal Supply (SNK)	
		

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Input/Output	Connection Example
Opto Output (1 & 2) A058 [Opto Out1 Sel] determines Opto-Output 1 (I/O Terminal 17) operation. A061 [Opto Out2 Sel] determines Opto-Output 2 (I/O Terminal 18) operation. When using Opto-Output with an inductive load such as a relay, install a recovery diode parallel to the relay as shown, to prevent damage to the output.	Opto-Output 1  Each Opto-Output is rated 30V DC 50 mA (Non-inductive).
Analog Output A065 [Analog Out Sel] determines analog output type and drive conditions. 0-10V, 1k ohm minimum 0-20mA/4-20mA, 525 ohm maximum	A065 [Analog Out Sel] = 0 through 14 The Analog Output Select DIP Switch must be set to match the analog output signal mode set in A065 [Analog Out Sel]. 

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Typical Multiple Drive Connection Examples

Input/Output	Connection Example
Multiple Digital Input Connections Customer Inputs can be wired per External Supply (SRC).	 When connecting a single input such as Run, Stop, Reverse or Preset Speeds to multiple drives, it is important to connect I/O Terminal 04 common together for all drives. If they are to be tied into another common (such as earth ground or separate apparatus ground) only one point of the daisy chain of I/O Terminal 04 should be connected. **ATTENTION:** I/O Common terminals should **not** be tied together when using SNK (Internal Supply) mode. In SNK mode, if power is removed from one drive, inadvertent operation of other drives that share the same I/O Common connection may occur.
Multiple Analog Connections	 When connecting a single potentiometer to multiple drives it is important to connect I/O Terminal 14 common together for all drives. I/O Terminal 14 common and I/O Terminal 13 (potentiometer wiper) should be daisy-chained to each drive. All drives must be powered up for the analog signal to be read correctly.

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Start and Speed Reference Control

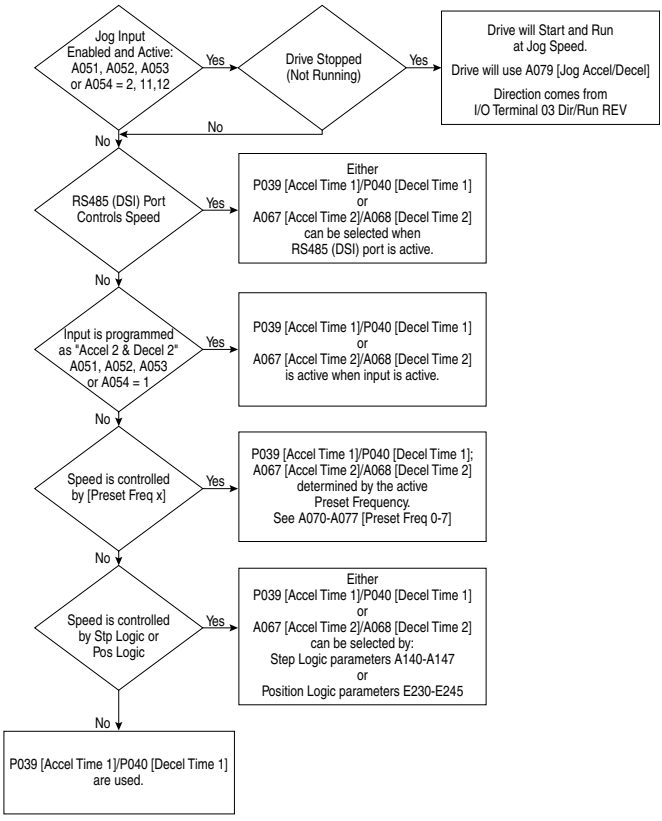
The drive speed command can be obtained from a number of different sources. The source is normally determined by P038 [Speed Reference]. However, when A051 - A054 [Digital Inx Sel] is set to option 2, 4, 5, 6, 11, 12, 13, 14, 15 and the digital input is active, or if A132 is not set to option 0, the speed reference commanded by P038 [Speed Reference] will be overridden. See the chart below for the override priority.



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Accel/Decel Selection

The Accel/Decel rate can be obtained by a variety of methods. The default rate is determined by P039 [Accel Time 1] and P040 [Decel Time 1]. Alternative Accel/Decel rates can be made through digital inputs, RS485 (DSI) communications and/or parameters. See the chart below for the override priority.



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EMC Instructions

CE Conformity[1]

Conformity with the Low Voltage (LV) Directive and Electromagnetic Compatibility (EMC) Directive has been demonstrated using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. PowerFlex Drives comply with the EN standards listed below when installed according to the User Manual.

CE Declarations of Conformity are available online at: **http://www.ab.com/certification/ce/docs**.

Low Voltage Directive (73/23/EEC)

- EN50178 Electronic equipment for use in power installations

EMC Directive (89/336/EEC)

- EN61800-3 Adjustable speed electrical power drive systems Part 3: EMC product standard including specific test methods.

General Notes

- If the plastic top panel is removed, or the encoder cover is not intact, or the optional conduit box is not installed, the drive must be installed in an enclosure with side openings less than 12.5 mm (0.5 in.) and top openings less than 1.0 mm (0.04 in.) to maintain compliance with the LV Directive.
- The motor cable should be kept as short as possible in order to avoid electromagnetic emission as well as capacitive currents.
- Use of line filters in ungrounded systems is not recommended.
- Conformity of the drive with CE EMC requirements does not guarantee an entire machine installation complies with CE EMC requirements. Many factors can influence total machine/installation compliance.
- If the DriveGuard Safe-Off Option (Series B) is installed, use only low voltage Class 2 circuits.
- When using the DriveGuard Safe-Off Option (Series B), the installation must meet all the requirements listed in the DriveGuard Safe-Off Option (Series B) *User Manual*, publication PFLEX-UM003.
- In CE installations, input power must be a Balanced Wye with Center Ground configuration.

(1) 600 Volt class drives are not CE Certified.

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Essential Requirements for CE Compliance

Conditions 1-3 listed below **must be** satisfied for PowerFlex drives to meet the requirements of **EN61800-3**.

1. Grounding as described in Figure 1.8. Refer to page 1-7 for additional grounding recommendations.
2. Output power, control (I/O) and signal wiring must be braided, shielded cable with a coverage of 75% or better, metal conduit or equivalent attenuation.
3. Allowable cable length in Table 1.L is not exceeded.

Table 1.L Allowable Cable Length

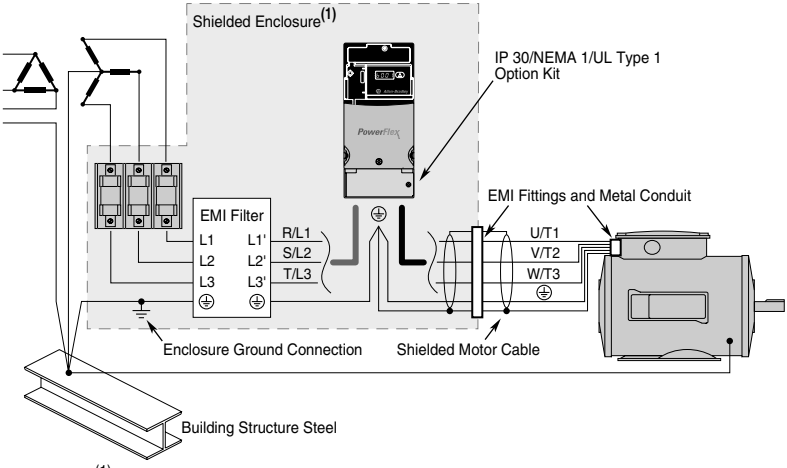
Filter Type	EN61800-3 First Environment Restricted Distribution or Second Environment (2)	EN61800-3 First Environment Unrestricted Distribution (3)
External - S Type(1)	10 meters (33 feet)	1 meter (3 feet)
External - L Type(1)	100 meters (328 feet)	5 meters (16 feet)

(1) Refer to Appendix B for details on optional external filters.

(2) Equivalent to EN55011 Class A.

(3) Equivalent to EN55011 Class B. To meet radiated emissions requirements for EN61800-3 First Environment Unrestricted Distribution when communications is used, ferrite cores need to be added to the communication lines. The recommended core is Fair-Rite part number 0446176451 or Erocore part number FH29.7x13x25.9/FH1300 or an equivalent core. The communication line must be wrapped a total of three times around the core. Two cores may be needed depending on the thickness of the wire and the core chosen. Both recommended cores are split-type and can be added to an existing installation.

Figure 1.8 Connections and Grounding



(1) First Environment Unrestricted Distribution installations require a shielded enclosure. Keep wire length as short as possible between the enclosure entry point and the EMI filter.

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EN61000-3-2

- 0.75 kW (1 HP) 240V 3-Phase drives are suitable for installation on a private low voltage power network. Installations on a public low voltage power network may require additional external harmonic mitigation.
- Other drive ratings meet the current harmonic requirements of EN61000-3-2 without additional external mitigation.

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Notes:

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Start Up

This chapter describes how to start up the PowerFlex 40P Drive. To simplify drive setup, the most commonly programmed parameters are organized in a single Basic Program Group.

Important: Read the *General Precautions* section before proceeding.

ATTENTION: Power must be applied to the drive to perform the following start-up procedures. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning. If an event does not occur while performing this procedure, **Do Not Proceed**. **Remove All Power** including user supplied control voltages. User supplied voltages may exist even when main AC power is not applied to the drive. Correct the malfunction before continuing.

Prepare For Drive Start-Up

Before Applying Power to the Drive

❑ **1.** Confirm that all inputs are connected to the correct terminals and are secure.

❑ **2.** Verify that AC line power at the disconnect device is within the rated value of the drive.

❑ **3.** Verify that any digital control power is 24 volts.

❑ **4.** Verify that the Sink (SNK)/Source (SRC) Setup DIP Switch is set to match your control wiring scheme. See Figure 1.5 on page 1-15 for location.

Important: The default control scheme is Source (SRC). The Stop terminal is jumpered to allow starting from comms. If the control scheme is changed to Sink (SNK), the jumper must be removed from I/O Terminals 01 and 11 and installed between I/O Terminals 01 and 04.

❑ **5.** Verify that the Stop input is present or the drive will not start.

Important: If I/O Terminal 01 is used as a stop input, the jumper between I/O Terminals 01 and 11 must be removed.

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Applying Power to the Drive

❑ **6.** Apply AC power and control voltages to the drive.

Start, Stop, Direction and Speed Control

Factory default parameter values allow the drive to be controlled from comms. No programming is required to start, stop, change direction and control speed directly from comms.

Important: To disable reverse operation, see A095 [Reverse Disable].

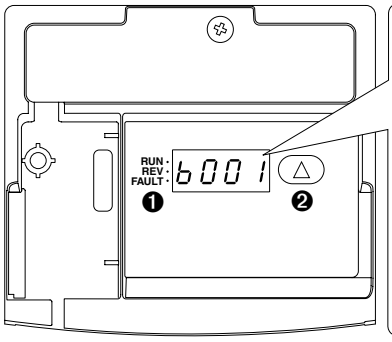
If a fault appears on power up, refer to Fault Descriptions on page 4-3 for an explanation of the fault code.

Variable Torque Fan/Pump Applications

For improved motor tuning performance when using a premium efficient motor on a variable torque load, set A084 [Boost Select] to option 2 “35.0, VT”.

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Display/Fault Reset



Menu	Description
b	**Basic Display Group (View Only)** Commonly viewed drive operating conditions.
d	**Advanced Display Group (View Only)** Consists of advanced drive operating conditions.
F	**Fault Designator** Consists of list of codes for specific fault conditions. Displayed only when fault is present.

No.	LED	LED State	Description
1	Run Status	Steady Red	Indicates drive is running.
		Flashing Red	Drive has been commanded to change direction.
	Direction Status	Steady Red	Indicates drive is running in reverse direction.
		Flashing Red	Drive has been commanded to change direction and motor is decelerating to zero.
	Fault Status	Flashing Red	Indicates drive is faulted.

No.	Key	Name	Description
2	△	Up Arrow	Scroll: Press and release to scroll through user-selectable display parameters. Refer to E201 [LED Display Opt] for options. Reset: Press and hold for three seconds to clear active fault.

Drive Programming Tools

For additional drive programming and control, a DSI remote HIM or PC programming tools (DriveExplorer or DriveTools SP) should be used.

Description	Catalog Number
Serial Converter Module	22-SCM-232
DriveExplorer Software(1)	9306-4EXP02ENE
DriveTools SP Software(1)	9303-4DTS01ENE
Remote Panel Mount, LCD Display	22-HIM-C2S
Remote Handheld, LCD Display	22-HIM-A3

(1) Requires a Serial Converter Module.

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Notes:

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Programming and Parameters

Chapter 3 provides a complete listing and description of the PowerFlex 40P parameters. Parameters are programmed (viewed/edited) using either a DSI Remote HIM or PC programming tools (DriveExplorer™ or DriveTools SP™ software), a personal computer and a serial converter module. Refer to Appendix B for catalog numbers.

For information on...	See page...
About Parameters	3-1
Parameter Organization	3-2
Basic Display Group	3-3
Basic Program Group	3-9
Advanced Program Group	3-15
Enhanced Program Group	3-49
Advanced Display Group	3-62
Parameter Cross Reference – by Name	3-64

About Parameters

To configure a drive to operate in a specific way, drive parameters may have to be set. Three types of parameters exist:

- **ENUM**
  ENUM parameters allow a selection from 2 or more items. Each item is represented by a number.
- **Numeric Parameters**
  These parameters have a single numerical value (i.e. 0.1 Volts).
- **Bit Parameters**
  Bit parameters have four individual bits associated with features or conditions. If the bit is 0, the feature is off or the condition is false. If the bit is 1, the feature is on or the condition is true.

Some parameters are marked as follows.

= Stop drive before changing this parameter.

32 = 32 bit parameter. Parameters marked 32 bit will have two parameter numbers when using RS485 communications and programming software.

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Parameter Organization

Refer to page 3-64 for an alphabetical listing of parameters.

Basic Display Group							
		Output Voltage	b004	Contrl In Status	b013	Analog In 4-20mA	b021
		DC Bus Voltage	b005	Dig In Status	b014	Output Power	b022
		Drive Status	b006	Comm Status	b015	Output Powr Fctr	b023
		Fault 1 Code	b007	Control SW Ver	b016	Drive Temp	b024
		Fault 2 Code	b008	Drive Type	b017	Counter Status	b025
Output Freq	b001	Fault 3 Code	b009	Elapsed Run Time	b018	Timer Status	b026
Commanded Freq	b002	Process Display	b010	Testpoint Data	b019	Stp Logic Status	b028
Output Current	b003	Control Source	b012	Analog In 0-10V	b020	Torque Current	b029
Basic Program Group		Motor NP Volts	P031	Minimum Freq	P034	Accel Time 1	P039
		Motor NP Hertz	P032	Maximum Freq	P035	Decel Time 1	P040
		Motor OL Current	P033	Start Source	P036	Reset To Defalts	P041
				Stop Mode	P037	Voltage Class	P042
				Speed Reference	P038	Motor OL Ret	P043
Advanced Program Group		Jog Frequency	A078	Anlg Out Setpt	A109	Stp Logic 0	A140
		Jog Accel/Decel	A079	Anlg In 0-10V Lo	A110	Stp Logic 1	A141
		DC Brake Time	A080	Anlg In 0-10V Hi	A111	Stp Logic 2	A142
		DC Brake Level	A081	Anlg In4-20mA Lo	A112	Stp Logic 3	A143
		DB Resistor Sel	A082	Anlg In4-20mA Hi	A113	Stp Logic 4	A144
Digital In1 Sel	A051	S Curve %	A083	Slip Hertz @ FLA	A114	Stp Logic 5	A145
Digital In2 Sel	A052	Boost Select	A084	Process Time Lo	A115	Stp Logic 6	A146
Digital In3 Sel	A053	Start Boost	A085	Process Time Hi	A116	Stp Logic 7	A147
Digital In4 Sel	A054	Break Voltage	A086	Bus Reg Mode	A117	Stp Logic Time 0	A150
Relay Out Sel	A055	Break Frequency	A087	Current Limit 2	A118	Stp Logic Time 1	A151
Relay Out Level	A056	Maximum Voltage	A088	Skip Frequency	A119	Stp Logic Time 2	A152
Opto Out1 Sel	A058	Current Limit 1	A089	Skip Freq Band	A120	Stp Logic Time 3	A153
Opto Out1 Level	A059	Motor OL Select	A090	Stall Fault Time	A121	Stp Logic Time 4	A154
Opto Out2 Sel	A061	PWM Frequency	A091	Analog In Loss	A122	Stp Logic Time 5	A155
Opto Out2 Level	A062	Auto Rstrt Tries	A092	10V Bipolar Enbl	A123	Stp Logic Time 6	A156
Opto Out Logic	A064	Auto Rstrt Delay	A093	Var PWM Disable	A124	Stp Logic Time 7	A157
Analog Out Sel	A065	Start At PowerUp	A094	Torque Perf Mode	A125	EM Brk Off Delay	A160
Analog Out High	A066	Reverse Disable	A095	Motor NP FLA	A126	EM Brk On Delay	A161
Accel Time 2	A067	Flying Start En	A096	Autotune	A127	MOP Reset Sel	A162
Decel Time 2	A068	Compensation	A097	IR Voltage Drop	A128	DB Threshold	A163
Internal Freq	A069	SW Current Trip	A098	Flux Current Ref	A129		
Preset Freq 0	A070	Process Factor	A099	PID Trim Hi	A130		
Preset Freq 1	A071	Fault Clear	A100	PID Trim Lo	A131		
Preset Freq 2	A072	Program Lock	A101	PID Ref Sel	A132		
Preset Freq 3	A073	Testpoint Sel	A102	PID Feedback Sel	A133		
Preset Freq 4	A074	Comm Data Rate	A103	PID Prop Gain	A134		
Preset Freq 5	A075	Comm Node Addr	A104	PID Integ Time	A135		
Preset Freq 6	A076	Comm Loss Action	A105	PID Diff Rate	A136		
Preset Freq 7	A077	Comm Loss Time	A106	PID Setpoint	A137		
		Comm Format	A107	PID Deadband	A138		
		Language	A108	PID Preload	A139		
Enhanced Program Group		Comm Write Mode	E207	Motor Fdbk Type	E216	Step Units 0	E230
		Power Loss Mode	E208	Motor NP Poles	E217	Step Units 1	E232
		Half Bus Enable	E209	Encoder PPR	E218	Step Units 2	E234
		Max Traverse	E210	Pulse In Scale	E219	Step Units 3	E236
		Traverse Inc	E211	Ki Speed Loop	E220	Step Units 4	E238
LED Display Opt	E201	Traverse Dec	E212	Kp Speed Loop	E221	Step Units 5	E240
Digital Term 3	E202	P Jump	E213	Positioning Mode	E222	Step Units 6	E242
Accel Time 3	E203	Sync Time	E214	Find Home Freq	E223	Step Units 7	E244
Decel Time 3	E204	Speed Ratio	E215	Find Home Dir	E224	Pos Reg Filter	E246
Accel Time 4	E205			Encoder Pos Tol	E225	Pos Reg Gain	E247
Decel Time 4	E206			Counts Per Unit	E226	Enh Control Word	E248
						Cmd Stat Select	E249
Advanced Display Group		Drive Status 2	d301	Slip Hz Meter	d303	Units Traveled H	d308
		Fibers Status	d302	Speed Feedback	d304	Units Traveled L	d309
				Encoder Speed	d306		

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Basic Display Group

b001 [Output Freq]

Related Parameter(s): b002, b010, P034, P035, P038

Output frequency present at T1, T2 & T3 (U, V & W).

Values	Default:	Read Only
	Min/Max:	0.00/P035 [Maximum Freq]
	Display:	0.01 Hz

b002 [Commanded Freq]

Related Parameter(s): b001, b013, P034, P035, P038

Value of the active frequency command. Displays the commanded frequency even if the drive is not running.

Important: The frequency command can come from a number of sources. Refer to Start and Speed Reference Control on page 1-27 for details.

Values	Default:	Read Only
	Min/Max:	0.00/P035 [Maximum Freq]
	Display:	0.01 Hz

b003 [Output Current]

The output current present at T1, T2 & T3 (U, V & W).

Values	Default:	Read Only
	Min/Max:	0.00/(Drive Rated Amps × 2)
	Display:	0.01 Amps

b004 [Output Voltage]

Related Parameter(s): P031, A084, A088

Output voltage present at terminals T1, T2 & T3 (U, V & W).

Values	Default:	Read Only
	Min/Max:	0/Drive Rated Volts
	Display:	1 VAC

b005 [DC Bus Voltage]

Present DC bus voltage level.

Values	Default:	Read Only
	Min/Max:	Based on Drive Rating
	Display:	1 VDC

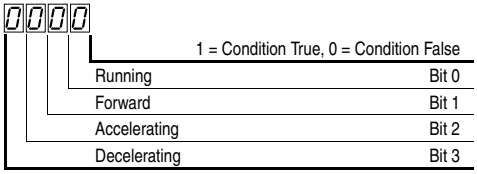
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Basic Display Group *(continued)*

b006 [Drive Status]

Related Parameter(s): A095

Present operating condition of the drive.



Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

b007 [Fault 1 Code]
b008 [Fault 2 Code]
b009 [Fault 3 Code]

A code that represents a drive fault. The codes will appear in these parameters in the order they occur (b007 [Fault 1 Code] = the most recent fault). Repetitive faults will only be recorded once.

Refer to Chapter 4 for fault code descriptions.

Values	Default:	Read Only
	Min/Max:	F2/F122
	Display:	F1

b010 [Process Display]

Related Parameter(s): b001, A099

32 bit parameter.

The output frequency scaled by A099 [Process Factor].

Output Freq x Process Factor = Process Display

Values	Default:	Read Only
	Min/Max:	0.00/9999
	Display:	0.01 – 1

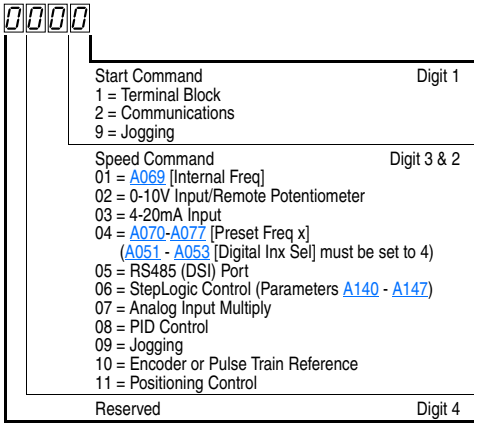
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Basic Display Group *(continued)*

b012 [Control Source]

Related Parameter(s): P036, P038, A051-A054

Displays the active source of the Start Command and Speed Command which are normally defined by the settings of P036 [Start Source] and P038 [Speed Reference] but may be overridden by digital inputs. Refer to the flowcharts on pages 1-27 and 1-28 for details.



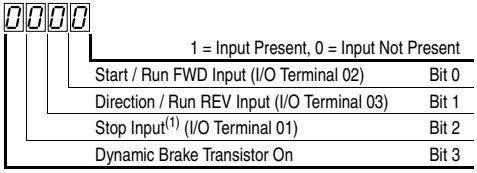
Values	Default:	Read Only
	Min/Max:	0/112
	Display:	1

b013 [Contrl In Status]

Related Parameter(s): b002, P034, P035

Status of the control terminal block control inputs.

Important: Actual control commands may come from a source other than the control terminal block.



(1) The stop input must be present in order to start the drive.
When this bit is a 1 the drive can be started.
When this bit is a 0 the drive will stop.

Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

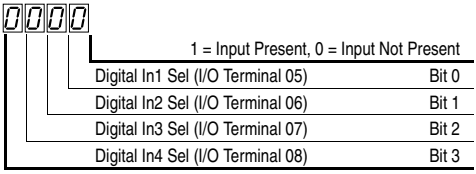
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Basic Display Group *(continued)*

b014 [Dig In Status]

Related Parameter(s): A051-A054

Status of the control terminal block digital inputs.

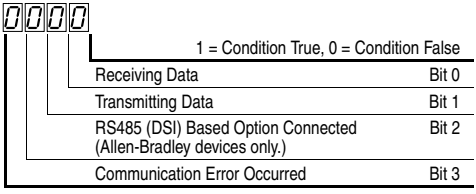


Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

b015 [Comm Status]

Related Parameter(s): A103-A107

Status of the communications ports.



Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

b016 [Control SW Ver]

Main Control Board software version.

Values	Default:	Read Only
	Min/Max:	1.00/99.99
	Display:	0.01

b017 [Drive Type]

Used by Rockwell Automation field service personnel.

Values	Default:	Read Only
	Min/Max:	1001/9999
	Display:	1

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Basic Display Group *(continued)*

b018 [Elapsed Run Time]

Accumulated time drive is outputting power. Time is displayed in 10 hour increments.

Values	Default:	Read Only
	Min/Max:	0/9999 Hrs
	Display:	1 = 10 Hrs

b019 [Testpoint Data]

Related Parameter(s): A102

The present value of the function selected in A102 [Testpoint Sel].

Values	Default:	Read Only
	Min/Max:	0/FFFF
	Display:	1 Hex

b020 [Analog In 0-10V]

Related Parameter(s): A110, A111

The present value of the voltage at I/O Terminal 13 (100.0% = 10 volts).

Values	Default:	Read Only
	Min/Max:	0.0/100.0%
	Display:	0.1%

b021 [Analog In 4-20mA]

Related Parameter(s): A112, A113

The present value of the current at I/O Terminal 15 (0.0% = 4mA, 100.0% = 20mA).

Values	Default:	Read Only
	Min/Max:	0.0/100.0%
	Display:	0.1%

b022 [Output Power]

Output power present at T1, T2 & T3 (U, V & W).

Values	Default:	Read Only
	Min/Max:	0.00/(Drive Rated Power × 2)
	Display:	0.01 kW

b023 [Output Powr Fctr]

The angle in electrical degrees between motor voltage and motor current.

Values	Default:	Read Only
	Min/Max:	0.0/180.0 deg
	Display:	0.1 deg

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Basic Display Group *(continued)*

b024 [Drive Temp]

Present operating temperature of the drive power section.

Values	Default:	Read Only
	Min/Max:	0/120 degC
	Display:	1 degC

b025 [Counter Status]

The current value of the counter when counter is enabled.

Values	Default:	Read only
	Min/Max:	0/9999
	Display:	1

b026 [Timer Status]

32 32 bit parameter.

The current value of the timer when timer is enabled.

Values	Default:	Read Only
	Min/Max:	0.0/9999 Secs
	Display:	0.1 Secs

b028 [Stp Logic Status]

When P038 [Speed Reference] is set to 6 “Stp Logic” or 9 “Positioning”, this parameter will display the current step of the Step Logic profile as defined by parameters A140-A147 [Stp Logic x].

Values	Default:	Read Only
	Min/Max:	0/8
	Display:	1

b029 [Torque Current]

The current value of the motor torque current.

Values	Default:	Read Only
	Min/Max:	0.00/(Drive Rated Amps × 2)
	Display:	0.01 Amps

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Basic Program Group

P031 [Motor NP Volts]

Related Parameter(s): b004, A084, A085, A086, A087

Stop drive before changing this parameter.

Set to the motor nameplate rated volts.

Values	Default:	Based on Drive Rating
	Min/Max:	20/Drive Rated Volts
	Display:	1 VAC

P032 [Motor NP Hertz]

Related Parameter(s): A084, A085, A086, A087, A090

Stop drive before changing this parameter.

Set to the motor nameplate rated frequency.

Values	Default:	60 Hz
	Min/Max:	15/500 Hz
	Display:	1 Hz

P033 [Motor OL Current]

Related Parameter(s): A055, A058, A061, A089, A090, A098, A114, A118

Set to the maximum allowable motor current.

The drive will fault on an F7 Motor Overload if the value of this parameter is exceeded by 150% for 60 seconds.

Values	Default:	Based on Drive Rating
	Min/Max:	0.0/(Drive Rated Amps × 2)
	Display:	0.1 Amps

P034 [Minimum Freq]

Related Parameter(s): b001, b002, b013, P035, A085, A086, A087, A110, A112

Sets the lowest frequency the drive will output continuously.

Values	Default:	0.00 Hz
	Min/Max:	0.00/500.0 Hz
	Display:	0.01 Hz

P035 [Maximum Freq]

Related Parameter(s): b001, b002, b013, P034, A065, A078, A085, A086, A087, A111, A113

Stop drive before changing this parameter.

Sets the highest frequency the drive will output.

Values	Default:	60.00 Hz
	Min/Max:	0.00/500.0 Hz
	Display:	0.01 Hz

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Basic Program Group *(continued)*

P036 [Start Source]

Related Parameter(s): b012, P037

Stop drive before changing this parameter.

Sets the control scheme used to start the drive and controls the behavior of I/O Terminals 01, 02, and 03. However, I/O Terminal 03 is fully programmable via E202 [Digital Term 3].

Refer to Start and Speed Reference Control on page 1-27 for details about how other drive settings can override the setting of this parameter.

Important: For all settings except option 3, the drive must receive a leading edge from the start input for the drive to start after a stop input, loss of power or fault condition.

Important: I/O Terminal 01 is always a stop and must be active for the drive to run regardless of stop source.

Options		
1	"3-Wire"(1)	I/O Terminal 01 "Stop" = stop according to the value set in P037 [Stop Mode]. I/O Terminal 03 "Direction"
2	"2-Wire"	I/O Terminal 01 "Stop" = coast to stop. I/O Terminal 03 "Run REV"
3	"2-W Lvl Sens"	I/O Terminal 01 "Stop" = coast to stop. Drive will restart after a "Stop" command when: • Stop is removed and • Start is held active I/O Terminal 03 "Run REV"

ATTENTION: Hazard of injury exists due to unintended operation. When P036 [Start Source] is set to option 3, and the Run input is maintained, the Run inputs do not need to be toggled after a Stop input for the drive to run again. A Stop function is provided only when the Stop input is active (open).

4	"2-W Hi Speed"	**Important:** There is greater potential voltage on the output terminals when using this option. • Outputs are kept in a ready-to-run state. The drive will respond to a "Start" command within 10 ms. • I/O Terminal 01 "Stop" = coast to stop. • I/O Terminal 03 "Run REV"
5	"Comm Port" (Default)	• Remote communications. Refer to Appendix C for details. • I/O Terminal 01 "Stop" = coast to stop.
6	"Momt FWD/REV"	• Drive will start after a momentary input from either the Run FWD Input (I/O Terminal 02) or the Run REV Input (I/O Terminal 03). • I/O Terminal 01 "Stop" = stop according to the value set in P037 [Stop Mode].

(1) If I/O Terminal 01 is used as hardware enable and 3-wire control is needed, program one of the digital inputs for the desired stop mode.

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Basic Program Group *(continued)*

P037 [Stop Mode]

Related Parameter(s): P036, A080, A081, A082, A105, A160

Active stop mode for all stop sources [e.g. run forward (I/O Terminal 02), run reverse (I/O Terminal 03), RS485 port] except as noted below.

Important: I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set for "3-Wire" control. When in three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode].

Hardware Enable Circuitry

By default, I/O Terminal 01 is a coast to stop input. The status of the input is interpreted by drive software. If the application requires the drive to be disabled without software interpretation, a "dedicated" hardware enable configuration can be utilized. This is accomplished by removing the ENBL enable jumper on the control board. In this case, I/O Terminal 01 will always cause the drive to coast to a stop regardless of the settings of P036 [Start Source] and P037 [Stop Mode].

DriveGuard Safe-Off Option (Series B)

The addition of the DriveGuard Safe-Off Option (Series B) board, when used with suitable safety components, provides protection according to EN 954-1:1997; Category 3 for safe-off and protection against restart.

Options	**0**	"Ramp, CF"(1) (Default)	Ramp to Stop. "Stop" command clears active fault.
	1	"Coast, CF"(1)	Coast to Stop. "Stop" command clears active fault.
	2	"DC Brake, CF"(1)	DC Injection Braking Stop. "Stop" command clears active fault.
	3	"DCBrkAuto,CF"(1)	DC Injection Braking Stop with Auto Shutoff. • Standard DC Injection Braking for value set in A080 [DC Brake Time]. OR • Drive shuts off if the drive detects that the motor is stopped. "Stop" command clears active fault.
	4	"Ramp"	Ramp to Stop.
	5	"Coast"	Coast to Stop.
	6	"DC Brake"	DC Injection Braking Stop.
	7	"DC BrakeAuto"	DC Injection Braking Stop with Auto Shutoff. • Standard DC Injection Braking for value set in A080 [DC Brake Time]. OR • Drive shuts off if current limit is exceeded.
	8	"Ramp+EM B,CF"	Ramp to Stop with EM Brake Control. "Stop" Command clears active fault.
	9	"Ramp+EM Brk"	Ramp to Stop with EM Brake Control.

(1) Stop input also clears active fault.

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Basic Program Group *(continued)*

P038 [Speed Reference]

Related Parameter(s): b001, b002, b012, b020, b021, P039,P040, A051-A054, A069, A070-A077, A110, A111, A112, A113, A123, A132, A140-A147, A150-A157

Sets the source of the speed reference to the drive.

The drive speed command can be obtained from a number of different sources. The source is normally determined by P038 [Speed Reference]. However, when A051 - A054 [Digital Inx Sel] is set to option 2, 4, 5, 6, 11, 12, 13, 14, 15 and the digital input is active, or if A132 [PID Ref Sel] is not set to option 0, the speed reference commanded by P038 [Speed Reference] will be overridden. Refer to the flowchart on page 1-27 for more information on speed reference control priority.

Options	**1**	"InternalFreq"	Internal frequency command from A069 [Internal Freq]. Must be set when using MOP function.
	2	"0-10V Input"	External frequency command from the 0-10V or ±10V analog input or remote potentiometer.
	3	"4-20mA Input"	External frequency command from the 4-20mA analog input.
	4	"Preset Freq"	External frequency command as defined by A070 - A077 [Preset Freq x] when A051 - A054 [Digital Inx Sel] are programmed as "Preset Frequencies" and the digital inputs are active.
	5	"Comm Port" (Default)	External frequency command from the communications port. Refer to Appendix C for details.
	6	"Stp Logic"	External frequency command as defined by A070 - A077 [Preset Freq x] and A140 - A147 [Stp Logic x]. If Step Logic-based positioning control is desired, select option 9 "Positioning" and adjust E222 [Positioning Mode].
	7	"Anlg In Mult"	External frequency command as defined by the product of the analog inputs (shown in b020 [Analog In 0-10V] and b021 [Analog In 4-20mA]). [Analog In 0-10V] × [Analog In 4-20mA] = Speed Command Example: 100% × 50% = 50%
	8	"Encoder"	External frequency command directly from encoder or pulse train input. Use E216 [Motor Fdbk Type] to select encoder type.
	9	"Positioning"	External position as defined by E222 and E230 - E245. Refer to Appendix F for detailed information on positioning.

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Basic Program Group *(continued)*

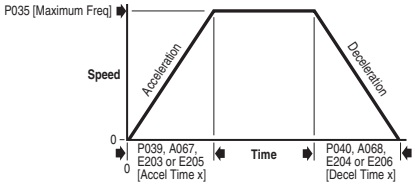
P039 [Accel Time 1]

Related Parameter(s): P038, P040, A051-A054, A067, A070-A077, A140-A147

Sets the rate of acceleration for all speed increases.

$$\frac{\text{Maximum Freq}}{\text{Accel Time}} = \text{Accel Rate}$$

Values	Default:	10.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs



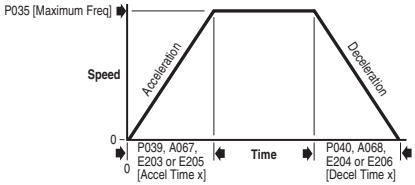
P040 [Decel Time 1]

Related Parameter(s): P038, P039, A051-A054, A068, A070-A077, A140-A147

Sets the rate of deceleration for all speed decreases.

$$\frac{\text{Maximum Freq}}{\text{Decel Time}} = \text{Decel Rate}$$

Values	Default:	10.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs



P041 [Reset To Defalts]

Stop drive before changing this parameter.

Resets all parameter values to factory defaults.

Options	**0**	"Ready/Idle" (Default)	
	1	"Factory Rset"	• After the reset function is complete, this parameter will set itself back to "0". • Causes an F48 Params Defaulted fault.

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Basic Program Group *(continued)*

P042 [Voltage Class]

Stop drive before changing this parameter.

Sets the voltage class of 600V drives.

Options	**2**	"Low Voltage"	480V
	3	"High Voltage" (Default)	600V

P043 [Motor OL Ret]

Related Parameter(s): P033

Enables/disables the Motor Overload Retention function. When Enabled, the value held in the motor overload counter is saved at power-down and restored at power-up. A change to this parameter setting resets the counter.

Options	**0**	"Disabled" (Default)
	1	"Enabled"

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Advanced Program Group

A051 [Digital In1 Sel]
(I/O Terminal 05)
A052 [Digital In2 Sel]
(I/O Terminal 06)
A053 [Digital In3 Sel]
(I/O Terminal 07)
A054 [Digital In4 Sel]
(I/O Terminal 08)

Related Parameter(s): b012, b014, P038, P039, P040, A067, A068, A070-A077, A078, A079, A118, A140-A147


Stop drive before changing this parameter.

Selects the function for the digital inputs. I/O Terminal 03 is fully programmable via E202 [Digital Term 3]. Refer to the flowchart on page 1-27 for more information on speed reference control priority.

Options	**0**	"Not Used"	Terminal has no function but can be read over network communications via b014 [Dig In Status].
	1	"Acc/Dec Sel1"	If active, can determine which Accel/Decel time will be used for all ramp rates except jog. Can be applied to one input only. Refer to A067 [Accel Time 2] for details. Can be used with option 28 "Acc/Dec Sel2" for additional Accel/Decel times.
	2	"Jog"	• When input is present, drive accelerates according to the value set in A079 [Jog Accel/Decel] and ramps to the value set in A078 [Jog Frequency]. • When input is removed, drive ramps to a stop according to the value set in A079 [Jog Accel/Decel]. • A valid "Start" command will override this input.
	3	"Aux Fault"	When enabled, an F2 Auxiliary Input fault will occur when the input is removed.
	4	"Preset Freq" (A051 & A052 Default)	In Velocity mode (P038 ≠ 9) selects a preset frequency. Refer to A070 - A077 [Preset Freq x]. In Positioning mode (P038 = 9) selects a preset frequency and position. Refer to E230 - E244 [Step Units x]. **Important:** Digital Inputs have priority for frequency and position control when programmed as Preset Speed and are active. Refer to the flowchart on page 1-27 for more information on speed reference control priority.
	5	"Reserved"	
	6	"Comm Port"	• When active, sets communications device as default start/speed command source. • Can only be tied to one input.
	7	"Clear Fault" (A053 Default)	When active, clears an active fault.
	8	"RampStop,CF"	Causes drive to immediately ramp to a stop regardless of how P037 [Stop Mode] is set.
	9	"CoastStop,CF"	Causes drive to immediately coast to a stop regardless of how P037 [Stop Mode] is set.
	10	"DCInjStop,CF"	Causes drive to immediately begin a DC Injection stop regardless of how P037 [Stop Mode] is set.
	11	"Jog Forward" (A054 Default)	Drive accelerates to A078 [Jog Frequency] according to A079 [Jog Accel/Decel] and ramps to stop when input becomes inactive. A valid start will override this command.

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A051 - A054 Options (Cont.)	**12** "Jog Reverse"	Drive accelerates to A078 [Jog Frequency] according to A079 [Jog Accel/Decel] and ramps to stop when input becomes inactive. A valid start will override this command.
	13 "10V In Ctrl"	Selects 0-10V or ±10V control as the frequency reference. Start source is not changed.
	14 "20mA In Ctrl"	Selects 4-20mA control as the frequency reference. Start source is not changed.
	15 "PID Disable"	Disables PID function. Drive uses the next valid non-PID speed reference.
	16 "MOP Up"	Increases the value of A069 [Internal Freq] at a rate of 2 Hz per second. Default for A069 is 60 Hz.
	17 "MOP Down"	Decreases the value of A069 [Internal Freq] at a rate of 2 Hz per second. Default for A069 is 60 Hz.
	18 "Timer Start"	Clears and starts the timer function. May be used to control the relay or opto outputs.
	19 "Counter In"	Starts the counter function. May be used to control the relay or opto outputs.
	20 "Reset Timer"	Clears the active timer.
	21 "Reset Countr"	Clears the active counter.
	22 "Rset Tim&Cnt"	Clears the active timer and counter.
	23 "Logic In1"	Logic function input number 1. May be used to control the relay or opto outputs (see parameters A055, A058, A061 Options 11-14). May be used in conjunction with Step Logic parameters A140 - A147 [Stp Logic x]. Logically ORed with E248 [Enh Control Word] bit 6 "Logic In 1".
	24 "Logic In2"	Logic function input number 2. May be used to control the relay or opto outputs (see parameters A055, A058, A061 Options 11-14). May be used in conjunction with Step Logic parameters A140 - A147 [Stp Logic x]. Logically ORed with E248 [Enh Control Word] bit 7 "Logic In 2".
	25 "Current Lmt2"	When active, A118 [Current Limit 2] determines the drive current limit level.
	26 "Anlg Invert"	Inverts the scaling of the analog input levels set in A110 [Anlg In 0-10V Lo] and A111 [Anlg In 0-10V Hi] or A112 [Anlg In4-20mA Lo] and A113 [Anlg In4-20mA Hi].
	27 "EM Brk Rlse"	If EM brake function is enabled, this input releases the brake. Refer to A160 [EM Brk Off Delay] for additional information.

ATTENTION: If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used.

	28 "Acc/Dec Sel2"	If active, can determine which Accel/Decel time will be used for all ramp rates except jog. Can be applied to one input only. Used with option 1 "Acc/Dec Sel1" for the Accel/Decel times listed in this table.

Option		
28	1	Description
0	0	Acc/Dec 1
0	1	Acc/Dec 2
1	0	Acc/Dec 3
1	1	Acc/Dec 4

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A051 - A054 Options (Cont.)	**29** "Precharge En"	Forces drive into precharge state. Typically controlled by auxiliary contact on the disconnect at the DC input to the drive. If this input is assigned, it must be energized for the pre-charge relay to close and for the drive to run. If it is de-energized, the pre-charge relay will open and the drive will coast to a stop.
	30 "Inertia Dcel"	Forces drive into Inertia Ride-Through state. The drive will attempt to regulate the DC bus at the current level.
	31 "Sync Enable"	Must be used in order to hold the existing frequency when Sync Time is set to enable speed synchronization. When this input is released the drive will accelerate to the commanded frequency in E214 [Sync Time].
	32 "Traverse Dis"	When an input is programmed the traverse function will be disabled while this input is active. Refer to E210 [Max Traverse].
	33 "Home Limit"	In Positioning mode, this indicates the drive is at the home position. Refer to Appendix F for detailed information on positioning.
	34 "Find Home"	In Positioning mode this causes the drive to return to the Home position when a start is issued. It does this by using the [Find Home Freq] and [Find Home Direction] until the "Home Limit" input is activated. If it passes this point, it then runs in the reverse direction at 1/10th the frequency of [Find Home Freq] until the "Home Limit" is activated again. As long as this input is active, any start command will cause the drive to enter the homing routing. Only functions if in Positioning mode. Once the Find Home routine has finished, the drive will stop. Refer to Appendix F for detailed information on positioning.
	35 "Hold Step"	In Positioning mode, this input over-rides other inputs and causes the drive to remain at its current step (running at zero speed once it reaches its position) until released. While in "Hold", the drive will ignore any input command which would normally result in a move to a new step. Timers continue to run. Therefore, when the Hold is removed, the drive must see any required digital inputs transition (even if they already transitioned during the hold), but it does not reset any timer. Refer to Appendix F for detailed information on positioning.
	36 "Pos Redefine"	In Positioning mode, this input resets the home position to the current position of the machine. Refer to Appendix F for detailed information on positioning.

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Advanced Program Group *(continued)*

A055 [Relay Out Sel]

Related Parameter(s): P033, A056, A092, A140-A147, A150-A157, A160, A161

Sets the condition that changes the state of the output relay contacts.

Options		
0 "Ready/Fault" (Default)	Relay changes state when power is applied. This indicates that the drive is ready for operation. Relay returns drive to shelf state when power is removed or a fault occurs.
1 "At Frequency"	Drive reaches commanded frequency.
2 "MotorRunning"	Motor is receiving power from the drive.
3 "Reverse"	Drive is commanded to run in reverse direction.
4 "Motor Overld"	Motor overload condition exists.
5 "Ramp Reg"	Ramp regulator is modifying the programmed accel/decel times to avoid an overcurrent or overvoltage fault from occurring.
6 "Above Freq"	• Drive exceeds the frequency (Hz) value set in A056 [Relay Out Level]. • Use A056 to set threshold.
7 "Above Cur"	• Drive exceeds the current (% Amps) value set in A056 [Relay Out Level]. • Use A056 to set threshold. **Important:** Value for A056 [Relay Out Level] must be entered in percent of drive rated output current.
8 "Above DCVolt"	• Drive exceeds the DC bus voltage value set in A056 [Relay Out Level]. • Use A056 to set threshold.
9 "Retries Exst"	Value set in A092 [Auto Rstrt Tries] is exceeded.
10 "Above Anlg V"	• Analog input voltage (I/O Terminal 13) exceeds the value set in A056 [Relay Out Level]. • Do not use if A123 [10V Bipolar Enbl] is set to 1 "Bi-Polar In". • This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 13) is wired to a PTC and external resistor. • Use A056 to set threshold.
11 "Logic In 1"	An input is programmed as "Logic In 1" and is active.
12 "Logic In 2"	An input is programmed as "Logic In 2" and is active.
13 "Logic 1 & 2"	Both Logic inputs are programmed and active.
14 "Logic 1 or 2"	One or both Logic inputs are programmed and one or both is active.
15 "StpLogic Out"	Drive enters Step Logic step with Digit 3 of Command Word (A140 - A147) set to enable Step Logic output.
16 "Timer Out"	• Timer has reached value set in A056 [Relay Out Level]. • Use A056 to set threshold.
17 "Counter Out"	• Counter has reached value set in A056 [Relay Out Level]. • Use A056 to set threshold.
18 "Above PF Ang"	• Power Factor angle has exceeded the value set in A056 [Relay Out Level]. • Use A056 to set threshold.

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A055 Options (Cont.)	**19** "Anlg In Loss"	Analog input loss has occurred. Program A122 [Analog In Loss] for desired action when input loss occurs.
	20 "ParamControl"	Enables the output to be controlled over network communications by writing to A056 [Relay Out Level]. (0 = Off, 1 = On.)
	21 "NonRec Fault"	• Value set in A092 [Auto Rstrt Tries] is exceeded. • A092 [Auto Rstrt Tries] in not enabled. • A Non-resettable fault has occurred.
	22 "EM Brk Cntrl"	EM brake is energized. Program A160 [EM Brk Off Delay] and A161 [EM Brk On Delay] for desired action.
	23 "At Position"	The drive is in Positioning mode and has reached the commanded position. Tolerance is adjusted with E225 [Encoder Pos Tol].
	24 "At Home"	The drive is in Positioning mode and has reached the home position. Tolerance is adjusted with E225 [Encoder Pos Tol].
	25 "Safe-Off"	The DriveGuard Safe Off option is installed and both safe-off inputs are active.

A056 [Relay Out Level]

Related Parameter(s): A055, A058, A061

32 bit parameter.

Sets the trip point for the digital output relay if the value of A055 [Relay Out Sel] is 6, 7, 8, 10, 16, 17, 18 or 20.

A055 Setting	A056 Min/Max
6	0/500 Hz
7	0/180%
8	0/815 Volts
10	0/100%
16	0.1/9999 Secs
17	1/9999 Counts
18	1/180 degs
20	0/1

Values	Default:	0.0
	Min/Max:	0.0/9999
	Display:	0.1

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Advanced Program Group *(continued)*

A058 [Opto Out1 Sel]
A061 [Opto Out2 Sel]

Related Parameter(s): P033, A056, A092, A140-A147, A150-A157

Determines the operation of the programmable opto outputs.

Options	**0**	"Ready/Fault"	Opto outputs are active when power is applied. This indicates that the drive is ready for operation. Opto outputs are inactive when power is removed or a fault occurs.
	1	"At Frequency" (A061 Default)	Drive reaches commanded frequency.
	2	"MotorRunning" (A058 Default)	Motor is receiving power from the drive.
	3	"Reverse"	Drive is commanded to run in reverse direction.
	4	"Motor Overld"	Motor overload condition exists.
	5	"Ramp Reg"	Ramp regulator is modifying the programmed accel/decel times to avoid an overcurrent or overvoltage fault from occurring.
	6	"Above Freq"	• Drive exceeds the frequency (Hz) value set in A059 or A062 [Opto Outx Level]. • Use A059 or A062 to set threshold.
	7	"Above Cur"	• Drive exceeds the current (% Amps) value set in A059 or A062 [Opto Outx Level]. • Use A059 or A062 to set threshold. **Important:** Value for A059 or A062 [Opto Outx Level] must be entered in percent of drive rated output current.
	8	"Above DCVolt"	• Drive exceeds the DC bus voltage value set in A059 or A062 [Opto Outx Level]. • Use A059 or A062 to set threshold.
	9	"Retries Exst"	Value set in A092 [Auto Rstrt Tries] is exceeded.
	10	"Above Anlg V"	• Analog input voltage (I/O Terminal 13) exceeds the value set in A059 or A062 [Opto Outx Level]. • Do not use if A123 [10V Bipolar Enbl] is set to 1 "Bi-Polar In". • This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 13) is wired to a PTC and external resistor. • Use A059 or A062 to set threshold.
	11	"Logic In 1"	An input is programmed as "Logic In 1" and is active.
	12	"Logic In 2"	An input is programmed as "Logic In 2" and is active.
	13	"Logic 1 & 2"	Both Logic inputs are programmed and active.
	14	"Logic 1 or 2"	One or both Logic inputs are programmed and one or both is active.
	15	"StpLogic Out"	Drive enters Step Logic step with Digit 3 of Command Word (A140 - A147) set to enable Step Logic output.
	16	"Timer Out"	• Timer has reached value set in A059 or A062 [Opto Outx Level]. • Use A059 or A062 to set threshold.
	17	"Counter Out"	• Counter has reached value set in A059 or A062 [Opto Outx Level]. • Use A059 or A062 to set threshold.

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A058, A061 Options (Cont.)	**18** "Above PF Ang"	• Power Factor angle has exceeded the value set in A059 or A062 [Opto Outx Level]. • Use A059 or A062 to set threshold.
	19 "Anlg In Loss"	Analog input loss has occurred. Program A122 [Analog In Loss] for desired action when input loss occurs.
	20 "ParamControl"	Enables the output to be controlled over network communications by writing to A059 or A062 [Opto Outx Level]. (0 = Off, 1 = On.)
	21 "NonRec Fault"	• Value set in A092 [Auto Rstrt Tries] is exceeded. • A092 [Auto Rstrt Tries] in not enabled. • A Non-resettable fault has occurred.
	22 "EM Brk Cntrl"	EM brake is energized. Program A160 [EM Brk Off Delay] and A161 [EM Brk On Delay] for desired action.
	23 "At Position"	The drive is in Positioning mode and has reached the commanded position. Tolerance is adjusted with E225 [Encoder Pos Tol].
	24 "At Home"	The drive is in Positioning mode and has reached the home position. Tolerance is adjusted with E225 [Encoder Pos Tol].
	25 "Safe-Off"	The DriveGuard Safe Off option is installed and both safe-off inputs are active.

A059 [Opto Out1 Level]
A062 [Opto Out2 Level]

32 bit parameter.

Determines the on/off point for the opto outputs when A058 or A061 [Opto Outx Sel] is set to option 6, 7, 8, 10, 16, 17, 18 or 20.

A058 & A061 Setting	A059 & A062 Min/Max
6	0/500 Hz
7	0/180%
8	0/815 Volts
10	0/100%
16	0.1/9999 Secs
17	1/9999 Counts
18	1/180 degs
20	0/1

Values	Default:	0.0
	Min/Max:	0.0/9999
	Display:	0.1

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Advanced Program Group *(continued)*

A064 [Opto Out Logic]

Determines the logic (Normally Open/NO or Normally Closed/NC) of the opto outputs.

A064 Option	Opto Out1 Logic	Opto Out2 Logic
0	NO (Normally Open)	NO (Normally Open)
1	NC (Normally Closed)	NO (Normally Open)
2	NO (Normally Open)	NC (Normally Closed)
3	NC (Normally Closed)	NC (Normally Closed)

Values	Default:	0
	Min/Max:	0/3
	Display:	1

A065 [Analog Out Sel]

Related Parameter(s): P035, A066

Sets the analog output signal mode (0-10V, 0-20mA, or 4-20mA). The output is used to provide a signal that is proportional to several drive conditions.

Option	Output Range	Minimum Output Value	Maximum Output Value A066 [Analog Out High]	DIP Switch Position	Related Parameter
0 “OutFreq 0-10”	0-10V	0V = 0 Hz	P035 [Maximum Freq]	0-10V	b001
1 “OutCurr 0-10”	0-10V	0V = 0 Amps	200% Drive Rated Output Current	0-10V	b003
2 “OutVolt 0-10”	0-10V	0V = 0 Volts	120% Drive Rated Output Volts	0-10V	b004
3 “OutPowr 0-10”	0-10V	0V = 0 kW	200% Drive Rated Power	0-10V	b022
4 “TstData 0-10”	0-10V	0V = 0000	65535 (Hex FFFF)	0-10V	b019
5 “OutFreq 0-20”	0-20mA	0 mA = 0 Hz	P035 [Maximum Freq]	0-20mA	b001
6 “OutCurr 0-20”	0-20mA	0 mA = 0 Amps	200% Drive Rated Output Current	0-20mA	b003
7 “OutVolt 0-20”	0-20mA	0 mA = 0 Volts	120% Drive Rated Output Volts	0-20mA	b004
8 “OutPowr 0-20”	0-20mA	0 mA = 0 kW	200% Drive Rated Power	0-20mA	b022
9 “TstData 0-20”	0-20mA	0 mA = 0000	65535 (Hex FFFF)	0-20mA	b019
10 “OutFreq 4-20”	4-20mA	4 mA = 0 Hz	P035 [Maximum Freq]	0-20mA	b001
11 “OutCurr 4-20”	4-20mA	4 mA = 0 Amps	200% Drive Rated Output Current	0-20mA	b003
12 “OutVolt 4-20”	4-20mA	4 mA = 0 Volts	120% Drive Rated Output Volts	0-20mA	b004
13 “OutPowr 4-20”	4-20mA	4 mA = 0 kW	200% Drive Rated Power	0-20mA	b022
14 “TstData 4-20”	4-20mA	4 mA = 0000	65535 (Hex FFFF)	0-20mA	b019
15 “OutTorq 0-10”	0-10V	0V = 0 Amps	200% Drive Rated FLA	0-10V	b029
16 “OutTorq 0-20”	0-20 mA	0 mA = 0 Amps	200% Drive Rated FLA	0-20 mA	b029
17 “OutTorq 4-20”	4-20 mA	4 mA = 0 Amps	200% Drive Rated FLA	0-20 mA	b029
18 “Setpnt 0-10”	0-10V	0V = 0%	100.0% Setpoint Setting	0-10V	A109
19 “Setpnt 0-20”	0-20 mA	0 mA = 0%	100.0% Setpoint Setting	0-20 mA	A109
20 “Setpnt 4-20”	4-20 mA	4 mA = 0%	100.0% Setpoint Setting	0-20 mA	A109

Values	Default:	0
	Min/Max:	0/20
	Display:	1

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Advanced Program Group *(continued)*

A066 [Analog Out High]

Related Parameter(s): A065

Scales the Maximum Output Value for the A065 [Analog Out Sel] source setting.

Examples:

A066 Setting	A065 Setting	A065 Max. Output Value
50%	1 “OutCurr 0-10”	5V for 200% Drive Rated Output Current
90%	8 “OutPowr 0-20”	18mA for 200% Drive Rated Power

Values	Default:	100%
	Min/Max:	0/800%
	Display:	1%

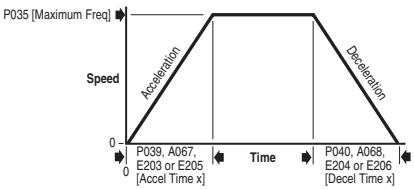
A067 [Accel Time 2]

Related Parameter(s): P039, A051-A054, A070-A077 A140-A147, E203-E206

When active, sets the rate of acceleration for all speed increases except jog.

$$\frac{\text{Maximum Freq}}{\text{Accel Time}} = \text{Accel Rate}$$

Values	Default:	20.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs



Option		
28	1	Description
0	0	Acc/Dec 1
0	1	Acc/Dec 2
1	0	Acc/Dec 3
1	1	Acc/Dec 4

A068 [Decel Time 2]

Related Parameter(s): P040, A051-A054, A067, A070-A077 A140-A147, E203-E206

When active, sets the rate of deceleration for all speed decreases except jog. Refer to graphic at A067 [Accel Time 2].

$$\frac{\text{Maximum Freq}}{\text{Decel Time}} = \text{Decel Rate}$$

Values	Default:	20.0 Secs
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs

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Advanced Program Group *(continued)*

A069 [Internal Freq]

Related Parameter(s): P038, A162

Provides the frequency command to the drive when P038 [Speed Reference] is set to 1 “InternalFreq”. When enabled, this parameter will change the frequency command in “real time”.

If A051 - A054 [Digital Inx Sel] is set to 16 “MOP Up” or 17 “MOP Down” this parameter acts as the MOP frequency reference.

Values	Default:	60.00 Hz
	Min/Max:	0.00/600.0 Hz
	Display:	0.01 Hz

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Advanced Program Group *(continued)*

A070 [Preset Freq 0](1)
A071 [Preset Freq 1]
A072 [Preset Freq 2]
A073 [Preset Freq 3]
A074 [Preset Freq 4]
A075 [Preset Freq 5]
A076 [Preset Freq 6]
A077 [Preset Freq 7]

Related Parameter(s): P038, P039, P040, A051-A053, A067, A068, A140-A147, A150-A157

Values	A070 Default:(1)	0.00 Hz
	A071 Default:	5.00 Hz
	A072 Default:	10.00 Hz
	A073 Default:	20.00 Hz
	A074 Default:	30.00 Hz
	A075 Default:	40.00 Hz
	A076 Default:	50.00 Hz
	A077 Default:	60.00 Hz
	Min/Max:	0.00/500.0 Hz
	Display:	0.01 Hz

Provides a fixed frequency command value when A051 - A053 [Digital Inx Sel] is set to 4 “Preset Freq”.

An active preset input will override speed command as shown in the flowchart on page 1-27.

(1) To activate A070-A077 in Velocity mode, set P038 [Speed Reference] to option 4 “Preset Freq”. In Positioning mode, set P038 [Speed Reference] to option 9 “Positioning” and E222 [Positioning Mode] to option 1 “Preset Input”.

Input State of Digital In 1 (I/O Terminal 05 when A051 = 4)	Input State of Digital In 2 (I/O Terminal 06 when A052 = 4)	Input State of Digital In 3 (I/O Terminal 07 when A053 = 4)	Freq Source	Position Source (when P038 = 9)	Accel / Decel Parameter Used(2)
0	0	0	A070	E230	[Accel Time 1] / [Decel Time 1]
1	0	0	A071	E232	[Accel Time 1] / [Decel Time 1]
0	1	0	A072	E234	[Accel Time 2] / [Decel Time 2]
1	1	0	A073	E236	[Accel Time 2] / [Decel Time 2]
0	0	1	A074	E238	[Accel Time 1] / [Decel Time 1]
1	0	1	A075	E240	[Accel Time 1] / [Decel Time 1]
0	1	1	A076	E242	[Accel Time 2] / [Decel Time 2]
1	1	1	A077	E244	[Accel Time 2] / [Decel Time 2]

(2) When a Digital Input is set to “Accel 2 & Decel 2”, and the input is active, that input overrides the settings in this table.

A078 [Jog Frequency]

Related Parameter(s): P035, A051-A054, A079

Sets the output frequency when a jog command is issued.

Values	Default:	10.00 Hz
	Min/Max:	0.00/[Maximum Freq]
	Display:	0.01 Hz

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Advanced Program Group *(continued)*

A079 [Jog Accel/Decel]

Related Parameter(s): A078, A051-A054

Sets the acceleration and deceleration time when a jog command is issued.

Values	Default:	10.0 Secs
	Min/Max:	0.1/600.0 Secs
	Display:	0.1 Secs

A080 [DC Brake Time]

Related Parameter(s): P037, A051-A054, A081

Sets the length of time that DC brake current is "injected" into the motor. Refer to parameter A081 [DC Brake Level].

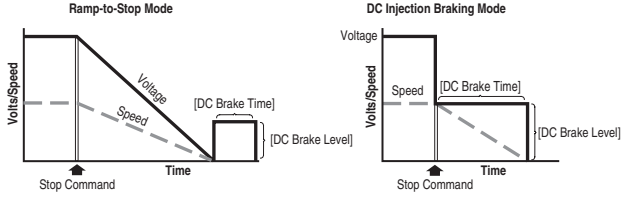
Values	Default:	0.0 Secs
	Min/Max:	0.0/99.9 Secs (A setting of 99.9 = Continuous)
	Display:	0.1 Secs

A081 [DC Brake Level]

Related Parameter(s): P037, A080, A051-A054

Defines the maximum DC brake current, in amps, applied to the motor when P037 [Stop Mode] is set to either option 4 "Ramp" or 6 "DC Brake".

Values	Default:	Drive Rated Amps × 0.05
	Min/Max:	0.0/(Drive Rated Amps × 1.8)
	Display:	0.1 Amps



ATTENTION: If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used.

ATTENTION: This feature should not be used with synchronous or permanent magnet motors. Motors may be demagnetized during braking.

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Advanced Program Group *(continued)*

A082 [DB Resistor Sel]

Related Parameter(s): P037

Stop drive before changing this parameter.

Enables/disables external dynamic braking.

Setting	Min/Max
0	"Disabled"
1	"Normal RA Res" (5% Duty Cycle) – Refer to Table B.C on page B-2.
2	"NoProtection" (100% Duty Cycle)
3-99	"x%Duty Cycle" Limited (3% – 99% of Duty Cycle)

The drive is able to provide full braking indefinitely. Braking power is limited by the external DB resistor. When this parameter is set to 1 "Normal RA Res" and an appropriate resistor is used (see selection Table B.C), the drive provides calculated resistor overload protection. However, the drive cannot protect against a brake IGBT failure.

For more information on external dynamic brake kits, refer to the External Dynamic Brake Kit *Installation Instructions*, publication RA-IN004.

ATTENTION: A risk of fire exists if external braking resistors are not protected. The external resistor package must be self-protected from over temperature or the protective circuit shown in Figure B.7 on page B-12, or equivalent, must be supplied.

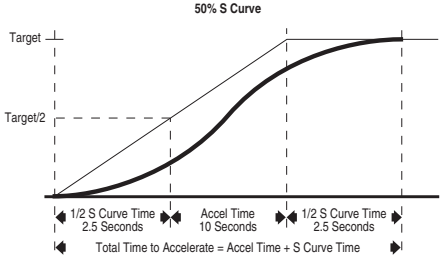
Values	Default:	0
	Min/Max:	0/99
	Display:	1

A083 [S Curve %]

Sets the percentage of acceleration or deceleration time that is applied to the ramp as S Curve. Time is added, 1/2 at the beginning and 1/2 at the end of the ramp.

Values	Default:	0% (Disabled)
	Min/Max:	0/100%
	Display:	1%

Example:
Accel Time = 10 Seconds
S Curve Setting = 50%
S Curve Time = 10 × 0.5 = 5 Seconds
Total Time = 10 + 5 = 15 Seconds



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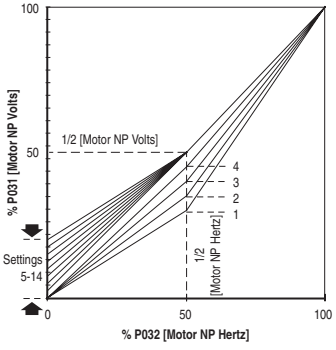
Advanced Program Group *(continued)*

A084 [Boost Select]

Related Parameter(s): b004, P031, P032, A085, A086, A087, A125

Sets the boost voltage (% of P031 [Motor NP Volts]) and redefines the Volts per Hz curve.
Active when A125 [Torque Perf Mode] = 0 “V/Hz”.
Drive may add additional voltage unless Option 5 is selected.

Options	**0**	“Custom V/Hz”	
	1	“30.0, VT”	Variable Torque (Typical fan/pump curves.)
	2	“35.0, VT”	
	3	“40.0, VT”	
	4	“45.0, VT”	
	5	“0.0 no IR”	Constant Torque
	6	“0.0”	
	7	“2.5, CT” [Default for 4.0, 5.5, 7.5 & 11 kW (5.0, 7.5, 10 & 15 HP) Drives]	
	8	“5.0, CT” (Default)	
	9	“7.5, CT”	
	10	“10.0, CT”	
	11	“12.5, CT”	
	12	“15.0, CT”	
	13	“17.5, CT”	
	14	“20.0, CT”	



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Advanced Program Group *(continued)*

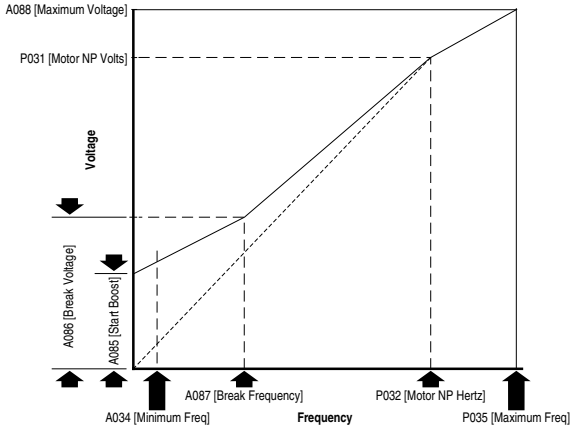
A085 [Start Boost]

Related Parameter(s): P031, P032, P034, P035, A084, A086, A087, A088, A125

Sets the boost voltage (% of P031 [Motor NP Volts]) and redefines the Volts per Hz curve when A084 [Boost Select] = 0 “Custom V/Hz” and A125 [Torque Perf Mode] = 0 “V/Hz”.

Drive may add additional voltage unless A084 [Boost Select] = 5 “0.0 no IR”.

Values	Default:	2.5%
	Min/Max:	0.0/25.0%
	Display:	0.1%



A086 [Break Voltage]

Related Parameter(s): P031, P032, P034, P035, A084, A085, A087, A088, A125

Sets the frequency where break voltage is applied when A084 [Boost Select] = 0 “Custom V/Hz” and A125 [Torque Perf Mode] = 0 “V/Hz”

Values	Default:	25.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

A087 [Break Frequency]

Related Parameter(s): P031, P032, P034, P035, A084, A085, A086, A088, A125

Sets the frequency where break frequency is applied when A084 [Boost Select] = 0 “Custom V/Hz” and A125 [Torque Perf Mode] = 0 “V/Hz”

Values	Default:	15.0 Hz
	Min/Max:	0.0/500.0 Hz
	Display:	0.1 Hz

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Advanced Program Group *(continued)*

A088 [Maximum Voltage]

Related Parameter(s): b004, A085, A086, A087

Sets the highest voltage the drive will output.

Values	Default:	Drive Rated Volts
	Min/Max:	20/Drive Rated Volts
	Display:	1 VAC

A089 [Current Limit 1]

Related Parameter(s): P033, A118

Maximum output current allowed before current limiting occurs.

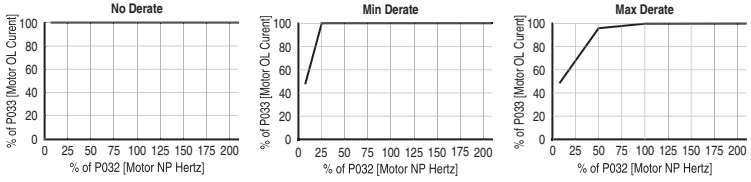
Values	Default:	Drive Rated Amps × 1.5
	Min/Max:	0.1/Drive Rated Amps × 1.8
	Display:	0.1 Amps

A090 [Motor OL Select]

Related Parameter(s): P032, P033

Drive provides Class 10 motor overload protection. Settings 0-2 select the derating factor for the I^2t overload function.

Options	**0**	"No Derate" (Default)
	1	"Min Derate"
	2	"Max Derate"



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Advanced Program Group *(continued)*

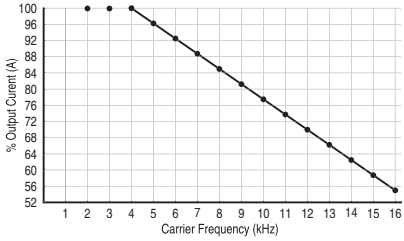
A091 [PWM Frequency]

Related Parameter(s): A124

Sets the carrier frequency for the PWM output waveform. The chart below provides derating guidelines based on the PWM frequency setting.

Important: Ignoring derating guidelines can cause reduced drive performance.

Values	Default:	4.0 kHz
	Min/Max:	2.0/16.0 kHz
	Display:	0.1 kHz



A092 [Auto Rstrt Tries]

Related Parameter(s): A055, A058, A061, A093

Sets the maximum number of times the drive attempts to reset a fault and restart.

For information on faults and fault codes refer to Chapter 4.

Clear a Type 1 fault and restart the drive.

1. Set A092 [Auto Rstrt Tries] to a value other than "0".
2. Set A093 [Auto Rstrt Delay] to a value other than "0".

Clear an OverVoltage, UnderVoltage or Heatsink OvrTmp fault without restarting the drive.

1. Set A092 [Auto Rstrt Tries] to a value other than "0".
2. Set A093 [Auto Rstrt Delay] to "0".

ATTENTION: Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

Values	Default:	0
	Min/Max:	0/9
	Display:	1

A093 [Auto Rstrt Delay]

Related Parameter(s): A092

Sets the time between restart attempts when A092 [Auto Rstrt Tries] is set to a value other than zero.

Values	Default:	1.0 Secs
	Min/Max:	0.0/120.0 Secs
	Display:	0.1 Secs

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Advanced Program Group *(continued)*

A094 [Start At PowerUp]

Stop drive before changing this parameter.

Enables/disables a feature that allows a Start or Run command to automatically cause the drive to resume running at commanded speed after drive input power is restored. Requires a digital input configured for Run or Start and a valid start contact.

This parameter will not function if parameter P036 [Start Source] is set to 4 "2-W High Speed".

ATTENTION: Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application. Do not use this function without considering applicable local, national and international codes, standards, regulations or industry guidelines.

Options	**0**	"Disabled" (Default)
	1	"Enabled"

A095 [Reverse Disable]

Related Parameter(s): b006

Stop drive before changing this parameter.

Enables/disables the function that allows the direction of motor rotation to be changed. The reverse command may come from a digital command or a serial command. All reverse inputs including two-wire Run Reverse will be ignored with reverse disabled.

Options	**0**	"Rev Enabled" (Default)
	1	"Rev Disabled"

A096 [Flying Start En]

Sets the condition that allows the drive to reconnect to a spinning motor at actual RPM.

Important: Do not use this feature with permanent magnet motors.

Options	**0**	"Disabled" (Default)
	1	"Enabled"

A097 [Compensation]

Enables/disables correction options that may improve problems with motor instability.

Options	**0**	"Disabled"	
	1	"Electrical" (Default)	Some drive/motor combinations have inherent instabilities which are exhibited as non-sinusodial motor currents. This setting attempts to correct this condition.
	2	"Mechanical"	Some motor/load combinations have mechanical resonances which can be excited by the drive current regulator. This setting slows down the current regulator response and attempts to correct this condition.
	3	"Both"	

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Advanced Program Group *(continued)*

A098 [SW Current Trip]

Related Parameter(s): P033

Enables/disables a software instantaneous (within 100 ms) current trip.

Values	Default:	0.0 (Disabled)
	Min/Max:	0.0/(Drive Rated Amps × 2)
	Display:	0.1 Amps

A099 [Process Factor]

Related Parameter(s): b010

Scales the output frequency value displayed by b010 [Process Display].

Output Freq x Process Factor = Process Display

Values	Default:	30.0
	Min/Max:	0.1/999.9
	Display:	0.1

A100 [Fault Clear]

Stop drive before changing this parameter.

Resets a fault and clears the fault queue. Used primarily to clear a fault over network communications.

Options	**0**	"Ready/Idle" (Default)	
	1	"Reset Fault"	
	2	"Clear Buffer"	(Parameters b007-b009 [Fault x Code])

A101 [Program Lock]

Protects parameters against change by unauthorized personnel with a 4-digit password.

Options	**0**	"Unlocked" (Default)
	1	"Locked"

A102 [Testpoint Sel]

Related Parameter(s): b019

Used by Rockwell Automation field service personnel.

Values	Default:	400
	Min/Max:	400/FFFF
	Display:	1 Hex

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Advanced Program Group *(continued)*

A103 [Comm Data Rate]

Related Parameter(s): b015

Sets the serial port rate for the RS485 (DSI) port.

Important: Power to drive must be cycled before any changes will affect drive operation.

Options	**0**	"1200"
	1	"2400"
	2	"4800"
	3	"9600" (Default)
	4	"19.2K"
	5	"38.4K"

A104 [Comm Node Addr]

Related Parameter(s): b015

Sets the drive node address for the RS485 (DSI) port if using a network connection.

Important: Power to drive must be cycled before any changes will affect drive operation.

Values	Default:	100
	Min/Max:	1/247
	Display:	1

A105 [Comm Loss Action]

Related Parameter(s): b015, P037, A106

Selects the drive's response to a loss of the communication connection or excessive communication errors.

Options	**0**	"Fault" (Default)	Drive will fault on an F81 Comm Loss and coast to stop.
	1	"Coast Stop"	Stops drive via coast to stop.
	2	"Stop"	Stops drive via P037 [Stop Mode] setting.
	3	"Continu Last"	Drive continues operating at communication commanded speed saved in RAM.

A106 [Comm Loss Time]

Related Parameter(s): b015, A105

Sets the time that the drive will remain in communication loss before implementing the option selected in A105 [Comm Loss Action].

Values	Default:	5.0 Secs
	Min/Max:	0.1/60.0 Secs
	Display:	0.1 Secs

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Advanced Program Group *(continued)*

A107 [Comm Format]

Related Parameter(s): b015

Selects the protocol (RTU only), data bits (8 data bits only), parity (None, Even, Odd), and stop bits (1 stop bit only) used by the RS485 port on the drive.

Refer to Appendix C for details on using the drive communication features.

Important: Power to drive must be cycled before any changes will affect drive operation.

Options	**0**	"RTU 8-N-1" (Default)
	1	"RTU 8-E-1"
	2	"RTU 8-O-1"
	3	"RTU 8-N-2"
	4	"RTU 8-E-2"
	5	"RTU 8-O-2"

A108 [Language]

Selects the language displayed by the remote communications option.

Options	**1**	"English" (Default)
	2	"Français"
	3	"Español"
	4	"Italiano"
	5	"Deutsch"
	6	"Reserved"
	7	"Português"
	8	"Reserved"
	9	"Reserved"
	10	"Nederlands"

A109 [Anlg Out Setpt]

Related Parameter(s): A065

When A065 [Analog Out Sel] is set to option 18, 19 or 20, this parameter sets the percentage of analog output desired.

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

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Advanced Program Group *(continued)*

A110 [Anlg In 0-10V Lo]

Related Parameter(s): b020, P034, P038, A122, A123

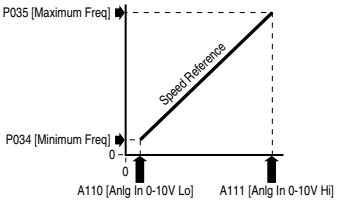
Stop drive before changing this parameter.

Sets the analog input level that corresponds to P034 [Minimum Freq] if a 0-10V input is used by P038 [Speed Reference].

When A123 [10V Bipolar Enbl] is set to 1 “Bi-Polar In” this parameter is ignored.

Analog inversion can be accomplished by setting this value larger than A111 [Anlg In 0-10V Hi].

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%



A111 [Anlg In 0-10V Hi]

Related Parameter(s): b020, P035, P038, A122, A123

Stop drive before changing this parameter.

Sets the analog input level that corresponds to P035 [Maximum Freq] if a 0-10V input is used by P038 [Speed Reference].

Analog inversion can be accomplished by setting this value smaller than A110 [Anlg In 0-10V Lo].

Values	Default:	100.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

A112 [Anlg In4-20mA Lo]

Related Parameter(s): b021, P034, P038

Stop drive before changing this parameter.

Sets the analog input level that corresponds to P034 [Minimum Freq] if a 4-20mA input is used by P038 [Speed Reference].

Analog inversion can be accomplished by setting this value larger than A113 [Anlg In4-20mA Hi].

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

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Advanced Program Group *(continued)*

A113 [Anlg In4-20mA Hi]

Related Parameter(s): b021, P035, P038

Stop drive before changing this parameter.

Sets the analog input level that corresponds to P035 [Maximum Freq] if a 4-20mA input is used by P038 [Speed Reference].

Analog inversion can be accomplished by setting this value smaller than A112 [Anlg In4-20mA Lo].

Values	Default:	100.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

A114 [Slip Hertz @ FLA]

Related Parameter(s): P033, E216

Compensates for the inherent slip in an induction motor. This frequency is added to the commanded output frequency.

Values	Default:	2.0 Hz
	Min/Max:	0.0/10.0 Hz
	Display:	0.1 Hz

A115 [Process Time Lo]

Related Parameter(s): b010, P034

Scales the time value when the drive is running at P034 [Minimum Freq]. When set to a value other than zero, b010 [Process Display] indicates the duration of the process.

Values	Default:	0.00
	Min/Max:	0.00/99.99
	Display:	0.01

A116 [Process Time Hi]

Related Parameter(s): b010, P035

Scales the time value when the drive is running at P035 [Maximum Freq]. When set to a value other than zero, b010 [Process Display] indicates the duration of the process.

Values	Default:	0.00
	Min/Max:	0.00/99.99
	Display:	0.01

A117 [Bus Reg Mode]

Controls the operation of the drive voltage regulation, which is normally operational at decel or when the bus voltage rises.

Refer to the Attention statement on page P-3 for important information on bus regulation.

Options	**0**	"Disabled"
	1	"Enabled" (Default)

A118 [Current Limit 2]

Related Parameter(s): P033, A051-A054, A089

Maximum output current allowed before current limiting occurs. This parameter is only active if A051 - A054 [Digital Inx Sel] is set to 25 "Current Lmt2" and is active.

Values	Default:	Drive Rated Amps × 1.5
	Min/Max:	0.1/(Drive Rated Amps × 1.8)
	Display:	0.1 Amps

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Advanced Program Group *(continued)*

A119 [Skip Frequency]

Related Parameter(s): A120

Sets the frequency at which the drive will not operate.

A setting of 0 disables this parameter.

Values	Default:	0 Hz
	Min/Max:	0/500 Hz
	Display:	1 Hz

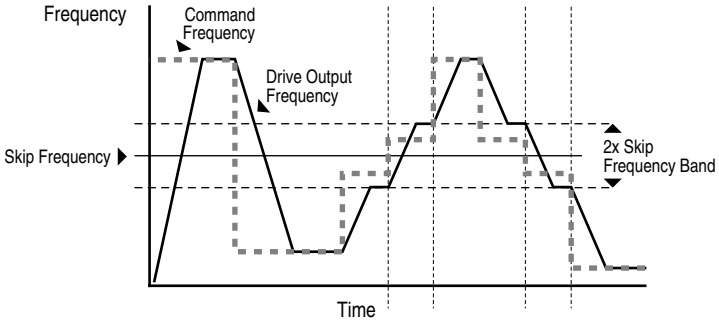
A120 [Skip Freq Band]

Related Parameter(s): A119

Determines the bandwidth around A119 [Skip Frequency]. A120 [Skip Frequency Band] is split applying 1/2 above and 1/2 below the actual skip frequency.

A setting of 0.0 disables this parameter.

Values	Default:	0.0 Hz
	Min/Max:	0.0/30.0 Hz
	Display:	0.1 Hz



A121 [Stall Fault Time]

Sets the time that the drive will remain in stall mode before a fault is issued.

Options	**0**	"60 Seconds" (Default)
	1	"120 Seconds"
	2	"240 Seconds"
	3	"360 Seconds"
	4	"480 Seconds"
	5	"Flt Disabled"

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Advanced Program Group *(continued)*

A122 [Analog In Loss]

Related Parameter(s): A110, A111, A132

Selects drive action when an input signal loss is detected. Signal loss is defined as an analog signal less than 1V or 2mA. The signal loss event ends and normal operation resumes when the input signal level is greater than or equal to 1.5V or 3mA. If using a 0-10V analog input, set A110 [Anlg In 0-10V Lo] to a minimum of 20% (i.e. 2 volts). Ensure that the Voltage Range Select DIP Switch is set to 10V.

Options	**0**	"Disabled" (Default)	
	1	"Fault (F29)"	F29 Analog Input Loss
	2	"Stop"	Uses P037 [Stop Mode]
	3	"Zero Ref"	Drive runs at zero speed reference.
	4	"Min Freq Ref"	Drive runs at minimum frequency.
	5	"Max Freq Ref"	Drive runs at maximum frequency.
	6	"Int Freq Ref"	Drive runs at internal frequency.

A123 [10V Bipolar Enbl]

Related Parameter(s): P038, A111

Enables/disables bipolar control. In bipolar mode direction is commanded by the sign of the reference.

Ensure that the Voltage Range Select DIP Switch setting matches the selected control scheme. Refer to Figure 1.5 on page 1-15.

Options	**0**	"Uni-Polar In" (Default)	0 to 10V only
	1	"Bi-Polar In"	±10V

A124 [Var PWM Disable]

Related Parameter(s): A091


Stop drive before changing this parameter.

Enables/disables a feature that varies the carrier frequency for the PWM output waveform defined by A091 [PWM Frequency].

Disabling this feature when low frequency conditions exist may result in IGBT stress and nuisance tripping.

Options	**0**	"Enabled" (Default)	
	1	"Disabled"	

A125 [Torque Perf Mode]

Related Parameter(s): A084, A085, A086, A087, A127


Stop drive before changing this parameter.

Enables/disables sensorless vector control operation.

Options	**0**	"V/Hz"	
	1	"Sensrls Vect" (Default)	

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Advanced Program Group *(continued)*

A126 [Motor NP FLA]

Related Parameter(s): A127

Set to the motor nameplate rated full load amps.

Values	Default:	Drive Rated Amps
	Min/Max:	0.1/(Drive Rated Amps × 2)
	Display:	0.1 Amps

A127 [Autotune]

Related Parameter(s): A125, A126, A128, A129

Stop drive before changing this parameter.

Provides an automatic method for setting A128 [IR Voltage Drop] and A129 [Flux Current Ref], which affect sensorless vector performance. Parameter A126 [Motor NP FLA] must be set to the motor nameplate full load amps before running the Autotune procedure.

Options	**0**	"Ready/Idle" (Default)
	1	"Static Tune"
	2	"Rotate Tune"

"Ready" (0) = Parameter returns to this setting following a "Static Tune" or "Rotate Tune."

"Static Tune" (1) = A temporary command that initiates a non-rotational motor stator resistance test for the best possible automatic setting of A128 [IR Voltage Drop]. A start command is required following initiation of this setting. The parameter returns to "Ready" (0) following the test, at which time another start transition is required operate the drive in normal mode. Used when motor cannot be uncoupled from the load.

"Rotate Tune" (2) = A temporary command that initiates a "Static Tune" followed by a rotational test for the best possible automatic setting of A129 [Flux Current Ref]. A start command is required following initiation of this setting. The parameter returns to "Ready/Idle" (0) following the test, at which time another start transition is required to operate the drive in normal mode. **Important:** Used when motor is uncoupled from the load. Results may not be valid if a load is coupled to the motor during this procedure.

ATTENTION: Rotation of the motor in an undesired direction can occur during this procedure. To guard against possible injury and/or equipment damage, it is recommended that the motor be disconnected from the load before proceeding.

If the Autotune routine fails, an F80 SVC Autotune fault is displayed.

A128 [IR Voltage Drop]

Related Parameter(s): A127

Value of volts dropped across the resistance of the motor stator.

Values	Default:	Based on Drive Rating
	Min/Max:	0.0/230.0 VAC
	Display:	0.1 VAC

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Advanced Program Group *(continued)*

A129 [Flux Current Ref]

Related Parameter(s): A127

Value of amps for full motor flux.

Values	Default:	Based on Drive Rating
	Min/Max:	0.00/[Motor NP FLA]
	Display:	0.01 Amps

A130 [PID Trim Hi]

Sets the maximum positive value that is added to a PID reference when PID trim is used.

Values	Default:	60.0 Hz
	Min/Max:	0.0/500.0 Hz
	Display:	0.1 Hz

A131 [PID Trim Lo]

Sets the minimum positive value that is added to a PID reference when PID trim is used.

Values	Default:	0.0 Hz
	Min/Max:	0.0/500.0 Hz
	Display:	0.1 Hz

A132 [PID Ref Sel]

Related Parameter(s): P038, A122

Stop drive before changing this parameter.

Enables/disables PID mode and selects the source of the PID reference. Refer to Appendix F for details.

Options	**0**	"PID Disabled" (Default)	
	1	"PID Setpoint"	
	2	"0-10V Input"	
	3	"4-20mA Input"	
	4	"Comm Port"	
	5	"Encoder"	Encoder or Pulse Train
	6	"Setpnt, Trim"	
	7	"0-10V, Trim"	
	8	"4-20mA, Trim"	
	9	"Comm, Trim"	
	10	"Encoder,Trim"	Encoder or Pulse Train

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Advanced Program Group *(continued)*

A133 [PID Feedback Sel]

Select the source of the PID feedback. Refer to Appendix F for details.



ATTENTION: The loss of analog input, encoder or other feedback may cause unintended speed or motion. Take appropriate precautions to guard against possible unintended speed or motion.

Options	**0**	"0-10V Input" (Default)	The PID will not function with a bipolar input. Negative voltages are treated as 0 volts.
	1	"4-20mA Input"	
	2	"Comm Port"	
	3	"Encoder"	Encoder or Pulse Train

A134 [PID Prop Gain]

Sets the value for the PID proportional component when the PID mode is enabled by A132 [PID Ref Sel].

Values	Default:	0.01
	Min/Max:	0.00/99.99
	Display:	0.01

A135 [PID Integ Time]

Sets the value for the PID integral component when the PID mode is enabled by A132 [PID Ref Sel].

Values	Default:	2.0 Secs
	Min/Max:	0.0/999.9 Secs
	Display:	0.1 Secs

A136 [PID Diff Rate]

Sets the value for the PID differential component when the PID mode is enabled by A132 [PID Ref Sel].

Values	Default:	0.00 (1/Secs)
	Min/Max:	0.00/99.99 (1/Secs)
	Display:	0.01 (1/Secs)

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Advanced Program Group *(continued)*

A137 [PID Setpoint]

Provides an internal fixed value for process setpoint when the PID mode is enabled by A132 [PID Ref Sel].

Values	Default:	0.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

A138 [PID Deadband]

Sets the lower limit of the PID output.

Values	Default:	0.0%
	Min/Max:	0.0/10.0%
	Display:	0.1%

A139 [PID Preload]

Sets the value used to preload the integral component on start or enable.

Values	Default:	0.0 Hz
	Min/Max:	0.0/500.0 Hz
	Display:	0.1 Hz

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Advanced Program Group *(continued)*

A140 [Stp Logic 0]
A141 [Stp Logic 1]
A142 [Stp Logic 2]
A143 [Stp Logic 3]
A144 [Stp Logic 4]
A145 [Stp Logic 5]
A146 [Stp Logic 6]
A147 [Stp Logic 7]

Related Parameter(s): P038, P039, P040, A051-A054, A055, A058, A061, A067, A068, A070-A077, A150-A157, E248

Stop drive before changing this parameter.

Values	Default:	00F1
	Min/Max:	0001/FAFF
	Display:	4 Digits

For detailed information on applying Step Logic and Position StepLogic refer to Appendix E and Appendix F.

Parameters A140-A147 are only active if P038 [Speed Reference] is set to 6 “Stp Logic” or 9 “Positioning”.

These parameters can be used to create a custom profile of frequency commands. Each “step” can be based on time, status of a Logic input or a combination of time and the status of a Logic input.

Digits 0-3 for each [Stp Logic x] parameter must be programmed according to the desired profile.

A Logic input is established by setting a digital input, parameters A051 - A054 [Digital Inx Sel], to 23 “Logic In1” and/or 24 “Logic In2” or by using Bits 6 and 7 of E248 [Enh Control Word].

A time interval between steps can be programmed using parameters A150 - A157 [Stp Logic Time x]. See the table below for related parameters.

The speed for any step is programmed using parameters A070 - A077 [Preset Freq x].

Step	StepLogic Parameter	Related Preset Frequency Parameter (Can be activated independent of StepLogic Parameters)	Related StepLogic Time Parameter (Active when A140-A147 Digit 0 or 1 are set to 1, b, C, d or E)
0	A140 [Stp Logic 0]	A070 [Preset Freq 0]	A150 [Stp Logic Time 0]
1	A141 [Stp Logic 1]	A071 [Preset Freq 1]	A151 [Stp Logic Time 1]
2	A142 [Stp Logic 2]	A072 [Preset Freq 2]	A152 [Stp Logic Time 2]
3	A143 [Stp Logic 3]	A073 [Preset Freq 3]	A153 [Stp Logic Time 3]
4	A144 [Stp Logic 4]	A074 [Preset Freq 4]	A154 [Stp Logic Time 4]
5	A145 [Stp Logic 5]	A075 [Preset Freq 5]	A155 [Stp Logic Time 5]
6	A146 [Stp Logic 6]	A076 [Preset Freq 6]	A156 [Stp Logic Time 6]
7	A147 [Stp Logic 7]	A077 [Preset Freq 7]	A157 [Stp Logic Time 7]

The position for any step is programmed using parameters E230 - E245 [Step Units x].

Step	StepLogic Position Parameters
0	E230 [Step Units 0] & E231 [Step Units F 0]
1	E232 [Step Units 1] & E233 [Step Units F 1]
2	E234 [Step Units 2] & E235 [Step Units F 2]
3	E236 [Step Units 3] & E237 [Step Units F 3]
4	E238 [Step Units 4] & E239 [Step Units F 4]
5	E240 [Step Units 5] & E241 [Step Units F 5]
6	E242 [Step Units 6] & E243 [Step Units F 6]
7	E244 [Step Units 7] & E245 [Step Units F 7]

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How StepLogic Works
The StepLogic sequence begins with a valid start command. A normal sequence always begins with A140 [Stp Logic 0].

Digit 0: Logic For Next Step
This digit defines the logic for the next step. When the condition is met the program advances to the next step. Step 0 follows Step 7. Example: Digit 0 is set 3. When “Logic In2” becomes active, the program advances to the next step.

Digit 1: Logic to Jump to a Different Step
For all settings other than F, when the condition is met, the program overrides Digit 0 and jumps to the step defined by Digit 2.

Digit 2: Different Step to Jump
When the condition for Digit 1 is met, the Digit 2 setting determines the next step or to end the program.

Digit 3: Step Settings
This digit defines additional characteristics of each step.

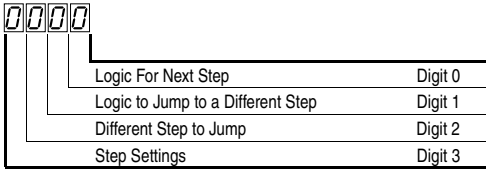
Any StepLogic parameter can be programmed to control a relay or opto output, but you can not control different outputs based on the condition of different StepLogic commands.

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StepLogic Settings

The logic for each function is determined by the four digits for each StepLogic parameter. The following is a listing of the available settings for each digit.

Refer to Appendix E for details.



Velocity Control Settings (Digit 3)

Required Setting	Accel/Decel Param. Used	StepLogic Output State	Commanded Direction
0	Accel/Decel 1	Off	FWD
1	Accel/Decel 1	Off	REV
2	Accel/Decel 1	Off	No Output
3	Accel/Decel 1	On	FWD
4	Accel/Decel 1	On	REV
5	Accel/Decel 1	On	No Output
6	Accel/Decel 2	Off	FWD
7	Accel/Decel 2	Off	REV
8	Accel/Decel 2	Off	No Output
9	Accel/Decel 2	On	FWD
A	Accel/Decel 2	On	REV
b	Accel/Decel 2	On	No Output

Positioning Settings (Digit 3)

Required Setting	Accel/Decel Param. Used	StepLogic Output State	Direction From Home	Type Of Command
0	Accel/Decel 1	Off	FWD	Absolute
1	Accel/Decel 1	Off	FWD	Incremental
2	Accel/Decel 1	Off	REV	Absolute
3	Accel/Decel 1	Off	REV	Incremental
4	Accel/Decel 1	On	FWD	Absolute
5	Accel/Decel 1	On	FWD	Incremental
6	Accel/Decel 1	On	REV	Absolute
7	Accel/Decel 1	On	REV	Incremental
8	Accel/Decel 2	Off	FWD	Absolute
9	Accel/Decel 2	Off	FWD	Incremental
A	Accel/Decel 2	Off	REV	Absolute
b	Accel/Decel 2	Off	REV	Incremental
C	Accel/Decel 2	On	FWD	Absolute
d	Accel/Decel 2	On	FWD	Incremental
E	Accel/Decel 2	On	REV	Absolute
F	Accel/Decel 2	On	REV	Incremental

Settings (Digit 2)

0 = Jump to Step 0
1 = Jump to Step 1
2 = Jump to Step 2
3 = Jump to Step 3
4 = Jump to Step 4
5 = Jump to Step 5
6 = Jump to Step 6
7 = Jump to Step 7
8 = End Program (Normal Stop)
9 = End Program (Coast to Stop)
A = End Program and Fault (F2)

Settings (Digit 1 and Digit 0)

0 = Skip Step (Jump Immediately)
1 = Step Based on [Stp Logic Time x]
2 = Step if “Logic In1” is Active
3 = Step if “Logic In2” is Active
4 = Step if “Logic In1” is Not Active
5 = Step if “Logic In2” is Not Active
6 = Step if either “Logic In1” or “Logic In2” is Active
7 = Step if both “Logic In1” and “Logic In2” is Active
8 = Step if neither “Logic In1” or “Logic In2” is Active
9 = Step if “Logic In1” is Active and “Logic In2” is Not Active
A = Step if “Logic In2” is Active and “Logic In1” is Not Active
b = Step after [Stp Logic Time x] and “Logic In1” is Active
C = Step after [Stp Logic Time x] and “Logic In2” is Active
d = Step after [Stp Logic Time x] and “Logic In1” is Not Active
E = Step after [Stp Logic Time x] and “Logic In2” is Not Active
F = Do Not Step/Ignore Digit 2 Settings

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Advanced Program Group *(continued)*

A150 [Stp Logic Time 0]
A151 [Stp Logic Time 1]
A152 [Stp Logic Time 2]
A153 [Stp Logic Time 3]
A154 [Stp Logic Time 4]
A155 [Stp Logic Time 5]
A156 [Stp Logic Time 6]
A157 [Stp Logic Time 7]

Related Parameter(s): P038, A055, A058, A061, A070-A077, A140-A147, E222

Sets the time to remain in each step if the corresponding StpLogic command word is set to "Step after Time" or if using E222 [Positioning Mode] set to 0.

Values	Default:	30.0 Secs
	Min/Max:	0.0/999.9 Secs
	Display:	0.1 Secs

A160 [EM Brk Off Delay]

Related Parameter(s): P037

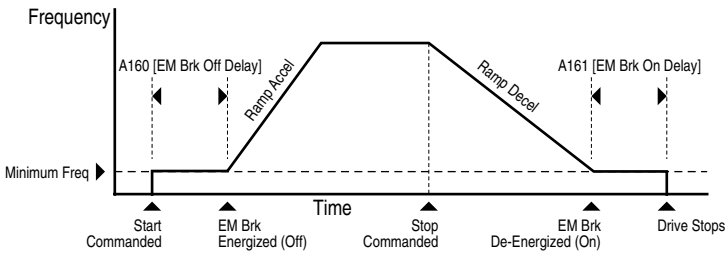
Sets the time the drive remains at minimum frequency before the relay or an opto output is energized and the drive ramps to the commanded frequency.

The relay or opto output is typically connected to a user-supplied electromechanical brake coil relay.

Set P037 [Stop Mode] to 8 "Ramp+EM B,CF" or 9 "Ramp+EM Brk" to enable the electromechanical brake option.

Set A055 [Relay Out Sel], A058 or A061 [Opto Outx Sel] to 22 "EM Brk Cntrl" to control brake operation.

Values	Default:	2.00 Secs
	Min/Max:	0.01/10.00 Secs
	Display:	0.01 Secs



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Advanced Program Group *(continued)*

A161 [EM Brk On Delay]

Related Parameter(s): P037

Sets the time the drive remains at minimum frequency before the relay or an opto output is de-energizing and the drive stops.

The relay or opto output is typically connected to a user-supplied electromechanical brake coil relay.

Set P037 [Stop Mode] to 8 “Ramp+EM B,CF” or 9 “Ramp+EM Brk” to enable the electromechanical brake option.

Set A055 [Relay Out Sel], A058 or A061 [Opto Outx Sel] to 22 “EM Brk Cntrl” to control brake operation.

Values	Default:	2.00 Secs
	Min/Max:	0.01/10.00 Secs
	Display:	0.01 Secs

A162 [MOP Reset Sel]

Related Parameter(s): A069

Set the drive to save the current MOP reference command.

Options	**0**	“Zero MOP Ref”	This option clamps A069 [Internal Freq] at 0.0 Hz when the drive is not running.
	1	“Save MOP Ref” (Default)	Reference is saved in A069 [Internal Freq].

A163 [DB Threshold]

Related Parameter(s): P037, A080, A081, A082

Sets the DC bus Voltage Threshold for Dynamic Brake operation. If the DC bus voltage falls below the value set in this parameter, the Dynamic Brake will not turn on. Lower values will make the Dynamic Braking function more responsive but may result in nuisance Dynamic Brake activation.

Values	Default	100.0%
	Min/Max:	0.0/110.0%
	Display:	0.0%



ATTENTION: Equipment damage may result if this parameter is set a value that causes the dynamic braking resistor to dissipate excessive power. Parameter settings less than 100% should be carefully evaluated to ensure that the dynamic brake resistor’s wattage rating is not exceeded. In general, values less than 90% are not needed. This parameter’s setting is especially important if parameter A082 [DB Resistor Sel] is set to 2 “No Protection”.

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Enhanced Program Group

E201 [LED Display Opt]

Selects which parameters can be viewed by the drive's LED interface.

E201 Option	Parameter Set
0	All Basic Display (Group b) and Advanced Display (Group d) parameters
1	All Basic Display Group (b001-b029) parameters
2	Basic Display Group parameters b001-b007 and b010
3	Basic Display Group parameter b001-b004

Values	Default:	2
	Min/Max:	0/3
	Display:	1

E202 [Digital Term 3]


Stop drive before changing this parameter.

Sets the function of I/O Terminal 03.

Options	**0**	"Start Source" (Default)	Input functions as defined by P036 [Start Source].
	1	"Acc/Dec Sel1"	If active, can determine which Accel/Decel time will be used for all ramp rates except jog. Can be applied to one input only. Refer to A067 [Accel Time 2] for details.
	2	"Jog"	• When input is present, drive accelerates according to the value set in A079 [Jog Accel/Decel] and ramps to the value set in A078 [Jog Frequency]. • When input is removed, drive ramps to a stop according to the value set in A079 [Jog Accel/Decel]. • A valid "Start" command will override this input.
	3	"Aux Fault"	When enabled, an F2 Auxiliary Input fault will occur when the input is removed.
	4	"Preset Freq"	Refer to A070 - A077 [Preset Freq x]. **Important:** Digital Inputs have priority for frequency control when programmed as Preset Speed and are active. Refer to the flowchart on page 1-27 for more information on speed reference control priority.
	5	"Reserved"	
	6	"Comm Port"	• When active, sets communications device as default start/speed command source. • Can only be tied to one input.
	7	"Clear Fault"	When active, clears an active fault.
	8	"RampStop,CF"	Causes drive to immediately ramp to a stop regardless of how P037 [Stop Mode] is set.
	9	"CoastStop,CF"	Causes drive to immediately coast to a stop regardless of how P037 [Stop Mode] is set.
	10	"DCInjStop,CF"	Causes drive to immediately begin a DC Injection stop regardless of how P037 [Stop Mode] is set.

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E202 Options (Cont.)	**11** "Jog Forward"	Drive accelerates to A078 [Jog Frequency] according to A079 [Jog Accel/Decel] and ramps to stop when input becomes inactive. A valid start will override this command.
	12 "Jog Reverse"	Drive accelerates to A078 [Jog Frequency] according to A079 [Jog Accel/Decel] and ramps to stop when input becomes inactive. A valid start will override this command.
	13 "10V In Ctrl"	Selects 0-10V or ±10V control as the frequency reference. Start source is not changed.
	14 "20mA In Ctrl"	Selects 4-20mA control as the frequency reference. Start source is not changed.
	15 "PID Disable"	Disables PID function. Drive uses the next valid non-PID speed reference.
	16 "MOP Up"	Increases the value of A069 [Internal Freq] at a rate of 2 Hz per second. Default for A069 is 60 Hz.
	17 "MOP Down"	Decreases the value of A069 [Internal Freq] at a rate of 2 Hz per second. Default for A069 is 60 Hz.
	18 "Timer Start"	Clears and starts the timer function. May be used to control the relay or opto outputs.
	19 "Counter In"	Starts the counter function. May be used to control the relay or opto outputs.
	20 "Reset Timer"	Clears the active timer.
	21 "Reset Countr"	Clears the active counter.
	22 "Rset Tim&Cnt"	Clears the active timer and counter.
	23 "Logic In1"	Logic function input number 1. May be used to control the relay or opto outputs (see parameters A055, A058, A061 Options 11-14). May be used in conjunction with StepLogic parameters A140 - A147 [Stp Logic x]. Logically ORed with E248 [Enh Control Word] bit 6 "Logic In 1".
	24 "Logic In2"	Logic function input number 2. May be used to control the relay or opto outputs (see parameters A055, A058, A061 Options 11-14). May be used in conjunction with StepLogic parameters A140 - A147 [Stp Logic x]. Logically ORed with E248 [Enh Control Word] bit 7 "Logic In 2".
	25 "Current Lmt2"	When active, A118 [Current Limit 2] determines the drive current limit level.
	26 "Anlg Invert"	Inverts the scaling of the analog input levels set in A110 [Anlg In 0-10V Lo] and A111 [Anlg In 0-10V Hi] or A112 [Anlg In4-20mA Lo] and A113 [Anlg In4-20mA Hi].
	27 "EM Brk Rlse"	If EM brake function is enabled, this input releases the brake. Refer to A160 [EM Brk Off Delay] for additional information.

ATTENTION: If a hazard of injury due to movement of equipment or material exists, an auxiliary mechanical braking device must be used.

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E202 Options (Cont.)	**28** "Acc/Dec Sel2"	If active, can determine which Accel/Decel time will be used for all ramp rates except jog. Can be applied to one input only.

Option		
28	1	Description
0	0	Acc/Dec 1
0	1	Acc/Dec 2
1	0	Acc/Dec 3
1	1	Acc/Dec 4

29 "Precharge En"	Forces drive into precharge state. Typically controlled by auxiliary contact on the disconnect at the DC input to the drive. If this input is assigned, it must be energized for the pre-charge relay to close and for the drive to run. If it is de-energized, the pre-charge relay will open and the drive will coast to a stop.
30 "Inertia Dcel"	Forces drive into Inertia Ride-Through state. The drive will attempt to regulate the DC bus at the current level.
31 "Sync Enable"	Must be used in order to hold the existing frequency when Sync Time is set to enable speed synchronization. When this input is released the drive will accelerate to the commanded frequency in E214 [Sync Time].
32 "Traverse Dis"	When an input is programmed the traverse function will be disabled while this input is active. Refer to E210 [Max Traverse]
33 "Home Limit"	In Positioning mode, this indicates the drive is at the home position. Refer to Appendix F for detailed information on positioning.
34 "Find Home"	In Positioning mode this causes the drive to return to the Home position when a start is issued. It does this by using the [Find Home Freq] and [Find Home Direction] until the "Home Limit" input is activated. If it passes this point, it then runs in the reverse direction at 1/10th the frequency of [Find Home Freq] until the "Home Limit" is activated again. As long as this input is active, any start command will cause the drive to enter the homing routing. However, it only functions if in Positioning mode. Once the Find Home routine has finished, the drive will stop. Refer to Appendix F for detailed information on positioning.
35 "Hold Step"	In Positioning mode, this input over-rides other inputs and causes the drive to remain at it's current step (running at zero speed once it reaches its position) until released. While in "Hold", the drive will ignore any digital input command which would normally result in a move to a new step. However, timers continue to run. Therefore, when the Hold is removed, the drive must see any required digital inputs transition (even if they already transitioned during the hold), but it does not reset any timer. Refer to Appendix F for detailed information on positioning.
36 "Pos Redefine"	In Positioning mode, this input resets the home position to the current position of the machine. Refer to Appendix F for detailed information on positioning.

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Enhanced Program Group *(continued)*

E203 [Accel Time 3]
E205 [Accel Time 4]

Related Parameter(s): A067

Sets the rate of acceleration for all speed increases when selected by digital inputs. Refer to graphic at A067 [Accel Time 2].

$$\frac{\text{Maximum Freq}}{\text{Accel Time}} = \text{Accel Rate}$$

Values	Default:	5.0 Secs (E203) 30.0 Secs (E205)
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs

E204 [Decel Time 3]
E206 [Decel Time 4]

Related Parameter(s): A067

Sets the rate of deceleration for all speed decreases when selected by digital inputs. Refer to graphic at A067 [Accel Time 2].

$$\frac{\text{Maximum Freq}}{\text{Decel Time}} = \text{Decel Rate}$$

Values	Default:	5.0 Secs (E204) 30.0 Secs (E206)
	Min/Max:	0.0/600.0 Secs
	Display:	0.1 Secs

E207 [Comm Write Mode]

Saves parameter values in active drive memory (RAM) or in drive non-volatile memory (EEPROM).

Important: Parameter values set prior to selecting option 1 “RAM only” will be saved in drive non-volatile memory (EEPROM).

Options	**0**	“EEPROM” (Default)
	1	“RAM only”

E208 [Power Loss Mode]

Sets the reaction to a loss of input power.

Options	**0**	“Coast” (Default)	Drive will fault and motor will coast to stop.
	1	“Decel”	Drive will decelerate and attempt to keep the DC Bus voltage above the undervoltage level.

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Enhanced Program Group *(continued)*

E209 [Half Bus Enable]

Enables/disables the power ride through function which allows the drive to maintain power to the motor at 50% drive input voltage during short-term power sag conditions.

Options	**0**	"Disabled" (Default)
	1	"Enabled"

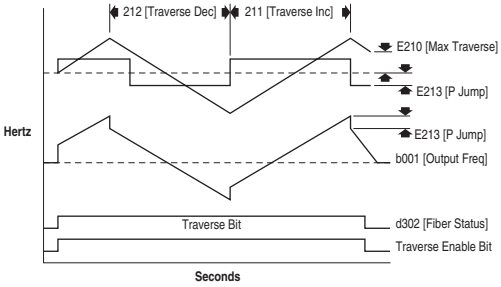
ATTENTION: To guard against drive damage, a minimum line impedance must be provided to limit inrush current when the power line recovers. The input impedance should be equal or greater than the equivalent of a 5% transformer with a VA rating 6 times the drive's input VA rating.

E210 [Max Traverse]

Related Parameter(s): E211, E212, E213

Sets the amplitude of triangle wave speed modulation.

Values	Default:	0.00 Hz (Disabled)
	Min/Max:	0.00/300.0 Hz
	Display:	0.01 Hz



E211 [Traverse Inc]

Related Parameter(s): E210

Sets time required for the Traverse function to accelerate from the minimum to the maximum traverse frequency. Refer to the diagram at E210 [Max Traverse].

Values	Default:	0.00 Secs
	Min/Max:	0.00/30.00 Secs
	Display:	0.01 Secs

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Enhanced Program Group *(continued)*

E212 [Traverse Dec]

Related Parameter(s): E210

Sets time required for the Traverse function to decelerate from the maximum to the minimum traverse frequency. Refer to the diagram at E210 [Max Traverse].

Values	Default:	0.00 Secs
	Min/Max:	0.00/30.00 Secs
	Display:	0.01 Secs

E213 [P Jump]

Related Parameter(s): E210

Sets the frequency amplitude that is added to or subtracted from the commanded frequency. Refer to the diagram at E210 [Max Traverse].

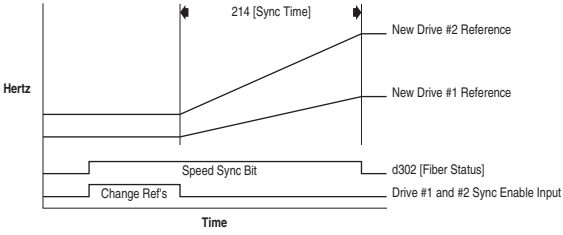
Values	Default:	0.00 Hz
	Min/Max:	0.00/300.0 Hz
	Display:	0.01 Hz

E214 [Sync Time]

Related Parameter(s): A051-A054, d302

Enables the function that holds the drive at the current frequency even if the commanded frequency changes. Used with A051-A054 [Digital Inx Sel] option 31 “Sync Enable”.

Values	Default:	0.0 Secs (Disabled)
	Min/Max:	0.0/3200.0 Secs
	Display:	0.1 Secs



E215 [Speed Ratio]

Stop drive before changing this parameter.

Enables the function that scales the drive speed command.

Values	Default:	1.00
	Min/Max:	0.01/99.99
	Display:	0.01

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Enhanced Program Group *(continued)*

E216 [Motor Fdbk Type]

Stop drive before changing this parameter.

Selects the encoder type. For additional information refer to Appendix F.

E216 Option	Encoder
0	None
1	Pulse Train
2	Single Chan
3	Single Check
4	Quadrature
5	Quad Check

ATTENTION: The loss of analog input, encoder or other feedback may cause unintended speed or motion. Take appropriate precautions to guard against possible unintended speed or motion.

Values	Default:	0
	Min/Max:	0/5
	Display:	1

E217 [Motor NP Poles]

Defines the number of poles in the motor.

Values	Default:	4
	Min/Max:	2/40
	Display:	1

E218 [Encoder PPR]

Specifies the encoder pulses per revolution when an encoder is used. For additional information refer to Appendix F.

Values	Default:	1024
	Min/Max:	1/20000
	Display:	1

E219 [Pulse In Scale]

Sets the scale factor/gain for the Pulse Input when E216 [Motor Fdbk Type] is set to 1 “Pulse Train”. For additional information refer to Appendix F.

$$\frac{\text{Input Pulse Rate}}{\text{Desired Command}} = \text{Speed Command}$$

Values	Default:	64
	Min/Max:	1/20000
	Display:	1

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Enhanced Program Group *(continued)*

E220 [Ki Speed Loop]

Sets the I-Gain used in the PI calculation of the speed loop.

Values	Default:	2.0
	Min/Max:	0.0/400.0
	Display:	0.1

E221 [Kp Speed Loop]

Sets the P-Gain used in the PI calculation of the speed loop.

Values	Default:	0.5
	Min/Max:	0.0/200.0
	Display:	0.1

E222 [Positioning Mode]


Stop drive before changing this parameter.

Defines the positioning transition mode used for the position steps. For additional information refer to Appendix F.

E222 Option	Transition Mode	Description
0	Time Steps	Steps based on time.
1	Preset Input	Preset inputs directly command a given step.
2	Step Logic	Use Step Logic commands. Always start from Step 0.
3	Preset StpL	Use Preset inputs to determine starting step then Step Logic commands.
4	StpLogic-Lst	Use Step Logic commands from last StepLogic step at last drive stop.

Values	Default:	0
	Min/Max:	0/4
	Display:	1

E223 [Find Home Freq]

Sets the maximum frequency the drive uses when “Find Home” is issued. For additional information refer to Appendix F.

Values	Default:	10.0 Hz
	Min/Max:	0.1/500.0 Hz
	Display:	0.1 Hz

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Enhanced Program Group *(continued)*

E224 [Find Home Dir]


Stop drive before changing this parameter.

Sets the direction the drive commands when “Find Home” is issued. For additional information refer to Appendix F.

Options	**0**	“Forward” (Default)
	1	“Reverse”

E225 [Encoder Pos Tol]

Sets the “At Position” and the “At Home” tolerance around the encoder count. The value is added to and subtracted from the target encoder unit value to create the tolerance range. For additional information refer to Appendix F.

Values	Default:	100
	Min/Max:	1/50000
	Display:	1

E226 [Counts Per Unit]

Related Parameter(s): E230-E245

Sets the number of encoder counts equal to one user-defined unit. For additional information refer to Appendix F.

Values	Default:	4096
	Min/Max:	1/32000
	Display:	1

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Enhanced Program Group *(continued)*

E230 [Step Units 0]
E232 [Step Units 1]
E234 [Step Units 2]
E236 [Step Units 3]
E238 [Step Units 4]
E240 [Step Units 5]
E242 [Step Units 6]
E244 [Step Units 7]

Related Parameter(s): E226

32 bit parameter.

Sets the position in whole number user-defined units the drive must reach at each step. For additional information refer to Appendix F.

Values	Default:	0
	Min/Max:	0/64000
	Display:	1

Input State of Digital In 1 (I/O Terminal 05 when A051 = 4)	Input State of Digital In 2 (I/O Terminal 06 when A052 = 4)	Input State of Digital In 3 (I/O Terminal 07 when A053 = 4)	Position Source	Freq Source	Accel / Decel Parameter Used(2)
0	0	0	E230	A070	[Accel Time 1] / [Decel Time 1]
1	0	0	E232	A071	[Accel Time 1] / [Decel Time 1]
0	1	0	E234	A072	[Accel Time 2] / [Decel Time 2]
1	1	0	E236	A073	[Accel Time 2] / [Decel Time 2]
0	0	1	E238	A074	[Accel Time 1] / [Decel Time 1]
1	0	1	E240	A075	[Accel Time 1] / [Decel Time 1]
0	1	1	E242	A076	[Accel Time 2] / [Decel Time 2]
1	1	1	E244	A077	[Accel Time 2] / [Decel Time 2]

(2) When a Digital Input is set to “Accel 2 & Decel 2”, and the input is active, that input overrides the settings in this table.

E231 [Step Units F 0]
E233 [Step Units F 1]
E235 [Step Units F 2]
E237 [Step Units F 3]
E239 [Step Units F 4]
E241 [Step Units F 5]
E243 [Step Units F 6]
E245 [Step Units F 7]

Related Parameter(s): E226

32 bit parameter.

Sets the position in fractional user-defined units the drive must reach at each step. For additional information refer to Appendix F.

Values	Default:	0.00
	Min/Max:	0.00/0.99
	Display:	0.01

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Enhanced Program Group *(continued)*

E246 [Pos Reg Filter]

Sets the error signal filter in the position regulator. For additional information refer to Appendix F.

Values	Default:	8
	Min/Max:	0/15
	Display:	1

E247 [Pos Reg Gain]

Sets the gain adjustment for the position regulator. For additional information refer to Appendix F.

Values	Default:	3.0
	Min/Max:	0.0/200.0
	Display:	0.1

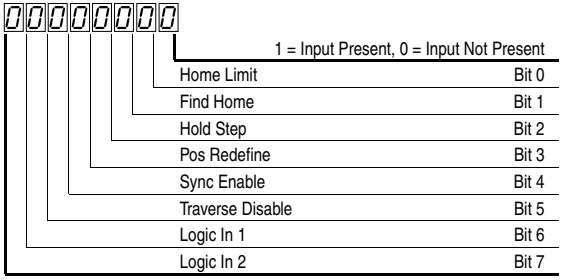
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Enhanced Program Group *(continued)*

E248 [Enh Control Word]

Allows control of positioning and other functions via parameter control for use over comms. The functions replicate the digital input options and function in the same way. For additional information refer to Appendix F.

Important: The Find Home and Position Redefine bits must be returned to 0 following the homing routine and before starting the drive.



Values	Default:		0
	Min/Max:		0/1
	Display:		1
Bit	**0**	"Home Limit"	In Positioning mode, this indicates the drive is at the home position.
	1	"Find Home"	When set, the next start command causes the drive to find home. Set this bit to 0 after completing the homing routine.
	2	"Hold Step"	In Positioning mode, this input over-rides other inputs and causes the drive to remain at its current step (running at zero speed once it reaches its position) until released.
	3	"Pos Redefine"	In Positioning mode, this input resets the home position to the current position of the machine. Set this bit to 0 after completing the homing routine.
	4	"Sync Enable"	Must be used in order to hold the existing frequency when Sync Time is set to enable speed synchronization. When this bit is reset to zero the drive will accelerate to the new commanded frequency based on E214 [Sync Time] setting.
	5	"Traverse Disable"	When set the traverse function will be disabled.
	6	"Logic In 1"	This provides an identical function as the "Logic In1" Digital Input option. This bit is logically ORed with a digital input A051 - A054 set to option 23 "Logic In1". It can be used to move through the Step-Logic functions (speed or position) via comms control without requiring actual digital input transitions.
	7	"Logic In 2"	This provides and identical function as the "Logic In2" Digital Input option. This bit is logically ORed with a digital input A051 - A054 set to option 24 "Logic In2". It can be used to move through the Step-Logic functions (speed or position) via comms control without requiring actual digital input transitions.

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Enhanced Program Group *(continued)*

E249 [Cmd Stat Select]

Selects velocity-specific or position/fibers-specific Command and Status Word bit definitions for use over a communication network. For additional information refer to Appendix C.

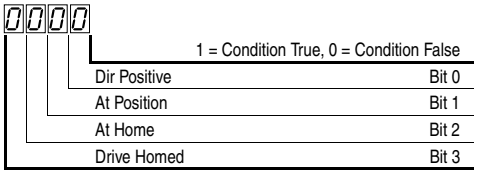
Options	**0**	"Velocity" (Default)
	1	"Position"

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Advanced Display Group

d301 [Drive Status 2]

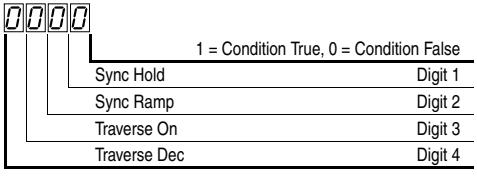
Present operating condition of the drive.
When in Positioning mode, Bit 10 indicates positive or negative position in relation to Home.



Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

d302 [Fibers Status]

Present status of the Fibers features.



Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

d303 [Slip Hz Meter]

Displays the current amount of slip being applied to the motor frequency.

Values	Default:	Read Only
	Min/Max:	0.0/25.0 Hz
	Display:	0.1 Hz

d304 [Speed Feedback]

Related Parameter(s): E218, d305

32 32 bit parameter.

Displays the value of the actual motor speed (whole number portion) whether measured by encoder/ pulse train feedback or estimated.

Values	Default:	Read Only
	Min/Max:	0/64000 RPM
	Display:	1 RPM

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Advanced Display Group *(continued)*

d305 [Speed Feedback F]

Related Parameter(s): d304

Displays the value of the actual motor speed (fractional portion) whether measured by encoder/pulse train feedback or estimated.

Values	Default:	Read Only
	Min/Max:	0.0/0.9
	Display:	0.1

d306 [Encoder Speed]

Related Parameter(s): d307

32 32 bit parameter.

Provides a monitoring point that reflects the speed (whole number portion) measured from the feedback device. This shows the encoder or pulse train speed even if this is not used directly to control the motor speed.

Values	Default:	Read Only
	Min/Max:	0/64000
	Display:	1

d307 [Encoder Speed F]

Related Parameter(s): d306

Provides a monitoring point that reflects the speed (fractional portion) measured from the feedback device. This shows the encoder or pulse train speed even if this is not used directly to control the motor speed.

Values	Default:	Read Only
	Min/Max:	0.0/0.9
	Display:	0.1

d308 [Units Traveled H]

Related Parameter(s): d309, E226

32 32 bit parameter.

Displays the number of user-defined units (whole number portion) traveled from the home position.

Values	Default:	Read Only
	Min/Max:	0/64000
	Display:	1

d309 [Units Traveled L]

Related Parameter(s): d308, E226

Displays the number of user-defined units (fractional portion) traveled from the home position.

Values	Default:	Read Only
	Min/Max:	0.00/0.99
	Display:	0.01

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Parameter Cross Reference – by Name

Parameter Name	No.	Group
10V Bipolar Enbl	A123	Advanced Program
Accel Time 1	P039	Basic Program
Accel Time 2	A067	Advanced Program
Accel Time 3	E203	Enhanced Program
Accel Time 4	E205	Enhanced Program
Analog In 0-10V	b020	Display
Analog In 4-20mA	b021	Display
Analog In Loss	A122	Advanced Program
Analog Out High	A066	Advanced Program
Analog Out Sel	A065	Advanced Program
Anlg In 0-10V Hi	A111	Advanced Program
Anlg In 0-10V Lo	A110	Advanced Program
Anlg In4-20mA Hi	A113	Advanced Program
Anlg In4-20mA Lo	A112	Advanced Program
Anlg Out Setpt	A109	Advanced Program
Auto Rstrt Delay	A093	Advanced Program
Auto Rstrt Tries	A092	Advanced Program
Autotune	A127	Advanced Program
Boost Select	A084	Advanced Program
Break Frequency	A087	Advanced Program
Break Voltage	A086	Advanced Program
Bus Reg Mode	A117	Advanced Program
Cmd Stat Select	E249	Enhanced Program
Comm Data Rate	A103	Advanced Program
Comm Format	A107	Advanced Program
Comm Loss Action	A105	Advanced Program
Comm Loss Time	A106	Advanced Program
Comm Node Addr	A104	Advanced Program
Comm Status	b015	Display
Comm Write Mode	E207	Enhanced Program
Commanded Freq	b002	Display
Compensation	A097	Advanced Program
Contrl In Status	b013	Display
Control Source	b012	Display
Control SW Ver	b016	Display
Counter Status	b025	Display
Counts Per Unit	E226	Enhanced Program
Current Limit x	A089, A118	Advanced Program
DB Resistor Sel	A082	Advanced Program
DB Threshold	A163	Advanced Program
DC Brake Level	A081	Advanced Program
DC Brake Time	A080	Advanced Program
DC Bus Voltage	b005	Display
Decel Time 1	P040	Basic Program
Decel Time 2	A068	Advanced Program
Decel Time 3	E204	Enhanced Program
Decel Time 4	E206	Enhanced Program
Dig In Status	b014	Display
Digital Inx Sel	A051-A054	Advanced Program
Digital Term 3	E202	Enhanced Program
Drive Status	b006	Display
Drive Status 2	d301	Advanced Display
Drive Temp	b024	Display
Drive Type	b017	Display
Elapsed Run Time	b018	Display
EM Brk Off Delay	A160	Advanced Program
EM Brk On Delay	A161	Advanced Program
Encoder Pos Tol	E225	Enhanced Program
Encoder PPR	E218	Enhanced Program
Encoder Speed	d306	Advanced Display
Encoder Speed F	d307	Advanced Display
Enh Control Word	E248	Enhanced Program
Fault Clear	A100	Advanced Program
Fault x Code	b007-b009	Display
Fibers Status	d302	Advanced Display
Find Home Dir	E224	Enhanced Program
Find Home Freq	E223	Enhanced Program
Flux Current Ref	A129	Advanced Program
Flying Start En	A096	Advanced Program
Half Bus Enable	E209	Enhanced Program
Internal Freq	A069	Advanced Program
IR Voltage Drop	A128	Advanced Program
Jog Accel/Decel	A079	Advanced Program
Jog Frequency	A078	Advanced Program
Ki Speed Loop	E220	Enhanced Program
Kp Speed Loop	E221	Enhanced Program
Language	A108	Advanced Program
LED Display Opt	E201	Enhanced Program
Max Traverse	E210	Enhanced Program
Maximum Freq	P035	Basic Program
Maximum Voltage	A088	Advanced Program
Minimum Freq	P034	Basic Program
MOP Reset Sel	A162	Advanced Program
Motor Fdbk Type	E216	Enhanced Program
Motor NP FLA	A126	Advanced Program
Motor NP Hertz	P032	Basic Program
Motor NP Poles	E217	Enhanced Program
Motor NP Volts	P031	Basic Program
Motor OL Current	P033	Basic Program
Motor OL Ret	P043	Basic Program
Motor OL Select	A090	Advanced Program
Opto Out Logic	A064	Advanced Program
Opto Outx Level	A059, A062	Advanced Program
Opto Outx Sel	A058, A061	Advanced Program
Output Current	b003	Display
Output Freq	b001	Display
Output Power	b022	Display
Output Powr Fctr	b023	Display
Output Voltage	b004	Display
P Jump	E213	Enhanced Program
PID Deadband	A138	Advanced Program
PID Diff Rate	A136	Advanced Program
PID Feedback Sel	A133	Advanced Program
PID Integ Time	A135	Advanced Program
PID Preload	A139	Advanced Program
PID Prop Gain	A134	Advanced Program
PID Ref Sel	A132	Advanced Program
PID Setpoint	A137	Advanced Program
PID Trim Hi	A130	Advanced Program
PID Trim Lo	A131	Advanced Program
Pos Reg Filter	E246	Enhanced Program
Pos Reg Gain	E247	Enhanced Program
Positioning Mode	E222	Enhanced Program
Power Loss Mode	E208	Enhanced Program
Preset Freq x	A070-A077	Advanced Program
Process Display	b010	Display

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Parameter Name	No.	Group
Process Factor	A099	Advanced Program
Process Time Hi	A116	Advanced Program
Process Time Lo	A115	Advanced Program
Program Lock	A101	Advanced Program
Pulse In Scale	E219	Enhanced Program
PWM Frequency	A091	Advanced Program
Relay Out Level	A056	Advanced Program
Relay Out Sel	A055	Advanced Program
Reset To Defalts	P041	Basic Program
Reverse Disable	A095	Advanced Program
S Curve %	A083	Advanced Program
Skip Freq Band	A120	Advanced Program
Skip Frequency	A119	Advanced Program
Slip Hertz @ FLA	A114	Advanced Program
Slip Hertz Meter	d303	Advanced Display
Speed Feedback	d304	Advanced Display
Speed Feedback F	d305	Advanced Display
Speed Ratio	E215	Enhanced Program
Speed Reference	P038	Basic Program
Stall Fault Time	A121	Advanced Program
Start At PowerUp	A094	Advanced Program
Start Boost	A085	Advanced Program
Start Source	P036	Basic Program
Step Units 0	E230	Enhanced Program
Step Units 1	E232	Enhanced Program
Step Units 2	E234	Enhanced Program
Step Units 3	E236	Enhanced Program
Step Units 4	E238	Enhanced Program
Step Units 5	E240	Enhanced Program
Step Units 6	E242	Enhanced Program
Step Units 7	E244	Enhanced Program
Step Units F 0	E231	Enhanced Program
Step Units F 1	E233	Enhanced Program
Step Units F 2	E235	Enhanced Program
Step Units F 3	E237	Enhanced Program
Step Units F 4	E239	Enhanced Program
Step Units F 5	E241	Enhanced Program
Step Units F 6	E243	Enhanced Program
Step Units F 7	E245	Enhanced Program
Stop Mode	P037	Basic Program
Stp Logic Status	b028	Display
Stp Logic Time x	A150-A157	Advanced Program
Stp Logic x	A140-A147	Advanced Program
SW Current Trip	A098	Advanced Program
Sync Time	E214	Enhanced Program
Testpoint Data	b019	Display
Testpoint Sel	A102	Advanced Program
Timer Status	b026	Display
Torque Current	b029	Display
Torque Perf Mode	A125	Advanced Program
Traverse Dec	E212	Enhanced Program
Traverse Inc	E211	Enhanced Program
Units Traveled H	d308	Advanced Display
Units Traveled L	d309	Advanced Display
Var PWM Disable	A124	Advanced Program
Voltage Class	P042	Basic Program

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Troubleshooting

Chapter 4 provides information to guide you in troubleshooting the PowerFlex 40P drive. Included is a listing and description of drive faults (with possible solutions, when applicable).

For information on...	See page...	For information on...	See page...
Drive Status	4-1	Fault Descriptions	4-3
Faults	4-1	Common Symptoms and Corrective Actions	4-6

ATTENTION: Risk of injury or equipment damage exists. Drive does not contain user-serviceable components. Do not disassemble drive chassis.

Drive Status

The condition or state of your drive is constantly monitored. Any changes will be indicated through the integral LED display.

LED Indications

See page 2-3 for information on drive status indicators and controls.

Faults

A fault is a condition that stops the drive. There are two fault types.

Table 4.A Fault Types

Type	Fault Description	
①	Auto-Reset/Run	When this type of fault occurs, and A092 [Auto Rstrt Tries] is set to a value greater than "0," a user-configurable timer, A093 [Auto Rstrt Delay], begins. When the timer reaches zero, the drive attempts to automatically reset the fault. If the condition that caused the fault is no longer present, the fault will be reset and the drive will be restarted.
②	Non-Resetable	This type of fault may require drive or motor repair, or is caused by wiring or programing errors. The cause of the fault must be corrected before the fault can be cleared.

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Fault Indication

Condition	Display
Drive is indicating a fault. The integral LED display provides visual notification of a fault condition by displaying the following. • Flashing fault number • Flashing fault indicator Press the Up Arrow key to regain control of the display.	

Manually Clearing Faults

Step	Key(s)
1. Address the condition that caused the fault. The cause must be corrected before the fault can be cleared. See Table 4.B. 2. After corrective action has been taken, clear the fault by one of these methods. • Press and hold the Up Arrow key for three seconds. • Cycle drive power. • Set A100 [Fault Clear] to "1" or "2". • Cycle digital input if A051-A054 [Digital Inx Sel] is set to option 7 "Clear Fault".	

Automatically Clearing Faults

Option / Step
Clear a Type 1 fault and restart the drive. 1. Set A092 [Auto Rstrt Tries] to a value other than "0". 2. Set A093 [Auto Rstrt Delay] to a value other than "0".
Clear an OverVoltage, UnderVoltage or Heatsink OvrTmp fault without restarting the drive. 1. Set A092 [Auto Rstrt Tries] to a value other than "0". 2. Set A093 [Auto Rstrt Delay] to "0".

Auto Restart (Reset/Run)

The Auto Restart feature provides the ability for the drive to automatically perform a fault reset followed by a start attempt without user or application intervention. This allows remote or "unattended" operation. Only certain faults are allowed to be reset. Certain faults (Type 2) that indicate possible drive component malfunction are not resettable. Fault types are listed in Table 4.A. Refer to Table 4.B for fault descriptions.

Caution should be used when enabling this feature, since the drive will attempt to issue its own start command based on user selected programming.

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Fault Descriptions

Table 4.B Fault Types, Descriptions and Actions

No.	Fault	Type(1)	Description	Action
F2	Auxiliary Input	①	Auxiliary input interlock is open.	1. Check remote wiring. 2. Verify communications programming for intentional fault.
F3	Power Loss	②	DC bus voltage remained below 85% of nominal or single phase operation detected.	1. Monitor the incoming AC line for low voltage or line power interruption. 2. Check input fuses.
F4	UnderVoltage	①	DC bus voltage fell below the minimum value.	Monitor the incoming AC line for low voltage or line power interruption.
F5	OverVoltage	①	DC bus voltage exceeded maximum value.	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option.
F6	Motor Stalled	①	Drive is unable to accelerate motor.	Increase P039 - A067 [Accel Time x] or reduce load so drive output current does not exceed the current set by parameter A089 [Current Limit 1].
F7	Motor Overload	①	Internal electronic overload trip.	1. An excessive motor load exists. Reduce load so drive output current does not exceed the current set by parameter P033 [Motor OL Current]. 2. Verify A084 [Boost Select] setting
F8	Heatsink OvrTmp	①	Heatsink temperature exceeds a predefined value.	1. Check for blocked or dirty heat sink fins. Verify that ambient temperature has not exceeded 40°C (104°F) for IP 30/NEMA 1/UL Type 1 installations or 50°C (122°F) for IP20/Open type installations. 2. Check fan.
F12	HW OverCurrent	②	The drive output current has exceeded the hardware current limit.	Check programming. Check for excess load, improper A084 [Boost Select] setting, DC brake volts set too high or other causes of excess current.
F13	Ground Fault	②	A current path to earth ground has been detected at one or more of the drive output terminals.	Check the motor and external wiring to the drive output terminals for a grounded condition.
F29	Analog Input Loss	①	An analog input is configured to fault on signal loss. A signal loss has occurred. Configure with A122 [Analog In Loss].	1. Check parameters. 2. Check for broken/loose connections at inputs.

(1) See page 4-1 for a description of fault types.

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No.	Fault	Type(1)	Description	Action
F33	Auto Rstrt Tries	②	Drive unsuccessfully attempted to reset a fault and resume running for the programmed number of A092 [Auto Rstrt Tries].	Correct the cause of the fault and manually clear.
F38	Phase U to Gnd	②	A phase to ground fault has been detected between the drive and motor in this phase.	1. Check the wiring between the drive and motor. 2. Check motor for grounded phase. 3. Replace drive if fault cannot be cleared.
F39	Phase V to Gnd			
F40	Phase W to Gnd			
F41	Phase UV Short	②	Excessive current has been detected between these two output terminals.	1. Check the motor and drive output terminal wiring for a shorted condition. 2. Replace drive if fault cannot be cleared.
F42	Phase UW Short			
F43	Phase VW Short			
F48	Params Defaulted		The drive was commanded to write default values to EEPROM.	1. Clear the fault or cycle power to the drive. 2. Program the drive parameters as needed.
F63	SW OverCurrent	①	Programmed A098 [SW Current Trip] has been exceeded.	Check load requirements and A098 [SW Current Trip] setting.
F64	Drive Overload	②	Drive rating of 150% for 1 minute or 200% for 3 seconds has been exceeded.	Reduce load or extend Accel Time.
F70	Power Unit	②	Failure has been detected in the drive power section.	1. Cycle power. 2. Replace drive if fault cannot be cleared.
F71	Net Loss		The communication network has faulted.	1. Cycle power. 2. Check communications cabling. 3. Check network adapter setting. 4. Check external network status.
F80	SVC Autotune		The autotune function was either cancelled by the user or failed.	Restart procedure.
F81	Comm Loss	②	RS485 (DSI) port stopped communicating.	1. If adapter was not intentionally disconnected, check wiring to the port. Replace wiring, port expander, adapters or complete drive as required. 2. Check connection. 3. An adapter was intentionally disconnected. 4. Turn off using A105 [Comm Loss Action]. 5. Connecting I/O Terminal 04 to ground may improve noise immunity.

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No.	Fault	Type[1]	Description	Action
F91	Encoder Loss		Requires differential encoder. One of the 2 encoder channel signals is missing.	1. Check Wiring. 2. If P038 [Speed Reference] = 9 "Positioning" and E216 [Motor Fdbk Type] = 5 "Quad Check" swap the Encoder channel inputs (see page 1-18) or swap any two motor leads. 3. Replace encoder.
F100	Parameter Checksum	②	The checksum read from the board does not match the checksum calculated.	Set P041 [Reset To Defalts] to option 1 "Reset Defaults".
F111	Enable Hardware		DriveGuard Safe-Off Option (Series B) board is installed and the ENBL enable jumper has not been removed.	1. Remove the ENBL enable jumper. 2. Cycle power.
			DriveGuard Safe-Off Option (Series B) board has failed.	1. Remove power to the drive. 2. Replace DriveGuard Safe-Off Option (Series B) board.
			Hardware Enable circuitry has failed.	Replace drive.
F122	I/O Board Fail	②	Failure has been detected in the drive control and I/O section.	1. Cycle power. 2. Replace drive if fault cannot be cleared.

(1) See page 4-1 for a description of fault types.

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Common Symptoms and Corrective Actions

Motor does not Start.

Cause(s)	Indication	Corrective Action
No output voltage to the motor.	None	Check the power circuit. • Check the supply voltage. • Check all fuses and disconnects. Check the motor. • Verify that the motor is connected properly. Check the control input signals. • Verify that a Start signal is present. If 2-Wire control is used, verify that either the Run Forward or Run Reverse signal is active, but not both. • Verify that I/O Terminal 01 is active. • Verify that P036 [Start Source] matches your configuration. • Verify that A095 [Reverse Disable] is not prohibiting movement. • If using the DriveGuard Safe-Off Option (Series B) board, verify that inputs are active.
Improper boost setting at initial start-up.	None	Set A084 [Boost Select] to option 2 “35.0, VT”.
Drive is Faulted	Flashing red status light	Clear fault. • Press and hold Up Arrow key for 3 seconds. • Cycle power • Set A100 [Fault Clear] to option 1 “Clear Faults”. • Cycle digital input if A051 - A054 [Digital Inx Sel] is set to option 7 “Clear Fault”.

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Drive does not Start from Start or Run Inputs wired to the terminal block.

Cause(s)	Indication	Corrective Action
Drive is Faulted	Flashing red status light	Clear fault. • Press and hold Up Arrow key for 3 seconds. • Cycle power • Set A100 [Fault Clear] to option 1 “Clear Faults”. • Cycle digital input if A051 - A054 [Digital Inx Sel] is set to option 7 “Clear Fault”.
Incorrect programming. • P036 [Start Source] is set to option 5 “Comm Port”.	None	Check parameter settings.
Incorrect input wiring. See 1-22 for wiring examples. • 2 wire control requires Run Forward, Run Reverse or Jog input. • 3 wire control requires Start and Stop inputs • Stop input is always required.	None	Wire inputs correctly and/or install jumper. If using the DriveGuard Safe-Off Option (Series B) board, verify that inputs are active.
Incorrect Sink/Source DIP Switch setting.	None	Set switch to match wiring scheme.

Drive does not respond to changes in speed command.

Cause(s)	Indication	Corrective Action
No value is coming from the source of the command.	The drive “Run” indicator is lit and output is 0 Hz.	• Check b012 [Control Source] for correct source. • If the source is an analog input, check wiring and use a meter to check for presence of signal. • Check b002 [Commanded Freq] to verify correct command.
Incorrect reference source is being selected via remote device or digital inputs.	None	• Check b012 [Control Source] for correct source. • Check b014 [Dig In Status] to see if inputs are selecting an alternate source. Verify settings for A051 - A054 [Digital Inx Sel]. • Check P038 [Speed Reference] for the source of the speed reference. Reprogram as necessary. • Review the Speed Reference Control chart on page 1-27.

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Motor and/or drive will not accelerate to commanded speed.

Cause(s)	Indication	Corrective Action
Acceleration time is excessive.	None	Reprogram P039 [Accel Time 1] or A067 [Accel Time 2].
Excess load or short acceleration times force the drive into current limit, slowing or stopping acceleration.	None	Compare b003 [Output Current] with A089 [Current Limit 1]. Remove excess load or reprogram P039 [Accel Time 1] or A067 [Accel Time 2]. Check for improper A084 [Boost Select] setting.
Speed command source or value is not as expected.	None	Verify b002 [Commanded Freq]. Check b012 [Control Source] for the proper Speed Command.
Programming is preventing the drive output from exceeding limiting values.	None	Check P035 [Maximum Freq] to insure that speed is not limited by programming. Verify programming of E215 [Speed Ratio].
Torque performance does not match motor characteristics.	None	Set motor nameplate full load amps in parameter A126 [Motor NP FLA]. Perform A127 [Autotune] “Static Tune” or “Rotate Tune” procedure. Set A125 [Torque Perf Mode] to option 0 “V/Hz”.

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Motor operation is unstable.

Cause(s)	Indication	Corrective Action
Motor data was incorrectly entered.	None	1. Correctly enter motor nameplate data into P031, P032 and P033. 2. Enable A097 [Compensation]. 3. Use A084 [Boost Select] to reduce boost level.

Drive will not reverse motor direction.

Cause(s)	Indication	Corrective Action
Digital input is not selected for reversing control.	None	Check [Digital Inx Sel] (See page 3-15). Choose correct input and program for reversing mode.
Digital input is incorrectly wired.	None	Check input wiring. (See page 1-17)
Motor wiring is improperly phased for reverse.	None	Switch two motor leads.
Reverse is disabled.	None	Check A095 [Reverse Disable].

Drive does not power up.

Cause(s)	Indication	Corrective Action
No input power to drive.	None	Check the power circuit. • Check the supply voltage. • Check all fuses and disconnects.
Jumper between I/O Terminals P2 and P1 not installed and/or DC Bus Inductor not connected.	None	Install jumper or connect DC Bus Inductor.

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Supplemental Drive Information

For information on...	See page...
Drive, Fuse & Circuit Breaker Ratings	A-1
Specifications	A-2

Drive, Fuse & Circuit Breaker Ratings

The tables on the following pages provide drive ratings and recommended AC line input fuse and circuit breaker information. Both types of short circuit protection are acceptable for UL and IEC requirements. Sizes listed are the recommended sizes based on 40 degree C and the U.S. N.E.C. Other country, state or local codes may require different ratings.

Fusing

If fuses are chosen as the desired protection method, refer to the recommended types listed below. If available amp ratings do not match the tables provided, the closest fuse rating that exceeds the drive rating should be chosen.

- IEC – BS88 (British Standard) Parts 1 & 2 [1], EN60269-1, Parts 1 & 2, type gG or equivalent should be used.
- UL – UL Class CC, T or J must be used. [2]

Circuit Breakers

Refer to listings in the following tables for recommended circuit breakers (inverse time or instantaneous trip) and 140M Self-Protecting Motor Starters.

[1] Typical designations include, but may not be limited to the following; Parts 1 & 2: AC, AD, BC, BD, CD, DD, ED, EFS, EF, FF, FG, GF, GG, GH.

[2] Typical designations include; Type CC - KTK-R, FNQ-R
Type J - JKS, LPJ
Type T - JJS, JJN

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Specifications

Table A.A Drive Ratings

Catalog Number(1)	Output Ratings		Input Ratings			Branch Circuit Protection		
	kW (HP)	*Amps*	*Voltage Range*	*kVA*	*Amps*	*Fuses*	*140M Motor Protectors*	*Contactors*
200 - 240V AC (±10%) – 3-Phase Input, 0 - 230V 3-Phase Output								
22D-B2P3	0.4 (0.5)	2.3	180-264	1.15	2.5	6	140M-C2E-B40	100-C07
22D-B5P0	0.75 (1.0)	5.0	180-264	2.45	5.7	10	140M-C2E-C10	100-C09
22D-B8P0	1.5 (2.0)	8.0	180-264	4.0	9.5	15	140M-C2E-C16	100-C12
22D-B012	2.2 (3.0)	12.0	180-264	5.5	15.5	25	140M-C2E-C16	100-C23
22D-B017	3.7 (5.0)	17.5	180-264	8.6	21.0	30	140M-F8E-C25	100-C23
22D-B024	5.5 (7.5)	24.0	180-264	11.8	26.1	40	140M-F8E-C32	100-C37
22D-B033	7.5 (10.0)	33.0	180-264	16.3	34.6	60	140M-G8E-C45	100-C60
380 - 480V AC (±10%) – 3-Phase Input, 0 - 460V 3-Phase Output								
22D-D1P4	0.4 (0.5)	1.4	342-528	1.4	1.8	3	140M-C2E-B25	100-C07
22D-D2P3	0.75 (1.0)	2.3	342-528	2.3	3.2	6	140M-C2E-B40	100-C07
22D-D4P0	1.5 (2.0)	4.0	342-528	4.0	5.7	10	140M-C2E-B63	100-C09
22D-D6P0	2.2 (3.0)	6.0	342-528	5.9	7.5	15	140M-C2E-C10	100-C09
22D-D010	4.0 (5.0)	10.5	342-528	10.3	13.0	20	140M-C2E-C16	100-C23
22D-D012	5.5 (7.5)	12.0	342-528	11.8	14.2	25	140M-D8E-C20	100-C23
22D-D017	7.5 (10.0)	17.0	342-528	16.8	18.4	30	140M-D8E-C20	100-C23
22D-D024	11.0 (15.0)	24.0	342-528	23.4	26.0	50	140M-F8E-C32	100-C43
460 - 600V AC (±10%) – 3-Phase Input, 0 - 575V 3-Phase Output								
22D-E1P7	0.75 (1.0)	1.7	414-660	2.1	2.3	6	140M-C2E-B25	100-C09
22D-E3P0	1.5 (2.0)	3.0	414-660	3.65	3.8	6	140M-C2E-B40	100-C09
22D-E4P2	2.2 (3.0)	4.2	414-660	5.2	5.3	10	140M-C2E-B63	100-C09
22D-E6P6	4.0 (5.0)	6.6	414-660	8.1	8.3	15	140M-C2E-C10	100-C09
22D-E9P9	5.5 (7.5)	9.9	414-660	12.1	11.2	20	140M-C2E-C16	100-C16
22D-E012	7.5 (10.0)	12.2	414-660	14.9	13.7	25	140M-C2E-C16	100-C23
22D-E019	11.0 (15.0)	19.0	414-660	23.1	24.1	40	140M-D8E-C25	100-C30

(1) Ratings apply to all drive types; Panel Mount (N104), Flange Mount (F104), and Plate Drive (H204).

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Table A.B Specifications

Category	Specification	
Agency Certification		Listed to UL508C and CAN/CSA-22.2
		Certified to AS/NZS, 1997 Group 1, Class A
		Marked for all applicable European Directives EMC Directive (89/336) EN 61800-3, EN 50081-1, EN 50082-2 Low Voltage Directive (73/23/EEC) EN 50178, EN 60204
		Certified to EN 954-1, Category 3. Meets Functional Safety (FS) when used with the DriveGuard Safe-Off Option (Series B).
	The drive is also designed to meet the appropriate portions of the following specifications: NFPA 70 - US National Electrical Code NEMA ICS 3.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems. IEC 146 - International Electrical Code.	
Protection	Bus Overvoltage Trip 200-240V AC Input: 380-460V AC Input: 460-600V AC Input:	 405V DC bus (equivalent to 290V AC incoming line) 810V DC bus (equivalent to 575V AC incoming line) 1005V DC bus (equivalent to 711V AC incoming line)
	Bus Undervoltage Trip 200-240V AC Input: 380-480V AC Input: 460-600V AC Input P042 = 3 “High Voltage”: P042 = 2 “Low Voltage”:	 210V DC bus (equivalent to 150V AC incoming line) 390V DC bus (equivalent to 275V AC incoming line) 487V DC bus (equivalent to 344V AC incoming line) 390V DC bus (equivalent to 275V AC incoming line)
	Power Ride-Thru:	100 milliseconds
	Logic Control Ride-Thru:	0.5 seconds minimum, 2 seconds typical
	Electronic Motor Overload Protection:	I^2t protection - 150% for 60 seconds, 200% for 3 seconds (Provides Class 10 protection)
	Overcurrent:	200% hardware limit, 300% instantaneous fault
	Ground Fault Trip:	Phase-to-ground on drive output
	Short Circuit Trip:	Phase-to-phase on drive output
Environment	Altitude:	1000 m (3300 ft) max. without derating. Above 1000 m (3300 ft) derate 3% for every 305 m (1000 ft).
	Maximum Surrounding Air Temperature without derating: IP20, Open Type: IP30, NEMA Type 1, UL Type 1: Flange and Plate Mount:	 –10 to 50° C (14 to 122° F) –10 to 40° C (14 to 104° F) Heatsink: –10 to 40° C (14 to 104° F) Drive: –10 to 50° C (14 to 122° F)
	Cooling Method Convection: Fan:	 0.4 kW (0.5 HP) drives and all Flange and Plate drives All other drive ratings
	Storage Temperature:	–40 to 85 degrees C (–40 to 185 degrees F)
	Atmosphere:	**Important:** Drive **must not** be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.
	Relative Humidity:	0 to 95% non-condensing
	Shock (operating):	15G peak for 11ms duration (±1.0 ms)
	Vibration (operating):	1G peak, 5 to 2000 Hz

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Category	Specification		
Electrical	Voltage Tolerance:		200-240V ±10% 380-480V ±10% 460-600V ±10%
	Frequency Tolerance:		48-63 Hz
	Input Phases:		Three-phase input provides full rating. Single-phase operation provides 35% rated current.
	Displacement Power Factor:		0.98 across entire speed range
	Maximum Short Circuit Rating:		100,000 Amps Symmetrical
	Actual Short Circuit Rating:		Determined by AIC Rating of installed fuse/circuit breaker
	Transistor Type:		Isolated Gate Bipolar (IGBT)
Control	Method:		Sinusoidal PWM, Volts/Hertz, and Sensorless Vector
	Carrier Frequency		2-16 kHz, Drive rating based on 4 kHz.
	Frequency Accuracy Digital Input: Analog Input: Analog Output:		 Within ±0.05% of set output frequency Within 0.5% of maximum output frequency, 10-Bit resolution ±2% of full scale, 10-Bit resolution
	Speed Regulation Open Loop with Slip Compensation: With Encoder:		 ±1% of base speed across a 80:1 speed range ±0.3% of base speed across a 80:1 speed range ±0.05% of base speed across a 20:1 speed range
	Output Frequency:		0-500 Hz (programmable)
	Efficiency:		97.5% (typical)
	Stop Modes:		Multiple programmable stop modes including - Ramp, Coast, DC-Brake, and Ramp-to-Stop
	Accel/Decel:		Four independently programmable accel and decel times. Each time may be programmed from 0 - 600 seconds in 0.1 second increments.
	Intermittent Overload:		150% Overload capability for up to 1 minute 200% Overload capability for up to 3 seconds
	Electronic Motor Overload Protection		Class 10 protection with selectable speed sensitive response and power-down overload retention function when enabled.
Control Inputs	Digital:	Bandwidth:	10 Rad/Secs for open and closed loop
		Quantity:	(2) Dedicated for start and stop (5) Programmable
		Current:	6 mA
		Type Source Mode (SRC): Sink Mode (SNK):	 18-24V = ON, 0-6V = OFF 0-6V = ON, 18-24V = OFF
	Analog:	Quantity:	(2) Isolated, –10 to 10V and 4-20mA
		Specification Resolution: 0 to 10V DC Analog: 4-20mA Analog: External Pot:	 10-bit 100k ohm input impedance 250 ohm input impedance 1-10k ohm, 2 Watt minimum
Encoder	Type:		Incremental, dual channel
	Supply:		12V, 250 mA. 12V, 10 mA minimum inputs isolated with differential transmitter, 250 kHz maximum.
	Quadrature:		90°, ±27 degrees at 25 degrees C.
	Duty Cycle:		50%, +10%
	Requirements:		Encoders must be line driver type, quadrature (dual channel) or pulse (single channel), 3.5-26V DC output, single-ended or differential and capable of supplying a minimum of 10 mA per channel. Allowable input is DC up to a maximum frequency of 250 kHz. The encoder I/O automatically scales to allow 5V, 12V and 24V DC nominal voltages.

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Category	Specification		
Control Outputs	Relay:	Quantity:	(1) Programmable Form C
		Specification Resistive Rating: Inductive Rating:	 3.0A at 30V DC, 3.0A at 125V, 3.0A at 240V AC 0.5A at 30V DC, 0.5A at 125V, 0.5A at 240V AC
	Opto:	Quantity:	(2) Programmable
		Specification:	30V DC, 50mA Non-inductive
	Analog:	Quantity:	(1) Non-Isolated 0-10V or 4-20mA
		Specification Resolution: 0 to 10V DC Analog: 4-20mA Analog:	 10-bit 1k ohm minimum 525 ohm maximum

Table A.C PowerFlex 40P Estimated Watts Loss (Rated Load, Speed & PWM)

Voltage	kW (HP)	External Watts	Internal Watts	Total Watts Loss
200–240V	0.4 (0.5)	22	18	40
	0.75 (1.0)	40	20	60
	1.1 (2.0)	63	22	85
	2.2 (3.0)	100	25	125
	3.7 (5.0)	150	30	180
	5.5 (7.5)	200	35	235
	7.5 (10)	265	40	305
380–480V	0.4 (0.5)	17	18	35
	0.75 (1.0)	30	20	50
	1.1 (2.0)	48	22	70
	2.2 (3.0)	75	25	100
	3.7 (5.0)	135	25	160
	5.5 (7.5)	140	35	175
	7.5 (10)	175	35	210
	11 (15)	260	40	300
460–600V	0.75 (1.0)	30	20	50
	1.5 (2.0)	48	22	70
	2.2 (3.0)	75	25	100
	4.0 (5.0)	135	25	160
	5.5 (7.5)	140	35	175
	7.5 (10)	175	35	210
	11 (15)	260	40	300

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Notes:

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Accessories and Dimensions

Product Selection

Table B.A Catalog Number Description

22D	-	B	2P3	N	1	0	4
Drive		Voltage Rating	Rating	Enclosure	HIM	Emission Class	Version

Table B.B PowerFlex 40P Drives

Drive Ratings				IP20/NEMA Type Open		IP20 Flange Mount[1]	Plate Drive
Input Voltage	kW	HP	Output Current	Catalog Number	Frame Size	Catalog Number	Catalog Number
240V 50/60 Hz 3-Phase No Filter	0.4	0.5	2.3A	22D-B2P3N104	B	22D-B2P3F104	22D-B2P3H204
	0.75	1.0	5.0A	22D-B5P0N104	B	22D-B5P0F104	22D-B5P0H204
	1.5	2.0	8.0A	22D-B8P0N104	B	22D-B8P0F104	22D-B8P0H204
	2.2	3.0	12.0A	22D-B012N104	B	22D-B012F104	22D-B012H204
	3.7	5.0	17.5A	22D-B017N104	B	22D-B017F104	22D-B017H204
	5.5	7.5	24.0A	22D-B024N104	C	22D-B024F104	22D-B024H204
	7.5	10.0	33.0A	22D-B033N104	C	22D-B033F104	22D-B033H204
480V 50/60 Hz 3-Phase No Filter	0.4	0.5	1.4A	22D-D1P4N104	B	22D-D1P4F104	22D-D1P4H204
	0.75	1.0	2.3A	22D-D2P3N104	B	22D-D2P3F104	22D-D2P3H204
	1.5	2.0	4.0A	22D-D4P0N104	B	22D-D4P0F104	22D-D4P0H204
	2.2	3.0	6.0A	22D-D6P0N104	B	22D-D6P0F104	22D-D6P0H204
	4.0	5.0	10.5A	22D-D010N104	B	22D-D010F104	22D-D010H204
	5.5	7.5	12.0A	22D-D012N104	C	22D-D012F104	22D-D012H204
	7.5	10.0	17.0A	22D-D017N104	C	22D-D017F104	22D-D017H204
	11.0	15.0	24.0A	22D-D024N104	C	22D-D024F104 [2]	22D-D024H204 [2]
600V 50/60 Hz 3-Phase No Filter	0.75	1.0	1.7A	22D-E1P7N104	B	22D-E1P7F104	22D-E1P7H204
	1.5	2.0	3.0A	22D-E3P0N104	B	22D-E3P0F104	22D-E3P0H204
	2.2	3.0	4.2A	22D-E4P2N104	B	22D-E4P2F104	22D-E4P2H204
	4.0	5.0	6.6A	22D-E6P6N104	B	22D-E6P6F104	22D-E6P6H204
	5.5	7.5	9.9A	22D-E9P9N104	C	22D-E9P9F104	22D-E9P9H204
	7.5	10.0	12.0A	22D-E012N104	C	22D-E012F104	22D-E012H204
	11.0	15.0	19.0A	22D-E019N104	C	22D-E019F104	22D-E019H204

(1) Meets IP40/54/65 (NEMA 1/12/4/4X) when installed in an enclosure of like rating.

(2) Requires use of external DC Bus Inductor or AC Line Reactor. See Table B.E for details.

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Table B.C Dynamic Brake Modules

Drive Ratings				
Input Voltage	**kW**	**HP**	**Minimum Resistance Ω**	**Catalog Number(1) (2)**
240V 50/60 Hz 3-Phase	0.4	0.5	48	AK-R2-091P500
	0.75	1.0	48	AK-R2-091P500
	1.5	2.0	48	AK-R2-091P500
	2.2	3.0	32	AK-R2-047P500
	3.7	5.0	19	AK-R2-047P500
	5.5	7.5	13	AK-R2-030P1K2
	7.5	10.0	10	AK-R2-030P1K2
480V 50/60 Hz 3-Phase	0.4	0.5	97	AK-R2-360P500
	0.75	1.0	97	AK-R2-360P500
	1.5	2.0	97	AK-R2-360P500
	2.2	3.0	97	AK-R2-120P1K2
	4.0	5.0	77	AK-R2-120P1K2
	5.5	7.5	55	AK-R2-120P1K2
	7.5	10.0	39	AK-R2-120P1K2
	11.0	15.0	24	AK-R2-120P1K2 (3)
600V 50/60 Hz 3-Phase	0.75	1.0	120	AK-R2-360P500
	1.5	2.0	120	AK-R2-360P500
	2.2	3.0	82	AK-R2-120P1K2
	4.0	5.0	82	AK-R2-120P1K2
	5.5	7.5	51	AK-R2-120P1K2
	7.5	10.0	51	AK-R2-120P1K2
	11.0	15.0	51	AK-R2-120P1K2 (3)

(1) The resistors listed in this tables are rated for 5% duty cycle.

(2) Use of Rockwell resistors is always recommended. The resistors listed have been carefully selected for optimizing performance in a variety of applications. Alternative resistors may be used, however care must be taken when making a selection. Refer to the P*owerFlex Dynamic Braking Resistor Calculator*, publication PFLEX-AT001.

(3) Requires two resistors wired in parallel.

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Table B.D Bulletin 1321-3R Series Line Reactors

Input Voltage	kW	HP	Fundamental Amps	Maximum Continuous Amps	Inductance mh	Watts Loss	Catalog Number (1)
240V 50/60 Hz 3-Phase	0.4	0.5	4	6	12.0	21 W	1321-3R4-D
	0.75	1.0	8	12	3.0	29 W	1321-3R8-B
	1.5	2.0	8	12	1.5	19.5 W	1321-3R8-A
	2.2	3.0	12	18	1.25	26 W	1321-3R12-A
	3.7	5.0	18	27	0.8	36 W	1321-3R18-A
	5.5	7.5	25	37.5	0.5	48 W	1321-3R25-A
	7.5	10.0	35	52.5	0.4	49 W	1321-3R35-A
480V 50/60 Hz 3-Phase	0.4	0.5	2	3	20.0	11.3 W	1321-3R2-B
	0.75	1.0	4	6	9.0	20 W	1321-3R4-C
	1.5	2.0	4	6	6.5	20 W	1321-3R4-B
	2.2	3.0	8	12	5.0	25.3 W	1321-3R8-C
	4.0	5.0	12	18	2.5	31 W	1321-3R12-B
	5.5	7.5	12	18	2.5	31 W	1321-3R12-B
	7.5	10.0	18	27	1.5	43 W	1321-3R18-B
	11.0	15.0	25	37.5	1.2	52 W	1321-3R25-B
600V 50/60 Hz 3-Phase	0.75	1.0	2	3	20.0	11.3 W	1321-3R2-B
	1.5	2.0	4	6	6.5	20 W	1321-3R4-B
	2.2	3.0	4	6	6.5	20 W	1321-3R4-B
	4.0	5.0	8	12	5.0	25.3 W	1321-3R8-C
	5.5	7.5	12	18	2.5	31 W	1321-3R12-B
	7.5	10.0	12	18	2.5	31 W	1321-3R12-B
	11.0	15.0	18	27	1.5	43 W	1321-3R18-B

(1) Catalog numbers listed are for 3% impedance open style units. NEMA Type 1 and 5% impedance reactor types are also available. Refer to publication 1321-TD001….

Table B.E DC Bus Inductors

Input Voltage	kW	HP	Amps	Inductance mh	Catalog Number
240V 50/60 Hz 3-Phase	5.5	7.5	32	0.85	1321-DC32-1
	7.5	10.0	40	0.5	1321-DC40-2
480V 50/60 Hz 3-Phase	5.5	7.5	18	3.75	1321-DC18-4
	7.5	10.0	25	4.0	1321-DC25-4
	11.0	15.0	32	2.68	1321-DC32-3
600V 50/60 Hz 3-Phase	5.5	7.5	12	6.0	1321-DC12-2
	7.5	10.0	18	6.0	1321-DC18-4
	11.0	15.0	25	4.0	1321-DC25-4

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Table B.F EMC Line Filters

Drive Ratings			S Type Filter Catalog Number (1)	L Type Filter Catalog Number (2)
Input Voltage	kW	HP		
240V 50/60 Hz 3-Phase	0.4	0.5	22-RF021-BS	22-RF021-BL(3)
	0.75	1.0	22-RF021-BS	22-RF021-BL(3)
	1.5	2.0	22-RF021-BS	22-RF021-BL(3)
	2.2	3.0	22-RF021-BS	22-RF021-BL(3)
	3.7	5.0	22-RF021-BS	22-RF021-BL(3)
	5.5	7.5	22-RF034-CS	22-RF034-CL
	7.5	10.0	22-RF034-CS	22-RF034-CL
480V 50/60 Hz 3-Phase	0.4	0.5	22-RF012-BS	22-RF012-BL
	0.75	1.0	22-RF012-BS	22-RF012-BL
	1.5	2.0	22-RF012-BS	22-RF012-BL
	2.2	3.0	22-RF012-BS	22-RF012-BL
	4.0	5.0	22-RF012-BS	22-RF012-BL
	5.5	7.5	22-RF018-CS(3)	22-RF018-CL
	7.5	10.0	22-RF018-CS(3)	22-RF018-CL
	11.0	15.0	22-RF026-CS(3)	22-RF026-CL
600V 50/60 Hz 3-Phase	0.75	1.0	–	22-RF8P0-BL
	1.5	2.0	–	22-RF8P0-BL
	2.2	3.0	–	22-RF8P0-BL
	4.0	5.0	–	22-RF8P0-BL
	5.5	7.5	–	22-RF015-CL
	7.5	10.0	–	22-RF015-CL
	11.0	15.0	–	22-RF024-CL

(1) This filter is suitable for use with a cable length of at least 10 meters (33 feet) for Class A and 1 meter for Class B environments.

(2) This filter is suitable for use with a cable length of at least 100 meters for Class A and 5 meters for Class B environments.

(3) Filter must be Series C or later.

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Table B.G Human Interface Module (HIM) Option Kits and Accessories

Item	Description	Catalog Number
LCD Display, Remote Panel Mount	Digital speed control CopyCat capable IP66 (NEMA Type 4X/12) indoor use only Includes 2.9 meter cable	22-HIM-C2S
LCD Display, Remote Handheld	Digital speed control Full numeric keypad CopyCat capable IP30 (NEMA Type 1) Includes 1.0 meter cable Panel mount with optional Bezel Kit	22-HIM-A3
Bezel Kit	Panel mount for LCD Display, Remote Handheld unit, IP30 (NEMA Type 1)	22-HIM-B1
DSI HIM Cable (DSI HIM to RJ45 cable)	1.0 Meter (3.3 Feet) 2.9 Meter (9.51 Feet)	22-HIM-H10 22-HIM-H30

Table B.H IP30/NEMA 1/UL Type 1 Kit

Item	Description	Drive Frame	Catalog Number
IP30/NEMA 1/UL Type 1 Kit	Field installed kit. Converts drive to IP30/ NEMA 1/UL Type 1 enclosure. Includes conduit box with mounting screws and plastic top panel.	B	22-JBAB
		C	22-JBAC
IP30/NEMA 1/UL Type 1 Kit for Communication Option	Field installed kit. Converts drive to IP30/ NEMA 1/UL Type 1 enclosure. Includes communication option conduit box with mounting screws and plastic top panel.	B	22-JBCB
		C	22-JBCC

Table B.I Other Options

Item	Description	Catalog Number
DriveGuard® Safe-Off Option Board	When used with suitable safety components, provides protection according to EN 954-1:1997; Category 3 for safe off and protection against restart.	20A-DG01

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Table B.J Communication Option Kits and Accessories

Item	Description	Catalog Number
Communication Adapters	Embedded communication options for use with the PowerFlex 4-Class drives. Requires a Communication Adapter Cover (Ordered Separately). ControlNet™ DeviceNet™ EtherNet/IP™ LonWorks™ PROFIBUS™ DP	 22-COMM-C 22-COMM-D 22-COMM-E 22-COMM-L 22-COMM-P
External DSI™ Communications Kit	External mounting kit for 22-COMM cards.	22-XCOMM-DC-BASE
External Comms Power Supply	Optional 100-240V AC Power Supply for External DSI Communications Kit.	20-XCOMM-AC-PS1
Compact I/O Module	Three channel.	1769-SM2
Communication Adapter Cover	Cover that houses the Communication Adapter. B Frame Drive C Frame Drive	 22D-CCB 22D-CCC
Universal Serial Bus™ (USB) Converter Module	Provides serial communication via DF1 protocol for use with DriveExplorer and DriveTools SP software. Includes: 2m USB cable (1) 20-HIM-H10 cable (1) 22-HIM-H10 cable (1)	1203-USB
Serial Converter Module (RS485 to RS232)	Provides serial communication via DF1 protocol for use with DriveExplorer and DriveTools SP software. Includes: DSI to RS232 serial converter (1) 1203-SFC serial cable (1) 22-RJ45CBL-C20 cable (1) DriveExplorer Lite CD (1)	22-SCM-232
Remote Handheld HIM	Wireless Interface Module with *Bluetooth®* technology, IP30 (NEMA Type 1), Panel Mount with optional bezel kit.	22-WIM-N1
Remote Panel Mount HIM	Wireless Interface Module with *Bluetooth®* technology, IP66 (NEMA Type 4X/12) indoor use only.	22-WIM-N4S
DSI Cable	2.0 meter RJ45 to RJ45 cable, male to male connectors.	22-RJ45CBL-C20
Serial Cable	2.0 meter serial cable with a locking low profile connector to connect to the serial converter and a 9-pin sub-miniature D female connector to connect to a computer.	1203-SFC
Null Cable Converter	For use when connecting the serial converter to DriveExplorer on a handheld PC.	1203-SNM
Splitter Cable	RJ45 one to two port splitter cable	AK-U0-RJ45-SC1
Terminating Resistors	RJ45 120 Ohm resistors (2 pieces)	AK-U0-RJ45-TR1
Terminal Block	RJ45 Two position terminal block (5 pieces)	AK-U0-RJ45-TB2P
DriveTools SP Software	Windows based software packages that provide an intuitive means for monitoring or configuring Allen-Bradley drives and communication adapters online. Compatibility: Windows 95, 98, ME, NT 4.0 (Service Pack 3 or later), 2000, XP and CE[1]	9303-4DTS01ENE
DriveExplorer Software (CD-ROM) Version 3.01 or later		9306-4EXP01ENE
DriveExecutive software (CD-ROM) Version 1.01 or later		9303-4DTE01ENE

(1) See www.ab.com/drives/driveexplorer.htm for supported devices.

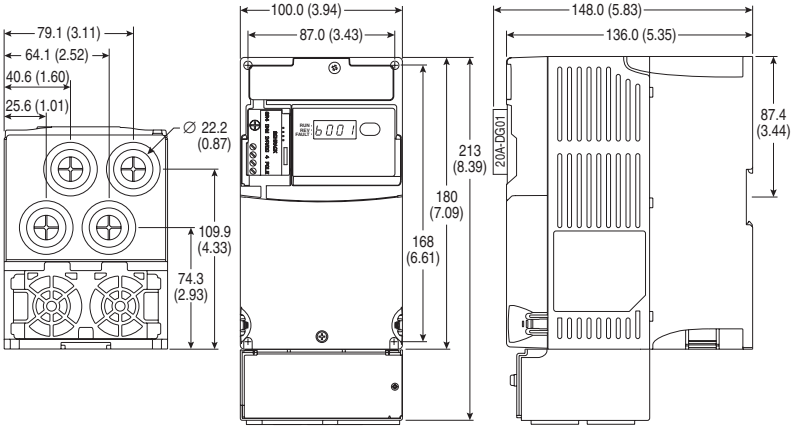
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Product Dimensions

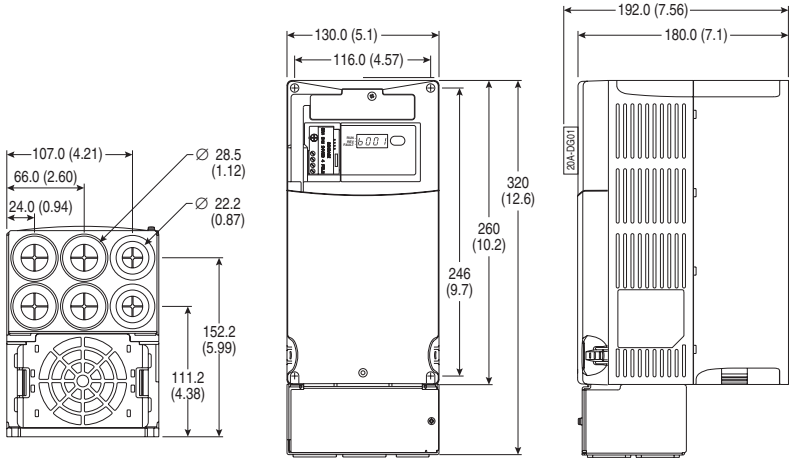
Table B.K PowerFlex 40P Frames – Ratings are in kW and (HP)

Frame	240V AC – 3-Phase		480V AC – 3-Phase		600V AC – 3-Phase	
B	0.4 (0.5) 0.75 (1.0) 1.5 (2.0)	2.2 (3.0) 3.7 (5.0)	0.4 (0.5) 0.75 (1.0) 1.5 (2.0)	2.2 (3.0) 4.0 (5.0)	0.75 (1.0) 1.5 (2.0)	2.2 (3.0) 4.0 (5.0)
C	5.5 (7.5) 7.5 (10.0)		5.5 (7.5) 7.5 (10.0)	11.0 (15.0)	5.5 (7.5) 7.5 (10.0)	11.0 (15.0)

Figure B.1 IP 30/NEMA 1/UL Type 1 Option Kit without Communication Option – Dimensions are in millimeters and (inches)



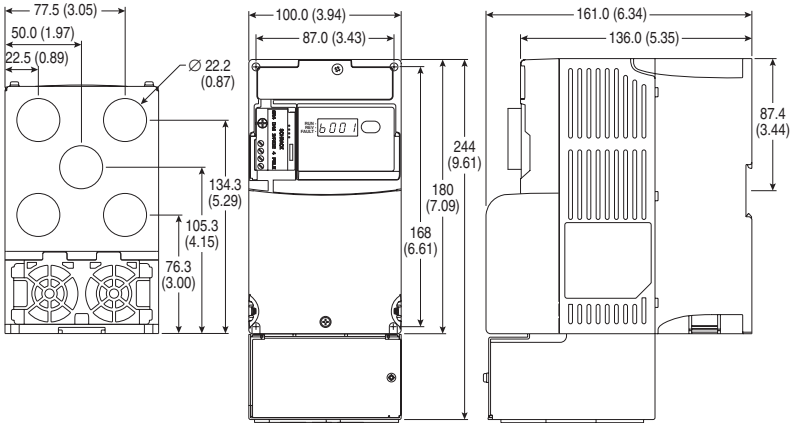
Frame B - 22-JBAB



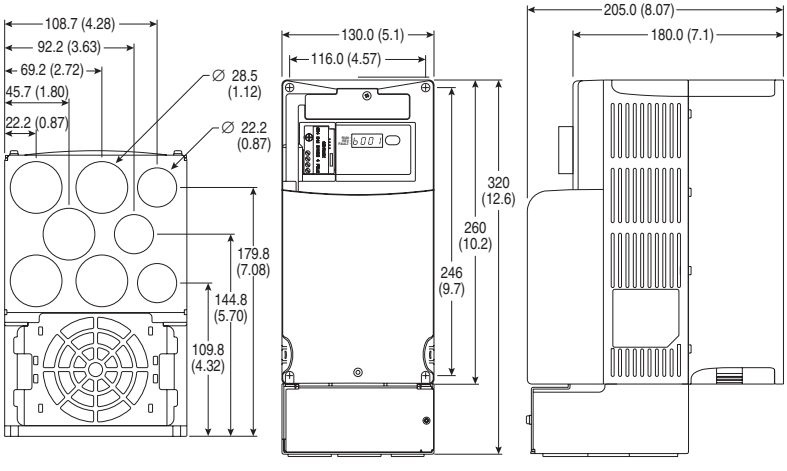
Frame C - 22-JBAC

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Figure B.2 IP 30/NEMA 1/UL Type 1 Option Kit with Communication Option – Dimensions are in millimeters and (inches)



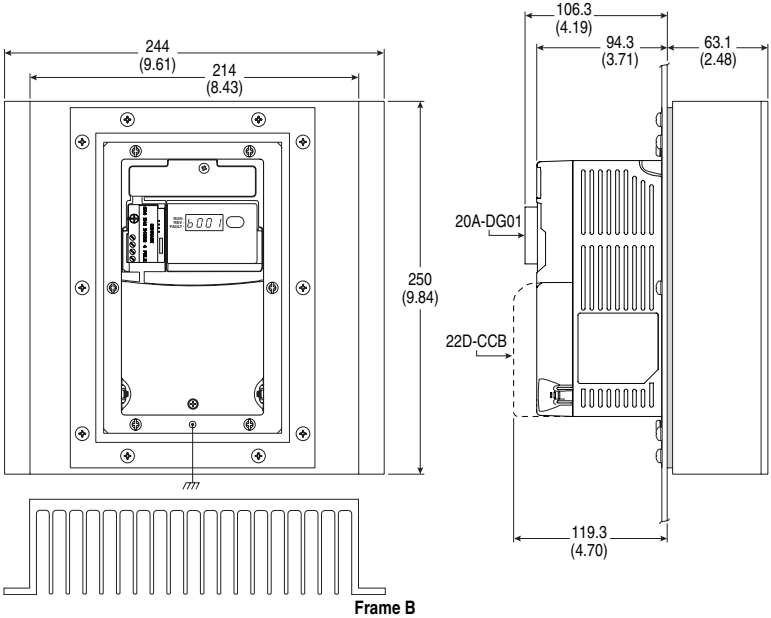
Frame B - 22-JBCB



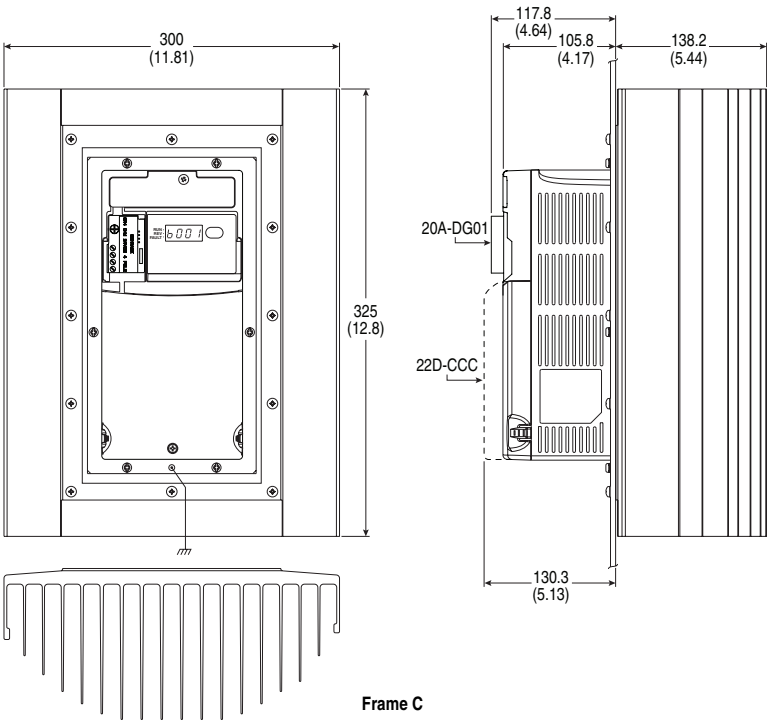
Frame C - 22-JBCC

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Figure B.3 PowerFlex 40P Flange Mount Drives – Dimensions are in millimeters and (inches)



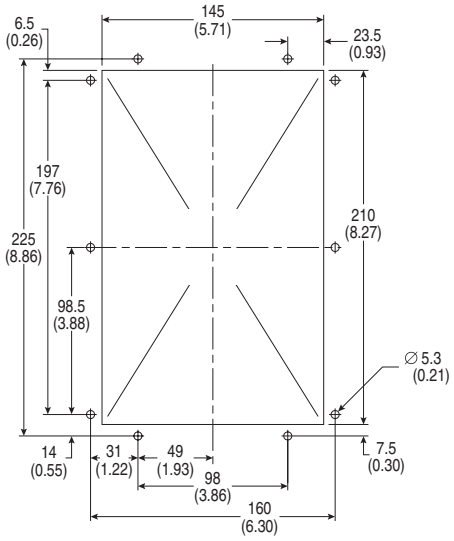
Frame B



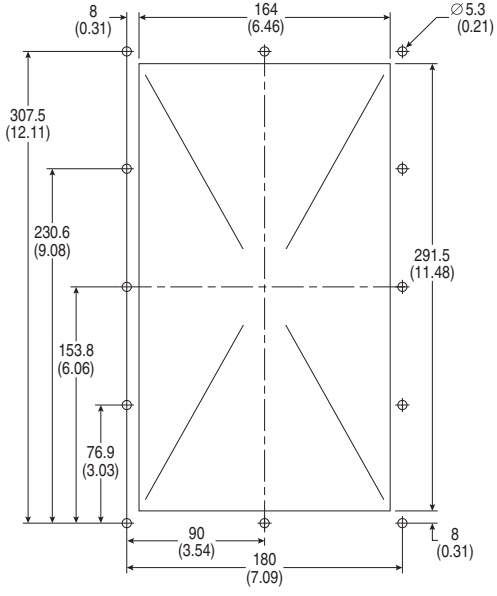
Frame C

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Figure B.4 PowerFlex 40P Flange Mount Cutout Dimensions – Dimensions are in millimeters and (inches)



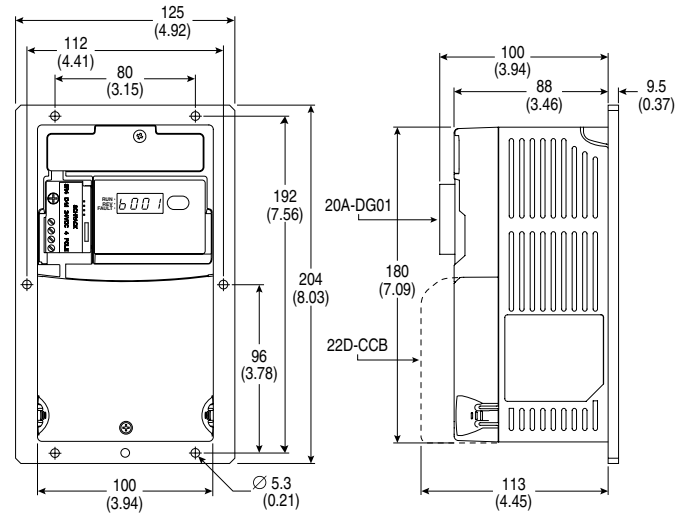
Frame B



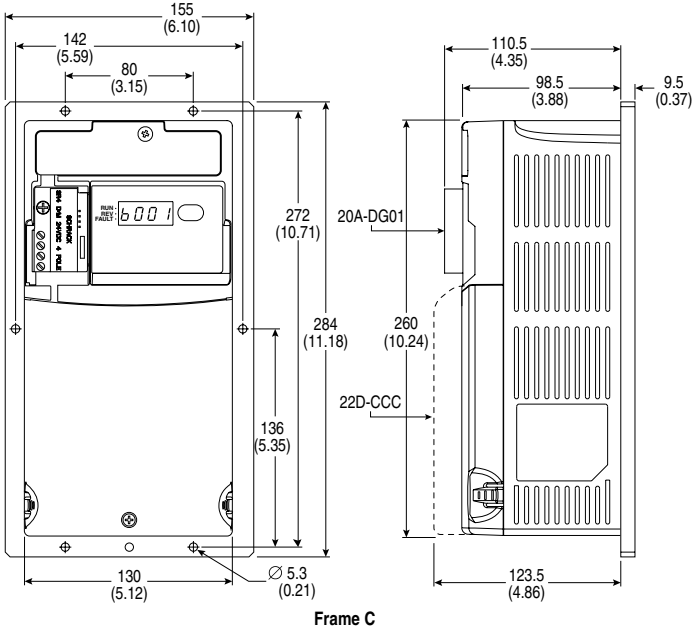
Frame C

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Figure B.5 PowerFlex 40P Plate Drive Dimensions – Dimensions are in millimeters and (inches)



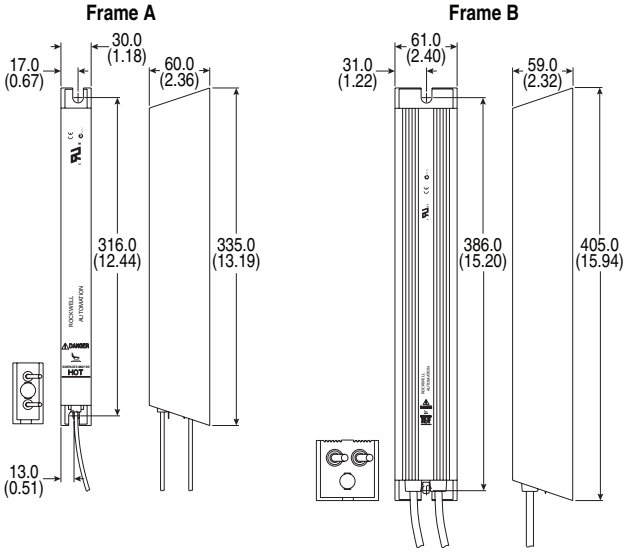
Frame B



Frame C

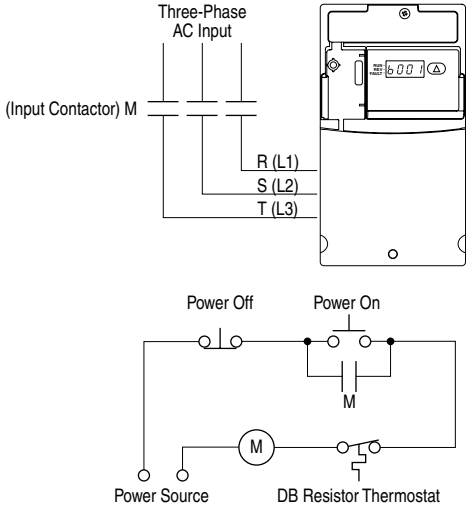
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Figure B.6 Dynamic Brake Modules – Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).



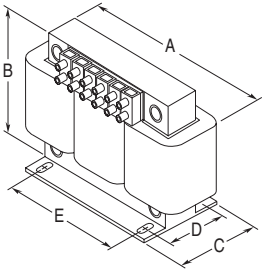
Frame	Catalog Number	Weight
A	AK-R2-091P500, AK-R2-047P500, AK-R2-360P500	1.1 (2.5)
B	AK-R2-030P1K2, AK-R2-120P1K2	2.7 (6)

Figure B.7 Recommended External Brake Resistor Circuitry



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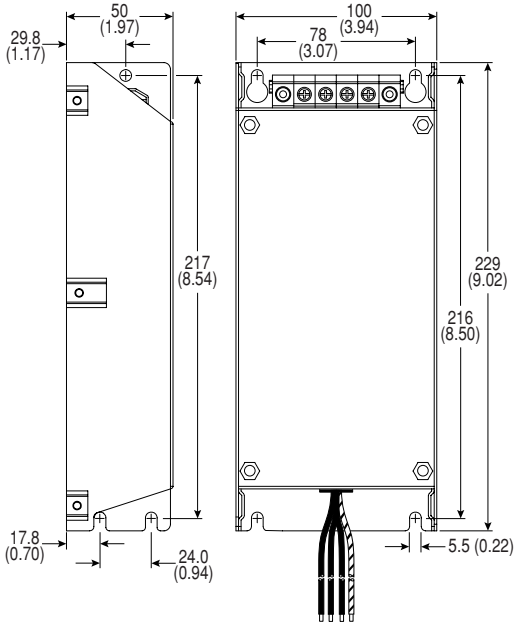
Figure B.8 Bulletin 1321-3R Series Line Reactors – Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).



Catalog Number	A	B	C	D	E	Weight
1321-3R2-A	112 (4.40)	104 (4.10)	70 (2.75)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R2-B	112 (4.40)	104 (4.10)	70 (2.75)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-A	112 (4.40)	104 (4.10)	76 (3.00)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-B	112 (4.40)	104 (4.10)	76 (3.00)	50 (1.98)	37 (1.44)	1.8 (4)
1321-3R4-C	112 (4.40)	104 (4.10)	86 (3.38)	60 (2.35)	37 (1.44)	2.3 (5)
1321-3R4-D	112 (4.40)	104 (4.10)	92 (3.62)	66 (2.60)	37 (1.44)	2.7 (6)
1321-3R8-A	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	3.1 (7)
1321-3R8-B	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	3.6 (8)
1321-3R8-C	152 (6.00)	127 (5.00)	85 (3.35)	63 (2.48)	51 (2.00)	4.9 (11)
1321-3R12-A	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	4.1 (9)
1321-3R12-B	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	4.5 (10)
1321-3R18-A	152 (6.00)	133 (5.25)	79 (3.10)	54 (2.13)	51 (2.00)	4.1 (9)
1321-3R18-B	152 (6.00)	133 (5.25)	86 (3.40)	63 (2.48)	51 (2.00)	5.4 (12)
1321-3R25-A	183 (7.20)	146 (5.76)	85 (3.35)	60 (2.35)	76 (3.00)	4.9 (11)
1321-3R35-A	193 (7.60)	146 (5.76)	91 (3.60)	66 (2.60)	76 (3.00)	6.3 (14)

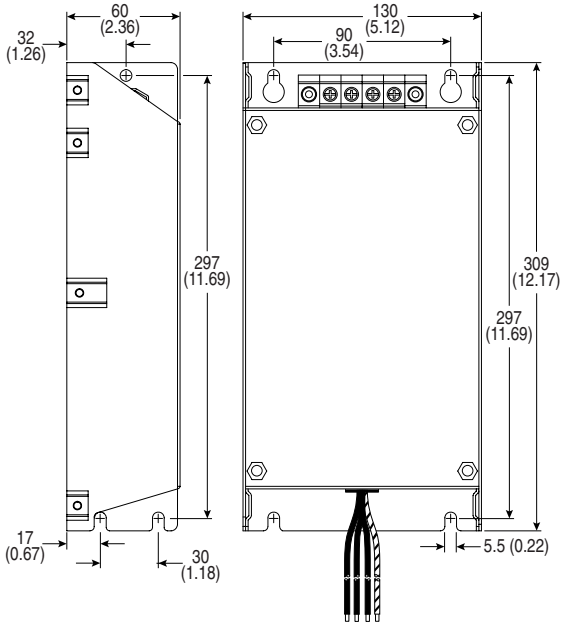
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Figure B.9 Frame B EMC Line Filters – Dimensions are in millimeters and (inches)
Catalog Numbers: 22-RF0P8-BL; 22-RF012-BS, -BL (Series B); 22-RF021-BS, -BL



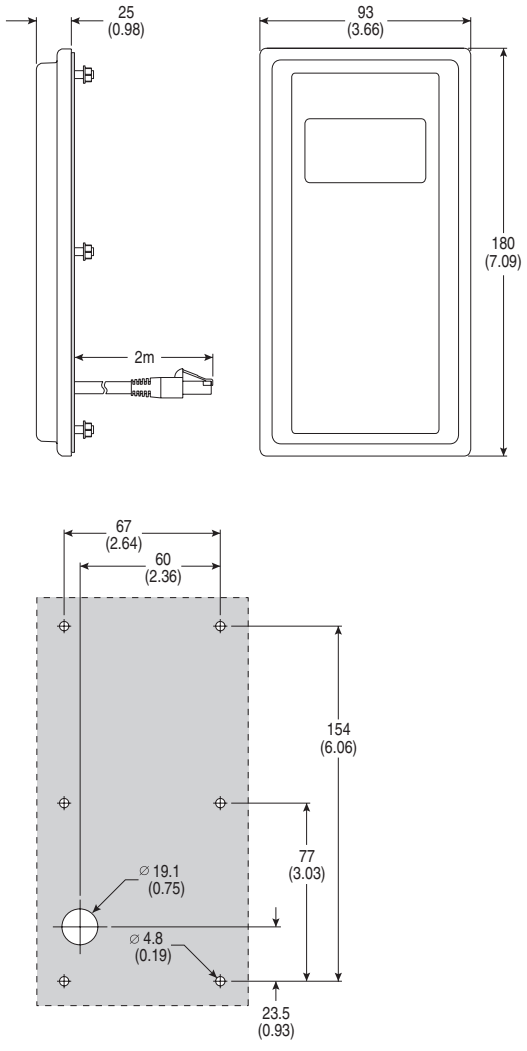
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Figure B.10 Frame C EMC Line Filters – Dimensions are in millimeters and (inches)
Catalog Numbers: 22-RF018-CS, -CL; 22-RF025-CL; 22-RF026-CS, -CL; 22-RF034-CS, -CL



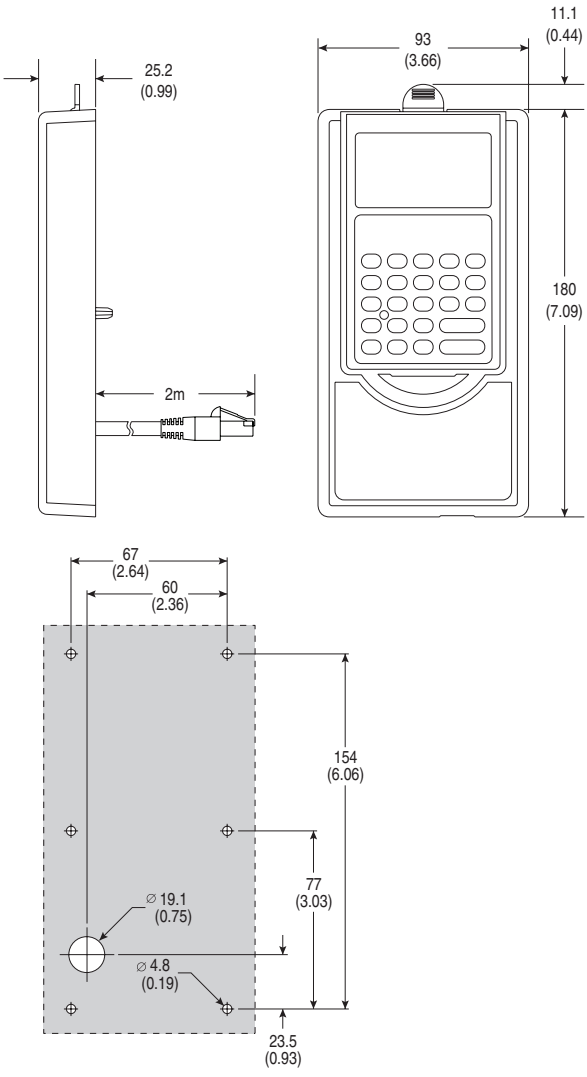
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Figure B.11 Remote (Panel Mount) HIM – Dimensions are in millimeters and (inches)
Catalog Number: 22-HIM-C2S



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Figure B.12 NEMA Type 1 Bezel – Dimensions are in millimeters and (inches)
Catalog Number: 22-HIM-B1



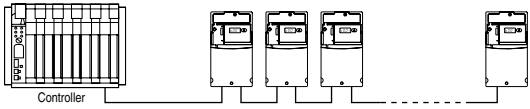
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Notes:

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RS485 (DSI) Protocol

PowerFlex 40P drives support the RS485 (DSI) protocol to allow efficient operation with Rockwell Automation peripherals. In addition, some Modbus functions are supported to allow simple networking. PowerFlex 40P drives can be multi-dropped on an RS485 network using Modbus protocol in RTU mode.

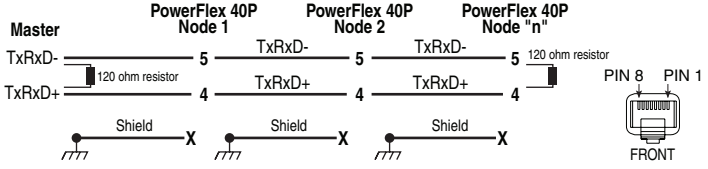


For information regarding DeviceNet or other communication protocols, refer to the appropriate user manual.

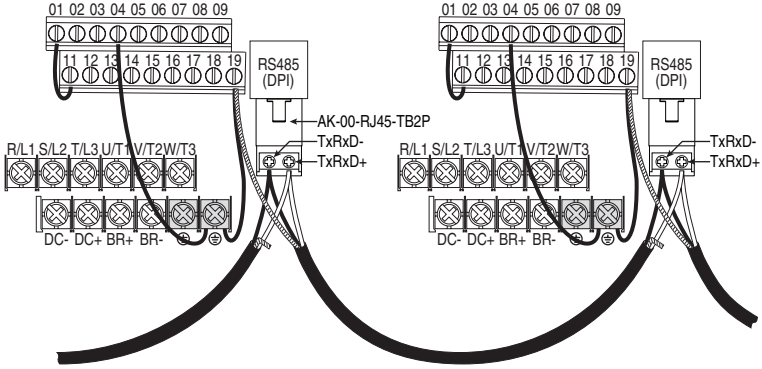
Network Wiring

Network wiring consists of a shielded 2-conductor cable that is daisy-chained from node to node.

Figure C.1 Network Wiring Diagram



NOTE: The shield is connected at ONLY ONE end of each cable segment.



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Only pins 4 and 5 on the RJ45 plug should be wired. The other pins on the PowerFlex 40P RJ45 socket must not be connected because they contain power, etc. for other Rockwell Automation peripheral devices.

Wiring terminations on the master controller will vary depending on the master controller used and “TxRxD+” and “TxRxD-” are shown for illustration purposes only. Refer to the master controller’s user manual for network terminations. Note that there is no standard for the “+” and “-” wires, and consequently Modbus device manufacturers interpret them differently. If you have problems with initially establishing communications, try swapping the two network wires at the master controller.

Standard RS485 wiring practices apply.

- Termination resistors need to be applied at each end of the network cable.
- RS485 repeaters may need to be used for long cable runs, or if greater than 32 nodes are needed on the network.
- Network wiring should be separated from power wires by at least 0.3 meters (1 foot).
- Network wiring should only cross power wires at a right angle.

I/O Terminal 19 (DSI Shield) on the PowerFlex 40P must also be connected to PE ground (there are two PE terminals on the drive). See Table 1.I for more information.

Network Common is internally tied to I/O Terminal 04 (Digital Common). Tying I/O Terminal 04 to PE ground may improve noise immunity in some applications.

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Parameter Configuration

The following PowerFlex 40P parameters are used to configure the drive to operate on a network.

Parameter	Details	Reference
P036 [Start Source]	Set to 5 “Comm Port” if Start is controlled from the network.	Page 3-10
P038 [Speed Reference]	Set to 5 “Comm Port” if the Speed Reference is controlled from the network.	Page 3-12
A103 [Comm Data Rate]	Sets the data rate for the RS485 (DSI) Port. All nodes on the network must be set to the same data rate.	Page 3-34
A104 [Comm Node Addr]	Sets the node address for the drive on the network. Each device on the network requires a unique node address.	Page 3-34
A105 [Comm Loss Action]	Selects the drive’s response to communication problems.	Page 3-34
A106 [Comm Loss Time]	Sets the time that the drive will remain in communication loss before the drive implements A105 [Comm Loss Action].	Page 3-34
A107 [Comm Format]	Sets the transmission mode, data bits, parity and stop bits for the RS485 (DSI) Port. All nodes on the network must be set to the same setting.	Page 3-35
E207 [Comm Write Mode]	Set to 0 “EEPROM” when programming drive. Set to 1 “RAM only” to only write to volatile memory.	Page 3-52

Supported Modbus Function Codes

The peripheral interface (DSI) used on PowerFlex 40P drives supports some of the Modbus function codes.

Modbus Function Code (Decimal)	Command
03	Read Holding Registers
06	Preset (Write) Single Register
16 (10 Hexadecimal)	Preset (Write) Multiple Registers

Important: Modbus devices can be 0-based (registers are numbered starting at 0) or 1-based (registers are numbered starting at 1). Depending on the Modbus Master used, the register addresses listed on the following pages may need to be offset by +1. For example, Logic Command may be register address 8192 for some master devices (e.g. ProSoft 3150-MCM SLC Modbus scanner) and 8193 for others (e.g. PanelViews).

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Writing (06) Logic Command Data

The PowerFlex 40P drive can be controlled via the network by sending Function Code 06 writes to register address 8192 (Logic Command). P036 [Start Source] must be set to 5 “Comm Port” in order to accept the commands. Parameter E249 [Cmd Stat Select] is used to select Velocity or Position Bit definitions.

Velocity Bit Definitions

Logic Command - E249 = 0 “Velocity”		
Address (Decimal)	**Bit(s)**	**Description**
8192	0	1 = Stop, 0 = Not Stop
	1	1 = Start, 0 = Not Start
	2	1 = Jog, 0 = No Jog
	3	1 = Clear Faults, 0 = Not Clear Faults
	5,4	00 = No Command
		01 = Forward Command
		10 = Reverse Command
		11 = No Command
	6	1 = Logic In 1
	7	1 = Logic In 2
	9,8	00 = No Command
		01 = Accel Rate 1
		10 = Accel Rate 2
		11 = Hold Accel Rate Selected
	11,10	00 = No Command
		01 = Decel Rate 1
		10 = Decel Rate 2
		11 = Hold Decel Rate Selected
	14,13,12	000 = No Command
		001 = Freq. Source = P036 [Start Source]
		010 = Freq. Source = A069 [Internal Freq]
		011 = Freq. Source = Comms (Addr 8193)
		100 = A070 [Preset Freq 0]
		101 = A071 [Preset Freq 1]
		110 = A072 [Preset Freq 2]
		111 = A073 [Preset Freq 3]
	15	Not Used

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Position Bit Definitions

Logic Command - E249 = 1 "Position"		
Address (Decimal)	**Bit(s)**	**Description**
8192	0	1 = Stop, 0 = Not Stop
	1	1 = Start, 0 = Not Start
	2	1 = Jog, 0 = No Jog
	3	1 = Clear Faults, 0 = Not Clear Faults
	5,4	00 = No Command
		01 = Forward Command
		10 = Reverse Command
		11 = No Command
	6	1 = Logic In 1
	7	1 = Logic In 2
	10,9,8	000 = A070 Freq. Source, E230 Position Source
		001 = A071 Freq. Source, E232 Position Source
		010 = A072 Freq. Source, E234 Position Source
		011 = A073 Freq. Source, E236 Position Source
		100 = A074 Freq. Source, E238 Position Source
		101 = A075 Freq. Source, E240 Position Sourcec
		110 = A076 Freq. Source, E242 Position Source
		111 = A077 Freq. Source, E244 Position Source
	11	1 = Find Home
	12	1 = Hold Step
	13	1 = Pos Redefine
	14	1 = Sync Enable
	15	1 = Traverse Disable

Writing (06) Reference

The Speed Reference to a PowerFlex 40P drive can be controlled via the network by sending Function Code 06 writes to register address 8193 (Reference). P038 [Speed Reference] must be set to 5 "Comm Port" in order to accept the Speed Reference.

Reference	
Address (Decimal)	**Description**
8193	A decimal value entered as xxx.xx where the decimal point is fixed. For example, a decimal "100" equals 1.00 Hz and "543" equals 5.43 Hz.

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Reading (03) Logic Status Data

The PowerFlex 40P Logic Status data can be read via the network by sending Function Code 03 reads to register address 8448 (Logic Status). Parameter E249 [Cmd Stat Select] is used to select Velocity or Position Bit definitions.

Velocity Bit Definitions

Logic Status - E249 = 0 "Velocity"		
Address (Decimal)	**Bit(s)**	**Description**
8448	0	1 = Ready, 0 = Not Ready
	1	1 = Active (Running), 0 = Not Active
	2	1 = Cmd Forward, 0 = Cmd Reverse
	3	1 = Rotating Forward, 0 = Rotating Reverse
	4	1 = Accelerating, 0 = Not Accelerating
	5	1 = Decelerating, 0 = Not Decelerating
	6	Not Used
	7	1 = Faulted, 0 = Not Faulted
	8	1 = At Reference, 0 = Not At Reference
	9	1 = Reference Controlled by Comm
	10	1 = Operation Cmd Controlled by Comm
	11	1 = Parameters have been locked
	12	Digital Input 1 Status
	13	Digital Input 2 Status
	14	Digital Input 3 Status
	15	Digital Input 4 Status

Position Bit Definitions

Logic Status - E249 = 1 "Position"		
Address (Decimal)	**Bit(s)**	**Description**
8448	0	1 = Ready, 0 = Not Ready
	1	1 = Active (Running), 0 = Not Active
	2	1 = Cmd Forward, 0 = Cmd Reverse
	3	1 = Rotating Forward, 0 = Rotating Reverse
	4	1 = Accelerating, 0 = Not Accelerating
	5	1 = Decelerating, 0 = Not Decelerating
	6	1 = Forward Travel Position, 0 = Reverse Travel Position
	7	1 = Faulted, 0 = Not Faulted
	8	1 = At Speed, 0 = Not At Speed
	9	1 = At Position, 0 = Not At Position
	10	1 = At Home, 0 = Not At Home
	11	1 = Drive Homed, 0 = Not Drive Homed
	12	1 = Sync Hold, 0 = Not Syc Hold
	13	1 = Sync Ramp, 0 = Not Syc Ramp
	14	1 =Traverse On, 0 = Traverse Off
	15	1 = Traverse Decel, 0 = Not Trav Decel

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Reading (03) Feedback

The Feedback (Output Frequency) from the PowerFlex 40P drive can be read via the network by sending Function Code 03 reads to register address 8451 (Feedback).

Feedback[1]	
Address (Decimal)	**Description**
8451	A xxx.x decimal value where the decimal point is fixed. For example, a decimal "123" equals 12.3 Hz and "300" equals 30.0 Hz.

(1) Returns the same data as Reading (03) Parameter d001 [Output Freq].

Reading (03) Drive Error Codes

The PowerFlex 40P Error Code data can be read via the network by sending Function Code 03 reads to register address 8449 (Drive Error Codes).

Logic Status		
Address (Decimal)	**Value (Decimal)**	**Description**
8449	0	No Fault
	2	Auxiliary Input
	3	Power Loss
	4	Undervoltage
	5	Overvoltage
	6	Motor Stalled
	7	Motor Overload
	8	Heatsink Overtemperature
	12	HW Overcurrent (300%)
	13	Ground Fault
	29	Analog Input Loss
	33	Auto Restart Tries
	38	Phase U to Ground Short
	39	Phase V to Ground Short
	40	Phase W to Ground Short
	41	Phase UV Short
	42	Phase UW Short
	43	Phase VW Short
	48	Parameters Defaulted
	63	Software Overcurrent
	64	Drive Overload
	70	Power Unit Fail
	71	Network Loss Fault
	80	AutoTune Fail
	81	Communication Loss
	94	Encoder Loss Fault
	100	Parameter Checksum Error
	111	Hardware Enable Fault
	122	I/O Board Fail

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Reading (03) and Writing (06) Drive Parameters

To access drive parameters, the Modbus register address equals the parameter number. For example, a decimal “1” is used to address Parameter d001 [Output Freq] and decimal “39” is used to address Parameter P039 [Accel Time 1].

Additional Information

Refer to **http://www.ab.com/drives/** for additional information.

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RJ45 DSI Splitter Cable

The PowerFlex 40P drive provides a RJ45 port to allow the connection of a single peripheral device. The RJ45 DSI Splitter Cable can be used to connect a second DSI peripheral device to the drive.

Connectivity Guidelines



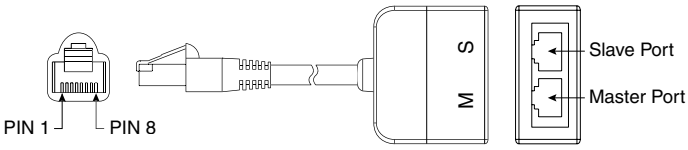
ATTENTION: Risk of injury or equipment damage exists. The peripherals may not perform as intended if these Connectivity Guidelines are not followed. Precautions should be taken to follow these Connectivity Guidelines.

- Two peripherals maximum can be attached to a drive.
- If a single peripheral is used, it must be connected to the Master port (M) on the splitter and configured for “Auto” (default) or “Master.” Parameter 9 [Device Type] on the DSI / MDI keypads and Parameter 1 [Adapter Cfg] on the Serial Converter are used to select the type (Auto / Master / Slave).
- **Do not use the RJ45 Splitter Cable with a drive that has an internal network communication adapter installed.** Since only one additional peripheral can be added, the second peripheral can be connected directly to the RJ45 port on the drive. The internal Comm is always the Master, therefore the external peripheral must be configured as “Auto” (for temporary connections) or “Slave” (for permanent connections).
- If two peripherals will be powered up at the same time, one must be configured as the “Master” and connected to the Master port (M) and the other must be connected as the “Slave” and connected to the Slave port (S).

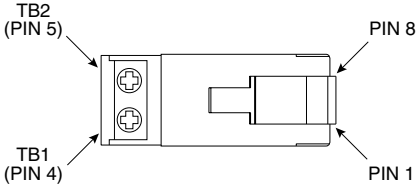
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DSI Cable Accessories

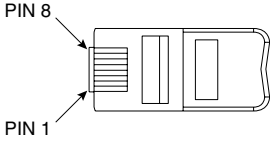
RJ45 Splitter Cable – Catalog Number: AK-U0-RJ45-SC1



RJ45 Two-Position Terminal Block Adapter –
Catalog Number: AK-U0-RJ45-TB2P

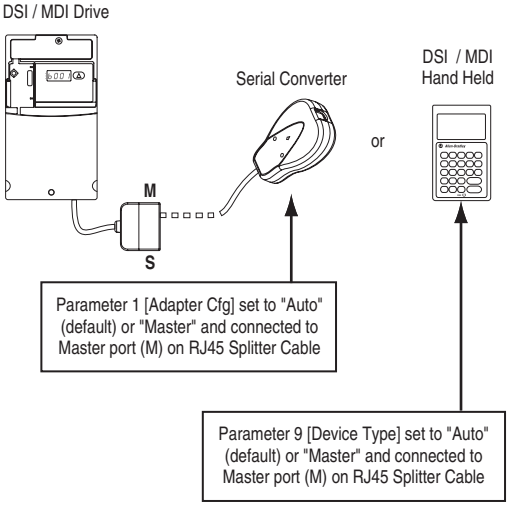


RJ45 Adapter with Integrated Termination Resistor –
Catalog Number: AK-U0-RJ45-TR1

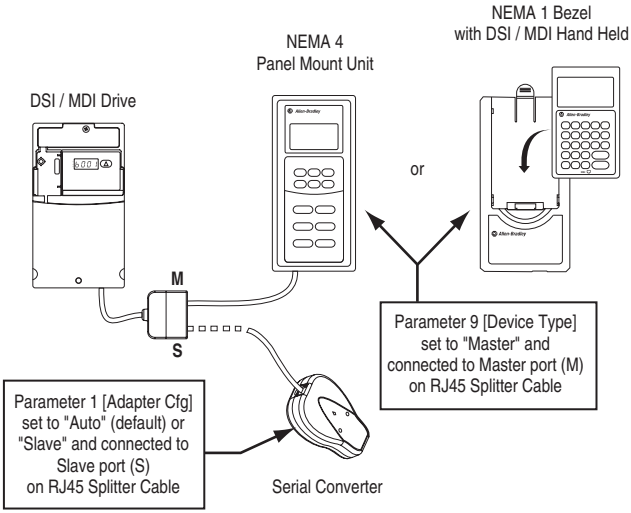


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Connecting One Temporary Peripheral

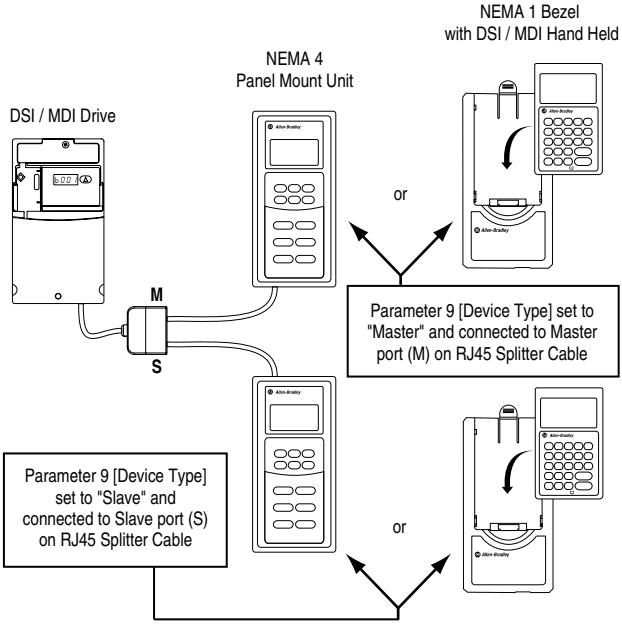


Connecting One Temporary Peripheral and One Permanent Peripheral

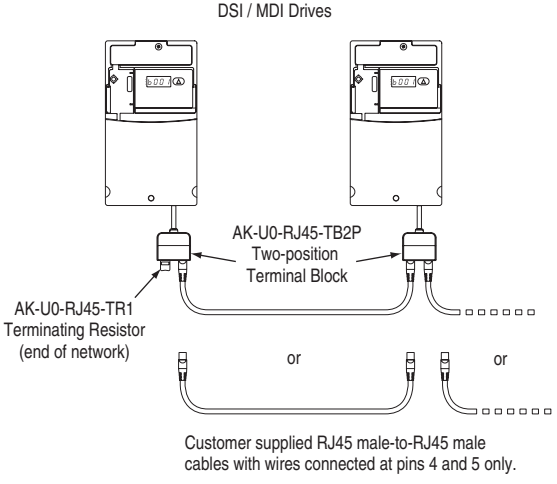


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Connecting Two Permanent Peripherals



Connecting an RS-485 Network



Both the Master (M) and Slave (S) ports on the RJ45 Splitter Cable operate as standard RS-485 ports in this configuration.

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Velocity StepLogic™, Basic Logic and Timer/Counter Functions

Four PowerFlex 40P logic functions provide the capability to program simple logic functions without a separate controller.

- Velocity StepLogic Function

  Steps through up to eight preset speeds based on programmed logic. Programmed logic can include conditions that need to be met from digital inputs programmed as “Logic In1” and “Logic In2” before stepping from one preset speed to the next. A timer is available for each of the eight steps and is used to program a time delay before stepping from one preset speed to the next. The status of a digital output can also be controlled based on the step being executed.

- Basic Logic Function

  Up to two digital inputs can be programmed as “Logic In1” and/or “Logic In2”. A digital output can be programmed to change state based on the condition of one or both inputs based on basic logic functions such as AND, OR, NOR. The basic logic functions can be used with or without StepLogic.

- Timer Function

  A digital input can be programmed for “Timer Start”. A digital output can be programmed as a “Timer Out” with an output level programmed to the desired time. When the timer reaches the time programmed into the output level the output will change state. The timer can be reset via a digital input programmed as “Reset Timer”.

- Counter Function

  A digital input can be programmed for “Counter In”. A digital output can be programmed as “Counter Out” with an output level programmed to the desired number of counts. When the counter reaches the count programmed into the output level the output will change state. The counter can be reset via a digital input programmed as “Reset Counter”.

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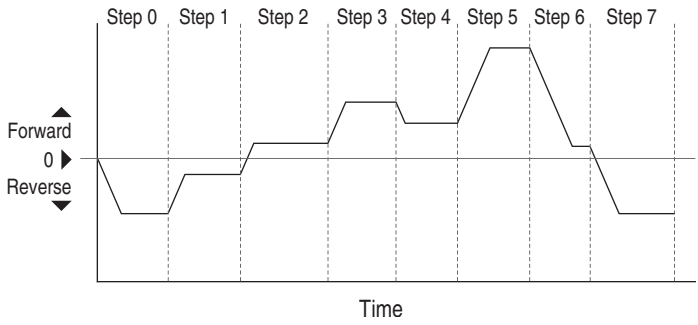
Velocity StepLogic Using Timed Steps

To activate this function, set parameter P038 [Speed Reference] to 6 “Stp Logic”. Three parameters are used to configure the logic, speed reference and time for each step.

- Logic is defined using parameters A140-A147 [Stp Logic x].
- Preset Speeds are set with parameters A070-A077 [Preset Freq x].
- Time of operation for each step is set with parameters A150-A157 [Stp Logic Time x].

The direction of motor rotation can be forward or reverse.

Figure E.1 Using Timed Steps



Velocity StepLogic Sequence

- Sequence begins with a valid start command.
- A normal sequence begins with Step 0 and transition to the next step when the corresponding StepLogic time has expired.
- Step 7 is followed by Step 0
- Sequence repeats until a stop is issued or a fault condition occurs.

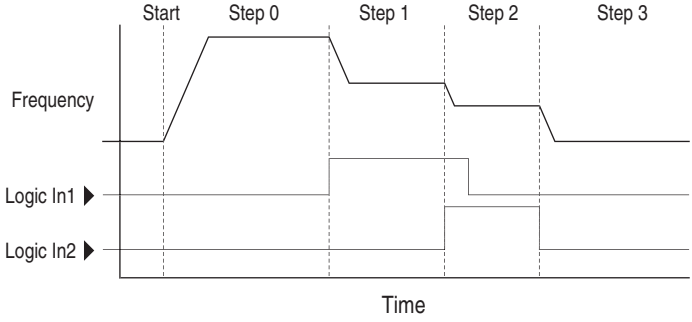
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Velocity StepLogic Using Basic Logic Functions

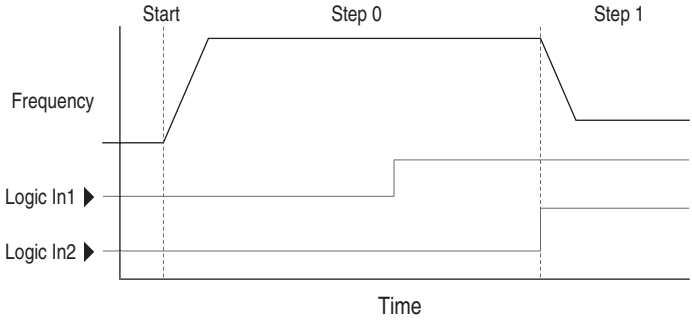
Digital input and digital output parameters can be configured to use logic to transition to the next step. Logic In1 and Logic In2 are defined by programming parameters A051-A054 [Digital Inx Sel] to option 23 “Logic In1” or option 24 “Logic In2”.

Example

- Run at Step 0.
- Transition to Step 1 when Logic In1 is true.
  Logic senses the edge of Logic In1 when it transitions from off to on. Logic In1 is not required to remain “on”.
- Transition to Step 2 when both Logic In1 and Logic In2 are true.
  The drive senses the level of both Logic In1 and Logic In2 and transitions to Step 2 when both are on.
- Transition to Step 3 when Logic In2 returns to a false or off state.
  Inputs are not required to remain in the “on” condition except under the logic conditions used for the transition from Step 2 to Step 3.



The step time value and the basic logic may be used together to satisfy machine conditions. For instance, the step may need to run for a minimum time period and then use the basic logic to trigger a transition to the next step.



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Timer Function

Digital inputs and outputs control the timer function and are configured with parameters A051-A054 [Digital Inx Sel] set to 18 “Timer Start” and 20 “Reset Timer”.

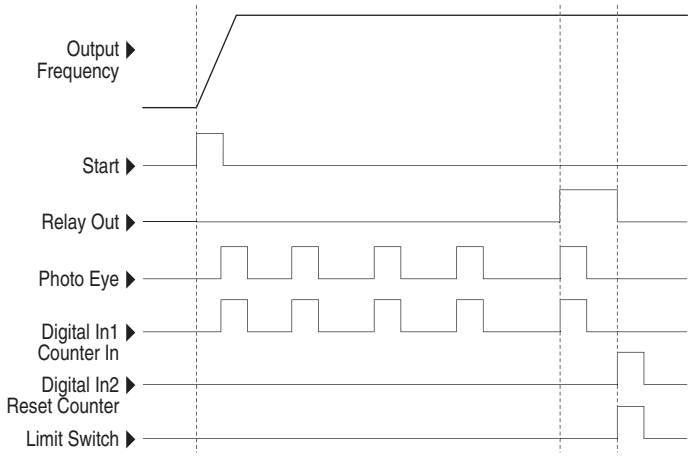
Digital outputs (relay and opto type) define a preset level and indicate when the level is reached. Level parameters A056 [Relay Out Level], A059 [Opto Out1 Level] and A062 [Opto Out2 Level] are used to set the desired time in seconds.

Parameters A055 [Relay Out Sel], A058 [Opto Out1 Sel] and A061 [Opto Out2 Sel] are set to option 16 “Timer Out” and causes the output to change state when the preset level is reached.

Example

- Drive starts up and accelerates to 30 Hz.
- After 30Hz has been maintained for 20 seconds, a 4-20mA analog input becomes the reference signal for speed control.
- The timer function is used to select a preset speed with a 20 second run time that overrides the speed reference while the digital input is active.
- Parameters are set to the following options:
  - P038 [Speed Reference] = 3 “4-20mA Input”
  - A051 [Digital In1 Sel] = 4 “Preset Freq”
  - A052 [Digital In2 Sel] = 18 “Timer Start”
  - A055 [Relay Out Sel] = 16 “Timer Out”
  - A056 [Relay Out Level] = 20.0 Secs
  - A071 [Preset Freq 1] = 30.0 Hz
- The control terminal block is wired such that a start command will also trigger the timer start.
- The relay output is wired to I/O Terminal 05 (Digital Input 1) so that it forces the input on when the timer starts.
- After the timer is complete, the output is turned off releasing the preset speed command. The drive defaults to following the analog input reference as programmed.

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Note that a “Reset Timer” input is not required for this example since the “Timer Start” input both clears and starts the timer.

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Counter Function

Digital inputs and outputs control the counter function and are configured with parameters A051-A054 [Digital Inx Sel] set to 19 “Counter In” and 21 “Reset Countr”.

Digital outputs (relay and opto type) define a preset level and indicate when the level is reached. Level parameters A056 [Relay Out Level], A059 [Opto Out1 Level] and A062 [Opto Out2 Level] are used to set the desired count value.

Parameters A055 [Relay Out Sel], A058 [Opto Out1 Sel] and A061 [Opto Out2 Sel] are set to 17 “Counter Out” which causes the output to change state when the level is reached.

Example

- A photo eye is used to count packages on a conveyor line.
- An accumulator holds the packages until 5 are collected.
- A diverter arm redirects the group of 5 packages to a bundling area.
- The diverter arm returns to its original position and triggers a limit switch that resets the counter.
- Parameters are set to the following options:
  - A051 [Digital In1 Sel] set to 19 to select “Counter In”
  - A052 [Digital In2 Sel] set to 21 to select “Reset Countr”
  - A055 [Relay Out Sel] set to 17 to select “Counter Out”
  - A056 [Relay Out Level] set to 5.0 (Counts)

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Velocity StepLogic Parameters

Table E.A Code Descriptions for Parameters A140-A147

Digit 3	Digit 2	Digit 1	Digit 0
0	0	F	1

Table E.B Digit 3 – Defines the action during the step currently executing.

Setting	Accel/Decel Parameters Used	StepLogic Output State	Commanded Direction
0	1	Off	FWD
1	1	Off	REV
2	1	Off	No Output
3	1	On	FWD
4	1	On	REV
5	1	On	No Output
6	2	Off	FWD
7	2	Off	REV
8	2	Off	No Output
9	2	On	FWD
A	2	On	REV
b	2	On	No Output

Table E.C Digit 2 – Defines what step to jump to or how to end program when the logic conditions specified in Digit 1 are met.

Setting	Logic
0	Jump to Step 0
1	Jump to Step 1
2	Jump to Step 2
3	Jump to Step 3
4	Jump to Step 4
5	Jump to Step 5
6	Jump to Step 6
7	Jump to Step 7
8	End Program (Normal Stop)
9	End Program (Coast to Stop)
A	End Program and Fault (F2)

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Table E.D Digit 1 – Defines what logic must be met to jump to a step other than the very next step.

Setting	Description	Logic
0	Skip Step (jump immediately)	SKIP
1	Step based on the time programmed in the respective [Stp Logic Time x] parameter.	TIMED
2	Step if “Logic In1” is active (logically true)	TRUE
3	Step if “Logic In2” is active (logically true)	TRUE
4	Step if “Logic In1” is not active (logically false)	FALSE
5	Step if “Logic In2” is not active (logically false)	FALSE
6	Step if either “Logic In1” or “Logic In2” is active (logically true)	OR
7	Step if both “Logic In1” and “Logic In2” is active (logically true)	AND
8	Step if neither “Logic In1” or “Logic In2” is active (logically true)	NOR
9	Step if “Logic In1” is active (logically true) and “Logic In2” is not active (logically false)	XOR
A	Step if “Logic In2” is active (logically true) and “Logic In1” is not active (logically false)	XOR
b	Step after [Stp Logic Time x] and “Logic In1” is active (logically true)	TIMED AND
C	Step after [Stp Logic Time x] and “Logic In2” is active (logically true)	TIMED AND
d	Step after [Stp Logic Time x] and “Logic In1” is not active (logically false)	TIMED OR
E	Step after [Stp Logic Time x] and “Logic In2” is not active (logically false)	TIMED OR
F	Do not step OR no “jump to”, so use Digit 0 logic	IGNORE

Table E.E Digit 0 – Defines what logic must be met to jump to the very next step.

Setting	Description	Logic
0	Skip Step (jump immediately)	SKIP
1	Step based on the time programmed in the respective [Stp Logic Time x] parameter.	TIMED
2	Step if “Logic In1” is active (logically true)	TRUE
3	Step if “Logic In2” is active (logically true)	TRUE
4	Step if “Logic In1” is not active (logically false)	FALSE
5	Step if “Logic In2” is not active (logically false)	FALSE
6	Step if either “Logic In1” or “Logic In2” is active (logically true)	OR
7	Step if both “Logic In1” and “Logic In2” is active (logically true)	AND
8	Step if neither “Logic In1” or “Logic In2” is active (logically true)	NOR
9	Step if “Logic In1” is active (logically true) and “Logic In2” is not active (logically false)	XOR
A	Step if “Logic In2” is active (logically true) and “Logic In1” is not active (logically false)	XOR
b	Step after [Stp Logic Time x] and “Logic In1” is active (logically true)	TIMED AND
C	Step after [Stp Logic Time x] and “Logic In2” is active (logically true)	TIMED AND
d	Step after [Stp Logic Time x] and “Logic In1” is not active (logically false)	TIMED OR
E	Step after [Stp Logic Time x] and “Logic In2” is not active (logically false)	TIMED OR
F	Use logic programmed in Digit 1	IGNORE

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Encoder Usage and Position StepLogic Application

Encoder Usage

The PowerFlex 40P includes a pulse-train/encoder input. When E216 [Motor Fdbk Type] is set to a value other than zero, the drive is set to use an encoder. The drive will use the encoder in several ways depending on the settings of other parameters. The drive will use the encoder as shown below (listed in order of priority):

1. If enabled by P038 [Speed Reference], the encoder will be used directly as a commanded speed (normally used with a pulse train) or as a position reference (normally used with a quadrature encoder).
2. If not enabled by P038 [Speed Reference], when the PID Feedback or PID Reference are set to use an encoder than the PID function will use the encoder or pulse train input.
3. If not enabled by P038 [Speed Reference] or the PID parameters, then if E216 [Motor Fdbk Type] is set the encoder is used for direct feedback and trim of the speed command. The normal slip compensation is not used in this case. Instead the drive will use the encoder to determine actual output frequency and adjust the output frequency to match the command. Parameters E220 [Ki Speed Loop] and E221 [Kp Speed Loop] are used in this control loop. The primary benefit of this mode is increased speed accuracy when compared to open-loop slip compensation. It does not provide speed bandwidth improvement.

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Wiring Notes

The encoder can supply 5V or 12V power (250 mA maximum) for an encoder. Be sure the DIP switch is set properly for the encoder. In general, 12V will provide higher noise immunity.

The pulse-train/encoder inputs can handle 5V, 12V, or 24V inputs. The inputs will automatically adjust to the voltage applied and no additional drive adjustment is necessary. If a pulse-train or single-channel input is used, it must be wired between the A (signal) and A- (signal common) channels.

Important: A quadrature encoder provides rotor speed and direction. Therefore, the encoder must be wired such that the forward direction matches the motor forward direction. If the drive is reading encoder speed but the position regulator or other encoder function is not working properly, remove power to the drive and swap the A and B encoder channels or swap any two motor leads. Drives using FRN 2.xx and greater will fault when an encoder is incorrectly wired and E216 [Motor Fdbk Type] is set to option 5 “Quad Check”.

Positioning Overview

The PowerFlex 40P includes a simple position regulator which can be used in a variety of position applications without the need for multiple limit switches or photo-eyes. This can be used as a stand-alone controller for simple applications (up to 8 positions) or in conjunction with a controller for more flexibility.

Please note that this is not intended to replace high end servo controllers or any application that needs high bandwidth or very high torque at low speeds.

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Common Guidelines for All Applications

The position regulator can be configured for operation appropriate for a variety of applications. Certain parameters will need to be adjusted in all cases.

P038 [Speed Reference] must be set to option 9 “Positioning”.

E216 [Motor Fdbk Type] must be set to the match the feedback device. Positioning mode must use E216 [Motor Fdbk Type] option 4.

E216 [Motor Fdbk Type] Options

0 “None” indicates no encoder is used. This can not be used for positioning.

1 “Pulse Train” is a single channel input, no direction, speed feedback only. This should not be used for positioning. The Single Channel selection is similar to a Pulse Train, but uses the standard encoder scaling parameters.

2 “Single Chan” is a single channel input, no direction, speed feedback only. This should not be used for positioning. Single channel uses the standard encoder scaling parameters.

3 “Single Check” is a single channel input with encoder signal loss detection. The drive will fault if it detects that the input pulses do not match the expected motor speed. This should not be used for positioning.

4 “Quadrature” is a dual channel encoder input with direction and speed from the encoder. This may be used for positioning control.

5 “Quad Check” is a dual channel encoder with encoder signal loss detection. The drive will fault if it detects that the encoder speed does not match the expected motor speed. FRN 2.xx or greater supports Option 5 “Quad Check” in Positioning mode.

Important: Drives using FRN 1.xx must use option 4 “Quadrature” for Positioning mode. FRN 1.xx does not support option 5 “Quad Check”.

A095 [Reverse Disable] should be set to option 0 “Rev Enabled” to allow bidirectional movement necessary for position control.

A125 [Torque Perf Mode] default setting of 1 “Sensrls Vect” is recommended for most applications to improve the low speed torque for positioning applications. The autotune routine can be completed to further improve the drive-motor performance.

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A117 [Bus Reg Mode] default setting is option 1 “Enabled”. If the deceleration time is too short, the drive may overshoot the desired position. For best results, a longer deceleration time may be necessary. A117 [Bus Reg Mode] can be disabled to provide precise stopping movements, but the deceleration time will need to be manually tuned so that it is long enough to avoid F5 OverVoltage faults.

A082 [DB Resistor Sel] default setting is 0 “Disabled”. If improved deceleration performance is required a Dynamic Brake resistor can be used. If used, this parameter should be set to the appropriate setting for the resistor selected.

E217 [Motor NP Poles] must be set to match the number of motor poles on the motor driven by the PowerFlex 40P drive.

E218 [Encoder PPR] must be set to match the number of pulses per revolution of the encoder used (i.e., 1024 PPR Encoder).

E226 [Counts Per Unit] sets the number of encoder counts that will be used to define one position unit. This allows the encoder positions to be defined in terms of units important to the application. For example, if 1cm of travel on a conveyor belt requires 0.75 turns of the motor, the motor encoder is 1024 PPR, and the Motor Feedback type is set to Quadrature, then this parameter would need to be set to (4 x 1024 x 0.75) = 3072 counts for 1cm of travel. Then all other positions could be setup in units of “cm”.

E225 [Encoder Pos Tol] indicates the desired position tolerance for the system. This will determine how close the drive must be to the commanded position before the drive will indicate “At Home” or “At Position” in units of raw encoder pulses. This has no effect on the actual positioning control of the motor.

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Positioning Operation

Parameter E222 [Positioning Mode] must be set to properly match the desired operation of the positioning function.

E222 [Positioning Mode] Options

0 "Time Steps" uses Step Logic times. This mode ignores the Step Logic settings and moves through the steps (Step 0 to Step 7 and back to Step 0) based on the times programmed into A150-A157 [Stp Logic Time x]. This can be used when the desired position is based only on time. In addition, this mode only accepts absolute positions in a positive direction from "home". This option provides an easy way to implement a simple positioning program or to test the basic positioning setup. For additional flexibility one of the other settings should be used.

1 "Preset Input" directly commands movement to any step based on the status of the digital inputs programmed for "Preset Freq". This setting ignores the Step Logic Commands settings and instead the drive will move directly to whatever step is currently commanded by A070-A077 [Preset Freq x] and E230-E244 [Step Units x]. This is useful when an application needs direct access to any position step based on discrete inputs.

Important: Advanced Step Logic options such as incremental move are not available in this mode.

2 "Step Logic" provides a highly flexible mode of operation. This can be used to move through the steps (Step 0 to Step 7 and back to Step 0) or can jump to a different step at any time based on time or the status of digital inputs or communication commands. In this mode the drive always starts at Step 0 of the Step Logic profile.

3 "Preset-StpL" is identical to option 2 "Step Logic" except the drive will use the current status of the Preset Inputs to determine which Step Logic step to begin. This only affects the initial step. After start, the drive will move through the steps in the same manner as if setting 2 was selected.

4 "StpLogic-Lst" is identical to option 2 "Step Logic" except the drive will use the step prior to its last stop command to determine which Step Logic step to begin. This only affects the initial step. After start, the drive will move through the steps in the same manner as if option 2 was selected. This allows a process to be stopped and then restarted at the position where it stopped.

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In all position modes, the following parameters will control the characteristics at each step:

E230-E244 [Step Units x]
These are the number value to the left of the decimal (whole number) of the 8 positions desired for an application, beginning with Step 0 (E230) and continuing with each step until Step 7 (E244). For example, enter 2 into this parameter if you would like a commanded position of 2.77.

E231-E245 [Step Units F x]
These are the number value to the right of the decimal (the portion less than 1) of the 8 positions desired for an application, beginning with Step 0 (E231) and continuing with each step until Step 7 (E245). For example, enter 0.77 into this parameter if you would like a commanded position of 2.77.

A070-A077 [Preset Freq x]
In Positioning mode, each preset frequency parameter defines the maximum frequency the drive will run at during the corresponding step. For example, if [Preset Freq 2] is set to 40Hz, the drive will accelerate to 40Hz maximum when moving to Position 2.

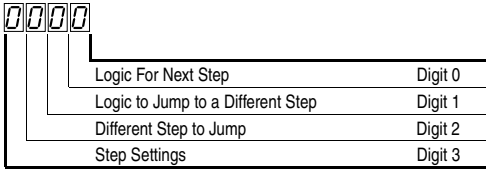
Frequency Source	Step Source	Position Source
A070 [Preset Freq 0]	A140 [Step Logic 0]	E230 [Step Units 0]
A071 [Preset Freq 1]	A141 [Step Logic 1]	E232 [Step Units 1]
A072 [Preset Freq 2]	A142 [Step Logic 2]	E234 [Step Units 2]
A073 [Preset Freq 3]	A143 [Step Logic 3]	E236 [Step Units 3]
A074 [Preset Freq 4]	A144 [Step Logic 4]	E238 [Step Units 4]
A075 [Preset Freq 5]	A145 [Step Logic 5]	E240 [Step Units 5]
A076 [Preset Freq 6]	A146 [Step Logic 6]	E242 [Step Units 6]
A077 [Preset Freq 7]	A147 [Step Logic 7]	E244 [Step Units 7]

Important: The default value for A070 [Preset Freq 0] is 0.00 Hz. This value needs to be changed or the drive will not be able to move during Step 0.

A150-A157 [Stp Logic Time x]
In Positioning mode, each Step Logic Time parameter defines the time the drive will remain in each corresponding step if that step is time-based. For example, if A152 [Stp Logic Time 2] is set to 5.0 seconds and that step is time-based, the drive will remain in Step 2 for 5.0 seconds. Note that this is the total time in that step, not the time at that position. Therefore, it will include the time needed to accelerate, run, and decelerate to that position.

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A140-A147 [Stp Logic x] – When a positioning mode is selected that utilizes the Step Logic functions these parameters allow additional flexibility and control various aspects of each step. Note that in Positioning mode these parameters have a different function than when used for normal velocity Step Logic. Each of the 4 digits controls one aspect of the each position step. The following is a listing of the available settings for each digit:



Settings For Positioning (Digit 3)

Required Setting	Accel/Decel Param. Used	StepLogic Output State	Direction From Home	Type Of Command
0	Accel/Decel 1	Off	FWD	Absolute
1	Accel/Decel 1	Off	FWD	Incremental
2	Accel/Decel 1	Off	REV	Absolute
3	Accel/Decel 1	Off	REV	Incremental
4	Accel/Decel 1	On	FWD	Absolute
5	Accel/Decel 1	On	FWD	Incremental
6	Accel/Decel 1	On	REV	Absolute
7	Accel/Decel 1	On	REV	Incremental
8	Accel/Decel 2	Off	FWD	Absolute
9	Accel/Decel 2	Off	FWD	Incremental
A	Accel/Decel 2	Off	REV	Absolute
b	Accel/Decel 2	Off	REV	Incremental
C	Accel/Decel 2	On	FWD	Absolute
d	Accel/Decel 2	On	FWD	Incremental
E	Accel/Decel 2	On	REV	Absolute
F	Accel/Decel 2	On	REV	Incremental

Settings (Digit 2)

0 = Jump to Step 0
1 = Jump to Step 1
2 = Jump to Step 2
3 = Jump to Step 3
4 = Jump to Step 4
5 = Jump to Step 5
6 = Jump to Step 6
7 = Jump to Step 7
8 = End Program (Normal Stop)
9 = End Program (Coast to Stop)
A = End Program and Fault (F2)

Settings (Digit 1 and Digit 0)

0 = Skip Step (Jump Immediately)
1 = Step Based on [Stp Logic Time x]
2 = Step if "Logic In1" is Active
3 = Step if "Logic In2" is Active
4 = Step if "Logic In1" is Not Active
5 = Step if "Logic In2" is Not Active
6 = Step if either "Logic In1" or "Logic In2" is Active
7 = Step if both "Logic In1" and "Logic In2" is Active
8 = Step if neither "Logic In1" or "Logic In2" is Active
9 = Step if "Logic In1" is Active and "Logic In2" is Not Active
A = Step if "Logic In2" is Active and "Logic In1" is Not Active
b = Step after [Stp Logic Time x] and "Logic In1" is Active
C = Step after [Stp Logic Time x] and "Logic In2" is Active
d = Step after [Stp Logic Time x] and "Logic In1" is Not Active
E = Step after [Stp Logic Time x] and "Logic In2" is Not Active
F = Do Not Step/Ignore Digit 2 Settings

Note: Incremental move commands will cause the drive to move the amount specified based on the current position. Absolute commands are always with reference to "Home".

E246 [Pos Reg Filter] provides a low pass filter at the input of the position regulator.

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E247 [Pos Reg Gain] is a single adjustment for increasing or decreasing the responsiveness of the position regulator. For faster response, the filter should be reduced and/or the gain should be increased. For smoother response with less overshoot, the filter should be increased and/or the gain should be reduced. In general, the gain will have a larger effect on most systems than the filter.

Homing Routine

This drive supports incremental encoders only. Therefore, when the drive powers up it will reset the current position to zero. If this is known to be correct the position routine can be started without further adjustment. However, in most applications the drive will need to be "homed" after each power-up and prior to starting the position routine.

This can be accomplished in one of the following two ways:

1. Manual Homing–Program the following drive parameters:

   A051-A054 [Digital Inx Sel] = 36 "Pos Redefine"
   Program one of the digital inputs to option 36 "Pos Redefine". Then, move the system into the home position via a run command, a jog command, or by manually moving the system into the home position. Then, toggle the "Pos Redefine" input. This will set the drive to "Home" at its current position and d308 [Units Traveled H] and d309 [Units Traveled L] are set to zero. Alternately, the "Pos Redefine" bit in E248 [Enh Control Word] can be toggled instead of utilizing a digital input.

   Important: The "Pos Redefine" input or bit must be returned to inactive before starting the position routine. Otherwise the drive will continuously read a position of "0" (home) and the position routine will not function correctly.

2. Automatic Homing to Limit Switch–Program the following drive parameters:

   A051-A054 [Digital Inx Sel] = 34 "Find Home"
   Program one of the digital inputs to option 34 "Find Home"

   A051-A054 [Digital Inx Sel] = 33 "Home Limit"
   Program one of the digital inputs to option 33 "Home Limit". Normally, the "Home Limit" input would be wired to a proximity switch or photo-eye and will indicate the system is in the home position.

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E223 [Find Home Freq]
This parameter sets the frequency the drive will use while it is moving to the home position during the automatic homing routine.

E224 [Find Home Dir]
This parameter sets the direction the drive will use while it is moving to the home position during the automatic homing routine.

To begin the automatic homing routine, activate the "Find Home" input and then initiate a valid start command. The drive will then ramp to the speed set in E223 [Find Home Freq] and in the direction set in E224 [Find Home Dir] until the digital input defined as "Home Limit" is activated. If the drive passes this point too quickly it will then reverse direction at 1/10th E223 [Find Home Freq] to the point where the Home Limit switch reactivates. Approximately one second after the routine finds home the drive will stop. Alternately, the "Find Home Freq" and/or "Home Limit" bits in E248 [Enh Control Word] can be activated instead of utilizing a digital input. The inputs or bits should be returned to inactive after the routine is complete.

Important: After the position is reached the drive will stop. If the Find Home is removed before the homing is complete, the drive will begin running the position routine without the proper home. In this case Home will not be reset and the position will be in relation to the power up position.

Encoder and Position Feedback

Parameter d304 [Speed Feedback] and d305 [Speed Feedback F] indicate the measured speed feedback or the calculated speed feedback when no feedback device is selected. Parameter d304 [Speed Feedback] is the number value to the left of the decimal (whole number) and d305 [Speed Feedback F] is the value to the right of the decimal (the portion less than 1).

d306 [Encoder Speed]
Parameter d306 [Encoder Speed] and d307 [Encoder Speed F] indicate the measured speed of the feedback device. This is useful if the encoder is not used for motor speed control. However, the encoder must be used for some purpose in order for [Encoder Speed] to indicate a value. Parameter d306 is the number value to the left of the decimal (whole number) and d307 is the number to the right of the decimal (the portion less than 1).

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d308 [Units Traveled]
Parameter d308 [Units Traveled H] and d309 [Units Traveled L] indicate the current position of the system in terms of units away from Home. Parameter d308 is the number value to the left of the decimal (whole number) and d309 is the number to the right of the decimal (the portion less than 1).

d301 [Drive Status 2]
Parameter d301 [Drive Status 2] indicates the status of the positioning functions. The indication bits are:

Bit 0 "Dir Positive" indicates the current direction the drive has moved from Home.

Bit 1 "At Position" indicates whether the drive is at its commanded position. If the drive is within E225 [Encoder Pos Tol] of the commanded position, this bit will be active.

Bit 2 "At Home" indicates whether the drive is at Home. If the drive is within E225 [Encoder Pos Tol] of "Home", this bit will be active.

Bit 3 "Drive Homed" indicates whether the drive has been homed since power-up. This bit will be active once the drive has been homed either manually or automatically. It will remain active until the next power down.

Use Over Communications

If 8 steps are not adequate for the application or if dynamic program changes are required, many of the positioning functions can be controlled via an active communication network. The following parameters will allow this control.

E207 [Comm Write Mode]
Repeated writes to parameters over a communication network can cause damage to the drive EEPROM. This parameter allows the drive to accept parameter changes without writing to the EEPROM.

Important: Parameter values set prior to setting option 1 "RAM only" will be saved in drive non-volatile memory (EEPROM).

E249 [Cmd Stat Select]
Selects velocity-specific or position/fibers-specific Command and Status Word bit definitions for use over a communication network.

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E248 [Enh Control Word]
This parameter allows many of the positioning functions to be completed via parameter control using an explicit message. This allows the operation over communications instead of with hardware inputs. The bits have the same functions as the digital input options of the same name. Options relating to positioning are:

Bit 0 “Home Limit”
Bit 1 “Find Home”
Bit 2 “Hold Step”
Bit 3 “Pos Redefine”

E230-E244 [Step Units x]
All of the position steps can be written to while the drive is running. The changes will take place at the next move. For example, if step 0 is over-written while the drive is moving to step 0, the drive will move to the previous commanded position at step 0. The next time the drive is commanded to return to step 0 it will proceed to the new position. One possible use of this capability is when an application requires full control of the movement by a controller external to the drive. The Step Logic program might be written to jump from step 0 back to step 0 when Input 1 is active. The controller could write any desired position to step 0 and then toggle the input 1 bit of E248 [Enh Control Word] to cause the drive to move to the new position. This allows almost unlimited flexibility and can be used with absolute or incremental moves.

Setup Notes

The RA computer tools (DriveExplorer and DriveTools SP) can make setup of the positioning functions much easier. Please refer to the latest versions for additional tools or wizards which can aid in the setup.

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Notes:

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PID Set Up

PID Loop

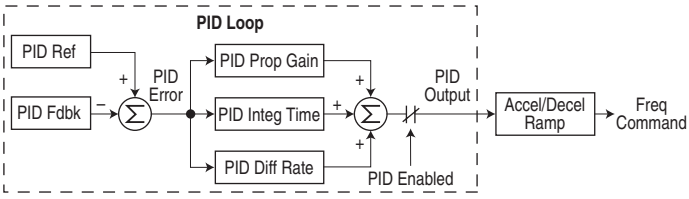
The PowerFlex 40P has a built-in PID (proportional, integral, differential) control loop. The PID loop is used to maintain a process feedback (such as pressure, flow or tension) at a desired set point. The PID loop works by subtracting the PID feedback from a reference and generating an error value. The PID loop reacts to the error, based on the PID Gains, and outputs a frequency to try to reduce the error value to 0. To enable the PID loop, parameter A132 [PID Ref Sel] must be set to an option other than 0 “PID Disabled”.

Exclusive Control and Trim Control are two basic configurations where the PID loop may be used.

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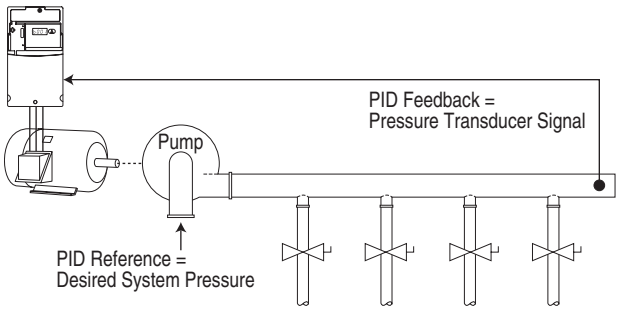
Exclusive Control

In Exclusive Control, the Speed Reference becomes 0, and the PID Output becomes the entire Freq Command. Exclusive Control is used when A132 [PID Ref Sel] is set to option 1, 2, 3, 4 or 5. This configuration does not require a master reference, only a desired set point, such as a flow rate for a pump.



Example

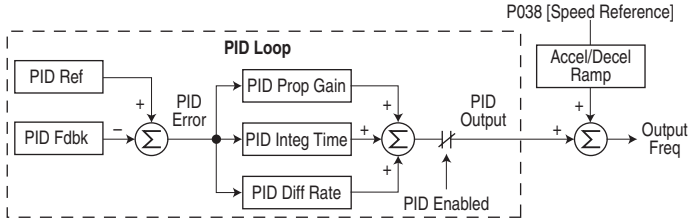
- In a pumping application, the PID Reference equals the Desired System Pressure set point.
- The Pressure Transducer signal provides PID Feedback to the drive. Fluctuations in actual system pressure, due to changes in flow, result in a PID Error value.
- The drive output frequency increases or decreases to vary motor shaft speed to correct for the PID Error value.
- The Desired System Pressure set point is maintained as valves in the system are opened and closed causing changes in flow.
- When the PID Control Loop is disabled, the Commanded Speed is the Ramped Speed Reference.



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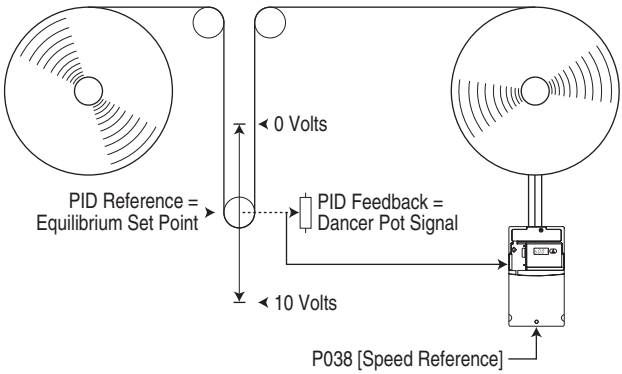
Trim Control

In Trim Control, the PID Output is added to the Speed Reference. In Trim mode, the output of the PID loop bypasses the accel/decel ramp as shown. Trim Control is used when A132 [PID Ref Sel] is set to option 6, 7, 8, 9 or 10.



Example

- In a winder application, the PID Reference equals the Equilibrium set point.
- The Dancer Pot signal provides PID Feedback to the drive. Fluctuations in tension result in a PID Error value.
- The Master Speed Reference sets the wind/unwind speed.
- As tension increases or decreases during winding, the Speed Reference is trimmed to compensate. Tension is maintained near the Equilibrium set point.



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PID Reference and Feedback

Parameter A132 [PID Ref Sel] is used to enable the PID mode (A132 = 0 "PID Disabled") and to select the source of the PID Reference. If A132 [PID Ref Sel] is not set to 0 "PID Disabled", PID can still be disabled by select programmable digital input options (parameters A051-A054) such as "Jog", "Local" or "PID Disable".

Table G.A A132 [PID Ref Sel] Options

Option	Description
0 "PID Disabled"	Disables the PID loop (default setting)
1 "PID Setpoint"	Selects Exclusive Control. A137 [PID Setpoint] will be used to set the value of the PID Reference
2 "0-10V Input"	Selects Exclusive Control. Selects the 0-10V Input. Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero.
3 "4-20mA Input"	Selects Exclusive Control. Selects the 4-20mA Input.
4 "Comm Port"	Selects Exclusive Control. The reference word from a communication network (see Appendix C for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Reference. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% reference. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% reference.
5 "Encoder"	Selects Exclusive Control. Encoder or Pulse train will be used as an input for the PID Reference.
6 "Setpnt, Trim"	Selects Trim Control. A137 [PID Setpoint] will be used to set the value of the PID Reference.
7 "0-10V, Trim"	Selects Trim Control. Selects the 0-10V Input. Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero.
8 "4-20mA, Trim"	Selects Trim Control. Selects the 4-20mA Input.
9 "Comm, Trim"	Selects Trim Control. The reference word from a communication network (see Appendix C for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Reference. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% reference. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% reference.
10 "Encoder,Trim"	Selects Trim Control. Encoder or Pulse train will be used as a trim input for the PID Feedback

A133 [PID Feedback Sel] is used to select the source of the PID feedback.

Table G.B A133 [PID Feedback Sel] Options

Option	Description
0 "0-10V Input"	Selects the 0-10V Input (default setting). Note that the PID will not function with a bipolar analog input. It will ignore any negative voltages and treat them like a zero.
1 "4-20mA Input"	Selects the 4-20mA Input.
2 "Comm Port"	The reference word from a communication network (see Appendix C of the PowerFlex 40P User Manual for details on the reference word) such as Modbus RTU or DeviceNet becomes the PID Feedback. The value sent over the network is scaled so that P035 [Maximum Freq] x 10 = 100% Feedback. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% Feedback.
3 "Encoder"	Encoder or Pulse train will be used as an input for the PID Feedback.

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Analog PID Reference Signals

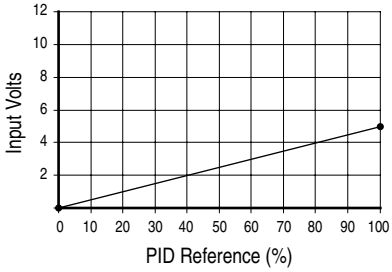
Parameters A110 [Anlg In 0-10V Lo] and A111 [Anlg In 0-10V Hi] are used to scale or invert an analog PID Reference or PID Feedback.

Examples

Scale Function

For a 0-5 volt signal, the following parameter settings are used so that a 0 volt signal = 0% PID Reference and a 5 volt signal = 100% PID Reference.

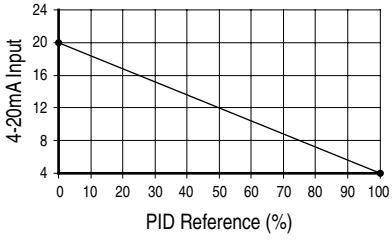
- A110 [Anlg In 0-10V Lo] = 0.0%
- A111 [Anlg In 0-10V Hi] = 50.0%
- A132 [PID Ref Sel] = 2 “0-10V Input”



Invert Function

For a 4-20mA signal, the following parameter settings are used so that a 20mA signal = 0% PID Reference and a 4mA signal = 100% PID Reference.

- A112 [Anlg In4-20mA Lo] = 100.0%
- A113 [Anlg In4-20mA Hi] = 0.0%
- A132 [PID Ref Sel] = 3 “4-20mA Input”



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PID Deadband

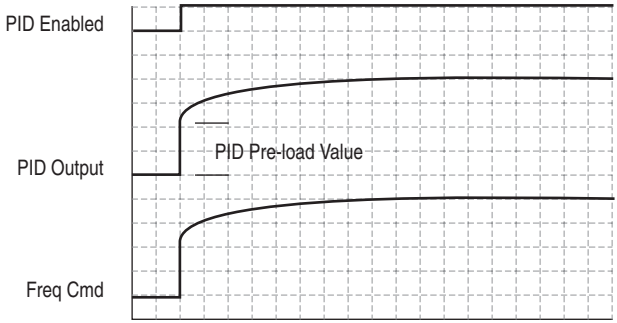
Parameter A138 [PID Deadband] is used to set a range, in percent, of the PID Reference that the drive will ignore.

Example

- [PID Deadband] is set to 5.0
- The PID Reference is 25.0%
- The PID Regulator will not act on a PID Error that falls between 20.0 and 30.0%

PID Preload

The value set in A139 [PID Preload], in Hertz, will be pre-loaded into the integral component of the PID at any start or enable. This will cause the drive's frequency command to initially jump to that preload frequency, and the PID loop starts regulating from there.



PID Limits

A130 [PID Trim Hi] and A131 [PID Trim Lo] are used to limit the PID output and are only used in trim mode. [PID Trim Hi] sets the maximum frequency for the PID output in trim mode. [PID Trim Lo] sets the reverse frequency limit for the PID output in trim mode. Note that when the PID reaches the Hi or Lo limit, the PID regulator stops integrating so that windup does not occur.

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PID Gains

The proportional, integral, and differential gains make up the PID regulator.

- A134 [PID Prop Gain]
  The proportional gain (unitless) affects how the regulator reacts to the magnitude of the error. The proportional component of the PID regulator outputs a speed command proportional to the PID error. For example, a proportional gain of 1 would output 100% of max frequency when the PID error is 100% of the analog input range. A larger value for [PID Prop Gain] makes the proportional component more responsive, and a smaller value makes it less responsive. Setting [PID Prop Gain] to 0.00 disables the proportional component of the PID loop.

- A135 [PID Integ Time]
  The integral gain (units of seconds) affects how the regulator reacts to error over time and is used to get rid of steady state error. For example, with an integral gain of 2 seconds, the output of the integral gain component would integrate up to 100% of max frequency when the PID error is 100% for 2 seconds. A larger value for [PID Integ Time] makes the integral component less responsive, and a smaller value makes it more responsive. Setting [PID Integ Time] to 0.0 disables the integral component of the PID loop.

- A136 [PID Diff Rate]
  The Differential gain (units of 1/seconds) affects the rate of change of the PID output. The differential gain is multiplied by the difference between the previous error and current error. Thus, with a large error the D has a large effect and with a small error the D has less of an effect. This parameter is scaled so that when it is set to 1.00, the process response is 0.1% of [Maximum Freq] when the process error is changing at 1% / second. A larger value for [PID Diff Rate] makes the differential term have more of an effect and a small value makes it have less of an effect. In many applications, the D gain is not needed. Setting [PID Diff Rate] to 0.00 (factory default) disables the differential component of the PID loop.

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Guidelines for Adjusting the PID Gains

1. Adjust the proportional gain. During this step it may be desirable to disable the integral gain and differential gain by setting them to 0. After a step change in the PID Feedback:
   - If the response is too slow increase A134 [PID Prop Gain].
   - If the response is too quick and/or unstable (see Figure G.1), decrease A134 [PID Prop Gain].
   - Typically, A134 [PID Prop Gain] is set to some value below the point where the PID begins to go unstable.
2. Adjust the integral gain (leave the proportional gain set as in Step 1). After a step change in the PID Feedback:
   - If the response is too slow (see Figure G.2), or the PID Feedback does not become equal to the PID Reference, decrease A135 [PID Integ Time].
   - If there is a lot of oscillation in the PID Feedback before settling out (see Figure G.3), increase A135 [PID Integ Time].
3. At this point, the differential gain may not be needed. However, if after determining the values for A134 [PID Prop Gain] and A135 [PID Integ Time]:
   - Response is still slow after a step change, increase A136 [PID Diff Rate].
   - Response is still unstable, decrease A136 [PID Diff Rate].

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The following figures show some typical responses of the PID loop at different points during adjustment of the PID Gains.

Figure G.1 Unstable

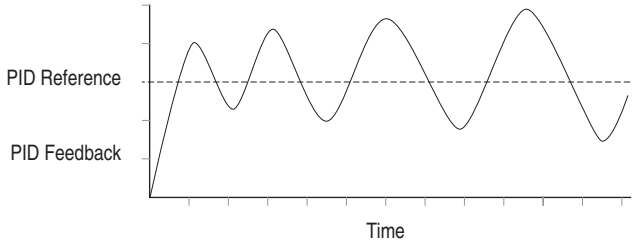


Figure G.2 Slow Response – Over Damped

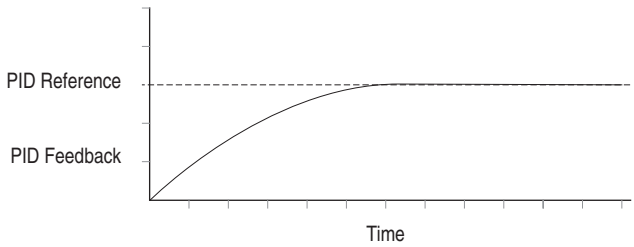


Figure G.3 Oscillation – Under Damped

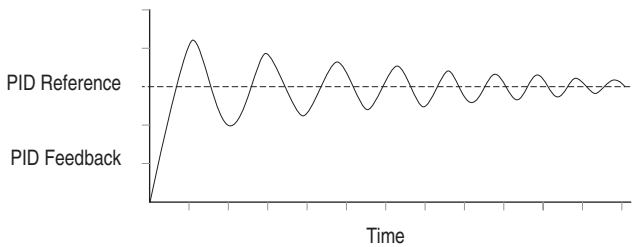
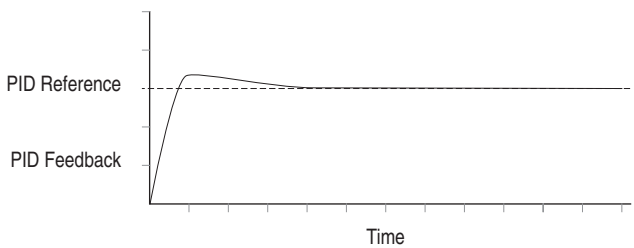


Figure G.4 Good Response – Critically Damped



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Plate Drive Installation Instructions

Introduction

The PowerFlex 40P is available in a plate drive version without heatsink. This is designed to allow mounting to a customer supplied heatsink. This may be a large heatsink to be shared by multiple drives, a large thermal mass that is part of a system, or some other heat-sinking system. Care must be taken to insure the heatsink used provides adequate cooling for the drive power components as well as a flat and clean surface for a proper thermal interface.

General Requirements

The drive is designed to operate with the drive enclosed and the heatsink exposed for improved cooling. Therefore, it is expected that the drive control section will experience a higher ambient temperature than the heatsink.

Table H.A Maximum Surrounding Air Temperature

Heatsink	40° C (104° F)
Drive	50° C (122° F)

Note that the standard 480V 11 kW (15 HP) drive includes an internal inductor. This inductor cannot be included in the plate drive. Therefore, this rating requires the use of an external DC inductor or an AC input reactor as described in Table B.E on page B-3.

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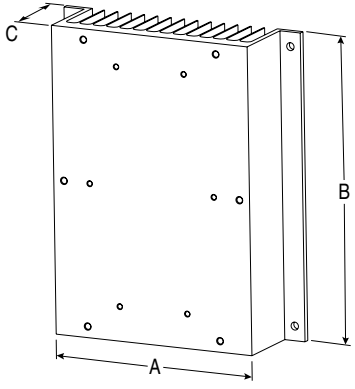
Heatsink Thermal Capacity

The heatsink provided must have the thermal capacity to cool the drive under worst-case loading conditions as well as for short duration overload conditions in the application. Refer to Table A.C on page A-5 for estimated watts loss data.

Table H.B Required Heatsink Degrees C/W Capabilities

Plate Drive Input Voltage	kW (HP)	Heatsink °C/W Needed
230V AC	0.4 (0.5)	1.59
	0.75 (1.0)	0.88
	1.5 (2.0)	0.56
	2.2 (3.0)	0.35
	3.7 (5.0)	0.23
	5.5 (7.5)	0.18
	7.5 (10)	0.13
460V AC	0.4 (0.5)	2.06
	0.75 (1.0)	1.17
	1.5 (2.0)	0.73
	2.2 (3.0)	0.47
	3.7 (5.0)	0.26
	5.5 (7.5)	0.25
	7.5 (10)	0.20
	11 (15)	0.13

Figure H.1 Approximate Heatsink Dimensions for One Drive without Heatsink Fan – Dimensions are in millimeters and (inches)



Drive Frame Size	A	B	C
B	214 (8.43)	250 (9.84)	63.1 (2.48)
C	300 (11.81)	325 (12.8)	138.2 (5.44)

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Heatsink Surface and Flatness Requirements

The drive comes with a thermal pad designed to provide a good interface between the drive and heatsink. However, in order for this to function properly the mounting surface for the plate drive must be clean and free of dirt, oil, and debris. It must be very flat and smooth and should have no scratches, nicks, or gouges. All mounting holes must be clean and deburred.

Table H.C Surface Requirements

Attribute	Requirement	Description
Surface Finish	1.6 µM (Ra Method)	Smoothness – Overall surface texture free from imperfections (scratches, nicks, or gouges)
Surface Flatness	-/+ 1.5 mil	Trueness – Free from warps, twists, and concavity (depressions)

Figure H.2 Smoothness Tolerance and Surface Pad Thickness

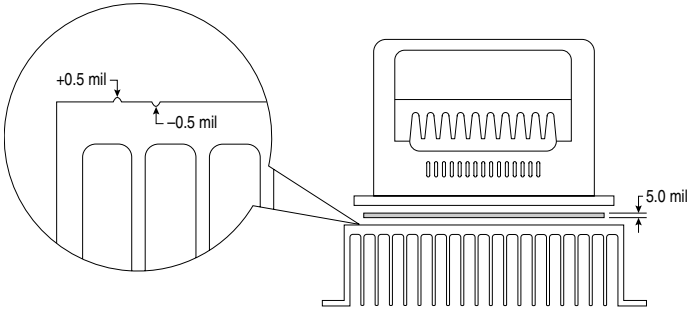
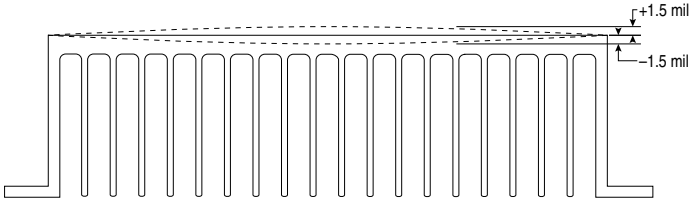


Figure H.3 Trueness Tolerance

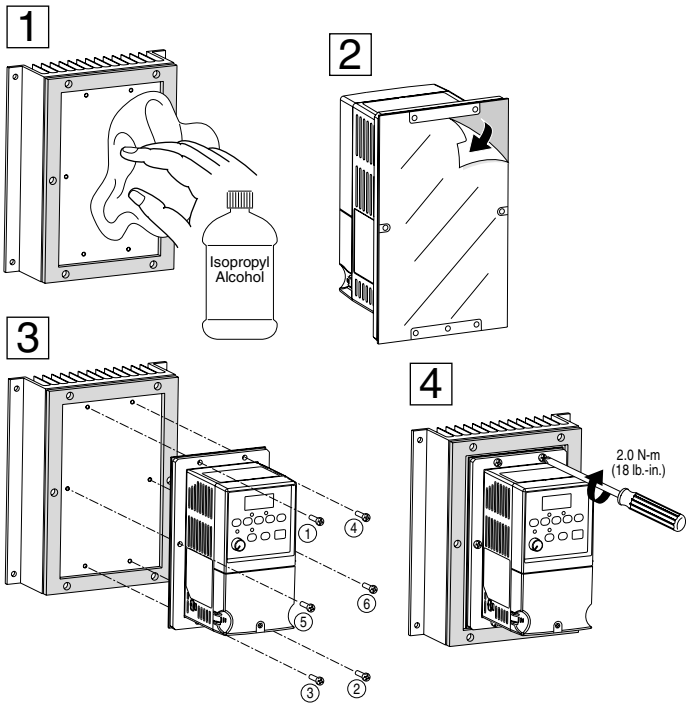


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Mounting Dimensions and Requirements

Refer to Figure B.5 on page B-11 for plate drive dimensions and mounting hole locations.

Use the pattern illustrated in Step 3 below to gradually tighten all mounting bolts to the recommend torque of 2.0 N-m (18 lb.-in.).



Verification

Once the drive is mounted, a worst-case test should be run to verify the design. The drive should run at its maximum load conditions at the highest expected surrounding air temperature. After four hours in this condition, the temperature of the drive plate should be measured. It should not exceed 75° C (167° F) at its hottest point. Also, parameter b024 [Drive Temp] should be monitored and should not exceed 80° C (176° F).

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