



Allen-Bradley

PowerFlex[®]
400

Adjustable Frequency AC Drive for Fan & Pump Applications

FRN 4.xx

User Manual

www.abpowerflex.com

**Rockwell
Automation**

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.

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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 400 *User Manual* since the August 2005 release.

Description of New or Updated Information	See Page(s)
Important statement regarding differences in parameter defaults for packaged drives added to parameter P041 [Reset To Defaults].	3-11
Important statement regarding related parameter added to parameter A167 [Flying Start En].	3-37

New Parameter

The following new parameter has been added with the release of Firmware Release Number (FRN) 4.xx.

Parameter Name	Parameter Number	See Page(s)
[Motor NP FLA]	A200	3-46

Manual Updates

The information below summarizes the changes to the PowerFlex 400 *User Manual* since the April 2005 release.

Description of New or Updated Information	See Page(s)
Attention statement clarified.	1-6
Min/Max wire sizes for Frame F corrected.	1-15
Note added regarding the function of I/O Terminal 18, Analog Common 2.	1-17
Connection Examples corrected for Analog Input and Analog Output.	1-20
Required filters corrected for 380-480V, 2.2-11 kW (3.0-15 HP) drives in First Environment Unrestricted.	1-28
Important statement regarding differences in parameter defaults for packaged drives added to parameter P041 [Reset To Defaults].	3-11
Fault F64 Drive Overload description corrected.	4-4
Overcurrent protection for hardware limit and instantaneous fault levels corrected.	A-3
Max storage temperatures corrected to 70 degrees C (158 degrees F).	A-3
Max and Actual Short Circuit Ratings added to Electrical specification.	A-4
Optional Relay specifications added.	A-5
Supported communication protocols expanded.	A-5
Watts Loss table added.	A-6
Power Structure detail added to Appendix A.	A-7
Appendix D provides setup information for Damper Control, PID Control, and Auxiliary Control schemes.	D-1
Appendix G, P1 network protocol added.	G-1

New Parameters

The following new parameters have been added with the release of Firmware Release Number (FRN) 3.xx.

Parameter Name	Parameter Number	See Page(s)
[Motor OL Ret]	P043	3-11
[Anlg Loss Delay]	T088	3-26
[Start Source 2]	C108	3-29
[Speed Ref 2]	C109	3-30

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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 400 Adjustable Frequency AC Drive.

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Drive Frame Sizes	P-2
General Precautions	P-3
Catalog Number Explanation	P-4

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	

Manual Conventions

- In this manual we refer to the PowerFlex 400 Adjustable Frequency AC Drive as; drive, PowerFlex 400 or PowerFlex 400 Drive.
- Parameter numbers and names are shown in this format:

P031	[Motor NP Volts]
	Name
	Number
	Group
	b = Basic Display Group
	P = Basic Program Group
	T = Terminal Block Group
	C = Communications Group
	A = Advanced Program Group
	R = Aux Relay Card Group
	d = Advanced Display Group

- 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 400 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](#).

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.

A darkened LCD display and 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 [A187](#)). In addition, installing a properly sized dynamic brake resistor will provide equal or better performance in most cases.

Catalog Number Explanation

1-3	4	5	6-8	9	10	11	12
22C	-	D	038	A	1	0	3
Drive	Dash	Voltage Rating	Rating	Enclosure	HIM	Emission Class	Comm Slot

Code

22C PowerFlex 400

Code Version

3 RS485

Code Rating

0 Not Filtered

Code Voltage Ph.

B 240V AC 3
D 480V AC 3

Code Interface Module

1 Fixed Keypad

Code Enclosure

N Panel Mount - IP20/UL Open-Type⁽¹⁾
A Panel Mount - IP30/NEMA 1/UL Type 1⁽²⁾
F Flange Mount - IP20/UL Open Type⁽³⁾

Output Current @ 200-240V 60Hz Input

Code	Amps	kW (HP)	Frame
012	12	2.2 (3.0)	C
017	17.5	3.7 (5.0)	C
024	24	5.5 (7.5)	C
033	33	7.5 (10)	C
049	49	11 (15)	D
065	65	15 (20)	D
075	75	18.5 (25)	D
090	90	22 (30)	D
120	120	30 (40)	E
145	145	37 (50)	E

Output Current @ 380-480V Input

Code	Amps	kW (HP)	Frame
6P0	6.0	2.2 (3.0)	C
010	10.5	4.0 (5.0)	C
012	12	5.5 (7.5)	C
017	17	7.5 (10)	C
022	22	11 (15)	C
030	30	15 (20)	C
038	38	18.5 (25)	D
045	45.5	22 (30)	D
060	60	30 (40)	D
072	72	37 (50)	E
088	88	45 (60)	E
105	105	55 (75)	E
142	142	75 (100)	E
170	170	90 (125)	F
208	208	110 (150)	F

⁽¹⁾ Frame C drives only available with IP20/UL Open-Type enclosure. Field installed conversion kit available to achieve IP30/NEMA 1/UL Type 1 rating.

⁽²⁾ Frame D, E and F drives only available with IP30/NEMA 1/UL Type 1 enclosure.

⁽³⁾ Frame C drives only.

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

Installation/Wiring

This chapter provides information on mounting and wiring the PowerFlex 400 Drive.

For information on...	See page	For information on...	See page
Opening the Cover	1-1	Fuses and Circuit Breakers	1-9
Mounting Considerations	1-4	Power Wiring	1-11
AC Supply Source Considerations	1-6	I/O Wiring Recommendations	1-15
General Grounding Requirements	1-8	EMC Instructions	1-27

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.

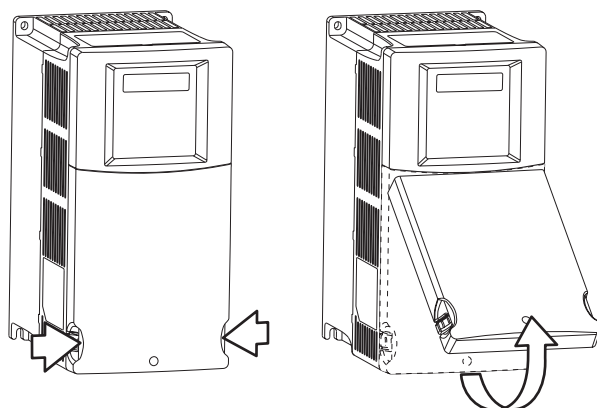


ATTENTION: The following information is merely a guide for proper installation. Rockwell Automation, Inc. cannot assume responsibility for the compliance or the noncompliance to any code, national, local or otherwise for the proper installation of this drive or associated equipment. A hazard of personal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

Opening the Cover

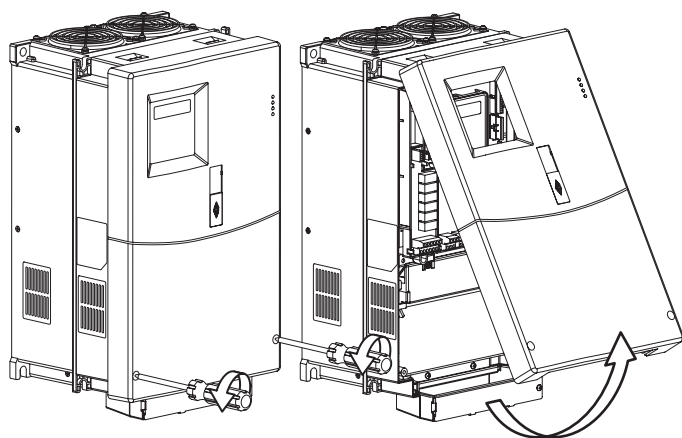
Frame C Drives

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



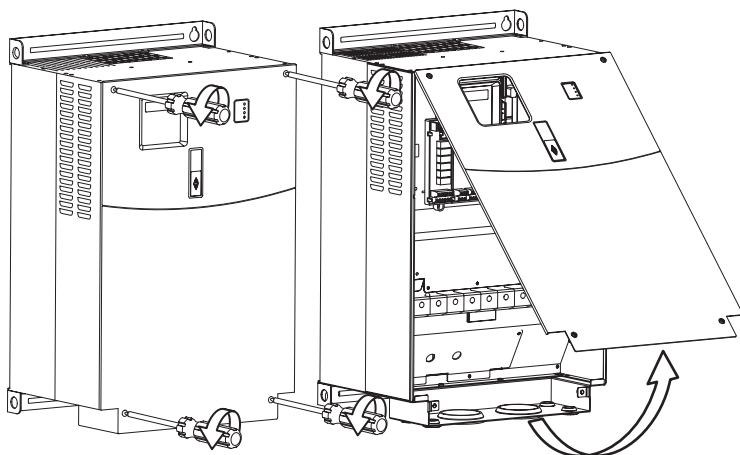
Frame D Drives

1. Loosen the two captive cover screws.
2. Pull the bottom of the cover out and up to release.



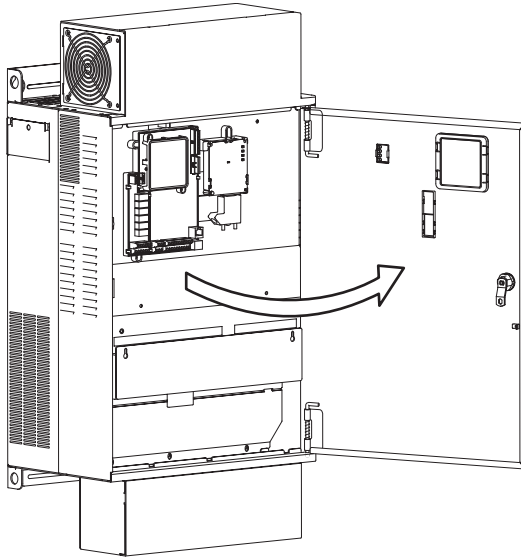
Frame E Drives

1. Loosen the four captive cover screws.
2. Pull the bottom of the cover out and up to release.



Frame F Drives

1. Turn the latch counterclockwise.
2. Pull on the latch to swing the door open.



Mounting Considerations

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

Frame	Screw Size	Screw Torque
C	M5 (#10-24)	2.45-2.94 N-m (22-26 lb.-in.)
D	M8 (5/16 in.)	6.0-7.4 N-m (53.2-65.0 lb.-in.)
E	M8 (5/16 in.)	8.8-10.8 N-m (78.0-95.3 lb.-in.)
F	M10 (3/8 in.)	19.6-23.5 N-m (173.6-208.3 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.

Maximum Surrounding Air Temperature

Frame	Enclosure Rating	Temperature Range	Minimum Mounting Clearances
C	IP 20/UL Open-Type	-10° to 45°C (14° to 113°F)	See Figure 1.1 , Mounting Option A
	IP 30/NEMA 1/UL Type 1 ⁽¹⁾	-10° to 45°C (14° to 113°F)	See Figure 1.1 , Mounting Option B
	IP 20/UL Open-Type	-10° to 50°C (14° to 122°F)	See Figure 1.1 , Mounting Option B
D	IP 30/NEMA 1/UL Type 1	-10° to 45°C (14° to 113°F)	See Figure 1.2
E			
F			

⁽¹⁾ Frame C drives require installation of the PowerFlex 400 IP 30/NEMA 1/UL Type 1 option kit to achieve this rating.

Minimum Mounting Clearances

Refer to [Appendix B](#) for mounting dimensions.

Figure 1.1 Frame C Mounting Clearances

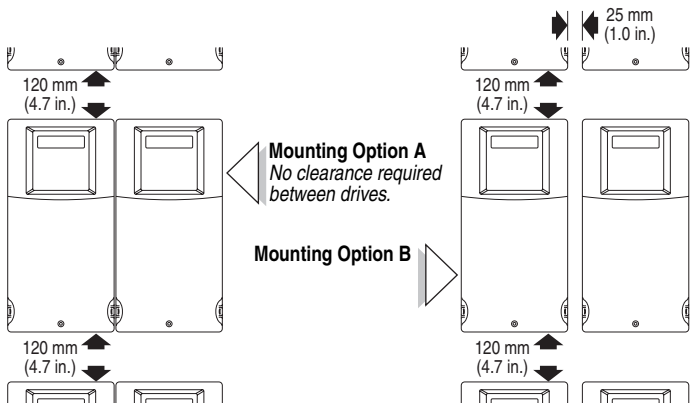
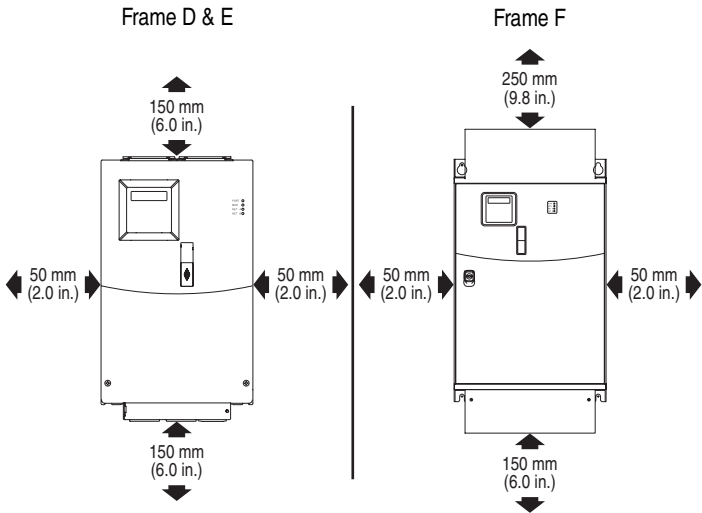


Figure 1.2 Frames D, E and F Mounting Clearances

Debris Protection

Frame C Drives – 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.

Frame D, E and F Drives – These drives have built-in debris protection. Installation of a protective panel is not required.

Storage

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

AC Supply Source Considerations

Ungrounded Distribution Systems



ATTENTION: PowerFlex 400 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 (Drive Frames C, E and F only.)

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 Figure 1.4.

Figure 1.3 Phase to Ground MOV Removal

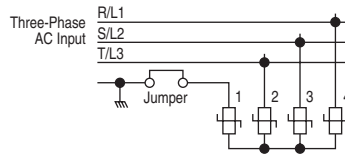
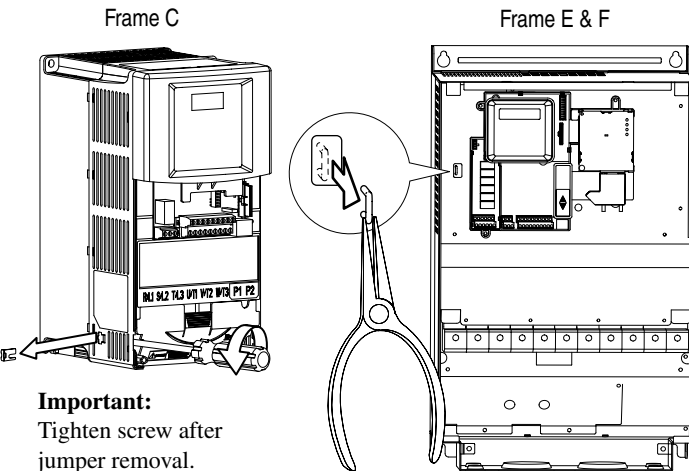


Figure 1.4 Jumper Location



Important:
Tighten screw after
jumper removal.

Note: Frame D drives do not contain a MOV to ground connection and are suitable for operation in both grounded and ungrounded distribution systems without modification.

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.A](#) 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.A](#), 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. The device should be mounted closest to the branch and sized to handle the total current of the branch circuit.

Table 1.A Input Power Conditions

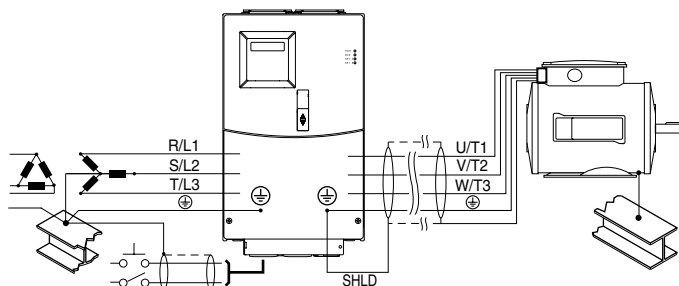
Input Power Condition	Corrective Action
Low Line Impedance (less than 1% line reactance)	• Install Line Reactor⁽¹⁾ • or Isolation Transformer
Line has power factor correction capacitors	• Install Line Reactor⁽¹⁾ • or Isolation Transformer
Line has frequent power interruptions	
Line has intermittent noise spikes in excess of 6000V (lightning)	
Phase to ground voltage exceeds 125% of normal line to line voltage	• Remove MOV jumper to ground (Frame C, E & F drives only) • or Install Isolation Transformer with grounded secondary if necessary
Ungrounded distribution system	

⁽¹⁾ Refer to [Appendix B](#) for accessory ordering information.

General Grounding Requirements

The drive Safety Ground - $\oplus$ (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 1.5 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 - $\oplus$ (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 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.

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 400 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.

Table 1.B Recommended Branch Circuit Protective Devices

Voltage Rating	Drive Rating kW (HP)	Fuse Rating⁽¹⁾ Amps	140M Motor Protectors⁽²⁾ Catalog No.	Recommended MCS Contactors Catalog No.
200-240V AC – 3-Phase	2.2 (3.0)	20	140M-D8E-C16	100-C23
	3.7 (5.0)	30	140M-F8E-C25	100-C37
	5.5 (7.5)	35	140M-F8E-C32	100-C37
	7.5 (10)	45	140M-F8E-C45	100-C45
	11 (15)	70	140-CMN-6300	100-C60
	15 (20)	90	140-CMN-9000	100-C85
	18.5 (25)	100	140-CMN-9000	100-D95
	22 (30)	125	–	100-D110
	30 (40)	175	–	100-D180
	37 (50)	200	–	100-D180
380-480V AC – 3-Phase	2.2 (3.0)	10	140M-D8E-C10	100-C09
	4.0 (5.0)	20	140M-D8E-C16	100-C16
	5.5 (7.5)	20	140M-D8E-C16	100-C23
	7.5 (10)	25	140M-D8E-C20	100-C23
	11 (15)	30	140M-F8E-C32	100-C30
	15 (20)	40	140M-F8E-C32	100-C37
	18.5 (25)	50	140M-F8E-C45	100-C60
	22 (30)	60	140-CMN-6300	100-C60
	30 (40)	80	140-CMN-9000	100-C85
	37 (50)	100	140-CMN-9000	100-C85
	45 (60)	125	–	100-D110
	55 (75)	150	–	100-D140
	75 (100)	200	–	100-D180
	90 (125)	250	–	100-D210
	110 (150)	250	–	100-D250

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

⁽²⁾ Refer to the Bulletin 140M Motor Protectors *Selection Guide*, publication 140M-SG001... to determine the frame and breaking capacity required for your application.

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 must use 600V, 75°C or 90°C wire.

Use copper wire only.

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.

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-7xxx-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.

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.C](#) for recommendations.

The reflected wave data applies to all frequencies 2 to 10 kHz.

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

Table 1.C Maximum Cable Length Recommendations

Reflected Wave		
380-480V Ratings	Motor Insulation Rating	Motor Cable Only ⁽¹⁾
	1000 Vp-p	7.6 meters (25 feet)
	1200 Vp-p	22.9 meters (75 feet)
	1600 Vp-p	152.4 meters (500 feet)

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

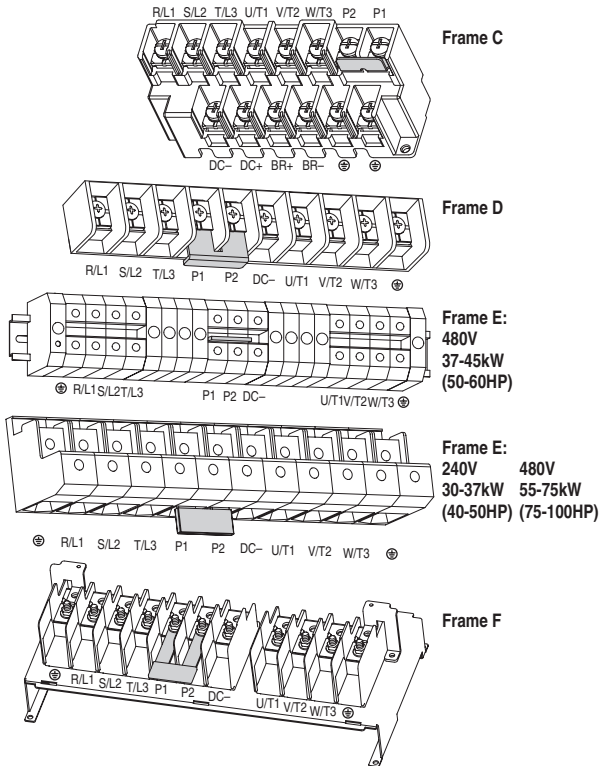
Output Disconnect

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.

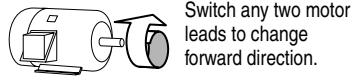
Power Terminal Block

Frame C, D, and F drives utilize a finger guard over the power wiring terminals. Replace the finger guard when wiring is complete.

Figure 1.6 Power Terminal Blocks



Terminal ⁽¹⁾	Description
R/L1, S/L2, T/L3	3-Phase Input
U/T1	To Motor U/T1
V/T2	To Motor V/T2
W/T3	To Motor W/T3
P2, P1	DC Bus Inductor Connection Drives are 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 (Frame C Drives)
P2, DC-	DC Bus Connection (Frame D, E, and F Drives)
BR+, BR-	Not Used
⊕	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.

Table 1.D Power Terminal Block Specifications

Frame	Maximum Wire Size ⁽¹⁾	Minimum Wire Size ⁽¹⁾	Recommended Torque
C	8.4 mm ² (8 AWG)	1.3 mm ² (16 AWG)	2.9 N-m (26 lb.-in.)
D	33.6 mm ² (2 AWG)	8.4 mm ² (8 AWG)	5.1 N-m (45 lb.-in.)
E 480V 37-45 kW (50-60 HP)	33.6 mm ² (2 AWG)	3.5 mm ² (12 AWG)	5.6 N-m (49.5 lb.-in.)
E 240V 30-37 kW (40-50 HP) 480V 55-75 kW (75-100 HP)	107.2 mm ² (4/0 AWG)	53.5 mm ² (1/0 AWG)	19.5 N-m (173 lb.-in.)
F	152.5 mm ² (300 MCM)	85.0 mm ² (3/0 AWG)	19.5 N-m (173 lb.-in.)

⁽¹⁾ Maximum/minimum sizes that the terminal block will accept - these are not recommendations. If national or local codes require sizes outside this range, lugs may be used.

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).



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

Control Wire Types

Table 1.E Recommended Control and Signal Wire⁽¹⁾

Wire Type(s)	Description	Minimum Insulation Rating
Belden 8760/9460 (or equiv.)	0.8 mm ² (18AWG), twisted pair, 100% shield with drain.	300V 60 degrees C (140 degrees F)
Belden 8770 (or equiv.)	0.8 mm ² (18AWG), 3 conductor, shielded for remote pot only.	

⁽¹⁾ 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.

I/O Terminal Block

Table 1.F I/O Terminal Block Specifications

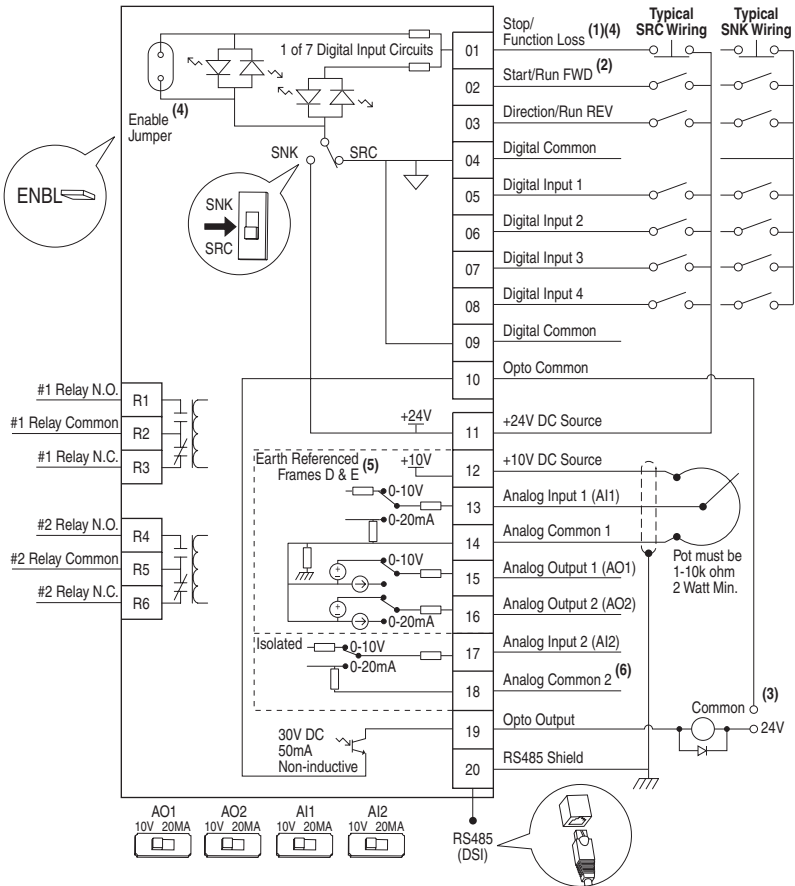
Frame	Maximum Wire Size ⁽²⁾	Minimum Wire Size ⁽²⁾	Torque
C, D, E, F	1.3 mm ² (16 AWG)	0.13 mm ² (26 AWG)	0.5-0.8 N-m (4.4-7 lb.-in.)

⁽²⁾ 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 must be connected to ground terminal/protective earth. If using the RS485 (DSI) port, I/O Terminal 20 should also be connected to ground terminal/protective earth.

Figure 1.7 Control Wiring Block Diagram



P036 [Start Source]	Stop	I/O Terminal 01 Stop
Keypad	Per P037	Coast
3-Wire	Per P037	Per P037 ⁽⁴⁾
2-Wire	Per P037	Coast
RS485 Port	Per P037	Coast

⁽¹⁾ **Important:** I/O Terminal 01 is always a coast to stop input except when P036 [Start Source] is set to option 1 "3-Wire" or 6 "2-W Lvl/Enbl". In three wire control, I/O Terminal 01 is controlled by P037 [Stop Mode]. All other stop sources are controlled by P037 [Stop Mode].

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. If reverse is enabled by A166, use a maintained input  for I/O Terminal 03 to change direction.
- (3) 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.
- (4) 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.
- (5) Most I/O terminals labeled "Common" are not referenced to the safety ground (PE) terminal and are designed to greatly reduce common mode interference. On Frame D and E drives, Analog Common 1 is referenced to ground.
- (6) Common for Analog Input 2 (AI2). Electronically isolated from digital I/O and opto output. Not to be used with Analog Input 1 (AI1), Analog Output 1 (AO1) or Analog Output 2 (AO2). With Analog Input 2, provides one fully isolated analog input channel.

Table 1.G Control I/O Terminal Designations

No.	Signal	Default	Description	Param.
01	Stop ⁽¹⁾ / Function Loss	Coast	Factory installed jumper or a normally closed input must be present for the drive to start. Program with P036 [Start Source].	P036 ⁽¹⁾
02	Start/Run FWD	–	HAND Mode: Command comes from Integral Keypad. AUTO Mode: I/O Terminal 02 is active. Program with P036 [Start Source].	P036, P037
03	Direction/Run REV	Rev Disabled	To enable reverse operation, program with A166 [Reverse Disable]. Program with P036 [Start Source].	P036, P037, A166
04	Digital Common	–	For digital inputs. Tied to I/O Terminal 09. Electronically isolated with digital inputs from analog I/O and opto output.	
05	Digital Input 1	Purge ⁽²⁾	Program with T051 [Digital In1 Sel].	T051
06	Digital Input 2	Local	Program with T052 [Digital In2 Sel].	T052
07	Digital Input 3	Clear Fault	Program with T053 [Digital In3 Sel].	T053
08	Digital Input 4	Comm Port	Program with T054 [Digital In4 Sel].	T054
09	Digital Common	–	For digital inputs. Tied to I/O Terminal 04. Electronically isolated with digital inputs from analog I/O and opto output.	
10	Opto Common	–	For opto-coupled outputs. Electronically isolated with opto output from analog I/O and digital inputs.	
11	+24V DC	–	Drive supplied power for digital inputs. Referenced to Digital Common. Max. Output: 100mA.	
12	+10V DC	–	Drive supplied power for 0-10V external potentiometer. Referenced to Analog Common. Max. Output: 15mA.	P038
13	Analog Input 1	0-10V	External 0-10V (unipolar), 0-20mA or 4-20mA input supply or potentiometer wiper. Default input is 0-10V. For current (mA) input, set AI1 DIP Switch to 20mA. Program with T069 [Analog In 1 Sel]. Input Impedance: 100k ohm (Voltage Mode) 250 ohm (Current Mode)	T069, T070, T071, T072
14	Analog Common 1	–	Common for Analog Input 1 and Analog Output 1 and 2. Electrically isolated from digital I/O and opto output.	
15	Analog Output 1	OutFreq 0-10	Default analog output is 0-10V. For current (mA) value, set AO1 DIP Switch to 20mA. Program with T082 [Analog Out1 Sel]. Maximum Load: 4-20mA = 525 ohm (10.5V) 0-10V = 1k ohm (10mA)	P038, T051-T054, A152
16	Analog Output 2	OutCurr 0-10	Default analog output is 0-10V. For a current (mA) value, set AO2 DIP Switch to 20mA. Program with T085 [Analog Out2 Sel]. Maximum Load: 4-20mA = 525 ohm (10.5V) 0-10V = 1k ohm (10mA)	T082, T084, T085, T086, T087
17	Analog Input 2	0-10V	Optically isolated external 0-10V (unipolar), $\pm 10V$ (bipolar), 0-20mA or 4-20mA input supply or potentiometer wiper. Default input is 0-10V. For current (mA) input, set AI2 DIP Switch to 20mA. Program with T073 [Analog In 2 Sel]. Input Impedance: 100k ohm (Voltage Mode) 250 ohm (Current Mode)	T073, T074, T075, T076
18	Analog Common 2	–	For Analog Input 2. Electronically isolated from digital I/O and opto output. With Analog Input 2, provides one fully isolated analog input channel.	
19	Opto Output	At Frequency	Program with T065 [Opto Out Sel].	T065, T066, T068
20	RS485 (DSI) Shield	–	Terminal connected to Safety Ground - PE when using the RS485 (DSI) Communication Port.	

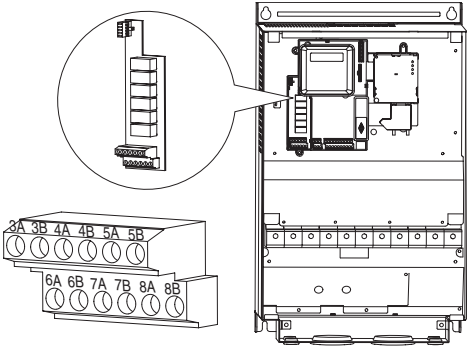
(1) See Footnotes (1) and (4) on page 1-17.

(2) **Important** information regarding Stop commands and the [Digital Inx Sel] Purge option is provided on page 3-12.

Table 1.H Relay Terminal Designations and DIP Switches

No.	Signal	Default	Description	Param.
R1	#1 Relay N.O.	Ready/Fault	Normally open contact for No. 1 output relay.	T055
R2	#1 Relay Common	–	Common for output relay.	
R3	#1 Relay N.C.	Ready/Fault	Normally closed contact for No. 1 output relay.	T055
R4	#2 Relay N.O.	Motor Running	Normally open contact for No. 2 output relay.	T060
R5	#2 Relay Common	–	Common for output relay.	
R6	#2 Relay N.C.	Motor Running	Normally closed contact for No. 2 output relay.	T060
Selection DIP Switches: Analog Input (AI1 & AI2) Analog Output (AO1 & AO2)		0-10V	Sets analog output to either voltage or current. Settings must match: AI1 & T069 [Analog In 1 Sel] AI2 & T073 [Analog In 2 Sel] AO1 & T082 [Analog Out1 Sel] AO2 & T085 [Analog Out2 Sel]	
Sink/Source DIP Switch		Source (SRC)	Inputs can be wired as Sink (SNK) or Source (SRC) via DIP Switch setting.	

Figure 1.8 User Installed Auxiliary Relay Card (Frames D, E, & F Only)



Important: If using auxiliary motor control, ensure that wiring and parameter configuration are correct before wiring contactor outputs. All relays on the Auxiliary Relay Card will energize on power-up by default. Failure to verify proper wiring and parameter configuration can result in improper motor operation or drive damage. Refer to Appendix D for more details.

Table 1.I User Installed Relay Board Terminal Designations

No.	Signal	Default	Description	Param.
3A	#3 Relay N.O.	Ready/Fault	Normally open contact for Number 3 Output Relay	R221
3B	#3 Relay Common	–	Common for Number 3 Output Relay	
4A	#4 Relay N.O.	Ready/Fault	Normally open contact for Number 4 Output Relay	R224
4B	#4 Relay Common	–	Common for Number 4 Output Relay	
5A	#5 Relay N.O.	Ready/Fault	Normally open contact for Number 5 Output Relay	R227
5B	#5 Relay Common	–	Common for Number 5 Output Relay	
6A	#6 Relay N.O.	Ready/Fault	Normally open contact for Number 6 Output Relay	R230
6B	#6 Relay Common	–	Common for Number 6 Output Relay	
7A	#7 Relay N.O.	Ready/Fault	Normally open contact for Number 7 Output Relay	R233
7B	#7 Relay Common	–	Common for Number 7 Output Relay	
8A	#8 Relay N.O.	Ready/Fault	Normally open contact for Number 8 Output Relay	R236
8B	#8 Relay Common	–	Common for Number 8 Output Relay	

I/O Wiring Examples

Input/Output	Connection Example	Required Settings
Potentiometer 1-10k Ohm Potentiometer Recommended (2 Watt Minimum)		DIP Switch AI1 = 10V Parameters P038 [Speed Reference] = 2 "Analog In1" T069 [Analog In 1 Sel] = 2 "0-10V" Scaling T070 [Analog In 1 Lo] T071 [Analog In 1 Hi] Check Results d305 [Analog In 1]
Analog Input Bipolar Speed Reference, $\pm 10V$ Input		DIP Switch AI2 = 10V Parameters P038 [Speed Reference] = 3 "Analog In2" T073 [Analog In 2 Sel] = 3 "-10 to +10V" Scaling T074 [Analog In 2 Lo] T075 [Analog In 2 Hi] Check Results d306 [Analog In 2]
Analog Input Unipolar Speed Reference, 0 to +10V Input		DIP Switch AI1 = 10V Parameters P038 [Speed Reference] = 2 "Analog In1" T069 [Analog In 1 Sel] = 2 "0-10V" Scaling T070 [Analog In 1 Lo] T071 [Analog In 1 Hi] Check Results d305 [Analog In 1]
Analog Input Unipolar Speed Reference, 4-20 mA Input		DIP Switch AI1 = 20MA Parameters P038 [Speed Reference] = 2 "Analog In1" T069 [Analog In 1 Sel] = 1 "4-20 mA" Scaling T070 [Analog In 1 Lo] T071 [Analog In 1 Hi] Check Results d305 [Analog In 1]
Analog Output Unipolar, 0 to +10V Output 1k Ohm Minimum		DIP Switch AO1 = 10V Parameters T082 [Analog Out1 Sel] = 0 through 6 Scaling T083 [Analog Out1 High] T084 [Analog Out1 Setpt]

Input/Output	Connection Example	Required Settings
Analog Output Unipolar, 4-20 mA Output 525 Ohm Maximum		DIP Switch AO1 = 20MA Parameters T082 [Analog Out1 Sel] = 14 through 20 Scaling T083 [Analog Out1 High] T084 [Analog Out1 Setpt]
2 Wire Control Sourcing (SRC), Internal Supply, Non-Reversing - Input must be active for the drive to run. - When input is opened, the drive will stop as specified by P037 [Stop Mode]. - Drive will not run if I/O Terminal 01 is open. Drive will coast to stop if opened while running.		DIP Switch SNK/SRC = SRC Parameters P036 [Start Source] = 2, 3, 4 P037 [Stop Mode] = 0 through 7
2 Wire Control Sourcing (SRC), External Supply, Non-Reversing - Input must be active for the drive to run. - When input is opened, the drive will stop as specified by P037 [Stop Mode]. - User supplied 24V DC power source must be used. - Each digital input draws 6 mA. - Drive will not run if I/O Terminal 01 is open. Drive will coast to stop if opened while running.		DIP Switch SNK/SRC = SRC Parameters P036 [Start Source] = 2, 3, 4 P037 [Stop Mode] = 0 through 7
2 Wire Control Sinking (SNK), Internal Supply, Non-Reversing - Input must be active for the drive to run. - When input is opened, the drive will stop as specified by P037 [Stop Mode]. - Drive will not run if I/O Terminal 01 is open. Drive will coast to stop if opened while running.		DIP Switch SNK/SRC = SNK Parameters P036 [Start Source] = 2, 3, 4 P037 [Stop Mode] = 0 through 7

Input/Output	Connection Example	Required Settings
2 Wire Control Sourcing (SRC), Internal Supply, Run FWD/Run REV - 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 FWD and Run REV inputs are closed at the same time, an undetermined state could occur. - Drive will not run if I/O Terminal 01 is open. Drive will coast to stop if opened while running.		DIP Switch SNK/SRC = SRC Parameters P036 [Start Source] = 2, 3, 4 P037 [Stop Mode] = 0 through 7 A166 [Reverse Disable] = 0 "Enabled"
2 Wire Control with Function Loss and SW Enable Sourcing (SRC), Internal Supply, Non-Reversing - Input must be active for the drive to run. - When input is opened, the drive will stop as specified by P037 [Stop Mode]. - Drive will not run if I/O Terminal 03 is open. Drive will coast to stop if opened while running. - Drive will fault if I/O Terminal 01 is open. Drive will coast to stop if opened while running. Requires drive reset once terminal is closed.		DIP Switch SNK/SRC = SRC Parameters P036 [Start Source] = 6 "2-W Lvl/Enbl" P037 [Stop Mode] = 0 through 7
3 Wire Control Sourcing (SRC), Internal Supply, Non-Reversing - 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].		DIP Switch SNK/SRC = SRC Parameters P036 [Start Source] = 1 "3-Wire" P037 [Stop Mode] = 0 through 7
3 Wire Control Sourcing (SRC), Internal Supply, Reversing - 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.		DIP Switch SNK/SRC = SRC Parameters P036 [Start Source] = 1 "3-Wire" P037 [Stop Mode] = 0 through 7 A166 [Reverse Disable] = 0 "Rev Enabled"

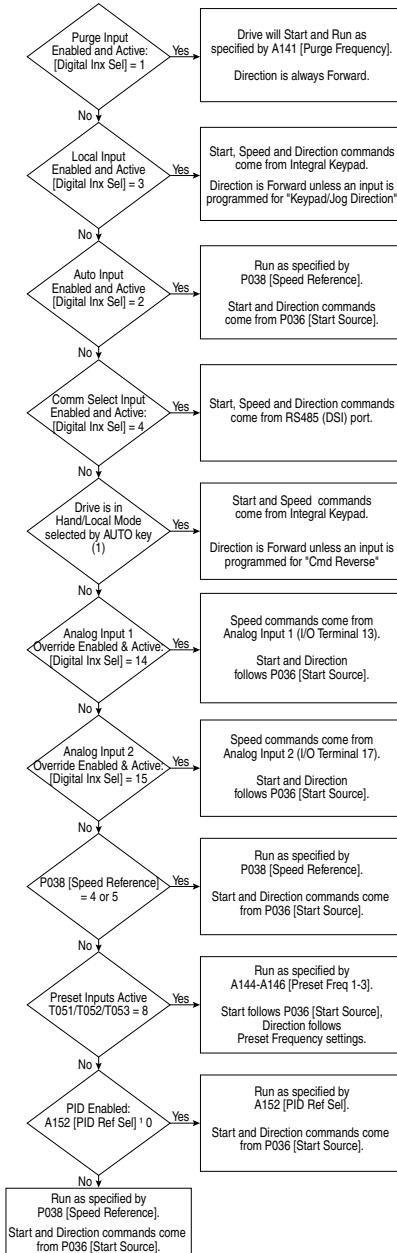
Input/Output	Connection Example	Required Settings
Opto Output - When using Opto Output with an inductive load such as a relay, install a recovery diode parallel to the relay as shown to prevent damage to the output. - Opto Output is rated 30V DC, 50 mA (non-inductive).		Parameters T065 [Opto Out Sel] = 0 through 15 T066 [Opto Out Level] T068 [Opto Out Logic]

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.

Start and Speed Reference Control

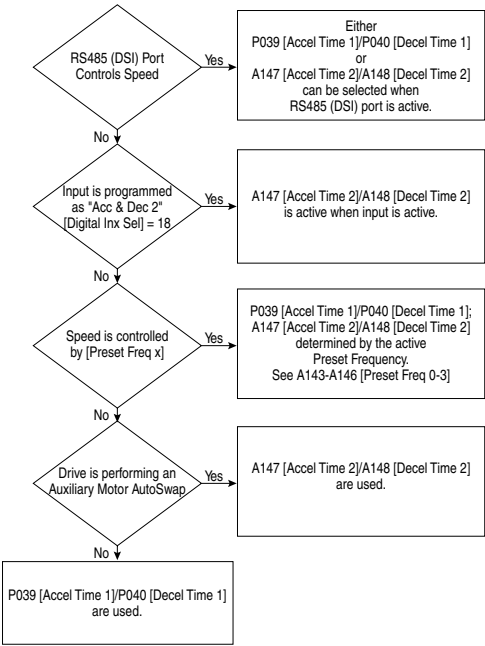
The drive speed command can be obtained from a number of different sources. The source is normally determined by [P038](#) [Speed Reference]. The drive Start command is normally determined by [P036](#) [Start Source]. However, the settings for these parameters can be overridden by a variety of methods. See the chart below for the override priority.



(1) Refer to [page 2-6](#) for additional information on the operation of the Hand/Auto Mode.

Accel/Decel Selection

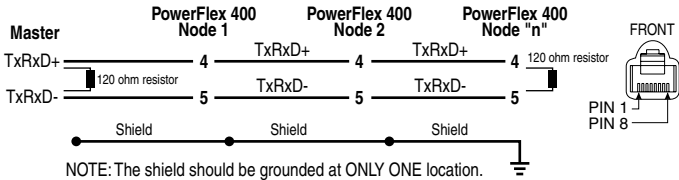
The Accel/Decel rate can be obtained by a variety of methods. The default rate is determined by P039 [Accel Time 1] and P040 [Decel Time 1]. Alternative Accel/Decel rates can be made through digital inputs, RS485 (DSI) communications and/or parameters. See the chart below for the override priority.



RS485 Network Wiring

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

Figure 1.9 Network Wiring Diagram



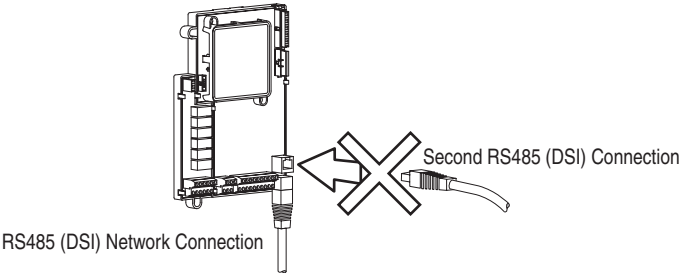
Only pins 4 and 5 on the RJ45 plug should be wired. The other pins on the PowerFlex 400 RJ45 socket contain power, etc. for other Rockwell Automation peripheral devices and must not be connected.

Wiring terminations on the master controller will vary depending on the master controller used and “TxRx+” and “TxRx-” 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.

On Drive Connections

PowerFlex 400 Frame D, E, and F drives are equipped with two RS485 (DSI) ports. One is accessible via an access door when the cover is on and one is only accessible with the cover off. When one of these ports has a Rockwell DSI device connected, the second port cannot be used.

Figure 1.10 Frame D, E, and F RS485 Ports



EMC Instructions

CE Conformity

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

All Drive Frames

- 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.

Frame C Drives Only

- If the plastic top panel is removed 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.

Essential Requirements for CE Compliance

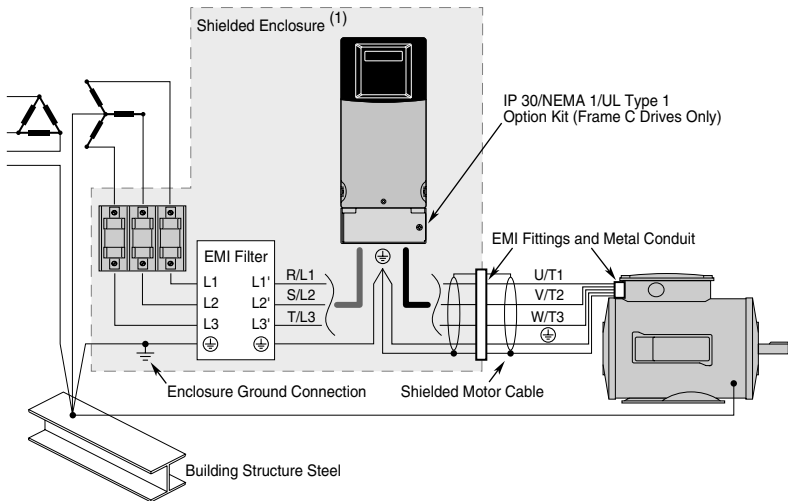
Conditions 1-4 listed below **must be** satisfied for PowerFlex drives to meet the requirements of **EN61800-3**.

1. Grounding as described in [Figure 1.11](#). Refer to [page 1-9](#) 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. All shielded cables should terminate with the proper shield connector.
4. Conditions in [Table 1.J](#).

Table 1.J PowerFlex 400 – EN61800-3 Compliance

PowerFlex 400 Drive		First Environment Restricted			First Environment Unrestricted		
kW (HP)	Cat. No. 22C-...	Required Filter (Allen-Bradley)	Restrict Motor Cable to (Meters)	Install Drive and Filter in Shielded Enclosure	Required Filter	Restrict Motor Cable to (Meters)	Install Drive and Filter in Shielded Enclosure
200-240 Volts							
2.2 (3.0)	B012N103	22-RF034-CS	10	No	22-RF034-CS	1	Required
3.7 (5.0)	B017N103	22-RF034-CS	10	No	22-RF034-CS	1	Required
5.5 (7.5)	B024N103	22-RF034-CS	10	No	22-RF034-CS	1	Required
7.5 (10)	B033N103	22-RF034-CS	10	No	22-RF034-CS	1	Required
11 (15)	B049A103	22-RFD070	150	Required	Deltron MIF Series	50	Required
15 (20)	B065A103	22-RFD100	150	Required	Deltron MIF Series	50	Required
18.5 (25)	B075A103	22-RFD100	150	Required	Deltron MIF Series	50	Required
22 (30)	B090A103	22-RFD150	150	Required	Deltron MIF Series	50	Required
30 (40)	B120A103	22-RFD150	150	No	Deltron MIF Series	50	Required
37 (50)	B145A103	22-RFD180	150	No	Deltron MIF Series	75	Required
380-480 Volts							
2.2 (3.0)	D6P0N103	22-RF018-CS	10	No	22-RF018-CS	1	Required
4.0 (5.0)	D010N103	22-RF018-CS	10	No	22-RF018-CS	1	Required
5.5 (7.5)	D012N103	22-RF018-CS	10	No	22-RF018-CS	1	Required
7.5 (10)	D017N103	22-RF018-CS	10	No	22-RF018-CS	1	Required
11 (15)	D022N103	22-RF026-CS	10	No	22-RF026-CS	1	Required
15 (20)	D030N103	22-RFD036	100	No	Deltron MIF Series	5	Required
18.5 (25)	D038A103	22-RFD050	150	No	Deltron MIF Series	5	Required
22 (30)	D045A103	22-RFD050	150	No	Deltron MIF Series	5	Required
30 (40)	D060A103	22-RFD070	50	No	Deltron MIF Series	5	Required
37 (50)	D072A103	22-RFD100	50	No	Deltron MIF Series	5	Required
45 (60)	D088A103	22-RFD100	50	No	Deltron MIF Series	5	Required
55 (75)	D105A103	22-RFD150	150	No	Deltron MIF Series	5	Required
75 (100)	D142A103	22-RFD180	50	No	Deltron MIF Series	5	Required
90 (125)	D170A103	Consult Factory			Consult Factory		
110 (150)	D208A103	Consult Factory			Consult Factory		

Figure 1.11 Connections and Grounding



- (1) Shielded Enclosure required to meet EN61800-3 First Environment Restricted for 200-240V AC 11-22 kW (15-30 HP) PowerFlex 400 drives and to meet EN61800-3 First Environment Unrestricted for all PowerFlex 400 ratings.

FCC Instructions

FCC Compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules when installed according to the User Manual. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the User Manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

Essential Requirements for FCC Compliance

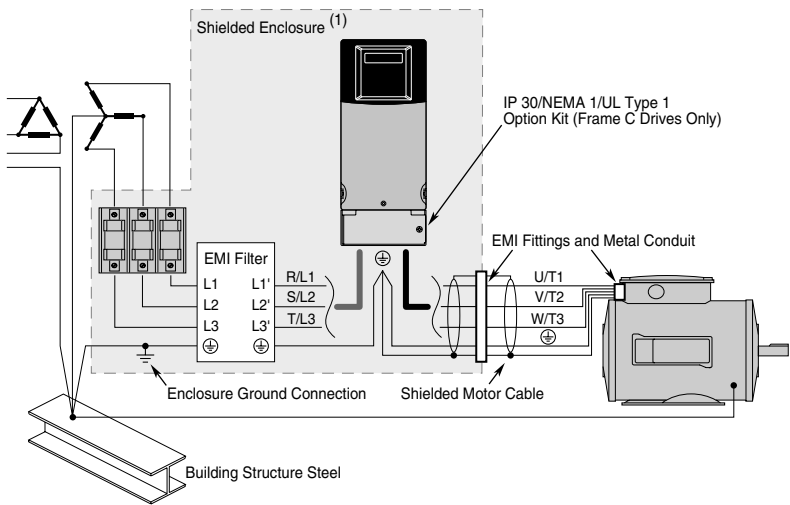
Conditions 1-4 listed below must be satisfied for PowerFlex 400 drives to meet the requirements of FCC Part 15 Subpart B.

1. Grounding as described in [Figure 1.11](#). Refer to [page 1-9](#) 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. All shielded cables should terminate with the proper shield connector.
4. Conditions in [Table 1.K](#).

Table 1.K PowerFlex 400 – FCC Part 15 Subpart B Compliance

PowerFlex 400 Drive		Required Filter	Restrict Motor Cable to (Meters)	Install Drive and Filter in Enclosure
kW (HP)	Cat. No.			
200-240 Volts				
2.2 (3.0)	22C-B012N103	22-RF034-CS	10	No
3.7 (5.0)	22C-B017N103	22-RF034-CS	10	No
5.5 (7.5)	22C-B024N103	22-RF034-CS	10	No
7.5 (10)	22C-B033N103	22-RF034-CS	10	No
11 (15)	22C-B049A103	22-RFD070	150	Required
15 (20)	22C-B065A103	22-RFD100	150	Required
18.5 (25)	22C-B075A103	22-RFD100	150	Required
22 (30)	22C-B090A103	22-RFD150	150	Required
30 (40)	22C-B120A103	22-RFD150	150	No
37 (50)	22C-B145A103	22-RFD180	150	No
380-480 Volts				
2.2 (3.0)	22C-D6P0N103	22-RF018-CS	10	No
4.0 (5.0)	22C-D010N103	22-RF018-CS	10	No
5.5 (7.5)	22C-D012N103	22-RF018-CS	10	No
7.5 (10)	22C-D017N103	22-RF018-CS	10	No
11 (15)	22C-D022N103	22-RF026-CS	10	No
15 (20)	22C-D030N103	22-RFD036	100	No
18.5 (25)	22C-D038A103	22-RFD050	150	No
22 (30)	22C-D045A103	22-RFD050	150	No
30 (40)	22C-D060A103	22-RFD070	50	No
37 (50)	22C-D072A103	22-RFD100	50	No
45 (60)	22C-D088A103	22-RFD100	50	No
55 (75)	22C-D105A103	22-RFD150	150	No
75 (100)	22C-D142A103	22-RFD180	50	No
90 (125)	22C-D170A103	Consult Factory		
110 (150)	22C-D208A103	Consult Factory		

Figure 1.12 Connections and Grounding



(1) Shielded Enclosure required for 200-240V AC 11-22 kW (15-30 HP) PowerFlex 400 drives.

Notes:

Start Up

This chapter describes how to start up the PowerFlex 400 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 [Table 1.G on page 1-18](#) for location.

Important: The default control scheme is Source (SRC). The Stop terminal is jumpered (I/O Terminals 01 and 11) to allow starting from the keypad. 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.

- ☐ 6. Verify that the Analog I/O DIP Switches are set to 10 volts.

Applying Power to the Drive

- ❑ 7. Apply AC power and control voltages to the drive.
- ❑ 8. Familiarize yourself with the integral keypad features (see [page 2-3](#)) before setting any Program Group parameters.

Start, Stop, Direction and Speed Control

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

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

Integral Keypad



Operator Keys

Key	Name	Description
	Escape	Back one step in programming menu. Cancel a change to a parameter value and exit Program Mode.
	Select	Advance one step in programming menu. Select a digit when viewing parameter value.
	Up Arrow Down Arrow	Scroll through groups and parameters. Increase/decrease the value of a flashing digit.
	Enter	Advance one step in programming menu. Save a change to a parameter value.
	Digital Speed Increment and Decrement Arrows	Used to control speed of drive. Default is active. Control is activated by parameter P036 [Speed Reference] or P042 [Auto Mode].
	Run/Start & Hand ⁽¹⁾	Used to start the drive. Default is Hand mode as controlled by parameter P042 [Auto Mode]. Control is activated by parameter P036 [Start Source] or P042 [Auto Mode].
	Auto ⁽¹⁾	Used to select Auto control mode. Controlled by parameter P042 [Auto Mode].
	Stop/Off	Used to stop the drive or clear a fault. This key is always active. Controlled by parameter P037 [Stop Mode].

(1) **Important:** Certain digital input settings can override drive operation. Refer to [Start and Speed Reference Control on page 1-24](#) for details.

LED Status Indicators

LED	LED State	Description
Program Status 	Steady Red	Indicates parameter value can be changed. Selected digit will flash.
Fault Status 	Flashing Red	Indicates that the drive is faulted.
Speed Status 	Steady Green	Indicates that the digital speed control keys are enabled.
Hand Status 	Steady Green	Indicates that the Run/Start key is enabled.
Auto Status 	Steady Yellow	Indicates that the drive is in Auto mode.

LCD Display



No.	Description
1	Parameter Name
2	Run/Stop Status: S[~] & S[~] = Stopped / R[~] & R[~] = Running R[~] or R[~] flashes to indicate that the drive is stopping, but is still decelerating. R[~] or R[~] flashes when DC Injection is commanded. Direction Indication: The Direction Arrow [~] & [~] indicates the commanded direction of rotation. If the Arrow is flashing, the drive has been commanded to change direction, but is still decelerating. Sleep Mode Indication: R[~] or R[~] flashes to indicate that the drive is in sleep mode.
3	Parameter Group and Number: b = Basic Display P = Basic Program T = Terminal Block C = Communications A = Advanced Program R = Aux Relay Card d = Advanced Display



4	Fault Indication and Fault Number
5	Fault Name

Viewing and Editing Parameters

The last user-selected Basic Display Group parameter is saved when power is removed and is displayed by default when power is reapplied.

The following is an example of basic integral keypad and display functions. This example provides basic navigation instructions and illustrates how to program the first Basic Program Group parameter.

Step	Key(s)	Example Displays
1. When power is applied, the last user-selected Basic Display Group parameter number is displayed with flashing characters. The display then defaults to that parameter's current value. (Example shows the value of b001 [Output Freq] with the drive stopped.)		Output Freq S* 0.00 Hz
2. Press the Up Arrow or Down Arrow to scroll through the Basic Display Group parameters. (Only in Display Groups)	▲ or ▼	
3. Press Esc once to display the Basic Display Group parameter number shown on power-up. The parameter number will flash.	ESC	Output Freq S* b001
4. Press Esc again to enter the group menu. The group menu letter will flash.	ESC	Basic Display S* b001
5. Press the Up Arrow or Down Arrow to scroll through the group menu (b, P, T, C, A and d).	▲ or ▼	Basic Program S* P001
6. Press Enter or Sel to enter a group. The right digit of the last viewed parameter in that group will flash.	↵ or SEL	Basic Program S* P001
7. Press the Up Arrow or Down Arrow to scroll through the parameters that are in the group.	▲ or ▼	
8. Press Enter or Sel to view the value of a parameter. If you do not want to edit the value, press Esc to return to the parameter number.	↵ or SEL	Motor NP Volts S* 230 Vac
9. Press Enter or Sel to enter program mode to edit the parameter value. The right digit will flash and the Program LED will illuminate if the parameter can be edited.	↵ or SEL	Motor NP Volts S* 230 Vac
10. If desired, press Sel to move from digit to digit or bit to bit. The digit or bit that you can change will flash.	SEL	Motor NP Volts S* 230 Vac
11. Press the Up Arrow or Down Arrow to change the parameter value.	▲ or ▼	
12. Press Esc to cancel a change. The digit will stop flashing, the previous value is restored and the Program LED will turn off.	ESC	
Or		
Press Enter to save a change. The digit will stop flashing and the Program LED will turn off.	↵	Motor NP Volts S* 220 Vac
13. Press Esc to return to the parameter list. Continue to press Esc to back out of the programming menu.	ESC	Basic Program S* P001
If pressing Esc does not change the display, then b001 [Output Freq] is displayed. Press Enter or Sel to enter the last group menu viewed.		

The Basic Program Group ([page 3-7](#)) contains the most commonly changed parameters.

Keypad Hand-Off-Auto Functions

Parameter P042 [Auto Mode] defines the operation mode of the control keys on the integral keypad.

Hand-Off-Auto Mode

In HAND mode:

- Control keys operate as Hand-Off-Auto.
- Start command and speed reference come from the integral keypad Start/Hand and Digital Speed Increment and Decrement keys.
- Auto key switches control from HAND mode to AUTO mode in a bumpless transfer as long as there is an active Run command.

In AUTO mode:

- Auto key LED is illuminated.
- Start command is defined by [P036](#) [Start Source].
- Speed Reference command is defined by [P038](#) [Speed Reference].
- Start/Hand key switches control to the integral keypad in a bumpless transfer and switches the speed reference to the integral keypad.
- Stop key stops the drive and the drive switches to HAND mode.

Table 2.A P042 [Auto Mode] = 1 “Hnd-Off-Auto” (Default)
T051-T054 [Digital Inx Sel] ≠ 2 “Auto Mode” or 3 “Local”

Key	HAND Mode		AUTO Mode	
	LED	Key Function	LED	Key Function
	On 	Starts drive. Runs according to Speed Increment/ Decrement keys.	On 	Changes to HAND Mode and Starts drive. Runs according to Speed Increment/ Decrement keys.
	On 	Changes speed.	Off 	Not active. Keys are only active if P038 [Speed Source] = 0 “Drive Pot”.
	Off 	Changes to AUTO Mode.	On 	Not active.
	N/A	Stops drive.	N/A	Changes to HAND Mode and Stops drive.

Important: Certain digital input settings can override drive operation.
Refer to [Start and Speed Reference Control on page 1-24](#)
for details.

Local/Remote Mode

In Local mode:

- Start command and speed reference come from the integral keypad Start/Hand and Digital Speed Increment and Decrement keys.
- Auto key stops the drive and the drive switches to Remote mode.

Important: If the drive is running and P036 [Start Source] = 3 or 6 (2-Wire Control), the drive will continue to run at reference defined by P038 [Speed Reference] if a valid start command is present.

In Remote mode:

- Auto key LED is illuminated.
- Start command is defined by [P036](#) [Start Source].
- Speed Reference command is defined by [P038](#) [Speed Reference].
- Auto key stops the drive and the drive switches to Local mode.

Table 2.B P042 [Auto Mode] = 2 “Local/Remote”
T051-T054 [Digital Inx Sel] ≠ 2 “Auto Mode” or 3 “Local”

Key	Local Mode		Remote Mode	
	LED	Key Function	LED	Key Function
	On	Starts drive.  Runs according to Speed Increment/Decrement keys.	Off	Not active.  Only active if P036 [Start Source] = 0 “Keypad”. Starts drive.
	On	Changes speed. 	Off	Not active.  Keys are only active if P038 [Speed Source] = 0 “Drive Pot”.
	Off	Stops drive and changes to Remote Mode. 	On	Stops drive and changes to Local Mode. 
	N/A	Stops drive.	N/A	Stops drive.

Important: Certain digital input settings can override drive operation. Refer to [Start and Speed Reference Control on page 1-24](#) for details.

Auto/Manual Mode

In Manual mode:

- Start command is defined by [P036](#) [Start Source].
- Speed Reference command is defined by the Digital Speed Increment and Decrement keys.
- Auto key toggles frequency control to AUTO in a bumpless transfer.

In AUTO mode:

- Auto key LED is illuminated.
- Start command is defined by [P036](#) [Start Source].
- Speed Reference command is defined by [P038](#) [Speed Reference].
- Auto key switches frequency control to the integral keypad in a bumpless transfer.

Table 2.C P042 [Auto Mode] = 3 “Auto/Manual”
T051-T054 [Digital Inx Sel] ≠ 2 “Auto Mode” or 3 “Local”

Key	Manual Mode		AUTO Mode	
	LED	Key Function	LED	Key Function
	Off 	Not active. Only active if P036 [Start Source] = 0 “Keypad”. Starts drive. Runs according to Speed Increment/Decrement keys.	Off 	Not active. Only active if P036 [Start Source] = 0 “Keypad”. Starts drive.
	On 	Changes speed.	Off 	Not active. Keys are only active if P038 [Speed Reference] = 0 “Drive Pot”.
	Off 	Changes to AUTO Mode. If running, drive will continue to run at reference defined by P038 [Speed Reference].	On 	Changes to Manual Mode. If running, drive will continue to run according to Digital Speed Increment and Decrement keys.
	N/A	Stops drive.	N/A	Stops drive.

Important: Certain digital input settings can override drive operation.
Refer to [Start and Speed Reference Control on page 1-24](#) for details.

No Function Mode

In No Function mode:

- The Auto key has no function
- Start command is defined by [P036](#) [Start Source]
- Speed Reference command is defined by [P038](#) [Speed Reference]

**Table 2.D P042 [Auto Mode] = 0 “No Function”
T051-T054 [Digital Inx Sel] ≠ 2 “Auto Mode” or 3 “Local”**

Key	LED	Key Function
	Off	Not active.
		Only active if P036 [Start Source] = 0 “Keypad”. Starts drive.
	On	Not active.
		Only active if P038 [Speed Reference] = 0 “Drive Pot”. Changes drive speed.
	Off	Not active.
		
	N/A	Stops drive.

Important: Certain digital input settings can override drive operation. Refer to [Start and Speed Reference Control on page 1-24](#) for details.

Notes:

Programming and Parameters

Chapter 3 provides a complete listing and description of the PowerFlex 400 parameters. Parameters are programmed (viewed/edited) using the integral keypad. As an alternative, programming can also be performed using DriveExplorer™ or DriveExecutive™ 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	3-4
Basic Program Group	3-7
Terminal Block Group	3-12
Communications Group	3-27
Advanced Program Group	3-31
Aux Relay Card Group	3-47
Advance Display Group	3-52
Parameter Cross-Reference – by Name	3-58

About Parameters

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

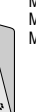
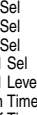
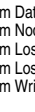
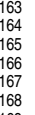
- **ENUM**
ENUM parameters allow a selection from 2 or more items. Each item is represented by a number.
- **Numeric Parameters**
These parameters have a single numerical value (i.e. 0.1 Volts).
- **Bit Parameters**
Bit parameters have four or more individual bits associated with features or conditions. 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 bit parameter. Parameters marked 32 bit will have two parameter numbers when using RS485 communications and programming software.

Refer to [page 3-58](#) for an alphabetical listing of parameters.

Group		Parameters			
Basic Display		Output Freq	b001	Drive Status	b006
		Commanded Freq	b002	Fault 1 Code	b007
		Output Current	b003	Process Display	b008
		Output Voltage	b004	Output Power	b010
		DC Bus Voltage	b005		
				Elapsed MWh	b011
				Elapsed Run Time	b012
				Torque Current	b013
				Drive Temp	b014
				Elapsed kWh	b015
Basic Program		Motor NP Volts	P031	Maximum Freq	P035
		Motor NP Hertz	P032	Start Source	P036
		Motor QL Current	P033	Stop Mode	P037
		Minimum Freq	P034	Speed Reference	P038
				Accel Time 1	P039
				Decel Time 1	P040
				Reset To Defaults	P041
				Auto Mode	P042
				Motor QL Ret	P043
Terminal Block		Digital In1 Sel	T051	Opto Out Sel	T065
		Digital In2 Sel	T052	Opto Out Level	T066
		Digital In3 Sel	T053	Opto Out Logic	T068
		Digital In4 Sel	T054	Analog In 1 Sel	T069
		Relay Out1 Sel	T055	Analog In 1 Lo	T070
		Relay Out1 Level	T056	Analog In 1 Hi	T071
		Relay 1 On Time	T058	Analog In 1 Loss	T072
		Relay 1 Off Time	T059	Analog In 2 Sel	T073
		Relay Out2 Sel	T060	Analog In 2 Lo	T074
		Relay Out2 Level	T061	Analog In 2 Hi	T075
		Relay 2 On Time	T063	Analog In 2 Loss	T076
		Relay 2 Off Time	T064		
				Sleep-Wake Sel	T077
				Sleep Level	T078
				Sleep Time	T079
				Wake Level	T080
				Wake Time	T081
				Analog Out1 Sel	T082
				Analog Out1 High	T083
				Analog Out1 Setpt	T084
				Analog Out2 Sel	T085
				Analog Out2 High	T086
				Analog Out2 Setpt	T087
				Anlg Loss Delay	T088
Communications		Language	C101	Comm Format	C102
				Comm Data Rate	C103
				Comm Mode Addr	C104
				Comm Loss Action	C105
				Comm Loss Time	C106
				Comm Write Mode	C107
				Start Source 2	C108
				Speed Ref 2	C109
Advanced Program		Purge Frequency	A141	Process Factor	A160
		Internal Freq	A142	Auto Rstrt Tries	A163
		Preset Freq 0	A143	Auto Rstrt Delay	A164
		Preset Freq 1	A144	Start At PowerUp	A165
		Preset Freq 2	A145	Reverse Disable	A166
		Preset Freq 3	A146	Flying Start En	A167
		Accel Time 2	A147	PWM Frequency	A168
		Decel Time 2	A148	PWM Mode	A169
		S Curve %	A149	Boost Select	A170
		PID Trim Hi	A150	Start Boost	A171
		PID Trim Lo	A151	Break Voltage	A172
		PID Ref Sel	A152	Break Frequency	A173
		PID Feedback Sel	A153	Maximum Voltage	A174
		PID Prop Gain	A154	Slip Hertz @ FLA	A175
		PID Integ Time	A155	DC Brake Time	A176
		PID Diff Rate	A156	DC Brake Level	A177
		PID Setpoint	A157	DC Brk Time@Strt	A178
		PID Deadband	A158	Current Limit 1	A179
		PID Preload	A159	Current Limit 2	A180
				Motor QL Select	A181
				Drive OL Mode	A182
				SW Current Trip	A183
				Load Loss Level	A184
				Load Loss Time	A185
				Stall Fault Time	A186
				Bus Reg Mode	A187
				Skip Frequency 1	A188
				Skip Freq Band 1	A189
				Skip Frequency 2	A190
				Skip Freq Band 2	A191
				Skip Frequency 3	A192
				Skip Freq Band 3	A193
				Compensation	A194
				Reset Meters	A195
				Testpoint Sel	A196
				Fault Clear	A197
				Program Lock	A198
				Motor NP Poles	A199
				Motor NP FLA	A200

Group	Parameters					
Aux Relay Card Aux Relay Card Group	Relay Out3 Sel	R221	Aux Motor Mode	R239	Aux Start Delay	R250
	Relay Out3 Level	R222	Aux Motor Qty	R240	Aux Stop Delay	R251
	Relay Out4 Sel	R224	Aux 1 Start Freq	R241	Aux Prog Delay	R252
	Relay Out4 Level	R225	Aux 1 Stop Freq	R242	Aux AutoSwap Tme	R253
	Relay Out5 Sel	R227	Aux 1 Ref Add	R243	Aux AutoSwap Lvl	R254
	Relay Out5 Level	R228	Aux 2 Start Freq	R244		
	Relay Out6 Sel	R230	Aux 2 Stop Freq	R245		
	Relay Out6 Level	R231	Aux 2 Ref Add	R246		
	Relay Out7 Sel	R233	Aux 3 Start Freq	R247		
	Relay Out7 Level	R234	Aux 3 Stop Freq	R248		
	Relay Out8 Sel	R236	Aux 3 Ref Add	R249		
	Relay Out8 Level	R237				
Advanced Display Advanced Display Group	Control Source	d301	Fault 1 Time-hr	d310	Output Power Fctr	d318
	Control In Status	d302	Fault 1 Time-min	d311	Testpoint Data	d319
	Comm Status	d303	Fault 2 Time-hr	d312	Control SW Ver	d320
	PID Setpoint Displ	d304	Fault 2 Time-min	d313	Drive Type	d321
	Analog In 1	d305	Fault 3 Time-hr	d314	Output Speed	d322
	Analog In 2	d306	Fault 3 Time-min	d315	Output RPM	d323
	Fault 1 Code	d307	Elapsed Time-hr	d316	Fault Frequency	d324
	Fault 2 Code	d308	Elapsed Time-min	d317	Fault Current	d325
	Fault 3 Code	d309			Fault Bus Volts	d326
					Status @ Fault	d327

Basic Display Group

b001 [Output Freq]

Related Parameter(s): [b002](#), [b008](#), [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](#), [P034](#), [P035](#), [P038](#), [d302](#)

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 1-24](#) 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:	0.0/(Drive Rated Amps × 2)
	Display:	0.1 Amps

b004 [Output Voltage]

Related Parameter(s): [P031](#), [A170](#), [A174](#)

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

Values	Default:	Read Only
	Min/Max:	0/510
	Display:	1 VAC

b005 [DC Bus Voltage]

Present DC bus voltage level.

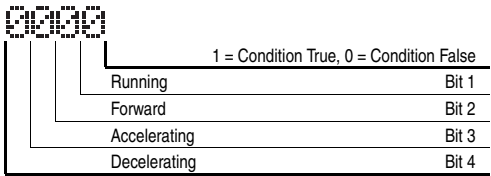
Values	Default:	Read Only
	Min/Max:	0/820
	Display:	1 VDC

Basic Display Group *(continued)*

b006 [Drive Status]

Related Parameter(s): [A166](#)

Present operating condition of the drive.



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

b007 [Fault 1 Code]

Related Parameter(s): [A186](#), [A197](#), [d307-d315](#)

A code that represents a drive fault. [Fault 1 Code] is 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:	0/122
	Display:	1

b008 [Process Display]

Related Parameter(s): [b001](#), [A160](#)

 32 bit parameter.

The output frequency scaled by [A160](#) [Process Factor].

$$\text{Output Freq} \times \text{Process Factor} = \text{Process Display}$$

Values	Default:	Read Only
	Min/Max:	0.00/9999.99
	Display:	0.01 – 1

b010 [Output Power]

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

Values	Default:	Read Only
	Min/Max:	0.0/999.9
	Display:	0.1 kW

Basic Display Group *(continued)*

b011 [Elapsed MWh]

Related Parameter(s): [b015](#), [A195](#)

Accumulated output energy of the drive.

Values	Default:	Read Only
	Min/Max:	0/3276.7
	Display:	0.1 MWh

b012 [Elapsed Run Time]

Related Parameter(s): [A195](#)

Displays the accumulated time that the drive has output power since the last [A195](#) [Reset Meter].
Time is displayed in 10 hour increments.

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

b013 [Torque Current]

Displays the torque portion of the output current.

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

b014 [Drive Temp]

Present operating temperature of the drive power section.

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

b015 [Elapsed kWh]

Related Parameter(s): [b011](#), [A195](#)

Accumulated output energy of the drive. This parameter works in conjunction with [Elapsed MWh].
When the maximum value of this parameter is reached, this parameter resets to zero and [Elapsed MWh] is incremented.

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

Basic Program Group

P031 [Motor NP Volts]

Related Parameter(s): [b004](#), [A170](#), [A171](#), [A172](#), [A173](#)



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): [A170](#), [A171](#), [A172](#), [A173](#), [A181](#), [A182](#)



Stop drive before changing this parameter.

Set to the motor nameplate rated frequency.

Values	Default:	60 Hz
	Min/Max:	15/320 Hz
	Display:	1 Hz

P033 [Motor OL Current]

Related Parameter(s): [P042](#), [T055](#), [T060](#), [T065](#), [A175](#), [A179](#), [A180](#), [A181](#), [A183](#)

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

P034 [Minimum Freq]

Related Parameter(s): [b001](#), [b002](#), [P035](#), [T070](#), [T074](#), [A171](#), [A172](#), [A173](#), [d302](#)

Sets the lowest frequency the drive will output continuously.

Values	Default:	0.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

P035 [Maximum Freq]

Related Parameter(s): [b001](#), [b002](#), [P034](#), [T071](#), [T075](#), [T082](#), [T083](#), [T085](#), [T086](#), [A171](#), [A172](#), [A173](#), [d302](#)



Stop drive before changing this parameter.

Sets the highest frequency the drive will output.

Values	Default:	60.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

Basic Program Group *(continued)*

P036 [Start Source]

Related Parameter(s): [P037](#), [P042](#), [A166](#), [d301](#)



Stop drive before changing this parameter.

Sets the control scheme used to start the drive when in Auto/Remote mode.

Refer to [Start and Speed Reference Control on page 1-24](#) for details about how other drive settings can override the setting of this parameter.

Important: For all settings except options 3 and 6, 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.

Options	0 "Keypad"	Integral keypad controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Not Used • I/O Terminal 03 = Not Used
1	"3-Wire"	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Stop: Per P037 [Stop Mode] • I/O Terminal 02 = Start • I/O Terminal 03 = Direction
2	"2-Wire"	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Run FWD • I/O Terminal 03 = Run REV
3	"2-W Lvl Sens" (Default)	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Run FWD • I/O Terminal 03 = Run REV Drive will restart after a "Stop" command when: • Stop is removed and Run FWD is held active
4	"2-W Hi Speed"	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Run FWD • I/O Terminal 03 = Run REV Outputs are kept in a ready-to-run state. The drive will respond to a "Start" command within 10 ms. Important: There is greater potential voltage on the output terminals when using this option.
5	"Comm Port"	Remote communications controls drive operation. • I/O Terminal 01 = Stop: Coast to Stop • I/O Terminal 02 = Not Used • I/O Terminal 03 = Not Used
6	"2-W Lvl/Enbl"	I/O Terminal Block controls drive operation. • I/O Terminal 01 = Function Loss: Fault and Coast to Stop • I/O Terminal 02 = Run FWD • I/O Terminal 03 = SW Enable Drive will restart after a "Stop" command when: • Stop is removed and Run FWD is held active



See Attention Below



See Attention Below



ATTENTION: Hazard of injury exists due to unintended operation. When P036 [Start Source] is set to option 3 or option 6, and the Run input is maintained, the Run inputs do not need to be toggled after a Stop input or a fault clear for the drive to run again. The drive will stop only when the stop command is maintained or the drive is faulted.

Basic Program Group *(continued)*

P037 [Stop Mode]

Related Parameter(s): [P036](#), [C105](#), [A176](#), [A177](#), [A178](#)

Active stop mode for all stop sources [e.g. keypad, 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. See [page 1-17](#) for details. In this case, the drive will always coast to a stop regardless of the settings of [P036](#) [Start Source] and [P037](#) [Stop Mode].

Options	0	"Ramp, CF" ⁽¹⁾	Ramp to Stop. "Stop" command clears active fault.
	1	"Coast, CF" ⁽¹⁾ (Default)	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 A176 [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 A176 [DC Brake Time]. - OR - Drive shuts off if the drive detects that the motor is stopped.

⁽¹⁾ Stop input also clears active fault.

Basic Program Group *(continued)*

P038 [Speed Reference] Related Parameter(s): [b001](#), [b002](#), [P038](#), [P040](#), [P042](#), [T051-T054](#), [T070](#), [T071](#), [T073](#), [T074](#), [T075](#), [C102](#), [A141](#), [A142](#), [A143-A146](#), [A152](#), [d301](#)

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 [T051](#) - [T054](#) [Digital Inx Sel] is set to option 1, 2, 3, 4, 5, 8, 14, 15, 16, 17 and the digital input is active, or if [A152](#) [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 1-24](#) for more information on speed reference control priority.

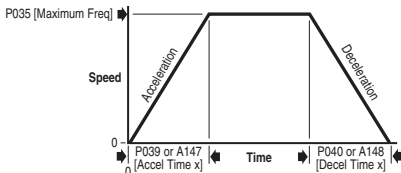
Options	0	"Drive Keypad"	Internal frequency command from the digital speed keys on the integral keypad.
	1	"InternalFreq"	Internal frequency command from A142 [Internal Freq]. Must be set when using MOP function.
	2	"Analog In 1" (Default)	External frequency command from an analog source as determined by T069 [Analog In 1 Sel] and DIP Switch AI1 on the control board. Default Dip Switch setting is 10V.
	3	"Analog In 2"	External frequency command from an analog source as determined by T073 [Analog In 2 Sel] and DIP Switch AI2 on the control board. Default Dip Switch setting is 10V.
	4	"Preset Freq"	External frequency command as defined by A143 - A146 [Preset Freq x] when T051 - T054 [Digital Inx Sel] are programmed as "Preset Frequencies" and the digital inputs are active.
	5	"Comm Port"	External frequency command from the communications port. Refer to Appendix D and Appendix E for details. Parameter C102 [Comm Format] is used to select a communications protocol.

P039 [Accel Time 1] Related Parameter(s): [P038](#), [P040](#), [T051-T054](#), [A141](#), [A143-A146](#), [A147](#)

Sets the rate of acceleration for all speed increases.

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

Values	Default:	20.00 Secs
	Min/Max:	0.00/600.00 Secs
	Display:	0.01 Secs



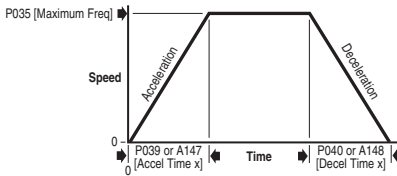
Basic Program Group *(continued)*

P040 [Decel Time 1] Related Parameter(s): [P038](#), [P039](#), [T051-T054](#), [A141](#), [A143-A146](#), [A148](#)

Sets the rate of deceleration for all speed decreases.

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

Values	Default:	20.00 Secs
	Min/Max:	0.00/600.00 Secs
	Display:	0.01 Secs



P041 [Reset To Defaults]



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.

Important: Drives packaged for fan and pump applications ship with custom default settings that differ from Factory Defaults. Setting this parameter to option 1 will require reprogramming of select parameters. Refer to publication 22C-IN002 for packaged drive default settings.

P042 [Auto Mode]

Related Parameter(s): [P036](#), [P038](#)



Stop drive before changing this parameter.

Determines the operation of the "Auto" key on the integral keypad. Refer to [page 2-6](#) for details.

Options	0 "No function"	LED above "Auto" key is always dark
	1 "Hnd-Off-Auto" (Default)	Toggles control start and frequency to and from keypad; starts drive.
	2 "Local/Remote"	Toggles control start and frequency to and from keypad.
	3 "Auto/Manual"	Toggles only the frequency control to and from keypad.

P043 [Motor OL Ret]

Related Parameter(s): [P033](#), [A181](#)

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.

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

Terminal Block Group

T051 [Digital In1 Sel]

(I/O Terminal 05)

Related Parameter(s): [P036](#), [P038](#), [P039](#), [P040](#)
[A141](#), [A142](#), [A143](#), [A146](#), [A147](#)
[A148](#), [A166](#), [A177](#), [A180](#), [d301](#), [d302](#)

T052 [Digital In2 Sel]

(I/O Terminal 06)

T053 [Digital In3 Sel]

(I/O Terminal 07)



Stop drive before changing this parameter.

T054 [Digital In4 Sel]

(I/O Terminal 08)

Selects the function for the digital inputs. Refer to the flowchart on [page 1-24](#) for more information on speed reference control priority.

Options	0 "Not Used"	Terminal has no function but can be read over network communications via d302 [Contrl In Status].
	1 "Purge" ⁽¹⁾ (T051 Default)	Starts the drive at Purge speed regardless of the selected start source. Purge can occur, and is operational, at any time whether the drive is running or stopped. If a valid stop condition is present, other than from the Comm Port or SW Enable input (I/O Terminal 03), the drive will not start on the Purge Input Transition.



ATTENTION: A Purge command will take precedence over a stop command from the Comm Port/Network and over a SW Enable command from the terminal block. Insure that another stop method is available, such as I/O Terminal 01 of the control terminal block, if stopping is necessary during a purge.

2	"Auto Mode" ⁽¹⁾	When active, forces drive into "Auto" control mode. Start source determined by P036 [Start Source] and speed reference determined by P038 [Speed Reference].
3	"Local" ⁽¹⁾ (T052 Default)	When active, sets integral keypad as start source and digital speed keys on the integral keypad as speed source.
4	"Comm Port" ⁽¹⁾ (T054 Default)	When active, sets communication device as default start/speed command source.
5	"PID Disable"	Disables PID function. Drive uses the next valid non-PID speed reference.
6	"PID Hold"	Drive output remains at current value. The integrator for Process PID loop is also clamped at current value.
7	"PID Reset"	The integrator for the Process PID loop is reset to zero and drive output is set to Preload value.
8	"Preset Freq"	Preset speed inputs that enable the use of preset speeds.
9	"Aux Fault"	If input is enable but not active, the drive will immediately fault.
10	"Clear Fault" (T053 Default)	Clears an active fault.
11	"RampStop,CF"	The drive immediately ramps to stop. Can also be used to clear a fault.
12	"CoastStop,CF"	The drive immediately coasts to stop. Can also be used to clear a fault.
13	"DCInjStop,CF"	The drive immediately begins a DC Injection stop. Can also be used to clear a fault.

T051-T054 Options (Cont.)	14 “Anlg1 InCtrl” ⁽¹⁾	Selects Analog Input 1 control for the frequency reference.
	15 “Anlg2 InCtrl” ⁽¹⁾	Selects Analog Input 2 control for the frequency reference.
	16 “MOP Up”	Increases the value of A142 [Internal Freq] at the current Accel rate if P038 [Speed Reference] is set to 1 “InternalFreq”. Default for A142 is 60 Hz.
	17 “MOP Down”	Decreases the value of A142 [Internal Freq] at the current Decel rate if P038 [Speed Reference] is set to 1 “InternalFreq”. Default for A142 is 60 Hz.
	18 “Acc & Dec 2” ⁽¹⁾	• When active, A147 [Accel Time 2] and A148 [Decel Time 2] are used for all ramp rates. • Can only be tied to one input. Refer to the flowchart on page 1-25 for more information on Accel/Decel selection.
	19 “Current Lmt2”	When active, A180 [Current Limit 2] determines the drive current limit level.
	20 “Force DC”	If the drive is not running, applying this input causes the drive to apply a DC Holding current (use A177 [DC Brake Level], ignoring A176 [DC Brake Time] while the input is applied.
	21 “Mtr I-Lock 1”	Can be used as a protective motor interlock in Auxiliary Motor Control mode. When programmed but not active, input will prevent corresponding motor from operating. Refer to Appendix C for details.
	22 “Mtr I-Lock 2”	
	23 “Mtr I-Lock 3”	
	24 “Mtr I-Lock 4”	
	25 “Cmd Reverse”	When programmed and active the drive will run in the reverse direction when started from the integral keypad.
	31 “Logic In 1”	Input 1 used by digital output settings.
	32 “Logic In 2”	Input 2 used by digital output settings.
	36 “Damper Input”	• When active, drive is allowed to run normally. • When inactive, drive is forced into sleep mode and is prevented from accelerating to commanded speed.

⁽¹⁾ This function may be tied to one input only.

Terminal Block Group *(continued)*

T055 [Relay Out1 Sel]

Related Parameter(s): [P033](#), [T056](#), [T058](#), [T059](#), [T069](#), [T072](#), [T073](#), [T076](#), [A163](#), [d318](#)

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	"Hand Active"	Active when drive is in local control.
	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 T056 [Relay Out1 Level]. - Use T056 to set threshold.
	7	"Above Cur"	- Drive exceeds the current (% Amps) value set in T056 [Relay Out1 Level]. - Use T056 to set threshold. Important: Value for T056 [Relay Out1 Level] must be entered in percent of drive rated output current.
	8	"Above DCVolt"	- Drive exceeds the DC bus voltage value set in T056 [Relay Out1 Level]. - Use T056 to set threshold.
	9	"Above Anlg 2"	- Analog input voltage (I/O Terminal 17) exceeds the value set in T056 [Relay Out1 Level]. - Do not use if T073 [Analog In 2 Sel] is set to 3 "Voltage Mode - Bipolar". - This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 17) is wired to a PTC and external resistor. - Use T056 to set threshold.
	10	"Above PF Ang"	- Power Factor angle has exceeded the value set in T056 [Relay Out1 Level]. - Use T056 to set threshold.
	11	"Anlg In Loss"	Analog input loss has occurred. Program T072 [Analog In 1 Loss] and/or T076 [Analog In 2 Loss] for desired action when input loss occurs.
	12	"ParamControl"	Enables the output to be controlled over network communications by writing to T056 [Relay Out1 Level]. (0 = Off, 1 = On.)
	13	"Retries Exst"	Value set in A163 [Auto Rstrt Tries] is exceeded.
	14	"NonRec Fault"	- Number of retries for [Restart Tries] is exceeded - OR - Non-resettable fault occurs - OR - Auto-retries is not enabled.
	15	"Reverse"	Drive is commanded to run in reverse direction.
	16	"Logic In 1"	An input is programmed as "Logic In 1" and is active.
	17	"Logic In 2"	An input is programmed as "Logic In 2" and is active.
	23	"Aux Motor"	Auxiliary Motor is commanded to run. Refer to Appendix C for details.

Terminal Block Group *(continued)*

T056 [Relay Out1 Level]

Related Parameter(s): [T055](#), [T058](#), [T059](#), [d318](#)



32 bit parameter.

Sets the trip point for the digital output relay if the value of [T055](#) [Relay Out1 Sel] is 6, 7, 8, 9, 10 or 12.

T055 Setting	T056 Min/Max
6	0/320 Hz
7	0/180%
8	0/815 Volts
9	0/100%
10	1/180 degs
12	0/1

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

T058 [Relay 1 On Time]

Related Parameter(s): [T055](#), [T056](#), [T059](#)

Sets delay time before Relay energizes after required condition testing.

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

T059 [Relay 1 Off Time]

Related Parameter(s): [T055](#), [T056](#), [T058](#)

Sets delay time before Relay de-energizes after required condition testing ceases.

Important: Do not use this parameter with Auxiliary Motor Control mode AutoSwap enabled.

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

Terminal Block Group *(continued)*

T060 [Relay Out2 Sel]

Related Parameter(s): [P033](#), [T061](#), [T063](#), [T064](#), [T076](#)
[A163](#), [d318](#)

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

Options	0	"Ready/Fault"	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" (Default)	Motor is receiving power from the drive.
	3	"Hand Active"	Active when drive is in local control.
	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 T061 [Relay Out2 Level]. - Use T061 to set threshold.
	7	"Above Cur"	- Drive exceeds the current (% Amps) value set in T061 [Relay Out2 Level]. - Use A061 to set threshold. Important: Value for T061 [Relay Out2 Level] must be entered in percent of drive rated output current.
	8	"Above DCVolt"	- Drive exceeds the DC bus voltage value set in T061 [Relay Out2 Level]. - Use T061 to set threshold.
	9	"Above Anlg 2"	- Analog input voltage (I/O Terminal 17) exceeds the value set in T061 [Relay Out2 Level]. - Do not use if T073 [Analog In 2 Sel] is set to 3 "Voltage Mode - Bipolar". - This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 17) is wired to a PTC and external resistor. - Use T061 to set threshold.
	10	"Above PF Ang"	- Power Factor angle has exceeded the value set in T061 [Relay Out2 Level]. - Use T061 to set threshold.
	11	"Anlg In Loss"	Analog input loss has occurred. Program T072 [Analog In 1 Loss] and/or T076 [Analog In 2 Loss] for desired action when input loss occurs.
	12	"ParamControl"	Enables the output to be controlled over network communications by writing to T061 [Relay Out2 Level]. (0 = Off, 1 = On.)
	13	"Retries Exst"	Value set in A163 [Auto Rstrt Tries] is exceeded.
	14	"NonRec Fault"	- Number of retries for A163 [Auto Rstrt Tries] is exceeded - OR - Non-resettable fault occurs - OR A163 [Auto Rstrt Tries] is not enabled.
	15	"Reverse"	Drive is commanded to run in reverse direction.
	16	"Logic In 1"	An input is programmed as "Logic In 1" and is active.
	17	"Logic In 2"	An input is programmed as "Logic In 2" and is active.
	23	"Aux Motor"	Auxiliary Motor is commanded to run. Refer to Appendix C for details.

Terminal Block Group *(continued)*

T061 [Relay Out2 Level]

Related Parameter(s): [T060](#), [T063](#), [T064](#), [d318](#)



32 bit parameter.

Sets the trip point for the digital output relay if the value of [T060](#) [Relay Out2 Sel] is 6, 7, 8, 9, 10 or 12.

T060 Setting	T061 Min/Max
6	0/320 Hz
7	0/180%
8	0/815 Volts
9	0/100%
10	1/180 degs
12	0/1

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

T063 [Relay 2 On Time]

Related Parameter(s): [T060](#), [T061](#), [T064](#)

Sets delay time before Relay energizes after required condition testing.

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

T064 [Relay 2 Off Time]

Related Parameter(s): [T060](#), [T061](#), [T063](#)

Sets delay time before Relay de-energizes after required condition testing ceases.

Important: Do not use this parameter with Auxiliary Motor Control mode AutoSwap enabled.

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

Terminal Block Group *(continued)*

T065 [Opto Out Sel]

Related Parameter(s): [P033](#), [T066](#), [T068](#), [T072](#)
[T076](#), [A163](#), [d318](#)

Determines the operation of the programmable opto output.

Options	0	"Ready/Fault"	Opto output is active when power is applied. This indicates that the drive is ready for operation. Opto output is inactive when power is removed or a fault occurs.
	1	"At Frequency" (Default)	Drive reaches commanded frequency.
	2	"MotorRunning"	Motor is receiving power from the drive.
	3	"Hand Active"	Active when drive is in local control.
	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 T066 [Opto Out Level]. - Use T066 to set threshold.
	7	"Above Cur"	- Drive exceeds the current (% Amps) value set in T066 [Opto Out Level]. - Use T066 to set threshold. Important: Value for T066 [Opto Out Level] must be entered in percent of drive rated output current.
	8	"Above DCVolt"	- Drive exceeds the DC bus voltage value set in T066 [Opto Out Level]. - Use T066 to set threshold.
	9	"Above Anlg 2"	- Analog input voltage (I/O Terminal 17) exceeds the value set in T066 [Opto Out Level]. - Do not use if T073 [Analog In 2 Sel] is set to 3 "Voltage Mode - Bipolar". - This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 17) is wired to a PTC and external resistor. - Use T066 to set threshold.
	10	"Above PF Ang"	- Power Factor angle has exceeded the value set in T066 [Opto Out Level]. - Use T066 to set threshold.
	11	"Anlg In Loss"	Analog input loss has occurred. Program T072 [Analog In 1 Loss] and/or T076 [Analog In 2 Loss] for desired action when input loss occurs.
	12	"ParamControl"	Enables the output to be controlled over network communications by writing to T066 [Opto Out Level]. (0 = Off, 1 = On.)
	13	"Retries Exst"	Value set in A163 [Auto Rstrt Tries] is exceeded.
	14	"NonRec Fault"	- Number of retries for A163 [Auto Rstrt Tries] is exceeded - OR - Non-resettable fault occurs - OR A163 [Auto Rstrt Tries] is not enabled.
	15	"Reverse"	Drive is commanded to run in reverse direction.
	16	"Logic In 1"	An input is programmed as "Logic In 1" and is active.
	17	"Logic In 2"	An input is programmed as "Logic In 2" and is active.

Terminal Block Group *(continued)*

T066 [Opto Out Level]

Related Parameter(s): [T065](#), [T068](#), [A163](#), [d318](#)



32 bit parameter.

Determines the on/off point for the opto output when [T065](#) [Opto Out Sel] is set to option 6, 7, 8, 9, 10 or 12.

T066 Setting	T066 Min/Max
6	0/400 Hz
7	0/180%
8	0/815 Volts
9	0/100%
10	1/180 degs
12	0/1

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

T068 [Opto Out Logic]

Related Parameter(s): [T065](#), [T066](#)

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

T068 Option	Opto Out Logic
0	NO (Normally Open)
1	NC (Normally Closed)

Note: Setting output to NC may cause output to “glitch” on power-up. The off/reset state of all outputs is open.

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

T069 [Analog In 1 Sel]

Related Parameter(s): [T055](#), [T070](#), [T071](#), [T072](#)

Sets the analog input signal mode (0-20mA, 4-20mA, or 0-10V). This parameter must match DIP Switch AI1 setting on the control board.

T069 Option	Setting	Input Range	DIP Switch AI1 Setting
0	Current Mode	0-20 mA	20 mA
1	Current Mode	4-20 mA	20 mA
2	Voltage Mode - Unipolar	0-10V	10V
4	Current Mode (Square Root)	0-20 mA	20 mA
5	Current Mode (Square Root)	4-20 mA	20 mA
6	Voltage Mode - Unipolar (Square Root)	0-10V	10V

Values	Default:	2
	Min/Max:	0/6
	Display:	1

Terminal Block Group *(continued)*

T070 [Analog In 1 Lo]

Related Parameter(s): [P034](#), [P038](#), [T069](#), [T071](#), [T072](#)
[A152](#), [A153](#)



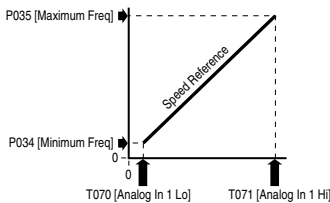
Stop drive before changing this parameter.

Sets the analog input level that corresponds to [P034](#) [Minimum Freq].

Analog inversion can be accomplished by setting this value larger than T071 [Analog In 1 Hi].

Important: If analog inversion is implemented the drive will go to maximum frequency in the event the analog input is lost. It is strongly recommended to activate T072 [Analog In 1 Loss] to protect from this potential occurrence.

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



T071 [Analog In 1 Hi]

Related Parameter(s): [P035](#), [P038](#), [T069](#), [T070](#), [T072](#)
[A152](#), [A153](#)



Stop drive before changing this parameter.

Sets the analog input level that corresponds to P035 [Maximum Freq].

Analog inversion can be accomplished by setting this value smaller than T070 [Analog In 1 Lo].

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

Terminal Block Group *(continued)*

T072 [Analog In 1 Loss]

Related Parameter(s): [T055](#), [T060](#), [T065](#), [T069](#), [T070](#), [T071](#), [A152](#)



Stop drive before changing this parameter.

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 [T070](#) [Analog In 1 Lo] to a minimum of 20% (i.e. 2 volts).

The drive will fault on an F29 [Analog Input Loss](#) when the analog signal is lost if this parameter and [A152](#) [PID Ref Sel] are both set to an option other than 0 "Disabled".

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 A143 [Preset Freq 0].

T073 [Analog In 2 Sel]

Related Parameter(s): [P038](#), [T055](#), [T065](#), [T074](#), [T075](#), [T076](#), [A152](#)

Sets the analog input signal mode (0-20mA, 4-20mA, 0-10V, -10 to +10V). This parameter must match DIP Switch AI2 setting on the control board.

T073 Option	Setting	Input Range	DIP Switch AI2 Setting
0	Current Mode	0-20 mA	20 mA
1	Current Mode	4-20 mA	20 mA
2	Voltage Mode - Unipolar	0-10V	10V
3 ⁽¹⁾	Voltage Mode - Bipolar	-10 to +10V	10V
4	Current Mode (Square Root)	0-20 mA	20 mA
5	Current Mode (Square Root)	4-20 mA	20 mA
6	Voltage Mode - Unipolar (Square Root)	0-10V	10V
7 ⁽¹⁾	Voltage Mode - Bipolar (Square Root)	-10 to +10V	10V

⁽¹⁾ Setting 3 is only available on [Analog In 2 Sel]. Input 2 is isolated and supports a bi-polar input, so that setting 3 determines if the voltage input is enabled for bipolar control. If bipolar is selected, P034 [Minimum Freq] and T074 [Analog In 2 Lo] are ignored. If input 2 is set up for current control, Bipolar mode is not possible. If the analog input is inverted ([Analog In 2 Lo] > [Analog In 2 Hi]), Bipolar mode is disabled and this input uses unipolar control only (negative values are treated like zero).

Values	Default:	2
	Min/Max:	0/7
	Display:	1

Terminal Block Group *(continued)*

T074 [Analog In 2 Lo]

Related Parameter(s): [P034](#), [P038](#), [T072](#), [T073](#), [T075](#)
[T076](#), [A152](#), [A153](#)

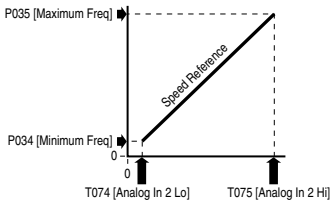
 Stop drive before changing this parameter.

Sets the analog input level that corresponds to [P034](#) [Minimum Freq].

Analog inversion can be accomplished by setting this value larger than [T075](#) [Analog In 2 Hi].

Important: If analog inversion is implemented the drive will go to maximum frequency in the event the analog input is lost. It is strongly recommended to activate [T072](#) [Analog In 1 Loss] to protect from this potential occurrence.

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



T075 [Analog In 2 Hi]

Related Parameter(s): [P035](#), [P038](#), [T073](#), [T074](#), [T076](#)
[A152](#), [A153](#)

 Stop drive before changing this parameter.

Sets the analog input level that corresponds to P035 [Maximum Freq].

Analog inversion can be accomplished by setting this value smaller than T074 [Analog In 2 Lo].

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

T076 [Analog In 2 Loss]

Related Parameter(s): [T055](#), [T060](#), [T065](#), [T073](#), [T074](#), [T075](#)

 Stop drive before changing this parameter.

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 [T074](#) [Analog In 2 Lo] to a minimum of 20% (i.e. 2 volts).

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 A143 [Preset Freq 0].

Terminal Block Group *(continued)*

T077 [Sleep-Wake Sel]

Related Parameter(s): [T078](#), [T079](#), [T080](#), [T081](#)

The drive “sleeps” if the appropriate analog input drops below the set [Sleep Level] for the time set in [Sleep Time] and the drive is running. When entering sleep mode the drive will ramp to zero and the run indicator ( or ) on the keypad display will flash indicating the drive is in “sleep” mode. When the appropriate analog input rises above the set [Sleep Level] the drive will “wake” and ramp to the commanded frequency.

Inversion can be accomplished by setting T078 [Sleep Level] to a higher setting than T080 [Wake Level].



ATTENTION: Enabling the Sleep-Wake function can cause unexpected machine operation during the Wake mode. Equipment damage and/or personal injury can result if this parameter is used in an inappropriate application. In addition, all applicable local, national & international codes, standards, regulations or industry guidelines must be considered.

Options	0	“Disabled” (Default)
	1	“Analog In 1” Sleep enabled from Analog Input 1.
	2	“Analog In 2” Sleep enabled from Analog Input 2.
	3	“Command Freq” Sleep enabled based on drive commanded frequency.

T078 [Sleep Level]

Related Parameter(s): [T077](#), [T079](#), [T080](#), [T081](#)

Sets the analog input level the drive must reach to enter sleep mode.

Values	Default:	10.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

T079 [Sleep Time]

Related Parameter(s): [T077](#), [T078](#), [T080](#), [T081](#)

Sets the analog input time the drive must stay below to enter sleep mode.

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

T080 [Wake Level]

Related Parameter(s): [T077](#), [T078](#), [T079](#), [T081](#)

Sets the analog input level the drive must reach to wake from sleep mode.

Values	Default:	15.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

T081 [Wake Time]

Related Parameter(s): [T077](#), [T078](#), [T079](#), [T080](#)

Sets the analog input time the drive must stay above to wake from sleep mode.

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

Terminal Block Group *(continued)*

T082 [Analog Out1 Sel]

Related Parameter(s): [P035](#), [T083](#), [T084](#)

Sets the analog output signal mode (0-20 mA, 4-20 mA, or 0-10V). The output is used to provide a signal that is proportional to several drive conditions. This parameter must match DIP Switch AO1 setting.

Setting	Output Range	Min. Output Value	Max. Output Value = [Analog Output Hi]	Filter ⁽¹⁾	DIP Switch AO1 Setting	Related Parameter	
0	OutFreq 0-10	0-10V	0V = 0 Hz	[Maximum Frequency]	None	10V	b001
1	OutCurr 0-10	0-10V	0V = 0 Amps	200% Drive Rated FLA	Filter A	10V	b003
2	OutTorq 0-10	0-10V	0V = 0 Amps	200% Drive Rated FLA	Filter A	10V	b013
3	OutVolt 0-10	0-10V	0V = 0 Volts	120% Drive Rated Output V	None	10V	b004
4	OutPowr 0-10	0-10V	0V = 0 kW	200% Drive Rated Power	Filter A	10V	b010
5	Setpnt 0-10	0-10V	0V = 0.0%	100.0% Setting	None	10V	T084
6	TstData 0-10	0-10V	0V = 0000	65535 (Hex FFFF)	None	10V	A196
7	OutFreq 0-20	0-20 mA	0 mA = 0 Hz	[Maximum Frequency]	None	20 mA	b001
8	OutCurr 0-20	0-20 mA	0 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b003
9	OutTorq 0-20	0-20 mA	0 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b013
10	OutVolt 0-20	0-20 mA	0 mA = 0 Volts	120% Drive Rated Output V	None	20 mA	b004
11	OutPowr 0-20	0-20 mA	0 mA = 0 kW	200% Drive Rated Power	Filter A	20 mA	b010
12	Setpnt 0-20	0-20 mA	0 mA = 0.0%	100.0% Setting	None	20 mA	T084
13	TstData 0-20	0-20 mA	0 mA = 0000	65535 (Hex FFFF)	None	20 mA	A196
14	OutFreq 4-20	4-20 mA	4 mA = 0 Hz	[Maximum Frequency]	None	20 mA	b001
15	OutCurr 4-20	4-20 mA	4 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b003
16	OutTorq 4-20	4-20 mA	4 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b013
17	OutVolt 4-20	4-20 mA	4 mA = 0 Volts	120% Drive Rated Output V	None	20 mA	b004
18	OutPowr 4-20	4-20 mA	4 mA = 0 kW	200% Drive Rated Power	Filter A	20 mA	b010
19	Setpnt 4-20	4-20 mA	4 mA = 0.0%	100.0% Setting	None	20 mA	T084
20	TstData 4-20	4-20 mA	4 mA = 0000	65535 (Hex FFFF)	None	20 mA	A196

⁽¹⁾ For settings with the filter enabled, if a 0-100% step change occurs, the output will reach 95% in 500 milliseconds, 99% in 810 milliseconds and 100% in 910 milliseconds.

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

T083 [Analog Out1 High]

Related Parameter(s): [P035](#), [T082](#), [T084](#)

Scales the Maximum Output Value for the T082 [Analog Out1 Sel] source setting.

Examples:

T083 Setting	T082 Setting	T082 Max. Output Value
50%	1 "OutCurr 0-10"	5V for 200% Drive Rated Output Current
90%	11 "OutPowr 0-20"	18mA for 200% Drive Rated Power

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

Terminal Block Group *(continued)*

T084 [Anlg Out1 Setpt]

 Related Parameter(s): [T082](#), [T083](#)

Sets direct parameter control over the analog output. If enabled, this sets the percent value of analog output.

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

T085 [Analog Out2 Sel]

 Related Parameter(s): [P035](#), [T086](#), [T087](#)

Sets the analog output signal mode (0-20 mA, 4-20 mA, or 0-10V). The output is used to provide a signal that is proportional to several drive conditions. This parameter must match DIP Switch AO2 setting.

Setting	Output Range	Min. Output Value	Max. Output Value = [Analog Output HI]	Filter ⁽¹⁾	DIP Switch AO2 Setting	Related Parameter
0 OutFreq 0-10	0-10V	0V = 0 Hz	[Maximum Frequency]	None	10V	b001
1 OutCurr 0-10	0-10V	0V = 0 Amps	200% Drive Rated FLA	Filter A	10V	b003
2 OutTorq 0-10	0-10V	0V = 0 Amps	200% Drive Rated FLA	Filter A	10V	b013
3 OutVolt 0-10	0-10V	0V = 0 Volts	120% Drive Rated Output V	None	10V	b004
4 OutPwr 0-10	0-10V	0V = 0 kW	200% Drive Rated Power	Filter A	10V	b010
5 Setpnt 0-10	0-10V	0V = 0.0%	100.0% Setting	None	10V	T084
6 TstData 0-10	0-10V	0V = 0000	65535 (Hex FFFF)	None	10V	A196
7 OutFreq 0-20	0-20 mA	0 mA = 0 Hz	[Maximum Frequency]	None	20 mA	b001
8 OutCurr 0-20	0-20 mA	0 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b003
9 OutTorq 0-20	0-20 mA	0 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b013
10 OutVolt 0-20	0-20 mA	0 mA = 0 Volts	120% Drive Rated Output V	None	20 mA	b004
11 OutPwr 0-20	0-20 mA	0 mA = 0 kW	200% Drive Rated Power	Filter A	20 mA	b010
12 Setpnt 0-20	0-20 mA	0 mA = 0.0%	100.0% Setting	None	20 mA	T084
13 TstData 0-20	0-20 mA	0 mA = 0000	65535 (Hex FFFF)	None	20 mA	A196
14 OutFreq 4-20	4-20 mA	4 mA = 0 Hz	[Maximum Frequency]	None	20 mA	b001
15 OutCurr 4-20	4-20 mA	4 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b003
16 OutTorq 4-20	4-20 mA	4 mA = 0 Amps	200% Drive Rated FLA	Filter A	20 mA	b013
17 OutVolt 4-20	4-20 mA	4 mA = 0 Volts	120% Drive Rated Output V	None	20 mA	b004
18 OutPwr 4-20	4-20 mA	4 mA = 0 kW	200% Drive Rated Power	Filter A	20 mA	b010
19 Setpnt 4-20	4-20 mA	4 mA = 0.0%	100.0% Setting	None	20 mA	T084
20 TstData 4-20	4-20 mA	4 mA = 0000	65535 (Hex FFFF)	None	20 mA	A196

⁽¹⁾ For settings with the filter enabled, if a 0-100% step change occurs, the output will reach 95% in 500 milliseconds, 99% in 810 milliseconds and 100% in 910 milliseconds.

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

Terminal Block Group *(continued)*

T086 [Analog Out2 High]

Related Parameter(s): [P035](#), [T085](#), [T087](#)

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

Examples:

T086 Setting	T085 Setting	T085 Max. Output Value
50%	1 "OutCurr 0-10"	5V for 200% Drive Rated Output Current
90%	11 "OutPowr 0-20"	18mA for 200% Drive Rated Power

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

T087 [Anlg Out2 Setpt]

Related Parameter(s): [T085](#), [T086](#)

Sets direct parameter control over the analog output. If enabled, this sets the percent value of analog output.

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

T088 [Anlg Loss Delay]

Related Parameter(s): [T069](#), [T070](#), [T071](#), [T072](#),
[T073](#), [T074](#), [T075](#), [T076](#)

Sets the length of time after power-up during which the drive will not detect an analog signal loss. The drive response to an analog signal loss is set in [T072](#) or [T076](#) [Analog In x Loss].

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

Communications Group

C101 [Language]

Selects the language displayed by the integral LCD display and 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"

C102 [Comm Format]

Related Parameter(s): [d303-d306](#)

Selects the protocol data bits (8 data bits only), parity (None, Even, Qdd), and stop bits (1 or 2) used by the RS485 port on the drive.

Refer to [Appendix D](#) and [Appendix E](#) 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"	
	6	"MetaSys N2"	
	7	"P1 8-N-1"	Floor Level Network (FLN)
	8	"P1 8-E-1"	Floor Level Network (FLN)
	9	"P1 8-O-1"	Floor Level Network (FLN)

C103 [Comm Data Rate]

Related Parameter(s): [d303](#)

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"

Communications Group *(continued)*

C104 [Comm Node Addr]

Related Parameter(s): [d303](#)

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

C105 [Comm Loss Action]

Related Parameter(s): [d303](#), [P037](#), [C106](#)

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.
	4	"Run Preset 0"	Drive will run at preset speed.
	5	"Kypd Inc/Dec"	Drive will run at keypad (digital pot) speed

C106 [Comm Loss Time]

Related Parameter(s): [d303](#), [C105](#)Sets the time that the drive will remain in communication loss before implementing the option selected in [C105](#) [Comm Loss Action].

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

C107 [Comm Write Mode]

Determines whether parameter changes made over communication port are saved or stored in RAM only. If they are stored in RAM, the values will be lost at power-down.

Options	0	"Save" (Default)
	1	"RAM Only"



ATTENTION: Risk of equipment damage exists. If configurable outputs are programmed to write parameter data to Non-Volatile Storage (NVS) frequently, the NVS will quickly exceed its life cycle and cause the drive to malfunction. Do not create a program that frequently uses configurable outputs to write parameter data to NVS.

Communications Group (continued)

C108 [Start Source 2]

Related Parameter(s): [P037](#), [P042](#), [A166](#), [d301](#)



Stop drive before changing this parameter.

Sets the control scheme used to start the drive when in Comm Control and the communication network commands the drive to run from Local Control. This function is normally used by Point 79 of a P1-FLN.

Refer to [Start and Speed Reference Control on page 1-24](#) for details about how other drive settings can override the setting of this parameter.

Important: For all settings except options 3 and 6, 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.

Options	0	"Keypad"	Integral keypad controls drive operation. - I/O Terminal 01 = Stop: Coast to Stop - I/O Terminal 02 = Not Used - I/O Terminal 03 = Not Used
	1	"3-Wire"	I/O Terminal Block controls drive operation. - I/O Terminal 01 = Stop: Per P037 [Stop Mode] - I/O Terminal 02 = Start - I/O Terminal 03 = Direction
	2	"2-Wire"	I/O Terminal Block controls drive operation. - I/O Terminal 01 = Stop: Coast to Stop - I/O Terminal 02 = Run FWD - I/O Terminal 03 = Run REV
	3	"2-W Lvl Sens" (Default)	I/O Terminal Block controls drive operation. - I/O Terminal 01 = Stop: Coast to Stop - I/O Terminal 02 = Run FWD - I/O Terminal 03 = Run REV Drive will restart after a "Stop" command when: - Stop is removed and Run FWD is held active
		 See Attention Below	
	4	"2-W Hi Speed"	I/O Terminal Block controls drive operation. - I/O Terminal 01 = Stop: Coast to Stop - I/O Terminal 02 = Run FWD - I/O Terminal 03 = Run REV Outputs are kept in a ready-to-run state. The drive will respond to a "Start" command within 10 ms. Important: There is greater potential voltage on the output terminals when using this option.
	5	"Comm Port"	Remote communications controls drive operation. - I/O Terminal 01 = Stop: Coast to Stop - I/O Terminal 02 = Not Used - I/O Terminal 03 = Not Used
	6	"2-W Lvl/Enbl"	I/O Terminal Block controls drive operation. - I/O Terminal 01 = Function Loss: Fault and Coast to Stop - I/O Terminal 02 = Run FWD - I/O Terminal 03 = SW Enable Drive will restart after a "Stop" command when: - Stop is removed and Run FWD is held active
		 See Attention Below	



ATTENTION: Hazard of injury exists due to unintended operation. When P036 [Start Source] is set to option 3 or option 6, and the Run input is maintained, the Run inputs do not need to be toggled after a Stop input or a fault clear for the drive to run again. The drive will stop only when the stop command is maintained or the drive is faulted.

Communications Group *(continued)*

C109 [Speed Ref 2] Related Parameter(s): [b001](#), [b002](#), [P038](#), [P040](#), [P042](#), [T051-T054](#), [T070](#), [T071](#), [T073](#), [T074](#), [T075](#), [C102](#), [A141](#), [A142](#), [A143-A146](#), [A152](#), [d301](#)

Sets the source of the speed reference to the drive when in Comm Control and the communication network commands the drive to run from Local Control.

Refer to the flowchart on [page 1-24](#) for more information on speed reference control priority.

Options	0	"Drive Keypad"	Internal frequency command from the digital speed keys on the integral keypad.
	1	"InternalFreq"	Internal frequency command from A142 [Internal Freq]. Must be set when using MOP function.
	2	"Analog In 1" (Default)	External frequency command from an analog source as determined by T069 [Analog In 1 Sel] and DIP Switch AI1 on the control board. Default Dip Switch setting is 10V.
	3	"Analog In 2"	External frequency command from an analog source as determined by T073 [Analog In 2 Sel] and DIP Switch AI2 on the control board. Default Dip Switch setting is 10V.
	4	"Preset Freq"	External frequency command as defined by A143 - A146 [Preset Freq x] when T051 - T054 [Digital Inx Sel] are programmed as "Preset Frequencies" and the digital inputs are active.
	5	"Comm Port"	External frequency command from the communications port. Refer to Appendix D and Appendix E for details. Parameter C102 [Comm Format] is used to select a communications protocol.

Advanced Program Group

A141 [Purge Frequency]

Related Parameter(s): [P038](#), [P039](#), [P040](#), [T051-T054](#)

Provides a fixed frequency command value when T051-T054 [Digital Inx Sel] is set to 1 "Purge". An active purge input will override speed command as shown in the flowchart on [page 1-24](#).

Values	Default:	5.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	1.0 Hz

A142 [Internal Freq]

Related Parameter(s): [P038](#), [T051-T054](#)

Provides the frequency command to the drive when [P038](#) [Speed Reference] is set to 1 "Internal Freq". When enabled, this parameter will change the frequency command in "real time" using the digital speed keys when in program mode.

Important: Once the desired command frequency is reached, the Enter key must be pressed to store this value to EEPROM memory. If the ESC key is used before the Enter key, the frequency will return to the original value following the normal accel/decel curve.

If [T051](#) - [T054](#) [Digital Inx Sel] is set to 16 "MOP Up" or 17 "MOP Down" this parameter acts as the MOP frequency reference if [P038](#) [Speed Reference] is set to 1 "Internal Freq".

Values	Default:	60.00 Hz
	Min/Max:	0.00/320.00 Hz
	Display:	0.01 Hz

A143 [Preset Freq 0]⁽¹⁾

Related Parameter(s): [P038](#), [P039](#), [P040](#), [T051-T052](#), [A147](#), [A148](#)

A144 [Preset Freq 1]

A145 [Preset Freq 2]

A146 [Preset Freq 3]

Values	A143 Default: ⁽¹⁾	0.0 Hz
	A144 Default:	5.0 Hz
	A145 Default:	10.0 Hz
	A146 Default:	20.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

Provides a fixed frequency command value when [T051](#) - [T052](#) [Digital Inx Sel] is set to 8 "Preset Freq".

An active preset input will override speed command as shown in the flowchart on [page 1-24](#).

⁽¹⁾ To activate A143 [Preset Freq 0] set [P038](#) [Speed Reference] to option 4 "Preset Freq".

Input State of Digital In 1 (I/O Terminal 05 when T051 = 8)	Input State of Digital In 2 (I/O Terminal 06 when T052 = 8)	Frequency Source	Accel / Decel Parameter Used ⁽²⁾
0	0	A143 [Preset Freq 0]	[Accel Time 1] / [Decel Time 1]
1	0	A144 [Preset Freq 1]	[Accel Time 1] / [Decel Time 1]
0	1	A145 [Preset Freq 2]	[Accel Time 2] / [Decel Time 2]
1	1	A146 [Preset Freq 3]	[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.

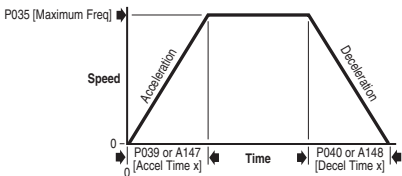
Advanced Program Group *(continued)*

A147 [Accel Time 2]
Related Parameter(s): [P039](#), [T051-T054](#), [A143-A146](#)

When active, sets the rate of acceleration for all speed increases. Refer to the flowchart on page [1-25](#) for details.

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

Values	Default:	30.00 Secs
	Min/Max:	0.00/600.00 Secs
	Display:	0.01 Secs



A148 [Decel Time 2]
Related Parameter(s): [P040](#), [T051-T054](#), [A143-A146](#)

When active, sets the rate of deceleration for all speed decreases. Refer to the flowchart on page [1-25](#) for details.

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

Values	Default:	30.00 Secs
	Min/Max:	0.01/600.00 Secs
	Display:	0.01 Secs

Advanced Program Group *(continued)*

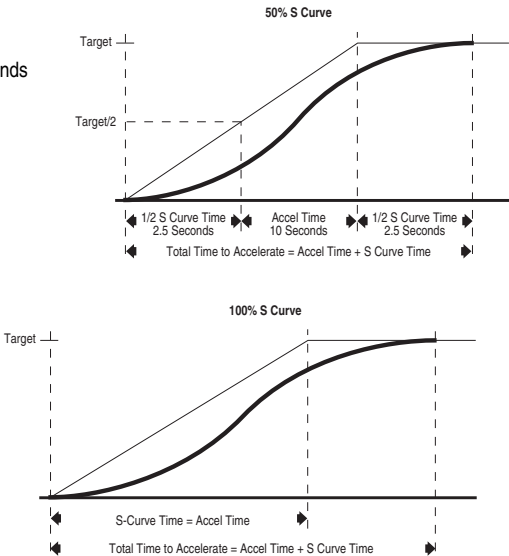
A149 [S Curve %]

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:	20%
	Min/Max:	0/100% (A setting of 0% disables this parameter.)
	Display:	1%

Example:

Accel Time = 10 Seconds
S Curve Setting = 50%
S Curve Time = $10 \times 0.5 = 5$ Seconds
Total Time = $10 + 5 = 15$ Seconds



A150 [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:	0.0/320.0 Hz
	Display:	0.1 Hz

A151 [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:	0.0/320.0 Hz
	Display:	0.1 Hz

Advanced Program Group *(continued)*

A152 [PID Ref Sel]

Related Parameter(s): [P038](#), [T070](#), [T071](#), [T072](#), [T074](#), [T075](#)



Stop drive before changing this parameter.

Enables/disables PID mode and selects the source of the PID reference. Refer to [Appendix D](#) for details.

Options	0	"PID Disabled" (Default)
	1	"PID Setpoint"
	2	"Analog In 1"
	3	"Analog In 2"
	4	"Comm Port"
	5	"Setpnt, Trim" Use PID output as Trim on [Frequency Select]
	6	"A-In 1, Trim" Use PID output as Trim on [Frequency Select]
	7	"A-In 2, Trim" ⁽¹⁾ Use PID output as Trim on [Frequency Select]
	8	"Comm, Trim" Use PID output as Trim on [Frequency Select]

⁽¹⁾ The PID will not function with bipolar input. It will ignore any negative voltages and treat them like zero.

Note: PID analog reference is scaled through the [Analog In x Hi/Lo] parameters. The invert operation is obtained through programming these two parameters. If A152 [PID Ref Sel] is not set to zero, PID can be disabled by programming a digital input.

A153 [PID Feedback Sel]

Related Parameter(s): [T070](#), [T071](#), [T074](#), [T075](#)

Select the source of the PID feedback. Refer to [Appendix D](#) for details.

Options	0	"Analog In 1" (Default) The PID will not function with a bipolar input. Negative voltages are treated as 0 volts.
	1	"Analog In 2" ⁽¹⁾
	2	"Comm Port"

⁽¹⁾ The PID will not function with bipolar input. It will ignore any negative voltages and treat them like zero.

Note: PID analog reference is scaled through the [Analog In x Hi/Lo] parameters. The invert operation is obtained through programming these two parameters.

A154 [PID Prop Gain]

Sets the value for the PID proportional component when the PID mode is enabled by A152 [PID Ref Sel].

Values	Default:	1.00
	Min/Max:	0.00/99.99
	Display:	0.01

A155 [PID Integ Time]

Sets the value for the PID integral component when the PID mode is enabled by A152 [PID Ref Sel].

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

Advanced Program Group *(continued)*

A156 [PID Diff Rate]

Sets the value for the PID differential component when the PID mode is enabled by A152 [PID Ref Sel].

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

A157 [PID Setpoint]

Provides an internal fixed value for process setpoint when the PID mode is enabled by A152 [PID Ref Sel].

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

A158 [PID Deadband]

Sets the lower limit of the PID output.

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

A159 [PID Preload]

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

Values	Default:	0.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

A160 [Process Factor]

Related Parameter(s): [b008](#)

Scales the output frequency value displayed by [b008](#) [Process Display].

$$\text{Output Freq} \times \text{Process Factor} = \text{Process Display}$$

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

Advanced Program Group *(continued)*

A163 [Auto Rstrt Tries]

Related Parameter(s): [T055](#), [T060](#), [T065](#), [T066](#), [A164](#)

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

Clear a Type 1 fault and restart the drive.

1. Set A163 [Auto Rstrt Tries] to a value other than “0”.
2. Set [A164](#) [Auto Rstrt Delay] to a value other than “0”.

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

1. Set A163 [Auto Rstrt Tries] to a value other than “0”.
2. Set [A164](#) [Auto Rstrt Delay] to “0”.

Note: If the parameter is not set to zero and [Auto Rstrt Time] is set to zero, auto fault clear is enabled. This feature automatically clears faults, but does not restart the drive.



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

A164 [Auto Rstrt Delay]

Related Parameter(s): [A163](#)

Sets the time between restart attempts when [A163](#) [Auto Rstrt Tries] is set to a value other than zero.

Note: If the parameter is not set to zero and [Auto Rstrt Time] is set to zero, auto fault clear is enabled. This feature automatically clears faults, but does not restart the drive.

Values	Default:	1.0 Secs
	Min/Max:	0.0/160.0 Secs
	Display:	0.1 Secs

A165 [Start At PowerUp]

Related Parameter(s): [P036](#)



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 Hi 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”

Advance Program Group *(continued)*

A166 [Reverse Disable]

Related Parameter(s): [b006](#), [P036](#), [T051-T054](#)



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 or a serial command. All reverse inputs including two-wire Run Reverse will be ignored with reverse disabled.

Options 0 "Rev Enabled"

1 "Rev Disabled"
(Default)

A167 [Flying Start En]

Related Parameter(s): [A200](#)

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

Important: When this parameter is enabled, verify that A200 [Motor NP FLA] is set to the motor's actual full load amp value.

Options 0 "Disabled" (Default)

1 "Enabled"

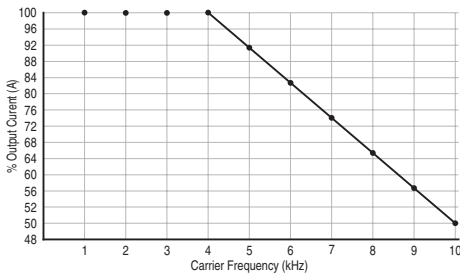
A168 [PWM Frequency]

Related Parameter(s): [A169](#)

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:	2.0/10.0 kHz (Frame C and D drives) 2.0/8.0 kHz (Frame E and F drives)
	Display:	0.1 kHz



A169 [PWM Mode]

Related Parameter(s): [A168](#)

Selects the PWM algorithm used.

Options 0 "Space Vector"	3-Phase Modulation: Provides quiet operation and produces less motor losses.
1 "2-Phase" (Default)	2-Phase Modulation: Provides less drive losses and best performance with long motor cable runs.

Advance Program Group *(continued)*

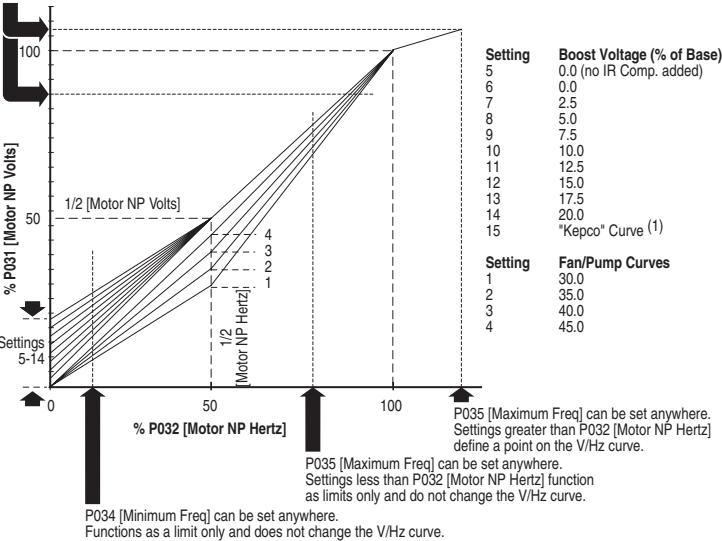
A170 [Boost Select]

Related Parameter(s): [b004](#), [P031](#), [P032](#), [A171](#), [A172](#), [A173](#)

Sets the boost voltage (% of [P031](#) [Motor NP Volts]) and redefines the Volts per Hz curve.
Drive may add additional voltage unless Option 5 is selected.

Options	0	"Custom V/Hz"	
	1	"30.0, VT"	Typical Fan/Pump Curves
	2	"35.0, VT"	
	3	"40.0, VT"	
	4	"45.0, VT" (Default)	
	5	"0.0 no IR"	Boost Curves
	6	"0.0"	
	7	"2.5"	
	8	"5.0"	
	9	"7.5"	
	10	"10.0"	
	11	"12.5"	
	12	"15.0"	
	13	"17.5"	
	14	"20.0"	
	15	"Kepco" Curve ⁽¹⁾	

A174 [Maximum Voltage] can be set anywhere.
Settings greater than P031 [Motor NP Volts] define a point on the V/Hz curve.
Settings less than P031 [Motor NP Volts] function as limits only and do not change the V/Hz curve.



⁽¹⁾ Kepco Curve is used in specific systems to meet requirements of the Korean Electric Power Company.

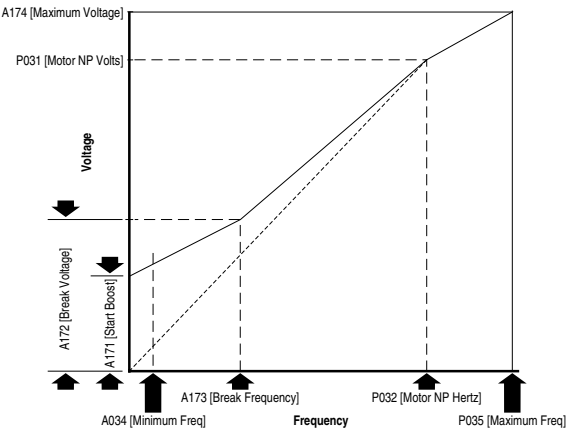
Advance Program Group *(continued)*

A171 [Start Boost]

Related Parameter(s): [P031](#), [P032](#), [P034](#), [P035](#), [A170](#), [A172](#), [A173](#), [A174](#)

Sets the boost voltage (% of [P031](#) [Motor NP Volts]) and redefines the Volts per Hz curve when A170 [Boost Select] = 0 "Custom V/Hz".

Values	Default:	2.5%
	Min/Max:	0.0/25.0%
	Display:	1.1%



A172 [Break Voltage]

Related Parameter(s): [P031](#), [P032](#), [P034](#), [P035](#), [A170](#), [A171](#), [A173](#), [A174](#)

Sets the break voltage applied at the break frequency when A170 [Boost Select] = 0 "Custom V/Hz".

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

A173 [Break Frequency]

Related Parameter(s): [P031](#), [P032](#), [P034](#), [P035](#), [A170](#), [A171](#), [A172](#), [A174](#)

Sets the frequency where break frequency is applied when A170 [Boost Select] = 0 "Custom V/Hz".

Values	Default:	15.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

Advance Program Group *(continued)*

A174 [Maximum Voltage]

Related Parameter(s): [b004](#), [A171](#), [A172](#), [A173](#)

Sets the highest voltage the drive will output.

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

A175 [Slip Hertz @ FLA]

Related Parameter(s): [P033](#)

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

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

A176 [DC Brake Time]

Related Parameter(s): [P037](#), [A177](#)

Sets the length of time that DC brake current is “injected” into the motor when [P037](#) [Stop Mode] is set to either 4 “Ramp” or 6 “DC Brake”. Refer to parameter [A177](#) [DC Brake Level].

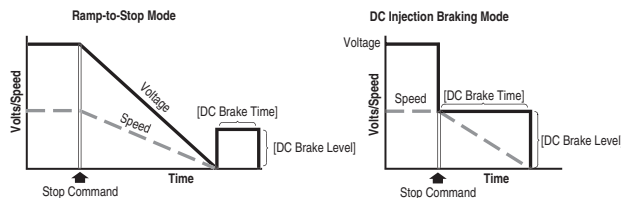
Values	Default:	0.0 Secs
	Min/Max:	0.0/99.9 Secs (A setting of 99.9 = Continuous)
	Display:	0.1 Secs

A177 [DC Brake Level]

Related Parameter(s): [P037](#), [T051-T054](#), [A176](#), [A178](#)

Defines the maximum DC brake current, in amps, applied to the motor.

Values	Default:	Drive Rated Amps $\times$ 0.05
	Min/Max:	0.0/(Drive Rated Amps $\times$ 1.5)
	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.

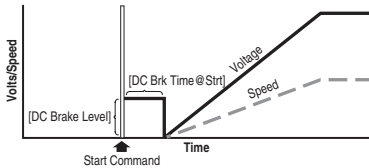
Advance Program Group *(continued)*

A178 [DC Brk Time@Strt]

Related Parameter(s): [P037](#), [A177](#)

Sets the length of time that DC brake current is "injected" into the motor after a valid start command is received. Parameter [A177](#) [DC Brake Level] controls the level of braking current used.

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



A179 [Current Limit 1]

Related Parameter(s): [P033](#)

Maximum output current allowed before current limiting occurs.

Values	Default:	Drive Rated Amps $\times$ 1.1
	Min/Max:	0.0/(Drive Rated Amps $\times$ 1.5)
	Display:	0.1 Amps

A180 [Current Limit 2]

Related Parameter(s): [P033](#)

Maximum output current allowed before current limiting occurs.

Values	Default:	Drive Rated Amps $\times$ 1.1
	Min/Max:	0.0/(Drive Rated Amps $\times$ 1.5)
	Display:	0.1 Amps

A181 [Motor OL Select]

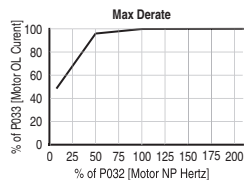
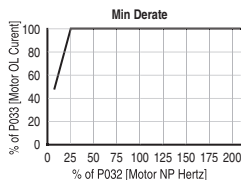
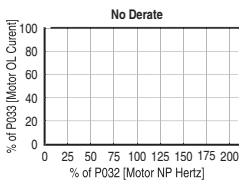
Related Parameter(s): [P032](#), [P033](#), [P043](#)

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"



Advance Program Group *(continued)*

A182 [Drive OL Mode]

Related Parameter(s): [P032](#), [P033](#)

Determines how the drive handles overload conditions that would otherwise cause the drive to fault.

Options	0	"Disabled"
	1	"Reduce CLim"
	2	"Reduce PWM"
	3	"Both-PWM 1st" (Default)

A183 [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 $\times$ 1.8)
	Display:	0.1 Amps

A184 [Load Loss Level]

Related Parameter(s): [P033](#)

Provides a software trip (Load Loss fault) when the current drops below this level for the time specified in [Load Loss Time].

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

A185 [Load Loss Time]

Related Parameter(s): [P033](#)

Sets the required time for the current to be below [Load Loss Level] before a Load Loss fault occurs.

Values	Default:	0 Secs (Disabled)
	Min/Max:	0/9999 Secs
	Display:	1 Secs

A186 [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"

Advance Program Group *(continued)*

A187 [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)

A188 [Skip Frequency 1]

Related Parameter(s): [A189](#)

Sets the frequency at which the drive will not operate.

A setting of 0 disables this parameter.

Values	Default:	0 Hz
	Min/Max:	0/320 Hz
	Display:	1 Hz

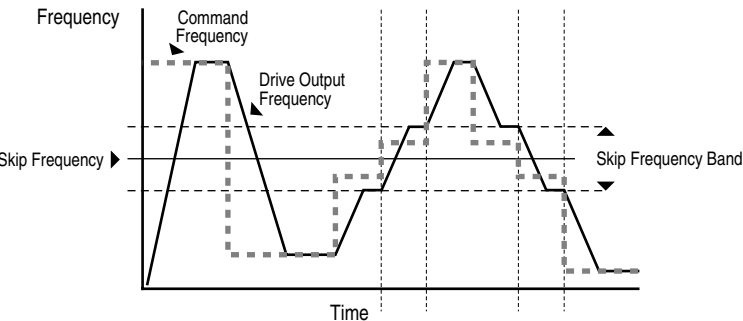
A189 [Skip Freq Band 1]

Related Parameter(s): [A188](#)

Determines the bandwidth around [A188](#) [Skip Frequency 1]. A189 [Skip Freq Band 1] 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



A190 [Skip Frequency 2]

Related Parameter(s): [A191](#)

Sets the frequency at which the drive will not operate.

A setting of 0 disables this parameter.

Values	Default:	0 Hz
	Min/Max:	0/320 Hz
	Display:	1 Hz

Advance Program Group (continued)

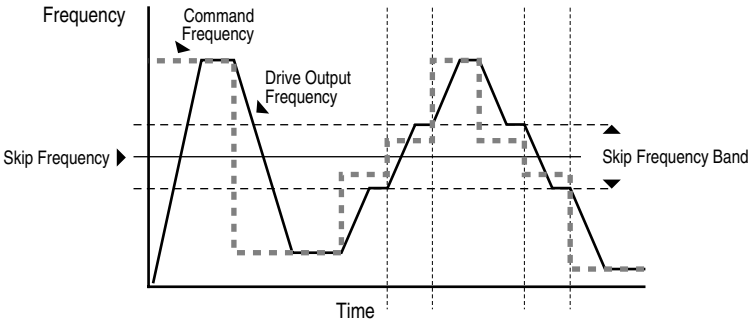
A191 [Skip Freq Band 2]

Related Parameter(s): [A190](#)

Determines the bandwidth around [A190](#) [Skip Frequency 2]. A191 [Skip Freq Band 2] 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



A192 [Skip Frequency 3]

Related Parameter(s): [A193](#)

Sets the frequency at which the drive will not operate.

A setting of 0 disables this parameter.

Values	Default:	0 Hz
	Min/Max:	0/320 Hz
	Display:	1 Hz

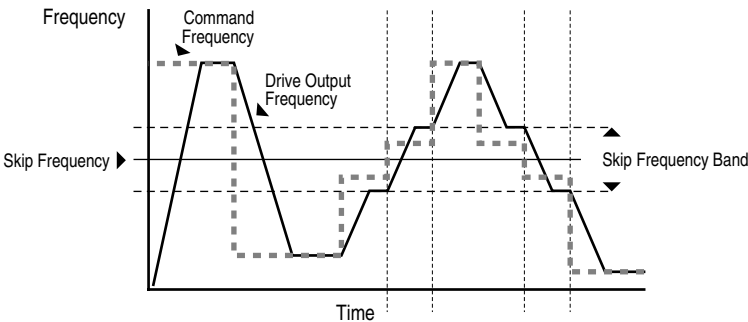
A193 [Skip Freq Band 3]

Related Parameter(s): [A192](#)

Determines the bandwidth around [A192](#) [Skip Frequency 3]. A193 [Skip Freq Band 3] 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



Advance Program Group *(continued)*

A194 [Compensation]

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

Options	0	"Disabled"	
	1	"Electrical" (Default) ⁽¹⁾	Some drive/motor combinations have inherent instabilities which are exhibited as non-sinusoidal 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" ⁽¹⁾	

- ⁽¹⁾ Use "Dead Time Compensation" algorithm to minimize flat spots in motor current waveforms. Use this solution also to achieve motor stability.

A195 [Reset Meters]

Related Parameter(s): [d310-d317](#)

Resets the marker that indicates Fault Times and Energy usage.

Options	0	"Ready/Idle" (Default)	
	1	"Reset MWh"	Also resets kWh marker.
	2	"Reset Time"	min, hr, and x10hr

A196 [Testpoint Sel]

Related Parameter(s): [d319](#)

Used by Rockwell Automation field service personnel.

Values	Default:	1024
	Min/Max:	1024/65535
	Display:	1

A197 [Fault Clear]

Related Parameter(s): [b007](#), [d307](#), [d308](#), [d309](#)



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"	Clears all fault buffers.

Advance Program Group *(continued)*

A198 [Program Lock]

Protects parameters against change by unauthorized personnel. Enter a user-selected password to lock the parameters via Option 1. Enter the same password to unlock the parameters.

Options	0	"Unlocked" (Default)
	1	"Locked" Locks all parameters.
	2	"Locked" Parameter edits allowed over communications network.
	3	"Locked" Locks P035 [Maximum Freq] and A170 [Boost Select].

A199 [Motor NP Poles]

Related Parameter(s): [d323](#)

Sets the motor poles. This is used to calculate [d323](#) [Output RPM].

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

A200 [Motor NP FLA]

Related Parameter(s): [A167](#)

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

Aux Relay Card Group

R221 [Relay Out3 Sel]

R224 [Relay Out4 Sel]

R227 [Relay Out5 Sel]

R230 [Relay Out6 Sel]

R233 [Relay Out7 Sel]

R236 [Relay Out8 Sel]

Related Parameters for the Aux Relay Card Group:

Aux Parameters

PID Parameters

Digital Inputs

Relays 1 and 2

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	"Hand Active"	Active when drive is in local control.
	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 [Relay OutX Level]. - Use T056 to set threshold.
	7	"Above Cur"	- Drive exceeds the current (% Amps) value set in [Relay OutX Level]. - Use T056 to set threshold. Important: Value for [Relay OutX Level] must be entered in percent of drive rated output current.
	8	"Above DCVolt"	- Drive exceeds the DC bus voltage value set in [Relay OutX Level]. - Use T056 to set threshold.
	9	"Above Anlg 2"	- Analog input voltage (I/O Terminal 17) exceeds the value set in [Relay OutX Level]. - Do not use if T073 [Analog In 2 Sel] is set to 3 "Voltage Mode - Bipolar". - This parameter setting can also be used to indicate a PTC trip point when the input (I/O Terminal 17) is wired to a PTC and external resistor. - Use T056 to set threshold.
	10	"Above PF Ang"	- Power Factor angle has exceeded the value set in [Relay OutX Level]. - Use T056 to set threshold.
	11	"Anlg In Loss"	Analog input loss has occurred. Program T072 [Analog In 1 Loss] and/or T076 [Analog In 2 Loss] for desired action when input loss occurs.
	12	"ParamControl"	Enables the output to be controlled over network communications by writing to [Relay OutX Level]. (0 = Off, 1 = On.)
	13	"Retries Exst"	Value set in A163 [Auto Rstrt Tries] is exceeded.
	14	"NonRec Fault"	- Number of retries for [Restart Tries] is exceeded - OR - Non-resettable fault occurs - OR - Auto-retries is not enabled.
	15	"Reverse"	Drive is commanded to run in reverse direction.
	16	"Logic In 1"	An input is programmed as "Logic In 1" and is active.
	17	"Logic In 2"	An input is programmed as "Logic In 2" and is active.
	23	"Aux Motor"	Auxiliary Motor is commanded to run. Refer to Appendix C .

Aux Relay Card Group *(continued)*

- R222 [Relay Out3 Level]
- R225 [Relay Out4 Level]
- R228 [Relay Out5 Level]
- R231 [Relay Out6 Level]
- R234 [Relay Out7 Level]
- R237 [Relay Out8 Level]

Sets the trip point for the digital output relay if the value of [Relay OutX Sel] is 6, 7, 8, 9, 10 or 12.

[Relay OutX Select Setting]	[Relay OutX Level] Min/Max
6	0/320 Hz
7	0/180%
8	0/815 Volts
9	0/100%
10	1/180 degs
12	0/1

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

Refer to [Appendix C](#) for details on the application of parameters R239 through R254.

R239 [Aux Motor Mode]

Enables operation of the auxiliary motor control modes when in PID mode.

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

Aux Relay Card Group *(continued)*

R240 [Aux Motor Qty]

Sets the number of auxiliary motors used while in Auxiliary Motor Control mode.

Options	1	"1 Aux Mtr" (Default)	1 Auxiliary Motor
	2	"2 Aux Mtr"	2 Auxiliary Motors
	3	"3 Aux Mtr"	3 Auxiliary Motors
	4	"1 Mtr + Swap" ⁽¹⁾	1 Auxiliary Motor and AutoSwap Active
	5	"2 Mtr + Swap" ⁽¹⁾	2 Auxiliary Motors and AutoSwap Active
	6	"3 Mtr + Swap" ⁽¹⁾	3 Auxiliary Motors and AutoSwap Active

R240 Option	Drive Relays		Auxiliary Relay Card Relays					
	#1 Relay	#2 Relay	#3 Relay	#4 Relay	#5 Relay	#6 Relay	#7 Relay	#8 Relay
1	Motor #2 AC Line	—	—	—	—	—	—	—
2	Motor #2 AC Line	Motor #3 AC Line	—	—	—	—	—	—
3	Motor #2 AC Line	Motor #3 AC Line	Motor #4 AC Line	—	—	—	—	—
4	Motor #1 Drive	Motor #1 AC Line	Motor #2 Drive	Motor #2 AC Line	—	—	—	—
5	Motor #1 Drive	Motor #1 AC Line	Motor #2 Drive	Motor #2 AC Line	Motor #3 Drive	Motor #3 AC Line	—	—
6	Motor #1 Drive	Motor #1 AC Line	Motor #2 Drive	Motor #2 AC Line	Motor #3 Drive	Motor #3 AC Line	Motor #4 Drive	Motor #4 AC Line

- ⁽¹⁾ **Important:** Proper wiring and parameter configuration of Aux Motor Control functions are especially important when using AutoSwap. Improper wiring or configuration could result in line power being applied to the drive outputs. Verify system operation before connecting auxiliary motor contactor outputs.

R241 [Aux 1 Start Freq]

R244 [Aux 2 Start Freq]

R247 [Aux 3 Start Freq]

Sets the frequency that causes the next available auxiliary motor to turn on.

Values	Default:	50.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

R242 [Aux 1 Stop Freq]

R245 [Aux 2 Stop Freq]

R248 [Aux 3 Stop Freq]

Sets the frequency that causes the next running auxiliary motor to turn off.

Values	Default:	25.0 Hz
	Min/Max:	0.0/320.0 Hz
	Display:	0.1 Hz

Aux Relay Card Group *(continued)*

R243 [Aux 1 Ref Add]

R246 [Aux 2 Ref Add]

R249 [Aux 3 Ref Add]

Sets the amount to add to the PID reference once the next auxiliary motor is turned on to compensate for a drop in the pipe due to the increased flow in a typical pump system.

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

R250 [Aux Start Delay]

Sets the delay time before turning on the next auxiliary motor once the output frequency has risen above the value set in [Aux X Start Freq].

Values	Default:	5.0 Secs
	Min/Max:	0.0/999.9 Secs
	Display:	0.1 Secs

R251 [Aux Stop Delay]

Sets the delay time before turning off the next running auxiliary motor once the output frequency has dropped below the value set in [Aux X Stop Freq].

Values	Default:	3.0 Secs
	Min/Max:	0.0/999.9 Secs
	Display:	0.1 Secs

R252 [Aux Prog Delay]

Sets the time delay between connecting the drive controlled motor contactor and running the drive controlled motor and starting the auxiliary motor control.

Values	Default:	0.50 Secs
	Min/Max:	0.00/60.00 Secs
	Display:	0.01 Secs

R253 [Aux AutoSwap Tme]

Sets the total running time between automatic motor changes.

Important: Proper wiring and parameter configuration of Aux Motor Control functions are especially important when using AutoSwap. Improper wiring or configuration could result in line power being applied to the drive outputs. Verify system operation before connecting auxiliary motor contactor outputs.

Values	Default:	0.0 Hr
	Min/Max:	0.0/999.9 Hr
	Display:	0.1 Hr

Aux Relay Card Group *(continued)*

R254 [Aux AutoSwap Lvl]

Sets the maximum level allowable for an AutoSwap to occur. If the PID output is above this level, AutoSwap will be delayed until the PID output drops below this parameter setting.

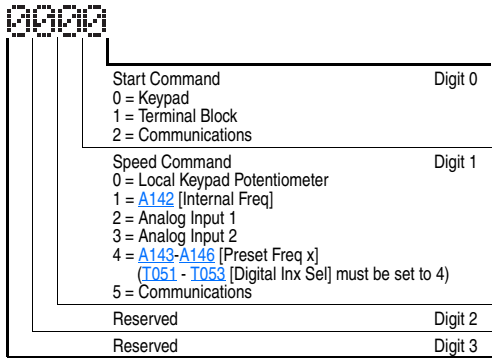
Values	Default:	50.0%
	Min/Max:	0.0/100.0%
	Display:	0.1%

Advance Display Group

d301 [Control Source]

Related Parameter(s): [P036](#), [P038](#), [T051-T054](#)

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 [1-24](#) and [1-25](#) for details.



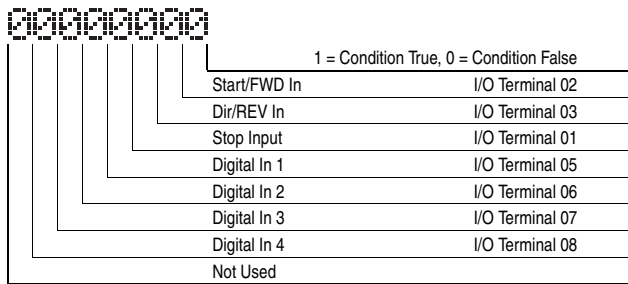
Values	Default:	Read Only
	Min/Max:	0/99
	Display:	1

d302 [Contrl In Status]

Related Parameter(s): [b002](#), [P036](#), [T051-T054](#)

Status of the control terminal block control inputs.

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



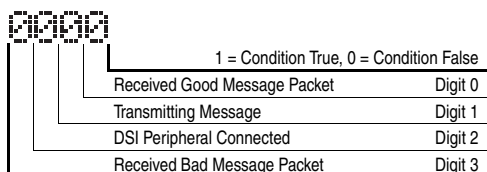
Values	Default:	Read Only
	Min/Max:	0/1
	Display:	1

Advance Display Group *(continued)*

d303 [Comm Status]

Related Parameter(s): [C102-C103](#)

Status of the communications ports.



Values	Default:	Read Only
	Min/Max:	0/1111
	Display:	1

d304 [PID Setpnt Displ]

Related Parameter(s): [C102-C103](#)

Displays the active PID Setpoint value.

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

d305 [Analog In 1]

Related Parameter(s): [C102-C103](#)

Displays the status of Analog Input 1.

Values	Default:	0.0%
	Min/Max:	0.0/120.0%
	Display:	0.1%

d306 [Analog In 2]

Related Parameter(s): [C102-C103](#)

Displays the status of Analog Input 2.

Values	Default:	0.0%
	Min/Max:	0.0/120.0%
	Display:	0.1%

d307 [Fault 1 Code]

Related Parameter(s): [A197](#)

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:	0/122
	Display:	1

Advance Display Group *(continued)*

d308 [Fault 2 Code]

Related Parameter(s): [A197](#)

A code that represents the second most recent 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. As faults occur, this parameter will be overwritten by [Fault 1 Code]. The value of this parameter is then moved to [Fault 3 Code].

Refer to [Chapter 4](#) for fault code descriptions.

Values	Default:	Read Only
	Min/Max:	0/122
	Display:	1

d309 [Fault 3 Code]

Related Parameter(s): [A197](#)

A code that represents the second most recent 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. As faults occur, this parameter will be overwritten by [Fault 2 Code].

Refer to [Chapter 4](#) for fault code descriptions.

Values	Default:	Read Only
	Min/Max:	0/122
	Display:	1

d310 [Fault 1 Time-hr]

Related Parameter(s): [A195](#), [d316](#)

Displays the value of the [d316](#) [Elapsed Time-hr] parameter when the fault occurred.

Values	Default:	Read Only
	Min/Max:	0/9999 Hr
	Display:	1 Hr

d311 [Fault 1 Time-min]

Related Parameter(s): [A195](#), [d317](#)

Displays the value of the [d317](#) [Elapsed Time-min] parameter when the fault occurred.

Values	Default:	Read Only
	Min/Max:	0.0/60.0 Min
	Display:	0.1 Min

d312 [Fault 2 Time-hr]

Related Parameter(s): [A195](#), [d316](#)

Displays the value of the [d316](#) [Elapsed Time-hr] parameter when the fault occurred.

Values	Default:	Read Only
	Min/Max:	0/9999 Hr
	Display:	1 Hr

Advance Display Group *(continued)*

d313 [Fault 2 Time-min]

Related Parameter(s): [A195](#), [d317](#)

Displays the value of the [d317](#) [Elapsed Time-min] parameter when the fault occurred.

Values	Default:	Read Only
	Min/Max:	0.0/60.0 Min
	Display:	0.1 Min

d314 [Fault 3 Time-hr]

Related Parameter(s): [A195](#), [d316](#)

Displays the value of the [d316](#) [Elapsed Time-hr] parameter when the fault occurred.

Values	Default:	Read Only
	Min/Max:	0/9999 Hr
	Display:	1 Hr

d315 [Fault 3 Time-min]

Related Parameter(s): [A195](#), [d317](#)

Displays the value of the [d317](#) [Elapsed Time-min] parameter when the fault occurred.

Values	Default:	Read Only
	Min/Max:	0.0/60.0 Min
	Display:	0.1 Min

d316 [Elapsed Time-hr]

Related Parameter(s): [A195](#), [d310](#), [d312](#), [d314](#)

Displays the total elapsed powered-up time (in hours) since timer reset. The timer stops when it reaches maximum.

Values	Default:	Read Only
	Min/Max:	0/32767 Hr
	Display:	1 Hr

d317 [Elapsed Time-min]

Related Parameter(s): [A195](#), [d311](#), [d313](#), [d315](#)

Displays the total elapsed powered-up time (in minutes) since timer reset. The timer will increment the hour parameter when appropriate.

Values	Default:	Read Only
	Min/Max:	0.0/60.0 Min
	Display:	0.1 Min

d318 [Output Powr Fctr]

Related Parameter(s): [T055](#), [T056](#), [T060](#), [T061](#), [T065](#), [T066](#)

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

Advance Display Group *(continued)*

d319 [Testpoint Data]

Related Parameter(s): [A196](#)

The present value of the function selected in [A196](#) [Testpoint Sel].

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

d320 [Control SW Ver]

Main Control Board software version.

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

d321 [Drive Type]

Used by Rockwell Automation field service personnel.

d322 [Output Speed]

Related Parameter(s): [P034](#)

Displays current output frequency in percent (%). The scale is 0% at 0.00 Hz to 100.0% at [P034](#) [Maximum Freq].

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

d323 [Output RPM]

Related Parameter(s): [A199](#)

Displays current output frequency in RPM. The scale is based on [A199](#) [Motor NP Poles].

Values	Default:	Read Only
	Min/Max:	0/24000 RPM
	Display:	1 RPM

d324 [Fault Frequency]

Related Parameter(s): [b001](#)

Displays the value of [b001](#) [Output Freq] when the last fault occurred.

Values	Default:	Read Only
	Min/Max:	0.00/320.00 Hz
	Display:	0.01 Hz

d325 [Fault Current]

Related Parameter(s): [b003](#)

Displays the value of [b003](#) [Output Current] when the last fault occurred.

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

Advance Display Group *(continued)*

d326 [Fault Bus Volts]

Related Parameter(s): [b005](#)

Displays the value of [b005](#) [DC Bus Voltage] when the last fault occurred.

Values	Default:	Read Only
	Min/Max:	0/820 VDC
	Display:	1 VDC

d327 [Status @ Fault]

Related Parameter(s): [b006](#)

Displays the value of [b006](#) [Drive Status] when the last fault occurred.

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

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Notes:

Troubleshooting

Chapter 4 provides information to guide you in troubleshooting the PowerFlex 400 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	4-5

Drive Status

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

LED Indications

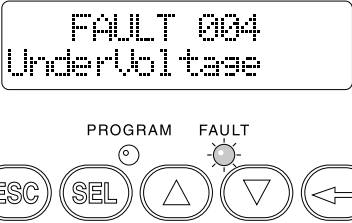
See [page 2-3](#) for information on drive status indicators and controls.

Faults

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

Type	Fault Description	
①	Auto-Reset/Run	When this type of fault occurs, and A163 [Auto Rstrt Tries] is set to a value greater than "0," a user-configurable timer, A164 [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.

Fault Indication

Condition	
Drive is indicating a fault. The integral keypad provides visual notification of a fault condition by displaying the following. - Flashing fault number - Flashing fault indicator Press the Escape key to regain control of the integral keypad.	 The diagram shows a rectangular display area at the top containing the text "FAULT 004" and "UnderVoltage" in a pixelated font. Below the display is a row of five circular buttons. Above the first two buttons are the labels "PROGRAM" and "FAULT". The buttons are: 1. A button with "ESC" inside. 2. A button with "SEL" inside. 3. A button with an upward-pointing triangle inside. 4. A button with a downward-pointing triangle inside. 5. A button with a left-pointing arrow inside.

Manually Clearing Faults

Step	Key(s)
1. Press Esc to acknowledge the fault. The fault information will be removed so that you can use the integral keypad. Access b007 [Fault 1 Code] to view the most recent fault information. 2. Address the condition that caused the fault. The cause must be corrected before the fault can be cleared. See Table 4.A. 3. After corrective action has been taken, clear the fault by one of these methods. - Press Stop if P037 [Stop Mode] is set to a value between "0" and "3". - Cycle drive power. - Set A197 [Fault Clear] to "1" or "2". - Cycle digital input if I051-I054 [Digital Inx Sel] is set to option 10 "Clear Fault".	  OFF

Automatically Clearing Faults

Option / Step
Clear a Type 1 fault and restart the drive. - Set A163 [Auto Rstrt Tries] to a value other than "0". - Set A164 [Auto Rstrt Delay] to a value other than "0". Clear an OverVoltage, UnderVoltage or Heatsink OvrTmp fault without restarting the drive. - Set A163 [Auto Rstrt Tries] to a value other than "0". - Set A164 [Auto Rstrt Delay] to "0".

Auto Restart (Reset/Run)

The Auto Restart feature allows 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.

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

Fault Descriptions

Table 4.A 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.	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 - A147 [Accel Time x] or reduce load so drive output current does not exceed the current set by parameter A179 [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 A170 [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 45°C (113°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 A170 [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.
F15	Load Loss	①	Output current has dropped below the level set in A184 [Load Loss Level].	Check for load loss (i.e., a broken belt).
F29	Analog Input Loss	①	An analog input is configured to fault on signal loss. A signal loss has occurred. Configure with I072 [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.

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 A163 [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 A183 [SW Current Trip] has been exceeded.	Check load requirements and A183 [SW Current Trip] setting.
F64	Drive Overload	②	Drive rating of 110% for 1 minute or 150% 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.
F81	Comm Loss	②	RS485 (DSI) port stopped communicating.	1. Check RS485 wiring connection. 2. Check if a communications adapter or HIM was disconnected. 3. Increase C106 [Comm Loss Time] to an appropriate time for application. 4. Change C105 [Comm Loss Action] to a value other than "0" (fault), if appropriate for the application.
F94	Function Loss	②	P036 [Start Source] is set to setting 6. The input to terminal 01 has been opened.	Close input to terminal 01 and re-start the drive.
F100	Parameter Checksum	②	The checksum read from the board does not match the checksum calculated.	Set P041 [Reset To Defaults] to option 1 "Reset Defaults".

No.	Fault	Type ⁽¹⁾	Description	Action
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.

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 A166 [Reverse Disable] is not prohibiting movement.
Drive is Faulted	Flashing red status light	Clear fault. • Press Stop • Cycle power • Set A197 [Fault Clear] to option 1 "Clear Faults". • Cycle digital input if T051 - T054 [Digital Inx Sel] is set to option 7 "Clear Fault".

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 Stop • Cycle power • Set A197 [Fault Clear] to option 1 "Clear Faults". • Cycle digital input if T051 - T054 [Digital Inx Sel] is set to option 7 "Clear Fault".
Incorrect programming. • P036 [Start Source] is set to option 0 "Keypad" or option 5 "RS485 (DSI) Port". • T051 - T054 [Digital Inx Sel] is set to option 5 "Local" and the input is active.	None	Check parameter settings.
Incorrect input wiring. See 1-20 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.
Incorrect Sink/Source DIP switch setting.	None	Set switch to match wiring scheme.

Drive does not Start from Integral Keypad.

Cause(s)	Indication	Corrective Action
Integral keypad is not enabled.	Green LED above Start key is not illuminated.	• Set parameter P036 [Start Source] to option 0 "Keypad". • Set parameter T051 - T054 [Digital Inx Sel] to option 5 "Local" and activate the input.
I/O Terminal 01 "Stop" input is not present.	None	Wire inputs correctly and/or install jumper.

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 d301 [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 d301 [Control Source] for correct source. - Check d302 [Control In Status] to see if inputs are selecting an alternate source. Verify settings for T051 - T054 [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 1-24.

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 A147 [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 A179 [Current Limit 1]. Remove excess load or reprogram P039 [Accel Time 1] or A147 [Accel Time 2]. Check for improper A170 [Boost Select] setting.
Speed command source or value is not as expected.	None	Verify b002 [Commanded Freq]. Check d301 [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.

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 A194 [Compensation]. 3. Use A170 [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 T051 - T054 [Digital Inx Sel] and P036 [Start Source]. Choose correct input and program for reversing mode.
Digital input is incorrectly wired.	None	Check input wiring. (See page 1-18)
Motor wiring is improperly phased for reverse.	None	Switch two motor leads.
Reverse is disabled.	None	Check A166 [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 Power Terminals P2 and P1 not installed and/or DC Bus Inductor not connected.	None	Install jumper or connect DC Bus Inductor.

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

Specifications

Drive Ratings									
Catalog Number	Output Ratings			Input Ratings			Branch Circuit Protection		
	kW (HP)	Amps 45°C	50°C	Voltage Range	kVA	Amps	Fuses	140M Motor Protectors ⁽¹⁾	Contactors
200 - 240V AC – 3-Phase Input, 0 - 230V 3-Phase Output									
22C-B012N103	2.2 (3.0)	12	12	180-265	6.5	15.5	20	140M-F8E-C16	100-C23
22C-B017N103	3.7 (5.0)	17.5	17.5	180-265	8.8	21	30	140M-F8E-C25	100-C37
22C-B024N103	5.5 (7.5)	24	24	180-265	10.9	26.1	35	140M-F8E-C32	100-C37
22C-B033N103	7.5 (10)	33	33	180-265	14.4	34.6	45	140M-F8E-C45	100-C45
22C-B049A103	11 (15)	49	49	180-265	21.3	51	70	140-CMN-6300	100-C60
22C-B065A103	15 (20)	65	65	180-265	28.3	68	90	140-CMN-9000	100-C85
22C-B075A103	18.5 (25)	75	75	180-265	32.5	78	100	140-CMN-9000	100-D95
22C-B090A103	22 (30)	90	81	180-265	38.3	92	125	–	100-D110
22C-B120A103	30 (40)	120	120	180-265	51.6	124	175	–	100-D180
22C-B145A103	37 (50)	145	130	180-265	62.4	150	200	–	100-D180
380 - 480V AC – 3-Phase Input, 0 - 460V 3-Phase Output									
22C-D6P0N103	2.2 (3.0)	6	6	340-528	6.3	7.5	10	140M-D8E-C10	100-C09
22C-D010N103	4.0 (5.0)	10.5	10.5	340-528	10.9	13	20	140M-D8E-C16	100-C16
22C-D012N103	5.5 (7.5)	12	12	340-528	11.9	14.2	20	140M-D8E-C16	100-C23
22C-D017N103	7.5 (10)	17	17	340-528	15.3	18.4	25	140M-D8E-C20	100-C23
22C-D022N103	11 (15)	22	22	340-528	19.2	23	30	140M-F8E-C32	100-C30
22C-D030N103	15 (20)	30	27	340-528	25.8	31	40	140M-F8E-C32	100-C37
22C-D038A103	18.5 (25)	38	38	340-528	33.3	40	50	140M-F8E-C45	100-C60
22C-D045A103	22 (30)	45.5	45.5	340-528	39.1	47	60	140-CMN-6300	100-C60
22C-D060A103	30 (40)	60	54	340-528	53.3	64	80	140-CMN-9000	100-C85
22C-D072A103	37 (50)	72	72	340-528	60.7	73	100	140-CMN-9000	100-C85
22C-D088A103	45 (60)	88	88	340-528	74.9	90	125	–	100-D110
22C-D105A103	55 (75)	105	105	340-528	89	107	150	–	100-D140
22C-D142A103	75 (100)	142	128	340-528	124.8	150	200	–	100-D180
22C-D170A103	90 (125)	170	170	340-528	142	170	250	–	100-D250
22C-D208A103	110 (150)	208	208	340-528	167	200	250	–	100-D250

⁽¹⁾ Refer to the Bulletin 140M Motor Protectors *Selection Guide*, publication 140M-SG001... to determine the frame and breaking capacity required for your application.

Category	Specification	
Agency Certification		Listed to UL508C and CAN/CSA-22.2 Listed to UL508C for plenums
		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
	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: 405V DC bus voltage (equivalent to 290V AC incoming line) 380-460V AC Input: 810V DC bus voltage (equivalent to 575V AC incoming line)
	Bus Undervoltage Trip:	200-240V AC Input: 210V DC bus voltage (equivalent to 150V AC incoming line) 380-480V AC Input: 390V DC bus voltage (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 ² t protection - 110% for 60 seconds (Provides Class 10 protection)
	Overcurrent:	180% hardware limit, 220% 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:	-10 to 50 degrees C (14 to 122 degrees F) -10 to 45 degrees C (14 to 113 degrees F)
	Cooling Method:	Fan: All drive ratings
	Storage Temperature:	-40 to 70 degrees C (-40 to 158 degrees F)
	Atmosphere:	Important: Drive <u>must not</u> 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
	Seismic Rating	Meets the seismic requirements of the 2003 International Building Code as specified by AC156.

Category		Specification
Electrical	Voltage Tolerance:	200-240V $\pm 10\%$ 380-480V $\pm 10\%$
	Frequency Tolerance:	48-63 Hz
	Input Phases:	Three-phase input provides full rating. Single-phase operation provides 50% rated current.
	Displacement Power Factor:	0.98 across entire speed range
	Efficiency:	97.5% at rated amps, nominal line voltage
	Maximum Short Circuit Rating:	100,000 Amps Symmetrical (Frame C Drives) 200,000 Amps Symmetrical (Frame D, E, F Drives)
	Actual Short Circuit Rating:	Determined by AIC Rating of installed fuse/circuit breaker
	Transistor Type:	Isolated Gate Bipolar (IGBT)
	Internal DC Bus Choke:	
	200-240V AC Input:	11-37 kW (15-50 HP) Panel Mount Drives
	380-480V AC Input:	11-110 kW (15-150 HP) Panel Mount Drives
Control	Method:	Sinusoidal PWM, Volts/Hertz
	Carrier Frequency	
	Frames C and D:	2-10 kHz, Drive rating based on 4 kHz
	Frames E and F:	2-8 kHz, Drive rating based on 4 kHz
	Frequency Accuracy	
	Digital Input:	Within $\pm 0.05\%$ of set output frequency
	Analog Input:	Within 0.5% of maximum output frequency, 10-Bit resolution
	Analog Output:	$\pm 2\%$ of full scale, 10-Bit resolution
	Speed Regulation - Open Loop with Slip Compensation:	$\pm 1\%$ of base speed across a 60:1 speed range
	Output Frequency:	0-320 Hz (programmable)
Control Inputs	Stop Modes:	Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold and S Curve.
	Accel/Decel:	Two independently programmable accel and decel times. Each time may be programmed from 0 - 600 seconds in 0.1 second increments.
	Intermittent Overload:	110% Overload capability for up to 1 minute
	Electronic Motor Overload Protection	Class 10 protection with speed sensitive response.
	Digital:	
	Quantity:	(3) Semi-programmable (4) Programmable
	Type	
	Source Mode (SRC):	18-24V = ON, 0-6V = OFF
	Sink Mode (SNK):	0-6V = ON, 18-24V = OFF
	Analog:	
	Quantity:	(1) Isolated, -10 to 10V or 4-20mA (1) Non-isolated, 0 to 10V or 4-20mA
	Specification	
	Resolution:	10-bit
	0 to 10V DC Analog:	100k ohm input impedance
	4-20mA Analog:	250 ohm input impedance
	External Pot:	1-10k ohm, 2 Watt minimum

Category	Specification		
Control Outputs	Relay:	Quantity:	(2) Programmable Form C
		Specification	
		Resistive Rating:	3.0A at 30V DC, 3.0A at 125V, 3.0A at 240V AC
		Inductive Rating:	0.5A at 30V DC, 0.5A at 125V, 0.5A at 240V AC
	Optional Relay Card:	Quantity:	(6) Optional Programmable Form A (Drive Frames D, E & F Only)
		Specification	
		Resistive Rating:	0.1A at 30V DC Class II circuits, 3.0A at 125V, 3.0A at 240V AC
		Inductive Rating:	0.1A at 30V DC Class II circuits, 3.0A at 125V 3.0A at 240V AC
	Opto:	Quantity:	(1) Programmable
		Specification:	30V DC, 50mA Non-inductive
	Analog:	Quantity:	(2) Non-Isolated, 0-10V or 4-20mA
		Specification	
		Resolution:	10-bit
		0 to 10V DC Analog:	1k ohm minimum
Keypad		4-20mA Analog:	525 ohm maximum
	Display:	Integral 2 line by 16 character LCD with (5) LED Indicators	
	Languages:	English, Français, Español, Italiano, Deutsch, Português, Nederlands	
Communication	Type:	Serial (RS485)	
	Supported Protocols (Standard):	Drive Serial Interface (DSI) Modbus RTU Metasys N2	
	Supported Protocols (Optional):	DeviceNet EtherNet/IP PROFIBUS DP ControlNet LonWorks P1 - Floor Level Network (FLN)	
	Software (Optional):	Windows Based Pocket PC/Windows Mobile 2003	

PowerFlex 400 Watts Loss (Rated Load, Speed & PWM)

Voltage	kW (HP)	Panel Mount Watts	Flange Mount Watts		
		Total	External	Internal	Total
200-240V AC	2.2 (3.0)	146	119	28	146
	3.7 (5.0)	207	174	33	207
	5.5 (7.5)	266	228	39	266
	7.5 (10)	359	315	44	359
	11 (15)	488	—	—	—
	15 (20)	650	—	—	—
	18.5 (25)	734	—	—	—
	22 (30)	778	—	—	—
	30 (40)	1055	—	—	—
	37 (50)	1200	—	—	—
380-480V AC	2.2 (3.0)	105	77	28	105
	4.0 (5.0)	171	143	28	171
	5.5 (7.5)	200	161	39	200
	7.5 (10)	267	229	39	267
	11 (15)	329	285	44	329
	15 (20)	435	380	55	435
	18.5 (25)	606	—	—	—
	22 (30)	738	—	—	—
	30 (40)	664	—	—	—
	37 (50)	1019	—	—	—
	45 (60)	1245	—	—	—
	55 (75)	1487	—	—	—
	75 (100)	2043	—	—	—
	90 (125)	2617	—	—	—
	110 (150)	3601	—	—	—

Input Power Connections

Figure A.1 Frame C, D, and E Connections

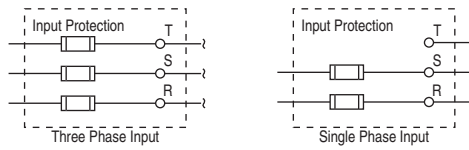
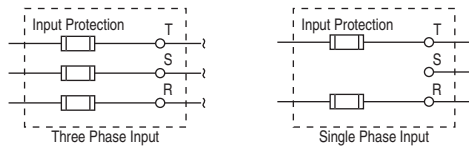


Figure A.2 Frame F Connections



Note: UL Approval pending for Single-Phase operation.

Notes:

Accessories and Dimensions

Product Selection

Table B.1 Catalog Number Description

22C	-	B	024	N	1	0	3
Drive		Voltage Rating	Rating	Enclosure	HIM	Emission Class	Comm Slot

Table B.2 PowerFlex 400 Drives

Drive Ratings					Catalog Number	Frame Size
Input Voltage	kW	HP	Output Current (Amps)			
			45°C	50°C		
240V 50/60 Hz 3-Phase	2.2	3.0	12	12	22C-B012N103	C
	3.7	5.0	17.5	17.5	22C-B017N103	C
	5.5	7.5	24	24	22C-B024N103	C
	7.5	10	33	33	22C-B033N103	C
	11	15	49	49	22C-B049A103	D
	15	20	65	65	22C-B065A103	D
	18.5	25	75	75	22C-B075A103	D
	22	30	90	81	22C-B090A103	D
	30	40	120	120	22C-B120A103	E
37	50	145	130	22C-B145A103	E	
480V 50/60 Hz 3-Phase	2.2	3.0	6	6	22C-D6P0N103	C
	4.0	5.0	10.5	10.5	22C-D010N103	C
	5.5	7.5	12	12	22C-D012N103	C
	7.5	10	17	17	22C-D017N103	C
	11	15	22	22	22C-D022N103	C
	15	20	30	27	22C-D030N103	C
	18.5	25	38	38	22C-D038A103	D
	22	30	45.5	45.5	22C-D045A103	D
	30	40	60	54	22C-D060A103	D
	37	50	72	72	22C-D072A103	E
	45	60	88	88	22C-D088A103	E
	55	75	105	105	22C-D105A103	E
	75	100	142	128	22C-D142A103	E
	90	125	170	170	22C-D170A103	F
	110	150	208	208	22C-D208A103	F

Table B.3 PowerFlex 400 Flange Mount Drives

Drive Ratings						Frame Size
Input Voltage	kW	HP	Output Current			
			45°C	50°C	Catalog Number	
240V 50/60 Hz 3-Phase	2.2	3	12A	12A	22C-B012F103	C
	3.7	5	17.5A	17.5A	22C-B017F103	C
	5.5	7.5	24A	24A	22C-B024F103	C
	7.5	10	33A	33A	22C-B033F103	C
480V 50/60 Hz 3-Phase	2.2	3	6.0A	6.0A	22C-D6P0F103	C
	4.0	5	10A	10A	22C-D010F103	C
	5.5	7.5	12A	12A	22C-D012F103	C
	7.5	10	17A	17A	22C-D017F103	C
	11	15	22A	22A	22C-D022F103 ⁽¹⁾	C
	15	20	30A	27A	22C-D030F103 ⁽¹⁾	C

⁽¹⁾ A DC bus inductor is required. See [Table B.7](#) for ordering information.

Table B.4 Bulletin 1321-3R Series Line Reactors – 200-240V, 60 Hz, Three-Phase

kW	HP	Fundamental Amps	Maximum Continuous Amps	Inductance mh	Watts Loss	Catalog Number	
						IP00 (Open Style)	IP11 (MENA Type 1)
3% Impedance							
2.2	3.0	12	18	1.25	26	1321-3R12-A	1321-3RA12-A
3.7	5.0	18	27	0.8	36	1321-3R18-A	1321-3RA18-A
5.5	7.5	25	37.5	0.5	48	1321-3R25-A	1321-3RA25-A
7.5	10	35	52.5	0.4	49	1321-3R35-A	1321-3RA35-A
11	15	45	67.5	0.3	54	1321-3R45-A	1321-3RA45-A
15	20	55	82.5	0.25	64	1321-3R55-A	1321-3RA55-A
18.5	25	80	120	0.2	82	1321-3R80-A	1321-3RA80-A
22	30	80	120	0.2	82	1321-3R80-A	1321-3RA80-A
30	40	100	150	0.15	94	1321-3R100-A	1321-3RA100-A
37	50	130	195	0.1	108	1321-3R130-A	1321-3RA130-A
5% Impedance							
2.2	3.0	12	18	2.5	31	1321-3R12-B	1321-3RA12-B
3.7	5.0	18	27	1.5	43	1321-3R18-B	1321-3RA18-B
5.5	7.5	25	37.5	1.2	52	1321-3R25-B	1321-3RA25-B
7.5	10	35	52.5	0.8	54	1321-3R35-B	1321-3RA35-B
11	15	45	67.5	0.7	62	1321-3R45-B	1321-3RA45-B
15	20	55	82.5	0.5	67	1321-3R55-B	1321-3RA55-B
18.5	25	80	120	0.4	86	1321-3R80-B	1321-3RA80-B
22	30	80	120	0.4	86	1321-3R80-B	1321-3RA80-B
30	40	100	150	0.3	84	1321-3R100-B	1321-3RA100-B
37	50	130	195	0.2	180	1321-3R130-B	1321-3RA130-B

Table B.5 Bulletin 1321-3R Series Line Reactors – 380-480V, 60 Hz, Three-Phase

Table 10: 3-Phase, 480V, 3-Wire, 3-Phase							
		Fundamental Amps	Maximum Continuous Amps	Inductance	Watts Loss	Catalog Number	
kW	HP					IP00 (Open Style)	IP11 (MENA Type 1)
3% Impedance							
2.2	3.0	8	12	5	25.3	1321-3R8-C	1321-3RA8-C
4.0	5.0	12	18	2.5	31	1321-3R12-B	1321-3RA12-B
5.5	7.5	12	18	2.5	31	1321-3R12-B	1321-3RA12-B
7.5	10	18	27	1.5	43	1321-3R18-B	1321-3RA18-B
11	15	25	37.5	1.2	52	1321-3R25-B	1321-3RA25-B
15	20	35	52.5	0.8	54	1321-3R35-B	1321-3RA35-B
18.5	25	35	52.5	0.8	54	1321-3R35-B	1321-3RA35-B
22	30	45	67.5	0.7	62	1321-3R45-B	1321-3RA45-B
30	40	55	82.5	0.5	67	1321-3R55-B	1321-3RA55-B
37	50	80	120	0.4	86	1321-3R80-B	1321-3RA80-B
45	60	80	120	0.4	86	1321-3R80-B	1321-3RA80-B
55	75	100	150	0.3	84	1321-3R100-B	1321-3RA100-B
75	100	130	195	0.2	180	1321-3R130-B	1321-3RA130-B
90	125	160	240	0.15	149	1321-3R160-B	1321-3RA160-B
110	150	200	300	0.11	168	1321-3R200-B	1321-3RA200-B
5% Impedance							
2.2	3.0	8	12	7.5	28	1321-3R8-D	1321-3RA8-D
4.0	5.0	12	18	4.2	41	1321-3R12-C	1321-3RA12-C
5.5	7.5	12	18	4.2	41	1321-3R12-C	1321-3RA12-C
7.5	10	18	27	2.5	43	1321-3R18-C	1321-3RA18-C
11	15	25	37.5	2.0	61	1321-3R25-C	1321-3RA25-C
15	20	35	52.5	1.2	54	1321-3R35-C	1321-3RA35-C
18.5	25	35	52.5	1.2	54	1321-3R35-C	1321-3RA35-C
22	30	45	67.5	1.2	65	1321-3R45-C	1321-3RA45-C
30	40	55	82.5	0.85	71	1321-3R55-C	1321-3RA550-C
37	50	80	120	0.7	96	1321-3R80-C	1321-3RA80-C
45	60	80	120	0.7	96	1321-3R80-C	1321-3RA80-C
55	75	100	150	0.45	108	1321-3R100-C	1321-3RA100-C
75	100	130	195	0.3	128	1321-3R130-C	1321-3RA130-C
90	125	160	240	0.23	138	1321-3R160-C	1321-3RA160-C
110	150	200	300	0.185	146	1321-3R200-C	1321-3RA200-C

Table B.6 Bulletin 1321 - DC Series Bus Inductors - 200-240V, 60 Hz, Three-Phase

kW	HP	DC Amps	Inductance mh	Watts Loss	Catalog Number IP00 (Open Style)
2.2	3	12	0.92	5	1321-DC12-1
3.7	5	18	0.63	5	1321-DC18-1
5.5	7.5	32	0.85	11	1321-DC32-1
7.5	10	40	0.75	15	1321-DC40-2

Table B.7 Bulletin 1321 - DC Series Bus Inductors - 380-480V, 60 Hz, Three-Phase

kW	HP	DC Amps	Inductance mh	Watts Loss	Catalog Number IP00 (Open Style)
2.2	3	9	3.68	7	1321-DC9-2
4.0	5	12	2.1	7	1321-DC12-2
5.5	7.5	18	3.75	17	1321-DC18-4
7.5	10	25	1.75	13	1321-DC25-4
11	15	32	2.68	21	1321-DC32-2 ⁽¹⁾
15	20	40	2.0	29	1321-DC40-4 ⁽¹⁾

⁽¹⁾ Required on 11 and 15 kW (15 and 20 HP) Frame C Flange Mount drive ratings.

Table B.8 EMC Line Filters

Drive Ratings			Catalog Number
Input Voltage	kW	HP	
240V 50/60 Hz 3-Phase	2.2	3.0	22-RF034-CS
	4.0	5.0	22-RF034-CS
	5.5	7.5	22-RF034-CS
	7.5	10	22-RF034-CS
	11	15	22-RFD070
	15	20	22-RFD100
	18.5	25	22-RFD100
	22	30	22-RFD150
	30	40	22-RFD150
480V 50/60 Hz 3-Phase	37	50	22-RFD180
	2.2	3.0	22-RF018-CS
	4.0	5.0	22-RF018-CS
	5.5	7.5	22-RF018-CS
	7.5	10	22-RF018-CS
	11	15	22-RF026-CS
	15	20	22-RFD036
	18.5	25	22-RFD050
	22	30	22-RFD050
	30	40	22-RFD070
	37	50	22-RFD100
	45	60	22-RFD100
	55	75	22-RFD150
	75	100	22-RFD180
	90	125	Consult Factory
	110	150	Consult Factory

Table B.9 Communication Option Kits and Accessories

Item	Description	Catalog Number
DeviceNet Communication Adapter	Embedded communication option for use with the PowerFlex family of drives. Requires a Communication Adapter Cover when used with Frame C PowerFlex 400 drives (Ordered Separately).	22-COMM-D
EtherNet/IP Communication Adapter	Embedded communication option for use with the PowerFlex family of drives. Requires a Communication Adapter Cover when used with Frame C PowerFlex 400 drives (Ordered Separately).	22-COMM-E
Profibus DP Communication Adapter	Embedded communication option for use with the PowerFlex family of drives. Requires a Communication Adapter Cover when used with Frame C PowerFlex 400 drives (Ordered Separately).	22-COMM-P
Communication Adapter Cover	Cover that houses the communication adapter. Frame C Drive	22C-CCC
Serial Converter Module (RS485 to RS232)	Provides serial communication via DF1 protocol for use with DriveExplorer and DriveExecutive software. Includes: DSI to RS232 serial converter (one) 1203-SFC serial cable (one) 22-RJ45CBL-C20 cable (one) DriveExplorer Lite CD (one)	22-SCM-232
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
DriveExplorer Software (CD-ROM) Version 3.01 or later	Windows based software package that provides 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⁾	9306-4EXP01ENE
DriveExecutive software (CD-ROM) Version 1.01 or later	Windows based software package that provides an intuitive means for monitoring or configuring Allen-Bradley drives and communication adapters online and offline. Compatibility: Windows 98, ME, NT 4.0 (Service Pack 3 or later), 2000 and XP	9303-4DTE01ENE
Serial Flash Firmware Kit	Use a PC to update drive firmware.	AK-U9-FLSH1

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

Table B.10 Human Interface Module (HIM) Option Kits and Accessories

Item	Description	Catalog Number
LCD Display, Remote Panel Mount	LCD Display Digital Speed Control CopyCat Capable IP66 (NEMA Type 4X/12) indoor use only Includes 2.0 meter cable	22-HIM-C2S
LCD Display, Remote Handheld	LCD Display 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.11 Frame C 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.	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.	C	22-JBCC

Table B.12 Field Installed Option

Item	Description	Catalog Number
Auxiliary Relay Board	Field installed kit. Expands drive output capabilities.	AK-U9-RLB1

Product Dimensions

Table B.13 PowerFlex 400 Frames and Weights

Frame	kW (HP)	Drive Weight kg (lbs.)	Packaged Weight kg (lbs.)
240V AC – 3-Phase			
C	2.2 (3.0)	2.89 (6.4)	3.41 (7.5)
C	4.0 (5.0)	2.97 (6.5)	3.49 (7.7)
C	5.5 (7.5)	3.72 (8.2)	4.27 (9.4)
C	7.5 (10)	3.78 (8.3)	4.33 (9.5)
D	11 (15)	12.1 (26.7)	13.4 (29.5)
D	15 (20)	12.7 (28.0)	14 (30.9)
D	18.5 (25)	12.7 (28.0)	14 (30.9)
D	22 (30)	12.7 (28.0)	14 (30.9)
E	30 (40)	38 (83.8)	48.2 (106.3)
E	37 (50)	38 (83.8)	48.2 (106.3)
480V AC – 3-Phase			
C	2.2 (3.0)	2.87 (6.3)	3.39 (7.5)
C	4.0 (5.0)	3.03 (6.7)	3.55 (7.8)
C	5.5 (7.5)	3.65 (8.0)	4.2 (9.3)
C	7.5 (10)	3.75 (8.3)	4.3 (9.5)
C	11 (15)	6.41 (14.1)	7.41 (16.3)
C	15 (20)	6.47 (14.3)	7.49 (16.5)
D	18.5 (25)	12.7 (28.0)	14 (30.9)
D	22 (30)	12.7 (28.0)	14 (30.9)
D	30 (40)	14.3 (31.5)	15.6 (34.4)
E	37 (50)	36 (79.4)	46.2 (101.9)
E	45 (60)	36 (79.4)	46.2 (101.9)
E	55 (75)	41 (90.4)	51.2 (112.9)
E	75 (100)	41 (90.4)	51.2 (112.9)
F	90 (125)	78 (172.0)	88 (194.0)
F	110 (150)	78 (172.0)	88 (194.0)
240V AC – 3-Phase, Plate Drive			
C	2.2 (3.0)	2.66 (5.9)	3.26 (7.2)
C	4.0 (5.0)	2.74 (6.0)	3.34 (7.4)
C	5.5 (7.5)	3.15 (6.9)	3.75 (8.3)
C	7.5 (10)	3.21 (7.1)	3.81 (8.4)
480V AC – 3-Phase, Plate Drive			
C	2.2 (3.0)	2.63 (5.8)	3.23 (7.1)
C	4.0 (5.0)	2.77 (6.1)	3.37 (7.4)
C	5.5 (7.5)	3.04 (6.7)	3.64 (8.0)
C	7.5 (10)	3.13 (6.9)	3.73 (8.2)
C	11 (15)	3.19 (7.0)	3.79 (8.4)
C	15 (20)	3.25 (7.2)	3.85 (8.5)

Figure B.1 **PowerFlex 400 Frame C Drive** - *Dimensions are in millimeters and (inches)*

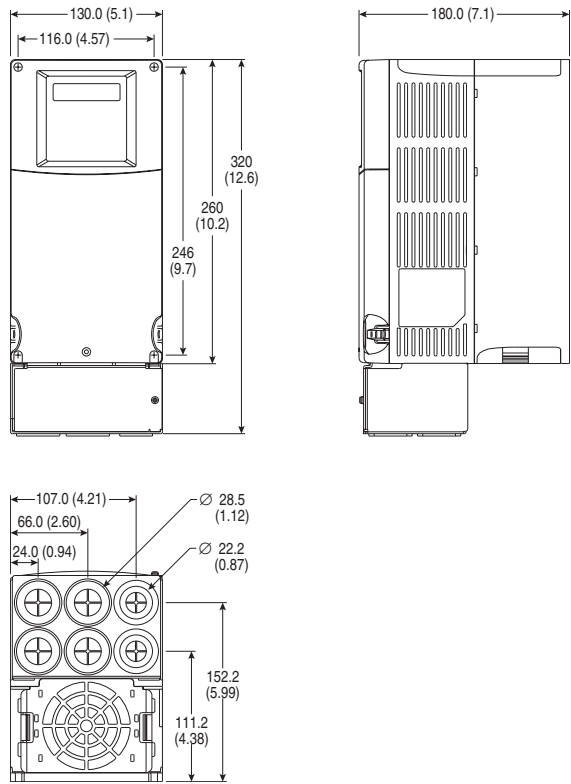


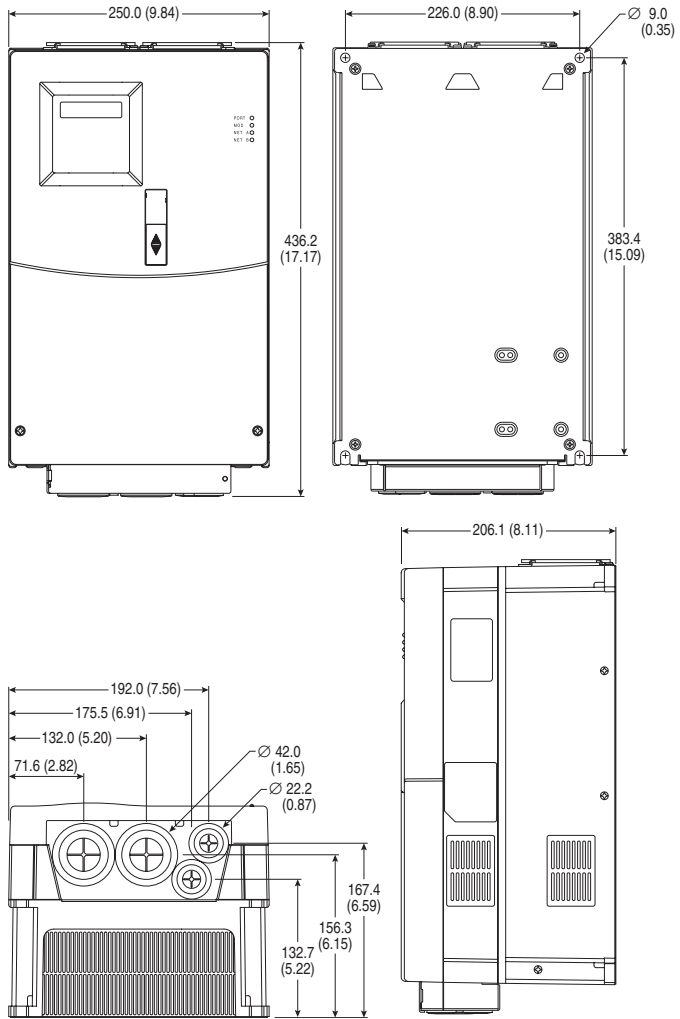
Figure B.2 PowerFlex 400 Frame D Drive - Dimensions are in millimeters and (inches)

Figure B.3 PowerFlex 400 Frame E Drive - *Dimensions are in millimeters and (inches)*

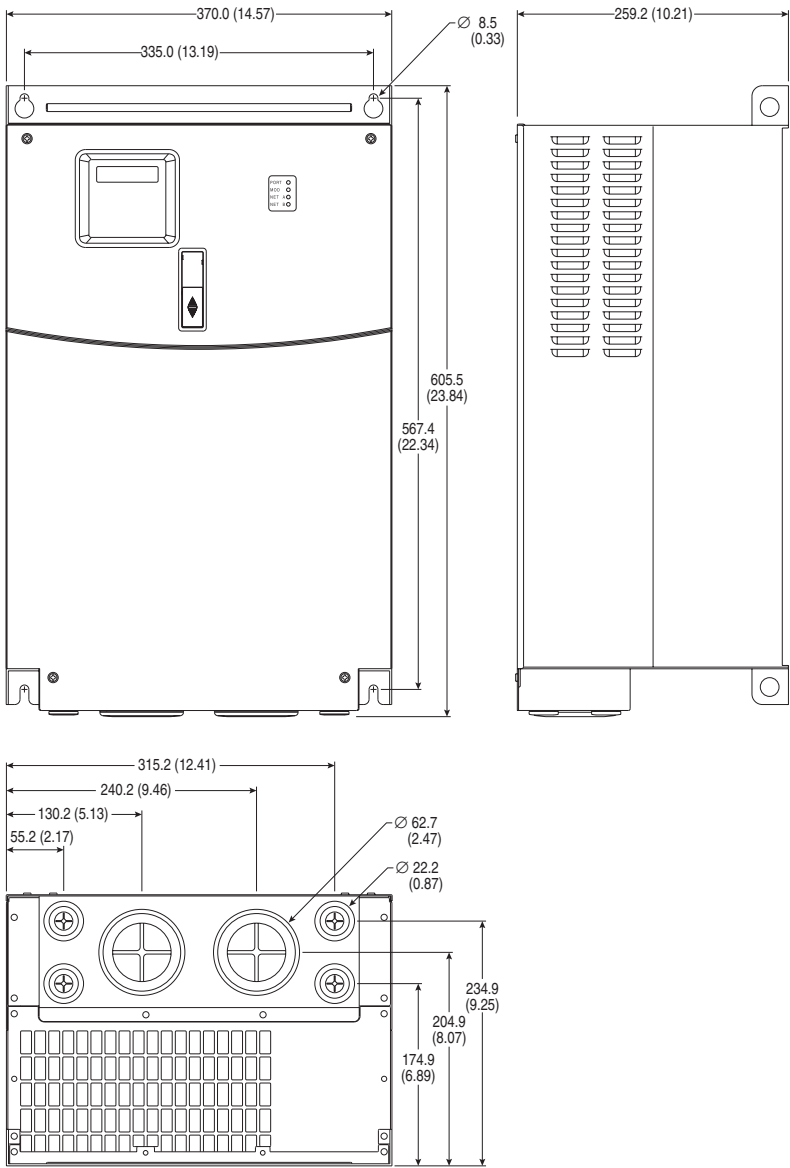


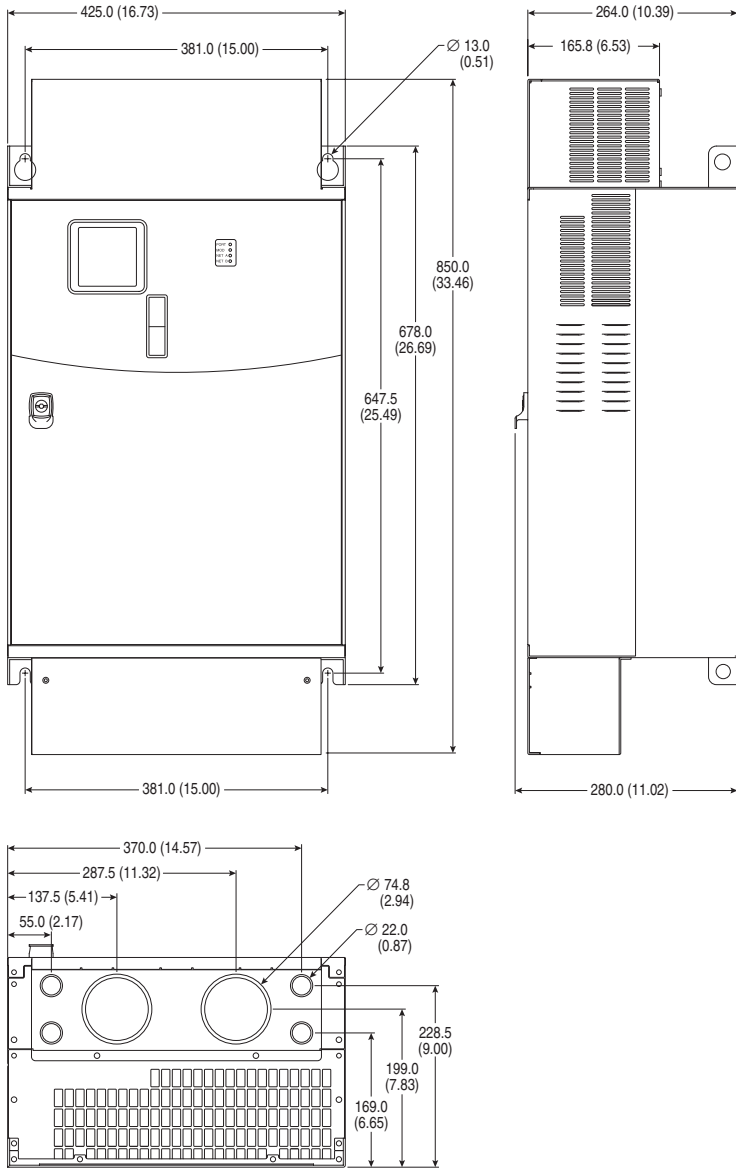
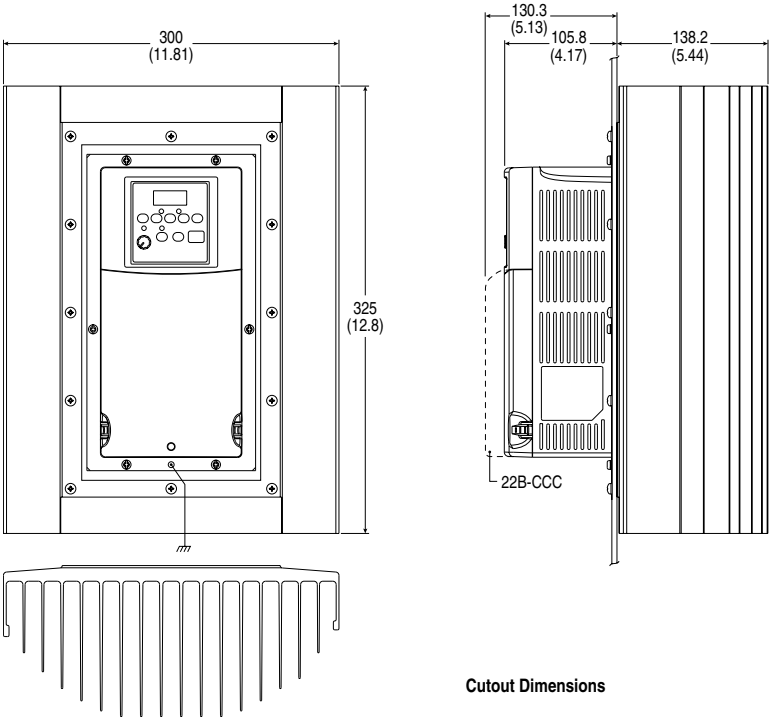
Figure B.4 PowerFlex 400 Frame F Drive - Dimensions are in millimeters and (inches)

Figure B.5 PowerFlex 400 Frame C Flange Mount Drive -
Dimensions are in millimeters and (inches)



Cutout Dimensions

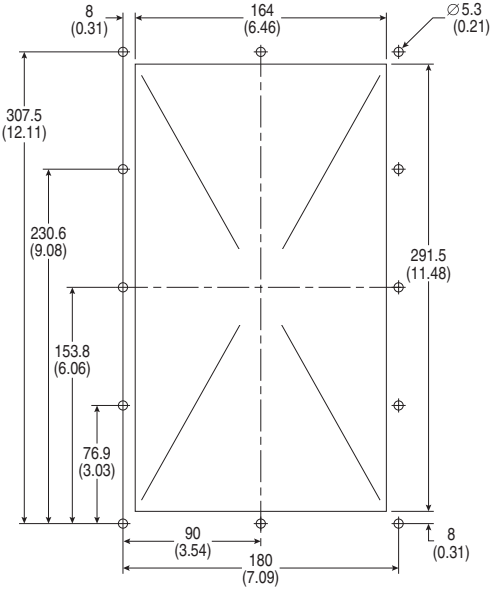
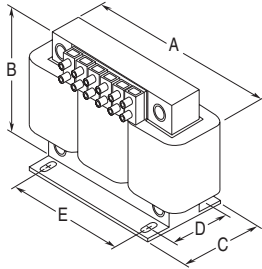
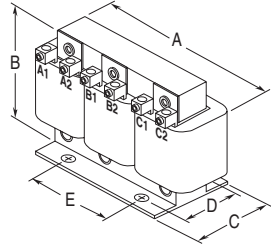


Figure B.6 Bulletin 1321-3R Series Line Reactors – Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).



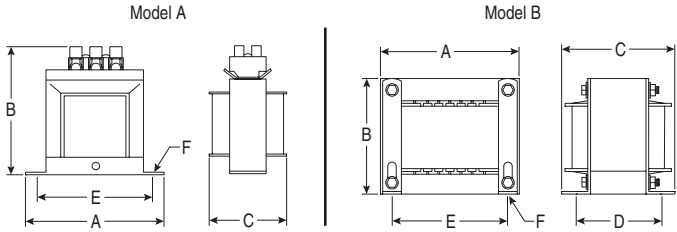
IP00 (Open) –
45 Amps (fundamental) and Below



IP00 (Open) –
55 Amps (fundamental) and Above

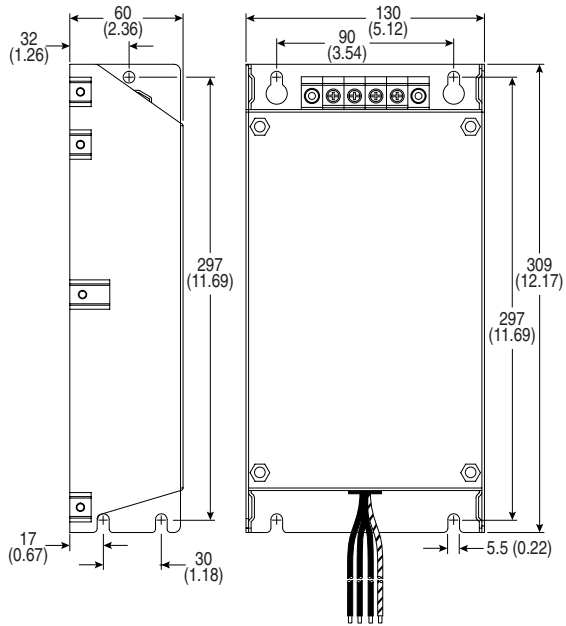
Catalog Number	A	B	C	D	E	Weight
1321-3R8-C	152 (6.00)	122 (4.80)	86 (3.40)	67 (2.62)	51 (2.00)	5.0 (11)
1321-3R8-D	152 (6.00)	122 (4.80)	86 (3.40)	63 (2.48)	51 (2.00)	5.9 (13)
1321-3R12-A	152 (6.00)	127 (5.00)	84 (3.30)	53 (2.10)	51 (2.00)	4.1 (9)
1321-3R12-B	152 (6.00)	127 (5.00)	76 (3.00)	53 (2.10)	51 (2.00)	4.5 (10)
1321-3R12-C	152 (6.00)	127 (5.00)	91 (3.60)	69 (2.73)	51 (2.00)	8.2 (18)
1321-3R18-B	152 (6.00)	135 (5.30)	89 (3.50)	63 (2.48)	51 (2.00)	5.5 (12)
1321-3R18-C	183 (7.20)	146 (5.76)	92 (3.63)	66 (2.60)	76 (3.00)	7.3 (16)
1321-3R25-A	183 (7.20)	146 (5.76)	85 (3.35)	60 (2.35)	76 (3.00)	4.9 (11)
1321-3R25-B	183 (7.20)	146 (5.76)	85 (3.35)	60 (2.35)	76 (3.00)	6.3 (14)
1321-3R25-C	183 (7.20)	146 (5.76)	105 (4.10)	79 (3.10)	76 (3.00)	8.1 (18)
1321-3R35-A	193 (7.60)	146 (5.76)	91 (3.60)	66 (2.60)	76 (3.00)	6.3 (14)
1321-3R35-B	183 (7.20)	147 (5.80)	95 (3.75)	79 (3.10)	76 (3.00)	7.3 (16)
1321-3R35-C	229 (9.00)	187 (7.35)	118 (4.66)	80 (3.16)	76 (3.00)	13.6 (30)
1321-3R45-A	229 (9.00)	187 (7.35)	118 (4.66)	80 (3.16)	76 (3.00)	10.4 (23)
1321-3R45-B	229 (9.00)	187 (7.35)	118 (4.66)	80 (3.16)	76 (3.00)	12.7 (28)
1321-3R45-C	229 (9.00)	184 (7.25)	135 (5.30)	93 (3.66)	76 (3.00)	17.7 (39)
1321-3R55-A	229 (9.00)	187 (7.35)	118 (4.66)	80 (3.16)	76 (3.00)	10.9 (24)
1321-3R55-B	229 (9.00)	187 (7.35)	118 (4.66)	80 (3.16)	76 (3.00)	12.3 (27)
1321-3R55-C	229 (9.00)	184 (7.25)	142 (5.60)	99 (3.90)	76 (3.00)	18.6 (41)
1321-3R80-A	274 (10.80)	216 (8.50)	139 (5.47)	88 (3.47)	92 (3.63)	19.5 (43)
1321-3R80-B	274 (10.80)	216 (8.50)	139 (5.47)	88 (3.47)	92 (3.63)	23.1 (51)
1321-3R80-C	274 (10.80)	210 (8.26)	156 (6.16)	106 (4.16)	92 (3.63)	25.0 (55)
1321-3R100-A	274 (10.80)	217 (8.55)	139 (5.48)	84 (3.30)	92 (3.63)	21.3 (47)
1321-3R100-B	274 (10.80)	210 (8.25)	144 (5.66)	93 (3.66)	92 (3.63)	23.1 (51)
1321-3R100-C	274 (10.80)	210 (8.25)	156 (6.16)	106 (4.16)	92 (3.63)	33.6 (74)
1321-3R130-A	229 (9.00)	179 (7.04)	118 (4.66)	80 (3.16)	76 (3.00)	13.2 (29)
1321-3R130-B	274 (10.80)	213 (8.40)	144 (5.66)	93 (3.66)	92 (3.63)	25.9 (57)
1321-3R130-C	279 (11.00)	216 (8.50)	156 (6.16)	106 (4.16)	92 (3.63)	29.0 (64)
1321-3R160-A	274 (10.80)	216 (8.50)	172 (6.80)	80 (3.16)	92 (3.63)	19.0 (42)
1321-3R160-B	279 (11.00)	216 (8.50)	178 (7.00)	88 (3.47)	92 (3.63)	23.0 (51)
1321-3R160-C	287 (11.30)	216 (8.50)	229 (9.00)	118 (4.66)	92 (3.63)	33.0 (72)
1321-3R200-B	274 (10.80)	216 (8.50)	210 (8.30)	112 (4.41)	92 (3.63)	31.0 (67)
1321-3R200-C	274 (10.80)	216 (8.50)	254 (10.00)	150 (5.91)	92 (3.63)	46.0 (100)

Figure B.7 Bulletin 1321-DC Series Bus Inductors – Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).

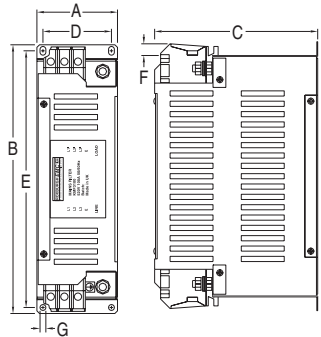


Catalog Number	Model	A	B	C	D	E	F	Weight kg (lbs.)
1321-DC9-2	A	95 (3.75)	83 (3.25)	51 (2.00)	—	80 (3.13)	4.7 (0.19)	
1321-DC12-1	A	95 (3.75)	83 (3.25)	44 (1.75)	—	80 (3.13)	4.7 (0.19)	
1321-DC12-2	B	97 (3.81)	114 (4.50)	72 (2.82)	51 (2.00)	80 (3.13)	5x8 (.20x.33)	5.9 (13.0)
1321-DC18-1	A	95 (3.75)	83 (3.25)	51 (2.00)	—	80 (3.13)	4.7 (0.19)	
1321-DC18-4	B	118 (4.63)	133 (5.25)	102 (4.00)	64 (2.50)	95 (3.75)	5x8 (.20x.33)	3.6 (8.0)
1321-DC25-4	B	97 (3.81)	114 (4.50)	76 (3.00)	64 (2.50)	80 (3.13)	5x8 (.20x.33)	5.9 (13.0)
1321-DC32-1	B	97 (3.81)	114 (4.50)	84 (3.32)	64 (2.50)	80 (3.13)	5x8 (.20x.33)	2.3 (5.0)
1321-DC32-2	B	118 (4.63)	133 (5.25)	108 (4.25)	76 (3.00)	95 (3.75)	5x8 (.20x.33)	4.5 (10.0)
1321-DC40-2	B	97 (3.81)	114 (4.50)	95 (3.75)	76 (3.00)	80 (3.13)	5x8 (.20x.33)	3.2 (7.0)
1321-DC40-4	B	165 (6.50)	166 (6.55)	152 (6.00)	86 (3.38)	135 (5.31)	7x13 (.28x.52)	9.5 (21.0)

Figure B.8 EMC Line Filters – Dimensions are in millimeters and (inches)
Catalog Numbers: 22-RF018-CS, 22-RF018-CL, 22-RF026-CS, 22-RF026-CL,
22-RF026-CL, 22-RF034-CS



Catalog Numbers: 22-RFD036, 22-RFD050, 22-RFD070, 22-RFD100, 22-RFD150, 22-RFD180



Catalog Number	A	B	C	D	E	F	G
22-RFD036	74 (2.91)	272 (10.71)	161 (6.34)	60 (2.36)	258 (10.16)	7.5 (0.30)	7 (0.28)
22-RFD050	93 (3.66)	312 (12.28)	190 (7.48)	79 (3.11)	298 (11.73)	13.5 (0.53)	7 (0.28)
22-RFD070	93 (3.66)	312 (12.28)	190 (7.48)	79 (3.11)	298 (11.73)	13.5 (0.53)	7 (0.28)
22-RFD100	93 (3.66)	312 (12.28)	190 (7.48)	79 (3.11)	298 (11.73)	13.5 (0.53)	7 (0.28)
22-RFD150	126 (4.96)	312 (12.28)	224 (8.82)	112 (4.41)	298 (11.73)	19.5 (0.77)	7 (0.28)
22-RFD180	126 (4.96)	312 (12.28)	224 (8.82)	112 (4.41)	298 (11.73)	27 (1.06)	7 (0.28)

Catalog Numbers: 22-RFD330

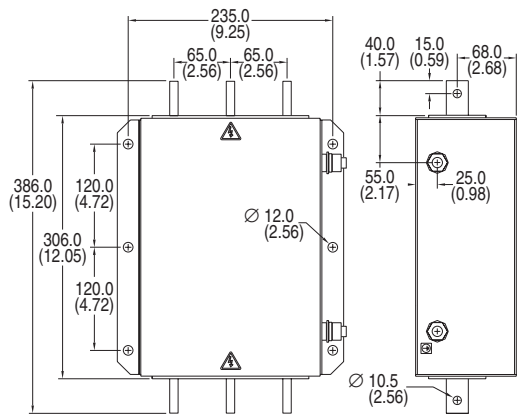


Figure B.9 Remote (Panel Mount) Small HIM – Dimensions are in millimeters and (inches)
Catalog Number: 22-HIM-C2S

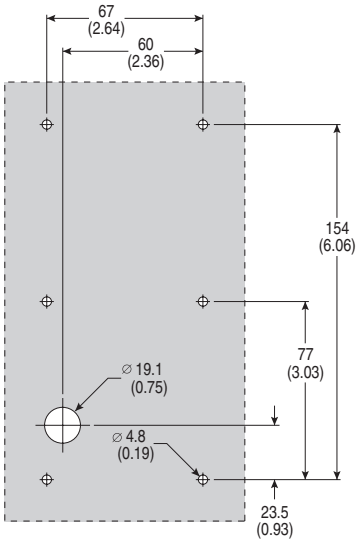
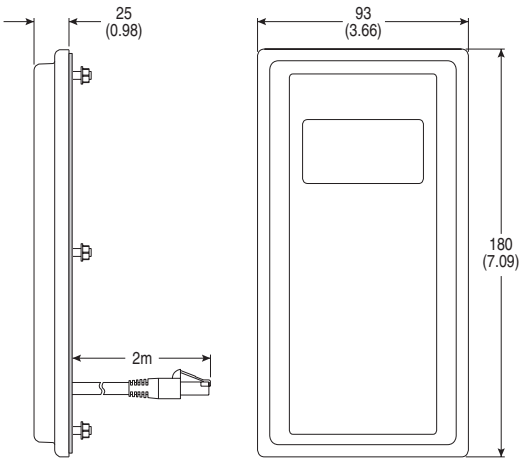
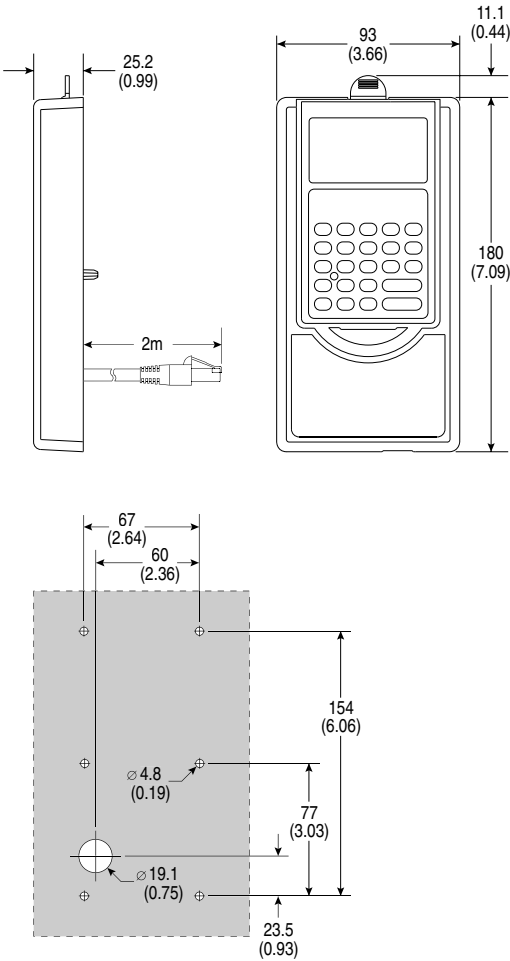


Figure B.10 NEMA Type 1 Bezel – Dimensions are in millimeters and (inches)
Catalog Number: 22-HIM-B1



RJ45 DSI Splitter Cable

The PowerFlex 400 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

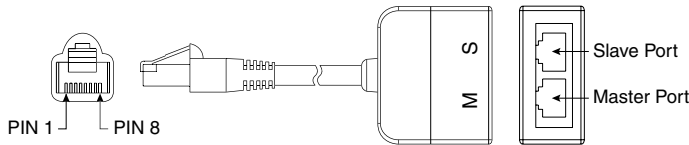


ATTENTION: Risk of injury or equipment damage exists. The peripherals may not perform as intended if these Connectivity Guidelines are not followed. Precautions should be taken to follow these Connectivity Guidelines.

- 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 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).

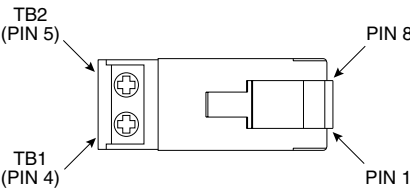
DSI Cable Accessories

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



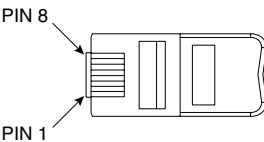
RJ45 Two-Position Terminal Block Adapter –

Catalog Number: AK-U0-RJ45-TB2P

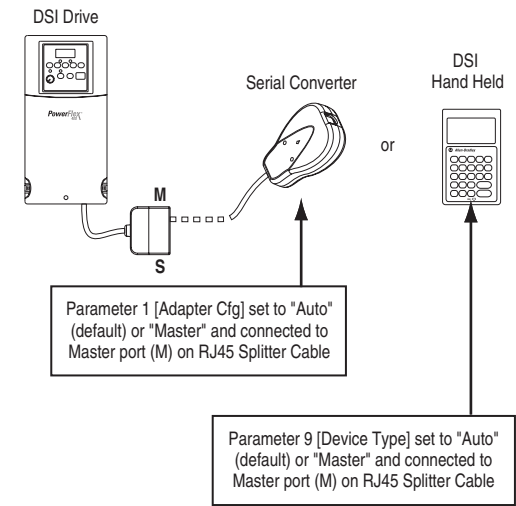


RJ45 Adapter with Integrated Termination Resistor –

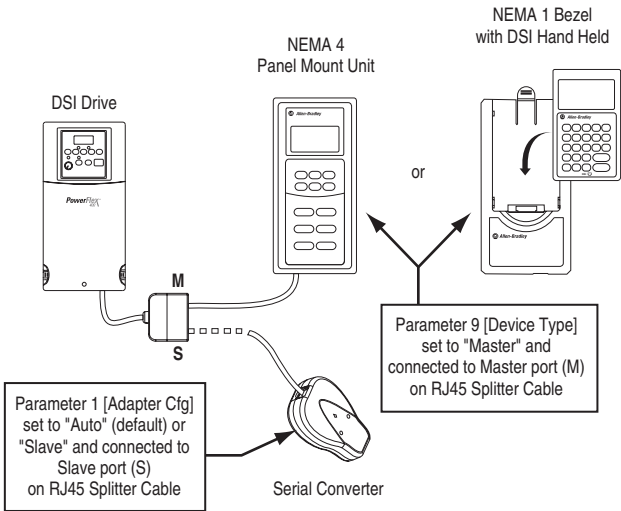
Catalog Number: AK-U0-RJ45-TR1



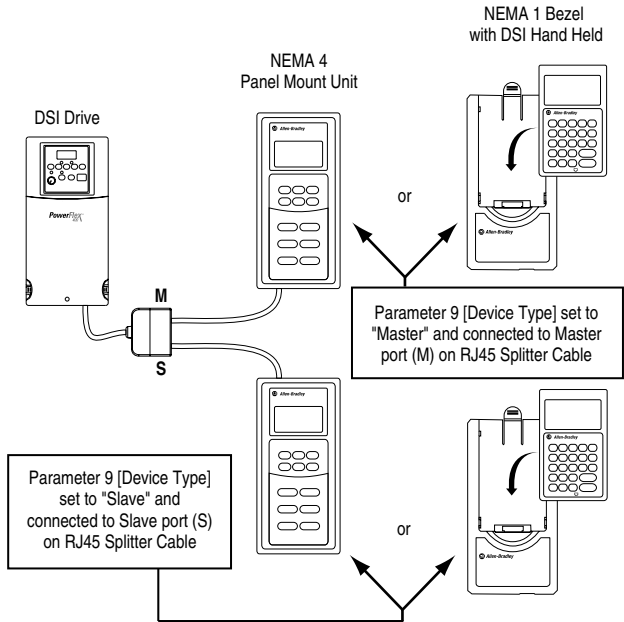
Connecting One Temporary Peripheral



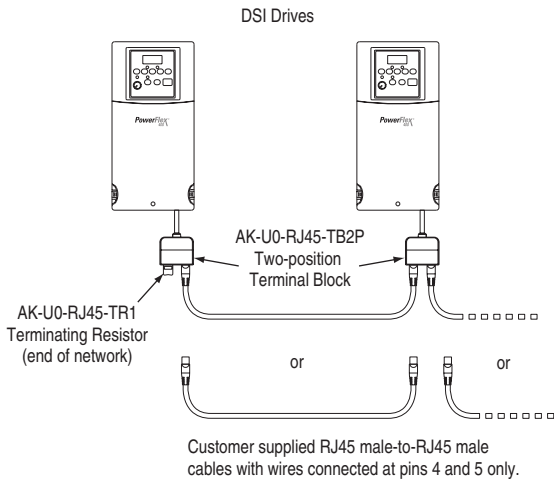
Connecting One Temporary Peripheral and One Permanent Peripheral



Connecting Two Permanent Peripherals



Connecting an RS-485 Network

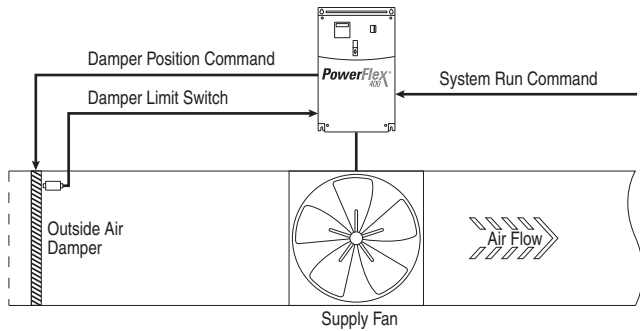


Both the Master (M) and Slave (S) ports on the RJ45 Splitter Cable operate as standard RS-485 ports in this configuration.

Application Notes

Damper Control Setup

The PowerFlex 400 allows damper control logic to be imbedded within the drive reducing cost associated with external control hardware and software. A system Run command can be wired directly into one of the drive inputs. Relay outputs can be used to energize the damper to either open or close. A damper limit switch can be wired back to the drive providing indication that the damper is in the proper position and that it is safe for the drive to run at commanded speed.



Example

- The System Run Command can come from a terminal block, integral keypad, or communication port. Configure parameter [P036](#) [Start Source] per application requirements.
- Set one of the available digital inputs, parameter [T051-T054](#) [Digital Inx Sel] to option 36 “Damper Input”. The damper end switch or limit switch should be wired into this input.
- Set one of the available relay outputs, parameter [T055/T060](#) [Relay Outx Sel] to option 2 “Motor Running”. This output should be used to energize the damper to either open or close.

PID Setup

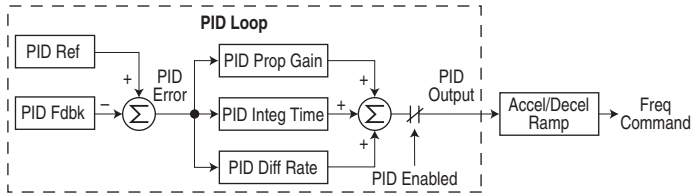
PID Control Loop

The PowerFlex 400 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 [A152](#) [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.

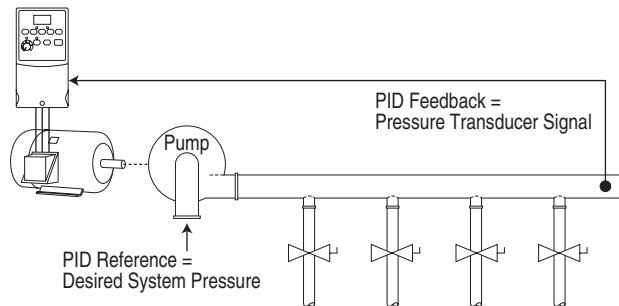
Exclusive Control

In Exclusive Control, the Speed Reference becomes 0, and the PID Output becomes the entire Freq Command. Exclusive Control is used when [A152](#) [PID Ref Sel] is set to option 1, 2, 3 or 4. This configuration does not require a master reference, only a desired set point, such as a flow rate for a pump.



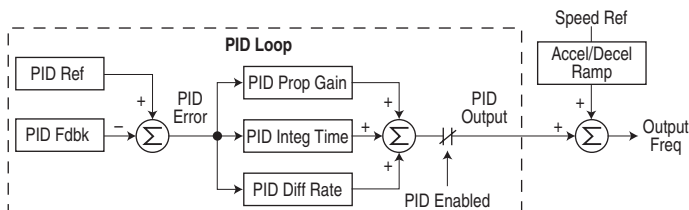
Example

- 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.



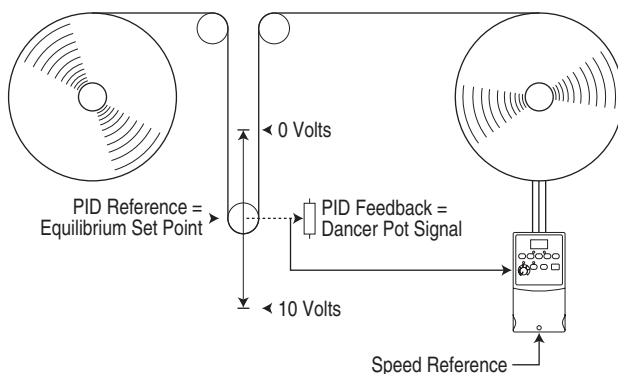
Trim Control

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 [A152](#) [PID Ref Sel] is set to option 5, 6, 7 or 8.



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.



PID Reference and Feedback

Parameter [A152](#) [PID Ref Sel] is used to enable the PID mode ($A152 = 0$ “PID Disabled”) and to select the source of the PID Reference. If [A152](#) [PID Ref Sel] is not set to 0 “PID Disabled”, PID can still be disabled by select programmable digital input options (parameters [T051](#)-[T054](#)) such as “Local” or “PID Disable”.

Table D.A A152 [PID Ref Sel] Options

Option	Description
0 “PID Disabled”	Disables the PID loop (default setting)
1 “PID Setpoint”	Selects Exclusive Control. A157 [PID Setpoint] will be used to set the value of the PID Reference
2 “Analog In 1”	Selects Exclusive Control. Selects the Analog In 1 Input.
3 “Analog In 2”	Selects Exclusive Control. Selects the Analog In 2 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.
4 “Comm Port”	Selects Exclusive Control. The reference word from a communication network (see Appendix E 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] $\times 10 = 100\%$ reference. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% reference.
5 “Setpnt, Trim”	Selects Trim Control. A157 [PID Setpoint] will be used to set the value of the PID Reference.
6 “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.
7 “4-20mA, Trim”	Selects Trim Control. Selects the 4-20mA Input.
8 “Comm, Trim”	Selects Trim Control. The reference word from a communication network (see Appendix E 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] $\times 10 = 100\%$ reference. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% reference.

[A153](#) [PID Feedback Sel] is used to select the source of the PID feedback.

Table D.B A153 [PID Feedback Sel] Options

Option	Description
0 “Analog In 1”	Selects the Analog In 1 Input (default setting).
1 “Analog In 2”	Selects the Analog In 2 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.
2 “Comm Port”	The reference word from a communication network (see Appendix E 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] $\times 10 = 100\%$ Feedback. For example, with [Maximum Freq] = 60 Hz, a value of 600 sent over the network would represent 100% Feedback.

Analog PID Reference Signals

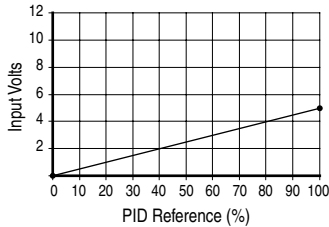
Parameters [T070](#) [Analog In 1 Lo], [T071](#) [Analog In 1 Hi], [T074](#) [Analog In 2 Lo], and [T075](#) [Analog In 2 Hi] are used to scale or invert an analog PID Reference.

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.

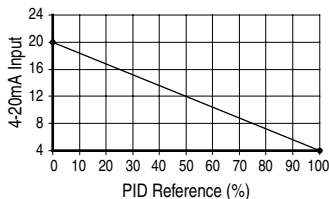
- [T069](#) [Analog In 1 Sel] or [T073](#) [Analog In 2 Sel] = 2 “Voltage Mode - Unipolar”.
- [T070](#) [Analog In 1 Lo] or [T074](#) [Analog In 2 Lo] = 0.0%
- [T071](#) [Analog In 1 Hi] or [T075](#) [Analog In 2 Hi] = 50.0%
- [A152](#) [PID Ref Sel] = 0 “0-10V Input”



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.

- [T069](#) [Analog In 1 Sel] or [T073](#) [Analog In 2 Sel] = 1 “Current Mode 4-20 mA”
- [T070](#) [Analog In 1 Lo] or [T074](#) [Analog In 2 Lo] = 100.0%
- [T071](#) [Analog In 1 Hi] or [T075](#) [Analog In 2 Hi] = 0.0%
- [A152](#) [PID Ref Sel] = 2 “Analog In 1” or 3 “Analog In 2”



PID Deadband

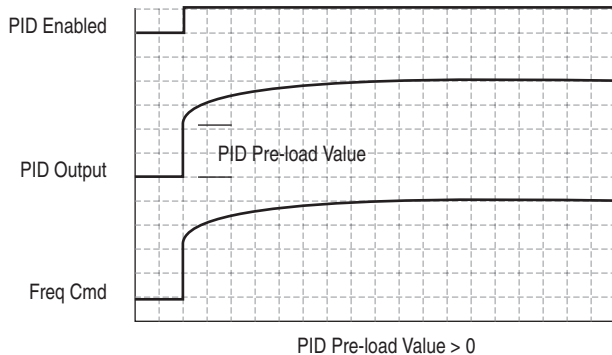
Parameter [A158](#) [PID Deadband] is used to set a range, in percent, of the PID Reference that the drive will ignore.

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 [A159](#) [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

[A150](#) [PID Trim Hi] and [A151](#) [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.

PID Gains

The proportional, integral, and differential gains make up the PID regulator.

- [A154](#) [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.

- [A155](#) [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 disables the integral component of the PID loop.

- [A156](#) [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.

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 [A154](#) [PID Prop Gain].
 - If the response is too quick and/or unstable (see [Figure D.1](#)), decrease [A154](#) [PID Prop Gain].
 - Typically, [A154](#) [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 D.2](#)), or the PID Feedback does not become equal to the PID Reference, decrease [A155](#) [PID Integ Time].
 - If there is a lot of oscillation in the PID Feedback before settling out (see [Figure D.3](#)), increase [A155](#) [PID Integ Time].
3. At this point, the differential gain may not be needed. However, if after determining the values for [A154](#) [PID Prop Gain] and [A155](#) [PID Integ Time]:
 - Response is still slow after a step change, increase [A156](#) [PID Diff Rate].
 - Response is still unstable, decrease [A156](#) [PID Diff Rate].

The following figures show some typical responses of the PID loop at different points during adjustment of the PID Gains.

Figure D.1 Unstable

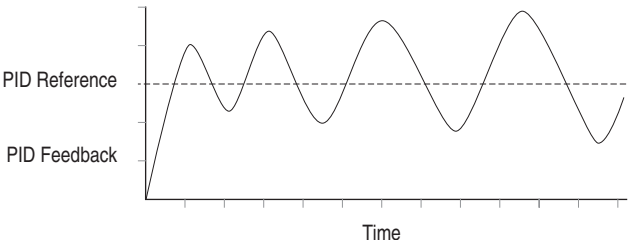


Figure D.2 Slow Response – Over Damped

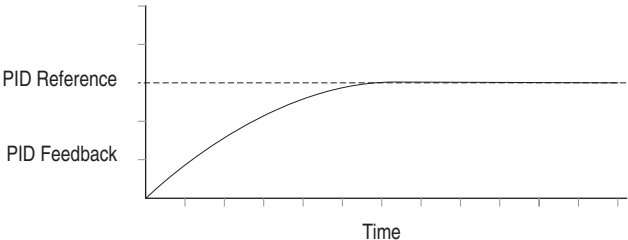


Figure D.3 Oscillation – Under Damped

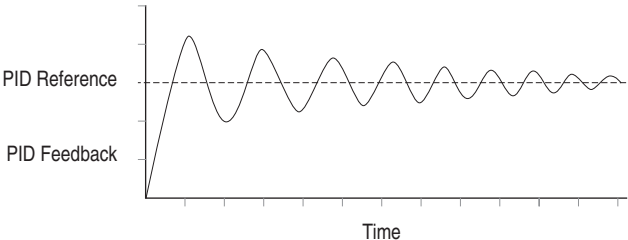
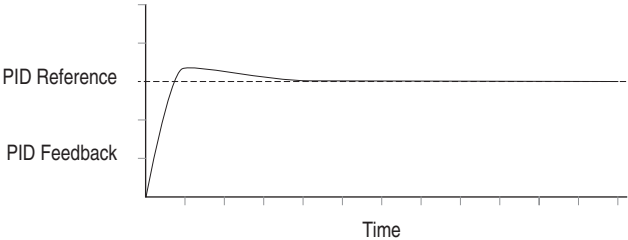


Figure D.4 Good Response – Critically Damped



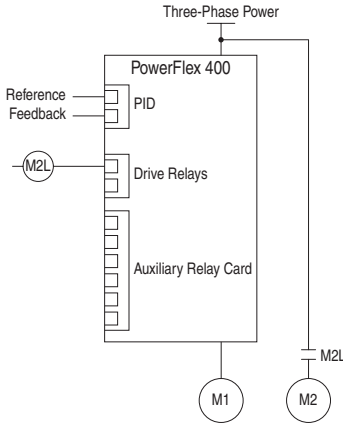
Auxiliary Motor Control Setup

The PowerFlex 400 has a built in Auxiliary Motor Control feature. This feature allows operation of up to three (3) line-started motors in addition to the motor controlled directly by the PowerFlex 400 drive. System output can vary from 0% (auxiliary motors off and drive-controlled motor at zero speed) to 400% (3 auxiliary motors and drive-controlled motor at full speed). To enable the Auxiliary Motor Control, parameter [R239](#) [Aux Motor Mode] must be set to an option 1 “Enabled.” When enabled, the internal PID controller in the PowerFlex 400 uses a reference and feedback signal to adjust the speed of the drive controlled motor such that the feedback signal follows the reference signal. When demand exceeds the first motors capacity, the PowerFlex 400 Auxiliary Motor Control automatically starts an auxiliary motor. The speed of the drive controlled motor is reduced to account for the auxiliary motors additional output to the system. If demand continues to increase, the PowerFlex Auxiliary Motor Control starts additional motors using the same process. When demand decreases, an auxiliary motor is stopped and the PowerFlex Auxiliary Motor Control increases the speed of the drive controlled motor to account for lost system output. A Motor Interlock input identifies motors that are out of service and causes them to be skipped over to the next available motor.

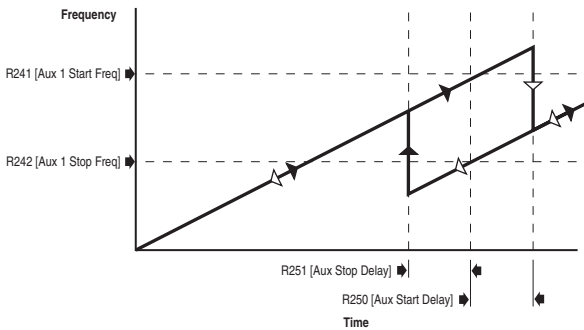
An AutoSwap function also can be used which allows equal wear to be placed on each motor by periodically swapping the drive controlled and auxiliary motors. Each motor in the system will over time be connected to the PowerFlex 400 drive and also directly to the AC line. During an AutoSwap, the motor directly connected to the PowerFlex 400 drive is stopped and the contactor is opened. The contactor of the next motor that will be controlled by the PowerFlex 400 drive is opened if running across the AC line. A contactor is closed connecting this motor directly to the PowerFlex 400 drive and is started. An additional motor is line started if required.

Example 1

One External Motor without AutoSwap



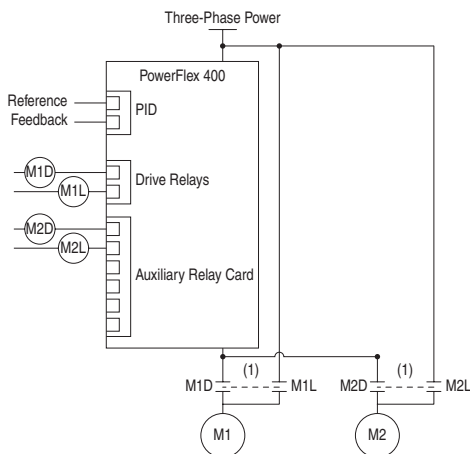
- Auxiliary Motor Control is enabled via Parameter [R239](#) [Aux Motor Mode].
- Number of auxiliary motors is set via Parameter [R240](#) [Aux Motor Qty].
- Relays are configured for Auxiliary Motor Control via parameters [T055](#), [T060](#), [R222](#), and [R225](#).
- The frequency of Motor #1 that Motor #2 turns on at is set via Parameter [R241](#) [Aux 1 Start Freq].
- The time that Motor #1 is above the value set by [R241](#) [Aux 1 Start Freq] before turning on Motor #2 is set via Parameter [R250](#) [Aux Start Delay].
- The frequency of Motor #1 that Motor #2 turns off at is set via Parameter [R242](#) [Aux 1 Stop Freq].
- The time that Motor #1 is below the value set by [R242](#) [Aux 1 Stop Freq] before turning off Motor #2 is set via Parameter [R251](#) [Aux Stop Delay].
- PID setup is done via Parameters [A150](#) through [A159](#). See Appendix D for additional information.



Important: If using auxiliary motor control, ensure that wiring and parameter configuration are correct before wiring contactor outputs. All relays on the Auxiliary Relay Card will energize on power-up by default. Failure to verify proper wiring and parameter configuration can result in improper motor operation or drive damage.

Example 2

One External Motor with AutoSwap



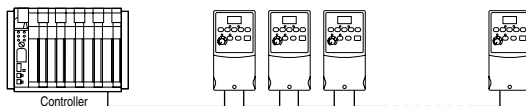
- (1) Mechanically interlocked contactors are recommended to ensure that the drive contactor and the line contactor do not close at the same time. If the drive and line contactor close at the same time, drive damage may result.
- Auxiliary Motor Control is enabled via Parameter [R239](#) [Aux Motor Mode].
 - Number of auxiliary motors is set via Parameter [R240](#) [Aux Motor Qty].
 - Relays are configured for Auxiliary Motor Control via parameters [T055](#), [T060](#), [R222](#), [R225](#), [R228](#), [R231](#), [R234](#), and [R237](#).
 - The frequency of Motor #1 that Motor #2 turns on at is set via Parameter [R241](#) [Aux 1 Start Freq].
 - The time that Motor #1 is above the value set by [R241](#) [Aux 1 Start Freq] before turning on Motor #2 is set via Parameter [R250](#) [Aux Start Delay].
 - The frequency of Motor #1 that Motor #2 turns off at is set via Parameter [R242](#) [Aux 1 Stop Freq].
 - The time that Motor #1 is below the value set by [R242](#) [Aux 1 Stop Freq] before turning off Motor #2 is set via Parameter [R251](#) [Aux Stop Delay].
 - The running time between the PowerFlex 400 switching control from Motor #1 to Motor #2 is set via [R253](#) [Aux AutoSwap Time].
 - PID setup is done via Parameters [A150](#) through [A159](#). See Appendix D for additional information.
 - The maximum PID output level that an AutoSwap can occur is set via Parameter [R254](#) [Aux AutoSwap Lvl]. AutoSwap will be delayed until the PID output drops below this parameter setting.

Important: If using auxiliary motor control, ensure that wiring and parameter configuration are correct before wiring contactor outputs. All relays on the Auxiliary Relay Card will energize on power-up by default. Failure to verify proper wiring and parameter configuration can result in improper motor operation or drive damage.

Notes:

Modbus RTU Protocol

PowerFlex 400 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 400 drives can be multi-dropped on an RS485 network using Modbus protocol in RTU mode.

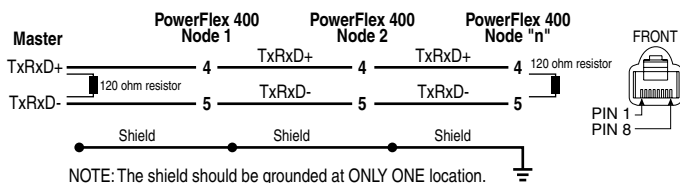


For information regarding DeviceNet or other communication protocols, refer to the appropriate user manual.

Network Wiring

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

Figure E.1 Network Wiring Diagram



Only pins 4 and 5 on the RJ45 plug should be wired. The other pins on the PowerFlex 400 RJ45 socket contain power, etc. for other Rockwell Automation peripheral devices and must not be connected.

Wiring terminations on the master controller will vary depending on the master controller used and “TxRx D+” and “TxRx D-” 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.

Parameter Configuration

The following PowerFlex 400 parameters are used to configure the drive to operate on a network.

Parameter	Details	Reference
P036 [Start Source]	Set to 5 "RS485 (DSI) Port" if Start is controlled from the network.	Page 3-8
P038 [Speed Reference]	Set to 5 "RS485 (DSI) Port" if the Speed Reference is controlled from the network.	Page 3-10
C102 [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 3-27
C103 [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 3-27
C104 [Comm Node Addr]	Sets the node address for the drive on the network. Each device on the network requires a unique node address.	Page 3-28
C105 [Comm Loss Action]	Selects the drive's response to communication problems.	Page 3-28
C106 [Comm Loss Time]	Sets the time that the drive will remain in communication loss before the drive implements C105 [Comm Loss Action].	Page 3-28
C107 [Comm Write Mode]	Determines whether parameter changes made over communication port are saved or stored in RAM only. If they are stored in RAM, the values will be lost at power-down.	Page 3-27

Supported Modbus Function Codes

The peripheral interface (DSI) used on PowerFlex 400 drives supports some of the Modbus function codes.

Modbus Function Code	Command
03	Read Holding Registers
06	Preset (Write) Single Register

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).

Writing (06) Logic Command Data

The PowerFlex 400 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 “RS485 (DSI) Port” in order to accept the commands.

Logic Command		
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 = Local Control ⁽¹⁾ , 0 = Comm Control
	7	1 = MOP Increment, 0 = Not Increment
	9,8	00 = No Command
		01 = Accel Rate 1 Enable
		10 = Accel Rate 2 Enable
		11 = Hold Accel Rate Selected
	11,10	00 = No Command
		01 = Decel Rate 1 Enable
		10 = Decel Rate 2 Enable
		11 = Hold Decel Rate Selected
	14,13,12	000 = No Command
		001 = Freq. Source = P038 [Speed Reference]
		010 = Freq. Source = A142 [Internal Freq]
		011 = Freq. Source = Comms (Addr 8193)
		100 = A143 [Preset Freq 0]
		101 = A144 [Preset Freq 1]
		110 = A145 [Preset Freq 2]
		111 = A146 [Preset Freq 3]
	15	1 = MOP Decrement, 0 = Not Decrement

⁽¹⁾ Local Control causes the drive to use [C108](#) [Start Source 2] and [C109](#) [Speed Ref 2] for start and speed reference control.

Writing (06) Reference

The PowerFlex 400 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 “RS485 (DSI) 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 “1000” equals 10.00 Hz and “543” equals 5.43 Hz.

Reading (03) Logic Status Data

The PowerFlex 400 Logic Status data can be read via the network by sending Function Code 03 reads to register address 8448 (Logic Status).

Error Codes		
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 = Alarm, 0 = No Alarm
	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

Reading (03) Feedback

The Feedback (Output Frequency) from the PowerFlex 400 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.xx decimal value where the decimal point is fixed. For example, a decimal "1234" equals 12.34 Hz and "300" equals 3.00 Hz.

⁽¹⁾ Returns the same data as Reading (03) Parameter b001 [Output Freq].

Reading (03) Drive Error Codes

The PowerFlex 400 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
	15	Load Loss
	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	Params Defaulted
	63	Software Overcurrent
	64	Drive Overload
	70	Power Unit Fail
	71	Net Loss
	81	Communication Loss
	94	Function Loss
	100	Parameter Checksum Error
	122	I/O Board Fail

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 b001 [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.

Notes:

Metasys N2

Appendix F provides information about controlling a PowerFlex 400 drive, setting its Reference, and accessing its parameters through configurable objects when the Metasys N2 network protocol is selected.

Topic	Page
Understanding Metasys N2	F-1
Network Points	F-3
Using Percent (%) for the Reference	F-5
Using Metasys Configurable Objects to Access Parameters	F-6

Understanding Metasys N2

Metasys nodes are built up by the use of several virtual objects. The Metasys N2 master performs read and write commands to these virtual objects, and the internal Metasys protocol firmware transfers/translate the data between these virtual objects and the drive.

When a read or write command occurs to a certain dedicated virtual object, data in the virtual objects is refreshed from or transferred to the drive.

The Metasys N2 master performs read and write commands to the virtual objects one at a time. The data types that are used in the virtual objects are binary input (BI), binary output (BO), analog input (AI), analog output (AO), and internal integer (ADI).

The Metasys N2 master also performs cyclic polling of all the virtual objects.

Metasys N2 Virtual Objects

A Metasys N2 node may contain up to 256 virtual objects in each of its seven different data types, called regions ([Table F.1](#)).

Table F.1 Description of the Regions of a Virtual Object

Region	Type	Short	Description
Region 1	Analog Input	AI	32-bit, IEEE-standard floats
Region 2	Binary Input	BI	1-bit
Region 3	Analog Output	AO	32-bit, IEEE-standard floats
Region 4	Binary Output	BO	1-bit
Region 5	Internal Float	ADF	32-bit, IEEE-standard floats (Analog Data Float)
Region 6	Internal Integer	ADI	16-bit (Analog Data Integer)
Region 7	Internal Byte	DB	8-bit (Analog Data Byte)

Metasys N2 Data Types

Table F.2 Internal Structure of Metasys N2 Analog Input (AI)

Attribute	Type	Description
1	Byte	Object Configuration
2	Byte	Object Status
3	Float	Analog Input Value
8	Float	Low Alarm Limit
9	Float	Low Warning Limit
10	Float	High Warning Limit
11	Float	High Alarm Limit
12	Float	Differential

Table F.3 Internal Structure of Metasys N2 Binary Input (BI)

Attribute	Type	Description
1	Byte	Object Configuration
2	Byte	Object Status

Table F.4 Internal Structure of Metasys N2 Analog Output (AO)

Attribute	Type	Description
1	Byte	Object Configuration
2	Byte	Object Status
3	Float	Current Value

Table F.5 Internal Structure of Metasys N2 Binary Output (BO)

Attribute	Type	Description
1	Byte	Object Configuration
2	Byte	Object Status
3	Integer	Minimum On-Time
4	Integer	Minimum Off-Time
5	Integer	Maximum Cycle/Hour

Table F.6 Internal Structure of Metasys N2 Internal Integer (ADI)

Attribute	Type	Description
1	Byte	Object Status
2	Integer	Current Value. Signed 16-bit.

Network Points

Table F.7 Binary Inputs

Network Point					
Type (NPT)	Address (NPA)	Name	Description	ON ("1")	OFF ("0")
BI	1	Ready	Logic Status bit 00	Ready	Not Ready
BI	2	Active	Logic Status bit 01	Active	Not Active
BI	3	Cmd Dir	Logic Status bit 02	Forward	Reverse
BI	4	Act Dir	Logic Status bit 03	Forward	Reverse
BI	5	Accel	Logic Status bit 04	Accelerating	Not Accelerating
BI	6	Decel	Logic Status bit 05	Decelerating	Not Decelerating
BI	7	Alarm	Logic Status bit 06	Alarm	No Alarm
BI	8	Fault	Logic Status bit 07	Fault	No Fault
BI	9	At Speed	Logic Status bit 08	At Reference	Not at Reference
BI	10	Main Freq	Logic Status bit 09	Comm Controlled	Not Comm Controlled
BI	11	Oper Cmd	Logic Status bit 10	Comm Controlled	Not Comm Controlled
BI	12	Param Lock	Logic Status bit 11	Locked	Not Locked
BI	13	Digital In 1	Logic Status bit 12 (Drive Terminal #2)	On	Off
BI	14	Digital In 2	Logic Status bit 13 (Drive Terminal #3)	On	Off
BI	15	Digital In 3	Logic Status bit 14 (Drive Terminal #4)	On	Off
BI	16	Digital In 4	Logic Status bit 15 (Drive Terminal #5)	On	Off
BI	17	Digital In 5	Drive Terminal #6	On	Off
BI	18	Digital In 6	Drive Terminal #7	On	Off
BI	19	Digital In 7	Drive Terminal #8	On	Off

Table F.8 Analog Inputs

Network Point					
Type (NPT)	Address (NPA)	Name	Description	Units	Min/Max
AI	1	Feedback	Feedback	%	0/100
AI	2	Speed	d323 [Output RPM]	RPM	0/24000
AI	3	Current	b003 [Output Current]	A	0.00/Rated $\times 2$
AI	4	DC Bus Volts	b005 [DC Bus Voltage]	V	0/820
AI	5	Last Fault	b307 [Fault 1 Code]	1	1/100
AI	6	2nd Fault	b308 [Fault 2 Code]	1	1/100
AI	7	Analog In 1	Drive Analog Input #1 (Drive Terminal #13)	%	—
AI	8	Analog In 2	Drive Analog Input #2 (Drive Terminal #17)	%	—
AI	9	Read Value	Read value of Param. selected by AO 10	Varies by the parameter selected.	
AI	10	User In 1	User-defined Input 1 (Param. selected via ADI 1)		
AI	11	User In 2	User-defined Input 2 (Param. selected via ADI 2)		
AI	12	User In 3	User-defined Input 3 (Param. selected via ADI 3)		
AI	13	User In 4	User-defined Input 4 (Param. selected via ADI 4)		

Table F.9 Binary Outputs

Network Point				Values	
Type (NPT)	Address (NPA)	Name	Description	ON ("1")	OFF ("0")
BO	1	Run Enable	Logic Command bit 00	Enable	Stop (Coast)
BO	2	Start/Stop	Logic Command bit 00 & 01	Start	Stop (Normal)
BO	3	Jog	Logic Command bit 02	Jog	Not Jog
BO	4	Clear Faults	Logic Command bit 03	Clear Flts	Not Clear Flts
BO	5	Fwd/Rev	Logic Command bit 04 & 05	Forward	Reverse
BO	6	Not Used	Logic Command bit 06	–	–
BO	7	MOP Inc	Logic Command bit 07	Increment	Not Increment
BO	8	Accel 1	Logic Command bit 08	Accel Rate 1	Not Accel 1
BO	9	Accel 2	Logic Command bit 09	Accel Rate 2	Not Accel 2
BO	10	Decel 1	Logic Command bit 10	Decel Rate 1	Not Decel 1
BO	11	Decel 2	Logic Command bit 11	Decel Rate 2	Not Decel 2
BO	12	Ref Sel 1	Logic Command bit 12	BO 14 13 12 0 0 0 = No Command 0 0 1 = P038 [Speed Reference] 0 1 0 = A142 [Internal Freq] 0 1 1 = Comm - Address 8193 ⁽¹⁾ 1 0 0 = A143 [Preset Freq 0] 1 0 1 = A144 [Preset Freq 1] 1 1 0 = A145 [Preset Freq 2] 1 1 1 = A146 [Preset Freq 3]	
BO	13	Ref Sel 2	Logic Command bit 13		
BO	14	Ref Sel 3	Logic Command bit 14		
BO	15	MOP Dec	Logic Command bit 15	Decrement	Not Decrement
BO	16	Pnl Lock	Lock-out Drive Front Panel	Lock	Unlock
BO	17	Digital Out 1	Relay #1 on Drive (Drive Terminal R1, R2, R3)	On	Off
BO	18	Digital Out 2	Relay #2 on Drive (Drive Terminal R4, R5, R6)	On	Off
BO	19	Opto Out	Terminal #19	On	Off

⁽¹⁾ See Writing (06) Reference on [page E-3](#).

Table F.10 Analog Outputs

Network Point				Units	Min/Max
Type (NPT)	Address (NPA)	Name	Description		
AO	1	Reference	Reference	%	0/100
AO	2	Accel 1	P039 [Accel Time 1]	Secs	0.0/600.0
AO	3	Decel 1	P040 [Decel Time 1]	Secs	0.0/600.0
AO	4	Mtr OL Current	P033 [Motor OL Current]	A	0.0/Rated × 2
AO	5	PID Setpoint	A157 [PID Setpoint]	%	0/100
AO	6	Analog Out 1	Drive Analog Output #1 (T084)	%	–
AO	7	Analog Out 2	Drive Analog output #2 (T087)	%	–
AO	8	Write Param #	Param. number to write in AO 9	–	0 to Max Param.
AO	9	Write Value	Write value of param. selected by AO 8	Based on AO 8 selected param.	
AO	10	Read Param #	Param. number to read in AI 9	–	0 to Max Param.
AO	11	User Out 1	User-defined Output 1 (Param. selected via ADI 5)	Varies by the parameter selected.	
AO	12	User Out 2	User-defined Output 2 (Param. selected via ADI 6)		
AO	13	User Out 3	User-defined Output 3 (Param. selected via ADI 7)		
AO	14	User Out 4	User-defined Output 4 (Param. selected via ADI 8)		

Table F.11 Internal Integer

Network Point Type (NPT)	Address (NPA)	Name	Description	Min/Max	Default
ADI	1	Param# IN1	User IN 1 (AI 10) Data Source (Param#)	0/Max Drive Params.	b001 [Output Freq] (Hz)
ADI	2	Param# IN2	User IN 2 (AI 11) Data Source (Param#)	0/Max Drive Params.	b011 [Elapsed MWh]
ADI	3	Param# IN3	User IN 3 (AI 12) Data Source (Param#)	0/Max Drive Params.	b012 [Elapsed Run Time]
ADI	4	Param# IN4	User IN 4 (AI 13) Data Source (Param#)	0/Max Drive Params.	b014 [Drive Temperature]
ADI	5	Param# OUT1	User OUT 1 (AO 11) Data Source (Param#)	0/Max Drive Params.	A154 [PID Gain]
ADI	6	Param# OUT2	User OUT 2 (AO 12) Data Source (Param#)	0/Max Drive Params.	A155 [PID Integral Time]
ADI	7	Param# OUT3	User OUT 3 (AO 13) Data Source (Param#)	0/Max Drive Params.	A156 [PID Diff Rate]
ADI	8	Param# OUT4	User OUT 4 (AO 14) Data Source (Param#)	0/Max Drive Params.	A158 [PID Deadband]

Using Percent (%) for the Reference

The Reference (AO 1) for Metasys N2 is set as a percentage from 0% to +100%.

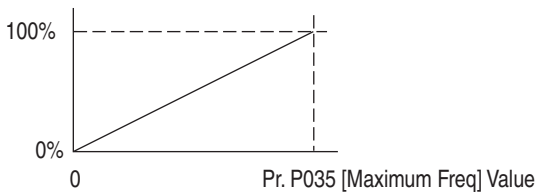


Table F.12 Example Speed Reference and Feedback for a PowerFlex 400 (P035 = 60 Hz)

Reference (AO 1)		Feedback (AI 1)	
Percent	Speed	Speed	Percent
100%	60 Hz	60 Hz	100%
50%	30 Hz	30 Hz	50%
25%	15 Hz	15 Hz	25%
0%	0 Hz	0 Hz	0%

Using Metasys Configurable Objects to Access Parameters

Configurable objects are inputs and outputs that let you read and write parameter values. These objects handle only 16-bit parameter values.

Reading Parameter Values

The configurable points may show any parameter in the drive by configuring the Param# for INx point. The drive reads the value of the parameter configured in the Param# for INx point and shows the result in the User INx point. The Param# for INx's default to commonly accessed parameters and can be changed if desired. A "0" disables the fetching of data and a "0" is returned in the respective User INx. See [Figure F.1](#) and [Table F.13](#).

Figure F.1 Configurable Input Point Operation Objects Inputs

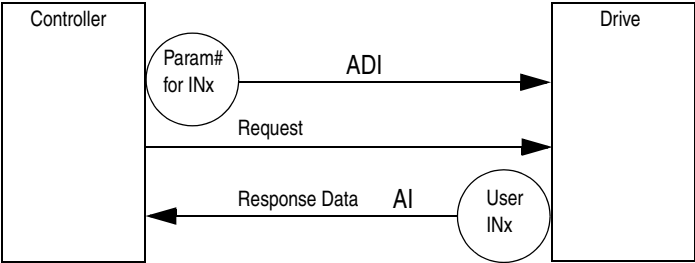


Table F.13 Configurable Objects: Inputs

Network Point		Name	Description	Default
Type (NPT)	Address (NPA)			
AI	10	User IN1	User-defined Input 1	0
AI	11	User IN2	User-defined Input 2	0
AI	12	User IN3	User-defined Input 3	0
AI	13	User IN4	User-defined Input 4	0
ADI	1	Param# for IN1	User IN1 (AI 10) Data Source (Param#)	b001 [Output Freq] (Hz)
ADI	2	Param# for IN2	User IN2 (AI 11) Data Source (Param#)	b011 [Elapsed MWh]
ADI	3	Param# for IN3	User IN3 (AI 12) Data Source (Param#)	b012 [Elapsed Run Time]
ADI	4	Param# for IN4	User IN4 (AI 13) Data Source (Param#)	b014 [Drive Temp]

Writing Parameter Values



ATTENTION: Risk of equipment damage exists. If configurable outputs are programmed to write parameter data to Non-Volatile Storage (NVS) frequently, the NVS will quickly exceed its life cycle and cause the drive to malfunction. Do not create a program that frequently uses configurable outputs to write parameter data to NVS.

These outputs are written each time the User OUTx point is written from the network.

The Param# for OUTx’s default to commonly accessed parameters and can be changed if desired. A value of “0” in the Param# for OUTx field disables the writing of data for that specific point.

Figure F.2 Configurable Objects: Outputs

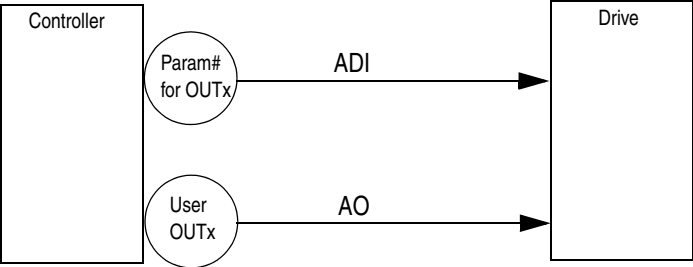


Table F.14 Configurable Objects: Outputs

Network Point		Description	Range	Default
Type (NPT)	Address (NPA)			
AO	6	User OUT1	Varies by the parameter selected by Param# for OUTx.	0
AO	7	User OUT2		0
AO	8	User OUT3		0
AO	9	User OUT4		0
ADI	5	User OUT1 (A06) Destination (Param#)	0 (not in use), 1 to maximum # of drive parameters	A154 [PID Prop Gain]
ADI	6	User OUT2 (A07) Destination (Param#)	0 (not in use), 1 to maximum # of drive parameters	A155 [PID Integ Time]
ADI	7	User OUT3 (A08) Destination (Param#)	0 (not in use), 1 to maximum # of drive parameters	A156 [PID Diff Rate]
ADI	8	User OUT4 (A09) Destination (Param#)	0 (not in use), 1 to maximum # of drive parameters	A158 [PID Deadband]

Notes:

P1 – Floor Level Network (FLN)

Appendix G provides information about controlling a PowerFlex 400 drive, setting its Reference, and accessing its parameters through configurable points when the P1-FLN protocol is selected. The P1-FLN protocol is a serial communication protocol used by the Siemens APOGEE® system.

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Understanding P1-FLN

The P1-FLN master performs read and write commands to certain points, and the internal P1-FLN protocol firmware transfers/translates the data between these points and the drive.

When a read or write command occurs to a certain point, data in the point is refreshed from or transferred to the drive.

The P1-FLN master also performs cyclic polling of all the virtual objects.

P1-FLN Points

A P1-FLN node may contain up to 99 points.

Network Points

Table G.1 Point Database for Application 2735

Point Number	Point Type	Subpoint Name	Factory Default (SI Units)	Engineering Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
01	LAO	CTLR ADDRESS	99	–	1	0	–	–
02	LAO	APPLICATION	2735	–	1	0	–	–
{03}	LAI	FREQ OUTPUT	0	HZ	0.01	0	–	–
{04}	LAI	PCT OUTPUT	0	PCT	0.1	0	–	–
{05}	LAI	SPEED	0	RPM	1	0	–	–
{06}	LAI	CURRENT	0	AMPS	0.1	0	–	–
{07}	LAI	TORQUE	0	AMPS	0.1	0	–	–
{08}	LAI	POWER	0	HP (KW)	0.1333 (0.1)	0 (0)	–	–
{09}	LAI	DRIVE TEMP	0	DEG F (DEG C)	1.8 (1)	32 (0)	–	–
{11}	LAI	DRIVE MWH	0	MWH	0.1	0	–	–
{12}	LAI	RUN TIME	0	HRS	10	0	–	–
{13}	LAI	DC BUS VOLT	0	VOLTS	1	0	–	–
20	LAO	OVRD TIME	1	HRS	1	0	–	–
{21}	LDI	FWD.REV MON	FWD	–	1	0	REV	FWD
{22}	LDO	CMD FWD.REV	FWD	–	1	0	REV	FWD
{23}	LDI	RUN.STOP MON	STOP	–	1	0	RUN	STOP
{24}	LDO	CMD RUN.STOP	STOP	–	1	0	RUN	STOP
{25}	LDI	READY	READY	–	1	0	READY	NOTRDY
{26}	LDO	RUN ENABLE	STOP	–	1	0	ENABLE	STOP
{29}	LDO	DAY NGT	DAY	–	1	0	NIGHT	DAY
30	LAO	CURRENT LIMIT	*1	AMPS	0.1	0	–	–
31	LAO	ACCEL TIME	20	SEC	0.02	0	–	–
32	LAO	DECEL TIME	20	SEC	0.02	0	–	–
33	LDO	KEYPAD LOCK	UNLOCK	–	1	0	LOCK	UNLOCK
{36}	LAO	READ PARAM	0	–	1	0	–	–
{37}	LAI	READ VALUE	0	–	1	0	–	–
{38}	LAO	WRITE PARAM	0	–	1	0	–	–
{39}	LAO	WRITE VALUE	0	–	1	0	–	–
{40}	LDO	DIGITAL OUT1	OFF	–	1	0	ON	OFF
{41}	LDO	DIGITAL OUT2	OFF	–	1	0	ON	OFF
{42}	LDO	DIGITAL OUT3	OFF	–	1	0	ON	OFF
{43}	LDO	OPT RELAY 1	OFF	–	1	0	ON	OFF
{44}	LDO	OPT RELAY 2	OFF	–	1	0	ON	OFF
{45}	LDO	OPT RELAY 3	OFF	–	1	0	ON	OFF
{46}	LDO	OPT RELAY 4	OFF	–	1	0	ON	OFF
{47}	LDO	OPT RELAY 5	OFF	–	1	0	ON	OFF
{48}	LDO	OPT RELAY 6	OFF	–	1	0	ON	OFF
{49}	LDI	DIGITAL IN 1	OFF	–	1	0	ON	OFF
{50}	LDI	DIGITAL IN 2	OFF	–	1	0	ON	OFF
{51}	LDI	DIGITAL IN 3	OFF	–	1	0	ON	OFF
{52}	LDI	DIGITAL IN 4	OFF	–	1	0	ON	OFF
{53}	LDI	DIGITAL IN 5	OFF	–	1	0	ON	OFF
{54}	LDI	DIGITAL IN 6	OFF	–	1	0	ON	OFF
{55}	LDI	DIGITAL IN 7	OFF	–	1	0	ON	OFF
{60}	LAI	INPUT REF 1	0	*3	0.1	0	–	–
{61}	LAI	INPUT REF 2	0	*3	0.1	0	–	–
{62}	LAO	ANALOG OUT 1	0	PCT	0.1	0	–	–
{63}	LAO	ANALOG OUT 2	0	PCT	0.1	0	–	–
{64}	LAI	LAST FAULT	0	–	1	0	–	–

Table G.1 Point Database for Application 2735

Point Number	Point Type	Subpoint Name	Factory Default (SI Units)	Engineering Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
65	LAO	PID GAIN	1	PTC	0.01	0	–	–
66	LAO	PID INT TIME	2	SEC	0.1	0	–	–
67	LAO	PID DIF RATE	0	PERSEC *2	0.01	0	–	–
68	LAO	PID SETPOINT	0	PTC	0.1	0	–	–
{70}	LDI	CMD DIR MON	FWD	–	1	0	REV	FWD
{71}	LDI	ACCELERATING	OFF	–	1	0	ON	OFF
{72}	LDI	DECELERATING	OFF	–	1	0	ON	OFF
{73}	LDI	ALARM	NORMAL	–	1	0	ALARM	NORMAL
{74}	LDI	AT SPEED	OFF	–	1	0	ON	OFF
{75}	LDI	MAIN FREQ	OFF	–	1	0	ON	OFF
{76}	LDI	OPER CMD	OFF	–	1	0	ON	OFF
{77}	LDI	PARAM LOCK	UNLOCK	–	1	0	LOCK	UNLOCK
{78}	LDO	JOG	OFF	–	1	0	ON	OFF
{79}	LDO	LOCAL CNTRL *4	OFF	–	1	0	ON	OFF
{80}	LDO	MOP INC	OFF	–	1	0	ON	OFF
{81}	LDO	ACCEL RATE 1	OFF	–	1	0	ON	OFF
{82}	LDO	ACCEL RATE 2	OFF	–	1	0	ON	OFF
{83}	LDO	DECEL RATE 1	OFF	–	1	0	ON	OFF
{84}	LDO	DECEL RATE 2	OFF	–	1	0	ON	OFF
{85}	LDO	REF SELECT 1	OFF	–	1	0	ON	OFF
{86}	LDO	REF SELECT 2	OFF	–	1	0	ON	OFF
{87}	LDO	REF SELECT 3	OFF	–	1	0	ON	OFF
{88}	LDO	MOP DEC	OFF	–	1	0	ON	OFF
{92}	LAO	REFERENCE	0	PCT	0.01	0	–	–
{93}	LDI	OK FAULT	OK	–	1	0	FAULT	OK
{94}	LDO	RESET FAULT	NORMAL	–	1	0	RESET	NORMAL
{99}	LAO	ERROR STATUS	0	–	1	0	–	–

a. Points not listed are not used in this application.

b. A single value in a column means that the value is the same in English units and in SI units.

c. Point numbers that appear in brackets { } may be unbundled at the field panel.

*1 Depends on drive model

*2 1 / Secs

*3 Depending on configuration, units can be volts or milliamperes.

*4 Local Control causes the drive to use C108 [Start Source 2] and C109 [Speed Ref 2] for start and speed reference control.

Table G.2 Point Database for Application 2735

Point Number	Subpoint Name	Parameter
01	CTRL ADDRESS	C104
02	APPLICATION	–
03	FREQ OUTPUT	b001
04	PCT OUTPUT	d322
05	SPEED	d323
06	CURRENT	b003
07	TORQUE	b013
08	POWER	b010
09	DRIVE TEMP	b014
11	DRIVE MWH	b011
12	RUN TIME	b012
13	DC BUS VOLT	b005
20	OVRD TIME	–
21	FWD.REV MON	–
22	CMD FWD.REV	–
23	RUN.STOP MON	b066, bit 1 (Running)
24	CMD RUN.STOP	–
25	READY	d302, bit 2 (I/O Terminal 01)
26	RUN ENABLE	–
29	DAY NGT	–
30	CURRENT LIMIT	P033
31	ACCEL TIME 1	P039
32	DECEL TIME 1	P040
33	KEYPAD LOCK	A198
36	READ PARAM #	–
37	READ VALUE	–
38	WRITE PARAM #	–
39	WRITE VALUE	–
40	DIGITAL OUT 1	T055, T056
41	DIGITAL OUT 2	T060, T061
42	DIGITAL OUT 3	T065, T066
43	OPT RELAY 1	R221, R222 *1
44	OPT RELAY 2	R224, R225 *1
45	OPT RELAY 3	R227, R228 *1
46	OPT RELAY 4	R230, R231 *1
47	OPT RELAY 5	R233, R234 *1
48	OPT RELAY 6	R236, R237 *1
49	DIGITAL IN 1	d302, bit 0 (I/O Terminal 02)
50	DIGITAL IN 2	d302, bit 1 (I/O Terminal 03)
51	DIGITAL IN 3	d302, bit 2 (I/O Terminal 01)
52	DIGITAL IN 4	d302, bit 3 (I/O Terminal 05)
53	DIGITAL IN 5	d302, bit 4 (I/O Terminal 06)
54	DIGITAL IN 6	d302, bit 5 (I/O Terminal 07)
55	DIGITAL IN 7	d302, bit 6 (I/O Terminal 08)
60	INPUT REF 1	d305
61	INPUT REF 2	d306
62	ANALOG OUT 1	T082
63	ANALOG OUT 2	T085
64	LAST FAULT	b007
65	PID GAIN	A154
66	PID INT TIME	A155
67	PID DIFF RATE	A156
68	PID SETPOINT	A157

Table G.2 Point Database for Application 2735

Point Number	Subpoint Name	Parameter
70	CMD DIR MON	b006, bit 2 (Forward)
71	ACCELERATING	b006, bit 3 (Accelerating)
72	DECELERATING	b006, bit 4 (Decelerating)
73	ALARM	–
74	AT SPEED	–
75	MAIN FREQ	d301 (Digit 0)
76	OPER CMD	d301 (Digit 1)
77	PARAM LOCK	–
78	JOG	–
79	LOCAL CNTRL	–
80	MOP INC	–
81	ACCEL RATE 1	–
82	ACCEL RATE 2	–
83	DECEL RATE 1	–
84	DECEL RATE 2	–
85	REF SELECT 1	–
86	REF SELECT 2	–
87	REF SELECT 3	–
88	MOP DEC	–
92	REFERENCE	b022
93	OK FAULT	–
94	RESET FAULT	–
99	ERROR STATUS	–

*1 These parameters affect the operation of an optional auxiliary relay board.

Using Percent (%) for the Reference

The Reference (Point 92) for P1 is set as a percentage from 0% to +100%.

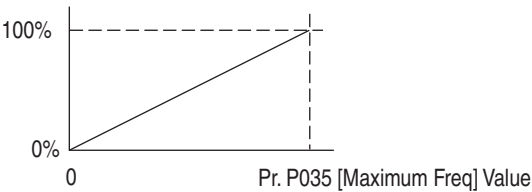


Table G.3 Example Speed Reference and Feedback for a PowerFlex 400 (P035 = 60 Hz)

Reference (Point 92)		PCT Output (Point 4)	
Percent	Speed	Speed	Percent
100%	60 Hz	60 Hz	100%
50%	30 Hz	30 Hz	50%
25%	15 Hz	15 Hz	25%
0%	0 Hz	0 Hz	0%

Using P1 Configurable Points to Access Parameters

Configurable points are inputs and outputs that let you read and write parameter values. These objects handle only 15-bit parameter values (0 – 32767).

Important: If a parameter has a decimal point, the value must be properly scaled by the user. For example, Accel Time has two decimal places. To use the value 60.00, the scaled value 6000 must be communicated to the drive. The scaled value 6000 will be returned.

Reading Parameter Values

The configurable points may show any parameter in the drive by configuring the Param# in the Read Param point. The drive reads the value of the parameter configured in the Param# for the Read Param point and shows the result in the Read Value point. The Param# for the Read Param point default to commonly accessed parameters and can be changed if desired. A “0” disables the fetching of data and a “0” is returned in the Read Value point. See [Figure G.1](#) and [Table G.4](#).

Figure G.1 Configurable Input Point Operation

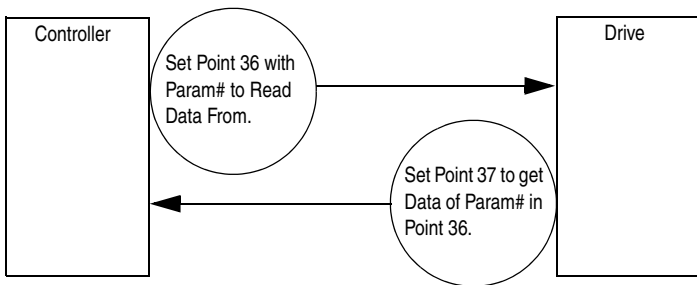


Table G.4 Configurable Points: Inputs

Point	Name	Description	Default
36	Read Param	Param# to read value	0
37	Read Value	Value of parameter specified by Point 36	0

Writing Parameter Values

These outputs are written each time the Write Value point is written from the network.

The Param# for Write Param point’s default to commonly accessed parameters and can be changed if desired. A value of “0” in the Param# for Write Param point field disables the writing of data.

Figure G.2 Configurable Output Point Operation

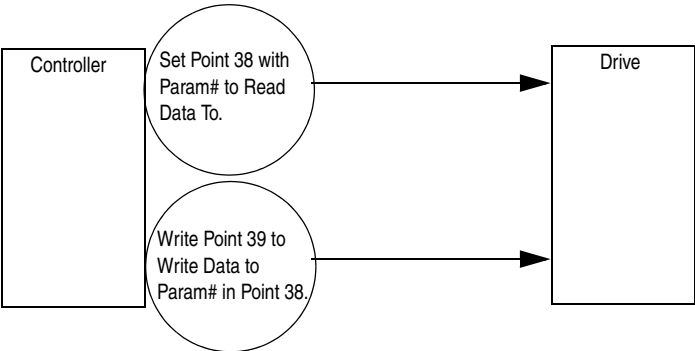


Table G.5 Configurable Points: Outputs

Point	Name	Description	Default
38	Write Param	Param# to write value	0
39	Write Value	New value of parameter specified by Point 38	0

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