PowerFlex 70 Adjustable Frequency AC Drive

When reading this document, look for this symbol " **Step x** " to guide you through the **5 BASIC STEPS needed to install, start-up and program the PowerFlex 70**. **The information provided Does Not replace the User Manual and is intended for qualified drive service personnel only.** For detailed PowerFlex 70 information including application considerations and related precautions refer to the following:

Title	Publication	Available...
PowerFlex 70 User Manual	20A-UM001...	on the CD supplied with the drive or at **www.ab.com/manuals/dr**
PowerFlex Reference Manual	PFLEX-RM001...	

For Allen-Bradley Drives Technical Support:

Title	Online at...
Allen-Bradley Drives Technical Support	**www.ab.com/support/abdrives**

Step 1 Read the General Precautions

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: 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: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. Measure the DC bus voltage at the +DC terminal of the Power Terminal Block and the -DC test point (refer to the User Manual for location). The voltage must be zero.

ATTENTION: Configuring an analog input for 0-20mA operation and driving it from a voltage source could cause component damage. Verify proper configuration prior to applying input signals.

ATTENTION: Hazard of personal injury or equipment damage exists when using bipolar input sources. Noise and drift in sensitive input circuits can cause unpredictable changes in motor speed and direction. Use speed command parameters to help reduce input source sensitivity.

ATTENTION: Risk of injury or equipment damage exists. DPI or SCANport host products must not be directly connected together via 1202 cables. Unpredictable behavior can result if two or more devices are connected in this manner.

ATTENTION: The “adjust freq” portion of the bus regulator function is extremely useful for preventing nuisance overvoltage faults resulting from aggressive decelerations, overhauling loads, and eccentric loads. It forces the output frequency to be greater than commanded frequency while the drive’s bus voltage is increasing towards levels that would otherwise cause a fault; however, it can also cause either of the following two conditions to occur.

1. Fast positive changes in input voltage (more than a 10% increase within 6 minutes) can cause uncommanded positive speed changes; however an “OverSpeed Limit” fault will occur if the speed reaches [Max Speed] + [Overspeed Limit]. If this condition is unacceptable, action should be taken to 1) limit supply voltages within the specification of the drive and, 2) limit fast positive input voltage changes to less than 10%. Without taking such actions, if this operation is unacceptable, the “adjust freq” portion of the bus regulator function must be disabled (see parameters 161 and 162).
2. Actual deceleration times can be longer than commanded deceleration times; however, a “Decel Inhibit” fault is generated if the drive stops decelerating altogether. If this condition is unacceptable, the “adjust freq” portion of the bus regulator must be disabled (see parameters 161 and 162). In addition, installing a properly sized dynamic brake resistor will provide equal or better performance in most cases.

Note: These faults are not instantaneous and have shown test results that take between 2 and 12 seconds to occur.

EMC Instructions

CE Conformity[1]

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

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

Low Voltage Directive (73/23/EEC)

- EN50178 Electronic equipment for use in power installations.

EMC Directive (89/336/EEC)

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

General Notes

- If the adhesive label is removed from the top of the drive, the drive must be installed in an enclosure with side openings less than 12.5 mm (0.5 in.) and top openings less than 1.0 mm (0.04 in.) to maintain compliance with the LV Directive.
- The motor cable should be kept as short as possible in order to avoid electromagnetic emission as well as capacitive currents.
- Use of line filters in ungrounded systems is not recommended.
- PowerFlex drives may cause radio interference if used in a residential or domestic environment. The installer is required to take measures to prevent interference, in addition to the essential requirements for CE compliance listed below, if necessary.
- Conformity of the drive with CE EMC requirements does not guarantee an entire machine or installation complies with CE EMC requirements. Many factors can influence total machine/installation compliance.
- PowerFlex drives can generate conducted low frequency disturbances (harmonic emissions) on the AC supply system. More information regarding harmonic emissions can be found in the *PowerFlex Reference Manual*.

[1] CE Certification testing has not been completed for 600 Volt class drives.

Essential Requirements for CE Compliance

Conditions 1-6 listed below **must be** satisfied for PowerFlex drives to meet the requirements of **EN61800-3**.

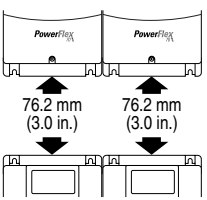
1. Standard PowerFlex 70 CE compatible Drive.
2. Review important precautions/attention statements throughout this manual before installing drive.
3. Grounding as described on page 1-5 of the User Manual.
4. Output power, control (I/O) and signal wiring must be braided, shielded cable with a coverage of 75% or better, metal conduit or equivalent attenuation.
5. All shielded cables should terminate with the proper shielded connector.
6. Conditions in Table A.

Table A PowerFlex 70 EN61800-3 EMC Compatibility

Frame(s)	Drive Description	Second Environment				First Environment Restricted Distribution
		Restrict Motor Cable to 40 m (131 ft.)	Internal Filter Option	External Filter	Input Ferrite (1)	
A	Drive Only	✔		✔		See *PowerFlex Reference Manual*
	with any Comm Option	✔		✔		
	with Remote I/O	✔		✔	✔	
B	Drive Only	✔	✔			
	with any Comm Option	✔	✔			
	with Remote I/O	✔	✔		✔	
C, D, E	Drive Only	✔				
	with any Comm Option	✔				
	with Remote I/O	✔			✔	

(1) Input cables through a Ferrite Core (Frames A, B and C Fair-Rite #2643102002 or equivalent, Frames D and E Fair-Rite #2643251002 or equivalent).

Step 2 Mount the Drive – Minimum Requirements



Minimum Mounting Clearances

Specified vertical clearance requirements are intended to be from drive to drive. Other objects can occupy this space; however, reduced airflow may cause protection circuits to fault the drive. In addition, inlet air temperature must not exceed the product specification.

Maximum Surrounding Air Temperature

Enclosure Rating	Temperature Range
Open Type, IP 20, NEMA Type 1 & Flange Mount	0 - 50°C (32 - 122°F)
IP54, IP 66 & NEMA Type 4X/12	0 - 40°C (32 - 104°F)

Important: Some drives are equipped with an adhesive label on the top of the chassis. Removing the adhesive label from the drive changes the NEMA enclosure rating from Type 1 Enclosed to Open Type.

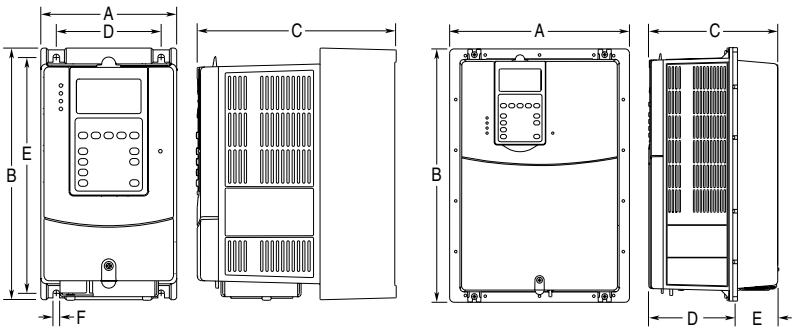
Dimensions

Table B PowerFlex 70 Frames

Output Power		Frame Size								
		208-240V AC Input			400-480V AC Input			600V AC Input		
kW ND (HD)	HP ND (HD)	Not Filtered	Filtered	IP66 (4X/12)	Not Filtered	Filtered	IP66 (4X/12)	Not Filtered	Filtered	IP66 (4X/12)
0.37 (0.25)	0.5 (0.33)	A	B	B	A	B	B	A	–	B
0.75 (0.55)	1 (0.75)	A	B	B	A	B	B	A	–	B
1.5 (1.1)	2 (1.5)	B	B	B	A	B	B	A	–	B
2.2 (1.5)	3 (2)	B	B	B	B	B	B	B	–	B
4 (3)	5 (3)	–	C	D	B	B	B	B	–	B
5.5 (4)	7.5 (5)	–	D	D	–	C	D	C	–	D
7.5 (5.5)	10 (7.5)	–	D	D	–	C	D	C	–	D
11 (7.5)	15 (10)	–	D	D	–	D	D	D	–	D
15 (11)	20 (15)	–	E	E	–	D	D	D	–	D
18.5 (15)	25 (20)	–	E	E	–	D	D	D	–	D
22 (18.5)	30 (25)	–	–	–	–	D	D	D	–	D
30 (22)	40 (30)	–	–	–	–	E	E	–	E	E
37 (30)	50 (40)	–	–	–	–	E	E	–	E	E

Figure 1 PowerFlex 70 Frames A-E

IP20/66 (NEMA Type 1/4X/12) **Flange Mount**



Dimensions are in millimeters and (inches).

Frame	A	B	C	D	E	F	Weight (1) *kg (lbs.)*
IP20 / NEMA Type 1							
A	122.4 (4.82)	225.7 (8.89)	179.8 (7.08)	94.2 (3.71)	211.6 (8.33)	5.8 (0.23)	2.71 (6.0)
B	171.7 (6.76)	234.6 (9.24)	179.8 (7.08)	122.7 (4.83)	220.2 (8.67)	5.8 (0.23)	3.60 (7.9)
C	185.0 (7.28)	300.0 (11.81)	179.8 (7.08)	137.6 (5.42)	285.6 (11.25)	5.8 (0.23)	6.89 (15.2)
D	219.9 (8.66)	350.0 (13.78)	179.8 (7.08)	169.0 (6.65)	335.6 (13.21)	5.8 (0.23)	9.25 (20.4)
E	280.3 (11.04)	555.8 (21.88)	207.1 (8.15)	200.0 (7.87)	491.0 (19.33)	6.9 (0.27)	18.60 (41.0)
IP66 / NEMA Type 4X/12							
B	171.7 (6.76)	239.8 (9.44)	203.3 (8.00)	122.7 (4.83)	220.2 (8.67)	5.8 (0.23)	3.61 (8.0)
D	219.9 (8.66)	350.0 (13.78)	210.7 (8.29)	169.0 (6.65)	335.6 (13.21)	5.8 (0.23)	9.13 (20.1)
E	280.3 (11.04)	555.8 (21.88)	219.8 (8.65)	200.0 (7.87)	491.0 (19.33)	6.9 (0.27)	18.60 (41.0)
Flange Mount							
A	156.0 (6.14)	225.8 (8.89)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	–	2.71 (6.0)
B	205.2 (8.08)	234.6 (9.24)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	–	3.60 (7.9)
C	219.0 (8.62)	300.0 (11.81)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	–	6.89 (15.2)
D	248.4 (9.78)	350.0 (13.78)	178.6 (7.03)	123.0 (4.84)	55.6 (2.19)	–	9.25 (20.4)
E	280.3 (11.04)	555.8 (21.88)	207.1 (8.15)	117.2 (4.61)	89.9 (3.54)	–	18.60 (41.0)

(1) Weights include HIM and Standard I/O.

Step 3 Wire the Drive – Wire Recommendations

Type		Wire Type(s)	Description	Min. Insulation Rating
Power (1)	Standard	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.	
Signal (1) (2) (3)	Standard Analog I/O	Belden 8760/9460 (or equiv.)	0.750 mm^2 (18 AWG), twisted pair, 100% shield with drain.	300V, 75-90 degrees C (167-194 degrees F)
		Belden 8770 (or equiv.)	0.750 mm^2 (18 AWG), 3 cond., shielded for remote pot only.	
Digital I/O (1) (2) (3)	Shielded	Multi-conductor shielded cable such as Belden 8770 (or equiv.)	0.750 mm^2 (18 AWG), 3 conductor, shielded.	300V, 60 degrees C (140 degrees F)

(1) Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

(2) 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.

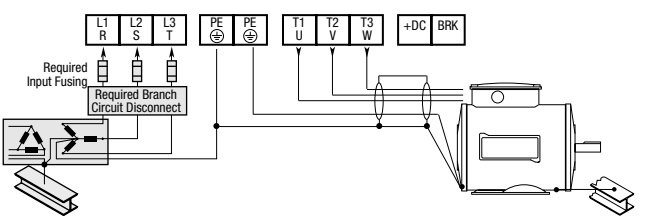
(3) I/O terminals labeled "(–)" or "Common" are not referenced to earth ground and are designed to greatly reduce common mode interference. Grounding these terminals can cause signal noise.

Terminal Block Specifications

Name	Frame	Description	Wire Size Range(1)		Torque	
			Maximum	Minimum	Maximum	Recommended
Power Terminal Block	A, B & C	Input power and motor connections	3.5 mm^2 (12 AWG)	0.3 mm^2 (22 AWG)	0.66 N-m (5.5 lb.-in.)	0.6 N-m (5 lb.-in.)
	D	Input power and motor connections	8.4 mm^2 (8 AWG)	0.8 mm^2 (18 AWG)	1.7 N-m (15 lb.-in.)	1.4 N-m (12 lb.-in.)
	E	Input power and motor connections	25.0 mm^2 (3 AWG)	2.5 mm^2 (14 AWG)	2.71 N-m (24 lb.-in.)	2.71 N-m (24 lb.-in.)
I/O Terminal Block	All	Signal & control connections	1.5 mm^2 (16 AWG)	0.05 mm^2 (30 AWG)	0.55 N-m (4.9 lb.-in.)	0.5 N-m (4.4 lb.-in.)
SHLD Terminal	All	Terminating point for wiring shields	—	—	1.6 N-m (14 lb.-in.)	1.6 N-m (14 lb.-in.)

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

Power & Ground Wiring



Standard and Enhanced Control I/O Terminal Block

No.	Signal	Factory Default	Description	Related Param.
1	Digital In 1	Stop – CF (CF = Clear Fault)	11.2 mA @ 24V DC 19.2V minimum on state 3.2V maximum off state Important: Use only 24V DC, not suitable for 115V AC circuitry. Inputs can be wired as sink or source. See page 8.	361 - 366
2	Digital In 2	Start		
3	Digital In 3	Auto/Man		
4	Digital In 4	Speed Sel 1		
5	Digital In 5	Speed Sel 2		
6	Digital In 6	Speed Sel 3		
7	24V Common	–	Drive supplied power for Digital In1-6 inputs. See examples on page 8. 150mA maximum load.	
8	Digital In Common	–		
9	+24V DC	–		
10	+10V Pot Reference	–	2 k ohm minimum load.	
11	Digital Out 1 – N.O.(1)	NOT Fault	Max Resistive Load: 250V AC / 30V DC, 50 VA / 60 Watts Max Inductive Load: 250V AC / 30V DC, 25 VA / 30 Watts Minimum DC Load: 10 µA, 10 mV DC	380 - 387
12	Digital Out 1 Common			
13	Digital Out 1 – N.C.(1)	Fault		
14	Analog In 1 (– Volts)	(2) Voltage – Reads value at 14 & 15	Non-isolated, 0 to +10V, 10 bit, 100k ohm input impedance.(3)	320 - 327
15	Analog In 1 (+ Volts)			
16	Analog In 1 (– Current)		Non-isolated, 4-20mA, 10 bit, 100 ohm input impedance.(3)	
17	Analog In 1 (+ Current)			
18	Analog In 2 (– Volts)	(2) Voltage – Reads value at 18 & 19	Isolated, bipolar, differential, 0 to +10V unipolar (10 bit) or ±10V bipolar (10 bit & sign), 100k ohm input impedance.(4)	
19	Analog In 2 (+ Volts)			
20	Analog In 2 (– Current)		Isolated, 4-20mA, 10 bit & sign, 100 ohm input impedance.(4)	
21	Analog In 2 (+ Current)			
22	10V Pot Common Analog Out (– Volts) Analog Out (– Current)	(2) Output Freq	0 to +10V, 10 bit, 10k ohm (2k ohm minimum) load. 0 to 20mA, 10 bit, 400 ohm maximum load.(5) Referenced to chassis ground. Common if internal 10V supply (terminal 10) is used.	340 - 344
23	Analog Out (+ Volts) Analog Out (+ Current)			
24	Digital Out 2 – N.O.(1)	Run	See description at No.s 11-13.	380 - 387
25	Digital Out 2 Common			
26	Digital Out 2 – N.C.(1)	NOT Run		

(1) Contacts shown in unpowered state. Any relay programmed as Fault or Alarm will energize (pick up) when power is applied to drive and deenergize (drop out) when fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will deenergize when condition is removed.

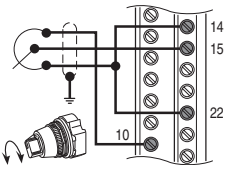
(2) These inputs/outputs are dependent on a number of parameters. See “Related Parameters.”

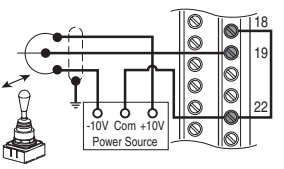
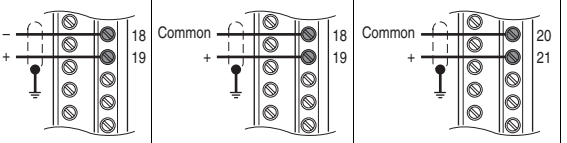
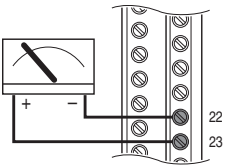
(3) Differential Isolation - External source must be less than 10V with respect to PE.

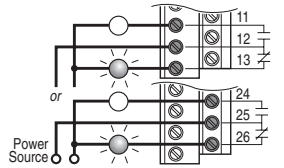
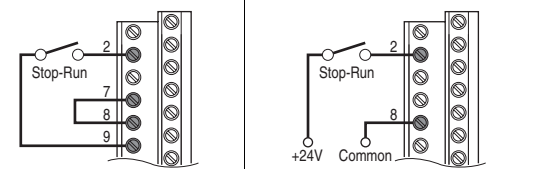
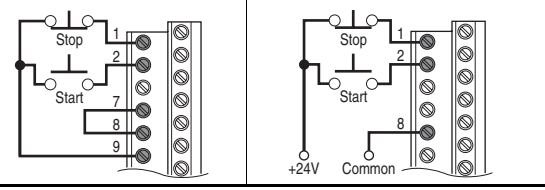
(4) Differential Isolation - External source must be maintained at less than 160V with respect to PE. Input provides high common mode immunity.

(5) Analog output current is only available with Enhanced Control drives.

I/O Wiring Examples

<table>
<tr><th>Input/Output</th><th>Connection Example(3)</th><th>Related Param.</th></tr>
<tr><td>Potentiometer(1)
10k Ohm Pot. Recommended (2k Ohm minimum)
Joystick(1)
±10V Input - 100k ohm input impedance</td><td>[Speed Ref A Sel] = “Analog In 1”
Potentiometer
 

Joystick
 
</td><td>090 to 095
320 to 327
361 to 366</td></tr>
<tr><td>Analog Input
Bipolar: ±10V
Unipolar: 0 to +10V, 100k ohm impedance
4-20 mA, 100 ohm impedance</td><td>[Speed Ref A Sel] = “Analog In 2”
Bipolar(1) | Unipolar (Voltage) | Unipolar (Current)
 
</td><td></td></tr>
<tr><td>Analog/Digital Output
0 to +10V Output - Can drive a 2k Ohm load (25 mA short circuit current limit)</td><td>Analog Output
 

Digital N.O. / N.C. Output
 
</td><td>341 to 344
380 to 387</td></tr>
<tr><td>2 Wire Control(2) - Non-Reversing
Requires 2-wire functions only ([Digital In1 Sel]). Using 3-wire selections will cause a type 2 alarm.</td><td>24V DC Input(4): [Digital In2 Sel] = “Run”
Internal Supply | External Supply
 
</td><td>361 to 366</td></tr>
<tr><td>3 Wire Control
Requires 3-wire functions only ([Digital In1 Sel]). Using 2-wire selections will cause a type 2 alarm.</td><td>24V DC Input(4): [Digital In1 Sel] = “Stop – CF”, [Digital In2 Sel] = “Start”
Internal Supply | External Supply
 
</td><td></td></tr>
</table>

(1) Refer to the Attention statement on page 2 for important bipolar wiring information.

(2) **Important:** Programming inputs for 2 wire control deactivates all HIM Start buttons.

(3) Examples show hardware wiring only. Refer to page 7 for parameters that must be adjusted.

(4) If desired, a User Supplied 24V DC power source can be used. Refer to the “External” example.

Step 4 Start-Up Check List

❑ **1.** Verify input supply voltage.

❑ **2.** Check output wiring.

❑ **3.** Check control wiring.

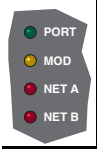
❑ **4.** Apply AC power and control voltages to the drive.

If any of the six digital inputs are configured to Stop – CF (CF = Clear Fault) or Enable, verify that signals are present or the drive will not start. Refer to Troubleshooting – Abbreviated Fault & Alarm Listing on page 16 for a list of potential digital input conflicts.

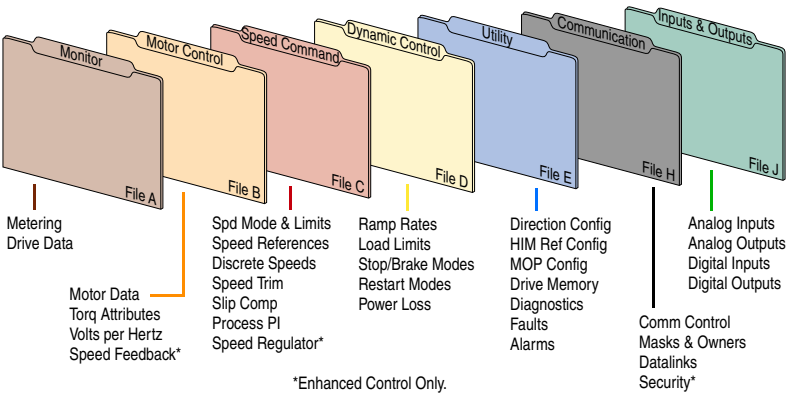
If the STS LED is not flashing green at this point, refer to Status Indicators on page 9.

❑ **5.** Select Start-Up method: SMART Start or Assisted Start-Up.

Status Indicators

Name	Color	State	Description
	Green	Flashing	Drive ready, but not running and no faults are present.
		Steady	Drive running, no faults are present.
	Yellow	Flashing, Drive Stopped	An inhibit condition exists, the drive cannot be started. Check parameter 214 [Start Inhibits].
		Flashing, Drive Running	An intermittent type 1 alarm condition is occurring. Check parameter 211 [Drive Alarm 1].
		Steady, Drive Running	A continuous type 1 alarm condition exists. Check parameter 211 [Drive Alarm 1].
	Red	Flashing	A fault has occurred.
		Steady	A non-resettable fault has occurred.
	Refer to the Communication Adapter User Manual.		Status of DPI port internal communications (if present).
			Status of communications module (when installed).
			Status of network (if connected).
			Status of secondary network (if connected).

Step 5 Program the Drive – Parameter Files & Groups



*Enhanced Control Only.

Frequently Used Parameters

MOTOR CONTROL (File B)

Motor Data

041	**[Motor NP Volts]**	Default: Drive Rating Based	
	Set to the motor nameplate rated volts.	Min/Max: 0.0/[Rated Volts] Units: 0.1 VAC	
042	**[Motor NP FLA]**	Default: Drive Rating Based	047 048
	Set to the motor nameplate rated full load amps.	Min/Max: 0.0/[Rated Amps] × 2 Units: 0.1 Amps	
045	**[Motor NP Power]**	Default: Drive Rating Based	046
	Set to the motor nameplate rated power.	Min/Max: 0.00/100.00 0.00/412.48 EC Units: 0.01 kW/HP See [Mtr NP Pwr Units]	
046	**[Mtr NP Pwr Units]**	Default: Drive Rating Based	
	Selects the motor power units to be used.	Options: 0 "Horsepower" 1 "kiloWatts"	
047	**[Motor OL Hertz]**	Default: Motor NP Hz/3	042 220
	Selects the output frequency below which the motor operating current is derated. The motor thermal overload will generate a fault at lower levels of current.	Min/Max: 0.0/500.0 Hz Units: 0.1 Hz	

Torq Attributes

053	Standard **[Torque Perf Mode]**	Default: 0 "Sensrls Vect"	062 063 069 070
	Sets the method of motor torque production.	Options: 0 "Sensrls Vect" 1 "SV Economize" 2 "Custom V/Hz" 3 "Fan/Pmp V/Hz"	
	EC **[Motor Cntl Sel]**	Default: 0 "Sensrls Vect"	
	Sets the method of motor control used in the drive. **Important:** "FVC Vector" mode requires autotuning of the motor, both coupled and uncoupled to the load. (1) Enhanced firmware 2.001 & later.	Options: 0 "Sensrls Vect" 1 "SV Economize" 2 "Custom V/Hz" 3 "Fan/Pmp V/Hz" 4 "FVC Vector"(1)	

MOTOR CONTROL (File B)	Torq Attributes	061	**[Autotune]** Provides a manual or automatic method for setting [IR Voltage Drop] and [Flux Current Ref], which affect sensorless vector performance. Valid only when parameter 53 is set to "Sensrls Vect" or "SV Economize."	Default: Options:	3 0 1 2 3	"Calculate" "Ready" "Static Tune" "Rotate Tune" "Calculate"	053 062
			"Ready" (0) = Parameter returns to this setting following a "Static Tune" or "Rotate Tune." It also permits manually setting [IR Voltage Drop] and [Flux Current Ref]. "Static Tune" (1) = A temporary command that initiates a non-rotational motor stator resistance test for the best possible automatic setting of [IR Voltage Drop]. A start command is required following initiation of this setting. The parameter returns to "Ready" (0) following the test, at which time another start transition is required to operate the drive in normal mode. Used when motor cannot be rotated. "Rotate Tune" (2) = A temporary command that initiates a "Static Tune" followed by a rotational test for the best possible automatic setting of [Flux Current Ref]. A start command is required following initiation of this setting. The parameter returns to "Ready" (0) following the test, at which time another start transition is required to operate the drive in normal mode. **Important:** Used when motor is uncoupled from the load. Results may not be valid if a load is coupled to the motor during this procedure. **ATTENTION:** Rotation of the motor in an undesired direction can occur during this procedure. To guard against possible injury and/or equipment damage, it is recommended that the motor be disconnected from the load before proceeding. "Calculate" (3) = This setting uses motor nameplate data to automatically set [IR Voltage Drop] and [Flux Current Ref].				
SPEED COMMAND (File C)	Spd Mode & Limits	080	Standard **[Speed Mode]** Sets the method of speed regulation.	Default: Options:	0 0 1 2	"Open Loop" "Open Loop" "Slip Comp" "Process PI"	121 thru 138
			E C **[Feedback Select]** Selects the source for motor speed feedback. Note that all selections are available when using Process PI. "Open Loop" (0) - no encoder is present, and slip compensation is not needed. "Slip Comp" (1) - tight speed control is needed, and encoder is not present. "Encoder" (3) - an encoder is present. "Simulator" (5) - Simulates a motor for testing drive operation & interface check.	Default: Options:	0 0 1 2 3 4 5	"Open Loop" "Open Loop" "Slip Comp" "Reserved" "Encoder" "Reserved" "Simulator"	
		081	**[Minimum Speed]** Sets the low limit for speed reference after scaling is applied. Refer to parameter 083 [Overspeed Limit].	Default: Min/Max: Units:	0.0 Hz 0.0/[Maximum Speed] 0.1 Hz		092 095
		082	**[Maximum Speed]** Sets the high limit for speed reference after scaling is applied. Refer to parameter 083 [Overspeed Limit].	Default: Min/Max: Units:	50.0 or 60.0 Hz (Dependent on voltage class) 5.0/400.0 Hz 5.0/500.0 Hz E C 0.0 Hz		055 083 091 094 202

SPEED COMMAND (File C)	Speed References	090	**[Speed Ref A Sel]** Selects the source of the speed reference to the drive unless [Speed Ref B Sel] or [Preset Speed 1-7] is selected. For more information on selecting a speed reference source, refer to the *PowerFlex 70 User Manual*, "Speed Reference Control". (1) See Appendix B of the User Manual for DPI port locations. (2) Enhanced Control Drives Only.	Default: 2 "Analog In 2" Options: 1 "Analog In 1" 2 "Analog In 2" 3-8 "Reserved" 9 "MOP Level" 10 "Reserved" 11 "Preset Spd1" 12 "Preset Spd2" 13 "Preset Spd3" 14 "Preset Spd4" 15 "Preset Spd5" 16 "Preset Spd6" 17 "Preset Spd7" 18 "DPI Port 1"(1) 19 "DPI Port 2"(1) 20 "DPI Port 3"(1) 21 "Reserved" 22 "DPI Port 5"(1) 23-29 "Reserved" 30 "HighRes Ref"(2)	002 091 thru 093 101 thru 107 117 thru 120 192 thru 194 213 272 273 320 361 thru 366
		091	**[Speed Ref A Hi]** Scales the upper value of the [Speed Ref A Sel] selection when the source is an analog input.	Default: [Maximum Speed] Min/Max: –/+[Maximum Speed] Units: 0.1 Hz		082
		092	**[Speed Ref A Lo]** Scales the lower value of the [Speed Ref A Sel] selection when the source is an analog input.	Default: 0.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz		081
	Discrete Speeds	101 102 103 104 105 106 107	**[Preset Speed 1]** **[Preset Speed 2]** **[Preset Speed 3]** **[Preset Speed 4]** **[Preset Speed 5]** **[Preset Speed 6]** **[Preset Speed 7]** Provides an internal fixed speed command value. In bipolar mode direction is commanded by the sign of the reference.	Default: 5.0 Hz 10.0 Hz 20.0 Hz 30.0 Hz 40.0 Hz 50.0 Hz 60.0 Hz Min/Max: –/+[Maximum Speed] Units: 0.1 Hz		090 093
DYNAMIC CONTROL (File D)	Ramp Rates	140 141	**[Accel Time 1]** **[Accel Time 2]** Sets the rate of accel for all speed increases. $\frac{\text{Max Speed}}{\text{Accel Time}}$ = Accel Rate	Default: 10.0 Secs 10.0 Secs Min/Max: 0.1/3600.0 Secs Units: 0.1 Secs		142 143 146 361 thru 366
		142 143	**[Decel Time 1]** **[Decel Time 2]** Sets the rate of decel for all speed decreases. $\frac{\text{Max Speed}}{\text{Decel Time}}$ = Decel Rate	Default: 10.0 Secs 10.0 Secs Min/Max: 0.1/3600.0 Secs Units: 0.1 Secs		140 141 146 361 thru 366

DYNAMIC CONTROL (File D)

Load Limits

148	**[Current Lmt Val]** Defines the current limit value when [Current Lmt Sel] = "Cur Lim Val."	Default: [Rated Amps] × 1.5 (Equation approximates default value.) Min/Max: Drive Rating Based Units: 0.1 Amps	147 149
151	**[PWM Frequency]** Sets the carrier frequency for the PWM output. Drive derating may occur at higher carrier frequencies. For derating information, refer to the *PowerFlex Reference Manual*, publication PFLEX-RM001….	Default: 4 kHz Min/Max: 2, 3, 4, 5, 6, 7, 8, 9, 10 kHz 2, 4, 8, 12 kHz E C Units: 1 kHz	

Stop/Brake Modes

155 156	Standard **[Stop Mode A]** Standard **[Stop Mode B]** Active stop mode. [Stop Mode A] is active unless [Stop Mode B] is selected by inputs. (1) When using options 1 or 2, refer to the Attention statements at [DC Brake Level].	Default: 1 "Ramp" Default: 0 "Coast" Options: 0 "Coast" 1 "Ramp"(1) 2 "Ramp to Hold"(1) 3 "DC Brake"	155 156
	ATTENTION: If a hazard of injury do to movement of equipment or material exists, an auxiliary mechanical braking device must be used.		
	E C v2 **[Stop/Brk Mode A]** E C v2 **[Stop/Brk Mode B]** See description above.		
161 162	**[Bus Reg Mode A]** **[Bus Reg Mode B]** Sets the method and sequence of the DC bus regulator voltage. Choices are dynamic brake, frequency adjust or both. Sequence is determined by programming or digital input to the terminal block. Dynamic Brake Setup If a dynamic brake resistor is connected to the drive, both these parameters must be set to either option 2, 3 or 4. Refer to the Attention statement on page 2 for important information on bus regulation.	Default: 1 "Adjust Freq" 4 "Both-Frq 1st" Options: 0 "Disabled" 1 "Adjust Freq" 2 "Dynamic Brak" 3 "Both-DB 1st" 4 "Both-Frq 1st"	160 163
	ATTENTION: The drive does not offer protection for externally mounted brake resistors. A risk of fire exists if external braking resistors are not protected. External resistor packages must be self-protected from over temperature or a protective circuit must be supplied. See the *PowerFlex 70 User Manual* for more information.		

DYNAMIC CONTROL (File D)	Stop/Brake Modes	163	**[DB Resistor Type]** Selects whether the internal or an external DB resistor will be used. If a dynamic brake resistor is connected to the drive, [Bus Reg Mode A & B] must be set to either option 2, 3 or 4. **ATTENTION:** The drive does not offer protection for externally mounted brake resistors. A risk of fire exists if external braking resistors are not protected. External resistor packages must be self-protected from over temperature or the protective circuit shown in Appendix C of the User Manual, or equivalent, must be supplied. **ATTENTION:** Equipment damage may result if a drive mounted (internal) resistor is installed and this parameter is set to "External Res." Thermal protection for the internal resistor will be disabled, resulting in possible device damage.	Default: Options:	0 "Internal Res" 2 "None" EC 0 "Internal Res" 1 "External Res" 2 "None"	161 162
	Restart Modes	169	**[Flying Start En]** Enables/disables the function which reconnects to a spinning motor at actual RPM when a start command is issued.	Default: Options:	0 "Disabled" 0 "Disabled" 1 "Enabled"	170
UTILITY (File E)	Drive Memory	201	**[Language]** Selects the display language when using an LCD HIM. This parameter is not functional with an LED HIM.	Default: Options:	0 "Not Selected" 0 "Not Selected" 1 "English" 2 "Français" 3 "Español" 4 "Italiano" 5 "Deutsch" 6 "Reserved" 7 "Português" 8-9 "Reserved" 10 "Nederlands"	
INPUTS & OUTPUTS (File J)	Analog Inputs	322 325	**[Analog In 1 Hi]** **[Analog In 2 Hi]** Sets the highest input value to the analog input x scaling block.	Default: Min/Max: Units:	10.000 Volt 10.000 Volt 4.000/20.000 mA Standard, 0.000/20.000 mA EC, –/+10.000V, 0.000/10.000V 0.001 mA, 0.001 Volt	091 092
		323 326	**[Analog In 1 Lo]** **[Analog In 2 Lo]** Sets the lowest input value to the analog input x scaling block.	Default: Min/Max: Units:	0.000 Volt 0.000 Volt 4.000/20.000 mA, 0.000/10.000V (No. 323), –/+10.000V (No. 326) 0.000/10.000V, 0.001 mA, 0.001 Volt	091 092

INPUTS & OUTPUTS (File J) — Digital Inputs

361 **[Digital In1 Sel]**
[Digital In2 Sel]
362 **[Digital In3 Sel]**
363 **[Digital In4 Sel]**
364 **[Digital In5 Sel]**
365 **[Digital In6 Sel]**
366

Selects the function for the digital inputs.

(1) When [Digital Inx Sel] is set to option 2 "Clear Faults" the Stop button cannot be used to clear a fault condition.

(2)

3	2	1	"Speed Sel 1-3"
0	0	0	Reference A
0	0	1	Reference B
0	1	0	Preset Speed 2
0	1	1	Preset Speed 3
1	0	0	Preset Speed 4
1	0	1	Preset Speed 5
1	1	0	Preset Speed 6
1	1	1	Preset Speed 7

To access Preset Speed 1, set [Speed Ref A Sel] or [Speed Ref B Sel] to "Preset Speed 1".

(3)

3	2	1	"Spd/Trq Sel1-3"
0	0	0	Zero Torque
0	0	1	Spd Reg
0	1	0	Torque Reg
0	1	1	Min Spd/Trq
1	0	0	Max Spd/Trq
1	0	1	Sum Spd/Trq
1	1	0	Absolute
1	1	1	Zero Trq

(4) Enhanced Control Drives Only.

(5) Enhanced Firmware V2.001 and later.

(6) Opening an "Enable" input will cause the motor to coast-to-stop, ignoring any programmed Stop modes.

(7) A dedicated hardware enable input is available via a jumper selection. Refer to the User Manual for further information.

(8) Auto/Manual - Refer to the User Manualfor details.

(9) Typical 3-Wire Inputs - Requires that only 3-wire functions are chosen. Including 2-wire selections will cause a type 2 alarm.

Default:	4	"Stop – CF"(1)	
Default:	5	"Start"	
Default:	18	"Auto/ Manual"	
Default:	15	"Speed Sel 1"	
Default:	16	"Speed Sel 2"	
Default:	17	"Speed Sel 3"	
Options:	0	"Not Used"	
	1	"Enable"(6)	
	2	"Clear Faults"(1)	
	3	"Aux Fault"	
	4	"Stop – CF"(1)	
	5	"Start"(9)(11)	
	6	"Fwd/ Reverse"(9)	
	7	"Run"(10)	
	8	"Run Forward"(3)	
	9	"Run Reverse"(3)	
	10	"Jog"(9) "Jog1"(4)	
	11	"Jog Forward"	100
	12	"Jog Reverse"	
	13	"Stop Mode B"	
	14	"Bus Reg Md B"	156
	15-17	"Speed Sel 1-3"(2)	162
	18	"Auto/ Manual"(8)	
	19	"Local"	
	20	"Acc2 & Dec2"	
	21	"Accel 2"	096
	22	"Decel 2"	
	23	"MOP Inc"(12)	140
	24	"MOP Dec"(12)	
	25	"Excl Link"(12)	
	26	"PI Enable"	194
	27	"PI Hold"	
	28	"PI Reset"	380
	29	"Reserved"	124
	30	"Precharge En"(4)(12)	
	31-33	"Spd/Trq Sel1-3"(5)	
	34	"Jog 2"(4)	
	35	"PI Invert"(4)	
	36-40	"Reserved"	
	41-42	"UserSet Sel1-2"(5)	
	43	"Run Level"(5)(12)	
	44	"RunFwd Level"(5)(12)	
	45	"RunRev Level"(5)(12)	
	46	"Run w/Comm"(5)(12)	

(10) Typical 2-Wire Inputs - Requires that only 2-wire functions are chosen. Including 3-wire selections will cause a type 2 alarm.

(11) A "Dig In ConflictB" alarm will occur if a "Start" input is programmed without a "Stop" input.
Type 2 Alarms - Some digital input programming may cause conflicts that will result in a Type 2 alarm. Example: [Digital In1 Sel] set to 5 "Start" in 3-wire control and [Digital In2 Sel] set to 7 "Run" in 2-wire.
Refer to the User Manual for information on resolving this type of conflict.

(12) Refer to Option Definitions in the User Manual.

Troubleshooting – Abbreviated Fault & Alarm Listing

For a complete listing of Faults and Alarms, refer to the PowerFlex 70 User Manual.

Fault	No.	Type(1)	Description	Action
Auxiliary Input	2	①	Auxiliary input interlock is open.	Check remote wiring.
Motor Overload	7	① ③	Internal electronic overload trip. Enable/Disable with [Fault Config 1].	An excessive motor load exists. Reduce load so drive output current does not exceed the current set by [Motor NP FLA].
OverSpeed Limit	25	①	Functions such as Slip Compensation or Bus Regulation have attempted to add an output frequency adjustment greater than that programmed in [Overspeed Limit].	Remove excessive load or overhauling conditions or increase [Overspeed Limit].
SW OverCurrent	36	①	Drive output current has exceeded the 1ms current rating. This rating is greater than the 3 second current rating and less than the hardware overcurrent fault level. It is typically 200-250% of the drive continuous rating.	Check for excess load, improper DC boost setting. DC brake volts set too high.
IR Volts Range	77		"Calculate" is the autotune default and the value determined by the autotune procedure for IR Drop Volts is not in the range of acceptable values.	Re-enter motor nameplate data.
FluxAmpsRef Rang	78		The value for flux amps determined by the Autotune procedure exceeds the programmed [Motor NP FLA].	1. Reprogram [Motor NP FLA] with the correct motor nameplate value. 2. Repeat Autotune.

(1) See the User Manual for a description of fault types.

Alarm	No.	Type(1)	Description
Dig In ConflictA	17	②	Digital input functions are in conflict. Combinations marked with a "■" will cause an alarm.

	Acc2/Dec2	Accel 2	Decel 2	Jog	Jog Fwd	Jog Rev	Fwd/Rev
Acc2 / Dec2		■	■				
Accel 2	■						
Decel 2	■						
Jog					■	■	
Jog Fwd				■			■
Jog Rev				■			■
Fwd / Rev					■	■	

<table>
<tr><th>Alarm</th><th>No.</th><th>Type(1)</th><th>Description</th></tr>
<tr><td>Dig In ConflictB</td><td>18</td><td>②</td><td>A digital Start input has been configured without a Stop input or other functions are in conflict. Combinations that conflict are marked with a “🔔” and will cause an alarm.
<table>
<tr><th></th><th>Start</th><th>Stop–CF</th><th>Run</th><th>Run Fwd</th><th>Run Rev</th><th>Jog</th><th>Jog Fwd</th><th>Jog Rev</th><th>Fwd/ Rev</th></tr>
<tr><td>Start</td><td></td><td></td><td>🔔</td><td>🔔</td><td>🔔</td><td></td><td>🔔</td><td>🔔</td><td></td></tr>
<tr><td>Stop–CF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Run</td><td>🔔</td><td></td><td></td><td>🔔</td><td>🔔</td><td></td><td>🔔</td><td>🔔</td><td></td></tr>
<tr><td>Run Fwd</td><td>🔔</td><td></td><td>🔔</td><td></td><td></td><td>🔔</td><td></td><td></td><td>🔔</td></tr>
<tr><td>Run Rev</td><td>🔔</td><td></td><td>🔔</td><td></td><td></td><td>🔔</td><td></td><td></td><td>🔔</td></tr>
<tr><td>Jog</td><td></td><td></td><td></td><td>🔔</td><td>🔔</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Jog Fwd</td><td>🔔</td><td></td><td>🔔</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Jog Rev</td><td>🔔</td><td></td><td>🔔</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Fwd / Rev</td><td></td><td></td><td></td><td>🔔</td><td>🔔</td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Dig In ConflictC</td><td>19</td><td>②</td><td>More than one physical input has been configured to the same input function. Multiple configurations are not allowed for the following input functions.
Forward/Reverse
Speed Select 1
Speed Select 2
Speed Select 3
Run Forward
Run Reverse
Jog Forward
Jog Reverse
Run
Stop Mode B
Bus Regulation Mode B
Acc2 / Dec2
Accel 2
Decel 2</td></tr>
</table>

(1) See User Manual for a description of alarm types.

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 HIM.	Esc
2. Address the condition that caused the fault. The cause must be corrected before the fault can be cleared.	
3. After corrective action has been taken, clear the fault by one of these methods: • Press Stop • Cycle drive power • Set parameter 240 [Fault Clear] to “1.” • “Clear Faults” on the HIM Diagnostic menu.	

www.rockwellautomation.com

Corporate Headquarters
Rockwell Automation, 777 East Wisconsin Avenue, Suite 1400, Milwaukee, WI, 53202-5302 USA, Tel: (1) 414.212.5200, Fax: (1) 414.212.5201

Headquarters for Allen-Bradley Products, Rockwell Software Products and Global Manufacturing Solutions
Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation SA/NV, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Headquarters for Dodge and Reliance Electric Products
Americas: Rockwell Automation, 6040 Ponders Court, Greenville, SC 29615-4617 USA, Tel: (1) 864.297.4800, Fax: (1) 864.281.2433
Europe/Middle East/Africa: Rockwell Automation, Brühlstraße 22, D-74834 Elztal-Dallau, Germany, Tel: (49) 6261 9410, Fax: (49) 6261 17741
Asia Pacific: Rockwell Automation, 55 Newton Road, #11-01/02 Revenue House, Singapore 307987, Tel: (65) 6356-9077, Fax: (65) 6356-9011

U.S. Allen-Bradley Drives Technical Support
Tel: (1) 262.512.8176, Fax: (1) 262.512.2222, Email: support@drives.ra.rockwell.com, Online: www.ab.com/support/abdrives

Publication 20A-QS001E-EN-P – February 2005 P/N 198682-P05
Supersedes June 2004
Copyright © 2005 Rockwell Automation, Inc. All rights reserved. Printed in USA.