

PowerFlex 4 AC Drive

Attention

This exercise is intended to provide basic introduction to programming an Allen-Bradley PowerFlex 4 AC drive. Please exercise care when using the demo units. If a procedure is unclear please ask for assistance.



Attention

LIVE VOLTAGES ARE PRESENT IN THE DEMO UNITS
PLEASE DO NOT REMOVE THE COVERS WHILE THE UNITS ARE UNDER
POWER.

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1. Getting Started

The drive suitcase demo units are equipped with a PowerFlex 4 AC drive, a motor, and several I/O devices with which to simulate drive functions.



- All references to the PowerFlex 4 User Manual are based on Allen-Bradley publication number 22A-UM001E-EN-E dated Oct 2007.
- Place the Rev-Fwd selector switch on the demo unit in the “Fwd” position.

2. Introduction

The Allen-Bradley PowerFlex 4 AC drive is a compact motor speed controller incorporating Scalar V/Hz Control, for use on 3-phase induction and synchronous AC motors. The drive is microprocessor controlled and fully programmable for a variety of applications.

The PowerFlex 4 is available in ratings from 0.37kW to 3.7kW at 380 – 460VAC, and 0.2 to 1.5kW at 200 – 240VAC single phase supply.

PowerFlex 4-Class drives (PowerFlex 4 and PowerFlex 40) have an integral LED Programming and Display keypad. The keypad also features local operator controls for Start / Stop, Reverse, and a Speed Control potentiometer.

PowerFlex 4-Class drives have an RS-485 DSI communications port allowing:

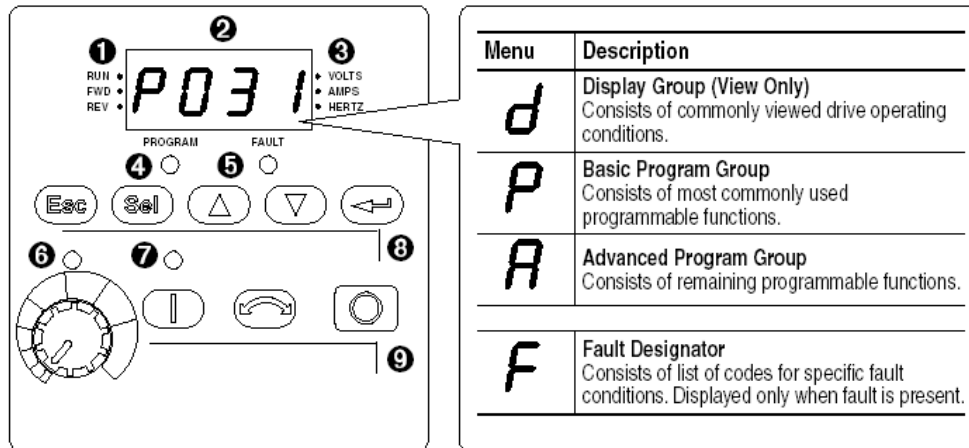
- the connection of remote LCD Human Interface Modules (HIMs) for programming and display.
- the connection of PC based programming software packages such as DriveExplorer and DriveTools SP.
- the integration of the drives onto a communications network.

PowerFlex 4-Class drives may be programmed in up to 7 languages using the remote 22-HIM-A3 LCD HIM module.

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3. Drive Integral Keypad

Located on the front of the drive is the integral Programming and Display Keypad. Drive parameters are organised in three groups – Display, Basic Program, and Advanced Program.



No.	LED	LED State	Description
1	Run/Direction Status	Steady Red	Indicates drive is running and commanded motor direction.
		Flashing Red	Drive has been commanded to change direction. Indicates actual motor direction while decelerating to zero.
2	Alphanumeric Display	Steady Red	Indicates parameter number, parameter value, or fault code.
		Flashing Red	Single digit flashing indicates that digit can be edited. All digits flashing indicates a fault condition.
3	Displayed Units	Steady Red	Indicates the units of the parameter value being displayed.
4	Program Status	Steady Red	Indicates parameter value can be changed.
5	Fault Status	Flashing Red	Indicates drive is faulted.
6	Pot Status	Steady Green	Indicates potentiometer on Integral Keypad is active.
7	Start Key Status	Steady Green	Indicates Start key on Integral Keypad is active. The Reverse key is also active unless disabled by A095 [Reverse Disable]

No.	Key	Name	Description
8		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.
9		Potentiometer	Used to control speed of drive. Default is active. Controlled by parameter P038 [Speed Reference] .
		Start	Used to start the drive. Default is active. Controlled by parameter P036 [Start Source] .
		Reverse	Used to reverse direction of the drive. Default is active. Controlled by parameters P036 [Start Source] and A095 [Reverse Disable] .
		Stop	Used to stop the drive or clear a fault. This key is always active. Controlled by parameter P037 [Stop Mode] .

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4. Viewing and Editing Parameters

The last user-selected 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 Program Group parameter.

Step	Key(s)	Example Displays
1. When power is applied, the last user-selected Display Group parameter number is briefly displayed with flashing characters. The display then defaults to that parameter's current value. (Example shows the value of d001 [Output Freq] with the drive stopped.)		
2. Press Esc once to display the Display Group parameter number shown on power-up. The parameter number will flash.	Esc	
3. Press Esc again to enter the group menu. The group menu letter will flash.	Esc	
4. Press the Up Arrow or Down Arrow to scroll through the group menu (d, P and A).	△ or ▽	
5. Press Enter or Sel to enter a group. The right digit of the last viewed parameter in that group will flash.	↵ or Sel	
6. Press the Up Arrow or Down Arrow to scroll through the parameters that are in the group.	△ or ▽	
7. 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	
8. 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	
9. Press the Up Arrow or Down Arrow to change the parameter value. If desired, press Sel to move from digit to digit or bit to bit. The digit or bit that you can change will flash.	△ or ▽	
10. Press Esc to cancel a change. The digit will stop flashing, the previous value is restored and the Program LED will turn off. Or Press Enter to save a change. The digit will stop flashing and the Program LED will turn off.	Esc ↵	
11. Press Esc to return to the parameter list. Continue to press Esc to back out of the programming menu. If pressing Esc does not change the display, then d001 [Output Frequency] is displayed. Press Enter or Sel to enter the group menu.	Esc	

The Basic Program Group ([page 3-8](#)) contains the most commonly changed parameters.

5. Power Up



ATTENTION:
Power must be applied to the PowerFlex 4 Demo to perform the lab. Do NOT remove the front cover of the drive. Hazardous voltages exist beneath this cover.

Rotate the red Power Switch to “ON” to power up the drive.

6. Reset to Defaults

Resetting to Defaults restores factory settings to all drive parameters. This is done by setting the value of Parameter #P041 [Reset to Defaults] to “1”.

In the text below a **BOLD** font is used to designate a **Flashing** LED display character. Eg. **P031** indicates that the “P” character is **flashing**.

- | | |
|---------------------------------------|--|
| • Press the [ESC] key | Display = <i>d001</i> |
| • Press the [ESC] key again | Display = d001 |
| • Press the [▲] key | Display = P031 |
| • Press [Enter] | Display = P031 |
| • Press the [▼] key | Display = P041 |
| • Press [Enter] | Display = “0” (current value of parameter) |
| • Press [Sel] | “Program” light On, and display = “0” |
| • Press the [▲] key | Display = “1” |
| • Press [Enter] to execute the reset. | |

What happened when the reset was performed? _____

What is this telling you? _____

(See PowerFlex 4 User Manual page 4-4 Fault Descriptions for detailed information)

- Press the [STOP] key to clear the fault.

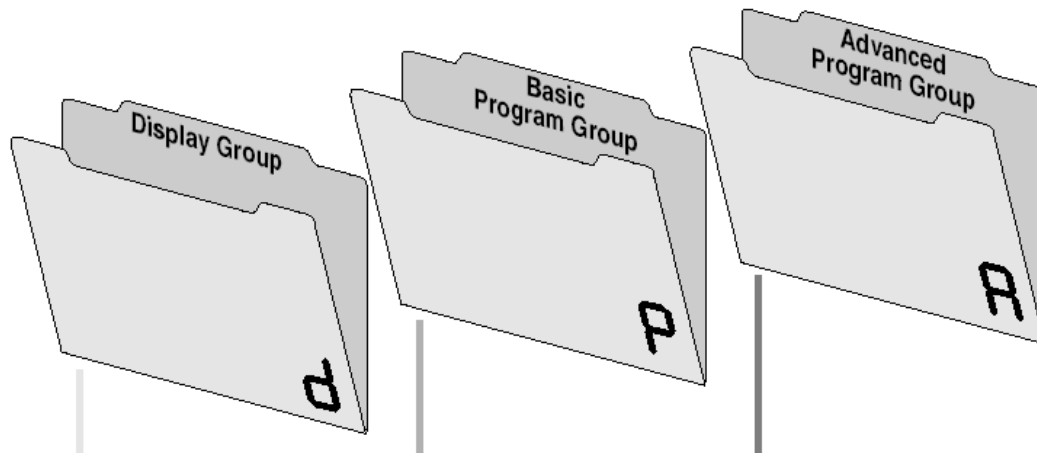
7. Introduction to PowerFlex Programming Parameters

To configure the drive to operate in a specific way, drive parameters have to be set. PowerFlex drives contain three types of parameters:

- | | |
|----------------|---|
| ENUM | - These parameters allow a selection from 2 or more possible options. Each option is represented by a number. |
| BIT | - This type has individual bits associated with features or conditions. If a 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. |
| NUMERIC | - These parameters have a single numerical value, eg. 415V |

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PowerFlex 4 parameter organisation is shown below.



See page 3-3

Output Freq	d001
Commanded Freq	d002
Output Current	d003
Output Voltage	d004
DC Bus Voltage	d005
Drive Status	d006
Fault 1 Code	d007
Fault 2 Code	d008
Fault 3 Code	d009
Process Display	d010
Control Source	d012
Contrl In Status	d013
Dig In Status	d014
Comm Status	d015
Control SW Ver	d016
Drive Type	d017
Elapsed Run Time	d018
Testpoint Data	d019
0-10V Analog Input	d020
4-20mA Analog Input	d021

See page 3-8

Motor NP Volts	P031
Motor NP Hertz	P032
Motor OL Current	P033
Minimum Freq	P034
Maximum Freq	P035
Start Source	P036
Stop Mode	P037
Speed Reference	P038
Accel Time 1	P039
Decel Time 1	P040
Reset To Defaults	P041

See page 3-13

Digital In1 Sel	A051
Digital In2 Sel	A052
Relay Out Sel	A055
Relay Out Level	A056
Accel Time 2	A067
Decel Time 2	A068
Internal Freq	A069
Preset Freq 0	A070
Preset Freq 1	A071
Preset Freq 2	A072
Preset Freq 3	A073
Jog Frequency	A078
Jog Accel/Decel	A079
DC Brake Time	A080
DC Brake Level	A081
DB Resistor Sel	A082
S Curve %	A083
Start Boost	A084
Maximum Voltage	A088
Current Limit	A089
Motor OL Select	A090
PWM Frequency	A091
Auto Rstrt Tries	A092
Auto Rstrt Delay	A093
Start At PowerUp	A094
Reverse Disable	A095
Flying Start En	A096
Compensation	A097
SW Current Trip	A098
Process Factor	A099
Fault Clear	A100
Program Lock	A101
Testpoint Sel	A102
Comm Data Rate	A103
Comm Node Addr	A104
Comm Loss Action	A105
Comm Loss Time	A106
Comm Format	A107
0-10V Analog Input Low	A110
0-10V Analog Input High	A111
4-20mA Analog Input Low	A112
4-20mA Analog Input High	A113
Slip Compensation	A114

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10. Remote Control of Drive Run

Press the remote green [START] button on the demo. This does NOT start the drive because the drive is set (by default) to use local keypad as the Start source and the Speed Reference source. Options for Parameter #P036 [Start Source] are shown below.

P036 [Start Source]

Options	0 "Keypad" (Default)	<ul style="list-style-type: none"> Integral keypad controls drive operation. I/O Terminal 1 "Stop" = coast to stop. When active, the Reverse key is also active unless disabled by A095 [Reverse Disable].
	1 "3-Wire"	I/O Terminal 1 "Stop" = stop according to the value set in P037 [Stop Mode].
	2 "2-Wire"	I/O Terminal 1 "Stop" = coast to stop.
	3 "2-W Lvl Sens"	Drive will restart after a "Stop" command when: <ul style="list-style-type: none"> Stop is removed and Start is held active
	4 "2-W Hi Speed"	Important: There is greater potential voltage on the output terminals when using this option. <ul style="list-style-type: none"> Outputs are kept in a ready-to-run state. The drive will respond to a "Start" command within 10 ms. I/O Terminal 1 "Stop" = coast to stop.
	5 "Comm Port"	<ul style="list-style-type: none"> Remote communications. Refer to Appendix C for details. I/O Terminal 1 "Stop" = coast to stop.

Select remote 3-wire Start / Stop control by programming Parameter #36 [Start Source] to a value of "1" (3-wire control), as follows:

- | | |
|---------------------------|--|
| • Press the [Sel] key | Display = P033 |
| • Press the [Enter] key | Display = P033 |
| • Press the [▲] key until | Display = P036 |
| • Press the [Enter] key | Display = "0" |
| • Press the [Sel] key | Display = " 0 " (Program LED lit) |
| • Press the [▲] key | Display = " 1 " |
| • Press the [Enter] key | Display = " 1 " |

Note: Observe the status of the Green led above the local Start Button

- Press [ESC] three times to return to the Hertz screen.
- Try to Start the drive by pressing the green [START] key on the Keypad.

Did the drive Start ? _____ Why not? _____

- Start the drive by pressing the remote green [START] button on the demo.
- Reverse the drive by selecting "REV" on the remote direction selector on the demo.

Does the Local Change Direction key function? _____

Where is the Speed Reference Control coming from? _____

What indication tells you this immediately? _____

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12. Changing the Stop Mode

By default, the drive use "Ramp" stop mode when a Stop command is issued. The options for Parameter #P037 [Stop Mode] are listed below:

P037 [Stop Mode]

Options	0	"Ramp, CF" ⁽¹⁾ (Default)	Ramp to Stop. "Stop" command clears active fault.
	1	"Coast, CF" ⁽¹⁾	Coast to Stop. "Stop" command clears active fault.
	2	"DC Brake, CF" ⁽¹⁾	DC Injection Braking Stop. "Stop" command clears active fault.
	3	"DCBrkAuto, CF" ⁽¹⁾	DC Injection Braking Stop with Auto Shutoff. <ul style="list-style-type: none"> • Standard DC Injection Braking for value set in A080 [DC Brake Time]. OR • Drive shuts off if the drive detects that the motor is stopped. "Stop" command clears active fault.
	4	"Ramp"	Ramp to Stop.
	5	"Coast"	Coast to Stop.
	6	"DC Brake"	DC Injection Braking Stop.
	7	"DC BrakeAuto"	DC Injection Braking Stop with Auto Shutoff. <ul style="list-style-type: none"> • Standard DC Injection Braking for value set in A080 [DC Brake Time]. OR • Drive shuts off if current limit is exceeded.

Using the programming techniques previously described, program Parameter #P037 [Stop Mode] to "2" (Coast Stop and Clear Fault). When complete:

- Start the drive and allow the motor to come to full speed (60Hz).
- Press a [STOP] button

Describe how the motor stopped? _____

13. Additional Exercises

Output Relay settings

The drive's output relay is wired to the orange Output lamp on the demo case. By default this functions as a "Fault" relay. Verify this by generating an UnderVoltage Fault (F004) by switching OFF the main power switch. When the drive faults, immediately re-apply power. Clear the fault.

Change the relay function to "At Frequency" by changing Parameter #A055 [Relay Out Sel] to "1". Run the drive and make incremental changes to the drive speed pot to observe the new relay function.

Acceleration & Deceleration Ramps

Change the Acceleration (Parameter #P039 [Accel Time 1]) and the Deceleration (Parameter #P040 [Decel Time 1]) to 1 second each. Note the change in response to the speed potentiometer.