

# PowerFlex 4 Sample Specification

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## GENERAL

## REFERENCES

Designed to meet 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.
- NEMA 250 - Enclosures for Electrical Equipment
- UL 508C - Underwriter's Laboratory
- CAN/CSA-C22 No. 14-M91. - Canadian Standards Association.
- IEC 146 - International Electrical Code.

## REGULATORY REQUIREMENTS

Conforms to the following requirements:

- NFPA 70
- IEC 146
- C-UL marking to provide an approved listing for Canadian users.
- UL listing  
Manufacturer will furnish the product as listed and classified by Underwriter's Laboratories as suitable for the purpose specified and indicated.
- EN Standard/CE marked for the following directives:

### **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.

Single phase drives has an internal EMC filter capable of meeting the Second Environment levels for the EMC directive without the need for additional components. First environment classification is achievable with the addition of an external filter.

- C-Tick EMC Standards for Australia / New Zealand

## QUALIFICATIONS

### **MANUFACTURER:**

Allen-Bradley entered the AC Variable speed drive market in 1980. Rockwell Automation / Allen-Bradley Standard Drives Business continues to specialize in the design and manufacturing of PWM Adjustable Frequency Drives.

### **SUPPORT:**

Rockwell Automation maintains factory trained and authorized service facilities within 100 miles of the project and has a demonstrated record of service for at least the previous three years. Rockwell Automation employs full-time support personnel.

### **CERTIFICATION:**

All Rockwell Automation drive manufacturing locations are certified to the ISO-9001 Series of Quality Standards as well as the ISO-14001 Environmental Standards. This insures all quality and corrective action procedures are documented and implemented with a goal of Total Customer Satisfaction.

## PRODUCT

### RATINGS

#### VOLTAGE CLASSES:

Available in the following voltage classes and is self-adjustable within each class:

100VAC – 10% to 120VAC +10%, one phase

200VAC – 10% to 240 VAC +10%, one phase

200VAC – 10% to 240 VAC +10%, three phase

380VAC – 10% to 480 VAC +10%, three phase

Displacement power factor is between 1.0 and 0.95, lagging, over the entire speed range.  
The efficiency is a minimum of 97% at full load and speed.

#### ENVIRONMENT:

Storage ambient temperature range: -40° C to 85° C (-40° to 185°F).

Operating ambient temperature range without derating:

IP20	-10° C to 50° C (0° to 122° F)
Nema 1	-10° C to 40° C (0° to 104° F)
Flange Mount - Heatsink:	-10° C to 40° C (0° to 104° F)
Drive:	-10° C to 50° C (0° to 122° F)

The relative humidity range is 0% to 95% non-condensing.

Operating elevation: up to 1000 Meters (3,300ft) without derating.

Shock: 15G peak for 11ms duration (+/- 1.0mS)

Vibration: 1G peak, 5 to 2000 Hz

Drives can be Zero-Stacked (mounted next to other drives with zero clearance between them in a 40° C ambient). Drives can operate 41° C - 50° C with minimum one inch spacing between drives.

#### REFLECTED WAVE

Drives 380VAC – 480VAC have a software algorithm to limit the reflected wave for due to long cable lengths to a maximum of 2.25 times the bus voltage or 1600V, whichever is less, up to cable lengths of 558 ft (170m). Hardware designs also limit peak voltages on the motor.

### DESIGN

#### HARDWARE:

Employs the following power components

- Diode or fully gated bridge on the input.
- Switching logic power supply operating from the DC bus.
- MOV protection - phase to phase and phase to ground with jumpers to remove the phase to ground unit when applicable.
- Gold plated plug-in connections on printed circuit boards.
- Microprocessor based inverter logic isolated from power circuits.
- Nominal IGBT rise time of 200ns or longer.
- Inverter section has no commutation capacitors.
- The Main Control Board is the same for all ratings.
- Common control connection for all ratings.
- Device Peripheral Interface (DSI) for connection to common options.
- Status LED for drive condition, viewable on the drives display

### **CONTROL LOGIC:**

Programmable or self-adjusting for the following:

- Operating the drive with motor disconnected.
- Controlled shut down, when properly fused, with no component failure in the event of an output phase to phase or phase to ground short circuit and fault annunciation.
- Advanced thermal manager to provide full protection of the power devices by reducing PWM frequency, and output speed.
- Adjustable PWM carrier frequency within a range of 2-16 kHz.
- Selectable V/ Hz with adjustable voltage boost setting for CT and VT loads.
  - Drive ratings are:
    - Rated Current continuously
    - 150% Overload capability for up to 1 minute
    - 200% Overload capability for up to 3 seconds
- Multiple programmable stop modes including - Ramp, Coast, DC-Brake, DC-Brake Auto with Shut-off and S-curve.
- Multiple acceleration and deceleration rates.
- All adjustments to be made with the door closed.
- Adjustable output frequency up to 240Hz.

### **POWER CONDITIONING:**

Designed to operate on an AC supply, which may contain line notching, and up to 10% harmonic distortion. An input isolation transformer is not required for protection from normal line transients. If line conditions dictate the use of a transformer, the required K factor is 4.0 or less.

### **OPERATOR INTERFACE:**

Display is a 1 line by 4 character LED display. It is used to display drive operating conditions, fault / alarm indications and programming information.

The monitoring mode provides the following information on the display.

1. A status indicating direction, status, fault conditions.
2. LED's indication when start and direction are active on the HIM.

The external Human Interface Module is available in two package styles:

- A backlit LCD display with graphics capability and rated for IP20 / Type 1 used as a handheld terminal by connecting via a separate cable, or used in a bezel kit mounted to a cabinet / panel. In all cases this package style is removable (slides out) without the use of a tool.
- An IP66 / UL Type 4X-12 remote mounted version for cabinet / panel mounting that is connected via cable.

The Human Interface Module is available programming keys, start/stop, direction and speed control. The ALT functions include HIM removal under power, language selection and user display.

### **ANALOG INPUTS**

(1) Optically isolated 0 to 10V or 4 to 20mA input ,  $\geq 10$  bit,  $\geq 10$ V common mode voltage range

The analog input is used for frequency command or PTC or external motor resistor input. Inputs are also programmable for scaling and offset.

**REFERENCE SIGNALS:**

Capable of the following speed reference signals:

- Jog
- HIM (Program/Control panel)
- Analog Input signals
- Preset Speeds (4)
- 16 bit network reference

Analog input references are independently scaleable (including invert), both from the analog input side and from the speed reference side.

**LOSS OF NETWORK REFERENCE:**

- In the event of loss Network reference signal, the following actions are programmable:

Fault the drive  
Coast to stop  
Stop  
Continue at last operating command

**DIGITAL INPUTS:**

Five inputs are provided and are configurable as 24Vdc sink or source. Two inputs are individually programmable for functions from a list of 16, which include Start (3-wire control), Run (2-wire control), Stop, Aux fault, Analog Invert, Jog, and others. The state of these inputs can also be communicated over a network, whether the drive is using them for control functions or not. One of the digital inputs supports a dedicated stop input. All other digital inputs do not require jumpers or switches for digital input configuration.

Inputs draw 6 mA minimum each @ 24 VDC and require 18V minimum for "ON" state and a maximum of 6V for "OFF" state.

**DIGITAL OUTPUTS:**

One Form C (1 N.O - 1 N.C) output relays are provided. Contact output resistive ratings are 3.0A at 30V DC, 125V, and 204V AC and inductive rating of 0.5A at 30V DC, 125V, and 240V AC. The relay is programmable for 13 different conditions including Fault, At Frequency, Motor Running, Above Current, and others. The input can also be controlled over network communications if they are not assigned to drive related functions.

## FEATURES

### **ACCELERATION/DECELERATION:**

Accel/Decel settings provide separate adjustments to allow either setting to be adjusted from 0 seconds to 600.0 seconds. A second set of remotely selectable Accel/Decel settings are accessible through digital inputs. Programming capability allows the user to produce acc/dec profiles with linear or "S-Curve" characteristics that provide changing accel/decel rates. S-Curve profiles are adjustable.

### **AUTO RESTART:**

Provides up to nine automatic fault reset and restarts following a fault condition before locking out and requiring manual restart. The automatic mode is not applicable to a ground fault, shorted output faults and other internal microprocessor faults. The time between restarts is adjustable from 0 seconds to 300.0 seconds.

### **BRAKING OPTIONS:**

#### **Dynamic Braking**

A standard built in 7<sup>th</sup> IGBT for use as a dynamic braking chopper. This IGBT can provide at least 100% braking torque on a continuous basis with an externally mounted brake resistor.

### **COMMUNICATIONS**

#### **DSI Peripheral INTERFACE**

Provides an interface for up to 2 independent peripherals to be connected to the drive at one time. This protocol that operates at 19.2K Bps. Connection and identification of DSI port addresses requires no user adjustments.

#### **COMMUNICATIONS INTERFACE:**

The Modbus protocol operates between 9600 and 38.4K Bps. Capability for one externally mounted communications interface cards. Externally mounted cards are separately powered and connected to the drive via a cable. The following are available:

- DeviceNet
- EtherNet IP
- ControlNet Coax
- Profibus DP
- LonWorks

### **CONTROL MODE:**

Programming provides the ability adjust the V/ Hz mode. The volts per hertz mode can be programmed for constant torque or variable torque.

### **CURRENT LIMIT:**

Programmable current limit up to 180% of drive rated amps. Current limit is active for all drive states; accelerating, constant speed and decelerating. Both the source of the current limit value and the gain for responsiveness adjustment are programmable.

### **DRIVE OVERLOAD PROTECTION:**

Provides overload protection that automatically adjusts PWM frequency, Current Limit, or both in an attempt to provide tripless operation.

### **FAULT MEMORY:**

The last three fault codes are stored in the fault buffer.

**FLYING START:**

Capable of determining the speed and direction of a spinning motor and matching the frequency and voltage, without the use of encoder feedback.

**MOTOR OVERLOAD PROTECTION:**

Provides UL listed Class 10 motor overload protection to comply with N.E.C. Article 430. Overload protection is speed sensitive and adjustable. To accommodate a variety of motors with different speed range capabilities, the frequency at which the overload begins to derate is programmable.

**CONTROL RIDE THROUGH:**

Control logic is capable of "riding through" a power outage of at least 0.5 seconds in duration.

**SKIP FREQUENCIES:**

Three adjustable setpoints that lock out continuous operation at frequencies that may produce mechanical resonance are provided. The setpoints have a bandwidth adjustable from 0Hz to 60Hz.

**SPEED REGULATION:**

- Open Loop with Slip Compensation: +/- 2% of base speed across a 40:1 speed range.

**START AT POWER UP:**

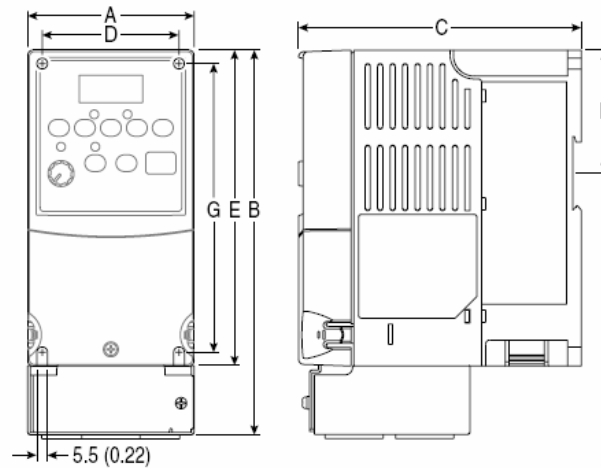
A user programmable restart function is provided to automatically restart the equipment after restoration of power after an outage. A run or start input is required for this function.

## Dimensions:

**Table B.I PowerFlex 4 Panel Mount Drives – Ratings are in kW and (HP)**

Frame	120V AC – 1-Phase	240V AC – 1-Phase No Brake	240V AC – 1-Phase	240V AC – 3-Phase	480V AC – 3-Phase
A	0.2 (0.25) 0.37 (0.5)	0.2 (0.25) 0.37 (0.5) 0.75 (1.0)	0.2 (0.25) 0.37 (0.5) 0.75 (1.0)	0.2 (0.25) 0.37 (0.5) 0.75 (1.0) 1.5 (2.0)	0.37 (0.5) 0.75 (1.0) 1.5 (2.0)
B	0.75 (1.0) 1.1 (1.5)	1.5 (2.0) 2.2 (3.0)	1.5 (2.0)	2.2 (3.0) 3.7 (5.0)	2.2 (3.0) 3.7 (5.0)

**Figure B.1 PowerFlex 4 Panel Mount Drives – Dimensions are in millimeters and (inches). Weights are in kilograms and (pounds).**

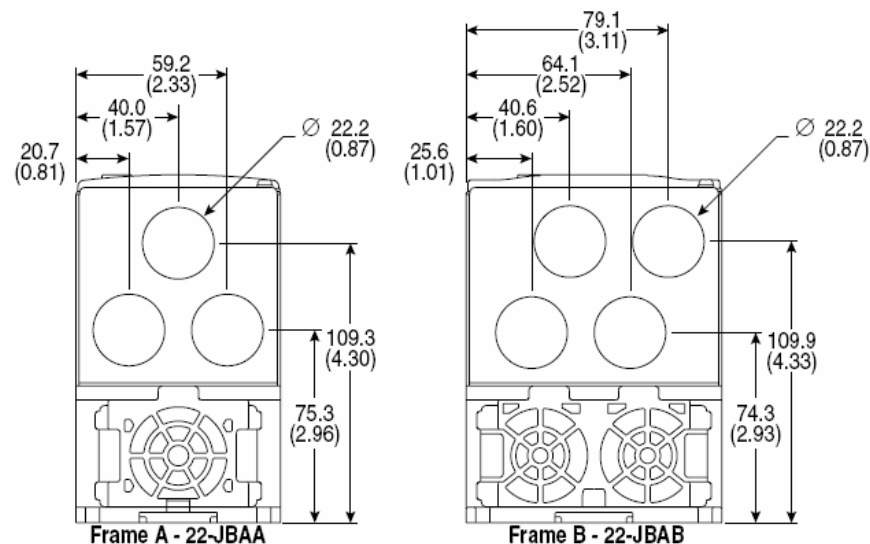


Frame	A	B <sup>(1)</sup>	C	D	E <sup>(2)</sup>	F	G	Shipping Weight
A	80 (3.15)	185 (7.28)	136 (5.35)	67 (2.64)	152 (5.98)	59.3 (2.33)	140 (5.51)	1.4 (3.1)
B	100 (3.94)	213 (8.39)	136 (5.35)	87 (3.43)	180 (7.09)	87.4 (3.44)	168 (6.61)	2.2 (4.9)

<sup>(1)</sup> Overall height of drive with IP 30/NEMA 1/UL Type 1 option kit installed.

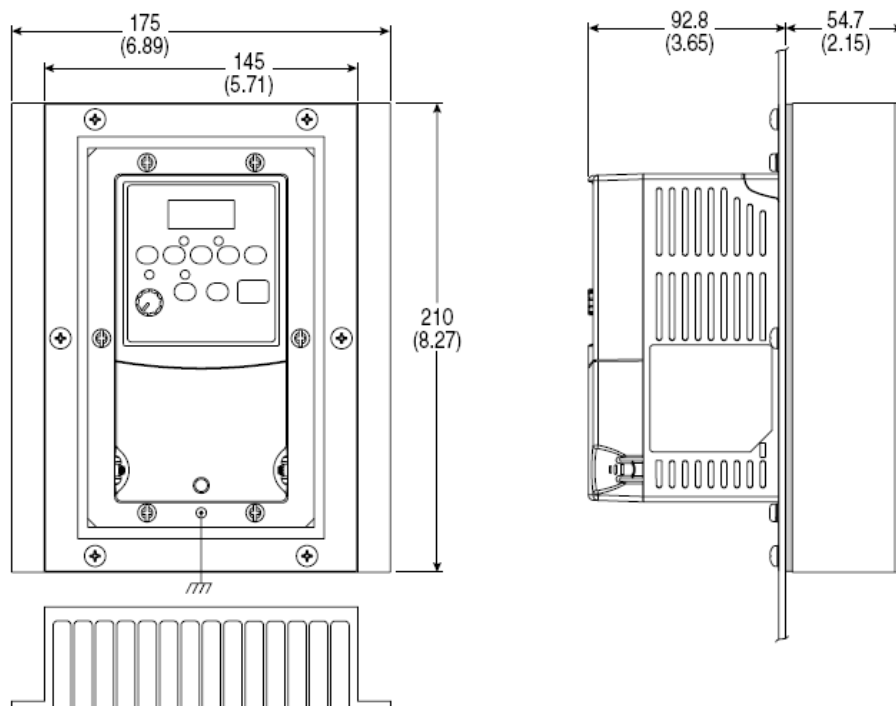
<sup>(2)</sup> Overall height of standard IP 20/Open Type drive.

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

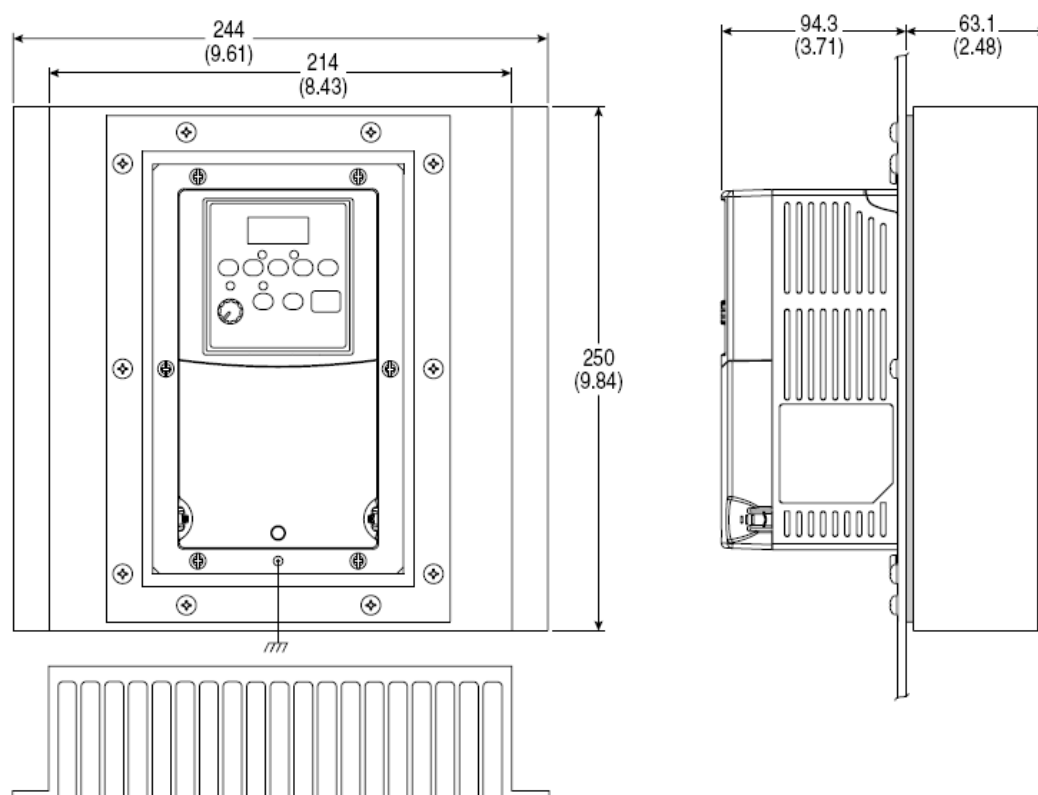


**Figure B.3 PowerFlex 4 Flange Mount Drives – Dimensions are in millimeters and (inches)**

**Frame A**



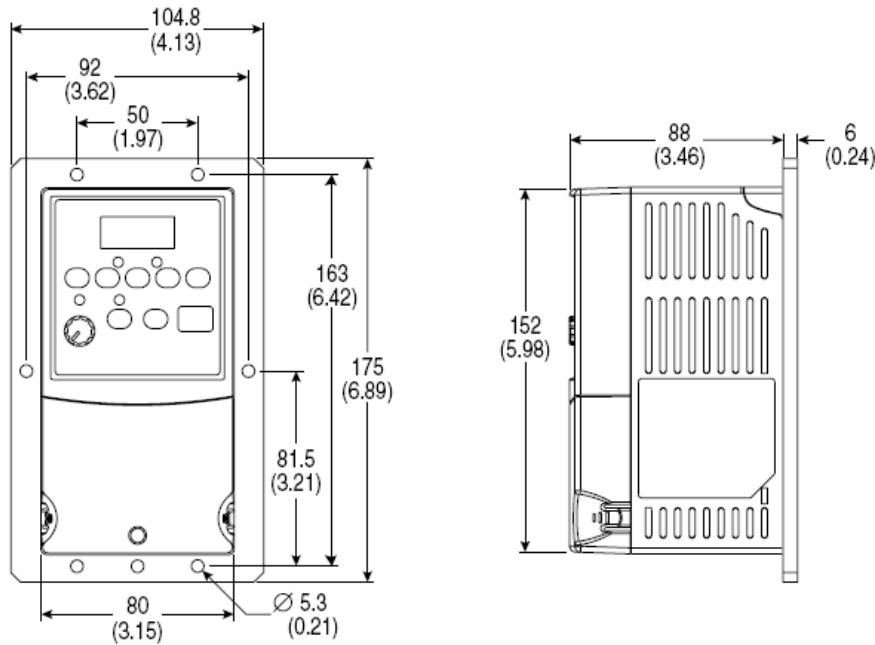
**Frame B**





**Figure B.5 PowerFlex 4 Replacement Plate Drive Dimensions – Dimensions are in millimeters and (inches)**

**Frame A**



**Frame B**

