

Allen-Bradley PowerFlex[®] Drive Packages for Fan and Pump Applications**1-15 HP @ 208 Volts****1-150 HP @ 480 Volts****3-150 HP @ 600 Volts**

Variable Frequency Drives

This specification should be used to define the requirements for Drive Packages 1 through 15 HP at 208 Volts, 1 through 150 HP at 480 Volts and 3 through 150 HP at 600 Volts.

Commonly specified options such as Main Input Disconnect and Contactor Bypass are included under General Options and Modification.

1.0 General

A single manufacturer of both motors, drives, contactors, terminal blocks, disconnects and associated relay logic shall provide, coordinate, and start-up a variable speed drive system to ensure proper application of equipment to the driven load. Rockwell Automation, shall manufacture the variable frequency drive and motor. Contactors, terminal blocks, disconnects and relays shall be manufactured by Rockwell Automation.

- A. Motor and VFD shall be of the same manufacturer for single source responsibility. Factory warranty for a period of at least 1 year from date of start up shall apply for both motor and drive.
- B. VFD shall be current rated at 4 kHz carrier frequency. All HP ratings shall meet or exceed Table 430-150 of the National Electric Code. Three Phase Motor Full Load Currents, HP, Maximum Current, and Rated Voltage shall appear on the drive nameplate.
- C. VFD shall not generate damaging voltage pulses at the motor terminals when applied within 200 feet of each other. Both Drive and Motor shall comply with NEMA MG1 section 30.40.4.2 which specifies these limits at a maximum peak voltage of 1600 Volts and a minimum rise time of .1 microseconds.

1.1 Codes/Standards

- A. VFD and options shall be UL-508c listed.
- B. All NEMA 1 enclosed VFD shall be UL-1995 approved for mounting in plenums and compartments handling conditioned air.
- C. The drive and options shall comply with the applicable requirement of the latest standards of ANSI, NEMA (NEMA ICS 3.1 – Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems), NFPA 70 – US National Electric Code NEC, IEC 146 – International Electric Code, NEPU-70, IEEE 519-1992, FCC Part 15 Subpart J, CE (EMC EN61800-3, Low voltage EN60204-1/EN50178).
- D. Drive manufacturing facility shall be ISO certified and audited yearly to ensure world class product quality processes and procedures are in place and followed.

1.2 Quality Assurance

Each drive shall be subjected to the following test and quality control procedures.

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- A. Every VFD shall be functionally tested under motor load. During this load test the VFD shall be monitored for correct phase current, phase voltages, and motor speed. Correct Current Limit operation shall be verified by simulating a motor overload. Manufacturing test data on each drive manufactured shall be recorded via bar codes and stored by the manufacturer at the time of production.
- B. Verification of proper factory presets shall performed on 100% of all parameters to ensure proper microprocessor settings. Verification that the proper factory settings are loaded correctly in the drive shall be done via the drive serial interface port. Any parameter changes that are required after the addition of options such as communication cards or bypass shall be verified in addition to the drive only defaults.
- C. The drive assembly shall have been tested for shock (15G peak for 11ms duration) and vibration (0.152 mm displacement, 1G peak).
- D. All options shall be functionally tested including operation of a motor in the bypass mode if supplied. Proper sizing and adjustment of the SMP II motor overload, if supplied, shall be verified.

1.3 Service

The VFD manufacturer shall maintain and staff worldwide service centers. The manufacturers shall have the ability to test both the drives and motors in these service centers.

- A. Start-up shall be included for each variable frequency drive provided.
- B. Service engineers shall be employed by the manufacturer or be certified by the manufacturer and provide start-up service including physical inspection of drive and connected wiring and final adjustments to meet specified performance requirements.

2.0 Drive Functions

The VFD shall have the following basic features:

- A. An electronic overload circuit designed to protect an AC motor operated by the VFD output from extended overload operation on an inverse time basis. This Electronic overload shall be UL and NEC recognized as adequate motor protection. No additional hardware such as motor overload relays or motor thermostats shall be required.
- B. A detachable alphanumeric LCD (liquid crystal display) keypad mounted on the door of the cabinet that digitally indicates:
 - 1. Frequency output
 - 2. Voltage output
 - 3. Current output
 - 4. Motor RPM
 - 5. Motor kW
 - 6. Elapsed Time
 - 7. Time Stamped Fault Indication
 - 8. DC Bus Volts
 - 9. Faults
 - 10. PI running, PI setpoint
 - 11. Parameter settings

The alphanumeric LCD keypad shall be detachable from the drive unit, and capable of being remotely mounted. The same LCD keypad shall be capable of being used on all sizes of the drive, and shall have the same programming procedure to program the parameters of the drive. The keypad shall have memory to store parameter settings from the drive, and the stored parameters shall be downloadable to the variable frequency drive's internal memory.

- C. The VFD shall have the capability of riding through power dips up to 10 seconds without a controller trip depending on load and operating condition. In this extended ride through, the drive shall use the energy generated by the rotating fan as a power source for all electronic circuits.
- D. Drive serial interface port and Windows™ based software for configuration, control, and monitoring of a single drive, or multiple drives connected over a network.
- E. Two isolated analog inputs 0-20mA, 4-20mA or 0-4, 0-8, 0-10 volt. Both shall be capable of providing speed feedback for internal PI setpoint control loop. Either may be mapped to option communication card for unitary control of temperature, pressure, or other analog control functions.
- F. An isolated 0-10V output signal proportional to speed or load.
- G. Six configurable digital inputs, factory pre-set for common HVAC control interface to minimize customization at start up.
- H. Two programmable Form C relay outputs. (E.g., Programmed for drive run, at speed, fault indication)

2.1 Protective Circuits and Features

- A. The VFD shall include the following protective circuits and features:
 - 1. Overload rating of 110% for 60 secs. and 150% for 3 secs.
 - 2. Output phase-to-phase short circuit condition.
 - 3. Total ground fault under any operating condition.
 - 4. High input line voltage.
 - 5. Low input line voltage.
 - 6. Loss of input or output phase.
 - 7. Two External fault connections:
 - a. Drive Enable which will not record a fault and permit running after external condition is met. Will not be active if Purge signal is received by drive.
 - b. Function Loss which will cause a drive fault and require control system to reset prior to returning to ready condition. Will always be active even during Purge. (This protective circuit shall permit wiring of remote N.C. safety contact to shut down the drive). User supplied end switches, thermal switches, fire-stats, freeze-stats inputs will be connected to this VFD supplied circuit.
 - 8. For 7.5 HP and higher the variable frequency drive shall have a DC link inductor inside the drive as standard – to reduce disturbances in the distribution due to harmonic distortion.
 - 9. Metal oxide varistors for surge suppression shall be provided at the VFD input terminals.
 - 10. The drive shall have an intelligent thermal management system wherein the drive shall have sensors on the heatsink to monitor temperature and reduce carrier frequency when the temperature exceeds a limit. This feature must be optional and the drive shall enable turning the thermal management system OFF.

2.2 General Options and Modifications

The following options shall be included as specified in the document:

- A. All options shall be factory mounted and wired and comply with same codes and standards as drive specified above.
- B. Input line fuses shall provide protection for the input rectification circuit using Class J fuses with interrupting rating of 200,000 AIC. The series interrupting rating of the VFD and fuses shall be a minimum of 100,000 AIC and shall be stated in the VFD Instruction Manual as required by UL.
- C. Door-Interlocked Main Input Disconnect shall mount within the standard NEMA 1 enclosure for positive power disconnect of the VFD. It shall have the capability for door padlocking.
- D. A complete three contactor bypass shall be provided to allow motor to be safely transferred from VFD output to the AC line, or from the AC line to the VFD, while the motor is at zero speed. The contactor bypass shall be electrically interlocked. The contactors shall have the following functionality:
 - 1. Drive-input contactor shall open and close input to the drive.
 - 2. Drive-output contactor shall open and close the connection between the drive and the motor.
 - 3. Bypass contactor shall open and close the connection to line start the motor.

Substituting a drive input fuse in lieu of the drive isolation contactor shall not be permitted.

The operation shall be done via a three-way Drive/Drive Test/Bypass switch on the bypass operator interface:

- 1. In Drive mode, the drive-input contactor and the drive-output contactor shall be closed to allow operation of the motor by the drive.
- 2. In Drive Test mode, the drive-input contactor shall be closed to keep the power on to the drive, and the drive-output contactor open. This shall enable the user to test the drive before running the motor. A jumper shall be added to test the drive while bypass is running the motor and must be field installed to alert operators of this condition.
- 3. In bypass mode, the drive-input and the drive-output contactor will be open to isolate the drive. The bypass contactor will be open to allow the motor to run directly from the AC line. Bypass motor overload protection shall be provided by bimetallic Class 20 Smart Motor Protection adjustable overload relay.

A three position Hand/Off/Auto switch on the bypass operator interface shall allow the user to:

- 1. Transfer the control source (Start/Stop) to the drive keypad in Hand mode.
- 2. Stop the motor in Off mode.
- 3. Transfer the control source (Start/Stop) to the drive's terminal block in Auto mode.

The operator interface on the bypass option box shall the following indicating LEDs:

- 1. Ready (green)
- 2. Interlock open (yellow)
- 3. Bypass run (green)
- 4. Bypass trip (red)
- 5. Purge (yellow)
- 6. Drive output enable (green)

- E. Building Automation System Communications:

1. A single RS-485 communication option card shall allow network protocol selection using dip-switches to allow direct connection from the drive to:

- Johnson Metasys N2
- Siemens Building Technologies FLN P1
- ModBus RTU compatible networks

This card shall have all 3 protocols resident in memory and not require any field programming to download software prior to operation.

2. LonWorks complying fully with designated drive variable sets.

All configuration and control functions may be accessed through these cards. These option cards shall permit direct communication between the drive microprocessor and the host control system. Fault diagnostics, start/stop, speed commands, and all drive feedback variables shall be available over a single communication connection. Discrete signals such as Bypass Run or Interlock Open shall also be mapped through the drive terminal strip to the system for unitary control. The cards shall have the ability to be used in a "monitor only" mode where control shall be from an AHU or similar type controller directly wired to the drive.

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NOTE: THIS MATERIAL IS NOT INTENDED TO PROVIDE OPERATIONAL INSTRUCTIONS. APPROPRIATE ROCKWELL AUTOMATION INSTRUCTION MANUAL PRECAUTIONS SHOULD BE STUDIED PRIOR TO INSTALLATION, OPERATION, OR MAINTENANCE OF EQUIPMENT.

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