

# SmartFan® AC-VX

Speed Control for AC Fans and Motors



AC-VX  
P/N 180V800



AC-VX  
P/N 180V800E

**SmartFan AC-VX** is a digital fan and motor control designed for HVAC applications. Automatic detection and adjustment for power factor permits efficient control of a wide range of single phase PSC and shaded pole fans with current ratings up to 8.0 Amps. It accepts 115 or 230 VAC (50/60 Hz) supply voltages. AC-VX proportionally controls fan speed over a range of about 4 to 1, as well as turns the fan off and on based on a control signal input. The control signal can be from a 20 mA current loop, 0 to 5 VDC, 0 to 10 VDC or P10-F remote temperature sensor input. Because the control signal is electrically isolated from the fan, it can be derived from nearly any source. No low voltage power source is required. Available with or without a NEMA 4X-rated polycarbonate enclosure.

## FEATURES

- Automatically detects and adjusts for power factor
- Compensates for variations in line voltage
- Does not require a separate low voltage power source
- Compatible with single phase PSC or shaded pole motors that are phase (TRIAC) controllable
- All connections through terminal blocks
- Control signal can be used to switch the fans on and off
- Fan speed is proportional to control signal
- Jumpers allow user selectable settings of:
  - Full speed temperature
  - Idle or off
  - Temperature differential
  - Idle speed
- Includes RFI noise filter
- UL: Recognized to UL508 (File E100344)



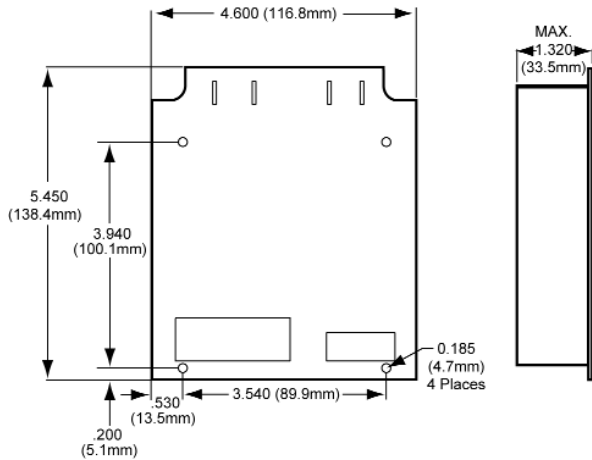
## SPECIFICATIONS<sup>1</sup>

Part Number	Power Source (50/60 Hz)	Maximum KVA	Maximum Current 104°F (40°C) Still Air	Control Signals	Enclosure
180V800	115 VAC ±15% 230 VAC ±15%	0.9 @ 115 V 1.8 @ 230 V	8.0 Amps	0-5 V, 0-10 V 0-20 mA, P10-F Sensor <sup>2</sup>	None
180V800E	115 VAC ±15% 230 VAC ±15%	0.9 @ 115 V 1.8 @ 230 V	8.0 Amps	0-5 V, 0-10 V 0-20 mA, P10-F Sensor <sup>2</sup>	AC-VX mounted in a NEMA 4X polycarbonate enclosure with liquid tight strain reliefs

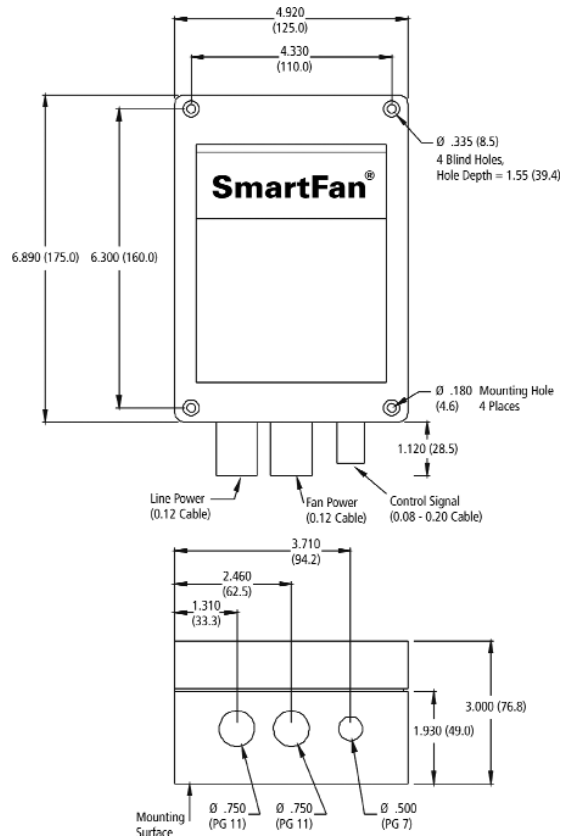
<sup>1</sup>Contact CRI customer service for RoHS compliance.

<sup>2</sup>See sensors page.

# SmartFan® AC-VX



AC-VX  
P/N 180V800



AC-VX  
P/N 180V800E

## SPECIFICATIONS

- Power Source: 115-230 VAC (+/- 15%)
- Frequency 50/60 Hz (+/- 5%)
- Output power rating at 40°C: 8 Amps
- Minimum fan/motor load: 0.50 Amps
- Input fuse: 15 Amp, Ceramic
- Storage temperature: -40°C to 65°C
- Operating temperature: -0°C to 55°C
- Relative humidity: 5 to 95% non-condensing
- Weight P/N 180V800: 10.7 oz. (303 grams)
- Weight P/N 180V800E: 1.4 lb. (635 grams)

## CONFIRM FAN/MOTOR COMPATIBILITY

**Confirm TRIAC (voltage control) compatibility with the fan/motor manufacturer before installation. Attempting to control a motor that is not compatible could cause excessive heating and permanent damage.**

## CONTROL MODES

The AC-VX has two modes of operation:

### Fan Speed Proportional to Analog Control Signal:

When used in this mode of operation, the AC-VX controls fan speed in proportion to a 0-20 mADC, 0-5 VDC, or 0-10 VDC analog control signal. Idle speed ON/OFF and the idle speed voltage can be adjusted in this mode (see jumper settings).

### Fan Speed Proportional to Temperature Sensor

**Input:** When used in this mode of operation, the AC-VX controls fan speed in proportion to temperature as sensed by a thermistor (CRI P/N P10-F). The following parameters can be adjusted using the four jumpers located on the AC-VX: Idle speed, Idle speed ON/OFF, full speed temperature, and differential temperature (see jumper settings).

## JUMPER SETTINGS

**Diff °F (J1):** Use this jumper to set the temperature difference between full speed and idle speed. The setting is only applicable to applications using the temperature sensor input (SENSE). The three temperature differential settings are 5, 10, and 15 °F. The factory setting is 10°F.

**Idle Speed (J2):** Use this jumper to set the idle voltage point, when the idle speed (J3) is set to ON. With the idle speed set to OFF, this jumper sets the point at which the voltage applied to the fan shuts off. The three positions in order of increasing idle voltage are LOW, MID, and HIGH. The factory setting is MID.

**ON/OFF (J3):** Use this jumper to determine if the fan voltage should shut off below the idle speed set by header J2. The factory setting is ON.

**Full Speed °F (J4):** Use this jumper to set the temperature above which the maximum voltage is applied to the fan. The setting is only applicable to applications using the temperature sensor input (SENSE). The four temperature settings are 75, 80, 85, and 90°F. The factory setting is 80°F.

## PERFORMANCE FEATURES

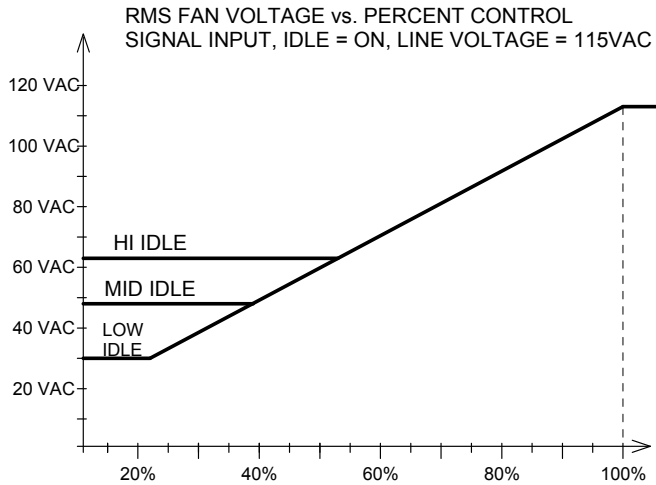
**Powering the Fans ON/OFF:** When the fan idle is set to OFF using jumper J3, the fan voltage drops to zero when the control signal commands the output to go below the idle speed set-point. The fan voltage will come on slightly above (5%) the idle speed OFF point. This is a built-in hysteresis feature. Example: If header J3 is set to OFF and header J2 is set to MID, the fan voltage will drop to zero below a 35% control signal and come back on when a control signal above 42% is applied.

**Power Factor Adjustment:** The power factor of the connected fan load is sensed at power up. This information is used by the microcontroller to adjust for optimum fan speed range. As a result, two fan types will have different voltage vs. control input profiles if their power factors are significantly different. For instance, the voltage range available for a high power factor fan will be larger than a low power factor fan.

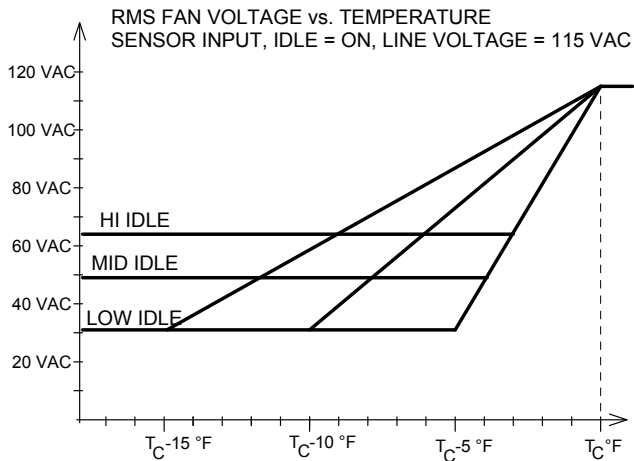
**Low Line Voltage Shut-Off:** If the line voltage drops below a predetermined level, the output power is halted until the condition is corrected. The feature functions as follows: (1) The line voltage is sensed at power up. (2) This line voltage value is used to select either a 95 VAC or a 190 VAC low voltage shut-off. For instance, if a nominal 115 VAC line voltage is sensed at power up, the 95 VAC cut-off is selected. In this instance, the output power will be halted for line voltages below 95 VAC.

**Fixed Start-Up Delay:** There is a fixed period of approximately 3 to 5 seconds before the control voltage is applied to the fan load. This brief delay occurs whenever the line power applied to the AC-VX is switched from OFF to ON. During this time fan voltage is at 0 VAC. This brief delay, which is not adjustable by the user, is required by the microprocessor to initialize system parameters.

**Performance Graphs:** The following graphs summarize the AC-VX performance with a typical Permanently Split Capacitor (PSC) type fan at 115 VAC line voltage.



**Figure 1.0:** Fan RMS voltage vs. Percentage of control signal for all idle voltage settings (J2) with Idle (J3) = ON.



**Figure 2.0:** Fan RMS voltage vs. Temperature Input for all differential temperature settings (J1) and all idle speed settings (J2) with Idle (J3) = ON. Note: The variable T<sub>c</sub> in the above graph is the full speed temperature as set by header J4. Three full speed temperature settings are available.

## MOUNTING

To satisfy safety agency requirements (UL, CSA, IEC, VDE, CE), either of the following two installation instructions must be followed:

### Mounting P/N 180V800 (AC-VX board only)

Mount the unit in a non-conductive enclosure that will inherently protect the user against accidental contact with dangerous voltages.

OR

Mount the unit in a conductive enclosure with spacing of 1/4" (6.3 mm) between the circuit board and chassis ground and 5/16" (8 mm) to any un-insulated secondary circuits. The non-conductive enclosure must inherently protect the user against accidental contact with dangerous voltages.

### Mounting P/N 180V800E (AC-VX in enclosure)

P/N 180V800E includes the AC-VX board mounted in a NEMA 4X rated polycarbonate enclosure. Electrical connections are made through three bottom entry holes fitted with liquid tight strain reliefs. There is a separate connection for line power, fan power, and control signal. Mount the enclosure with the strain reliefs tightened and pointing down.

## CONNECTIONS

**WARNING: Dangerous voltages are present on the circuit board when connected to the power line. Power must be removed before making any connections or adjustments to avoid electrical shock or damage to the unit.**

### Power & Ground Connections

It is recommended that an adequately sized circuit breaker be connected between the power service and the AC-VX to permit fail-safe removal of power before making adjustments or connections. A 15 Amp. Ceramic fuse is supplied.

Line power and ground connections are made through the LINE terminals on terminal block TB1 marked B (line power, black wire), W (line power, white wire) and G (ground, green wire). Number 14 AWG insulated wire must be used for input power. Connect line power to terminals B and W and earth ground to terminal G. Connections are made by (1) stripping back 1/4" (6 mm) of wire insulation from the end of each power wire and ground, (2) inserting the exposed wire from each line under the screw clamp plate at each connection, and (3) securely tightening down each screw. Recommended torque is 7 in-lb.

The AC-VX is not compatible with Uninterruptible Power Supplies (UPS) that generate a square wave.

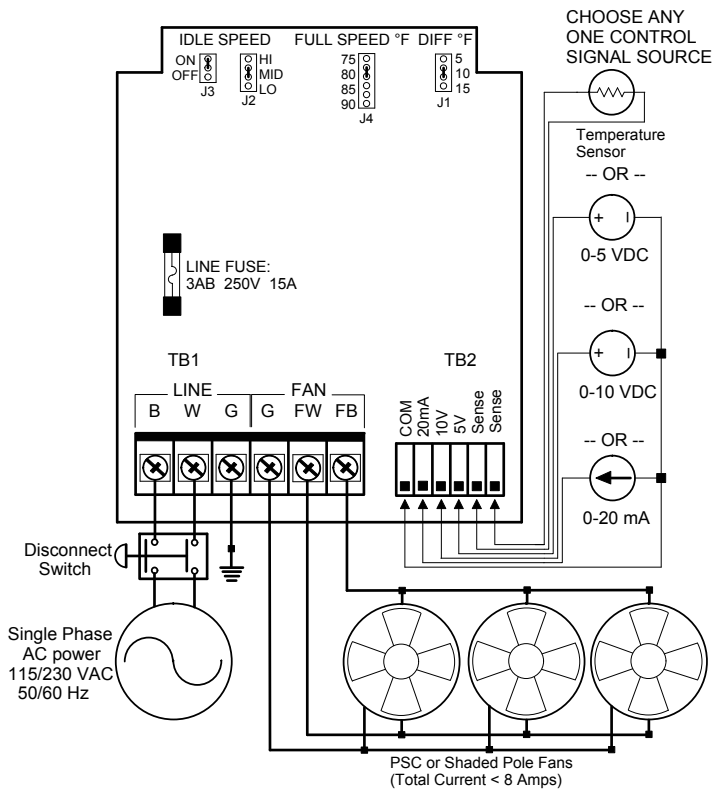


Figure 3.0: Wiring diagram.

Table 1.0: Power and Signal Connections		
Connection	Function	Type
TB1:B Lin	e Power	14 AWG Wire Ready, #6 Raised Screw Terminal Blocks
TB1:W Lin	e Neutral	
TB1:G Circuit	Ground	
TB1:G Circuit	Ground	
TB1:FW F	an Neutral	
TB1:FB F	an Power	16-22 AWG Screw Clamp
TB2:COM Contro	l Signal Common	
TB2:20mA	20 mA Control Signal Input	
TB2:10V	10 VDC Control Signal Input	
TB2:5V	5 VDC Control Signal Input	
TB2:Sense	Temperature Sensor Input	
TB2:Sense	Temperature Sensor Input	

Table 2.0: Jumper Settings	
Header	Function
J1	Differential Temperature Setting
J2	Idle Speed Setting
J3	Idle Speed ON/OFF
J4	Full Speed Temperature Setting

**Fan Connections**

Fan power connections are made through the FAN terminals on terminal block TB1 marked FB (fan power, black wire), FW (fan power, white wire), and G (fan ground, green wire). Multiple fans can be connected in parallel so long as the total current drawn by all fans does not exceed 8.0 Amps. Some fan may draw more current at reduced speed than at full speed. The 8.0 Amp current rating of the Ac-VX should not be exceeded at any speed. An insulated wire size recommended by the fan manufacturer to carry the full load amperage should be used. Maximum wire size is number 14 AWG insulated wire. Connect fan power wires to terminals FB and FW and the fan ground wire to terminal G. Connections are made by (1) stripping back ¼” (6 mm) of wire insulation from the end of each fan wire and ground, (2) inserting the exposed wire from each line under the screw clamp plate at each connection, and (3) securely tightening down each screw. Recommended torque is 7 in-lb. Note that the fan ground (G) and earth ground (G) terminals on TB1 are internally connected.

**Control Signal/Thermistor Connections**

The AC-VX is controlled by either an external temperature sensor (CRI P/N P10-F) or voltage/current signal. All control signals at terminal block TB2 are isolated from line power.

**Voltage/Current Signal Control:** Connect one of three possible control signal sources, as shown in Figure 3, to its respective connection on terminal block TB2. Number 14-24 AWG insulated wire should be used to connect a voltage/current control source to TB2. Connections are made by (1) stripping back ¼” (6 mm) of wire insulation from the end of each control signal wire, (2) inserting the exposed wire from each line into the screw clamp at each connection, and (3) securely tightening down each screw. Recommended torque is 4.4 in-lb.

**Temperature Sensor Control:** The temperature sensor input is located at the two terminals on TB2 labeled SENSE. There is no polarity consideration when connecting the sensor. The input is compatible with CRI sensor P/N P10-F. Connections are made by (1) stripping back ¼” (6 mm) of wire insulation from the end of each sensor lead, (2) inserting the exposed wire from each lead into each SENSE screw clamp terminal, and (3) securely tightening down each screw. Recommended torque is 4.4 in-lb.

## TESTING & TECHNICAL DATA

**Fan/Motor Compatibility:** The AC-VX is compatible with many PSC (Permanent Split Capacitor) and shaded pole motors. The AC-VX is not compatible with capacitor start motors. **Confirm TRIAC controllability with the motor manufacturer before installation. Attempting to control a motor that is not compatible could cause excessive heating and could permanently damage the motor.**

**Voltage Loss:** For a typical fan, expect a voltage drop to the fan of about 4-10% at full voltage.

**Changing Control Settings:** The AC-VX will not recognize any changes in jumper settings made with power applied. Power must be turned OFF before changing any jumper settings.

**Minimum Motor currents:** Motors may not control properly if the total current draw is less than 0.5 Amp.

**Maximum Motor currents:** Some motors draw higher current at less than maximum voltage. Contact motor manufacturer for details.

## TROUBLESHOOTING GUIDE

**Output Always Measuring Full Voltage:** (1) No motor connected. AC-VX requires a minimum 0.50 Amp load. (2) Wiring error bypassing AC-VX with "pigtailed" neutral wires. (3) Wrong or faulty sensor. (4) Incorrect jumper settings. (5) AC-VX damaged or defective.

**Output always measuring zero volts:** (1) No power to the AC-VX. (2) Wiring error or broken power wire(s). (3) Sensor/control signal is low or not connected. (4) Incorrect jumper settings. (5) AC-VX damaged or defective.

**Output measuring wrong voltage:** (1) wrong or faulty sensor. (2) Incorrect jumper settings. (3) AC-VX damaged or defective.

## SPECIFICATIONS

- Power Source: 115-230 VAC (+/- 15%)
- Frequency 50/60 Hz (+/- 5%)
- Output power rating at 40°C: 8 Amps
- Minimum fan/motor load: 0.50 Amps
- Input fuse: 15 Amp, Ceramic
- Storage temperature: -40°C to 65°C
- Operating temperature: -0°C to 55°C
- Relative humidity: 5 to 95% non-condensing
- Weight P/N 180V800: 10.7 oz. (303 grams)
- Weight P/N 180V800E: 1.4 lb. (635 grams)