

Fan Relay Board (FRBii) Assembly

Installation, Operation, and Maintenance Instructions

PK-FCU030-0, PK-FCU050-0

Part No. 24-10143-1221, Rev. A
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Application

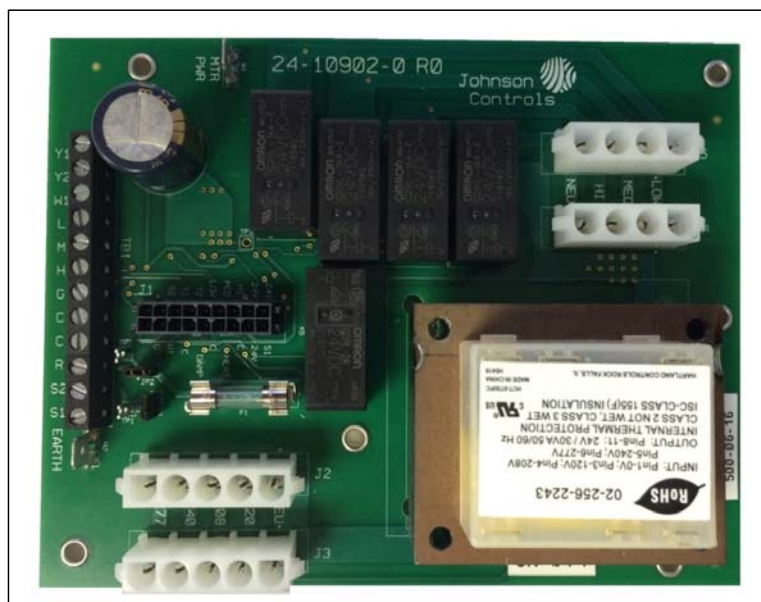
The Fan Relay Board assembly (FRBii) provides electronic control for the fan motor and various connections for peripheral devices. It is an incorporated control assembly that is used with HVAC equipment. The FRBii accepts incoming single phase power of nominal AC voltages 120, 208, 240 and 277. The assembly includes a multi-tap transformer (30 VA or 50 VA) that steps each of these primary side voltages to a nominal secondary side voltage of 24 VAC. The FRBii includes a regulated power supply to provide 24 VDC for fan-speed relays that allow for quieter operation than AC relay coils. The assembly allows for the control of a three-speed fan motor, including a relay for control of the neutral voltage signal path.

The FRBii can be connected to an external device to control the three fan speeds. The FRBii includes logic to detect when multiple speeds are commanded simultaneously and block all but the highest of the commanded speeds from being sent to the motor windings. A signal to call for electric heat from an external controller verifies that a fan speed is selected before providing the command signal to the external electric heat control ensuring that electric heat can only be energized when the fan motor is operational. The assembly includes connectorized I/O to allow for faster installation and improved troubleshooting by the end user.

The FRBii allows connection of peripheral devices (for example, thermostat controllers, electric heat relays, water valve actuators, condensate drain pan float switches, and air dampers) by either the OEM or the installer. The fan relay board also includes a fuse on the secondary side of the transformer to protect against incorrect wiring of external components that would short the transformer leads.

The signals in the screw terminal block (TB1) and 18-pin black connector (J1) have a nominal voltage of 24 VAC. These signals are properly insulated from line voltage present on the assembly (J2-J5). The control assembly is a Type 1 automatic action, as defined by UL60730-1.

Figure 1: Fan Relay Board (FRBii)



Materials and Special Tools Needed

The following tools are required for installation and troubleshooting:

- six No. 8-3/4 in. screws
- digital multimeter capable of measuring 30 Volts AC/DC
- insulated 1/8 in. flat-bladed screwdriver
- fuse puller
- mini-hook test clips for multimeter (optional)

Mounting

IMPORTANT: Do not overtighten the screws. Overtightening may strip the threads and will void the warranty.

Use No. 8-3/4 in. screws (quantity of six) and install the assembly in an approved electrical enclosure with the provided standoffs in the assembly.

Wiring

⚠ WARNING

Risk of Electric Shock.

Disconnect or isolate all power supplies before making electrical connections. More than one disconnection or isolation may be required to completely de-energize equipment. Contact with components carrying hazardous voltage can cause electric shock and may result in severe personal injury or death.

⚠ ADVERTISSEMENT

Risque de décharge électrique.

Débrancher ou isoler toute alimentation avant de réaliser un branchement électrique. Plusieurs isolations et débranchements sont peut-être nécessaires pour -couper entièrement l'alimentation de l'équipement. Tout contact avec des composants conducteurs de tensions dangereuses risque d'entraîner une décharge électrique et de provoquer des blessures graves, voire mortelles.

⚠ WARNING

Risk of Electric Shock.

Disconnect power from the controller before making any adjustments. Do not touch any part of the printed circuit board while power is applied. Failure to follow these precautions can result in personal injury or death.

⚠ ADVERTISSEMENT

Risque de décharge électrique.

Déconnecter l'alimentation du contrôleur avant toute opération de réglage. Veiller à ne toucher aucune partie du circuit imprimé lorsque celui-ci est sous tension. Le non-respect de ces précautions peut provoquer des blessures graves, voire mortelles.

 **WARNING**

Risk of Electric Shock.

Ground the FRBii according to local, national, and regional regulations. Failure to ground the FRBii may result in electric shock and severe personal injury or death.

 **ADVERTISSEMENT**

Risque de décharge électrique.

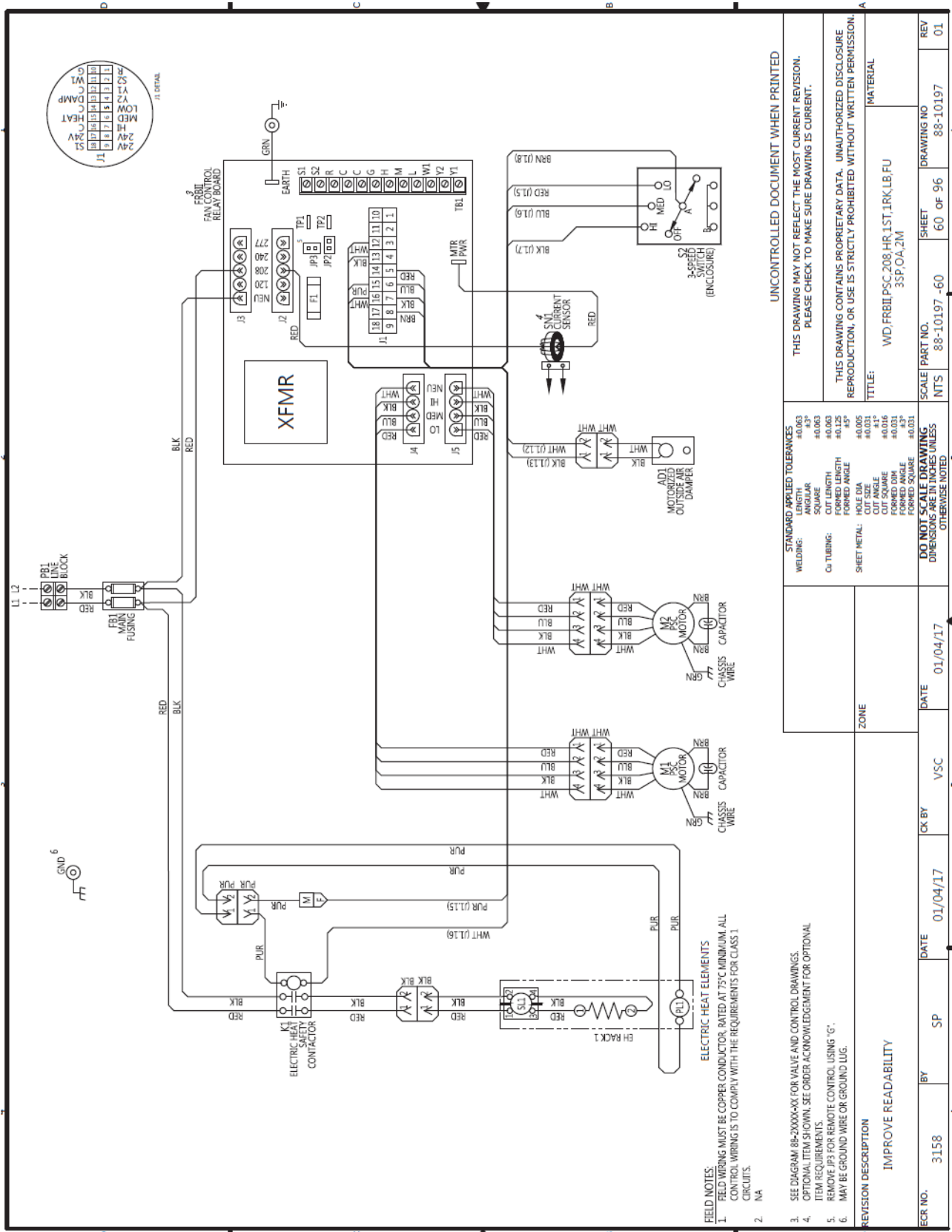
Raccorder l'FRBii à la terre conformément aux réglementations locales et nationales en vigueur. Le non-respect de l'obligation de mise à la terre de l'FRBii risque d'entraîner une décharge électrique et de provoquer des blessures graves, voire mortelles.

IMPORTANT: Use copper conductors only for line voltage terminations. Make all wiring connections in accordance with local, national, and regional regulations. Do not exceed the FRBii electrical ratings..

To wire the FRBii assembly:

1. Install the wiring in a manner that ensures it does not cause a hazard. Verify that the wiring is protected against electrical and mechanical damage.
2. Ground the assembly from the EARTH terminal (W2) to the enclosure (Figure 2).

Figure 2: Wiring Diagram Example



Ratings

Table 1: FRBii Ratings

Model Numbers	PK-FCU030-0 (25-3034-7), PK-FCU050-0 (25-3043-15)
Voltage	120 to 277 VAC
Current (Fan Relays)	12 A
Transformer Capacity	30 VA, 50 VA
Operating Temperature	-20° to 60°C (-4° to 140°F)
Pollution Degree	2
Rated Impulse Voltage	4,000 V (basic insulation), 6,000 V (reinforced insulation)

Inputs and Outputs

Table 2: Low Voltage Peripheral Devices Screw Terminal (TB1) Signal Identification

Pin Number	Signal
1	Y1 - Cool 1
2	Y2 - Cool 2
3	W1 - Heat 1
4	L - Low
5	M - Medium
6	H - High
7	G - Fan Enable
8	C - Common (through JP2)
9	C - Common (through JP2)
10	R - 24 VAC
11	S2 - Auxiliary Input (Heat 2)
12	S1 - Common

Table 3: Low Voltage Peripheral Devices (J1) Signal Identification (Part 1 of 2)

Pin Number	Signal
1	R - 24 VAC
2	S2 - Aux In (Heat 2)
3	Y1 - Cool 1
4	Y2 - Cool 2
5	LOW
6	MED
7	HIGH
8	24 V
9	24 V
10	G - Fan Enable
11	W1 - Heat 1
12	COM
13	DAMP - Damper
14	COM
15	HEAT - Heat Output

Table 3: Low Voltage Peripheral Devices (J1) Signal Identification (Part 2 of 2)

Pin Number	Signal
16	COM
17	24 V
18	S1 - Common

Table 4: Incoming Power (J2 and J3) Signal Identification

Pin Number	Signal
1	NEUT
2	120
3	208
4	240
5	277

Table 5: Motor Output (J4 and J5) Signal Identification

Pin Number	Signal
1	LOW
2	MED
3	HIGH
4	NEUT

W1 — MTR PWR

The MTR PWR quick connect provides voltage to the line side of the fan speed relays through an external jumper. For PSC motor, this is the line voltage of the unit. For EC motors, this is either the 24 VAC (without PWM) or a switch contact common (with PWM).

W2 — EARTH

EARTH connection grounds the secondary side of the transformer to the enclosure cabinet through a wire bonded to the control enclosure.

To install connectors J1 through J5, insert the mating connector until the locking tabs latch. The connectors are keyed and can only be installed in one orientation. To remove connectors J1 through J5, press the locking tabs to release the latch and remove the connector.

To install W1 or W2, insert a female quick connect over the spade connector on the board. To remove, pull gently on the female quick connector (not the wire).

Fuse

A fuse is included on the secondary side of the transformer to protect the transformer from incorrect wiring of the devices (for example, thermostat and controller) that shorts the 24 VAC and COM. The fuse is a fast-acting glass body cylindrical fuse (5 x 20 mm). If tripped, replace the fuse by removing the tripped fuse with fuse pullers and replace using one of the fuses in Table 6.

Table 6: Fuse Replacement Information

Transformer	Fuse	Manufacturer	Part Number
30 VA	2A	Littelfuse®	0235003.MXP
		Bussmann™	BK/GMA-2-R
50 VA	3A	Littelfuse®	0235003.MXP
		Bussmann™	BK/GMA-3-R

Heat Output

The HEAT Output connects to an electrical heat contractor or relay. This output represents the command signal from the thermostat or controller on the W1 input. However, the output is interlocked with the fan relays to ensure that a fan speed is commanded when electric heat is requested.

DAMP Output

The DAMP output connects to a motorized damper actuator used to control airflow from an external source. The external source can be fresh air from outside the building or air from somewhere else inside the building. This output provides 24 VAC to energize the damper actuator. Like the electric heat output, this output is interlocked with the fan relays to ensure that a fan speed is commanded before energizing the damper actuator.

Where to Install Float Switch

To install a float switch, wire the float switch leads into S1 and C on the screw terminals. After wiring the float switch, remove jumper JP2. Remove the JP2 jumper for the float switch to correctly operate. If JP2 remains installed, the float switch is shorted and the unit does not respond appropriately when the float switch opens.

Note: If a float switch was installed in the factory, the float switch may be connected to the J1 connector instead of wired to the screw terminal.

How to Start/Stop the Fan

To start or stop the fan from an external controller, wire the leads for the switch contacts (either made or broken) to R and G on the screw terminals. After wiring the switch, remove jumper JP3. Remove the JP3 jumper for the external start/stop control to correctly operate.

How to Add a Remote Three-Speed Switch

To add a remote three-speed switch, wire the leads for the switch to G, H, M and L on the screw terminals. After wiring the switch, remove jumper JP1. Remove the JP1 jumper for the remote 3-speed switch to correctly operate.

Jumpers

JP1: Speed Select Jumper – This jumper is installed between 24 V and HIGH when a three-speed switch is not included (remote or unit mounted). The jumper is installed at the end of the harness connected to J1. If a three-speed switch is added later, JP1 must be removed.

JP2: Float Switch Jumper – This jumper is installed between S1 and C when a float switch is not installed. The jumper is removed when a float switch is installed.

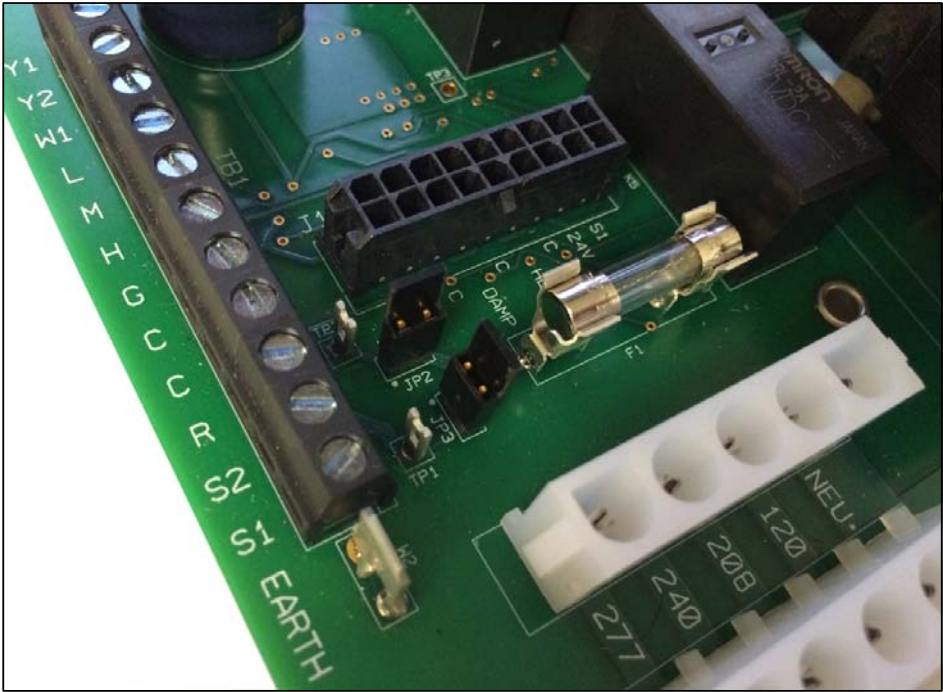
JP3: Fan Enable Jumper – This jumper is installed between R and G/24V. The jumper is removed for remote control of the fan motor. In most instances, JP3 is installed (unless a thermostat or controller is remotely controlling the equipment).

Figure 3 shows the JP2 and JP3 locations.

Test Points

TP1: 24VAC and TP2: COM – If incoming voltage is within tolerance, then use these test points to verify the transformer is correctly producing 24 V. Connect to the test points with mini-hook test clips for a digital multimeter. Test point locations for TP1 and TP2 can be seen in Figure 3.

Figure 3: FRBii Jumpers and Test Positions



Screw Terminal Signals

Table 7: Screw Terminal Signal Identification

PIN	Signal	Internal Connections	Description
1	Y1 — Cool 1	J1-3	Chilled water valve actuator control input, and thermostat cooling output.
2	Y2 — Cool 2	J1-4	“Close” input of modulating chilled water valve actuator or 2nd stage chilled water valve actuator control input, and thermostat cooling output. Y1 is “Open” output if floating {tristate} chilled water valve actuator is installed.
3	WI — Heat 1	J1-11 J1-15 (through fan interlock relay for factory termination to EH relay)	Wire connection point for hot water valve actuator or 1st-stage EH control input, and thermostat heating output.
4	L — Low	J1-5	Low-speed control input for onboard relay.
5	M — Medium	J1-6	Medium-speed control for onboard relay.
6	H — High	J1-7	High-speed control input for onboard relay.
7	G — Fan Enable	J1-8 J1-9 J1-10 J1-17 J1-1 (through JP3) TP1 (through JP3)	Used to allow external start-stop control from an external source.
8	C — Common (through JP2)	J1-12 J1-14	Device common, including onboard speed relays (all terminals C and COM on board are internally connected).
9	C — Common (through JP2)	J1-16 TP2 J1-18 (through JP2) W2 (through JP2)	
10	R — 24 VAC	J1-1 TP1 J1-8 (through JP3) J1-9 (through JP3) J1-10 (through JP3) J1-17 (through JP3)	Transformer “hot” connection (24 VAC).
11	S2 — Auxiliary Input (Heat 2)	J1-2	Used for different functions based on application, such as: <ul style="list-style-type: none"> • 2nd stage heat control for two-stage EH applications • Changeover water valve/aquastat for two pipe changeover applications. • “Close” input of modulating hot water valve actuator and “Close” output of thermostat in floating (tristate) water valve applications.
12	S1 — Common	J1-18 W2 TP2 (through JP2) J1-12 (through JP2) J1-14 (through JP2) J1-16 (through JP2)	Common side of transformer. Jumped to C (common) through JP2. If application calls for float switch, JP2 is removed and float switch is connected between S1 and C.

Fan Relay Board Troubleshooting Guidelines

WARNING

Risk of Electric Shock.

Disconnect or isolate all power supplies before making electrical connections. More than one disconnection or isolation may be required to completely de-energize equipment. Contact with components carrying hazardous voltage can cause electric shock and may result in severe personal injury or death.

AVERTISSEMENT

Risque de décharge électrique.

Débrancher ou isoler toute alimentation avant de réaliser un branchement électrique. Plusieurs isolations et débranchements sont peut-être nécessaires pour -couper entièrement l'alimentation de l'FRBii. Tout contact avec des composants conducteurs de tensions dangereuses risque d'entraîner une décharge électrique et de provoquer des blessures graves, voire mortelles.

The fan relay board requires no routine maintenance. Table 8 describes the screw terminal signals.

Table 8: Fan Relay Board Troubleshooting

Problem	Possible Cause	Corrective Action
No 24 VAC Power	Incorrect incoming line voltage	Verify incoming voltage to the unit is within 10% of nominal voltage on the label.
	Improper wiring connections	Verify that the unit is wired per the wiring diagram for incoming voltage. If the unit includes main fusing, verify that the fuses are not blown.
	Blown fuse onboard (F1)	Measure resistance across fuse: <ul style="list-style-type: none"> • A properly working fuse measures < 1.0 ohms • A blown fuse measures as an open circuit. Replace the fuse if blown. Use one of the replacement fuses identified in Table 6.
	JP2 removed without float switch installed	Verify that either a float switch or a JP2 is installed. If neither are present, install one of them.
	Float switch tripped	Verify float switch is connected.
	JP3 removed without external start/stop control installed	Verify that either an external start/stop or a JP3 jumper is installed. If neither are present, install one of them.
	Damaged transformer	If all of the above are confirmed or revised, replace the fan relay board.
Fan Motor does not run	No 24 VAC power	See above?
	Fan speed is not commanded	Verify that the fan motor is running. The fan speed may be commanded from jumper JP1, a unit- or remote-mounted three-speed switch, or a three-speed thermostat.
Electric heat will not turn on	Fan speed is not commanded	Verify that the fan motor is running. The fan speed may be commanded from jumper JP1, a unit-or remote-mounted three-speed switch, or a three-speed thermostat, but must be commanded from one of these sources to energize the electric heat contactor on a call for heat.
Outside Air Damper actuator will not energize	Fan speed is not commanded	Verify that the motor is running. The fan speed may be commanded from jumper JP1, a unit-or remote-mounted three-speed switch, or a three-speed thermostat, but must be commanded from one of these sources to energize the damper actuator.

Checking Wiring Harnesses

Use ohmmeter to verify that the ground wire has continuity from S1 to the enclosure case. To check the incoming power wire harness:

- Refer to wiring diagram.
- Remove power from the unit. Unplug power harness J2 or J3 connector.
- Unplug power wires from connections (line block, disconnect switch, toggle switch or fuse(s)) in electrical enclosure. Verify continuity of wires, then reconnect to J2 or J3 connector.

To check the motor harness:

- Refer to wiring diagram.
- Remove power from the unit. Unplug motor harness J4 and/or J5 connector.
- Unplug motor harness from motor connection or PWM board (depending on type of motor). Verify continuity of wires, then reconnect to J4 or J5 connector and to motor or PWM board.

To check the low voltage wire harnesses:

- Remove power from the unit. Unplug low voltage harness J1 connector and disconnect connections at other end of J1 harness.
- Use ohmmeter to check continuity for each conductor, then reconnect harness to J1 connector and to other connections.

Before reconnecting power to unit, verify all harnesses are connected per diagram.

Note: Use light force when inserting meter probe into plug. Excess force damages the contacts.

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