Fan Coil Unit (FCU) Fan Motor Control

Fan Relay Board 2 (FRBii) – Installation, Operation, and Maintenance

The Fan Relay Board assembly (FRBii) provides electronic control for the fan motor and various connections for peripheral devices. The FRBii accepts incoming single phase power of nominal AC voltages 120, 208, 240 and 277. The assembly includes a multi-tap transformer (30VA or 50VA) that steps each of these primary voltages to 24 VAC. 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 (e.g., thermostat, controller, 3-speed switch) 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 will verify that a fan speed is selected before providing the command signal to the external electric heat control to ensure that electric heat can only be energized when the fan motor is operational. The assembly includes factory provided harnesses to allow for faster installation and improved troubleshooting by the end user.

The FRBii allows for peripheral devices (e.g., thermostat controllers, electric heat relays, water valve actuators, condensate drain pan float switches, air dampers) to be connected by either the OEM or by 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, shorting the transformer leads.

The signals in the screw terminal block (TB1) and 18-pin black connector (J1) have a nominal voltage of 24VAC. These signals are properly insulated from line voltage present on the assembly (J2-J5).

Figure 1- Fan Relay Board (FRBii)

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Installation

Mounting

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

Using #8-3/4" screws (quantity six), install the assembly using the provided standoffs.

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.

Wiring

Install the wiring so it does not cause a hazard, and is protected against electrical and mechanical damage.

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.

Ratings

Model(s):	30VA – PC-01-0134, PK-FCU030-0 (25-3043-7) 50VA – PC-01-0135, PK-FCU050-0 (25-3043-15)
Voltage:	120 through 277VAC
Current (Fan Relays):	12A
Operating Temperature:	-4°F to 140°F (-20°C to 60°C)

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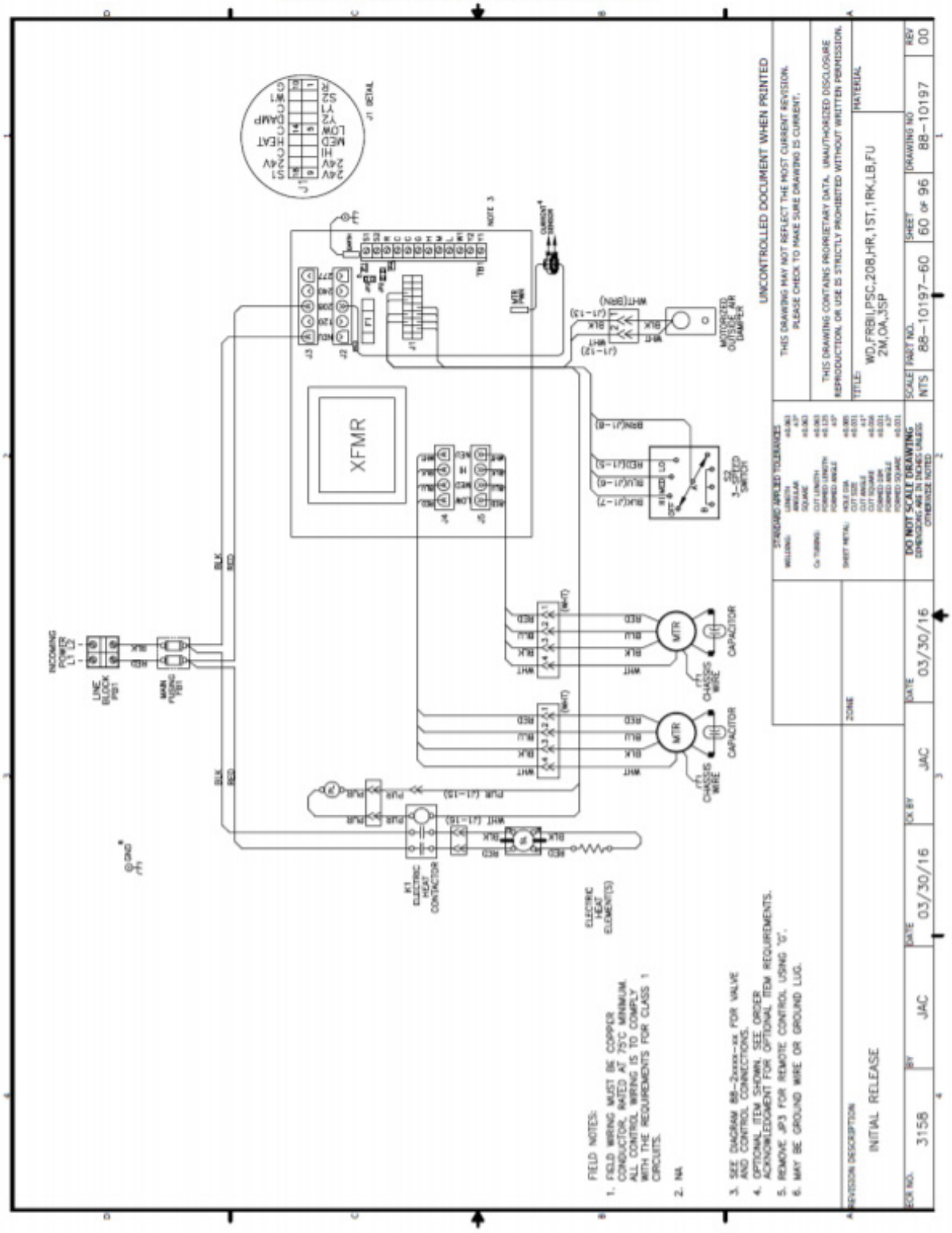
REFERENCE WIRING DIAGRAM



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FRBii Inputs and Outputs

TB1 – Low Voltage Peripheral Devices

TABLE F.1 – SCREW TERMINAL (TB1) SIGNAL IDENTIFICATION (see Table F.9 for detailed description of each signal)	
Pin	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 - 24VAC
11	S2 - Auxiliary Input (Heat 2)
12	S1 - Common

J1 – Low Voltage Peripheral Devices

TABLE F.2 – LOW VOLTAGE PERIPHERAL DEVICE (J1) SIGNAL IDENTIFICATION			
Pin	Signal	Pin	Signal
1	R - 24VAC	10	G - Fan Enable
2	S2 - Aux In (Heat 2)	11	W1 - Heat 1
3	Y1 - Cool 1	12	COM
4	Y2 - Cool 2	13	DAMP - Damper
5	LOW	14	COM
6	MED	15	HEAT - Heat output
7	HIGH	16	COM
8	24V	17	24V

J2/J3 – Incoming Power

TABLE F.3 – INCOMING POWER (J2 & J3) SIGNAL IDENTIFICATION	
Pin	Signal
1	NEUT
2	120
3	208
4	240
5	277

J4/J5 – Motor Output

TABLE F.4 – MOTOR OUTPUT (J4 & J5) SIGNAL IDENTIFICATION	
Pin	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 motors, this will be the line voltage of the unit. For EC motors, this will either be 24VAC (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.

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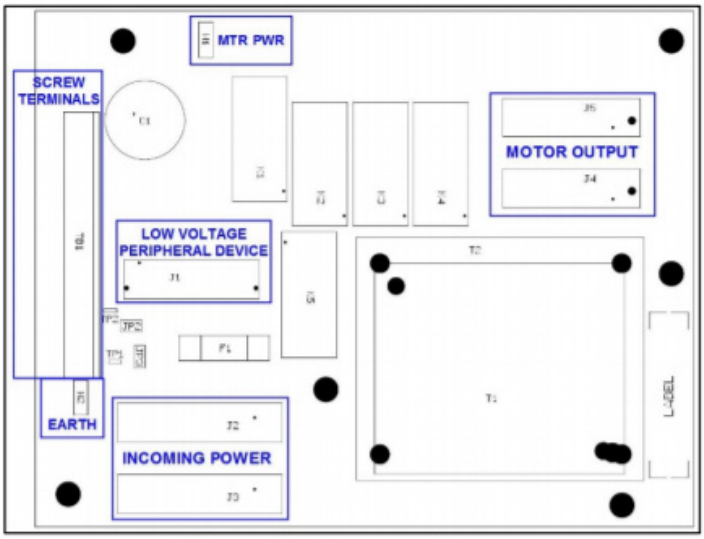

Figure 2 – Connector Layout

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Tools Needed for Installation/Troubleshooting:

- Digital multimeter capable of measuring 30 volts AC
- Insulated 1/8" flat bladed screwdriver
- Fuse puller (optional)
- Mini Hook Test Clips for multimeter (optional)

Fuse – A fuse is included on the secondary side of the transformer to protect the transformer from incorrect wiring of thermostat, controller, etc. that shorts the 24VAC and COM. The fuse is a fast-acting glass body cylindrical fuse (5x20mm). If tripped, replace the fuse by removing the tripped fuse with fuse pullers and replace using one of the below listed fuses.

Suggested fuse replacement information:

TABLE F.5 – REPLACEMENT FUSE

Transformer	Fuse	Part Number	Manufacturer	Part Number
30VA	2A	PE-06-0000	Littelfuse	0235002.MXP
			Bussmann	BK/GMA-2-R
50VA	3A	PE-06-0016	Littelfuse	0235003.MXP
			Bussmann	BK/GMA-3-R

HEAT Output – The HEAT output connects to an electric heat contactor or relay. This output represents the command signal from the thermostat or controller on the W1 input. 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. This output provides 24VAC to energize the damper actuator. This output is interlocked with the fan relays to ensure that a fan speed is commanded before energizing the damper actuator

TABLE F.6 – FIELD INSTALLED COMPONENT DESCRIPTIONS

Name	Description
Field-provided 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. The JP2 jumper must be removed for the float switch to operate correctly. *Note: If a float switch was installed in the factory, the float switch may be connected through a factory-provided harnesses instead of wired to the screw terminal.*
Start/Stop for the fan	To start or stop the fan from an external controller, wire the leads for the switch contacts that will be made or broken to R and G on the screw terminals. After wiring the switch, remove jumper JP3.
Remote 3-speed switch	To add a remote 3-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.

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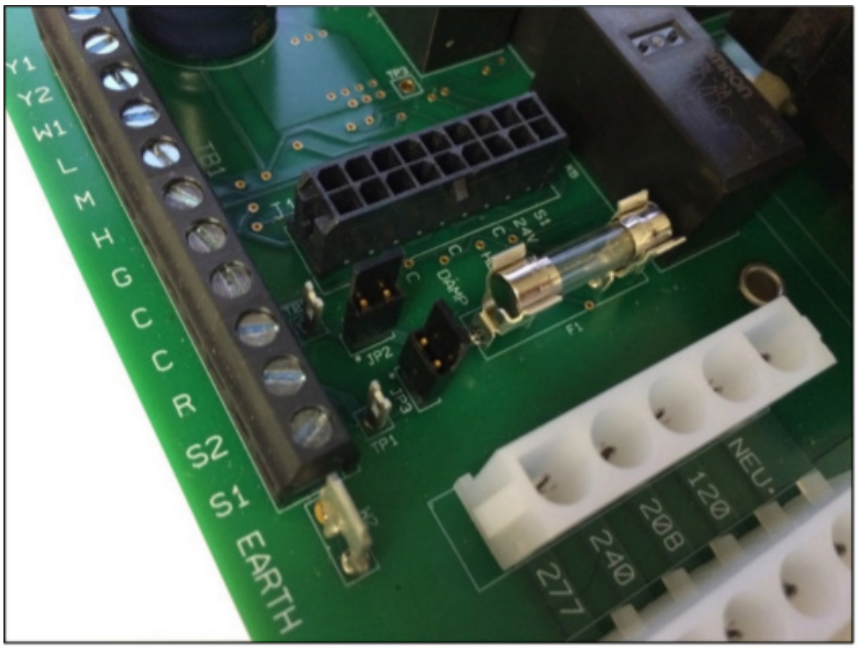
Jumpers

TABLE F.7 – JUMPER DESCRIPTION		
Jumper	Name	Description
JP1	Speed Select Jumper	This jumper is installed between 24V and HIGH when no three speed switch is included (remote or unit mounted). The jumper will be 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 when remote control of the fan motor is desired. In most instances, JP3 will be installed (unless a thermostat or controller is remotely controlling of the equipment).

JP2 and JP3 locations can be seen in Figure 3.

Test Points

TABLE F.8 – TEST POINT DESCRIPTION		
Test Point	Name	Description
TP1	24VAC	These test points can be used to verify 24VAC assuming incoming voltage is within tolerance. They can be connected to with minihook test clips for a digital multimeter. Test point locations for TP1 and TP2 can be seen in Figure 3.
TP2	COM	



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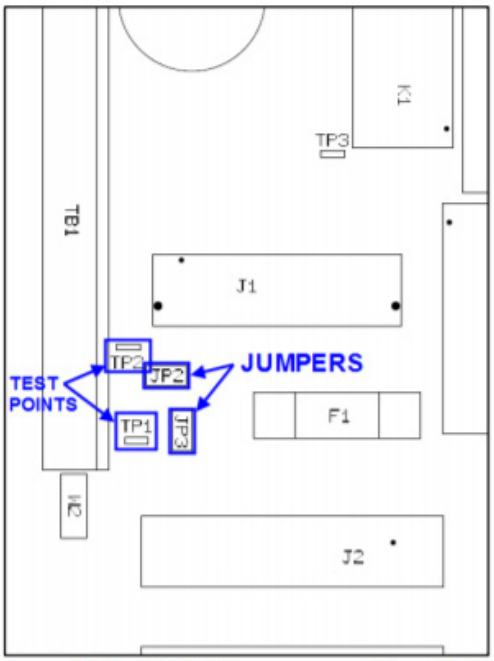

Figure F.2 - FRBii Jumpers and Test Points

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Screw Terminal Signals:

TABLE F.9 – SCREW TERMINAL SIGNAL IDENTIFICATION			
Pin	Signal	Signal Name	Description
1	Y1	Cool 1	Chilled water valve actuator control input, and thermostat cooling output
2	Y2	Cool 2	"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	W1	Heat 1	Wire connection point for hot water valve actuator or 1st stage EH control input, and thermostat heating output.
4	L	Low	Low speed control input for onboard relay.
5	M	Medium	Medium speed control for onboard relay.
6	H	High	High speed control input for onboard relay.
7	G	Fan Enable	Used to allow external start-stop control from an external source.
8	C	Common (through JP2)	Device common, including onboard speed relays (all terminals C and "COM" on board are internally connected).
9	C		
10	R	24VAC	Transformer "hot" connection (24VAC).
11	S2	Auxiliary Input (Heat 2)	Used for different functions based on application, such as: - 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	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.

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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.

No routine maintenance is required for the fan relay board.

TABLE F.10 - FAN RELAY BOARD TROUBLESHOOTING GUIDELINES

Problem	Possible Cause	Corrective Action
No 24VAC power	Blown fuse onboard (F1)	Measure resistance across fuse: A properly working fuse will measure <1.0 Ω A blown fuse will measure as an open circuit Replace fuse if blown using replacement fuse identified above
	Incorrect incoming line voltage	Verify incoming voltage to the unit is within tolerance
	Improper wiring connections	Verify that the unit is wired per the unit wiring diagram for incoming voltage. If the unit includes main fusing, verify that the fuses are not blown. Verify wire harness connections are secure. See "Checking Wire Harnesses" section.
	JP2 removed without float switch installed	Verify that either a float switch or JP2 are installed. If neither, install one of them.
	Float switch tripped	Verify float switch (if present) is made.
	JP3 removed without external start/stop control installed	Verify that either an external start/stop or JP3 are installed. If neither, install one of them.
	Damaged transformer	If all of the above are confirmed, replace the fan relay board.
Fan motor will not run	No 24VAC power	See above
	Fan speed is not commanded	Verify a fan speed is commanded from either jumper JP1, a unit-mounted or remote-mounted three speed switch, or a thermostat.
Electric heat signal is not provided to contactor	Fan speed is not commanded	Verify that fan motor is running. A fan speed must be commanded from one of these sources to allow the electric heat contactor to energize on a call for heat.
Outside Air Damper actuator will not energize	Fan speed is not commanded	Verify that fan motor is running. A fan speed must be commanded from one of these sources to allow the damper actuator to energize.

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Checking Wire Harnesses

Use ohmmeter to verify that ground wire has continuity from S1 to enclosure case.

To check 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 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 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.

Use caution when inserting meter probe into plug. Excess force will damage contacts.