SERVICE MANUAL

RESIDENTIAL FAN COIL UNITS

FA4, FB4, FC4,
FD3, FE4, FF1,
FG3, FH4, FK4,
FV4, FX4, 40FK

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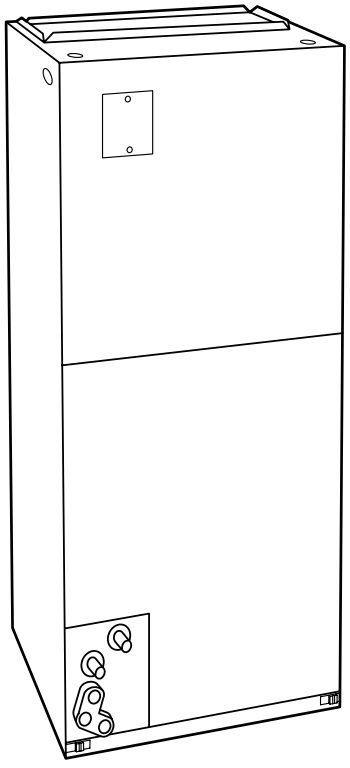
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Fig. 1—Typical Fan Coil

Form: F-6SM Cancels: F-5SM / SM03-5 Printed in U.S.A. 02-05 Catalog No. 03FA-4A6

This symbol → indicates a change since the last issue.

SAFETY CONSIDERATIONS

Improper installation, adjustment, alteration, service, maintenance, or use can cause explosion, fire, electrical shock, or other conditions which may cause personal injury or property damage. Consult a qualified installer, service agency, or your distributor or branch for information or assistance. The qualified installer or agency must use factory-authorized kits or accessories when modifying this product. Refer to the individual installation instructions packaged with the kits or accessories for detailed information.

Follow all safety codes. Wear safety glasses and work gloves. Use quenching cloth for brazing operations. Have fire extinguisher available. Read these instructions thoroughly and follow all warnings or cautions attached to the unit. Consult local building codes and National Electrical Code (NEC) for special installation requirements.

It is important to recognize safety information. This is the safety-alert symbol ⚠ . When you see this symbol on the unit or in instructions and manuals, be alert to the potential for personal injury.

Understand the signal words DANGER, WARNING, and CAUTION. These words are used with the safety-alert symbol. DANGER identifies the most serious hazards which **will** result in severe personal injury or death. WARNING signifies hazards which **could** result in personal injury or death. CAUTION is used to identify unsafe practices which **would** result in minor personal injury or product and property damage.

⚠ **WARNING: UNIT OPERATION AND SAFETY HAZARD**

Failure to follow this caution could result in personal injury or possible equipment damage.

Puron (R-410A) systems operate at higher pressures than R-22 systems. Do not use R-22 service equipment or components on R-410A equipment. Ensure service equipment is rated for R-410A.

INTRODUCTION

The "F" series fan coil units are designed for flexibility in a variety of applications, meeting upflow, horizontal, or downflow requirements. Units are available in 1-1/2 through 5 ton nominal cooling capacities. Factory-authorized, field-installed electric heater packages are available in 3 through 30 kilowatts.

⚠ **WARNING: ELECTRICAL SHOCK HAZARD**

Failure to follow this warning could result in personal injury or possible equipment damage.

Before installing or servicing fan coil, always turn off all power to unit. There may be more than 1 disconnect switch. Turn off accessory heater power if applicable.

UNIT IDENTIFICATION

The 16 position numbering chart allows identification of all available fan coil units. (See Fig. 2.)

FAN COIL DESCRIPTION AND TROUBLESHOOTING

FK4B

The FK4B has an integrated control and motor (ECM/ECM/ICM) and special circuit board.

Setting up desired airflow on the FK4B is obtained by the selections made on Easy Select™ circuit board. The motor delivers requested airflow as defined by signals received from Easy Select Board and its internal programming. The major difference is that the FK4B motor reacts to changes in system static pressures to maintain constant airflow.

Unlike conventional fan coils where static pressure affects airflow, the FK4B is a constant airflow unit. The blower delivers requested airflow up to about 0.7 in. of static pressure. The motor is pre-programmed and contains airflows for all modes of operation. Blower characteristics (airflow, torque, and speed-vs-static pressure) are known from laboratory testing. If any 3 characteristics are known, the fourth is defined.

Requested airflow is known because of Easy Select board configuration and thermostat signals. Torque is known because it is directly related to armature current which is measured by motor control. Speed is measured from its generated back EMF. This information is entered into an expression which calculates torque from speed and airflow numbers. If calculation does not match stored blower characteristics, torque is adjusted every 0.8 seconds until agreement is reached. The unit does not directly measure static pressure, but does react to a change in static to maintain constant airflow.

PROCEDURE 1—INTEGRATED CONTROLS AND MOTOR - FK4B

The motor is similar to the ECM/ICM1 used in FK4A series units, but cannot be used as a replacement without some modification to FK4A unit. The electronics of motor are built into rear of motor, deriving the name ECM/ICM. (See Fig. 3.)

An ECM/ECM/ICM is first fed high voltage AC power through the 5-pin connector. The AC power is then rectified to DC by a diode module. After rectification, DC signal is electronically communicated and fed in sequential order to 3 stator windings. The frequency of communication pulses determines motor speed. The rotor is permanently magnetized.

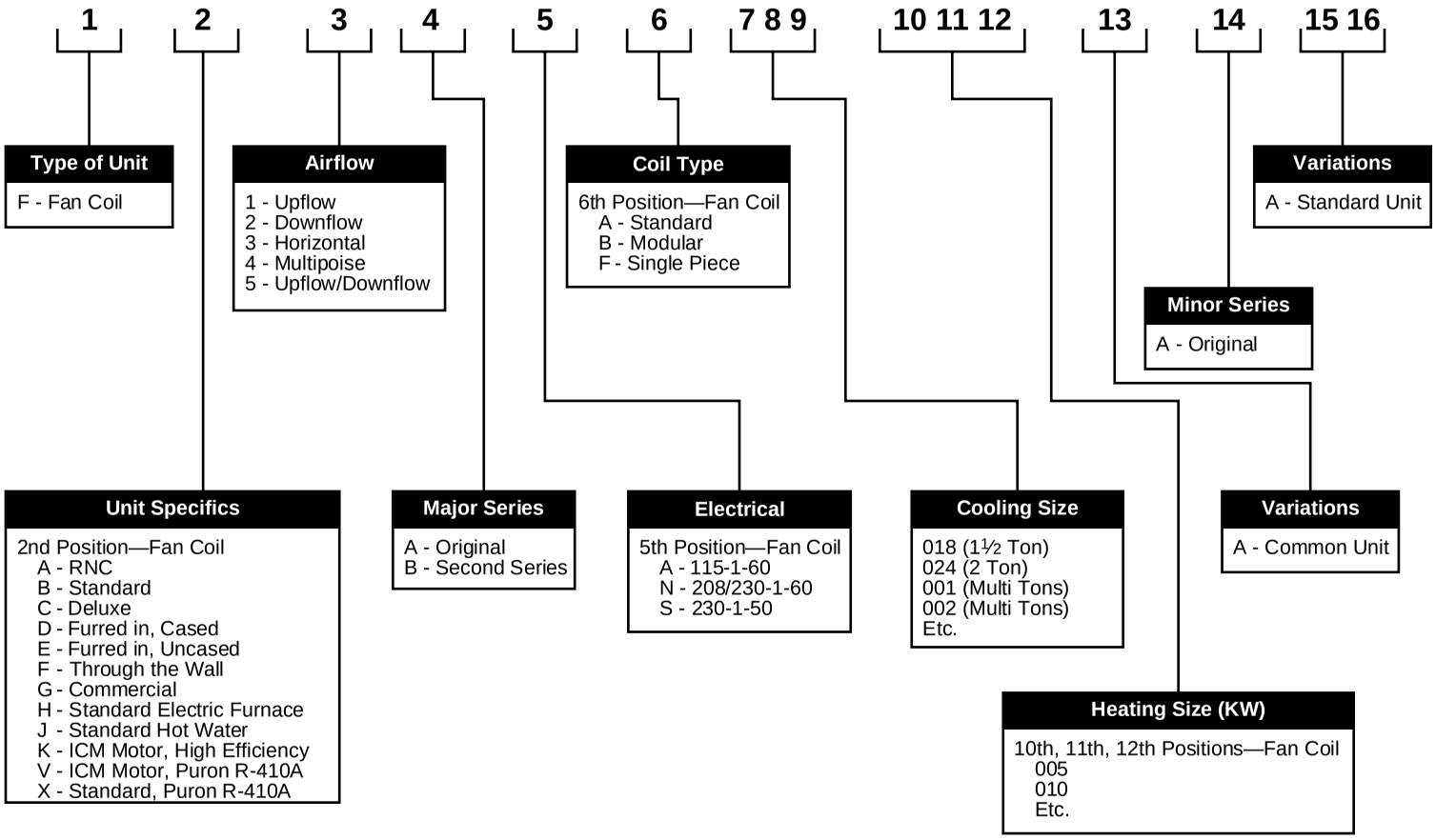
An ECM/ICM is powered with high voltage at all times. The motor will not run with high voltage alone. Low voltage must be applied to control plug to run motor.

PROCEDURE 2—PCB LAYOUT AND DESCRIPTION - FK4B

NOTE: Layout of actual PCB is depicted in Fig. 4 and 5.

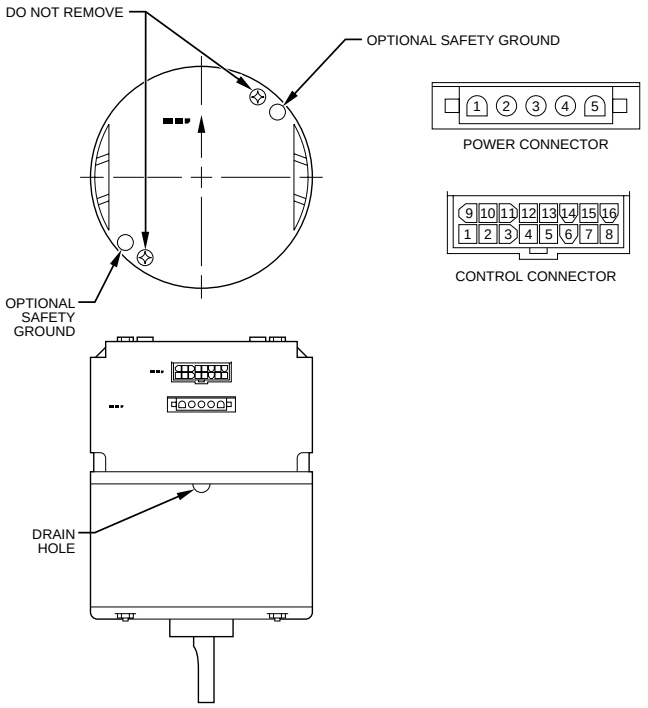
The control is a single PCB which interfaces a variable-speed motor with other system components.

Power for system is supplied from a 230-vac, 60-Hz line. Class 2 voltage (24 vac nom), used for thermostat connections, is derived from a transformer located in close proximity to control. The primary and secondary of transformer are connected to control board. The 24-vac secondary circuit includes a socket, soldered into circuit at SEC2, to receive a 5-amp automotive-type fuse.



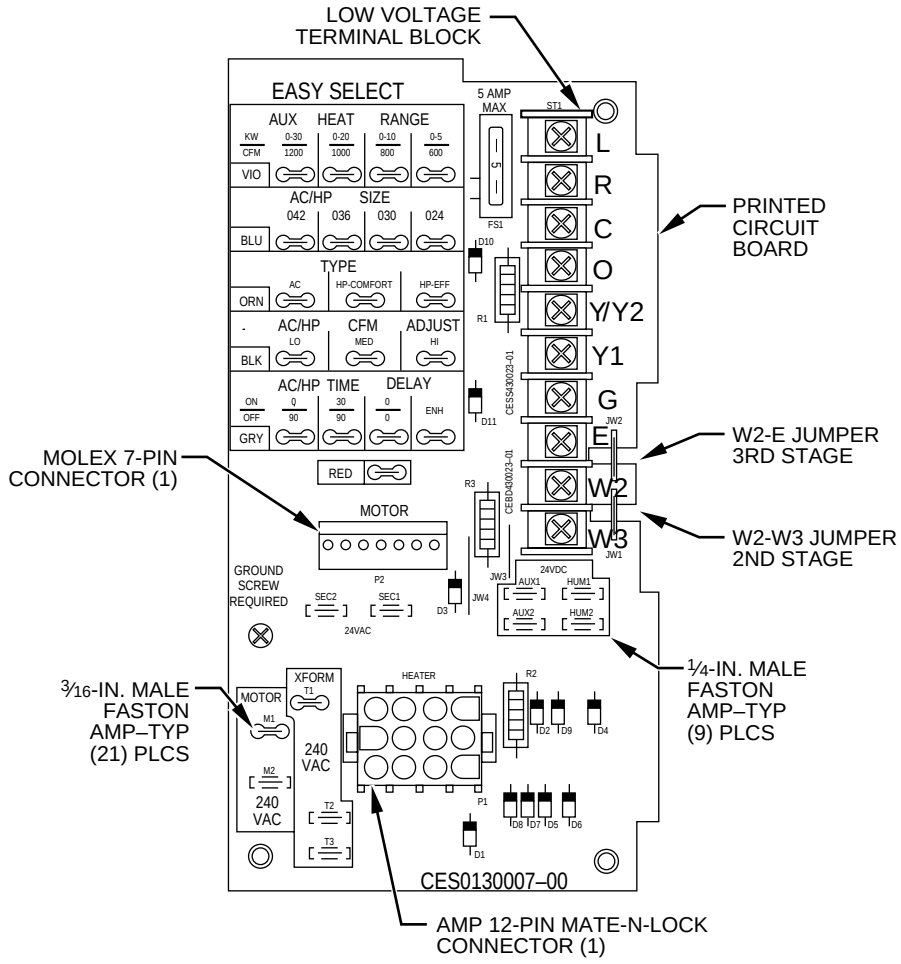
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Fig. 2—Fan Coil 16-Position Numbering System



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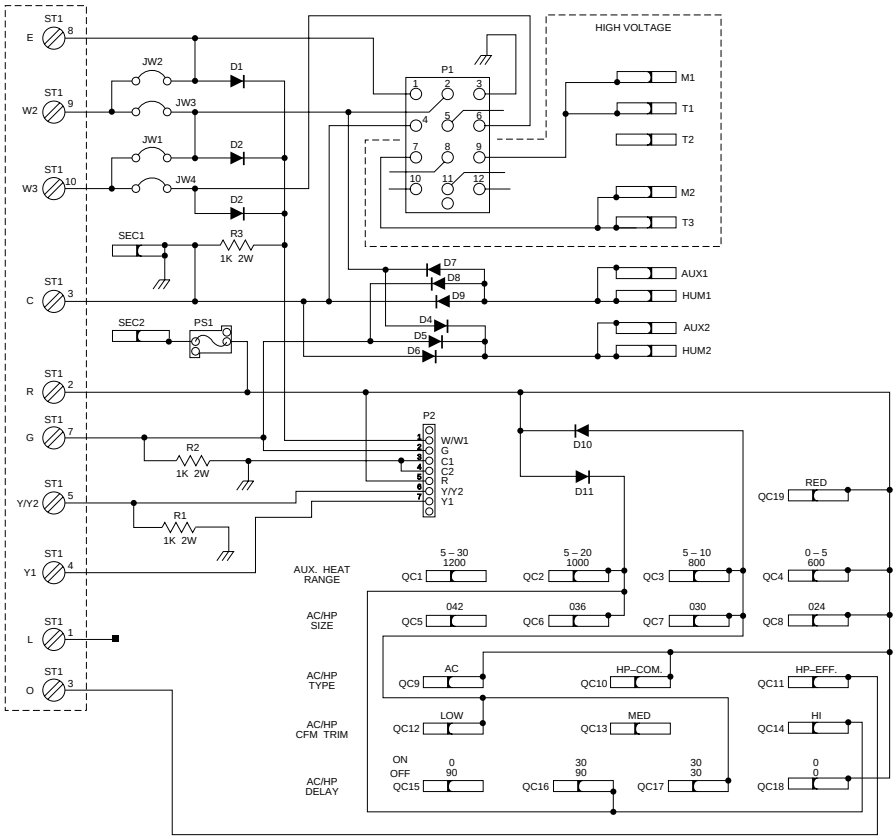
Fig. 3—FK4B, FK4C and FV4A motor Motor



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Fig. 4—Easy Select Board (FK4B)

Connection to heater panel is made through 12-circuit connector P1. Connections to thermostat are made at screw terminals. Line voltage for motor is made through 12-circuit connector P1. Eighteen quick-connect terminals comprise field select taps for motor.



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Fig. 5—Easy Select Board Circuitry (FK4B)

Fuse Data: 5-amp automotive-type ATC/ATO (tan)
32v
200 percent current opening time of 5 sec maximum

A. Electrical Connections

Eighteen 0.187-in quick-connect terminals are used to provide programming selections for operating modes of motor. The 5 selection modes are listed below. For additional information, refer to Easy Select Configuration Taps section.

AUX Heat Range—(Violet Wire)
AC/HP Size—(Blue Wire)
Type—(Orange Wire)
AC/HP CFM Adjust—(Black Wire)
AC/HP Time Delay—(Grey Wire)

PROCEDURE 3—SEQUENCE OF OPERATION - FK4B

A. Continuous Fan Mode

The thermostat closes circuit R to G. The G signal is sent directly to motor.

B. Cooling Mode—Single Speed or 2-Speed High

Thermostat closes circuits R to Y/Y2 and R to O (heat pump only) for single speed. A circuit from R to Y1 is also required for 2-speed high. The Y/Y2 signal is sent directly to motor.

C. Cooling Mode—Two-Speed Low

Thermostat closes circuits R to Y1 and R to O (heat pump only). The Y1 signal is sent directly to motor.

D. Electric Heat Heating Mode

Thermostat closes circuit R to W2, W3, or E.

The terminal block positions W2, W3, and E are tied together by jumpers JW1 and JW2. These jumpers are provided for field staging of electric heater banks through use of thermostats. When staging is a requirement, installer cuts jumpers and wires in thermostats as is the common practice with other fan coils. To ensure motor operation if any 1 of the inputs is energized, the 3 electric heater inputs are also interlocked through diodes D1, D2, and D3 to motor W input.

E. Heat Pump Heating Mode—Single Speed or 2-Speed High

Thermostat closes circuit R to Y/Y2 for single speed. A circuit from R to Y1 is also required for 2-speed high. The Y/Y2 signal is sent directly to motor.

F. Heat Pump Heating Mode—Two-Speed Low

Thermostat closes R to Y1. The Y1 signal is sent directly to motor.

Table 1—Male/Female Quick-Connect Terminals (FK4B)

Size Female	Size Male	Description
0.250 X 0.032	M2	Motor line voltage connection (230 vac 60 Hz)
	T3	Transformer line voltage connection (230 vac 60 Hz)
	T2	Transformer tap storage terminal for 208-vac lead
	SEC1	Secondary connection from transformer (24 vac) This connection is common to chassis ground through eyelet marked GROUND SCREW REQUIRED.
	SEC2	Secondary connection from transformer (24 vac)
	HUM1	Low voltage ground for humidifier option (24 vdc)
	HUM2	Low voltage output for humidifier option (24 vdc)
	AUX1	Low voltage ground for auxiliary option (24 vdc)
	AUX2	Low voltage output for auxiliary option (24 vdc)
0.187 X 0.032	M1	Common connection to blower motor
	T1	Common connection for transformer
	RED	Common to R screw terminal and SEC2

Table 2—Connections on FK4B Screw Terminal Block

Screw Terminal	Description
W2	Connection for W2 signal from thermostat
W3	Connection for W3 signal from outdoor thermostat
E	Connection for E signal from thermostat
Y/Y2	Connection for Y signal from thermostat
G	Connection for G signal from thermostat
O	Connection for O signal from thermostat
L	This connection is a field termination for use in connecting L lines of thermostat and outdoor unit together. There is no connection of this terminal with control circuity.
Y1	Connection for low-speed compressor operation
R	Connection for R signal to thermostat (24 vac)
C	Connection for C terminal to thermostat (24 vac common)

G. Heat Pump Heating With Auxiliary Electric Heat

Thermostat closes circuits R to Y/Y2 and/or R to Y1 with R to W2, W3, or E (and R to O in the case of defrost).

See previously described modes for circuit paths.

In the event that electric heating is called for by thermostat while heat pump is also operating in either heating or defrost mode, electric heating signal will appear at motor connector pin 1 as described previously. If necessary, the motor will modify its airflow output to provide an airflow which is defined as safe for operation of electric heater.

H. CFM Select Configuration Taps

The CFM Select taps are used by installer to configure system. The motor is capable of discerning wave shapes on some of its inputs and uses this capability to modify its operation to a pre-programmed table of airflows and can be modified in response to other inputs such as the need for de-humidification.

I. Motor Control Power

The motor control power is supplied from R circuit through printed circuit runs to motor control connector pin 6, through motor control harness to motor. The C side of low-voltage control power circuit is connected by printed circuit runs to motor connector pins 4 and 5, then through motor control harness to motor.

J. Low-Voltage Circuit Fusing and Reference

The low-voltage circuit is fused by a board-mounted 5-amp automotive-type fuse placed in series with transformer SEC2 and R circuit. The C circuit of transformer is referenced to chassis ground through a printed circuit run at SEC1 connected to metal standoff marked GROUND SCREW REQUIRED.

NOTE: A ground screw must be in place or erratic motor operation can result.

K. Transformer, Motor, and Electric Heater Power Connections

The high-voltage (230-vac) power input to board is provided through electric heater connector pins 7 and 9. The high voltage is then connected through printed circuit runs to motor power connections M1 and M2 and transformer power connections T1 and T3. Transformer connection T2 is a dummy terminal used for unused primary power lead. The transformer secondary connections are made at SEC1 and SEC2 connectors.

Table 3—Connections and Connector (FK4B)

Type Connection	Type Connector	Pin No.	Description
Heater Connection	12-Pin	Pin 1	Common to E screw terminal
		Pin 2	Common to W2 screw terminal
		Pin 3	Common to C screw terminal, SEC1 terminal, and chassis ground
		Pin 4	Common to C screw terminal, SEC1 terminal, and chassis ground
		Pin 5	No connection
		Pin 6	Common to W3 screw terminal
		Pin 7	Common to M2 and T3 quick-connects, 230 vac input
		Pin 8	No connection
		Pin 9	Common to M1 and T1 quick-connects, 230 vac input
		Pin 10	No connection
		Pin 11	No connection
		Pin 12	No connection
Motor	7-Pin Header	Pin 1	Diode OR output of E or W3 or W2 thermostat signals
		Pin 2	Thermostat G signal
		Pin 3	Common to C, SEC1, and chassis ground
		Pin 4	Common to C, SEC1, and chassis ground
		Pin 5	Common to R and SEC2 (via 5-amp fuse)
		Pin 6	Thermostat Y/Y2 signal
		Pin 7	Thermostat Y1 signal

PROCEDURE 4—EASY SELECT CONFIGURATION TAPS - FK4B

The Easy Select taps are used by installer to configure system. The motor uses selected taps to modify its operation to a pre-programmed table of airflows. Airflows are based on system size or mode of operation and those airflows are modified in response to other inputs such as the need for de-humidification.
(See Fig. 4.)

The FK4B Fan Coil must be configured to operate properly with system components with which it is installed. To successfully configure a basic system (see information printed on circuit board located next to select pins), move the 5 select wires to pins which match components used.

A. Auxiliary Heat Range

The installer must select the auxiliary heat airflow approved for application with kw size heater installed. If no heater is installed, skip this step. Each select pin is marked with a range of heaters for which airflow (also marked) is approved. For increased comfort select the narrowest kw range matching the heater size, for example, 0-10 for a 10-kw heater. This airflow must be greater than the minimum CFM for electric heater application with the size system installed for safe and continuous operation. Note that airflow marked is the airflow which will be supplied in emergency heat mode and heating mode on air conditioners when electric heat is primary heating source. To ensure safe heater operation in heat pump heating mode when electric heaters are energized, the motor will run the higher of heat pump efficiency airflow and electric heater airflow. The factory selection is largest heater range approved. (See Fig. 4.)

B. AC/HP Size

The factory setting for air conditioner or heat pump size is largest unit meant for application with model of fan coil purchased. The installer needs to select air conditioner or heat pump size to ensure that airflow delivered falls within proper range for size of unit installed in all operational modes. (See Fig. 4.)

C. System Type

The type of system must be selected.

1. AC—air conditioner
2. HP-COMFORT—provides same airflow as air conditioner selection (approximately 375 CFM/ton)
3. HP-EFF—provides most efficient airflow for heating and cooling modes (approximately 410 CFM/ton heating and 375 CFM/ton cooling)

The factory setting is AC. (See Fig. 4.)

D. AC/HP CFM Adjust

Select low, medium, or high airflow. The factory selection is LO. The adjust selections HI/LO will regulate airflow supplied for all operational modes, except non heat pump heating modes, +10 percent and -10 percent respectively. The adjust selection options are provided to adjust airflow supplied to meet individual installation needs for such things as noise, comfort, and humidity removal. (See Fig. 4.)

E. AC/HP Time Delay

Select desired time delay profile. Four motor operation delay profiles are provided to customize and enhance system operation. (See Fig. 4.) The selection options are:

NOTE: Selectable ON and OFF delay active in heat pump heating and cooling modes only. Auxiliary heat modes have a fixed delay profile: 0 seconds ON or 2 minutes OFF. This cannot be overridden.

1. The standard 90 sec off delay (factory setting).
2. No delay option used for servicing unit or when a thermostat is utilized to perform delay functions.
3. A 30 sec on/90 sec off delay profile used when it is desirable to allow system coils time to heat up/cool down prior to airflow. This profile will minimize cold blow in heat pump operation and could enhance system efficiency.
4. ENH, enhanced selection provides a 30 sec on/180 sec off delay at half airflow, adding comfort and efficiency.

PROCEDURE 5—TROUBLESHOOTING CIRCUIT BOARD - FK4B

Use Fig. 5 and 6 and Tables 3, 4, 5, and 6 as guides in troubleshooting PCB unless otherwise noted.

A. If Fan Will Not Turn On From Thermostat:

IF THERE IS NO HIGH VOLTAGE TO PCB:

1. Check connection of 12-pin plug from heaters to receptacle on Easy Select board. This supplies power to PCB. Be sure plug is connected properly.
2. Check sequencer number 1 and plug wiring. Yellow wire should be connected to pin number 9 of plug and to limit switch. Black wire should be connected to pin number 7 of plug and to sequencer number 1.
3. Check power leads L1 and L2. If these are not receiving power, system cannot function.

IF PCB HAS HIGH VOLTAGE APPLIED TO IT:

1. Check low-voltage transformer leads (red and brown). Be sure they are wired to correct locations. (See Fig. 14 and 18.)
2. Check output voltage of transformer secondary side SEC2 and SEC1. Be sure transformer output is around 24 vac. If transformer output is zero vac and transformer is receiving correct input voltage (208v or 240v), then transformer needs to be replaced with recommended transformer. If transformer output is 24 vac, proceed to items 3 and 4.
3. Check low-voltage fuse shown in Fig. 4. If fuse is blown, replace it. The transformer cannot supply power to board with fuse blown or loose. If fuse blows when unit has power applied to it, the system most likely has 1 of the following problems:
   a. Check control circuit for a short or miswiring problem.
   b. The maximum load on transformer is 40 VA. If load on transformer is excessive, the low-voltage 5-amp fuse will blow to protect transformer. If load exceeds VA rating of transformer, a larger VA rated transformer needs to be installed. Check sequencers for excessive current draw.
   c. Check wiring of heaters. If a heater is miswired, fuse may blow. If a heater is miswired, correct miswiring.
4. Check T1, T2, and T3 connections on primary side of transformer. If they are not connected properly, low-voltage terminal board cannot supply 24-v signal to energize fan motor. If transformer is receiving correct primary voltage but is not putting out correct secondary voltage, transformer needs to be replaced.

B. If Electric Heat Stages Will Not Turn On But Fan Will Turn On:

1. Check wiring of sequencers. Pay particular attention to high- and low-voltage wiring of sequencers.
2. Check plug wiring to make sure that it is wired correctly.
3. Check voltage to sequencer. Sequencer number 1 receives a 24-vac signal. If it is receiving correct voltage, check to see if sequencer is closing. If sequencer is not closing but is receiving correct voltage, replace sequencer. If sequencer is closing, check high-voltage wiring as discussed in items 1 and 2.

IF THERE ARE BLOWN DIODES:

If diodes are blown, it is probable that electric heater plug is miswired. Correct miswiring.

NOTE: Board will need to be replaced if diode is bad.

IF TRACES ARE OVERHEATED ON BACK OF PCB:

Usually whenever there is a trace blown on PCB, it means either there has been a high-voltage short or high voltage has been applied to low-voltage circuit. This can be prevented by making sure PCB is wired correctly before PCB has power applied to it.

C. If PCB Fuse Keeps Blowing:

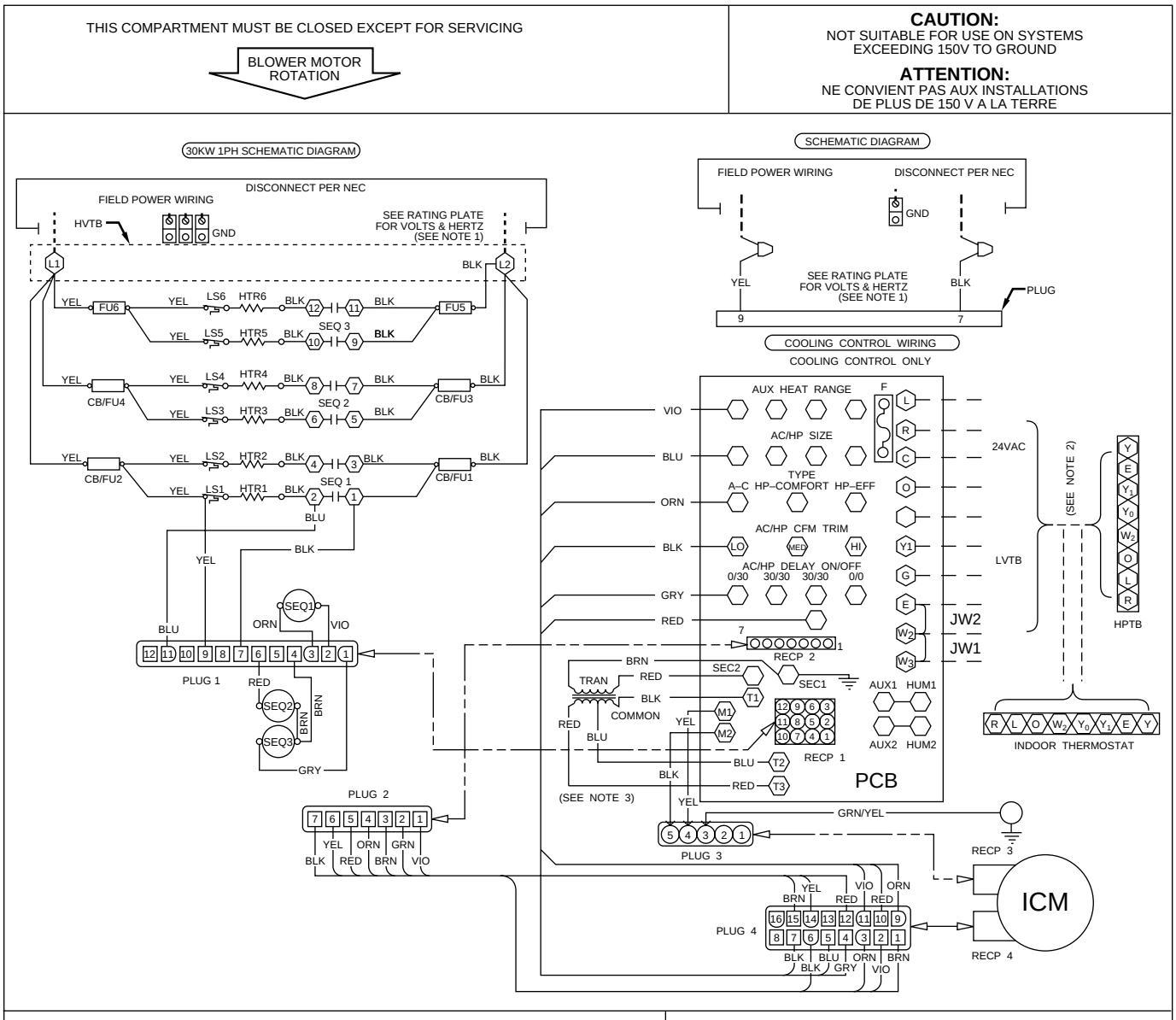
When low-voltage fuse blows, it means transformer would have blown if fuse had not been in circuit to protect it. The fuse usually blows when there is a high current drawn on transformer, high voltage applied to low-voltage circuit, or a direct secondary short. When there is a high current drawn on transformer, it is most likely because transformer has been shorted or system is trying to draw more VA than transformer rating allows. When fuse blows because of high voltage, the system has mixed high- and low-voltage signals.

1. Check transformer and thermostat wiring. (See Fig. 4 and 6.) Be sure transformer is not shorting out because thermostat wires are miswired.
2. Check wiring of sequencers. (See Fig. 4 and 6.) Be sure low-voltage and high-voltage wiring are connected to proper sequencers.
3. Check VA draw on transformer. If VA draw is more than VA rating of transformer, fuse will blow. If this is the case, replace transformer with one that has a higher VA rating and meets system specifications.

PROCEDURE 6—TROUBLESHOOTING FAN MOTOR - FK4B

A. If Motor Does Not Run:

1. With power turned off, check all plugs and receptacles on circuit board and at motor for any deformation that may cause a bad connection. Be sure all plugs are placed fully seated.



NOTES:

1. Use copper wire only between disconnect switch and unit.
2. Connect (Y) to (Y), (C) to (C), etc. in pattern shown.
3. Transformer primary leads: BLUE 208V, RED 230V.
4. To be wired in accordandce with NEC and local codes.
5. If any of the original wire, as supplied, must be replaced, use the same or equivalent type wire.
6. Replace low voltage fuse with no greater than 5 amp fuse.
7. Fuse is wired in series between transformer SEC2 and low voltage "R" circuit.
8. 20KW heater uses one double pole LS on middle top element.
9. 18, 24 and 30KW heaters use double pole limit switches.
10. Largest heaters are shown, smaller heaters will have fewer elements and components.
11. 1 phase heaters are shown wired for single supply circuit. Multiple supply circuits may be wired directly to fuse/C.B.'S.

- LEGEND -

⬡	MARKED TERMINAL	LS	LIMIT SWITCH
○	UNMARKED TERMINAL	ICM	FAN MOTOR
- - - - -	FIELD POWER WIRING	TRAN	TRANSFORMER
—»—	PLUG AND RECEPTACLE	GND	EQUIPMENT GROUND
———	PCB BREAKOFF JUMPER	FU	FUSE
AUX	AUXILIARY	RECP	RECEPTACLE
PCB	PRINTED CIRCUIT BOARD	CB	CIRCUIT BREAKER
HPTB	HEAT PUMP TERM BRD	F	LOW VOLTAGE FUSE
LVTB	LOW VOLT TERM BRD		
SEQ	SEQUENCER		
HTR	HEATER		
HVTB	HIGH VOLTAGE TERMINAL BOX		
HUM	HUMIDIFIER		

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Fig. 6—Typical FK4B Wiring Diagram with 6-Element Heater

Table 4—FK4B Motor Control Test Values
(With 16-pin connector at motor unplugged)

Terminals Jumpered	Volt Meter on 16 PIN Harness Plug		Volt Meter on 7-pin Easy Select Board Plug		Voltage
	+	-	+	-	
R to W1 or W2	Pin 2	Pin 1 or 3	Pin 1	Pin 3 or 4	12vdc
R to Y1	Pin 6	Pin 1 or 3	Pin 7	Pin 3 or 4	24vac
R to Y/Y2	Pin 14	Pin 1 or 3	Pin 6	Pin 3 or 4	24vac
R to G	Pin 15	Pin 1 or 3	Pin 2	Pin 3 or 4	24vac

2. Verify that there are approximately 230v at terminals M1 and M2. If not, determine if high voltage is entering board. It enters through black and yellow wires at pins 7 and 9 in 12-pin plug.
3. Verify that there is a low-voltage control signal to motor. The motor receives its control signals through the 7-pin motor plug P2. The voltage output of each pin in plug will be different for each mode of operation. Table 4 lists circuit board screw terminals that have 24 vac present (powered by thermostat) and lists voltage that is present at each pin of 7-pin plug for each operating mode. Tests should be taken between points listed and common (C screw terminal). If all values of any 1 of operating modes checks OK and motor fails to run, then motor is defective and should be replaced.

B. If Motor Does Not Run Smoothly:

First verify that the cause is not an out of balance or damaged blower wheel. If it is not blower wheel, motor is defective and should be replaced.

C. If Motor Shaft Does Not Rotate Smoothly:

When manually turning shaft of ECM/ICM, the shaft does not rotate smoothly. The shaft has steps during rotation referred to as motor cogging. The cogging is caused by permanent magnets passing each pole of motor. However, shaft should not require excessive force to turn. If shaft is VERY difficult to turn, motor control or bearings have failed and motor must be replaced.

D. If Motor Does Not Stop Running

1. Check for good ground between motor ground lead and transformer common lead.
2. If motor continues to run, remove all thermostat wires. If motor stops, check thermostat wiring for short.
3. If motor continues to run, remove the 7-pin plug. If motor continues to run after 2 minutes, replace motor.

PROCEDURE 7—CONDENSED VERSION OF TROUBLESHOOTING FK4B MOTOR AND CONTROLS

This section provides a quick summary of how to troubleshoot the FK4B. If more information is needed, refer to appropriate sections of this service manual.

+ MOTOR

- If motor is hard to turn manually, but turns freely, replace module.
- If motor does not run, check the components listed below according to their instructions.
- If motor runs in some operation modes and not in others, check for a good ground connection between motor ground lead and circuit board screw marked "ground screw" and check the room thermostat and wiring harness according to instructions listed in Table 4.
- If motor does not stop running, remove the 7-pin plug from circuit board. If motor continues to run, replace motor. If motor stops running after 2 minutes, it is either the circuit board or thermostat causing the problem. Test whether thermostat is at fault by disconnecting it from the board.

+ CIRCUIT BOARD

- Check 5-amp fuse.
- Check for 230v between terminals M1 and M2. If no voltage is present, check power to board. 230-v power enters the board through the black and yellow lead in the 12-pin plug.
- Check for 24v between SEC1 and SEC2. If no voltage is present, check the transformer.
- Check for burn traces or burnt components. If burn spots are present, replace board.

+ ROOM THERMOSTAT

- Remove thermostat wires from the circuit board.
- Jumper screw terminals (1 at a time) R-G, R-Y/Y2, R-Y1, and R-W2. If motor runs in all cases, thermostat or thermostat wiring is bad. If motor does not run, or runs in some cases but not in others, continue by checking the wiring harness.

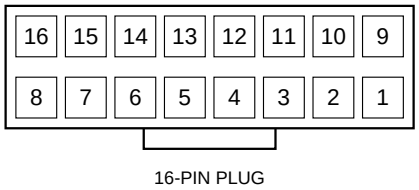
+ WIRING HARNESS

- Shut off power to unit.
- Remove 5-pin plug from motor.

⚠ WARNING: ELECTRICAL SHOCK HAZARD
Failure to follow this warning could result in personal injury or possible equipment damage.
Never remove 5-pin high voltage plug from the motor with the power on.

- Remove 16-pin plug from motor.
- Replace 5-pin plug and turn on power.

- Check for 24v between pin-1 and pin-12 on the 16-pin plug. (See Fig. 7.) If no voltage is present, replace wiring harness. If voltage is present,



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Fig. 7—Wiring Harness 16-Pin Plug

jumper screw terminal R-Y/Y2 on circuit board and check for 24v between pin 1 and pin 12 and pin 1 and pin 14 on 16-pin plug. (See Fig. 7.) If voltage is present, replace harness.

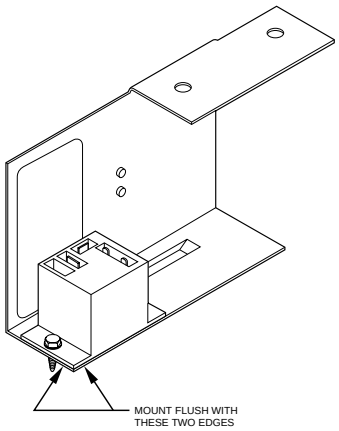
- If 24v is present on both pins, the motor or module is bad. Replace motor.

PROCEDURE 8—ACCESSORIES (FK4B)

A. Electronic Air Cleaner (EAC)

Familiar 230-vac EAC control/power signal EAC1 and EAC2 is not available, because the motor blower motor used in the FK4B Fan Coil is controlled by low-voltage signals. This signal is replaced by a 24-vdc signal which is provided at circuit board terminals AUX1 and AUX2. (See Fig 16.)

This signal is present when either G or W is present and is active in all heating and cooling modes. Because 24-vdc relays may not be readily available to installer, a kit exists, KFAIR0101ACR, containing a 24-vdc relay which mounts directly inside EAC cabinet. User-supplied 110 vac is switched by relay to power air cleaner when G or W are present. (See Fig. 8)



A93216

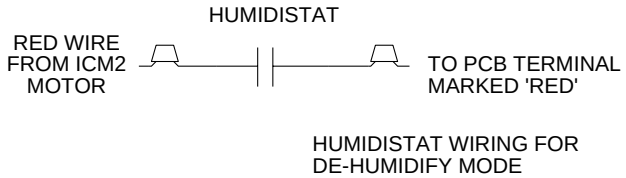
Fig. 8—Mounting KFAIR0101ACR Relay Kit

In heat pump applications, the G signal is present in both cooling and heating modes, permitting EAC to be controlled from G signal only. For this application, a user-supplied 24-vac relay can be driven by G terminal eliminating need for relay kit.

B. FK4B De-Humidify Mode

NOTE: Humidistat must open on humidity rise.

Latent capacities for systems using the FK4B Fan Coil are better than average systems. If increased latent capacity is an application requirement, the FK4B can be wired to provide this requirement by adjusting its airflow in response to standard humidistat input. Fig. 9 illustrates the wiring connections to activate de-humidify mode. Carefully consult product airflow data for cooling and dehumidifying mode.

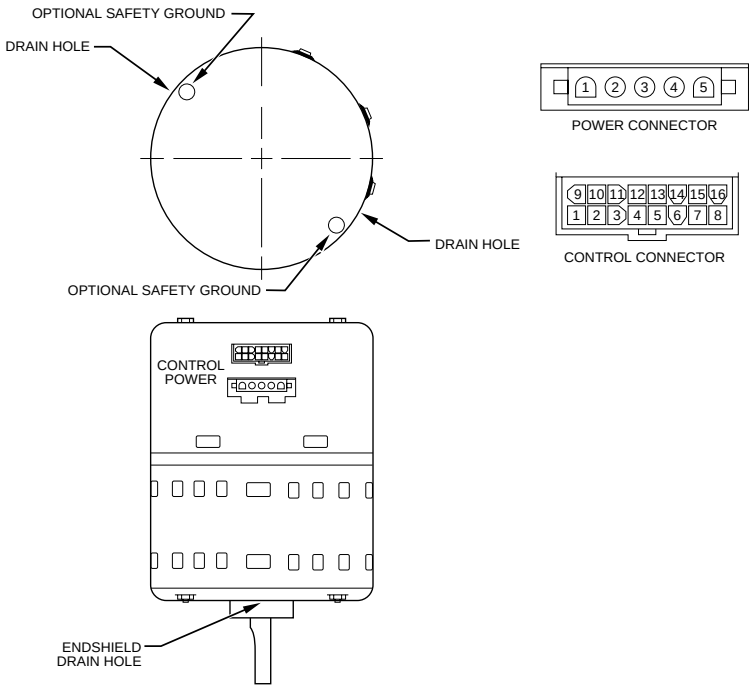


A93215

Fig. 9—Humidistat Wiring for De-Humidify Mode

FV4B, FK4D, FK4C, FV4A, AND 40FKA

The FK4C fan coil was introduced several years before the FV4A and 40FKA models. All three units contain the motor and use the same control board. The 40FKA was introduced as part of the Comfort Heat Pump system and is identical to the FK4C except it is factory supplied with a Thermidistat Control. Both the 40FKA and FK4 R-22 units with a factory supplied R-22 TXV. Other than the pressure differences in the Puron system, all three units are constant airflow machines and operate the same way. The FV4B and FK4D include the added benefits of low sweat/low leak cabinet.



A98201

Fig. 10—FK4C, FV4A, and 40FKA motor/ECM2.3 Motor

Constant Air Flow

Unlike fan coils using induction motors where static pressure affects airflow, these fan coils are constant airflow units. The blower delivers requested airflow regardless of static pressure. Consult fan coil Product Data for static pressure limits. The motor/ECM2 is pre-programmed and contains airflow tables for all modes of operation. Blower characteristics (requested airflow, torque, and speed) are known from laboratory testing. If any 2 characteristics are known, the third is defined.

Requested airflow is known from Easy Select board configuration and thermostat signals. Torque is known because it is directly related to stator current which is measured by motor control. Speed is measured by counting back EMF pulses from stator windings. This information is entered into an expression which calculates torque from speed and airflow numbers. If calculation does not match stored blower characteristics, torque is adjusted until agreement is reached. This calculation and adjustment is performed every 0.8 sec while motor is in operation. There is no direct measure of static pressure, but unit does react to a change in static to maintain constant airflow. A change in pressure will result in a change in stator speed and torque. The motor will begin to adjust on the next sampling, calculate new desired speed and torque, and adjust as necessary.

PROCEDURE 1—INTEGRATED CONTROLS AND MOTOR ECM / /ECM2)

An motor/ECM2 is fed high voltage AC power through the 5-pin connector. (See Fig. 10.) The AC power is then internally rectified to DC by a diode module. After rectification, DC signal is electronically communicated and fed in sequential order to 3 stator windings. The frequency of these commutation pulses determines motor speed. The rotor is permanently magnetized.

An motor/ECM2 is powered with high voltage at all times. The motor will not run with high voltage alone. Low voltage must be applied to control plug to run motor.

ECM/ICM 2 CONTROL POWER

The motor/ECM2 control power is supplied from R circuit through printed circuit runs to motor control connector pin 8, through motor control harness to motor. The C side of low-voltage control power circuit is connected by printed circuit runs to motor connector pins 9, 10, and 11 then through motor control harness to motor.

LOW-VOLTAGE CIRCUIT FUSING AND REFERENCE

The low-voltage circuit is fused by a board-mounted 5-amp automotive-type fuse placed in series with transformer SEC2 and R circuit. The C circuit of transformer is referenced to chassis ground through a printed circuit run at SEC1 connected to metal standoff marked.

NOTE: The PCB must be mounted with 2 screws and motor ground lead secured to blower housing or erratic motor operation can result.

TRANSFORMER, MOTOR, AND ELECTRIC HEATER POWER CONNECTION

Transformer high voltage supplied from electric heater package or high voltage leads through 12-pin heater connector plug/recp2. The motor/ECM2 power connections are made at the transformer primary terminals. The transformer secondary connections are made at SEC1 and SEC2 connectors.

COMFORT HEAT PUMP SYSTEM

In 1998, the Comfort Heat Pump System was introduced in which a 40FK, FK4 or FV4 fan coil can be installed. This introduced many new features for enhanced comfort. To activate these modes, they must be configured into the indoor control. The Thermidistat Control and current zoning have the capability of both of these modes.

To initiate these operating modes, the control drops out the G signal to reduce airflow for extra comfort in heating and maximum dehumidification in cooling. This must be kept in mind while troubleshooting these fan coils. Be aware that a cooling or heating input without the G input energized will result in significantly lower airflow than may be expected. When verifying airflow in normal heating and cooling modes (including emergency heat in newer motors), remember that G must be energized to achieve full airflow.

Table 5 — Motor & Modules Capable of Comfort Heat / SuperDehumidfy Modes

Model	Motor Part Number	Replacement Module Part No.
FK4C, FV4A, 40FKA001, 002	HD44AE128, 131, 125*	RMOD44AE128, 131
FK4C, FV4A, 40FKA003	HD44AE129, 132, 127*	RMOD44AE129, 131
FK4C, FV4A, 40FKA005	HDD44AE130, 133, 126*	RMOD44AE130, 133
FK4C, FV4A, 40FKA006	HD46AE243, 244, 242*	RMOD46AE243, 244

*These motors will not adjust airflow with G in electric heat modes.

The FK4 has some earlier series that were produced before the Comfort Heat Pump System was introduced. Some of the motors will not have the programming that slows the fan down on a loss of the G signal. The following units are factory programmed for Super Comfort Heat and SuperDehumidify Modes:

40FKA/B.....ALL
FV4A/B.....ALL
FK4C.....Series A through E (1995-1997)NONE
FK4C.....Series F reduces airflow in heat pump heating and cooling modes only (not in electric heating modes).
FK4C/D.....Series G reduces airflow in all modes
FK4A.....NONE with original motor. If upgraded to motor/ECM2 motor, it may have programming
FK4B.....NONE with original motor. Replacement motor or module may have programming.

IF an original motor or module has been replaced, it may have Super Comfort Heat and SuperDehumidify capability.

PROCEDURE 2—PCB LAYOUT AND DESCRIPTION (FK4, FV4, 40FK)

NOTE: Layout of actual PCB is depicted in Fig. 11 and 25.

The Easy Select Board is the interface between the ECM motor and other system components. The board offers choices of electric heater size, outdoor unit size and type, comfort or efficiency settings, on and off delay profiles, and continuous fan speed. The installer should select the correct size of components that are being installed in each installation. If no selections are made, the factory default settings are for the largest heater, largest outdoor unit, AC system type, nominal airflow adjust, and 0/90 time delay.

NOTE: Outdoor unit model should have an ARI rating with the variable speed fan coil. Some outdoor unit models will not work properly with this fan coil.

Power for system is supplied from a 230-vac, 60-Hz line. Class 2 voltage (24 vac nom.), used for thermostat connections, is derived from transformer located in close proximity to PCB. The 24-vac secondary circuit includes 5-amp automotive-type fuse in SEC2 circuit.

Connection to heater panel is made through 12-pin connector PL-1. Connections to thermostat are made at screw terminals. Twenty-one pin terminals comprise field select taps for motor.

Fuse Data: 5-amp automotive-type ATC/ATO (tan)
32v
200 percent current opening time of 5 sec maximum

A. Electrical Connections

Twenty-one 0.110-in pin terminals are used to provide programming selections for operating modes of motor/ECM2. The 6 selection modes are listed below. For additional information, refer to Easy Select Configuration Taps section.

AUX Heat Range—(Violet Wire)
AC/HP Size—(Blue Wire) Type—(Orange Wire)
AC/HP CFM Adjust—(Black Wire)
AC/HP Time Delay—(Grey Wire)
Continuous Fan—(Yellow Wire)

PROCEDURE 3—SEQUENCE OF OPERATION (FK4, FV4, 40FK)

A. Continuous Fan Mode

The thermostat closes circuit R to G. The unit delivers the airflow selected for fan only operation.

B. Cooling Mode—Single Speed or 2-Speed High

Thermostat closes circuits R to G, R to Y/Y2 and R to O (heat pump only). A circuit R to Y1 is required for 2-speed high operation. Airflow delivered the airflow selected by AC/HP SIZE selection and CFM ADJUST selection.

C. Cooling Mode—Two-Speed Low

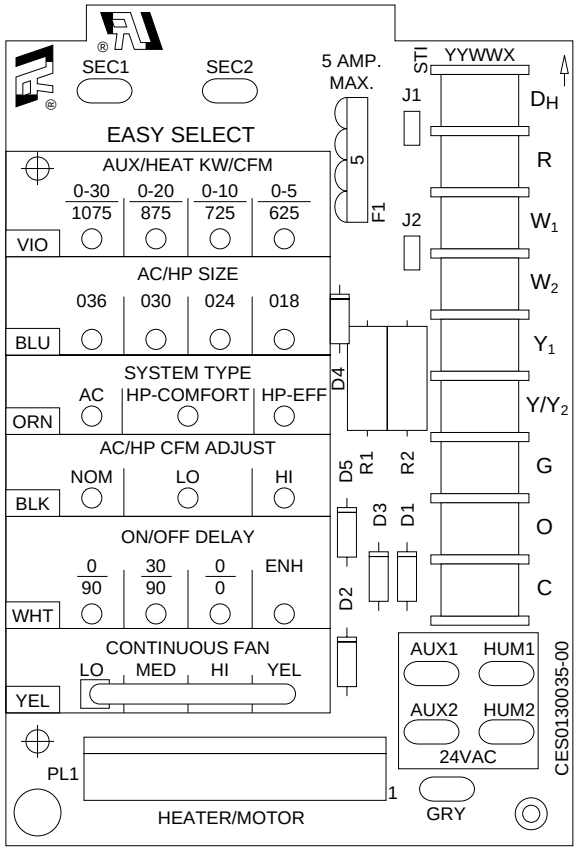
Thermostat closes R to G and R to Y1 and R to O (heat pump only). Unit delivers 2-speed low airflow for AC/HP SIZE and CFM ADJUST selected.

D. Cooling + Dehumidify Mode (Thermidistat or Comfort Zone II-B and Single-Speed Outdoor Unit Installed)

J1 jumper must be pulled from Easy Select Board. Control closes R to G, R to Y/Y2, and R to O (heat pump only) and open R to DH. Dehumidification is active when 24vac is removed from DH terminal. Unit delivers 20% less airflow.

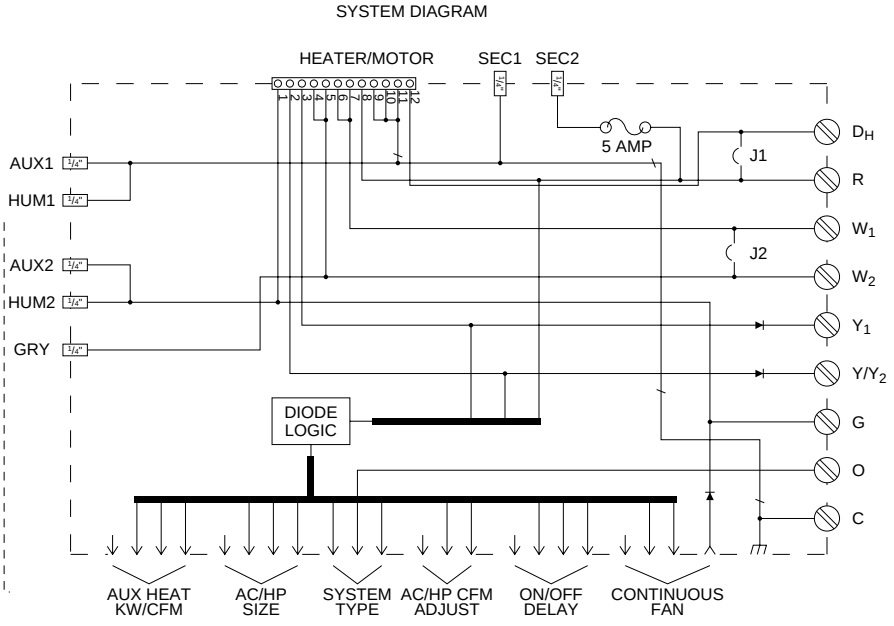
E. SuperDehumidify Mode (Thermidisat or Comfort Zone II-B indoor control, Single-Speed Outdoor Unit)

This mode is only activated by the indoor control when COOL to DEHUMIDIFY and SUPERDEHUMIDIFY are configured at the control and there is a call for dehumidfication without a call for cooling. The control closes R to Y/Y2, R to O (heat pump only) and opens R to DH and R to G. This signals the fan coil to run at minimum airflow for maximum humidity removal. The control will cycle the equipment 10 minutes on and 10 minutes off until satisfied.



A96430

Fig. 11—Easy Select Board



A96431

Fig. 12—Easy Select Board Schematic

F. Heat Pump Heating Mode — Single Speed or 2-Speed High

Thermostat closes R to Y/Y2 and R to G. A circuit R to Y1 is required for 2-speed high operation. The unit delivers airflow selected by AC/HP SIZE selection and CFM ADJUST selection. Selected delay profile is active in this mode.

G. Heat Pump Heating Mode — 2-Speed Low

Thermostat closes R to G and R to Y1. Unit delivers 2-speed low airflow for AC/HP SIZE and CFM ADJUST selected. Selected delay profile is active in this mode.

Table 6—Connections and Connector (FK4C)

Type Connection	Type Connector	Pin No.	Description
Heater Connection	12-Pin	Pin 1	Common to screw terminal G
		Pin 2	Common to screw terminal Y/Y2 through diode D3
		Pin 3	Common to Y1 through diode D2
		Pin 4	Common to W2 screw terminal
		Pin 5	Common to W2 screw terminal
		Pin 6	Common to screw terminal W1 screw terminal
		Pin 7	Common to W1 screw terminal
		Pin 8	R 24VAC
		Pin 9	Common to transformer C
		Pin 10	Common to transformer C
		Pin 11	Common to transformer C
		Pin 12	Common to DH screw terminal

H. Non-Staged Auxiliary Heat with Heat Pump Heating Mode

Thermostat should already have closed R to G, R to Y2 for heat pump heating operation. With J2 jumper in place, energizing either W1 or W2 will produce the W2 airflow. This is the greater of heat pump heating and auxiliary heat airflow plus an additional 15%. The elected delay profile is not active in this mode.

I. Staged Auxiliary Heat with Heat Pump Heating Mode

The auxiliary heat can be staged by removing the J2 jumper that ties W1 and W2 terminals together. Staging can be done by using outdoor thermostats or by using the Intelligent Heat Staging option where the indoor control can be configured for 3-stage electric heat. The unit will automatically adjust airflow when the different stages of heat are energized. The airflow delivered will depend on the heat pump size selected and electric heat size selected. The greater of the two airflows will be delivered. The selected delay profile is not active in this mode.

J. Electric Heat without Heat Pump

Thermostat closes R to W and thermostat should be set up to energize G with W. This is due to the Super Comfort Heat programming in the motor. Energizing W without G will result in 25% lower airflow delivery. The selected delay profile is not active in this mode.

K. Super Comfort Heat Mode

This is a special heating mode only available on FK4, FV4, and 40FK fan coils combined with a Thermidistat Control or Comfort Zone II-B. When this option is selected, the indoor control will monitor the outdoor temperature. The control will drop the G signal to the fan coil when the outdoor temperature is between 10° and 40° F. This triggers the motor to slow to approximately 213 CFM per ton. The heaters will stage as needed during this mode and the motor will adjust airflow as required. Below 10° F., theW1 control output will automatically energize on a call for heat. The motor/ECM2 power connections are made at the transformer primary terminals. The transformer secondary connections are made at SEC1 and SEC2 connectors.

PROCEDURE 4—EASY SELECT CONFIGURATION TAPS

The Easy Select taps are used by installer to configure system. The motor/ECM2 uses selected taps to modify its operation to a pre-programmed table of airflows. Airflows are based on system size and mode of operation and those airflows are modified in response to other inputs such as the need for de-humidification. (See Fig. 11.)

The FK4, FV4, and 40FK Fan Coils must be configured to operate properly with system components with which it is installed. To successfully configure a basic system (see information printed on circuit board located next to select pins), move the 6 select wires to pins which match components used, along with homeowner preferences.

A. Auxiliary Heat Range

The installer must select the auxiliary heat airflow approved for application with kw size heater installed. Each select pin is marked with a range of heaters for which airflow (also marked) is approved. For increased comfort select the narrowest kw range matching the heater size, for example, 0-10 for a 10-kw heater. This airflow must be greater than the minimum CFM for electric heater application with the size system installed for safe and continuous operation. Note that airflow marked is the airflow which will be supplied in emergency heat mode and heating mode on air conditioners when electric heat is primary heating source. To ensure safe heater operation in heat pump heating mode when electric heaters are energized, the motor/ECM2 will run the higher of heat pump airflow and electric heater airflow. The factory default selection is largest heater range approved. (See Fig. 11.)

B. AC/HP Size

The factory default setting for air conditioner or heat pump size is largest unit meant for application with model of fan coil purchased. The installer needs to select air conditioner or heat pump size to ensure that airflow delivered falls within proper range for size of unit installed in all operational modes. (See Fig. 11.)

C. System Type

The type of system must be selected.

1. AC—air conditioner (approx. 350 CFM/ton)
2. HP-COMFORT—provides lower airflow than air conditioner selection (approximately 315 CFM/ton) in heating mode. In cooling mode supplies 350 CFM/ton.

Table 7—Typical Operating Modes

Operating Mode	Terminals Energized
Heat Pump Only Heating	R, Y/Y2, G, DH
Heat Pump Only Heating + Super Comfort Heat Mode	R, Y/Y2, DH
Heat Pump Heating + Auxiliary Heat (non-staged)	R, Y/Y2, G, DH, W2
Cooling	R, Y/Y2, G, DH, O
Cooling + Dehumidification	R, Y/Y2, G, 0
Cooling + Superdehumidify	R, Y/Y2, O

3. HP-EFF—provides same airflow for heat pump heating and cooling modes (approximately 350 CFM/ton).

The factory setting is AC. (See Fig. 11.)

D. AC/HP CFM Adjust

Select low, nominal, or high airflow. The factory selection is NOM. The adjust selections HI/LO will regulate airflow supplied for cooling and heat pump heating modes only, +15 percent and -10 percent respectively. The adjust selection options are provided to adjust airflow supplied to meet individual installation needs for such things as noise, comfort, and humidity removal. (See Fig. 11.)

E. ON/OFF Delay

NOTE: ON/OFF Delay is active only in cooling and heat pump only heating modes. In auxiliary heat mode or emergency heat mode, the ON delay is 0 seconds and the OFF delay is fixed and cannot be overridden.

Select desired time delay profile. Four motor operation delay profiles are provided to customize and enhance system operation. (See Fig. 11.) The selection options are:

1. The standard 90 sec off delay (factory setting 0/90).
2. No delay option used for servicing unit or when a thermostat is utilized to perform delay functions (0/0).
3. A 30 sec on/90 sec off delay profile used when it is desirable to allow system coils time to heat up/cool down prior to airflow. This profile will minimize cold blow in heat pump operation and could enhance system efficiency (30/90).
4. ENH, enhanced selection provides a 30 sec on/150 sec at 70 percent airflow and no off delay.

F. Continuous Fan

Select desired Continuous fan profile LO, MED, or HI. Airflow are provided to customize and enhance the continuous fan functions. (See Fig. 11.) The possible selections are:

1. LO—provides 50% of Y/Y2 Cool airflow.
2. MED—provides 65% of Y/Y2 Cool airflow (71% on 006 model).
3. HI—provides 100% of Y/Y2 Cool airflow.

The factory setting is LO.

NOTE: If applied to two-speed unit, do not select continuous fan as HI since low speed cooling will also run at HIGH airflow and insufficient dehumidification may result.

G. Easy Select Board Jumpers

J1 - This jumper must be pulled to activate dehumidification mode. The jumper connects R to DH. With the jumper in, the DH terminal is always energized. With the jumper pulled, the DH terminal is de-energized. A control such as the Thermidistat must be used to supply the 24-volt signal when there is no call for dehumidification, and turn off the 24 volts when there is a call for dehumidfication.

J2 - This jumper activates heat staging. The jumper connects the W1 and W2 terminals together. If either is energized, W2 airflow is delivered. With the jumper pulled, there are separate airflows for W1 and W2.

H. Airflow Delivery

These units deliver airflow depending on the system size selections and operating mode. The thermostat energizes a combination of terminals on the Easy Select Board which tells the motor what CFM to deliver. The following are typical operating modes and the terminals that should be energized on the Easy Select Board.

NOTE: The DH terminal on the Easy Select Board is for dehumidification. It is de-energized on a call for dehumidification.

I. Variable Speed Motor Logic Sequence:

The ECM motors in these fan coils are programmed to deliver a variety of airflows. The motor goes through:

COOLING

The nominal cooling airflow for these fan coils is 350 CFM per ton. Selecting the HI adjust tap increases the airflow to 400 CFM per ton. The LO tap decreases airflow to 315 CFM per ton. The low adjustment is only active during normal cooling mode. Removing the signal from the DH terminal reduces the airflow to 80% of cooling airflow. Removing the G signal for Superdehumidify reduces the airflow to 50% of cooling.

HEATING

The base heat pump only heating airflow is determined by the SYSTEM TYPE selection on the Easy Select Board. If HP-EFFICIENCY is selected, the airflow is the same as Cooling. IF HP-COMFORT is selected, the airflow is 315 CFM per ton. The airflow will adjust up if necessary when auxiliary heating is required. When both the Y/Y2 and W1 or W2 terminals are energized, the motor will run the higher of the heat pump or electric heat airflows. During Super Comfort Heat mode, the indoor control removes the G signal from the board. This slows the motor to 75% of heat pump airflow. If the CFM adjust is set to LO, it will deliver 67.5% of heat pump airflow during Super Comfort Heat mode.

PROCEDURE 5—TROUBLESHOOTING

A. Troubleshooting Easy Select Board (FK4, FV4, 40FK)

IF TRACES ARE OVERHEATED ON BACK OF PCB:

Usually whenever there is a trace broken on PCB, it means either there has been a high-voltage short or high voltage has been applied to low-voltage circuit. This can be prevented by making sure PCB is wired correctly before fan coil has power applied to it.

If PCB Fuse Keeps Blowing:

When low-voltage fuse blows, it means transformer would have blown if fuse had not been in circuit to protect it. The fuse usually blows when there is a high current drawn on transformer, high voltage applied to low-voltage circuit, or a direct secondary short. When there is a high current drawn on transformer, it is most likely because transformer has been shorted or system is trying to draw more vac than transformer rating allows. When fuse blows because of high voltage, the system has mixed high- and low-voltage signals.

1. Check transformer and thermostat wiring. (See Fig. 11 and 13.) Be sure transformer is not shorting out because thermostat wires are miswired.
2. Check wiring of relays. (See Fig. 11 and 13.) Be sure low-voltage and high-voltage wiring are connected to proper sequencers.
3. Check VA draw on transformer. If VA draw is more than VA rating of transformer, fuse will blow. If this is the case, replace transformer with one that has a higher VA rating.

B. Troubleshooting Common Problems

Airflow Too Low:

Y1 instead of Y/Y2 on single-speed air conditioner or heat pump application. Y1 input is only for 2-speed applications. Using this terminal will deliver about 60% of full cooling airflow.

Wrong Easy Select Board selection. Selecting an outdoor unit or electric heater smaller than actually installed will result in low airflow for the application.

G not energized with call for cooling or heating. This triggers Super Comfort Heat or SuperDehumidify mode which delivers 50% of cooling airflow.

J1 jumper pulled with no Thermidistat or dehumidistat installed. The J1 jumper ties the DH terminal to R and is installed at the factory. When pulled, a Thermidistat or dehumidistat supplies a 24-volt signal to DH when there is no call for dehumidification (reverse logic). When there is no signal on DH, the motor reduces airflow to 80% for better dehumidification.

Airflow Too High:

Wrong Easy Select Board selection. Fan coil is factory set for the largest outdoor unit and largest electric heater. Select sizes that are actually installed.

Continuous fan set too high for 2-speed applications. Set to MED or LO.

Motor Will Not Stop:

Allow time for off delay to time out. In units built before serial number 0101A, any W call will have a 2 minute off delay independent of delay selection. This is programmed into the motor and cannot be overridden.

In units built after 0101A, the off delay on any W call is 1 minute and cannot be overridden.

Some power stealing thermostats could bleed enough voltage to cause motor to run slowly when there is no heating or cooling call. Disconnect thermostat wires and wait 2 minutes to see if motor stops. If it stops, replace thermostat, or install resistor per thermostat installation instructions.

Motor Will Not Start:

See following section, ″Troubleshooting motor/ECM2 Motor and Controls″

C. Troubleshooting motor/ECM2 Motor and Controls

⚠ CAUTION: ELECTRICAL OPERATION HAZARD
Failure to follow this caution may result in equipment damage or improper operation.
High voltage is always present at motor. Disconnect power to unit before removing or replacing connectors or servicing motor. Wait at least 5 minutes after disconnecting power before opening motor.

The ECM/ICM motor used with this product contains two parts: the control module and the motor winding section. Do not assume the motor or module is defective if it will not start. Go through the steps described below before replacing control module, Easy Select Board or entire motor. The control module is available as a replacement part.

D. If Motor Turns Slowly:

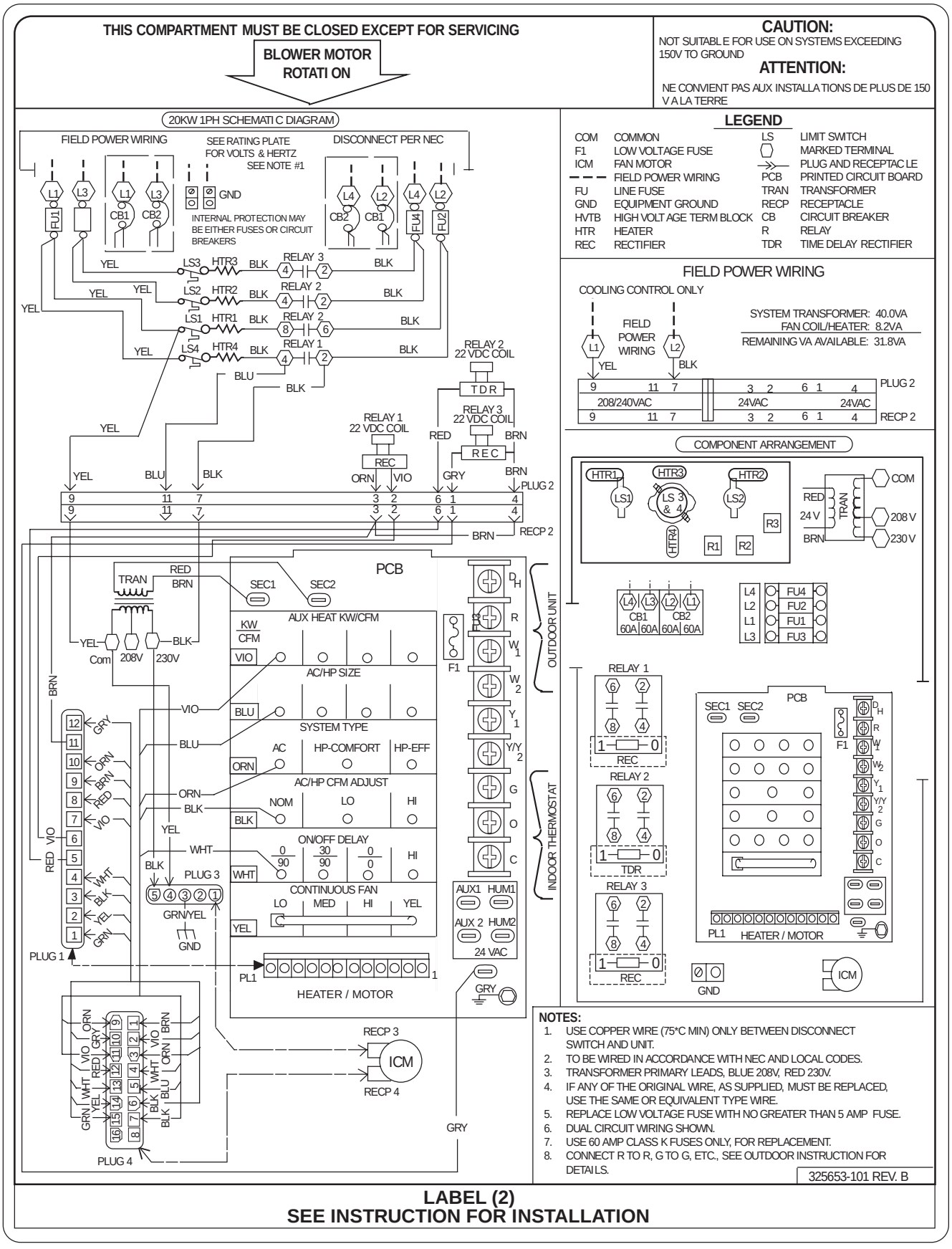
1. It is normal operation to run noticeably slower if G terminal is not energized in cooling or heat pump heating modes.
2. Attach blower access panel. Motor may appear to run slowly if access panel is removed.

E. If Motor Does Not Run:

Turn power off, wait 5 minutes and check the following:

1. With power turned off, check 5 amp fuse on Easy Select Board
2. Check all plugs and receptacles for any deformation or corrosion that could cause bad connections. Be sure plugs are fully seated.

⚠ CAUTION: ELECTRICAL OPERATION HAZARD
Failure to follow this caution may result in equipment damage or improper operation.
DO NOT remove or apply 5-pin plug on motor with power on. Arcing could occur which can damage control module.



A00178

Fig. 13—FK4C, FV4A, and 40FKA Wiring Diagram with 20kw heater after heater serial # 1900A56372

Turn power back on and check the following:

3. Check for 24vac on SEC1 and SEC2. If no voltage is present, check transformer.
4. Verify that approximately 230vac is present at motor.
5. Verify low voltage control signals to motor according to procedure below.

Use following procedure to check low voltage signals:

The ECM motor in these fan coils receive low voltage signals from the Easy Select Board through the wiring harness assembly. The combination of pins energized at the motor determines the speed the motor will run. The procedure below isolates the fan coil from all external devices such as a thermostat, condensing unit, humidifier or electronic air cleaner. There is also a specific troubleshooting example to demonstrate the process. Table 7 provides information needed to verify that the correct voltages are present at the motor and the Easy Select Board.

THERMOSTAT:

1. Remove all thermostat and accessory wires from Easy Select Board.
2. On Easy Select Board, jumper screw terminals (1 at a time): R-G, R-Y/Y2, R-Y1, R-W1, R-W2. If motor runs in all cases, check thermostat outputs. Thermostat wires may be broken, or thermostat may be miswired, configured incorrectly, or defective. If the motor does not run, or runs in some cases, but not others, continue this procedure to check wiring harness and circuit board.

WIRING HARNESS:

1. Remove 16-pin plug from motor.
2. Check for appropriate voltages on 16-pin connector with screw terminals jumpered. (See Table 6.)
3. If signals check correctly, and motor does not run, inspect wiring harness for loose pins or damaged plastic that could cause poor connections.
4. If connections are good, either control module or motor is defective.
5. If proper signals are not present, check circuit board using procedure below:

12-PIN PLUG (PL-1) ON EASY SELECT BOARD:

1. Completely disconnect wire harness from Easy Select Board.
2. Jumper the screw terminals one at a time; R-G, R-Y/Y2, R-Y1, R-W1, R-W2 and check for appropriate voltages on the Easy Select Board pins. If proper signals are not present, replace Easy Select Board. If proper signals are present at the pins and not at 16-pin connector to the motor, the wiring harness is defective.

TROUBLESHOOTING EXAMPLE:

Motor is not running on a call for heat pump heating after jumpering the Easy Select Board screw terminals as described in Thermostat section above:

With all thermostat wires removed from Easy Select Board, place a jumper wire between R and Y/Y2 low-voltage screw terminals on the Easy Select Board

1. Check Table 8 for pin number on 16-pin connector associated with the Y/Y2 signal. The correct pin is #14. The far right column of Table 8 shows that (-) 12vdc should be present between pin #14 and pin #1 (common) on the 16-pin connector.
2. Set meter to read DC voltage. Place meter leads between pins #1 (common) and #14 and check for (-) 12vdc. If signal is present, the problem is in the module or motor. If signal is not present, the problem is either in wiring harness or Easy Select Board.

These steps can be repeated for other modes of operation.

To check Easy Select Board:

1. Leave jumper wire in place between R and Y/Y2.
2. Check Table 8 under ″Volt Meter on Easy Select Board Plug″ column and row for pin #14 on motor plug to see pin # on Easy Select Board that should have voltage. The correct pin is #2. The column on far right will show voltage that should be present between pin #2 and pin #9 (common).
3. Place meter leads between pins #2 and #9 on Easy Select Board and check for (-) 12vdc.
4. If voltage is present, the wiring harness is bad. If not, the Easy Select Board is bad.

Verify Motor Winding Section:

Before proceeding with module replacement, check the following to ensure motor winding section is functional. With control module removed and unplugged from winding section:

1. The resistance between any 2 motor leads should be similar.
2. The resistance between any motor lead and the unpainted motor end plate should be greater than 100K ohms.

If motor winding fails one of these tests, it is defective and must be replaced.

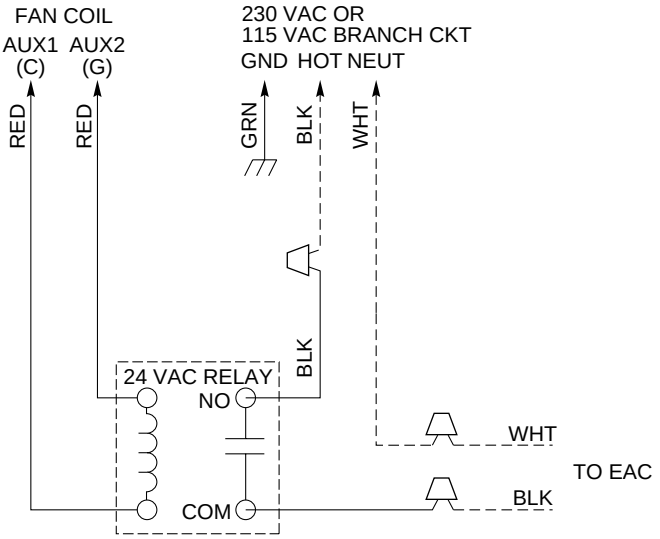
F. Accessories

AUXILIARY TERMINALS

The AUX and HUM terminals on the Easy Select Board are tied directly to the G terminal, and provide a 24-vac signal whenever the G terminal is energized (See Fig. 5 and Fig. 6). During Superdehumidify mode, the G signal is not present and the auxiliary terminals are not energized. If the installation includes the use of this operating mode, do not use these terminals to control accessories. See Electronic Air Cleaner and Humidifier sections for further information.

Table 8—FK4C Motor Control Test Values
(With 16-pin connector at motor unplugged)

Terminals Jumpered	Volt Meter on 16 PIN Harness Plug		Volt Meter on 12-pin Easy Select Board Plug		Voltage
	+	-	+	-	
R to W1	Pin 2	Pin 1	Pin 7	Pin 9	24vac
R to W2	Pin 13	Pin 1	Pin 4	Pin 9	24vac
R to Y1	Pin 6	Pin 1	Pin 3	Pin 9	(-)12vdc
R to Y/Y2	Pin 14	Pin 1	Pin 2	Pin 9	(-)12vdc
R to G (LO)	Pin 15	Pin 1	Pin 3	Pin 9	Ovac
R to G (MED)	Pin 6	Pin 1	Pin 3	Pin 9	(-)12vdc
R to G (HI)	Pin 14	Pin 1	Pin 2	Pin 9	(-)12vdc



A98625

Fig. 14—KFAIR0201ACR Relay Kit
Wiring Schematic

ELECTRONIC AIR CLEANER CONNECTIONS

The AUX1 and AUX2 terminals are not always energized during blower operation, as described above. When using an electronic air cleaner with the FV4 fan coil, use Airflow Sensor . The airflow sensor turns on electronic air cleaner when the fan coil blower is operating.

HUMIDIFIER / HUMIDISTAT CONNECTIONS

Easy Select Board terminals HUM1 and HUM2 are provided for direct connection to the low-voltage control of a humidifier through a standard humidistat. These terminals are energized with 24vac when G thermostat signal is present. Alternately, the 24-vac signal may be sourced from the W and C terminal block connections when electric heaters are used as primary heating source. When using a Thermidistat™ Control, Zone Perfect Plus, or Comfort Zone II, the 24-vac signal may be source directly from the Thermidistat HUM terminal.

G. FK4, FV4, and 40FK Dehumidify Mode

NOTE: Humidistat must open on humidity rise.

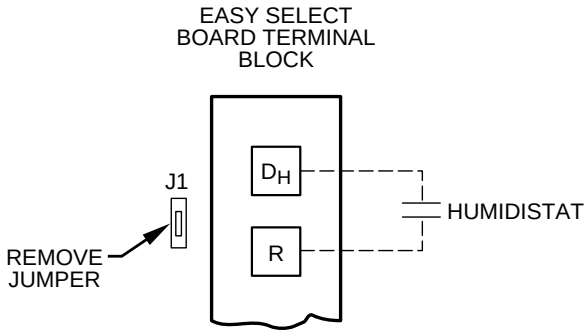
Latent capacities for systems using the FK4, FV4, and 40FK fan coils are better than average systems. If increased latent capacity is an application requirement, the field wiring terminal block provides connection terminals for use of a standard humidistat. The FK4, FV4, and 40FK fan coils will detect the humidistat contacts opening on increasing humidity and reduce its airflow to approximately 80 percent of nominal cooling mode airflow. This reduction will increase the system latent capacity until the humidity falls to a level which causes the humidistat to close its contacts. When the contacts close, airflow will return to 100 percent of the selected cooling airflow. To activate this mode, remove jumper J1 and wire in a standard humidistat. (See Fig. 15.) Carefully consult product airflow data for cooling and dehumidification modes.

FE4

Model FE4A fan coil is designed to be installed with a communicating user interface. The FE4A fan coil will provide airflow at a rate commanded by the User Interface. The nominal airflow/ton rate is 350 CFM/ton. The User Interface will modify the commanded airflow under certain operating modes. Refer to the User Interface literature for further system control details. This fan coil will not respond to commands from a common thermostat except under certain emergency situations explained in this document.

PROCEDURE 1—ELECTRONICALLY COMPUTED MOTOR (ECM2.5)

An ECM2.5 is fed high voltage AC power through the 5-pin connector. The AC power is then internally rectified to DC by a diode module. After rectification, DC signal is electronically communicated and fed in sequential order to 3 stator windings. The frequency of these communication pulses determines motor speed. The rotor is permanently magnetized.



A95316

Fig. 15—Humidistat Wiring for De-Humidify Mode

ECM2.5 CONTROL POWER

The ECM2.5 control power is supplied from R circuit through printed circuit runs to motor control connector Plug 1, pin 1, through motor control harness to motor. The C side of low-voltage control power circuit is connected by printed circuit runs to motor connector Plug1, pin 2 then through motor control harness to motor. A digital signal is sent from Plug 1, pins3 and 4 to communicate with the motor including all airflow requirements.

LOW-VOLTAGE CIRCUIT FUSING AND REFERENCE

The low-voltage circuit is fused by a board-mounted 5-amp automotive type fuse placed in series with transformer SEC2 and R circuit. The C circuit of transformer is referenced to chassis ground through a printed circuit run at SEC1 connected to metal standoff.

NOTE: The PCB must be mounted with 2 screws and motor ground lead secured to blower housing or erratic motor operation can result.

TRANSFORMER, MOTOR, AND ELECTRIC HEATER POWER CONNECTION

Transformer high voltage supplied from electric heater package or high voltage leads through 12-pin heater connector plug/recp2. The ECM2.5 power connections are made at the transformer primary terminals. The transformer secondary connections are made at SEC1 and SEC2 connectors.

PROCEDURE 2—TROUBLESHOOTING (FE4)

NOTE: Always check high and low voltage supply to the fan coil components. Check the integrity of the plug receptacle connections and fan coil wiring harness prior to assuming a component failure.

A. LED Description:

LEDs built into fan coil control provide installer or service person information concerning operation and/or fault condition of the fan coil control and ECM motor. This information is also available at system User Interface in text with basic troubleshooting instructions. Careful use of information displayed will reduce the need for extensive manual troubleshooting.

The amber LED located at bottom center of control adjacent to motor harness plug is Motor Status LED and it is labeled MOTOR. A second amber LED located in upper right center of control adjacent to System Communications connector (A,B,C,D) is the System Status LED and it is labeled STATUS. The green LED labeled COMM is also located adjacent to System Communications connector, below STATUS LED, and is used as an indicator of system communications status. Status Codes will be displayed on the STATUS LED using the following protocol:

1. The number of short flashes indicates first digit of code.
2. The number of long flashes indicates second digit of code.
3. A short flash is 0.25 seconds on. A long flash is 1 second on.
4. The time between flashes is 0.25 seconds.
5. The time between last short flash and first long flash is 1 second.
6. The LED will be off for 2.5 seconds before repeating code.

B. Fan Coil Control Start-Up and System Communications Troubleshooting:

On power up, green COMM LED will be turned off until successful system communications are established (this should happen within 10 seconds). Once communications with User Interface are successful, COMM LED will be lit and held on. At the same time, amber STATUS LED will be lit and held continuously on until a request for operating mode is received. The STATUS LED will be on any time fan coil is in idle mode.

If, at any time, communications are not successful for a period exceeding 2 minutes, fan coil control will only allow emergency heating or cooling operation using a common thermostat, a non-communicating outdoor unit and the R, C, Y, O, W outdoor unit terminal strip connections and will display **Status Code 16, System Communication Fault**, on amber STATUS LED. No further fan coil troubleshooting information will be available at User Interface until communications are re-established.

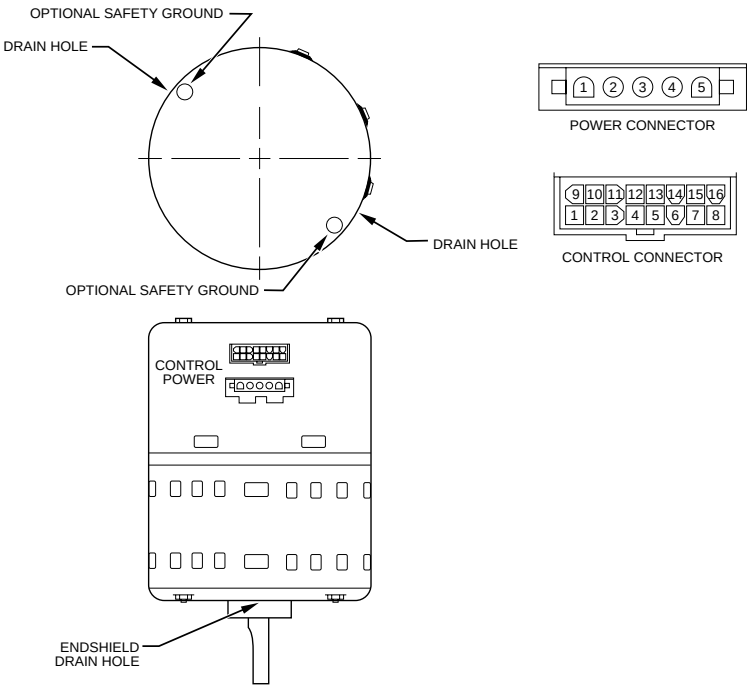
If COMM LED does not light within proper time period and status code is not displayed,

1. Check system transformer high and low voltage to be sure the system is powered.
2. Check fuse on fan coil control to be sure it is not blown. If fuse is open, check system wiring before replacing it to be sure a short does not cause a failure of replacement fuse.

If COMM LED does not light within proper time period and status code is displayed,

1. Check system wiring to be sure User Interface is powered and connections are made A to A, B to B, etc. and wiring is not shorted. Mis-wiring or shorting of the ABCD communications wiring will not allow successful communications.

NOTE: Shorting or mis-wiring low voltage system wiring **will not** cause damage to fan coil control or User Interface but may cause low voltage fuse to open.



A98201

Fig. 16—FE4A ECM2.5 Motor

C. ECM Motor Troubleshooting

The ECM motor used in this product consists of two parts: the control module and the motor winding section. Do not assume motor or module is defective if it will not start. Use the designed-in LED information aids and follow troubleshooting steps described below before replacing motor control module or entire motor. Motor control module is available as a replacement part.

VERIFY MOTOR WINDING SECTION:

⚠ **WARNING: ELECTRICAL SHOCK HAZARD**

Failure to follow this warning could result in personal injury or possible equipment damage.

After disconnecting power from the ECM motor, wait at least 5 minutes before removing the control section. Internal capacitors require time to discharge. Minor injury from electrical shock may result from early contact with live metal parts.

Before proceeding to replace a motor control module:

1. Check motor winding section to be sure it is functional.
2. Remove motor control module section and unplug winding plug. Motor shaft should turn freely, resistance between any two motor leads should be similar and resistance between any motor lead and unpainted motor end should exceed 100,000 ohms.
3. Failing any of these tests, entire ECM motor must be replaced.
4. Passing all of the tests, motor control module alone can be replaced.

MOTOR TURNS SLOWLY:

1. Low static pressure loading of blower while access panel is removed will cause blower to run slowly. Particularly at low airflow requests. This is normal, do not assume a fault exists.
2. Recheck airflow and system static pressure using User Interface service screens with access panel in place.

NOTE: Blower motor faults will not cause a lockout of blower operation. Fan coil control will attempt to run the blower motor as long as User Interface maintains a demand for airflow. Fan coil control will not operate electric heaters while a fault condition exists. The fan coil control communicates with the motor at least once every 5 seconds, even when the motor is idle. If, during operation, the fan coil control does not communicate with the motor for more than 25 seconds, the motor will shut itself down and wait for communications to be reestablished.

D. Using Motor LED in Troubleshooting

The MOTOR LED is connected to the blower motor communication line and works with the fan coil control microprocessor and the STATUS LED to provide fan coil operation and troubleshooting information. When the motor is commanded to operate, the MOTOR LED will be turned on and will flash each time instructions are sent to the motor. When the motor is commanded to stop, the MOTOR LED will be turned off.

If the MOTOR LED is lit, flashing and the motor is running or if the MOTOR LED is off and the motor is stopped, operation is normal and no motor fault exists.

If the MOTOR LED is lit, flashing and the motor does not run, or if the MOTOR LED is off and the motor is running, check the STATUS LED for the Status Code. Refer to the troubleshooting instructions for the indicated Status Code in Section E, Fan Coil Troubleshooting.

E. Fan Coil Troubleshooting

Fan coil faults indicated by flashing codes on the amber system STATUS LED can be resolved using troubleshooting information provided below. Codes are listed in order of their priority, highest to lowest. Though multiple faults can exist at any time, only the highest priority code will be displayed on STATUS LED. Clearing the indicated fault when multiple faults exist will cause the next highest priority Status Code to be flashed. All existing faults, as well as a fault history, can be viewed at User Interface.

STATUS CODE 45, CONTROL BOARD TEST FAULT:

Fan coil control has failed internal start-up tests and must be replaced. No other service procedure will correct.

STATUS CODE 37, HEATER OUTPUT SENSED ″ON″ WHEN NOT ENERGIZED:

Fan coil control is provided with circuitry to detect presence of a 24 vac signal on Electric Heater stage 1 and stage 2 outputs.

If fan coil control detects a 24 vac signal on either heater stage output and it is not supplying signal, Status Code 37 will be displayed on STATUS LED. Fan coil control will turn off output and command blower motor to supply an airflow determined to be safe for current operation mode with electric heaters energized.
To find the fault:

1. Stop all system operations at User Interface and check heater stage 24 vac outputs.
2. Disconnect electric heater at plug/receptacle 2 and check heater wiring for faults. See Status Code 36 for more information.

STATUS CODE 44, MOTOR COMMUNICATION FAULT:

The MOTOR LED is connected to the blower motor communication line and works with the fan coil control microprocessor and STATUS LED to provide fan coil operation and troubleshooting information.

When motor is commanded to operate, the MOTOR LED will be turned on and will flash each time instructions are sent to the motor.

When the motor is commanded to stop, the MOTOR LED will be turned off. The MOTOR LED will not flash to indicate communications when it is turned off.

Fan coil control is constantly communicating with the motor, even when the motor and MOTOR LED are off. If motor does not acknowledge receipt of communications, the control will display Status Code 44 on STATUS LED and continue to try to communicate with the motor. If motor acknowledges communication, status code will be cleared.

If MOTOR LED is lit and flashing and motor does not run:

1. Check the STATUS LED. If STATUS LED is indicating a Status 44 code, check the motor wiring harness for proper connection to control and motor receptacles.
2. Check motor wiring harness to be sure all wiring complies with wiring diagram description, makes a complete circuit from connector to connector and is not shorted.
3. Check 12 Vdc low voltage supply to motor at pins 1 (+) and 2 (-) of motor header connection to fan coil control. See wiring diagram Fig. 17.

If all checks are normal, fan coil control is good and control module on motor may need replacement. Check motor and Motor Control Module following the instructions in Section C. ECM Motor Troubleshooting.

Shorted or mis-wiring of the low voltage motor harness wiring will not cause damage to fan coil control or to motor control module.

If the MOTOR LED is off, STATUS LED is indicating a Status Code 44 and motor is running:

1. Disconnect the motor harness at the fan coil control. If motor continues to run, fan coil control is good and control module on motor may need replacement

STATUS CODE 25, INVALID MOTOR / MODEL SELECTION:

On initial start-up, fan coil control shall poll motor for its size data and check fan coil size data stored in fan coil control memory.

1. If motor size is incorrect for fan coil size or fan coil size data is invalid, Status Code 25 will be displayed on STATUS LED.
2. If model size data is missing (as is the case when a replacement fan coil control is installed), system User Interface will prompt installer to enter correct model size from a list of valid sizes.
3. If motor size is incorrect for model size, motor must be replaced with proper size motor. **Fan coil control will not respond to operation requests until this fault condition is resolved.**

STATUS CODE 27, INVALID OUTDOOR UNIT SIZE:

On initial power-up, fan coil control will write into memory outdoor unit size as provided by User Interface in a fully communicating system.

1. If outdoor unit size is invalid, Status Code 27 will be displayed on STATUS LED.
2. User Interface will prompt the installer to choose size from a list of valid sizes for application with fan coil.
3. Check communications wiring to be sure User Interface has established communications with outdoor unit or select proper size from valid size list provided at User Interface.
4. Check motor and motor control module following the instructions in Section C. ECM Motor Troubleshooting.

STATUS CODE 26, INVALID HEATER SIZE:

On initial power-up, fan coil control will write into memory electric heater size as read from heater if heater is provided with Identifier Resistor (IDR). Heater size must be valid for combination of indoor and outdoor components installed. Fan coil control will read IDR value connected to pins 5 and 8 of heater harness connector. If no resistor is found, system User Interface will prompt installer to verify that no heater is installed. Verifying that this is correct will establish that fan coil is operating without an electric heater accessory. Upon choosing negative option, installer will be prompted to select heater size installed from a list of valid heater sizes for fan coil and outdoor unit size installed.
If heater ID resistor value read is invalid, Status Code 26 will be displayed on STATUS LED.
If heater installed is equipped with a resistor connected to pins 5 and 8 of heater harness connector and status code 26 is displayed on STATUS LED,

1. Check wiring harness connections to be sure connections are secure.

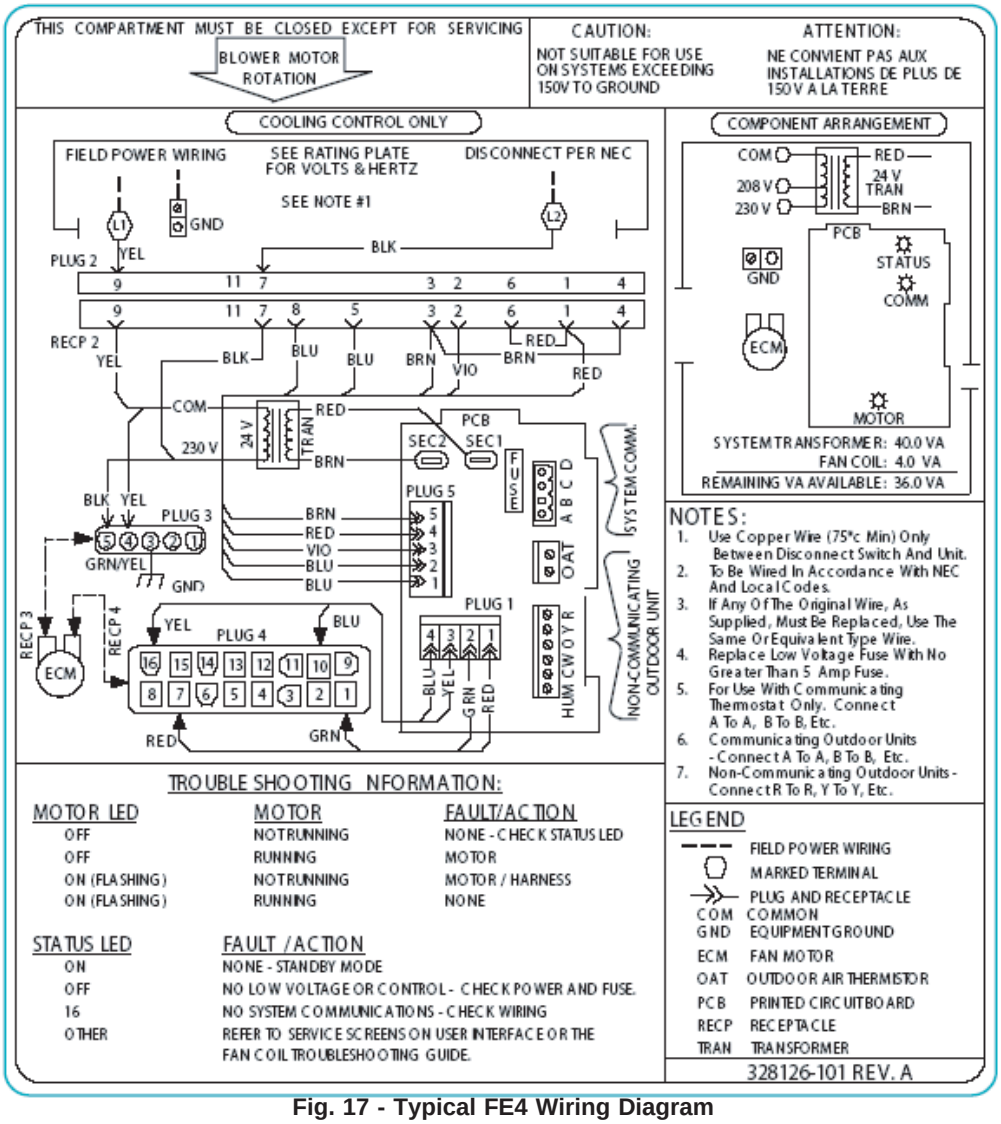


Fig. 17 - Typical FE4 Wiring Diagram

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2. If symptoms persist, disconnect wiring harness at fan coil control heater header and check for a resistance value greater than 5000 ohms.
3. Check for proper wiring of resistor assembly.
4. Make sure heater size installed is an approved size for outdoor unit and fan coil sizes installed.

NOTE: Fan coil control will not operate electric heater until this Status Code is resolved. If the heater size is set through the User Interface, the heater will be operated as a single stage heater. If staging is desired, the IDR value must be read in by the fan coil control.

STATUS CODE 36, HEATER OUTPUT NOT SENSED WHEN ENERGIZED:

Fan coil control is provided with circuitry to detect presence of a 24 vac signal on Electric Heater stage 1 and stage 2 outputs.
If fan coil control energizes either heater stage and does not detect the 24 vac signal on output, Status Code 36 will be displayed on the STATUS LED Fan coil control will continue to energize heater output(s) and adjust blower operation to a safe airflow level for energized electric heat stage(s).
To find the fault,

1. Check for 24 vac on heater stage outputs. Fan coil control or sensing circuit may be bad.

NOTE: It may be useful as an electric heater troubleshooting procedure to disconnect the system communications to force Status Code 16 enabling of emergency heat mode. It is difficult to know which heater output is energized or not energized in normal operation. When fan coil is operated in emergency heat mode using electric heaters, both outputs are energized and de-engergized together. Terminal strip inputs to control can then be connected R to W to turn on both electric heat outputs. Heater output sensing circuits can then be checked to resolve Status Code 36 or 37 problems.

STATUS CODE 41, BLOWER MOTOR FAULT:

If MOTOR LED is lit and flashing and motor does not run:

1. Check STATUS LED. If STATUS LED is indicating Status Code 41, motor control has detected that the motor will not come up to speed within 30 seconds of being commanded to run or that the motor has been slowed to below 250 rpm for more than 10 seconds after coming up to speed. Motor wiring harness and fan coil control are operating properly, do not replace.
2. Check to be sure that the blower wheel is not rubbing the housing.

3. Check motor to be sure that the motor shaft is not seized (motor control module must be removed and electronics disconnected from windings to perform this check properly).
4. Check motor windings section following instructions in Section C. ECM Motor Troubleshooting.

If all these checks are normal, the motor control module may need replacement.

STATUS CODE 16, SYSTEM COMMUNICATION FAULT:

If, at any time, system communications are not successful for a period exceeding 2 minutes, the fan coil control will only allow emergency heating or cooling operation using a common thermostat, a non-communicating outdoor unit, and the R, C, Y, O, W outdoor unit terminal strip connections and will display Status code 16 on the amber STATUS LED (see section E, Emergency Heating and Cooling Modes). No further fan coil troubleshooting information will be available at the User Interface until communications are reestablished.

Check system wiring to be sure the User Interface is powered and connections are made A to A, B to B, etc. and wiring is not shorted. Mis-wiring or shorting of the ABCD communications wiring will not allow successful communications. Correcting wiring faults will clear the code and reestablish communications.

Shorting or mis-wiring the low voltage system wiring will not cause damage to fan coil control or to User Interface but may cause the low voltage fuse to open.

STATUS CODE 46, BROWNOUT CONDITION:

If the secondary voltage of the transformer falls below 15 vac for a period exceeding 4 seconds, Status Code 46 will be displayed on STATUS LED. If system includes a non-communicating outdoor air conditioner or heat pump, the User Interface will command the fan coil to turn off Y output controlling compressor.

When secondary voltage rises above 17 vac for more than 4 seconds, the brownout condition is cleared and normal system operation will resume subject to any minimum compressor off delay function which may be in effect. Brownout does not affect blower or electric heater operation.

STATUS CODE 53, OUTDOOR AIR TEMPERATURE SENSOR FAULT:

If an OAT sensor is found at power-up, input is constantly checked to be within a valid temperature range. If sensor is found to be open or shorted at any time after initial validation, Status Code 53 will be displayed at amber STATUS LED.

Check for faults in wiring connecting sensor to OAT terminals. Using an Ohmmeter, check resistance of thermistor for a short or open condition. If thermistor is shorted or open, replace it to return the system to normal operation. If fault is in the wiring connections, correcting the fault will clear the code and return the system to normal operation.

NOTE: If fault condition is an open thermistor or a wiring problem that appears to be an open thermistor and the power to the fan coil control is cycled off, the fault code will be cleared on the next power-up but the fault will remain and system operation will not be as expected. This is because on power-up, the fan coil control cannot discern the difference between an open sensor or if a sensor is not installed.

F. Emergency Heating and Cooling Modes

Fan coil control can provide **emergency** heating or cooling using a common heat/cool thermostat in the event that there are no system communications, fault is in User Interface and no replacement is immediately available.
To activate these modes, the thermostat and outdoor unit must be wired as a common heating/cooling system to fan coil control RYWC terminals . Fan coil control must be powered and displaying Status Code 16, System Communication Fault.

NOTE: These emergency modes do not provide the level of comfort and efficiency expected by the consumer and should only be activated when User Interface cannot be replaced immediately.

PROCEDURE 3—FE4A FAN COIL SEQUENCE OF OPERATION

The FE4A fan coil is designed for installation with a communicating User Interface. This fan coil will not respond to commands provided by a common thermostat except under certain emergency situations described in Procedure 9 — Start Up and Troubleshooting.

The User Interface uses temperature; humidity and other data supplied from indoor and outdoor system components to control heating or cooling system for optimum comfort. The fan coil will be commanded by User Interface to supply airflow and, in the case of a non-communicating outdoor unit, Air Conditioner or Heat Pump control. The fan coil will operate blower at requested airflow for most modes.

The nominal requested airflow will be 350 cfm per ton of nominal cooling capacity as defined by outdoor unit size. Actual airflow request will be adjusted from nominal using indoor and outdoor temperature and indoor humidity data to optimize the system operation for occupant comfort and system efficiency. Refer to User Interface literature for further system control details.

FE4 ADVANCED TROUBLESHOOTING:

Further diagnostics can be done by following the flow chart shown in Fig. 18. Voltages can be measured at the communication bus with the voltages show in Table 9.

CARE AND MAINTENANCE

To continue high performance, and minimize possible equipment failure, it is essential periodic maintenance be performed on this equipment.

The ability to properly perform maintenance on this equipment requires certain mechanical skills and tools. The only consumer service recommended or required is filter maintenance. (See Filter Assembly.)

⚠ WARNING: ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

Disconnect all power to the unit before servicing the field wires or removing the control package. The disconnect (when used) on the access panel does not disconnect power to the line side of the disconnect, but does allow safe service to all other parts of the unit.

The minimum maintenance requirements for this equipment are as follows:

1. Inspect and clean or replace air filter each month or as required.

Table 9—Advanced Troubleshooting
Fan Coil / Furnace / 2-Spd. Communication Bus

Voltage Readings With board power applied and no U.I. connected	
A to B	~3 vdc
A to C	~3 vdc
B to C	~.01 to 0.3 vdc
C to D	24 vac

FE Control Board HK38EA002
Furnace Control Board HK42FZ022
Two-Speed Control Board HK38EA001

2. Inspect cooling coil, drain pan, and condensate drain each cooling season for cleanliness. Clean as necessary. An inspection port is provided on all A-coil delta plates. Remove plastic plug to inspect. Replace plug after inspection.
3. Inspect blower motor and wheel for cleanliness each heating and cooling season. Clean as necessary.
4. Inspect electrical connections for tightness and controls for proper operation each heating and cooling season. Service as necessary.

⚠ **CAUTION: CUT HAZARD**
Failure to follow this caution could result in personal injury.
As with any mechanical equipment, personal injury can result from sharp metal edges. Be careful when removing parts.

PROCEDURE 1—FILTER ASSEMBLY

To clean or replace air filter, push plastic connectors toward center of unit and remove filter access panel outward. Push filter up and back into unit. Then slide filter out. Clean filter by using cold water and mild detergent. Rinse and allow filter to dry. No oiling or coating of filter is required. New filters are available from your local distributor. Place filter in slot with cross-mesh binding up or facing cooling coil and replace filter access panel.

PROCEDURE 2—COOLING COIL, DRAIN PAN, AND CONDENSATE DRAIN

The cooling coil is easily cleaned when it is dry. Inspect the coil and clean (if necessary) before each cooling season. To check or clean cooling coil, remove coil access panel. If coil is coated with dirt or lint, vacuum it with a soft brush attachment.

Be careful not to bend coil fins. If coil is coated with oil or grease, clean it with a mild detergent and water solution. Rinse coil thoroughly with clear water. Be careful not to splash water on insulation.

Inspect drain pan and condensate drain at the same time cooling coil is checked. Clean drain pan and condensate drain by removing any foreign matter from pan. Flush pan and drain tube with clear water.

If drain tube is restricted, it can generally be cleared by high-pressure water. Cut plastic line and work outside condensate pan and away from coil to clean drain tube.

⚠ **CAUTION: UNIT DAMAGE HAZARD**
Failure to follow this caution could result in equipment damage.
Do not use caustic household drain cleaners in the condensate pan or near the coil. Drain cleaners can quickly destroy a coil.

PROCEDURE 3—BLOWER MOTOR AND WHEEL

Clean blower motor and wheel when cooling coil is cleaned.

⚠ **WARNING: ELECTRICAL SHOCK HAZARD**
Failure to follow this warning could result in personal injury or death.
Disconnect electrical power before removing any access panels.

To clean blower motor or blower wheel:

1. Remove blower access panel.
2. Remove motor leads from PCB. Note lead location for ease of reassembly.
3. Remove 2 outside screws holding blower/motor assembly against blower deck flange and slide assembly out of cabinet.
4. Remove screw in strap holding motor capacitor to blower housing and slide capacitor out from under strap. Remove screw with green wire from blower housing. Mark blower wheel, motor, and motor support in relation to blower housing before disassembly to ensure proper reassembly. Note position of blades on wheel.
5. Loosen setscrew holding blower wheel onto motor shaft.
6. Remove 3 bolts holding motor mount to blower housing and slide motor and mount out of housing. Further disassembly should not be necessary as adequate clearance is available.
7. Remove blower wheel from housing by removing cutoff plate from blower housing outlet. Note wheel orientation and cutoff location for reassembly. The blower motor and wheel may be cleaned by using a vacuum with a soft brush attachment.
8. Remove grease with a mild solvent such as hot water and detergent. Be careful not to disturb balance weights (clips) on blower-wheel vanes. Also, do not drop or bend wheel, as balance will be affected.

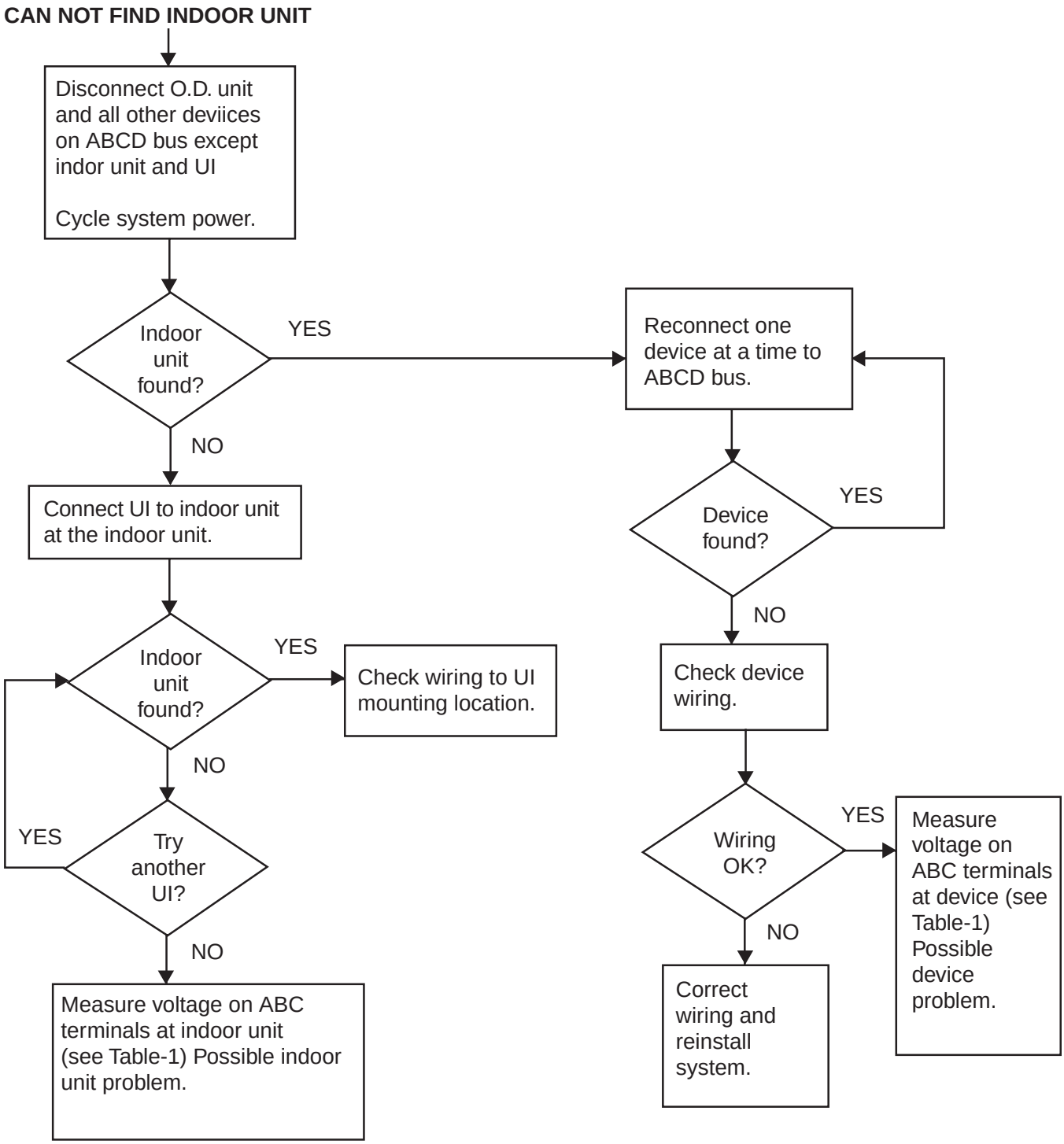
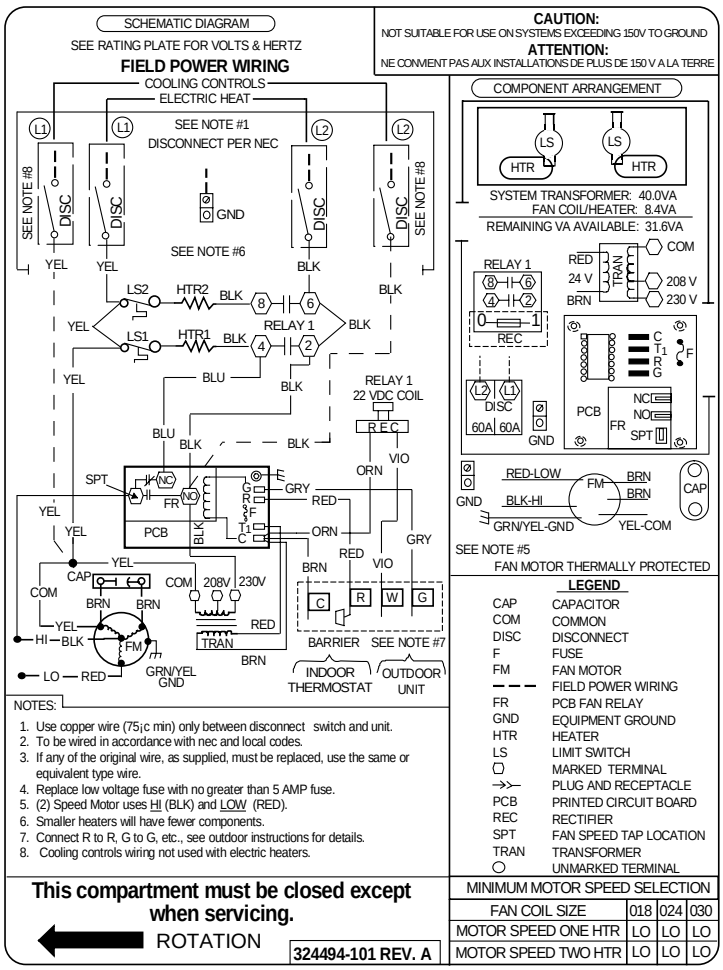


Fig. 18 - FE4 Advanced Troubleshooting Flow Chart

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To reassemble blower:

1. Place blower wheel back into housing. Be sure to position correctly for proper location.
2. Reassemble cutoff plate to housing using identified holes from disassembly procedure.
3. Position motor and mount in same position as when blower housing was in unit. Secure motor mount on housing, using removed bolts. Make sure mount or motor is grounded to blower housing.
4. Locate blower wheel setscrew over flat on motor shaft. Rotate wheel in housing. It should not rub housing and should be centered in inlet opening. If not, loosen setscrew and align as necessary.
5. Attach green wire to blower housing with screw.
6. Secure motor capacitor under strap and tighten strap screw.



A98229

Fig. 19—FF1D Typical Wiring Diagram

7. Slide blower assembly to blower deck. Be sure (once blower is within the unit casing) to force blower assembly toward control box while sliding assembly into unit to ensure that blower assembly engages deck properly.
8. Fasten blower assembly to deck with screws previously removed.
9. Reconnect electrical leads to PCB.
10. Reconnect electrical power to unit and test fan for proper rotation.

FF1A/FF1B/FF1C SERVICE AND TROUBLESHOOTING

NOTE: For FF1D Service and Troubleshooting refer to FA4A, FB4A, FF1D, FH4A, AND FX4A Circuit Board Function and Troubleshooting on page 2. (For FF1D typical wiring diagram, see Fig. 19.)

⚠ WARNING: ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

Before installation or servicing system, always turn off main power to system. There may be more than 1 disconnect switch. Turn off accessory heater power if applicable.

PROCEDURE 1—FAN MOTOR

The motor is 2-speed direct drive. High-speed lead is black, low-speed lead is red, and common lead is violet. Be sure proper blower speed has been selected. For units with electrical heat, low-speed tap can be used. For cooling, use high-speed tap.

The motor is turned on through 2 different routes. The first occurs when thermostat calls for the fan in cooling, heat pump, or fan-only mode. A 24-vac signal is sent to relay, causing relay to close its normally open contacts, turning fan on. The second occurs when there is a call for electric heat. A 24-vac signal is sent to heater sequencer/relay, causing it to close, directing 230v through the normally closed contact of fan relay, turning fan on. The fan remains on until sequencer/relay opens. Refer to FF1A/FF1B/FF1C typical wiring diagram. (See Fig. 21.)

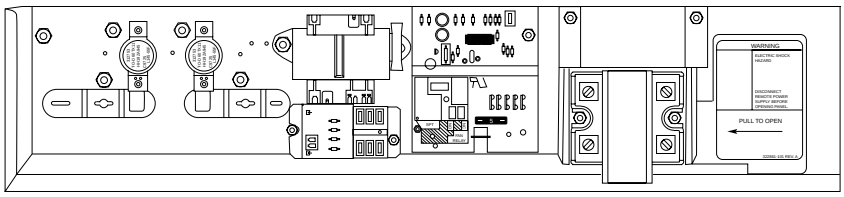
If motor does run, test motor for an open winding or a winding shorted to motor case. If any 1 of the 2 is present, replace motor.

PROCEDURE 2—ELECTRIC HEATER SERVICE

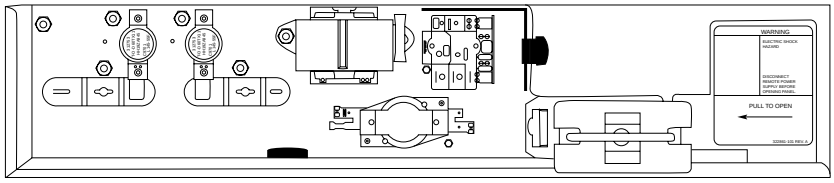
Service can be completed with heater in place. Shut off power before servicing.

A. Limit Switch

Refer to Electric Heater Function and Troubleshooting section of this manual.



FF1D CONTROL BOX



FF1A/FF1B/FF1C CONTROL BOX

A98184

Fig. 20—Electric Heater Control Boxes

B. Sequencer

Refer to Electric Heater Function and Troubleshooting section of this manual.

C. Transformer

A 40-VA transformer supplies 24-v power for control circuit. Check for 208/230v on primary side of transformer. If present, check for 24v on secondary side.

NOTE: Transformer is fused. Do not short circuit.

D. Fan Relay

Relay coil is 24 volts. Check for proper control voltage. Replace relay if faulty.

PROCEDURE 3—CLEANING OR REPLACING REFRIGERANT FLOW-CONTROL DEVICE

Refer to Fig. 27 and instructions given in Piston Body Cleaning or Replacement section above.

PROCEDURE 4—LIQUID TUBE STRAINER

The refrigerant flow-control device is protected by a wire mesh strainer. It is located inside the 3/8-in. liquid tube at field braze joint next to flow-control device. Access to strainer is through field braze joint.

PROCEDURE 5—SEQUENCE OF OPERATION

Refer to Fig. 21.

A. Condensing Unit

COOLING

When thermostat calls for cooling, the circuit between R and G is complete and single-pole single-throw relay FR is energized. The normally open contacts close causing blower to operate. The circuit between R and Y is also complete. This completed circuit causes contactor in outdoor unit to close which starts compressor and outdoor fan.

HEATING

When thermostat calls for heating and FAN switch is set on AUTO, the circuit between R and W is complete. The heater sequence SEQ is energized which closes contacts of relay. There will be a time delay. This completed circuit energizes all heating elements HTR and blower motor.

B. Heat Pump

COOLING

On a call for cooling, the thermostat makes circuits R-O, R-Y, and R-G. Circuit R-O energizes reversing valve, switching it to cooling position. Circuit R-Y energizes contactor starting outdoor fan motor and compressor. Circuit R-G energizes indoor unit blower relay starting indoor blower motor. When thermostat is satisfied, its contacts open de-energizing contactor reversing valve and blower relay. This stops compressor and fan motors.

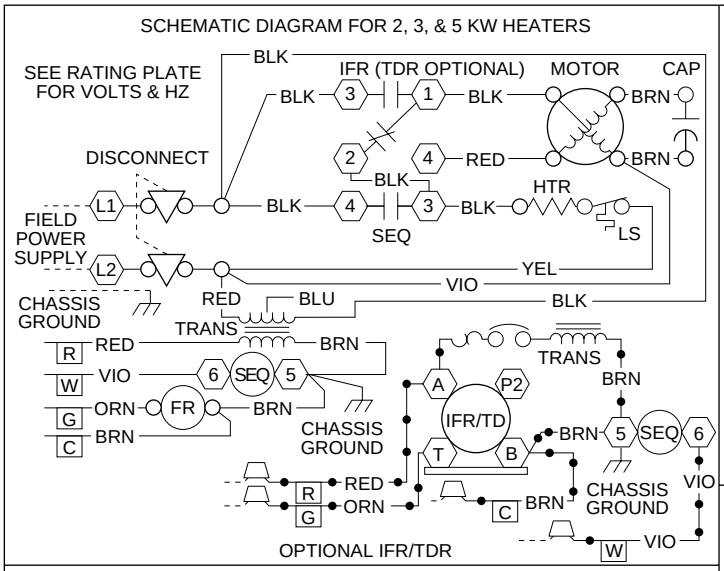
HEATING

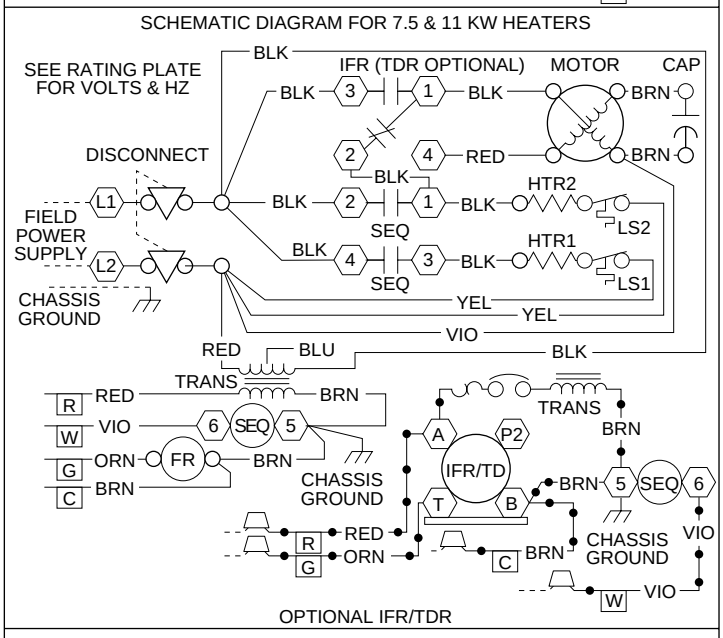
On a call for heating, the thermostat makes circuits R-Y and R-G. Circuit R-Y energizes contactor starting outdoor fan motor and compressor. Circuit R-G energizes indoor blower relay starting blower motor. Should temperature continue to fall, R-W circuit is made through second-stage room thermostat bulb. Circuit R-W energizes a sequencer bringing on supplemental electric heat. When thermostat is satisfied, its contacts open de-energizing contactor and sequencer. All heaters and motors should stop.

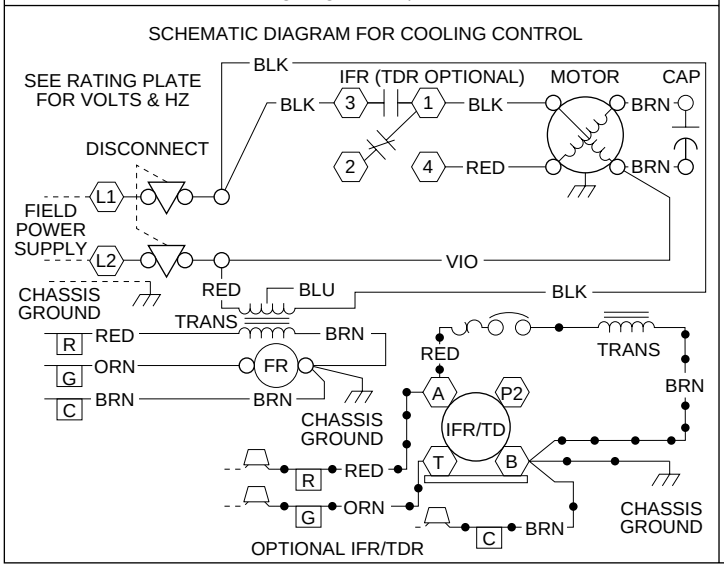
PROCEDURE 6—CARE AND MAINTENANCE

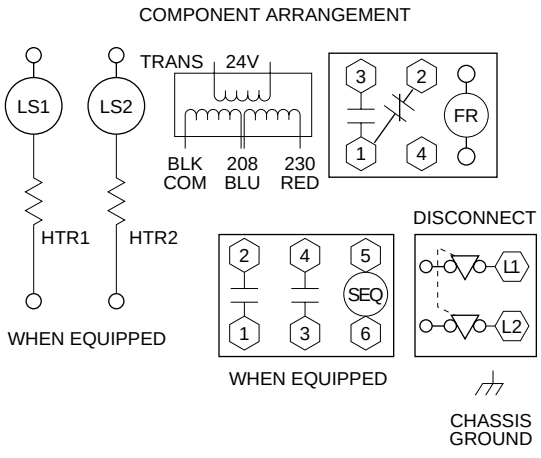
The minimum maintenance requirements for this equipment are as follows:

1. Inspect and clean or replace air filter each month or as required.
2. Inspect cooling coil, drain pan, and condensate drain each cooling season for cleanliness. Clean as necessary.









MOTOR SPEED SELECTION

HI = BLACK LOW = RED COMMON = VIO

FIELD WIRE

HEAT PKG.	SIZE	TEMP. RATING
2 KW	14	90°C
3 KW	12	90°C
5 KW	10	90°C
7.5 KW	8	90°C
11 KW	6	90°C
0 (COOLING)	14	90°C

LEGEND

⬡	MARKED TERMINAL
○	UNMARKED TERMINAL
LS	LIMIT SWITCH
FR	FAN RELAY
IFR	INDOOR FAN RELAY
IFR/TD	INDOOR FAN RELAY/TIME DELAY
SEQ	SEQUENCER
CAP	CAPACITOR
HTR	HEATER
TRANS	TRANSFORMER
- - - - - - -	FIELD POWER WIRING
●●●	OPTIONAL WIRING
∿	FUSE
⏚	CHASSIS GROUND

NOTES

1. UNIT WIRED FOR 230V OPERATION USING BLACK AND RED TRANSFORMER PRIMARY LEADS. FOR 208V OPERATION, USE BLACK AND BLUE TRANSFORMER PRIMARY LEADS.
2. UNUSED TRANSFORMER LEADS MUST BE TAPED AND LOOPED.
3. IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED, MUST BE REPLACED, USE THE SAME OR EQUIVALENT WIRE.
4. FIELD WIRING, USE COPPER CONDUCTORS, ONLY.
5. FAN RELAY #4 IS A DEAD TERMINAL FOR UNUSED MOTOR LEAD STORAGE. TO CHANGE MOTOR SPEEDS, EXCHANGE THE BLACK AND RED MOTOR LEADS ON THE FAN RELAY.

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Fig. 21—FF1A/FF1B/FF1C Typical Unit Wiring Label

Table 10—PSC Fan Motor Speed Taps

Model	Unit Size	Number of Speeds	High Speed	Medium Speed	Low Speed	Common
FA4A	018-036	2	Black	—	Blue	Yellow
FA4A	042-060	3	Black	Blue	Red	Yellow
FB4A	018-070	3	Black	Blue	Red	Yellow
FC4B	024-070	3	Black	Blue	Red	Yellow
FD3A	018-030	2	Black	—	Red	Yellow
FF1A/FF1B/FF1C/FF1D	018-030	2	Black	—	Red	Violet**
FG3A	024, 036, 048, 060	1*	—	—	—	—
FH4A	001-004	3	Black	Blue	Red	Yellow
FX4A	030-060	3	Black	Blue	Red	Yellow

*Belt drive.
→**Yellow on FF1D

3. Inspect blower motor and wheel for cleanliness each heating and cooling season. Clean as necessary.
4. Inspect electrical connections for tightness and controls for proper operation each heating and cooling season. Service as necessary.

⚠ **WARNING: CUT HAZARD**
Failure to follow this warning could result in personal injury.
As with any mechanical equipment, personal injury can result from sharp metal edges. Be careful when removing parts.

A. Air Filter

To clean or replace air filter, grasp it at bottom and lift it out of unit. Clean filter using cold water. Rinse clean and let dry. Oiling or coating of filter is not required. To replace, stand filter in rack with binding facing coil. Press top edge under access panel.

NOTE: Steel rods in filter prevent it from being pulled into coil. Retain these rods and reinstall after cleaning or before replacement if new filter is used.

⚠ **CAUTION: UNIT DAMAGE HAZARD**
Failure to follow this caution could result in equipment damage.
Never operate unit without a filter.

B. Cooling Coil, Drain Pan, and Condensate Drain

The cooling coil is easily cleaned when it is dry. Inspect coil and clean (if necessary) before each cooling season. To check or clean cooling coil, remove blower/heater access panel to gain full access to cooling coil. If coil is coated with dirt or lint, vacuum with a soft brush attachment.

Be careful not to bend coil fins. If coil is coated with oil or grease, clean it with a mild detergent and water solution. Rinse coil with clear water. Be careful not to splash water onto insulation.

Inspect drain pan and condensate drain at same time cooling coil is checked. Clean drain pan and condensate drain by removing any foreign matter from pan. Flush pan and drain tube with clear water.

If drain tube is restricted, it can generally be cleared by high-pressure water. Cut plastic line and work outside condensate pan and away from coil to clear drain tube.

NOTE: There MUST be a trap in condensate line. Trap must be at least 3-in. deep, not higher than the bottom of unit condensate drain opening, and pitched downward to an open drain or sump.

⚠ **CAUTION: UNIT DAMAGE HAZARD**
Failure to follow this caution could result in equipment damage.
Do not use caustic household drain cleaners in condensate pan or near coil. Drain cleaners can quickly destroy coils.

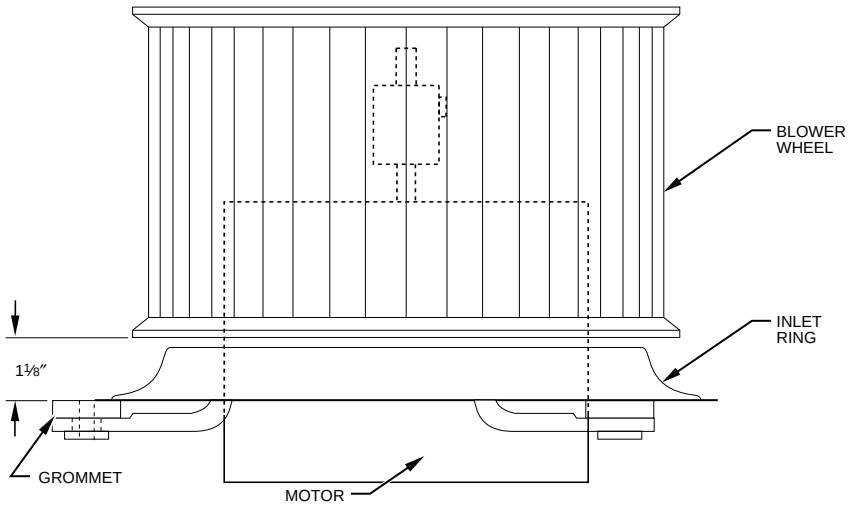
C. Blower Motor and Wheel

Clean blower motor and wheel when cooling coil is cleaned.

To clean or service wheel or motor, proceed as follows:

1. Pull unit disconnect (when used) and remove blower access panel.
2. Disconnect motor electrical leads from control box and capacitor. Mark location of wires for reassembly.
3. Remove 3 bolts holding motor mount to blower housing while supporting motor shell with hand.
4. Pull motor inlet ring and blower wheel assembly out of blower housing.
5. With blower wheel, inlet ring, and motor mount still attached to motor, place motor on flat, horizontal surface, shaft up. Mark position of wheel on motor shaft for reassembly.
6. Loosen blower wheel setscrew and remove blower wheel from motor shaft.

NOTE: Further disassembly of motor and mount is not necessary as adequate clearance is available to clean motor.



A86006

Fig. 22—FF1A/FF1B/FF1C Motor, Inlet Ring, and Blower Wheel Assembly

7. Clean blower motor and wheel using a vacuum with a soft brush attachment. Remove grease with a mild solvent such as hot water and detergent. Be careful not to disturb balance weights (clips) on blower wheel vanes. Do not drop or bend wheel as balance will be affected.

To reassemble unit, proceed as follows:

1. Place motor with mount attached on flat, horizontal surface with shaft up.
2. Set inlet ring on top of motor mount grommets. Center inlet ring flush on all 3 grommets.
3. Slide blower wheel onto motor shaft with setscrew upward and aligned with shaft flat portion. Vertically position wheel along shaft to position marked during disassembly.

NOTE: If previous shaft was not marked or if replacing previous motor, set blower wheel position by sliding blower wheel along motor shaft to 1-1/8 in. above rubber grommets. (See Fig. 22.)

4. Hold blower wheel in place and carefully tighten setscrew.
5. Position motor and blower wheel assembly to blower housing as originally oriented.
6. Secure motor mount to blower housing using bolts previously removed.
7. Attach green wire to blower housing with screw.
8. Connect electrical and capacitor leads to original terminals.
9. Replace blower access door and tighten all 4 screws.
10. Reinsert disconnect pullout only after blower access door is secured. Test blower for proper operation.

FD3A SERVICE AND TROUBLESHOOTING

⚠ WARNING: ELECTRICAL SHOCK HAZARD

Failure to follow this warning could result in personal injury or death.

Before installation or servicing system, always turn off main power to system. There may be more than 1 disconnect switch. Turn off accessory heater power if applicable.

PROCEDURE 1—FAN MOTOR

The motor is 2-speed direct drive. High-speed lead is black, low-speed lead is red, and common lead is yellow.

NOTE: Unused fan speed leads must be tapped off to prevent direct short to cabinet surface.

The motor is turned on through 2 different routes. The first occurs when thermostat calls for the fan in cooling, heat pump, or fan-only mode. A 24-vac signal is sent to relay, causing relay to close its normally open contacts, turning fan on. The second occurs when there is a call for electric heat. A 24-vac signal is sent to heater sequencer, causing it to close, directing 230v through the normally closed contact of fan relay, turning fan on. The fan remains on until sequencer opens. Refer to FD3A typical wiring diagram. (See Fig. 23.)

PROCEDURE 2—ELECTRIC HEATER SERVICE

Service can be completed with heater in place. Shut off power before servicing.

A. Limit Switch

Refer to Electric Heater Function and Troubleshooting section of this manual.

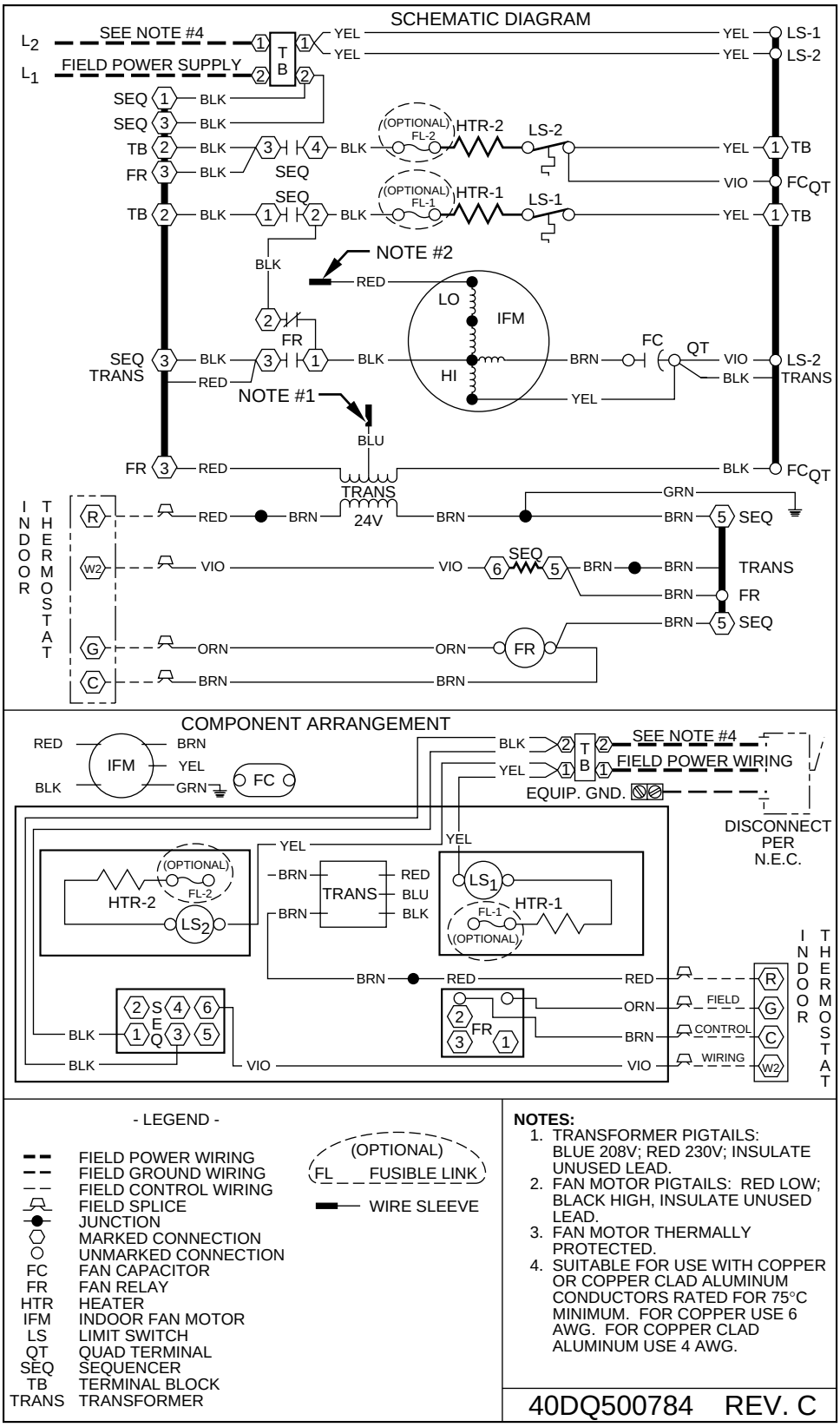
B. Sequencer

Refer to Electric Heater Function and Troubleshooting section of this manual.

C. Transformer

A 60-VA transformer supplies 24-v power for control circuit. Check for 208/230-v on primary side of transformer. If present, check for 24-v on secondary side. Replace transformer if faulty.

NOTE: Transformer is fused. Do not short circuit.



A94376

Fig. 23—FD3A Typical Wiring Diagram

D. Fan Relay

Relay coil is 24 volts. Check for proper control voltage. Replace relay if faulty.

E. Heater Removal

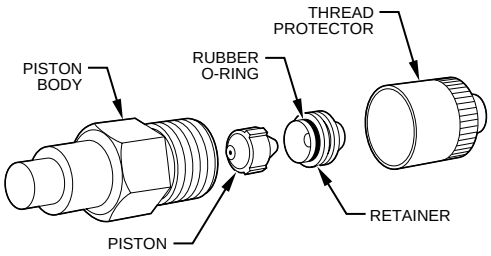
Disconnect wiring, remove 2 sheet metal screws, and pull heater out through open hinged access panel. When replacing heater, ensure orientation of heater element is same as when removed.

PROCEDURE 3—CLEANING OR REPLACING REFRIGERANT FLOW-CONTROL DEVICE

1. Pump down outdoor unit. Close service valves at outdoor unit.

⚠ CAUTION: UNIT DAMAGE HAZARD
Failure to follow this caution could result in equipment damage.
Damage may occur to the scroll compressor if operated at a negative suction pressure during a system pumpdown.

2. Bleed and (if possible) recover remaining refrigerant from tubing and coil through gage port on vapor-tube service valve.
3. Disconnect liquid refrigerant tube from refrigerant flow-control device. Refer to Fig. 24.
4. Remove refrigerant flow-control device piston retainer. Avoid damaging O-ring or machined surfaces on piston, bore, and retainer.
5. Using small wire with a hook on end of it, remove piston from refrigerant flow-control device body.



A92219

Fig. 24—Refrigerant Flow-Control Device (For FD3A and FG3A)

⚠ CAUTION: UNIT DAMAGE HAZARD
Failure to follow this caution could result in equipment damage.
When cleaning piston orifice, be careful not to scratch or enlarge opening as this will affect operation.

⚠ CAUTION: UNIT COMPONENT HAZARD
Failure to follow this caution could result in equipment damage.
Use a backup wrench and do not overtighten as deformation of refrigerant flow-control device body will occur, causing piston to lodge in a partially open or closed position.

6. Install new or cleaned piston in refrigerant flow-control device body.
7. Install new retainer (because of probable damage which occurred in initial removal).
8. Reconnect refrigerant tube to refrigerant flow-control device.
9. Pressurize tubing and coil, then leak-check.
10. Evacuate tubing and coil as necessary.

PROCEDURE 4—LIQUID TUBE STRAINER

The refrigerant flow-control device is protected on indoor coil by a wire mesh strainer. If strainer becomes plugged:

1. Complete items 1 and 2 under Cleaning or Replacing Refrigerant Flow-Control Device section.
2. Loosen flare fitting joint connecting refrigerant flow-control device to coil liquid refrigerant tube.
3. Remove sheet metal screw holding bracket clip in place. Screw is located between coil and refrigerant flow-control device.
4. Pull bracket clip out.
5. Remove refrigerant flow-control device assembly.
6. Pull strainer out of coil liquid refrigerant tube and replace with new strainer.

PROCEDURE 5—CARE AND MAINTENANCE

⚠ WARNING: PERSONAL INJURY HAZARD
Failure to follow this caution could result in personal injury.
Hinged access panel contains electrical components and is heavy. Support panel when lowering to clean unit to avoid personal injury.

⚠ WARNING: ELECTRICAL SHOCK HAZARD
Failure to follow this warning could result in personal injury or death.
Disconnect electrical power to all circuits before servicing unit. Failure to do so may result in personal injury from electrical shock or moving parts.

⚠ WARNING: CUT HAZARD
Failure to follow this warning could result in personal injury.
As with any mechanical equipment, personal injury can result from sharp metal edges. Be careful when removing parts.

The minimum maintenance requirements for this equipment are as follows:

1. Inspect and clean or replace field-supplied air filter each month or as required.
2. Inspect cooling coil, drain pan, and condensate drain each cooling season for cleanliness. Clean as necessary. (To be performed by trained personnel.)
3. Inspect blower motor and wheel for cleanliness each heating and cooling season. Clean as necessary.
4. Inspect electrical connections for tightness and controls for proper operation each heating and cooling season. Service as necessary.

NOTE: Never operate without a filter or with hinged access door open. Damage to blower motor may result.

A. Cooling Coil, Drain Pan, and Condensate Drain

Remember to disconnect electrical power before opening hinged access panel.

The cooling coil is easily cleaned when dry. Inspect coil and clean (if necessary) before each cooling season. If coil inlet face is coated with dirt or lint, vacuum with a soft brush attachment.

Be careful not to bend coil fins. If coil is coated with oil or grease, clean it with a mild detergent and hot water solution. Rinse coil with clear water. Be careful not to splash water onto insulation.

Inspect drain pan and condensate drain at same time cooling coil is checked. Clean drain pan and condensate drain by removing any foreign matter from pan. Flush pan and drain tube with clear water. Clear drain line if restricted.

NOTE: There MUST be a trap in condensate line. Trap must be at least 3-in. deep, not higher than the bottom of unit condensate drain opening, and pitched downward to an open drain or sump.

B. Blower Motor and Wheel

Clean blower motor and wheel when cooling coil is cleaned. Lubricate motor every 5 years if motor is used on intermittent operation (thermostat FAN switch at AUTO position), or every 2 years if motor is in continuous operation (thermostat FAN switch at ON position). Remove motor to lubricate. Put approximately 8 drops of SAE 10 nondetergent oil in each oil hole. Do not over oil motor. Plug hole securely so that oil does not drip when hinged access panel is lowered to open position.

Blower motor and wheel may be cleaned using a vacuum with a soft brush attachment. Remove grease with a mild solvent such as hot water and detergent. Be careful not to disturb balance weights (clips) on blower wheel vanes. Do not drop or bend wheel as balance will be affected.

FG3A SERVICE AND TROUBLESHOOTING

PROCEDURE 1—SERVICE

A. Motor

Ball bearing oilers are provided on blower motor. Use electric motor oil or SAE 10 or 20 nondetergent oil. Check motor mount bracket and base bolts. Tighten as required.

B. Blower

Check ball bearings for wear. Ball bearings are self-aligning and grease packed. Replace as required. Check thrust collars for end play and alignment of wheel. Check blades for accumulation of dirt. Clean as required. Check mounting brackets, base bolts, and isolation material.

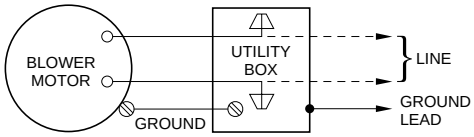
See Fig. 25 for diagram of internal wiring for blower coil assembly. Control box (standard 4-in. junction box) is mounted on refrigerant connection side of unit. All leads pass through strain relief where they enter control box. Wiring inside cabinet is located so it does not come in contact with moving parts or sharp edges.

C. Pulley and Belts

Check belt tension and pulley alignment. (See Fig. 26.) Belt tension is adjusted by motor tailpiece bolt. A deflection of about 3/4 in. to 1 in. per foot of span should be obtained by pressing belt firmly. Lock adjusting bolt in position after adjustment is made. Align pulley grooves by locating motor pulley on motor shaft or by moving entire motor along motor mounting bracket. Adjust blower speed by loosening setscrew in outer (moveable) pulley face and turning this face (half or full turns) so that adjusting setscrew is positioned precisely over the flat on pulley hub. Speed is reduced by adjusting pulley faces so they are further apart; speed is increased with faces closer together. Check pulley setscrews and bolts.

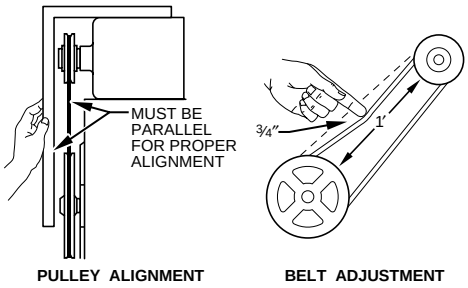
D. Cleaning or Replacing Refrigerant Flow-Control Device

Refer to Fig. 24 and instructions given in FD3A Service and Troubleshooting section above.



A91151

Fig. 25—Wiring Schematic



A91150

Fig. 26—Checking Pulley Alignment and Tightness

PROCEDURE 2—MAINTENANCE

⚠ WARNING: ELECTRICAL SHOCK HAZARD
Failure to follow this warning could result in personal injury or death.
Disconnect electrical power to all circuits before servicing unit. Failure to do so may result in personal injury from electrical shock or moving parts.

⚠ WARNING: CUT HAZARD
Failure to follow this warning could result in personal injury.
As with any mechanical equipment, personal injury can result from sharp metal edges. Be careful when removing parts.

A. Return-Air Filter

To clean or replace air filter, remove screws and filter access door. Slide out filter. For washable type filters, clean with hot soapy water. Rinse clean and let dry.

New filters are available from a local distributor. Place filter in slot with filter arrow facing direction of airflow. Replace filter access doors with screws previously removed.

⚠ CAUTION: UNIT DAMAGE HAZARD
Failure to follow this caution could result in equipment damage.
Never operate unit without a filter or with filter access door removed. Damage to blower motor may result.

B. Coil, Drain Pan, and Condensate Drain

⚠ WARNING: ELECTRICAL SHOCK HAZARD
Failure to follow this warning could result in personal injury or death.
Disconnect electrical power before removing any access panels or electrical shock may result.

The coil is easily cleaned when dry. To check or clean coil, remove coil access panel. If coil is coated with dirt or lint, vacuum with a soft brush attachment.

Be careful not to bend fins. If coil is coated with oil or grease, it may be cleaned with mild detergent and water solution. Rinse coil with clean water. Be careful not to splash water on insulation or filter.

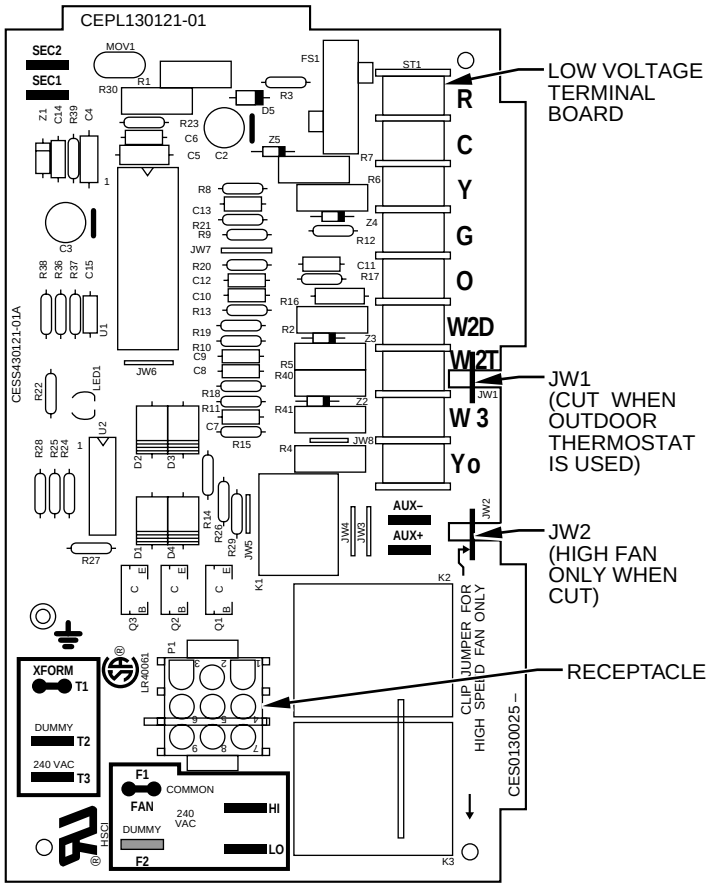
Check drain pan and condensate drain at same time cooling coil is checked. Clean drain pan and condensate drain by removing any foreign matter from pan. Check for rust and holes. Flush pan and drain tube with clear water. If drain is restricted, clean with high-pressure water. If this does not work, use a plumber's snake or similar probe device. Repitch drain pan to promote proper drainage.

FA4, FB4, FC4, FX4 SMART HEAT CIRCUIT BOARD FUNCTION AND TROUBLESHOOTING

PROCEDURE 1—PCB COMPONENT LAYOUT, DESCRIPTION, AND FUNCTION

NOTE: All voltages are AC unless otherwise specified.

1. The low-voltage terminal board is used to connect indoor thermostat to low, 24-v side of transformer and to serve as a junction between indoor thermostat and outdoor section.



A94127

Fig. 27—Smart Heat Printed Circuit Board (PCB)

a. R terminal is used to connect secondary side of transformer to thermostat and outdoor unit. R is fused.

b. C terminal is used to connect transformer secondary common for thermostat and outdoor unit.

c. Y terminal provides input signal from thermostat signaling heat pump operation.

d. G terminal provides input signal from thermostat signaling continuous fan operation.

e. O terminal provides input and junction terminal for reversing valve signal.

f. W2D terminal provides input from outdoor unit (heat pump) signaling control board that heat pump is in defrost.

g. W2T terminal provides input from thermostat signaling for supplemental or emergency heat.

h. W3 terminal provides input from outdoor thermostat. W3 and W2T are factory connected by JW1. This input is used only if an outdoor thermostat is required by local codes.

i. Y_o terminal provides output from control board to energize outdoor unit (heat pump) contactor.

2. Jumper wires (JW1 and JW2). (See Fig. 27.)
   a. JW1 connects W2T to W3 to limit staging of electric heat with use of an outdoor thermostat. See Table 11 for staging. Smart Heat PCB controls staging to the extent that this feature is unnecessary unless required by local codes or regulations.
   b. Cutting JW2 sets Smart Heat PCB in efficiency mode. With JW2 cut, there is no loss of performance due to reduced indoor blower speed when heat pump is operating near balance point. This jumper may need to be cut if selected cooling fan speed is the same as required minimum motor LO speed tap selection. With JW2 cut, fan terminal LO becomes a dummy terminal.
3. A fuse is used to protect low-voltage transformer and PCB.
4. AUX+ and AUX- are connections for air conditioning accessories (EAC, humidifier, etc.).
5. F1, F2, HI, and LO are connections for indoor fan.
6. The 9-pin receptacle connects heater package wiring harness.
7. SEC1 and SEC2 are used to connect secondary side of transformer to PCB. SEC1 is internally connected to equipment ground.

PROCEDURE 2—UNIT FUNCTIONS

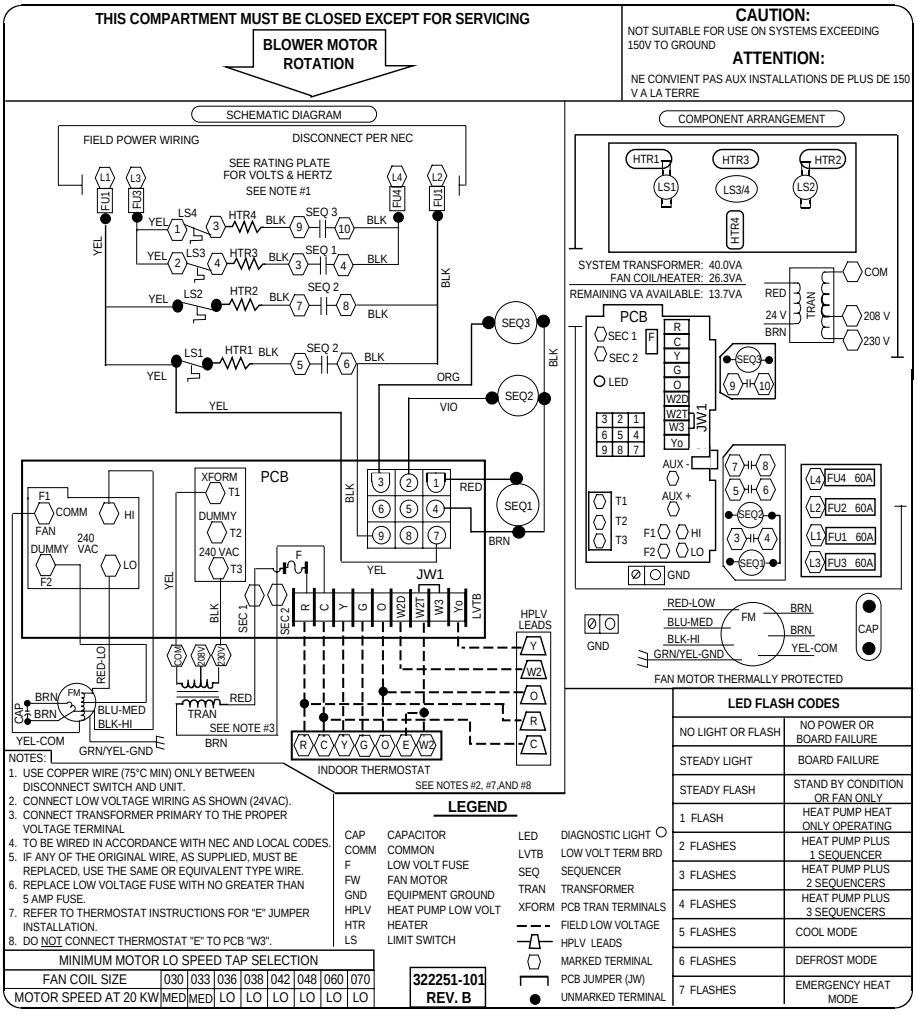
A. Transformer

NOTE: Terminals T1, T2 (if used), and T3 are wired to primary or high side of transformer. The 208-v terminal (or blue wire if transformer has primary leads) is used on T3 for 208-v applications. The 230-v terminal (or red wire) is used on T3 for 230-v applications. T2 is a dummy terminal.

B. Electric Heat

NOTE: When troubleshooting elements, position thermostat to emergency heat. Wait approximately 12 minutes after all thermostat delays for all elements to come on.

1. When thermostat calls for supplementary heat, a 24-v signal is sent to PCB through W2T. The PCB energizes first stage of electric heat.



A94132

Fig. 28—Smart Heat Typical Wiring Diagram (Motor Speed at 20kw Shown)

Table 11—Electric Heater Stage Limiting

Heater Part No.		Stages (KW Operating)			
		W2T Only (JW1 cut)		W2T and W3	
	Heater Stage	1	2	3	4
KFAEH2201H10 or KFCEH0101H10	10 kw Non-Fused	3	6	9	9
KFAEH2301H15 or KFCEH0201H15	15 kw Fused	3	8	11	15
KFAEH2401H20 or KFCEH0301H20	20 kw Fused	5	10	15	20

2. The first 2 stages come on if W2T and Y are energized at the same time. After each 10 minutes W2T is energized, another stage of electric heat is energized.
3. As W2T is de-energized, electric heat stages down in 8 minute steps with the exception of first step. The first step will be on only half as long as it was prior to W2T de-energizing.
4. When W2T is energized by itself, JW1 is cut, and an outdoor thermostat is used and is open, staging is limited as in Table 11.
5. When both W3 and W2T are energized without JW1 being cut or with outdoor thermostat closed, system operation stages heat up to maximum level if signal is energized for proper amount of time.
6. If only W3 is energized (JW1 is cut), there is no effect on PCB. No heat is energized.

C. Accessories

Terminals AUX+ and AUX- are energized with 24 vdc when fan is energized. The accessory kit KFAIR0101ACR is used to connect an EAC or humidifier.

NOTE: Loads cannot be connected directly to AUX+ and AUX-. Use the specified kit only.

D. Blower

1. Blower On Delay—To optimize comfort, there is a 30-sec blower on delay in heat pump heating mode only.
2. Blower Off Delay—Smart Heat control uses a 60-sec off blower delay, as opposed to the standard 90-sec delay.

PROCEDURE 3—SMART HEAT OPERATION

A. Cooling

The Smart Heat option controls cooling mode in same manner as conventional heat pumps are controlled. The fan has a 90-sec delay off/on cycle down.

B. Heat Pump Heating

The Smart Heat option does not control heating in the conventional method. The PCB energizes compressor 30 sec before indoor fan is energized. This allows indoor coil to heat up eliminating cold-blow on start-up.

The electric heat is staged-on to allow continuous operation of heat pump and electric resistance heat below balance point (below point where heat pump cannot maintain dwelling temperature without supplemental heat) independent of outdoor thermostats.

Although PCB has provisions for an outdoor thermostat, it is not needed for staging. On cycle down, indoor fan remains on 60 sec to recover heat stored in indoor coil.

C. Defrost

The Smart Heat PCB stages the correct amount of supplemental heat during defrost. If too much heat is added, system stays in defrost for completion of defrost cycle even though thermostat is satisfied. On next cycle, 1 less element is energized during next defrost period.

NOTE: If the signal from thermostat is interrupted (ie., thermostat is satisfied) while unit is in defrost mode, the defrost cycle will be completed before unit shuts down.

D. Troubleshooting Printed Circuit Board (Diagnostic LED)

The PCB of Smart Heat option heater package contains a microprocessor which controls fan operation, fan speed, outdoor unit, and heater elements. For troubleshooting, a service LED indicates condition of PCB. See Table 12 for LED flash codes.

Table 12—LED Codes for Smart Heat PCB

Flash Condition	Input Signals	System Operation
No Light/Flash	—	No Power or Board Failure
Steady Light	—	Board Failure
Steady Flash	—	Stand By Condition or Fan Only
1 Flash	Y only	Heat Pump Only Operating
2 Flashes	Y and/or W2T	Heat Pump Plus 1 Sequencer
3 Flashes	Y and/or W2T	Heat Pump Plus 2 Sequencers
4 Flashes	Y and/or W2T	Heat Pump Plus 3 Sequencers
5 Flashes	Y, O	Cool Mode
6 Flashes	Y, W2D, and/or W2T	Defrost Mode
7 Flashes	W2T	Emergency Heat Mode

PROCEDURE 4—ELECTRICAL OPERATING SEQUENCES AND TROUBLESHOOTING

NOTE: Refer to Table 13 for proper input and output voltages. See Fig. 28 for Smart Heat Proper Wiring Diagram.

A. Ready-To-Start

In ready-to-start (standby) mode, LED on board indicates a steady flash.

In this mode, 24-v power should be available at control's low voltage terminal strip terminals R and C. If 24v is not present across R and C, check the following:

- Is low-voltage fuse on control board good?
- Are line voltage fuses FU1 and FU2 good?
- Is LED on control on steadily or not on at all? Both of these indications signal a possible board failure.
- Is 208/230-v power available to control across pins 7 and 9 of 9-pin connector? Is connection to board tight?

B. Continuous Fan

On a call for continuous fan, thermostat provides a 24-v input signal to G terminal on low-voltage terminal strip. Sensing this signal, the microprocessor energizes a relay on control to provide power to high-speed winding of fan motor, at 1. The fan continues to run until fan switch on thermostat is turned off.

Table 13—Troubleshooting Voltage Readings and Test Points

Input Voltages

Location	Normal Reading	Purpose
L1 and L2	208/230 vac	Main power supply input to fan coil
L3 and L4	208/230 vac	Power to electric heaters
9-pin connector 7 and 9	208/230 vac	Power to smart control
T1 and T3	208/230 vac	Power to transformer
SEC1 and SEC2	24 vac	Power from transformer secondary
R and C	24 vac	Power from transformer secondary
G and C	24 vac	Call for continuous fan signal from room thermostat
Y and C	24 vac	Call for heat/cool signal from room thermostat
O and C	24 vac	Signal to energize reversing valve from room thermostat (cooling). Also present during defrost.
W2T and C	24 vac	Call for electric heat from room thermostat
W2D and C	24 vac	Defrost initiation signal from heat pump

Output Voltages

Location	Normal Reading	Purpose
HI and F1	208/230 vac	Power to blower motor (high speed)
LO and F1	208/230 vac	Power to blower motor (low speed)
Y_o and C	24 vac	Power to energize contactor in heat pump (heat and cool modes)
9-pin connector 1 and 4	24 vdc	Power to energize SEQ 1 NOTE: Sequencers use DC voltage
9-pin connector 2 and 4	24 vdc	Power to energize SEQ 2
9-pin connector 3 and 4	24 vdc	Power to energize SEQ 3

vac—volts AC
vdc—volts DC

During continuous fan operation with no call for heating or cooling, LED indicates a steady flash, the same indication seen when system is in standby.

The call for continuous fan operation signal can be checked by placing voltmeter leads across terminals G and C of control's low-voltage terminal strip. If 24v is not seen across these terminals, check for the following:

- Is 24v available across R and C? If not, refer to Ready-To-Start section for items to check if 24v is not available.
- Is thermostat fan switch set for continuous operation?

Confirm fan operation. Voltage to operate fan can be confirmed by placing voltmeter leads across terminals F1 and HI on control. The reading should be 208/230v. If 208/230v is not observed, check the following:

- Is 208/230v available at pins 7 and 9 of 9-pin connector? Is connection to board tight?
- Are line voltage fuses FU1 and FU2 good?

If 208/230v is available across terminals F1 and HI and fan does not operate, check the following:

- Is fan motor capacitor good?
- Is blower wheel jammed or loose? Are there any other mechanical problems preventing fan operation?

C. Cooling

On a call for cooling, room thermostat provides input signals to control board at terminals Y and O. The O signal is also available to heat pump to energize reversing valve.

When it receives both these signals, the microprocessor responds by providing a 24-v output signal at the Y_o terminal. This output signal energizes contactor in heat pump and starts compressor. There is a 3 to 5 sec delay in output of Y_o signal.

At the same time, control energizes fan coil's fan motor on high speed through terminals F1 and HI. The LED indicator on control signals 5 flashes, indicating cooling operation.

The call for cooling signals can be confirmed by placing voltmeter leads across low-voltage terminals Y, O, Y_o, and C. The reading should be 24v. If 24v is not available, check the following:

- Is 24v available across R and C? See Ready-To-Start section for items to check if 24v is not available.
- Is thermostat function switch set in COOL position with thermostat calling for cooling?

Assuming heat pump has power and is adequately charged, it should be running at this time in cooling mode. Indoor fan should also be running at this time. If indoor fan is not running, refer to Continuous Fan section for items to check.

D. Heating (Compressor Only)

On a call for heat, room thermostat provides an input signal to control board at terminal Y. This signal causes the microprocessor to provide a 24-v output signal at terminal Y_o to energize contactor in heat pump. There is a 3 to 5 sec delay in output of Y_o signal.

Thirty sec after Y is energized, control energizes fan motor. It may run on high or low speed, depending on its operation in previous cycle.

Compressor operation in current cycle is monitored by the smart control to determine whether a fan speed change is required for enhanced indoor comfort. The LED indicator on control signals 1 flash, indicating compressor operation only with no electric heat.

The call for heat signals can be confirmed by placing voltmeter leads across low-voltage terminals Y, Y_o, and C. The readings should be 24v. If 24v is not available, check the following:

- Is 24v available across R and C? See Ready-To-Start section for items to check if 24v is not available.
- Is thermostat function switch set in HEAT position with thermostat calling for heat?

Assuming heat pump has power and is adequately charged, it should be running at this time in heating mode. Indoor fan should also be running at this time. If indoor fan is not running, refer to Continuous Fan section for items to check. When room thermostat is satisfied, indoor fan continues to run an additional 60 sec to recover heat remaining in indoor coil.

E. Heating (Compressor and Electric Heat)

If heat pump alone cannot satisfy heat requirements of structure, room thermostat calls for additional heat by way of an input to W2 terminal of control. When this occurs, control begins sequencing on electric heaters by energizing the first sequencer/heat relay. Indoor fan should be running at this time.

If room temperature requirements cannot be met, additional stages of electric heat are energized through the other 2 sequencers/relays, at 2.

The logic of control determines how much and how soon these additional stages are brought on. By observing LED status light, the number of operating stages of electric heat can be determined. The control also varies indoor fan speed depending on number of energized stages of heat. In general, the more stages of electric heat, the higher the fan speed.

There is no hard and fast rule for determining exactly when stages will be energized since microprocessor in the smart control constantly monitors duration of previous heating cycle, setting of room thermostat, and number of stages of heat needed in previous cycle to satisfy room thermostat. Rather than try to determine what should be operating when, service technicians should check LED status light to see how many stages of electric heat are energized at a given time and confirm operation of sequencer/relay using a voltmeter. If a quick check of all stages is desired, set room thermostat as high as it will go. With a constant signal on W2T terminal, sequencers/relays energize every 10 minutes until all heaters are on.

The previous paragraphs described how to check for low-voltage inputs to control by placing voltmeter leads across low-voltage terminal strip and checking for 24v. The call for electric heat can be confirmed by placing voltmeter leads across W2T and C.

To check for operation of sequencers/relays, check directly across appropriate coil for 24 volts DC.

NOTE: All sequencer/relay coils are powered by 24 volts DC. This voltage is generated internally by the smart control.

In this example, sequencer/relay 1 is being checked. The procedure is the same for all other sequencers/relays. If 24 volts DC is not observed, check the following:

- Is room thermostat calling for electric heat? This can be confirmed by checking for 24 volts AC between low-voltage terminal strip terminals W2T and C.
- Is LED flashing appropriate code for number of sequencers/relays energized? In this example, 2 flashes should be visible, indicating 1 sequencer/relay is energized. Indicator tells how many sequencers/relays are energized, but does not tell which ones are.
- Is 9-pin connector for heater package tightly secured to control board?

F. Checking Sequencer Operation

To check for operation of power circuit of sequencer/relay, place voltmeter leads across sequencer/relay terminal 4 of sequencer/relay 1 and terminal 4 of limit switch 3. The reading should be 208/230v, and heater should be energized.

If 208/230v is not observed at terminals specified, check the following:

- Are fuses FU3 and FU4 good?
- Is limit switch LS3 open? If so, check fan coil air filter or air distribution system for blocking or restriction that might reduce airflow and cause limit switch to open.

Operation of heaters can be confirmed further by using a clamp-on ammeter in circuit shown to verify current is flowing through heaters. Amperage readings will depend on size of heater. The procedure for checking other sequencers/relays in system is identical to that just described.

G. Emergency Heat

Emergency heat mode requires that room thermostat be placed in EMERGENCY HEAT position. This locks out and prevents operation of heat pump outdoor unit. In this mode, heat is provided exclusively by electrical heaters in fan coil.

In this mode, room thermostat, at 1, provides an emergency heat input signal to smart control at terminal W2T. If jumper JW1, at 2, has not been cut and an outdoor thermostat installed to control electric heat stages, that same input signal is applied to terminal W3. For this example, assume that jumper JW1 has not been cut.

Eventually, the total number of heaters is cycled on. In emergency heat mode, LED indicator signals 7 flashes.

The amount of emergency heat available depends on whether jumper JW1 is cut and the number of heating elements. Table 14 illustrates results under various conditions. The heaters cycle on two elements initially and an additional element every 5 minutes until maximum level is reached.

With JW1 cut, an outdoor thermostat (if closed) could cycle on additional heaters and system would perform as if JW1 was not cut. In effect, closed outdoor thermostat replaces cut jumper.

H. Defrost

In defrost mode, LED indicator signals 6 flashes. Defrost is initiated by heat pump and is signalled to smart control by an input to W2D terminal. During defrost, outdoor unit switches to cooling mode, making it necessary to cycle on electric heaters to temper indoor air.

Table 14—Effect of JW1 on Emergency Heat

JW1 cut*	
4 elements	3 elements
50%	66.7%
JW1 not cut	
4 elements	3 elements
100%	100%

* Outdoor thermostat opens

If electric heaters were not energized prior to defrost, smart control energizes sufficient elements to temper air. If heaters were energized prior to defrost, additional heaters will be cycled on to provide additional heat.

A defrost initiation signal can be confirmed by attaching voltmeter leads across low-voltage terminals W2D and C. If 24v is not observed, check the following:

- Is 24v available across R and C? See Ready-To-Start section for items to check if 24v is not available.
- Is there continuity in thermostat leads between heat pump and smart control?
- Is defrost control in heat pump operating properly?

CES013003-00 AND 01 (HK61EA002) CIRCUIT BOARD FUNCTION & TROUBLESHOOTING (FA4A, FB4A, FC4B, FF1D, FH4A, AND FX4A)

This section of the service manual describes the CESO130003-00 and -01 PCB by examining the functional operation of the PCB components.

PROCEDURE 1—PRINTED CIRCUIT BOARD (PCB) COMPONENT LAYOUT AND DESCRIPTION

Layout of the actual PCB is depicted in Fig. 29.

1. The low-voltage stripped leads are used to connect the 24-v side of transformer to indoor thermostat and outdoor section.
2. A 5-amp fuse is used to protect the low-voltage transformer secondary.
3. The fan relay is controlled by thermostat and turns fan on and off.
4. A plug is used as the connection for PCB power and electric heaters. Note the pin numbers on plug.
5. A time-delay relay circuit keeps fan motor running for approximately 90 sec after G is de-energized. The time-delay can be defeated by cutting jumper JW1 on the CES0130003-01 and HK61EA002.

PROCEDURE 2—UNIT FUNCTIONS

A. Transformer

1. Proper Wiring of Transformer Primary or High Side

   Yellow wire from Molex plug is wired to C terminal on transformer and black wire from PCB relay (normally-open) terminal is wired to 208v or 230v terminal on transformer. Units are factory wired at 230v terminal.

2. Proper Wiring of Transformer Secondary or 24-v Side

   Red wire of transformer is wired to T terminal on PCB and brown wire of transformer is wired to C terminal on PCB.

NOTE: T terminal on PCB is used to protect transformer. T terminal is connected through the fuse to R terminal on PCB.

B. Indoor Fan

1. Wiring

   Indoor fan motor yellow lead is wired to C terminal on transformer. The red, blue, or black speed lead is wired to SPT terminal on fan relay part of PCB. Units are factory wired on medium speed (blue lead connected).

NOTE: Unused fan speed leads must be capped or taped off to prevent direct short to cabinet surface.

2. Functional Control
   a. Thermostat and Relay Control

      When thermostat calls for the fan in cooling, heat pump, heating, or fan-only mode, a 24-vac signal is sent to relay. This causes the relay to close its normally-open contacts, turning on fan. When thermostat no longer calls for the fan, the signal sent to relay is turned off and relay opens causing fan to turn off after a 90-sec fan-off delay.

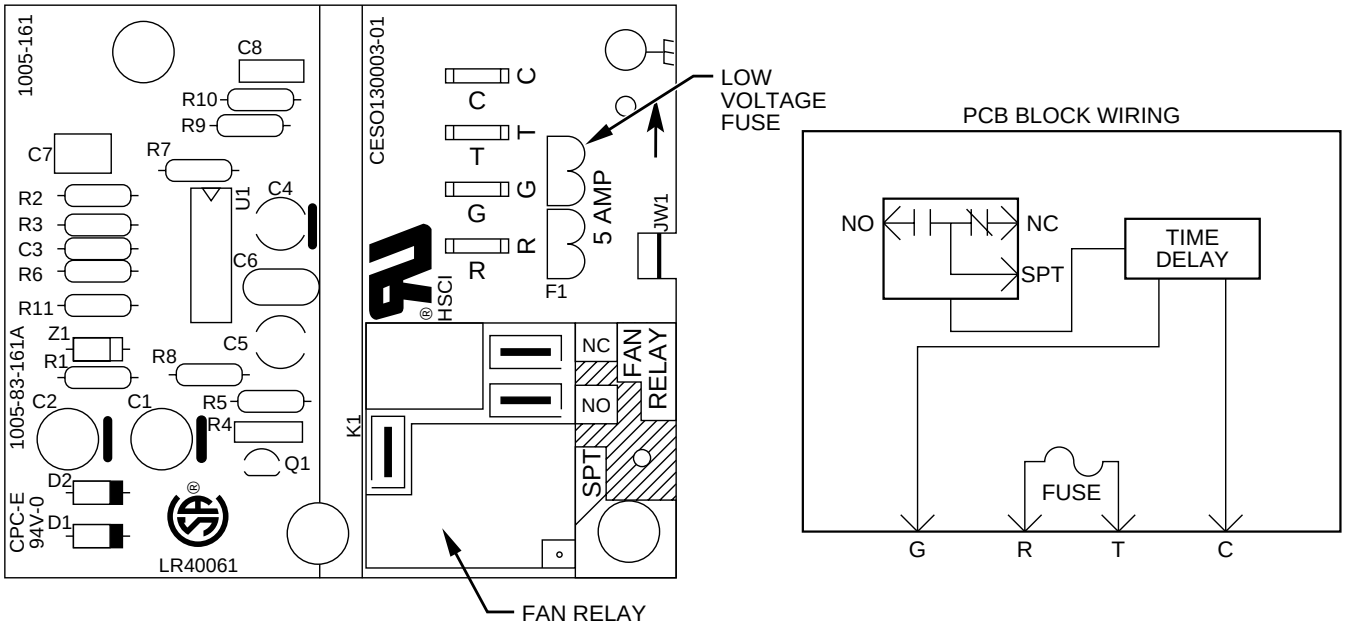
   b. Sequencer/Electric Heat Relay Interlock

      The fan will also operate whenever there is a call for electric heat, even if fan relay is not energized. This happens because fan is interlocked with first stage of electric heat through the normally-closed contact of fan relay.

NOTE: The fan interlock is only connected to first stage electric heat (W2). W3 and E do not contain an interlock with fan. See outdoor thermostat Installation Instructions when electric heat staging is desired.

C. Electric Heat

When thermostat calls for electric heat, a 24-vac signal is sent to sequencer/heat relay through W2, causing first stage to turn on. W3 and E also receive signal if wired in with W2. If W3 and E are not wired to W2, the sequencers/heat relays can be controlled individually to stage additional electric heat. The sequence control is described in the following section:



A97020

Fig. 29—Fan Coil Printed Circuit Board (CES013C00-00,01 / HK61EA002)

1. W2

   When thermostat sends a signal to W2, a 24-vac signal is applied across sequencer/relay number 1, causing it to close. When sequencer/relay number 1 closes, first stage of electric heat is energized. In straight electric heat, fan is also energized through the normally closed contacts of fan relay. In cooling, heat pump, or manual fan mode, fan will already be running since fan relay would have been energized. When thermostat stops calling for electric heat, the 24-vac signal to sequencer/relay number 1 turns off and sequencer opens after a delay of 60 to 90 sec. Heaters equipped with relays will be de-energized immediately. When sequencer/relay opens, first stage of heat turns off along with fan, providing thermostat is not calling for the fan.

2. W3

   When a signal is sent to W3, a 24-vac signal to sequencer/relay number 2 causes it to close, with second stage of electric heat turning on. The 24-vac signal applied to sequencer/relay number 1 causes fan to operate. Timing is such that sequencer/relay number 1 will turn on before sequencer/relay number 2. When signal to W3 is turned off, sequencer/relay number 2 opens. If W2 is also satisfied, first stage of electric heat and fan will also turn off, providing thermostat is not calling for the fan.

3. E

   When thermostat sends a signal to E, a 24-vac signal is sent to sequencer/relay number 3. The 24-vac signal applied to sequencer/relay number 3 turns on third stage of electric heat. The 24-vac signal applied to sequencer/relay number 1 turns on first stage of electric heat and fan. When thermostat stops calling for electric heat, the signal to sequencers/relays 1, 2, and 3 are turned off, and sequencers/relays open. This causes electric heat to turn off with fan providing thermostat is not calling for the fan.

NOTE: Electric heaters are factory wired with all stages tied together. If independent staging is desired, consult outdoor thermostat installation instructions, or corporate thermostat instructions.

PROCEDURE 3—TROUBLESHOOTING THE PRINTED CIRCUIT BOARD (CES013000-00, 01 / HK61EA002)

Use wiring schematics shown in Fig. 30 and 29 as a guide in troubleshooting PCB unless otherwise noted.

A. If Fan Will Not Turn On from Thermostat:

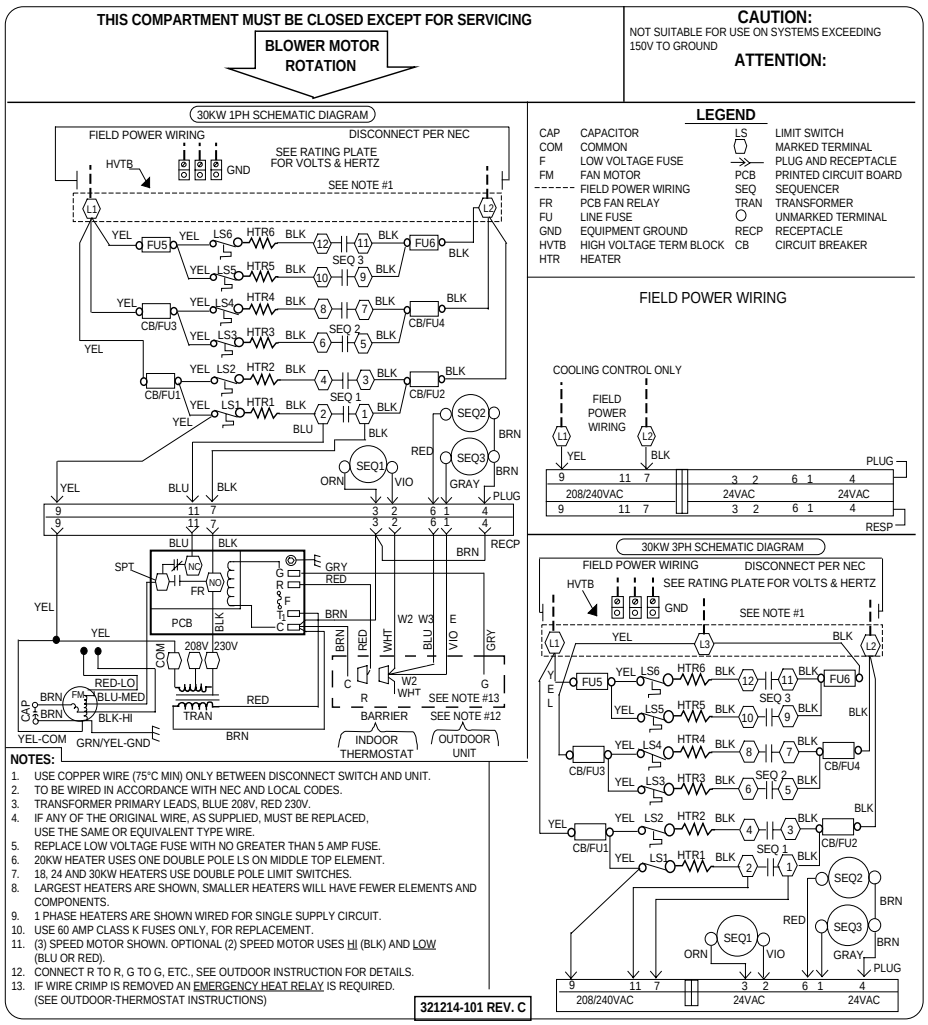
IF THERE IS NO HIGH VOLTAGE TO TRANSFORMER:

1. Check plug/receptacle connection. This supplies power from heaters to PCB Fan Relay. Be sure plug is connected properly.
2. Check sequencer/relay number 1 and plug wiring. Yellow wire should be connected to pin number 9 of plug and to limit switch. Black wire should be connected to pin number 7 of plug and to sequencer/relay number 1.
3. Check field power leads L1 and L2. If these are not receiving power, system cannot function.

If Transformer Has High Voltage Applied To It:

1. Check low-voltage transformer leads R (red) and C (brown). Be sure they are wired to correct locations.
2. Check output voltage of transformer secondary side R (red) and C (brown). Be sure transformer output is between 18 and 30 vac. If transformer output is incorrect and transformer is receiving correct input voltage (208v or 230v), then transformer needs to be replaced with recommended transformer. If no problem exists with transformer secondary, proceed to items 3 and 4.
3. Check low-voltage fuse shown in Fig. 29. If fuse is blown, replace it with an identical 5-amp fuse. The transformer cannot supply power to board with fuse blown or loose. If fuse blows when unit has power applied to it, the system most likely has 1 of the following problems:

   a. Check all 24-v wiring for an electrical short.



A94346

Fig. 30—Wiring Diagram of 6-Element Sequencer Heater

b. The maximum load on transformer is 40 VA. If load on transformer is excessive, the low-voltage 5-amp fuse will blow to protect transformer. If load exceeds VA rating of transformer, a larger VA rated transformer needs to be installed. Check sequencers/relays for excessive current draw.

c. Check wiring of heaters. If a heater is miswired, fuse may blow. If a heater is miswired, correct miswiring by comparing it to heater wiring label.

4. Check connections on primary side of transformer. If they are not connected properly, the transformer secondary cannot supply the 24-v signal to energize fan relay. If transformer is receiving correct primary voltage but is not putting out correct secondary voltage, transformer needs to be replaced.

B. If Electric Heat Stages Will Not Turn On But Fan Will Turn On:

IF THERE IS NO HIGH VOLTAGE TO TRANSFORMER:

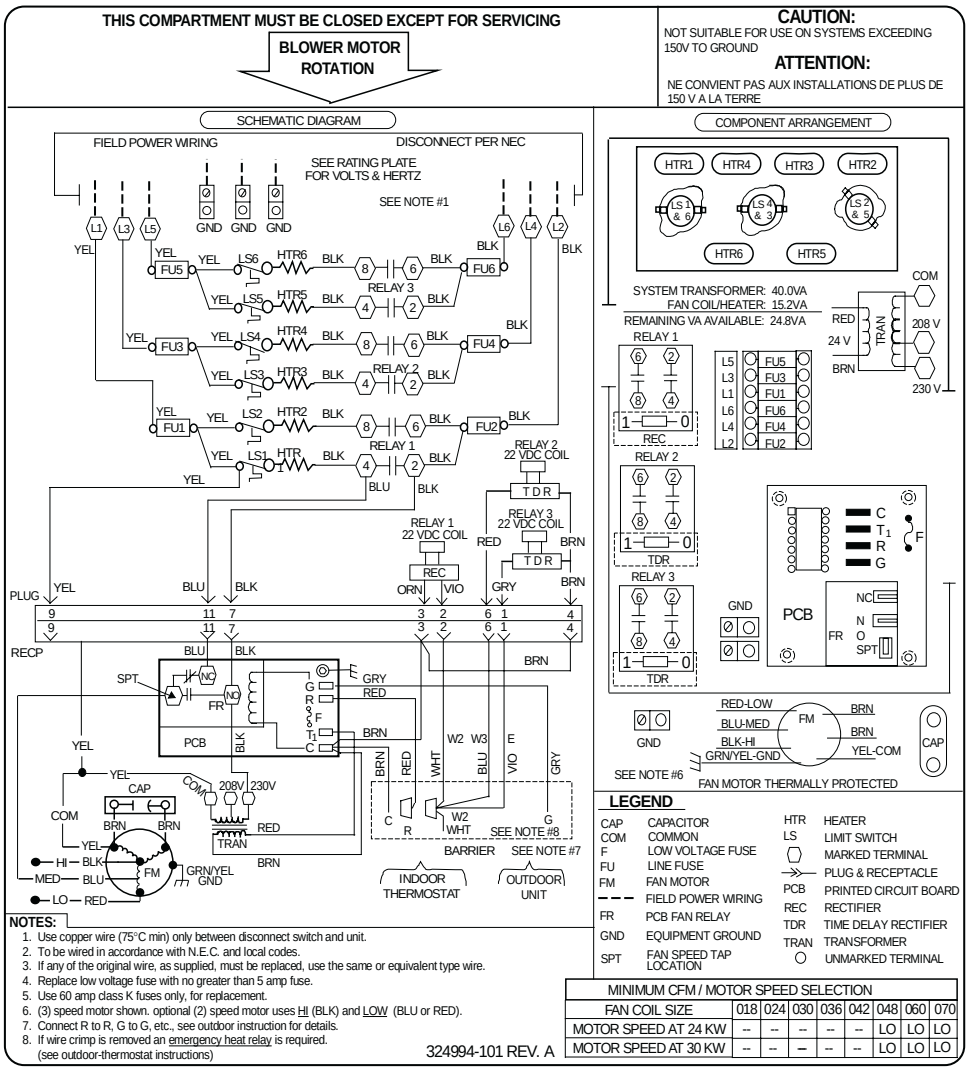
1. Check plug connection between heaters and board. This supplies power to transformer and fan. Be sure plug is connected properly.
2. Check sequencer/relay number 1 and plug wiring. Yellow wire should be connected to pin number 9 of plug and to limit switch. Black wire should be connected to pin number 7 of plug and to sequencer/relay number 1.
3. Check incoming high-voltage power leads. If these are not receiving power, system cannot function.

IF TRANSFORMER HAS HIGH VOLTAGE APPLIED TO IT:

1. Check low-voltage transformer leads R (red) and C (brown). Make sure they are wired to correct location. The unit will not function without proper connections.
2. Check output voltage of transformer secondary side R (red) and C (brown). If transformer output is low (less than 18 vac), refer to items 3 and 4 of previous "If Transformer Has High Voltage Applied To It" section.

IF TRACES ARE OVERHEATED ON BACK OF PCB:

Usually whenever a trace is blown on PCB, it means either there has been a high-voltage short or high voltage has been applied to low-voltage circuit. This can be prevented by making sure PCB is wired correctly before PCB has power applied to it.



A00173

Fig. 31—Wiring Diagram of 6-Element Relay Heater

C. If Transformer Fuse Keeps Blowing:

When low-voltage fuse blows, it means transformer would have blown if fuse had not been in circuit to protect it. The fuse usually blows when there is a high current draw on transformer, high voltage applied to low-voltage circuit, or a direct secondary short. When there is a high current draw on transformer, it is most likely because transformer has been shorted or system is trying to draw more VA than transformer rating allows. When fuse blows because of high voltage, the system has mixed high- and low-voltage signals.

1. Check wiring of sequencers/relays as shown in Fig. 30 and 29. Be sure transformer is not shorting out because thermostat wires are miswired.
2. Check wiring of sequencers/relays as shown in Fig. 30 and 29. Be sure low-voltage and high-voltage wiring is correct.
3. Check VA draw on transformer. If VA draw is more than VA rating of transformer, fuse will blow. If this is the case, replace transformer with one that has a higher VA rating and meets system specifications.

D. If Fan Runs Continuously:

1. If PCB has no low-voltage power, check blue and black fan leads. These may be switched at sequencer/relay.
2. If PCB has low-voltage power, check fan relay to see if it is opening and closing. It may be stuck in the normally closed position due to debris in relay.

E. Transformer Failure:

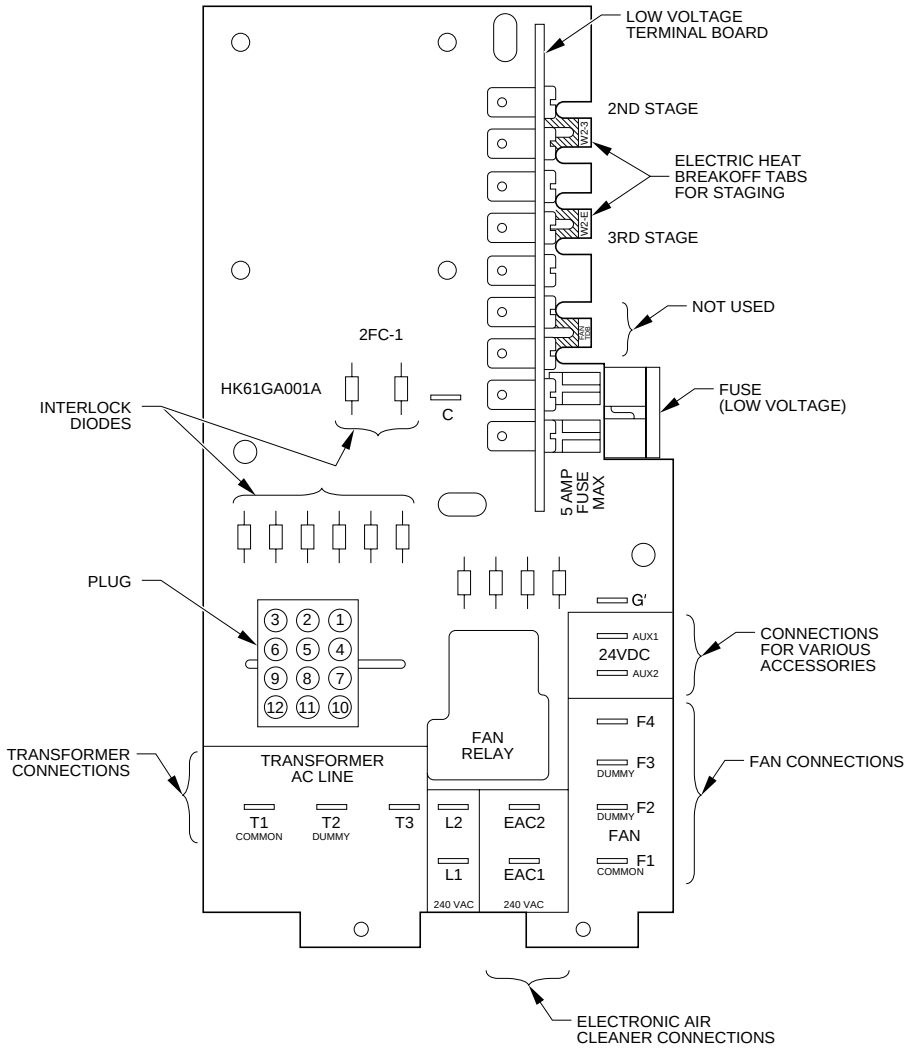
1. Check 208-v and 230-v transformer connections. They may be miswired.

HK61GA001 AND HK61GA003 CIRCUIT BOARD FUNCTION & TROUBLESHOOTING

This section of the service manual describes the HK61GA001 and HK61GA003 printed circuit boards (PCB) by examining the functional operation of the printed circuit board's components.

PROCEDURE 1—PCB COMPONENT LAYOUT AND DESCRIPTION

Layout of the actual printed circuit boards are depicted in Fig. 32 and Fig. 33.



A97025

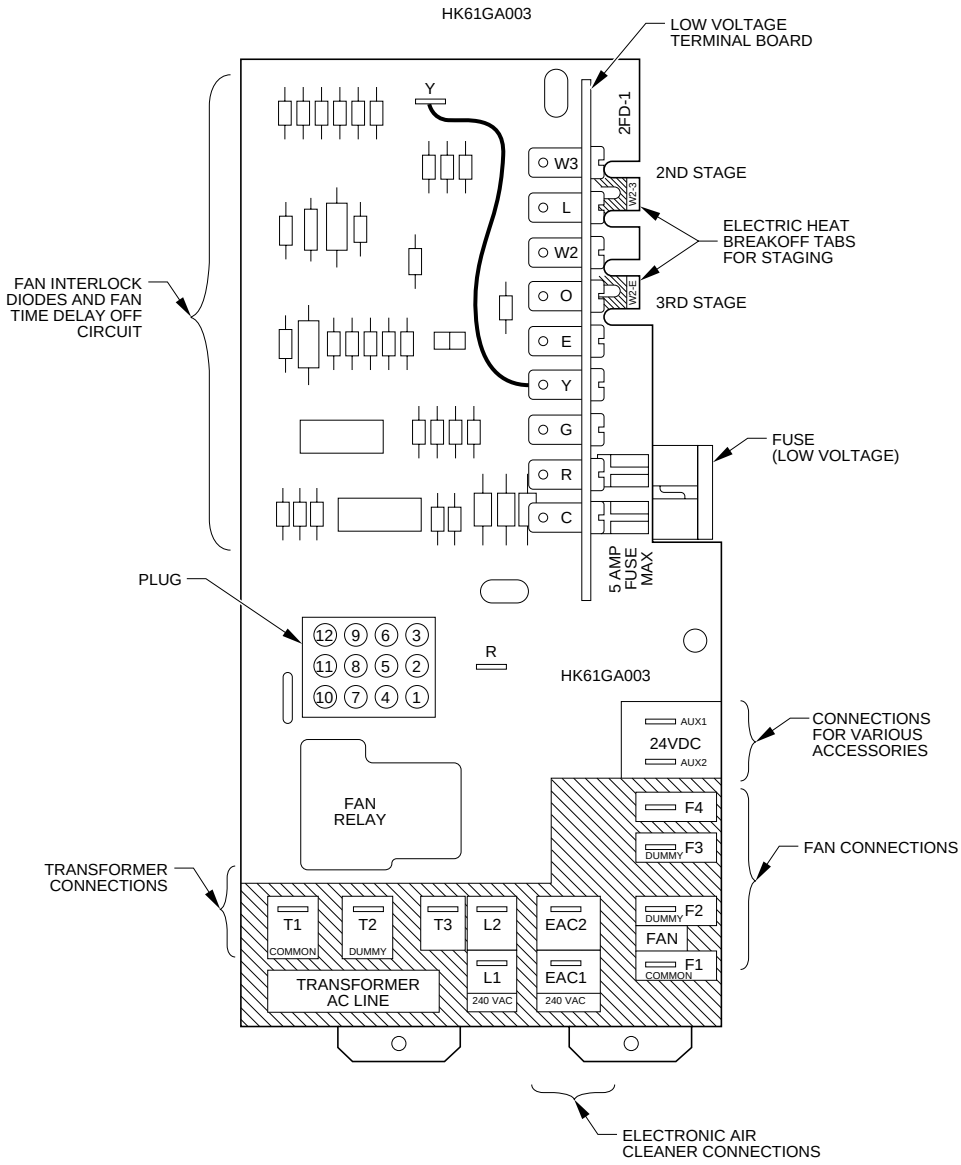
Fig. 32—HK61GA001 Printed Circuit Board

1. The low-voltage terminal board is used to connect the indoor thermostat to the low, 24-v side of the transformer, and to serve as a junction between the indoor thermostat and the outdoor section.
2. Break off the tabs.
   a. W2-3 — Used to control (stage) the second stage of electric heat. The first stage controlling electric heat and the indoor fan are interlocked through diodes.
   b. W2-E — Used to control (stage) the third stage of electric heat.
3. A fuse is used to protect the low-voltage transformer.
4. AUX 1 and AUX 2 are connections for the latent capacity control, delay off kit, 2-speed kit and air conditioning accessories.
5. F1, F2, F3, and F4 are connections for the indoor fan.
6. EAC1 and EAC2 are 240-v connections, which parallel fan lead connections, for the electronic air cleaner.
7. L1 and L2 are 240-v connections which parallel power input.
8. T1, T2 and T3 are connections for the primary, high-voltage side of the transformer.
9. The fan relay is controlled by the thermostat and turns the fan on and off.
10. A plug is used as the connection for the PCB power and electric heaters. Note the pin numbers on the plug.
11. Diodes provide DC power for the fan relay and the first stage of electric heat: W2, W3 or E.

PROCEDURE 2—PCB COMPONENT FUNCTIONS

A. Low-Voltage Terminal Board (HK61GA001, 003)

The low-voltage terminal board connects the indoor thermostat to the outdoor unit as shown in Fig. 34. The terminals are listed as follows along with their functional control.



A97026

Fig. 33—HK61GA003 Printed Circuit Board

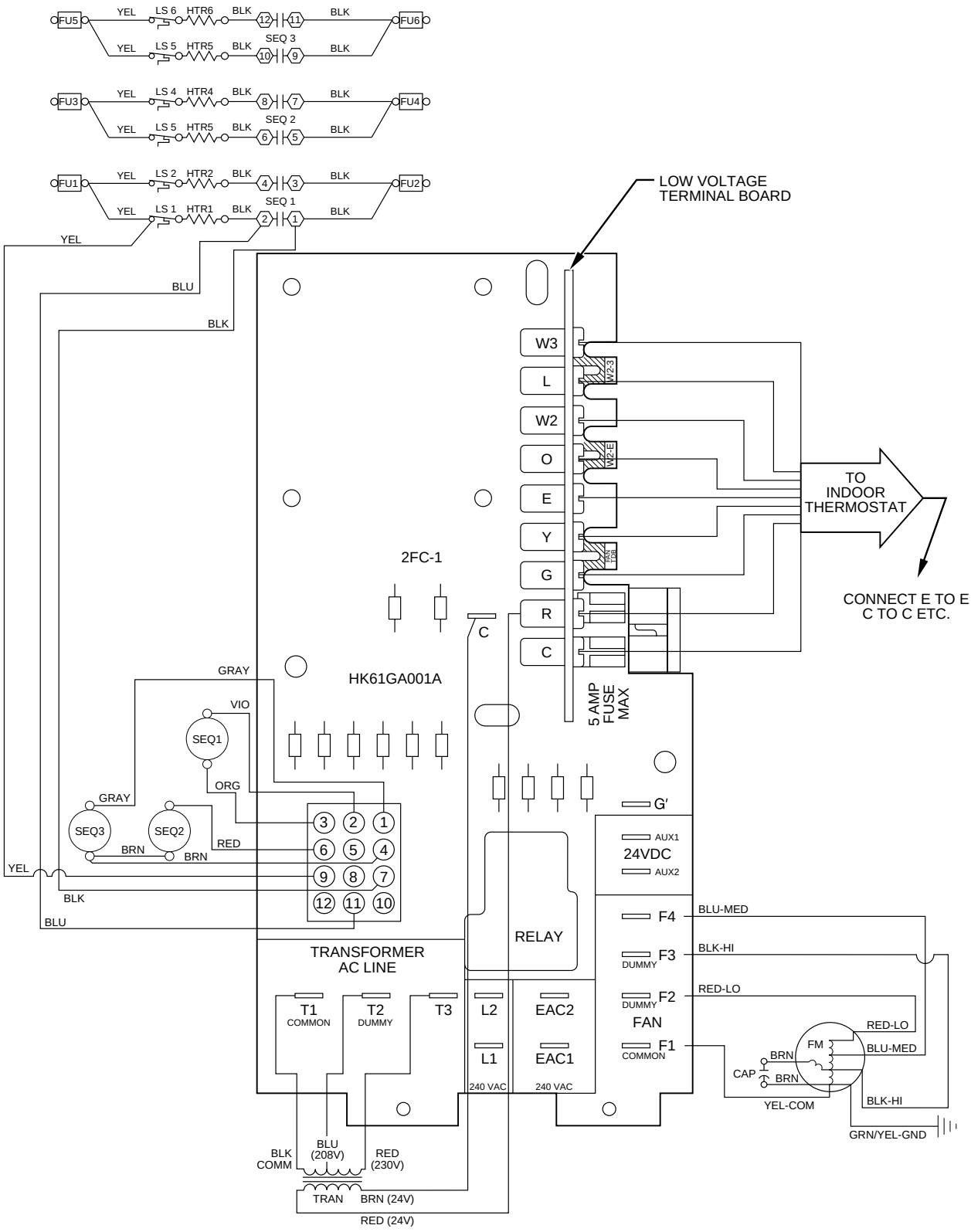
1. R is used to connect the secondary side of the transformer. The red wire provides low voltage (24v) to the PCB and the thermostat. R is fused on the HK61GA003 board.
2. C is used to connect the brown wire of the thermostat to provide a return path to ground through the fuse which protects the transformer. C is fused on the HK61GA001 board.
3. G is used to control the switching of the relay to turn the fan on through the normally open contact of the relay. Y on the HK61GA001 is used as the junction for the outdoor section's Y connection which controls the compressor contactor for heat pump and cooling modes. The HK61GA003 board contains a 90-sec fan-off delay which begins timing when the Y is de-energized.
4. O is used as a junction for a heat pump reversing valve circuit.
5. W2 is used to turn on the first stage of electric heat which is interlocked with the fan through the normally closed fan relay. Unless the tabs are broken off, all stages of electric heat will turn on when W2 receives a signal from the thermostat.
6. W3 is used to turn on the second stage of electric heat. Note the W2 and W3 tab must be broken off for individual staging to take place. Energizing W3 will always turn on the first stage through the diodes even if the tabs are broken off.
7. E is used to turn on the third stage of electric heat. Note that the W3 and E tab must be broken for this individual staging. Energizing E will always turn on the first stage through the diodes even if the tab is broken off.
8. L is used as a junction to wire a diagnostic light (LED) on selected thermostats.

B. Transformer

The proper wiring of the transformer on the HK61GA001 board is illustrated in Fig. 34. Note that T1, T2, and T3 are wired to the primary or high side of the transformer. The blue wire is connected to T3 for 208-v applications. The red wire is connected to T3 for 230-v applications. Units are factory wired at 230v. The T2 terminal is a dummy.

C. Indoor Fan

1. Wiring--The fan connects to F1, F2, F3, and F4 as shown in Fig. 34. Note that F2 and F3 are dummy terminals. The desired fan speed is connected to F4 and the common is connected to F1. Units are factory wired at medium speed.
2. Functional Control



A97027

Fig. 34— Typical HK61GA001 View
10kw to 20kw Circuits

a. Thermostat and Relay Control--When the thermostat calls for the fan in cooling, heat pump, electric heat, or fan-only mode, a **24-v dc** signal is sent to the relay. This causes the relay to close its normally open contacts, thus turning on the fan. When the thermostat no longer calls for the fan, the signal sent to the relay is turned off and the relay opens causing the fan to turn off. The HK61GA003 board contains a 90-sec fan-off delay when Y is de-energized.

a. Sequencer Interlock--The fan will also turn on whenever there is any call for electric heat, even if the fan relay is not energized. This happens because the fan is interlocked with the first stage of electric heat through the normally closed contact of the fan relay.

D. Electric Heat

When the thermostat calls for electric heat, a 24-v signal is sent to the PCB through W2, causing the first stage to turn on. W3 and E also receive the signal if the tabs are not broken off the PCB. The signal sent to W2 causes the first stage to turn on. If the tabs are broken off the PCB, the sequencers can be controlled individually to stage the electric heat. The sequence control is described in the following section:

1. W2--When the thermostat sends a signal to W2, a 24-v dc signal is applied across sequencer number 1, causing it to close. When sequencer number 1 closes, the first stage of electric heat energizes after a short delay. In straight electric heat, the fan is also energized through the normally closed contacts of the fan relay. In cooling, heat pump, or manual fan mode, the fan will already be running since the fan relay would have been energized. When the thermostat stops calling for electric heat, the 24-v dc signal to sequencer number 1 turns off and the sequencer opens after a delay of 60 to 90 sec. When the sequencer opens, the first stage of heat turns off along with the fan, providing that the thermostat is not calling for the fan. Note that the electric heat cannot be turned on without the fan being turned on at the same time. This is a fan interlock system.
2. W3--When a signal is sent to W3, 2 control signals are sent out to the sequencers; a 24-v dc signal to sequencer number 1 through the diode interlock, and a 24-vac signal to sequencer number 2. The 24-vac signal applied to sequence number 2 causes the sequencer to close, with the second stage of electric heat turning on after a short delay.

The 24-v dc signal applied to sequencer number 1 causes the first stage of electric heat to turn on in the same manner as described in W2 above. Note that W3 is interlocked with the fan, since sequencer number 1 is turned on whenever W3 has a signal sent to it. Timing is such that sequencer number 1 will turn on before sequencer number 2. When the signal to W3 is turned off, sequencer number 2 opens after a short delay. If W2 is also satisfied, the first stage of electric heat and the fan will also turn off, providing the thermostat is not calling for the fan to be on.

E--When the thermostat sends a signal to E 2 signals are sent out to the sequencers. A 24-vac signal is sent to sequencer number 3 and a 24-v dc signal is sent to sequencer number 1. The 24-vac signal applied to sequencer number 3 turns on the third stage of electric heat. The 24-v dc signal applied to sequencer 1 turns on the first stage of electric heat and the fan in the same manner as W3. Note that E is also interlocked with the fan.

When the thermostat stops calling for electric heat, the signals to sequencers 1 and 3 are turned off and the sequencers open. This causes the electric heat to turn off with the fan if the thermostat is not calling for the fan.

E. Accessories (HK61GA001, 003)

1. EAC1 and EAC2 for Electronic Air Cleaners
   a. There are 240-v electronic air cleaner contacts provided at EAC1 and EAC2. The electronic air cleaner is connected in parallel with the fan so that it is on whenever the fan is on. A 120-v installation is similar in function but connected between EAC2 and neutral of 230-v: 120-v transformer connected to EAC1 and EAC2. Refer to electronic air cleaner literature for further information.
2. AUX1 and AUX2 for 2-Speed Fan Relay Kit
   a. Use to control fan speed operation, high speed for cooling, heat pump, and fan-only modes. Low speed is used for electric heat. Fig. 35 shows proper connection for 24-v dc 2-speed fan relay kit. Note that kit's relay coil is in parallel with fan relay coil on PCB connected to AUX1 and AUX2. Make sure the normally closed contact is connected to the lower speed.
   b. The latent capacity control kit is used to control fan speed operation when the relative humidity is above a set point on humidistat. Humidistat opens and 2-speed fan relay remains in normally closed position with fan motor running at a lower speed for maximum humidity control. Fig. 36 shows proper connection for latent capacity control kit. Note that it is connected in the same manner as 2-speed fan relay kit but with relay connected to humidistat (orange wires).
   c. Time delay-off relay kit is used to increase the efficiency of the system by delaying the fan from turning off after the thermostat is satisfied on the HK61GA001 board. The HK61GA003 board has this feature as standard. The proper wiring and mounting of the time delay-off relay kit is shown in Fig. 37.
   d. Latent capacity control and time delay-off connections are shown in Fig. 38, for the HK61GA001 board only.

PROCEDURE 3—TROUBLESHOOTING THE PRINTED CIRCUIT BOARD (HK61GA001, 003)

Use Fig. 39 wiring schematic as a guide in troubleshooting the PCB unless otherwise noted.

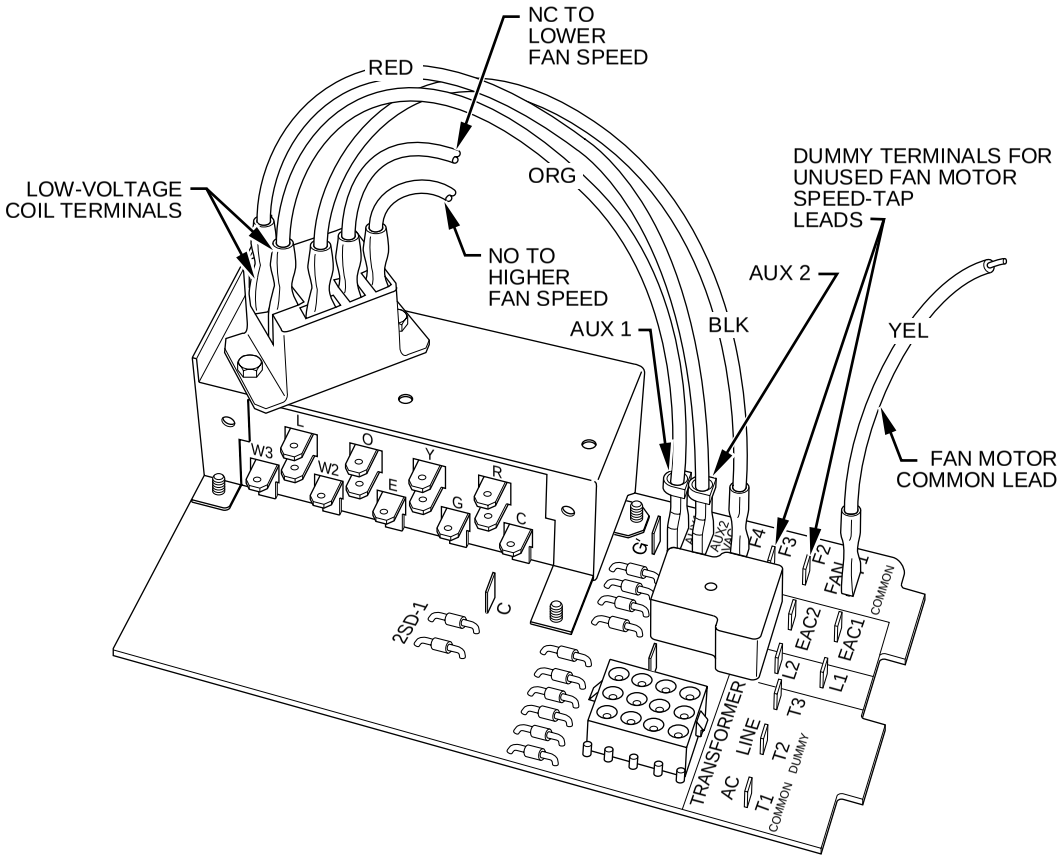
A. If the fan will not turn on from the thermostat:

IF THERE IS NO HIGH VOLTAGE TO THE PCB:

1. Check the plug/receptacle connection; this brings power to the PCB. Make sure the plug is connected properly.
2. Check sequencer number 1 and the plug's wiring; the yellow wire should be connected to pin number 9 of the plug and the limit switch. A black wire should be connected to pin number 7 of the plug and to sequencer number 1.
3. Check power leads L1 and L2. If these are not receiving power, the system cannot function.

IF THE PCB HAS HIGH VOLTAGE APPLIED TO IT:

1. Check the low-voltage transformer leads, R and C. Make sure they are wired to the correct locations. Note that Fig. 39 shows wiring of the HK61GA001 board.



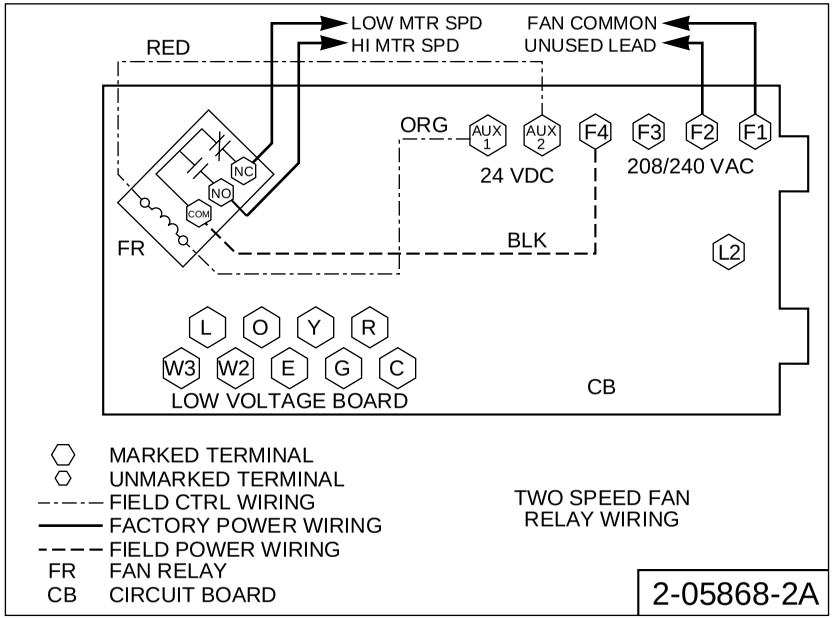
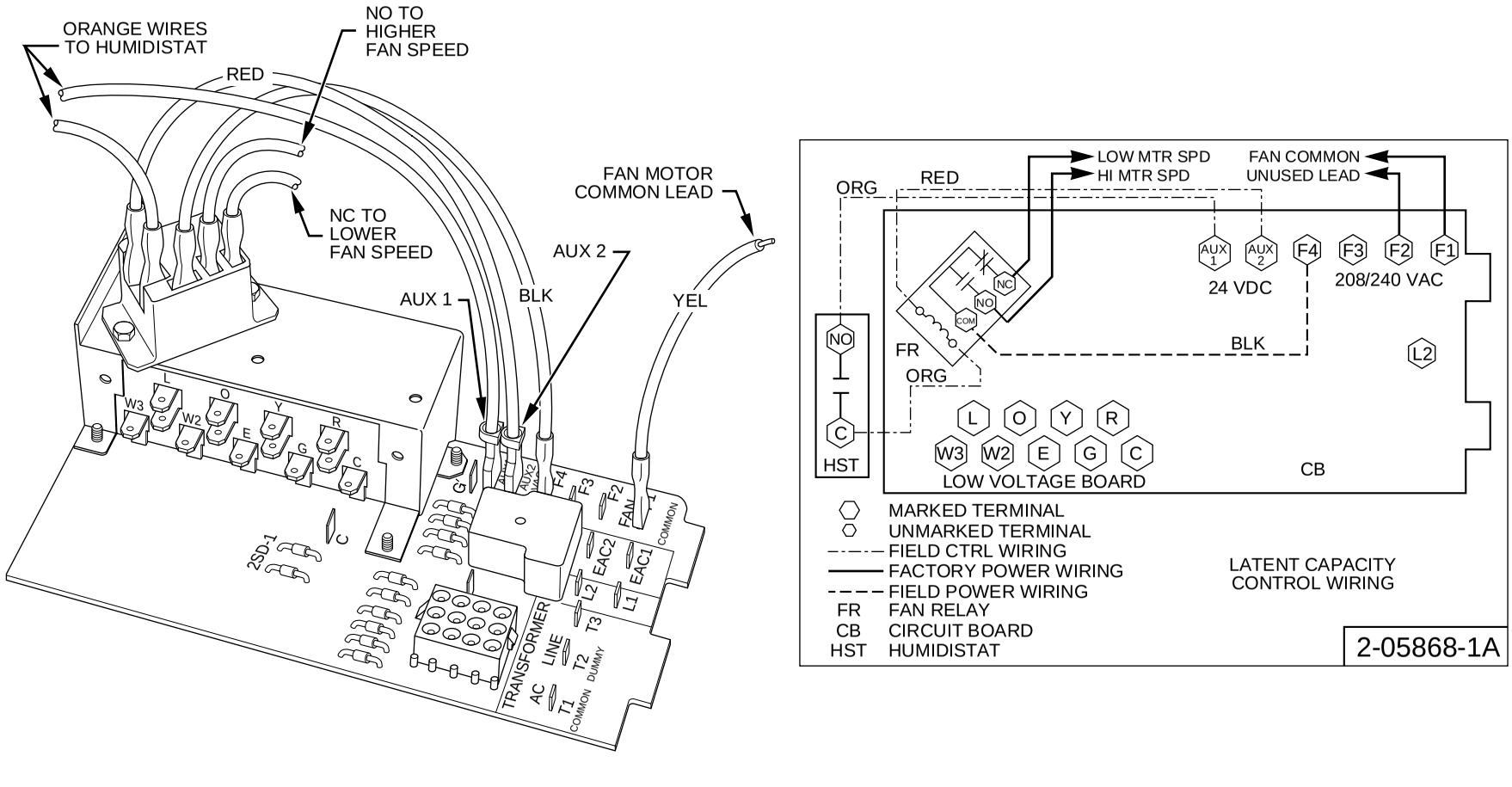


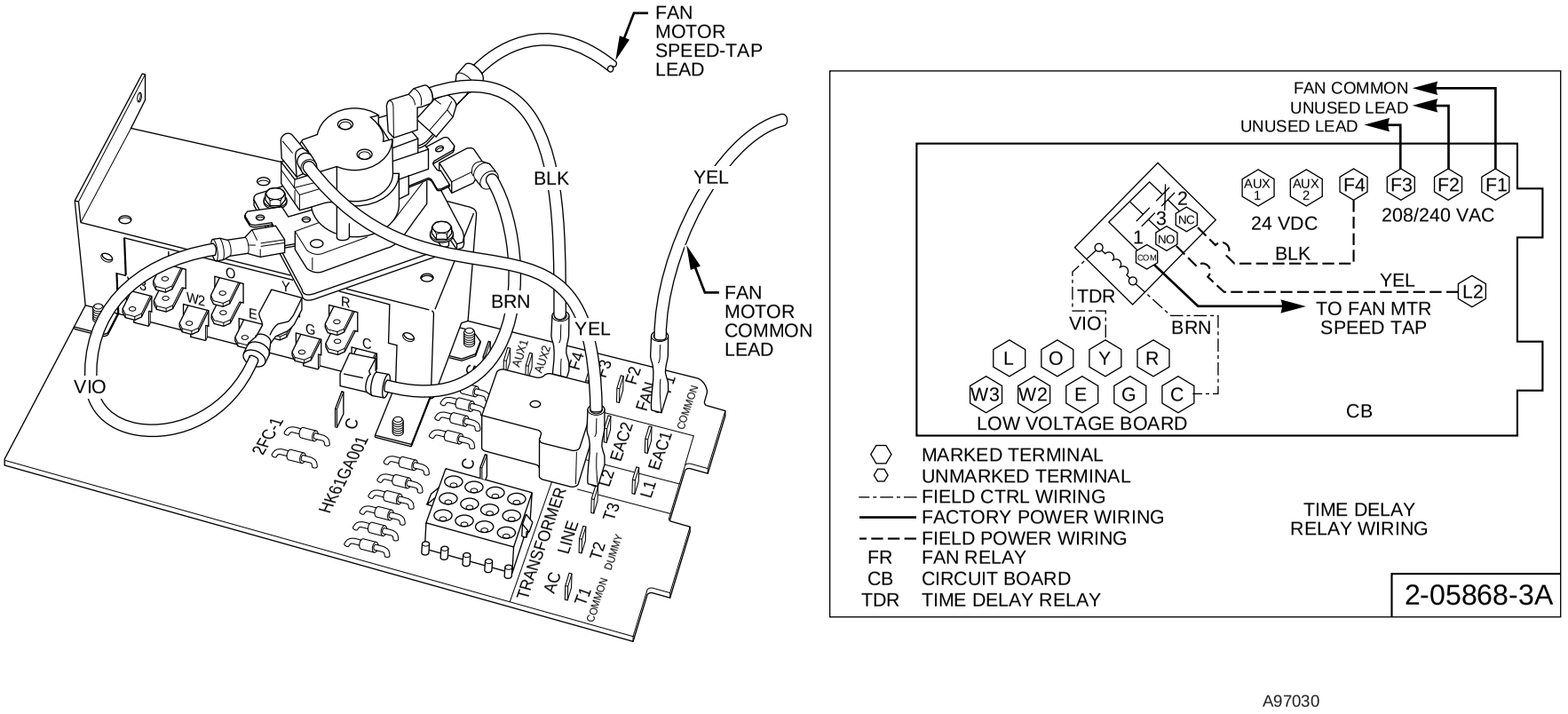
Fig. 35—Two-Speed Fan Relay Kit

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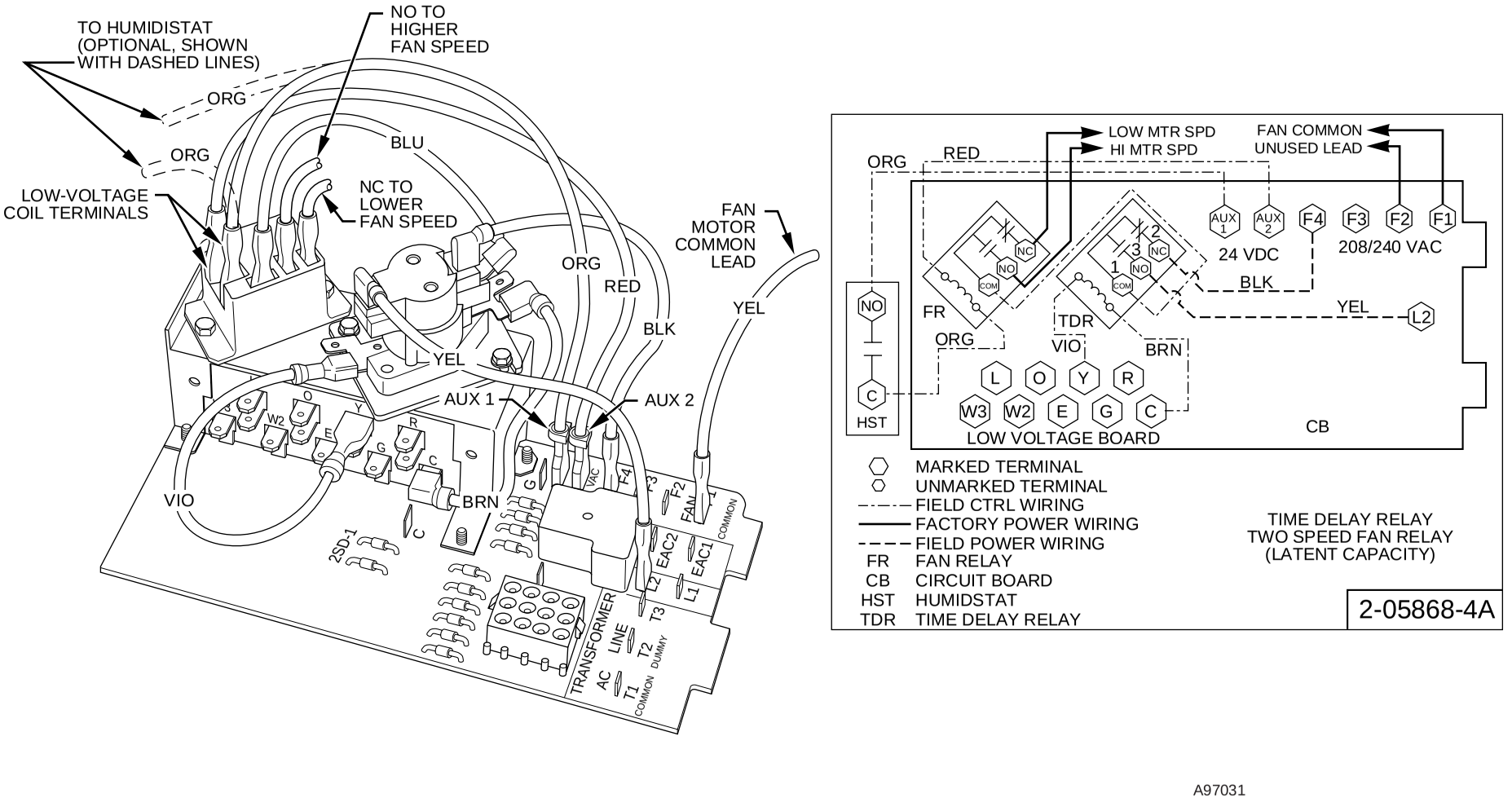
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Fig. 36—Latent Capacity Control Kit



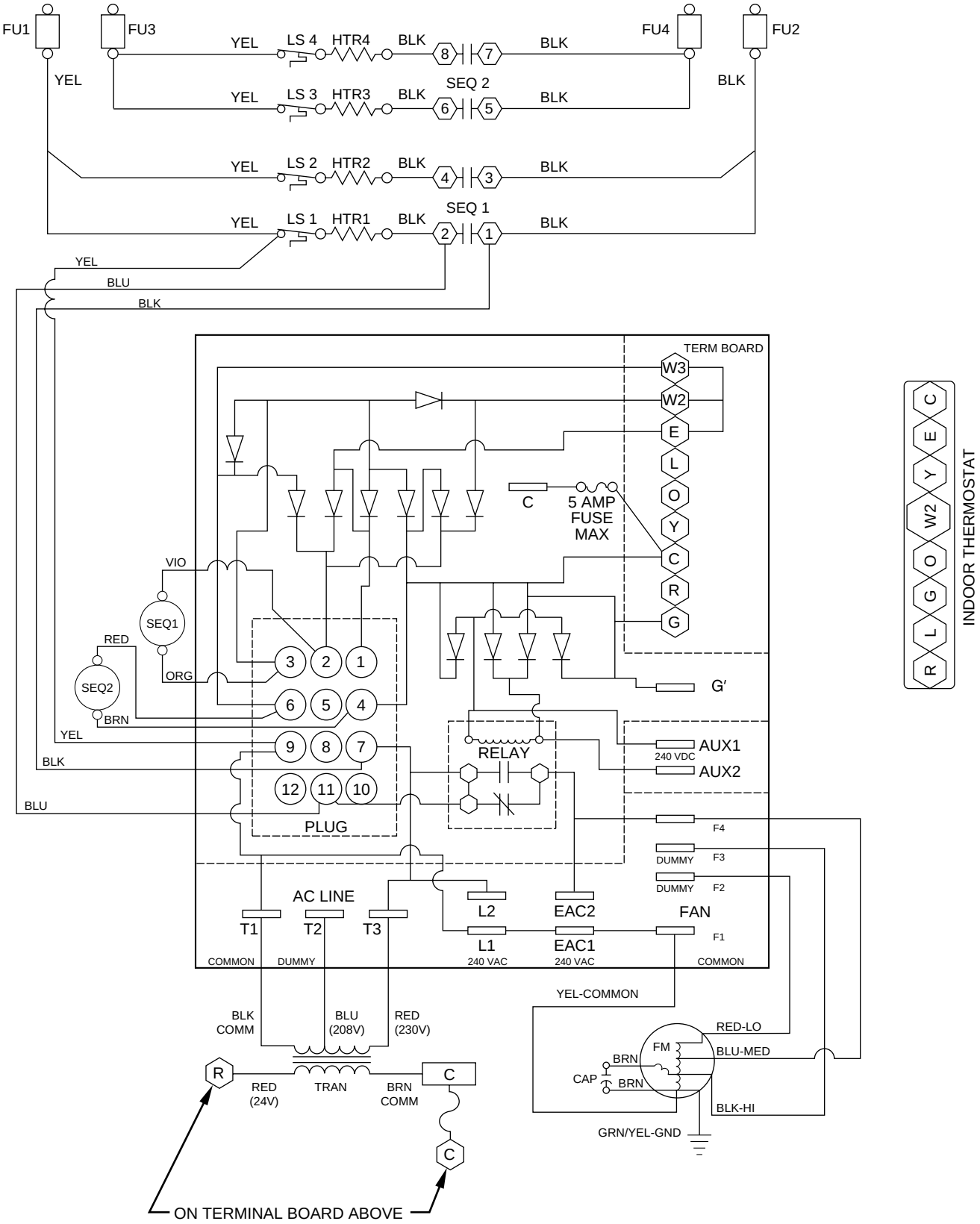
A97030

Fig. 37—Time Delay-Off Relay Kit



A97031

Fig. 38—Latent Capacity Control and Time Delay-Off Relay Kits



A97032

Fig. 39—Wiring Schematic (HK61GA001)

2. Check the output voltage of the secondary side, R and C, of the transformer. If the circuit board is a HK61GA003, make sure the ground strap is in place from C to the bracket. This strap must be in place to complete the 24-v circuit. Make sure the transformer output is around 24-vac. If the transformer output is zero-vac and the transformer is receiving the correct input voltage (208-v or 240-v), then the transformer needs to be replaced with the recommended transformer. If the transformer output is 24-vac, then proceed to 3 and 4.
3. Check the low-voltage fuse shown in Fig. 32 and Fig. 33. If the fuse is blown, replace it. The transformer cannot supply power to the board with the fuse blown or loose. If the fuse blows when the unit has power applied to it, the system most likely has 1 of the following problems:
   a. If the transformer is shorting out, check the wiring of the transformer.
   a. The maximum load on the transformer is 40 VA. If the load on the transformer is excessive, the low-voltage, 5-amp fuse will blow to protect the transformer. If the load exceeds the VA rating of the transformer, a larger VA rated transformer needs to be installed. Check the sequencers for excessive current draw.
   b. Check the wiring of the heaters. If the heater is miswired, the fuse may blow. Check the diodes shown in Fig. 40 for signs of overheating. If the heater is miswired, correct the miswiring.
4. Check the T1, T2, and T3 connections on the primary side of the transformer. If they are not connected properly, the low-voltage terminal board cannot supply the 24-v signal to energize the fan relay. If the transformer is receiving the correct primary voltage but is not outputting the correct secondary voltage, the transformer needs to be replaced.

B. If the electric heat stages will not turn on but the fan will turn on:

1. Check the wiring of the sequencer. Pay particular attention to the high and low-voltage wiring of the sequencers.
2. Check the plug wiring to make sure that it is wired correctly.
3. Check the voltage to the sequencer; sequencer number 1 receives a 24-vac signal. If it is receiving the correct voltage, check to see if the sequencer is closing. If the sequencer is not closing but is receiving the correct voltage, replace the sequencer. If the sequencer is closing, check the high-voltage wiring as discussed in 1 and 2.

C. If the electric heat and the fan will not turn on:

IF THERE IS NO HIGH VOLTAGE TO THE PCB:

1. Check the plug connection. This brings power to the PCB transformer and the fan. Make sure the plug is connected properly.
2. Check sequencer number 1 and the plug wiring. The yellow wire should be connected to pin number 9 of the plug and the limit switch. The black wire should be connected to pin number 7 of the plug and to sequencer number 1.
3. Check incoming high-voltage power leads. If these are not receiving power, the system cannot function.

IF THE PCB HAS HIGH-VOLTAGE APPLIED TO IT:

1. Check the low-voltage transformer leads, R and C. Make sure they are wired to the correct location. The unit will not function without proper connections.
2. Check the output voltage of the secondary side, R and C, of the transformer. If the circuit board is an HK61GA003, make sure the ground strap is in place from C to the bracket. This strap must be in place to complete the 24-v circuit. If the transformer output is zero-vac, refer to "If the PCB has high voltage applied to it" in column 1, numbers 3 and 4.

D. If the traces are burnt off the back of the PCB:

Usually whenever there is a trace blown on the PCB it means either there has been a high-voltage short or high voltage has been applied to the low-voltage circuit. This can be prevented by making sure the PCB is wired correctly before the PCB has power applied to it.

E. If there are blown diodes:

1. If diodes a and b are blown, it is probable the electric heater plug was miswired. Correct the miswiring. It should be noted the board will need to be replaced if the diode indicated is bad.
2. If any of the c diodes are blown, the fan is miswired to 1 of the low-voltage terminals, AUX1 or AUX2. Check to make sure that the fan leads are connected to the proper terminals as shown in Fig. 39. If the fan is connected properly, make sure that no other high voltage is applied to the AUX terminals.

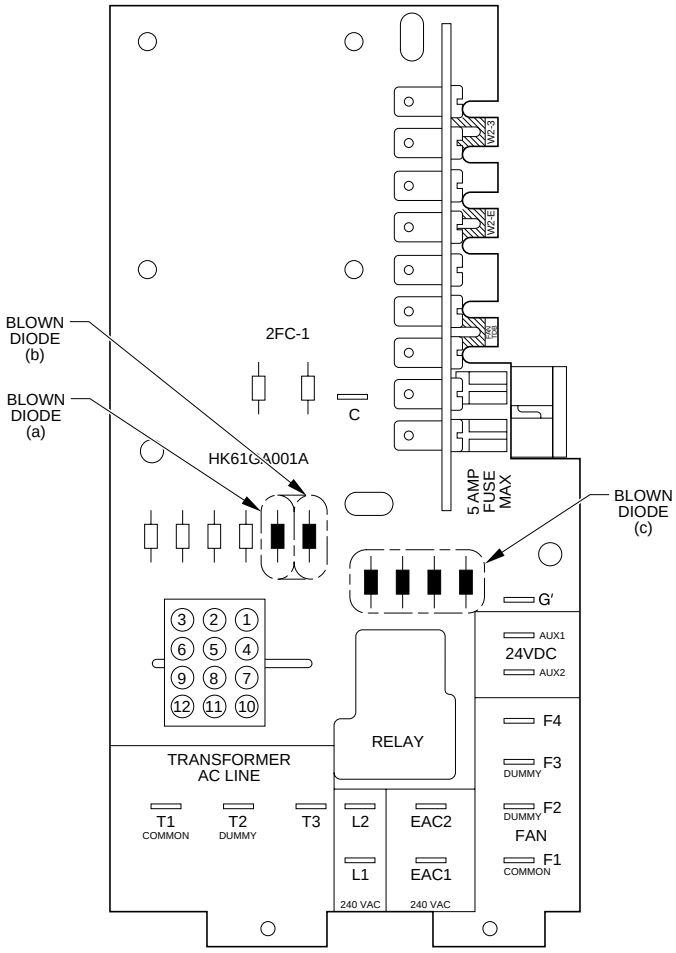
F. The PCB fuse keeps blowing:

When the low-voltage fuse blows, it means the transformer would have just blown if the fuse had not been in the circuit to protect it. The fuse usually blows when there is a high current draw on the transformer, high voltage applied to the low-voltage circuit, or a direct secondary short. When there is a high current draw on the transformer, it is most likely because the transformer has been shorted or the system is trying to draw more VA than the transformer is rated for. When the fuse blows because of high voltage, the system has mixed high- and low-voltage signals.

1. Check the transformer and thermostat wiring as shown in Fig. 37. Make sure the transformer is not shorting out by the thermostat wires being miswired.
2. Check the wiring of the sequencers as shown in Fig. 39. Make sure the low-voltage and the high-voltage wiring are connected to the proper sequencers.
3. Check the VA draw on the transformer. If the VA draw is more than the VA rating of the transformer, the fuse will blow. If this is the case, replace the transformer with 1 that has a higher VA rating and meets system specifications.

G. The fan runs continuously:

1. If the PCB has no low-voltage power, check the blue and black fan leads. These may be switched at the sequencer.
2. If the PCB has low-voltage power, check the fan relay to see if it is opening and closing. It may be stuck in the normally closed position due to debris in the relay.



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Fig. 40—Control Board Noting Diodes (HK1GA001)

H. Transformer failure:

1. Check the 208-v and 240-v taps connected to T1, and T3. They may be miswired.

I. Replacement Motor Position:

The position of the blower motor should be properly located in the blower housing to reduce any frequency pulsations. The position is generated based upon the bellyband placement around the center of the motor as shown in Fig. 41. Do not cover motor vent holes or the motor will overheat. Table 15 shows the position of the motor from center.

Table 15—Replacement Motor Position

FA4, FB4, FC4, FX4 -030	Out ’3/8″
FA4, FB4, FC4, FX4, -036	Out ’3/4″
FA4, FB4, FC4, FX4 -060	In ’1/2″
FA4, FB4, FC4, FX4 -018, 024, 042, 048	Center

ELECTRIC HEATER FUNCTION AND TROUBLESHOOTING

This section describes KFA, KFB, KFC, and KFD series electric heaters in exclusion of Smart Heat by examining the functional operation of these heaters.

PROCEDURE 1—DESCRIPTION OF ELECTRIC HEATER COMPONENTS

A. Limit Switch

The limit switch is a temperature sensitive control whose function is to prevent system from overheating in abnormal conditions. The temperature settings often vary from heater to heater due to variations in airflow patterns and element radiant heat conditions. The devices are sized to remain on-line under heat pump conditions (115°F air off coil) and minimum CFM, but trip to prevent outlet air conditions above 200°F or excessive component or duct temperatures.

The device itself consists of a bimetallic disc, which when overheated "snaps through" to open a normally closed high-voltage, high-current switch. When system temperatures cool sufficiently, the switch will automatically reset to its closed position. Normal failure mode for this switch is open.

If a limit switch has been determined to be defective, NEVER BYPASS THE LIMIT SWITCH. When replacing limit switch, ensure that it is replaced with a limit switch of identical opening temperature and closing differential. Limits switches are typically color coded to identify their range.

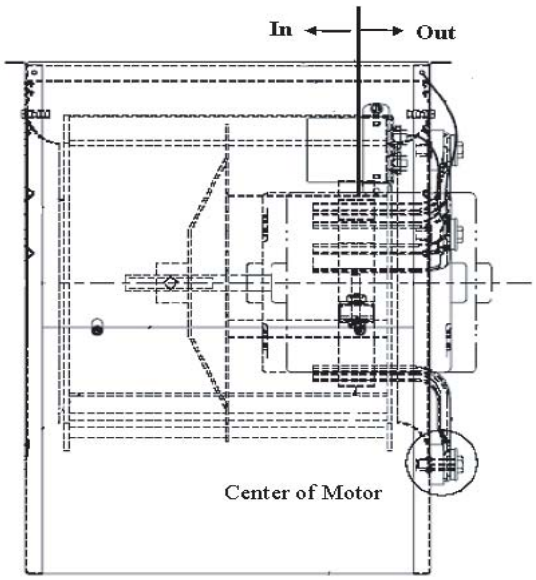


Fig. 41 - Motor Position from Center

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B. KFA and KFB Sequencer

The sequencer is essentially a thermally activated time-delay relay normally activated by low-voltage control signals from thermostat. The typical sequencer is a 1- or 2-pole normally open device which energizes within 30 to 70 sec after application of control signal and de-energizes 60 to 90 sec after control signal is removed.

In simplistic terms, the sequencers which we use are nothing more than normally open limit switches which sit on top of a small resistive heater. When voltage is applied to this heater, a positive temperature coefficient resistor (PTC), heat is supplied to a bimetallic disc which "snaps through" and closes switch.

The time required for PTC to heat to a sufficient point controls ON timing of device. The time required for disc to cool down when power is removed controls OFF time of device. The PTC can be varied to provide varied timing. Typically a short ON equates to a long OFF.

Because this is a thermally-activated device, ambient conditions affect the ON/OFF cycle. Higher ambient temperature means shorter ON times and longer OFF times.

These sequencers may be "ganged up" to 3 on a common mounting plate to control up to 6 heater elements. In this situation, PTCs are different in each sequencer to provide a staged ON of a minimum of 10 sec between each sequencer — 3 stages of 2 elements since the KFA and KFB series heaters use sequencers in which both switches of the 2-pole sequencer close simultaneously. Older models used sequencers which had a minimum delay of 10 sec between each switch.

Application of these devices is such that the first switch ON not only turns on first heater element, but also ensures that indoor fan is energized, because first ON is last OFF. This ensures fan remains ON until the last heater de-energizes.

C. KFC and KFD Electric Heat Relay

KFC and KFD electric heater packages have relays controlling the heater elements instead of sequencers. A small rectifier PCB is mounted to each relay which converts the incoming 24-vac control signal to dc. In addition to the rectifier circuit, the second and third stage relays contain a time-on delay circuit of 5 seconds for second stage, and 8 seconds for third stage. When the control signal is removed from the relays, all relays will open with no time-off delay.

PROCEDURE 2—TROUBLESHOOTING KFA, KFB, KFC, AND KFD SERIES ELECTRIC HEATERS

A. Discolored Wire Insulation at Terminal

Check quick-connect terminal at discoloration. Connection may be loose, creating a high resistance through connection point.

B. Fuse Failure

1. Check for shorted wire. Replace wire. Never try to fix wire using electrical tape.
2. Check shorted element. If element is shorted, replace heater.

C. No Heat

1. Check fuse for failure. If fuse has failed, refer to Fuse Failure section.
2. Check for faulty transformer. Check output voltage of transformer secondary side R (red) and C (brown). Make sure output is between 18 and 30 vac. If output voltage is low and input voltage tests normal, replace transformer.
3. Check for miswired heater plug harness.
4. Check limit switch or sequencer failure. These switches should have failed in open position. If output voltage is zero volts, replace switch.
5. Check heater relay and PCB (KFC and KFD heaters only). Control voltage input to PCB should be 24-vac. Output to relay should be 18-vdc minimum. If input is present but no output, replace PCB. If output is present, replace relay.

D. Heater Will Not Turn Off

1. Check low-voltage wiring for miswire.
2. Check for shorted elements to ground.
3. Replace sequencer/relays. They may be stuck closed.

E. Nuisance Trips

1. Check for low airflow due to dirty filters, blocked registers, or undersized duct.
2. Check blower motor and wheel for proper operation. Excessive current draw of motor will cause internal overload to trip.
3. The fan speed may be low.

THERMOSTATIC EXPANSION VALVES (TXV)

The FC4, FK4, FX4, FV4, and 40FK Fan Coils are factory equipped with a hard shutoff (HSO) TXV.

The hard shutoff TXV has no bleed port and allows no bleed-through after system is shutdown. A start capacitor and relay must be installed on single-phase reciprocating compressors to boost torque to compressor motor so it may overcome the unequalized system pressures.

The standard TXV is a bi-flow metering device that is used in condensing and heat pump systems to adjust to changing load conditions by maintaining a preset superheat temperature at outlet of evaporator coil. The volume of refrigerant metered through valve seat is dependent upon the following:

1. Superheat temperature sensed by sensing bulb on suction tube at outlet of evaporator coil. As long as this bulb contains some liquid refrigerant, this temperature is converted into pressure pushing downward on the diaphragm, which opens the valve via push rods.
2. The suction pressure at outlet of evaporator coil is transferred via the external equalizer tube to underside of diaphragm.
3. The needle valve on pin carrier is spring-loaded, which also exerts pressure on underside of diaphragm via push rods, which closes valve. Therefore, bulb pressure equals evaporator pressure at outlet of coil plus spring pressure. If load increases, temperature increases at bulb, which increases pressure on topside of diaphragm, which pushes pin carrier away from seal, opening valve and increasing flow of refrigerant. The increased refrigerant flow causes increased leaving evaporator pressure which is transferred via the equalizer tube to underside of diaphragm, with which the pin carrier spring pressure closes valve. The refrigerant flow is effectively stabilized to load demand with negligible change in superheat.

The bi-flow TXV is used on split system heat pumps. In cooling mode, TXV operates the same as a standard TXV previously explained. However, when system is switched to heating mode of operation, refrigerant flow is reversed. The bi-flow TXV has an additional internal check valve and tubing. These additions allow refrigerant to bypass TXV when refrigerant flow is reversed with only a 1- to 2-psig pressure drop through device. When heat pump switches to defrost mode, refrigerant flows through a completely open (not throttled) TXV. The bulb senses the residual heat of outlet tube of coil that had been operating in heating mode (about 85°F and 155 psig). This temporary, not throttled valve, decreases indoor pressure drop, which in turn increases refrigerant flow rate, decreases overall defrost time, and enhances defrost efficiency.

PROCEDURE 1—PROBLEMS AFFECTING TXV

A. Low Suction Pressure

1. Restriction in TXV
2. Low refrigerant charge
3. Low indoor load
4. Low evaporator airflow

B. High Suction Pressure

1. Overcharging
2. Sensing bulb not secure to vapor tube
3. High indoor load
4. Large evaporator face area

When installing or removing TXV, wrap TXV with a wet cloth. When reattaching TXV, make sure sensing bulb is in good thermal contact with suction tube.

PISTON BODY CLEANING OR REPLACEMENT

⚠ CAUTION: Do not vent refrigerant to atmosphere. Recover during system repair or final unit disposal.

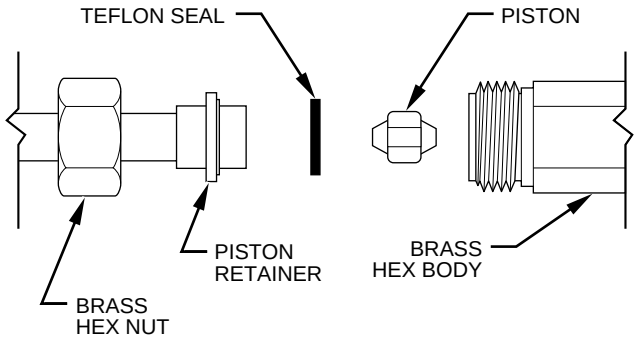
⚠ CAUTION: UNIT DAMAGE HAZARD

Failure to follow this caution could result in equipment damage.

Damage may occur to the scroll compressor if operated at a negative suction pressure during a system pumpdown.

1. Pump down outdoor unit. Close service valves at outdoor unit.
2. Recover remaining refrigerant from tubing and coil through gage port on vapor-tube service valve. Disconnect refrigerant (liquid) tube from piston body. (See Fig. 42.)

3. Avoid damaging seal ring or machined surfaces on piston, bore, and retainer.
4. Using small wire with a hook on end of it, remove piston from body.



A93530

Fig. 42—Refrigerant Flow-Control Device (For FA, FB, and FF)

⚠ **CAUTION: UNIT DAMAGE HAZARD**
Failure to follow this caution could result in equipment damage.
When cleaning the piston orifice, be careful not to scratch or enlarge the opening, as this will affect operation.

5. Install new or cleaned piston into body.
6. Replace seal ring on retainer.
7. Reconnect refrigerant tube to piston body.
8. Pressurize tubing and coil, then leak check.
9. Evacuate tubing and coil as necessary.

⚠ **CAUTION: UNIT DAMAGE HAZARD**
Failure to follow this caution could result in equipment damage.
Use a backup wrench and do not over tighten, as deformation of the piston body will occur, causing the piston to lodge in a partially open or closed position.

LIQUID TUBE STRAINER

In R-22 units, the TXV and refrigerant flow-control device is protected on the indoor coil by a wire mesh strainer. It is located inside the 3/8-in. liquid tube at field braze joint just outside unit casing. Access to strainer is through field braze joint.

FV, FA, FB, FC, FK COIL/CONDENSATE PAN REMOVAL AND REPLACEMENT

PROCEDURE 1—A-COIL UNITS

If it is determined that system does not have leaks and refrigerant is not contaminated, proceed as follows:

1. Recover system refrigerant.
   a. Attach manifold/gage set to service valves.
   b. Front seat (close) liquid tube service valve.
   c. Start unit in cooling mode.
   d. Run unit until low pressure switch opens at 27 psig or vapor pressure reaches 5 psig (35kPa). Do not allow compressor to pump into a vacuum.
   e. Turn off electrical supply to outdoor unit.
   f. Front seat vapor service valve.
   g. Recover any remaining refrigerant.

NOTE: All outdoor unit coils will hold only factory-supplied amount of refrigerant. Excess refrigerant, such as in long-line applications, may cause compressor internal pressure relief valve to open (indicated by sudden rise in vapor pressure) before vapor pressure reaches 5 psig (35kPa). If this occurs, turn off electrical supply to outdoor unit immediately, front seat vapor service valve, and recover any remaining refrigerant.

2. Turn off electrical supply to indoor unit.
3. Disconnect condensate drain tube.
4. Disconnect liquid and vapor tubes from indoor coil. Use a tubing cutter to cut tubes.

NOTE: If a torch is used to unbraze tube set, protect fitting panel with a wet cloth or braze shield, as necessary.

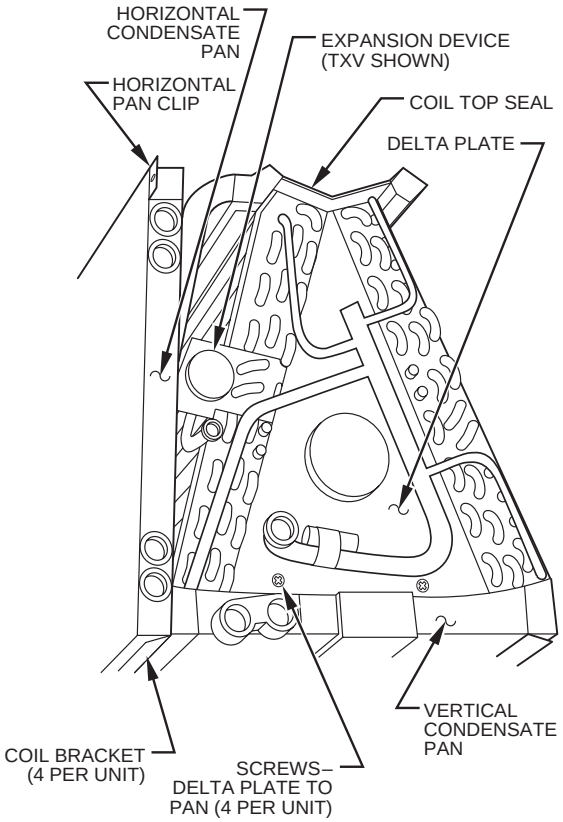


Fig. 43—A-Coil Component Location

5. Remove coil access panel.
6. Remove clip securing fitting panel to condensate drain pan. Remove fitting panel.
7. Remove any shipping clips, including horizontal pan clip, and slide coil/condensate pan assembly out of unit.
8. **Upflow or Horizontal Applications Only**—Remove horizontal condensate drain pan from coil/condensate pan assembly. (See Fig. 43.)
9. Remove 4 coil brackets. (See Fig. 43.)
10. Remove screws at delta plates and remove coil from vertical condensate drain pan. (See Fig. 43.)
11. **Horizontal Applications Only**—Remove coil top seal (attached with 4 screws) and J-shaped tube from original coil and install it in same position on new coil. (See Fig. 43.)
12. Place coil assembly in plastic condensate pan and secure using 4 screws through delta plate. (See Fig. 43.)
13. **Horizontal and Upflow Applications Only**—Attach 4 coil brackets to coil/pan assembly. (See Fig. 43.)
14. **Horizontal Applications only**—Place horizontal condensate pan into position on coil/pan assembly.

NOTE: Installation of horizontal condensate pan is not necessary for upflow or downflow applications.

15. Slide complete assembly into unit.
16. Reinstall fitting panel and reconnect clip securing fitting panel to condensate drain pan.
17. **Horizontal Applications Only**—Reinstall horizontal pan clip. Secure with 1 screw. (See Fig. 43.)
18. Reinstall coil access panel.
19. Reconnect liquid and vapor refrigerant tubes, and condensate drain tube. Install new liquid line filter-drier.
20. Evacuate tube set and indoor coil to 500 microns, back seat (open) liquid and vapor service valves.
21. Turn on electrical supplies to indoor and outdoor units.
22. Check system refrigerant charge and operation. See "Split-System Residential Air Conditioners and Heat Pumps Service Manual" for further information.

PROCEDURE 2—SLOPE COIL UNITS

If it is determined that system does not have leaks and refrigerant is not contaminated, proceed as follows:

1. Recover system refrigerant.
   a. Attach manifold/gage set to service valves.
   b. Front seat (close) liquid tube service valve.
   c. Start unit in cooling mode.

d. Run unit until low pressure switch opens or vapor pressure reaches 5 psig (35kPa). Do not allow compressor to pump into a vacuum.

e. Turn off electrical supply to outdoor unit.

f. Front seat vapor service valve.

g. Recover any remaining refrigerant.

NOTE: All outdoor unit coils will hold only factory-supplied amount of refrigerant. Excess refrigerant, such as in long-line applications, may cause compressor internal pressure relief valve to open (indicated by sudden rise in vapor pressure) before vapor pressure reaches 5 psig (35kPa). If this occurs, turn off electrical supply to outdoor unit immediately, front seat vapor service valve, and recover any remaining refrigerant.

2. Turn off electrical supply to indoor unit.
3. Disconnect condensate drain tube.
4. Disconnect liquid and vapor tubes from indoor coil. Use either a tubing cutter to cut tubes or a torch to unbraze tubes as required.

NOTE: If a torch is used to unbraze line set, protect fitting panel with a wet cloth or braze shield, as necessary. System contains oil vapors which may ignite when exposed to a flame.

5. Remove coil access and fitting panels.
6. Remove 1 screw securing coil to unit casing.
7. Remove coil/pan assembly from unit.
8. Place assembly on a flat surface. Remove 2 screws securing coil support columns to pan. (See Fig. 44.)
9. Rotate columns 90°, pull away from coil, and remove columns from assembly.
10. Remove remaining 2 screws securing coil to condensate pan.
11. Remove coil from condensate pan.
12. Remove coil top seal. (See Fig. 44.)
13. Install new coil into condensate pan using 2 original screws and 2 support columns.

NOTE: Correct coil position in condensate pan is essential to reliable operation.

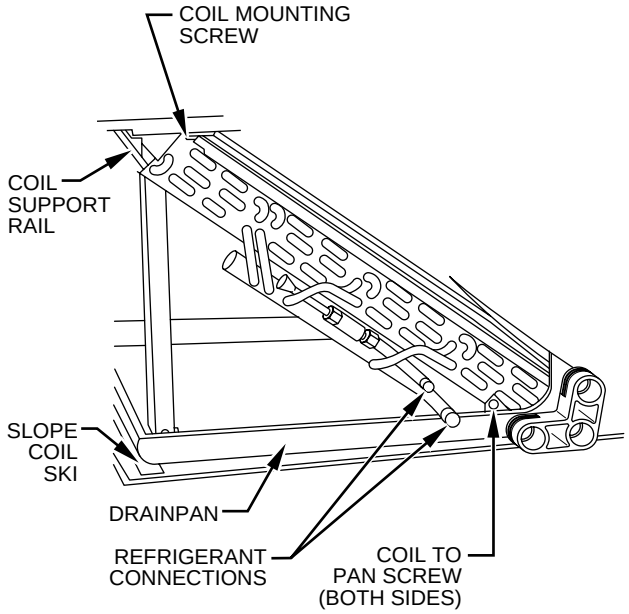
14. Install new coil/pan assembly into unit. Secure with 2 screws previously removed from unit casing.
15. Reinstall coil access and fitting panels.
16. Reconnect liquid and vapor refrigerant tubes, and condensate drain tube. Install new liquid line filter-drier.
17. Evacuate tube set and indoor coil to 500 microns, back seat (open) liquid and vapor service valves.
18. Turn on electrical supplies to indoor and outdoor units.
19. Check system refrigerant charge and operation. See "Split-System Residential Air Conditioners and Heat Pumps Service Manual" for further information.

FX4 AND FV4 COIL/CONDENSATE PAN REMOVAL AND REPLACEMENT (PURON REFRIGERANT)

PROCEDURE 1—A-COIL UNITS

If it is determined that system does not have leaks and refrigerant is not contaminated, proceed as follows:

1. Recover system refrigerant.
   a. Attach manifold/gage set to service valves.



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Fig. 44—Slope Coil Component Location

b. Front seat (close) liquid tube service valve.

c. Start unit in cooling mode.

d. Run unit until low pressure switch opens (350kPa) or vapor pressure reaches 5 psig (35kPa). Do not allow compressor to pump into a vacuum.

e. Turn off electrical supply to outdoor unit.

f. Front seat vapor service valve.

g. Recover any remaining refrigerant.

NOTE: All outdoor unit coils will hold only factory-supplied amount of refrigerant. Excess refrigerant, such as in long-line applications, may cause compressor internal pressure relief valve to open (indicated by sudden rise in vapor pressure) before vapor pressure reaches 5 psig (35kPa). If this occurs, turn off electrical supply to outdoor unit immediately, front seat vapor service valve, and recover any remaining refrigerant.

2. Turn off electrical supply to indoor unit.

3. Disconnect condensate drain tube.

4. Disconnect liquid and vapor tubes from indoor coil. Use a tubing cutter to cut tubes.

NOTE: If a torch is used to unbraze tube set, protect fitting panel with a wet cloth or braze shield, as necessary.

5. Remove coil access panel.

6. Remove clip securing fitting panel to condensate drain pan. Remove fitting panel.

7. Remove any shipping clips, including horizontal pan clip, and slide coil/condensate pan assembly out of unit.

8. **Upflow or Horizontal Applications Only**—Remove horizontal condensate drain pan from coil/condensate pan assembly. (See Fig. 43.)

9. Remove 4 coil brackets. (See Fig. 43.)

10. Remove screws at delta plates and remove coil from vertical condensate drain pan. (See Fig. 43.)

11. **Horizontal Applications Only**—Remove coil top seal (attached with 4 screws) and J-shaped tube from original coil and install it in same position on new coil. (See Fig. 43.)

12. Place coil assembly in plastic condensate pan and secure using 4 screws through delta plate. (See Fig. 43.)

13. **Horizontal and Upflow Applications Only**—Attach 4 coil brackets to coil/pan assembly. (See Fig. 43.)

14. **Horizontal Applications only**—Place horizontal condensate pan into position on coil/pan assembly.

NOTE: Installation of horizontal condensate pan is not necessary for upflow or downflow applications.

15. Slide complete assembly into unit.

16. Reinstall fitting panel and reconnect clip securing fitting panel to condensate drain pan.

17. **Horizontal Applications Only**—Reinstall horizontal pan clip. Secure with 1 screw. (See Fig. 43.) Reinstall coil access panel.

18. Reconnect liquid and vapor refrigerant tubes, and condensate drain tube. Install new Puron (R-410A) liquid line filter-drier.

19. Evacuate tube set and indoor coil to 500 microns, back seat (open) liquid and vapor service valves.

20. Turn on electrical supplies to indoor and outdoor units.

21. Check system refrigerant charge and operation. See "Application Guideline and Service Manual for R-410A" for further information.

PROCEDURE 2—SLOPE COIL UNITS

If it is determined that system does not have leaks and refrigerant is not contaminated, proceed as follows:

1. Recover system refrigerant.

a. Attach manifold/gage set to service valves.

b. Front seat (close) liquid tube service valve.

c. Start unit in cooling mode.

d. Run unit until low pressure switch opens at 50 psig (350kPa) or vapor pressure reaches 5 psig (35kPa). Do not allow compressor to pump into a vacuum.

e. Turn off electrical supply to outdoor unit.

f. Front seat vapor service valve.

g. Recover any remaining refrigerant.

NOTE: All outdoor unit coils will hold only factory-supplied amount of refrigerant. Excess refrigerant, such as in long-line applications, may cause compressor internal pressure relief valve to open (indicated by sudden rise in vapor pressure) before vapor pressure reaches 5 psig (35kPa). If this occurs, turn off electrical supply to outdoor unit immediately, front seat vapor service valve, and recover any remaining refrigerant.

2. Turn off electrical supply to indoor unit.

3. Disconnect condensate drain tube.

4. Disconnect liquid and vapor tubes from indoor coil. Use either a tubing cutter to cut tubes or a torch to unbraze tubes as required.

NOTE: If a torch is used to unbraze line set, protect fitting panel with a wet cloth or braze shield, as necessary. System contains oil vapors which may ignite when exposed to a flame.

5. Remove coil access and fitting panels.
6. Remove 1 screw securing coil to unit casing.
7. Remove coil/pan assembly from unit.
8. Place assembly on a flat surface. Remove 2 screws securing coil support columns to pan. (See Fig. 44.)
9. Rotate columns 90°, pull away from coil, and remove columns from assembly.
10. Remove remaining 2 screws securing coil to condensate pan.
11. Remove coil from condensate pan.
12. Remove coil top seal. (See Fig. 44.)
13. Install new coil into condensate pan using 2 original screws and 2 support columns.

NOTE: Correct coil position in condensate pan is essential to reliable operation.

14. Install new coil/pan assembly into unit. Secure with 2 screws previously removed from unit casing.
15. Reinstall coil access and fitting panels.
16. Reconnect liquid and vapor refrigerant tubes, and condensate drain tube. Install new Puron (R-410A) liquid line filter-drier.
17. Evacuate tube set and indoor coil to 500 microns, back seat (open) liquid and vapor service valves.
18. Turn on electrical supplies to indoor and outdoor units.
19. Check system refrigerant charge and operation. See "Application Guideline and Service Manual for R-410A" for further information.

PURON® (R-410A) QUICK REFERENCE GUIDE FOR INSTALLERS AND TECHNICIANS

- Puron (R-410A) refrigerant operates at 50-70 percent higher pressures than R-22. Be sure that servicing equipment and replacement components are designed to operate with Puron (R-410A).
- Puron (R-410A) refrigerant cylinders are rose colored.
- Recovery cylinder service pressure rating must be 400 psig, DOT 4BA400 or DOT BW400.
- Puron (R-410A) systems should be charged with liquid refrigerant.
- Use a commercial type metering device in the manifold hose.
- Manifold sets should be at least 750 psig high-side and 200 psig low-side with 520 psig low-side retard.
- Use hoses with 750 psig service pressure rating.
- Leak detectors should be designed to detect HFC refrigerant.
- Puron (R-410A), as other HFC's, is only compatible with POE oils.
- Vacuum pumps will not remove moisture from oil.
- Do not use liquid-line filter driers with rated working pressures less than 600 psig.
- Do not install a suction-line filter drier in liquid line.
- POE oils absorb moisture rapidly. Do not expose oil to atmosphere.
- Wrap all filter driers and service valves with wet cloth when brazing.
- A liquid-line filter drier is required on every unit.
- Indoor unit is equipped with a TXV. Replacement TXV must be designed for Puron (R-410A).
- Do not use an R-22 TXV.
- Never open system to atmosphere while it is under a vacuum.
- When system must be opened for service, break vacuum with dry nitrogen and replace filter driers.
- Do not vent Puron (R-410A) into the atmosphere.
- Do not use capillary tube indoor coils.
- Observe all **warnings**, **cautions** and **bold** text.