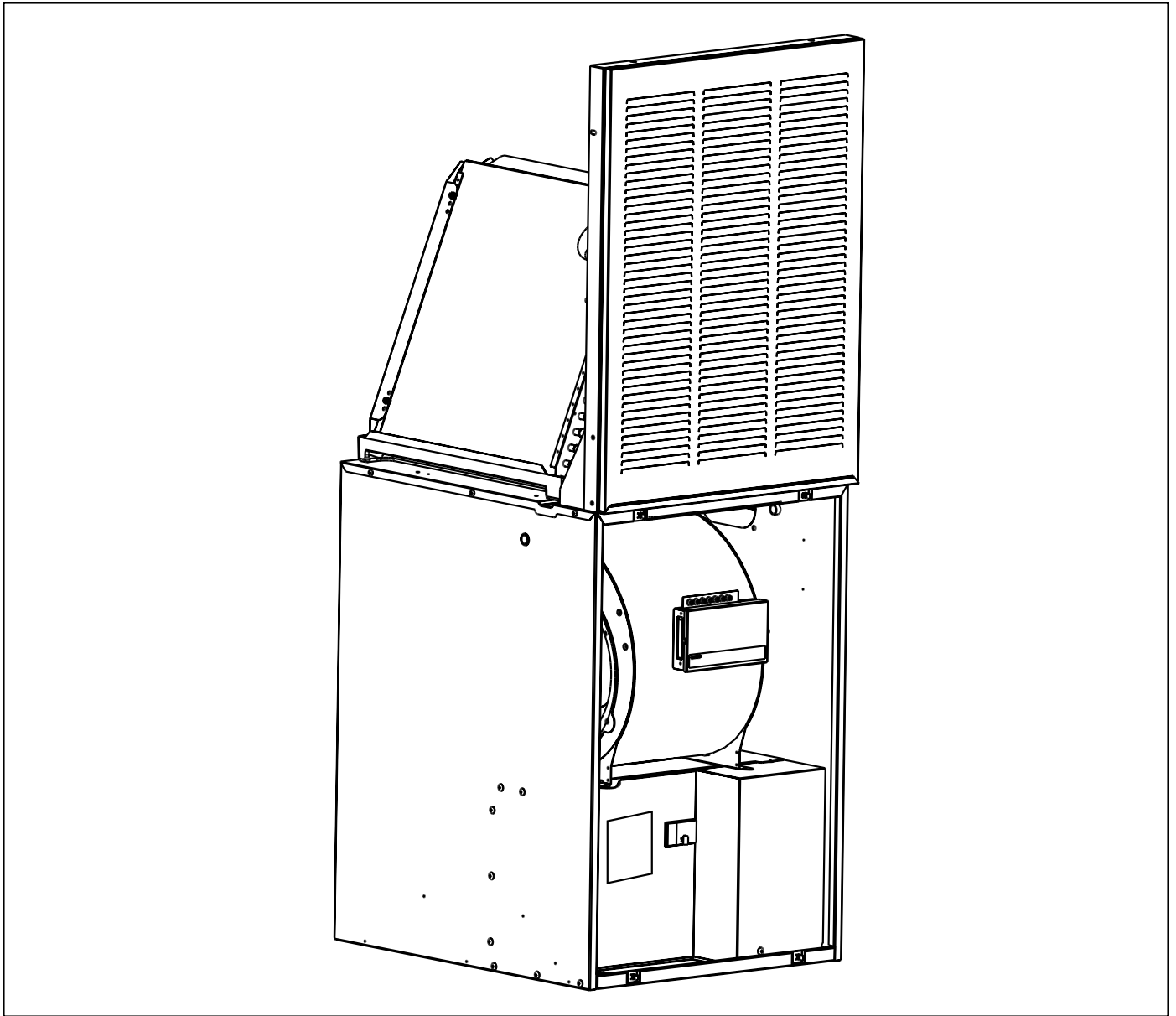


E2 Series Electric Furnaces



Service Manual

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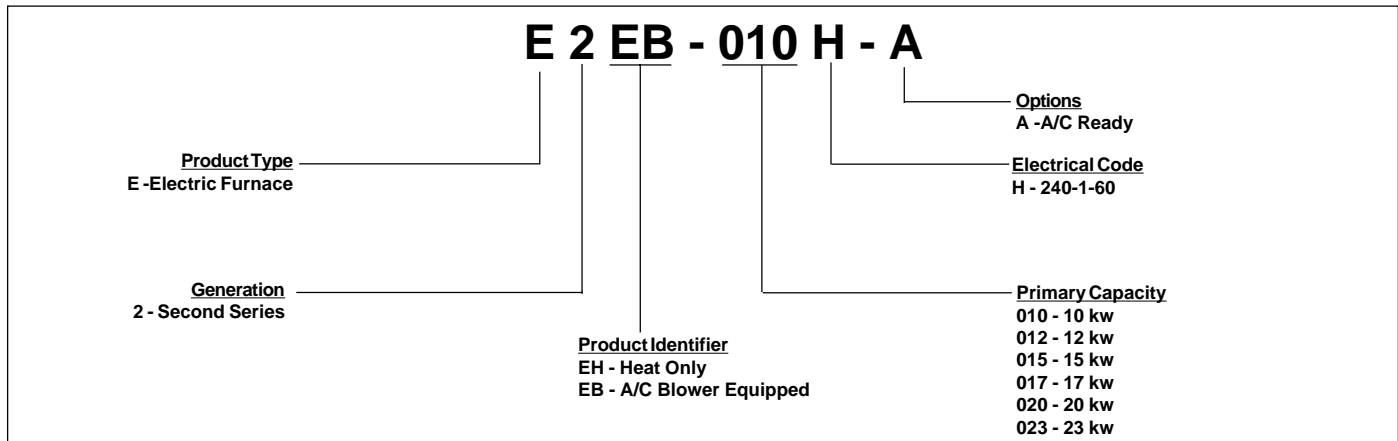
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General

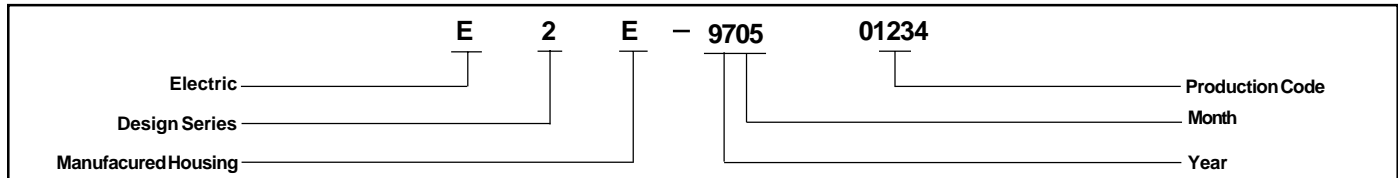
E2 series electric furnaces are approved for use in mobile/modular homes. The E2 series furnaces are approved for downflow and upflow installations as free standing units, or for alcove installations. All furnaces models are approved for "zero" inch clearance from combustible materials. For downflow alcove installations a grille with frame may be attached to the top of the furnace and all paneling and trim flushed to it.

This installations provides an access door for future installation of an air conditioning/heat pump coil. All E2 series furnaces are A/C, heat pump adaptable. Refer to table 2 For optional air conditioner/ heat pump equipment. The E2 series includes two models: E2EH and E2EB models. The E2EH models are equipped with a two speed blower and require the addition of a replay package for the addition of air conditioning or heat pump. The E2EB furnaces are equipped with a multi-speed (4-speed) blower, blower relay, and cabinet insulation.

MODEL IDENTIFICATION CODE



SERIAL NUMBER IDENTIFICATION CODE



Electric Furnace Models	E2EH						E2EB					
	010H	012H	015H	017H	020H	023H	010H	012H	015H	017H	020H	023H
Rated Heating Output, Btuh (see note 1)	35,000	41,000	53,000	57,000	70,000	75,000	35,000	41,000	53,000	57,000	70,000	75,000
Watts (Total kw, Heating Elements and Blower)	10.4	12.0	15.4	16.6	20.4	22.0	10.4	12.0	15.4	16.6	20.4	22.0
Supply Voltage	240/208 Volts/60Hz/1-Phase											
Heating Elements, No.(Total kw)	2 (10.0)	2 (11.6)	3 (15.0)	3 (16.2)	4 (20.0)	4 (21.6)	2 (10.0)	2 (11.6)	3 (15.0)	3 (16.2)	4 (20.0)	4 (21.6)
Blower:	Wheel Size	10.5" Dia., 8" Wide					10.5" Dia., 8" Wide					
	Motor Speeds, H.P. Rating, Amps	2 Speed, 1/5 Hp, 2.0 Amps					4 Speed, 1/3 Hp, 2.9 Amps					
Test ESP, in. w.c. Max							0.3					
Optional Cooling Available with factory installed blower	2.0 - 3.0 ton (see note 3)						2.0 - 4.0 ton (see note 4)					
Optional Heat Pump Available with factory installed blower	2.0 - 3.0 ton (see note 3)				n/a (see note 3)		2.0 - 4.0 ton (see note 4)					
Air Filter (Standard)	16" x 20" x 1" (nominal)											
Furnace Dimensions	Width - 20" (508 mm) Height - 29" (737 mm) (see note 2) Depth - 24-1/2" (623 mm)											

1. Heating output rated at listed voltage. For outputs at voltages other than 240V, multiply Btuh rating by the following factors: x 0.92 (230V), x 0.84 (220V), x 0.75 (208V)

2. Height is 56" with return air grille installed, 58" with coil cabinet and 72" with coil cabinet and upflow stand.

3. The factory installed blower for the EH models can be replaced with a multi-speed blower allowing the units to accept up to 4 or 5 tons of air conditioning or heat pump.

4. The factory installed blower for the EB models can be replaced with a multi-speed blower allowing the units to accept up to 5 tons of air conditioning or heat pump.

Table 1. Unit Specifications

Item Number (See Fig. 1)	Description
1	4-Speed Blower 4 Ton - See Notes: 1 & 5 5 Ton - See Note: 1
2	A.C./H.P. Relay Control Box (not req'd on E2EB models) See Note: 1
3	Cabinet Insulation Kit See Notes: 1 & 5
4	"A"-Coil Conversion Kit See Note: 2
5	Coil Cabinet See Note: 3
6	Upflow Stand See Note: 4
7	A/C and H/P Indoor Coils
8	Return Air Grille and Frame Assembly

Notes:

- 1) For A/C and H/P use.
- 2) Includes coil filters.
- 3) For upflow or downflow installations.
- 4) For upflow A/C or H/P installations (includes one filter; use filter from furnace to complete filtering system in this accessory).
- 5) Standard in EB models.

Table 2. Optional Air Conditioning and Heat Pump Equipment

Sequence of operation

With the circuit breakers in the on position and the blower switch in the auto position. One half of the control heating element and motor electrical circuit is activated. When the contacts close in the wall thermostat 24 volts is supplied by the 240/24 volt transformer to the sequencer heater. This heats a bi-metal in the sequencer which closes a set of contacts and completes the circuit to the no.1 element and the blower motor. As the heater continues to build up heat, the bi-metal closes the remaining circuits to other elements, until all elements are on. The "off" cycle is reverse of the "on" cycle the blower and no.1 element are first on and the last to be de-energized.

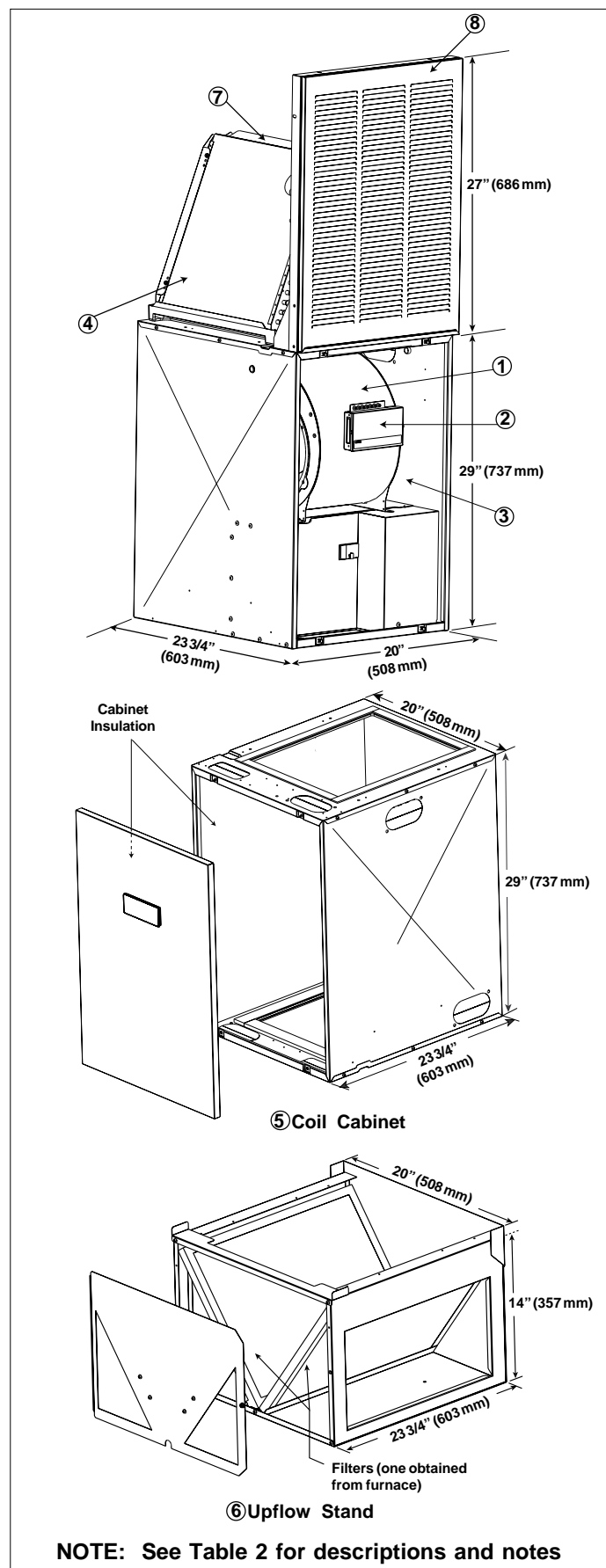


Figure 1. Optional Accessories

Sequencer (Figure 2)

In general all sequencers operate the same way. In some applications one sequencer may be sufficient (10 and 12 kw models) in other applications. One two or more sequencers may be required.

Important: Sequencers should never be mixed. If different brands of sequencer are used and their timing may be different.

Testing Sequencer

1. Shut off the power supply to the furnace, there could be two circuits. Be sure both "A" and "B" circuits are de-energized.
 - a. Remove all wires from the sequencer (making note of wire color and terminal location). The bi-metal heater portion of the sequencer will be unmarked and at the bottom, closest to the mounting plate. The switching portion will be marked M1 through M8 depending on the number of switches. Refer to unit wiring diagram.
 - b. With an ohmmeter, test for continuity across the bi-metal heater terminals. There should be 70 to 90 ohms of resistance. If the meter reads no continuity, the bi-metal heater is open and must be replaced. The OHMS value should be 70 to 90 across the bi-metal.
- c. With an ohmeter check all switches in the sequencer. They are labeled M1-M2, M3-M4...refer to Figure 2. All of the switches should be open and have no continuity.
2. With all power on to furnace, and thermostat contacts closed: using a voltmeter (set scale for 220 vac.) On contact terminals of sequencer, check each set of terminals of sequencer, check each set individually. If you read voltage, contacts are open. If you do not read voltage, contacts are closed. Allow a maximum time (110 seconds) for heater to close contacts. If any of the contacts remain open after three minutes the sequencer is defective and should be replaced.

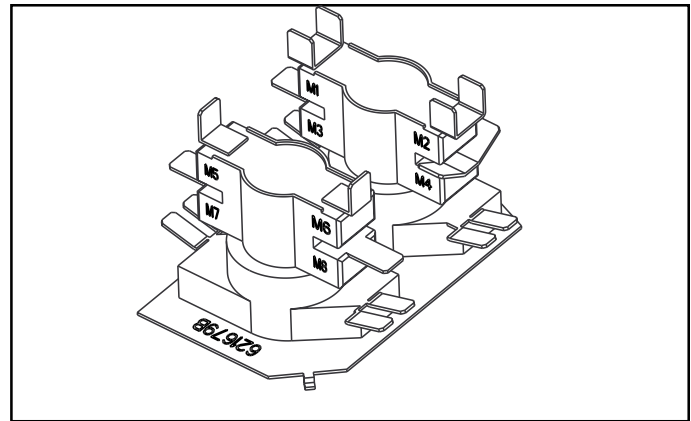
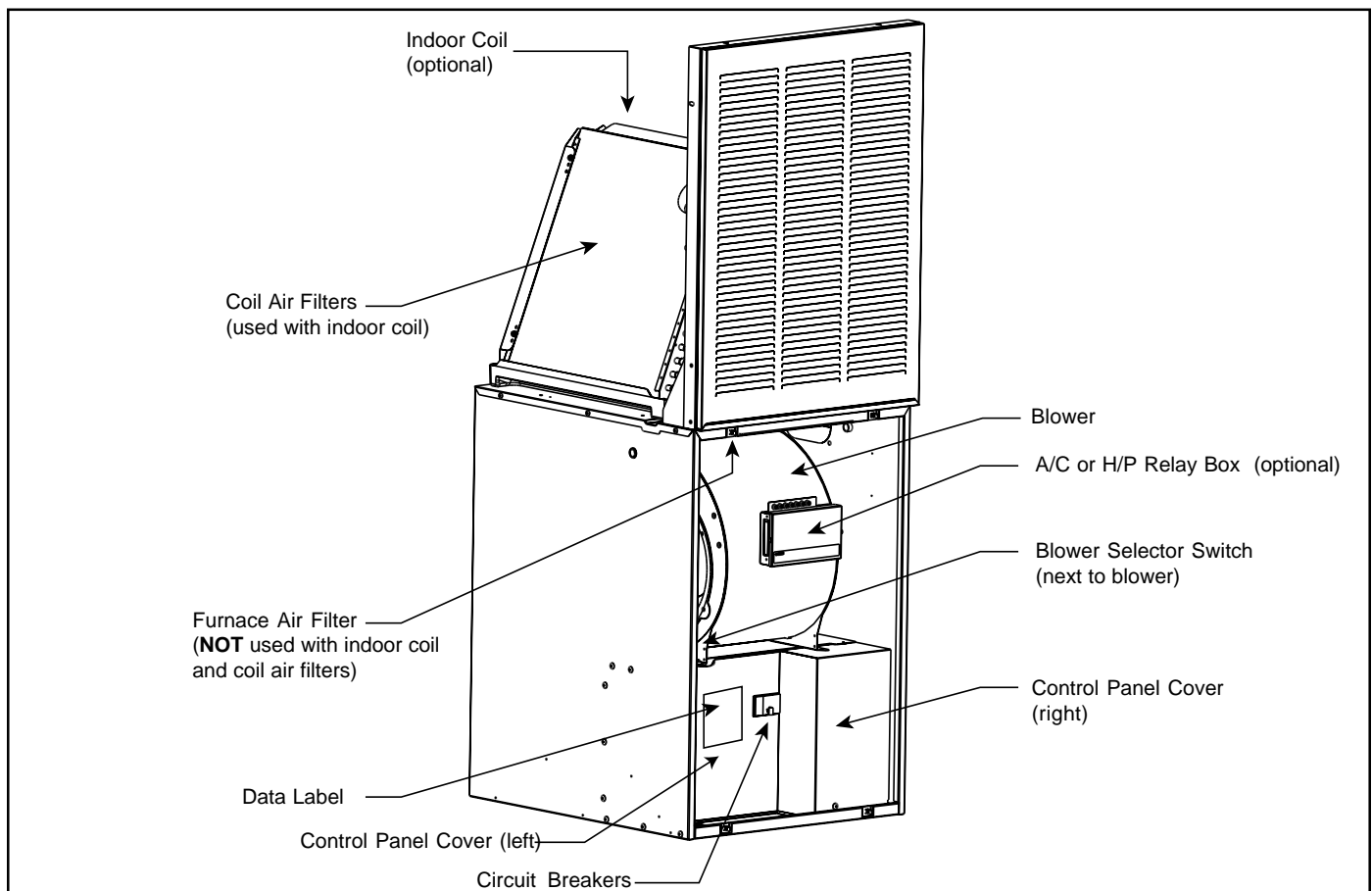


Figure 2. Sequencer



Refer to unit wiring diagram section for wiring of sequencer for each model furnace.

Control Transformer (Figure 3)

All E2 furnaces are equipped with a 30 VA, 240/208 vac primary, 24 vac secondary transformer.

The function of the transformer is to supply the 24 volts for the low voltage circuit which activates the controls. Note: never replace a transformer with one of less VA rating: however a higher rated transformer can replace a lower rated unit. Example: unit has 30 VA replacement can be 40 VA.

Checking Transformer

1. Using a voltmeter, test power supply on the primary leads of the transformer- must be 240 v +/- 10%. If less than 226 vac switch black and blue primary leads.
2. Remove wires from the secondary side of the transformer. Or find the area where the wires terminate and remove from component.
3. Use the voltmeter check the output of the transformer, it should read 22 to 28 volts. If not,

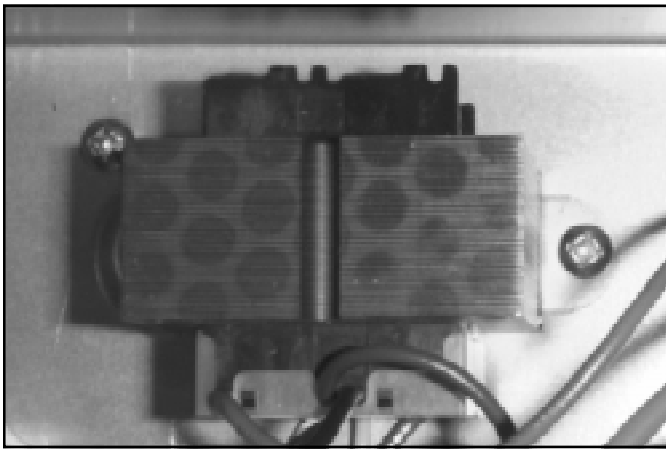


Figure 3. Transformer

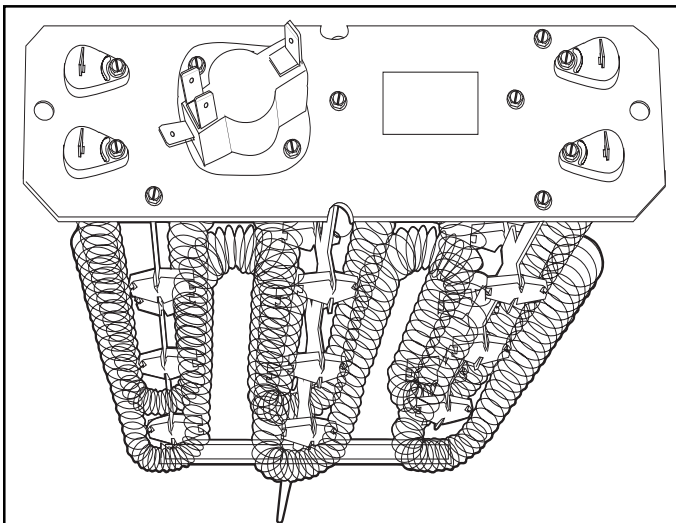


Figure 4. Heating Element

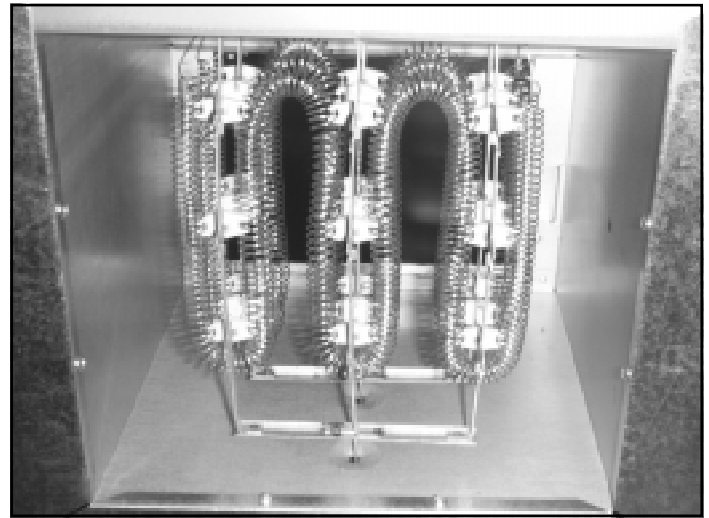


Figure 5. Heating Elements in Furnace

then the transformer is nonfunctional and should be replaced. Observe the transformer there should be no distortion in shape, oil residue or odor. If any of these symptoms exist replace the transformer.

Heating Elements (Figures 4 & 5)

The heating elements used are of modular design consisting of helical-coiled nichrome resistance wire. An insulated wire formed assembly supports the heating elements. All elements are rated at 240 volts. Each element is individually controlled by a switch of the sequencing system and is protected by a limit switch.

The function of the heating element, of course, is to heat the air passed across them by the blower system.

Testing Heating Elements (Ohmmeter)

1. Shut off all electric supply to furnace
2. Remove all wires from terminals of heating coils
3. Using the ohmmeter test from terminal to terminal of the coil-must show continuity-if not replace element assembly.
4. Using the ohmmeter test from heating element terminal to ground wire in the control panel, there should be no continuity. If there is the coil is grounded and must be replaced.

Caution: Heating elements must always be replaced by an identical kW replacement. Substitution by higher kW's or elements of a different design may result in unsafe operation of the furnace. Lower kW rated elements will reduce output and may result in unsatisfactory operation of the appliance. Refer to element rating labels and furnace wiring diagrams.

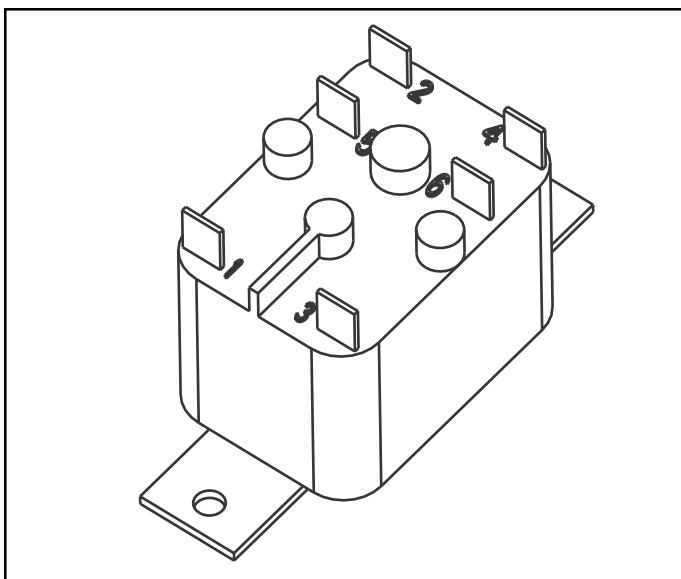


Figure 6. Cooling Relay

Cooling Relay (Figure 6)

The E2EB has a factory installed cooling relay. The cooling relay operates the air circulator at the high speed when the relay is energized. The relay is energized by the low voltage circuit by the g terminal of the thermostat. At the same time it breaks the circuit to the heating speed of the air circulator. the cooling relay has one set of normally closed and one set of normally open contacts.

Testing Cooling Relay

1. Turn off all power supply to furnace.
 - a. Remove all wires from cooling relay.
 - b. Using ohmmeter, test from terminal no. 1 to terminal no.3 the coil should have resistance of around 76 ohms. If there is no continuity, the relay has a open coil and must be replaced.
 - c. Using ohmmeter, test from terminal no.5 to terminal no. 6 there should be continuity, if no continuity is shown relay is defective and must be replaced.
 - d. Replace wires on terminal no.1 and 3 restore power supply.
 - e. Energize relay by positioning the fan switch on the thermostat to the fan position. The relay should click.
 - f. Using ohmmeter, test terminals 2 and 4 there should be continuity. If no continuity relay is defective.
 - g. Turn off all power to furnace, reconnect all wires to relay and restore power.

Limit switches

A limit switch is a heat sensing device utilizing a bi-metal disc to open a set of normally, closed contacts.



Figure 7. Limits in furnace

The limit device is a safety which can be compared to a fuse or a breaker in a electrical circuit. The function of the limit switch is to open the electrical circuit to the heating elements if over heating should occur. This could be caused by air circulator failure, dirty filters, lack of return air, restricted ducts, etc. All limit switches used are of the automatic reset type. On cool down they will automatically reset.

Testing the Limit Switches

1. Shut off all electric supply to furnace.
2. Allow enough time for limit to cool down (5 to 10 minutes)
3. Remove wires from terminals of limit switches. Note: all limit switches will be located on the heating element rack face plate with red wires attached to them.
4. Using the ohmmeter, test from terminal to terminal continuity must be read. If no continuity is read after cool down time, switch is defective and should be replaced.

Caution: Limit switches must always be replaced by their identical replacement part, i.e. Same setting, style limits on the E2 series are either single or double pole type thermo disc. Under no circumstance should a limit of a higher setting or of a different type be installed. Replacement with a lower setting limit may result cycling of the control and insufficient heat output.

Air Circulation Switch

The air circulation switch is a manual rocker type switch, single pole double throw, the switch when in the "auto" position, allows the blower to be activated by the

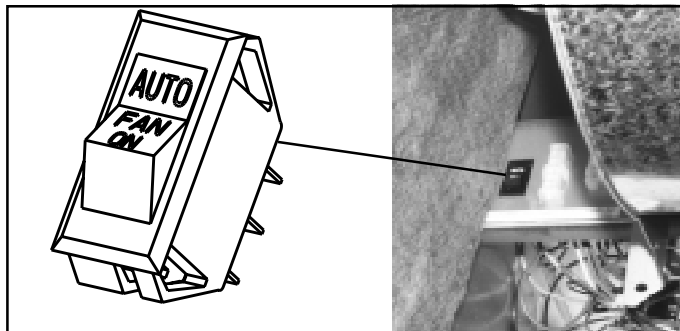


Figure 8. Air Circulation Switch

sequencer. The blower will run during the heating cycle of the furnace. When the switch is in the “fan” position the blower will run continuously. See Figure 8 for air circulation switch.

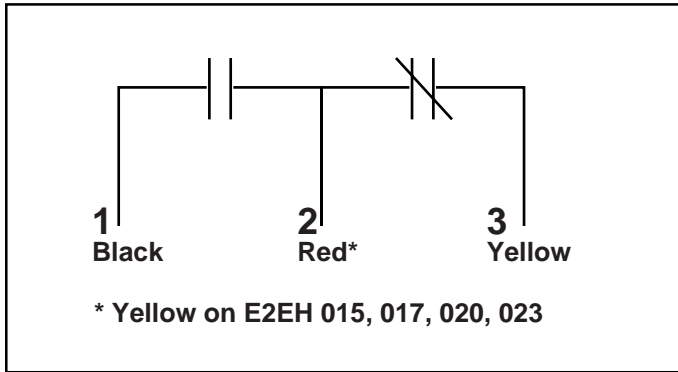


Figure 9. Fan Switch Schematic

Checking the Air Circulator Selector Switch

To check the air circulator switch shut off all power to the furnace. Remove wires from air circulator selector switch terminals. Check continuity of terminals with the switch in “on” and “auto” position. See Figure 9 for fan switch schematic.

Air Circulator Motor

The circulator motor and blower wheel combination move air across the heating elements to supply the duct system with warm air.

To check the motor, be certain the capacitor is functional.

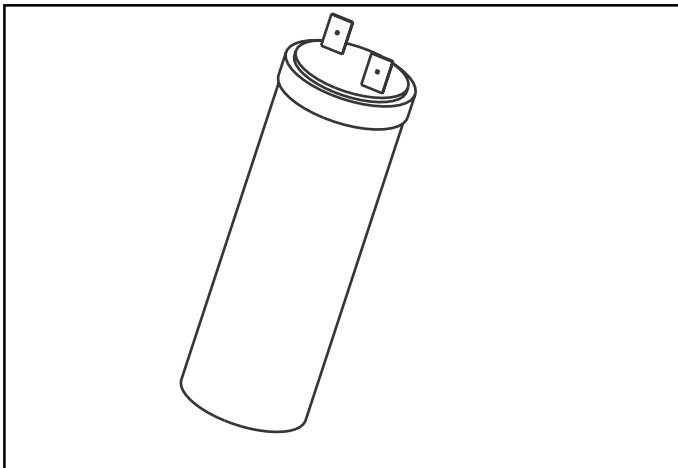


Figure 10. Capacitor

Capacitor(See Figure 10):

1. Shut off the electrical supply to the unit.
2. Disconnect the electrical leads to the capacitor.
3. Discharge the capacitor using a 1500 ohm resistor.
4. Check the capacitor using a capacitor tester.

Blower Motor (See Figure 11):

1. Shut power off to the furnace.
2. Disconnect the electrical motor leads.
3. Using an ohmmeter, check for continuity from each terminal to the shell of the motor, if there is continuity, the motor is grounded and should be replaced.
4. Using the ohmmeter, check the resistance across the motor leads. See diagrams below. Note: the higher the speed the lower the resistance of the motor winding.

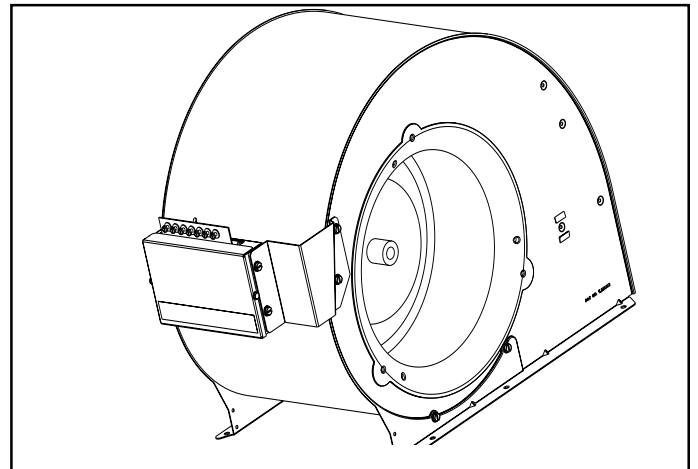


Figure 11. Blower

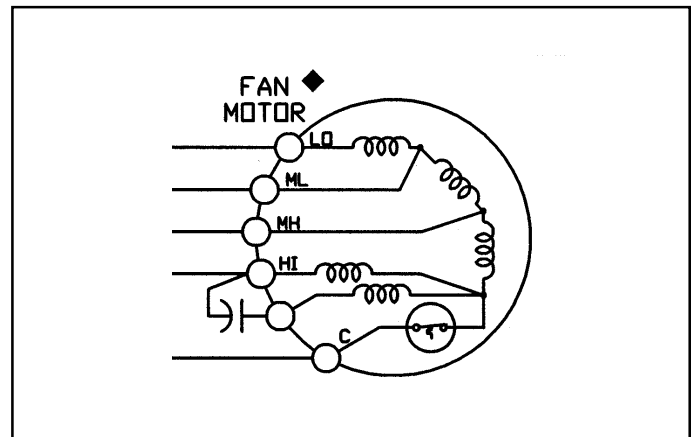


Figure 12. Motor Schematic

ELECTRICAL REQUIREMENTS

! WARNING:

To avoid the risk of electrical shock, personal injury or death, disconnect all electrical power to the unit before performing any maintenance or service. The unit may have more than one electrical power supply.

Codes, Specifications, and Requirements

The wiring, installation, and electrical hookup of this furnace must comply with the National Electrical Code (or the Canadian Electrical Code) and all regulations of local authorities having jurisdiction. See Table 3 for minimum circuit ampacity, maximum over-current protection, and recommended wire size. See the unit wiring diagram for other wiring details.

Supply-circuit requirements are as follows:

- -010 model is factory-wired for single-branch supply circuit only.
- -012 models are factory-wired for single-branch supply circuit (single-circuit kit installed). Dual-branch circuit can be used by removing factory-installed single-circuit kit (see Figures 13 and 14).
- -015, -017, -020 and -023 models are factory-wired for dual-branch supply circuit. Single-branch circuit can be used by installing optional single-circuit kit.

! IMPORTANT:

Note: Circuit breakers installed within this unit are for short-circuit protection of the internal wiring and to serve as a disconnect. Circuit breakers installed within this unit **DO NOT** provide over-current protection of the supply wiring and therefore may be sized larger than the branch circuit protection.

Connecting Supply Service Wires

1. Remove right-hand control panel (when viewing in downflow position).
2. Locate power supply hole plugs in side of unit and in bottom of unit. Remove appropriate plug(s) or knockout opening applicable to recommended wire size(s).
3. Install listed cable connector(s) in opening(s). If metal-sheathed conduit is used for incoming power line(s), provide an approved metal clamp on conduit and secure it in entrance knockout.
4. Insert supply service wire(s) through cable connector(s) and connect wires to circuit breakers (Figures 13 and 14).

NOTE: To install single-circuit kit, perform step 5. If single-circuit kit installation is not necessary, go to step 6.

5. To install single-circuit kit.
 - a. Loosen lugs at supply side of circuit breakers.
 - b. Remove cover from single-circuit kit (if supplied).
 - c. Insert metal buss bars of kit into lugs of circuit breaker.
 - d. Tighten lugs securely (45 in.-lbs. recommended).
6. Connect service ground wire(s) to grounding lug(s) provided. One ground is required for each supply circuit used.

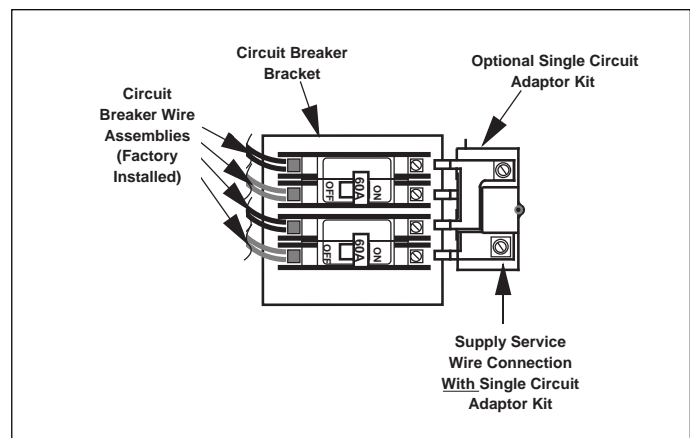


Figure 13. Installation of Optional Single Circuit Adaptor Kit

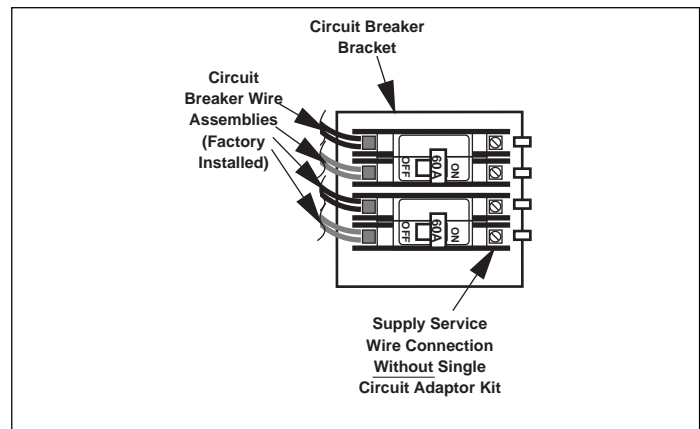


Figure 14. Installation of Supply Service Wires

! WARNING:

To avoid personal injury or property damage, make certain that the motor leads cannot come into contact with non-insulated metal components of the unit.

Model E2EH/ E2EB-	Supply Circuit		Total Amperes	Max Over- Current Rating	Min. Circuit Ampacity	Sizes*		Low-Voltage Thermostat Wire Size
						75°C Copper		
						Wire Size	Ground Size	
010	Single		45.5	60	57	6	10	2-Wire system max wire lengths : 24 Ga. = 55' 22 Ga. = 90' 20 Ga. = 140' 18 Ga. = 225' 4 or more-Wire system max wire lengths : 24 Ga. = 25' 22 Ga. = 45' 20 Ga. = 70' 18 Ga. = 110'
012	Single		52.1	70	65	6	8	
	Dual	"A"	28.0	40	35	8	10	
		"B"	24.2	30	30	10	10	
015	Single		66.3	90	83	4	8	
	Dual	"A"	45.5	60	57	6	10	
		"B"	20.8	30	26	10	10	
017	Single		71.3	90	89	3	8	
	Dual	"A"	48.8	60	61	6	10	
		"B"	22.5	30	28	10	10	
020	Single		87.1	125	109	2	6	
	Dual	"A"	45.5	60	57	6	10	
		"B"	41.7	60	52	6	10	
023	Single		93.8	125	117	1	6	
	Dual	"A"	45.5	60	57	6	10	
		"B"	48.3	60	60	6	10	

* All wire sizes for copper conductors only, based on NEC Table 310-16. Equivalent wiring may be used per NEC.

Table 3. Electrical Specifications

Selecting Blower Speed

⚠ WARNING:

To avoid personal injury or property damage, make certain that the motor leads cannot come into contact with non-insulated metal components of the unit.

See Table 4 for the lowest speed approved for the heating output of the unit. Since the blower leads connect to the control box, blower speed selection is accomplished through use of the proper color-coded blower lead located inside the control box. The speed(s) set by the factory may be different from that shown on the wiring diagrams. See the unit control box for blower speed(s) set at factory.

Plug/Receptical Position	Pin 1	Pin 2	Pin 3	Pin 4
2-Speed Blower	Low	High	-	-
4-Speed Blower	Low	Med-Lo	Med-Hi	High
Control Box Blower Lead	Red	Yellow	Blue	Black

Minimum approved
speed for 010, 012
and 015 models.

Minimum approved speed for
017, 020 and 023 models.

Table 4. Furnace Blower Speed Data

⚠ IMPORTANT:

If a relay box is installed, blower speeds for heating and cooling are set inside the relay box (see instructions included with relay box). The blower speed inside the furnace control box **must** be set to low or medium-low. Never change to a heating speed lower than that shown in Table 4.

Changing Blower Speed

E2EH: The selected heating blower lead is attached to terminal 2 of blower selector switch.

- Remove blower lead from terminal 2.
- Choose desired speed and install new blower lead onto terminal 2 of blower selector switch.

E2EB: The selected heating blower lead is attached to terminal 6 on blower relay. The selected cooling blower lead is attached to terminal 4 on blower relay.

- Remove heating blower lead from terminal 6 on blower relay.
- Choose desired speed and install new blower lead onto terminal 6 of blower relay for new heating speed.

- c. Remove cooling blower lead from terminal 4 on blower relay.
- d. Install new blower lead onto terminal 4 of blower relay for new cooling speed.

See Table 5 for blower performance data.

Standard 2-Speed Blower, with filter, @ 0.3" ESP

Pin No.	Speed	CFM
#1	Low	840
#2	High	1160

4-Speed Blower, with Coil and Coil Filters, @ 0.3" ESP

Pin No.	Speed	CFM
#1	Low	880
#2	Med.-Low	1170
#3	Med.-High	1310
#4	High	1460

Table 5. Blower Performance

THERMOSTAT SEQUENCE OF OPERATION

NOTE: If appliance(s) is equipped with time delay control, the system operation will lag behind the thermostat.

For Heating

1. Turn on electrical power to appliance.
2. With thermostat cover off, move temperature-setting lever until right-hand (heating) contacts close. For CM65A-5ABO, CM65A-5JBO or CM65 with optional sub-base, set heat/cool switch to "HEAT" and set ventilate switch to "AUTO." Heating system and air circulator blower should turn on.
3. Check air temperature at supply duct registers.
4. Move temperature-setting lever until right-hand (heating) contacts open. Heating system and air circulator blower should turn off.
5. Replace thermostat cover.

For Cooling

1. Turn on electrical power to the appliance.
2. With the thermostat cover off, move temperature-setting lever until left-hand (cooling) contacts close. For CM65A-5ABO, CM65A-5JBO or CM65 with optional sub-base, set heat/cool switch to "COOL" and set ventilate switch to "AUTO." Cooling system and air circulator blower should turn on.
3. Check air temperature at supply duct registers.
4. Move temperature-setting lever until left-hand (cooling) contacts open. Cooling system and air circulator blower should turn off.
5. Replace thermostat cover.

For Continuous Air Circulation and Ventilation

NOTE: For CM65, see furnace owner's manual on independent blower operation. For CM65A-5ABO, CM65A-5JBO or CM65 with optional sub-base, follow the steps below.

1. Set thermostat heat/cool switch to "OFF" and set ventilate switch to "ON." Air circulator blower only should turn on.
2. Set thermostat heat/cool switch to "HEAT." Air circulator blower should operate continuously with on and off heat cycles.
3. Set thermostat heat/cool switch to "COOL." Air circulator blower should operate continuously with on and off cooling cycles.

For System Shutoff

1. With electrical power to appliance turned on, move temperature-setting lever to turn on heating or cooling system.
2. Set ventilate switch to "AUTO" and set heat/cool switch to "OFF." All system operations should turn off.

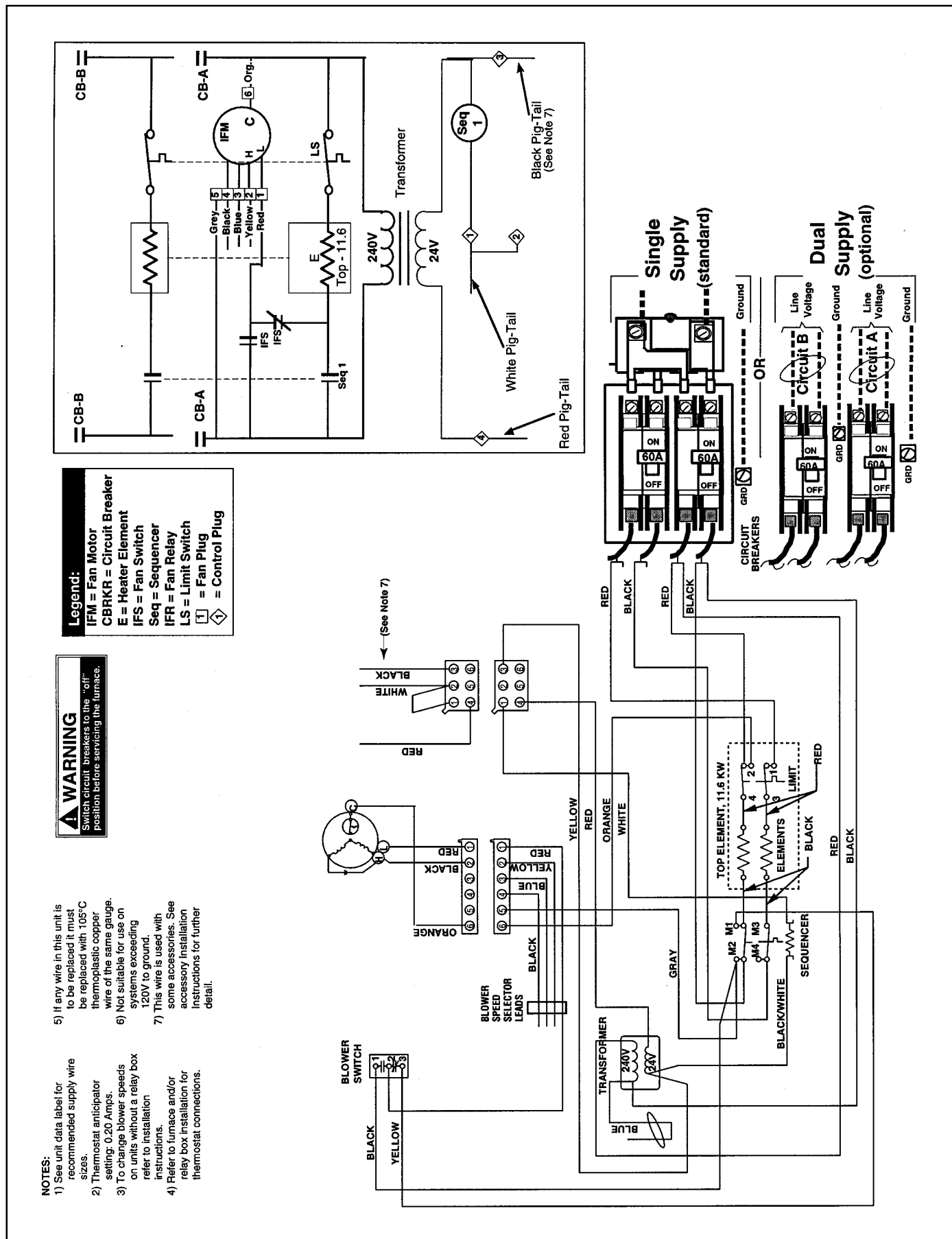


Figure 16. E2EH 012 Wiring Diagram



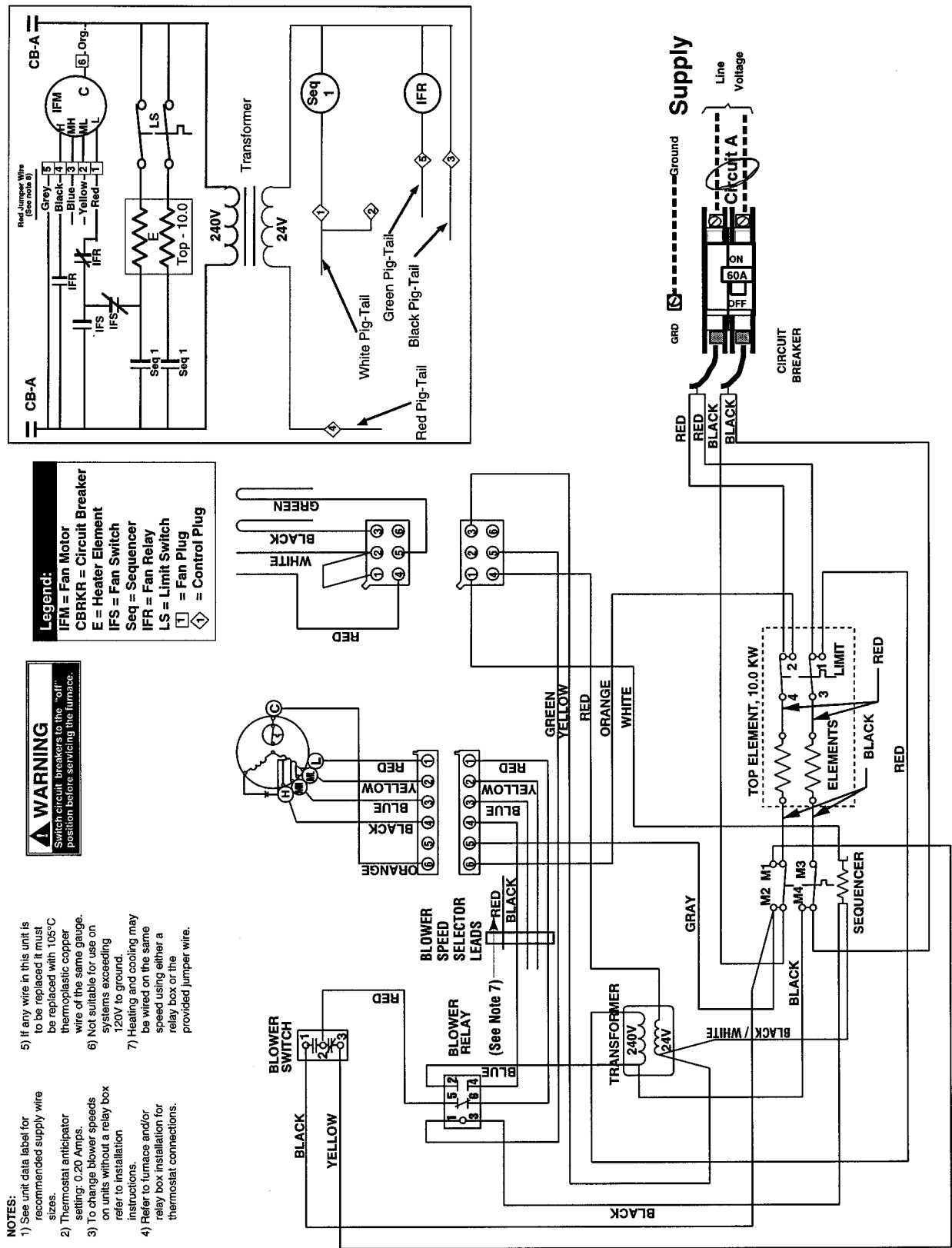


Figure 19. E2EB 010 Wiring Diagrams

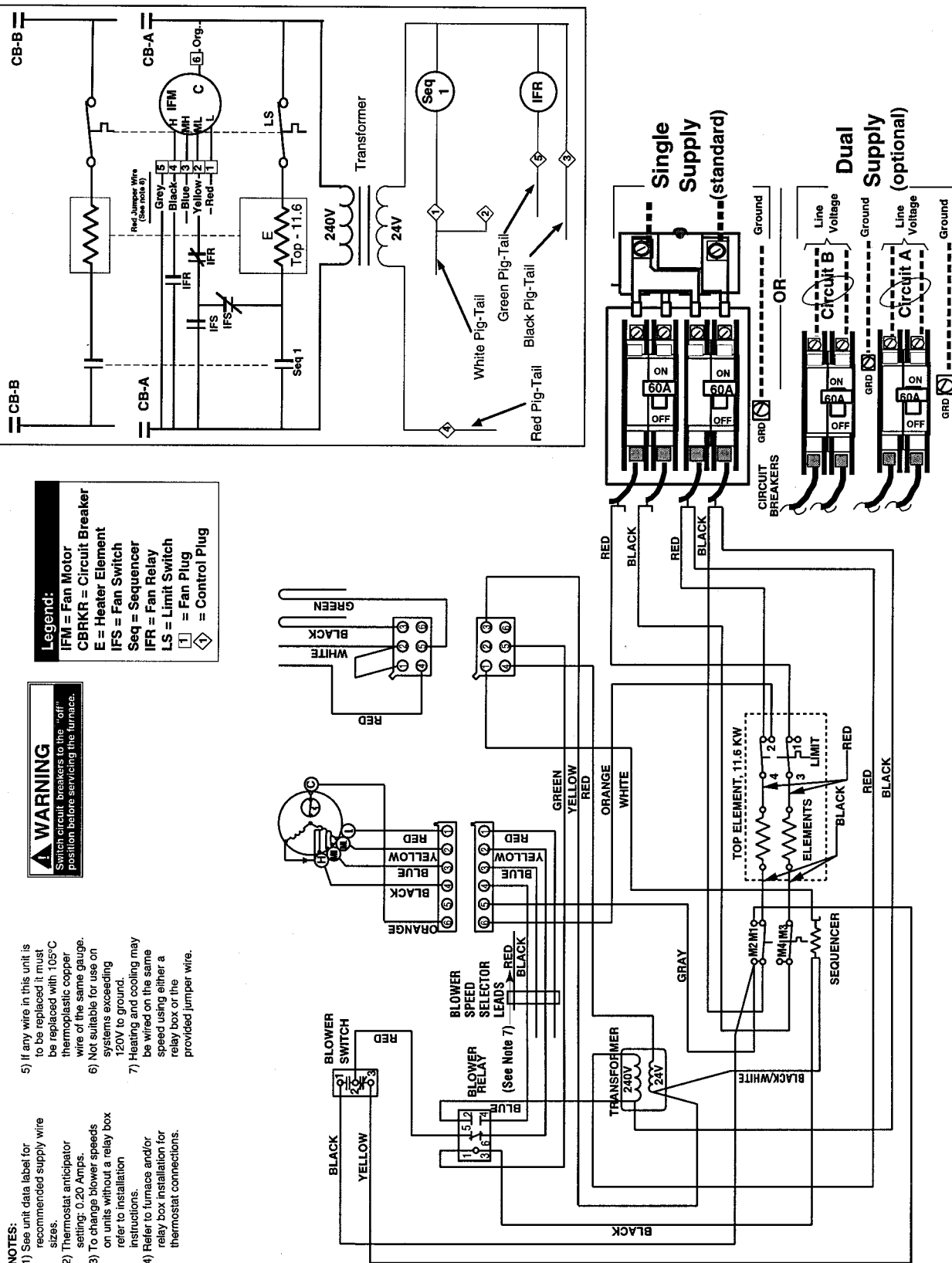


Figure 20. E2EB 012 Wiring Diagram

NOTES:

- 1) See unit data label for recommended supply wire sizes.
- 2) Thermostat anticipator setting: 0.20 Amps.
- 3) To change blower speeds on units without a relay box refer to installation instructions.
- 4) Refer to furnace and/or relay box installation for thermostat connections.
- 5) If any wire in this unit is to be replaced it must be replaced with 105°C thermoplastic copper wire of the same gauge.
- 6) Not suitable for use on systems exceeding 120V to ground.
- 7) Heating and cooling may be wired on the same speed using either a relay box or the provided jumper wire.

⚠ WARNING
Switch circuit breakers to the "off" position before servicing the furnace.

Legend:
IFM = Fan Motor
CBKR = Circuit Breaker
E = Heater Element
IFS = Fan Switch
Seq = Sequencer
IFR = Fan Relay
LS = Limit Switch
T = Fan Plug
◇ = Control Plug

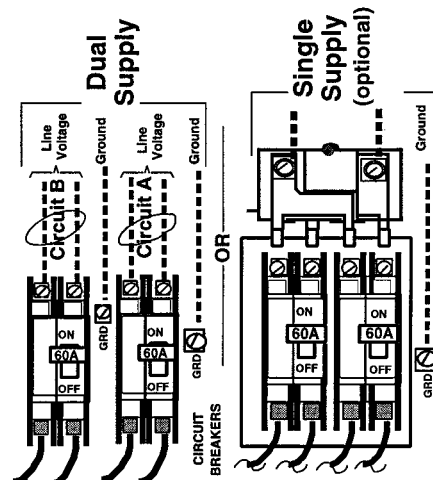
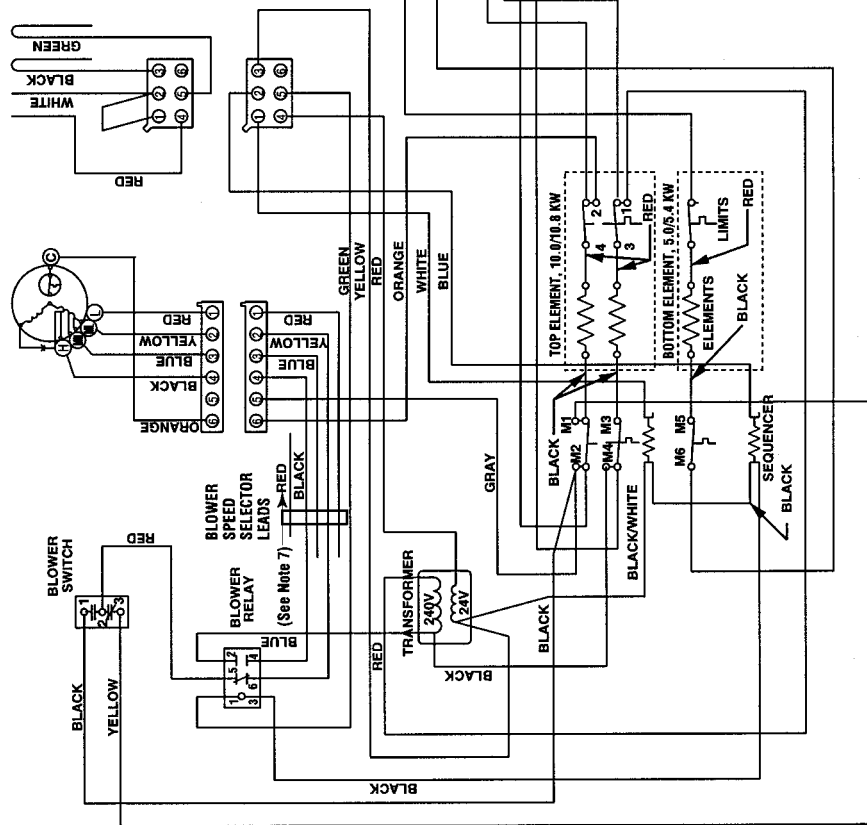
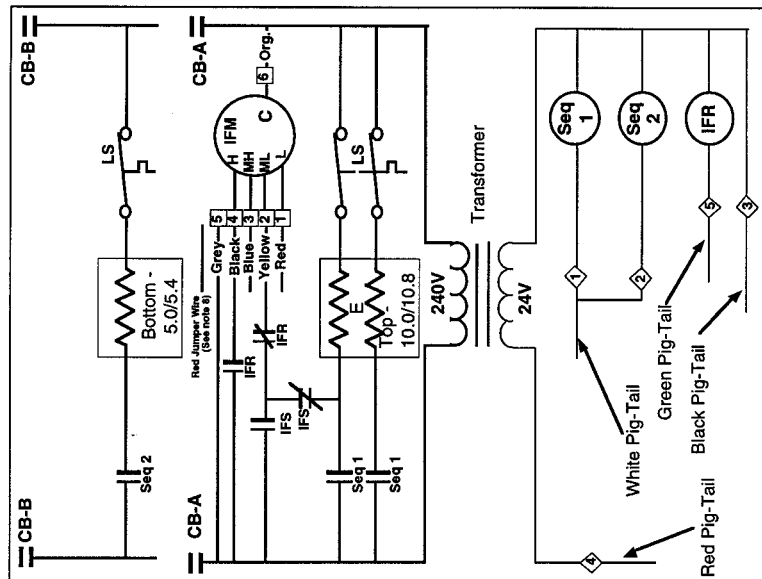


Figure 21. E2EB 015, 017 Wiring Diagram

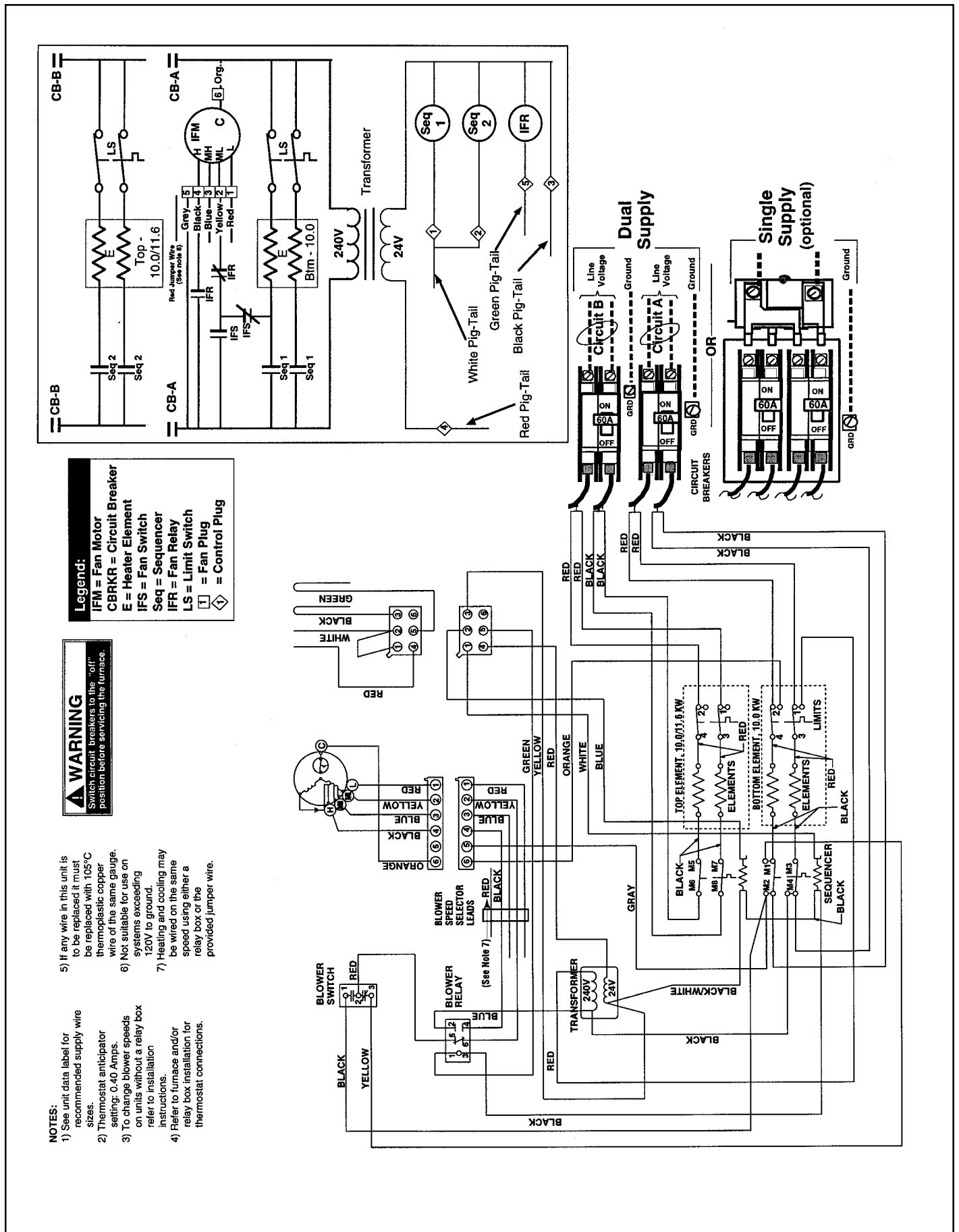


Figure 22. E2EB 020, 023 Wiring Diagram

Figure 23. Two-Wire Relay Box for A/C E2EH 020 and 023 Units

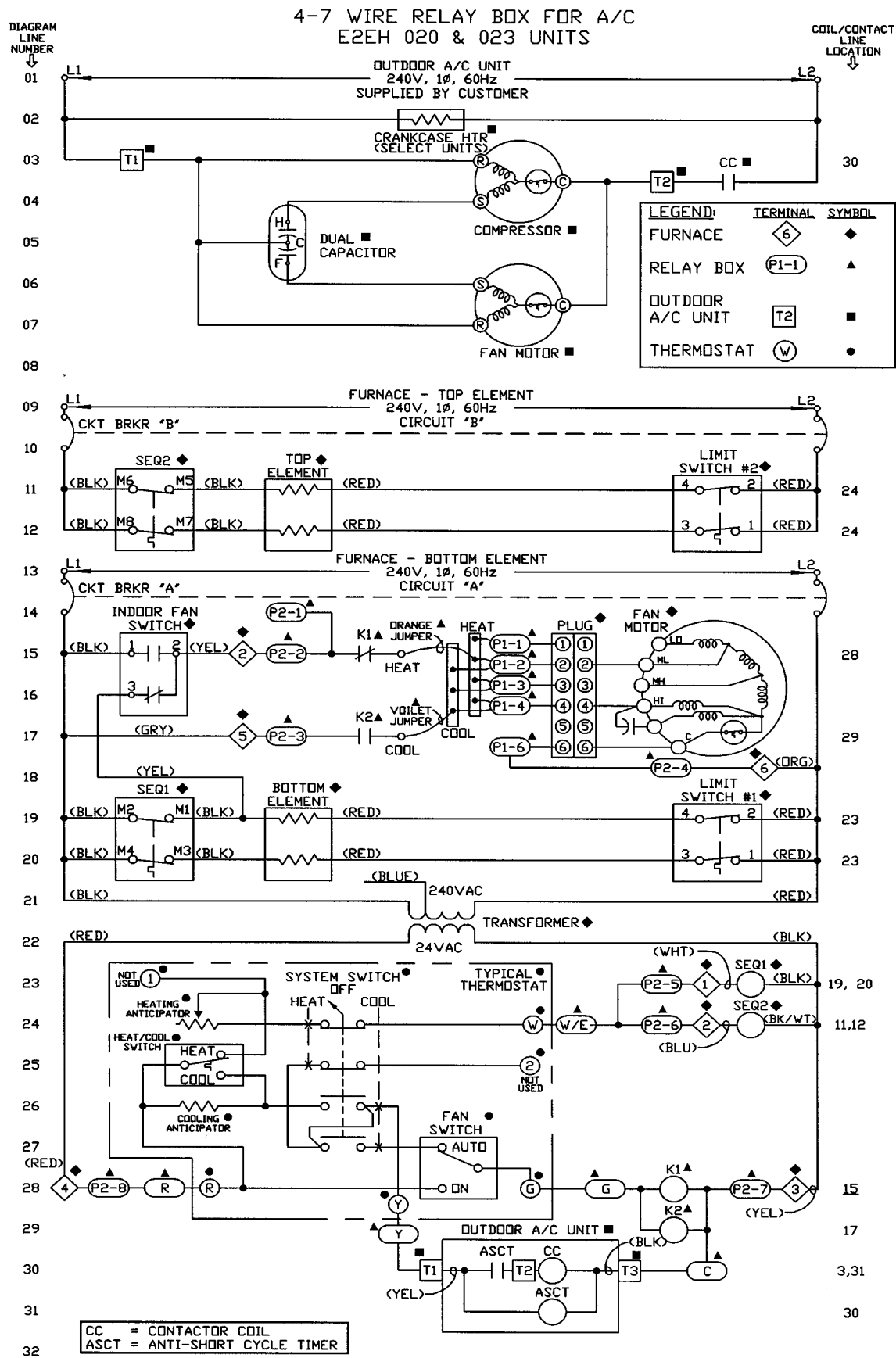
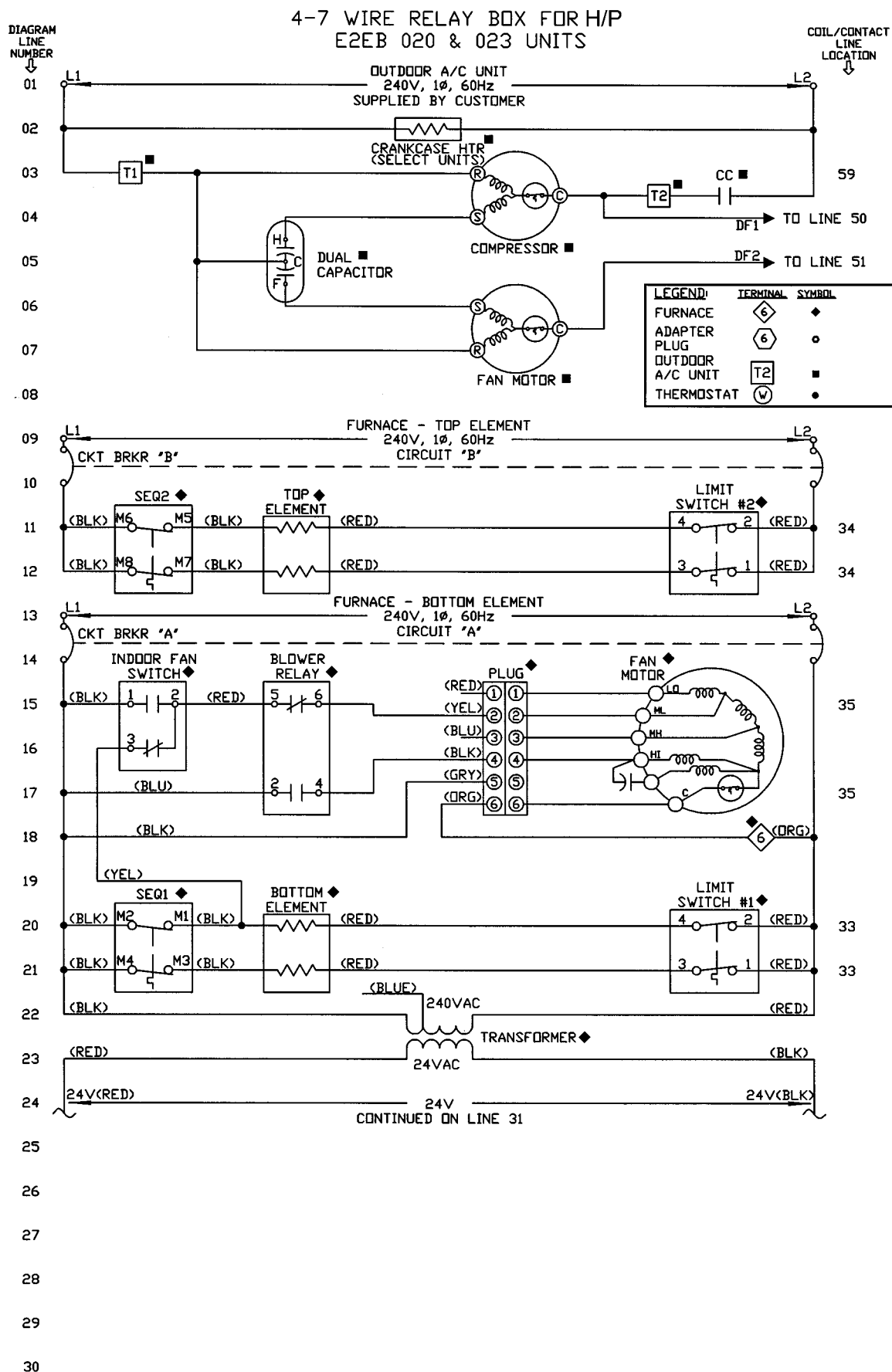


Figure 24. 4-7-Wire Relay Box for H/P E2EH 020 and 023 Units



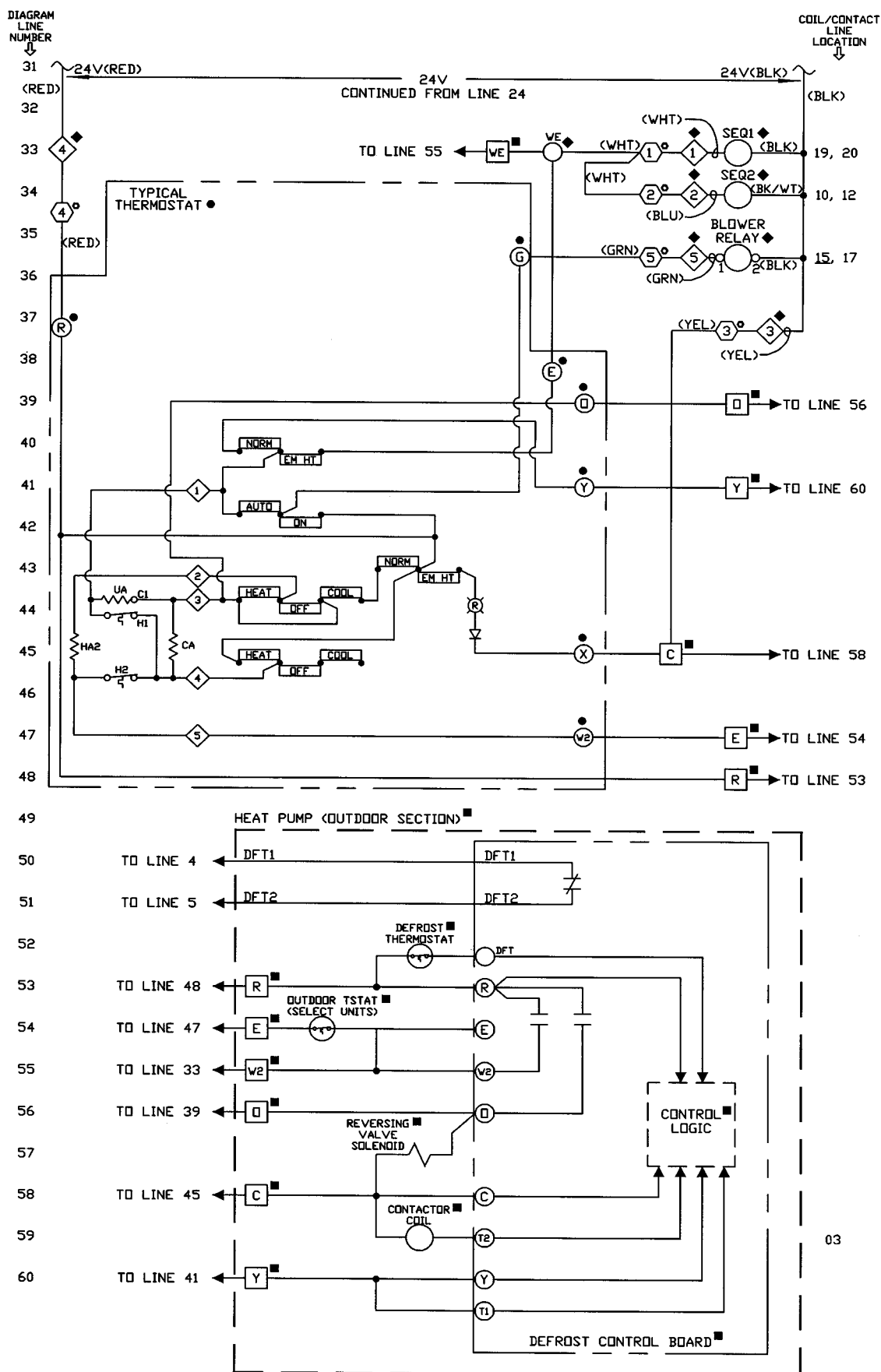


Figure 26. 4-7-Wire Relay Box for H/P E2EB 020 and 023 Units (Part 2)

NOTES:

[illegible]

