

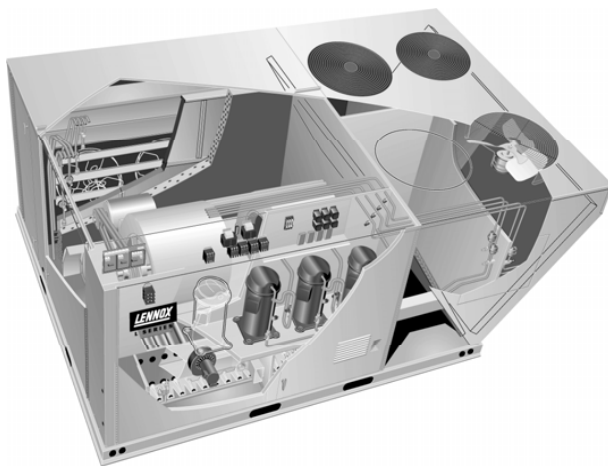
HVAC Economizers 101

Section #6

Manufacturer Specific RTU Economizer Controls

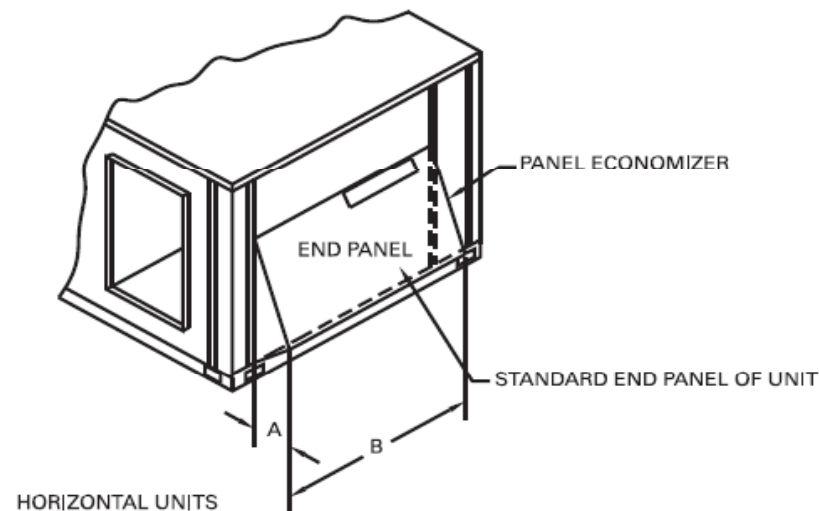
Section #6-Manufacturer Specific RTU Economizer Controls

- Trane Voyager
- Carrier Durablade & Centurian
- York equipment
- Lennox “LGC” and “T” Model RTU



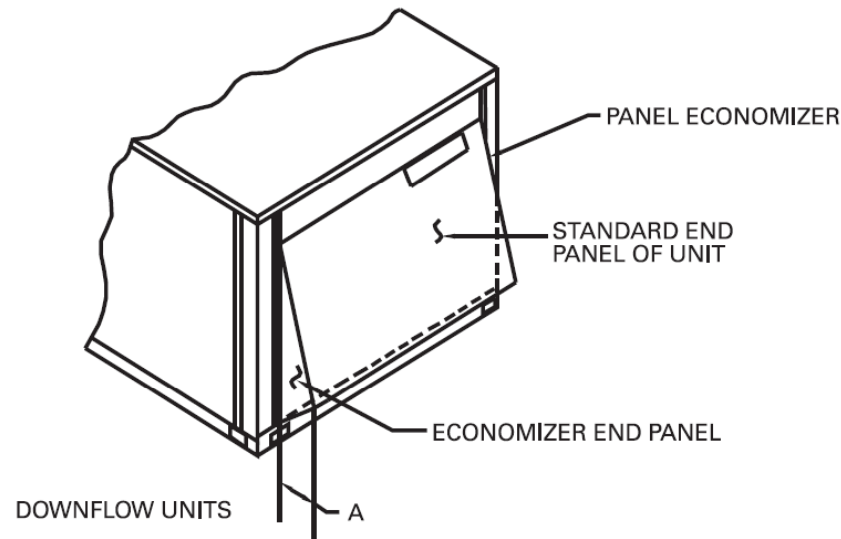
Trane Voyager / Economizer Features and Operations – Down Flow

- The down flow assembly includes fully modulating 0-100% motor and dampers, barometric relief, minimum position setting, preset linkage, fixed drybulb and spring return actuator.
- The barometric relief damper shall be standard with the down flow economizer and shall provide a pressure operated damper that shall be closed during the “off” cycle. Solid state enthalpy and differential enthalpy controls are field-installed.



Trane Voyager / Economizer Features and Operations-Horizontal

- The horizontal economizer contains the same features as the down flow economizer with the exception of barometric relief.
- Motorized outside air dampers manually set outdoor air dampers and provide up to 50% outside air. Once set, outdoor air dampers shall open to set position when indoor fan starts. The damper shall close to the full closed position when indoor fan shuts down.



Trane Voyager Packaged RTU with Economizer Control Actuator (ECA)

- The standard control equipment in the Voyager is a economizer control (ECA), which is a microelectronic control system (See controller on next page).
- The unit comes with a fixed drybulb changeover control with two optional controls, enthalpy and differential enthalpy control.
- The ECA monitors and controls the mixed air temperature, return air temperature, minimum position set point (local or remote), power exhaust set point, CO₂, and ambient drybulb/enthalpy sensor or comparative humidity (return air humidity against ambient humidity) sensors, if selected.
- The economizer actuator is spring returned to the closed position any time power is lost to the unit, and is powered by 24vac.
- Economizer operation and status conditions are determined via LED status light (more information provided later in presentation.)

Trane Voyager with Economizer Control

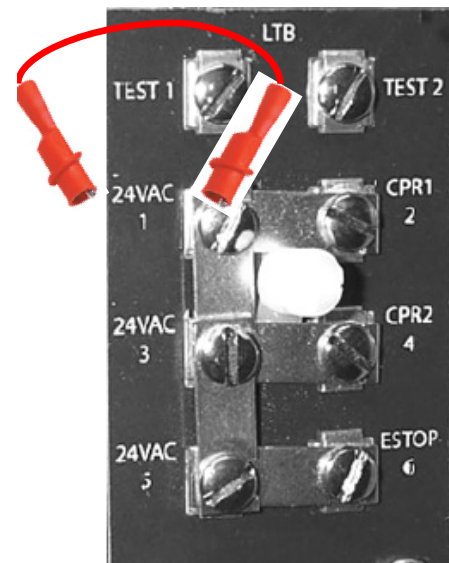
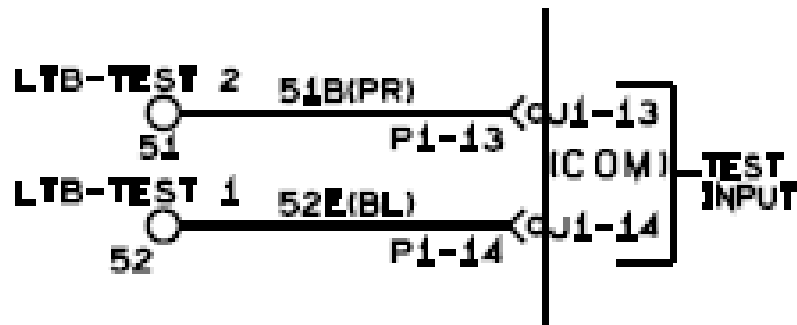
Economizer Control Start-Up Procedures



- Using the Service Test Guide in Table 7, (see next slide) momentarily jump across the Test 1 & Test 2 terminals on LTB1 one time to start the minimum ventilation test (see next slide for jumper clarification). Each time the jumper touches the terminals, the controller will cycle to the next function.
- 1. Set the minimum position set point for the economizer to the required percentage of minimum ventilation using the remote set point potentiometer located on the economizer control (ECA). The economizer will drive to its minimum position set point; fans will start when the SERVICE TEST is initiated.
- 2. Verify that the dampers stroked to the minimum position by visually opening up the unit and physically looking at the dampers. Note: The only way to determine the true minimum percentage control point is by calculating the percentage of OSA using the formula discussed later in this presentation.
- 3. To stop the SERVICE TEST, turn the main power disconnect switch to the “Off” position or proceed to the next component start-up procedure.

Trane Voyager Easy Access Low Voltage Terminal Board (LTB)

- Voyager's low voltage terminal board (LTB) is external to the electrical control cabinet. It is extremely easy to locate and attach a temporary jumper wire to test operation of the economizer and all unit functions.



Trane Voyager with Economizer Control - Test Guide

Table 7. Service test guide for component operation

Test Step	Mode	Fan	Econ (Note 2)	Comp1	Comp 2	Heat 1	Heat 2	Ohms
1	Fan	On	Minimum Position Setpoint 0%	Off	Off	Off	Off	2.2K
	Minimum Ventilation	On	Selectable	Off	Off	Off	Off	
2	Economizer Test Open	On	Open	Off	Off	Off	Off	3.3K
3	Cool Stage 1	On	Minimum Position	On (Note 1)	Off	Off	Off	4.7K
4 (Note 3)	Cool Stage 2	On	Minimum Position	On (Note 1)	On	Off	Off	6.8K
5 (Note 3)	Reheat	On	Minimum	On	On	Off	Off	33K
6 (Note 3)	Heat Stage 1	On	Minimum	Off	Off	On	Off	10K
7 (Note 3)	Heat Stage 2	On	Minimum	Off	Off	On	On	15K

Notes:

1. The condenser fans will operate any time a compressor is "On" providing the outdoor air temperatures are within the operating values.
2. The exhaust fan will turn on anytime the economizer damper position is equal to or greater than the exhaust fan setpoint.
3. Steps for optional accessories and non-applicable modes in unit will be skipped.

Voyager ReliaTel Control Unit Economizer Control (ECA) Troubleshooting

Verify Economizer Status of Economizer Actuator (ECA) by LED indicator:

- OFF: No power or failure
- ON: Normal, OK to economize
- Slow Flash: Normal, not OK to economize
- Fast Flash - ¼ second On / 2 seconds off:
 - Error Code: Communications failure
- Pulse Flash: 1/30 second On / ¼ second off: (2 seconds between pulse sequences)

Error Code:

- 1 Flash: Actuator fault
- 2 Flashes: CO₂ sensor
- 3 Flashes: RA humidity sensor
- 4 Flashes: RA temperature sensor
- 5 Flashes: OA quality sensor
- 6 Flashes: OA humidity sensor
- 7 Flashes: OA temperature sensor
- 8 Flashes: MA temperature sensor
- 9 Flashes: RAM fault
- 10 Flashes: ROM fault
- 11 Flashes: EEPROM fault

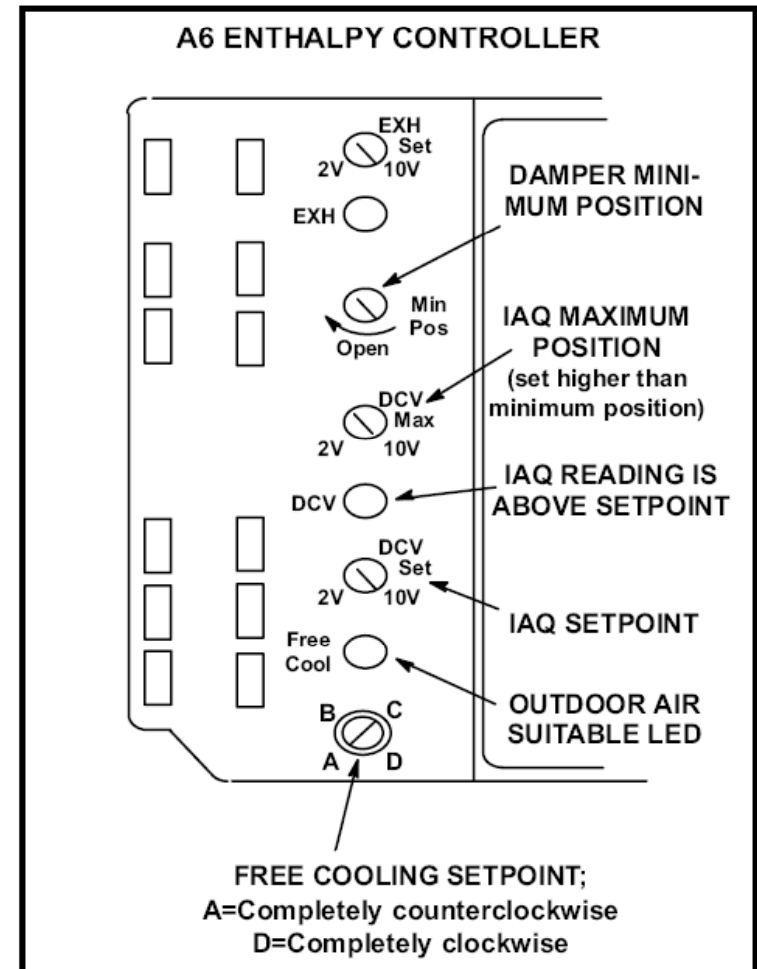
Trane Voyager

Procedure to Verify System Operation

- Outside air damper is at minimum position when the supply fan is enabled. Note: This is a non-integrated economizer control system.
- The outside air damper opens completely and the return damper closes completely during economizer mode.
- Outside air damper is at minimum position when the compressor is enabled.
- Outside air damper is at minimum position when heating is enabled.
- Verify mixed/discharge cut-out sensor wire is terminated on the SA terminal on the OEM board. If the sensor wire is not landed on the SA terminal, the economizer will not operate properly.

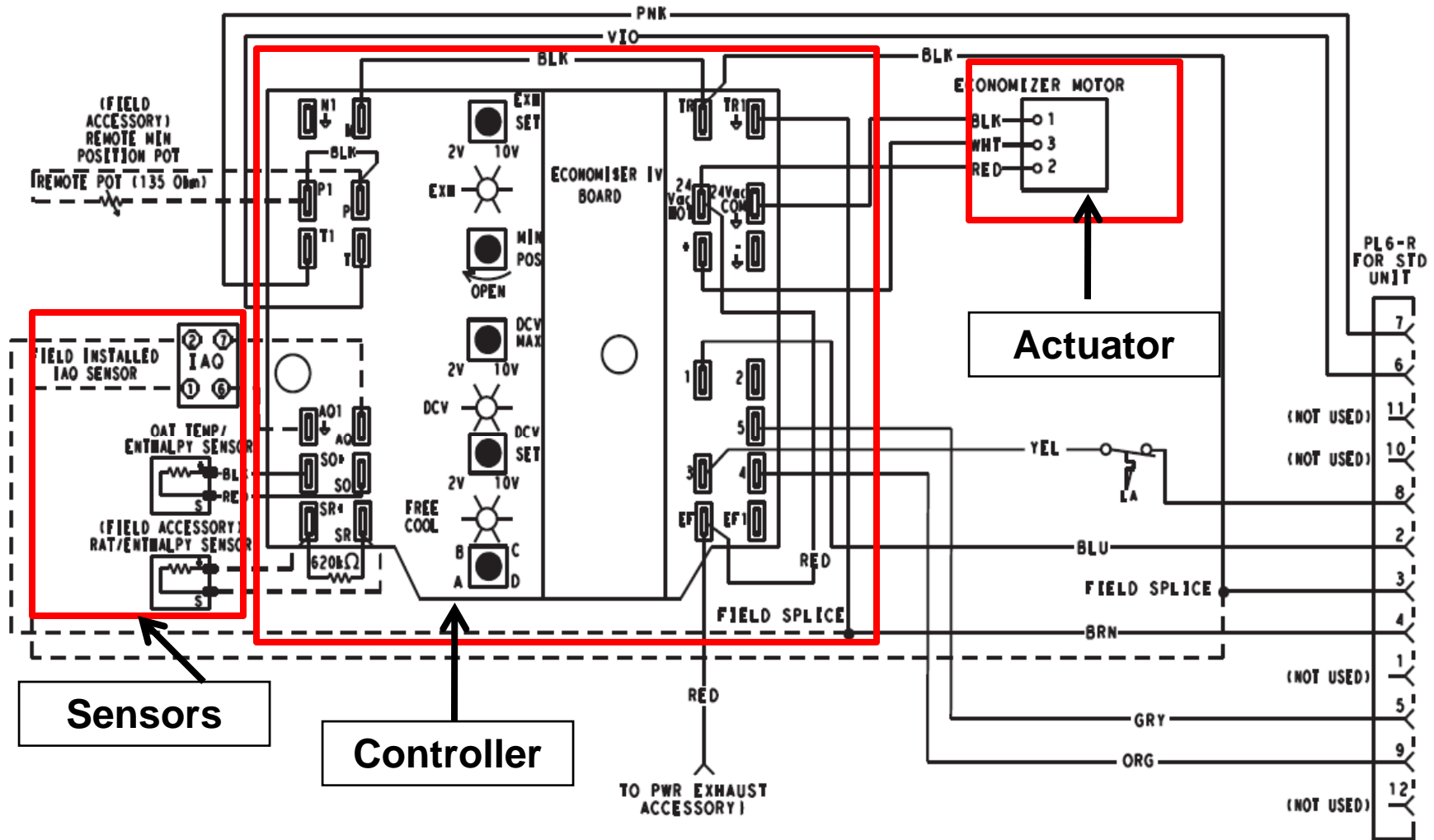
Carrier Durablade

- Enthalpy control typically utilizes a customized Honeywell controller. Checkout procedures are similar to Honeywell guidelines
- For a drybulb thermostat
 - Generate call for cooling
 - Jumper across outside air thermostat
 - Verify outside air damper opens fully
- Disconnect outside air thermostat from circuit
 - Verify outside air damper closes and goes to minimum set point

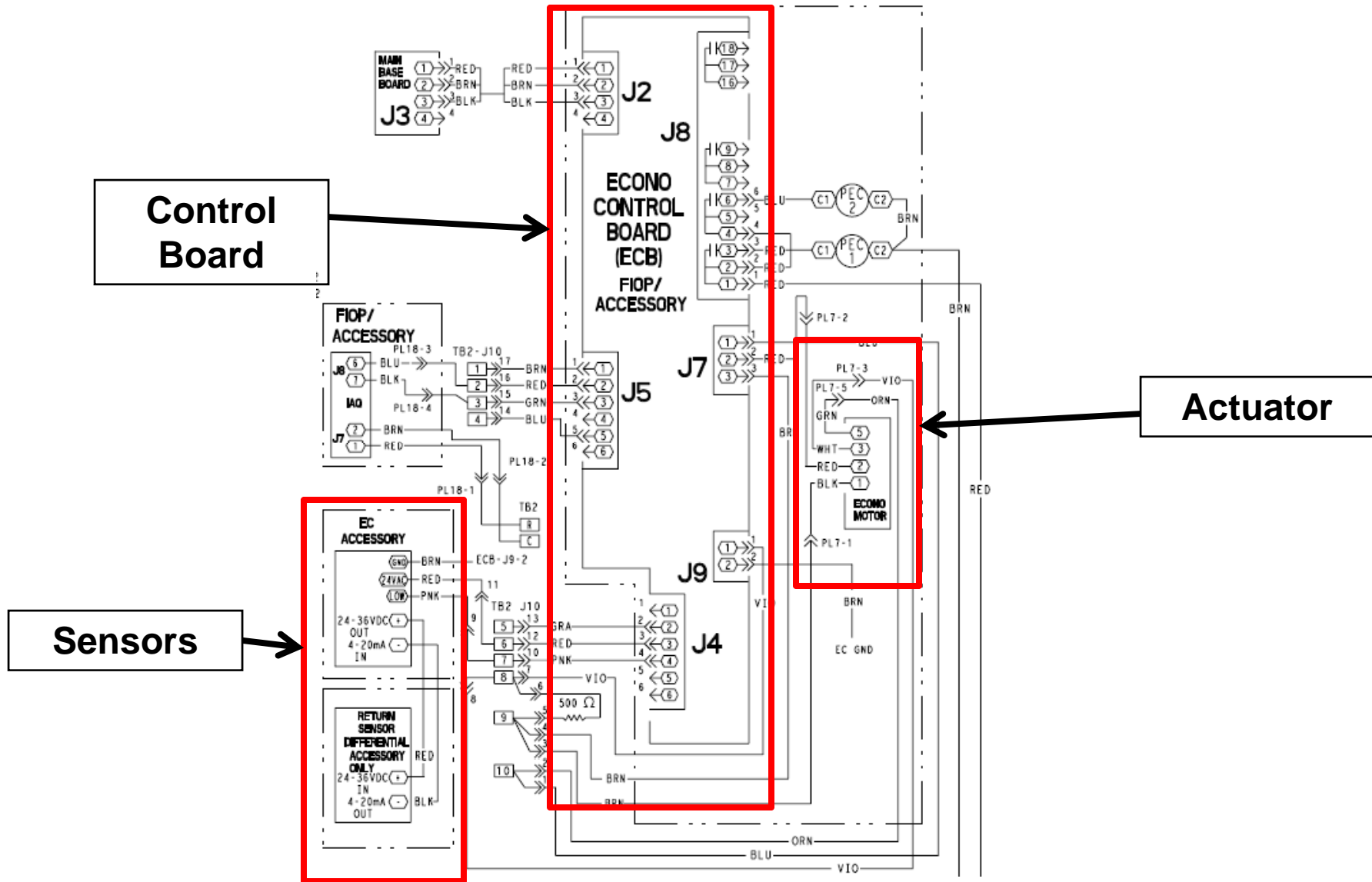


Troubleshooting Carrier RTU Controls Utilizing the Schematics

ECONOMIZER WIRING--50H EQ003-006, 50HJQ004-012, 50TFQ004-012



Troubleshooting Carrier 48HG RTU Controls Utilizing the Schematics



Control Board

Actuator

Sensors

Troubleshooting Carrier 50PG RTU Controls Utilizing the Schematics

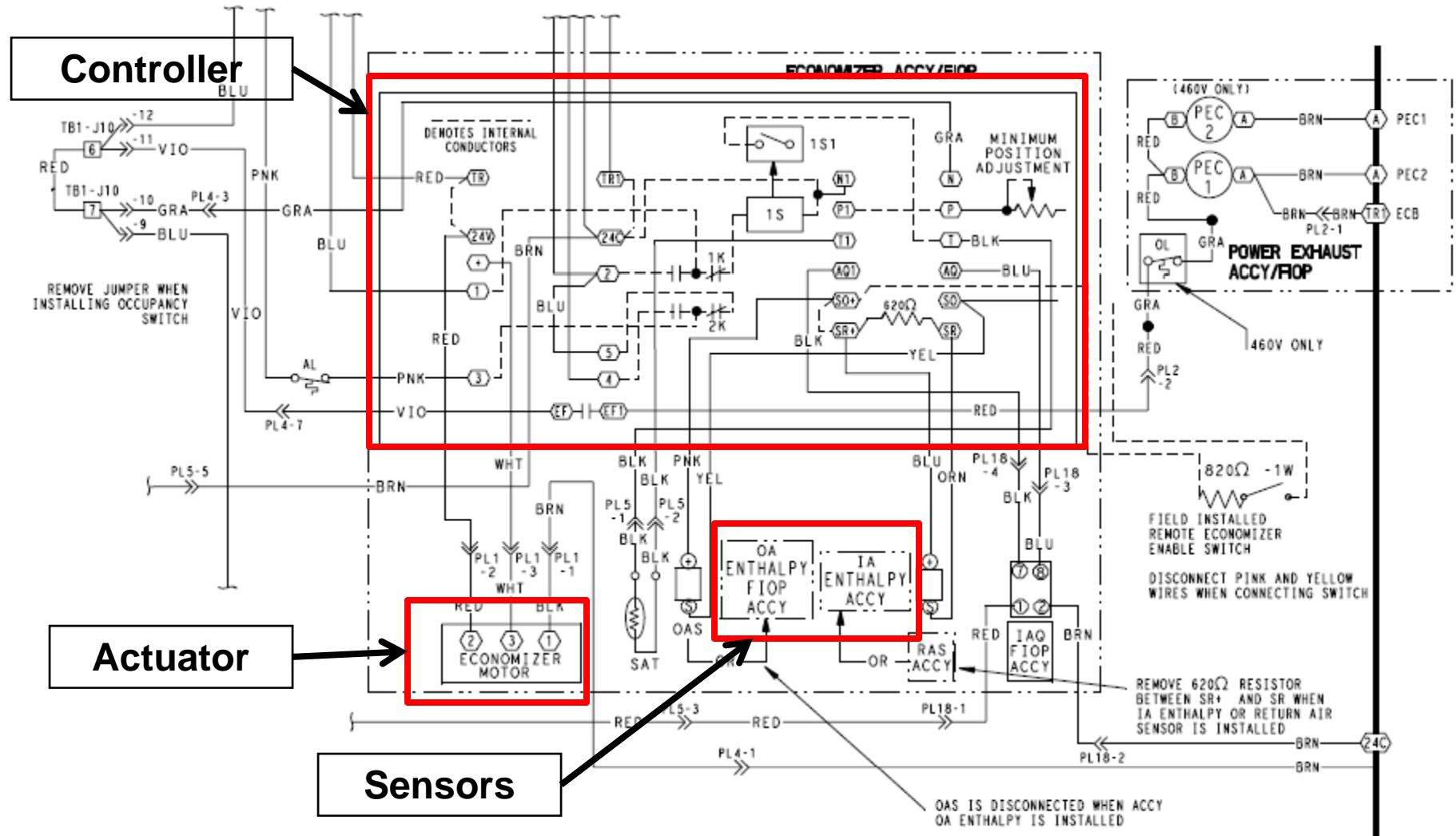


Fig. 14 — EconoMi\$er IV Wiring

Troubleshooting Carrier 50PG RTU Testing the Actuator Motor

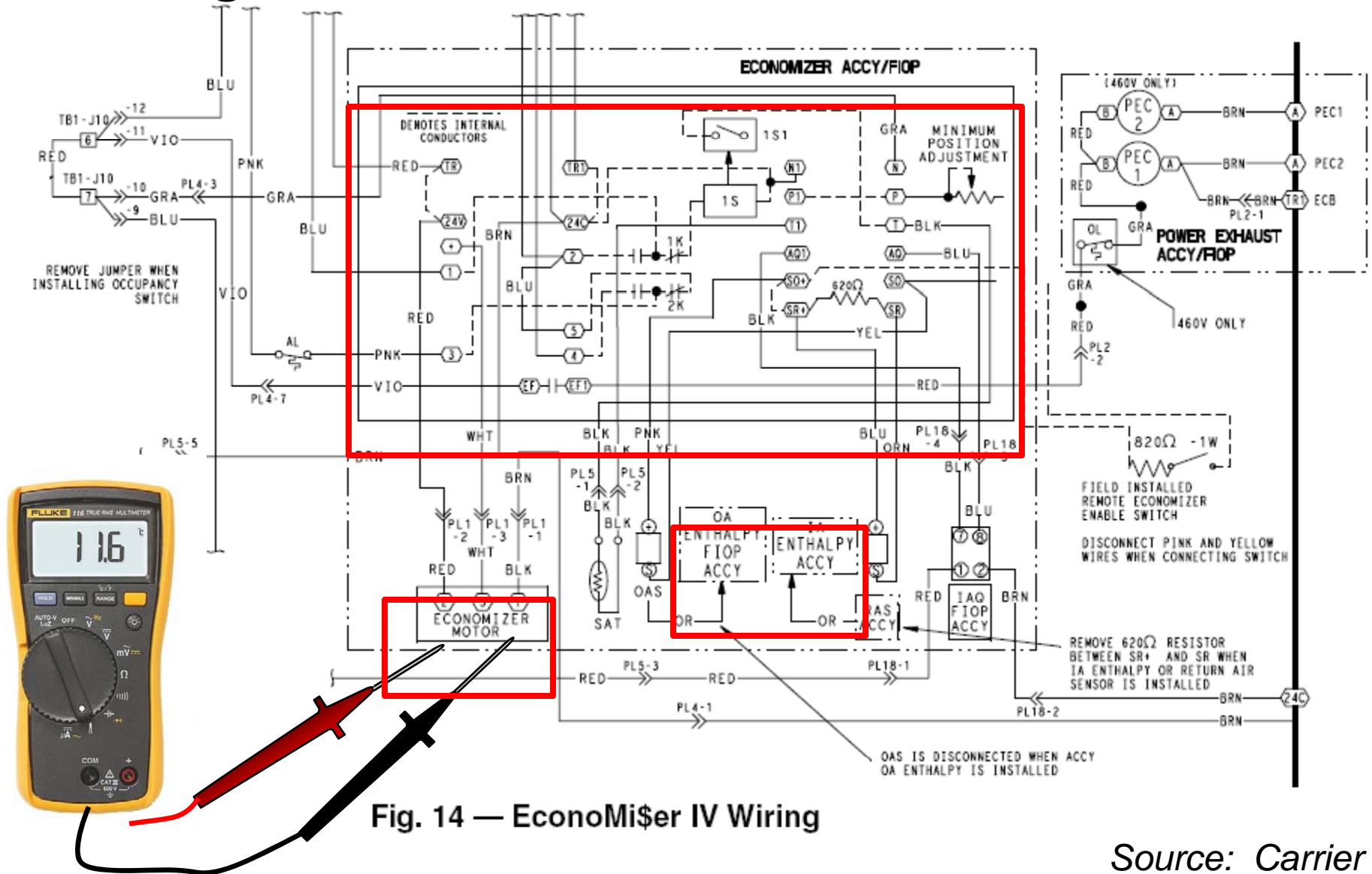


Fig. 14 — EconoMiSer IV Wiring

Source: Carrier

Troubleshooting Carrier 50PG RTU Controls Utilizing the Schematics

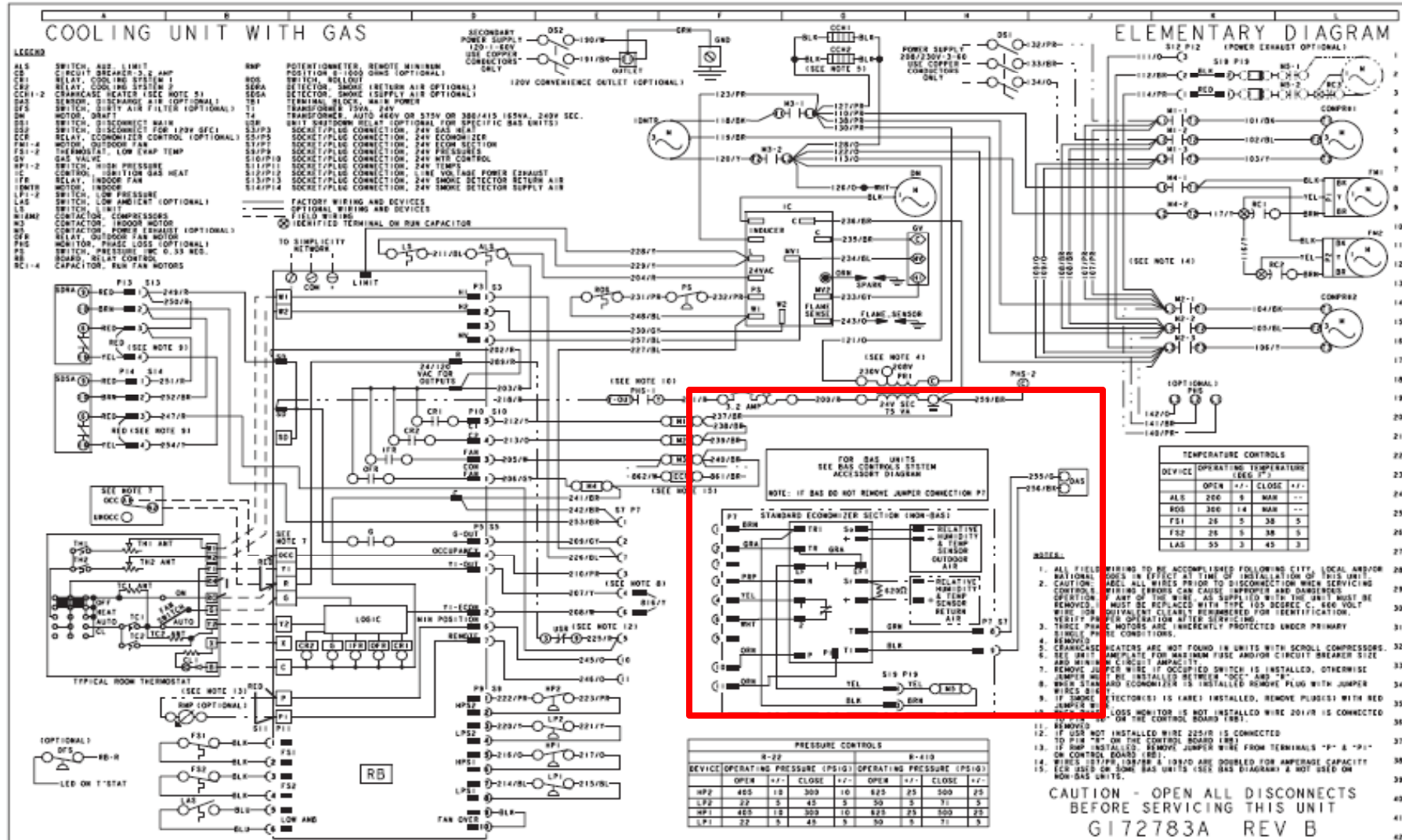
EconoMi\$er IV Troubleshooting

- **ECONOMI\$ER IV PREPARATION** — This procedure is used to prepare the EconoMi\$er IV for troubleshooting. No troubleshooting or testing is done by performing the following procedure.
- **NOTE:** This procedure requires a 9-V battery, 1.2 kilo-ohm resistor, and a 5.6 kilo-ohm resistor, which are not supplied with the EconoMi\$er IV.

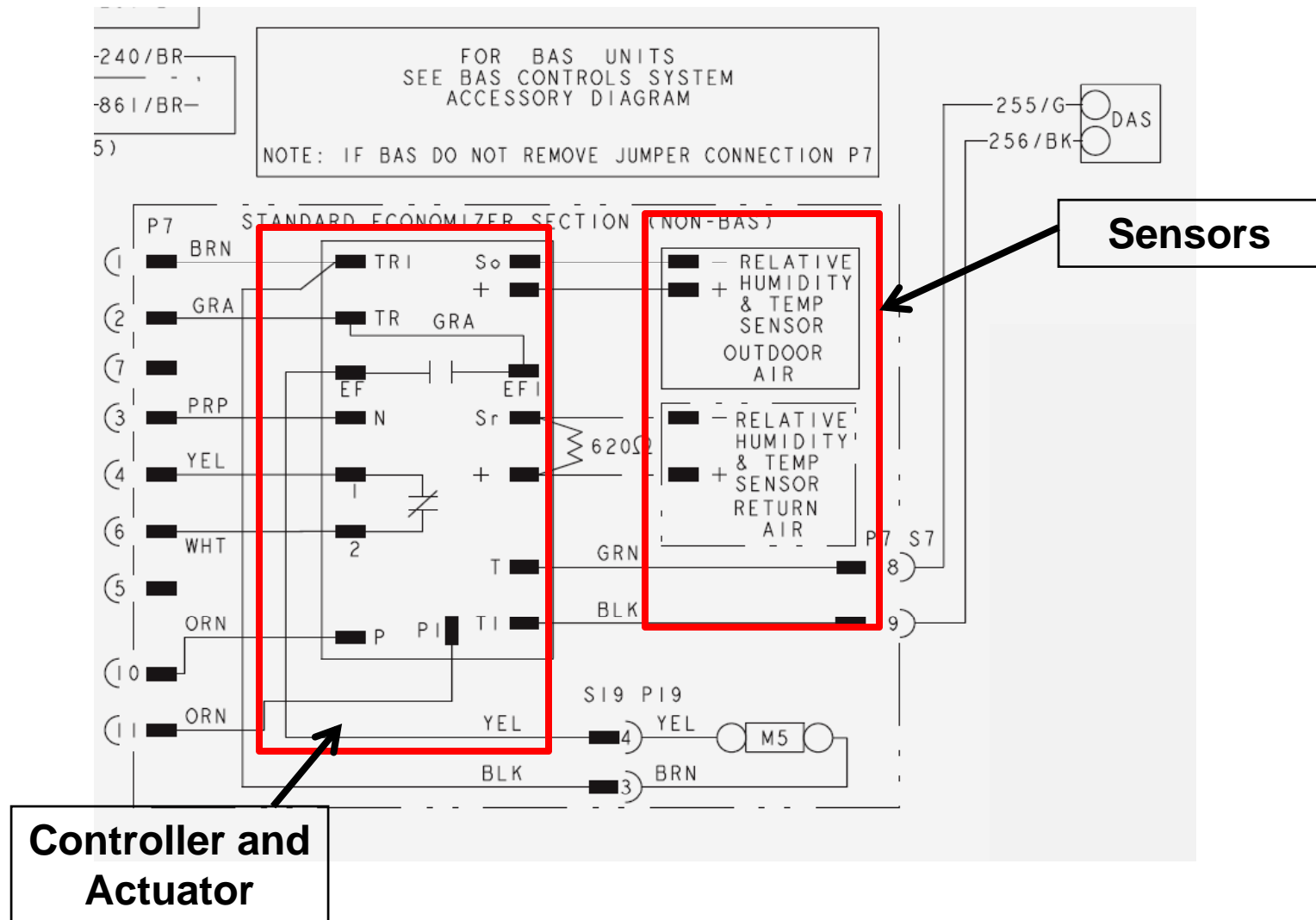
Troubleshooting Steps

- Disconnect power at TR and TR1. All LEDs should be off. Exhaust fan contacts should be open.
- **Notice:** Follow the Honeywell W7459 Reference Guide for remaining steps. Carrier Model 50PG comes equipped with Honeywell economizer controls.

York Predator RTU- Economizer Schematic



York-Predator RTU Economizer Section on Schematic



Lennox LGC RTU's with Economizers

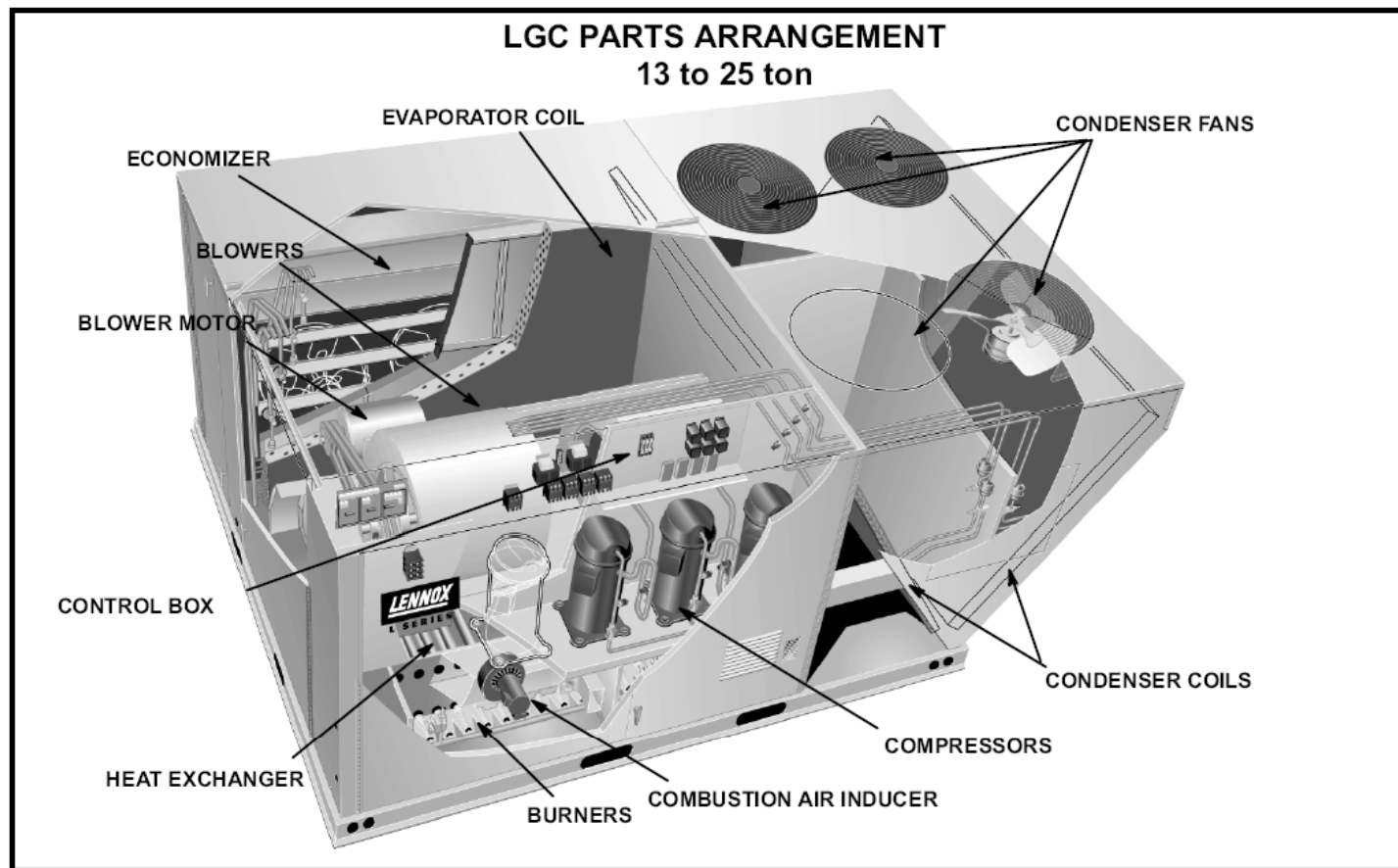
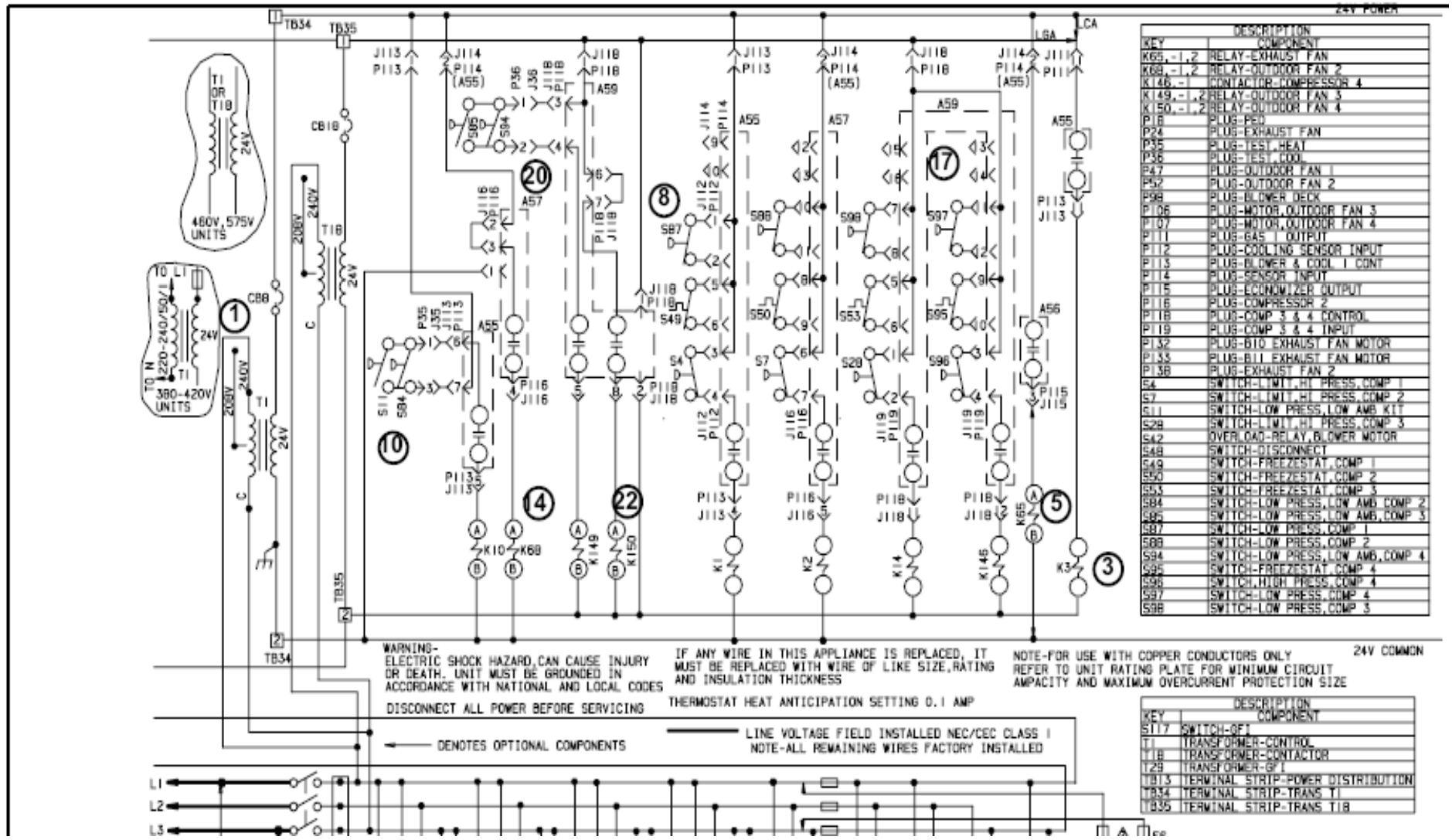


FIGURE 2

Lennox LGC Series RTU Economizers are Powered by 24 Vac at TB34



Lennox LGC Series RTU Economizers

SEQUENCE OF OPERATION, L" SERIES ECONOMIZER

(See Next Slide for Associated Schematic)

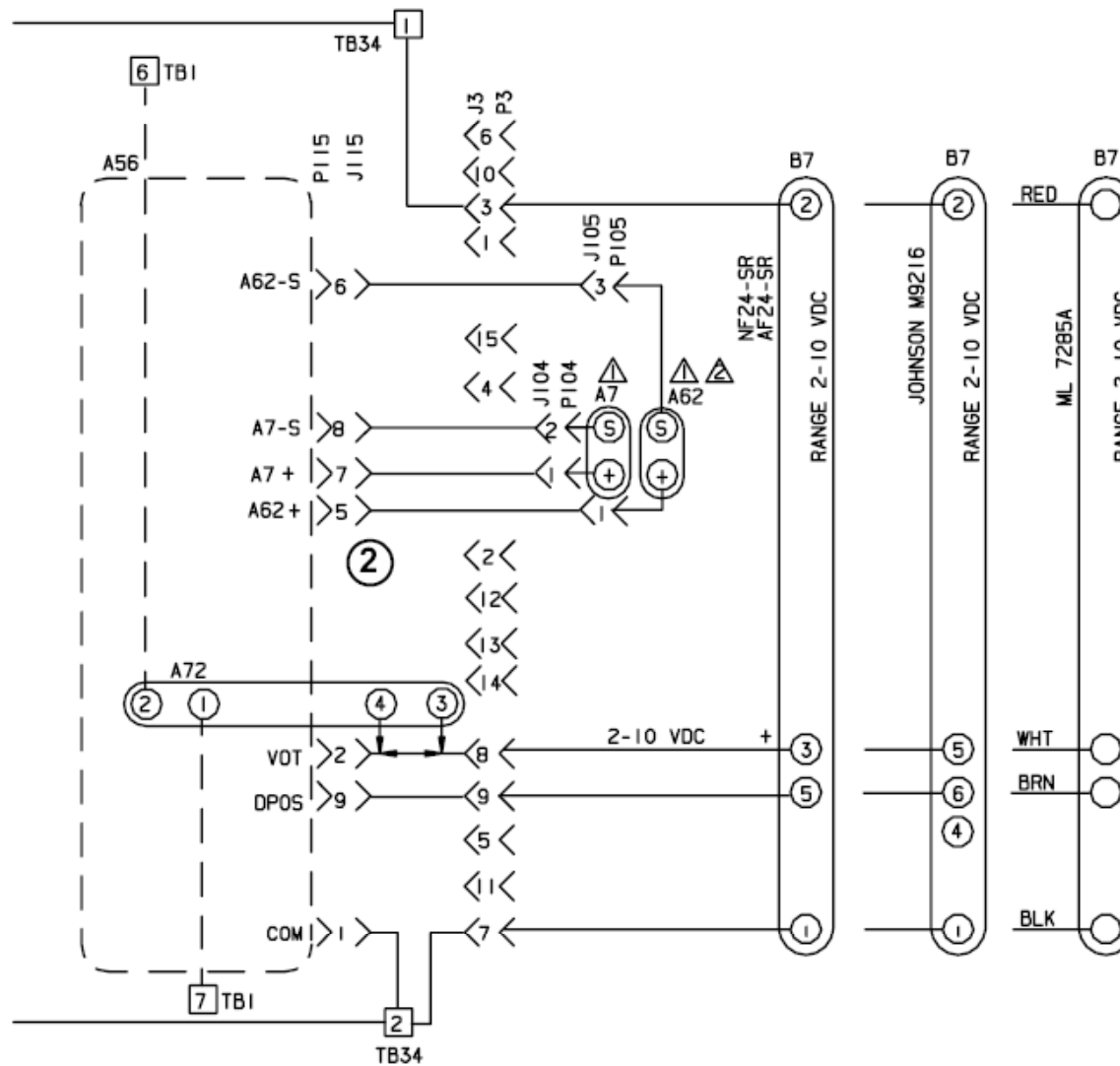
POWER:

1. Terminal strip TB34 energizes the economizer components with 24 Vac.

OPERATION:

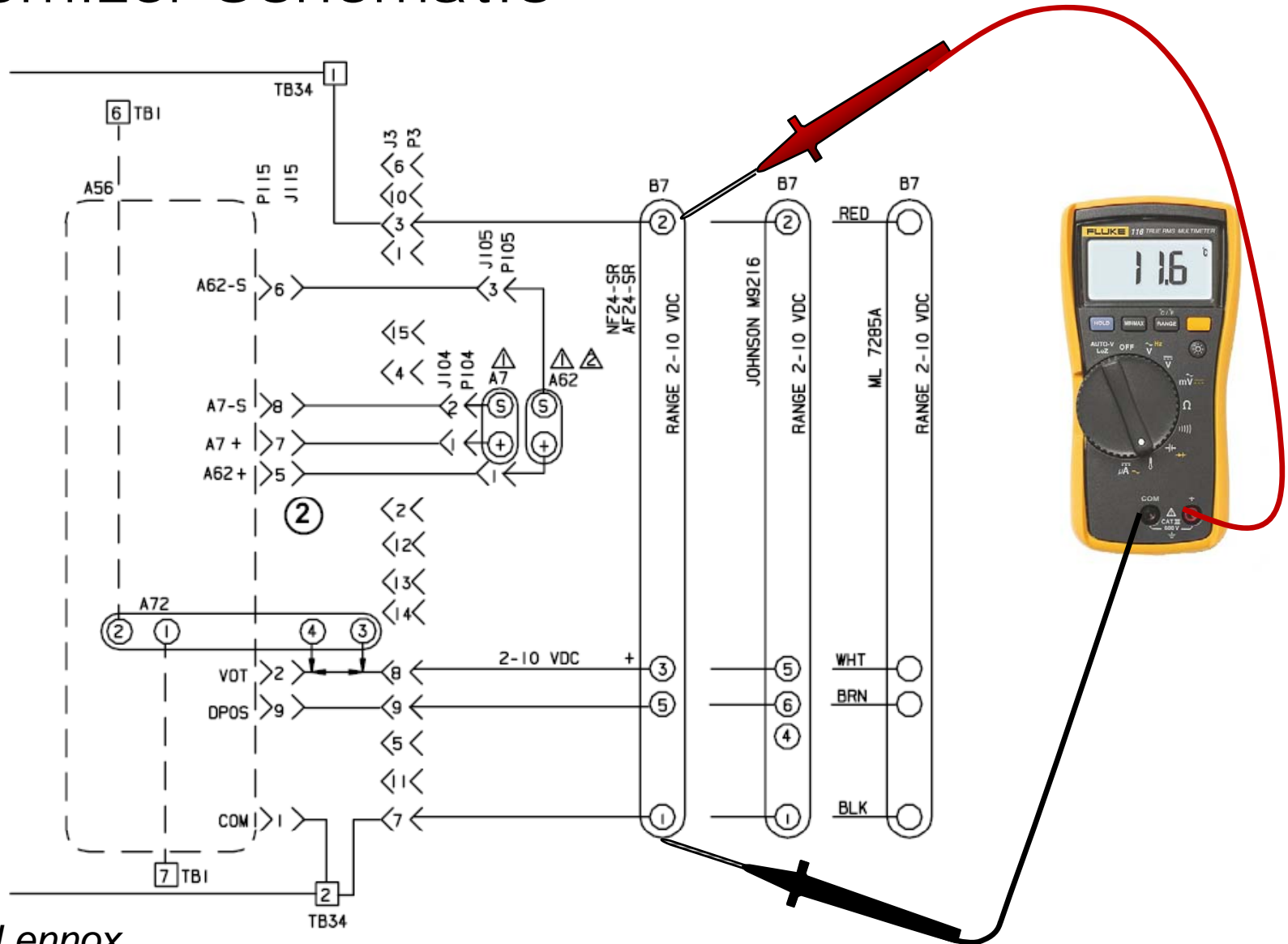
2. The main control module A55 along with outdoor enthalpy sensor A7 and indoor enthalpy sensor A62 (if differential enthalpy is used) communicates to the economizer control module A56 when to power the damper motor B7.
3. The economizer control module A56 supplies B7 with between 0 and 10 Vdc to control the positioning of economizer.
4. The damper actuator provides 2 to 10 Vdc position feedback.
5. The economizer control module A56 receives a demand and energizes exhaust fan relay K65 with 24 Vac at 50% (travel) outside air damper open (adjustable).
6. N.O. K65-1 and K65-2 both close, energizing exhaust fan motors B10 and B11.

Troubleshooting the Lennox LGC Series RTU Economizer Schematic



Source: Lennox

Testing the Lennox LGC Series RTU's Economizer Schematic



Source: Lennox

Lennox Economizer Logic

TABLE 15

ECONOMIZER OPERATION-OUTDOOR AIR IS NOT SUITABLE FOR FREE COOLING -- FREE COOL LED "OFF"

THERMOSTAT DEMAND	DAMPER POSITION		MECHANICAL COOLING
	UNOCCUPIED	OCCUPIED	
Off	Closed	Closed	No
G	Closed	Minimum*	No
Y1	Closed	Minimum*	Stage 1
Y2	Closed	Minimum*	Stage 2
Y3	Closed	Minimum*	Stage 2

*IAQ sensor can open damper to DCV max.

TABLE 16

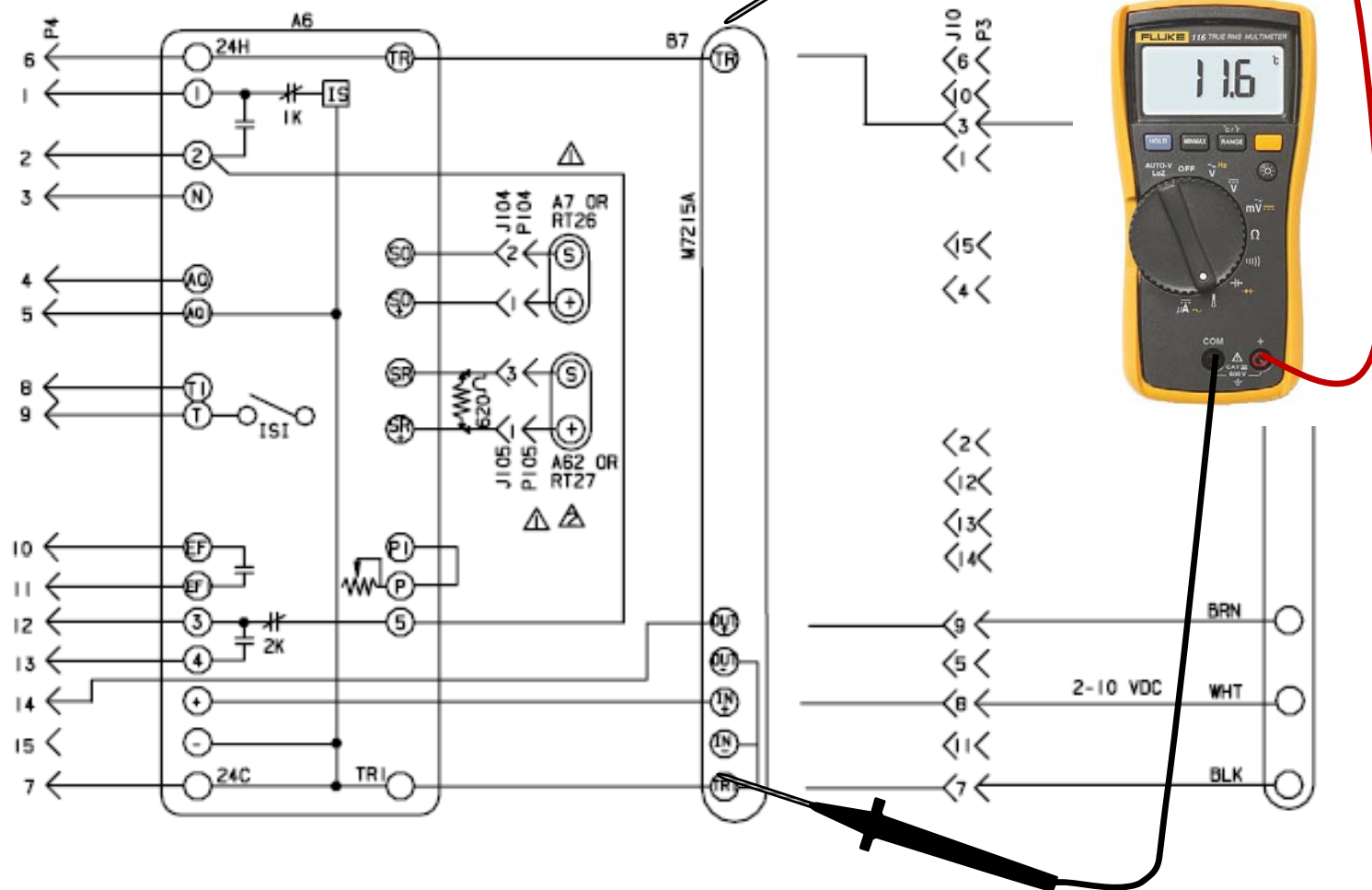
ECONOMIZER OPERATION-OUTDOOR AIR IS SUITABLE FOR FREE COOLING -- FREE COOL LED "ON"

THERMOSTAT DEMAND	DAMPER POSITION		MECHANICAL COOLING
	UNOCCUPIED	OCCUPIED	
Off	Closed	Closed	No
G	Closed	Minimum	No
Y1	Modulating	Modulating	No
Y2	Modulating	Modulating	Stage 1
Y3	Modulating	Modulating	Stage 2

Testing the Lennox "T" Series RTU Economizer

Lennox "T" Series Economizer

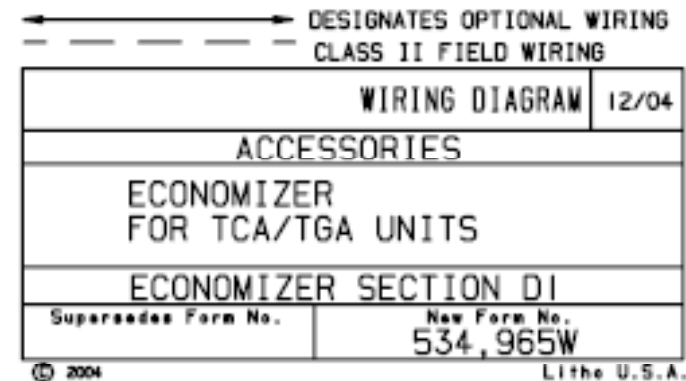
"T" SERIES ECONOMIZER



Lennox "T" Series Economizer

DESCRIPTION	
KEY	COMPONENT
A6	CONTROL-SOLID STATE ENTHALPY
A7	SENSOR-SOLID STATE ENTHALPY
A62	SENSOR-ENTHALPY, INDOOR
B7	MOTOR-DAMPER, ECONOMIZER
J10	JACK-ECONOMIZER
J104	JACK-SENSOR, OUTDOOR ENTHALPY
J105	JACK-SENSOR, RETURN AIR ENTHALPY
P3	PLUG-LESS ECONOMIZER
P4	PLUG-ECONOMIZER
P104	PLUG-SENSOR, OUTDOOR ENTHALPY
P105	PLUG-SENSOR, RETURN AIR ENTHALPY
RT26	SENSOR-OUTDOOR AIR TEMP
RT27	SENSOR-INDOOR AIR TEMP

- ▲ USED ON C BOX UNITS
- ▲ A62 ENTHALPY SENSOR OR RT27 USED FOR DIFFERENTIAL SENSING
- ▲ RT26 AND RT27, TEMPERATURE SENSORS MAY BE USED INSTEAD OF A7 AND A62 ENTHALPY SENSORS



SEQUENCE OF OPERATION

POWER:

1. Economizer control module A6 is energized through main module A45, P142 when contactor K3 is energized.

OPERATION:

2. Enthalpy sensor A7 and A62 (if differential enthalpy is used) communicates to the economizer control module A6 when to power the damper motor B7.
3. Economizer control module A6 supplies B7 with 0 - 10 VDC to control the positioning of economizer.
4. The damper actuator provides 2 to 10 VDC position feedback.

Exercise #6

(Provide Answers below on notes page)

1. On the Trane model #WSC060E, with economizer Control, what terminals are jumpered to start the economizer test?
2. On the Carrier 50PG RTU, what terminals are tested to verify a signal to the OSA actuator?
3. When testing the outside air temp sensor on the York Predator RTU, what terminals are used?
4. On the Lennox L Series RTU, what is the signal that goes to the OSA damper motor?
5. When troubleshooting any rooftop unit, what is one of the first steps a tech should practice prior to touching any piece of the equipment?