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.
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

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

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.
Trane ECA Economizer
Control Module and Accessories
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 an 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

A6 ENTHALPY CONTROLLER

FREE COOLING SETPOINT;  
A=Completely counterclockwise  
D=Completely clockwise
Troubleshooting Carrier RTU Controls
Utilizing the Schematics

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

Actuator

Sensors

Controller
Troubleshooting Carrier 48HG RTU Controls Utilizing the Schematics

Fig. 1B — Low Voltage Control Schematic — 48HG Units (DR1)
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 — EconoMi$er 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

LGC PARTS ARRANGEMENT
13 to 25 ton

- Economizer
- Evaporator coil
- Condenser fans
- Condenser coils
- Compressors
- Combustion air inducer
- Burners
- Heat exchanger
- Blower motor
- Control box
- Blowers

Figure 2
Lennox LGC Series RTU Economizers are Powered by 24 Vac at TB34
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).
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”**

<table>
<thead>
<tr>
<th>THERMOSTAT DEMAND</th>
<th>DAMPER POSITION</th>
<th>MECHANICAL COOLING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UNOCCUPIED</td>
<td>OCCUPIED</td>
</tr>
<tr>
<td>Off</td>
<td>Closed</td>
<td>Closed</td>
</tr>
<tr>
<td>G</td>
<td>Closed</td>
<td>Minimum*</td>
</tr>
<tr>
<td>Y1</td>
<td>Closed</td>
<td>Minimum*</td>
</tr>
<tr>
<td>Y2</td>
<td>Closed</td>
<td>Minimum*</td>
</tr>
<tr>
<td>Y3</td>
<td>Closed</td>
<td>Minimum*</td>
</tr>
</tbody>
</table>

*IAQ sensor can open damper to DCV max.

#### TABLE 16
**ECONOMIZER OPERATION - OUTDOOR AIR IS SUITABLE FOR FREE COOLING -- FREE COOL LED “ON”**

<table>
<thead>
<tr>
<th>THERMOSTAT DEMAND</th>
<th>DAMPER POSITION</th>
<th>MECHANICAL COOLING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UNOCCUPIED</td>
<td>OCCUPIED</td>
</tr>
<tr>
<td>Off</td>
<td>Closed</td>
<td>Closed</td>
</tr>
<tr>
<td>G</td>
<td>Closed</td>
<td>Minimum</td>
</tr>
<tr>
<td>Y1</td>
<td>Modulating</td>
<td>Modulating</td>
</tr>
<tr>
<td>Y2</td>
<td>Modulating</td>
<td>Modulating</td>
</tr>
<tr>
<td>Y3</td>
<td>Modulating</td>
<td>Modulating</td>
</tr>
</tbody>
</table>
Testing the Lennox “T” Series RTU Economizer

Lennox “T” Series Economizer

“T” SERIES ECONOMIZER

[Diagram of electrical connections]
**SEQUENCE OF OPERATION**

**POWER:**
1. Economizer control module A6 is energized through main module M6, 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?