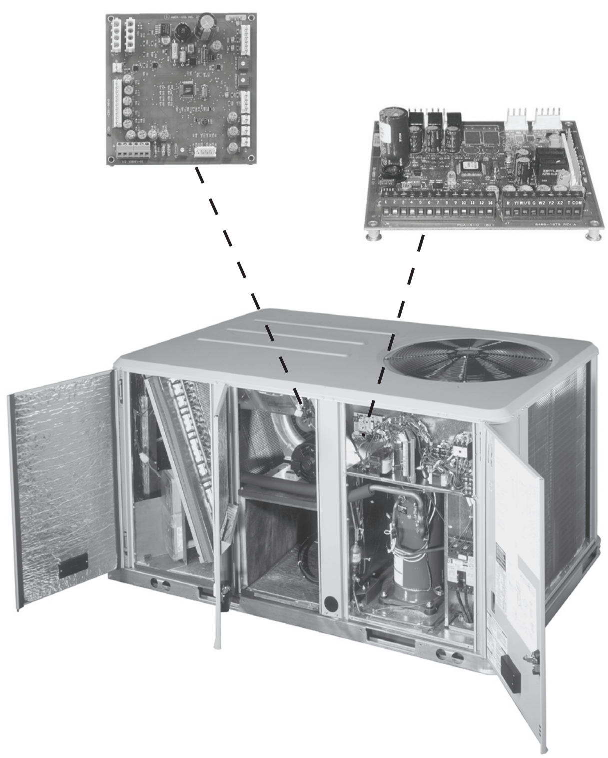
# Service Diagnostic

## ReliaTel™
## Microprocessor Controls



**⚠SAFETY WARNING**

**Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.**

September 2013

**RT-SVD03H-EN**

Ingersoll Rand

# Introduction

## 3-through 10-ton Convertible and 12½-through 50-ton Dedicated Packaged Rooftops

3-through 10-ton cooling only and gas electric convertible packaged units can be built with either electromechanical or ReliaTel™ controls. 12½-through 50-ton units are built with ReliaTel™ controls only. All Heat pumps are built exclusively with ReliaTel™ controls. This publication covers both electromechanical and ReliaTel™ controls. Due to the more complex application and service opportunities, greater emphasis is placed on units with ReliaTel™ controls.

This publication does not cover all aspects of service. It assumes that the service person is an experienced commercial service technician with a strong background in electrical controls and DC circuits. If you are not experienced and fully qualified in HVAC service, do not attempt to use this manual to service equipment. Doing so could cause personal injury to yourself or others and could result in expensive equipment or property damage.

## ReliaTel™ Introduction

ReliaTel™ is not the name of a circuit board, but rather an overall communicating control system consisting of up to eight communicating modules.

ReliaTel™ is the name given to the second generation microprocessor controls developed by Trane®.

ReliaTel™ controls were first used in the 3-10 ton convertible packaged cooling with electric heat, gas electric, and heat pumps. ReliaTel™ has been added to other commercial products as well. In April 2003, 12½-through 25-ton dedicated units were converted to ReliaTel™ controls. In April 2004, ReliaTel™ controls were added to 27½-through 50-ton dedicated units

## Why change?

The Micro has proven itself to our customers in thousands of applications around the world. A microprocessor based unit provides superior comfort, unmatched reliability and much greater flexibility than conventional systems. ReliaTel™ has even more flexibility, is more compact, has additional system reliability enhancements and more.

Much of what ReliaTel does will be very familiar to service technicians accustomed to the previous generation Micro. Testing and troubleshooting is similar, and in many cases the same. There are, however, some significant differences, so it is important that the service person use the correct material for the unit being serviced.

# Table of Contents

# General Information

## ReliaTel™ vs. Electromechanical

Three to ten ton convertible packaged gas/electric (YSC, YHC) and cooling only (TSC, THC) are available without microprocessor controls. With electromechanical controls, zone sensors cannot control the units, nor can building automation systems communicate with it. Electromechanical units require the use of a thermostat or relay based control system to directly control relays, contactors, etc. The ignition control and economizer are different than the ones used with ReliaTel. Service information for these components are handled separately in this book.

- ReliaTel Controls: 9th digit "R"
- Electromechanical Controls: 9th digit "E"
- 27½-through 50-Ton: ReliaTel™ controls 10th digit "M" or greater

## ReliaTel™ – Module Descriptions

Each ReliaTel™ Module is a communicating control.

### ReliaTel™ Refrigeration Module (RTRM)

Every ReliaTel™ unit uses an RTRM. The RTRM provides primary unit control for heating and cooling. In addition, it has built-in logic that controls heating and cooling staging, minimum run times, diagnostics, heat pump defrost control, short cycle timing and more. It can be controlled directly by any of the following:

- Zone Sensor Module (BAYSENS006-11B, AYSTAT661-664B)
- Programmable Zone Sensor (BAYSENS019*, 20*, AYSTAT666*)
- Conventional Thermostat (such as BAYSTAT036-038A, ASYSTAT701-703)

***Note:*** *Unlike the previous Micro, a conventional thermostat does not require any sort of interface. It can be wired directly to the RTRM.*

In addition, the unit can be controlled using Trane® ICS systems by applying the appropriate interface. The RTRM is configured through the unit wiring harness. The same module is used on gas/electric, cooling only with electric heat, and heat pumps. The following additional inputs are connected to the RTRM:

- Outdoor Air Sensor (OAS)
- Coil Temperature Sensor (CTS) heat pump only
- Smoke detector (unless it is factory installed) or other shutdown device

### ReliaTel™ Option Module (RTOM)

The RTOM gets power from and communicates with the RTRM.

Any of these optional ReliaTel™ devices require the use of an RTOM:

- Frostat™ (FOS)
- Clogged Filter Switch (CFS)
- Fan Failure Switch (FFS)
- Discharge Air Sensor (DAS) used for supply air tempering and ICS input data
- Smoke Detector - Factory-Installed (A factory-installed Smoke Detector provides instant shutdown and ICS alarm output.)

***Note:*** *On 27½-through 50-ton units RTOM is standard.*

### ReliaTel™ Ventilation Module (RTVM)

The RTVM is a module required for units configured with Space Pressure Control with Statitrac™. The module controls the Exhaust Damper Position 0-10Vdc output as well as the Space Pressure Sensor calibration routine. The module accepts the following inputs:

- Statitrac™ Configuration
- Space Pressure Input
- Space Pressure Setpoint
- Space Pressure Setpoint Deadband

### ReliaTel™ Dehumidification Module (RTDM)

The RTDM is a module required for units configured with Modulating Dehumidification. The module controls Modulating Cooling and Reheat valves as well as the Reheat Circuit Pumpout Solenoid. The module accepts the following inputs:

- Reheat Circuit Entering Evaporator Temperature
- Reheat Circuit Low Pressure Cutout Input

## Economizer Actuator w/ Module (ECA or RTEM)

The economizer can be used with or without the Options module. The actuator has a detachable communicating module, which can be replaced separately. The outdoor air sensor, connected to the RTRM, provides outdoor temperature information for the changeover decision.

The ECA accepts the following inputs:

- Mixed Air Sensor (MAS)
- Return Air Sensor (RAS) for comparative enthalpy or ICS input data
- Outdoor Humidity Sensor (OHS) for reference or comparative enthalpy
- Return Air Humidity Sensor (RHS) for comparative enthalpy
- $CO_2$ Sensor 0-10VDC input
- Remote Minimum Potentiometer (RMP)
- Active/Passive DCV Configuration Input (RTEM only)
- The Power Exhaust relay is connected to the ECA module as well

## COMM3/4 Communication Interface

Allows ICS communication between a ReliaTel™ unit and Trane® ICS systems as follows:

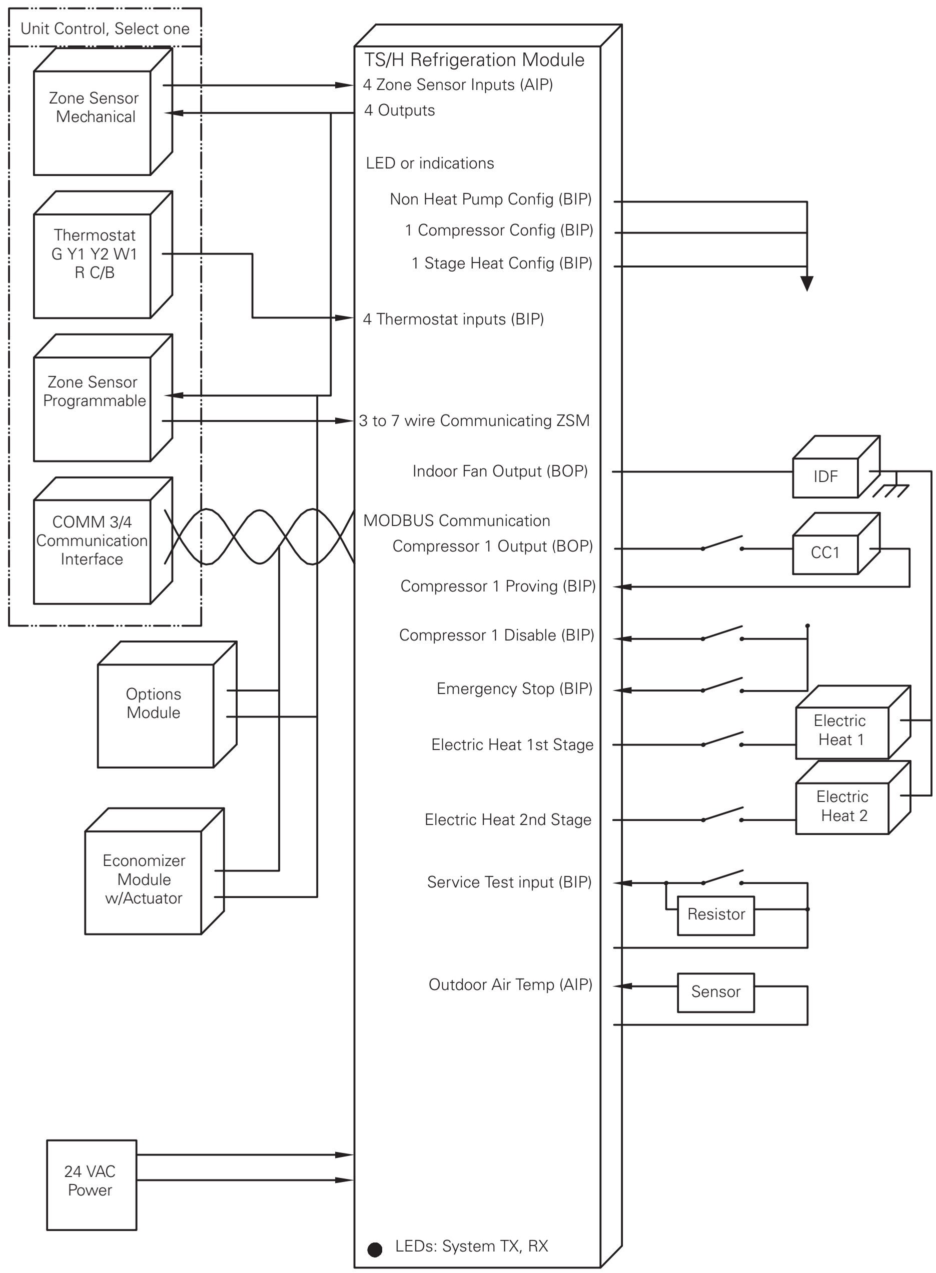
- Tracer™ 100 series
- Tracer™ Summit
- Tracker™
- ComforTrac™
- VariTrac™ 1 (Comfort Manager)
- VariTrac™ 2 (Central Control Panel)

## LonTalk® Communication Interface

Allows Building Management System (BMS) communication to a ReliaTel unit. There are 2 LCI versions, one for SCC control (constant volume units) and one for DAC control (VAV units).

# Module Flow Diagram

**Figure 1. TSC/THC refrigeration module (RTRM) electric heat/no heat**



## Module Flow Diagram

**Figure 2. Refrigeration module (RTRM) gas heating**

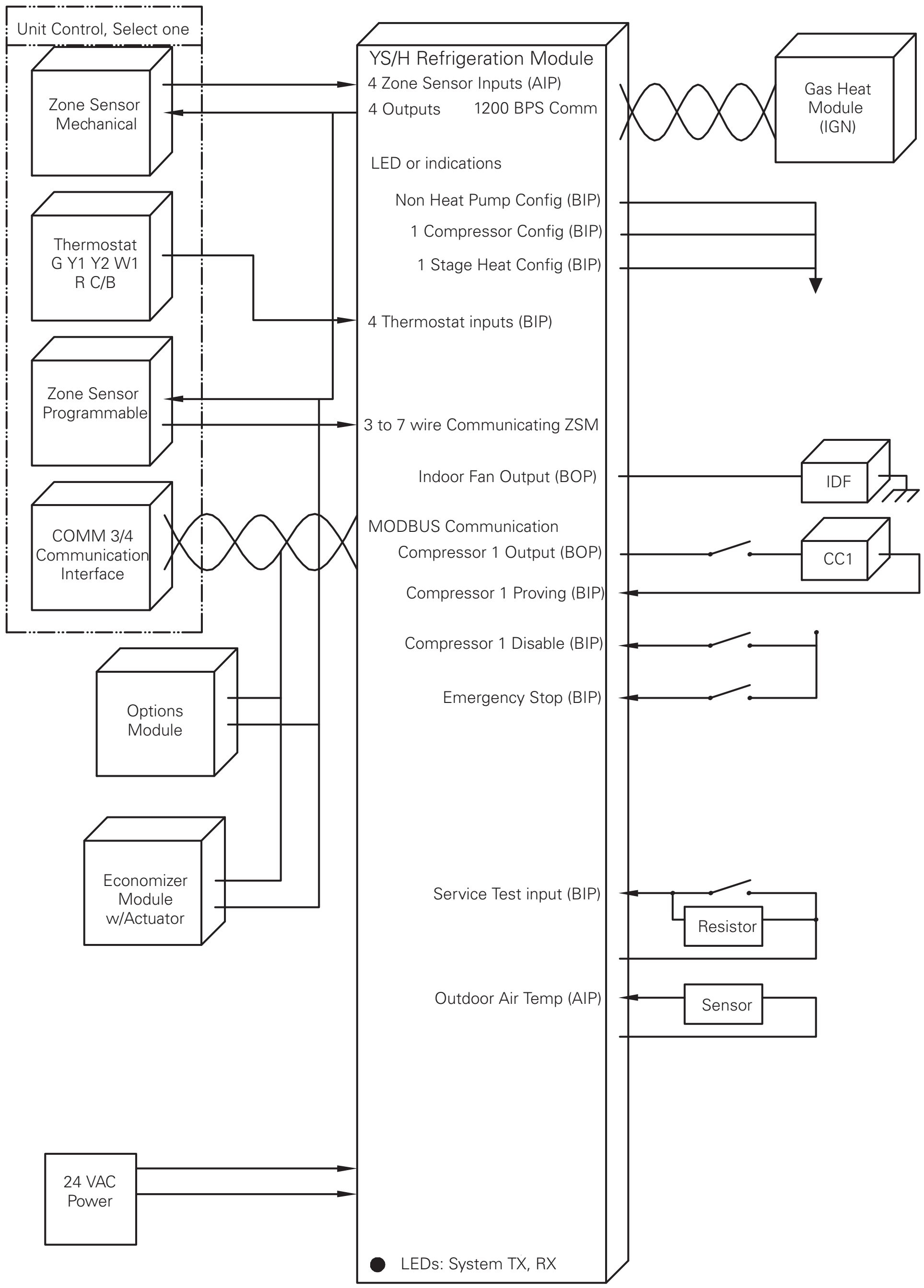
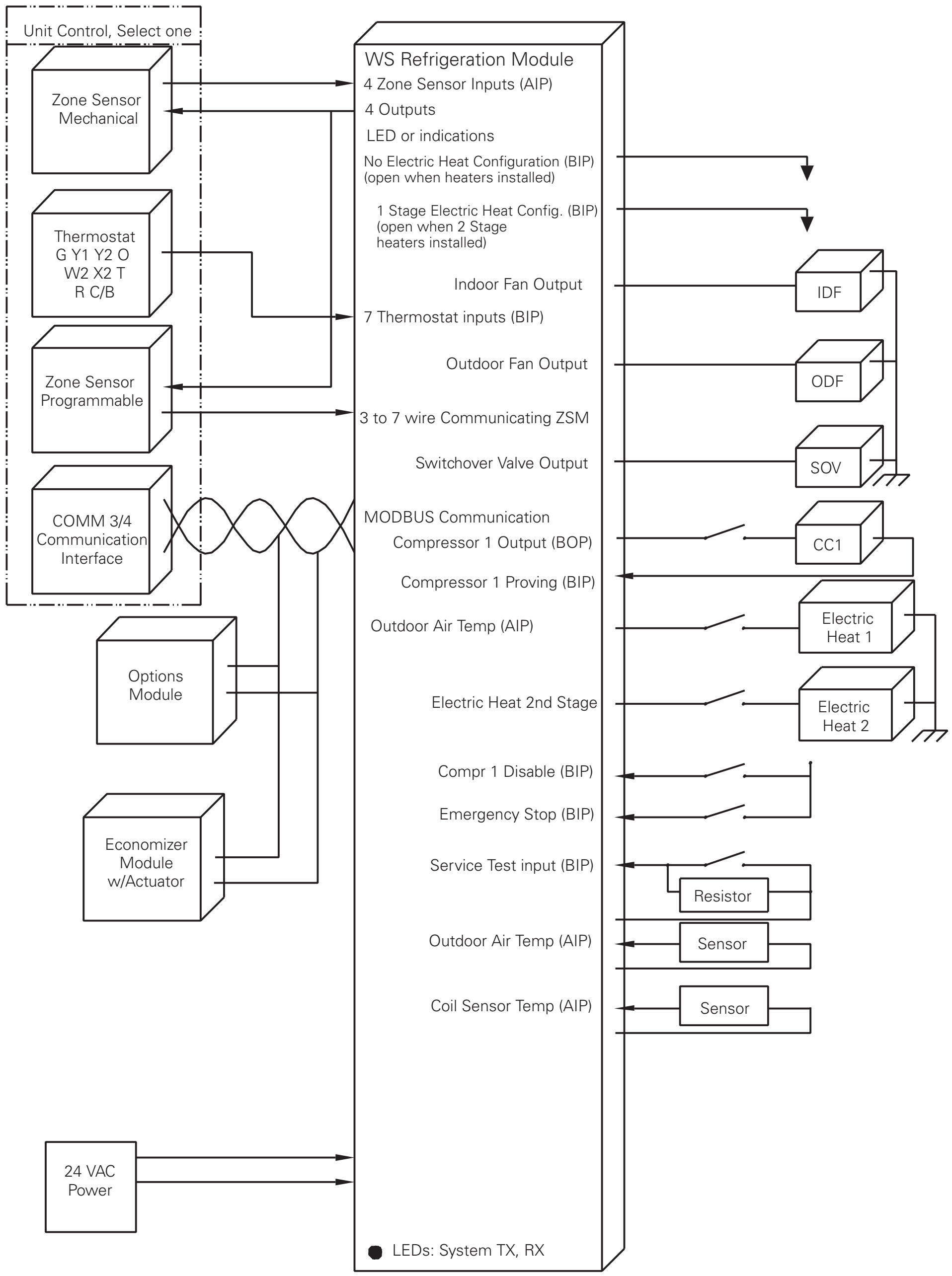


**Figure 3. Refrigeration module (RTRM) heat pump**



## Module Flow Diagram

**Figure 4. Options module (RTOM)**

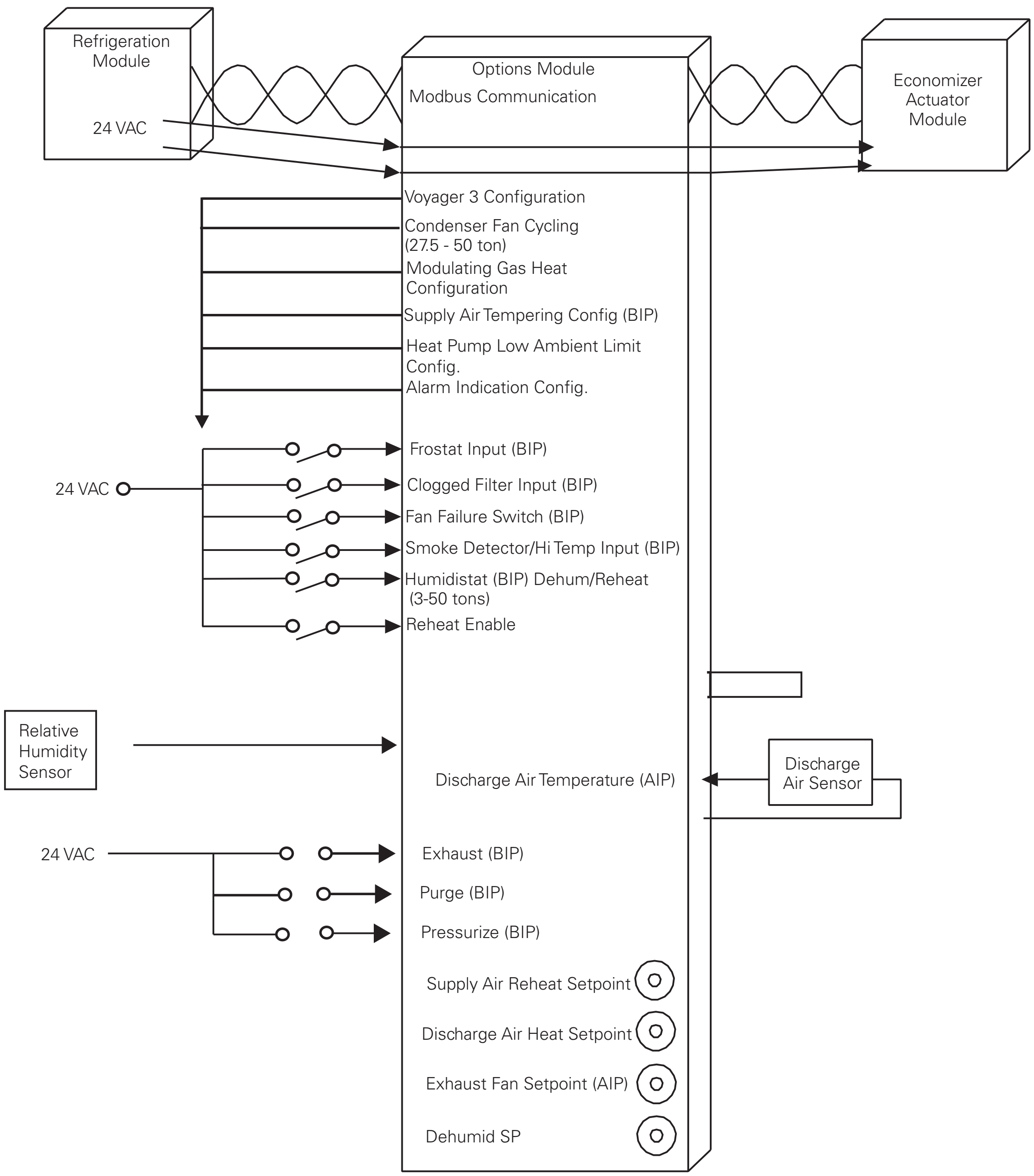
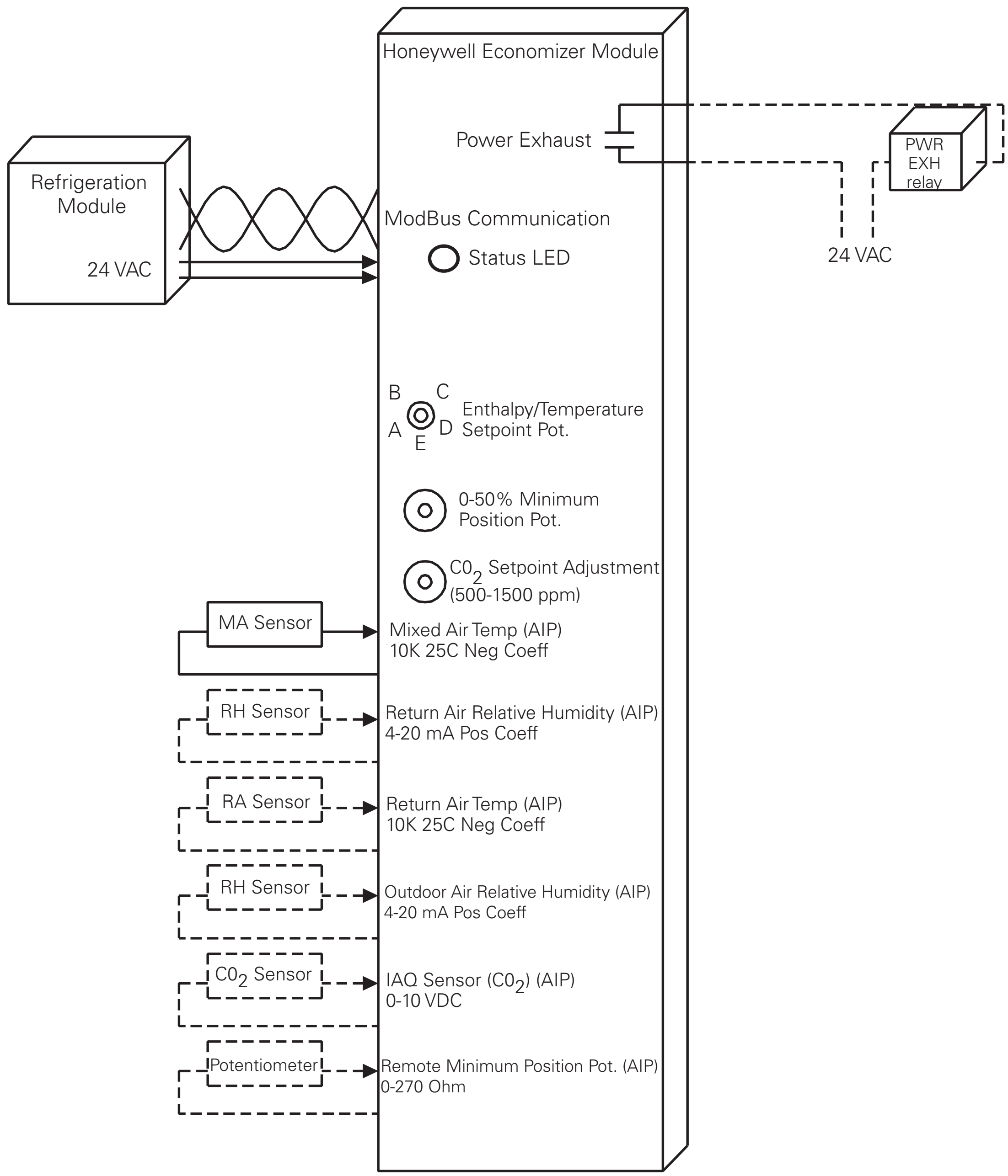


**Figure 5. Honeywell economizer module (ECA)**



## Module Flow Diagram

**Figure 6. Economizer module (RTEM)**

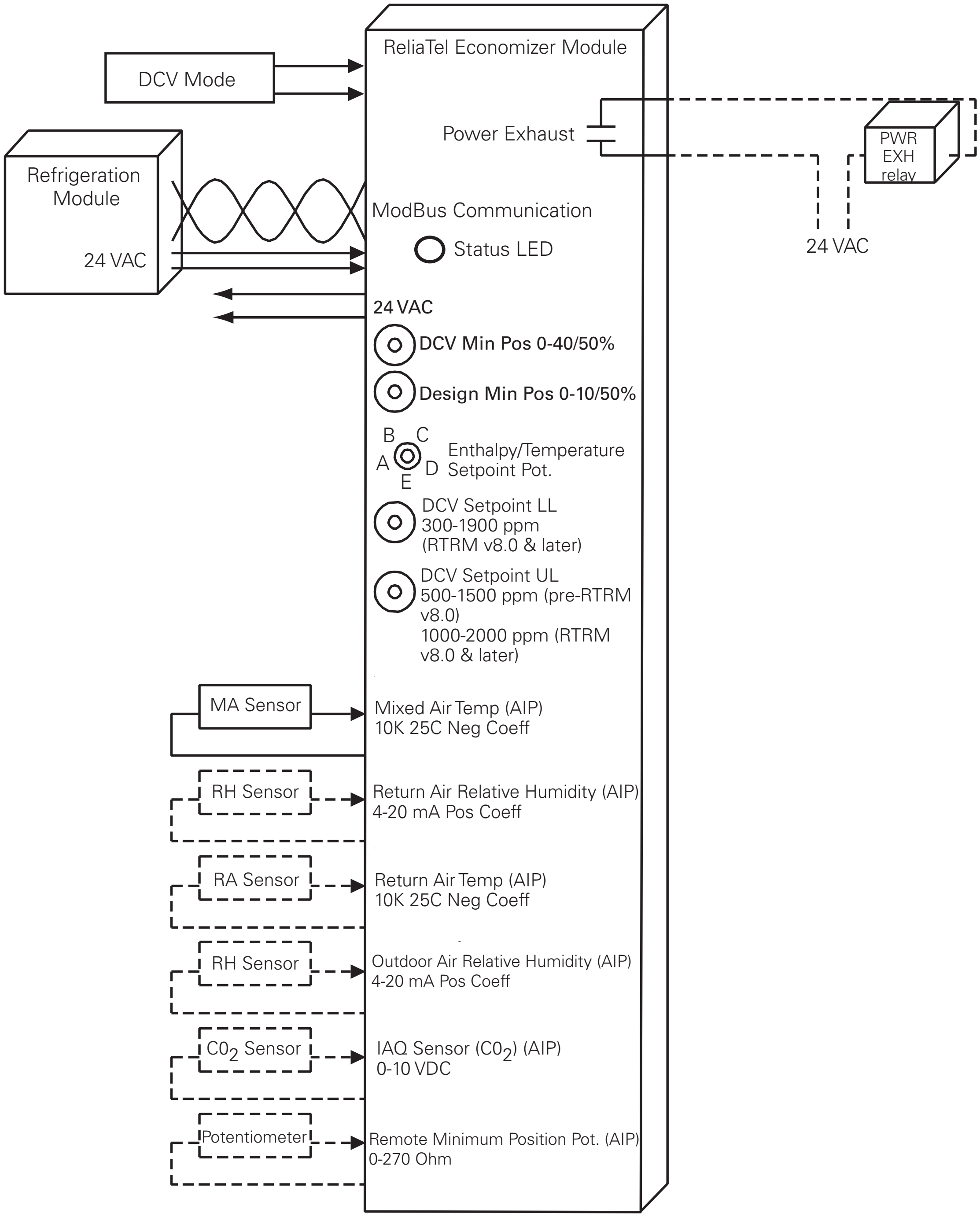
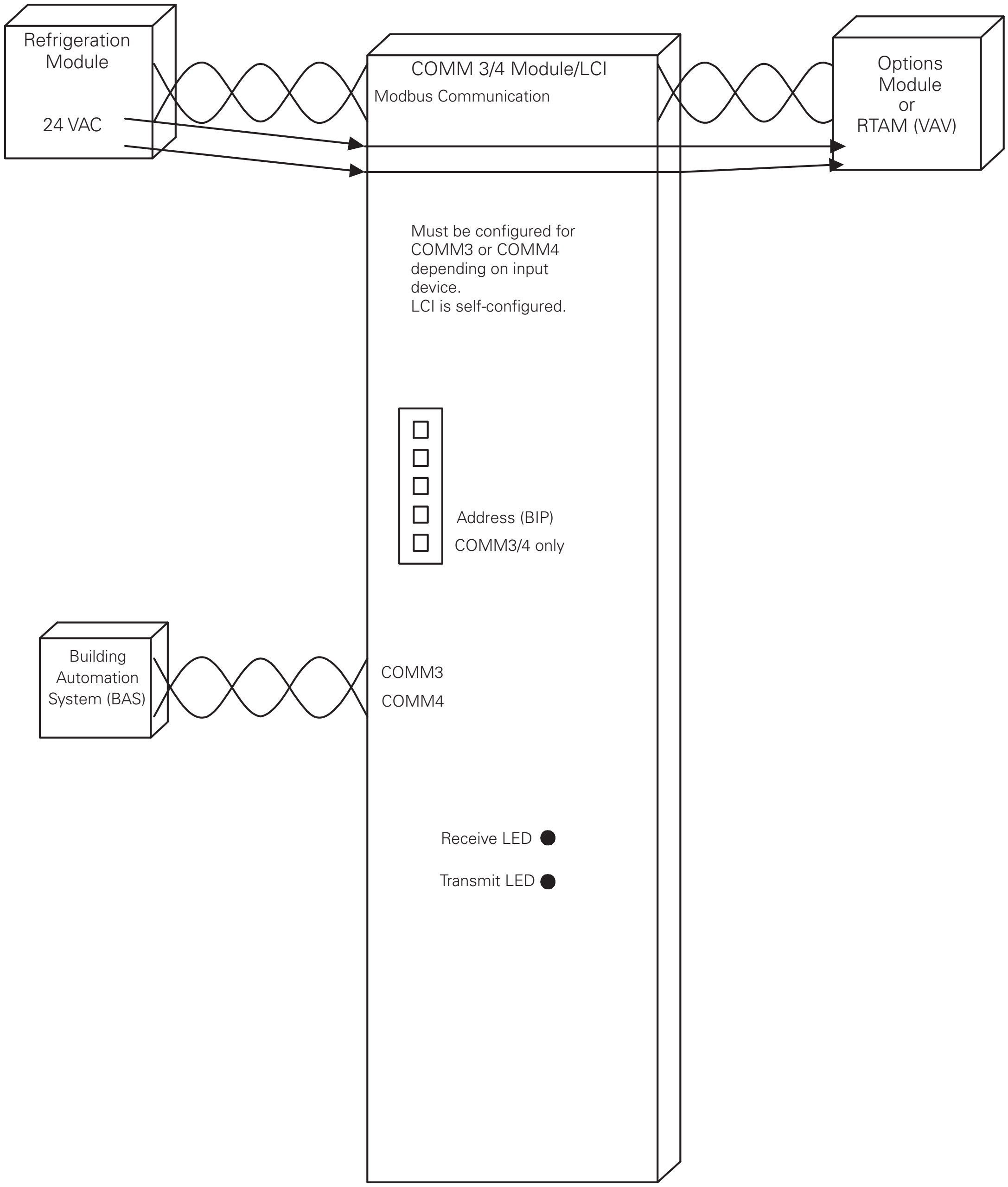


**Figure 7. COMM 3/4 module for ICS communication/ LonTalk® Communication Interface (LCI/TCI)**



## Module Flow Diagram

**Figure 8. Air control module (RTAM)**

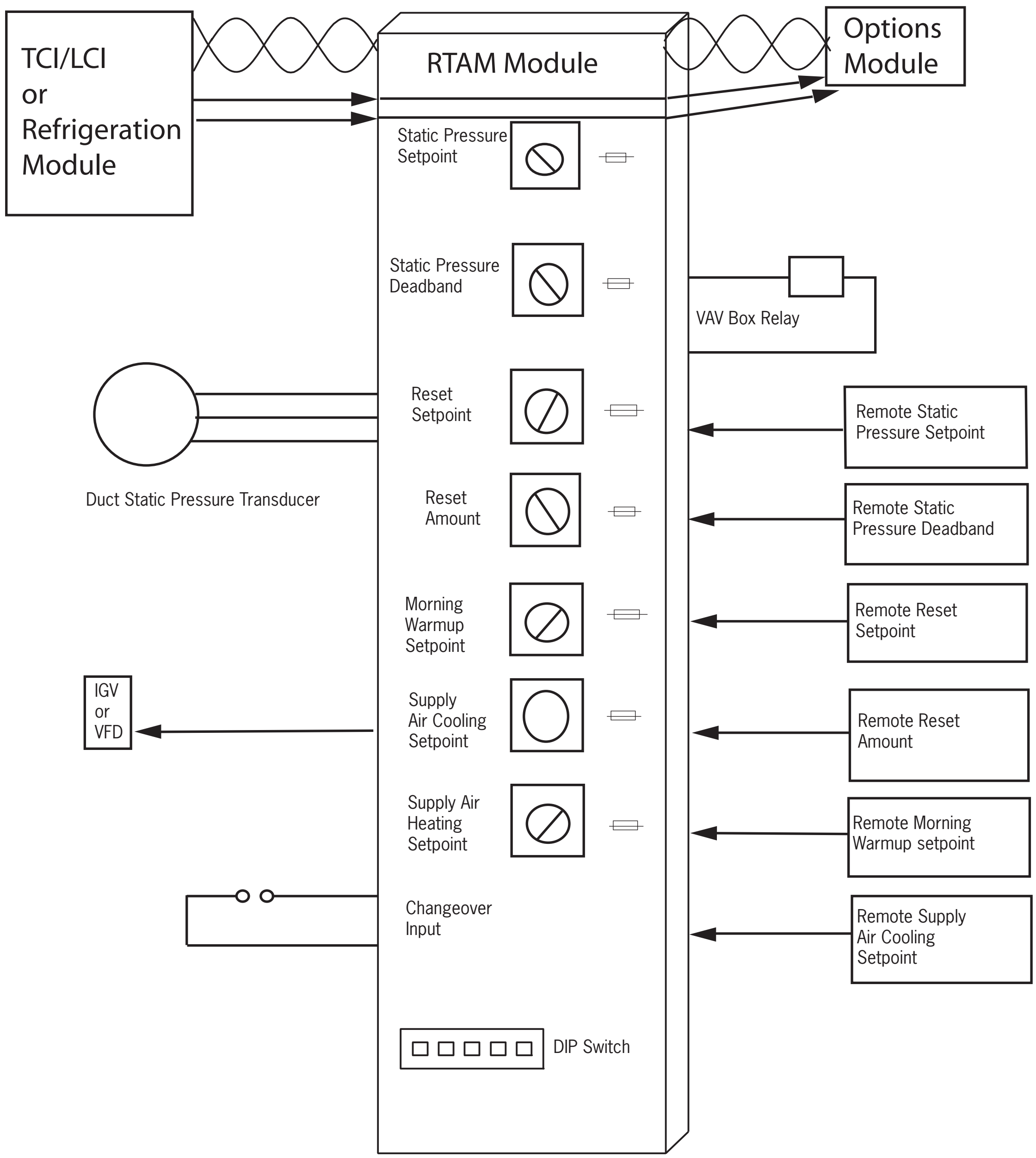
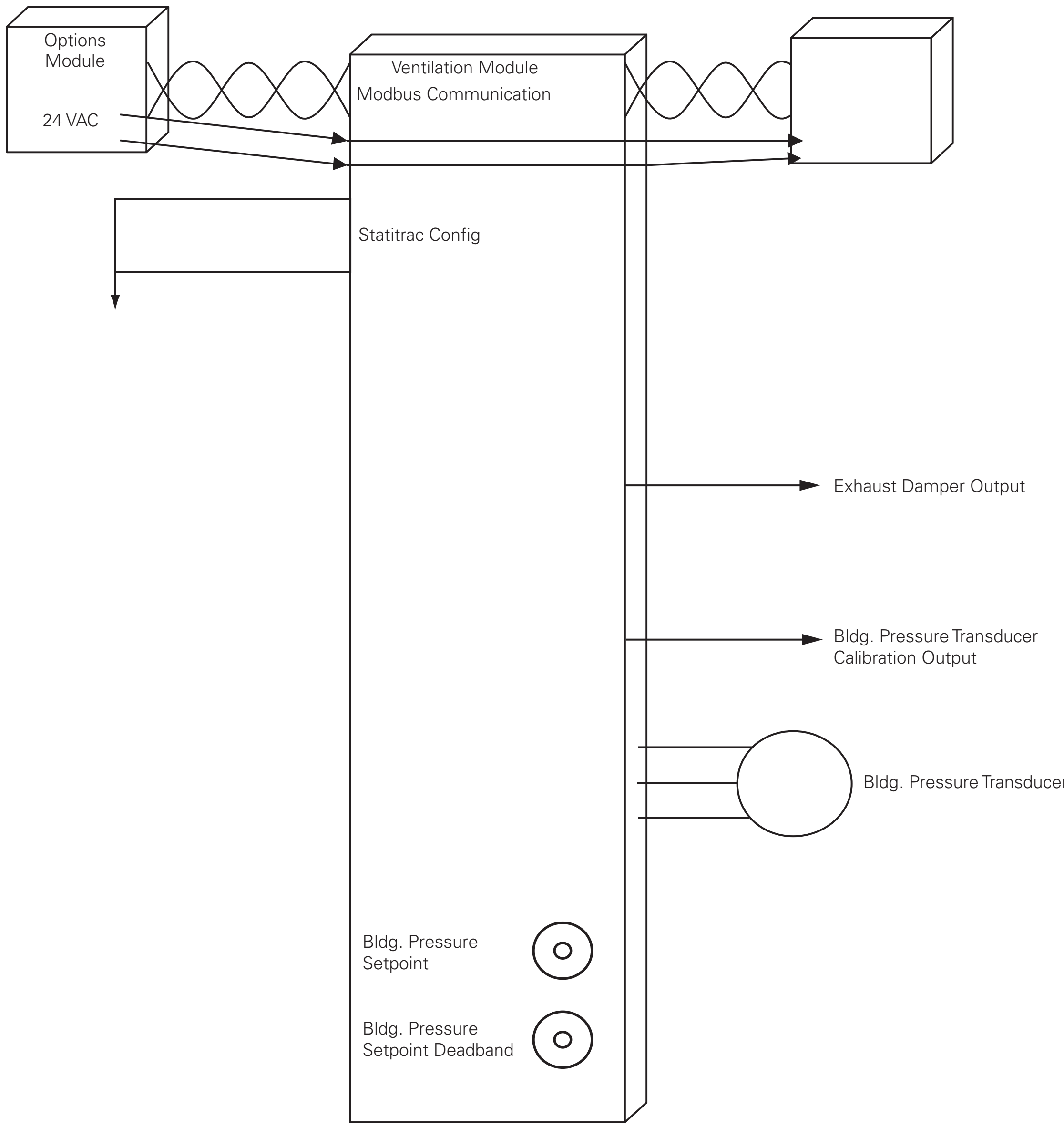


**Figure 9. ReliaTel ventilation module (RTVM)**



# Low Voltage Terminal Strip

**TEST terminals.** By jumpering from TEST1 to TEST2, the service technician can test the unit or start it with or without any controls attached. See TEST MODE section for details.

**Compressor 1 disable.** If the factory installed jumper from 1 to 2 is removed (Compressor 1 disable), compressor 1 will not run, even in the TEST MODE. This is where a load shedding device could be connected.

**Compressor 2 disable.** If the factory installed jumper from 3 to 4 is removed (Compressor 2 disable), compressor 2 will not run, even in the TEST MODE. This is where a load shedding device could be connected.

**Emergency Stop.** If the factory installed jumper from 5 to 6 is removed (Emergency Stop), the unit will not run. The RTRM system LED will be on. The unit will have Heat + Cool diagnostic. An external smoke detector or other interlock device can be added here.

**Figure 10. Low voltage terminal strip**

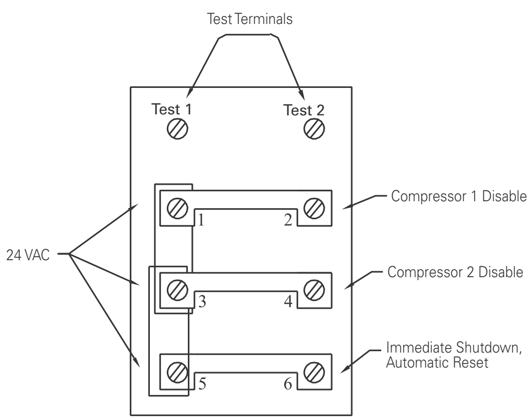
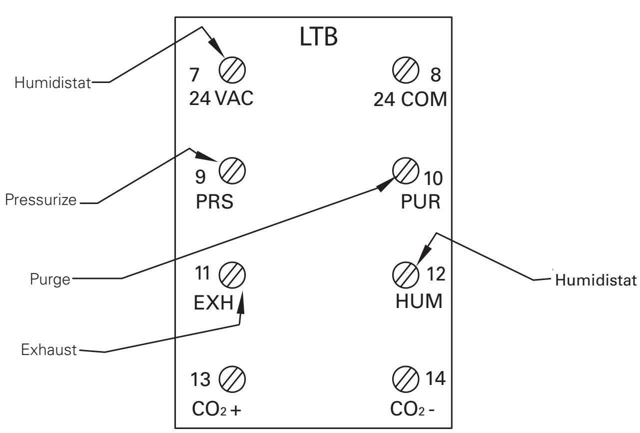
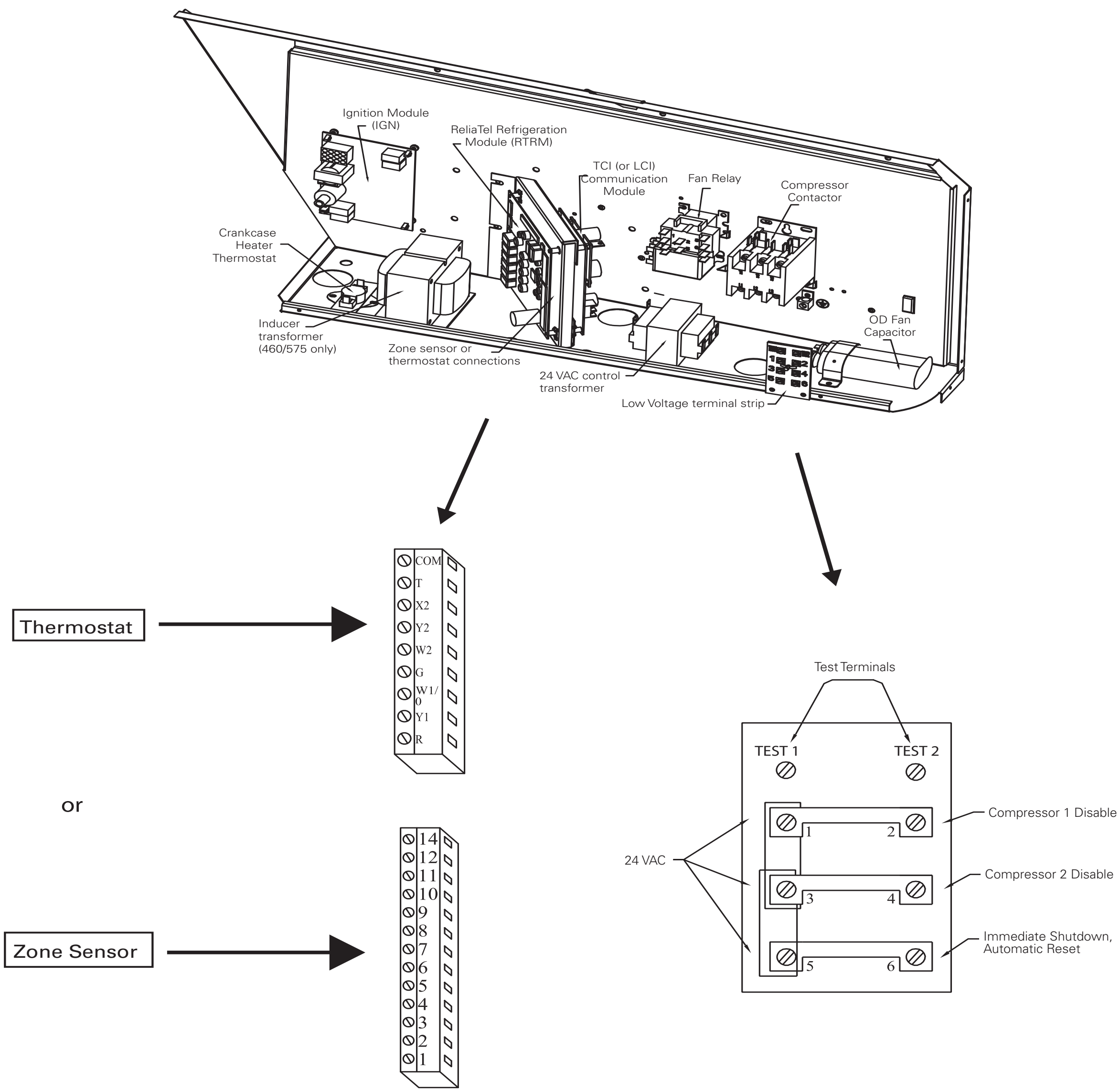



**Figure 11. Low voltage terminal strip**



# Typical Control Box Layout

**Figure 12. Typical control box layout (3-through 5-tons)**



## Typical Control Box Layout

**Figure 13. Typical control box layout (T/YSC072-102E, T/YHC048-072E, & WSC060-090E)**

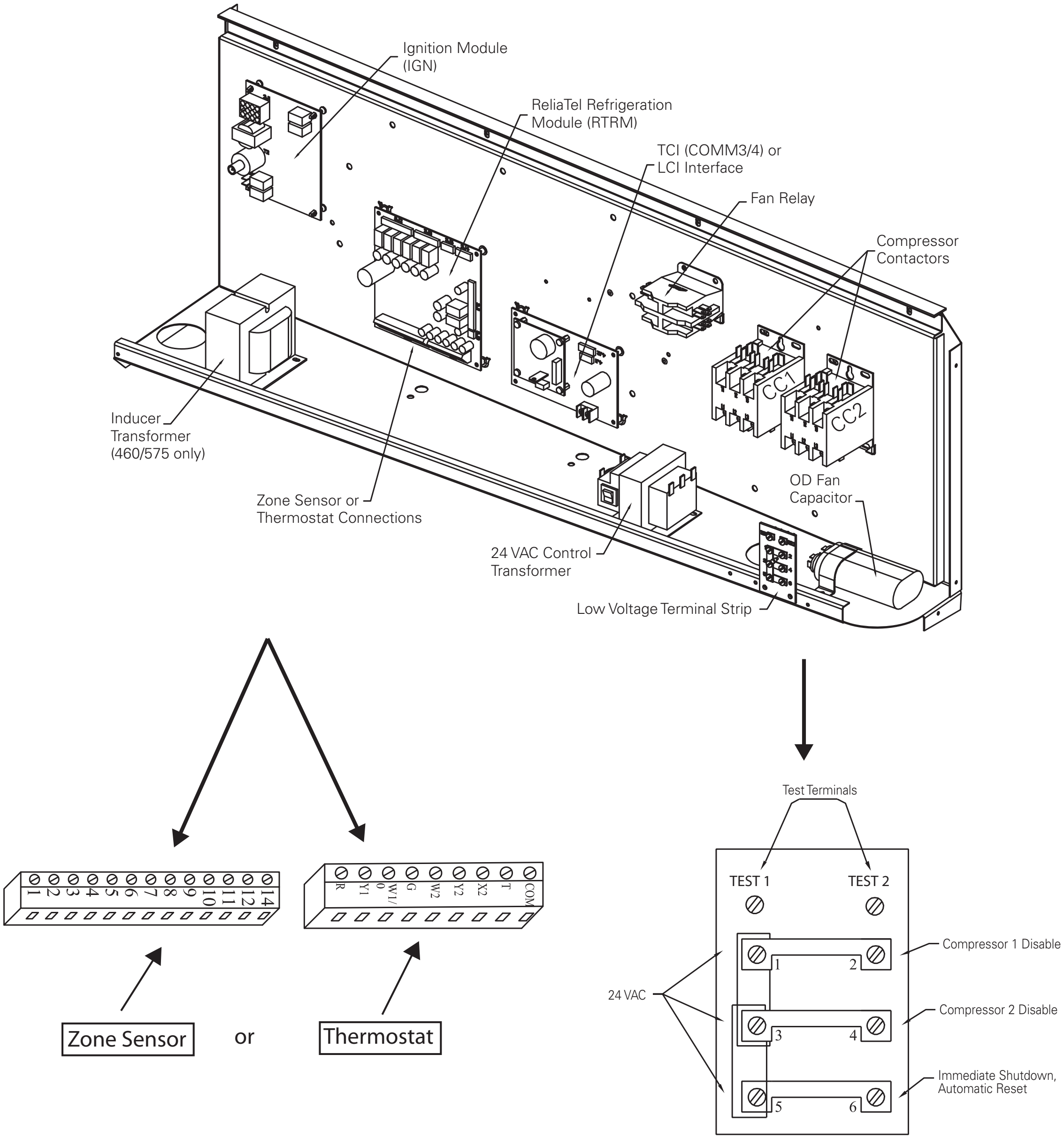


**Figure 14. Typical control box layout (T/YSC120E, T/YHC092-120E, & WSC120E)**

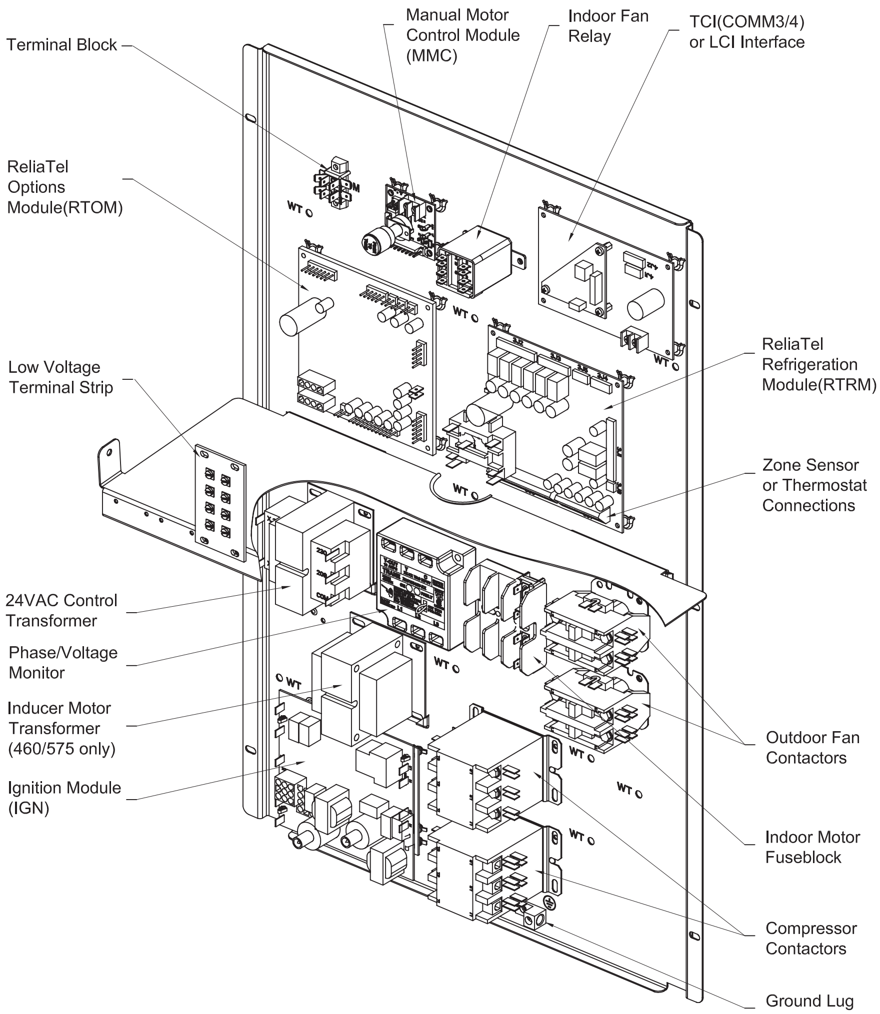
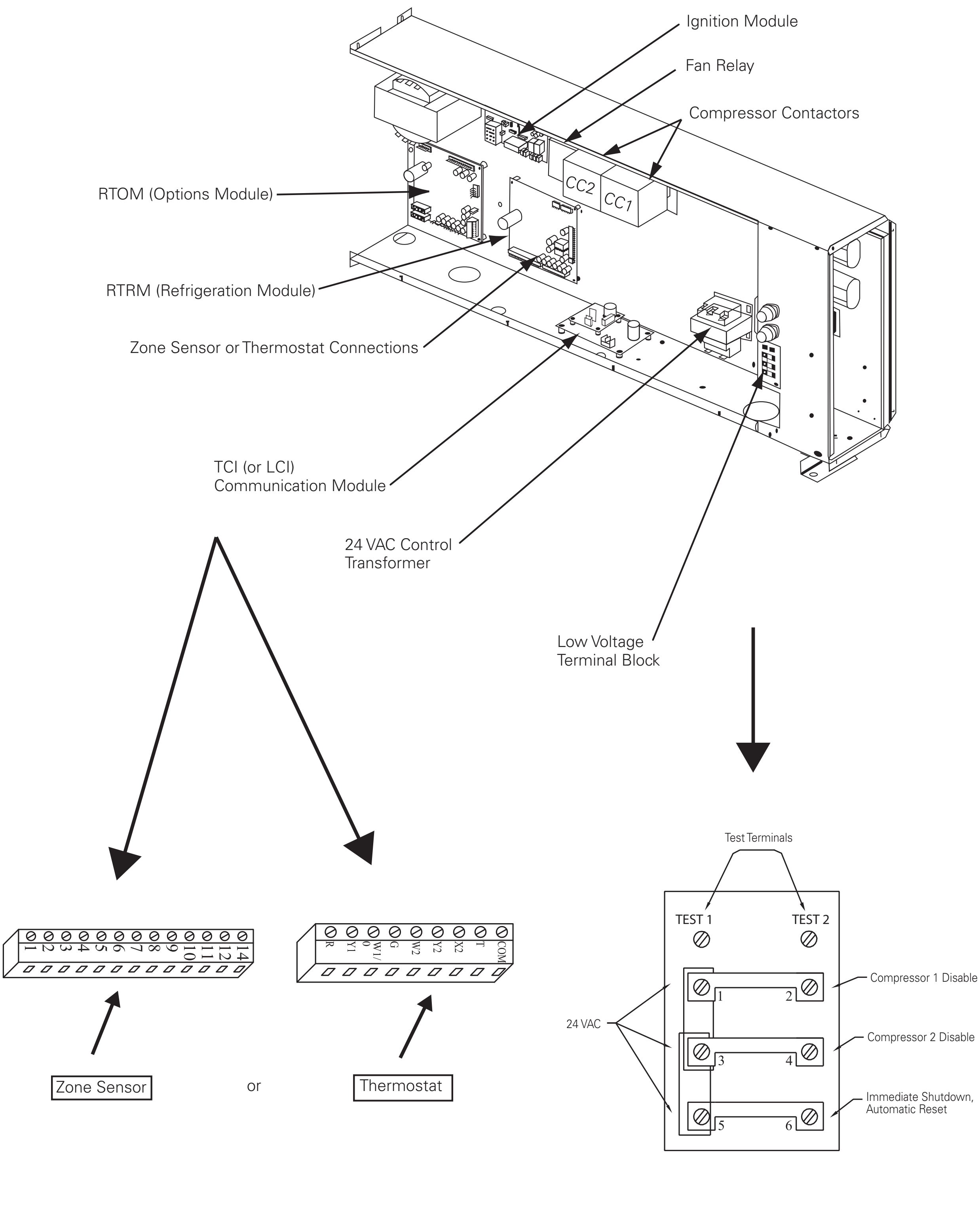
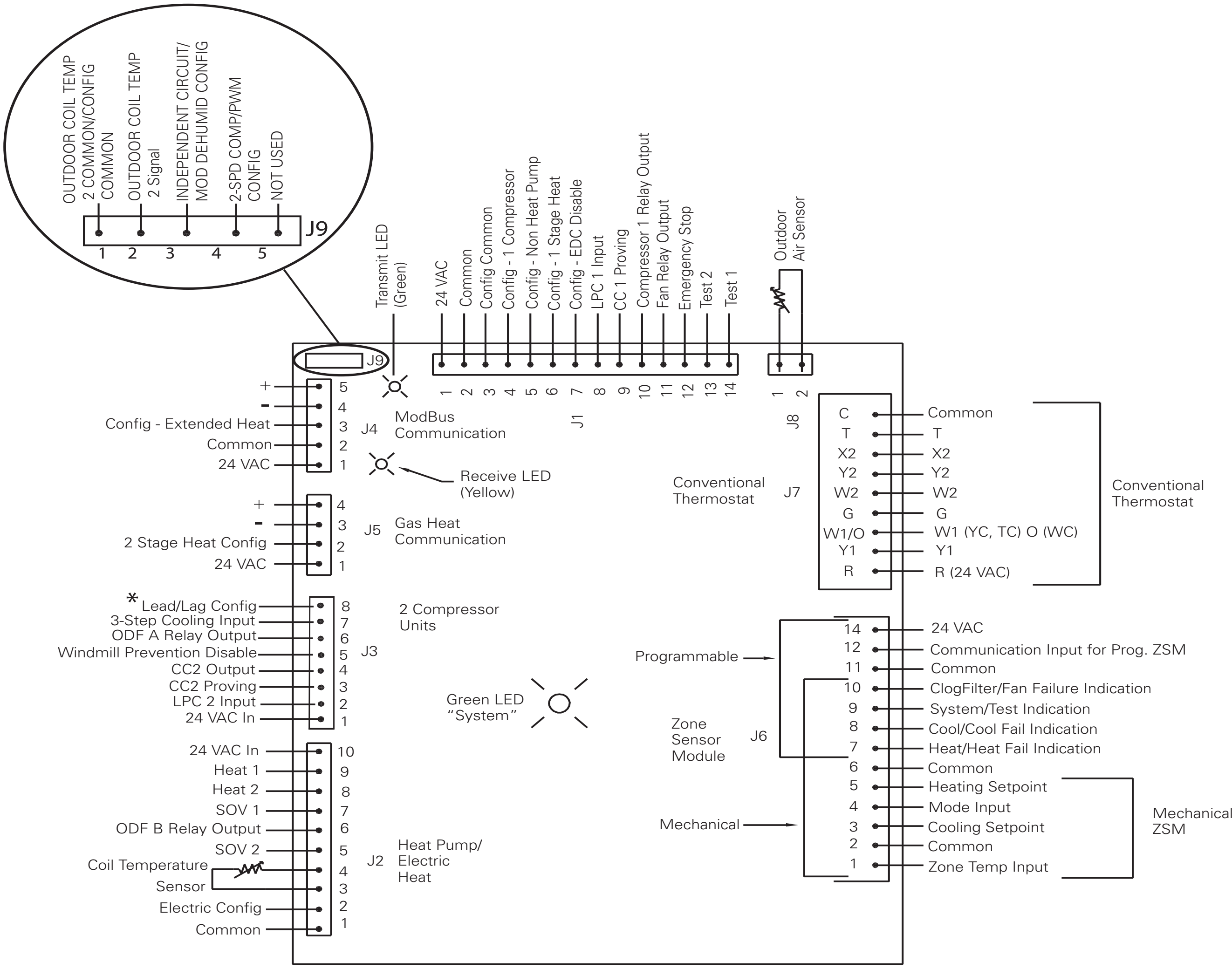


**Figure 15. Typical control box layout (12½-through 25-tons)**



# ReliaTel™ Refrigeration Module (RTRM)

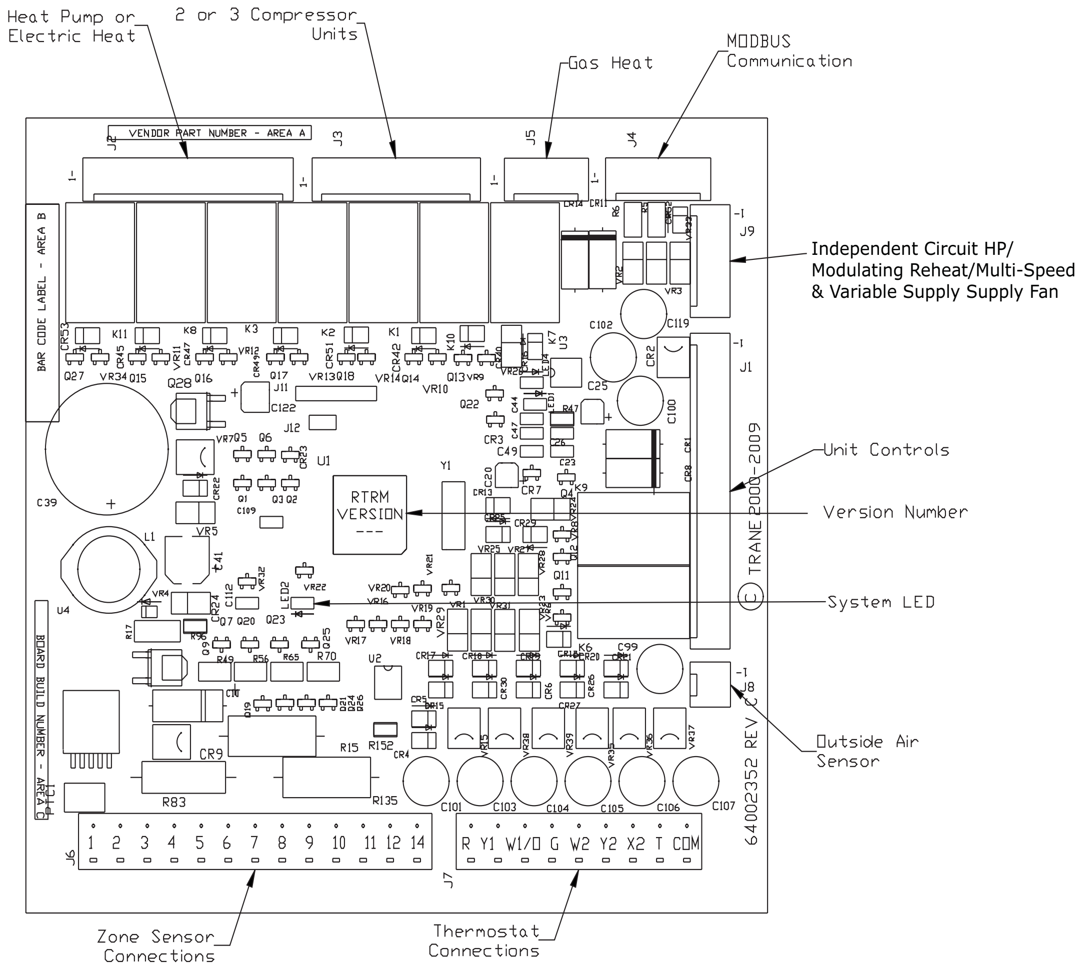
**Figure 16. ReliaTel™ refrigeration module (RTRM) - layout**




| | |
|---|---|
| Green System LED | On - Normal |
| | Off - No Power, Board Failure |
| | Blinking - Test Mode |
| | Two 1/4 Second Blinks Every 2 Seconds Diagnostic Present (Version 4.0+) |
| Green TX LED | Two 1/4 Second Blinks Every 2 Seconds - Diagnostic Present |
| | Off - No Power, Board Failure |
| Yellow RX LED | 1/4 Second Blink Every 2 Seconds - No ModBus Communication |
| | Very Fast Flash .5 Second, Off 1.5 Second - ModBus Communication Occuring |

* To enable lead/lag on multiple compressor units, cut wire connected to J-3-8

**Figure 17. ReliaTel™ refrigeration module (RTRM) - board connections**




# RTRM Diagnostics

***Note:*** *For production, several versions of the RTRM are used depending on unit functions. There is one replacement module for all units.*

## RTRM System LED Diagnostic Indicator

On RTRM version 4.0 or higher, the green system LED on the RTRM module can provide a quick visual indication of the presence of certain diagnostics. If the green LED on the RTRM is blinking with two ¼ second blinks every two seconds, one or more of the following diagnostics is present:

## 3-through 50-Ton Units

Supply fan fail
Zone temperature sensor input failure on CV units
Programmable ZSM communication failure
Manual compressor lockout (one or both circuits)
Outdoor coil temp sensor failure (heat pumps only)
Defrost fault condition (heat pumps only)
Gas heat failure
Discharge Air Temperature Failure on Modulating Heat and Modulating Reheat units
Froststat™ Active
Outdoor Air Temperature Sensor Failure
Smoke Detector Active
Entering Evaporator Temp. Failure (On Modulating Reheat Units)
RTOM Comm. Failure
RTDM Comm. Failure (On Modulating Reheat Units)
RTVM Comm. Failure
Space Pressure Sensor Failure
Dehumidification Mis-Configuration
Reheat Circuit Entering Evaporator Temperature Failure

## 27½-through 50-Ton Units

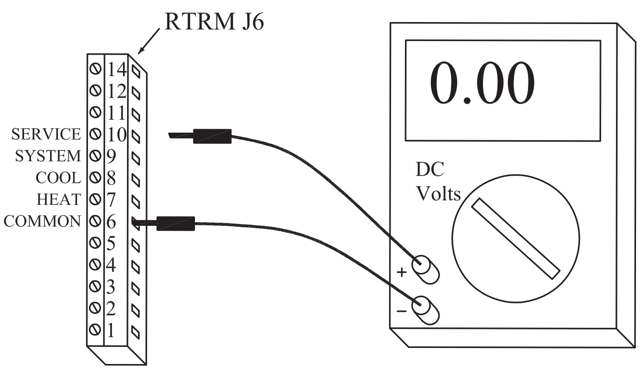
Zone temperature sensor failure during unoccupied mode and on units with Modulating Reheat (VAV only)
Static pressure transducer output failure (VAV only)
High duct static pressure trip (VAV only)
Discharge air sensor failure (VAV only)

If the service technician sees the RTRM fault indication, the next step is to check for diagnostics as indicated on the following pages to help determine which of the above diagnostics is present.

**Note:** *Since Constant Volume (CV) units 3-through 50-ton may use a conventional thermostat, the RTRM will not display a diagnostic if a zone sensor is not attached when power is applied to the unit. Also, the RTRM ignores a zone sensor if it is attached to a powered-up unit (after a brief time-out). Therefore, always reset power after installing a mechanical ZSM such as a BAYSENS006 – 010 to terminals RTRM J6-1 through J6-10.*

The RTRM provides certain diagnostic information to the end user or service technician depending on the type of controls used. Regardless of controls used however, a service technician with a DC voltmeter can read the diagnostics at the RTRM as shown below.

**Note:** *When a voltmeter is first applied, allow 2-3 seconds for the reading to stabilize.The actual readings obtained vary depending on the controls used.*




*The following charts show what readings to expect, as well as what the readings mean.*

**Table 1. Approximate voltage readings (depending on control used)**

| See "What the readings mean" on the following pages. | Thermostat or mechanical ZSM without indicators or with no controls attached at all | Programmable ZSM with indicators | Mechanical ZSM with indicators |
|---|---|---|---|
| **ON** | 32 VDC ± 10% | 26 VDC ± 10% | 2.0 VDC ± 10% |
| **OFF** | 0.75 VDC ± 10% | 0.75 VDC ± 10% | 0.75 VDC ± 10% |
| **PULSING** | 20 to 30 VDC | 1.5 to 2.5 VDC | 14 to 30 VDC |

## What the readings mean

### Service- RTRM-J6-10.

**ON** - Clogged filter switch has been closed for at least 2 minutes, indicating a clogged filter. This example illustrates what would be seen if the unit did not have a zone sensor with indicator LEDs, such as would be the case with an ICS system. Table 1, p. 25 lists voltages seen if a zone sensor is attached. Volt meter readings should be within 10%.

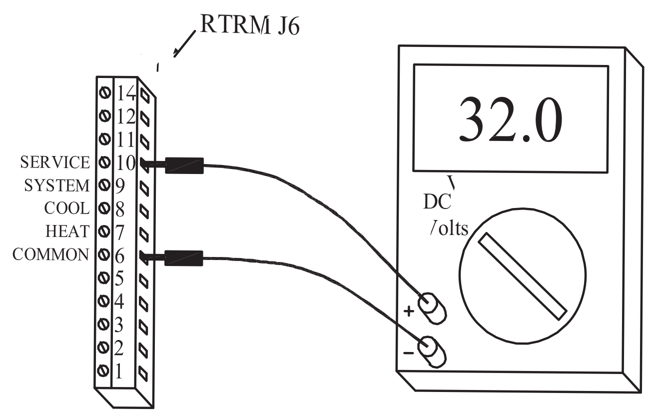
**OFF** -

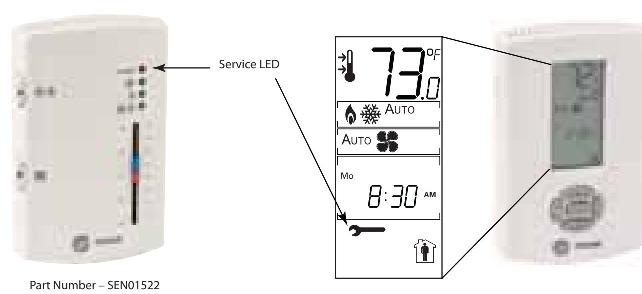
1. Clogged filter switch is in open position or no switch is installed.
2. Fan Fail switch (if installed) has opened (3-25 Ton) or closed (27.5-50 Ton) within the first 40 seconds, proving that the supply fan has started.

**PULSING** -

1. Fan Proving switch (also called Fan Fail Switch FFS) has failed to open (3-through 25-ton) or closed (27.5-through 50-ton) before 40 seconds. During this condition, the unit will run for 40 seconds and then stop. Only the fan will run during the TEST mode, except during the first 40 seconds.
2. Freezestat Active
3. Smoke Detector Active

**Note:** *Note that at the bottom of the meter display, the "analog bar" will pulse back and forth. Some meters do not have this extra feature.*



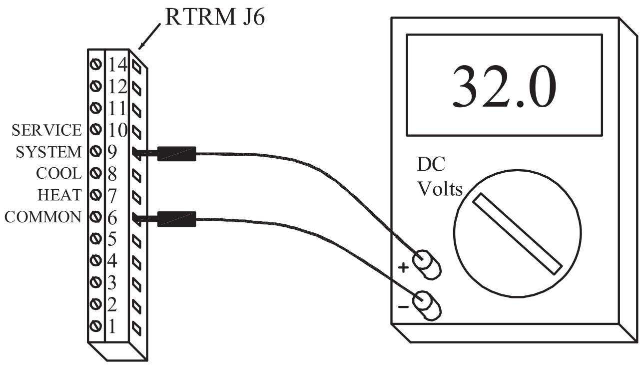

## What the readings mean

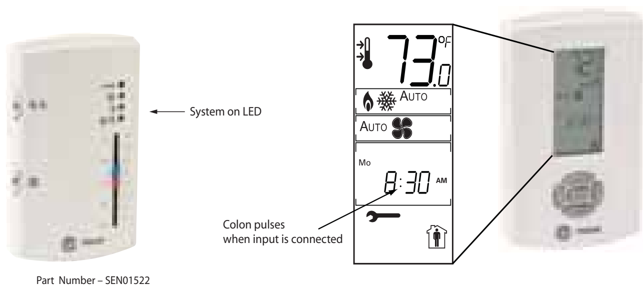
### System- RTRM-J6-9.

**ON** – System is powered up. This output should be on whenever the green RTRM System LED is on. Incidentally, this LED may flicker as part of its normal function on older version boards.

**OFF –** If 0 VDC is seen, the RTRM does not have power, the output wiring is shorted, or there is an internal failure. Remove any wires connected to this terminal and check again.

**PULSING** – Unit is in the TEST mode. Also during the TEST mode the System LED will pulse on and off. This output does not provide any diagnostic information, but is a good place to confirm that voltage readings taken are consistent with what should be seen on other outputs.




## What the readings mean

### Cooling-RTRM-J6-8.

**ON** – System is in the cooling mode and actively cooling. The unit could be economizing or have one or both compressors on. If the unit is a heat pump, the reversing valve is energized as well.

**OFF –** System is not actively cooling. It may or may not be in the cooling mode.

**PULSING –** This indicator can mean one or more of the following:

## Any controls

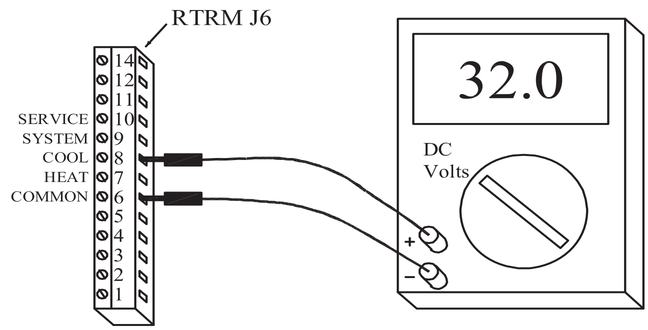
1. CC1 or CC2 opens during cooling, or is open when a call for compressor occurs. The unaffected circuit will still run. With RTRM version 4.0 or greater, CC1 or CC2 circuit must open on 3 consecutive cycles. On the 4th trip, the unit will lockout.
2. CPR1 Disable or CPR 2 Disable input has opened during a compressor cycle each time a compressor starts (within the first 3 minutes) for 3 consecutive cycles. It locks out on the fourth cycle. The unaffected circuit will still run.
3. Supply Air Temperature is invalid and unit is VAV or CV with Modulating Reheat.

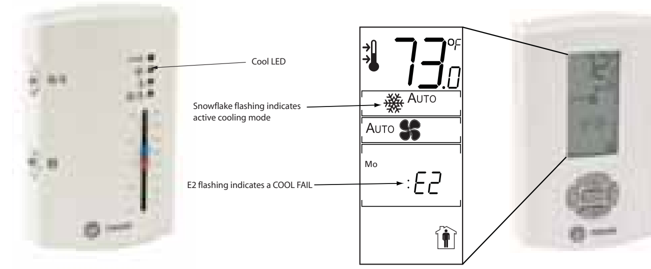
## Mechanical ZSM

1. Zone temperature input failure after a successful input.
2. Both heating and cooling setpoint inputs have failed or are not attached (such as when using a 2 - wire sensor on terminals 1 & 2).

## Programmable ZSM

The ZSM has failed to communicate for 15 consecutive minutes after successful communication has occurred.




## What the readings mean

### Heating-RTRM-J6-7.

**ON** – System is actively heating.

**OFF –** System is not actively heating.

**PULSING** – See below:

## Gas heat

If any failure occurs such as loss of flame, limit switch trip, flame rollout etc, this indication is present. Further diagnostics are available by examining the Ignition Module LED. See the gas heat section for detail.

## Electric heat

These units have safety limit switches in the electric heat control circuit. Should a limit switch trip, no diagnostic will occur. the HEAT indication will stay ON.

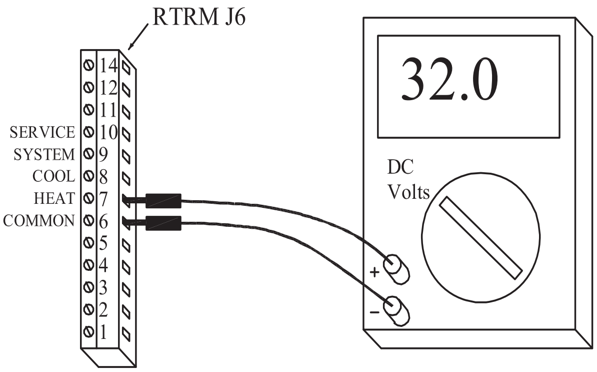
## Heat pump

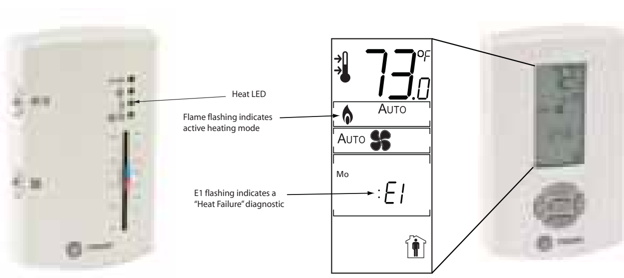
Unit is in the EMERGENCY HEAT mode.

If the Compressor Disable circuit or CC1, CC2 circuits create a lockout during heating mode, a COOL FAIL (pulsing) indication will occur, not a HEAT FAIL (pulsing) indication. See COOL indications for details.

### Any unit

Supply Air Temperature Sensor Failure and Unit is CV with Modulating Heat or Modulating Reheat.

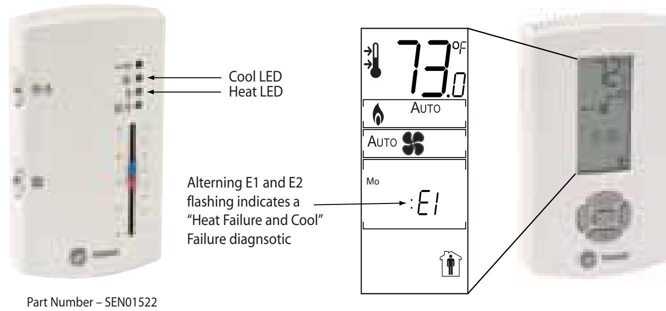



### What the readings mean

**HEAT FAIL and COOL FAIL at the same time, RTRM-J6-7 & 8 pulsing voltage:** 1.

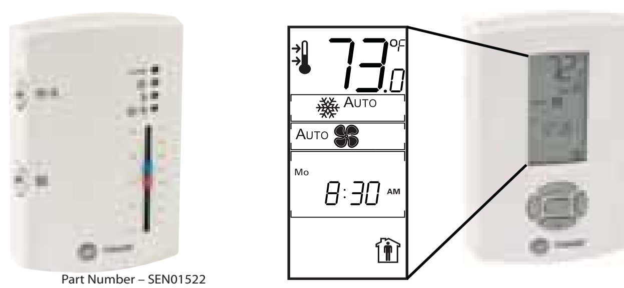
1. Coil temperature sensor is open or shorted. (Heat Pump)
2. Unit has failed to defrost properly. See Heat Pump section for further details.
3. Outdoor air sensor is open or shorted. (RTRM version 4.0 or greater.)
4. Dehumidification unit- RTOM disconnected or not communicating. RTOM will flash once every few seconds.
5. Emergency stop input is open.
6. Factory installed phase monitor is indicating a fault
7. Frostat™ Input Active
8. Smoke Detector Active
9. Entering Evaporator Temp. Failure (On Modulating Reheat Units)
10. RTDM Communication Failure (On Modulating Reheat Units)




### Compressor will not run, no diagnostics:

1. Frostat™ trip (RTRM v8.0 and later will exhibit diagnostics as described above).
2. Compressor disable input open.
3. Unit is economizing, and outside air damper is not yet at 100%.
4. Unit is in heat mode or off mode.
5. Tracer™ or building management system is preventing compressor operation (demand limit).

### Supply fan OFF, no diagnostic




Unit is in OFF mode locally or through TCI/LCI

### Heat Pump- Compressors will not run

1. Unit is in the EMERGENCY HEAT mode.
2. If the Compressor Disable circuit or CC1, CC2 circuits create a lockout during heating mode, a COOL FAIL (pulsing) indication will occur, not a HEAT FAIL (pulsing) indication. See COOL indications for details.

## 27½-through 50-Ton Unit Additional Diagnostics (VAV only)

If only one diagnostic is present, refer to that diagnostic. If more than one diagnostic is present, refer to combination diagnostics such as COOL + HEAT as appropriate. On a BAYSENS020*, the display will show HEAT FAIL or COOL FAIL or SERVICE (or an appropriate combination) if a diagnostic is present.

### HEAT (YC only)

1. TCO1, TCO2, or TCO3 has opened.
2. IGN Module lockout (see gas heat section for troubleshooting).
3. Supply Air Temperature sensor has failed if configured for Modulating Heat.

### COOL

1. Discharge air sensor (DTS) is open, shorted, or has failed.
2. Zone temp input (RTRM J6-1) is open, shorted, or failed during an unoccupied mode. If the unit has a default mode input (jumper from RTRM J6-2 to RTRM J6-4, a valid zone temp input is needed for unoccupied heating, MWU and DWU.
3. CC1 or CC2 24 VAC control circuit has opened 3 times during a cooling mode. Check CC1, CC2 coils or any control in series with the coils (winding thermostat, HPC, circuit breaker auxiliary contacts).
4. LPC 1 or LPC 2 has opened during the 3 minute minimum “on” time during 4 consecutive compressor starts. Check LPC 1 circuit by measuring voltage from RTRM J1-8 to chassis ground. Check LPC 2 circuit by measuring voltage from RTRM J3-2 to chassis ground. If 24 VAC is not present, the circuit is open. 24 VAC should present at these terminals at all times.

### SERVICE

The supply fan proving switch (FFS) has failed to open within 40 seconds after the fan starts or has closed during fan operation.

### COOL + SERVICE

1. Static Pressure Transducer output voltage at RTAM J1-3 is less than 0.25VDC. The transducer output is open, shorted, or the transducer is reading a negative supply air pressure.

### HEAT + COOL

1. The Emergency Stop input (TB1-5 and TB1-6) is open. Check this input at the RTRM by measuring voltage from RTRM J1-12 to chassis ground. 24 VAC should be present whenever the Emergency Stop input is closed.
2. Outdoor air sensor (OAS) input is open, shorted, or has failed.

### HEAT + COOL + SERVICE

1. Static Pressure High Duct Static Trip. The static pressure has exceeded 3.5" W.C. three consecutive times.
2. Ground wire on transducer is open.

### LonTalk® Communication Interface (LCI)

1. When an LCI (LonTalk® Communication Interface) is installed on a Voyager™ Commercial VAV unit, the morning Warmup (MWU) setpoint located on the RTAM board is ignored. The Morning Warmup and Daytime Warmup setpoints come from the higher priority LCI-R DAC.
2. The MWU terminate setpoint is identified as NCI (Network Configuration Input) nciSetpoints.occupied heat. The default setpoint is 71F.
3. The MWU initiate setpoint is nciSetpoints.occupied heat - 1.5F.

## Default Operations

The ReliaTel Refrigeration Module (RTRM) can accept input from any of the following:

Mechanical Zone Sensor Module (ZSM) BAYSENS106-111A, AYSTAT106A-109A.

Programmable Zone Sensor BAYSENS119*, AYSTAT666*Conventional thermostat BAYSTAT036-038A (or similar).

ICS systems – Tracer™ , Tracker™ , VariTrac™

With each installed device, default modes of operation come into play, depending on that device’s inputs. Following is a summary of functions and defaults.

**Table 2. Default operation for mechanical ZSM (CV only):**

| J6 Input/connection | if no input/connection this happens: |
|---|---|
| J6-1- Zone Temperature | Unit stops |
| J6-2 Common terminal for 1-5 | Unit stops |
| J6-3 Cooling Set Point (CSP) | HSP + 3F if Local Unit Mode is Auto, otherwise Local HSP |
| J6-5*- Heating Set Point (HSP) | Local CSP - 3F if Local Unit Mode is Auto, otherwise, Local CSP |
| J6-3&5- No CSP or HSP from ZSM | 74F CSP, 71F HSP |
| J6-4- Mode Input from ZSM | Auto Changeover with continuous fan |
| J6-6*- Common terminal for 7-10 | LED’s will not function any time |
| J6-7*- Heat indication | LED will not come on while heating<br>LED will not flash during heat fail |
| J6-8*-Cool indication | LED will not come on while cooling<br>LED will not flash during cool fail* |
| J6-9*- System indication | LED will not come on while unit has power |
| J6-10*- Service indication | LED will not come on when CFS or FFS trips |

*these connections are only on certain model ZSMs

**Table 3. Default operation for programmable ZSM:**

| J6 Input/connection | if no input/connection this happens: |
|---|---|
| J6-7- Heat indication from RTRM to ZSM | "Heat" will not be displayed while heating<br>"Heat fail" will not be displayed during heat fail |
| J6-8- Cool indication from RTRM to ZSM | "Cool" will not be displayed while cooling<br>"Cool fail" will not be displayed during cool fail* |
| J6-9- System indication from RTRM to ZSM | Colon (:) will not blink during normal operation<br>"Test" will not be displayed during TEST mode |
| J6-10- Service indication from RTRM to ZSM | "Service" will not be displayed when clogged filter switch has tripped<br>"Service" will not flash when the FFS has tripped |
| J6-11- Common | No display, no communication |
| J6-12- Communication | No communication- "Cool fail" indication |
| J6-14-24 VAC power | No display, no communication |

*cool fail indication can occur for several reasons. See diagnostic section for more on this.

***Note:** Version 1.1 and 1.3 RTRM do not provide Heat, Cool, Service, Cool Fail, Heat Fail indications for Programmable ZSM. Later versions (with a higher number) do.*

COMM3/4 and COMM5 Communication Interface Module use MODBUS communication directly with the RTRM. Tracker and Tracer™ require inputs as shown:

**Table 4. Default operation for ICS control:**

| J6 input/connection | if no input this happens: |
|---|---|
| J6-1- Zone temperature | Unit stops unless Tracer™ is providing zone temperature input (CV units) |
| J6-2- Common terminal for J6-1, J6-3, J6-4, J6-5 | Unit stops unless Tracer™ is providing zone temperature input (CV units) or mode input (VAV units). |
| J6-4 Mode input (VAV units) | Unit stops unless Tracer™ is providing a Mode input. |

***Note:** VariTrac™ does not require any input to J6*

**Table 5. Conventional ZSM thermostat-default operation**

| Input/connection | if no input, this happens: |
|---|---|
| G (Indoor fan)<br>The purpose of G is to provide a way to run the fan continuously | A heat or cool call will also enable the fan. |

See section on Conventional Thermostat Operation for more on this.

**Table 6. 27½-through 50-Ton VAV units**

| Input/connection (27½-through 50ton VAV only)- | If no input, this happens: |
|---|---|
| Default mode input jumper J6-2 to J6-4. | Without a mode input, the unit will not run. |
| Zone temperature input J6-2 to J6-1 | Unoccupied mode (short J6-11 to J6-12).<br>Gives cool fail diagnostic. |

# ReliaTel™ Option Module (RTOM)

## RTOM Layout

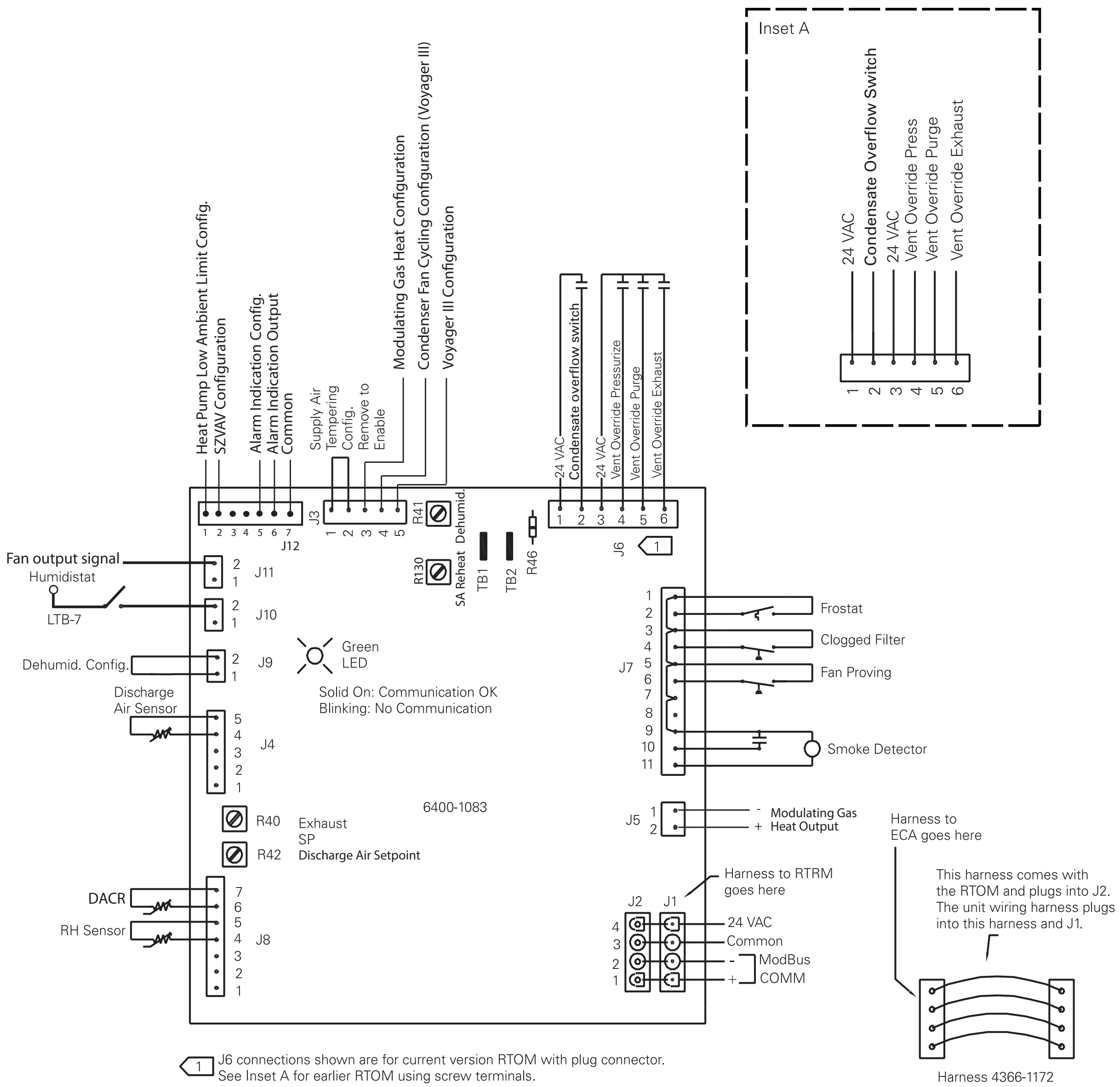
### 3-through 10-Ton

The RTOM is installed in the indoor fan section. When field installed, it comes with a short harness which allows both ends of the unit control harness to be attached.

### 12½-through 50-Ton

The RTOM is installed in the control panel.

**Figure 18. ReliaTel™ option module (RTOM) layout**



# RTOM Inputs

## J1, J2 Inputs:

J1 provides 24VAC power and MODBUS communication to and from the RTRM (via the COMM module if used). J2 sends power and communication to the ECA (if used).

## J3 Inputs:

J3-1 to J3-2 – Allows supply air tempering when using a mechanical ZSM. Removed = supply air tempering enabled, installed = disabled. Supply air tempering can also be enabled or disabled by using the BAYSENS119* or a Trane® ICS system.

J3-3 is modulating gas heat config. input

J3-4 is used with 27.5 - 50 ton units to configure condenser fan control type.

J3-5 is used to configure the unit as a Voyager™ Commercial unit. (27½-through 50-ton units only).

## J4 Inputs:

**Discharge air sensor** (10K @ 77°F/25°C) allows supply air tempering, also discharge air information for Building Automation systems (BAS) using COMM5 such as Tracer Summit™ V13 and Tracker™ Version 10. Earlier versions of Tracker™ (V6.5 and below) and any Tracer system using COMM3 or COMM4 do not recognize this input.

The input seen by Tracer™ (using COMM3 or COMM4) and Tracker™ (prior to Version 10) is "Supply Air Temperature", which is actually the Mixed Air Temperature input from the ECA to the RTRM. The other inputs on J4 are not used.

## J5 Output:

J5 is the 2-10 VDC output used when the unit has modulating gas heat.

## J6 Inputs:

**Ventilation override inputs** J6-1, 2, 3 are explained in the application section of this manual.

**Remote shutdown** – when this input is open, the unit runs normally. When closed, the unit shuts down after minimum run times are met, up to 4 minutes. This is not the same as the emergency stop inputs on LTB 5&6.

### J7 Inputs:

**Frostat™:**

| | |
|---|---|
| 3-through 25 -ton | Closes 10F ±2º<br>Opens 50F ±2º |
| 27½-through 50-ton | Closes 30F ±2º<br>Opens 40F ±2º |

When the Frostat™ opens, the compressors will re-start. There is no diagnostic during Frostat trip.

**Clogged filter switch** is factory set to close at 0.45", however is adjustable from 0.05" to 12.0". A 7/32" allen wrench is required for this adjustment. When the switch is closed for 2 minutes, the service indicator on the ZSM will be on (see diagnostics section for details). When the switch opens, the indicator is off (auto reset).

**Fan proving switch (3-through 25-tons)** is factory set to open at 0.07", and is adjustable from 0.05" to 12.0", though adjustment is not recommended. If the switch does not open within 40 seconds after the fan starts, the unit stops, requiring manual reset from the Zone Sensor or BAS system, or by resetting power to the unit. The SERVICE indicator on the ZSM will pulse during fan fail mode.

**Fan proving switch (27½-through 50-tons)** is factory set to close at 0.15", and is adjustable from 0.05" to 12.0", though adjustment is not recommended. If the switch does not close within 40 seconds after the fan starts, the unit stops, requiring manual reset from the Zone Sensor or BAS system, or by resetting power to the unit. The SERVICE indicator on the ZSM will pulse during fan fail mode.

**Smoke detector** contacts are open during normal operation. When closed, the unit shuts down immediately. When the contacts are re-opened, the unit will automatically restart.

***Note:*** *Ventilation override option will override smoke detector input through the RTOM.*

## J8 Input:

**DACR potentiometer** for SZVAV use or configuration jumper for multi speed use

**Relative humidity sensor** provides input to reheat for dehumidification.

## J9 Input:

**Reheat enable input** provides a binary input to configure the unit for reheat.

## J10 Input:

**Humidistat** provides binary input to energize the reheat valve for dehumidification. When the humidistat is satisfied, the reheat valve is de-energized (3-through 25-ton units only).

## J11 Output:

**Fan control output** for Multi-speed and SZVAV

## J12 Input:

**Heat pump low ambient limit config** provides a configuration input to disable compressor heating on heat pumps when the outdoor temperature falls below 1.4°F. Compressor Heating is re-enabled when the Outdoor Temperature rises to 3.5°F.

**Alarm Indication config** provides a configuration input to determine which diagnostics will energize the Alarm Indication output. If Open, the Alarm Indication output will energize whenever the RTRM System LED is blinking a 2-blink error code. If Closed to common, the Alarm Indication output will energize whenever any key system component is locked out (Cooling, Heating, etc.)

**Alarm indication output** provides a 24vac output when the system is in an alarm condition as determined by the Alarm Indication config.

## Setpoint Potentiometers

**Exhaust setpoint potentiometer** sets the point to which the exhaust fan will come on. It can be set from 0% (exhaust is always on unless overridden off) to 100% (exhaust fan comes on when economizer is 100% outside air). Turn clockwise to increase setpoint.

**Discharge air heat setpoint potentiometer** sets the Discharge Air Heat Setpoint on units configured with Modulating Gas Heat under thermostat control.

**SA reheat setpoint potentiometer -** For 27½-through 50-ton Voyager™ Commercial units, used to set the Supply Air Reheat setpoint for units with Modulating Dehumidification.

**Dehumid. setpoint -** For units with reheat (On/Off and Modulating) installed, used to set the space humidity setpoint used for dehumidification control.

**DA COOL-FAN SPD** potentiometer sets the fan speed on some Precedent™ and Odyssey™ products. It also sets the discharge air cooling setpoint limit on Voyager™ units.

***Note:*** *For RTOM v3.0 and later, test point "hooks" are included on the module next to each setpoint potentiometer to allow a more accurate setup. Connect a DC volt meter to the test point and ground to verify the setpoint desired according to the tables below:*

**Table 7. RTOM discharge air heat setpoint**

| Voltage (Vdc) | Setpoint (ºF) |
|---|---|
| 0.00 | 50 |
| 0.09 | 51 |
| 0.13 | 52 |
| 0.16 | 53 |
| 0.20 | 54 |
| 0.24 | 55 |
| 0.28 | 56 |
| 0.31 | 57 |
| 0.35 | 58 |
| 0.39 | 59 |
| 0.42 | 60 |
| 0.46 | 61 |
| 0.50 | 62 |
| 0.53 | 63 |
| 0.57 | 64 |
| 0.61 | 65 |
| 0.65 | 66 |
| 0.68 | 67 |
| 0.72 | 68 |
| 0.76 | 69 |
| 0.79 | 70 |
| 0.83 | 71 |
| 0.87 | 72 |
| 0.90 | 73 |
| 0.94 | 74 |
| 0.98 | 75 |
| 1.00 | 76 |
| 1.03 | 77 |
| 1.06 | 78 |
| 1.08 | 79 |
| 1.11 | 80 |
| 1.13 | 81 |
| 1.16 | 82 |
| 1.46 | 94 |
| 1.48 | 95 |
| 1.51 | 96 |
| 1.53 | 97 |
| 1.56 | 98 |
| 1.58 | 99 |
| 1.61 | 100 |
| 1.63 | 101 |
| 1.66 | 102 |
| 1.69 | 103 |
| 1.71 | 104 |
| 1.72 | 105 |
| 1.74 | 106 |
| 1.76 | 107 |
| 1.78 | 108 |
| 1.79 | 109 |
| 1.81 | 110 |
| 1.83 | 111 |
| 1.84 | 112 |
| 1.86 | 113 |
| 1.88 | 114 |
| 1.89 | 115 |
| 1.91 | 116 |
| 1.93 | 117 |
| 1.95 | 118 |
| 1.96 | 119 |
| 1.98 | 120 |
| 2.00 | 121 |
| 2.01 | 122 |
| 2.03 | 123 |
| 2.05 | 124 |
| 2.06 | 125 |
| 2.08 | 126 |
| 2.23 | 138 |
| 2.24 | 139 |
| 2.25 | 140 |
| 2.26 | 141 |
| 2.28 | 142 |
| 2.29 | 143 |
| 2.30 | 144 |
| 2.32 | 145 |
| 2.33 | 146 |
| 2.34 | 147 |
| 2.36 | 148 |
| 2.37 | 149 |
| 2.40 | 150 |

**Table 7. RTOM discharge air heat setpoint (continued)**

| Voltage (Vdc) | Setpoint (ºF) | Voltage (Vdc) | Setpoint (ºF) | Voltage (Vdc) | Setpoint (ºF) |
|---|---|---|---|---|---|
| 1.18 | 83 | 2.09 | 127 | | |
| 1.21 | 84 | 2.11 | 128 | | |
| 1.23 | 85 | 2.12 | 129 | | |
| 1.26 | 86 | 2.13 | 130 | | |
| 1.28 | 87 | 2.13 | 131 | | |
| 1.31 | 88 | 2.14 | 132 | | |
| 1.33 | 89 | 2.16 | 133 | | |
| 1.36 | 90 | 2.17 | 134 | | |
| 1.38 | 91 | 2.19 | 135 | | |
| 1.41 | 92 | 2.20 | 136 | | |
| 1.43 | 93 | 2.21 | 137 | | |

**Table 8. RTOM supply air reheat setpoint**

| Voltage (Vdc) | Setpoint (ºF) | Voltage (Vdc) | Setpoint (ºF) |
|---|---|---|---|
| 0.002 | 65 | 1.683 | 73 |
| 0.169 | 65.5 | 1.766 | 73.5 |
| 0.317 | 66 | 1.822 | 74 |
| 0.395 | 66.5 | 1.887 | 74.5 |
| 0.552 | 67 | 1.940 | 75 |
| 0.672 | 67.5 | 1.998 | 75.5 |
| 0.785 | 68 | 2.064 | 76 |
| 0.915 | 68.5 | 2.118 | 76.5 |
| 1.028 | 69 | 2.175 | 77 |
| 1.114 | 69.5 | 2.196 | 77.5 |
| 1.206 | 70 | 2.234 | 78 |
| 1.275 | 70.5 | 2.275 | 78.5 |
| 1.365 | 71 | 2.318 | 79 |
| 1.445 | 71.5 | 2.368 | 79.5 |
| 1.525 | 72 | 2.415 | 80 |
| 1.610 | 72.5 | | |

**Table 9. RTOM dehumidification setpoint**

| Voltage (Vdc) | Setpoint (%) | Voltage (Vdc) | Setpoint (%) |
|---|---|---|---|
| 0.002 | 40 | 1.745 | 53 |
| 0.238 | 41 | 1.824 | 54 |
| 0.445 | 42 | 1.853 | 55 |
| 0.539 | 43 | 1.929 | 56 |
| 0.677 | 44 | 1.978 | 57 |
| 0.811 | 45 | 2.07 | 58 |
| 0.984 | 46 | 2.136 | 59 |
| 1.117 | 47 | 2.184 | 60 |
| 1.245 | 48 | 2.259 | 61 |
| 1.349 | 49 | 2.268 | 62 |
| 1.428 | 50 | 2.324 | 63 |
| 1.552 | 51 | 2.397 | 64 |
| 1.625 | 52 | 2.448 | 65 |

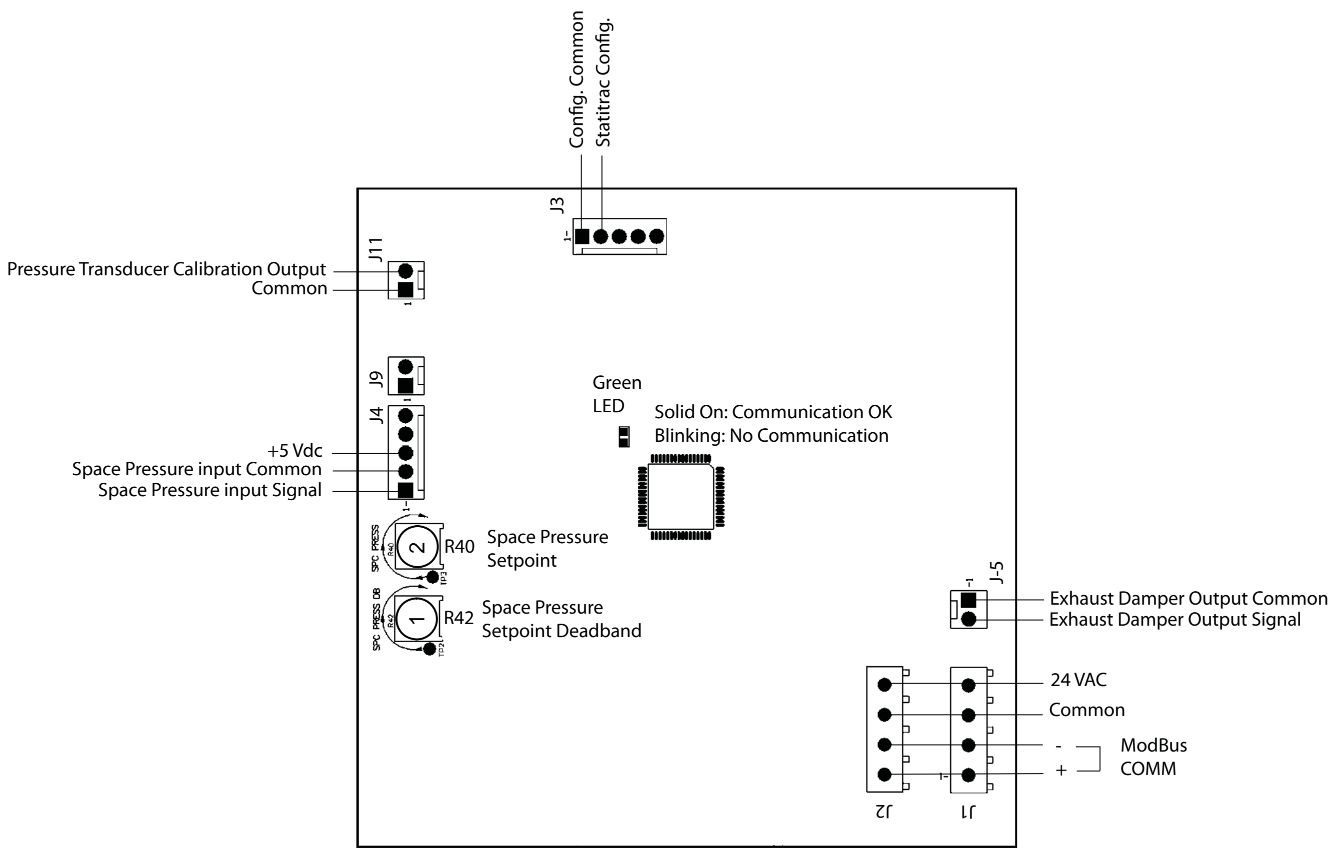
# ReliaTel™ Ventilation Module (RTVM)

## RTVM Layout

### 27½-through 50-Ton

The RTVM is installed in the economizer section for Voyager™ Commercial units with Statitrac™.

**Figure 19. ReliaTel™ ventilation module (RTVM) layout**




## RTVM Inputs

### J1, J2 Inputs:

J1 provides 24VAC power in to the board and MODBUS communication to and from the RTRM. J2 provides 24VAC power and MODBUS communication downstream to the ECA.

### J3 Inputs:

J3 - 1, 2 inputs allow configuration for Statitrac™ Control. If closed, the unit is configured for Statitrac™ control.

### J4 Inputs:

J4 - 3, 4, 5 provide 5Vdc to the Space Pressure Transducer, an input for the space pressure signal to the control board, and a common for the transducer.

### J5 Output

J5 - 1, 2 provides a 2-10Vdc output signal and common to the exhaust damper actuator.

### J11 Output

J11 - 1, 2 provides a 23Vdc output and common for Space Pressure Transducer calibration. This output is energized once every 60 seconds.

## Setpoint Potentiometers

**Space Pressure Setpoint** (R40) potentiometer provides a space pressure setpoint for Statitrac™ Control. The range is -0.20iwc to 0.30iwc. Default is 0.08iwc.

**Space Pressure Setpoint Deadband** (R42) potentiometer provides a selectable deadband for the space pressure setpoint control. The range is 0.02iwc to 0.20iwc. Default is 0.04iwc.

For RTVM v3.0 and later, test point "hooks" are included on the module next to each setpoint potentiometer to allow a more accurate setup. Connect a DC volt meter to the test point and ground to verify the desired setpoint according to the tables below:

**Table 10. RTVM space pressure setpoint**

| Voltage (Vdc) | Setpoint (IWC) |
|---|---|
| 0.04 | -0.2 |
| 0.118 | -0.19 |
| 0.196 | -0.18 |
| 0.274 | -0.17 |
| 0.352 | -0.16 |
| 0.43 | -0.15 |
| 0.508 | -0.14 |
| 0.586 | -0.13 |
| 0.664 | -0.12 |
| 0.742 | -0.11 |
| 0.82 | -0.1 |
| 0.898 | -0.09 |
| 0.976 | -0.08 |
| 1.02 | -0.07 |
| 1.08 | -0.06 |
| 1.129 | -0.05 |
| 1.178 | -0.04 |

| Voltage (Vdc) | Setpoint (IWC) |
|---|---|
| 1.227 | -0.03 |
| 1.276 | -0.02 |
| 1.325 | -0.01 |
| 1.374 | 0 |
| 1.423 | 0.01 |
| 1.472 | 0.02 |
| 1.521 | 0.03 |
| 1.57 | 0.04 |
| 1.619 | 0.05 |
| 1.668 | 0.06 |
| 1.72 | 0.07 |
| 1.759 | 0.08 |
| 1.798 | 0.09 |
| 1.82 | 0.1 |
| 1.8565 | 0.11 |
| 1.893 | 0.12 |
| 1.9295 | 0.13 |

| Voltage (Vdc) | Setpoint (IWC) |
|---|---|
| 1.966 | 0.14 |
| 2.0025 | 0.15 |
| 2.039 | 0.16 |
| 2.0755 | 0.17 |
| 2.112 | 0.18 |
| 2.1485 | 0.19 |
| 2.15 | 0.2 |
| 2.17 | 0.21 |
| 2.19 | 0.22 |
| 2.22 | 0.23 |
| 2.25 | 0.24 |
| 2.275 | 0.25 |
| 2.3 | 0.26 |
| 2.325 | 0.27 |
| 2.35 | 0.28 |
| 2.375 | 0.29 |
| 2.42 | 0.3 |

**Table 11. RTVM space pressure setpoint deadband**

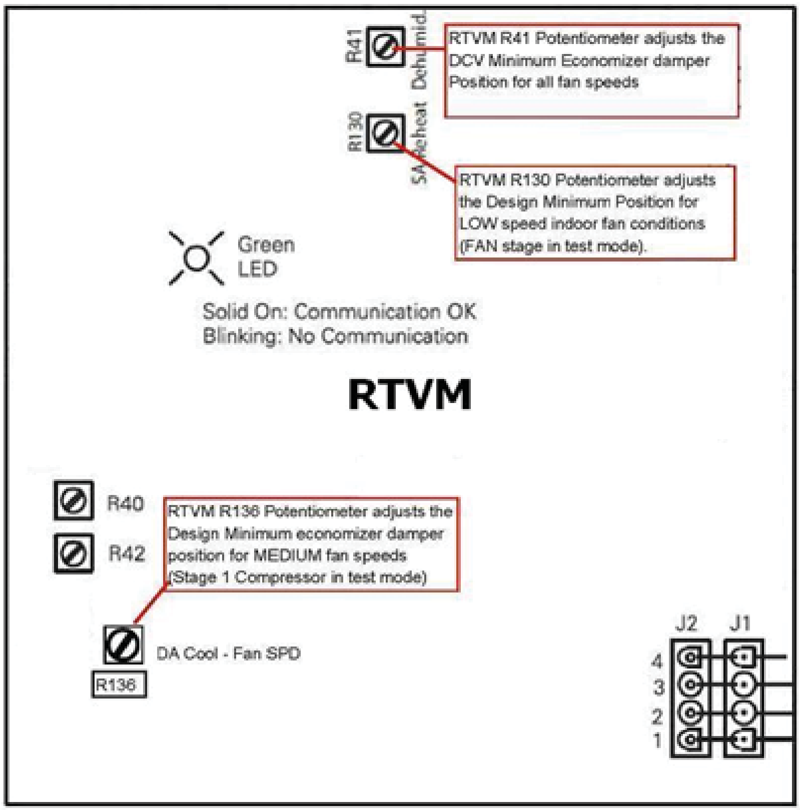
| Voltage (Vdc) | Setpoint (IWC) |
|---|---|
| 0.2 | 0.02 |
| 0.35 | 0.03 |
| 0.53 | 0.04 |
| 0.71 | 0.05 |
| 0.91 | 0.06 |
| 1.1 | 0.07 |
| 1.235 | 0.08 |
| 1.37 | 0.09 |
| 1.505 | 0.1 |
| 1.65 | 0.11 |
| 1.75 | 0.12 |

| Voltage (Vdc) | Setpoint (IWC) |
|---|---|
| 1.85 | 0.13 |
| 1.95 | 0.14 |
| 2.05 | 0.15 |
| 2.13 | 0.16 |
| 2.21 | 0.17 |
| 2.28 | 0.18 |
| 2.35 | 0.19 |
| 2.42 | 0.2 |

# Light Commercial RTVM

The Light Commercial RTVM is used with 17 Plus, Multispeed evaporator fan and SZVAV units with Demand Controlled Ventilation (DCV/$CO_2$).

**Figure 20. ReliaTel™ ventilation module (RTVM) layout**




BAYRTVM001AA KIT for Voyager™ 12½-through 25-ton.

BAYCO2K101A / ASYSTAT721A 17 Plus, Multi-speed and SZVAV Precedent™ (Wall Mount)

BAYCO2K103A / ASYSTAT721A 17 Plus, Multi-speed and SZVAV Precedent™ (Duct Mount)

## Light Commercial RTVM Inputs

### J1 Inputs:

J1 provides 24 VAC power and MODBUS communication to the RTVM from the RTRM.

J2 provides 24 VAC power and MODBUS communication from the RTVM to other optional circuit boards.

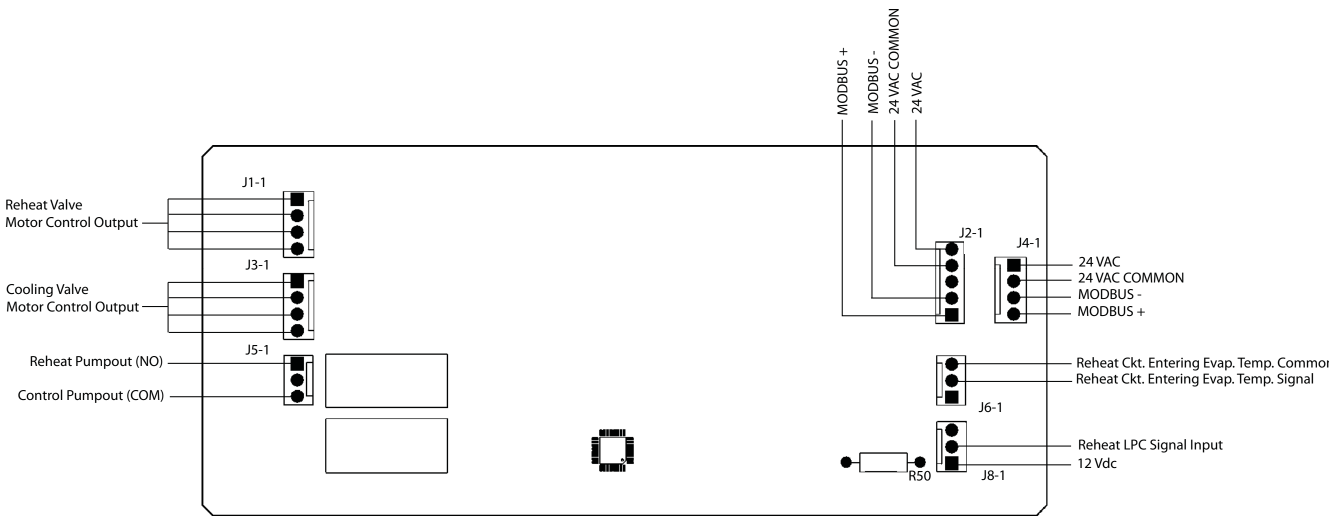
# ReliaTel™ Dehumidification Module (RTDM)

## RTDM Layout

### 27½-through 50-Ton

The RTDM is installed in the control box section for Voyager™ Commercial units with Modulating Dehumidification.

**Figure 21. ReliaTel™ dehumidification module (RTDM) layout**




## RTDM Inputs

### J4, J2 Inputs:

J4 provides 24VAC power in to the board and MODBUS communication to and from the RTRM. J2 provides 24VAC power and MODBUS communication to the RTOM.

### J6 Inputs:

J6 - 2, 3 provides a temperature input for the Reheat Circuit Entering Evaporator Temperature.

### J8 Inputs:

J8 - 1, 2 provide 12Vdc to the Reheat LPC switch and an input for the Reheat LPC Signal.

### J5 Output

J5 - 1, 3 provides a normally open contact to be used for Reheat Pumpout solenoid control.

### J1 Output

J1 - 1, 2, 3, 4 provides the output signals for the Reheat Valve stepper motor control.

### J3 Output

J3 - 1, 2, 3, 4 provides the output signals for the Cooling Valve stepper motor control.

# Voyager™, Precedent™ and Odyssey™ — Single Zone VAV, Multi-Speed and 17 Plus Features and Operation

Single Zone Variable Air Volume (SZVAV) and Multi-Speed evaporator fan operation was developed to meet ASHRAE 90.1 and California Title 24 Requirements. Both SZVAV and Multi-Speed units reduce energy consumption by decreasing the indoor fan speed and reducing the compressor cooling stage during part load conditions. Efficiency at full load may not be affected but part load efficiency and energy savings is increased.

Single Zone Variable Air Volume (SZVAV) units must have ZSM or ICS controls, and will not operate correctly with 24 VAC thermostats. 17 Plus and multi-speed units will work with 24 volt thermostats but 3 stages of cooling will not be available on 2 compressor units.

Single Zone VAV and multi-speed evaporator fan units are neither designed to be discharge air controlled (DAC) units nor used in a multi zone application (VAV boxes).

Single Zone VAV and multi-speed evaporator fan units do have a Discharge Air Setpoint Limit that must be adjusted at start up but this only acts as a discharge temperature threshold. If the Discharge Air Setpoint Limit is set too high it will limit the cooling capacity of the unit. If the setpoint limit setting is unknown it is recommended that it be set all the way counter clockwise to the coolest setting. Precedent™ and Odyssey™ SZVAV units have this potentiometer remotely mounted but Voyager™ units use the R-136 "DA Cool - Fan Spd" potentiometer on the RTOM circuit board.

Different products use different methods to vary the evaporator fan speed. Voyager™ units use a variable frequency drive (VFD) to control evaporator fan speed but sheaves and pulleys are still used for maximum fan speed adjustment. Odyssey™ units also use a VFD in the air handler but unlike Voyager™ units, airflow is adjusted directly on the VFD keypad and by adjusting R-136 potentiometer on the RTOM circuit board. Precedent™ units do not use VFDs but instead use direct drive variable speed motors. Maximum airflow can be changed on both types of Precedent™ units by adjusting the R-136 potentiometer on the RTOM circuit board. Each unit's IOM will have specific information regarding verifying proper airflow.

## Enhanced Dehumidification

All 17 Plus units have the additional standard feature of Enhanced Dehumidification. Once the space humidity value exceeds the Dehumidification Setpoint on the RTOM (R 41) the unit will energize the first stage of cooling and drive the evaporator fan to low speed. Enhanced Dehumidification is terminated once space humidity falls below 2% of the humidity setpoint.

Enhanced Dehumidification requires a field installed humidity sensor or a BAS provided space humidity value. A humidistat cannot be used with Enhanced dehumidification. Enhanced Dehumidification does not require the hot gas reheat (HGRH) option but will work in conjunction with HGRH as the first stage of dehumidification if present.

## General Sequence of Evaporator fan operation

The evaporator fan is energized approximately 1 second after a call for cooling or heating for all units except for those equipped with gas heat. Gas heat units energize the evaporator fan approximately 45 seconds after gas heat ignition. The RTRM de-energizes the evaporator fan approximately 160 seconds after a cooling call is satisfied and 90 seconds after a heating call is satisfied to enhance efficiency.

Precedent™ multi-speed units maintain the evaporator fan speed at approximately 50% (low speed) of maximum during "fan on" and economizer operation. After cooling stage 1 is energized the evaporator fan is ramped up to approximately 82% (medium speed) of maximum fan speed. If cooling stage 2, hot gas reheat (if equipped) or any stage of heat is called, the evaporator fan is ramped up to 100% (high speed) of maximum. Voyager™ and Odyssey™ multi-speed units will only have two speeds 100% high speed (used when both compressors are running and any stage heating) and approximately 50% on low speed (all other fan operations).

SZVAV units work differently than multi-speed units. SZVAV units modulate the evaporator fan based on the cooling demand of the space. The ReliaTel™ controller monitors the space temperature, space temperature deviation from setpoint, discharge air temperature, and space temperature recovery rate to determine the best airflow level. This control algorithm is not adjustable. Only the maximum airflow of the unit is adjustable.

On all multi- speed and SZVAV products the evaporator fan will operate at 100% (high speed) during any stage of heating except for Voyager™ units with modulating gas heat.

# Indoor fan control description; Precedent 17 SEER (17 Plus)

## Unit identification

The "7" in the 6th digit indicates the unit is a 17 Plus unit.

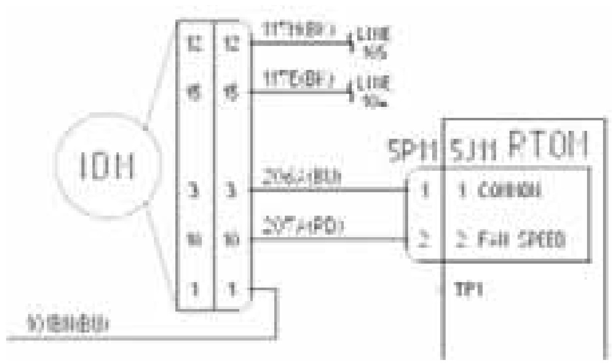
YHC067E4RHA03D0A1000000000 - the 15th digit (0) indicates this model is a multispeed evaporator fan unit.

YHC067E3RHA03D6B0C1B0B000 - the 15th digit (6) indicates this is a SZVAV unit.

## Wiring and configuration

3-through 5-ton (037, 047, and 067) 17 Plus Precedent™ units use a constant CFM ECM direct drive evaporator fan motor. Airflow is controlled by a Pulse Width Modulated (PWM) output signal from the J11 header of the RTOM. It is important to note that the J-11 output controls the cfm but does not directly control fan speed. The ECM motor will determine actual rpm based on static pressure conditions and current draw of the motor to maintain the set cfm.

**Figure 22.**




Multi-Speed operation is standard on all 17 Plus units. Single Zone VAV is available on 17 Plus units as a factory installed option.

Proper wiring configuration is required for correct unit operation. Wiring harness plugs should be configured as shown below for 17 Plus Precedent™ units.

**Figure 23. 17 plus SZVAV configuration**

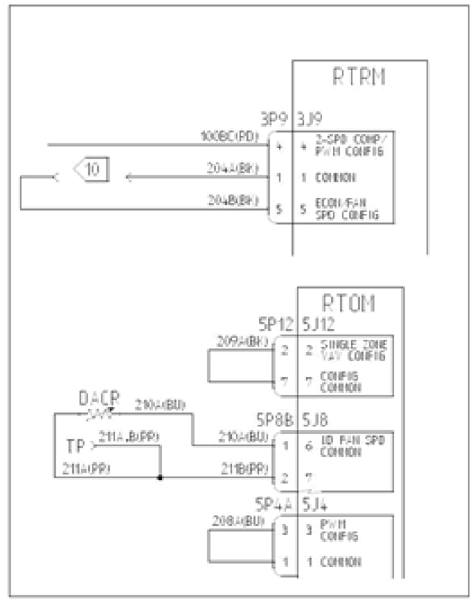
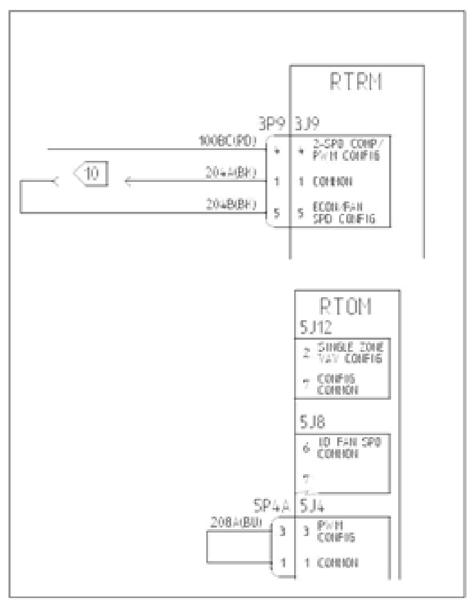



**Figure 24. 17 plus standard (multi-speed) configuration**




## Adjusting maximum unit airflow

Make adjustments to the maximum airflow of a 17 Plus unit while in either Cooling stage 2 or any stage of heat while in the factory test mode. This will force the indoor fan to maximum speed and ready for adjustment.

To change the maximum airflow, adjust the R 136 potentiometer on the RTOM.

***Note:*** *Voyager™ units use this potentiometer to set the Discharge air setpoint limit.*

Figure 25.

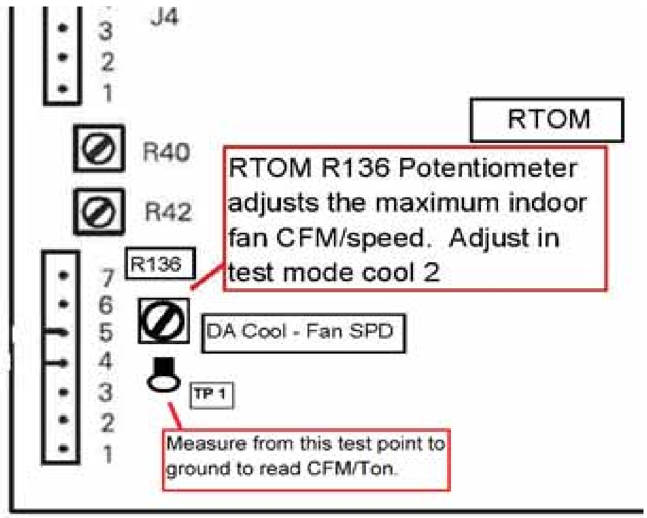
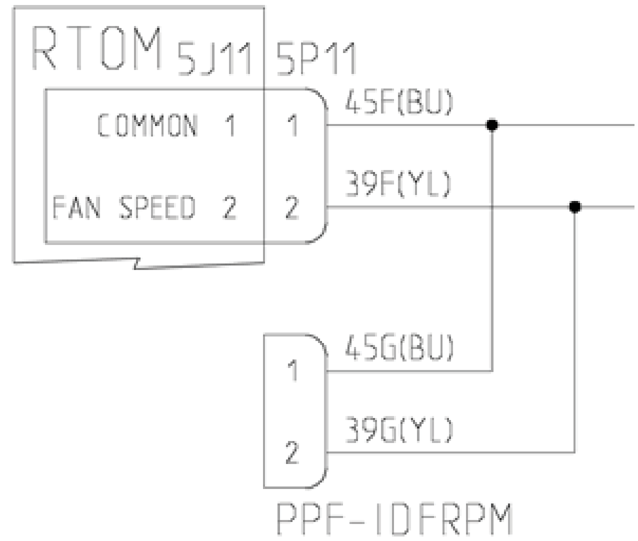



Figure 26.




To verify the proper cfm setting, measure the DC voltage on the test point (TP1) next to R136 and compare it to the "cfm vs. vdc chart". The cfm vs. vdc chart is located on a sticker on the fan housing itself and in the unit Installation and Operations Manual (IOM).

# Indoor fan control description; Backwards Curved (BC) Plenum fan control

## Unit identification

Digit 15 in the model number indicates whether the unit has a standard constant volume, multi-speed or SZVAV fan operation.

### Examples:

- YSC120FWRLA01D6E0A1060004 is a SZVAV unit.
- YSC120FWRLA01D7E0A1060004 is a multi-speed unit.
- SC120FWRLA01D0E0A1060004 is a standard constant volume indoor motor.

## Wiring and configuration

7½-through 10-ton high efficiency (YHC092-120) and 10-ton standard efficiency (YSC120) Precedent™ units use a constant torque, Backwards curved (BC), indoor fan motor. Airflow is controlled by a 0 to 10 vdc output signal from the J11 header of the RTOM. Unlike the 17 Plus products this voltage level directly corresponds to fan rpm and not cfm.

Measure the PPF-IDFRPM wire harness to check the "Potentiometer Voltage" output.

Proper wiring configuration is required for correct unit operation. Wiring harness plugs should be configured as shown below for 7½-through 10-ton Precedent™ units.

**Figure 27. Precedent™ 7½-through 10-ton SZVAV configuration**

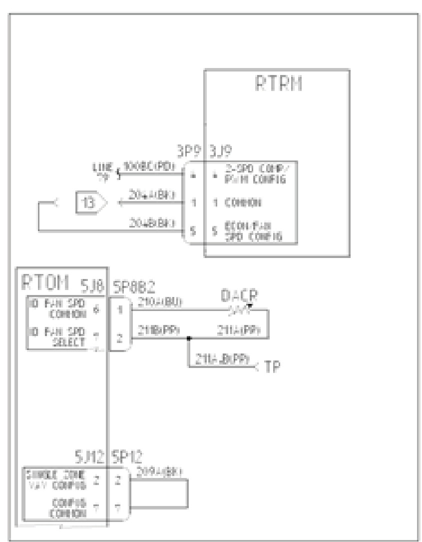


**Figure 28. Precedent™ 7½-through 10-ton multi-speed configuration**

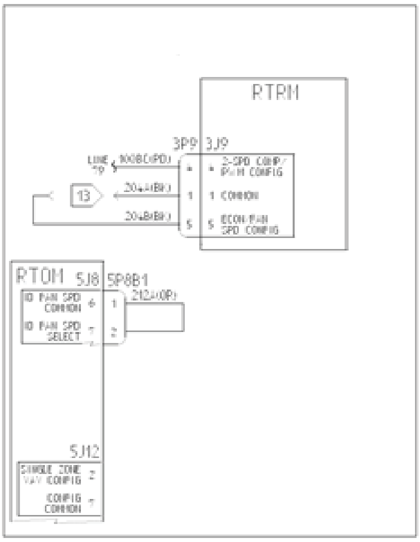



**Figure 29. Precedent™ 7½-through 10-ton standard configuration**

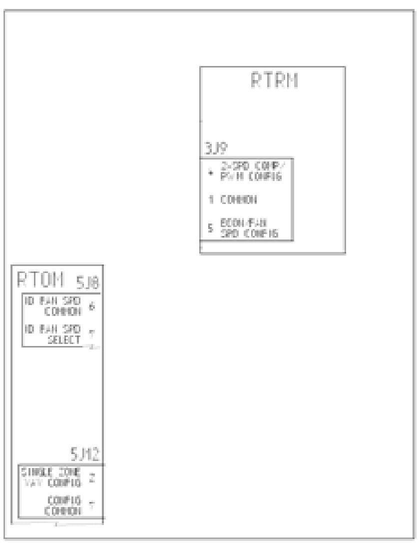



**Figure 30.**


## Adjusting maximum unit airflow

Adjust the R136 potentiometer on the RTOM (same as with 17 Plus) to change the "Potentiometer voltage" J-11 output and thus change maximum fan speed. BC Plenum fan units will output a 0-10 vdc signal from the RTOM J-11. The "Potentiometer Voltage" chart is located on a sticker on the fan housing itself and in the unit Installation and Operations Manual (IOM).

# Indoor fan control description; Voyager™ multi speed and SZVAV VFD controlled evaporator fan motor

## Unit identification

Voyager units use a forward curved evaporator fan with a VFD controlled motor for multi speed and SZVAV options. Unit fan control type can be identified by the 9th digit in the model number as described in the following chart:

| Fan type | Standard | Multi-speed | SZVAV |
|---|---|---|---|
| No heat (TC*, WC*) | 0 (zero) | A | F |
| Low heat | L | B | G |
| High heat | H | C | H |
| Mod heat | V | D | K |

***Note:*** *TCH241F4F0AB is a SZVAV unit without electric heat.*

## Wiring and configuration

Multi-speed units use two relays located in the control box to switch speeds at the VFD.

Single Zone VAV units use one relay and a vdc signal from the J-11 of the RTOM to modulate the fan speed.

**Figure 31.**


Proper wiring configuration is required for correct unit operation. Wiring harness plugs should be configured as shown below for Voyager™ units.

**Figure 32. Voyager™ SZVAV configuration**

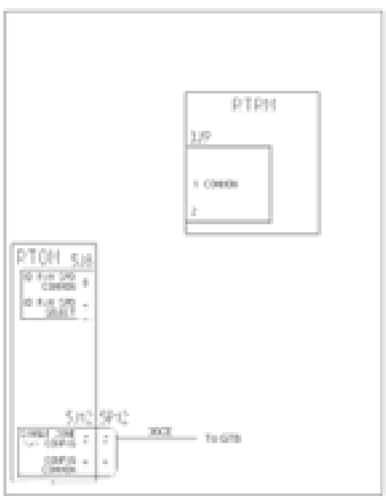



**Figure 33. Voyager™ multi-speed configuration**

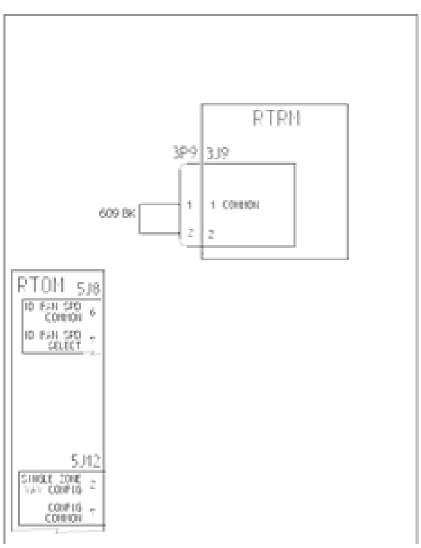
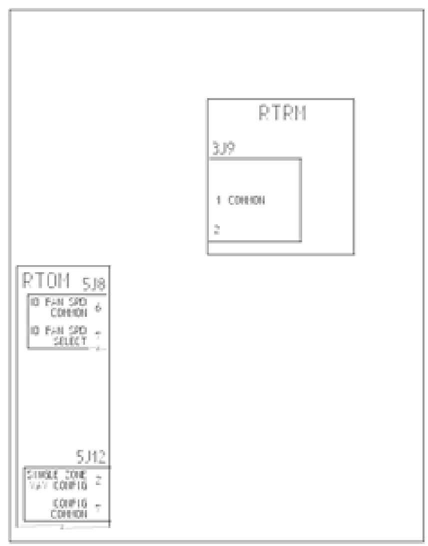



**Figure 34. Voyager™ standard configuration**




## Adjusting maximum unit airflow

Adjust the maximum airflow with sheaves and pulleys as one would with a standard unit. Verify adjustments in test mode in either maximum cooling (both compressors running) or any stage of heat.

Field adjustment of the VFD is not necessary or recommended with Voyager™ multi-speed or SZVAV package units.

# Indoor fan control description; Odyssey™ multi-speed and SZVAV VFD controlled evaporator fan motor

## Unit identification

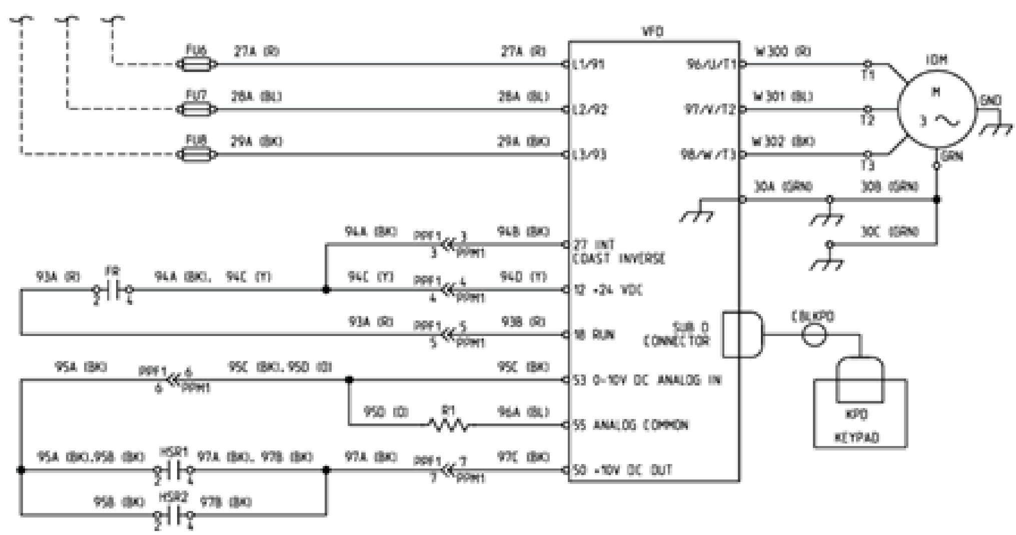
Digits 9 and 10 of the TWE air handler identify the air handler as standard constant volume, multi speed or SZVAV.

***Note:*** *TWE240E3R4AB is a SZVAV with an oversized motor.*

| Fan type | Digits 9 and 10 |
|---|---|
| Standard constant volume | 00 |
| Multi speed w/standard motor | 03 |
| Multi speed w/oversized motor | 04 |
| SZVAV w/standard motor | R3 |
| SZVAV w/oversized motor | R4 |

Oversized motors are only factory installed options. Multi-speed air handlers MUST be paired with an electromechanical outdoor unit. SZVAV air handlers MUST be paired with ReliaTel™ controlled outdoor units.

**Figure 35. Wiring and configuration - multi speed wiring (electro-mechanical only)**

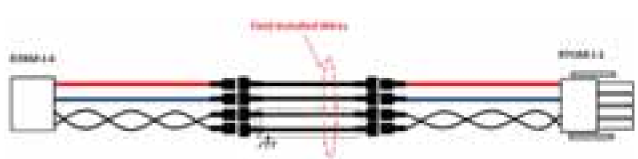



24 volt signals from the thermostat (Y,W,and G etc.) energize relays that command the VFD to the appropriate speed.

## SZVAV (ReliaTel™ only)

Field wiring MUST be provided between the RTRM in the Outdoor Unit and the RTOM in the air handler.

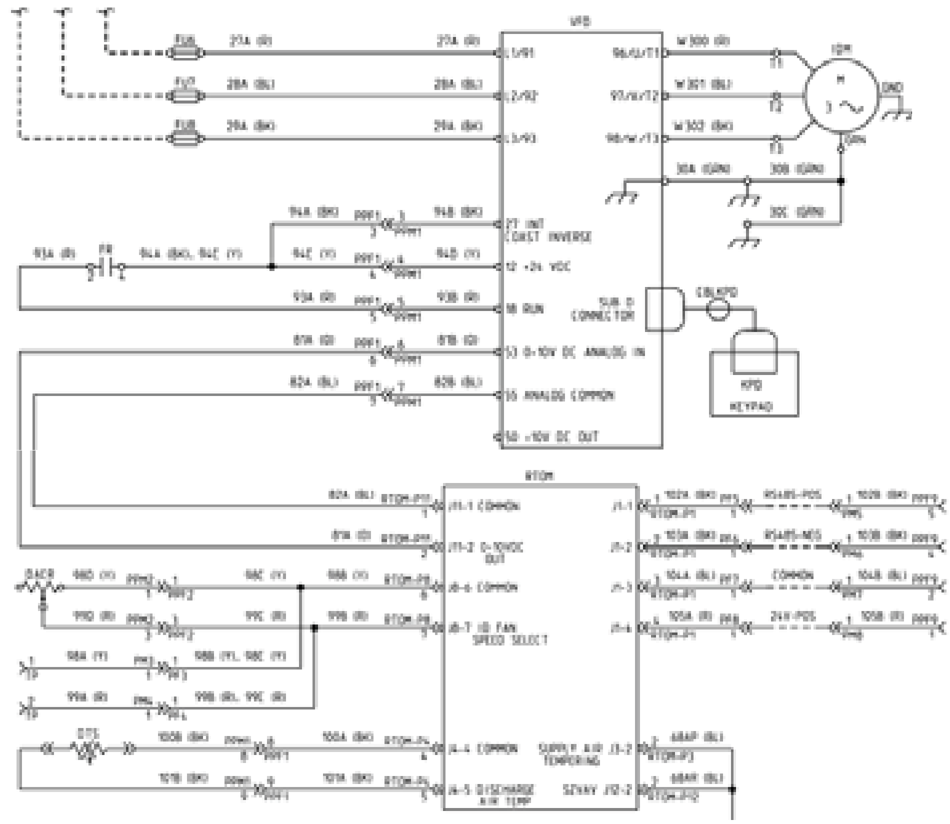
**Figure 36. Multi speed wiring (electro-mechanical only)**



Communication wiring from the RTRM to the RTOM MUST be shielded and grounded at the outdoor unit ONLY.

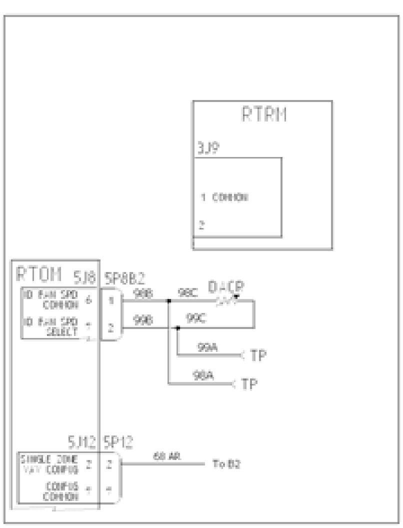
The RTRM communicates information to the RTOM regarding evaporator fan modulation. The RTOM then sends a 0-10 volt dc signal from the J-11 plug to the VFD to modulate the fan speed.

**Figure 37.**



Proper wiring configuration is required for correct unit operation. Wiring harness plugs should be configured as shown below for Odyssey™ SZVAV units.

**Figure 38.**




Multi-speed Odyssey™ units are electromechanical and do not require configuration jumpers.

## Adjusting maximum unit airflow

Multi-speed (2 Speed) and SZVAV Odyssey™ split systems have a fixed motor pulley. Maximum and minimum airflow adjustment is accomplished by changing the frequency output of the air handler VFD (parameter 6-14) using the provided VFD keypad. Refer to the unit IOM for specific instructions on airflow adjustment.

SZVAV air handlers use a combination of adjusting the R136 potentiometer on the RTOM (similar to Precedent™) and frequency parameter adjustment in the VFD. Refer to the unit IOM for specific instructions on airflow adjustment.

# Verifying Proper Air Flow

## Units with Direct Drive Indoor Fan

Much of the systems performance and reliability is closely associated with, and dependent upon having the proper airflow supplied both to the space that is being conditioned and across the evaporator coil. The indoor fan speed is changed by adjusting the input voltage to the direct drive fan. Before starting the SERVICE TEST, set the minimum position setpoint for the economizer to 0% using the setpoint potentiometer located on the Economizer Control Module, if applicable.

**ReliaTel™ Control:** Momentarily jump across the Test 1 & Test 2 terminals on LTB1 one time to start the Minimum Ventilation Test.

**Electro Mechanical Control:** Perform the proper test mode connections.

Once the supply fan has started, determine the total system airflow (CFM) by (ReliaTel™ / Electromechanical):

1. Measure the DC voltage across pins Vt and com on MMC board or note the DC voltage shown on the ECM board display. Using the fan rpm table shown on the Power Diagram or in the unit Service Facts, determine RPM correlated to measured voltage.
2. Measure the amperage at the supply fan contactor and compare it with the full load amp (FLA) rating for the evaporator motor stamped on the unit nameplate.
   a. Calculate the theoretical BHP using (Actual Motor Amps/ Motor Nameplate Amps) X Motor HP.
   b. Using the fan performance tables in the unit Service Facts, plot the actual RPM (step 1) and the BHP (step 2a) to obtain the operating CFM.
3. If the required CFM is too low, (external static pressure is high causing motor HP output to be below table value),
   a. Relieve supply and/or return duct static.
   b. Change indoor fan speed and repeat steps 1 and 2.
      - For MMC board: To increase or decrease Fan RPM push and turn knob counter-clockwise or clockwise respectively. Then measure the DC voltage across pins Vt and com on the MMC. Using the fan rpm table in the unit Service Facts, determine RPM correlated to measured voltage.
      - For ECM board: To Increase/Decrease Fan RPM:
         a. Push and hold the SET button for 3 sec. Board will display Motor 1 parameter name: Hi 1.
         b. Slow push SET again to display the parameters current value =7.50 volts.
         c. Push on + or – button to adjust parameter to desired value = XXX volts.
         d. Push and hold SET button for 3 sec to “save” the value. After save is complete, Hi 1 will show again.
         e. After the voltage Hi 1 is successfully changed, the display sequence will be: MTR 1---> XXX -----> MTR2 -----> 0.00----->FST1---->ON/OFF----->FST2------>ON/OFF------->EhEn----->ON/OFF
            And the motor will ramp up or down to adjust to the input signal. Using the fan rpm table in the unit Service Facts, determine RPM correlated to displayed voltage.
4. If the required CFM is too high, (external static pressure is low causing motor HP output to be above table value), change indoor fan speed and repeat steps 1 and 2.
5. To stop the SERVICE TEST, turn the main power disconnect switch to the "Off" position or proceed to the next component start-up procedure.

# ReliaTel™ LED Functions

## ReliaTel™ Refrigeration Module (RTRM)

### Green System LED

- On: Normal operation (slight flickering is normal)
- Off: No power, board failure
- One blink: Emergency stop open when attempting test mode.
- 2 flashes every two seconds indicates a diagnostic is present (V 4.0 or greater) [see p. 24 for a list of diagnostics]
- Continuous¼ second blink: Test Mode

### Green Transmit LED

- Very fast flash: Normal operation, information being sent to other modules.
- Off: System failure

### Yellow Receive LED

- Very fast flash.5 second, off 1.5 second:
- Normal communication
- 1/4 second wink every 2 seconds:
- Not communicating with any other module
- Off: Board failure

## ReliaTel™ Options Module (RTOM)

### Green system LED

- On: Normal communication with RTRM
- 1/4 second on, 2 seconds off: No communication
- Off: No power or board failure

## ReliaTel™ Ventilation Module (RTVM)

### Green system LED

- On: Normal communication with RTRM
- 1/4 second on, 2 seconds off: No communication
- Off: No power or board failure

## ReliaTel™ Air Handling Module (RTAM)

### Green system LED

- On: Normal communication with RTRM
- 1/4 second on, 2 seconds off: No communication
- Off: No power or board failure

## ReliaTel™ Dehumidification Module (RTDM)

### Green system LED

- NA - No Onboard LED

## Economizer Actuator Module (ECA)

### Green system LED

- On: OK to economize
- Slow flash: Not OK to economize
- Fast flash: Not communicating with RTRM
- OFF: No power or system failure
- 1/2 second on, 2 seconds off: no communication
- Error codes — 1/2 second on, 1/4 second off
- 1 flash – Actuator fault
- 2 flash – CO2 sensor
- 3 flash – RA humidity sensor
- 4 flash – RA temp sensor
- 6 flash – OA humidity sensor
- 7 flash – No Communication with RTRM or OAT sensor has failed.
- 8 flash – MA temp sensor
- 9-11 flash – Internal fault

## Ignition Control (IGN)

**Note:** *See ignition control section for specific flash code schedule.*

### Green

- On: Normal no call for heat
- Slow flash: Active call for heat
- Fast flash: Not communicating with RTRM
- Error codes
- 2 flash – system lockout – failure to sense flame
- 3 flash – pressure switch failure to close when CBM stops or open when CBM starts (not applicable to 12½- through 50-tons)
- 4 flash – TCO circuit open
- 5 flash – Flame being sensed yet gas valve not energized

- 6 flash - Flame Rollout (FR) circuit open (Not applicable to 12½-through 50-tons)

# TCI COMM3/4 Interface (Tracer™, VariTrac™)

## Yellow RX (Receive) LED

- Flashing intermittently: ICS line activity
- Off: Communication down or no power

## Green TX (Transmit) LED

- Flashing intermittently: Unit is communicating OK with ICS system
- Off yet RX light flashes – address wrong, COMM3/4 board in wrong position

# LCI (LonTalk®)

## LED1 Green MODBUS LED

- Flashing intermittently: Unit is communicating to RTRM
- Off: LCI-R not operating
- Flashing slow (1/4 second on and 2 seconds off): RTRM not responding

## LED4 Green COMM 5 status LED

- Steady on: Normal operation.

## LED2 Red Service LED

- Steady on: Bad circuit board
- OFF: Normal
- Flashing 1 second on, 1 second off, LCI is in unconfigured state.

## LED3 Yellow Comm RX

- Flashing intermittently: normal operation.

# ReliaTel™ Test Mode

## Protocol of Communications

It is possible, though not recommended, to connect multiple control devices to a ReliaTel™ system. The terminal strip is arranged such that simultaneous connection of ICS communication (Tracker™, Tracer™, Summit, VariTrac™), Mechanical Zone Sensor Module (ZSM), Programmable Zone Sensor, and a conventional thermostat is possible. Of course, only one device can control the unit at a time. Following is a protocol of communication; if communication fails, the RTRM seeks the next lower priority level device. If no device is connected, the unit will not run except during the TEST MODE.

- Highest priority — ICS (Tracker™, Tracer™, VariTrac™, Summit)— Using BAYSENS013, 014, 017 as needed
- Next priority — Programmable Zone Sensor (BAYSENS019, AYSTAT666, BAYSENS020)
- Next priority — Mechanical ZSM(BAYSENS006-11B, AYSTAT661-664)
- Least priority —Conventional Thermostat (R, G, Y, W, C)

Although it's possible to connect multiple devices, doing so increases the chance for error in application and troubleshooting.

***Note:*** *27½-through 50-ton VAV- conventional thermostat inputs do not work and are ignored by the RTRM.*

On power up, the RTRM looks for a zone temperature input (J6-1, J6-2). If it doesn't see one, it then ignores zone sensor inputs and looks for thermostat (RGYW) inputs.

However, if the unit does see a valid zone temperature input on startup then the thermostat (RGYW) inputs are ignored. A programmable zone sensor will take priority over either input when connected, and an ICS system takes the highest priority.

### Service Test Mode

Allows the qualified service technician or installer to activate all functions of the unit, regardless of thermostat, sensor, or in some cases ICS input.

Test Mode is activated using either a fixed resistance or a jumper as explained below.

In Service Test Mode, the unit can be operated in any of several pre-defined operating modes that exercise all unit functions. The operating modes include Supply Fan On, Economizer open and close, Cool 1, Cool 2, Cool 3, Reheat Valve (for Staged Dehumidification), Modulating Reheat and Cooling Valves, Reheat Circuit Pumpout Solenoid, Heat 1, Heat 2, Emergency Heat (heat pumps only), and Outdoor Coil Defrost (heat pump only).

If a unit does not have a component, such as an economizer, that test stage is skipped.There are 3 ways to use the Test Mode. In each case, the unit can be running in any mode or not running at all.

Service Test Mode can be initiated any time the unit is powered and an open condition has been detected on the Test Terminals at some time since power-up.

### Auto-Cycle Test

Place a jumper from TEST 1 to TEST 2. The unit will run in each mode for 30 seconds, scrolling through all modes, then exiting the Test mode automatically.

To go through Test Mode again, remove then restore the jumper.

If the jumper is removed at any time during the test mode, the unit will stay in the selected mode for 1 hour (except for the defrost mode on heat pumps), then revert to normal operation.

Unused states, such as Heat 2 when no Heat 2 is present, shall be skipped.

### Resistance Test

Specific operating states can be selected by applying an appropriate resistance from TEST 1 to TEST 2.

Operating modes can be changed in any order by applying the correct resistance values. Operation in any one mode is limited to 60 minutes as with the jumper method.

**Resistance Test Table:**

| | | |
|---|---|---|
| 1 | Indoor fan on | 2.2k ohms |
| 2* | Economizer open | 3.3k ohms |
| 3 | Cool 1 | 4.7k ohms |
| 4* | Cool 2 | 6.8k ohms |
| 5* | Cool 3 | 8.2k ohms |
| 5 | Heat 1 | 10k ohms |
| 6* | Heat 2 | 15k ohms |
| 7* | Heat 3 | 22k ohms |
| 9* | Heat 4 | 27k ohms |
| 8** | Defrost cycle/reheat | 33k ohms |
| 9* | Emergency heat | 47k ohms |

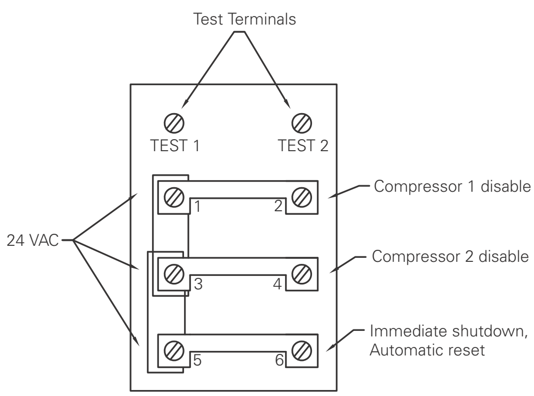
*Optional components
**defrost cycle in test mode runs for at least 1 minute, up to 10 minutes, depending on outdoor ambient and outdoor coil temperature. Reheat step is valid only with dehumidification option and will be step 5 of the test.

## Step Test

By placing a jumper from TEST 1 to TEST 2 for 2 continuous seconds nominal, allowing the unit to energize the mode for at least 2 seconds, then placing the jumper again, the unit can be scrolled through modes as in method 1 but more quickly. Unused states, such as Heat 2 when no Heat 2 is present, shall be skipped.

***Note:*** *27½-through 50-ton units see test mode chart* *Table 17 on page 52* and *Table 18 on page 53.*

**Figure 39. LTB Layout with jumpers**




# Test Mode

## Service Tips:

- To ensure appropriate unit restart after operating in Service TEST MODE, Service TEST MODE termination causes a system reset resulting in execution of the startup sequence identical to initial power-on startup.
- To prevent undesired activation of Service TEST MODE at startup, Service TEST MODE can only be activated after an open condition has been detected on the Service Test terminals.
- When initiating the test mode immediately after power-up, the RTRM 20 seconds self-test must be completed before the test mode will work.
- The TEST MODE bypasses timing functions including minimum run times.
- TEST MODE does not bypass safety controls such as the high temperature limit switch, high pressure control or smoke detector circuits.
- To help with troubleshooting, unplug J4 from the RTRM. This removes all optional components such as the COMM3/4, ECA and RTOM. (this may prevent key features from functioning. Avoid this procedure on 27½-through 50-ton units as the Voyager™ Commercial configuration will be lost).
- Some test functions do not work with LCI installed. Remove LCI from the circuit before entering the TEST mode.

### Emergency Stop input, LTB 5&6 (3J1-12 on RTRM)

If this input is open, the *indoor fan, heat & cooling will not run* in the TEST MODE. The diagnostic for this condition is HEAT FAIL + COOL FAIL. When this input is closed, the unit will restart.

When initiating the test mode, if emergency stop is open, the LED on the RTRM will flash one time.

### Fan Proving input, 5J7-6 on RTOM –

The indoor fan will run in the TEST MODE for 40 seconds and then stop if this input fails to open (3-through 25-ton) or close (27½-through 50-ton) within 40 seconds. The diagnostic for this failure is SERVICE (pulsing 1.5 – 2.5VDC from RTRM J6-6 to J6-10).

### Compressor disable inputs, 3J1-8, 3J3-2 (2 compressor units) on RTRM

If this input is open, ie. 24VAC not present, that compressor circuit will not run during TEST MODE. No diagnostic will be seen.

### Compressor proving circuits, 3J1-9, 3J3-3 (2 compressor units) on RTRM

If this input is open when the contactor is energized by the RTRM, that circuit will not run during TEST MODE. The diagnostic for this failure is COOL FAIL (pulsing 1.5 – 2.5VDC from RTRM J6-6 to J6-8).

**Gas heat failures, such as TCO, PS, FR .** will not be bypassed during TEST MODE (see unit wiring diagram). Diagnostics can be picked up at the Ignition Control Module. Also, an additional diagnostic for this failure is HEAT FAIL (pulsing 1.5 – 2.5VDC from RTRM J6-6 to J6-7).

### Ventilation Override mode (VOM), J6 on the RTOM

While in the test mode, if a VOM is activated, test mode will temporarily be halted. When the VOM is terminated, the test mode will continue from where it was halted.

### $CO_2$ Option through DCV Input on ECA

Test mode will operate normally with a $CO_2$ signal. When the economizer step is initiated, the $CO_2$ signal is overridden. When the test mode goes to the next step, the $CO_2$ signal is re-established. The economizer will drive to the closed position and then proceed to drive open from the $CO_2$ signal.

### ECA Minimum Position Adjustment

During the economizer step (step 2 of test mode), the "Min pos" on the ECA Module is disabled. It can only be adjusted during step 1 of the test when the fan is on.

## Frostat™ Input

J7-1, J7-2 on RTOM - if this input closes indicating a frosted suction line, the compressors will not run during the TEST MODE. No diagnostic will be seen.

**Table 12. Electric/Electric units 3-through 25-ton**

| Step | Mode | IDM | Econ | CPR1 | CPR2 | HT1 | HT2 | ODM1 | ODM2 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Fan On | On/Low* | Min | Off | Off | Off | Off | Off | Off |
| 2* | Econ. | On/Low* | Open | Off | Off | Off | Off | Off | Off |
| 3 | Cool 1 | On/Medium* | Min | On | On(1) | Off | Off | On | ** |
| 4 | Cool 2 | On/Low*/ Medium*/ High* | Min | On | On(2) | Off | Off | On | ** |
| 5 | Cool 3 | On/High* | Min | On | On | Off | Off | On | ** |
| 6* | Reheat | On/High* | Min | On | On | Off | Off | On | ** |
| 7* | Heat 1 | On/High* | Min | Off | Off | On | Off | Off | Off |
| 8* | Heat 2 | On/High* | Min | Off | Off | On | On | Off | Off |

* With Optional Accessory
** "**Off**" if OAT falls below 60°F, "**On**" if OAT rises above 65°F. During Reheat, if the unit is configured with 1 compressor, ODM2 is "**Off**" if the OAT falls below 70°F, "**On**" if the OAT rises above 75°F.

**Note:** Steps for optional accessories and modes not present in unit will be skipped.

(1) CPR2 ON during Cool 1 if configured for 3-Step Cooling; CPR1 OFF.
(2) CPR2 OFF during Cool 2 on a 3-Step Cooling unit.

**Table 13. Voyager™ and Precedent™ heat pump units 3-through 25-ton**

| Step | Mode | IDM | Econ | CPR1 | CPR2 | HT1 | HT2 | SOV1 | ODM1 | ODM2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Fan On | On/Low* | Min | Off | Off | Off | Off | Off | Off | Off |
| 2* | Econ. | On/Low* | Open | Off | Off | Off | Off | Off | Off | Off |
| 3 | Cool 1 | On/ Medium*/ Low | Min | On | On(1) | Off | Off | On | On | ** |
| 4 | Cool 2 | On/Low*/ Medium*/ High* | Min | On | On(2) | Off | Off | On | On | ** |
| 5 | Cool 3 | On/High* | Min | On | On | Off | Off | On | On | ** |
| 6 | Heat 1 | On/High* | Min | On | On(3) | Off | Off | Off | On | On |
| 7* | Heat 2 | On/High* | Min | On | On | On(4) | Off | Off | On | On |
| 8* | Heat 3 | On/High* | Min | On | On | On | On(5) | Off | On | On |
| 9* | Heat 4 | On/High* | Min | On | On | On | On | Off | On | On |
| 10*** | Defrost | On/High* | Min | On | On | On | On | On | Off | Off |
| 11 | Em Heat | On/High* | Min | Off | Off | On | On | Off | Off | Off |

* With Optional Accessory
** "**Off**" if OAT falls below 60°F, "**On**" if OAT rises above 65°F.
*** Defrost cycle in test mode runs for at least 1 minute, up to 10 minutes, depending on outdoor ambient and outdoor coil temperature.

**Note:** Steps for optional accessories and modes not present in unit will be skipped.

(1) CPR2 ON during Cool 1 if configured for 3-Step Cooling; CPR1 OFF.
(2) CPR2 OFF during Cool 2 on a 3-Step Cooling unit.
(3) CPR2 OFF during Heat 1 if configured for 2-Step mechanical heating.
(4) HT1 OFF during Heat 2 if the unit is configured for 2-Step mechanical heating.
(5) HT2 OFF during Heat 3 if the unit is configured for 2-Step mechanical heating.

### Table 14. Odyssey™ independent circuit heat pump units 15-through 20-ton

| Step | Mode | IDM | Econ | CPR1 | CPR2 | HT1 | HT2 | SOV 1 | SOV 2 | ODM1 | ODM2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Fan On | On/Low* | Min | Off | Off | Off | Off | Off | Off | Off | Off |
| 2* | Econ. | On/Low* | Open | Off | Off | Off | Off | On | On | Off | Off |
| 3 | Cool 1 | On/Low* | Min | On | Off | Off | Off | On | On | On | Off |
| 4 | Cool 2 | On/High* | Min | On | On | Off | Off | On | On | On | On |
| 5 | Heat 1 | On/High* | Min | On | Off | Off | Off | Off | Off | On | Off |
| 6 | Heat 2 | On/High* | Min | On | On | Off | Off | Off | Off | On | On |
| 7* | Heat 3 | On/High* | Min | On | On | On | Off | Off | Off | On | On |
| 8* | Heat 4 | On/High* | Min | On | On | On | On | Off | Off | On | On |
| 9** | Defrost | On/High* | Min | On | On | On | Off | On | On | Off | Off |
| 10 | Em. Heat | On/High* | Min | Off | Off | On | On | Off | Off | Off | Off |

*With Optional Accessory
**Defrost cycle in test mode runs for at least 1 minute, up to 10 minutes, depending on outdoor ambient and outdoor coil temperature.
**Note:** Steps for optional accessories and modes not present in unit will be skipped.

### Table 15. Gas/Electric units 3-through 25-ton

| Step | Mode | IDM | Econ | CPR1 | CPR2 | HT1 | HT2 | Mod Gas* | ODM1 | ODM2 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Fan On | On/Low* | Min | Off | Off | Off | Off | Off | Off | Off |
| 2* | Econ. | On/Low* | Open | Off | Off | Off | Off | Off | Off | Off |
| 3 | Cool 1 | On/Low*/ Medium* | Min | On | On(1) | Off | Off | Off | On | ** |
| 4 | Cool 2 | On/Low*/ Medium*/ High* | Min | On | On(2) | Off | Off | Off | On | ** |
| 5 | Cool 3 | On/High* | Min | On | On | Off | Off | Off | On | ** |
| 6* | Reheat | On/High* | Min | On | On | Off | Off | Off | On | ** |
| 7* | Heat 1 | On/Low*/ High* | Min | Off | Off | On | Off | 50% | Off | Off |
| 8* | Heat 2 | On/High* | Min | Off | Off | On | On | 100% | Off | Off |

* With Optional Accessory
** "**Off**" if OAT falls below 60°F, "**On**" if OAT rises above 65°F. During Reheat, if the unit is configured with 1 compressor, ODM2 is "**Off**" if the OAT falls below 70F, "**On**" if the OAT rises above 75F.

**Note:** Steps for optional accessories and modes not present in unit will be skipped.

(1) CPR2 ON during Cool 1 if configured for 3-Step Cooling; CPR1 OFF.
(2) CPR2 OFF during Cool 2 on a 3-Step Cooling unit.

### Table 16. Voyager™ Commercial VAV service test with reheat and Statitrac™

| Test Step | MODE | IGV/ VFD(1) | FAN | Econ* | EXH FAN(2)* | POWER EXHAUST DAMPER* | COMP 1 | COMP 2 | H1* | H2* | Mod. Heat* | Cool Valve * | Reheat Valve* | Reheat Pump out* | VHR Relay (3) | OHMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | IGV/ VFD TEST | OPEN/ 100% | OFF | CLOSED | OFF | MIN | OFF | OFF | OFF | OFF | 0% | 100% | 0% | OFF | ON | 2.2k |
| 2 | IGV/ VFD TEST | CLOSED /0% | OFF | CLOSED | OFF | MIN | OFF | OFF | OFF | OFF | 0% | 100% | 0% | OFF | ON | 3.3k |
| 3 | MINIMUM VENTILATION | IN CONTROL | ON | MIN | OFF | MIN | OFF | OFF | OFF | OFF | 0% | 100% | 0% | OFF | ON | 4.7k |
| 4 | ECONOMIZER | IN CONTROL | ON | 100% | ON | 100% | OFF | OFF | OFF | OFF | 0% | 100% | 0% | OFF | ON | 6.8k |
| 5 | COOL STAGE 1 | IN CONTROL | ON(5) | MIN | OFF | MIN | ON(6) | OFF | OFF | OFF | 0% | 100% | 0% | OFF(8) | ON | 10k |
| 6 | COOL STAGE 2 | IN CONTROL | ON(5) | MIN | OFF | MIN | OFF(4) | ON(4)(6) | OFF | OFF | 0% | 100% | 0% | ON(8) | ON | 15k |

Table 16. Voyager™ Commercial VAV service test with reheat and Statitrac™ (continued)

| Test Step | MODE | IGV/ VFD(1) | FAN | Econ* | EXH FAN(2)* | POWER EXHAUST DAMPER* | COMP 1 | COMP 2 | H1* | H2* | Mod. Heat* | Cool Valve * | Reheat Valve* | Reheat Pump out* | VHR Relay (3) | OHMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | COOL STAGE 3 | IN CONTROL | ON | MIN | OFF | MIN | ON(6) | ON(6) | OFF | OFF | 0% | 100% | 0% | ON(8) | ON | 22k |
| 8 | REHEAT * | IN CONTROL | ON | MIN | OFF | MIN | ON(6) | ON(6) | OFF | OFF | 0% | 50% | 50% | OFF | ON | 27k |
| 9 | HEAT STAGE 1* | OPEN/ 100% (7) | ON(5) | MIN | OFF | MIN | OFF | OFF | ON (7) | OFF | 50% | 100% | 0% | OFF | ON | 33k |
| 10 | HEAT STAGE 2* | OPEN/ 100% (7) | ON(5) | MIN | OFF | MIN | OFF | OFF | ON (7) | ON (7) | 100% | 100% | 0% | OFF | ON | 47k |
| 11 | Reset | | | | | | | | | | | | | | | |

* With Optional Feature

1. The IGV/VFD will be controlled to the supply pressure setpoint unless test mode has been running for 6 minutes or longer. After 6 minutes, the IGV damper will be allowed to drive to 100% for step 9 and 10.
2. The exhaust fan will turn on anytime the economizer damper position is equal to or greater than the exhaust fan setpoint. It will not turn off until the economizer damper position is at Exhaust Enable Setpoint - 10% or lower.
3. The VHR relay output will be energized at the start of the test mode to allow time for the VAV boxes to open. It takes 6 minutes for the boxes to drive from the full closed position to the full open position. The timing cannot be changed in the field.
4. 27.5-35 ton units have 2 stages of mechanical cooling. Both compressors run during cool stage 2.
5. The supply fan will not be allowed to go from an off state to an on state until the IGV are fully closed.
6. The condenser fans will operate any time a compressor is ON providing the outdoor air temperatures are within normal operating range.
7. The heat outputs will not be allowed to come on until the unit has been in test mode for at least 6 minutes and the IGV/VFD is at 100%.
8. The reheat pumpout output will be energized whenever the reheat circuit (circuit 2 for 40-50T) is energized for Cooling operation.

**Note:** Steps for optional accessories and modes not present in unit will be skipped.

Table 17. CV Test Modes (Also VAV w/o IGV) 27½-through 50-ton without reheat

| TEST STEP | MODE | SF | Econ.* | EXH FAN(1)* | POWER EXH DAMPER* | COMP 1 | COMP 2 | HEAT 1* | HEAT 2* | MOD HEAT* | OHMS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MINIMUM VENTILATION | ON | Min | OFF | Min | OFF | OFF | OFF | OFF | 0% | 4.7k |
| 2 | ECONOMIZER TEST OPEN | ON | 100% | ON | 100% | OFF | OFF | OFF | OFF | 0% | 6.8k |
| 3 | COOL STAGE 1 | ON | Min | OFF | Min | ON(2) | OFF | OFF | OFF | 0% | 10k |
| 4 | COOL STAGE 2 | ON | Min | OFF | Min | OFF(3) | ON(2)(3) | OFF | OFF | 0% | 15k |
| 5 | COOL STAGE 3 | ON | Min | OFF | Min | ON(2) | ON(2) | OFF | OFF | 0% | 22k |
| 6 | HEAT STAGE 1 | ON | Min | OFF | Min | OFF | OFF | ON | OFF | 50% | 33k |
| 7 | HEAT STAGE 2 | ON | Min | OFF | Min | OFF | OFF | ON | ON | 100% | 47k |
| 8 | Reset | | | | | | | | | | |

* With Optional Feature

1. The exhaust fan will turn on anytime the economizer damper position is equal to or greater than the exhaust fan setpoint. It will not turn off until the economizer damper position is at Exhaust Enable Setpoint - 10% or lower.
2. The condenser fans will operate any time a compressor is ON providing the outdoor air temperatures are within normal operating range.
3. 27.5-35 ton units have 2 stages of mechanical cooling. Both compressors run during cool stage 2.

**Note:** Steps for optional accessories and modes not present in unit will be skipped.

### *Units with two heat exchangers (high heat models)*

Heat Stage 1 - The 2 stage burner runs high heat for 60 seconds, then drops to low heat. Modulating gas heat stays off.

Heat Stage 2 - The 2 stage burner stays on low. Modulating burner comes on and stays at 100%.

**Table 18. CV Test modes 27½-through - 50-ton with reheat**

| TEST STEP | MODE | FAN | ECON * | EXH FAN (1)* | POWER EXH DAMPER* | COMP 1 | COMP 2 | HEAT 1* | HEAT 2* | MOD HEAT* | COOL VALVE * | REHEAT VALVE* | REHEAT PUMP OUT* | OHMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MINIMUM VENTILA TION | ON | Min | OFF | MIN | OFF | OFF | OFF | OFF | 0% | 100% | 0% | OFF | 2.2k |
| 2 | ECONOMI ZER TEST OPEN | ON | 100% | ON | 100% | OFF | OFF | OFF | OFF | 0% | 100% | 0% | OFF | 3.3k |
| 3 | COOL STAGE 1 | ON | Min | OFF | MIN | ON(2) | OFF | OFF | OFF | 0% | 100% | 0% | OFF | 4.7k |
| 4 | COOL STAGE 2 | ON | Min | OFF | MIN | OFF(3) | ON (2)(3) | OFF | OFF | 0% | 100% | 0% | ON(4) | 6.8k |
| 5 | COOL STAGE 3 | ON | Min | OFF | MIN | ON(2) | ON(2) | OFF | OFF | 0% | 100% | 0% | ON(4) | 8.2k |
| 6 | HEAT STAGE 1 | ON | Min | OFF | MIN | OFF | OFF | ON | OFF | 50% | 100% | 0% | OFF | 10k |
| 7 | HEAT STAGE 2 | ON | Min | OFF | MIN | OFF | OFF | ON | ON | 100% | 100% | 0% | OFF | 15k |
| 8 | REHEAT | ON | Min | OFF | MIN | ON(2) | ON(2) | OFF | OFF | 0% | 50% | 50% | OFF | 33k |
| 9 | Reset | | | | | | | | | | | | | |

* With Optional Feature

1. The exhaust fan will turn on anytime the economizer damper position is equal to or greater than the exhaust fan setpoint. It will not turn off until the economizer damper position is at Exhaust Enable Setpoint - 10% or lower.
2. The condenser fans will operate any time a compressor is ON providing the outdoor air temperatures are within normal operating range.
3. 27.5-35 ton units have 2 stages of mechanical cooling. Both compressors run during cool stage 2.
4. The reheat pumpout output will be energized whenever the reheat circuit (circuit 2 for 40-50T) is energized for Cooling operation.

**Note:** Steps for optional accessories and modes not present in unit will be skipped.

# Thermostats and Sensors

**Table 19. Thermostat and sensor descriptions**

| Accessory Model # | Zone Sensor Module Description | Required # Conductors | Terminal Connections at J6 |
|---|---|---|---|
| Heat/Cool | | | |
| BAYSENS106* | Single Set Point | 4 | 1,2,3,4 |
| ASYSTAT106* | Manual change Over | | |
| BAYSENS108* | Dual Set Point<br>Manual/Auto Change Over | 5 | 1,2,3,4,5 |
| BAYSENS110*<br>ASYSTAT111* | Dual Set Point with LEDs Manual/Auto Change Over | 10 | 1,2,3,4,5,6,7,8,9,10 |
| BAYSENS119*<br>ASYSTAT666* | Programmable with Night Setback and LCD Indicators | 3-7 | 7,8,9,10,11,12,14 (7-10 are optional) |
| BAYSENS077* | Remote Sensor | 2 | 1,2 |
| BAYSENS135A<br>ASYSTAT709A | Digital Dual Setpoint with Manual /Auto Changeovert | 11 | 1,2,3,4,5,6,7,8,9,10<br>1,2,3,4,5 |
| **Heat Pump** | | | |
| BAYSENS107*<br>ASYSTAT107* | Single Set Point<br>Manual Change Over | 6 | 1,2,3,4,5<br>6,7 |
| BAYSENS109*<br>ASYSTAT109* | Dual Set Point with<br>LEDs Manual/Auto<br>Change Over | 10 | 1,2,3,4,5<br>6,7,8,9,10 |
| BAYSENS019*<br>ASYSTAT666* | Programmable with Night Setback and LCD Indicators | 3-7 | 7,8,9,10<br>11,12,14<br>(7-10 are optional) |
| BAYSENS077* | Remote sensor | 2 | 1,2 |
| BAYSENS031A | Digital Heat Pump Dual Setpoint with Manual/Auto Changeover | 11 | 1,2,3,4,5,6<br>1,2,3,4,5 |
| **VAV 27½-through 50-ton units** | | | |
| BAYSENS119* | Programmable with Night Setback and LCD indicators | 3-7 | 7,8,9,10,11,12,14<br>(7-10 are optional) |
| BAYSENS021 | VAV Setpoint Panel w/LED's | 9 | 1,2,3,4,6,7,8,9,10 |
| Tracer/Tracker ICS | | | |
| BAYSENS073* | Override Sensor with Override / Cancel | 2 | 1,2 |
| BAYSENS174* | Override Sensor with Setpoint and Override / Cancel | 3 | 1,2,3 |

## BAYSENS016A Sensor w/ plug (see: SENS-IN-12) Thermistor Sensor (OAS, SAS, RAS, CTS)

**Outdoor Air Sensor**: Located in the condenser section, lower left corner. The compressor access panel has a slotted opening to provide airflow across the sensor. Standard with all ReliaTel™ controlled units.

**Return Air Sensor**: Field or factory installed accessory. Located on the return air damper of the economizer, used with comparative enthalpy control only.

**Figure 40. Thermistor Sensor**


**Coil Temperature Sensor**: Located in a 3/8" copper tube well, which is brazed to the lowest circuit entering the outdoor coil (2-10 ton heat pumps only).

**Mixed Air Sensor:** Field or factory installed in the supply fan section, protruding through the fan housing.

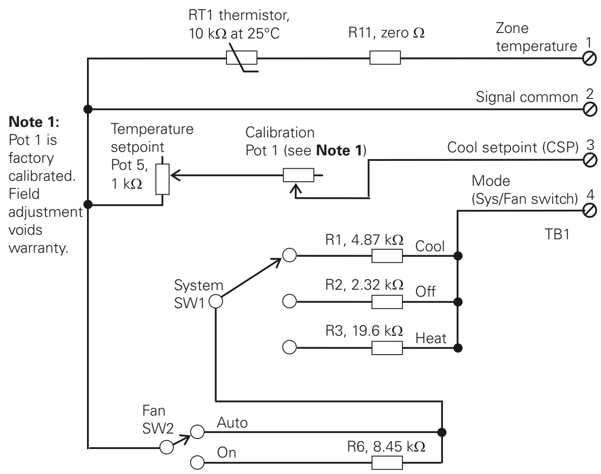
**Discharge Air Sensor:** Field or factory installed in the supply fan section, using an averaging tube located downstream of the heat section.

## BAYSENS106*/ASYSTAT106*

Accessory Heat / Cool Zone Sensor Module (ZSM) single set point, manual changeover. Four conductors required.

**Figure 41. BAYSENS106*/ASYSTAT106***

Part Number – SEN01515

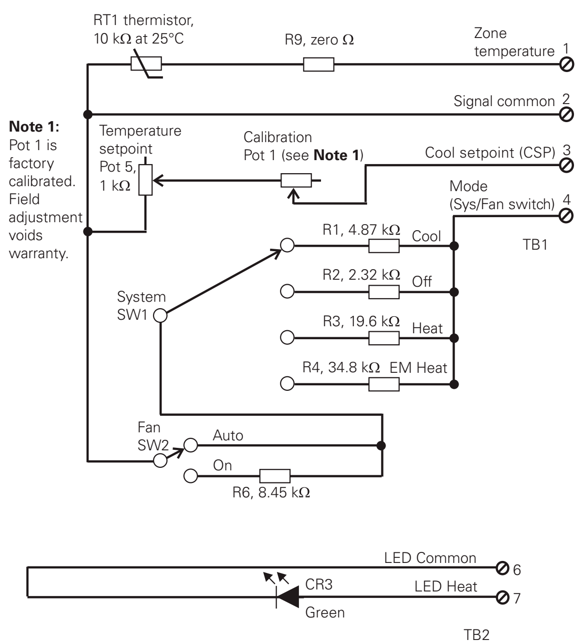



## BAYSENS107*/ASYSTAT107*

Accessory Heat Pump Zone Sensor Module (ZSM) single set point, manual changeover. Six conductors required.

**Figure 42. BAYSENS107*/ASYSTAT107***

Part Number – SEN01528

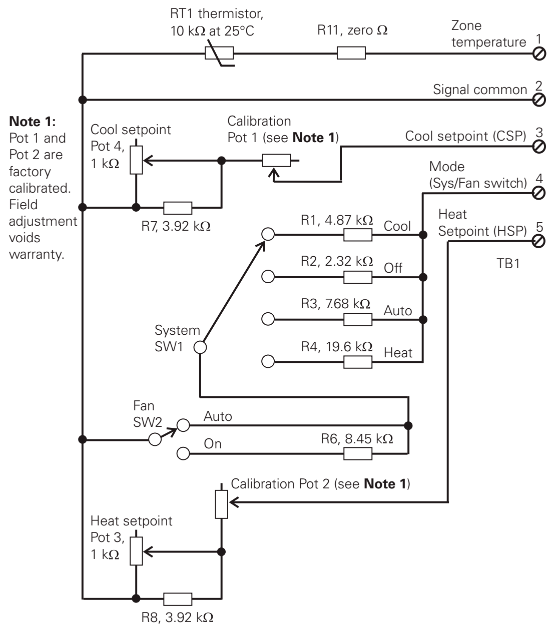


## BAYSENS108*/ASYSTAT108*

Accessory Heat / Cool Zone Sensor Module (ZSM) dual set point, manual / auto changeover. Five conductors required.

**Figure 43. BAYSENS108*/ASYSTAT108***

Part Number – SEN01513

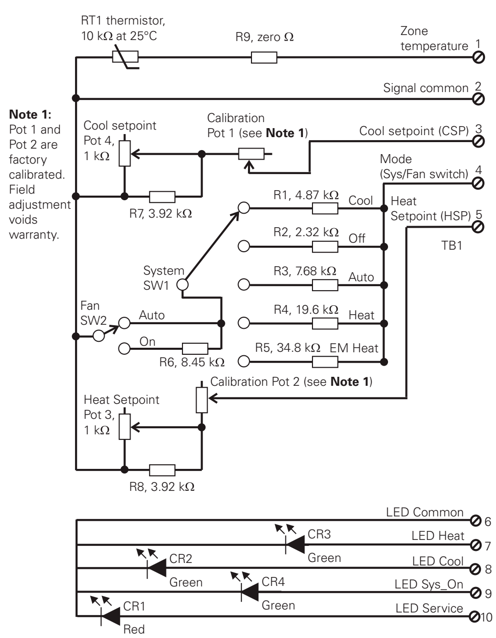



## BAYSENS109*/ASYSTAT109*

Accessory Heat Pump Zone Sensor Module (ZSM) dual set point with LEDs, manual / auto changeover. Ten conductors required.

**Figure 44. BAYSENS109*/ASYSTAT109***

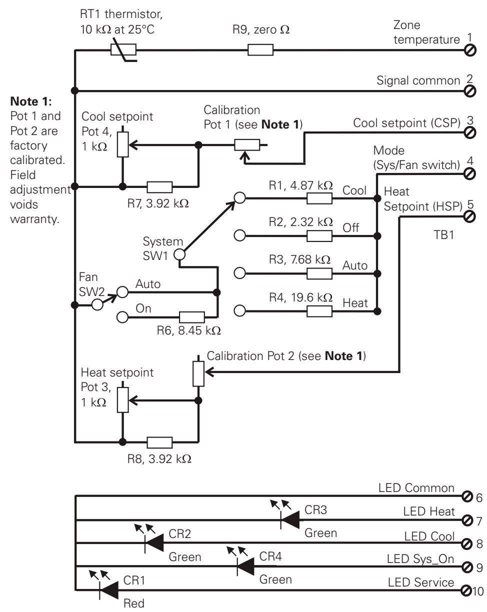
Part Number – SEN01523



## BAYSENS110*

Accessory Heat / Cool Zone Sensor Module (ZSM) dual set point with LEDs, manual / auto changeover. Ten conductors required.

**Figure 45. BAYSENS110***

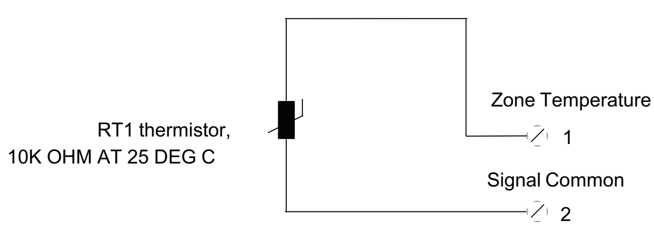



Part Number – SEN01522

## BAYSENS077*

Accessory Zone Sensor Remote, used with all current zone sensors. Two conductors required.

**Figure 46. BAYSENS077***

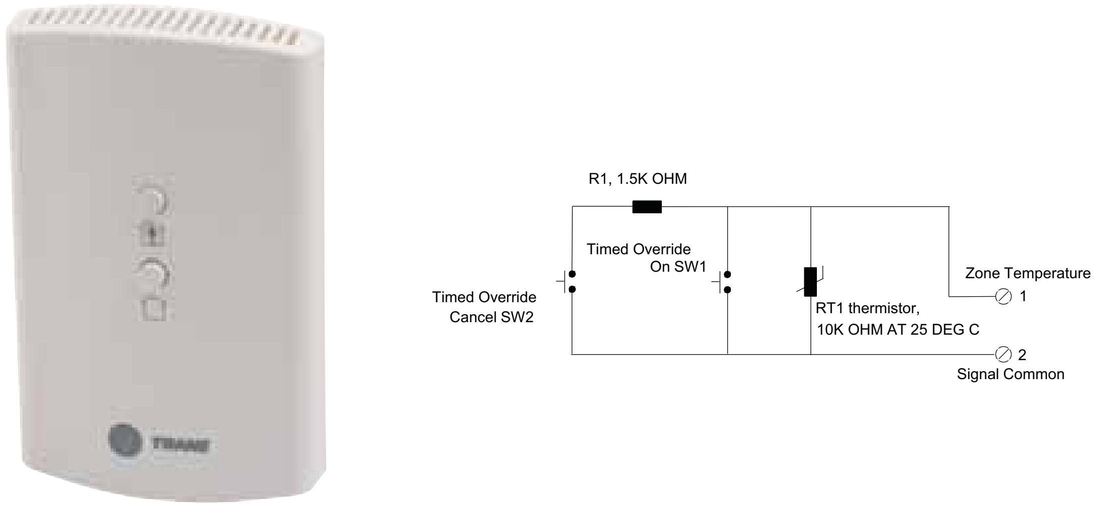



Part Number – SEN01448

## BAYSENS073*

Accessory ICS (Tracker™/Tracer™) Zone Sensor Module (ZSM), with override button, and override cancel button. Two conductors required.

**Figure 47. BAYSENS073***

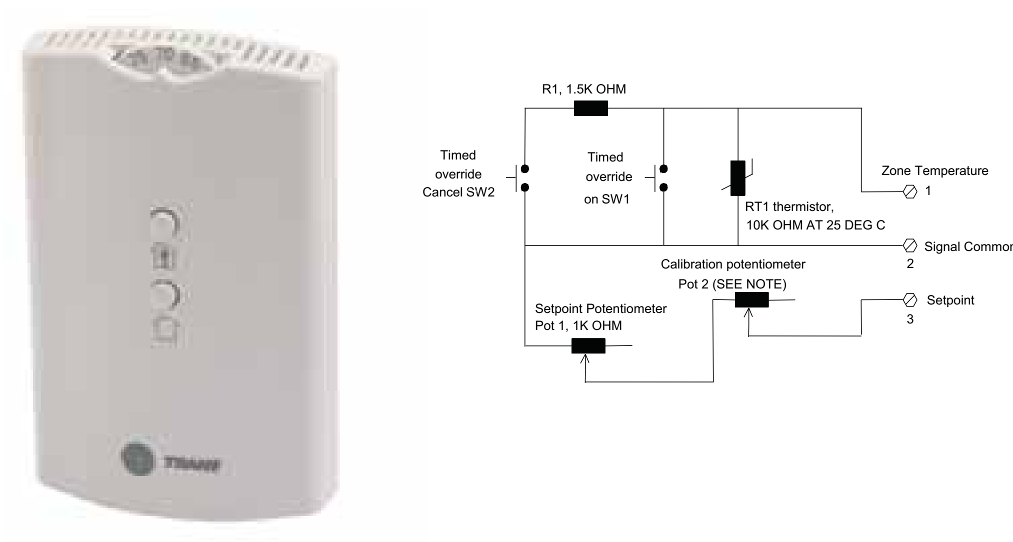



Part Number – SEN01450

## BAYSENS074*

Accessory ICS (Tracker™/Tracer™) Zone Sensor Module (ZSM), with override button, set point, and override cancel button. Three conductors required.

**Figure 48. BAYSENS074***



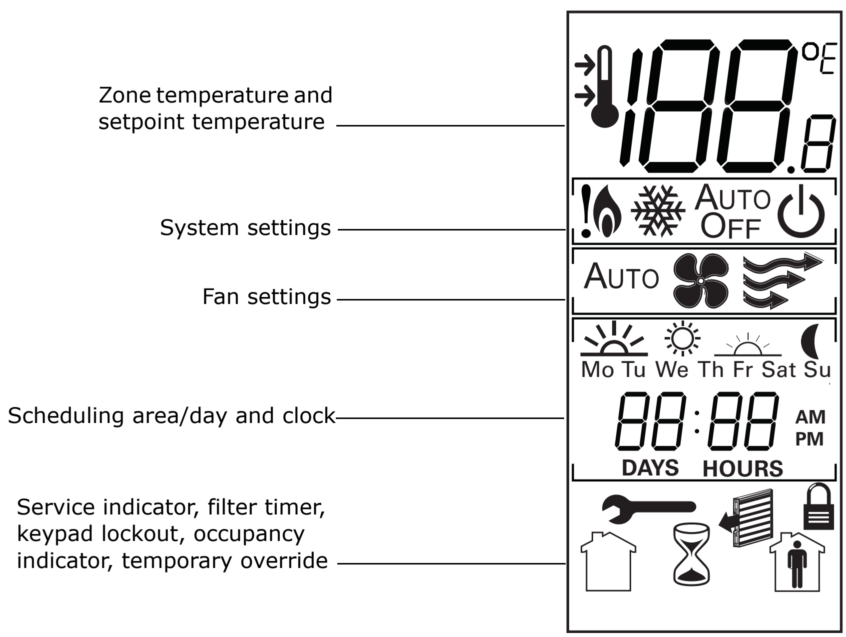

Part Number – SEN01447

## BAYSENS119* Programmable Zone sensor

**Figure 49. BAYSENS119***

The BAYSENS119A supersedes the BAYSENS019C. The BAYSENS119A has the same programming options and capabilities as the BAYSENS019C but also has improved thermistors that increases sensing accuracy and is still compatible with all equipment using either UCP or ReliaTel™ micro controls. The BAYSENS119A can be used with VAV, constant volume or heat pump equipment.

**Figure 50. Display with all the symbols showing**



### Table 20. ReliaTel™ and UCP wiring locations

| Sensor | | 3–through 25-ton packaged rooftops *CD/*CH/*SC/*HC | | 3-through 20-ton split system units TTA/TWA | 27.5-through 50-ton packaged rooftops YC*/TC*/TE* | |
|---|---|---|---|---|---|---|
| | | UCP control LTB[a] | ReliaTel Control J6 | ReliaTel Control J6 | UCP control LTB1[a] | ReliaTel Control J6 |
| REMOTE SENSOR INPUT[b] | S2 | Optional remote sensor | | | | |
| REMOTE SENSOR INPUT[b] | S1 | Optional remote sensor | | | | |
| 24 VAC INPUT[c] | 14 | 14[d] | 14 | 14 | 14 | 14 |
| COMMUNICATIONS[e] | 12 | 12 | 12 | 12 | 12 | 12 |
| COMMON[c] | 11 | 11 | 11 | 11 | 11 | 11 |
| SERVICE STATUS (UCM INPUT) | 10 | 10 | 10 | 10 | 10 | 10 |
| SYSTEM STATUS (ON/OFF INPUT) | 9 | 9 | 9 | 9 | 9 | 9 |
| COOL STATUS (UCM INPUT) | 8 | 8 | 8 | 8 | 8 | 8 |
| HEAT STATUS (UCM INPUT) | 7 | 7 | 7 | 7 | 7 | 7 |
| AUX RELAY (CLOSED—UNOCCUPIED) | A3 | The auxiliary relay on the sensor is form C, rated for 1.25 A at 30 Vac. It is energized during occupied periods. | | | | |
| AUX RELAY (COMMON) | A2 | | | | | |
| AUX RELAY (CLOSED—OCCUPIED) | A1 | | | | | |

(a) LTB and LTB1 refer to low-voltage terminal boards with numbers 1–20 and two test terminals.
(b) Connect an optional remote sensor (p/n BAYSENS017) to terminals S1 and S2. Connect the shield wire (drain wire) from the shielded cable to terminal 11.
(c) Connect the 24 Vac power supply from the unit controller to terminals 11 and 14.
(d) Use terminal 15 on older 3–25 ton Voyager units with low-voltage terminal boards numbered 1–18 with two test terminals.
(e) Data communication between the unit controller and the sensor is accomplished by a serial link connected at terminal 12.

## Error Codes

An error code indicates that technical assistance may be required.

***Note:*** *On the display, error codes toggle with the clock.*

| | | |
|---|---|---|
| E1 | Heat failure | Indicates that there is an error in the heating system. |
| E2 | Cool failure | Indicates that there is an error in the cooling system. |
| E3 | Test mode | Indicates that the system is operating in test mode. |
| E4 | Fan failure | Indicates that a fan failure has occurred and service is required. |

## BAYSENS135* Non-Programmable zone sensor

**Figure 51. BAYSENS135***

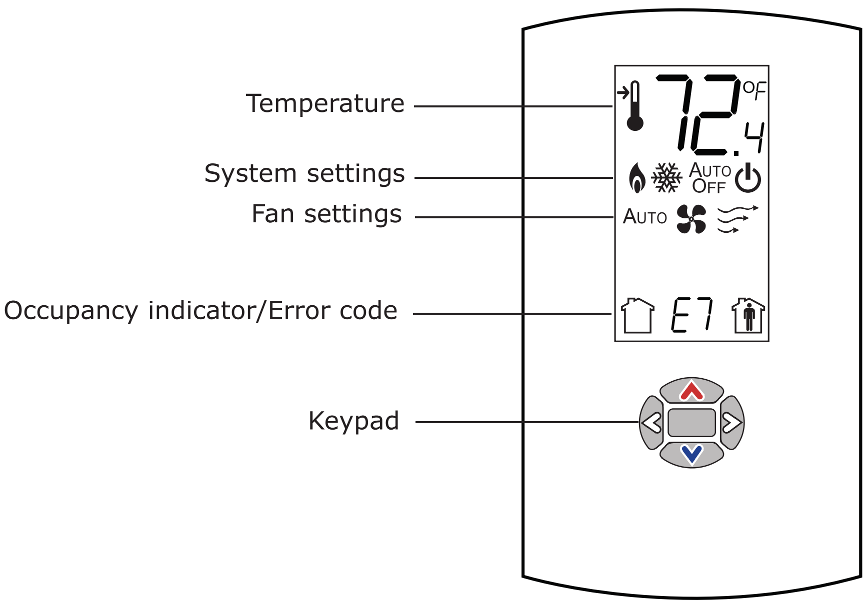
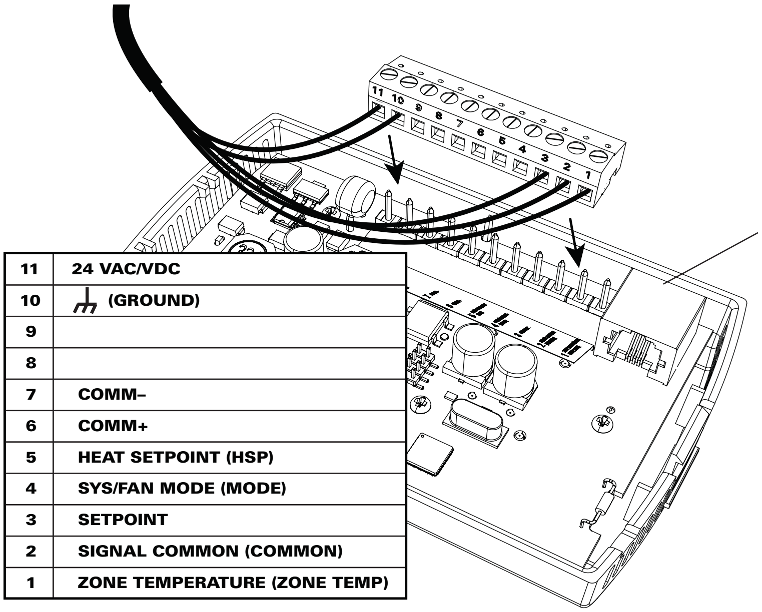



**Table 21. BAYSENS135A ReliaTel™ and UCP wiring locations**

| Feature description | BAYSENS135A | Reliatel RTRM terminal block (J6) position | UCP LTB screw terminal position |
|---|---|---|---|
| **Zone temperature** | 1 | 1 | 1 |
| **5 volt common** | 2 | 2 | 2 |
| **cooling setpoint** | 3 | 3 | 3 |
| **System/Fan Mode** | 4 | 4 | 4 |
| **Heating setpoint** | 5 | 5 | 5 |
| **COMM+** | 6 (not used) | NA | NA |
| **COMM-** | 7 (not used) | NA | NA |
| **NA** | 8 (not used) | NA | NA |
| **NA** | 9 (not used) | NA | NA |
| **Ground (24 VAC common)** | 10 | 11 | 20 |
| **24 VAC** | 11 | 14 | 14 |

A remote temperature sensor may be used with the BAYSENS135* but it will not display the remote temperature on the LCD screen.

**Figure 52. BAYSENS135***




| | |
|---|---|
| 11 | 24 VAC/VDC |
| 10 | (GROUND) |
| 9 | |
| 8 | |
| 7 | COMM– |
| 6 | COMM+ |
| 5 | HEAT SETPOINT (HSP) |
| 4 | SYS/FAN MODE (MODE) |
| 3 | SETPOINT |
| 2 | SIGNAL COMMON (COMMON) |
| 1 | ZONE TEMPERATURE (ZONE TEMP) |

## Error Codes

| | | |
|---|---|---|
| E0 | Main processor error | Replace sensor. |
| E6 | Software version conflict | Replace sensor. |
| E7 | Communication error | Replace sensor. |
| E8 | Temperature input outside valid operating range (32°F–122°F [0°C–50°C]) | Replace sensor if space temperature is within valid range. |

## Lock Symbol

| | | |
|---|---|---|
|  | Indicates that the keypad is locked | The lock symbol appears if you try to adjust a setting that cannot be changed. |

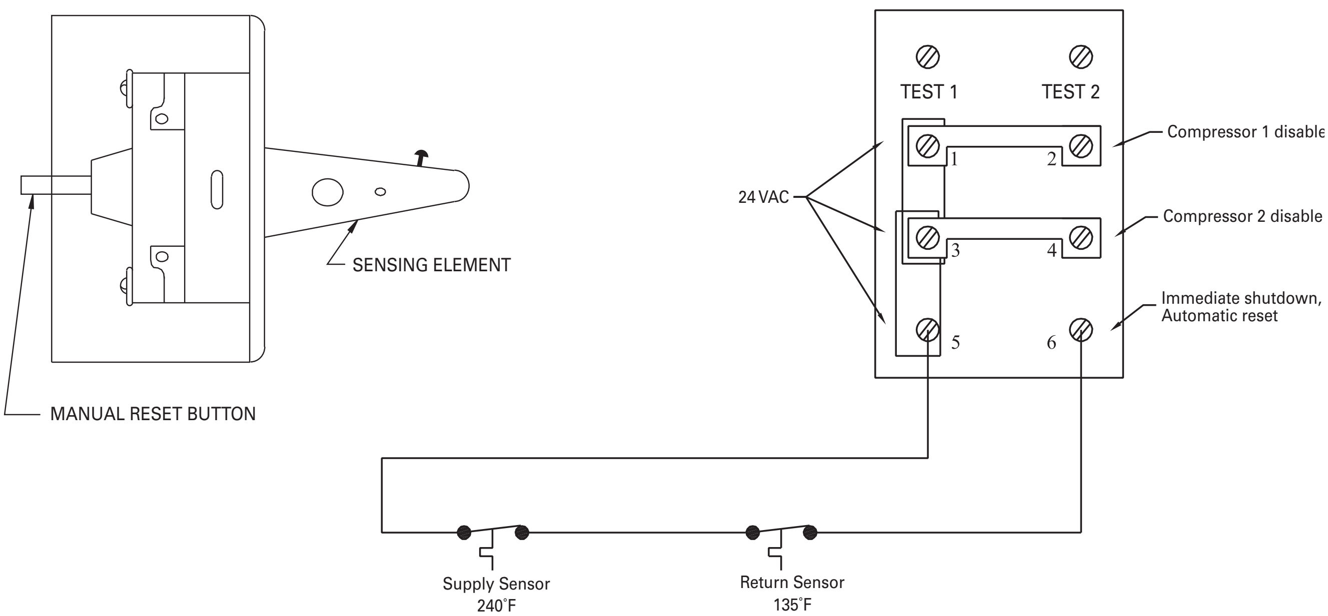
# High Temperature Sensor Diagram

## High Temperature Sensor

The high temperature sensor accessory (BAYFRST001*) provides high limit cutout with manual reset in ICS device Tracer™ / Tracker™ /ComforTrac™ / VariTrac™ systems. The sensors are wired to the LTB5 and LTB6 in the control panel. Jumper must be removed.

The sensors may be used to detect excessive heat in air conditioning or ventilation ducts and provide system shut down. Immediately after sensor opens, the associated unit will completely shut down. The sensors come with case and cover, and mount directly to the ductwork. There are two sensors that are included in the accessory. Both sensors are factory set; one opens at 135° F and should be installed in the return air duct, the other opens at 240° F and should be installed in the supply duct.

**Figure 53. High temperature sensor diagram**




| Component Description | Part Number |
|---|---|
| BAYFRST001A | CNT-0637 & CNT-0638 |

***Note:*** *This accessory can also be applied in Non-ICS applications. The wiring on the unit is the same. The unit will shut down immediately when the sensor opens.*

To reset a sensor which has opened, push and release the button protruding through the cover. See reset button. The sensor temperature must drop 25° F below. To reset a sensor which has opened, push and release the button protruding through the cover. See reset button. The sensor temperature must drop 25

There are no field adjustments that can be made to the sensor; if a problem exists, the sensor must be replaced.

- Part Number “CNT-0637” = 135° F sensor
- Part Number “CNT-0638” = 240° F sensor

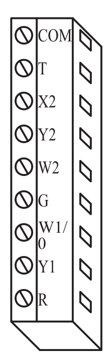
# Operation with a Conventional Thermostat (Constant Volume)

The ReliaTel™ module has conventional thermostat connections as well as Zone Sensor Module connections. When a conventional thermostat is controlling the unit, operation differs as follows.

- Supply Air Tempering feature is not available. If outdoor air is being introduced through the equipment, discharge air temperature may be cold when not actively heating.
- Proportional Integral (PI) control is not available.
- Zone Sensor Diagnostics are only available on the RTRM module on the J6 terminals, instead of at the Zone Sensor in the space.
- Intelligent Fall-Back is not available. If a failure occurs in the device controlling the equipment, operation will cease.
- Heat Pump Smart Recovery and Smart Staging is not available. Heat Pump operation becomes more costly unless the generic control being applied can accomplish this.
- Remote Sensing Capabilities are not available on most mechanical thermostats.
- Space Temperature Averaging capabilities are not available on most mechanical thermostats
- Built in Night Set Back and Unoccupied Functions function differently with a conventional mechanical thermostat.
- A built-in algorithm which allows for automatic reset of the discharge air temperature while economizing is not available.

***Note:*** *27½-through 50-ton VAV -conventional thermostat input terminals are inactive.*

The terminal strip for attaching the thermostat wires is located on the RTRM module in the control compartment. The purpose of each terminal is discussed in the next section. Customers occasionally require operation with a conventional thermostat rather than a zone sensor. In some cases there is a preference for a specific thermostat model, and in others there is reluctance to adopt newer technology that may not be as well understood as conventional thermostats.




In addition, non-Trane® Building Controllers typically provide an interface to HVAC equipment based on a conventional thermostat interface. Units applied with this type of controller need to accept conventional thermostat inputs.

Conventional thermostat signals represent direct calls for unit functions. In their simplest applications, thermostat contacts directly control contactors or other load switching devices. This function provides inputs for the thermostat signals and processing to enhance reliability and performance. Compressor protection and reliability enhancement functions (HPC, LPC, Minimum On/Off timers, etc.) all operate the same whether applied with zone sensors or a conventional thermostat.

Logic is also provided to cause appropriate unit functions when inappropriate thermostat signals are provided.

Simultaneous calls for heating and cooling will be ignored (the unit will not heat or cool). The supply fan will be turned on with a call for heating or cooling even if the fan request is not detected.

If the thermostat is immediately changed from a heating to a cooling call, or vice versa, there will be a five minute delay before the new call will initiate. For units with modulating gas heat, see p. 67 for a flow chart outlining operation with a conventional thermostat.

***Note:*** *Single Zone VAV units will not work properly with a 24 volt thermostat. Use of a 24 volt thermostat with a SZVAV unit is not recommended*

**Table 22. Thermostat signals**

| | |
|---|---|
| R | 24VAC power to thermostat |
| Y1 | Call for compressor 1 or first stage cooling |
| Y2 | Call for compressor 2 or 2nd stage cooling |
| G | Call for supply fan |
| W1 | Call for heat 1 (for modulating gas, see Figure 54, p. 67) |
| W2 | Call for heat 2 |
| **Heat pump only:** | |
| X2 | Call for emergency heat |
| O | Switchover valve On = cooling, Off = heating |
| T | Bias for heat anticipation for those mechanical thermostats that use this function |

**Table 23. Conventional thermostat – gas/electric, electric heat**

| Input/connection | Function when energized: |
|---|---|
| G (fan) | Fan runs continuously except during unoccupied mode (see next page) |
| Y1 (compressor 1 or economizer) | Compressor #1 runs or economizer operates |
| Y2 (compressor 2 or compressor 1 while economizing) | Compressor #2 also runs, or #1compressor runs while economizing |
| W1 (gas / electric heat first stage) | 1st stage heat |
| W2 (gas / electric heat 2nd stage) | 2nd stage heat (if available) |

**Table 24. Conventional thermostat – heat pump**

| Input/connection | Function when energized |
|---|---|
| **Cooling mode:** | |
| G (fan) | Fan runs continuously except during unoccupied mode (see next page) |
| O (reversing valve during cooling) | Reversing valve in cool mode |
| Y1 + O (first stage cooling) | Compressor #1 runs or economizer operates |
| Y1 + Y2 + O (2nd stage cool) | Compressor #2 also runs, or #1 compressor runs while economizing. |
| **Heating mode:** | |
| G (fan) | Fan runs continuously except during unoccupied mode (see below) |
| Y1 (both compressors 1st stage heat)[a] | Both compressors run |
| Y2 (during heating – nothing happens)[a] | No change |
| W2 (electric heat 2nd stage) | 2nd stage (electric) heat |
| X2 (electric heat only) | Electric heat only – no compressors |

(a) For units configured with 2-Step Mechanical Heating (Odyssey Independent Circuit Heat Pump), Y1 will correspond to a request for Compressor 1 operation and Y2 will correspond to a request for Compressor 2 operation.

**T:** provides heat anticipation signal for those mechanical thermostats that use this feature. If the thermostat used does not have a “T” terminal, disregard this terminal.

**Unoccupied mode:** If the thermostat being used is programmable, it will have its own strategy for unoccupied mode and will control the unit directly. If a mechanical thermostat is being used, a field applied time clock with relay contacts connected to J6-11 and J6-12 can initiate an unoccupied mode as follows:

## Operation with a Conventional Thermostat (Constant Volume)

**Contacts open:** Normal occupied operation.

**Contacts closed:** Unoccupied operation as follows - Fan in auto mode regardless of fan switch position. Economizer closes except while economizing regardless of minimum position setting.

### Cooling/Economizer Operation:

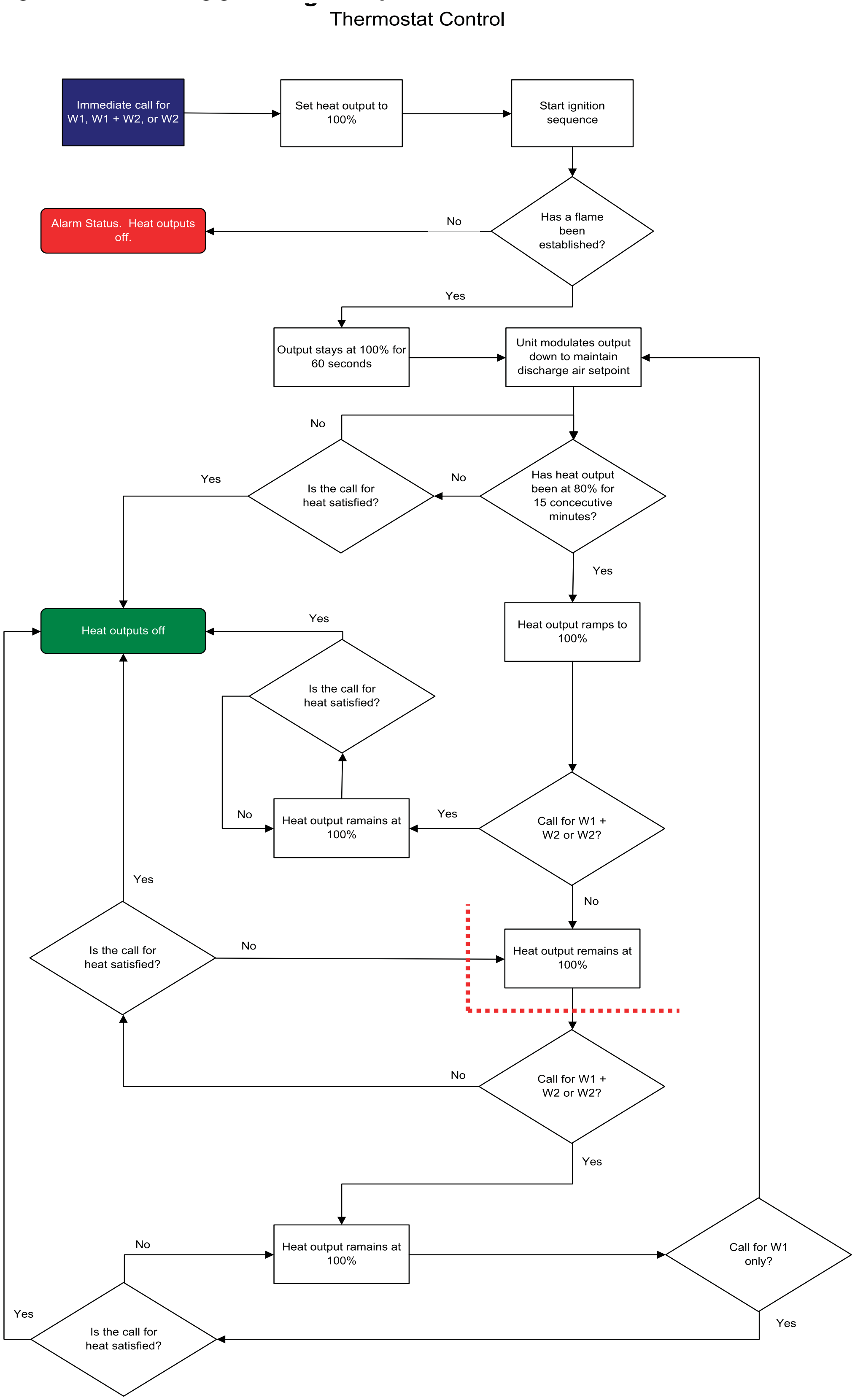
If unit does not have an economizer, the Cool/Econ Stage 1 and Stage 2 will call directly for mechanical cooling (compressor) stages. If the unit has an economizer, the Cool/Econ stages will function as follows.

**Table 25. Cooling/economizer operation with thermostat**

| OK to Economize? | Thermostat Y1 | Call for Thermostat Y2 | Economizer Cooling | Compressor Staging Request |
|---|---|---|---|---|
| No | On | Off | Inactive | Compressor Output 1 |
| No | Off | On | Inactive | Compressor Output 2 |
| No | On | On | Inactive | Compressor Outputs 1 & 2 |
| Yes | On | Off | Active | Off |
| Yes | Off | On | Active | Off |
| Yes | On | On | Active | Compressor Output 1 |

40 to 50 ton CV only.
This unit has 3 stages of cooling if using a zone sensor or binary inputs as shown above.
If using a conventional thermostat it has 2 stages as follow:
Y1 = 1st stage
Y1 + Y2 = 3rd stage
VAV
Thermostat inputs are ignored on VAV units.

**Figure 54. Modulating gas heat control process**



# Zone Sensor Module Testing

## Mechanical Zone Sensor Module

### Temperature Input

#### Terminals to Read Voltage: RTRM J6-1, J6-2

Read DC voltage with the sensor attached. If voltage does not appear to be correct, read the resistance of the circuit, then the sensor itself, to see if a problem exists in the sensor or the wiring. With the sensor not attached there should be 5.00 VDC at the terminals as shown below.

### Problems to Look for:

- Mis-wire/short/open
- Excessive resistance in circuit (corroded or loose connection)
- Sensor inaccurate (should be ± 2F of chart)
- Moisture in sensor (becomes accurate when dry)
- Induced voltage (high voltage wires in same conduit)

### Service Tips:

To check for induced voltage, read AC voltage to ground from each sensor wire. Should be less than 1 VAC.

**Figure 55. ZSM testing/voltmeter display**

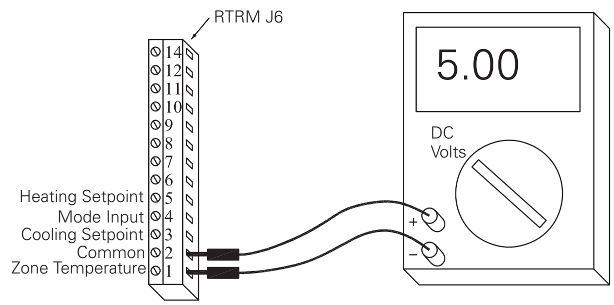



**Table 26. Temperature input**

| Temp °F | Resistance (K ohms) | DC Volts | Temp °F | Resistance (K ohms) | DC Volts | Temp °F | Resistance (K ohms) | DC Volts | Temp °F | Resistance (K ohms) | DC Volts |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 40 | 26.097 | 3.613 | 54 | 17.847 | 3.203 | 68 | 12.435 | 2.770 | 82 | 8.815 | 2.342 |
| 41 | 25.383 | 3.585 | 55 | 17.382 | 3.173 | 69 | 12.126 | 2.739 | 83 | 8.607 | 2.312 |
| 42 | 24.690 | 3.557 | 56 | 16.930 | 3.142 | 70 | 11.827 | 2.708 | 84 | 8.404 | 2.283 |
| 43 | 24.018 | 3.528 | 57 | 16.491 | 3.111 | 71 | 11.535 | 2.677 | 85 | 8.206 | 2.253 |
| 44 | 23.367 | 3.500 | 58 | 16.066 | 3.080 | 72 | 11.252 | 2.646 | 86 | 8.014 | 2.224 |
| 45 | 22.736 | 3.471 | 59 | 15.654 | 3.050 | 73 | 10.977 | 2.616 | 87 | 7.827 | 2.195 |
| 46 | 22.123 | 3.442 | 60 | 15.253 | 3.019 | 74 | 10.709 | 2.58 | 88 | 7.645 | 2.166 |
| 47 | 21.530 | 3.412 | 61 | 14.864 | 2.988 | 75 | 10.448 | 2.554 | 89 | 7.468 | 2.137 |
| 48 | 20.953 | 3.383 | 62 | 14.486 | 2.957 | 76 | 10.194 | 2.523 | 90 | 7.295 | 2.109 |
| 49 | 20.396 | 3.353 | 63 | 14.119 | 2.926 | 77 | 9.949 | 2.493 | 91 | 7.127 | 2.080 |
| 50 | 19.854 | 3.324 | 64 | 13.762 | 2.895 | 78 | 9.710 | 2.462 | 92 | 6.963 | 2.052 |
| 51 | 19.330 | 3.294 | 65 | 13.416 | 2.864 | 79 | 9.477 | 2.432 | 93 | 6.803 | 2.024 |
| 52 | 18.821 | 3.264 | 66 | 13.078 | 2.832 | 80 | 9.250 | 2.402 | 94 | 6.648 | 1.996 |
| 53 | 18.327 | 3.233 | 67 | 12.752 | 2.801 | 81 | 9.030 | 2.372 | 95 | 6.497 | 1.969 |

### Setpoint Input

#### Terminals to Read Voltage: RTRM J6-3 (cooling), J6-5 (heating), J6-2

Read DC voltage with Zone Sensor Module (ZSM) attached. If voltage read does not appear to be correct, read the resistance of the circuit, then the ZSM itself, to see if a problem exists in the ZSM or the wiring. With the ZSM not attached there should be 5.00 VDC at the terminals as shown. To check for induced voltage, read AC voltage to ground from each sensor wire. Should be less than 2VAC.

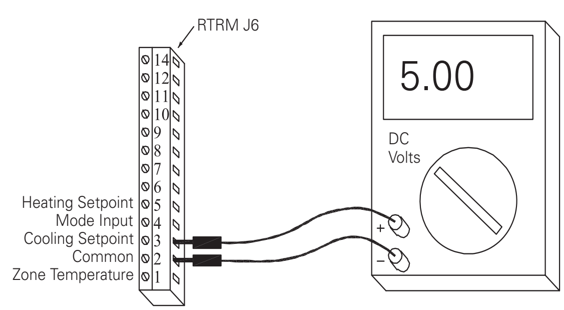


**Table 27.**

| Setpoint Inputs | Read voltage at either location | |
|---|---|---|
| Cooling setpoint | RTRM J6-3 | ZSM terminal 3 |
| Heating setpoint | RTRM J6-5 | ZSM terminal 5 |
| Common | RTRM J6-2 | ZSM terminal 2 |

## Problems to Look for:

- Mis-wire/short/open
- Excessive resistance in circuit (corroded or loose connection)
- Setpoint lever inaccurate (should be +-2F of chart)
- Induced voltage (high voltage wires in same conduit)

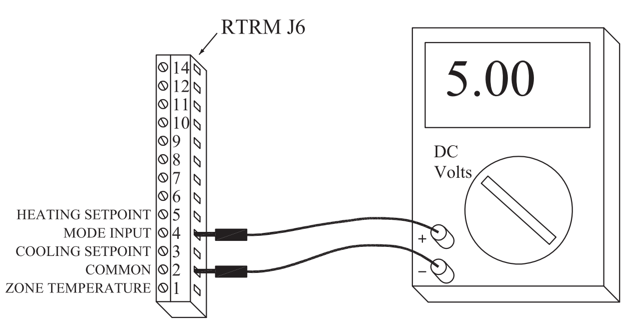
**Table 28. Setpoint inputs**

| Temp °F | Resistance (K ohms) | DC Volts | Temp °F | Resistance (K ohms) | DC Volts | Temp °F | Resistance (K ohms) | DC Volts | Temp °F | Resistance (K ohms) | DC Volts |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | open | 5.00 (open circuit) | 53 | 0.8373 | 2.278 | 67 | 0.5584 | 1.792 | 81 | 0.2858 | 1.111 |
| 40 | 1.0841 | 2.601 | 54 | 0.8166 | 2.247 | 68 | 0.5390 | 1.751 | 82 | 0.2663 | 1.051 |
| 41 | 1.0656 | 2.579 | 55 | 0.7958 | 2.216 | 69 | 0.5195 | 1.709 | 83 | 0.2468 | 0.990 |
| 42 | 1.0472 | 2.557 | 56 | 0.7751 | 2.183 | 70 | 0.5000 | 1.667 | 84 | 0.2273 | 0.926 |
| 43 | 1.0287 | 2.535 | 57 | 0.7544 | 2.150 | 71 | 0.4805 | 1.623 | 85 | 0.2079 | 0.860 |
| 44 | 1.0102 | 2.513 | 58 | 0.7337 | 2.116 | 72 | 0.4610 | 1.578 | 86 | 0.1884 | 0.793 |
| 45 | 0.9918 | 2.490 | 59 | 0.7142 | 2.083 | 73 | 0.4416 | 1.532 | 87 | 0.1689 | 0.723 |
| 46 | 0.9733 | 2.466 | 60 | 0.6948 | 2.050 | 74 | 0.4221 | 1.484 | 88 | 0.1495 | 0.650 |
| 47 | 0.9548 | 2.442 | 61 | 0.6753 | 2.015 | 75 | 0.4026 | 1.435 | 89 | 0.1301 | 0.575 |
| 48 | 0.9363 | 2.418 | 62 | 0.6558 | 1.980 | 76 | 0.3832 | 1.385 | 90 | 0.1106 | 0.498 |
| 49 | 0.9179 | 2.393 | 63 | 0.6363 | 1.944 | 77 | 0.3637 | 1.333 | (shorted/no power) | | 0.000 |
| 50 | 0.8994 | 2.368 | 64 | 0.6169 | 1.908 | 78 | 0.3442 | 1.280 | | | |
| 51 | 0.8787 | 2.338 | 65 | 0.5974 | 1.870 | 79 | 0.3247 | 1.226 | | | |
| 52 | 0.8580 | 2.309 | 66 | 0.5779 | 1.831 | 80 | 0.3053 | 1.169 | | | |

# Mode Input

## Terminals to Read Voltage: RTRM J6-4, J6-2

Read DC voltage with Zone Sensor Module (ZSM) attached. If voltage read does not appear to be correct, read the resistance of the circuit, then the ZSM itself, to see if a problem exists in the ZSM or the wiring. With the ZSM not attached there should be 5.00 VDC at the terminals listed above. To check for induced voltage, read AC voltage to ground from each sensor wire. Should be less than 2VAC.




| Mode Input: | | |
|---|---|---|
| Mode Input | RTRM J6-4 | ZSM terminal 4 |
| Common | RTRM J6-2 | ZSM terminal 2 |

## Problems to Look for:

- Miswire/short/open
- Excessive resistance in circuit (corroded or loose connection)
- Induced voltage (high voltage wires in same conduit)

**Table 29.**

| System Switch | Fan switch | Ohms Rx1K | Volts DC +- 5% |
|---|---|---|---|
| Short to common | | 0 | 0.00 |
| OFF | AUTO | 2.32 | 0.94 |
| COOL | AUTO | 4.87 | 1.64 |
| AUTO | AUTO | 7.68 | 2.17 |
| OFF | ON | 10.77 | 2.59 |
| COOL | ON | 13.32 | 2.85 |
| AUTO | ON | 16.13 | 3.08 |
| HEAT | AUTO | 19.48 | 3.30 |
| HEAT | ON | 27.93 | 3.68 |
| EM HEAT | AUTO | 35.00 | 3.88 |
| EM HEAT | ON | 43.45 | 4.06 |
| Open circuit | | | 5.00 |

## Programmable Zone Sensor BAYSENS119* and BAYSENS019C (Obsolete)

The BAYSENS019* Programmable Zone sensor is a digital display sensor that communicates to micro controls. This programmable sensor is compatible with the following constant volume (CV) units:

- Voyager™ UCP 3-through 25-tons
- Voyager™ UCP 27.5-through 50-tons CV
- Precedent™ ReliaTel™ 3-through 10-tons
- Voyager™ ReliaTel™ 12.5-through 25-tons
- Voyager™ ReliaTel™ 27.5-through 50-tons CV
- IntelliPak™ Rooftop 20-through 130-tons CV
- Odyssey™ ReliaTel™ 6-through 20-tons

For programming information, refer to literature ACC-SVN28*-EN.

### Testing the Programmable Zone Sensor (PZS)

1. Verify unit operation by running unit through test mode.
2. Verify that the PZS has a normal display of time, temperature, fan and system status.
3. For UCP Micro, disconnect wires from LTB-11 (-) and LTB-12 (+); For ReliaTel™ controls, disconnect wires from J6-11 and J6-12. Measure the dc voltage between terminals 11 and 12. Voltage should read between 28 to 32 vdc. If no voltage is present for UCP micro, check wiring between UCP and LTB.
4. Reconnect wires to terminals 11 and 12. Measure the voltage between 11 and 12 again. Voltage should flash at 0.5 second rate, with a voltage value randomly changing from approximately 24 to 32 vdc.
5. On the PZS, press the FAN button to turn the fan ON. If the fan comes on, the PZS is good; if the fan does not come on, the PZS may be defective and will need to be replaced.

***Note:*** *The sensor will not communicate if the wrong baud rate is selected. The PZS is shipped with the baud rate set to 1200. See Option Menu setup in the literature to verify proper baud rate. The baud rate may need to be changed to 1024 for units built before 1/96.*

### Troubleshooting the Programmable Zone Sensor

Because the PZS is a communicating sensor, troubleshooting is very limited. Step 2 through Step 5 of testing the sensor are the first steps to verify. The following table will provide other troubleshooting tips for diagnosing the sensor and unit operations.

If all wiring and preliminary tests do not indicate any defects, disconnect the PZS from the wall and take to the unit, and with a short (approx. two feet) length of thermostat wire, connect the PZS and see if symptoms still exist. If not, check for thermostat wire routing in close proximity of high voltage wires and fluorescent lights.

**Table 30. Troubleshooting**

| Symptom | Probable Cause and solution |
|---|---|
| Display does not come on. | Check for 24 vac on terminals 11 and 12 of the sensor. |
| No communication with unit. | Verify a varying voltage per step 2 of testing the sensor. If no voltage is present, check with wiring to unit. |
| Sensor is communicating, but unit won't run | Check option 18 in Option Menu setup for correct baud rate. |
| Displayed zone temperature is different from actual temperature. | Follow Option Menu setup in literature to calibrate the display. |
| Zone temperature is not displayed | Check option selection in Option menu setup |
| Displayed zone temperature reads "99". | Space temperature is above or below the measurable range of the sensor. |
| Displayed zone temperature reads Sh and the COOL FAIL icon is illuminated. | Verify that option 11 in Option Menu is set correctly. If correct, check the wiring from the remote sensor at terminals S1 and S2 for a shorted condition. |
| Displayed zone temperature reads oPand the COOL FAIL icon is illuminated. | Verify that option 11 in Option Menu is set correctly. If correct, check remote sensor wiring at terminals S1 and S2 for an open circuit condition. |
| Programmable sensor will not respond to keypad selections | Check lower left corner of display for a padlock icon. If displayed, press and hold the Time (+) and (-) key until the icon goes away. |
| Fan mode is set to on, but does not run during unoccupied mode. Periods | Check option 6 in Option menu setup for Auto selection during unoccupied. |
| Buzzer indicates System Failure, Check filter or service is required. | Press erase key to reset filter lapse timer. Buzzer will be reset until noon of the next day if a system failure has not been corrected. |
| sensor will not hold override changes. | Press the HOLDTEMP button within 20 seconds after changes are made. |
| COOL FAIL flashes and unit doesn't run. Check for varying voltage on terminals. | Sensor not communicating with unit. 11 and 12 at the unit. If voltage is steady at approximately 30 vdc, check for open circuit in wiring. |
| COOL FAIL + HEAT FAIL icons flash simultaneously | Check for defective outside air sensor. Emergency input is open. (RTRM version 4.0)<br>Coil Temp Sensor fail (HP). |
| HEAT FAIL flashing | A heat failure has occurred. If HP unit, the unit may be in emergency heat, or there is a defrost problem. |

# RTRM/RTOM (Temperature Inputs)

## Outdoor Air Sensor, Discharge Air Sensor, Coil Temperature Sensor

### Terminals to Read Voltage:

Outdoor Air Sensor — RTRM J8-2, J8-1

Discharge Air Sensor — RTOM J4-5, J4-4

Coil Temperature Sensor 1 — RTRM J2-3, J2-4

Coil Temperature Sensor 2 — RTRM J9-2, J9-1

***Note:*** *These are RTRM, RTOM inputs only. Economizer inputs (MAS, RAS, OHS, RHS, $CO_2$) are in the ReliaTel™ Economizer inputs section.*

Read DC voltage with the sensor attached. If voltage does not appear to be correct, read the resistance of the circuit, then the sensor itself, to see if a problem exists in the sensor or the wiring. With the sensor not attached there should be 5.00 VDC at the terminals listed above.

### Service Tips:

The second sensor terminal listed above is common. All common terminals are grounded, therefore one volt meter lead can be attached to ground for voltage tests. To check for induced voltage, read AC voltage to ground from each sensor wire. Should be less than 1 VAC.

### Problems to Look for:

- Mis-wire / short / open
- Excessive resistance in circuit (corroded or loose connection)
- Sensor inaccurate (should be +- 2F of chart)
- Moisture in sensor (becomes accurate when dry)
- Induced voltage (high voltage wires in same conduit)

**Table 31. Temperature input**

| Temp °F | Resistance (K ohms) | DC Volts | Temp °F | Resistance (K ohms) | DC Volts | Temp °F | Resistance (K ohms) | DC Volts | Temp °F | Resistance (K ohms) | DC Volts |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -40 | 345.684 | 4.856 | -20 | 169.798 | 4.718 | 1 | 84.537 | 4.468 | 21 | 45.354 | 4.094 |
| -39 | 333.237 | 4.851 | -19 | 164.076 | 4.709 | 2 | 81.868 | 4.453 | 22 | 44.007 | 4.072 |
| -38 | 321.274 | 4.845 | -18 | 158.562 | 4.7 | 3 | 79.291 | 4.437 | 23 | 42.705 | 4.049 |
| -37 | 309.777 | 4.84 | -17 | 153.248 | 4.69 | 4 | 76.802 | 4.421 | 24 | 41.446 | 4.026 |
| -36 | 298.724 | 4.834 | -16 | 148.127 | 4.680 | 5 | 74.403 | 4.404 | 25 | 40.226 | 4.002 |
| -35 | 288.097 | 4.828 | -15 | 143.192 | 4.67 | 6 | 72.087 | 4.388 | 26 | 39.046 | 3.978 |
| -34 | 277.879 | 4.823 | -14 | 138.435 | 4.66 | 7 | 69.849 | 4.371 | 27 | 37.904 | 3.954 |
| -33 | 268.053 | 4.816 | -12 | 129.449 | 4.638 | 8 | 67.687 | 4.353 | 28 | 36.797 | 3.929 |
| -32 | 258.603 | 4.81 | -11 | 125.199 | 4.627 | 9 | 65.597 | 4.336 | 29 | 35.726 | 3.904 |
| -31 | 249.523 | 4.804 | -10 | 121.1 | 4.615 | 10 | 63.577 | 4.317 | 30 | 34.689 | 3.879 |
| -30 | 240.81 | 4.797 | -9 | 117.146 | 4.603 | 11 | 61.624 | 4.299 | 31 | 33.686 | 3.853 |
| -29 | 232.425 | 4.79 | -8 | 113.331 | 4.591 | 12 | 59.737 | 4.28 | 32 | 32.72 | 3.827 |
| -28 | 224.355 | 4.783 | -7 | 109.652 | 4.579 | 13 | 57.913 | 4.261 | 33 | 31.797 | 3.801 |
| -27 | 216.59 | 4.776 | -6 | 106.102 | 4.566 | 14 | 56.153 | 4.241 | 34 | 30.903 | 3.775 |
| -26 | 209.114 | 4.768 | -5 | 102.676 | 4.553 | 15 | 54.452 | 4.221 | 35 | 30.037 | 3.749 |
| -25 | 201.918 | 4.76 | -4 | 99.377 | 4.54 | 16 | 52.807 | 4.201 | 36 | 29.198 | 3.722 |
| -24 | 194.991 | 4.752 | -3 | 96.197 | 4.526 | 17 | 51.216 | 4.18 | 37 | 28.386 | 3.695 |
| -23 | 188.32 | 4.744 | -2 | 93.127 | 4.512 | 18 | 49.677 | 4.159 | 38 | 27.599 | 3.668 |
| -22 | 181.904 | 4.736 | -1 | 90.163 | 4.498 | 19 | 48.188 | 4.138 | 39 | 26.836 | 3.641 |
| -21 | 175.738 | 4.727 | 0 | 87.301 | 4.483 | 20 | 46.748 | 4.116 | 40 | 26.097 | 3.613 |
| 41 | 25.383 | 3.585 | 85 | 8.206 | 2.253 | 129 | 3.104 | 1.185 | 173 | 1.331 | 0.588 |
| 42 | 24.69 | 3.557 | 86 | 8.014 | 2.224 | 130 | 3.041 | 1.166 | 174 | 1.308 | 0.579 |
| 43 | 24.018 | 3.528 | 87 | 7.827 | 2.195 | 131 | 2.98 | 1.148 | 175 | 1.284 | 0.57 |
| 44 | 23.367 | 3.5 | 88 | 7.645 | 2.166 | 132 | 2.919 | 1.13 | 176 | 1.261 | 0.561 |
| 45 | 22.736 | 3.471 | 89 | 7.468 | 2.137 | 133 | 2.861 | 1.113 | 177 | 1.239 | 0.552 |
| 46 | 22.123 | 3.442 | 90 | 7.295 | 2.109 | 134 | 2.804 | 1.095 | 178 | 1.217 | 0.543 |
| 47 | 21.53 | 3.412 | 91 | 7.127 | 2.08 | 135 | 2.748 | 1.078 | 179 | 1.196 | 0.535 |
| 48 | 20.953 | 3.383 | 92 | 6.963 | 2.052 | 136 | 2.693 | 1.061 | 180 | 1.174 | 0.526 |
| 49 | 20.396 | 3.353 | 93 | 6.803 | 2.024 | 137 | 2.64 | 1.045 | 181 | 1.154 | 0.518 |
| 50 | 19.854 | 3.324 | 94 | 6.648 | 1.996 | 138 | 2.587 | 1.028 | 182 | 1.133 | 0.51 |

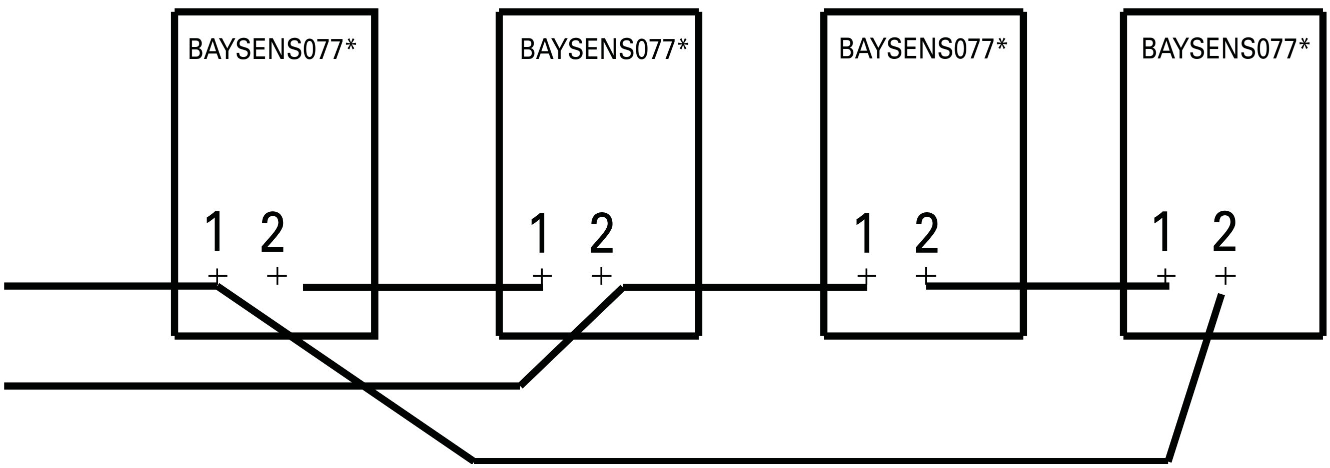
### Table 31. Temperature input (continued)

| Temp °F | Resistance (K ohms) | DC Volts | Temp °F | Resistance (K ohms) | DC Volts | Temp °F | Resistance (K ohms) | DC Volts | Temp °F | Resistance (K ohms) | DC Volts |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 51 | 19.33 | 3.294 | 95 | 6.497 | 1.969 | 139 | 2.536 | 1.012 | 183 | 1.113 | 0.502 |
| 52 | 18.821 | 3.264 | 96 | 6.35 | 1.942 | 140 | 2.486 | 0.996 | 184 | 1.094 | 0.494 |
| 53 | 18.327 | 3.233 | 97 | 6.207 | 1.915 | 141 | 2.438 | 0.981 | 185 | 1.076 | 0.487 |
| 54 | 17.847 | 3.203 | 98 | 6.067 | 1.888 | 142 | 2.39 | 0.965 | 186 | 1.057 | 0.479 |
| 55 | 17.382 | 3.173 | 99 | 5.931 | 1.861 | 143 | 2.343 | 0.95 | 187 | 1.038 | 0.471 |
| 56 | 16.93 | 3.142 | 100 | 5.798 | 1.835 | 144 | 2.298 | 0.935 | 188 | 1.02 | 0.464 |
| 57 | 16.491 | 3.111 | 101 | 5.668 | 1.809 | 145 | 2.253 | 0.92 | 189 | 1.003 | 0.457 |
| 58 | 16.066 | 3.08 | 102 | 5.543 | 1.783 | 146 | 2.21 | 0.906 | 190 | 0.986 | 0.45 |
| 59 | 15.654 | 3.05 | 103 | 5.42 | 1.757 | 147 | 2.167 | 0.891 | 191 | 0.969 | 0.443 |
| 60 | 15.253 | 3.019 | 104 | 5.3 | 1.732 | 148 | 2.125 | 0.877 | 192 | 0.952 | 0.436 |
| 61 | 14.864 | 2.988 | 105 | 5.184 | 1.707 | 149 | 2.085 | 0.863 | 193 | 0.937 | 0.429 |
| 62 | 14.486 | 2.957 | 106 | 5.07 | 1.682 | 150 | 2.044 | 0.849 | 194 | 0.92 | 0.422 |
| 63 | 14.119 | 2.926 | 107 | 4.959 | 1.658 | 151 | 2.006 | 0.836 | 195 | 0.905 | 0.416 |
| 64 | 13.762 | 2.895 | 108 | 4.851 | 1.633 | 152 | 1.967 | 0.823 | 196 | 0.89 | 0.41 |
| 65 | 13.416 | 2.864 | 109 | 4.745 | 1.609 | 153 | 1.93 | 0.81 | 197 | 0.875 | 0.403 |
| 66 | 13.078 | 2.832 | 110 | 4.642 | 1.585 | 154 | 1.894 | 0.797 | 198 | 0.86 | 0.397 |
| 67 | 12.752 | 2.801 | 111 | 4.542 | 1.562 | 155 | 1.859 | 0.784 | 199 | 0.846 | 0.391 |
| 68 | 12.435 | 2.77 | 112 | 4.444 | 1.539 | 156 | 1.823 | 0.772 | 200 | 0.831 | 0.385 |
| 69 | 12.126 | 2.739 | 113 | 4.349 | 1.516 | 157 | 1.789 | 0.759 | Shorted or no power | | 0 |
| 70 | 11.827 | 2.708 | 114 | 4.256 | 1.493 | 158 | 1.756 | 0.747 | | | |
| 71 | 11.535 | 2.677 | 115 | 4.165 | 1.47 | 159 | 1.723 | 0.736 | | | |
| 72 | 11.252 | 2.646 | 116 | 4.076 | 1.448 | 160 | 1.691 | 0.724 | | | |
| 73 | 10.977 | 2.616 | 117 | 3.99 | 1.426 | 161 | 1.659 | 0.712 | | | |
| 74 | 10.709 | 2.585 | 118 | 3.906 | 1.405 | 162 | 1.629 | 0.701 | | | |
| 75 | 10.448 | 2.554 | 119 | 3.824 | 1.383 | 163 | 1.599 | 0.69 | | | |
| 76 | 10.194 | 2.523 | 120 | 3.743 | 1.362 | 164 | 1.57 | 0.688 | | | |
| 77 | 9.949 | 2.493 | 121 | 3.665 | 1.341 | 165 | 1.541 | 0.679 | | | |
| 78 | 9.71 | 2.462 | 122 | 3.589 | 1.321 | 166 | 1.512 | 0.658 | | | |
| 79 | 9.477 | 2.432 | 123 | 3.514 | 1.301 | 167 | 1.485 | 0.647 | | | |
| 80 | 9.25 | 2.402 | 124 | 3.442 | 1.281 | 168 | 1.458 | 0.637 | | | |
| 81 | 9.03 | 2.372 | 125 | 3.371 | 1.261 | 169 | 1.432 | 0.627 | | | |
| 82 | 8.815 | 2.342 | 126 | 3.302 | 1.241 | 170 | 1.406 | 0.617 | | | |
| 83 | 8.607 | 2.312 | 127 | 3.234 | 1.222 | 171 | 1.380 | 0.607 | | | |
| 84 | 8.404 | 2.283 | 128 | 3.169 | 1.204 | 172 | 1.356 | 0.598 | | | |

# Zone Sensor Averaging

In some applications, 1 zone sensor does not give a good representation of zone temperature. The internal thermistors, 10K ohm resistance @ 25C/77F, can be wired as shown below in order to provide an average input to the mechanical or programmable Zone Sensor Module BAYSENS106*-BAYSENS111*/ASYSTAT106-109, ASYSTAT111, BAYSENS019*/AYSTAT666*. If using a Programmable ZSM, the remote sensor wiring must be twisted/shielded. Connect the shield to terminal J6-11.

**Figure 56. Zone sensor averaging**



# COMM3/4 Interface Operation & Troubleshooting

## Wiring:

The COMM3/4 board communicates with the RTRM via the MODBUS link using the harness, labeled 4366-1151. The connections to the board are shown below.

Communication wires must be twisted/shielded as specified by the BAS system being applied. Do not attach the shield to the COMM3/4 board. It must be taped back to prevent it from touching the unit.

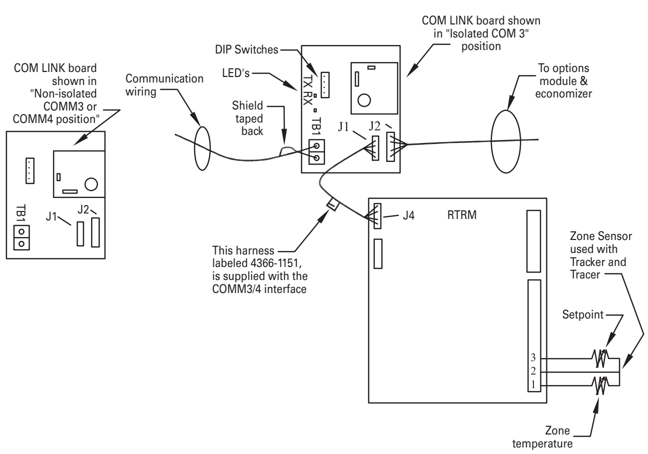
## LED's:

Amber receive (RX) LED: Blinks whenever communication is occurring with any device. This tells the service technician that the BAS system is communicating or trying to communicate with other devices as well as this one.

Green transmit (TX) LED: Blinks once every several seconds, sometimes up to 45 seconds between blinks, when the unit is sending data to the BAS system. This tells the service technician that this unit is communicating information to the BAS system. When the TX LED is blinking, the unit is communicating.

## Communication Problems:

**Figure 57. Troubleshooting outline**




### Won't communicate with Tracker™ 3-through 25-ton only

- Harness, labeled 4366-1151, must be plugged into RTRM correctly – see previous page.
- Com Link board must be in "ISOLATED COM 3" position. If it is in the wrong position or not installed, the unit will not communicate.
- Each unit must have a unique address by setting the DIP switches according to the IOM. If 2 units have the same address, neither will communicate. If the unit has a DIP switch setting other than the ones specified in the IOM, Tracker™ will not recognize it.
- Once the unit communicates with Tracker™, the Tracker™ panel will automatically recognize the unit.
- Resistor missing at last unit in daisy chain (depending on length of line run).

### Won't communicate with Tracer™ SUMMIT:

- Harness, labeled 4366-1151, must be plugged into RTRM correctly – see above.
- Com Link board must be in "NON ISOLATED COMM3 or COMM4" position. If it is in the wrong position or not installed, the unit will not communicate.
- Each unit must have a unique address by setting the DIP switches according to the IOM. If 2 units have the same address, neither will communicate. If the unit has a DIP switch setting other than the ones specified in the IOM, Tracer™ will not recognize it.
- Once the unit communicates with Tracer™, the Tracer™ panel will automatically recognize the unit.

### Won't communicate with VariTrac™ CCP zoning system:

- Harness, labeled 4366-1151, must be plugged into RTRM correctly – see above.
- Com Link board must be in "NON ISOLATED COMM3 or COMM4" position. If it is in the wrong position or not installed, the unit will not communicate.

### VariTrac™ I Comfort Manager and VariTrac™ II Center Control Panel:

- The DIP switches must all be in the ON position. If not, the VariTrac™ CCP will not recognize it.
- The communication wires must be in the same daisy chain link as the dampers.
- VariTrac™ III central control panel (optional touch screen) — All DIP switches must be in the off position. If not, the VariTrac™ CCP will not recognize it.

### Communicates but will not run, even in TEST mode:

- Emergency stop input is open (RTRM 3J1-12).

### Communicates but will not run; fan (but not heating or cooling) runs in TEST mode for 40 seconds only:

#### 3-through 25-tons.

- Fan proving circuit (RTOM 5J7-6) is closed; should open when fan is on. If not, the fan will run in TEST mode for 40 seconds and then stop.

#### 27½-through 50-tons.

- Fan proving circuit (RTOM 5J7-6) is opened; should close when fan is on. If not, the fan will run in TEST mode for 40 seconds and then stop.

### Communicates but will not run compressor(s); fan and heating run in TEST mode:

- Compressor disable circuit(s) (RTRM 3J1-8, 3J3-2) open due to loss of charge or LTB jumper removal.

### Communicates but will not run compressors, yet everything runs in TEST mode:

- FROSTAT™ circuit (RTOM 5J7-2) is closed; should open when indoor coil is frost free. Prior to RTRM v8.0, there is no diagnostic output when this occurs.
- 27.5-through 50-tons VariTrac™ CCP with constant volume unit with bypass VAV: Unit must have a discharge air sensor installed at RTOM J4-4, J4-5.

# Direct Spark Ignition Control (Texas Instruments, 3-through 10-Ton Units only)

This microprocessor based, communicating solid state device provides gas valve control, proof of ignition, ignition retries, 1 hour reset, operation of the inducer and diagnostics through an LED as well as communication to the refrigeration module. Inputs to the control include a pressure switch, rollout switch and limit switch as well as a flame proving circuit.

This device takes control of the ignition, timings related to the ignition cycle, and supervision of the gas components.

The RTRM controls all functions via a MODBUS communication link.

The remote flame sensor is located on the top burner which ensures that all burners are lit. Field measured flame sensor voltage can vary significantly due to the construction of typical voltmeters used.

The control has a 20 second pre-purge cycle as well as a 60 second inter-purge between cycles should a flame not be established on the first try.

**Table 32. Ignition module specifications**

| | |
|---|---|
| Voltage range | 18-32 VAC, 50/60Hz |
| Power consumption | 350mA @ 24vac |
| Spark Voltage | 25,000 volts max @ 10-13 mJ |
| Flame sense voltage | Nominal 90Vrms |
| Flame sense signal | Nominal 4.5 micro amps, minimum 1.2 micro amps |
| Pre-purge | 20 seconds |
| Post-purge | 5 Seconds |
| Inter-purge | 60 seconds |
| Flame establishment period | 2 to 7 seconds |
| Flame failure response time | 0.8 seconds |
| Loss of flame lockout | 3 tries, locks out after 3rd try |
| Lockout reset | Interrupt power for 3 seconds minimum |
| Auto reset | 1 hour |
| Loss of communication lockout (with RTRM) | 10 seconds |

The ignition module has a green LED for diagnostics:

**Table 33. Ignition module diagnostics**

| | |
|---|---|
| Steady light | Module is powered up, but no active call for heat. |
| Blinking at continuous steady rate | Active call for heat. |
| One blink | Loss of communication. |
| Two blinks | System lockout (failure to ignite, no spark, low/no gas pressure, etc). |
| Three blinks | Pressure switch (no vent air flow, bad CBM, closed at initial call for heat). Auto reset. (Applicable to 3-through 10-tons units only.) |
| Four blinks | High limit (excessive heat in combustion chamber, low airflow). Auto reset. |
| Five blinks | Flame sensed and gas valve not energized or flame sensed and no call for heat. |
| Six blinks | Flame rollout (CBM failure, incorrect gas pressure, incorrect primary air). Requires manual reset of the switch. (Applicable to 3-through 10-tons units only) |
| Seven blinks | W1& W2 swapped (electromechanical 3-through 10-tons units). ReliaTel™ module will communicate a heat fail diagnostic back to the RTRM. |

# Direct Spark Ignition Control (Sequence of Operation, 3-through 10-Ton Units Only)

## 1-stage units

Ignition control (IGN) runs a self check (including verification that the gas valve is de-energized). IGN checks the high limit switch (TCO1) for closed contacts, the pressure switch (PS) for open contacts, flame rollout (FR) for closed contacts.

IGN energizes inducer blower. When PS closes, 20 second pre-purge begins. After 20 seconds, the IGN energizes the spark and gas valve at the same time. The spark will stay energized for at least 2 seconds attempting to establish flame. If a flame is not established, the spark will continue up to 7 seconds. Once a flame is established, spark is de-energized and indoor blower motor (IBM) timing begins. 45 seconds later, the RTRM energizes the IBM. When the zone sensor or thermostat is satisfied, the gas valve is de-energized, the inducer runs for 5 seconds then stops (post-purge), and the IBM runs for 60 seconds then stops unless being requested to run continuously.

## 2-stage units

Ignition control (IGN) runs a self check (including verification that the gas valve is de-energized). IGN checks the high limit switches (TCO1 & TCO2) for closed contacts, the pressure switch (PS) for open contacts, flame rollout (FR) for closed contacts.

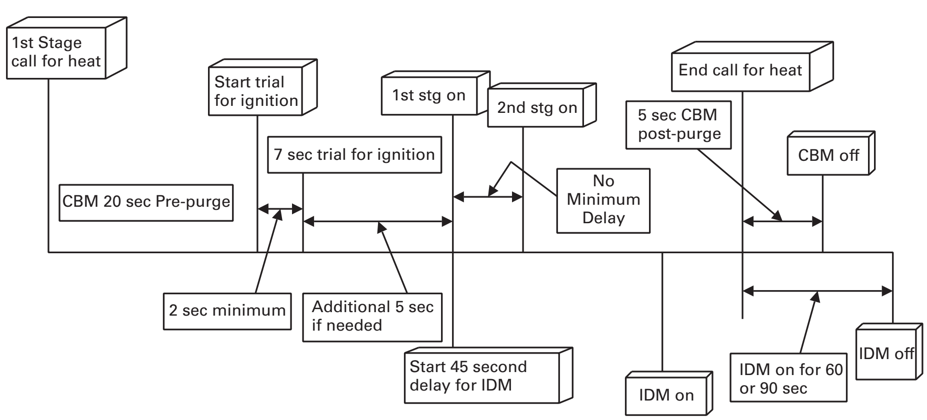
IGN energizes inducer blower on high speed. When PS closes, 20 second (15 seconds on high, 5 seconds on low) pre-purge begins. After 20 seconds, the IGN energizes the spark and gas valve at the same time. The spark will stay energized for at least 2 seconds attempting to establish flame. If a flame is not established, the spark will continue up to 7 seconds. Once a flame is established, spark is de-energized and indoor blower motor (IBM) timing begins. 45 seconds later, the RTRM energizes the IBM. If deviation from setpoint is great enough, there is no minimum delay before 2nd stage is energized. When the zone sensor or thermostat is satisfied, the gas valve is de-energized, the inducer runs for 5 seconds then stops (post-purge), and the IBM runs for 60 seconds then stops unless being requested to run continuously.

If the burner fails to ignite, the ignition module will attempt two more ignition cycles before locking out. The green LED will indicate a lockout by two fast flashes. An ignition lockout can be reset by:

1. Opening for 3 seconds and closing the main power disconnect switch.
2. By switching the 'Mode' switch on the zone sensor to 'OFF' and then to the desired position, or
3. Allowing the ignition control module to reset automatically after one hour.

If the burner trips due to a high temperature limit, the unit will shut down and initiate a four flash diagnostic. After the limit cools down and closes, the burner will again restart. There is no limit to the number of high limit trips that can occur.

**Figure 58. Direct spark ignition control sequence of operation**



# ReliaTel™ Hot Surface Ignition Control (12.5-through 50-Ton 1 Stage, 2 Stage, and Modulating Gas Heat)

This microprocessor based, communicating solid state device provides gas valve control, proof of ignition, ignition retries, one hour reset, operation of the inducer and diagnostics through an LED, as well as communication to the RTRM via a MODBUS communication link. Inputs to the control include high limits and flame sensor operation. A combustion fan proving switch is used with modulating gas heat units but is not used with 1 or 2 stage burners. This device takes control of the ignition, timings related to the ignition cycle and supervision of the gas components.

**Table 34. Ignition module specifications**

| | |
|---|---|
| Voltage range | 18-32 vac, 50/60 Hz |
| Ignitor voltage | 115vac, 50/60 Hz |
| Flame sense current | 4.5 microamps (nominal), 1 microamp minimum |
| Pre-purge | 45 sec |
| Flame establishment period | 2 sec min, 7 sec max |
| Flame failure response time | 0.8 sec or less |
| Loss of flame lockout | 3 tries, locks out after 3rd try |
| Lockout reset | Interrupt power for 3 seconds minimum |
| Auto reset | 1 hour |
| Loss of communication lockout (with RTRM) | 10 sec |

## Ignition Control Module Diagnostics

There is a green LED located on the ignition module. The table below lists the diagnostics and the status of the LED during the various operating states.

Any time the Ignition module is powered, the LED will be lit to provide status of the ignition system. At initial power-up, the LED will flash for one second.

The pause between groups of flashes is approximately two seconds.

Modbus voltage (measure between RTRM J5-3 and J5-4):

- With J5 plug connected, will read approximately 9.6 to 10.7 vdc (Flashing)
- With J5 unplugged, will read approximately 10.5 to 11.2 vdc (Flashing).

**Table 35. Ignition module diagnostics**

| | |
|---|---|
| Steady OFF | No power/ Internal failure |
| Steady ON | Normal power-up, with no heat call. |
| Slow flash rate | Normal call for heat, ¾ second on, ¼ second off. |
| Fast flash rate | Used for error indication only |

**Error Code Flashes-**

| | |
|---|---|
| One flash | Communication loss between RTRM and IGN |
| Two flashes | System lockout; failed to detect or sustain flame |
| Three flashes | Not used |
| Four flashes | High limit switch open |
| Five flashes | Flame sensed and gas valve not energized; or flame sensed and no call for heat |

## Sequence of Operations (1 and 2 heat units)

The 12½-through 50-ton packaged units use a drum and tube heat exchanger with a negative pressure gas valve and hot surface ignition. This design is the same as was used with the UCP micro controls, but the control circuitry for ignitions has changed to take advantage of ReliaTel MODBUS communications.

When the system switch is set to the "Heat" position and the zone temperature falls below the heating setpoint, a heat cycle is initiated when the RTRM communicates ignition information to the ignition module (IGN).

The IGN runs a self-check (including verification that the gas valve is de-energize). IGN checks the high-limit switches (TC01 & TCO2) for normally closed contacts. With 115 vac supplied to the ignition module (IGN), the hot surface ignitor probe (IP) is preheated for approximately 45 seconds. The gas valve (GV) is energized for approximately 7 seconds for trial ignition to ignite the burner.

Once the burner is ignited, the hot surface ignition probe (IP) is de-energized by the ignition module and then functions as the flame sensor. The unit initially fires on high heat, but after approximately 60 seconds, if no additional heating is required, the ignition module will drop back to low heat.

When the fan selection switch is set to the "AUTO" position, the RTRM energizes the indoor fan relay (F) approximately 45 seconds after initiating the heating cycle to start the indoor fan motor (IDM).

If the burner fails to ignite, the ignition module will attempt two more ignition cycles before locking out. The green LED will indicate a lockout by two fast flashes. An ignition lockout can be reset by:

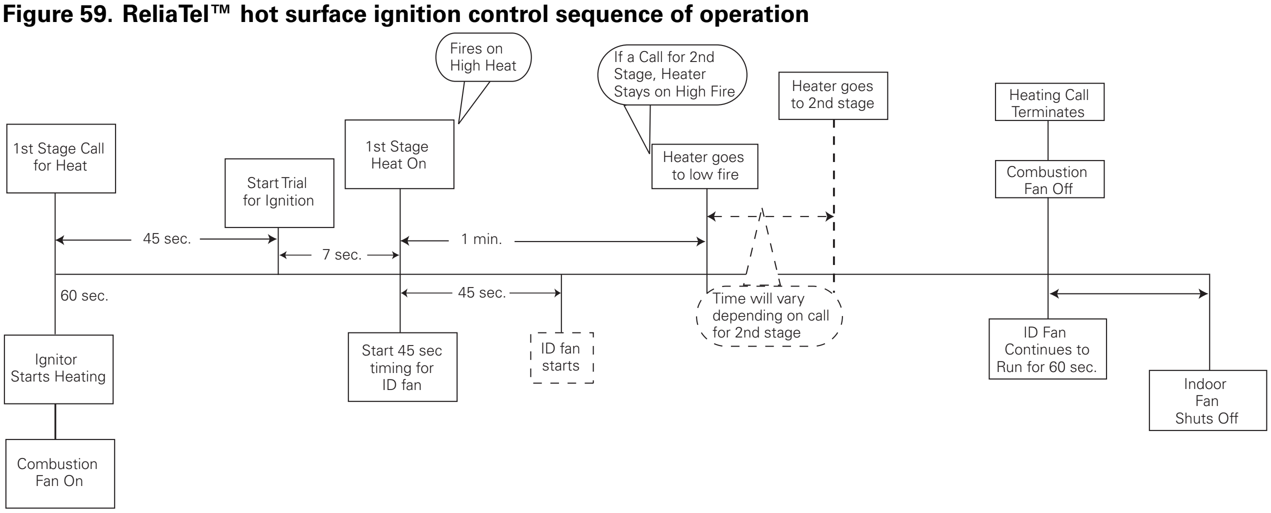
1. Opening for 3 seconds and closing the main power disconnect switch,
2. By switching the "Mode" switch on the zone sensor to "OFF" and then to the desired position, or
3. Allowing the ignition control module to reset automatically after one hour.

If the burner trips due to a high temperature limit, the unit will shut down and initiate a four flash diagnostic. After the limit cools down and closes, the burner will again restart. There is no limit to the number of high limit trips that can occur.

When the RTRM is communicating with the ignition module (IGN), the MODBUS voltage can be measured at the 3J5 plug, pins 3 (negative) and 4 (positive). The voltage will be flashing at approximately 10.7 to 9.6 vdc at a rate of once every three seconds. If the 3J5 plug is disconnected, the measured voltage at pins 3 and 4 on the RTRM will be approximately 10.5 to 11.2 vdc and will be flashing. Flame current measurements can also be made at two pins on the ignition module labeled "FLAME CHECK" located at the bottom of the module. Flame current can be measured with a DC voltmeter. One volt dc equals one microamp of flame current (1vdc = 1mA).

27.5-through 50-ton "high heat" units use two drum and tube heat exchangers. Two ignition controls work in tandem to provide heat as required.

**Figure 59. ReliaTel™ hot surface ignition control sequence of operation**




Modulating heat units utilize a variable speed combustion blower motor that enables the motor to operate at the necessary speed required to provide the amount of heat required to satisfy the current heating load of the building. The table below can be used to help determine the output rpm of the combustion blower motor.

**Table 36. Modulating heat voltage ranges**

| DC Volts | Approx. RPM | Approx. Rate (MBH) 350 heater/390 heater |
|---|---|---|
| 2.0 | 950 | 70/80 |
| 3.5 | 1680 | 126/142 |
| 5.0 | 2410 | 182/204 |
| 6.5 | 3140 | 238/266 |
| 9.0 | 3870 | 294/328 |
| 10.5 | 4600 | 350/390 |

# Heat Pump Demand Defrost

There are two schemes in common usage for heat pump outdoor coil defrosting: demand defrost and time-temperature defrost. Demand Defrost is more efficient because defrost cycles are initiated only when necessary, compared with initiation based on operating time below the threshold temperature. All 3-through 10-ton convertible packaged heat pumps use Demand Defrost.

Outdoor coil defrosting occurs only when operating in heating mode with outdoor ambient temperature below 52°F and the outdoor coil temperature below 33°F. The first defrost cycle after power-up is initiated based on operating time at the required conditions. Shortly after completion of the defrost cycle, the temperature difference between the outdoor coil and outdoor air is calculated and is used as an indicator of unit performance at dry coil conditions.

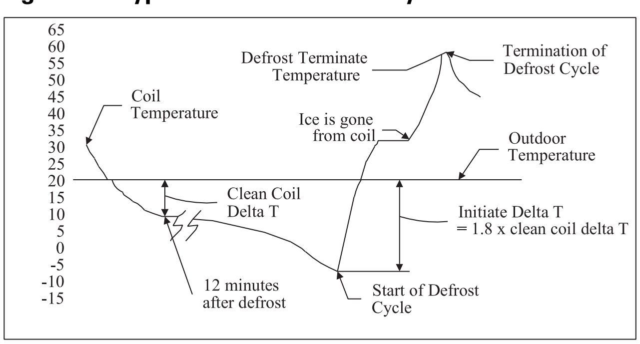
Over time, as moisture and frost accumulate on the coil, the coil temperature will drop, increasing the temperature difference. When the temperature difference reaches 1.8 times the dry coil temperature differential ($\Delta$ T), a defrost cycle is initiated. While defrosting, the reversing valve is in the cooling position, outdoor fans are off, and the compressors continue to operate.

The defrost cycle is terminated when the coil temperature rises high enough to indicate that the frost has been eliminated. Termination of the defrost cycle includes a "soft start" delay. At the end of each defrost cycle, the outdoor fan comes on 5 seconds before the reversing valve is de-energized. This reduces stress on the compressor and makes for a quieter defrost.

There are three conditions that must be met for Demand Defrost to operate:

- Heating mode with compressor(s) operating.
- Outdoor ambient < 52°F.
- Outdoor coil < 33°F on any circuit.

**Figure 60. Typical demand defrost cycle**




## Defrost Service Test

When a Service Test Defrost Request is received, defrost mode is initiated immediately. The defrost cycle will remain active for a minimum of 1 minute, after which the normal termination will occur when the coil temperature exceeds the defrost termination temperature as defined below. The Service Test Defrost Request will remain active for a maximum of 10 minutes, after which the unit will transition out of the defrost step as described below.

## Defrost Mode Operation

Defrost Mode shall remain active until the Outdoor Coil Temperature (OCT) exceeds the Defrost Termination Temperature (DTT) or until ten (10) minutes have passed, whichever occurs first. If all Compressor Outputs turn Off during the defrost cycle, such as during a High Pressure Cutout, Defrost Mode will terminate.

When Defrost Mode has terminated, the function will track twelve (12) minutes to assure that a dry coil condition has been achieved. At the twelve-minute point, $D_T$ will be calculated using the current values of OAT and OCT (OAT is expected to be higher than OCT). This value is multiplied by 1.8 to calculate the new Initiate Value. Figure 60 presents a graphical representation of a typical demand defrost cycle.

## Sequence of Operation

Demand defrost is standard feature which permits defrost whenever coil icing conditions begin to significantly reduce unit capacity. To permit defrost, the outdoor temperature must be below 52°F, coil temperature must be below 33°F, and the $\Delta$ temperature F must exceed a RTRM calculated value. After 30 minutes of run time under defrost permit conditions, the RTRM initiates a defrost cycle. Upon termination of this cycle, the RTRM monitors the outdoor temperature (ODT) and the coil temperature (CT) and calculates the $\Delta$ temperature F (ODT-CT). This value is stored in memory and the RTRM calculates a defrost initiate value. The RTRM continually compares the $\Delta$ temperature F to the defrost initiate value. Once the $\Delta$ T reaches the initiate value, a defrost cycle is initiated.

During the defrost cycle, the RTRM energizes the relay (K3), which energizes the switch over valve (SOV) through the normally open K3 relay contact. This will then turn the outdoor fan motor(s) (ODM) 'Off' by de-energizing the (K8) and (K7) relays, which de-energizes the (ODF) relays. The RTRM energizes the auxiliary electric heat contactor (AH), and (BH) (if applicable), if they are not operating, while maintaining compressor (CPR1) operation. The defrost cycle is terminated based on the RTRM termination temperature calculation using the outdoor temperature (ODT) +47°F. The defrost termination temperature (DTT) will be limited between 57°F and 72°F.

## Emergency Heat Operation

When the system selection switch is in the 'EM HEAT' Mode, and the zone temperature falls below the heating setpoint controlband, the RTRM bypasses compressor and outdoor fan operation and energizes the K1 relay located on the RTRM. When K1 relay contacts close, the first stage auxiliary electric heat contactor (AH) is energized. If the first stage of auxiliary electric heat cannot satisfy the heating requirement, the RTRM energizes the K2 relay located on the RTRM.

When the K2 relay contacts close, the second stage auxiliary electric heat contactor (BH) is energized. The RTRM cycles both the first and second stages of heat 'On' and 'Off' as required to maintain the zone temperature setpoint.

Correct defrost operation relies on accurate temperature information from the outside air sensor (OAS) and the coil temperature sensors (CTS).

If either of these sensors fail, the unit will revert to the default mode any time the unit is in the active heat mode with compressors running.

When any Defrost Fault is active, or if any sensor has failed, a 5-minute defrost cycle will be initiated after each 30 minutes of cumulative compressor heating operation.

## Diagnostic Information

Demand Defrost also tracks failures and operating problems as follows:

**Table 37. Demand defrost fault designation**

| Symptom | Diagnostic | Response |
|---|---|---|
| Coil temperature Sensor Failure | Sensor is shorted or open | Activate Defrost Fault |
| Outdoor Temperature Sensor Failure | Sensor is shorted or open | Activate Defrost Fault |
| $D_T$ is below Minimum Value 12 minutes after defrost is terminated | Low $D_T$ | If> 2 hours, activate Defrost Fault Reset timer if $D_T$ returns within bounds. |
| Defrost Terminated on time requirement | Time Termination | If defrost is terminated on time requirement (vs. differential temperature) After 10 consecutive Time Terminations, activate Defrost Fault. |
| $D_T$ is above Maximum Value 12 minutes after defrost is terminated | High $D_T$ | Initiate Defrost<br>After 16 consecutive High $D_T$ Initiations activate Defrost Fault. |
| $D_T$ does not change by 2 degrees in an hour's time starting 12 minutes after defrost is terminated and $D_T$ is less than or equal to 4 degrees 12 minutes after defrost is terminated | Unchanging $D_T$ | Initiate Defrost and activate Defrost Activate Defrost Fault |

Defrost Termination Temperature (DTT) = Outdoor Air Temperature (OAT) + 47ºF
57ºF <= DDT <= 72ºF
DT = Outdoor Air Temperature (OAT) – Outdoor Coil Temperature (OCT)
Defrost Initiate Temperature= 1.8 * (DT) 12 Minutes After Defrost Mode is terminated)

## Independent Circuit Defrost Operation

For Odyssey and EMEIA Independent Circuit Heat Pump units with two outdoor coil temperature sensors, the unit will perform defrost per circuit based on its own coil temperature sensor value, the outdoor ambient temperature, and the accumulated circuit run time. At least one stage of auxiliary heat will be energized anytime either circuit is in defrost mode. All other defrost functionality, including the diagnostic conditions, will perform as described above independently per circuit.

# ReliaTel™ Economizer Module Layout (Honeywell)

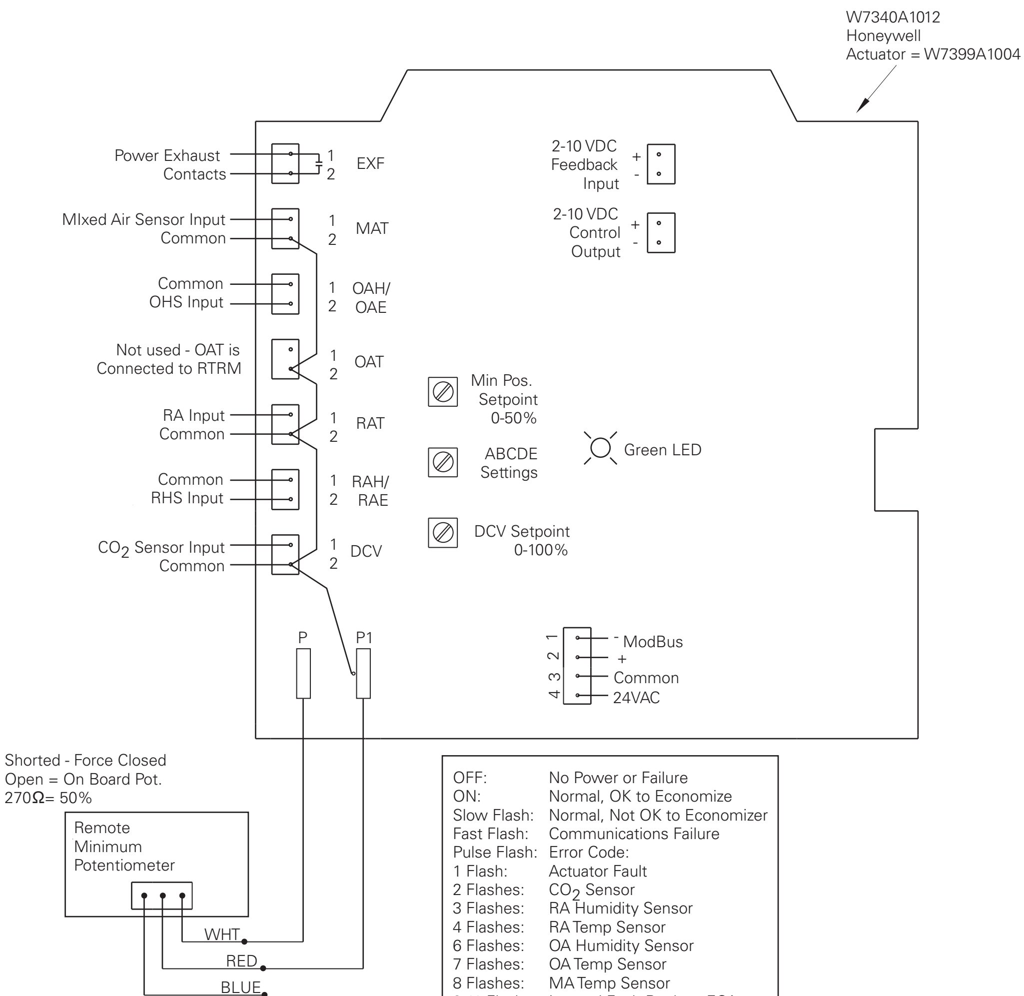
The economizer module plugs directly onto the actuator. It has a diagnostic LED, which under normal operation is either ON (OK to economize) or FLASHING (Not OK to economize). It communicates via MODBUS with the RTRM, and receives outside air temperature input from the RTRM. Mixed air sensor (MAS), return air sensor (RAT), outdoor humidity sensor (OHS), and return humidity sensor (RHS) are all plugged directly into the ECA. The application section of this manual shows how to apply a $CO_2$ sensor.

A new stripped down version of the ECA Module was implemented in April, 2005 which only contains the MAT, input, min. pos. adjustment and the wire plug for power and ModBus communications. This module will only be applied on units that are supplied from the factory without any economizer options such as, Reference Enthalpy, Comparative Enthalpy or $CO_2$. Options installed in the field will require the "full-up" version in order to operate properly.

- To read the actual damper position, read the DC voltage at the '2-10 vdc feedback input' terminals. 2 vdc is closed, 10 vdc is 100% open.
- To drive 2 actuators with 1 control, connect field wiring as shown in Figure 63, p. 84.

***Note:*** *Remote minimum position input does not work when a CCP is controlling the unit.*

**Figure 61. ReliaTel™ economizer module layout (Honeywell)**




| | |
|---|---|
| OFF: | No Power or Failure |
| ON: | Normal, OK to Economize |
| Slow Flash: | Normal, Not OK to Economizer |
| Fast Flash: | Communications Failure |
| Pulse Flash: | Error Code: |
| 1 Flash: | Actuator Fault |
| 2 Flashes: | $CO_2$ Sensor |
| 3 Flashes: | RA Humidity Sensor |
| 4 Flashes: | RA Temp Sensor |
| 6 Flashes: | OA Humidity Sensor |
| 7 Flashes: | OA Temp Sensor |
| 8 Flashes: | MA Temp Sensor |
| 9-11 Flashes: | Internal Fault-Replace ECA |

# ReliaTel™ Economizer Layout (RTEM)

The RTEM Module plugs directly onto the actuator. It has a diagnostic LED, which under normal operation is either ON (OK to economize) or FLASHING (not OK to economize). It communicates via MODBUS with the RTRM, and receives an outside air temperature input from the RTRM. Mixed air sensor (MAS), return air sensor (RAT), outdoor humidity sensor (OHS), and return humidity sensor (RHS) are all plugged directly into the RTEM. The application section of this manual shows how to apply a $CO_2$ sensor.

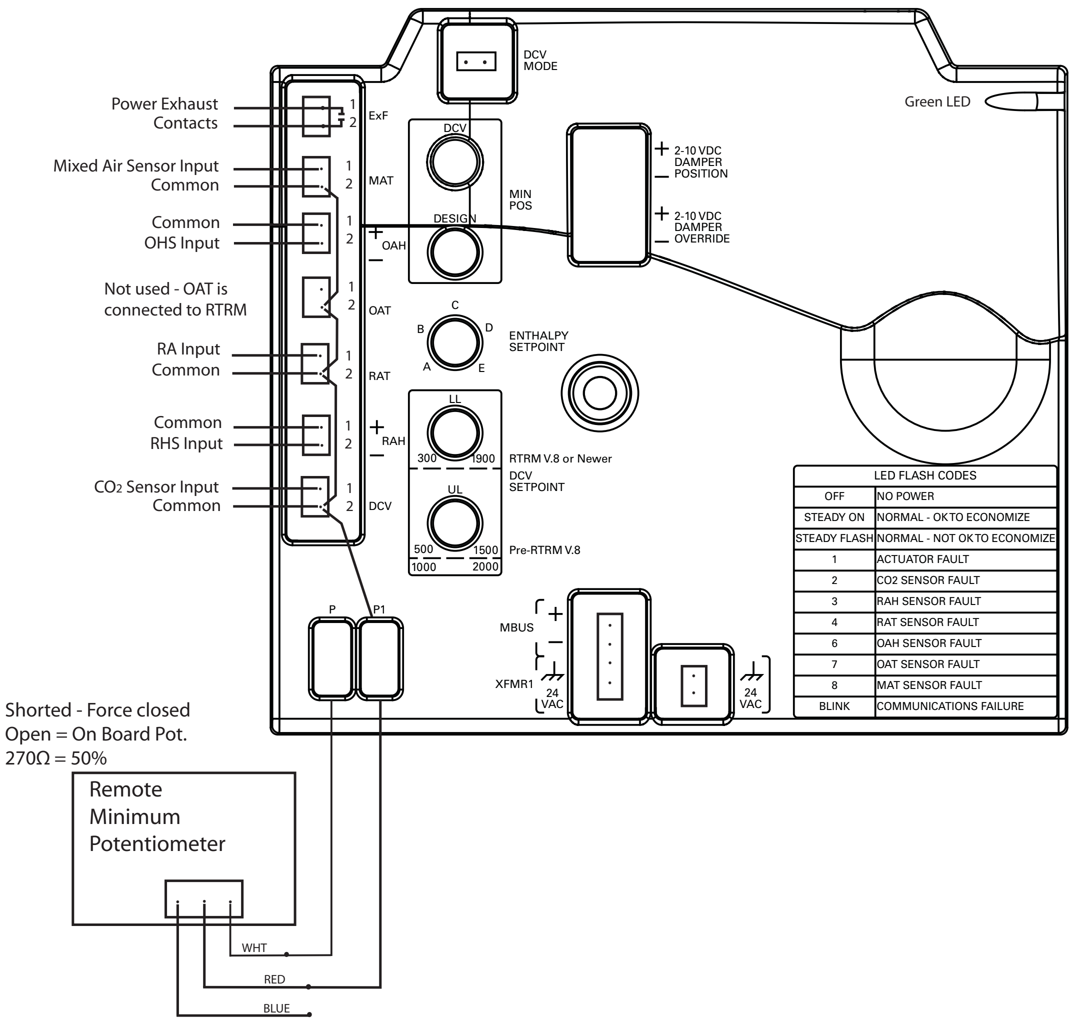
A stripped down version of the RTEM, which only contains the MAT input, Design min. pos. adjustment, Remote Min Position input, Enthalpy Setpoint, and the wire plug for power and ModBus communications, is also available.

This module will only be applied on units that are supplied from the factory without any economizer options such as, Reference Enthalpy, Comparative Enthalpy or $CO_2$. Options installed in the field will require the "full-up" version in order to operate properly.

- To read the actual damper position, read the DC voltage at the '2-10 vdc Damper Position' input terminals; 2 vdc is closed, 10 vdc is 100% open.
- To drive 2 actuators with 1 control, connect field wiring as shown in Figure 63, p. 84.

***Note:*** *Remote minimum position input does not work when a CCP is controlling the unit.*

**Figure 62. Reliatel™ economizer module layout (RTEM)**



# ReliaTel™ Economizer Actuator Layout

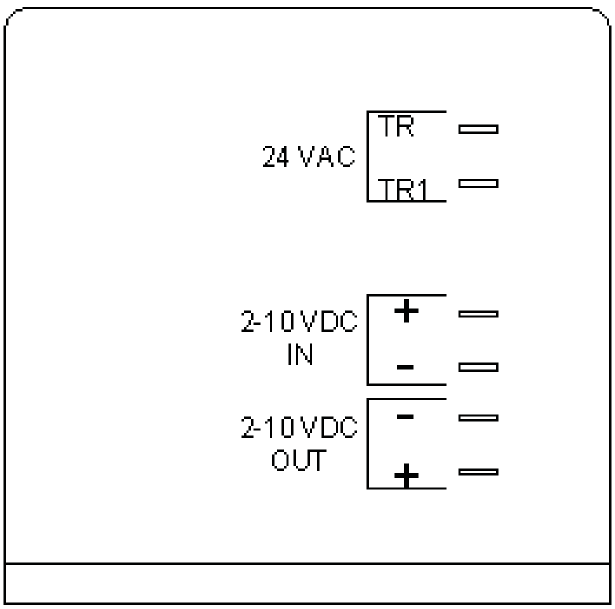
Remove the screw in the center of the actuator module. Remove the actuator module (this will not be used). Then, remove the wiring from the module.

Terminals that are exposed by removal of the actuator module are ¼" spades labeled 24 VAC, TR & TR1 and 2-10 VDC IN (+/-)

Apply 24 VAC to TR and TR1 and 2-10 VDC signal to (+/-) on 2-10 VDC IN.

**DO NOT USE** the lower terminals labeled 2-10 VDC OUT.

**Figure 63. ReliaTel™ economizer terminals**



# ReliaTel™ Economizer Operation

## Customer Benefit

An economizer consists of a fresh air damper, a return air damper, linkage to maintain an inverse relationship between the two, and an actuator to control the damper position. An economizer is used to provide two unit functions: ventilation and economizer cooling. In either case, the inverse relationship between the return and outdoor air dampers allows the unit to maintain the same approximate total airflow regardless of economizer position. A linkage adjustment is typically required in the field to adjust for differences in pressure drops due to different duct designs.

Economizer cooling is provided to take advantage of cooler outdoor air to satisfy a cooling load in a conditioned space minimizing the need for mechanical cooling (with compressors). While economizer cooling, it is necessary to limit the damper position so that the mixed air temperature does not fall below 53°F (± 3°F) and cause excessively cool air from being discharged from the unit. When used with a zone sensor, an economizer setpoint that is below the cooling setpoint is used to allow sub-cooling essentially for free, further reducing the need for more expensive mechanical cooling. To maximize the use of an economizer, mechanical cooling is delayed from running until it has been determined that the economizer alone cannot satisfy the load.

Any time the supply fan is On and the building (unit) is occupied, the economizer damper will be maintained at or above minimum position. The economizer damper is held closed when the supply fan is off to prevent water from getting into the economizer section of the unit.

Compressors will be delayed from operating until the economizer has opened to 100% for 5 minutes on all unit types other than Voyager™ III which will have a 3-minute delay.

## VAV Economizer Cooling Operation

A similar method of determining and adjusting the economizer setpoint as described in CV operation will be used in VAV Cooling operation with the additional VAV requirements below.

- Economizer Setpoint = SA Temp Control Point - 2°F.
- Economizer Cooling is only allowed when economizing is enabled and SA temp is greater than Economizer Setpoint - 1.5°F.
- If conditions allow enabling of economizer cooling after a compressor is active, the economizer damper is forced to 100% open until all compressors are deactivated or conditions change to disable economizing.
- If economizer cooling is active prior to mechanical cooing, compressor operation will be inhibited until the economizer damper reaches 100%. Once the economizer reaches 100%, mechanical cooling will be enabled without delay.
- During VAV Unoccupied operation economizer cooling will operate as it does in CV Unoccupied.

## Economizer Operation with Zone Sensor, Programmable Zone Sensor or ICS

When economizing is enabled and the unit is operating in the cooling mode with a zone sensor, the economizer damper is modulated between its minimum position and 100% to maintain the zone temperature at the economizer setpoint.

When the unit is applied with a zone sensor, programmable sensor or ICS, the economizer setpoint (ESP) is derived from the Cooling and Heating setpoints (CSP and HSP) so that ESP is the higher of 1) CSP – 1.5°F or 2) HSP + 1.5°F.

When enabled, the economizer will modulate between minimum position and 100% to maintain the mixed air temperature to the calculated mixed air setpoint (53°F minimum). If the mixed air temperature starts to fall below the mixed air setpoint, the economizer starts closing. If the mixed air temperature falls to 50°F or below, the damper will close to the minimum position.

If the economizer is not able to satisfy the cooling setpoint, 1st stage cooling will be energized. Should the cooling setpoint not be satisfied with 1st stage cooling, 2nd stage cooling will be energized. Most often, the economizer and 1st stage cooling will be adequate to satisfy the load. 1st stage cooling will not start until the economizer has been full open for five minutes on a non-V3 (3 minutes if the unit is a V3) and the zone temperature error has not been reduced quickly enough.

## Economizer Operation with Conventional Thermostat (CV only)

When the unit is operating from a conventional thermostat or other binary input, the economizer setpoint feature, relative to the cooling and heating setpoints, is lost.

The economizer control is based strictly on a signal from the thermostat, but still maintains mixed air temperature control of 53°±3°F when in the economizer mode. The economizer enable and disable function is still determined by the outside air sensor through the RTRM.

If a single-stage thermostat is used, only the economizer (if enabled) or the compressor (if economizer is disabled) will operate on a call for cooling. A two-stage thermostat is required to achieve economizer operation and compressor operation at the same time.

With economizer enabled, a Y1 call for 1st stage cooling will be the economizer. The damper will modulate between minimum position and 100% to maintain mixed air temperature at 53°±3°. At 50°F the damper will be at minimum position. If the economizer is enabled, a Y2 call for 2nd stage cooling will start the first compressor only if the economizer damper is at 100% open continuously for 5 minutes on a non-V3 (3 minutes if the unit is a V3).

If the economizer is disabled, 1st stage (Y1) will be the first compressor. If the unit has two compressors, a call for 2nd stage cooling (Y2) will start the second compressor.

When using a conventional thermostat, or other binary input, the ReliaTel™ controls will only allow two stages of cooling.

## Barometric Relief

Units with economizers bring in outside air for ventilation and/or economizer cooling. Because the economizer contains a return air damper that operates inversely to the outdoor air damper, the outdoor air will tend to pressurize the conditioned space. This can cause exterior doors to open or audible noise from air escaping through various building openings.

Units without exhaust fans rely on barometric dampers to vent the pressure that builds up in the space due to outdoor airflow.

## Power Exhaust

Exhaust fans offer improved performance since they can be sized to overcome the pressure drops associated with the return duct that would otherwise add to the space pressure. This function allows the exhaust fan to operate when appropriate to maintain space pressure.

**Units without RTOM:** The power exhaust is on whenever the economizer damper is at 25% outside air or greater. This is not adjustable. The power exhaust is off whenever the economizer damper is below 15%. This is not adjustable.

**Units with RTOM:** The power exhaust set point (point at which the power exhaust is turned on) is adjustable from 0% to 100% at the RTOM “exhaust setpoint” potentiometer. The power exhaust will be off when the economizer damper falls below the Power Exhaust Setpoint - 10%.

## Economizer Control Methods

Three different methods can be used to determine if outdoor air contains more cooling capacity than the return air and are described below. The different methods are suited for different applications and environments.

- Comparative Enthalpy — Outdoor Air Enthalpy is compared with Return Air Enthalpy. This method is best suited for high humidity climates and applications in which humidity can affect the cooling capacity of the outdoor air or return air.
- Reference Enthalpy — Outdoor Air Enthalpy is compared with a reference enthalpy point. This method is best suited for high humidity climates in which humidity can affect the cooling capacity of the outdoor air, but not necessarily the return air.
- Reference Dry Bulb— Outdoor Air Temperature is compared with a user set reference temperature. This method is best suited for low humidity climates and applications in which humidity does not strongly affect cooling capacity of the outdoor air or return air.

Dry bulb temperature and relative humidity data are used to determine enthalpy.

Economizer-based cooling is enabled only when outdoor air is determined to have more cooling capacity than the return air. The method used is according to the available data. When temperature and humidity data are available for the outdoor air and return air, the Comparative Enthalpy method is used. One of the other methods are used if data is invalid or unavailable. Ultimately, when there is insufficient data to use any of the three methods, economizer-based cooling is disabled.

# Thermostat Notes

When the Active Unit Mode is Cool, one of the enthalpy or temperature methods are used to determine if economizer-based cooling should be enabled or disabled.

If the unit is applied with a thermostat, the algorithms use a fixed mixed air temperature setpoint of 53°±3° when the Y1 input is closed. If the unit is applied with a zone sensor, the algorithms use a dynamically calculated mixed air temperature setpoint, which is calculated by other algorithms, when cooling is requested.

The damper can be in four different states.

- Closed — The damper is held at 0%.
- Minimum Position — The damper is held at the Minimum Position as determined by the Minimum Position Potentiometer on the ECA or by an edited input from ICS. This position is between 0% and 50%.

***Note:*** *When making minimum position adjustments, allow 30-45 seconds for actuator to respond.*

- Modulating — Algorithms control the damper to meet cooling demand. When modulating, the damper’s range of motion is between Active Minimum Position and 100%.
- Night Setback — During NSTS, the damper drives to full closed position. If there is a call for cooling, the damper opens to satisfy the cooling requirement. The damper stays closed during heating mode.

During unoccupied mode, the minimum position is 0%

### The following inputs are used:

### Mixed Air Sensor (MAS)

MAS measures the dry bulb temperature of the air leaving the evaporator coil while economizing. Return air, outdoor air and cooling caused by any compressor cooling make up the Mixed Air input. The MAS is plugged into the Economizer Actuator Module (ECA).

### Outdoor Air Sensor (OAS)

The OAS measures the ambient air surrounding the unit. It is located in the compressor section on the lower or upper left side for Precedent units depending on model, or the right side beneath the control panel on Voyager 2, or the economizer end of unit for Voyager™ III units. Ventilation holes in the access panel of the unit allow air movement across the sensor. The OAS connects to the RTRM module.

### Outdoor Humidity Sensor (OHS)

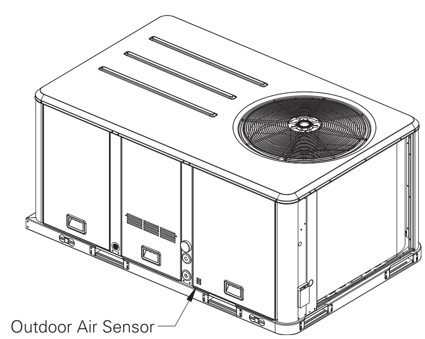
The OHS measures the relative humidity of the outside air. It is located inside the economizer hood. The OHS is plugged into the ECA.

### Return Air Temperature Sensor (RAT)

The RAT measures the return air temperature. It is located on the return air damper of the economizer. The RAT is plugged into the ECA.

### Return Humidity Sensor (RHS)

The RHS measures the relative humidity of the return air. It is located on the return air damper of the economizer. The RHS is plugged into the ECA.

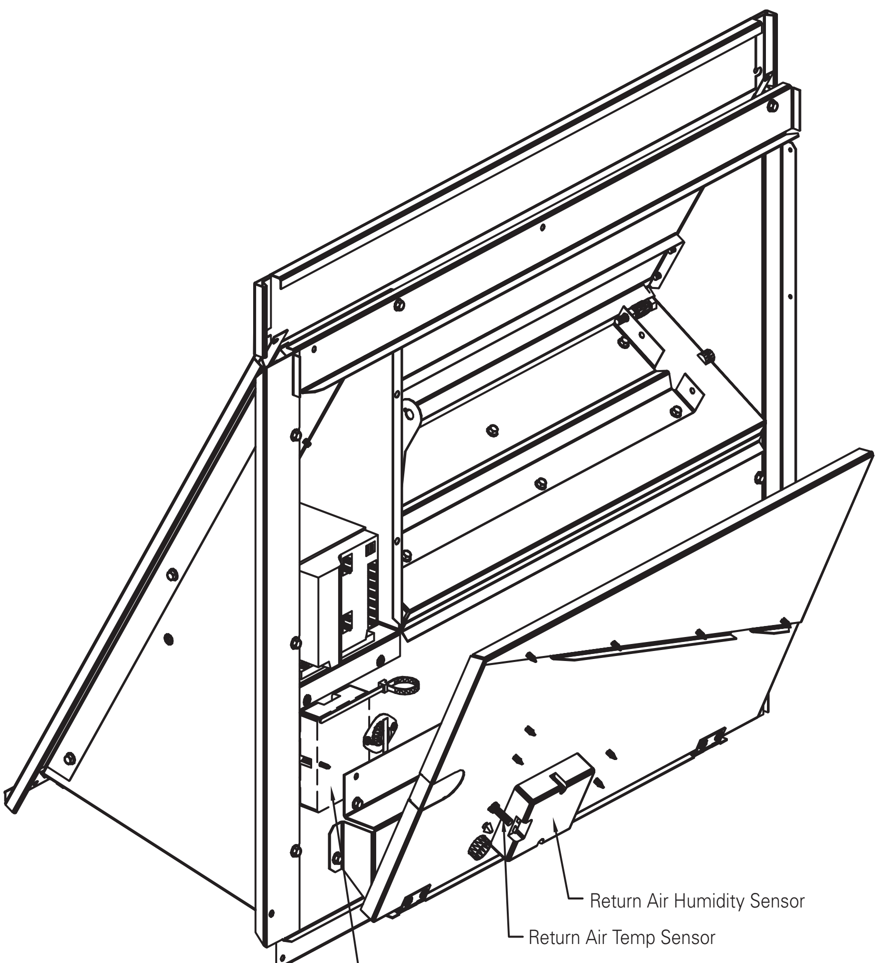


# Economizer Damper Enthalpy Layout

**Table 38. Choice of enthalpy method**

| Method used to determine economizer effectiveness | Required Data |
|---|---|
| Comparative Enthalpy | MAS, OAT, OAH, RAT, RAH |
| Reference Enthalpy | MAS, OAT, OAH |
| Reference Dry Bulb | MAS, OAT |
| Unit will not economize | MAS or OAT data is invalid or unavailable |

**Figure 64. Economizer**



# Economizer Operation Enthalpy Changeover

## Dry bulb/Reference Point Selections

The Dry Bulb or Reference Enthalpy Point is user-selectable, according to the choices below. This selection is made on the ECA.

| Potentiometer Setting Point | Dry bulb changeover Point | Reference Enthalpy |
|---|---|---|
| A | 73°F | 27 BTU/lb. |
| B | 70°F | 25 BTU/lb. |
| C* | 67°F* | 23 BTU/lb. |
| D | 63°F | 22 BTU/lb. |
| E | 55ºF | 19 BTU/lb. |

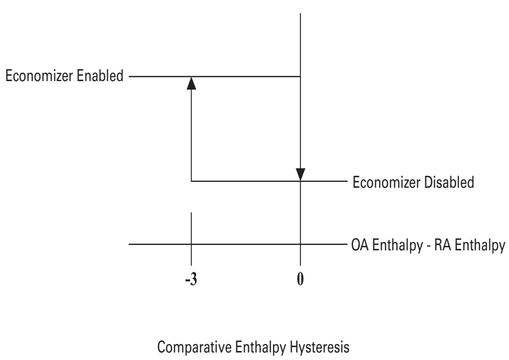
*factory setting

## Comparative Enthalpy Method

OA Enthalpy is compared with RA Enthalpy.

- The Economizer is enabled when OA Enthalpy < [RA Enthalpy - 3.0 BTU/lb.]
- The Economizer is disabled when OA Enthalpy > RA Enthalpy.
- While [RA Enthalpy - 3.0 BTU/lb.] < OA Enthalpy < RA Enthalpy, the Economizer enable/disable status is not changed.

**Figure 65. Comparative enthalpy enable**

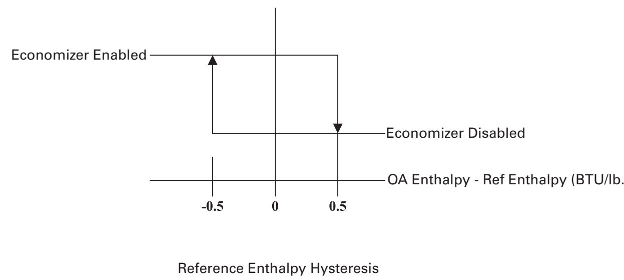



## Reference Enthalpy Method

OA Enthalpy is compared with a reference enthalpy point.

- The Economizer is enabled when OA Enthalpy < [reference enthalpy point - 0.5 BTU/lb.].
- The Economizer is disabled when OA Enthalpy > [reference enthalpy point + 0.5 BTU/lb.].
- While [reference enthalpy point - 0.5 BTU/lb.] < OA Enthalpy < [reference enthalpy point + 0.5 BTU/lb.], the Economizer enable/disable status is not changed.

**Figure 66. Reference enthalpy enable**

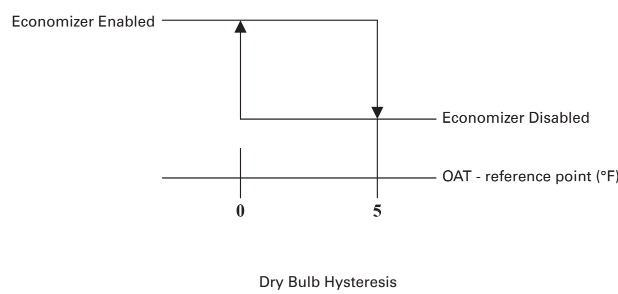



## Reference Dry Bulb Method

OA Temperature is compared with a reference dry bulb point.

- The Economizer is enabled when OA Temp ≤ reference dry bulb point.
- The Economizer is disabled when OA Temp ≥ (reference dry bulb point + 5.0)°F.
- While reference dry bulb point < OA Temp < (reference dry bulb point + 5.0°F), the Economizer enable/disable status is not changed.

**Figure 67. Dry bulb enthalpy enable**




***Note:*** *If on a unit with Comparative Enthalpy control the OA or RA Temp is greater than 120°F or less than 32°F, the economizer control will revert to Reference Enthalpy Control if the OA temp is within 32°F and 120°F. If the unit is configured with Comparative or Reference Enthalpy control, if the OA temp. is not within this range, the economizer control will revert to Dry Bulb Control. Once this occurs, the "out of range" temperature(s) must fall to 118°F or rise to 34°F to again enable Comparative or Reference Enthalpy control. If either OA or RA Humidity is measured to be greater than 90% or less than 10%, the value of Humidity which is reported by the RTEM and used for enthalpy calculation will be 90% or 10% respectively.*

## Internal Calculations

Air enthalpy is a value calculated from the air temperature and relative humidity using the relationship:

**Enthalpy= 0.24 x O.A.Temp(deg. F) + h(R.H.,OA**T)

Air enthalpy is calculated (Btu/Lb. dry air) using:

H = 0.24 * T + W * Hv

Where

T= dry bulb temperature, deg. F

W= humidity ration, lb. water/lb. dry air

W = 0.622 * P/ (14.696 - P)

Hv= enthalpy of water at T, Btu/lb.

Hv= 1062.1 + 0.43 * T

Also,

P= partial pressure of water at T, psia

P= (0.421 - 0.01503 * T + 0.000202 * T**2) * RH

# ReliaTel™ Economizer Operation & Inputs

## ReliaTel Economizer Inputs

Terminals to read voltage:

| | | |
|---|---|---|
| **Mixed Air Sensor** | ECA Module | MAT |
| **Return Air Sensor** | ECA Module | RAT |

***Note:*** *These are Economizer inputs only. RTRM, RTOM inputs (Zone temp, Setpoints, OAS, DAS) are in the ReliaTel Temperature inputs section.*

***Note:*** *The ECA module was upgraded August 1st, 2005 to widen the temperature range measured by the mixed air and return air sensor. As a result, the open DC voltage values measured at the ECA also changed. To determine which module you have, disconnect the sensor and measure the DC voltage at the MAT or RAT terminals on the ECA. The voltage reading for modules before August 1st, 2005 will read 2.50 VDC. Modules for August 1st, 2005 and later will be 5.0 VDC.*

## Economizer Actuator Module W7340A1004 (used prior to 08/1/05)

Read DC voltage with the sensor attached. If voltage does not appear to be correct, read the resistance of the circuit, then the sensor itself, to see if a problem exists in the sensor or the wiring. With the sensor not attached there should be approximately 2.50 VDC at the terminals listed above.

## Service Tips

Terminal 1 in each of these circuits is common. All common terminals are grounded, therefore one volt meter lead can be attached to ground for voltage measurements.

**Table 39. W7340A1004 used before August 1st, 2005**

| Temp °F | Resistance (K ohms) | DC Volts | Temp°F | Resistance (K ohms) | DC Volts |
|---|---|---|---|---|---|
| 40 | 26.105 | 1.853 | 61 | 14.899 | 1.551 |
| 41 | 25.393 | 1.839 | 62 | 14.521 | 1.536 |
| 42 | 24.703 | 1.826 | 63 | 14.154 | 1.520 |
| 43 | 24.033 | 1.812 | 64 | 13.797 | 1.505 |
| 44 | 23.385 | 1.799 | 65 | 13.451 | 1.490 |
| 45 | 22.756 | 1.785 | 66 | 13.114 | 1.475 |
| 46 | 22.146 | 1.771 | 67 | 12.787 | 1.460 |
| 47 | 21.554 | 1.757 | 68 | 12.469 | 1.444 |
| 48 | 20.980 | 1.743 | 69 | 12.160 | 1.429 |
| 49 | 20.424 | 1.728 | 70 | 11.860 | 1.413 |
| 50 | 19.884 | 1.714 | 71 | 11.568 | 1.398 |
| 51 | 19.360 | 1.699 | 72 | 11.284 | 1.383 |
| 52 | 18.852 | 1.685 | 73 | 11.008 | 1.367 |
| 53 | 18.359 | 1.670 | 74 | 10.740 | 1.352 |
| 54 | 17.880 | 1.656 | 75 | 10.479 | 1.337 |
| 55 | 17.415 | 1.641 | 76 | 10.225 | 1.321 |
| 56 | 16.964 | 1.626 | 77 | 9.978 | 1.306 |
| 57 | 16.527 | 1.611 | 78 | 9.738 | 1.291 |
| 58 | 16.102 | 1.596 | 79 | 9.505 | 1.276 |
| 59 | 15.689 | 1.581 | 80 | 9.278 | 1.261 |
| 60 | 15.288 | 1.566 | | | |

## Economizer Actuator Module W7340B1002 (08/01/05 and later)

Read DC voltage with the sensor attached. If voltage does not appear to be correct, read the resistance of the circuit, then the sensor itself, to see if a problem exists in the sensor or the wiring. With the sensor not attached there should be approximately 5.0 VDC at the terminals listed above.

**Table 40. W7340B1002 used August 1, 2005 and later**

| Temp °F | Resistance (K Ohms) | DC Volts | Temp °F | Resistance (K Ohms) | DC Volts | Temp °F | Resistance (K Ohms) | DC Volts | Temp °F | Resistance (K Ohms) | DC Volts |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 63.577 | 3.926 | 45 | 22.736 | 2.832 | 80 | 9.250 | 1.735 | 115 | 4.165 | 0.966 |
| 11 | 61.624 | 3.899 | 46 | 22.123 | 2.799 | 81 | 9.030 | 1.708 | 116 | 4.076 | 0.949 |
| 12 | 59.737 | 3.872 | 47 | 21.530 | 2.765 | 82 | 8.815 | 1.681 | 117 | 3.990 | 0.933 |
| 13 | 57.913 | 3.845 | 48 | 20.953 | 2.732 | 83 | 8.607 | 1.655 | 118 | 3.906 | 0.917 |
| 14 | 56.153 | 3.817 | 49 | 20.396 | 2.698 | 84 | 8.404 | 1.628 | 119 | 3.824 | 0.901 |
| 15 | 54.452 | 3.789 | 50 | 19.854 | 2.665 | 85 | 8.206 | 1.602 | 120 | 3.743 | 0.885 |
| 16 | 52.807 | 3.761 | 51 | 19.330 | 2.631 | 86 | 8.014 | 1.577 | | | |
| 17 | 51.216 | 3.732 | 52 | 18.821 | 2.598 | 87 | 7.827 | 1.551 | | | |
| 18 | 49.677 | 3.703 | 53 | 18.327 | 2.565 | 88 | 7.645 | 1.526 | | | |
| 19 | 48.188 | 3.674 | 54 | 17.847 | 2.532 | 89 | 7.468 | 1.502 | | | |
| 20 | 46.748 | 3.644 | 55 | 17.382 | 2.499 | 90 | 7.295 | 1.477 | | | |
| 21 | 45.354 | 3.614 | 56 | 16.930 | 2.466 | 91 | 7.127 | 1.453 | | | |
| 22 | 44.007 | 3.583 | 57 | 16.491 | 2.433 | 92 | 6.963 | 1.429 | | | |
| 23 | 42.705 | 3.553 | 58 | 16.066 | 2.400 | 93 | 6.803 | 1.405 | | | |
| 24 | 41.446 | 3.522 | 59 | 15.654 | 2.368 | 94 | 6.648 | 1.382 | | | |
| 25 | 40.226 | 3.490 | 60 | 15.253 | 2.336 | 95 | 6.497 | 1.359 | | | |
| 26 | 39.046 | 3.459 | 61 | 14.864 | 2.303 | 96 | 6.350 | 1.337 | | | |
| 27 | 37.904 | 3.427 | 62 | 14.486 | 2.272 | 97 | 6.207 | 1.315 | | | |
| 28 | 36.797 | 3.395 | 63 | 14.119 | 2.240 | 98 | 6.067 | 1.293 | | | |
| 29 | 35.726 | 3.362 | 64 | 13.762 | 2.208 | 99 | 5.931 | 1.271 | | | |
| 30 | 34.689 | 3.330 | 65 | 13.416 | 2.177 | 100 | 5.798 | 1.250 | | | |
| 31 | 33.686 | 3.297 | 66 | 13.078 | 2.145 | 101 | 5.668 | 1.229 | | | |
| 32 | 32.720 | 3.264 | 67 | 12.752 | 2.115 | 102 | 5.543 | 1.208 | | | |
| 33 | 31.797 | 3.232 | 68 | 12.435 | 2.084 | 103 | 5.420 | 1.188 | | | |
| 34 | 30.903 | 3.199 | 69 | 12.126 | 2.053 | 104 | 5.300 | 1.167 | | | |
| 35 | 30.037 | 3.166 | 70 | 11.827 | 2.023 | 105 | 5.184 | 1.148 | | | |
| 36 | 29.198 | 3.133 | 71 | 11.535 | 1.993 | 106 | 5.070 | 1.128 | | | |
| 37 | 28.386 | 3.100 | 72 | 11.252 | 1.964 | 107 | 4.959 | 1.109 | | | |
| 38 | 27.599 | 3.067 | 73 | 10.977 | 1.934 | 108 | 4.851 | 1.090 | | | |
| 39 | 26.836 | 3.033 | 74 | 10.709 | 1.905 | 109 | 4.745 | 1.071 | | | |
| 40 | 26.097 | 3.000 | 75 | 10.448 | 1.876 | 110 | 4.642 | 1.053 | | | |
| 41 | 25.383 | 2.966 | 76 | 10.194 | 1.847 | 111 | 4.542 | 1.035 | | | |
| 42 | 24.690 | 2.933 | 77 | 9.949 | 1.819 | 112 | 4.444 | 1.017 | | | |
| 43 | 24.018 | 2.899 | 78 | 9.710 | 1.791 | 113 | 4.349 | 1.000 | | | |
| 44 | 23.367 | 2.866 | 79 | 9.477 | 1.763 | 114 | 4.256 | 0.983 | | | |

# ReliaTel™ Economizer Control Actuator (LED Fault Code Info.)

## Actuator Fault (Honeywell)

An actuator fault will occur when the economizer position signal to the actuator is 25% different than the feedback signal from the actuator. Example: if the economizer is not attached to the motor, you would get an actuator fault only after the economizer would tell the motor to drive to at least 25% open.

## Actuator Fault (RTEM)

An actuator fault will occur when the economizer position signal to the actuator is 10% different than the feedback signal from the actuator for 4 continuous minutes. Example: if the economizer is not attached to the motor, you would get an actuator fault only after the economizer would tell the motor to drive to at least 10% open for at least 4 minutes.

## Sensor Faults

A sensor fault will occur if a sensor fails during normal operation. When power is freshly applied to the unit, the ECA and RTEM recognize which sensors are installed. Example: if only the MAT is hooked up, the economizer control action will be dry bulb. If the OAH/OAE and MAT are hooked up, the economizer control action will be in Reference Enthalpy.

If after power up one of the connected sensors is disconnected, the economizer should indicate a fault.

***Note:*** *The actuator has an internal potentiometer that reports the actual damper position. Should the linkage become bound, the actuator may report an unexpected output to a BAS output (Tracer™, Tracker™, CCP).*

The mixed air sensor (MAS) and outdoor air sensor (OAS) input from the RTRM are minimum required sensors.

If a $CO_2$ sensor is not hooked up, the economizer will not look for it and will not fault.

The flash codes are prioritized. The higher the flash count, the more priority the fault has. If there is more than one fault, only the higher priority fault will flash.

The green system LED is located near the center of the Honeywell ECA Module and in the corner of the RTEM.

On: OK to economize

Slow flash: Not OK to economize

½ second on, 2 seconds off: no communication

OFF: No power or system failure

Error codes — ½ second on, ¼ second off

1 flash — Actuator fault

2 flash — $CO_2$ sensor

3 flash — RA humidity sensor

4 flash — RA temp sensor

6 flash — OA humidity sensor

7 flash — No communication with RTRM at power-up, loss of communication with RTRM, or no reading from the outdoor air sensor (OAS) in the condenser section

8 flash — MA temp sensor

9-11 flash — Internal fault (Honeywell only)

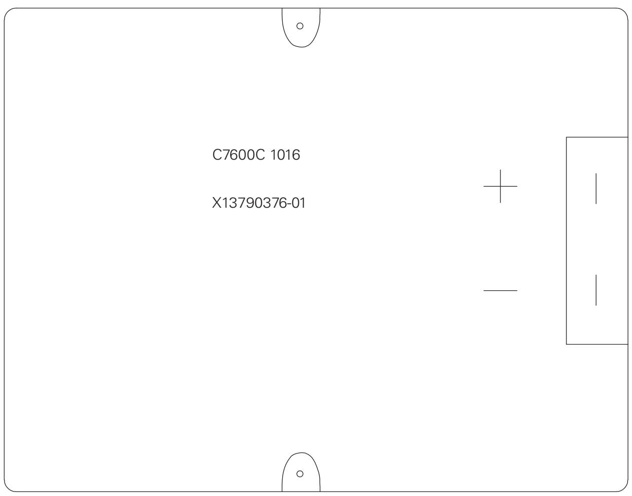
Modbus Communication voltage when measured at ECA — J17-1 and J17-2 (MBUS +/-) will read approximately 0.5 - 2.0 vdc (flashing)

# ReliaTel™ Humidity Sensors

## Outdoor Humidity Sensor

Field installed accessory, located below and to the left of economizer actuator motor. Used in reference (BAYENTH005*) and comparative (BAYENTH006*) enthalpy control. Operates from 10-90% RH, 32°F – 90°F.

**Figure 68. Humidity sensor**




| Component Description | Part Number |
|---|---|
| Humidity Sensor (OHS, RHS) | SEN-01036 |

## Return Humidity Sensor

Field installed accessory, located inside economizer barometric relief hood. Used in comparative (BAYENTH006*) enthalpy control only. (Honeywell #C7600C).

## To Test Humidity Sensors

| | | |
|---|---|---|
| Return Air Humidity Sensor | ECA | RAH/RAE |
| Outdoor Humidity Sensor | ECA | OAH/OAE |

To test this circuit, place a DC milliamp meter in series with either of the leads to the humidity sensor. If the reading is 0ma, polarity may be reversed. Reverse + & - and retest. If the reading does not correspond to the table below, check the output voltage from the ECA with the sensor disconnected.

The DC voltage at the OAH and RAH pins on the Honeywell ECA module should be approximately 15 or 20VDC (depending on the ECA version) or 23Vdc if the module is a RTEM. If so, and all connections are intact, replace the sensor. If the appropriate Vdc signal is not present, yet the economizer module's green LED is on, the economizer module has failed.

## ECA Module Voltages

W7340A1004 (Production part prior to 8/1/2005) - 20.0 VDC

W7340B1002 (Production part since 8/1/2005) - 15.0 VDC

## RTEM Module Voltage

X13651513 - 23Vdc

**Table 41.**

| RH% | DCma | RH% | DCma | RH% | DCma |
|---|---|---|---|---|---|
| 100% | 20.000 | 52.6 | 12.414 | 31.2 | 9.000 |
| 97.7 | 19.636 | 51.7 | 12.273 | 30.8 | 8.926 |
| 95.5 | 19.286 | 50.8 | 12.135 | 30.3 | 8.852 |
| 93.4 | 18.947 | 50.0 | 12.000 | 29.9 | 8.780 |
| 91.4 | 18.621 | 49.2 | 11.868 | 29.4 | 8.710 |
| 89.4 | 18.305 | 48.4 | 11.739 | 29.0 | 8.640 |
| 87.5 | 18.000 | 47.6 | 11.613 | 28.6 | 8.571 |
| 85.7 | 17.705 | 46.8 | 11.489 | 28.1 | 8.504 |
| 83.9 | 17.419 | 46.1 | 11.368 | 27.7 | 8.438 |
| 82.1 | 17.143 | 45.3 | 11.250 | 27.3 | 8.372 |
| 80.5 | 16.875 | 44.6 | 11.134 | 26.9 | 8.308 |
| 78.8 | 16.615 | 43.9 | 11.020 | 26.5 | 8.244 |
| 77.3 | 16.364 | 43.2 | 10.909 | 26.1 | 8.182 |
| 75.7 | 16.119 | 42.5 | 10.800 | 25.8 | 8.120 |
| 74.3 | 15.882 | 41.8 | 10.693 | 25.4 | 8.060 |
| 72.8 | 15.652 | 41.2 | 10.588 | 25.0 | 8.000 |
| 71.4 | 15.429 | 40.5 | 10.485 | 24.6 | 7.941 |
| 70.1 | 15.211 | 39.9 | 10.385 | 24.3 | 7.833 |
| 68.8 | 15.000 | 39.3 | 10.286 | 23.9 | 7.826 |
| 67.5 | 14.795 | 38.7 | 10.189 | 23.6 | 7.770 |
| 66.2 | 14.595 | 38.1 | 10.093 | 23.2 | 7.714 |
| 65.0 | 14.400 | 37.5 | 10.000 | 22.9 | 7.660 |
| 63.8 | 14.211 | 36.9 | 9.908 | 22.5 | 7.606 |
| 62.7 | 14.026 | 36.4 | 9.818 | 22.2 | 7.552 |
| 61.5 | 13.846 | 35.8 | 9.730 | 21.9 | 7.500 |
| 60.4 | 13.671 | 35.3 | 9.463 | 21.6 | 7.448 |
| 59.4 | 13.500 | 34.7 | 9.558 | 21.2 | 7.397 |
| 58.3 | 13.333 | 34.2 | 9.474 | 20.9 | 7.347 |
| 57.3 | 13.171 | 33.7 | 9.391 | 20.6 | 7.297 |
| 56.3 | 13.012 | 33.2 | 9.310 | 20.3 | 7.248 |
| 55.4 | 12.857 | 32.7 | 9.231 | 20.0 | 7.200 |
| 54.4 | 12.706 | 32.2 | 9.153 | | |
| 53.5 | 12.558 | 31.7 | 9.076 | | |

# Space Pressure Control with Statitrac™ (27.5-through 50-Tons)

## Description of Function

With the RTRM v9.0 release, Voyager™ III units will have the option to utilize Space Pressure Control with Statitrac for applications requiring tighter building pressure control. The Space Pressure Control function turns the exhaust fan on and off and modulates the exhaust dampers independent of the outside air dampers to maintain Space Pressure within the Space Pressure Deadband. The Space Pressure Deadband is centered around the user selectable Space Pressure Setpoint. This function is active whenever configured for Space Pressure Control with Statitrac and the Supply Fan is energized.

***Note:*** *The unit must be equipped with an RTRM v9.0 or later, RTEM v1.0 or later, RTOM v3.0 or later, and RTVM 3.0 or later to fully utilize Space Pressure Control with Statitrac.*

### Exhaust Fan Control

The Exhaust Fan(s) will be turned ON when the Space Pressure value rises above the deadband and

1. the Exhaust Enable Setpoint is set to 0% or
2. the Exhaust Enable Setpoint is greater than 0%, the OA Damper position is greater than the Exhaust Enable Setpoint, and the integration of the control has determined that the exhaust fans are needed

Once the Exhaust Fan(s) are energized, the Space Pressure control algorithm then provides control of the exhaust damper which will open beyond its minimum position (3.5Vdc) up to 100% when the pressure is above the Deadband and close toward min position when the pressure is below the Deadband.

***Note:*** *The exhaust damper will be held at a control signal of 3.5Vdc any time the unit is powered up, except during override conditions, to ensure that the exhaust fan does not run against a closed damper.*

The Exhaust Fan(s) will be turned OFF when either of the following conditions occur:

1. The exhaust damper is at minimum position for 30 continuous minutes.
2. Integration of space pressure error determines that the exhaust fan is not required.

### Sensor and Setpoint Arbitration

Sensor and setpoint values may be provided from local sensor and setpoint inputs located on the RTVM and RTOM and also from BAS/NETWORK provided data. If a valid value is provided from BAS/NETWORK for the Space Pressure, Space Pressure Setpoint, or Exhaust Enable setpoint that value will override the local setpoint and sensor inputs and will be used for control. If BAS/NETWORK is not providing a valid value for any of these sensors or setpoints, the control will utilize the local sensors and setpoints for space pressure control.

### Space Pressure Zero Function

The Space Pressure Control function will provide a 23Vdc output signal from the RTVM approximately every 60 seconds to energize solenoids for calibration purposes.

### Exhaust Damper Output Control

The RTVM will provide a 2-10Vdc output signal range from 0-100% for Exhaust Damper control. Note that any time the unit is powered up, the Exhaust Damper Output signal will be at 3.5Vdc unless overridden completely closed. This is to ensure that the Exhaust Fan does not run against fully closed dampers.

### Failure and Override Modes of Operation

#### Failure Modes

1. Space Pressure Sensor Failure: Diagnostic condition is called out and unit falls back to exhaust fan and damper control w/o Statitrac. The exhaust damper position will track the active OA Damper position once the OA Damper rises above the Exhaust Enable Setpoint and the exhaust fan energizes. For the duration of the sensor failure, the RTRM System LED will flash the 2-blink error code. Once the Space Pressure sensor returns within the valid range, the unit will resume normal space pressure control with Statitrac.
2. Space Pressure Setpoint Failure: Unit falls back to using default setpoint values to continue space pressure control.
3. RTVM Communication Failure:

If the RTVM loses communication with the RTRM, the following actions shall occur:

   a. The Space Pressure Control function will be disabled.
   b. The Exhaust Fan will be de-energized.
   c. The Exhaust Damper will be closed to min position.
   d. The Outside Air Damper will be forced to min position (economizing will be disabled.)

e. The RTRM System LED will blink a 2-flash error code after 2 minutes.

f. The RTVM System LED will blink the ¼ second ON and 2 seconds OFF error code.

4. RTOM Comm. Failure: The unit shall utilize the default Exhaust Enable Setpoint of 25% for exhaust fan control.

5. RTEM Comm. Failure: The unit will disable space pressure control; the OA Damper and Exhaust damper will be at min position and the Exhaust Fan will be OFF.

6. Supply Fan Failure: Once the unit has a supply fan failure, the exhaust fan will be de-energized and the exhaust damper will be closed to min position until the unit goes through a manual reset or power cycle.

## Override Modes

1. Ventilation Override Modes
   - Pressurize - During VOM Pressurize, the unit will de-energize the exhaust fan and override the exhaust damper closed (2Vdc)if configured for Statitrac.
   - Purge - During VOM Purge, the unit will energize the Exhaust Fan and open the Exhaust Damper 100% if configured for Statitrac.
   - Exhaust - During VOM Exhaust, the unit will energize the Exhaust Fan and open the Exhaust Damper 100% if configured for Statitrac.
2. Service Test Mode

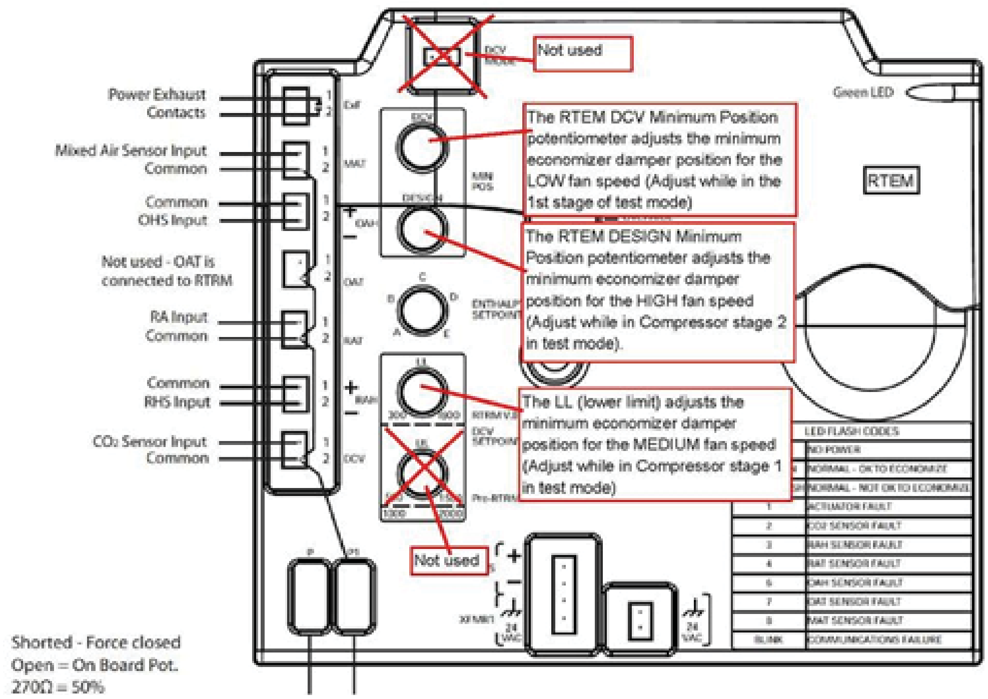
   The exhaust damper shall actuate up to 100% during the Economizer step of Service Test when the unit is configured with Statitrac. For all other service test steps, the exhaust damper will be at minimum position.

# SZVAV, multi-speed and 17 Plus unit outdoor air compensation and economizer minimum position

Because of the need to maintain the same outdoor cfm during different fan speeds, set up of the economizer minimum position is different than for constant volume units.

There are 3 speeds and damper positions to set up, LOW, MEDIUM, and HIGH.

**Figure 69.**




Damper minimum position adjustments should be done in the test mode.

- Test step 1 (supply fan) forces the supply fan to run at LOW speed. The minimum position of the economizer damper is allowed to travel between 0% and 100% when the fan is at LOW speed. This is adjusted by the DCV Min potentiometer on the RTEM.
- Test step 3 (Compressor stage 1) forces the supply fan to run at MEDIUM speed. The minimum position of the economizer damper is allowed to travel between 0% and 75% when the fan is at Medium speed. This is adjusted by the LL potentiometer on the RTEM.
- Test step 4 (Compressor stage 2) forces the supply fan to run at HIGH speed. The minimum position of the economizer damper is allowed to travel between 0% and 50% when the fan is at HIGH speed. This is adjusted by the DESIGN Min potentiometer on the RTEM.

BAS setpoints override any local potentiometer adjustments.

An economizer on a Light Commercial multi speed supply fan or the single zone VAV option must have the fully populated "enhanced" RTEM of at least version 2.0 or greater.

The Powered Exhaust set point should be set in the HIGH fan speed (Test step 4, Compressor stage 2). ReliaTel™ will determine an adjusted setpoint for other fan speeds based on this setting.

It is not recommend using a motorized damper with multi speed or Single Zone VAV units.

# Electromechanical Economizer Functions

**Figure 70. Economizer actuator (ECA) connected to the unit**

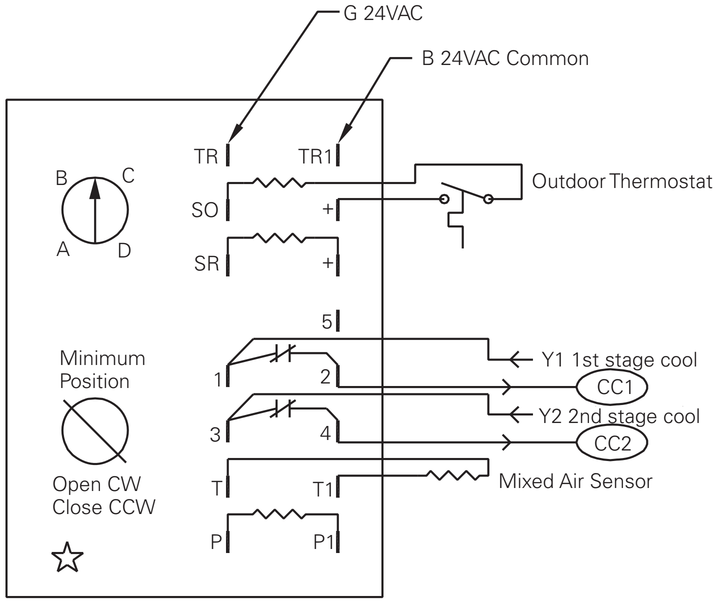
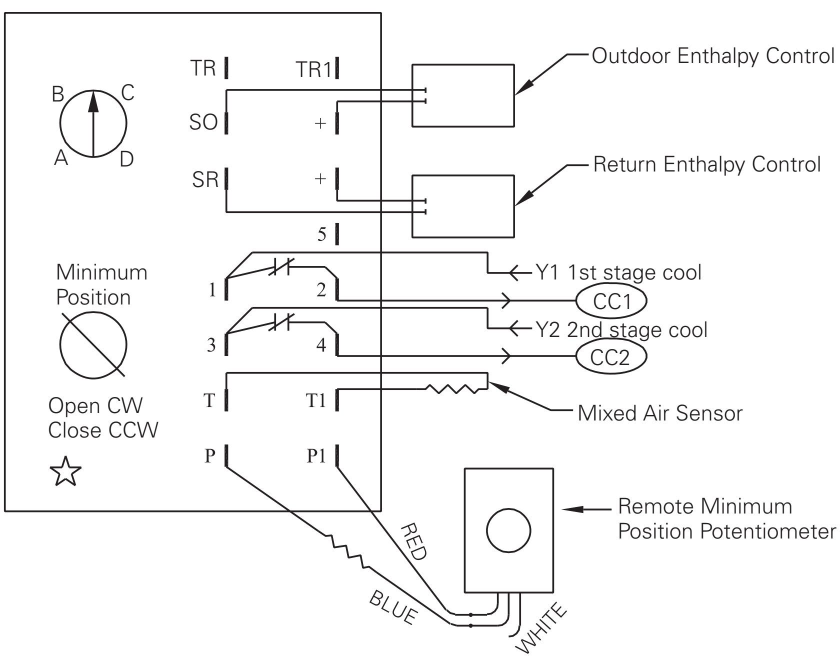



**Figure 71. Economizer actuator (ECA) connected to the unit**



# Electromechanical Economizer Testing

## Electromechanical Mixed Air Sensor

When the outdoor air thermostat is in the cold position (closed), the unit will attempt to economize if a fan (G) and cooling (Y1) call exists at the ECA module. This is readily apparent at the ECA, as the “OK to economize” LED will be on. During this time, the ECA is measuring the Mixed Air temperature via the Mixed Air Sensor (MAS).

## Service Tips

The MAS sensor is not energized unless the LED is on (G signal present, OK to economize), and the Y1 signal is present.

If the MAS is open, approximately 4.3 VDC will be seen.

Outdoor Air Thermostat opens at 70°F and closes at 60°F.

Read the voltage with the sensor connected, read the resistance with the sensor disconnected.

**Table 42. Temperature input**

| Temp F | Temp C | R(K OHMS) | DC Volts | Temp F | Temp C | R(K OHMS) | DC Volts |
|---|---|---|---|---|---|---|---|
| 33.8 | 1 | 9.576 | 3.910 | 89.6 | 32 | 2.204 | 2.714 |
| 35.6 | 2 | 9.092 | 3.882 | 91.4 | 33 | 2.111 | 2.676 |
| 37.4 | 3 | 8.636 | 3.894 | 93.2 | 34 | 2.023 | 2.639 |
| 39.2 | 4 | 8.204 | 3.863 | 95.0 | 35 | 1.938 | 2.600 |
| 41.0 | 5 | 7.796 | 3.829 | 96.8 | 36 | 1.858 | 2.561 |
| 42.8 | 6 | 7.412 | 3.790 | 98.6 | 37 | 1.781 | 2.526 |
| 44.6 | 7 | 7.048 | 3.749 | 100.4 | 38 | 1.708 | 2.484 |
| 46.4 | 8 | 6.705 | 3.713 | | | | |
| 48.2 | 9 | 6.380 | 3.674 | | | | |
| 50.0 | 10 | 6.073 | 3.634 | | | | |
| 51.8 | 11 | 5.782 | 3.590 | | | | |
| 53.6 | 12 | 5.507 | 3.550 | | | | |
| 55.4 | 13 | 5.247 | 3.507 | | | | |
| 57.2 | 14 | 5.000 | 3.420 | | | | |
| 59.0 | 15 | 4.767 | 3.373 | | | | |
| 60.8 | 16 | 4.545 | 3.328 | | | | |
| 62.6 | 17 | 4.335 | 3.283 | | | | |
| 64.4 | 18 | 4.136 | 3.239 | | | | |
| 66.2 | 19 | 3.948 | 3.180 | | | | |
| 68.0 | 20 | 3.769 | 3.157 | | | | |
| 69.8 | 21 | 3.599 | 3.118 | | | | |
| 71.6 | 22 | 3.437 | 3.080 | | | | |
| 73.4 | 23 | 3.284 | 3.034 | | | | |
| 75.2 | 24 | 3.138 | 3.007 | | | | |
| 77.0 | 25 | 3.000 | 2.971 | | | | |
| 78.8 | 26 | 2.869 | 2.932 | | | | |
| 80.6 | 27 | 2.744 | 2.896 | | | | |
| 82.4 | 28 | 2.625 | 2.860 | | | | |
| 84.2 | 29 | 2.512 | 2.824 | | | | |
| 86.0 | 30 | 2.404 | 2.787 | | | | |
| 87.8 | 31 | 2.301 | 2.750 | | | | |

# Electromechanical Economizer (3 Position Damper)

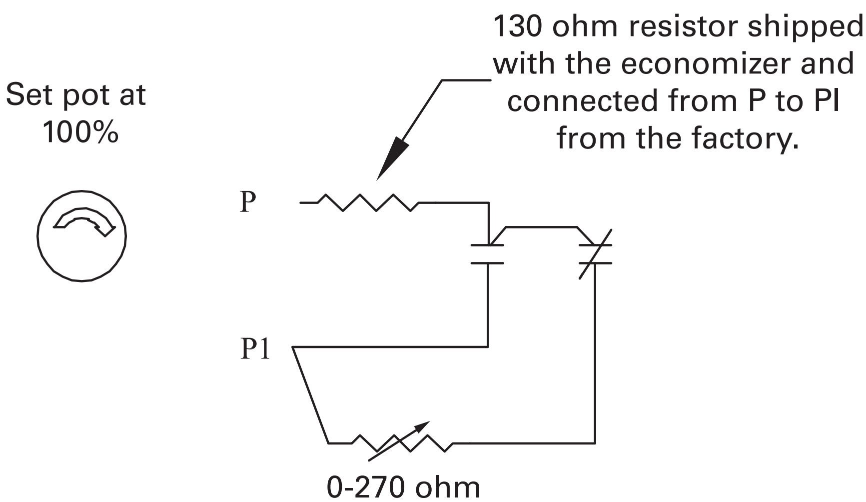
Full open economizer minimum position is accomplished by setting the ECA 50% minimum position potentiometer to 100% and installing a set of contacts in series with the existing 130 ohm resistor to terminals P and P1 on the ECA.

Any intermediate (0 - 50%) economizer position is accomplished by installing a 0 - 270 ohm potentiometer in series with an additional set of contacts and the existing 130 ohm resistor to terminals P and P1 on the ECA. 0 ohms = 50% outside air and 270 ohms = 0% outside air.

Fully closed position is accomplished when the indoor fan is disabled.

***Note:*** *Actual outside airflow is also dependent on return air static pressure.*

**Figure 72. Electromechanical economizer**



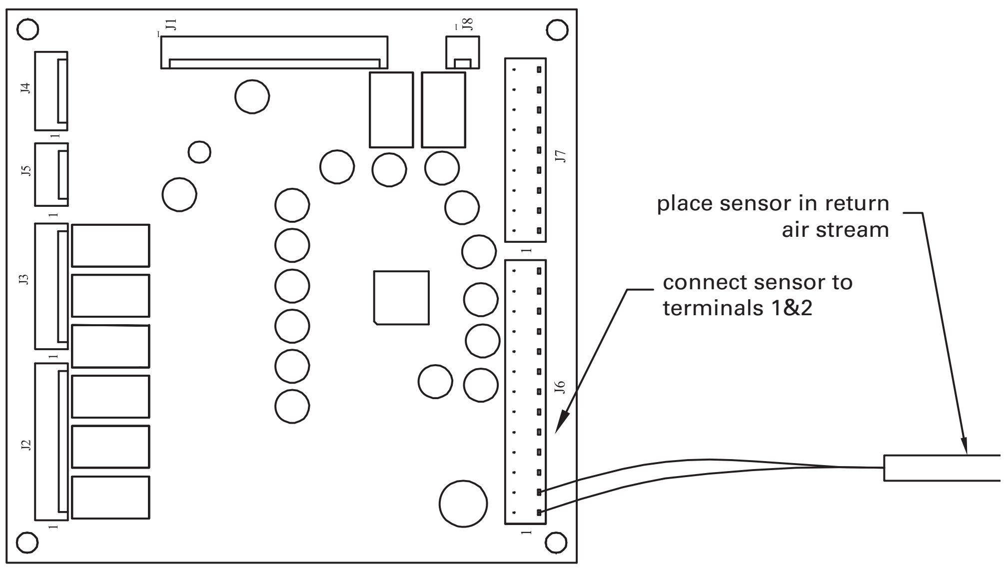
# ReliaTel™ Control Temporary Operation 3-through 25-tons

Temporary comfort can be provided without a Zone Sensor Module or thermostat in place by using the Outdoor Air Sensor or a spare Supply Air / Return Air Sensor. How to do it: remove the sensor from the unit, add enough thermostat wire to it so that it can be placed in the return air stream, then connect the sensor to J6-1 & J6-2.

After the permanent Zone Sensor or thermostat is in place, the sensor must be removed from J6-1 & J6-2.

**Figure 73. ReliaTel™ refrigeration module**

ReliaTel Refrigeration Module




If the RTRM does not have a space temperature input (J6-1, J6-2), or have a conventional thermostat input (G, Y, W), the unit will not run (except in the test mode).

## Temporary Sensor (thermistor) attached to J6-1 and J6-2 only:

Continuous fan

Auto changeover

74°F cooling, 71°F heating

***Note:*** *27½-through 50-ton units - the outdoor air sensor should not be used for this purpose.*

# ReliaTel™ Supply Air Tempering Control

Supply air tempering maintains the supply air temperature above a lower limit during minimum ventilation periods when in heat mode on a CV unit and during inactive cool mode on a VAV unit. Supply air tempering is available when using a BAYSENS019*/ AYSTAT666* Programmable Zone Sensor, BAYSENS006-11/AYSTAT661-664 Mechanical Zone Sensor, or Trane ICS system.

The unit requires an RTOM (options module) and BAYTUBE discharge air sensing kit. Supply air tempering will not work with a conventional thermostat.

## Enable Supply Air Tempering

**Mechanical Zone Sensor BAYSENS006-11/ AYSTAT661-664:** remove the jumper from RTOM J3-1 and J3-2.

**Programmable Zone Sensor BAYSENS019*/ AYSTAT666*:** change Option 4 in the options menu to 1=enabled. Or, remove the jumper from RTOM J3-1 and J3-2.

**COMM 3/4 (TCI):** Enable through appropriate menu. Supply air tempering can also be enabled by removing the jumper from RTOM J3-1 and J3-2.

**LonTalk (LCI):** Enable through nciPersonality2. This function may not be available with some 3rd party systems. Supply air tempering can also be enabled by removing the jumper from RTOM J3-1 and J3-2.

**Voyager 27.5-50 ton VAV with Staged Heat:** Supply air tempering is not available. The RTOM J3-1 and J3-2 jumper is ignored.

# Sequence of Operation

## Constant Volume Units with Staged Heat

When Supply Air Tempering is enabled, the fan mode is on, active mode is Heat or Emergency Heat, and with the unit not actively heating. Stage 1 of heat is turned ON when the supply air temperature is 10°F below the Active Heating Setpoint.

Stage 1 of heat is turned OFF when the supply air temperature is 10°F above the Active Heating Setpoint or the Mode is no longer Heat or Emergency Heat. Should the zone temperature exceed the Active Heating Setpoint by 1-2F, Supply Air Tempering will cease until another normal heating cycle resumes.

For heat pump units, the auxiliary heat is used for tempering.

***Note:*** *Tempering on CV units with Modulating Heat is inherent to the modulating heat control design.*

## Variable Air Volume Units

For VAV units configured with a modulating heat type if the unit is operating in Occupied Supply Air Cooling mode, but the unit is not actively cooling, the unit will energize and modulate the Mod. Heat output to prevent the Supply Air from falling below the SA Cool Setpoint deadband low end (SACSP – 3.5°F) once the unit has de-energized all mechanical cooling (if energized). Upon satisfying the SA Tempering requirements a five-minute ‘SA Tempering Delay’ timer will start whenever the modulating heat is commanded to 0%. This timer will be reset to 5 minutes whenever there is an active call for heat to meet SA Tempering demands.

Tempering will be discontinued whenever:

1. The five-minute ‘SA Tempering Delay’ timer has timed-out

and

2. There is an active cooling request from the VAV Occupied Mechanical Cooling function.

# Discharge Air Sensing with TCI Comm3/4

Units connected to ICS systems have the ability to look at discharge air temperature. Units using COMM3/4 only have the ability to see one point for discharge air temperature and that is through the Mixed Air sensor input on the ECA Module labeled MAT. This input is reported back to the ICS display graphics as SAS (Supply Air Sensor). The discharge air sensor is used for supply air tempering with an ICS system or a BAYSENS019* programmable zone sensor.

Systems using LonTalk® and LCI have the ability to see both Mixed Air and Discharge Air temperature.

The following discussion is focused only on units utilizing COMM3/4 communications.

If an economizer is not installed, the discharge air sensor option is required to monitor discharge air temperature. The sensor must be used in conjunction with the RTOM module (optional on 3-through 25-ton units). The discharge sensor will be located in the discharge opening of the unit.

## 3-through 25-Ton Units

If a unit has an economizer, in order to monitor true discharge air temperature, the unit can use the Mixed Air sensor, but it will have to be relocated to the discharge of the unit. If the Mixed Air sensor is relocated to the discharge of the unit, no further action is required. The sensor will report back true discharge temperature through the economizer module, and also still function as the Mixed Air sensor for the economizer operation. The Discharge Air sensor option is the recommended method because it uses an averaging tube to sense the air across the discharge opening. This sensor will have to be wired back to the Mixed Air Sensor (MAT) input on the economizer module and replaces the MAT sensor.

***Note:*** *If the unit has an economizer and the Discharge Air sensor option is installed, then a 5.6K (1/4 watt) resistor must be installed on the OAT terminals of the economizer actuator module (ECA). This resistor will allow the economizer to continue operation from the Mixed Air sensor. The discharge air sensor will report true discharge temperature to the RTOM, and in turn, to the ICS panel via the TCI COMM3/4 communications. KIT08318 can be ordered for the 5.6K resistor.*

## 27.5-through 50-Ton Units

The discharge air sensor is standard on VAV units, but is optional on CV units.

### Service Note

Should there be a failure of either the Mixed Air sensor or the Discharge Air sensor, the diagnostic will be reported back as a Supply Air Sensor failure. It will require a visit to the job site to determine which sensor has failed.

# $CO_2$ Sensor Connections (ReliaTel™ Units with Demand Controlled Ventilation)

## Demand Controlled Ventilation (DCV)

Demand Controlled Ventilation (DCV) describes a control strategy that responds to the actual demand (need) for ventilation by regulating the rate at which the HVAC system brings outdoor air into the building. There are several ways to assess ventilation demand:

- Occupancy sensors, which detect the presence or number of people in each monitored space.
- Occupancy schedules, which allow a building automation system to predict the current population based on the time of day.
- Carbon dioxide ($CO_2$) sensors, which monitor the concentration of $CO_2$ that the occupants continuously produce.

Regardless of which method is used, DCV strategies vary the outdoor air intake in response to the current population. The practice of using carbon dioxide concentration as an indicator of population or ventilation rate is often called $CO_2$-Based, Demand-Controlled Ventilation.

The $CO_2$ DCV function is only available for units with economizers; the 50% motorized damper option will not operate with a $CO_2$ sensor. The 50% motorized damper opens to one position; it does not modulate like the economizer. Also, the 50% damper does not come with a return blade or a mixed air sensor.

The $CO_2$ option does not require an RTOM (3-25 tons) board.

The $CO_2$ sensor can be configured for 0-10 vdc, 0-20 ma, or 4-20 mA analog outputs. For use with the ReliaTel economizer, the sensor must be set for 0-10 vdc. As the $CO_2$ level increases, the voltage output increases accordingly.

The potentiometers used for setting the $CO_2$ setpoints and outdoor air damper position setpoints are located on the ReliaTel RTEM module.

**Table 43. $CO_2$ levels and associated voltage outputs**

| $CO_2$ Level (ppm) | 0 | 200 | 400 | 600 | 800 | 1000 | 1200 | 1400 | 1600 | 1800 | 2000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Voltage Output (vdc) | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

## RTEM Operation

Units equipped with an RTEM economizer logic module will perform Demand Controlled Ventilation differently based on the RTRM version also installed in the unit. See below for information concerning the different configurations of RTEM and RTRM versions.

### RTEM w/ RTRM v8.0 and Later

For units equipped with an RTRM v8.0 or later and also an RTEM, the control will utilize two separate Space $CO_2$ Setpoints and two separate Damper Minimum Position Setpoints as described below:

#### CO2 Setpoints

The $CO_2$ Setpoints will be obtained through two onboard potentiometers located on the RTEM; Building Design $CO_2$ Setpoint (Upper Limit) and DCV Minimum CO2 Setpoint (Lower Limit). The Upper Limit $CO_2$ Setpoint will have a range of 1000-2000 ppm and the Lower Limit $CO_2$ Setpoint will have a range of 300-1900 ppm. A 100 ppm differential will be enforced between the Upper Limit $CO_2$ Setpoint and Lower Limit $CO_2$ Setpoint. In the case of the Lower Limit $CO_2$ Setpoint being set to compromise this 100 ppm differential, the Upper Limit $CO_2$ Setpoint will not be "pushed-" and the 100 ppm differential will be enforced. However, if the Upper Limit $CO_2$ Setpoint is set to compromise the 100 ppm differential, the Lower Limit $CO_2$ Setpoint will be pushed down in order to enforce the 100 ppm differential and to allow the Upper Limit $CO_2$ Setpoint to be set as desired.

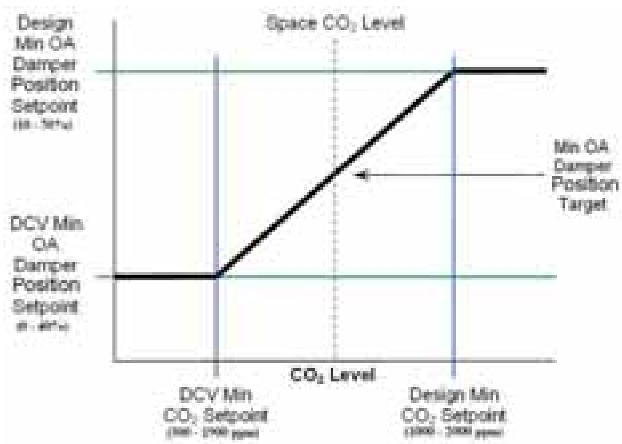
#### OA Damper Min Position Setpoints

The OA Damper Min Position setpoints will be determined by the position of two onboard potentiometers located on the RTEM; Building Design Min Position Setpoint (10-50%) and DCV Min Position Setpoint (0-40%). A 10% differential will be enforced between the Design Min Position Setpoint and DCV Min Position Setpoint; the DCV Min Position Setpoint will always be 10% less than the Design Min Position Setpoint. If the unit is configured for DCV and a Remote Min Position value is present on the P0 and P1 terminals, the Remote Min Position will become the Design Min Position Setpoint and the 10% differential will not be enforced. If the Remote Min Position is set to be lower than the DCV Min Position Setpoint, the Remote Min Position setpoint will be used for the Design Min Position and the DCV Min Position.

## Sequence of Operation

When the unit is in the occupied mode, the outdoor-air (OA) damper opens to the DCV Min Position Setpoint. If the space $CO_2$ level is less than or equal to the Lower Limit $CO_2$ Setpoint, the OA damper will close to the DCV Min Position Setpoint. If the space $CO_2$ level is greater than or equal to the Upper Level $CO_2$ Setpoint, the OA damper will open to the Design Min Position Setpoint. If the space $CO_2$ level is greater than the Lower Limit $CO_2$ Setpoint and less than the Upper Limit $CO_2$ Setpoint, the OA damper position is modulated proportionally between the DCV Min and the Design Min Position Setpoints. If there is a call for economizer cooling, the outdoor air damper may be opened further to satisfy the cooling request. See Figure below.

**Figure 74. Damper position**




When the unit is in the unoccupied mode, DCV control is deactivated.

***Note:*** *When using $CO_2$-based DCV with an RTRM (v8.0 or later) and also an RTEM, set the Design Min Position Setpoint to the minimum outdoor airflow required by the local building code. The DCV Min Position Setpoint is typically based on either 1) the minimum exhaust airflow rate from the building or 2) the base ventilation rate required to dilute building- or process-related contaminants. See HVAC Knowledge Center wave52581 for guidance on determining the $CO_2$ setpoints and OA damper position setpoints for a given application.*

During normal occupied mode, if the unit is not actually heating or cooling, and the fan switch is set to auto, the supply fan will be off. If the unit is configured for Active DCV control (DCV Mode OPEN), the supply fan will be energized when the space $CO_2$ level rises above the Lower Limit $CO_2$ Setpoint and the DCV algorithm will be in control of the outdoor air damper position. When the space $CO_2$ level falls below the Lower Limit $CO_2$ Setpoint minus 50 ppm, DCV control will begin to close the damper to the DCV Min Position Setpoint. Once the space $CO_2$ level is below the Lower Limit $CO_2$ Setpoint minus 50 ppm and the OA damper is at the DCV Min Position the Supply Fan will de-energize if not requested ON by another function.

The RTEM allows the selection of either Active or Passive DCV control. Installing a jumper across J10-1 and J10-2 on the RTEM module configures the unit for Passive DCV control. When configured for Passive DCV control, DCV control is not allowed to force on the supply fan, and DCV control will only be allowed when the supply fan is on (commanded ON by another function, such as comfort heating or cooling control, or the supply fan mode set to ON). Passive DCV will operate identically to Active DCV once the Supply Fan is energized.

***Important:*** *While the ReliaTel will allow Active DCV control when the fan mode is set to AUTO (cycle on and off with the compressor or heater), this practice is discouraged because it can result in excessive fan cycling and may not comply with ASHRAE Standard 62.1. If $CO_2$-based DCV is used, the supply fan mode should be set to ON (operate whenever the zone is occupied) or the unit should be configured for Passive DCV control.*

## RTEM w/ RTRM v7.0 and Earlier

For units equipped with an RTRM v7.0 or earlier and also an RTEM, the control will utilize a single $CO_2$ Setpoint and two separate Damper Minimum Position Setpoints as described below:

### Setpoint Selection

Units equipped with an RTRM v7.0 or earlier will utilize a single $CO_2$ Setpoint. The RTEM will use this setpoint and space $CO_2$ input value to determine the active OA damper position setpoint between the Bldg Design Min Position and DCV Min Position Setpoints.

For DCV control in these units, the $CO_2$ Setpoint will have a range of 500 to 1500 ppm. The Bldg Design Min Position will be set using the onboard potentiometer which will have a range of 10 to 50% and the DCV Min Position will be set using the onboard potentiometer which will have a range of 0 to 40%. This scheme enforces a 10% differential between the Bldg Design Min Position and the DCV Min Position Setpoints.

### Sequence of Operation

For units equipped with RTRM v7.0 or earlier and an RTEM, only Active DCV control is available, as the DCV Mode Configuration input is not recognized prior to RTRM v8.0.

#### *Supply Fan Mode = ON*

When the unit is in the occupied mode, the outdoor-air (OA) damper opens to the DCV Min Position Setpoint. If the space $CO_2$ level rises above the $CO_2$ Setpoint, the OA damper will open to the Bldg Design Min Position Setpoint. If the space $CO_2$ level drops below the $CO_2$ Setpoint, but is not yet 50 ppm below the setpoint, the OA damper will stop modulating (holding its current position). If the space $CO_2$ level drops below the $CO_2$ Setpoint minus 50 ppm, the OA damper will close to the DCV Min Position Setpoint. If there is a call for economizer cooling, the outdoor air damper may be opened further to satisfy the cooling request.

#### *Supply Fan Mode = AUTO (from Zone Sensor or all T-stat inputs inactive)*

When the supply fan is energized (commanded ON by another function, such as comfort heating or cooling control), DCV control will operate as described above ("Supply Fan Mode = ON").

When the supply fan is de-energized, if the space $CO_2$ level rises above the CO2 Setpoint, DCV control will energize the supply fan and open the OA damper to the Design Min Position Setpoint. When the space $CO_2$ level drops below the $CO_2$ Setpoint, the supply fan will be de-energized and the OA damper will close to 0%.

### Failure and Override Conditions

1. If the $CO_2$ value goes invalid while DCV is enabled:
   a. A $CO_2$ Sensor failure diagnostic is called out.
   b. DCV is disabled.
   c. Design Min Position Setpoint will be used for the Damper Min Position
   d. After power is cycled to the unit, the $CO_2$ sensor failure diagnostic is cleared and DCV is disabled.
2. For all configurations, (RTEM, RTRM 8.0, Honeywell, etc.) if a $CO_2$ sensor value becomes valid at any point during unit operation the unit will utilize the value and perform Demand Controlled Ventilation.
3. If a Ventilation Override Mode goes active it will take priority over DCV.
4. If an Emergency Override Mode goes active it will take priority over DCV.
5. Any BAS Economizer minimum position request takes priority over DCV.
6. The remote minimum position input will be used as the Design Minimum Position Setpoint when connected.

## Honeywell Operation

When the indoor $CO_2$ level rises above the DCV setpoint (upper limit), the supply fan will energize, and a PID control loop modulates the position of the outdoor-air damper to bring in more outdoor air to maintain indoor $CO_2$ level at this upper limit (the operation of compressors or heat are not affected; they still operate to maintain space or discharge air temperature at setpoint). When the indoor $CO_2$ level drops back below this limit minus 50 PPM, the outdoor-air damper is allowed to return to its minimum position and the supply fan is allowed to de-energize if no longer requested.

***Note:*** *When using $CO_2$-based demand controlled ventilation with the ReliaTel controller, the minimum OA damper position should be set to be less then the code required design ventilation rate for the system. See HVAC Knowledge Center case #4144 for guidance on determining the indoor $CO_2$ setpoint and minimum OA damper position for a given application.*

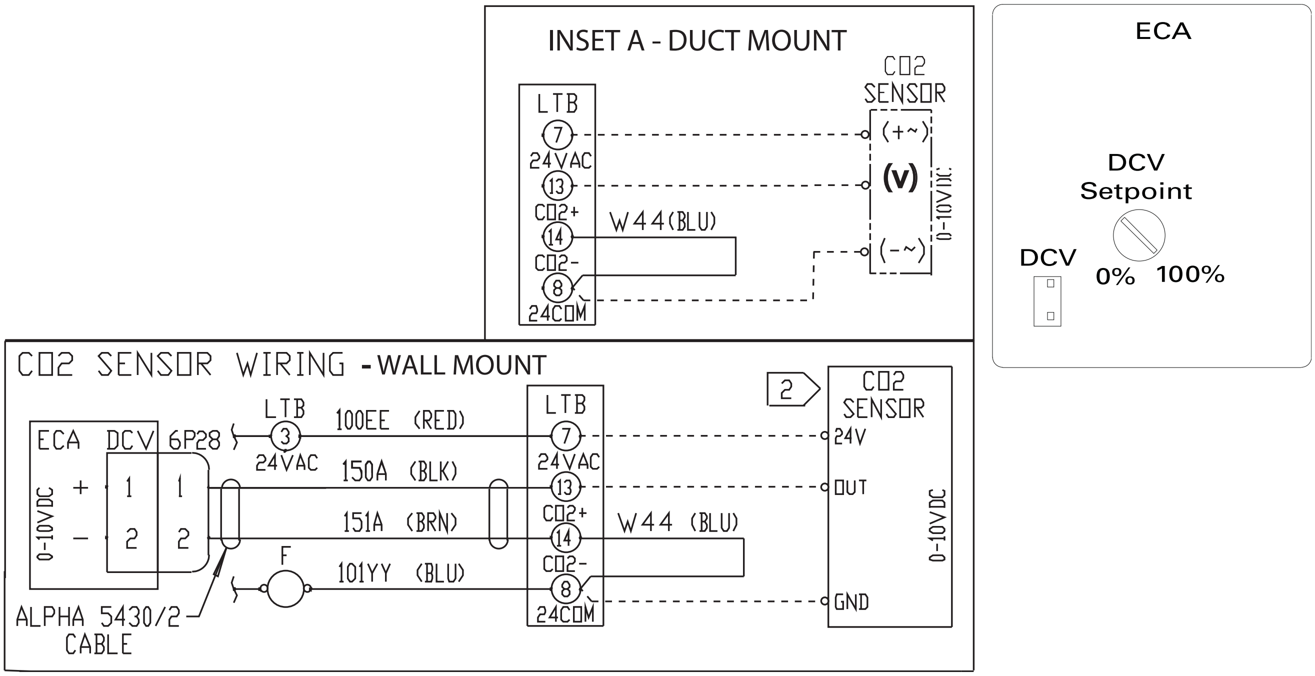
As a safety precaution, if the mixed air temperature drops to 40° F, the mixed air sensor overrides DCV control and closes the outdoor-air damper to its minimum position to protect the gas heat exchanger (or to prevent water coils, if installed, from freezing). When the mixed air temperature rises to 43° F, DCV control reverts to normal.

***Note:*** *Since it is possible for the outdoor air damper to drive wide open, it is also recommended to install an evaporative defrost control to prevent the evaporator coil from freezing (Frostat is a standard feature on the Voyager Commercial 27.5 - 50 ton units).*

### Voyager 27.5-through 50-tons VAV Notes

- During morning warm-up (MWU), the DCV setpoint is ignored.
- During unoccupied mode, the DCV setpoint is ignored.
- During occupied cooling or daytime warm-up (DWU) mode, DCV control is allowed.

**Figure 75. Wiring connections using $CO_2$ accessory**



# Demand Controlled Ventilation ($CO_2$) setup for Single Zone VAV, Multi Speed and 17 Plus units

Because of the need to maintain the same outdoor cfm during different fan speeds, set up of Demand Controlled Ventilation is different than for constant volume units.

There are 3 fan speed reference points which will be referred to as Low, Medium, and High fan speeds.

The DCV set up procedure should be done in test mode.

- The supply fan test (1st step in test mode) forces the supply fan in the Low fan speed.
- The compressor stage 1 test (3rd step in test mode) forces the supply fan into the Medium fan speed.
- The compressor stage 2 test (4th step in test mode) forces the supply fan to the High fan speed.

It is highly recommended to connect the $CO_2$ sensor directly at the unit to LTB4 for convenience. It is much more difficult to verify set points and functionality with the $CO_2$ sensor in the space away from the unit. Breathing on the $CO_2$ sensor simulates a high $CO_2$ concentration in the space.

In addition to the RTEM (ReliaTel™ Economizer Module) a circuit board called the RTVM (ReliaTel Ventilation Module) is required for DCV operation on Light Commercial multi speed supply fan and single zone VAV units. This module is based off of the RTOM (ReliaTel Options Module) but the RTVM has different components and firmware installed. The RTVM is mounted next to the RTOM or in the return air section. See the accessory kit instructions for installation details.

**Figure 76.**

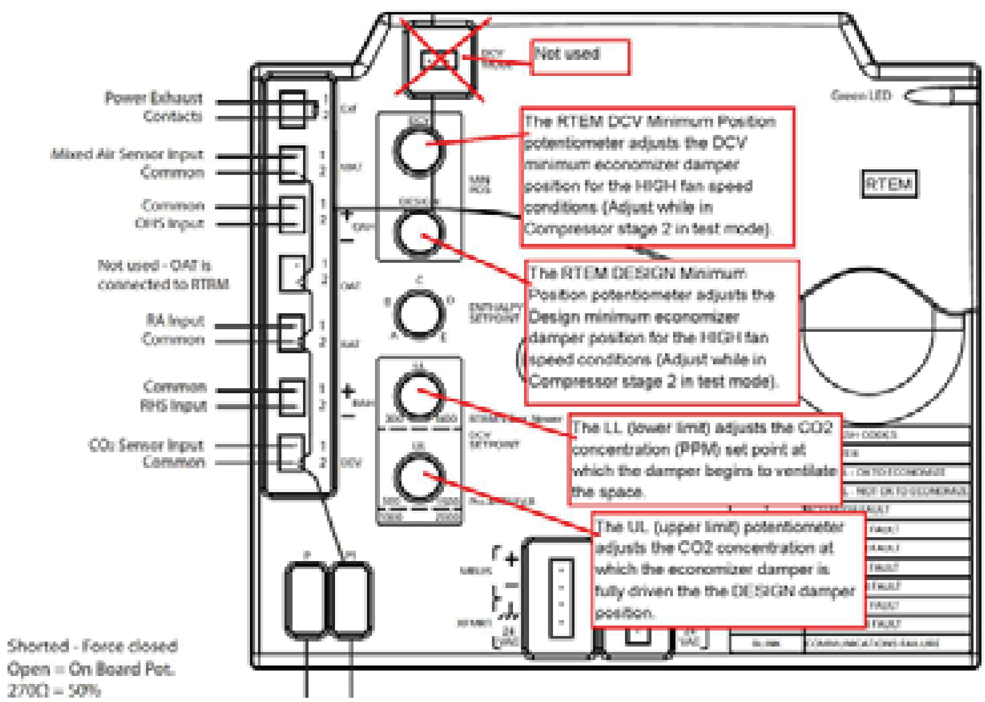
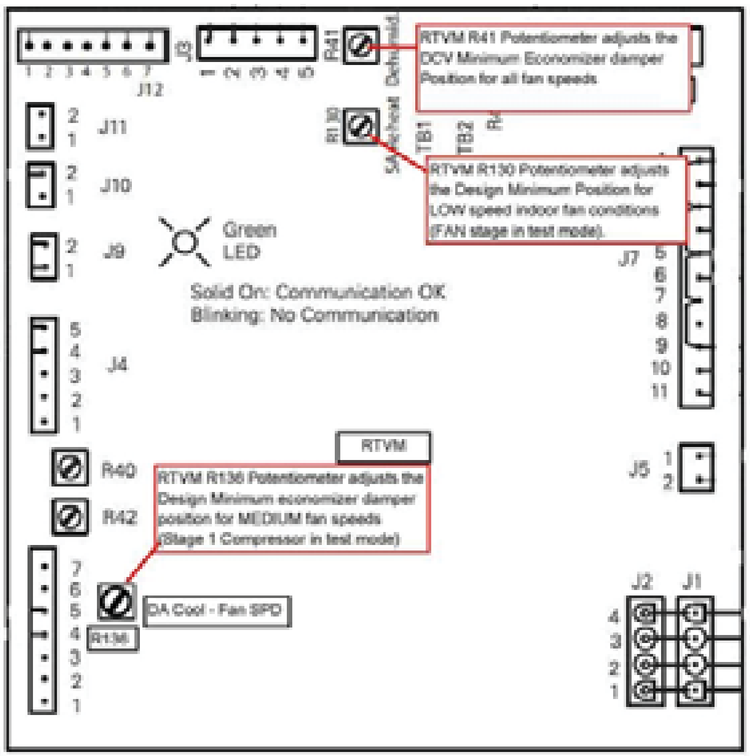


**Figure 77.**




# Initial set up

- For damper position adjustment, the Lower Limit (LL) $CO_2$ PPM adjustment potentiometer should be set to the lowest position (counter clockwise) and the Upper Limit (UL) $CO_2$ PPM adjustment potentiometer should be set to approximately half way. These can be adjusted later to the required $CO_2$ levels.
- A $CO_2$ sensor should be wired at the unit at LTB4 for the convenience of set up.
- All three of the 'Design Minimum" adjustment potentiometers (R130 on the RTVM, R136 on the RTVM, and "Design Min" on the RTEM should be set to the maximum position (fully clockwise) and both of the "DCV Minimum" adjustment potentiometers (R41 of the RTVM and "DCV Min" of the RTEM) should be set to the minimum position as a starting position.

## Set up the LOW fan speed damper positions

- Enter into the test mode to the supply fan test step (1st step in test mode).
- Adjust the R130 potentiometer on the RTVM to set the LOW fan speed Design minimum damper position. The Design minimum position set point controls the damper position when there is a high concentration of $CO_2$ in the space and ventilation is required. The damper can be set from 0% open to 100% open during the LOW fan speed.
- Adjust the R41 potentiometer on the RTVM to set the LOW fan speed DCV minimum position. The DCV minimum position set point controls the damper position when there is a low concentration of $CO_2$ in the space. The damper can be set from 0% open to 100% open in the LOW fan speed.
- Ensure that the R130 LOW fan speed Design minimum damper position is set greater than the LOW fan speed DCV minimum damper position.
- Blow on the $CO_2$ sensor to simulate a high concentration of $CO_2$ to confirm the economizer damper responds to the call for ventilation.

This procedure must also be repeated for the MEDIUM and HIGH fan speeds

## Set up the MEDIUM fan speed damper position

- Advance to the 3rd step in the test mode (1st stage compressor). This forces the supply fan to the MEDIUM fan speed.
- Adjust the R136 potentiometer on the RTVM to set the MEDIUM fan speed Design minimum damper position. The damper can be set from 0% open to approximately 75% open in the MEDIUM fan speed.
- There is no "DCV Min" setup for MEDIUM fan speed. The value from R41 from the previous step is retained for the MEDIUM fan speed.
- Again blow on the $CO_2$ sensor to simulate a high concentration of $CO_2$ to confirm the economizer damper responds to the call for ventilation.

## Set up the HIGH fan speed damper positions

- Advance to the full compressor cooling in the test mode (both compressor running) or any stage of heat. This forces the supply fan to the High fan speed.
- Adjust the "DesignMin" potentiometer on the RTEM to set the HIGH fan speed Design minimum damper position. The damper can be set from 0% open to approximately 50% open in the High fan speed.
- Adjust the "DCV Min" potentiometer on the RTEM to set the High fan speed DCV minimum position.
- Again blow on the $CO_2$ sensor to simulate a high concentration of $CO_2$ to confirm the economizer damper responds to the call for ventilation.

After this procedure is finished adjust the Lower Limit (LL) $CO_2$ PPM adjustment potentiometer and the Upper Limit (UL) $CO_2$ PPM adjustment potentiometer on the RTEM to the required settings for the application. This is often determined by local codes.

RTVM modules for Light Commercial units are different than RTVM modules for Large Commercial units and are not interchangeable.

Design minimum position set up is different for Light Commercial multi speed supply fan and single zone VAV units without DCV.

Communicated BAS set points override any local potentiometer setting.

# ReliaTel™ Ventilation Override

Three Ventilation modes are available with ReliaTel™ through use of an Options Module (RTOM) and economizer (ECA) with Power Exhaust. Following is a list of each mode and what happens during each.

Connections to the unit to accomplish Ventilation Modes are shown below. All three inputs are shown for illustration; only one is typically used.

***Note:*** *Although not associated with ventilation override, humidistat connections for dehumidification are also provided on this terminal block.*

Emergency shutdown from the LTBI 5&6 will override any ventilation override mode.

Ventilation override inputs override smoke detector inputs through the RTOM. (3-through 25-tons only).

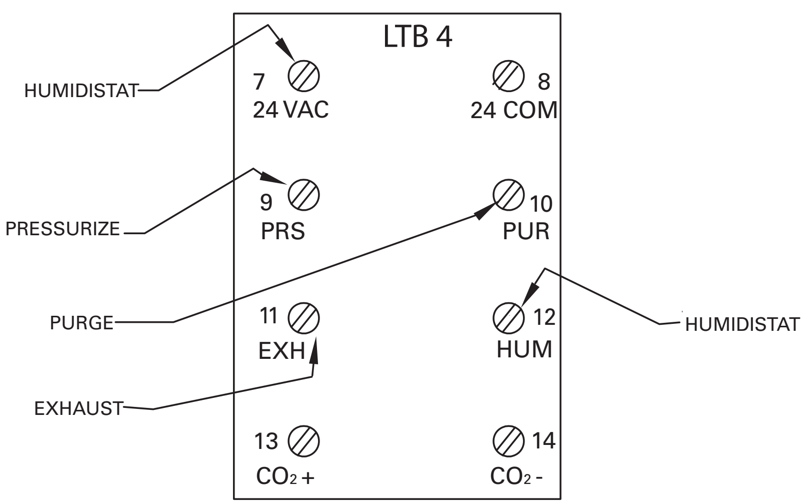
**Table 44.**

| Supply Fan forced: | | IGV/ VFD* | Compressors may run? | OK to heat (gas/elect.)? | Economizer position? | Power Exhaust? | Exhaust Damper[(a)] | VHR Relay* |
|---|---|---|---|---|---|---|---|---|
| Pressurization | ON | 100% | No | No | 100% | Off | 0% | ON |
| Purge | ON | 100% | No | No | 100% | On | 100% | ON |
| Exhaust | OFF | 100% | No | No | 0% | On | 100% | ON |

*Voyager 27.5-through 50-tons VAV

(a) Exhaust Damper is controlled on units with Power Exhaust w/Statitrac™.

**Figure 78. LTB layout**



# Dehumidification with Hot Gas Reheat (3-through 25-Tons)

Factory installed hot gas reheat allows application of dehumidification. Initiation of reheat is performed by an input to the RTOM module from either a relative humidity sensor or a humidistat type device. These connections are made through the low voltage terminal strip located in the unit control panel.

Actuation of the reheat is accomplished by energizing a valve that allows refrigerant hot gas to flow through the hot gas reheat coil.

Dehumidification is allowed only when the outside air temperature is above 40°F and below 100°F. Dehumidification is also not allowed if there is an active call for heating or a request for greater than 50% cooling.

If, during a dehumidification cycle, there is a call for heating or cooling, the dehumidification cycle is terminated. The economizer outside air damper is also driven to minimum position during dehumidification.

A humidity sensor that is capable of providing a 4 - 20 ma output can be used. The RH setpoint is established by adjusting the R41 potentiometer (labeled Dehumid SP) on the RTOM module. The range can be set from 40 to 60%. In the absence of a zone humidity sensor input, an on/off input from a zone humidistat is used to initiate or terminate the dehumidification cycle.

***Note:*** *If a non-Trane® humidity sensor is provided from another source, it may be necessary for a wiring modification to the RTOM. Refer to HVAC case5284.*

A relative humidity sensor takes priority over a humidistat. Dehumidification takes priority over a call for one stage cooling. Heating or 2 stage cooling takes priority over dehumidification.

## Sequence of Events

### Single compressor units

On a call for dehumidification, the reheat valve is energized and the compressor is turned on. When the humidity control setpoint is satisfied, the valve is de-energized and the compressor is turned off. If there is a call for cooling or heating from the space temperature controller, i.e. zone sensor or thermostat, while in reheat, the reheat valve is de-energized and the compressor continues to run, or the heat is turned on. The three-minute compressor on and off times are still active during compressor operation.

### Dual Compressor units

On a call for dehumidification, the reheat valve is energized and both compressors are turned on. When the humidity control setpoint is satisfied, the valve is de-energized and both compressors are turned off. If there is a call for 1st stage cooling from the zone sensor or thermostat while in the dehumidification mode, no action takes place.

If there is a call for heating or 2nd stage cooling, the reheat valve is de-energized, and the unit reverts to the cooling or heating mode. If 2nd stage cooling is satisfied and there is still a call for dehumidification, the reheat valve will once again be energized, and the second compressor will again be started. The three-minute compressor on and off times are still active during compressor operation.

If both compressors are running, and there is a call for dehumidification, the dehumidification call is ignored and unit stays in the cooling mode.

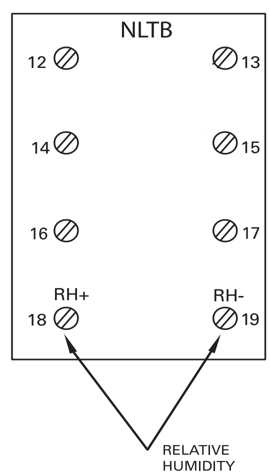
Refer to appropriate unit wiring diagrams for control connections.

For reliability reasons, a purge time function was added to ensure that adequate oil is being returned to the compressor.

During normal cooling mode or during dehumidification mode, if the unit stays in a mode for 90 continuous minutes without switching to the other mode, a three minutes purge time will initiate.

If the unit has been in cooling mode for 90 minutes, the purge sequence will switch to the dehumidification mode for three minutes. If there is still a call for cooling, the unit will once again switch back to cooling.

The same sequence is also true if unit is in the dehumidification mode. It will switch to cooling for three minutes and then back to dehumidification.




A unit with dehumidification installed will operate normally if a humidity sensor or humidistat is not installed. The compressor will switch to the dehumidification mode for a total of three minutes after 90 minutes of compressor run time in the cooling mode.

Verification of the RH setpoint can be determined by measuring the dc voltage at TB1 and TB2 on the RTOM.

**Table 45.**

| Setpoint (%) | Voltage (vdc) | Setpoint (%) | Voltage (vdc) |
|---|---|---|---|
| 40 | 0.0 | 51 | 1.77 |
| 41 | .238 | 52 | 1.88 |
| 42 | .455 | 53 | 1.97 |
| 43 | .652 | 54 | 2.06 |
| 44 | .833 | 55 | 2.14 |
| 45 | 1.00 | 56 | 2.22 |
| 46 | 1.15 | 57 | 2.30 |
| 47 | 1.30 | 58 | 2.37 |
| 48 | 1.43 | 59 | 2.44 |
| 49 | 1.55 | 60 | 2.50 |
| 50 | 1.67 | | |

Calculation to convert mA to RH = (mA reading - 4) * 6.25
4mA = 0%

20mA = 100%

Example: (12mA - 4) * 6.25 = 50% RH

To measure the mA input current from the humidity sensor, disconnect sensor wire that is connected to terminal 18 of LTB. Connect amp meter in series with the wire and terminal 18 of the LTB.

**Table 46.**

| mA | % | mA | % |
|---|---|---|---|
| 4 | 0 | 13 | 56.25 |
| 5 | 6.25 | 14 | 62.5 |
| 6 | 12.5 | 15 | 68.75 |
| 7 | 18.75 | 16 | 75 |
| 8 | 25 | 17 | 81.25 |
| 9 | 31.25 | 18 | 87.5 |
| 10 | 37.5 | 19 | 93.75 |
| 11 | 43.75 | 20 | 100 |
| 12 | 50 | | |

Dehumidification/Reheat is disabled if any of these conditions exist:

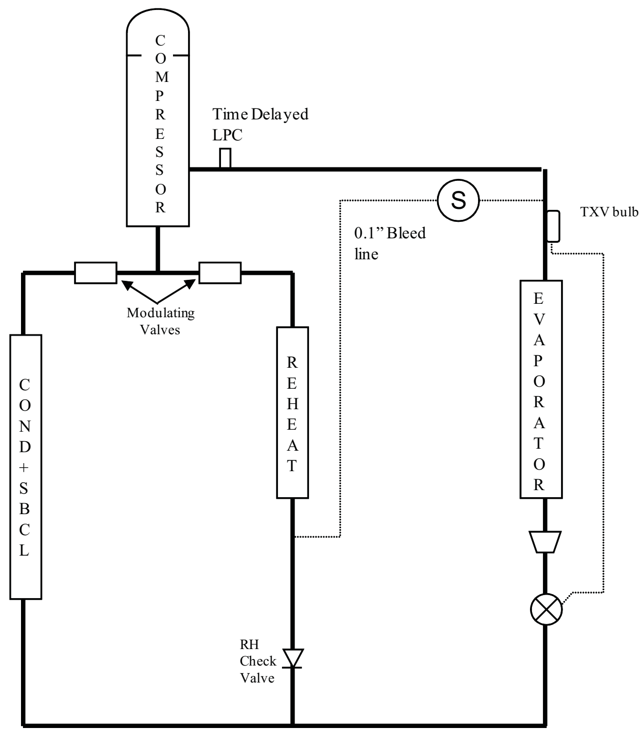
- Active Unit Mode = Off with Zone Sensor
- Humidistat Active OPEN from Humidity Stat
- Active Humidity < Active Humidity Set Point –5%
- Outdoor Air temperature < 40° F or Invalid or > 100°F and 1 compressor
- Compressor 1 (or 2 for multi-compressor units) Auto or Manual Reset lockout
- Active call for heating
- Slave Mode is active and requesting the supply fan off.
- Dehumidification Setpoint is set to 0% (Tracer Override)
- If using a zone sensor and Unit Mode is set to Manual/ Heat and Active Zone Temp > or equal to Active Zone Cool Setpoint
- If using a zone sensor and Unit Mode is set to Manual/ Cool and Active Zone Temp < Active Zone Heat Setpoint + 0.5° F.

# Modulating Dehumidification with Hot Gas Reheat (27.5-through 50-Tons)

## Controls Overview

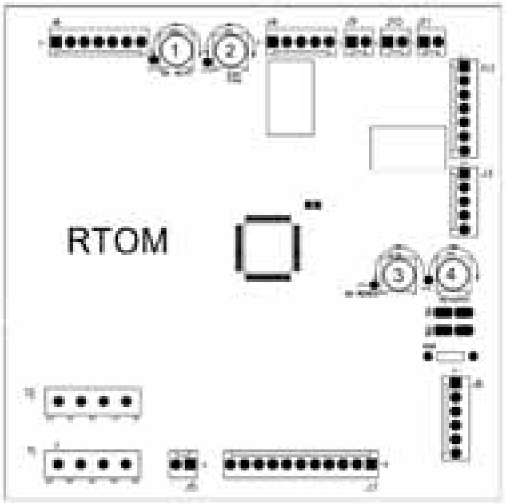
- Reheat LPC (RTDM input)
    - Manual lockout after four trips.
    - Additional 60# low pressure cutout ignored for the first 10 minutes of compressor run time in reheat mode.
    - Will also be active during service test.
- Two Modulating valves are controlled by the leaving unit temperature sensor
    - Cooling mode: Cooling valve 100% open, Reheat valve 0% open.
    - Reheat mode: Cooling and Reheat valves open/close inverse of each other. Reheat valve allowed to operate from 15 to 85% open.
- Reheat pump out solenoid
    - Energized when in cooling mode. It is inactive in all other modes.
    - A three minutes purge cycle will take place after one continuous hour (hard coded) of operation in reheat or cooling mode.
- Entering Evaporator Temperature (overrides Frostat™ during reheat)
    - During reheat operation if the temp is below 35° F for 10 minutes the control will shed compressors (or circuits).
    - The unit will not be allowed to stage up until leaving reheat.
    - If the temp is below 35° F for 10 more continuous minutes all compressors will stage off and the ID fan will continue to run.
    - Once reaching 45° F the compressor (circuit) will be re-enabled.
- The condenser fans will be staged differently in reheat mode than cooling mode.
    - Single circuit units (3 total condenser fans): A maximum of 2 outdoor fans above 85° F and a maximum of 1 outdoor fan below 80° F.
    - Dual circuit units (4 total condenser fans): A maximum of 4 outdoor fans above 85° F and a maximum of 2 outdoor fans below 80° F.
- Service mode operation
    - Reheat step will follow the last cooling step in service test mode.
    - All compressors energized.
    - Reheat / Cooling Modulating valve positions are 50%.
    - Pump out solenoid de-energized.
    - 60 minute service test interval timer will be in control.

**Figure 79. Voyager™ Commercial modulating hot gas reheat**




- RTRM handles the main dehumidification logic.
- RTOM contains the humidity and supply air set point.
- RTDM (New module) handles the reheat/cooling valve and pump out relay control.
- Customer adjustable set points
    - Supply air reheat set point located on RTOM (65-80°F default 70°F)
    - Dehumidification (humidity) set point located on RTOM (40-65% default 50%)
    - VAV Dehumidification Override Zone Cooling and Heating Set points (75°F Cooling, 68°F Heating). A customer can adjust them if a CV Remote Zone sensor is connected to the RTRM or by using resistors.

**Figure 80. Modulating hot gas reheat control boards**



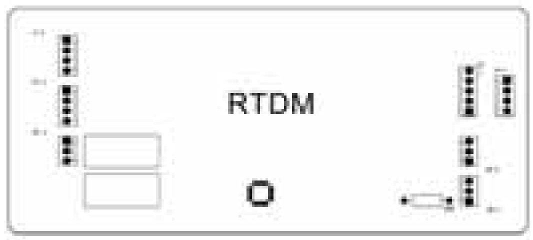

**SETPOINT LEGEND**

**1.Discharge Air Heat SP**
- 50-150° F

**2.Exhaust Fan Enable SP**
- 0 to 100%

**3.Supply Air Reheat SP**
- 65-80° F

**4.Dehumidification SP (%)**
- 40 to 65% RH

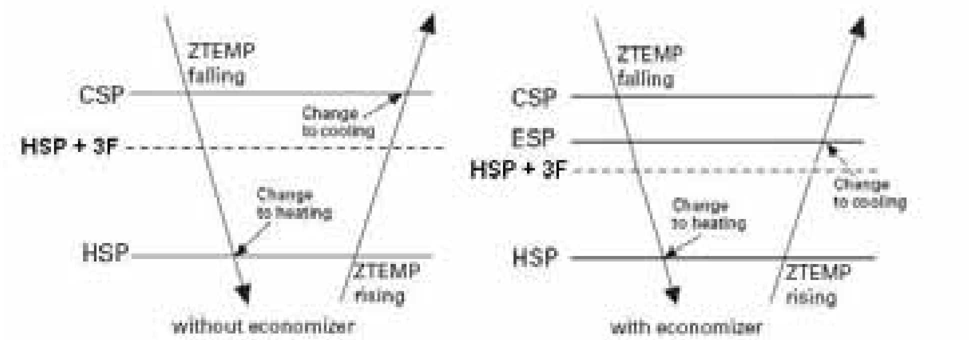


# Heating/Cooling Changeover

The change over from heating to cooling is accomplished in two different ways. The first drawing below illustrates change over in a system without an economizer, and the second drawing illustrates change over in a system with an economizer. Change over from cooling to heating is accomplished in the same manner for both economizer and non-economizer systems.

If the unit is in the cooling mode and the zone temperature is falling, the unit will change to the heating mode when the zone temperature is less than the heating set point and it has been 5 minutes since the last active call for cooling was terminated. For systems without economizers or with economizers, but the economizer is enthalpy disabled, if the unit is in the heating mode, and the zone temperature is rising, the unit will change to the cooling mode when the zone temperature is greater than the greater of the Active Cooling Setpoint or Active Heating Setpoint + 3ºF, and it has been 5 minutes since the last active call for heating has been terminated. For systems with economizers and the economizer is enthalpy enabled, if the unit is in the heating mode, and the zone temperature is rising, the unit will change to the cooling mode when the zone temperature is greater than the greater of the economizer setpoint or the Active Heating Setpoint + 3ºF, and it has been 5 minutes since the last active call for heating has been terminated.

**Figure 81. Heating/Cooling changeover**



# Low Ambient Mechanical Cooling Operation (3-25 Ton Units)

## Evaporator Defrost Control (EDC) Function

The Evaporator Defrost Control (EDC) function provides low ambient cooling, standard, down to 0° F. At this temperature, equipment can provide approximately 60% of the mechanical cooling capacity. During low ambient operation compressor run time is counted and accumulated by the RTRM.

Low ambient operation is defined as 55° F for single compressor units, and 40° F for dual compressor units. Dual condenser fan units provide condenser cycling.

***Note:*** *If the outside air sensor fails, the EDC logic is disabled and the #2 condenser fan will run continuously.*

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Compressor | ← OFF → | | ← ON (10 minutes accumulated compressor run time) → | | | | | | | | ← OFF → | | | ←ON → | | | | |
| Indoor Fan | ← OFF → | | ←ON (Continues to run during 3 min. Defrost time) → | | | | | | | | | | | | | | | |
| Minutes | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |

When accumulated compressor run time reaches approximately 10 minutes, an evaporator defrost cycle is initiated. An evaporator defrost cycle lasts for 3 minutes; this matches the compressor 3 minutes minimum OFF time.

When an evaporator defrost cycle occurs, the compressors are turned off and the indoor fan motor continues to run. After completing an evaporator defrost cycle, the unit returns to normal operation, and the compressor run time counter is reset to zero.

***Note:*** *Economizer operation is not affected by an evaporator defrost cycle.*

# ReliaTel™ Condenser Fan Control Logic

## 12.5-through - 25-Ton

For units that have two condenser fans, special control logic is designed to provide proper condenser head pressure control at different ambient conditions. With normal operation, either one or both fans will be operating depending on the outdoor temperature.

Control logic resides in the RTRM module. When the outdoor ambient drops below 60 degrees the second condenser fan will be turned off. When the outdoor temperature reaches 65 degrees, the fan will once again restart.

When only one condenser fan is running, the second fan will "windmill" backwards. This is caused by air being drawn in through the opening of the fan orifice which bypasses the condenser coil. If the windmilling is fast enough and the condenser fan is energized, it can actually start and run in the reverse direction. To prevent this, when there is a call for the second condenser fan to start, control logic forces the first condenser fan to shut off for seven seconds to allow the second fan to slow down. After seven seconds, both the first and the second condenser fan will restart.

Because the contactors that provide power to the condenser fan are also the same ones used to power the compressors, both compressors (if the second compressor is running) will also shut down during the seven second interval. When the fans restart, the compressor will also restart.

## 27.5-through - 50-Ton

### Condenser Fan Sequencing Control

The condenser fans are cycled according to the outdoor air temperature and the number of cooling steps that are operating. Table 47, p. 118 lists the temperatures at which the A and B Condenser Fan Outputs on the RTRM switches the fans "Off". The fans are switched back "ON" when the outdoor temperature rises approximately 5° F above the "Off" temperature.

Figure 82, p. 119 shows the condenser fans as viewed from the top of the unit facing the control panel. Whenever a condenser fan is cycled back "On", the condenser fan Outputs A and B and the compressor steps are de-energized for approximately seven seconds to prevent problems with fan windmill.

**Table 47. Condenser fan/compressor sequence**

| Unit Size | Compressor Staging Sequence | | | Condenser Fan Output | | O/A Temp. (°F) |
|---|---|---|---|---|---|---|
| (Tons) | Step 1 | Step2 | Step 3 | Output A | Output B | Fans "Off" |
| 27.5 - 30 | CPR 1* | CPR 1, 2 | N/A | Fan #2 | Fan #3 | 70 |
| | | | | | | 90 |
| | | | | Fan #2 | Fan #3 | -10 |
| | | | | | | 60 |
| 35 | CPR 1* | CPR 1, 2 | N/A | Fan #2 | Fan #3 | 65 |
| | | | | | | 85 |
| | | | | Fan #2 | Fan #3 | -20 |
| | | | | | | 55 |
| 40 | CPR 1 ** | CPR 2, 3*** | CPR 1, 2, 3 | Fan #2 | Fan #3, 4 | 50 |
| | | | | | | 70 |
| | | | | Fan #2 | Fan #3, 4 | 20 |
| | | | | | | 60 |
| | | | | Fan #2 | Fan #3, 4 | -30 |
| | | | | | | 50 |
| 50 | CPR 1** | CPR 2, 3*** | CPR 1, 2, 3 | Fan #2 | Fan #3, 4 | 20 |
| | | | | | | 60 |
| | | | | Fan #2 | Fan #3, 4 | -10 |
| | | | | | | 55 |
| | | | | Fan #2 | Fan #3, 4 | -30 |
| | | | | | | -303.3.3.3[a] |

1. The Compressor(s) listed under each step are the operating compressors. On 27.5-through 35-ton units with Lead/Lag, CPR1 will alternate but the fan sequence will remain the same. On 40 & 50 Ton units with Lead/Lag, the compressor(s) in step 2 & 3 will alternate and the fan sequence listed for that step will be in operation.
2. Conventional thermostat sequence: Y1=CPR1, Y2=CPR2 (40 & 50 CPR 2,3), Y1 + Y2 = CPR1,2 (40 & 50 CPR 1,2,3)

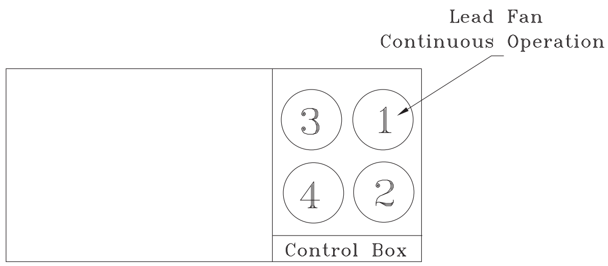
* Single circuit, manifolded compressors pair.

** First Stage, Number one refrigeration circuit, Stand alone compressor is "On".

*** First Stage is "Off", Number two refrigeration circuit, manifolded compressor pair is "On" operating simultaneously.

(a) For RTRM 8.0+, the fan off temperature is 45ºF.

**Figure 82. Condenser fan location**




## Odyssey™ Independent Circuit Heat Pump Condenser Fan Control

For Odyssey™ Independent Heat Pump units, the Outdoor Fan B output will be energized whenever Compressor Circuit 1 is energized. The Outdoor Fan A output will be energized whenever Compressor Circuit 2 is energized. These statements hold true for active Heating and Cooling modes except during active Defrost.

# Phase Monitor

## 3-through 25-Ton ReliaTel™ Units

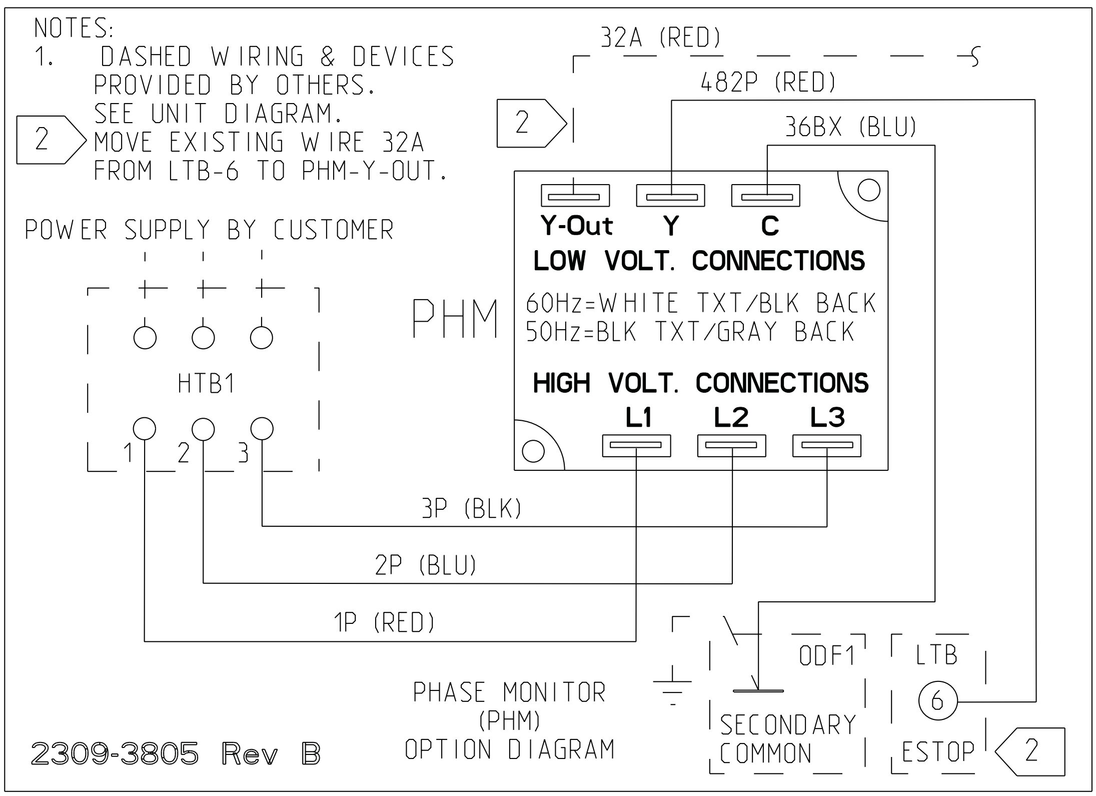
Phase monitors are installed on all 3-through 25-ton products with three-phase power. The main purpose of the phase monitor is to ensure that the scroll compressors are rotating in the proper direction. A green LED on the phase monitor indicates proper phasing.

If the input leads are crossed, the phase monitor will sense this and will immediately shut the unit down. The monitor will illuminate a red LED indicating a phase reversal condition.

If the control wires are crossed on the Y and Y-out terminals on the phase monitor, this will also cause the red LED to illuminate and will not allow the unit to run.

If a red LED is displayed, swap two leads on the incoming power to the unit. If the red LED is still illuminated, check for proper control wiring connections to the phase monitor. If all wiring is correct, the phase monitor is defective and needs to be replaced.

**Figure 83. Wiring diagram**



# Electromechanical Time Delay Relay

## Time Delay Relay

This time delay circuit board attaches to the side of the relay. When energized, the fan starts immediately and when de-energized shuts off 80 seconds later. This delay is not adjustable.

## Fan "Off" Delay Solid State Timer

When "G" is energized, the N.O. contacts between 1 and 2 close immediately, energizing the fan relay (F), which in turn starts the indoor fan. When "G" is de-energized, the contacts between 1 and 2 remain closed for 80 seconds, then open. This in turn de-energizes the F relay, which stops the indoor fan.

**Figure 84. Transformer and thermostat layout**

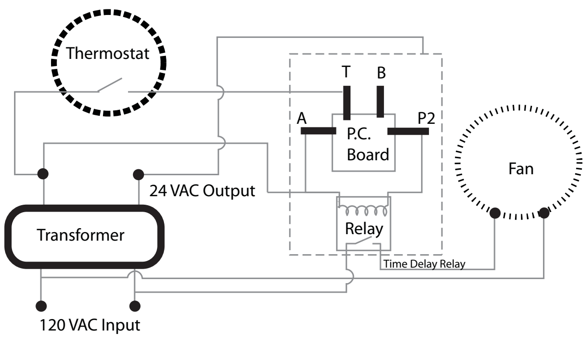



**Figure 85. Time delay relay**

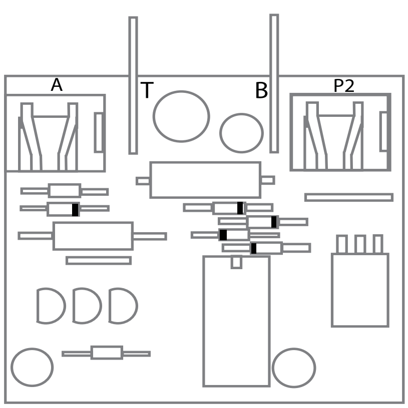
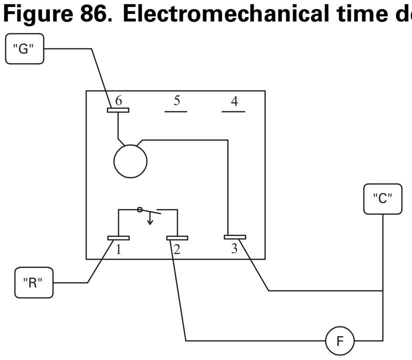



**Figure 86. Electromechanical time delay solid state**



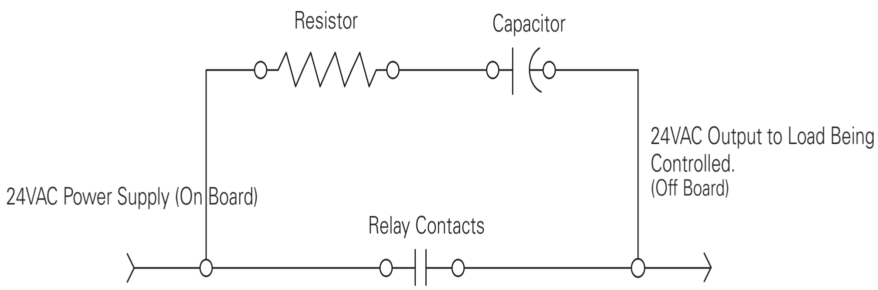
# Snubber Circuits

ReliaTel™ controls utilize relays to energize alternating current (AC) loads. Because of the characteristics of AC loads dealing with inrush current, snubber circuits are used.

The purpose of a snubber circuit is to act as a filter to help dampen the voltage peaks associated with the opening and closing of the relay contacts. The snubber circuit is a resistive/capacitive circuit, with a resistor and capacitor wired in series across the on-board relay contacts.

Snubber circuits may cause confusion because 24 vac will be present if the output wire is disconnected from the load; such as a relay or contactor coil, and the contacts of the board relay are open. The voltage potential between the disconnected wire and ground will be 24 vac, but no current will be present. When the wire is placed back on the contactor coil, the 24 vac potential will disappear. To properly verify whether voltage is present to energize a relay and contactor, the circuit must be complete and in tact.

**Figure 87. Snubber circuits**



# Transformer Troubleshooting

The graph shows how as current caused by loads on the transformer increases, voltage decreases. Once the voltage drops below the level that the contractor can pull in, usually about 16-18 volts, the current raises up to the point where the transformer burns out. The chart below is for illustration only.

A transformer usually burns out due to a short circuit. When this occurs, the technician can usually find the source of the short.

Sometimes though, the cause of transformer failure is not so obvious. It can also fail when excessive voltage drops occur because of poor connections, thermostat wires too long, bad contacts on the smoke detector, etc.

The excessive voltage drop results in low voltage to the load (contactor, relay) and then the transformer blows.

## Transformer Troubleshooting

Here’s what to look for:

Transformer on the wrong voltage tap, i.e. 208 volts at the unit, transformer on the 230 volt tap. Voltage drop across contacts (measure with a load on the circuit):

Voltage drop across contacts when load is applied should be less than ½ volt.

**Figure 88. Transformer chart**

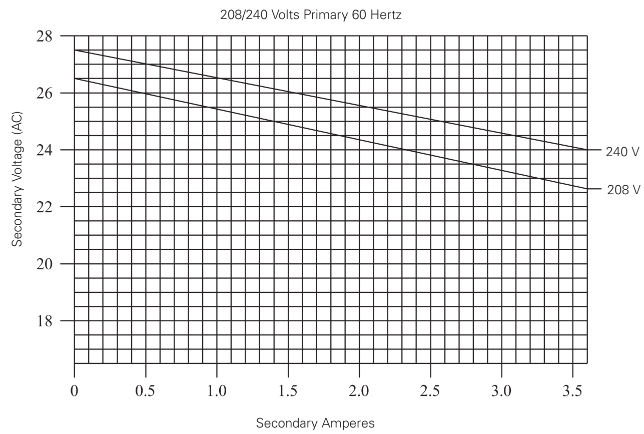
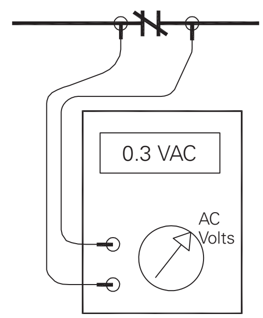



**Figure 89. Transformer troubleshooting**



# High Pressure and Low Pressure Lockout Circuits

High Pressure Cutout (HPC) and Low Pressure Cutout (LPC) circuits are designed to shut compressor operation down when pressures are too low, such as loss of charge; or too high, such as would result from dirty condenser coils.

The operational logic of these circuits is somewhat unique and requires explanation to fully understand how they operate.

## LPC Logic

LPC logic was changed with version 3.1 of the RTRM. Timing was changed from two minutes to 10 seconds to enhance compressor reliability due to no-flow issues for the TXV option during compressor starts.

However, due to unexpected compressor lockout issues, the timing was again revised with version 6.0 of the RTRM. The timing function will be different depending on the outdoor temperature. If the OA Temp is below 40°F, the timing is one minute. If OA Temp is 40°F or above, timing is 30 seconds.

For RTRM version 8.0 + the timing has been revised and is still dependent on outdoor ambient temperature. If the outdoor temperature is less than 40°F the LPC Bypass Delay will be set to 60 seconds. When the outdoor temperature is between 40 to 49.9°F the delay will be set to 30 seconds. For all outdoor temperatures 50°F and above, there will be no delay in setting a LPC. These delays will apply to all units.

### LPC Sequence of Operation

On a call for cooling, there is an LPC bypass delay period (depending on OA Temp) where the LPC switch is ignored. If there is a low charge condition or low pressure condition due to extreme cold ambient conditions, the unit is allowed to run for the delay period to build up pressure.

If the switch is closed after the LPC bypass delay time, the compressor will continue to run. If the switch is open, the compressor will shut down immediately. After three minutes, if there is still an active call for cooling, the unit will once again start. If the switch is still open after the initial LPC bypass delay time, the compressor will again shutdown. The unit will try to start four times. If the switch is still open after the fourth try, the unit will shut down and be locked out, and will require a manual reset to start the unit again.

If the switch is closed and the compressor continues to run for three minutes, the counter is reset and the logic sequence starts over.

If the call for cooling goes away at any time during the routine, the counter is reset and the logic sequence starts over.

***Note:*** *If the unit is configured as a Heat Pump and is actively heating with the outdoor ambient temperature at or below 0°F, or the unit is in an active defrost mode, the LPC inputs will be ignored.*

### LPC Operation for 27.5-through 50-Ton Units with Modulating Reheat

Units configured with Modulating Dehumidification will control compressors in regards to the Compressor 1 and 2 Disable inputs slightly different than traditional units and will also include an extra LPC switch connected to the RTDM. The following describes the implementation of this function for these units:

- RTRM Compressor 1 Disable Input will function as today's units function.
  - If active on a Dual Circuit Unit, only Circuit 1 will de-energize after the appropriate delays during Active Cooling. Both Circuits will de-energize during Active Reheat (Circuit 2 after its minimum on timer expires).
  - If active on a Single Circuit Dual Compressor unit, Compressor 1 and Compressor 2 will de-energize after the appropriate delays during Active Cooling and Active Reheat.
- RTRM Compressor 2 Disable Input will function as follows:
  - If Active on a Dual Circuit Unit, only Circuit 2 will de-energize during Active Cooling. Both Circuits will de-energize after the appropriate delays during Active Reheat (Circuit 1 after its minimum on timer expires).
  - If Active on a Single Circuit Dual Compressor unit, only Compressor 2 will de-energize during Active Cooling and Active Reheat. Reheat will not be disabled in the case of the Compressor 2 Disable Input going OPEN on these units. This is to ensure that a customer who chooses to utilize the demand limit (load shedding) capabilities of the Compressor 2 Disable Input will still have some Reheat functionality. The LPC Lockout Incremental counter will not increment if this input goes active since it is not actually in the refrigeration system.
- RTDM Low Pressure Cutout Input:

  The RTDM Low Pressure Cutout Input will be ignored for the first 10 minutes of compressor run time on the reheat circuit (or compressor 1 if on a Single Circuit, dual Compressor unit). Once active (OPEN), the associated circuit/output will de-energize and not be allowed to re-energize until the 3 minute off timer is expired and the input has cleared. If the Reheat LPC trips 4 times in any mode after the circuit has been energized for 10 minutes, dehumidification will be disabled (all compressors off) and the reheat circuit will be locked out.

***Note:*** *For dual circuit units, a lockout on the reheat circuit will not disable cooling for the opposite circuit.*

The reheat LPC input will function in addition to the normal LPC input(s) located on the RTRM. For units with modulating reheat, the RTRM LPC for the reheat circuit will cause the unit to de-energize the appropriate circuit(s) and the total LPC count will be incremented. For these units, a total of 4 LPC events on the reheat circuit (any combination from the RTRM or the RTDM reheat circuit LPC inputs) will cause the unit to lock out the appropriate circuit(s). For dual circuit units, the RTRM LPC input for circuit 2 will function as on normal, non-reheat units. See below for unit configuration specific details:

- For Voyager™ III Dual Circuit Units if the RTDM Low Pressure Cutout input goes active (OPEN) after the Reheat Circuit has been active for 10 minutes, the Reheat Circuit (Compressor 2 Output) will de-energize along with Circuit 1 (after its minimum on time) during Active Reheat. For dual circuit units, if the unit is in Active Cool mode, the non-reheat circuit will remain energized if the Reheat LPC goes active. Once this input clears, the unit will allow dehumidification and cooling as necessary to meet demands and the inactive circuit(s) will be allowed to re-energize after the 3 minute minimum off timer expires if necessary.
- For Voyager™ III Single Circuit (Dual Compressor) Units if the RTDM Low Pressure Cutout input goes active after 10 minutes of run time on Compressor 1, both compressors will de-energize during Active Reheat or Active Cooling. Once this input clears, the unit will allow dehumidification and cooling as necessary to meet demands and the inactive circuit(s) will be allowed to re-energize after the 3 minute minimum off timer expires if necessary.

There is no requirement to differentiate between the RTRM LPC inputs and the RTDM LPC input for BAS/ Network systems. If the unit has either the RTRM LPC input go active for the Reheat Circuit or the RTDM LPC input go active, the control should just report an LPC event for that circuit, regardless of which input is reflecting the condition. Also, the counter for RTDM LPC events will not be reset unless power is cycled to the unit controller independent of how much time has passed since the last RTDM LPC event.

***Note:*** *This function will also be active during Service Test.*

# HPC Logic

High Pressure Cutout (HPC) is similar to the LPC in that the unit may be given up to four tries to operate. Like the LPC, the HPC provides reliability protection for compressors, but it is also used for safety protection due to the high operating pressures that the unit may see.

***Note:*** *At no time should the HPC be removed or disabled in order to maintain unit operation.*

## HPC Sequence of Operation

On a call for cooling, if the HPC switch is closed, the compressor will be allowed to start. If at any time the HPC opens, the unit will shut down immediately. After a fifteen minute period, if there is still a call for cooling, the control logic will check to see if the switch has closed. If not, the unit is locked out and requires a manual reset to restart the unit.

If after fifteen minutes the HPC is closed, and there is still a call for cooling, the unit will be allowed to restart. Once again, if the HPC opens, the unit will shut down and wait fifteen minutes to validate a restart. If the switch is closed, the unit will be allowed to restart.

If the HPC opens and closes four times during an active call for cooling, the unit will be shut down and locked out, and will require a manual reset.

If any time during the counter routine, the call for cooling goes away, the counter will reset and the logic sequence starts all over again.

# Novar Controls (Sequence of Operation)

Novar is a control system that is often interfaced with ReliaTel™ controls which allows others to take control of our equipment. The Novar system includes, but is not limited to, a control module EMT2024 or EMT3051, a relay panel and various sensors such as discharge and return.

The Novar system connects to our unit in the same manner as a conventional thermostat. Other modifications are also made that allows the Novar system to take control of the economizer.

## Novar Controls Sequence of Operation

### General

Novar Control units use a hybrid ReliaTel™ -Novar control scheme. The Reliatel system is controlled using the RTRM thermostat inputs connected to a Novar Electronic Thermostat Controller that serves as a master unit controller and BAS network communication device.

In addition to basic thermostat operation control, a Novar unit includes some additional relay connections that provide master control of economizer operation.

### Cooling with an Economizer

On a Novar-controlled system the master controller initiates control requests to the RTRM through its Indoor Fan, Cool, and Heat command outputs and the RTRM thermostat inputs.

The economizer control actuator **(ECA)** is wired to a **Damper** relay and a **Night mode** Damper relay as described in the Economizer Set-up section. To enter an economizer-cooling only mode, the master controller will energize its **Fan** (G) output activating the supply fan and close the contacts on the **Damper** relay allowing a valid signal from the mixed air sensor.

The unit will then modulate the outdoor air damper open if the mixed air sensor reading is high compared to the mixed air setpoint of 53° F. If the Damper relay is not energized when the supply fan is on the ECA will maintain the outdoor air damper at default minimum position.

When the Novar controller senses conditions that require additional cooling greater than that provided from economizing, it will energize its **Cool 1** (Y1) output calling for compressor operation.

If additional cooling is required above that provided by the first stage of compressors the second stage will be activated by energizing the **Cool 2** (Y2) output.

Compressors will respond to these calls independent of the position or status of the economizer, but they will continue to adhere to minimum on, off, and inter-stage timing.

***Note:*** *When compressors are activated and the indoor coil begins to cool down the temperature of the mixed air sensor may drop below the mixed air setpoint causing the ECA to close the outdoor air damper to minimum position.*

### Cooling without an Economizer

The Novar controller uses its zone temperature input and setpoint input to determine when to initiate requests for compressors or heat. Calls for cooling are interpreted by the Reliatel controller as thermostat requests. When the zone temperature is sufficiently greater than the setpoint, the Novar will energize its **Cool 1** (Y1) output to turn compressors on. It will also close the contacts on its **Fan** (G) output to call for the Supply Fan to turn on.

The first compressor will energize after its minimum 3-minute off time has expired. If additional cooling capacity is required above that provided by the first stage the second stage of compressors will be activated by energizing the **Cool 2** (Y2) output.

Once the zone temperature falls below the setpoint sufficiently the compressor and fan outputs on the Novar controller will be deactivated and the RTRM will respond appropriately and deactivate its respective outputs. As with normal thermostat control the Supply Fan will remain on for a period of 60 seconds after the compressor output is de-energized for free cooling.

### Economizer Set-up

The economizer function on a Novar-controlled unit is controlled more directly than in normal operation. The economizer is wired with additional inputs from the Novar controller to provide this control:

#### Manual Enthalpy Override

The economizer control actuator (ECA) is configured for Novar operation by placing a 100K resistor across the normally unused outdoor air temp input on the ECA. This signals the economizer to enter Manual Enthalpy Override which enables economizer cooling operation at all times regardless of outdoor or indoor conditions.

#### Damper Relay

A relay output on the Novar controller is that signals a relay placed in-line with the mixed air temperature sensor. It is used to interrupt the mixed air sensor signal to the ECA indicating when to modulate for economizing or to go to minimum position. If an open is detected on the mixed air temperature input the ECA will hold the damper at minimum position.

## Night Mode Damper Relay

A relay on the Novar controller is connected across the remote minimum position potentiometer inputs (P and P1) on the ECA. When the relay contacts are closed for night mode operation the ECA uses a default damper minimum position of 0%. When they are not closed it uses the standard minimum position adjustment on the ECA as default.

### [Gas/electric] Heating

The Novar controller uses its zone temperature input and setpoint input to determine when to initiate requests for compressors or heat. Calls for heating are interpreted by the Reliatel™ controller as thermostat requests. When the zone temperature is sufficiently lower than the setpoint the Novar will energize its **Heat 1** (W1) output to turn the first stage of heat on. It will also close the contacts on its Fan (G) output to call for the Supply Fan to turn on.

The first stage of [Gas/Electric] heat will energize. If additional heating capacity is required above that provided by the first stage the second stage of [Gas/Electric] will be activated by energizing the **Heat 2** (W2) output.

Once the zone temperature rises above the setpoint sufficiently the heat and fan outputs on the Novar controller will be deactivated and the RTRM will respond appropriately and deactivate its respective outputs.

On Gas Heat units the Supply Fan will remain on for a period of 90 seconds after heat is deactivated for free heating and heat exchanger cool down.

# Novar Controls Checkout/ Troubleshooting Procedure

## General

The Novar Electronic Thermostat Module (ETM) includes an installation manual that describes the basic connections and checkout of the Novar controller. This manual should be consulted during installation, checkout, or troubleshooting.

If problems are encountered with unit operation after consulting the Novar ETM installation manual, the following checkout procedures may help to determine and isolate the cause of the problem.

## Checkout Procedure

1. If the Novar controller is connected to the BAS network, check for any failure messages related to the controller in question. Take appropriate actions if messages exist.
2. Verify proper power connection and that it is connected to a 24VAC source with at least a 10VA consumption rating.
3. Apply power to the unit.
4. Verify all installed boards are energized by checking the status LED's on each. On the Novar board the Status LED will either be OFF if in Scheduled On mode and blink ON when network communications are exchanged, or be ON steady and blink OFF during communications if in Scheduled ON mode. The status lights on the main ReliaTel control modules will be on steady if the boards are powered up and properly communicating on the inter-module bus.
5. Check the 1-amp fuse on the Novar ETM (located next to the night mode output relay) for integrity.
6. Verify all inputs are connected according to the ETM installation instructions.
7. Other than economizer connection verification, for all jumper locations and short connections refer to the ETM.
8. Apply a short across the jumper tabs on the Fan output relay on the ETM. Verify the supply fan energizes within a few seconds. Remove the short. The supply fan should turn off within a few seconds. If the supply fan does not energize, verify proper connection of the Fan output relay to the RTRM Thermostat-G input and verify the Supply Fan Relay on the RTRM is properly connected.
9. To completely check economizer (if installed) operation, the conditions at the Mixed Air Temperature Sensor must be at least 55° F or warmer. The Mixed Air Temp Sensor is located downstream of the indoor coil so this test should be performed in the absence of active compressor operation. This would produce sub-cooled air across the Mixed Air Sensor that would prevent the economizer from opening. Mixed air sensor resistance should be less than 20K.
10. To verify proper economizer operation, place a short across the jumper tabs on the Fan output relay and the night mode output relay. Ensure that the 100K resistor is in place on the Outdoor Air Temp (OAT) input on the economizer module. Verify the supply fan energizes and the outdoor air damper opens to the minimum position set by the on-board Economizer Module potentiometer.

    Once the damper reaches minimum position apply a short across the night mode output relay. The damper should close completely. Disconnect the short and verify the damper opens back to minimum position.
11. If the outdoor air damper does not actuate as described above, verify proper operation and connection of the economizer actuator as described in the Reliatel Controls installation guide. Also verify proper connection between the night mode Damper relay and the P and P1 connections.

12. To continue the economizer operation check, place a short across the jumper tabs on the Damper output relay. If conditions are warm enough at the Mixed Air Sensor the economizer actuator should begin opening the damper toward fully open.

    The travel time is dependent on the temperature of the air flowing across the sensor. If the Mixed Air Sensor temperature falls below the 53° F economizer setpoint the damper will stop opening and begin to close back to minimum position.

13. If incoming air conditions are warmer than the setpoint and the damper is not opening, check the damper relay connection in the Mixed Air Sensor circuit and verify the proper sensor and sensor wiring. Also measure the 100K resistor and verify correctness and that it is connected to the proper input.

14. To check out compressor operation from the Novar ETM connect a short across the jumper tabs on the Cool 1 output relay. Verify that the 1st stage of compressors activates within 3 minutes. Each stage of compressors will be forced off for a minimum of 3 minutes at power up and after a period of operation.

    Be aware that the compressor will remain on for a minimum of 3 minutes even if the short is removed. To immediately discontinue compressor operation disconnect unit power. Verify that the unit is producing cool, conditioned air.

    Keep in mind that the outdoor air damper will close to minimum position when the discharge air cools below the economizer setpoint.

15. If compressors do not activate within 3 minutes of placing the short verify the Cool 1 relay output is properly connected to the Thermostat-Y1 input on the RTRM and that compressor circuit 1 is properly connected according to the ReliaTel™ Installation guide. Verify the compressor(s) has properly connected line power and that all in-line safety limits and contactors are functioning correctly.

16. Follow the same procedure as above to check proper operation of the 2nd stage of compressors by placing a short across the Cool 2 output relay. Keep in mind that the Cool 1 and Cool 2 thermostat controls operate independently of each other and must adhere to a 3-minute delay between stage additions.

    If problems are encountered complete the checks above except verify proper connection between the Cool 2 output relay and the RTRM Thermostat-Y2 input.

17. After verifying proper operation of both refrigeration circuits remove all shorts. Compressors should deactivate immediately if they have been running for at least 3 minutes. The supply fan will remain on for 60 seconds, and the outdoor damper will close after the supply fan shuts off.

18. For heating checks (if installed) place a short across the jumper tabs on the Heat 1 output relay. If the unit is a gas heat unit the gas modules will begin the approximately 45 seconds cycle initiation. The supply fan will remain off until the gas heat has successfully initiated and operated for approximately 60 seconds.

    If the unit is an electric heat unit the 1st stage of electric heat will be energized and the supply fan will come on immediately. The unit should be discharging warm air.

19. If heat does not activate after placing the short, verify proper connection of the Heat 1 output relay to the RTRM Thermostat-W1 input. Verify proper Reliatel Module heater connections and function using the Reliatel Installation Guide.

20. To activate the second stage of heat (if applicable) place a short across the jumper tabs on the Heat 2 output relay. A similar process as described with the 1st stage of heat will take place. Verify, if possible, the 2nd stage of heat activates.

    If the 2nd stage of heat does not activate, verify proper connection of the Heat 2 output relay to the RTRM Thermostat-W2 and verify proper ReliaTel heat module output connections. Also verify line power connections to the heating units.

21. If heat operation is correct, disconnect all shorts from the jumper tabs on the relays. All heat will deactivate within a few seconds. Supply fan will deactivate when electric heat deactivates or 90 seconds after gas heat deactivates.

# Voyager Commercial 27½-through 50-Tons CV and VAV

## Overview

As of April 19, 2004, all 27½-through 50-ton commercial rooftop units YCD, YCH, TED, TEH, TCD, TCH 330-600 are built using ReliaTel™ controls. The 10th digit of the model number is "M" and beyond. ReliaTel™ controls replace the now obsolete UCP controls.

## Constant Volume (CV)

CV units operate much like 3-through 25-ton units with a few exceptions. These units may use a conventional thermostat or zone sensor. The units can be controlled using a LonTalk® Communications Interface (LCI) or Tracer™ Summit. Every unit comes with an RTRM and RTOM. All other circuit boards are optional depending upon unit configuration. Troubleshooting the controls is comparable to 3-through 25-ton units.

## Variable Air Volume (VAV)

VAV units use the same circuit boards as CV models, but operation and in some cases troubleshooting, are significantly different. The following section contains operating and troubleshooting information on VAV units. Every unit comes with an RTRM, RTOM, and RTAM. Additional information can be found in the Installation Operation and Maintenance (IOM) guide.

### VAV with ReliaTel versus VAV with UCP

ReliaTel™ units do everything UCP units did and more. Here are some differences between UCP and ReliaTel™ units:

VAV Setpoint panel: ReliaTel™ has the same setpoints as UCP but they are mounted on (and integral to) the RTAM module. Also, every setpoint can be provided remotely by clipping the appropriate jumper and using the terminal strip on the RTAM

Exhaust Fan Setpoint panel: ReliaTel™ exhaust fan setpoint potentiometer is located on the RTOM module in the main control box.

Zone sensor and NSB inputs: With ReliaTel™, these inputs are located on the RTRM module instead of LTB1 (UCP).

***Note:*** *The thermostat inputs on the RTRM are ignored. These inputs are for CV units only.*

Emergency stop: This input, called ESTOP, is located on LTB1-5 and LTB1-6 instead of LTB1-16 and LTB1-17 (UCP).

The following modules are used in 27.5-through 50-ton Voyager™ units as of 4/19/04. Digit 10 of the model number is M or higher. ReliaTel™ modules communicate with each other on a ModBus link. Each module has a status LED indicating that the module is communicating with the link.

## RTRM - ReliaTel Refrigeration Module - (standard)

This is the primary control module. It has built-in terminal strips for Zone Sensor, thermostat, and Night Setback connections as well as diagnostic outputs for service. In addition, the RTRM has the following inputs and outputs:

- Compressor outputs
- Outdoor fan relay outputs
- Low Pressure (LPC) inputs
- Outdoor Air Sensor (OAS) input
- Supply Fan output
- Electric Heat outputs (TE* only)
- TEST mode input
- Emergency Stop input

***Note:*** *There is only one module used for 27.5-through 50-ton units regardless of configuration (VAV, CV). The unit is configured by wire harness inputs. See the unit wiring diagram for details.*

## RTOM - ReliaTel™ Options Module - (standard)

This module has inputs for the following:

- Ventilation Override (LTB4)
- Frost Stat input
- Clogged Filter Switch (optional)
- Discharge Air Sensor (optional on CV, standard on VAV)

***Note:*** *Discharge Air Sensor required with CCP/ICS*

## RTAM - ReliaTel™ Air Handler Module - (standard on VAV)

This module contains the VAV setpoint potentiometers as well as the following inputs and outputs:

- DIP switch inputs for Supply Air Reset, Daytime Warm-up enable, and IGV/VFD configuration.
- Supply pressure transducer input Inlet Guide Vane (IGV) or Variable Frequency Drive (VFD) output.
- Ventilation Heat Relay (VHR) output.

## ECA - Economizer Actuator - (optional)

If the unit has an economizer this module is present. It is screwed to the top of the economizer actuator motor in the economizer section of the unit. The ECA has the following inputs and outputs:

- Mixed Air Sensor - this sensor is located in the supply air section of the unit.
- Return Air Sensor (optional) - This sensor is used when the unit has Comparative Enthalpy.
- Return Humidity Sensor (optional) - this sensor is used when the unit has Comparative Enthalpy.
- Outdoor Humidity Sensor (optional) - this sensor is used when the unit has Reference Enthalpy or Comparative Enthalpy.
- Exhaust Fan Relay output.
- $CO_2$ Sensor input (optional).
- Remote minimum position potentiometer (optional).

## TCI - Trane® Communication Interface - (optional)

Input and output for communication to Tracer Summit (COMM4) or CCP (COMM4).

***Note:*** *ReliaTel™ TCI does support communication from earlier versions of Tracker™, Tracer™ 100 or ComforTrac™.*

## LCI - LonTalk® Communication Interface (optional)

Input and output for LON communication with Tracer Summit, Tracker Version 10+, or 3rd party LonTalk building management systems.

## IGN - Ignition Control Module (YC* only)

This module has the following inputs and outputs:

- TCO 1, TCO 2, TCO 3 input (limit switches)
- Hot Surface Ignitor output / flame sensor input
- Combustion blower motor output
- Gas valve output

## Configuration Input

***Note:*** *The unit is hard wired with specific inputs as indicated below. These inputs cause the unit to respond with the appropriate outputs. Configuration inputs are only recognized at unit power-up.*

Where "GND" is indicated below, the input is connected to chassis ground. Where "JUMPER" is indicated below, both connection points are shown.

| Unit Type | RTOM J3-5 | RTRM J1-3,J1-5 |
|---|---|---|
| Voyager™ Commercial | GND | |
| Voyager™ Light Commercial, Precedent™ | Open | |
| Non Heat Pump | | Jumper |

| Cond Fan Cycling | RTOM J3-4 |
|---|---|
| 27.5-through 30-Ton | GND |
| 35 Ton | Open |
| 40 Ton | GND |
| 50 Ton | Open |

| SA Tempering (CV Units Only) | RTOM J3-1,J3-2 |
|---|---|
| Enabled | Open |
| Disabled | Jumper |

| Electric Heat | RTRM J2-1,J2-2 |
|---|---|
| Heat | Open |
| No Heat | Jumper |

| 3 Compressor | RTRM J3-7 |
|---|---|
| 27.5-through 35-Ton | Open |
| 40-50 Ton | GND |

| Lead/Lag | RTRM J3-8 |
|---|---|
| Disabled | GND |
| Enabled | Open |

| Modulating Gas | RTOM J3-3 |
|---|---|
| No Modulating Gas | Open |
| Modulating Gas | Ground |

| High Heat (2 Heat Exchangers) | IGN #2 J1-5 |
|---|---|
| High Heat | Ground |

Unit functions are determined by the inputs on RTRM J6 as follows. The possible inputs are shown in the top (horizontal) row. The functions available are shown in the vertical columns below each input.

Table 48. VAV default mode input

| | No Inputs on RTRM J6 | Jumper RTRM J6-2&4 | BAYSENS077A w/ RTRM J6-2&4 Jumper | BAYSENS021* or BAYSENS077A w/ 7.68k resistor between RTRM J6-2&4 | BAYSENS020* or ICS™ system (Tracer Summit) |
|---|---|---|---|---|---|
| **Occupied Cooling** | No | Yes | Yes | Yes | Yes |
| **Daytime Warm-up** | No | No | Yes | Yes | Yes |
| **Morning Warm-up** | No | No | Yes | Yes | Yes |
| **Indoor Blower (occupied mode)** | Off | On | On | On | On |
| **Indoor Blower (unoccupied mode)** | N/A | Off | Auto | Auto | Auto |
| **Unoccupied Cooling** | N/A | No | No | No | Yes |
| **Unoccupied Heating** | N/A | No | Yes | Yes | Yes |
| **Short Across RTRM J6-11&12 creates an unoccupied mode (Night setback)** | No | No | Yes | Yes | N/A |

**Note:** * Means 'B' or 'C'

## Supply Duct Static Pressure Control

The supply duct static pressure is measured by using a 0 to 5VDC transducer. The transducer is mounted on the supply fan bulkhead on the motor side of the supply fan section. The transducer is comparing the supply duct pressure (actually the pressure of the heat section of the unit) to outdoor air pressure. The high port of the transducer is connected to the static pressure sensing cover plate located on the supply fan bulkhead. The low port of the transducer is connected to a tubing connector on a vertical support of the unit and is field-connected to the Outside Air Pressure Sensor as pictured below. The transducer is wired to the RTAM and the decision to modulate the IGV or VFD is made at the RTRM.

## Modes of Operation

Setpoints are provided by using the potentiometers on the RTAM, through remote potentiometers, or through ICS. The setpoint range is 0.3" WC to 2.5" WC. The deadband range is 0.2" WC to 1.0" WC.

The control band is the setpoint plus or minus ½ of the deadband.

For example:

Setpoint 1.5"

Deadband 0.4"

The IGV or VFD output will increase if the supply pressure goes below 1.3".

The IGV or VFD output will decrease if the supply pressure goes above 1.7"

The IGV or VFD output will not change if the supply pressure stays between 1.3" and 1.7".

DIP switch settings for this function are as follows:

RTAM SW1 switch 1 OFF for IGV, ON for VFD.

RTAM SW1 switch 2 OFF for VAV, ON for "VAV without IGV".

**Figure 90. Supply duct static pressure control**

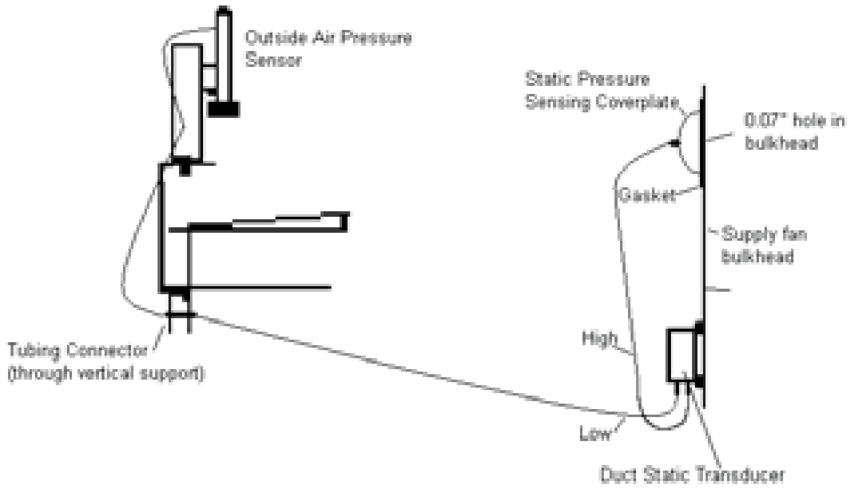



**Figure 91. RTAM module**

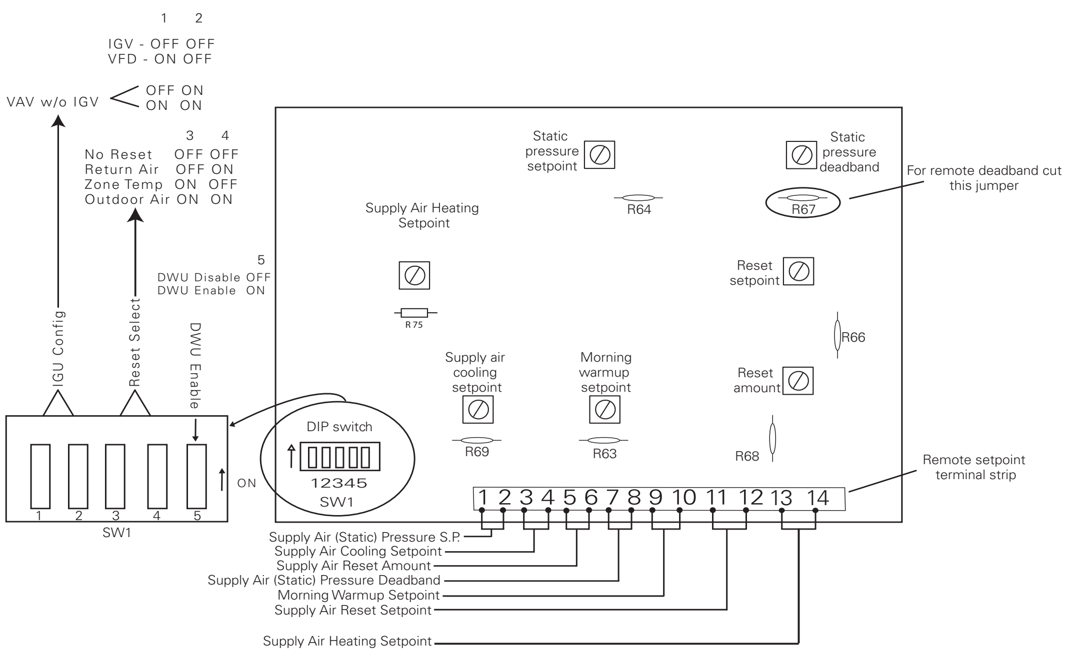
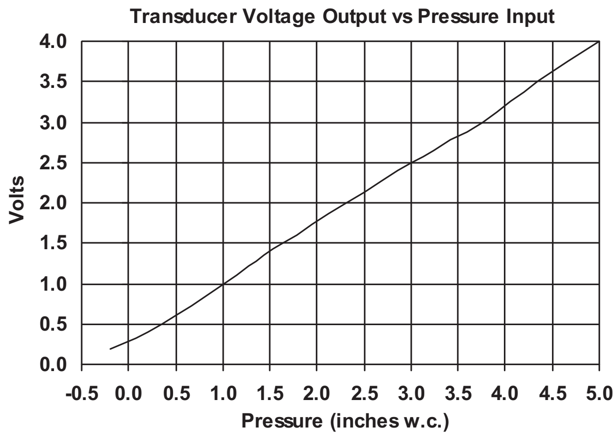


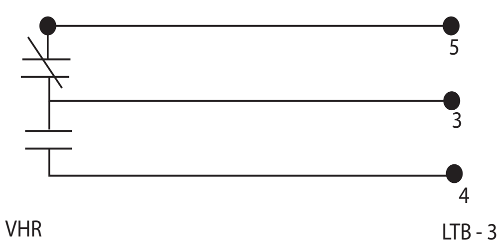
**Figure 92. Transducer voltage output vs. pressure**




The transducer has a 0 to 5VDC range with a 0.25 to 2.125 VDC valid output range. The output is proportional. The chart illustrates the measured output voltage at typical supply duct pressures.

## VHR Relay

When the unit transitions from occupied mode to morning warm-up, daytime warm-up or unoccupied mode, the VHR relay is energized, as long as the unit has a valid zone temperature input at RTRM J6 1&2, or through a BAYSENS020* zone sensor.




The VHR relay has a set of contacts on TB3 for the purpose of commanding the VAV boxes to drive open to maximum airflow position.

If the unit has heat, the VAV boxes must be driven open. If the boxes are allowed to stay in control, the boxes may try to close instead of open when the warm air enters the room.

Additional notes:

1. When RTAM DIP SW1-1 is on, the output voltage range is approximately 0 to 10.5VDC.
2. When RTAM DIP SW1-1 is off, the output voltage range is approximately 2.5 to 8.5VDC.
3. IGV: When the supply fan is on and the output is 0%, the IGV are closed.
4. VFD: When the supply fan is on and the output is 0%, the VFD runs at 35hz.
5. If the supply static pressure goes below -0.2" (0.2VDC) the IGV / VFD output will stay at 0% and the diagnostic COOL FAIL + SERVICE FAIL will be present.
6. If the static pressure exceeds 3.8" WC the supply fan will stop and the diagnostic HEAT FAIL + COOL FAIL +SERVICE FAIL will be present.
7. During the heating modes; Daytime Warm-up, Morning Warm-up, and Unoccupied, the IGV or VFD output is always 100%.

## Troubleshooting Tips

If the transducer output voltages do not seem right, connect a 0-5" manometer in parallel with the transducer. This way you can see the same pressure the transducer is seeing. Many transducers get replaced in error when the real culprit is a loose tube or clogged fitting.

The polyethylene tubing in the transducer circuit does not readily go back to its original shape after use. Therefore, if a tube is removed from a fitting it should be cut back to a fresh end prior to reattaching.

Measure the transducer output voltage at RTAM terminal J1-3 to chassis ground.

When the supply fan is off, the transducer output voltage should be approximately 0.25VDC. If the voltage output is high or low, unplug the transducer tubing to see if the voltage increases or decreases. If it does, a tube is probably clogged.

The input voltage to the transducer is measured between RTAM J1-4 and chassis ground. It should be 5VDC. If it is low, unplug the transducer and measure the voltage again. If OK now, the transducer or transducer wiring is shorted to common or ground.

The outdoor air pressure sensor must be mounted as shown in Figure 90, p. 132. If the sensor is mounted upside down the tubing can fill with water during heavy rains.

The static pressure sensing cover plate in the fan section of the unit is bolted to the fan bulkhead. The bulkhead has a very small (0.07") hole in the center area. The purpose of using such a small hole is to ensure that the transducer only sees the average supply air pressure. If the hole is enlarged, the transducer could respond erratically. If the hole is plugged, the transducer will not respond. If the gasket between the cover plate and bulkhead is leaking, the supply pressure will appear to be abnormally low since the cover plate is in the fan section.

## Application Notes

Some applications call for relocating the supply air tube to 2/3 of the way down the duct. If this is done, be certain that there is no potential obstruction between the unit and the pickup point (such as fire dampers). A separate high duct static switch may need to be added.

The Outside Air Pressure Sensor should be located on top of the unit as shown in Figure 90, p. 132. Some applications with extreme winds could require mounting the sensor in an area less affected by wind.

## BAYSENS021* Setpoint Input

This chart lists setpoint /voltage/resistance for the VAV Supply Air Cooling setpoint on the RTRM module. The chart can be used for troubleshooting units that have a remote setpoint at this input.

The typical remote setpoint input device is a BAYSENS021 zone sensor.

The connection points are RTRM J6-2 and RTRM J6-3.

If a remote setpoint is used, clip jumper R69 on the RTAM module. If the jumper is not clipped, the unit will ignore the RTRM setpoint.

***Note:*** *A remote setpoint can also be applied to the RTAM Supply Air Cooling Setpoint input. However, the RTAM inputs use different temperature/ resistance inputs. See VAV Setpoint Inputs for input values.*

**Table 49. Supply air cooling setpoint**

| Supply Air Cooling Setpoint (deg F) | Resistance (ohms) | DC Volts | Supply Air Cooling Setpoint (deg F) | Resistance (ohms) | DC Volts |
|---|---|---|---|---|---|
| 40 | 1084 | 2.6 | 61 | 675 | 2.02 |
| 41 | 1065 | 2.58 | 62 | 656 | 1.98 |
| 42 | 1045 | 2.56 | 63 | 636 | 1.94 |
| 43 | 1026 | 2.53 | 64 | 617 | 1.91 |
| 44 | 1006 | 2.51 | 65 | 597 | 1.87 |
| 45 | 987 | 2.48 | 66 | 578 | 1.83 |
| 46 | 967 | 2.46 | 67 | 558 | 1.79 |
| 47 | 948 | 2.43 | 68 | 539 | 1.75 |
| 48 | 928 | 2.41 | 69 | 519 | 1.71 |
| 49 | 909 | 238 | 70 | 500 | 1.67 |
| 50 | 889 | 2.35 | 71 | 481 | 1.62 |
| 51 | 870 | 2.33 | 72 | 461 | 1.58 |
| 52 | 850 | 2.3 | 73 | 442 | 1.53 |
| 53 | 831 | 2.27 | 74 | 422 | 1.48 |
| 54 | 812 | 2.24 | 75 | 403 | 1.44 |
| 55 | 792 | 2.21 | 76 | 383 | 1.39 |
| 56 | 773 | 2.18 | 77 | 364 | 1.33 |
| 57 | 753 | 2.15 | 78 | 344 | 1.28 |
| 58 | 734 | 2.12 | 79 | 325 | 1.23 |
| 59 | 714 | 2.08 | 80 | 305 | 1.17 |
| 60 | 695 | 2.05 | | | |

This chart lists setpoint/voltage/resistance for VAV setpoints on the RTAM module in the control compartment. The chart can be used for troubleshooting the RTAM module or for applying a remote setpoint to the unit.

Each setpoint can be provided remotely by applying the appropriate resistance as shown in the table after cutting the resistor next to the setpoint knob. See Figure 93, p. 135.

## Remote Setpoint Inputs on RTAM J7

J7-1, 2 Supply Air Pressure Setpoint

J7-3, 4 Supply Air Cooling Setpoint

J7-5, 6 Supply Air Reset Amount

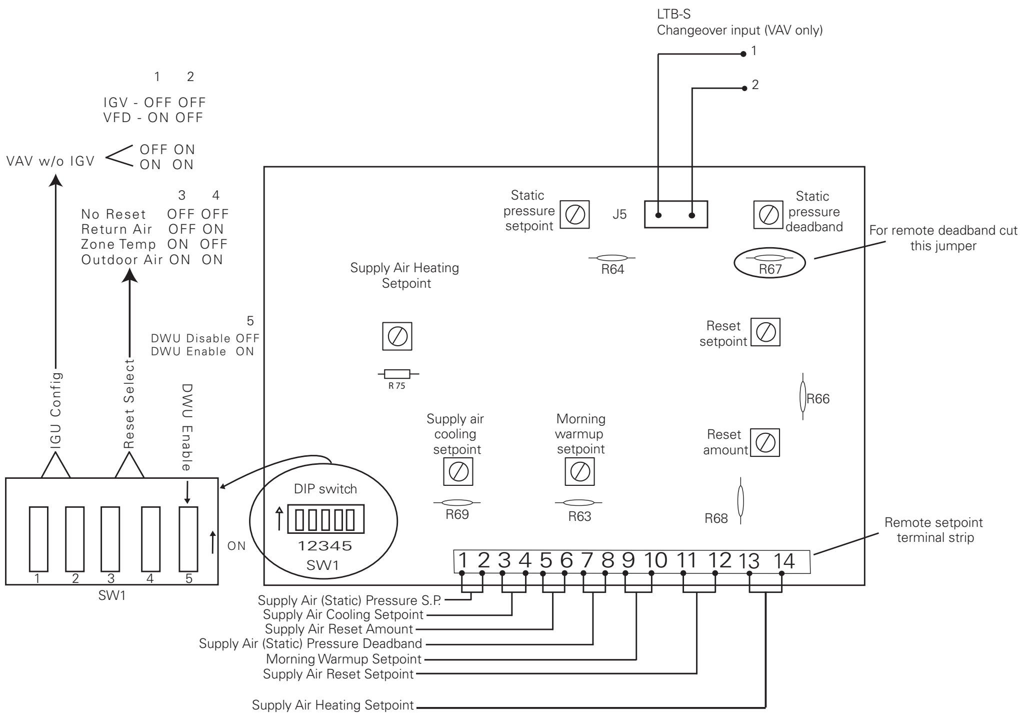
J7-7, 8 Supply Air Pressure Deadband

J7-9, 10 Morning Warm-up Setpoint

J7-11, 12 Supply Air Reset Setpoint

J7-13, 14 Supply Air Heating Setpoint

**Figure 93. RTAM module**




For remote setpoint cut this jumper:

Supply Air Pressure Setpoint R64

Supply Air Cooling Setpoint R69

Supply Air Heating Setpoint R75

Supply Air Reset Amount R68

Supply Air Pressure Deadband R67

Morning Warm-up Setpoint R63

Supply Air Reset Setpoint R66

***Note:*** *Remote SA Cooling Setpoint can be installed on RTAM J7-2, 3 (as shown) or on RTRM J6-2, 3. If the SA Cooling Setpoint is installed on RTRM J6-2, 3 or a BAYSENS021* is being used; see VAV Supply Air Cooling remote setpoint - BAYSENS021*.*

## Morning Warm-up:

- Is allowed even if DWU is disabled.
- Enabled by transition from unocc to occup (power reset, emergency reset will not do it)

## Unoccupied Heating:

- Is allowed even if DWU is disabled

## Supply Air Heating

40-150 deg F +/- 2 deg F

5 Minute Changeover Heat/Cool Input

Changeover input required

**Table 50. VAV setpoints**

| | | **Supply Air(a) Pressure Setpoint** | **Supply Air Cooling Setpoint** | **Supply Air Reset Amount** | **Supply Air(b) Pressure Deadband** | **Morning Warm-up Setpoint** | **Supply Air Reset Setpoint Outdoor** | **Supply Air Reset Setpoint Zone or Return Air** | **RTAM Supply Air Heat Setpoint** |
|---|---|---|---|---|---|---|---|---|---|
| | | J7-1,2 | J7-3,4 | J7-5,6 | J7-7,8 | J7-9,10 | J7-11,12 | J7-11,12 | J7 - 13, 14 |
| Resistance (Ohms) | DC Volts | "WC | Deg F | Deg F | "WC | Deg F | Deg F | Deg F | Deg F |
| 0 | 0.00 | 0.00 | 40.00 | 0.00 | 0.00 | 50.00 | 0.00 | 50.00 | 40.0 |
| 10 | 0.05 | 0.02 | 40.27 | 0.13 | 0.01 | 50.27 | 0.67 | 50.27 | 40.7 |
| 20 | 0.10 | 0.05 | 40.81 | 0.40 | 0.02 | 50.81 | 20.02 | 50.81 | 42.2 |
| 30 | 0.15 | 0.08 | 41.29 | 0.65 | 0.03 | 51.29 | 3.23 | 51.29 | 43.6 |
| 40 | 0.19 | 0.11 | 41.23 | 0.91 | 0.05 | 51.23 | 4.57 | 51.83 | 45.1 |
| 50 | 0.24 | 0.14 | 42.31 | 1.16 | 0.06 | 52.31 | 5.78 | 52.31 | 46.4 |
| 60 | 0.28 | 0.17 | 42.79 | 1.40 | 0.07 | 52.79 | 6.99 | 52.79 | 47.8 |
| 70 | 0.33 | 0.20 | 43.28 | 1.64 | 0.08 | 53.28 | 8.19 | 53.28 | 49.1 |
| 80 | 0.37 | 0.24 | 43.76 | 1.88 | 0.09 | 53.76 | 9.40 | 53.76 | 50.4 |
| 90 | 0.41 | 0.27 | 44.24 | 2.12 | 0.11 | 54.24 | 10.61 | 54.24 | 51.8 |
| 100 | 0.45 | 0.30 | 44.73 | 2.36 | 0.12 | 54.73 | 11.82 | 54.73 | 53.1 |
| 110 | 0.50 | 0.32 | 45.16 | 2.58 | 0.13 | 55.16 | 12.89 | 55.16 | 54.3 |
| 120 | 0.54 | 0.35 | 45.59 | 2.79 | 0.14 | 55.59 | 13.97 | 55.59 | 55.5 |
| 130 | 0.58 | 0.38 | 46.02 | 3.01 | 0.15 | 56.02 | 15.04 | 56.02 | 56.7 |
| 140 | 0.61 | 0.40 | 46.45 | 3.22 | 0.16 | 56.45 | 16.12 | 56.45 | 57.9 |
| 150 | 0.65 | 0.43 | 46.88 | 3.44 | 0.17 | 56.88 | 17.19 | 56.88 | 59.1 |
| 160 | 0.69 | 0.46 | 47.31 | 3.65 | 0.18 | 57.31 | 18.26 | 57.31 | 60.3 |
| 170 | 0.73 | 0.48 | 47.68 | 3.84 | 0.19 | 57.68 | 19.20 | 57.68 | 61.3 |
| 180 | 0.76 | 0.51 | 48.11 | 4.06 | 0.20 | 58.11 | 20.28 | 58.11 | 62.5 |
| 190 | 0.80 | 0.53 | 48.49 | 4.24 | 0.21 | 58.49 | 21.22 | 58.49 | 63.6 |
| 200 | 0.83 | 0.55 | 48.86 | 4.43 | 0.22 | 58.86 | 22.16 | 58.86 | 64.6 |
| 210 | 0.87 | 0.58 | 49.24 | 4.62 | 0.23 | 59.24 | 23.10 | 59.24 | 65.7 |
| 220 | 0.90 | 0.60 | 49.62 | 4.81 | 0.24 | 59.62 | 24.04 | 59.62 | 66.7 |
| 230 | 0.93 | 0.62 | 49.99 | 5.00 | 0.25 | 59.99 | 24.98 | 59.99 | 67.8 |
| 240 | 0.97 | 0.65 | 50.37 | 5.18 | 0.26 | 60.37 | 25.92 | 60.37 | 68.8 |
| 250 | 1.00 | 0.67 | 50.69 | 5.34 | 0.27 | 60.69 | 26.72 | 60.69 | 69.7 |
| 260 | 1.03 | 0.70 | 51.26 | 5.63 | 0.28 | 61.26 | 28.14 | 61.26 | 71.3 |
| 270 | 1.06 | 0.73 | 51.74 | 5.87 | 0.29 | 61.74 | 29.35 | 61.74 | 72.6 |
| 280 | 1.09 | 0.77 | 52.30 | 6.15 | 0.31 | 62.30 | 30.76 | 62.30 | 74.2 |
| 290 | 1.12 | 0.80 | 52.79 | 6.39 | 0.32 | 62.79 | 31.97 | 62.79 | 75.5 |
| 300 | 1.15 | 0.83 | 53.27 | 6.63 | 0.33 | 63.27 | 33.17 | 63.27 | 76.9 |
| 310 | 1.18 | 0.86 | 53.75 | 6.88 | 0.34 | 63.75 | 34.38 | 63.75 | 78.2 |
| 320 | 1.21 | 0.89 | 54.24 | 7.12 | 0.36 | 64.24 | 35.59 | 64.24 | 79.5 |
| 330 | 1.24 | 0.92 | 54.72 | 7.36 | 0.37 | 64.72 | 36.80 | 64.72 | 80.9 |
| 340 | 1.27 | 0.95 | 55.12 | 7.56 | 0.38 | 65.12 | 37.81 | 65.12 | 82.0 |
| 350 | 1.30 | 0.98 | 55.61 | 7.80 | 0.39 | 65.61 | 39.01 | 65.61 | 83.3 |
| 360 | 1.32 | 1.01 | 56.09 | 8.04 | 0.40 | 66.09 | 40.22 | 66.09 | 84.7 |
| 370 | 1.35 | 1.03 | 56.49 | 8.25 | 0.41 | 66.49 | 41.23 | 66.49 | 85.8 |
| 380 | 1.38 | 1.06 | 56.89 | 8.45 | 0.42 | 66.89 | 42.24 | 66.89 | 86.9 |
| 390 | 1.40 | 1.09 | 57.38 | 8.69 | 0.43 | 67.38 | 43.45 | 67.38 | 88.3 |
| 400 | 1.43 | 1.11 | 57.78 | 8.89 | 0.44 | 67.78 | 44.45 | 67.78 | 89.4 |
| 410 | 1.45 | 1.14 | 58.18 | 9.09 | 0.45 | 68.18 | 45.46 | 68.18 | 90.5 |

**Table 50. VAV setpoints**

| | | Supply Air[a] Pressure Setpoint | Supply Air Cooling Setpoint | Supply Air Reset Amount | Supply Air[b] Pressure Deadband | Morning Warm-up Setpoint | Supply Air Reset Setpoint Outdoor | Supply Air Reset Setpoint Zone or Return Air | RTAM Supply Air Heat Setpoint |
|---|---|---|---|---|---|---|---|---|---|
| | | J7-1,2 | J7-3,4 | J7-5,6 | J7-7,8 | J7-9,10 | J7-11,12 | J7-11,12 | J7 - 13, 14 |
| Resistance (Ohms) | DC Volts | "WC | Deg F | Deg F | "WC | Deg F | Deg F | Deg F | Deg F |
| 420 | 1.48 | 1.16 | 58.59 | 9.29 | 0.46 | 68.59 | 46.47 | 68.59 | 91.6 |
| 430 | 1.50 | 1.19 | 58.99 | 9.49 | 0.47 | 68.99 | 47.47 | 68.99 | 92.7 |
| 440 | 1.53 | 1.21 | 59.39 | 9.70 | 0.48 | 69.39 | 48.48 | 69.39 | 93.9 |
| 450 | 1.55 | 1.24 | 59.80 | 9.90 | 0.49 | 69.80 | 49.49 | 69.80 | 95.0 |
| 460 | 1.58 | 1.26 | 60.20 | 10.10 | 0.50 | 70.20 | 50.50 | 70.20 | 96.1 |
| 470 | 1.60 | 1.29 | 60.60 | 10.30 | 0.52 | 70.60 | 51.50 | 70.60 | 97.2 |
| 480 | 1.62 | 1.31 | 61.00 | 10.50 | 0.53 | 71.00 | 52.51 | 71.00 | 98.3 |
| 490 | 1.64 | 1.33 | 61.33 | 10.66 | 0.53 | 71.33 | 53.32 | 71.33 | 99.2 |
| 500 | 1.67 | 1.36 | 61.73 | 10.86 | 0.54 | 71.73 | 54.32 | 71.73 | 100.4 |
| 510 | 1.69 | 1.39 | 62.25 | 11.12 | 0.56 | 72.25 | 55.62 | 72.25 | 101.8 |
| 520 | 1.71 | 1.43 | 62.81 | 11.41 | 0.57 | 72.81 | 57.03 | 72.81 | 103.4 |
| 530 | 1.73 | 1.45 | 63.26 | 11.63 | 0.58 | 73.26 | 58.16 | 73.26 | 104.6 |
| 540 | 1.75 | 1.49 | 63.83 | 11.91 | 0.60 | 73.83 | 59.57 | 73.83 | 106.2 |
| 550 | 1.77 | 1.52 | 64.28 | 12.14 | 0.61 | 74.28 | 60.70 | 74.28 | 107.4 |
| 560 | 1.79 | 1.55 | 64.73 | 12.36 | 0.62 | 74.73 | 61.82 | 74.73 | 108.7 |
| 570 | 1.82 | 1.57 | 65.18 | 12.59 | 0.63 | 75.18 | 62.95 | 75.18 | 109.9 |
| 580 | 1.84 | 1.60 | 65.63 | 12.82 | 0.64 | 75.63 | 64.08 | 75.63 | 111.2 |
| 590 | 1.86 | 1.63 | 66.08 | 13.04 | 0.65 | 76.08 | 65.21 | 76.08 | 112.5 |
| 600 | 1.88 | 1.67 | 66.65 | 13.32 | 0.67 | 76.65 | 66.62 | 76.65 | 114.0 |
| 610 | 1.89 | 1.69 | 66.99 | 13.49 | 0.67 | 76.99 | 67.46 | 76.99 | 115.0 |
| 620 | 1.91 | 1.71 | 67.44 | 13.72 | 0.69 | 77.44 | 68.59 | 77.44 | 116.2 |
| 630 | 1.93 | 1.74 | 67.89 | 13.94 | 0.70 | 77.89 | 69.72 | 77.89 | 117.5 |
| 640 | 1.95 | 1.77 | 68.34 | 14.17 | 0.71 | 78.34 | 70.85 | 78.34 | 118.7 |
| 650 | 1.97 | 1.80 | 68.79 | 14.40 | 0.72 | 78.79 | 71.98 | 78.79 | 120.0 |
| 660 | 1.99 | 1.83 | 69.24 | 14.62 | 0.73 | 79.24 | 73.10 | 79.24 | 121.2 |
| 670 | 2.01 | 1.85 | 69.58 | 14.79 | 0.74 | 79.58 | 73.95 | 79.58 | 122.2 |
| 680 | 2.02 | 1.88 | 70.03 | 15.02 | 0.75 | 80.03 | 75.08 | 80.03 | 123.4 |
| 690 | 2.04 | 1.91 | 70.48 | 15.24 | 0.76 | 80.48 | 76.21 | 80.48 | 124.7 |
| 700 | 2.06 | 1.93 | 70.82 | 15.41 | 0.77 | 80.82 | 77.05 | 80.82 | 125.6 |
| 710 | 2.08 | 1.95 | 71.27 | 15.64 | 0.78 | 81.27 | 78.18 | 81.27 | 126.9 |
| 720 | 2.09 | 1.98 | 71.61 | 15.81 | 0.79 | 81.61 | 79.03 | 81.61 | 127.8 |
| 730 | 2.11 | 2.00 | 72.06 | 16.03 | 0.80 | 82.06 | 80.15 | 82.06 | 129.1 |
| 740 | 2.13 | 2.02 | 72.40 | 16.20 | 0.81 | 82.40 | 81.00 | 82.40 | 130.0 |
| 750 | 2.14 | 2.05 | 72.74 | 16.37 | 0.82 | 82.74 | 81.85 | 82.74 | 130.9 |
| 760 | 2.16 | 2.08 | 73.29 | 16.65 | 0.83 | 83.29 | 83.23 | 83.29 | 132.5 |
| 770 | 2.18 | 2.11 | 73.75 | 16.87 | 0.84 | 83.75 | 84.36 | 83.75 | 133.7 |
| 780 | 2.19 | 2.14 | 74.20 | 17.10 | 0.85 | 84.20 | 85.49 | 84.20 | 135.0 |
| 790 | 2.21 | 2.17 | 74.65 | 17.32 | 0.87 | 84.65 | 86.62 | 84.65 | 136.2 |
| 800 | 2.22 | 2.20 | 75.25 | 17.62 | 0.88 | 85.25 | 88.12 | 85.25 | 137.9 |
| 810 | 2.24 | 2.23 | 75.70 | 17.85 | 0.89 | 85.70 | 89.25 | 85.70 | 139.2 |
| 820 | 2.25 | 2.26 | 76.15 | 18.08 | 0.90 | 86.15 | 90.38 | 86.15 | 140.4 |
| 830 | 2.27 | 2.29 | 76.60 | 18.30 | 0.92 | 86.60 | 91.51 | 86.60 | 141.7 |

**Table 50. VAV setpoints**

| | | Supply Air[a] Pressure Setpoint | Supply Air Cooling Setpoint | Supply Air Reset Amount | Supply Air[b] Pressure Deadband | Morning Warm-up Setpoint | Supply Air Reset Setpoint Outdoor | Supply Air Reset Setpoint Zone or Return Air | RTAM Supply Air Heat Setpoint |
|---|---|---|---|---|---|---|---|---|---|
| | | J7-1,2 | J7-3,4 | J7-5,6 | J7-7,8 | J7-9,10 | J7-11,12 | J7-11,12 | J7 - 13, 14 |
| Resistance (Ohms) | DC Volts | "WC | Deg F | Deg F | "WC | Deg F | Deg F | Deg F | Deg F |
| 840 | 2.28 | 2.32 | 77.05 | 18.53 | 0.93 | 87.05 | 92.63 | 87.05 | 142.9 |
| 850 | 2.30 | 2.34 | 77.50 | 18.75 | 0.94 | 87.50 | 93.76 | 87.50 | 144.2 |
| 860 | 2.31 | 2.37 | 77.96 | 18.98 | 0.95 | 87.96 | 94.89 | 87.96 | 145.4 |
| 870 | 2.33 | 2.40 | 78.41 | 19.20 | 0.96 | 88.41 | 96.02 | 88.41 | 146.7 |
| 880 | 2.34 | 2.43 | 78.86 | 19.43 | 0.97 | 88.86 | 97.15 | 88.86 | 147.9 |
| 890 | 2.35 | 2.46 | 79.31 | 19.65 | 0.98 | 89.31 | 98.27 | 89.31 | 149.2 |
| 900 | 2.37 | 2.49 | 79.76 | 19.88 | 0.99 | 89.76 | 99.40 | 89.76 | 150 |
| 910 | 2.38 | 2.50 | 80.00 | 20.00 | 1.00 | 90.00 | 100.00 | 90.00 | 150 |
| 920 | 2.40 | 2.50 | 80.00 | 20.00 | 1.00 | 90.00 | 100.00 | 90.00 | 150 |
| 930 | 2.41 | 2.50 | 80.00 | 20.00 | 1.00 | 90.00 | 100.00 | 90.00 | 150 |
| 940 | 2.42 | 2.50 | 80.00 | 20.00 | 1.00 | 90.00 | 100.00 | 90.00 | 150 |
| 950 | 2.44 | 2.50 | 80.00 | 20.00 | 1.00 | 90.00 | 100.00 | 90.00 | 150 |
| 960 | 2.45 | 2.50 | 80.00 | 20.00 | 1.00 | 90.00 | 100.00 | 90.00 | 150 |
| 970 | 2.46 | 2.50 | 80.00 | 20.00 | 1.00 | 90.00 | 100.00 | 90.00 | 150 |
| 980 | 2.47 | 2.50 | 80.00 | 20.00 | 1.00 | 90.00 | 100.00 | 90.00 | 150 |
| 990 | 2.49 | 2.50 | 80.00 | 20.00 | 1.00 | 90.00 | 100.00 | 90.00 | 150 |
| 1000 | 2.50 | 2.50 | 80.00 | 20.00 | 1.00 | 90.00 | 100.00 | 90.00 | 150 |

(a) Supply Air Pressure Setpoint valid range is 0.3”-2.5”.
(b) Supply Air Pressure Deadband valid range is 0.2”-1”.

# Outdoor Air Flow Compensation for VAV Units

## Outdoor Airflow Compensation (27½-through 50-Ton VAV only)

When a VAV unit is modulating supply airflow, the pressure drop across the outdoor air damper changes. This usually means that the quantity of outside air will drop as the IGV closes or the VFD slows down. VAV units have a feature called Outside Air (OA) Flow Compensation to help maintain consistent OA flow regardless of supply airflow.

***Note:*** *OA Flow Compensation mode is disabled if the unit has a $CO_2$ sensor, min position input from ICS, or remote min position input at LTB3-1 and LTB3-2. It is also overridden during all Ventilation Override modes. Also, the minimum position can only be adjusted from 0 to 50% damper position regardless of OA Flow setpoints.*

## Set up

Once set up, the OA damper position will increase as the IGV closes or VFD slows down. The 27K resistor with plug in KIT#PLU00970 provides a signal to the unit to enable this function. The resistor must be plugged to the "OAT" input (this is an otherwise unused input) on the economizer module (ECA) and power reset to the unit.

## Operation for RTRM 7.0 and Earlier with RTEM or Any RTRM with Honeywell ECA

The potentiometers MIN POS and DCV SETPOINT (DCV UL Setpoint if RTEM) must now each be set in order to control the OA damper position. The MIN POS setpoint determines the OA damper position (from 0 to 50%) when the IGV / VFD is at 100% regardless of DCV SETPOINT (DCV UL Setpoint).

***Note:*** *This function is disabled if a building management system (ICS, Tracer, LonTalk) is providing a OA damper minimum position setpoint to the unit. This function is disabled if the unit is using a $CO_2$ sensor input at the DCV input or if a building management system (ICS, Tracer™, LonTalk®) is providing a $CO_2$ sensor input to the unit.*

The DCV SETPOINT (DCV UL Setpoint) determines the percentage increase of the OA damper position when the IGV / VFD is at 0%. The percentage of OA damper increase between 0 and 100% IGV / VFD is linear. To have no effect on the OA damper position when the IGV/VFD output is 0%, set the DCV SETPOINT to 0%. To have the maximum effect on the OA damper position when the IGV/VFD output is 0%, set the DCV SETPOINT (DCV UL Setpoint) to 100%. This chart shows the effect of DCV input vs. MIN POS when the IGV/VFD is at 0%.

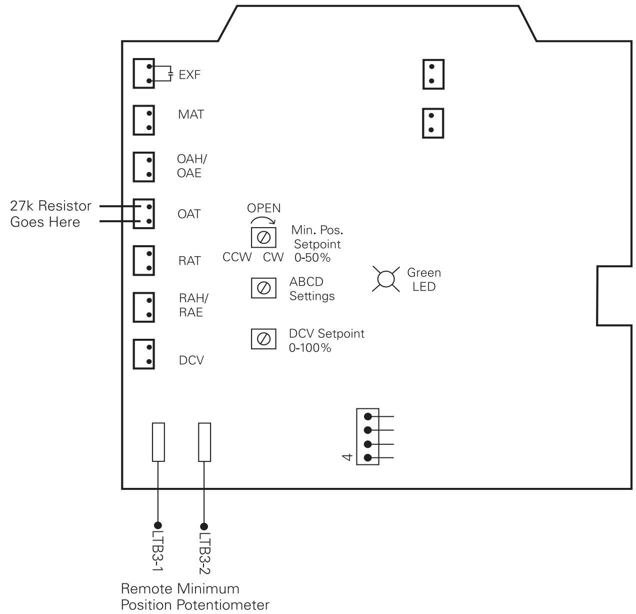



**Table 51. OA damper minimum position when IGV is closed /VFD at min. HZ**

| | MIN POS 0% (CCW) | MIN POS 25% | MIN POS 50% (CW) |
|---|---|---|---|
| DCVSP (DCV UL SP)0% | 0 (closed) | 25% | 50% |
| DCVSP (DCV UL SP) 50% | 25% | 37.5% | 50% |
| DCVSP (DCV UL SP)100% | 50% | 50% | 50% |

## Operation for RTRM 8.0 and Later with RTEM

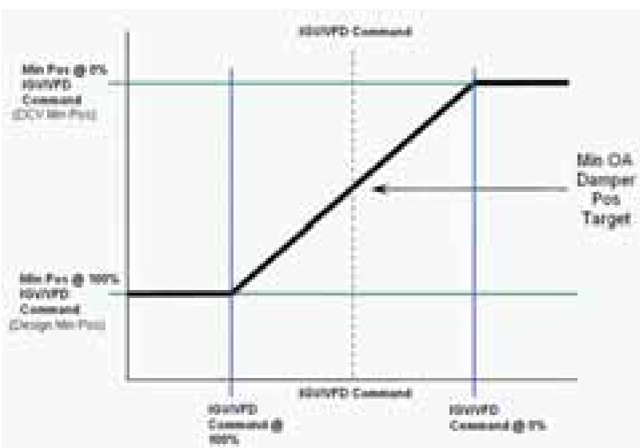
Once configured appropriately as described above, the potentiometers "Design Min Pos" and "DCV Min Pos" must each be set in order to control the OA damper position. The Design Min Pos potentiometer determines the OA damper position (from 0 to 50%) when the IGV / VFD is at 100%. The DCV Min Pos potentiometer determines the OA damper position (from 0 to 50%) when the IGV / VFD is at 0%.

***Note:*** *This function is disabled if a building management system (ICS, Tracer™, LonTalk®) is providing an OA damper minimum position setpoint to the unit. This function is disabled if the unit is using a $CO_2$ sensor input at the DCV input or if a building management system (ICS, Tracer™, LonTalk®) is providing a $CO_2$ sensor input to the unit.*

The Active Economizer Minimum Position will be computed as a linear function, based on reported inlet vane or VFD position, given the two endpoints:

1. Minimum Position with IGV @ 100%
2. Minimum Position with IGV @ 0%

**Figure 94. OA damper minimum position with IGV/VFD at 0% and 100%**



# Software Change History

**Table 52. Software change history**

| RTRM | | | |
|---|---|---|---|
| V1.1 | 4/12/01 | X13650864010 | -Initial Release |
| V1.3 | 6/11/01 | X13650867010 | -Correct thermostat versus zone sensor detection. |
| V2.4 | 11/28/04 | X13650866010 | -Hardware change for power robbing thermostats and NSB status LCD's<br>-Revise test mode logic for heating and cooling.<br>-Revise fan cycling when changing from economizer to mechanical cooling<br>-Correct LPC2 diagnostic not to show on single circuit unit.<br>-Correct defrost not to run less than one minute if coil was thought to be clean |
| V2.6 | 11/28/01 | X13650867020 | -Local ventilation fixed to work in remote.<br>-Fix all outdoor fans to run if outdoor sensor fails.<br>-Fix indoor fan on gas heat to run only if heat fires.<br>-Change Timed Override (TOV) bit for Tracer™ from two hours two minutes.<br>-If outdoor sensor fails, fix so that unit will still do default defrost.<br>-Set unit mode to auto with no sensor if unit transitions from remote to local. |
| V2.7 | 11/28/05 | X13650867020 | -Fix outdoor fan control in service test.<br>-Add ICS communication failure if comm. stops for 2 minutes.<br>-Fix stages of heat & cool to report correctly on ICS.<br>-Fix ICS Lead/Lag hardware to work if in remote control<br>-Correct algorithm Heat proportional gain to stop heat cycling.<br>-Fixed ICS cool and heat stage reporting.<br>-Fixed supply fan lockout to reset with ICS.<br>-Fixed supply fan lockout so zone sensor mode setting to off will reset.<br>-Fixed default defrost without call for heat. |
| V2.9 | 4/1/02 | X13650867020 | -Fix unit mode with remote.<br>-Fix defrost function to halt defrost if call for heat is removed or switched to cooling.<br>-Added stage 1 electric heat to defrost service test.<br>-Added 15 second delay before RTRM talks to TCI to prevent economizer false diagnostic.<br>-Fix software to ignore fault for MAS below 40 degrees with compressors on. |
| V2.10 | 8/13/02 | X13650867020 | -Fixed thermostat Y call on heat pump to keep SOV energized until three minute time has elapsed.<br>-Fixed false diagnostic reports on COMM5 without RTOM.<br>-Correct invalid economizer MAS from 65.4 to 53 F.<br>-Change hardware initialization to stop false diagnostics on Tracker 10. |
| V3.0 | 3/15/03 | X13650867030 | -Feature Enhancement: Add Dehumidification/Reheat Control.<br>Bug fixes:<br>-Fix unit mode when going from off to auto.<br>-Fix supply fan to not wait 20 seconds at power-up if test mode is activated.<br>-Fix RTRM to ignore ICS compressor disable during service test mode.<br>-Fix ICS zone temp to work without local zone sensor |
| V3.1 | 8/25/03 | X13650867040 | -Fixed Cool 1 and Cool 2 in slave mode to allow economizing.<br>-Changed LPC startup bypass time from two minutes to ten seconds.<br>-Turn off electric heat if defrost terminates on HPC.<br>-Fix reheat with zone sensor, override reheat with cooling call.<br>-Ignore-40F MAT if compressor is running. |
| V4.0 | 1/13/04 | X13650867040 | Feature Enhancement:<br>-Add Voyager III control functions.<br>-Added two flash diagnostic code and steady light.<br>Bug fixes:<br>-Fix service test to lock out after power reset with resistance.<br>-Fix outdoor fan operation on one compressor unit during Service Test with dehumidification/reset.<br>-Fix to disable Dehumidification if either compressor circuit becomes disabled.<br>-Fix Defrost Default A timing issues.<br>-Add 30 second delay before looking at Mixed Air and Return Air temperature. |
| V5.0 | 4/21/04 | X13650867050 | -Added dehumidification purge cycle.<br>-Fixed Fan Fail input to normally open input for Voyager III. |
| V5.1 | 1/1/05 | X13650867050 | -Fix compressor staging in test mode. |

### Table 52. Software change history (continued)

| RTRM | | | |
|---|---|---|---|
| V6.0 | 10/15/06 | X13650867060 | Bug Fixes:<br>-Fix RTRM to revert to local control if Modbus Comm lost TCI/LCI for > 2 min.<br>-Fix dual gas ignition module configs to lockout both modules if either one has a failure.<br>-Fix VAV units to disable MWU/DWU on cooling only units.<br>-Fix VAV gas heat units only to shut off supply fan on high duct static trip in CV heating modes.<br>-Fix service test to hold economizer closed when at the "econ open" step and a supply fan fail is present.<br>-Implemented range limits for ICS Zone Temp value from TCI/LCI. Range is -40F to 150F.<br>-Fix compressor disable inputs to lock out individual compressor (27.5-30 tons)<br>Feature Enhancements:<br>-Extended LPC delay at compressor start from 10 seconds to 30 sec. when OAT> or = to 40F and 60 sec. when below 40F.<br>-Extended supply fan off delay after compressor cycle in cooling and mechanical heating from 60 seconds to 80 seconds.<br>-Removed coordinated shut off of Comp 1 on a comp 2 Disable event on single-circuit VIII units. (Allows demand limiting of Comp2 w/o affecting Comp)<br>-Dehumidification is now disabled in Slave Mode when the slave state requested is "Fan On".<br>-"Heat fail" diagnostic can be cleared now with an ICS Diagnostic Reset command.<br>-New unit type supported: International V3 Heat pump units w/2-step mechanical heating. (China & France production only)/ This unit is configured by setting 2-step cooling, heat pump, and Voyager™ III configuration inputs. |
| V7.0 | 12/1/07 | X13650864-867-07 | Bug Fixes:<br>-Added 1-Comp Dehumidification unit using Thermostat with econ cooling enabled<br>-Implemented range limits for ICS OA Temp value from TCI/LCI. Range is -40F to 150F.<br>-Eliminated the "Inhibit Mechanical Cooling" limitation when ECA "actuator fault" is present.<br>-Corrected Compressors not staging intermittently in Service Test with Thermostat<br>-Correct Demand Defrost Initate sequence with Thermostat.<br>-$CO_2$ disable from Rover causing supply fan on continuous.<br>-Fix defect in Reheat Disable from BAS (setting Dehumid Setpoint = 0%).<br>-Fix Frostat trip in Heat Pump heating mode.<br>Feature Enhancement:<br>-Added 2-Stage Single-circuit Voyager III Mechanical Heating for Heat Pump.<br>-Added Resistance Test Support.<br>-Changed Compressor Staging Order for 3-Step Cooling on non-Voyager™ Commercial units.<br>-Supported for New Binary Input to Disable Windmilling.<br>-Supported for new Binary Input to Disable EDC (Indoor Coil Frost).<br>-Added an additional Analog Input.<br>-Added Modulating Gas Heat Feature and VAV Heating Mode on Voyager 3.<br>-Expanded Voyager III Heat Pump feature to 2-circuit functionality with 2-steps mechanical heating.<br>-Implemented new max $\Delta$T temps for the Voy3 configured heat pumps.<br>-Prevented configuration of lead/lag on 3 step cool units that are not Voy 3 and those with reheat installed.<br>-Implemented binary input for 2-step mechanical heating.<br>-Added supply air heating setpoint input to RTAM.<br>-Implement a low-ambient auto-reset LPC diagnostic reporting bypass feature. |

**Table 52. Software change history (continued)**

| RTRM | | | |
|---|---|---|---|
| V8.0 | 07/2009 | X13650867-08 | -Odyssey™ Only Release.<br>-Independent Circuit Heat Pump control for Odyssey™: Includes operation as two-step mechanical heat unit with independent defrost control per circuit as well as new outdoor fan control; ODF B on with C1 and ODF A on with C2 except during Defrost.<br>-The SOV control is changed to be ON anytime the thermostat "O" input is active or a zone sensor is in "Cool" mode. "OFF" mode will shut the SOV off. On independent circuit heat pump units both SOVs will be on as stated above.<br>-Lead/Lag functionality is included for independent-circuit Heat Pump operation with two-steps of mechanical heating.<br>-Changed LPC bypass to no delay for OA Temps 50F and higher. 30 second delay from start of compressor for OA Temps below 50 F but greater than or equal to 40 F and 60 seconds of delay from comp start for OA Temps below 40 F.<br>-Windmilling prevention control was adjusted to eliminate the unnecessary windmilling request if the OA temp rises above the threshold to add another OD fan during compressor minimum "ON" time but returns below the threshold prior to the end of the "ON" time.<br>-Added Frostat™ Trip indication to the Zone Sensor and RTRM LED blink routine.<br>-Added OA Temp failure to the RTRM LED blink routine.<br>-Implemented a fix to Unit Mode Control to eliminate a fall-through issue when transition from Unoccupied to Morning Warm-up on VAV units. In the transition it gets stuck in OFF mode instead of transitioning to MWU.<br>-Implemented a change to OD Fan staging for Voyager™ III units to change the staging threshold for the 3rd step of cooling for OD Fan B from -30F to 45F.<br>-Implemented the RTRM Fan Fail input and configuration pin. If configured, this input is the only ID Fan Fail input monitored. If not configured, the RTOM Fan Fail input is the only input that can be used for fan proving indication.<br>-Support for the new RTEM module is included. This includes recognition of connection to an RTEM vs. a Honeywell ECA module to handle enhanced features of the RTEM. Includes new BAS "read/config" data points: DCV Min Position, $CO_2$ Low Limit SP, Design Min Position/Remote Min Pot local value, $CO_2$ Low Limit STP Fail. No BAS "write/control" variables were supported in Phase 1 due to space limitations.<br>-Fixed diagnostic reset when there are no calls from the thermostat when using thermostat for control.<br>-Reset main control algorithm upon occurrence of Emergency Stop or VOM.<br>-Added fix to RTRM so if the unit is in unoccupied the min position would not be forced to 0% if Service Test is active. The system will send Occupied mode to the RTEM/ECA and not override min position to 0% in Service Test.<br>-Enhanced OA CFM Compensation to use the DCV Min Position Pot if available when the RTEM is present in the system.<br>-Fixed defect in BAS-controlled operation where compressor disable only disables the 1st compressor output instead of both circuits. This was a defect only on 7.0. |
| V8.1 | 02/2010 | X13650864-867-09 | -V8.0 release for all products (Precedent™, Voyager™ Light Commercial, Odyssey™, Voyager™ Commercial, EMEIA).<br>-Same features as in V8.0. |
| V9.0 | 3/2010 | X13650867-10 | -Release for V3 only<br>-Modulating Dehumidification Support<br>-Space Pressure Control with Statitrac™<br>-Changed VAV Changeover to have priority over DWU.<br>-Added the ability to use the W2 thermostat input for Emergency Heat for thermostats that do not have an X2 output. |
| V9.1 | NA | X13650867-10 | -Manufacturing error. Microprocessor software version sticker mistakenly made with V9.1. No differences between V9.1 and V9.0 |
| V9.2 | 07/2010 | X13650867-10 | -Changed Defrost for Independent Circuit Heat Pumps with Aux. Gas Heat to always energize the RTRM Heat 1 output during Defrost. No change for U.S. units. |
| V9.3 | 10/2010 | X13650867-10 | -Implemented Hydronic Heat First for EMEIA. No change for U.S. units. |
| V9.4 | 7/31/2010 | X13650867-10 | -Fix of neisance alarm and setpoint range issues with $CO_2$ setpoint, RTDM Entering Evap Temp, and SA Reheat setpoint. Released to Voyager™ Commercial only. |
| V11.0 | 5/31/2011 | X13650867-11 | -Implemented support for Precedent™ 17Plus units<br>-Released on Precedent™ 17 Plus units only." |
| V12.4 | 12/31/2011 | X13650867-12 | -Implemented 2-Speed Fan and Single Zone VAV features for all products. |

## Software Change History

**Table 52. Software change history (continued)**

| | | | |
|---|---|---|---|
| **RTRM** | | | |
| V13.1 | 6/30/2012 | X13650867-13 | -Added support for Condensate Drain Pan Overflow switch.<br>-Added operation for Single Zone VAV units connected to Thermostats.<br>-Fixed Single Compressor (Precedent™) Dehumidification Units not entering dehumidification due to Comp 2 Disable Input.<br>-Fixed Modulating Dehumid (Voyager™ Commercial) control to allow dehumid up to CSP + 1.5 deg F instead of CSP - 1.5 deg F<br>-Changed notification of Flame Sense Failure to BAS to only indicate when locked out.<br>-Extended Mod Gas heat post purge from 10 sec to 60 sec.<br>-Fixed Exhaust Fan Setpoint chaing with fan speed on Single Zone units when Min Position Setpoint is sent from BAS." |
| V13.3 | 10/31/2012 | X13650867-13 | -Increased Minuimum Fire voltage |
| V14.0 | 5/1/2013 | X13650867-14 | -Implemented True VAV on Precedent™ and Voyager™ units.<br>-Implemented TRAQ for Voyager™ Commercial.<br>-Enhanced Reheat Purge cycle.<br>-Released for all unit types." |
| **RTOM** | | | |
| V1.0 | 4/6/01 | X13650868010 | -Initial production release. |
| V1.1 | 5/28/01 | X13650868010 | -Fix Supply Air Tempering enable input by inverting jumper configuration. |
| V1.4 | 11/12/01 | X13650868010 | -Fixed false diagnostics with COMM5. |
| V2.0 | 4/1/04 | X13650868020 | -Add Dehumidification support<br>-Add Voyager™ Commercial Control Function |
| V3.0 | 03/2010 | X13650868-05 | -Heat Pump Low Ambient Limit Support<br>-Alarm Indication Output and Configuration |
| V3.2 | 1/31/2011 | X13650868-05 | -Fixed configuration bit used by Rover showing incomplete future feature information. |
| V4.0 | 5/31/2011 | X13650868-06 | -Added I/O to support 17SEER 4-Speed fan and Single Zone VAV units only.<br>-Modified Slew Rate on Modulating Gas Heat.<br>-Release on Precedent™ 17 Plus units only." |
| V8.0 | 12/31/2011 | X13650868-07 | -Added I/O to support 2-Speed Fan and Single Zone VAV for all unit types. |
| V9.0 | 6/30/2012 | X13650868-08 | -Implementation for Condensate Drain Pan Overflow Switch. |
| **RTVM** | | | |
| V3.0 | 03/2010 | X13651517-01 | -Initial Release<br>-Space Pressure Control with Statitrac™ Support |
| V3.2 | 1/31/2011 | X13651517-01 | -Fix for RTOM |
| V4.0 | 5/31/2011 | X13651517-02 | -Implementation of 17Plus 4-Speed fan and Single Zone VAV units only.<br>-Released on Precedent 17Plus units only." |
| V10.0 | 7/9/1931 | X13651517-03 | -Implementation of TRAQ for Voyager™ Commercial.<br>-Released on all unit types." |
| **ECA** | | | |
| V1.05 | 4/12/01 | X13650878020 | -Initial production release - W7399A, W7340A. |
| V2.05 | 7/15/02 | X13650878020 | -Fixed 60 seconds communication loss. |
| V2.07 | 10/21/03 | X13650878060 | -Changed to Masked chip.<br>-Fixed comparative enthalpy. |
| V2.08 | 8/25/04 | X13650878080 | -Went back to OTP chip to resolve Masked chip problems. |
| V1.0 | 4/1/05 | X13651082010 | -Upgraded ECA actuator and module W7399B, W7340B |
| V1.0 | 4/1/05 | X13651082020 | -First production ECA manual with ALL sensor inputs. |
| V1.0 | 4/1/05 | X13651081010 | -First production release of ECA module with dry bulb only input. |
| **RTEM** | | | |
| V1.1 | 03/2010 | X13651513-01 | -Initial Release full configuration logic module.<br>-DCV updated to meet ASHRAE 62.1 2007.<br>-DCV Mode Configuration input added.<br>-Changed that a minimum position provided from BAS would have priority over all local damper position requests, including DCV. |
| V1.1 | 03/2010 | X13651514-01 | -Initial Release dry bulb only module. |

**Table 52. Software change history (continued)**

| | | | |
|---|---|---|---|
| **RTRM** | | | |
| V2.0 | 5/31/2011 | X13651513-02<br>X13651514-02 | -Support for implementation of 17 Plus 4-Speed fan and Single Zone VAV units only.<br>-Released for Precedent™ 17Plus units only. |
| V2.2 | 10/31/2011 | X13651513-02<br>X13651514-02 | -Modifications to support Single Zone VAV and Multi-Speed Indoor Fan functionality.<br>-Release on all unit types. |
| **RTDM** | 5/31/2011 | X13651466-03 | -Fixed intermittent communications issues causing Modulating Dehumidification units to shut down all compressor operations. |
| V1.2 | 03/2010 | X13651466-02 | -Initial Release<br>-Voyager™ Commercial Modulating Dehumidification Support |
| V2.2 | | | |
| **RTAM** | | | |
| V2.0 | 01/2004 | X13650871-01 | -Initial release to support VAV for Voyager™ Commercial. |
| V2.2 | 08/2004 | X13650871-01 | -Enhancements to IGV/VFD control. |
| V3.0 | 12/2007 | X13650871-02 | -Added Supply Air Heating Setpoint to be used with Modulating Gas Heat units. |
| V3.1 | 09/2010 | X13650871-02 | -Fixed SA Pressure input conversion logic so that when systems start the VAV Box fans the negative pressure does not cause the SA Pressure reading to go invalid and cause a temporary SA Pressure Failure until the ID Fan starts. |
| V4.0 | ? | X13650871-02 | -Software support for implementation of new microprocessor. |
| **TCI** | | | |
| V1.3 | 4/16/01 | X13650869010 | -First production release. |
| V1.23 | 12/31/01 | X13650869010 | -Fix a variety of false diagnostics. |
| V1.24 | 1/25/01 | X13650869010 | -Revised to allow true discharge air sensor to be reported through RTOM if unit doesn't have economizer option. |
| V3.1 | 3/10/04 | X13650869030 | -Add status LED support and VAV enhancements.<br>-Added code to fix VAV lockup. |
| **LCI-SCC** | | | |
| V1.02 | 4/16/01 | X13650870010 | -First production release. |
| V2.06 | 10/01/03 | X13650870020 | -Fixed to allow stand-alone operation without communication link. |
| V2.06 | 3/10/2004 | X13650870-02 | Feature Enhancement:<br>-Add support for nviSpaceRH - Communicated SpaceRH<br>-Add support for nviOutdoor Temp - Communicated Outdoor Air Temperature -Add support for nviOutdoorRH - Communicated Outdoor RH<br>-Add support for nviTraneVar1401 - Communicated Service Test<br>-Add support for nviBldgStatPress - Not Supported in RTRM<br>-Add support for nvoMixedAirTemp - Reports Mixed Air temperature -Add support for nvoBldgStatPress - Not Supported in RTRM<br>-Add support for nciSpaceRHSetpt - Communicated Space RH Set Point<br>-Add support for nciExhaustConfig - Communicated Exhaust Fan Start Position -Add support for nciBldgStaticSP - Not Supported in RTRM<br>-Add support for nciExhaustConfig - Communicated Exhaust Fan Start Position -Add support for nciBldgStaticSP - Not Supported in RTRM<br>Bug Fix:<br>-Fixed bug to allow communicated Emergency Heat Mode |
| V2.07 | 11/1/2004 | X13650870-02 | Bug Fix:<br>-Fix Active Set point to report the cooling set point during dehumidification mode instead of 32 |
| V2.08 | 1/15/2007 | X13650870-02 | Bug Fix:<br>-Fix the ApplicMode to change if the unit is in dehumidification when using a BAS in optimal start & nite purge |
| V2.11 | 2/6/2012 | X13650870-02 | -Modifications to support Building Static Pressure<br>-Modifications to Space Relative Humidity<br>-Modifications to existing variable for support of Single Zone VAV |
| **LCI-DAC** | | | |
| V1.0 | 4/01/04 | X1365106601 | -LCI for VAV Voyager™ Commercial |
| V1.08 | 2/6/2012 | X1365106601 | -Modifications to support Building Static Pressure<br>-Modifications to existing variable for support of Single Zone VAV |
| **LCI-SCC** | | | |

**Table 52. Software change history (continued)**

| RTRM | | | |
|---|---|---|---|
| 2.06 | 3/10/04 | X13650870-02 | Feature Enhancement:<br>-Add support for nviSpaceRH - Communicated SpaceRH<br>-Add support for nviOutdoor Temp - Communicated Outdoor Air Temperature<br>-Add support for nviOutdoorRH - Communicated Outdoor RH<br>-Add support for nviTraneVar1401 - Communicated Service Test<br>-Add support for nviBldgStatPress - Not Supported in RTRM<br>-Add support for nvoMixedAirTemp - Reports Mixed Air temperature<br>-Add support for nvoBldgStatPress - Not Supported in RTRM<br>-Add support for nciSpaceRHSetpt - Communicated Space RH Set Point<br>-Add support for nciExhaustConfig - Communicated Exhaust Fan Start Position<br>-Add support for nciBldgStaticSP - Not Supported in RTRM<br>Bug Fix:<br>-Fixed bug to allow communicated Emergency Heat Mode |
| 2.07 | 11/1/04 | X13650870-02 | Bug Fix:<br>-Fix Active Set point to report the cooling set point during dehumidification mode instead of 32 |
| 2.08 | 1/15/07 | X13650870-02 | Bug Fix:<br>-Fix the ApplicMode to change if the unit is in dehumidification when using a BAS in optimal start & night purge |

# Index

The manufacturer optimizes the performance of homes and buildings around the world. A business of Ingersoll Rand, the leader in creating and sustaining safe, comfortable and energy efficient environments, the manufacturer offers a broad portfolio of advanced controls and HVAC systems, comprehensive building services, and parts. For more information, visit www.IRCO.com.



RT-SVD03H-EN 10 Sep 2013
Supersedes RT-SVD03G-EN (03 Nov 2010)



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