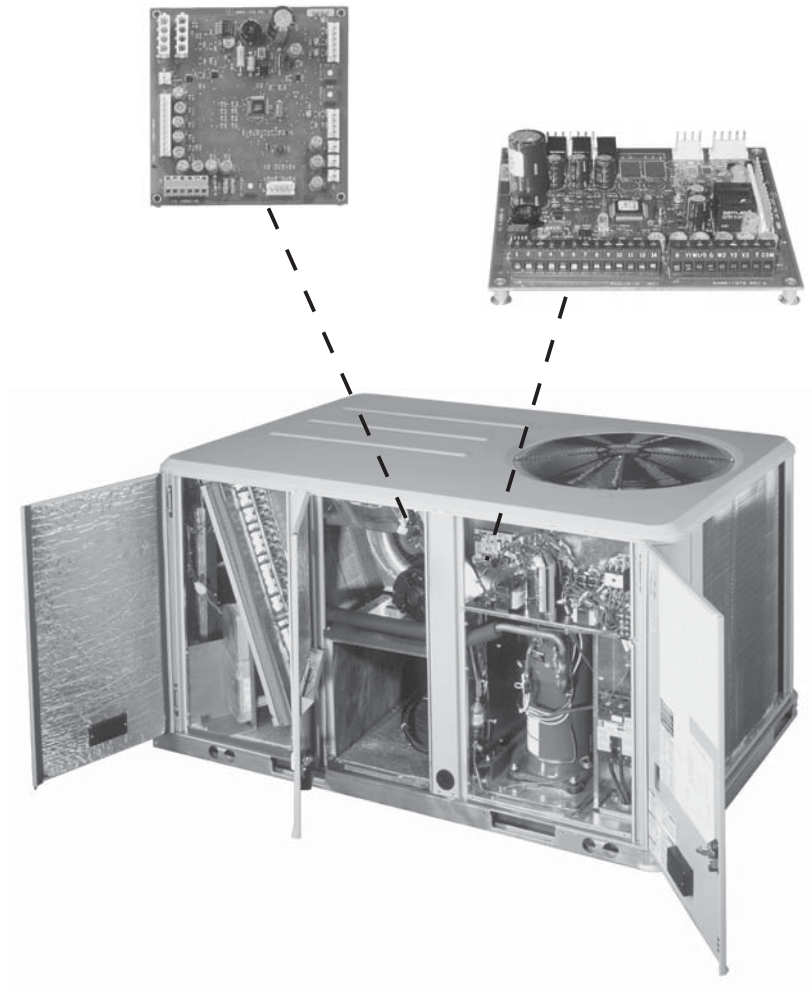


# ReliaTel™ Microprocessor Controls

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# Introduction

## 3 to 10 ton Convertible and 12½ to 50 ton Dedicated Packaged Rooftops

3 to 10 ton cooling only and gas electric convertible packaged units can be built with either electromechanical or ReliaTel™ controls. 12½ to 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 seven communicating modules.

ReliaTel is the name given to the second generation microprocessor controls developed by Trane/American Standard.

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, 12½-25 ton dedicated units were converted to ReliaTel controls. In April 2004, ReliaTel controls were added to 27½ to 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.

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# 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.

- a. ReliaTel Controls: 9th digit "R"
- b. Electromechanical Controls: 9th digit "E"

**Note:** 27.5-50 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.

(See (RTOM) outlines on the following pages)

The RTOM gets power from and communicates with the RTRM.

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

- Froststat (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 27.5-50 Ton Units RTOM is standard.

(See (ECA) outlines on the following pages)

### **Economizer Actuator w/ Module (ECA)**

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<sub>2</sub> Sensor 0-10VDC input

Remote Minimum Potentiometer (RMP)

The Power Exhaust relay is connected to the ECA module as well.

See (COMM3/4) outlines on the following pages

### **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)

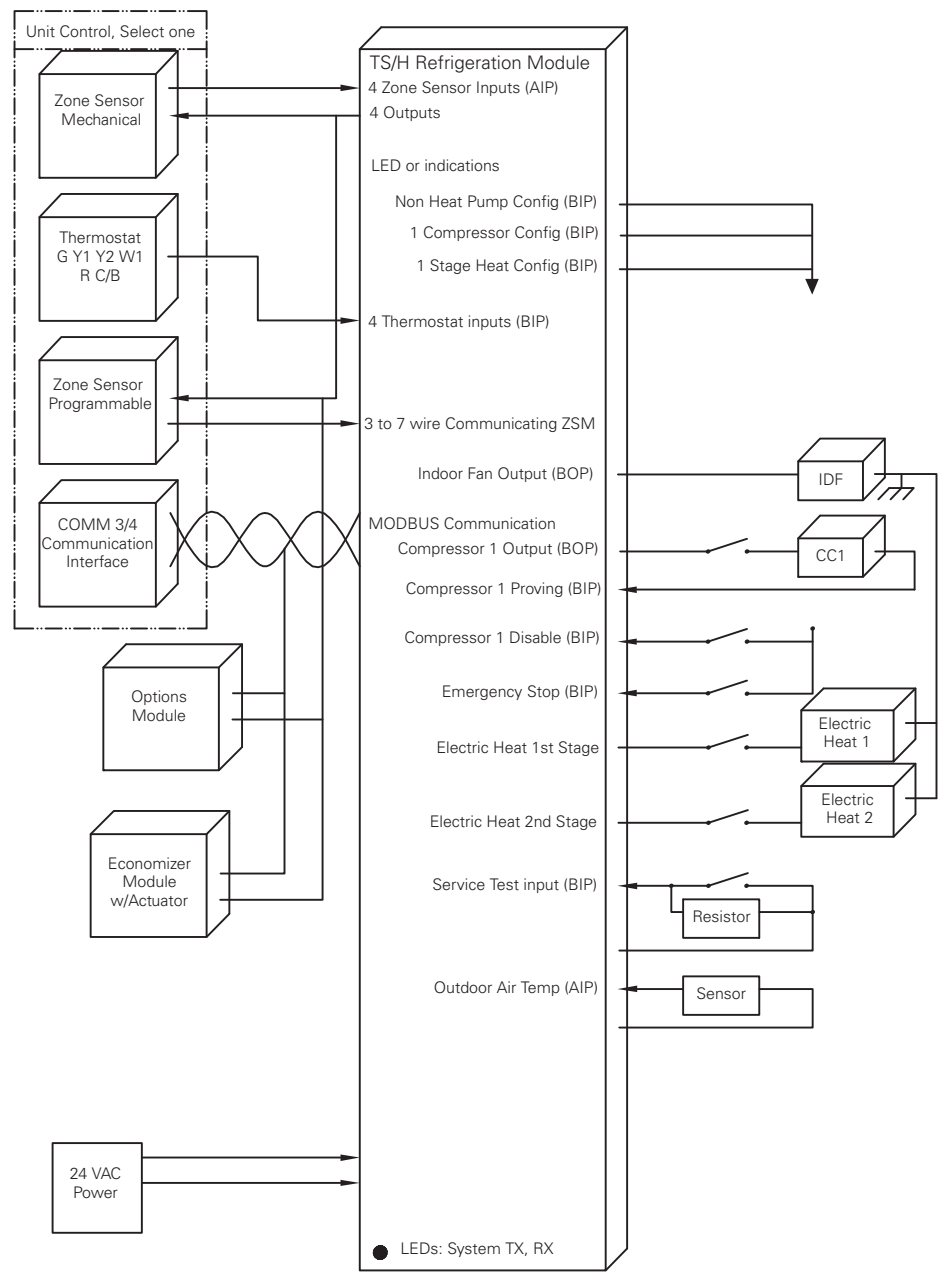
VariTrac 2 (Central Control Panel)

### **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



RTRM

Figure 2. Refrigeration Module (RTRM) Gas Heating

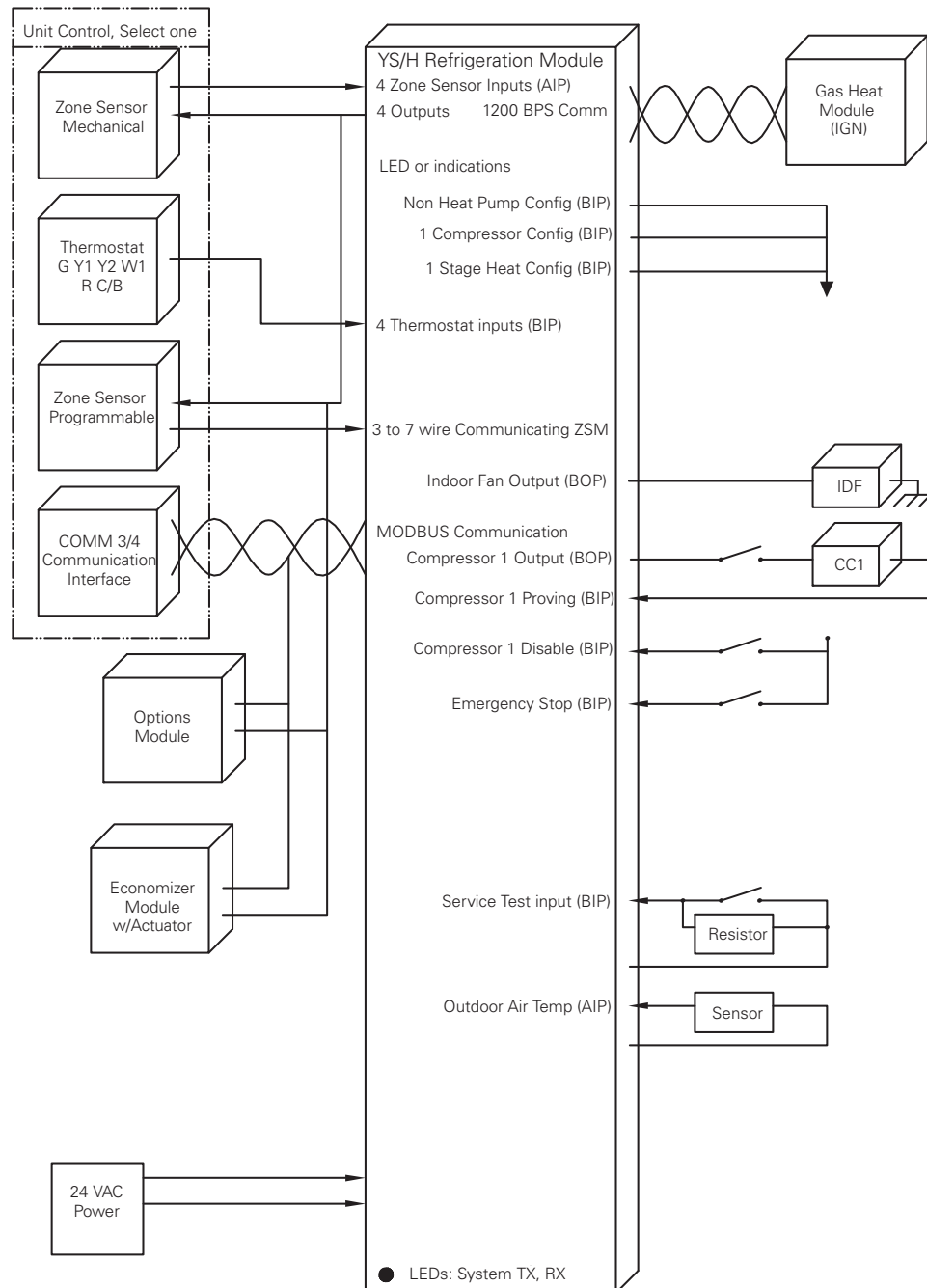
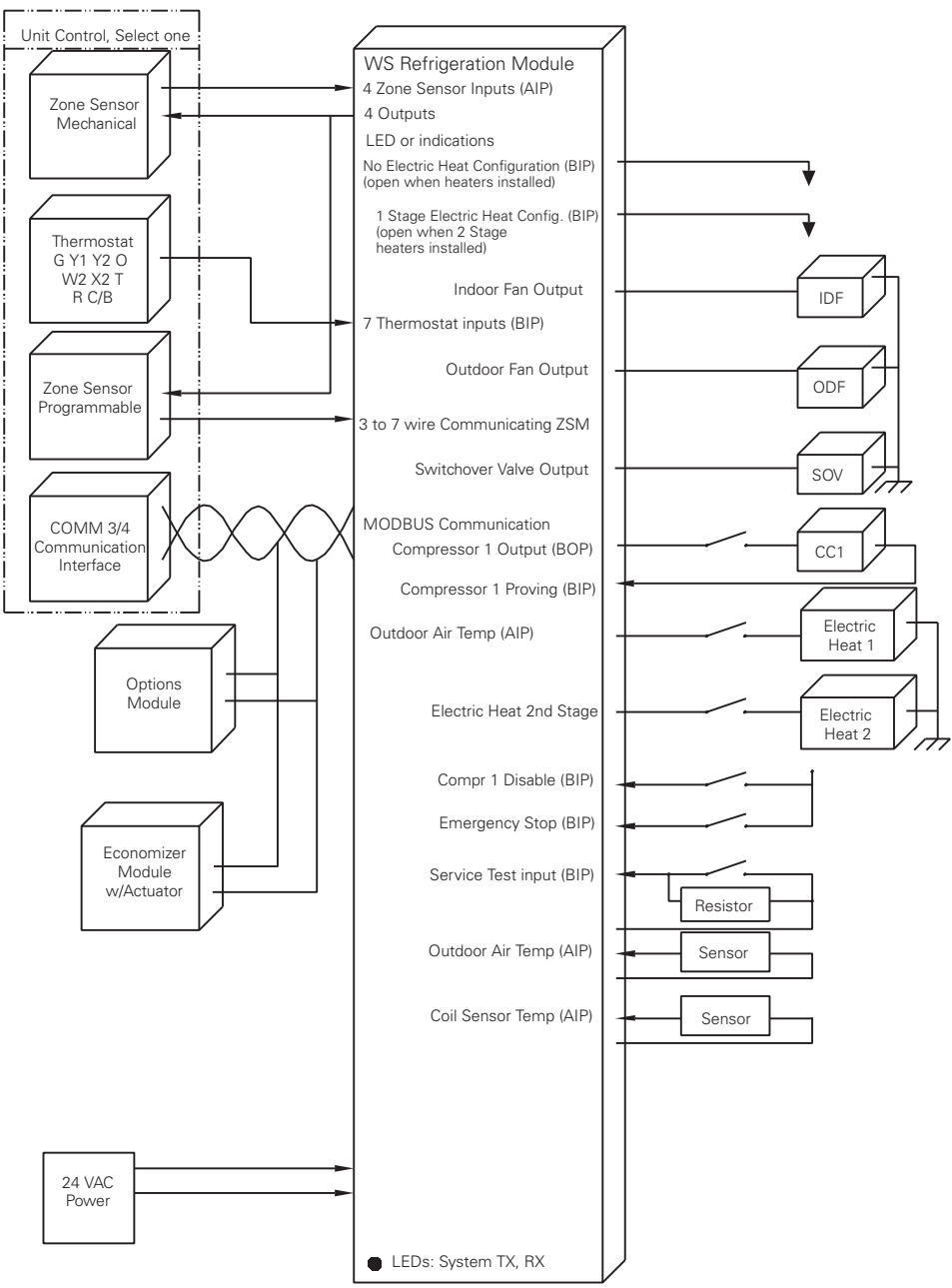


Figure 3. Refrigeration Module (RTRM) Heat Pump



RTOM

Figure 4. Options Module (RTOM)

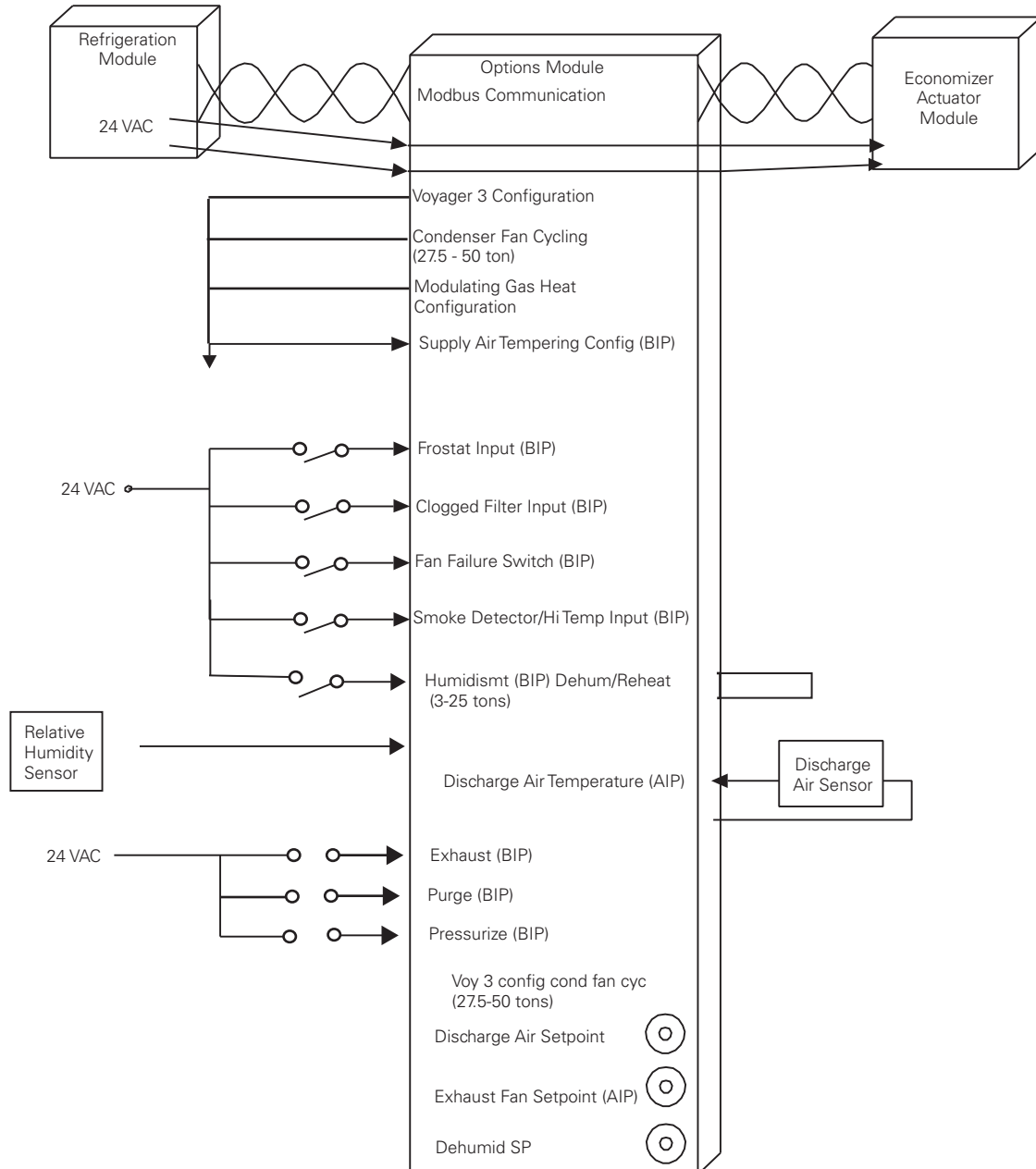


Figure 5. Economizer Module (ECA)

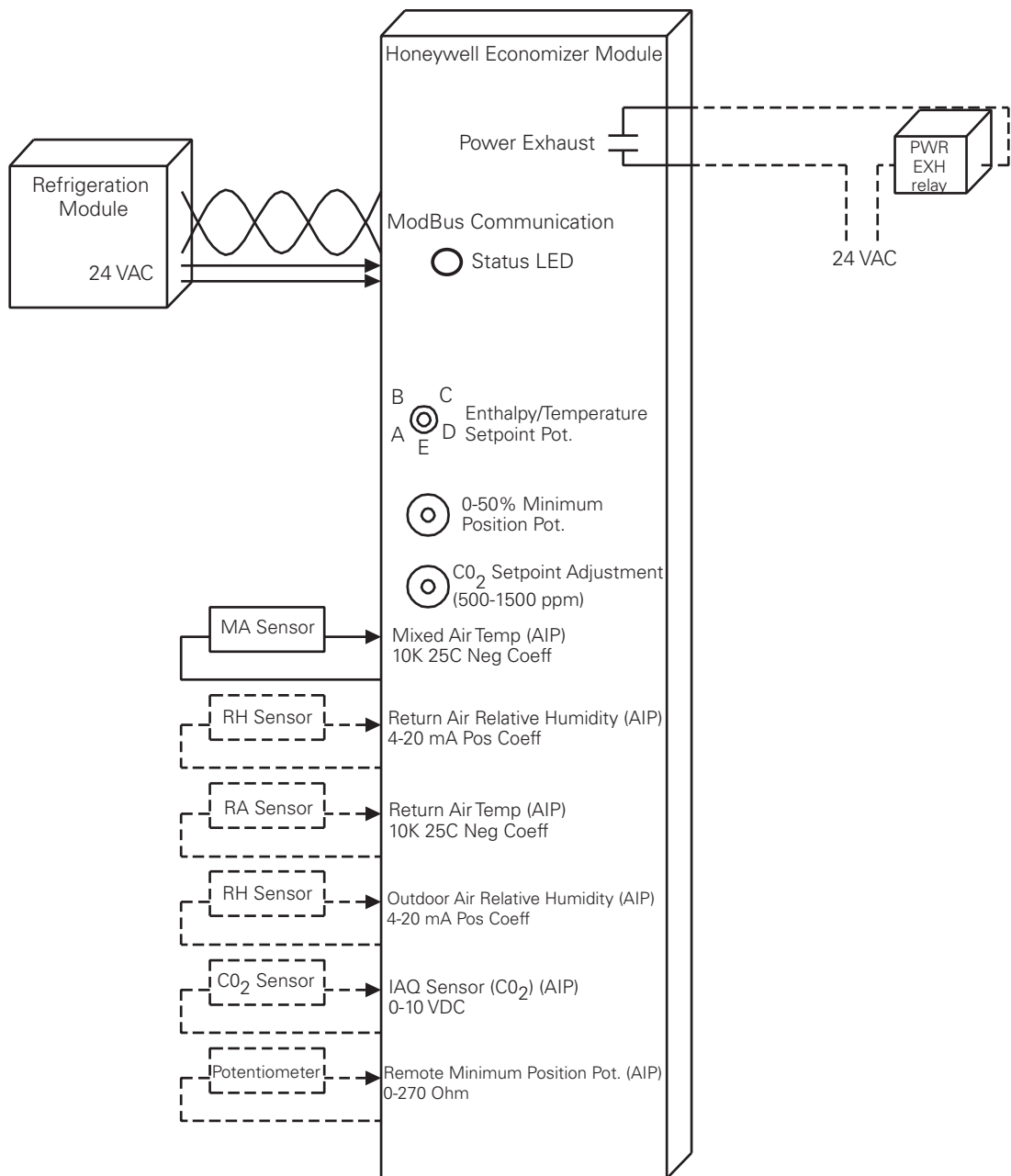


Figure 6. COMM 3/4 Module for ICS Communication/ LonTalk Communication Interface (LCI/TCI)

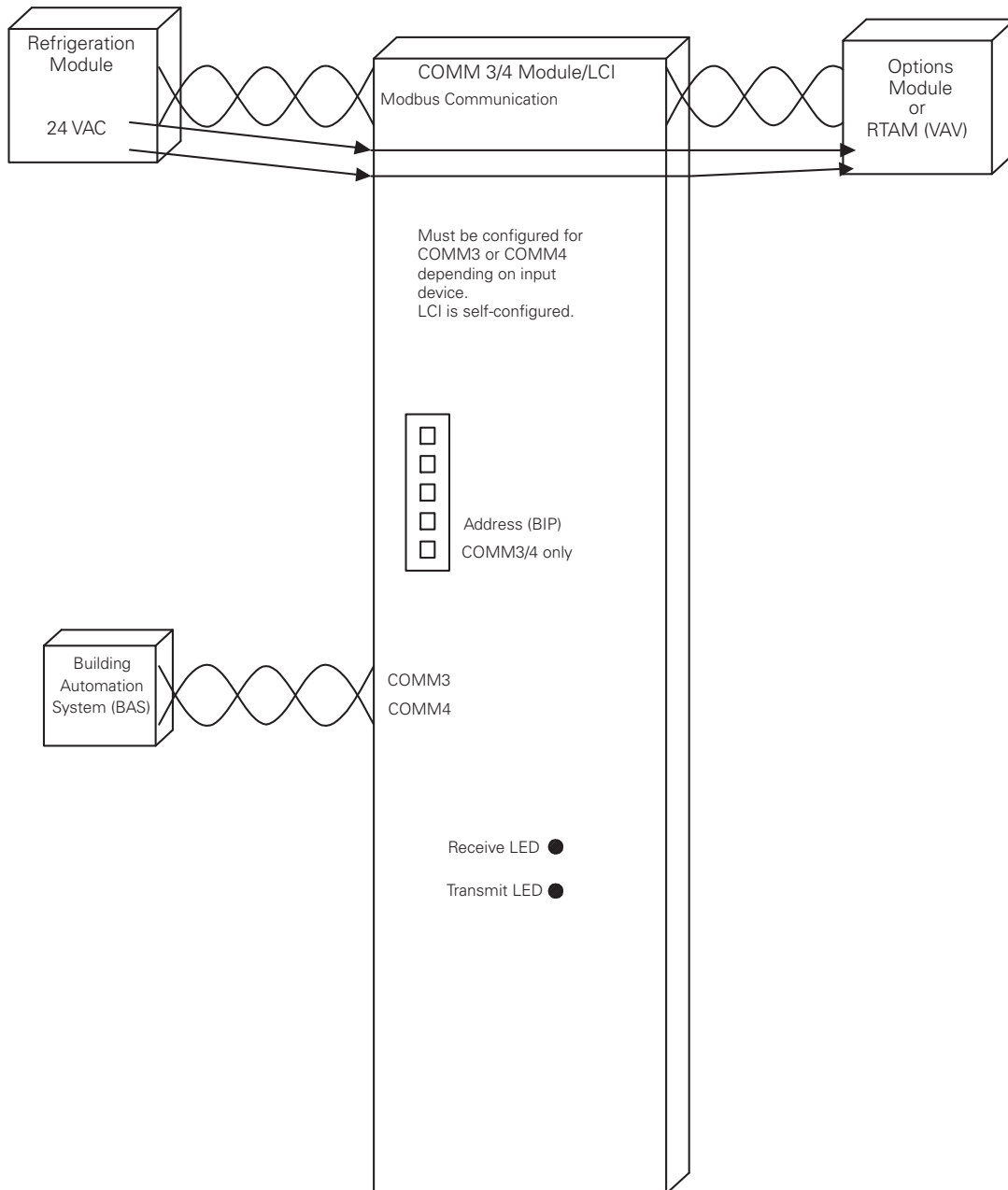
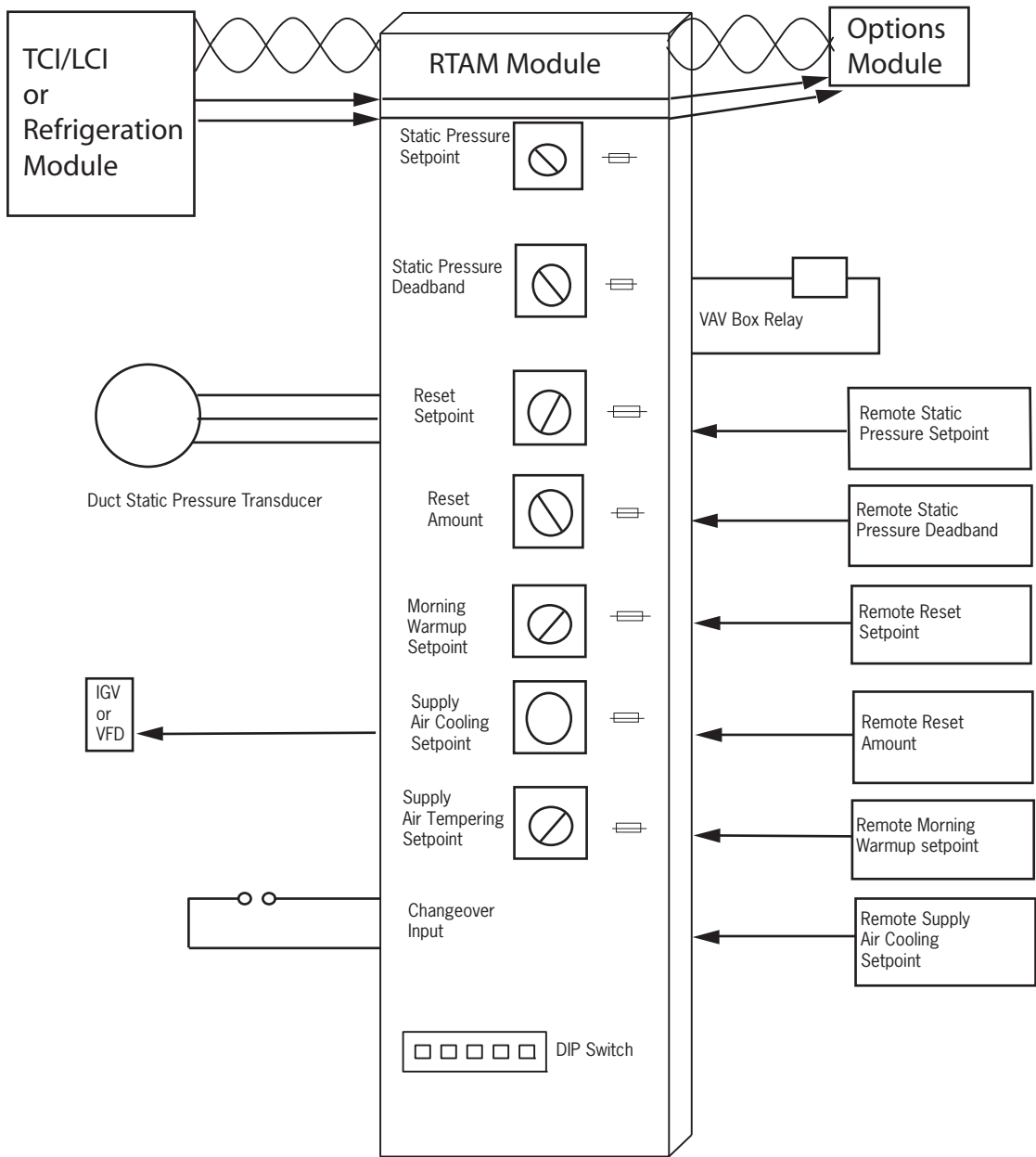


Figure 7. Air Control Module (RTAM)





# 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.

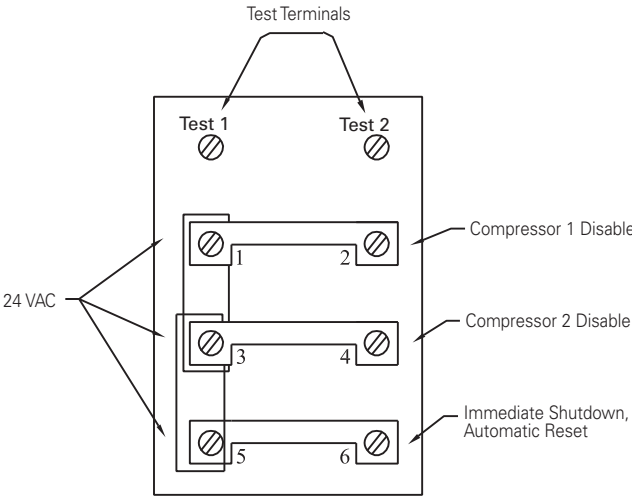
**Compressor 2 disable.**

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.

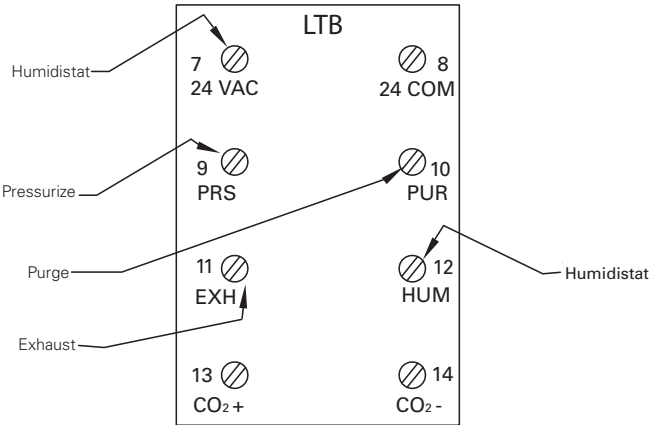
**Emergency Stop.**

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 8. Low Voltage Terminal Strip**

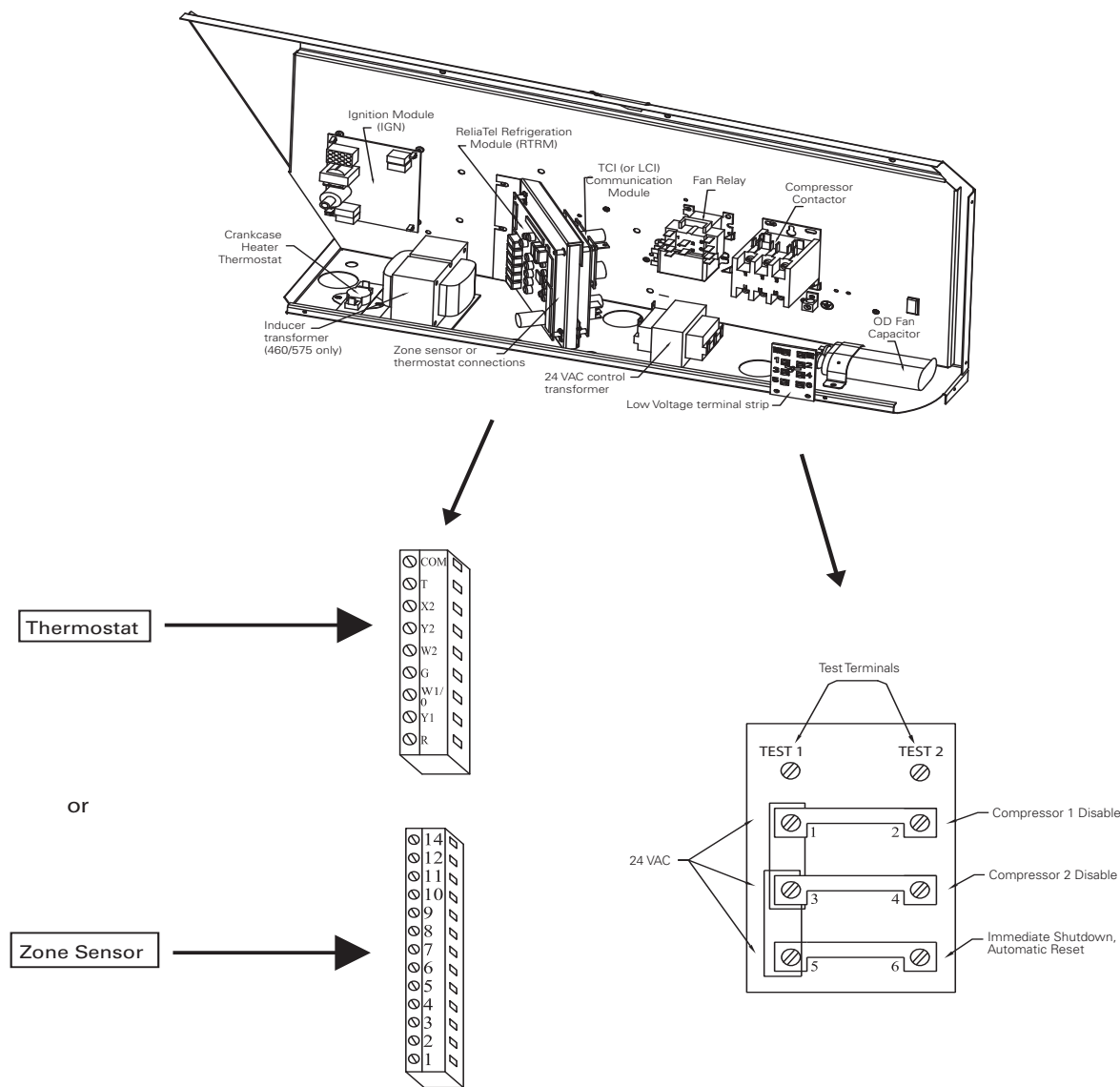


**Figure 9. LTB Layout**

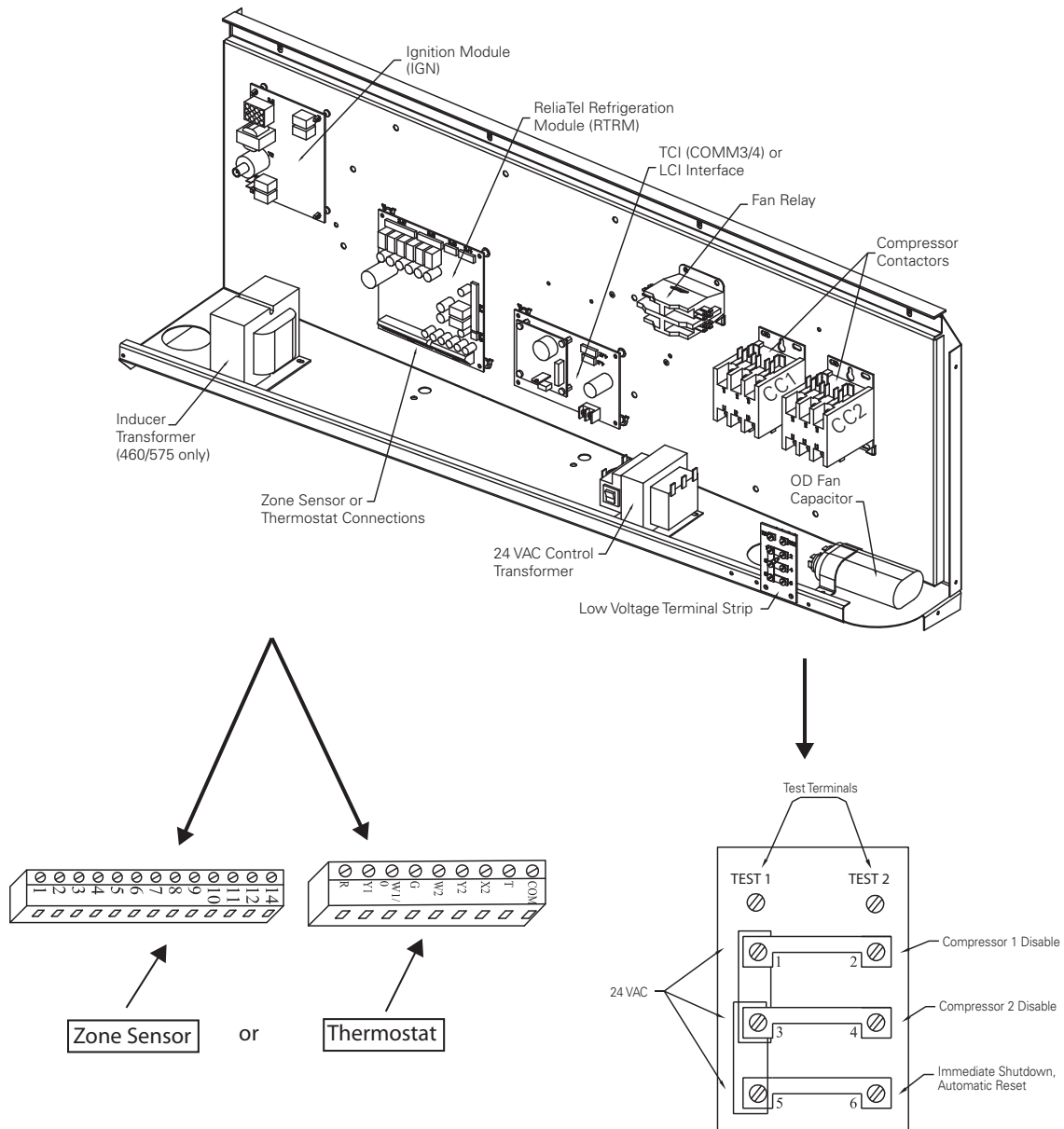


# Typical Control Box Layout

Figure 10. Typical Control Box Layout (3-5 tons)

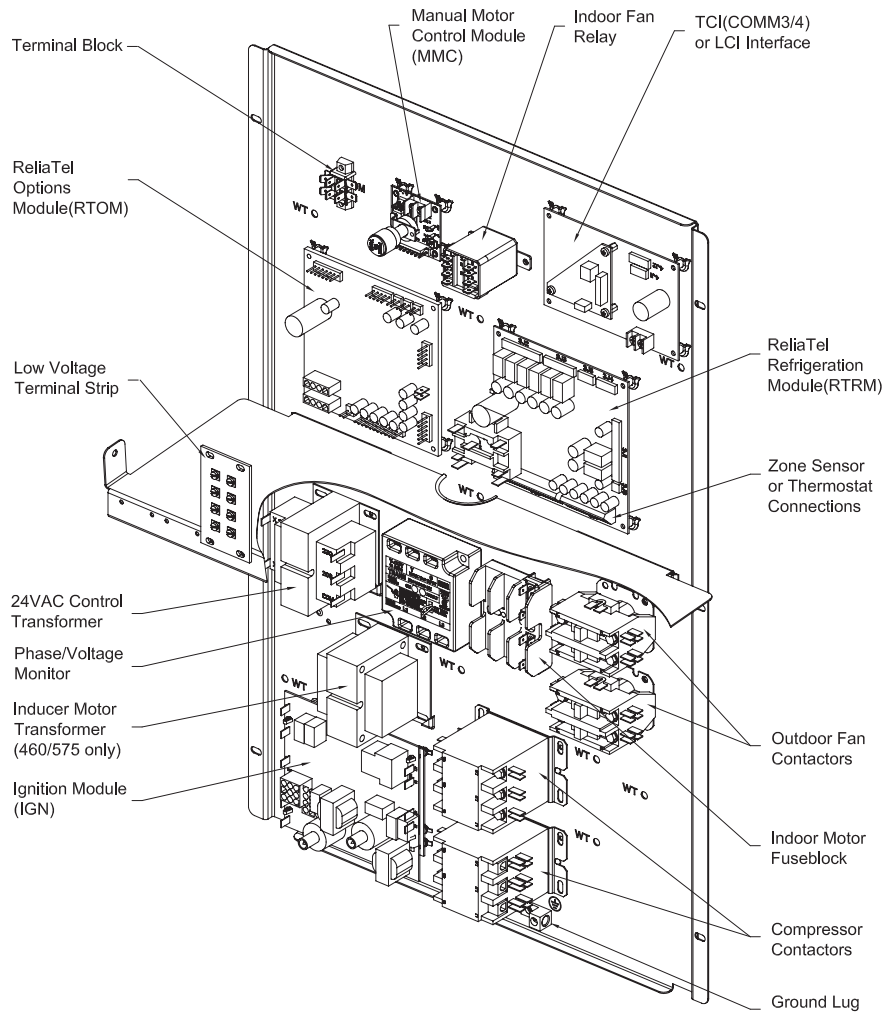


**Figure 11. Typical Control Box Layout (T/YSC072-102E, T/YHC048-072E, & WSC060-090E)**

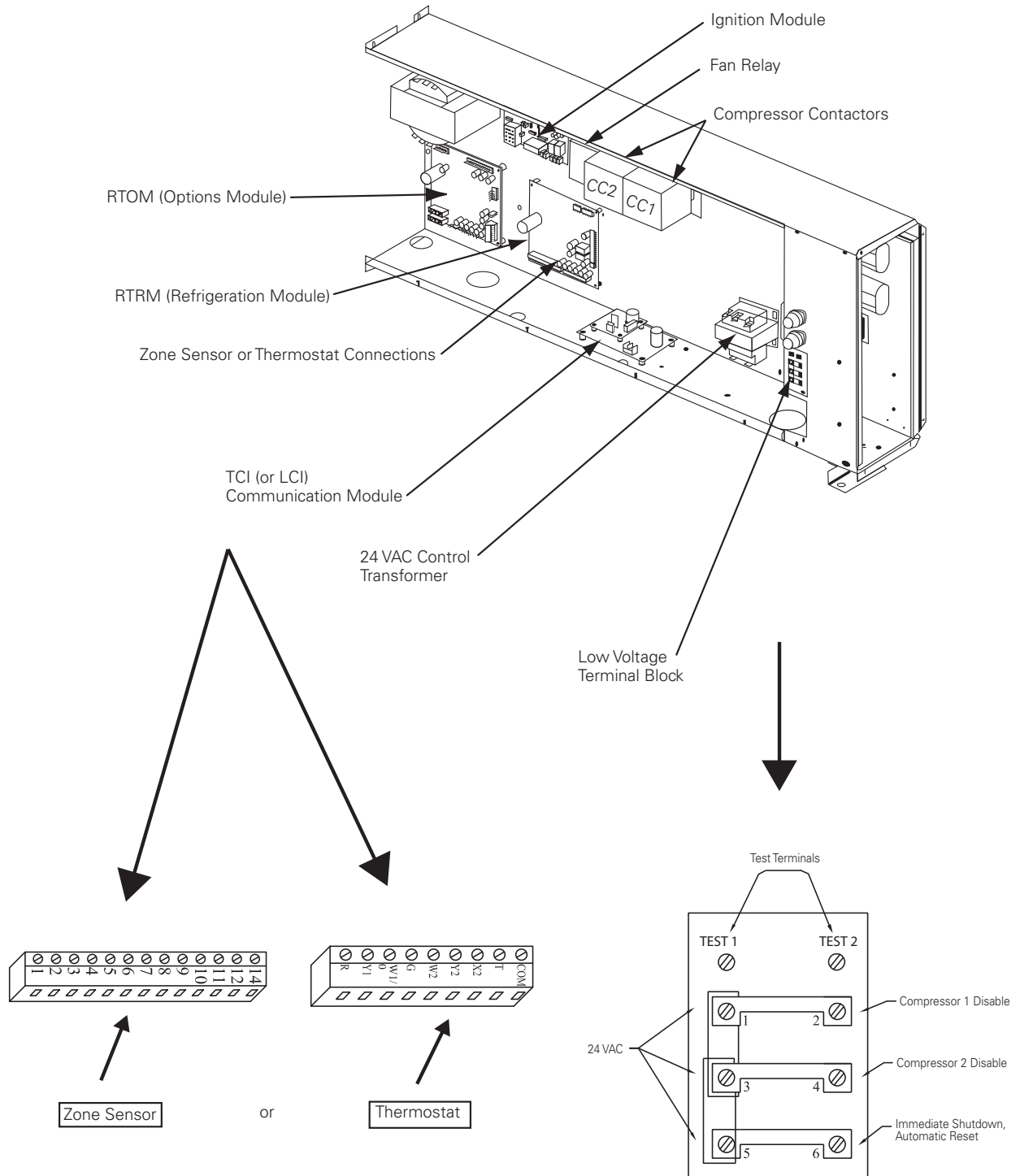


## Typical Control Box Layout

**Figure 12. Typical Control Box Layout (T/YSC120E, T/YHC092-120E, & WSC120E)**

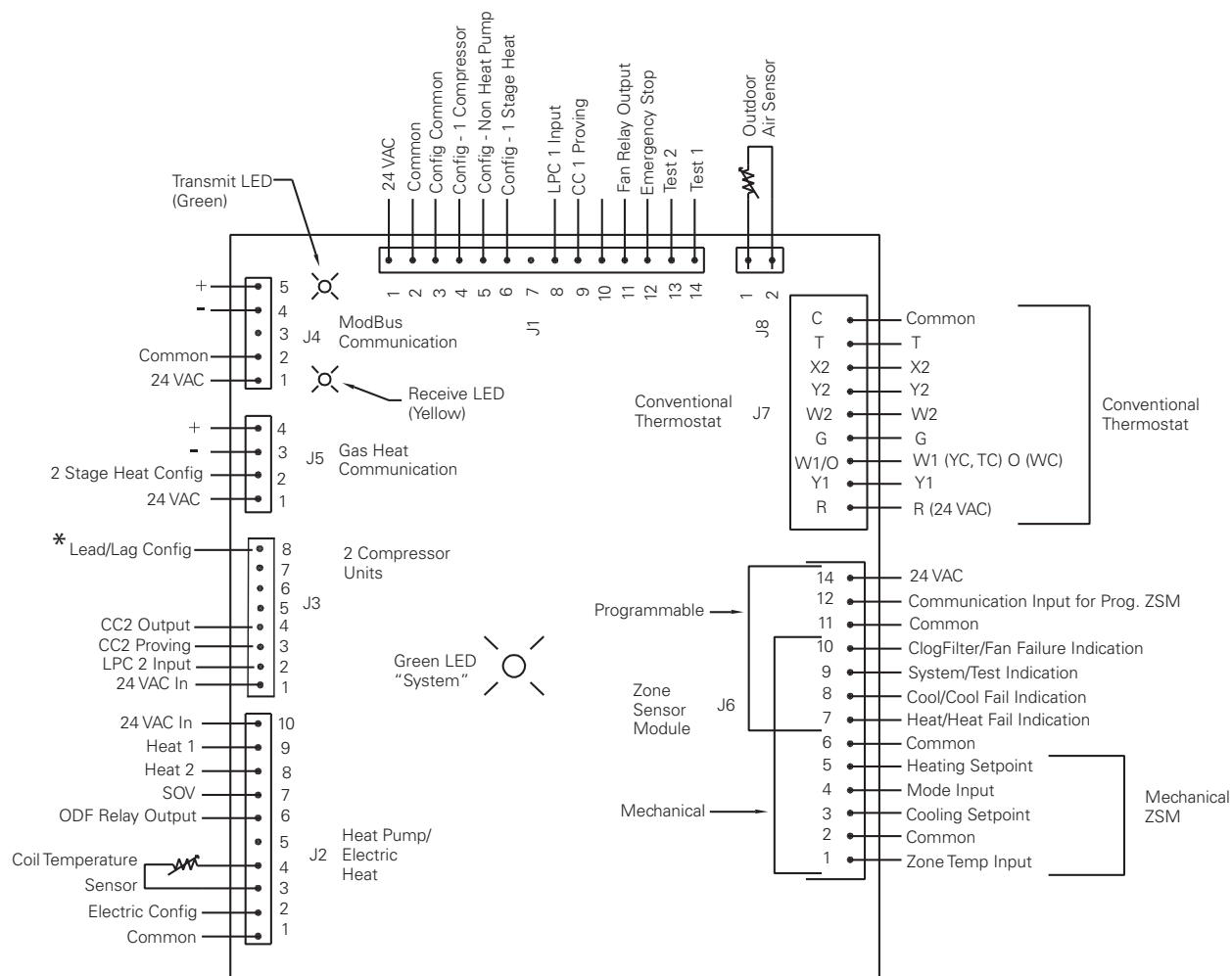


**Figure 13. Typical Control Box Layout (12½ - 25 tons)**



# ReliaTel Refrigeration Module (RTRM)

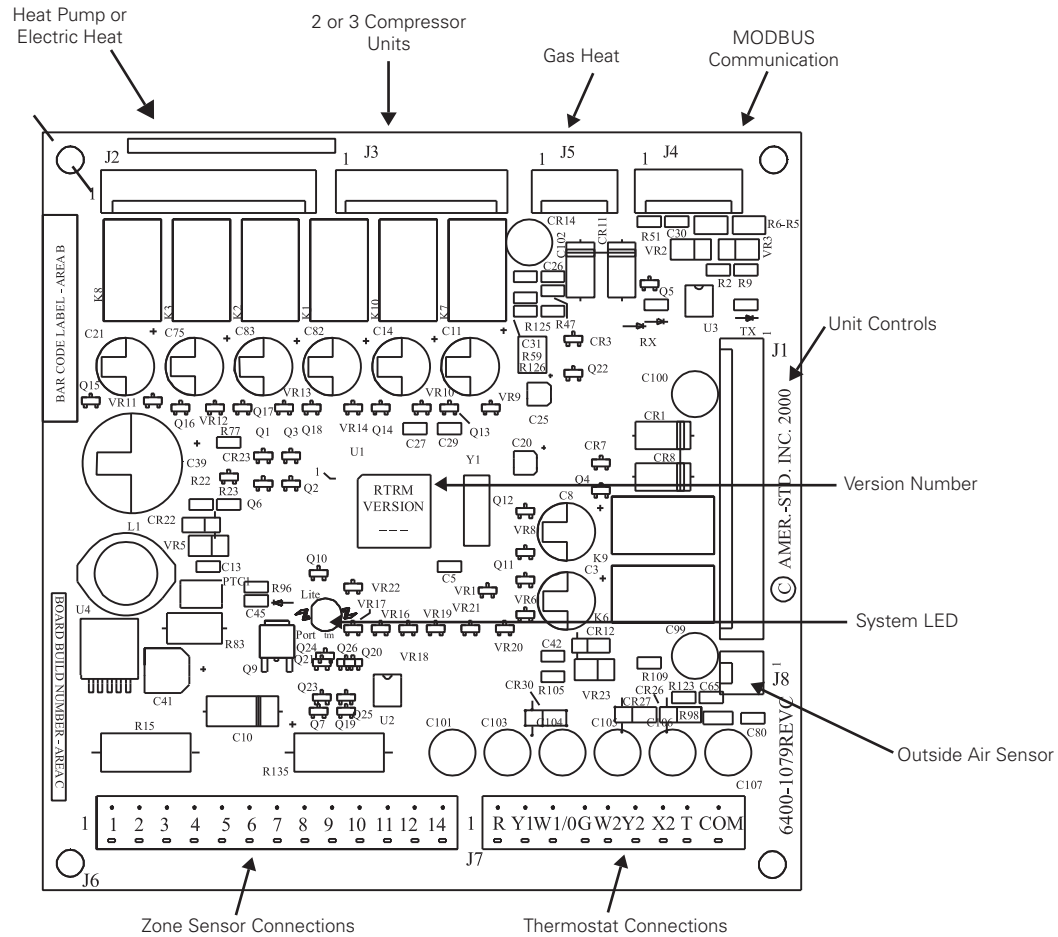
Figure 14. ReliaTel Refrigeration Module (RTRM) - Layout



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 15. 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:

#### 3-50 Ton Units

- Supply fan fail
- Zone temperature sensor input failure
- 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

27½ to 50 Ton Units:

- Zone temperature sensor failure during unoccupied mode (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 3-50 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.

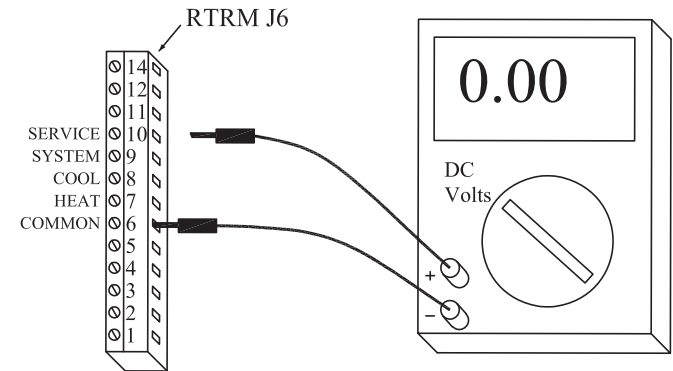


Table 1. Approximate voltage readings (depending on control used)

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

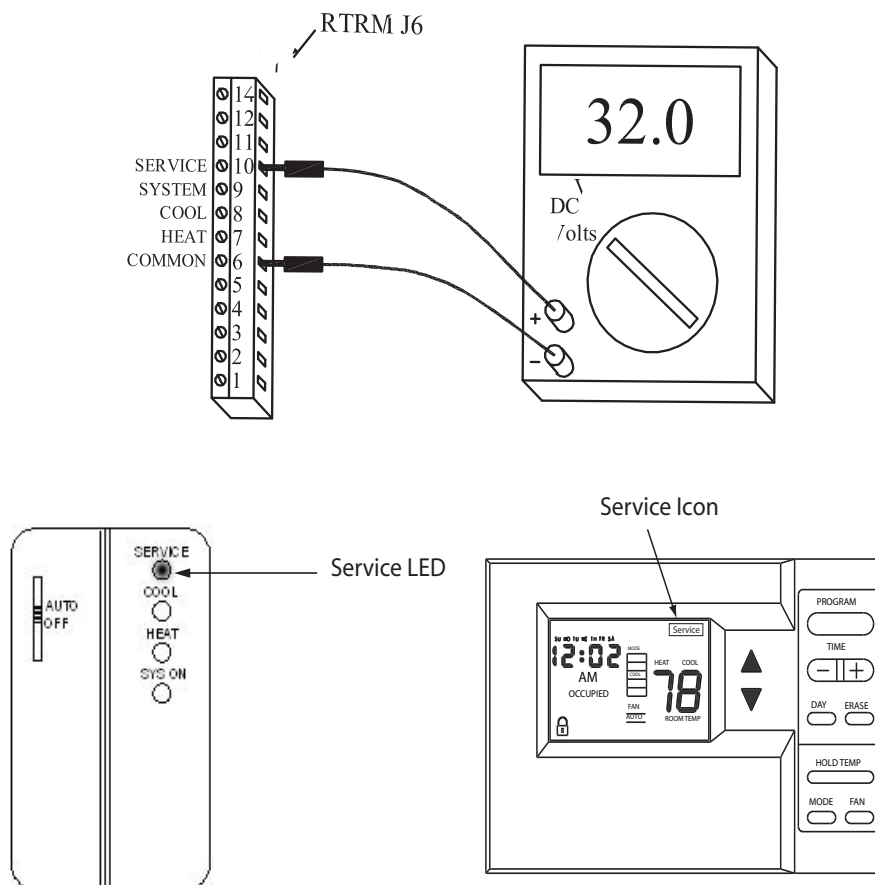
#### Service- RTRM-J6-10.

**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. Page 18 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** - Fan Proving switch (also called Fan Fail Switch FFS) has failed to open (3-25 Ton) or closed (27.5-50 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. 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.



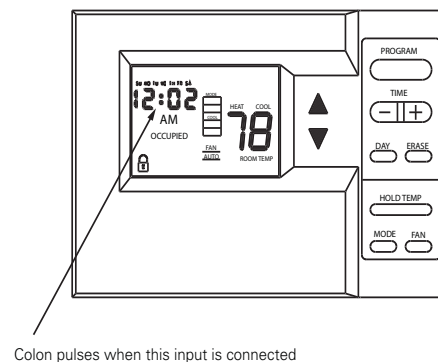
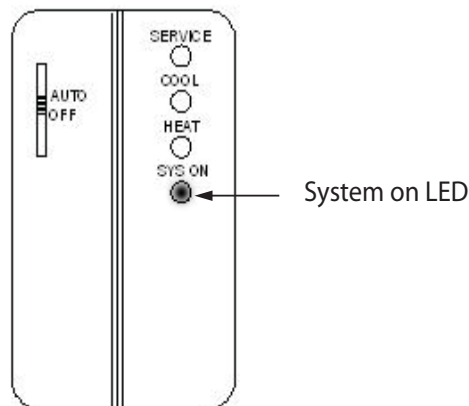
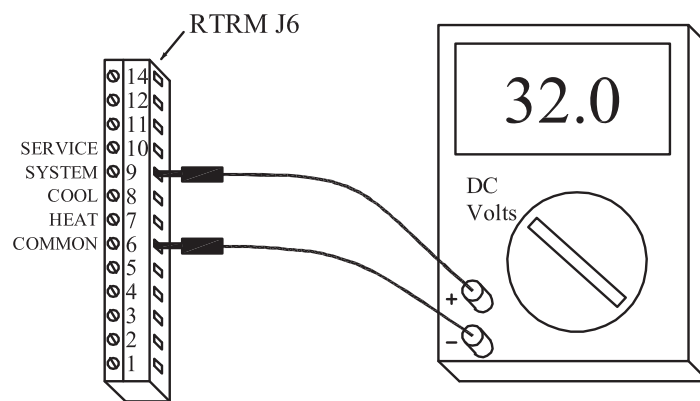
### What the readings mean

#### 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 0VDC 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.



## Cool Diagnostic

### 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

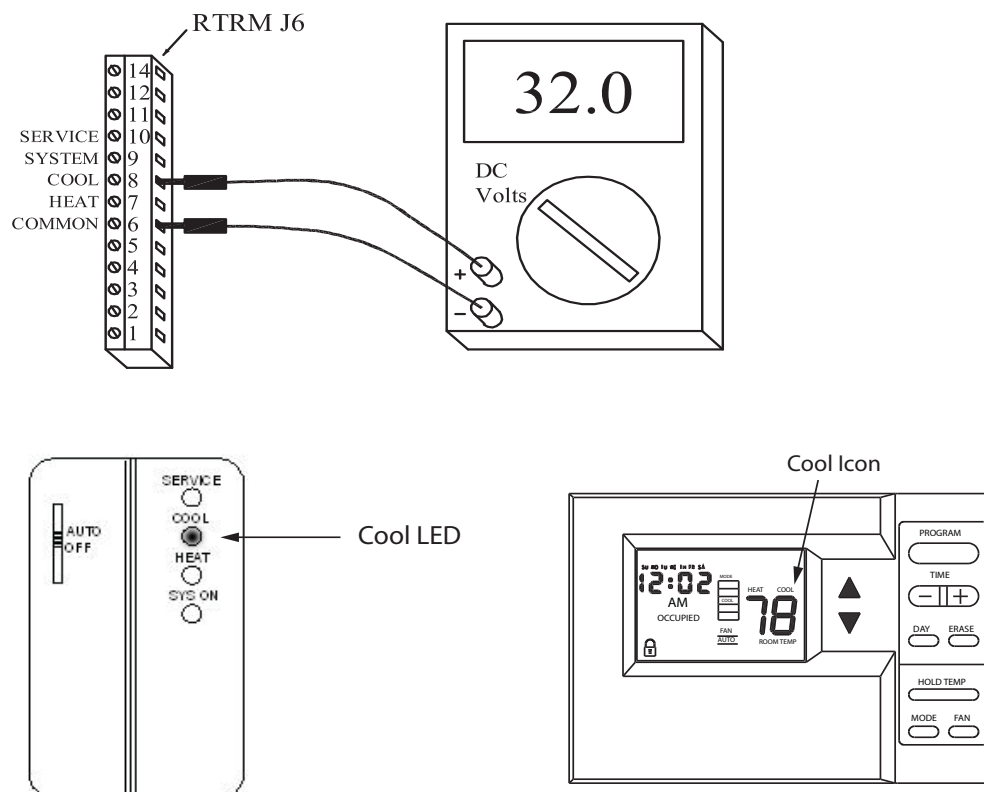
1. CC1 or CC2 opens during cooling, or is open when a call for compressor occurs. The unaffected circuit will still run. With RTRM version 4.0 or greater, CC1 or CC2 circuit must open on 3 consecutive cycles. On the 4th trip, the unit will lockout.
2. CPR1 Disable or CPR 2 Disable input has opened during 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.

#### 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

#### 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.

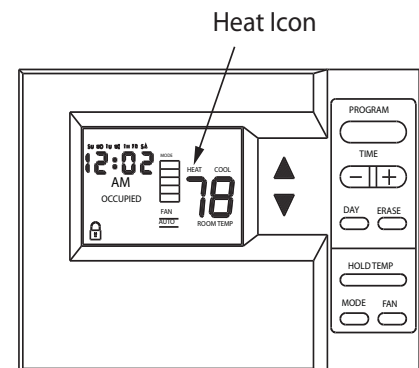
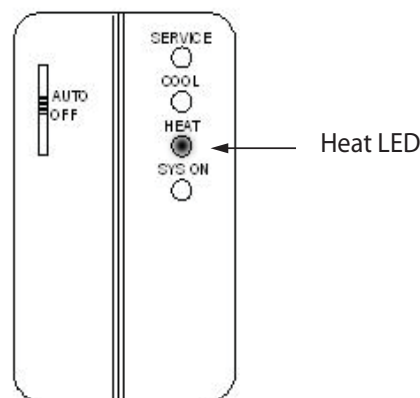
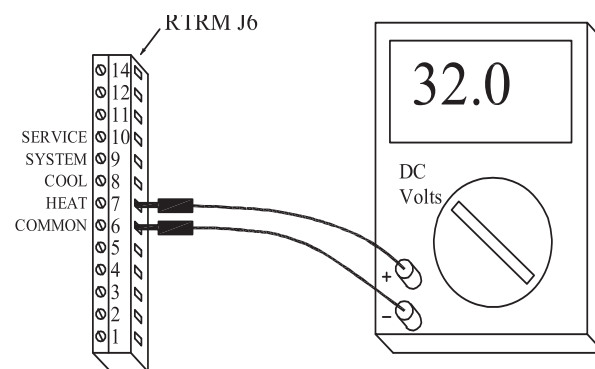
#### Electric Heat

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

3. Unit is in the EMERGENCY HEAT mode.

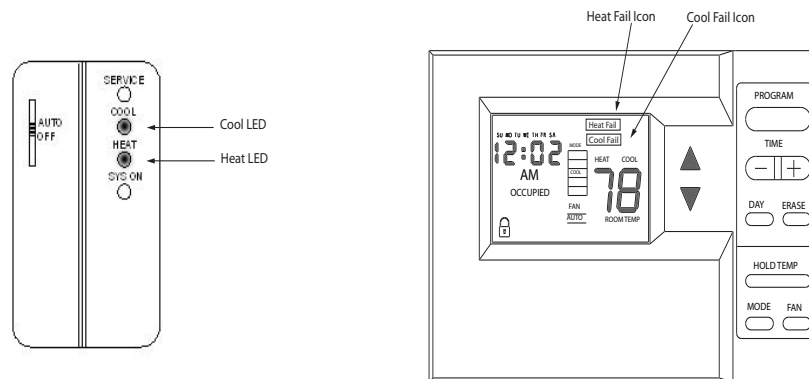
If the Compressor Disable circuit or CC1, CC2 circuits create a lockout during heating mode, a COOL FAIL (pulsing) indication will occur, not a HEAT FAIL (pulsing) indication. See COOL indications for details



## Heat Fail - Cool Fail Diagnostic

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

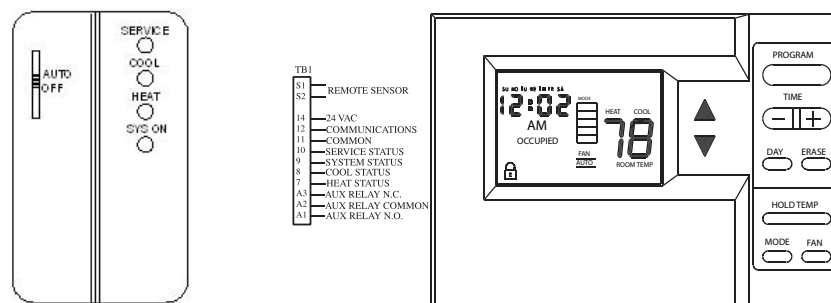
1. Coil temperature sensor is open or shorted. (Heat Pump)
2. Unit has failed to defrost properly. See Heat Pump section for further details.
3. Outdoor air sensor is open or shorted. (RTRM version 4.0 or greater.)
4. Dehumidification unit- RTOM disconnected or not communicating. RTOM will flash once every few seconds.
5. Emergency stop input is open.
6. Factory installed phase monitor is indicating a fault



**Compressor will not run, no diagnostics:**

1. Froststat trip
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 to 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)

### 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

2. 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+4F
J6-5* - Heating Set Point (HSP)	CSP-4F
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 LED will not flash during heat fail
J6-8* -Cool indication	LED will not come on while cooling 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 ZSM's

**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 "Heat fail" will not be displayed during heat fail
J6-8- Cool indication from RTRM to ZSM	"Cool" will not be displayed while cooling "Cool fail" will not be displayed during cool fail*
J6-9- System indication from RTRM to ZSM	Colon (:) will not blink during normal operation "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 "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.

## ReliaTel Refrigeration Module (RTRM)

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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 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) 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. 27.5-50 Ton VAV Units**

Input/connection (27½ to 50 ton 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). Gives cool fail diagnostic.



# ReliaTel Option Module (RTOM)

## RTOM Layout

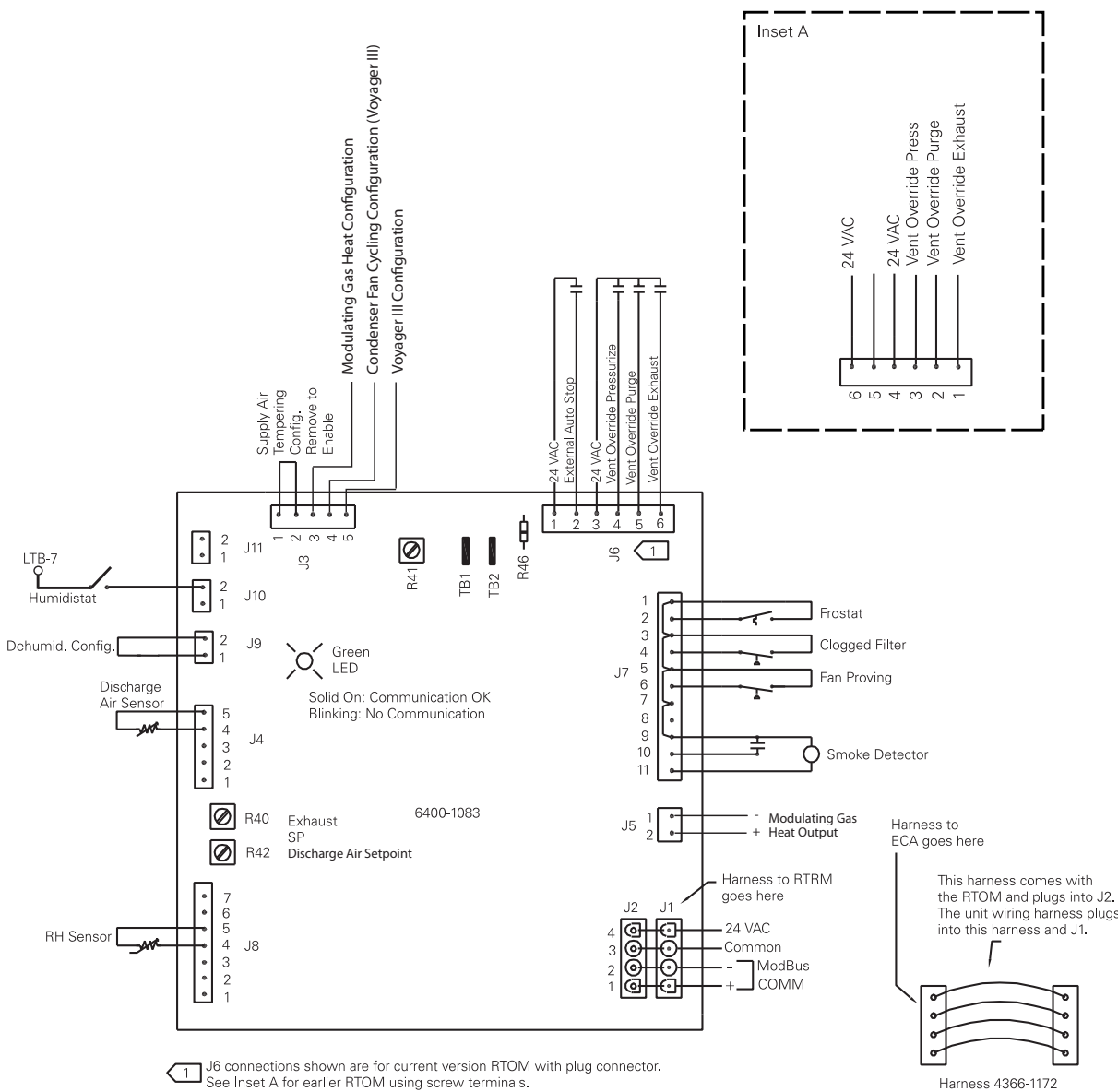
### 3 to 10 Ton

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 to 50 Ton

The RTOM is installed in the control panel.

Figure 16. 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 BAYSENS019\*/AYSTAT666\* or a Trane ICS system.
- J3-3 is modulating gas heat 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 III unit. (27.5 - 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 – 25 ton	Closes 10F ±2° Opens 50F ±2°
27.5 – 50 ton	Closes 30F ±2° Opens 40F ±2°

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 (3-25 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 (27½-50 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. *Ventilation override option will override smoke detector input through the RTOM.*

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

Discharge Air Setpoint Potentiometer

27.5 - 50 ton VAV units use this input to control compressors and modulating gas heat. All units with modulating gas heat will require this potentiometer.

### **J8 Input:**

Relative Humidity Sensor provides input to energize the reheat valve for dehumidification (3-25 ton units only).

### **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 - 25 ton units only).

# Verifying Proper Air Flow

## Units with Direct Drive Indoor Fan with MMC

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 output voltage from the MMC 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 (ECA), 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 the MMC. Using the fan rpm table shown on the access panel label 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.
    - To Increase Fan RPM; Push & Turn the knob on the MMC counter-clockwise. 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.
    - To Decrease Fan RPM; Push & Turn the knob on the MMC clockwise. 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.
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. 23](#) for a list of diagnostics]
- Continuous 1/4 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

## 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 to 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 to 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

### LED4 Green LCI status LED

- Flashing intermittently: Unit is connected to a LonTalk link.

### LED2 Red Service LED

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

### LED3 Yellow Comm RX

# 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:** 27½-50 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, Reheat Valve, 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	Heat 1	10k ohms
6*	Heat 2	15k ohms
7*	heat 3	22k ohms
8**	Defrost cycle/reheat	33k ohms
9*	Emergency heat	47k ohms

\*Optional components

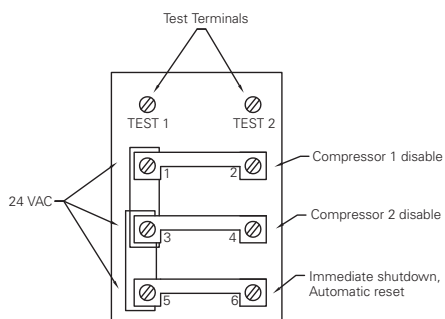
\*\*defrost cycle in test mode runs for at least 1 minute, up to 10 minutes, depending on outdoor ambient and outdoor coil temperature. Reheat step is valid only with dehumidification option and will be step 5 of the test.

### 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:** 27.5-50 ton units see test mode chart [Table 10 on page 43](#) and [Table 11 on page 43](#).

**Figure 17. 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 27.5-50 ton units as the V3 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, 5J2-6 on RTOM –

The indoor fan will run in the TEST MODE for 40 seconds and then stop if this input fails to open (3-25 ton) or close (27.5-50 ton) within 40 seconds. The diagnostic for this failure is SERVICE (pulsing 1.5 – 2.5VDC from 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 J6-6 to J6-8).

### Gas heat failures, such as TCO, PS, FR

(see wiring diagram) will not be bypassed during TEST MODE. 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 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<sub>2</sub> Option through DCV Input on ECA

Test mode will operate normally with a CO<sub>2</sub> signal. When the economizer step is initiated, the CO<sub>2</sub> signal is overridden. When the test mode goes to the next step, the CO<sub>2</sub> signal is re-established. The economizer will drive to the closed position and then proceed to drive open from the CO<sub>2</sub> 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 7. Electric/Electric Units 3-25 Ton**

Step	Mode	IDM	Econ	CPR1	CPR2	HT1	HT2	ODM1	ODM2
1	Fan On	On	Min	Off	Off	Off	Off	Off	Off
2*	Econ.	On	Open	Off	Off	Off	Off	Off	Off
3	Cool 1	On	Min	On	Off	Off	Off	On	**
4	Cool 2	On	Min	On	On	Off	Off	On	**
5*	Reheat	On	Min	On	On	Off	Off	On	**
6*	Heat 1	On	Min	Off	Off	On	Off	Off	Off
7*	Heat 2	On	Min	Off	Off	On	On	Off	Off

\* With Optional Accessory

\*\* "Off" if temperature falls below 60° (±2°)F, "On" if temperature rises above 65° (±2°)F.

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

**Table 8. Heat Pump Units 3-25 Ton**

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

\* With Optional Accessory

\*\* "Off" if temperature falls below 60° (±2°)F, "On" if temperature rises above 65° (±2°)F.

\*\*\* defrost cycle in test mode runs for at least 1 minute, up to 10 minutes, depending on outdoor ambient and outdoor coil temperature

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

**Table 9. Gas/Electric Units 3-25 Ton**

Step	Mode	IDM	Econ	CPR1	CPR2	HT1	HT2	Mod Gas*	ODM1	ODM2
1	Fan On	On	Min	Off	Off	Off	Off	Off	Off	Off
2*	Econ.	On	Open	Off	Off	Off	Off	Off	Off	Off
3	Cool 1	On	Min	On	Off	Off	Off	Off	On	**
4	Cool 2	On	Min	On	On	Off	Off	Off	On	**
5*	Reheat	On	Min	On	On	Off	Off	Off	On	**
6*	Heat 1	On	Min	Off	Off	On	Off	50%	Off	Off
7*	Heat 2	On	Min	Off	Off	On	On	100%	Off	Off

\* With Optional Accessory

\*\* "Off" if temperature falls below 60° (±2°)F, "On" if temperature rises above 65° (±2°)F.

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

Table 10. VAV Test Modes 27 1/2 - 50 Ton

TEST STEP	MODE	IGV/VFD <sup>(a)</sup>	FAN	ECON <sup>(b)</sup>	COMP 1	COMP 2	HEAT 1	HEAT 2	MOD GAS	VHR RELAY <sup>(c)</sup>	OHMS
1	IGV/VFD TEST	OPEN/100%	OFF	CLOSED	OFF	OFF	OFF	OFF	OFF	ON	2.2K
2	IGV/VFD TEST	CLOSED/OFF	OFF	CLOSED	OFF	OFF	OFF	OFF	OFF	ON	3.3K
3	MINIMUM VENTILATION	IN CONTROL <sup>(e)</sup>	ON	MINIMUM POSITION	OFF	OFF	OFF	OFF	OFF	ON	4.7K
4	ECONOMIZER	IN CONTROL	ON	OPEN	OFF	OFF	OFF	OFF	OFF	ON	6.8K
5	COOL STAGE 1	IN CONTROL	ON <sup>(e)</sup>	MINIMUM POSITION	ON <sup>(f)</sup>	OFF	OFF	OFF	OFF	ON	10K
6	COOL STAGE 2	IN CONTROL	ON <sup>(e)</sup>	MINIMUM POSITION	OFF <sup>(d)</sup>	ON <sup>(d)(f)</sup>	OFF	OFF	OFF	ON	15K
7	COOL STAGE 3	IN CONTROL	ON <sup>(e)</sup>	MINIMUM POSITION	ON <sup>(f)</sup>	ON <sup>(f)</sup>	OFF	OFF	OFF	ON	22K
8	HEAT STAGE 1	OPEN/100% <sup>(g)</sup>	ON <sup>(e)</sup>	CLOSED	OFF	OFF	ON <sup>(g)</sup>	OFF	50%	ON	33K
9	HEAT STAGE 2	OPEN/100% <sup>(g)</sup>	ON <sup>(e)</sup>	CLOSED	OFF	OFF	ON <sup>(g)</sup>	ON <sup>(g)</sup>	100%	ON	47K
10	RESET										

(a) 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 8 and 9.

(b) The exhaust fan will turn on anytime the economizer damper position is equal to or greater than the exhaust fan setpoint.

(c) 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.

(d) 27.5-35 ton units have 2 stages of mechanical cooling. Both compressors run during cool stage 2.

(e) The supply fan will not be allowed to go from an off state to an on state until the IGV are fully closed.

(f) The condenser fans will operate any time a compressor is ON providing the outdoor air temperatures are within normal operating range.

(g) 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%.

Table 11. CV Test Modes (Also VAV w/o IGV) 27 1/2 - 50 Ton

TEST STEP	MODE	FAN	ECON <sup>(a)</sup>	COMP 1	COMP 2	HEAT 1	HEAT 2	MOD GAS	OHMS
1	MINIMUM VENTILATION	ON	MINIMUM POSITION	OFF	OFF	OFF	OFF	OFF	4.7K
2	ECONOMIZER TEST OPEN	ON	OPEN	OFF	OFF	OFF	OFF	OFF	6.8K
3	COOL STAGE 1	ON	MINIMUM POSITION	ON <sup>(b)</sup>	OFF	OFF	OFF	OFF	10K
4	COOL STAGE 2	ON	MINIMUM POSITION	OFF <sup>(c)</sup>	ON <sup>(b)(c)</sup>	OFF	OFF	OFF	15K
5	COOL STAGE 3	ON	MINIMUM POSITION	ON <sup>(b)</sup>	ON <sup>(b)</sup>	OFF	OFF	OFF	22K
6	HEAT STAGE 1	ON	CLOSED	OFF	OFF	ON	OFF	50%	33K
7	HEAT STAGE 2	ON	CLOSED	OFF	OFF	ON	ON	100%	47K

(a) The exhaust fan will turn on anytime the economizer damper position is equal to or greater than the exhaust fan setpoint.

(b) The condenser fans will operate any time a compressor is ON providing the outdoor air temperatures are within normal operating range.

(c) 27.5-35 ton units have 2 stages of mechanical cooling. Both compressors run during cool stage 2.

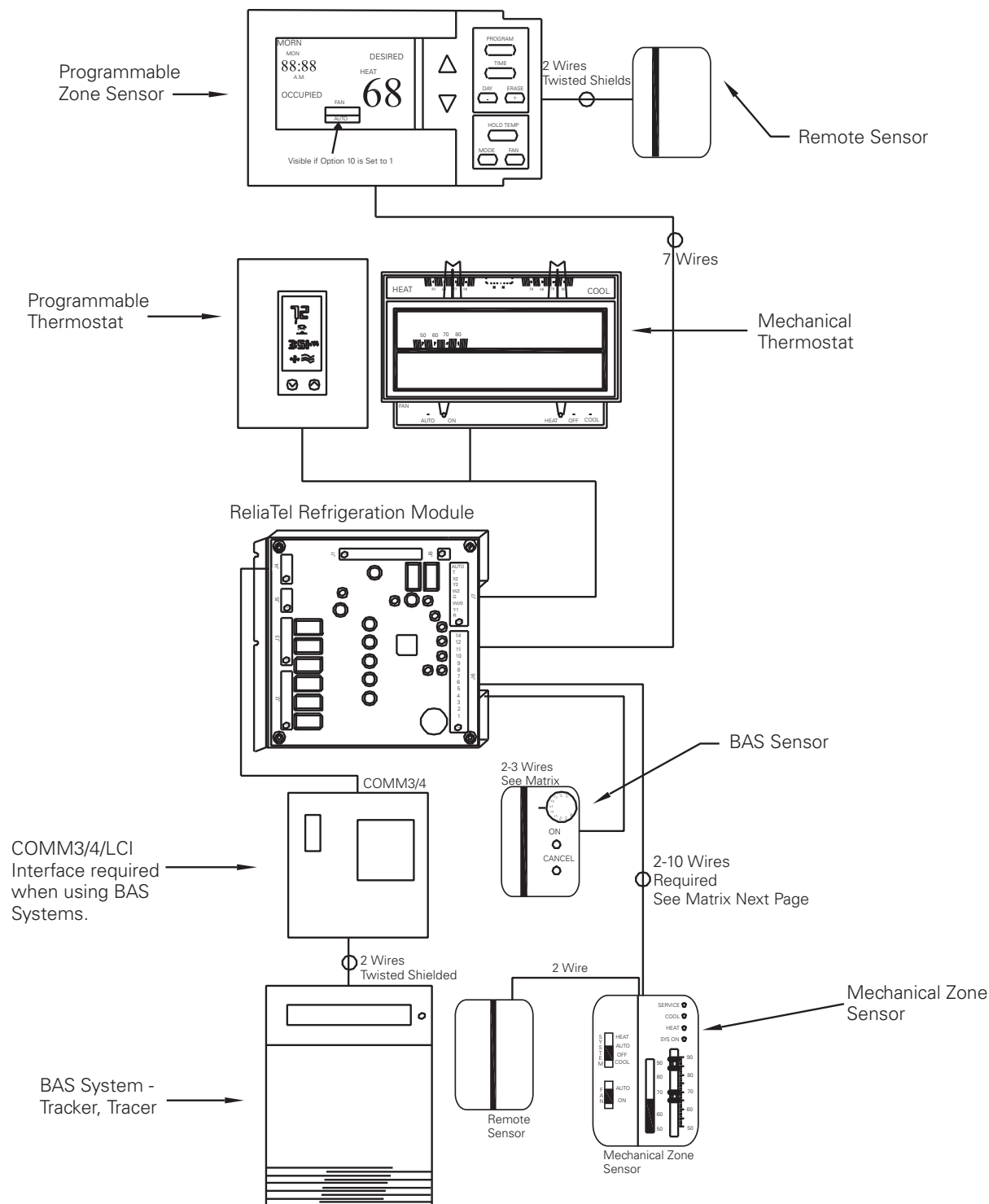
### Units with two heat exchangers (high heat models)

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%

# Thermostats and Sensors

Figure 18. Thermostat, Sensor and ICS layout



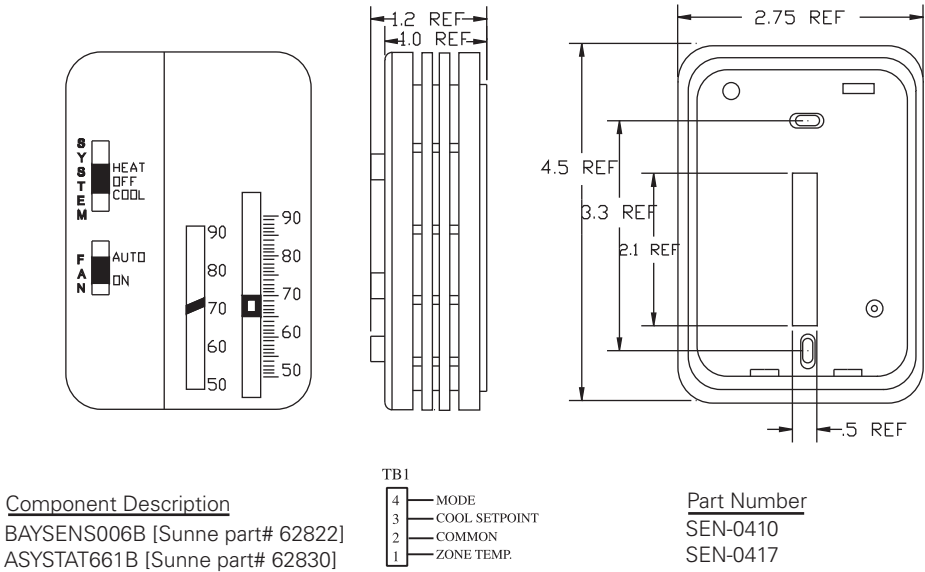
**Table 12. Thermostat and Sensor Descriptions**

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

**BAYSENS006B/ASYSTAT661B (obsolete)**

Accessory Heat / Cool Zone Sensor Module (ZSM) single set point, manual change over. Four conductors required. Manufactured by Sunne, introduced 12/93.

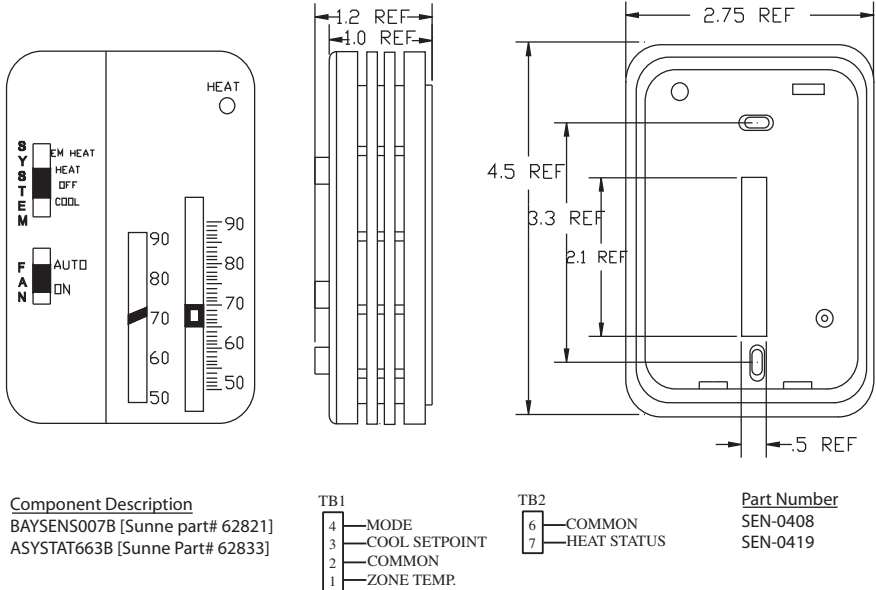
Figure 19. BAYSENS006B/ ASYSTAT661B layout



**BAYSENS007B/ASYSTAT662B (obsolete)**

Accessory Heat Pump Zone Sensor Module (ZSM), single set point, manual change over. Six conductors required. Manufactured by Sunne, introduced 12/93.

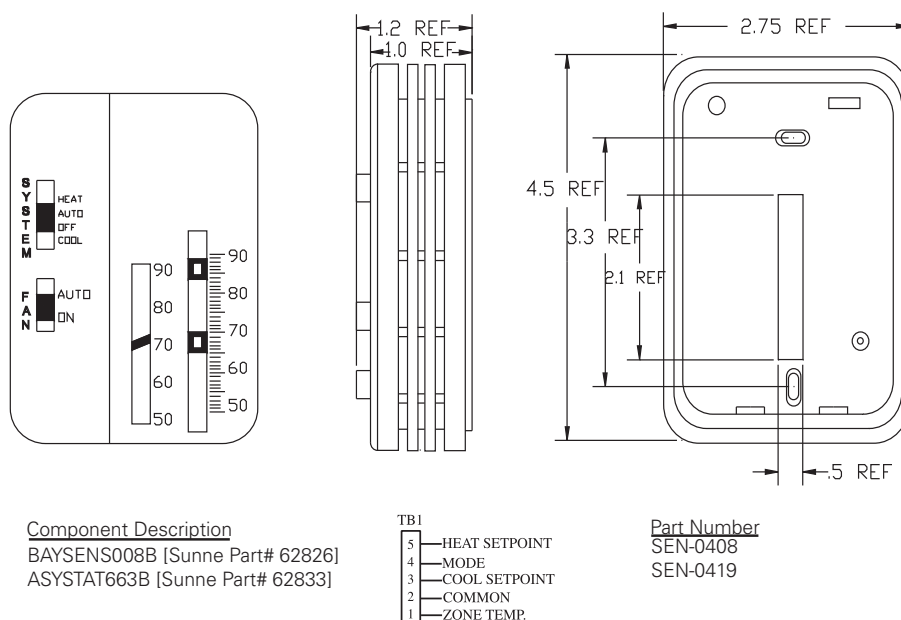
Figure 20. BAYSENS007B/ ASYSTAT662B layout



### BAYSENS008B/ASYSTAT663B (obsolete)

Accessory Heat / Cool Zone Sensor Module (ZSM), dual set point, manual / auto change over. Five conductors required. Manufactured by Sunne, introduced 12/93

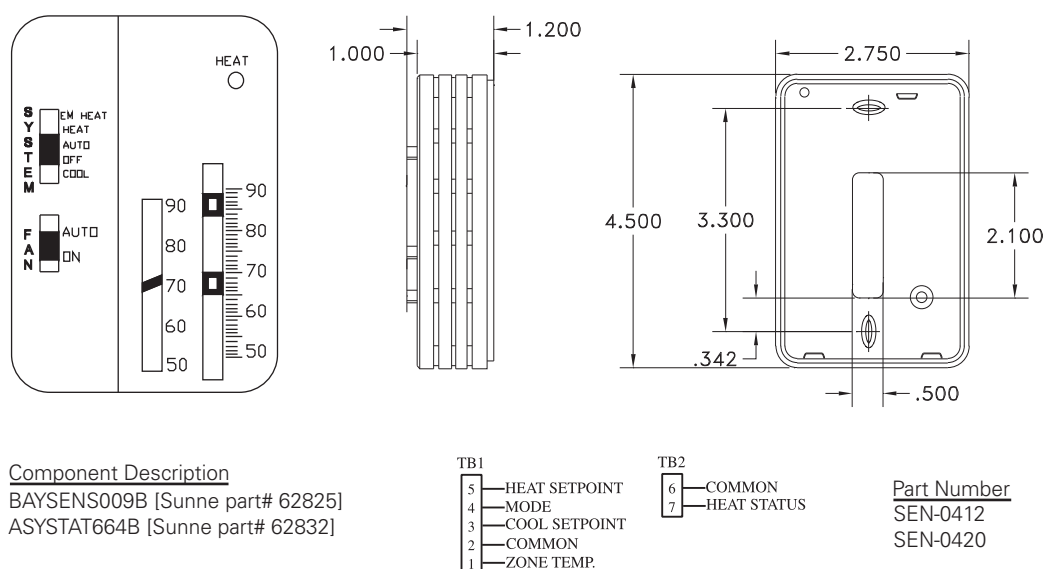
Figure 21. BAYSENS008B/ASYSTAT663B



### BAYSENS009B/ ASYSTAT664B (obsolete)

Accessory Heat Pump Zone Sensor Module (ZSM), dual set point, manual/ auto changeover. Seven conductors required. Manufactured by Sunne, introduced 12/93.

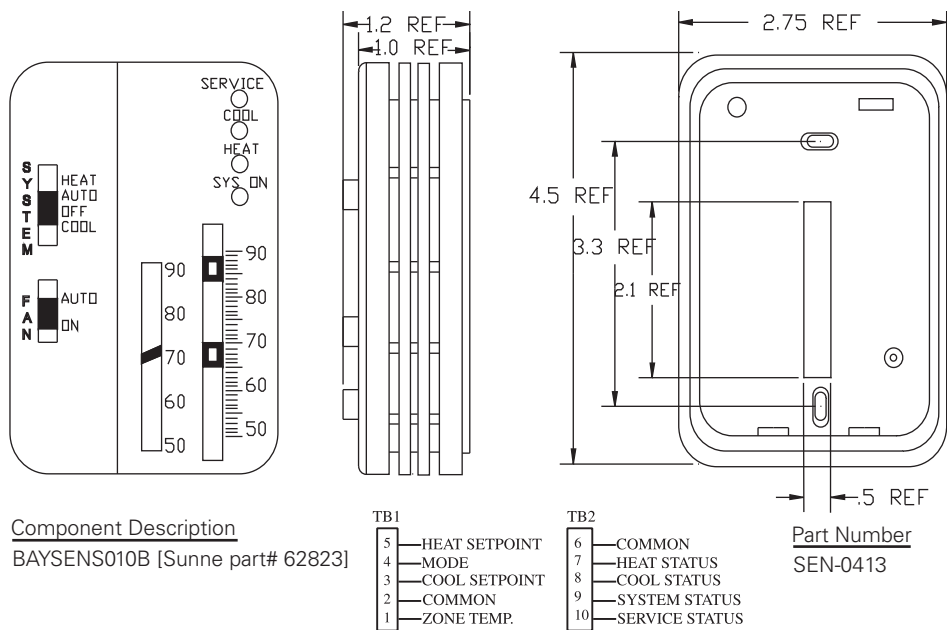
Figure 22. BAYSENS009B/ASYSTAT664B



**BAYSENS010B (obsolete)**

Accessory Heat / Cool Zone Sensor Module (ZSM), dual set point with LEDs, manual/ auto change over. Ten conductors required. Manufacture by Sunne, introduced 12/93

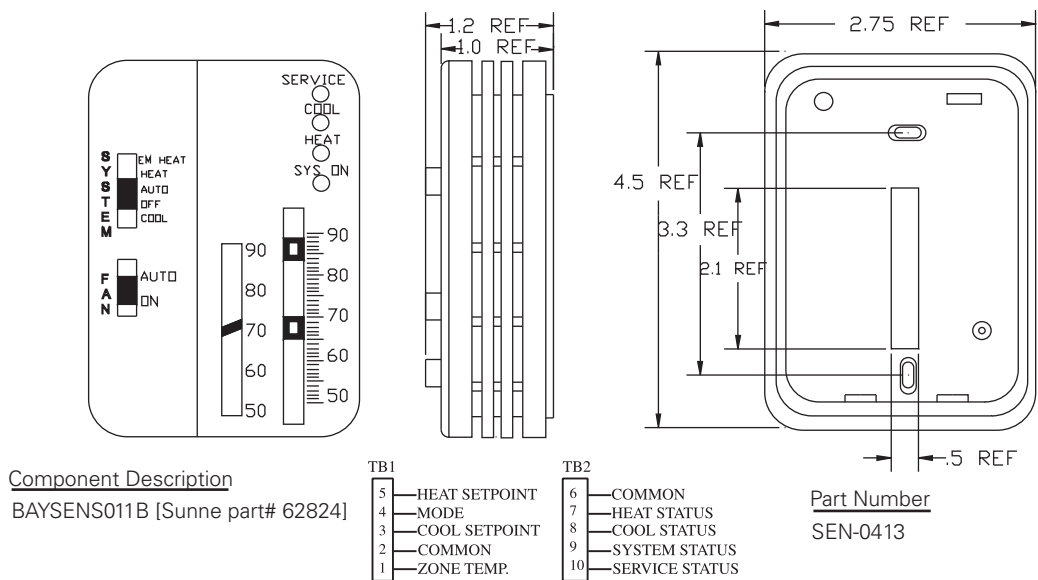
Figure 23. BAYSENS010B Layout



**BAYSENS011B (obsolete)**

Accessory Heat Pump Zone Sensor Module (ZSM), dual set point with LEDs, manual/ auto changeover. Ten conductors required. Manufactured by Sunne, introduced 12/93.

Figure 24. BAYSENS011B Layout

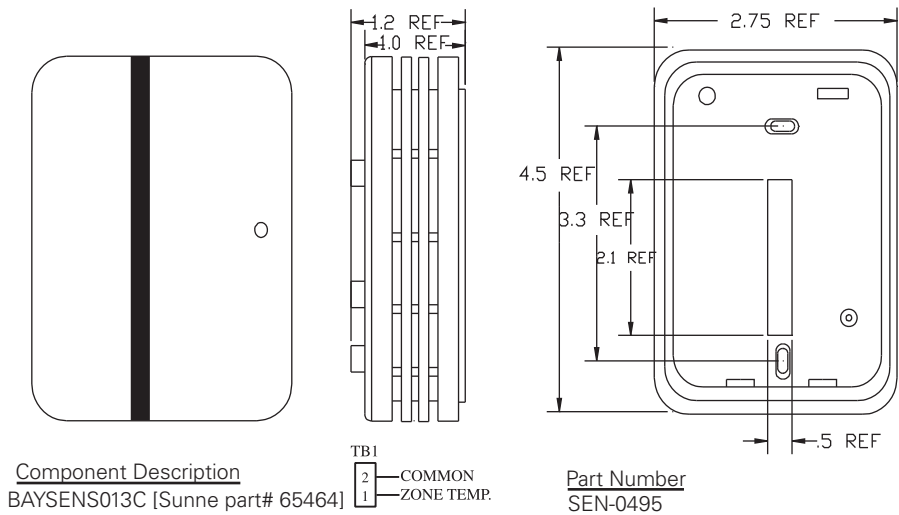




**BAYSENS013C (obsolete)**

Accessory ICS (Tracer/Tracker/ComforTrac) Zone Sensor Module (ZSM), with override button, and override cancel button. Two conductors required. Manufactured by Sunne, introduced 08/95.

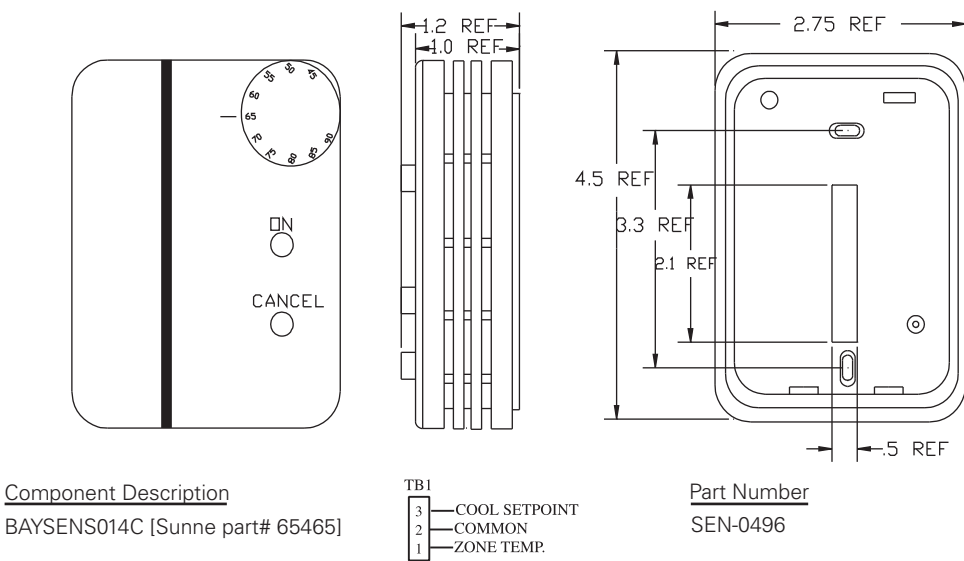
Figure 25. BAYSENS013C Layout



**BAYSENS014C (obsolete)**

Accessory ICS (Tracer/Tracker/ComforTrac) Zone Sensor Module (ZSM), with override button, set point, and override cancel button. Three conductors required. Manufactured by Sunne, introduced 08/ 95

Figure 26. BAYSENS014C Layout



**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.

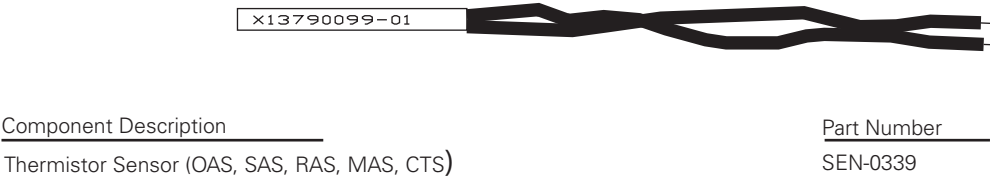
**Return Air Sensor:** Field or factory installed accessory. Located on the return air damper of the economizer, used with comparative enthalpy control only.

**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.

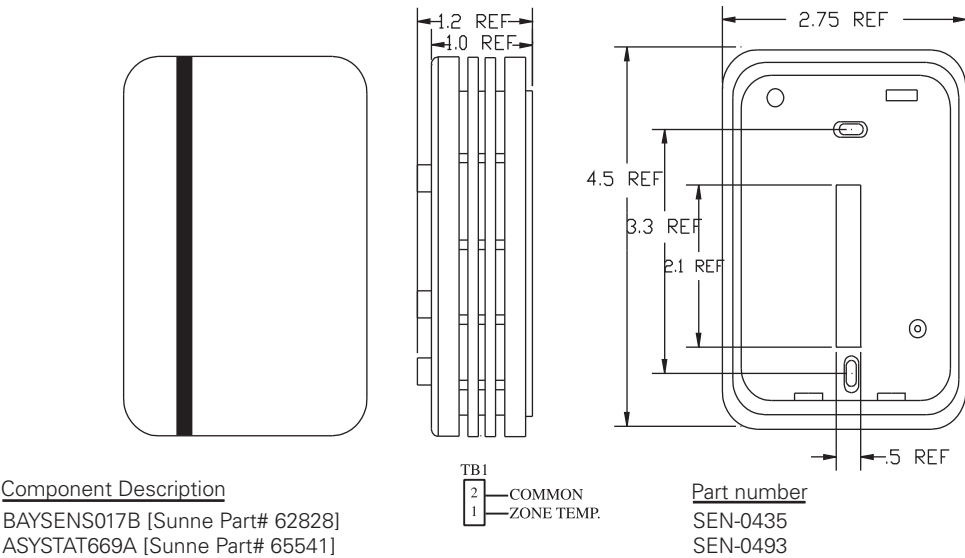
Figure 27. Thermistor Sensor



**BAYSENS017B/ASYSTAT669A (obsolete)**

Accessory Zone Sensor Remote. Two conductors required. Manufactured by Sunne, introduced 12/93.

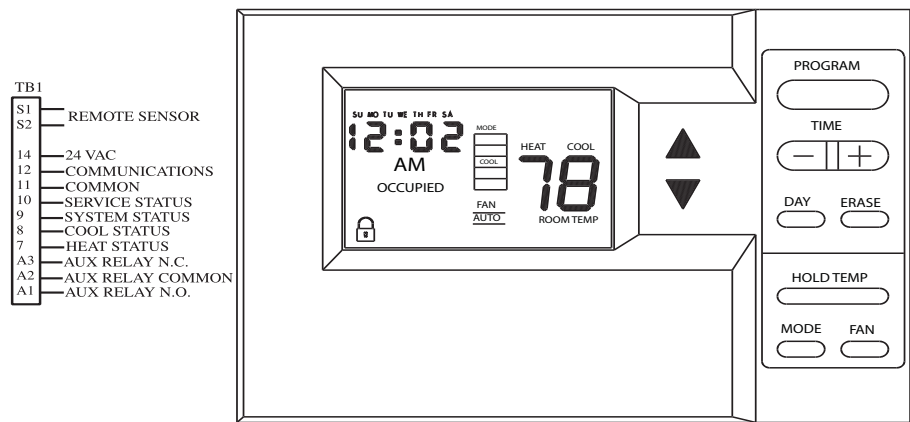
Figure 28. BAYSENS017B/ ASYSTAT669A Layout



**BAYSENS019\*/ASYSTAT666\* (CV 3-50 Ton)**

Accessory Heat/Cool, programmable night set back Zone Sensor Module (ZSM), with LCD status / diagnostic indicators. Seven conductors: terminals 11, 12 & 14 required, 7 through 10 optional. Manufactured by Caradon, introduced 06/98.

Figure 29. Programmable night set back Sensor Module (ZSM)



Component Description

BAYSENS019\* [Caradon part# 91k91]  
ASYSTAT666\* [Caradon part# 91k92]

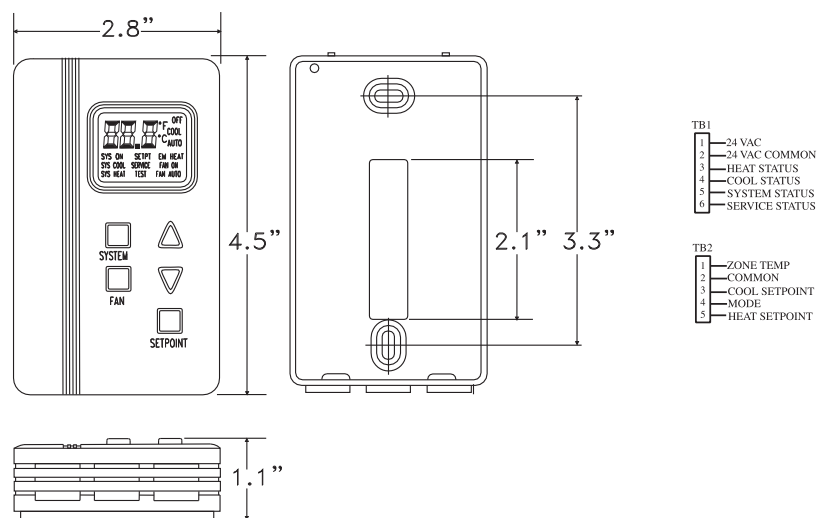
Part Number

SEN-0874  
SEN-0907

**BAYSENS031A/ ASYSTAT707A**

Accessory Digital Heat Pump Zone Sensor Module (ZSM), Dual Set Point, Manual/Auto Changeover. Ten conductors required. Manufactured by Sunne, introduced 5/03.

Figure 30. BAYSENS031A/ASYSTAT707A Layout



Component Description

BAYSENS031A [Sunne part# SD155-002]  
ASYSTAT707A [Sunne part# SD155-005]

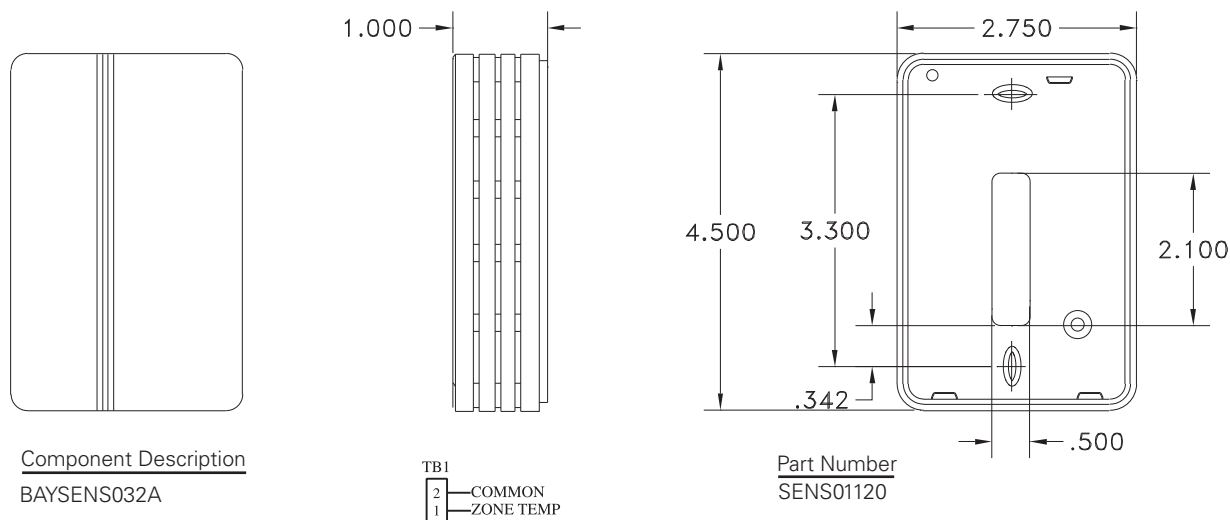
Part Number

SEN01078  
SEN01235

**BAYSENS0032A (CV 3-50 Ton) (obsolete)**

Accessory Averaging, Remote Zone Sensor, Dual Thermistors, Two conductors required.

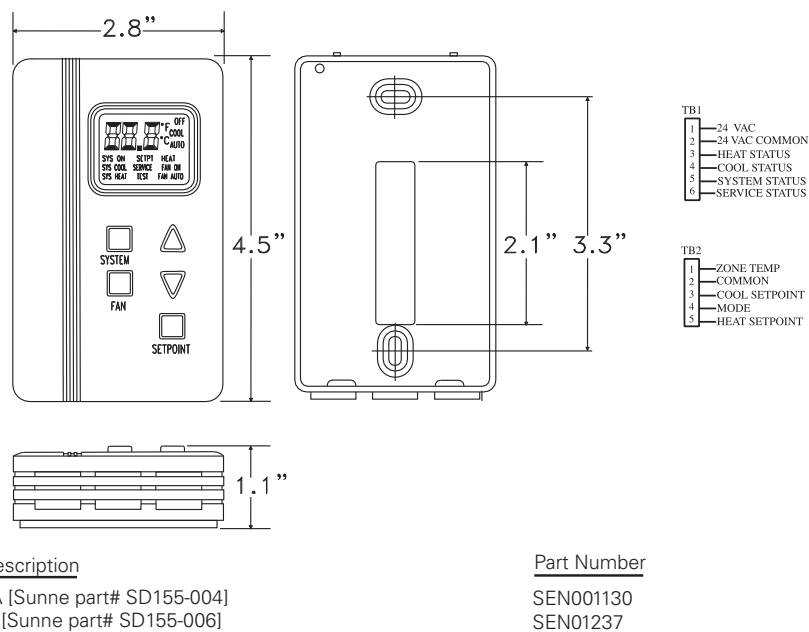
**Figure 31. BAYSENS0032A Layout**



**BAYSENS035A/AYSTAT709A**

Accessory Digital Heat/Cool Zone Sensor Module (ZSM), Dual SetPoint, Manual/Auto Changeover. Ten conductors required.

**Figure 32. BAYSENS035A/AYSTAT709A Layout**



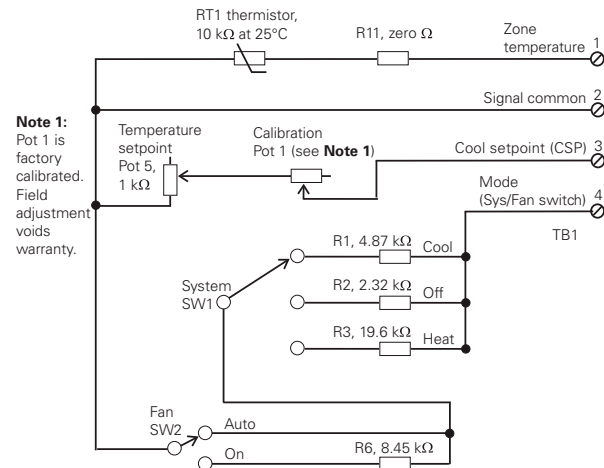
### BAYSENS106\*/ASYSTAT106\*

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

Figure 33. BAYSENS106A/ASYSTAT106A



Part Number – SEN01515



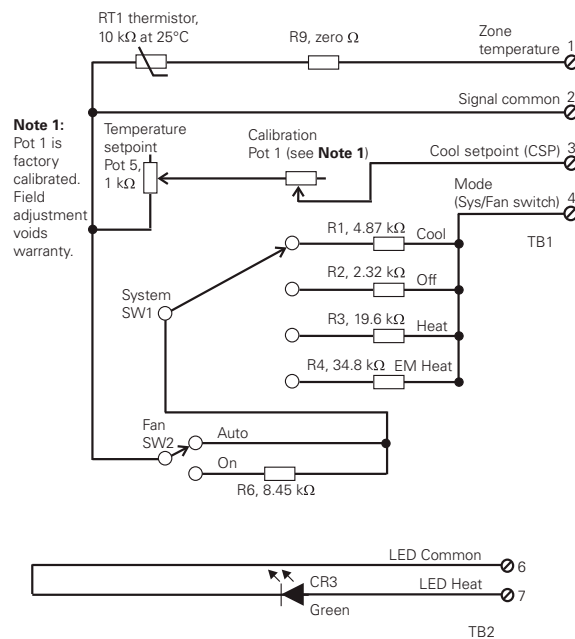
### BAYSENS107A/ASYSTAT107A

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

Figure 34. BAYSENS107A/ASYSTAT107A



Part Number – SEN01528



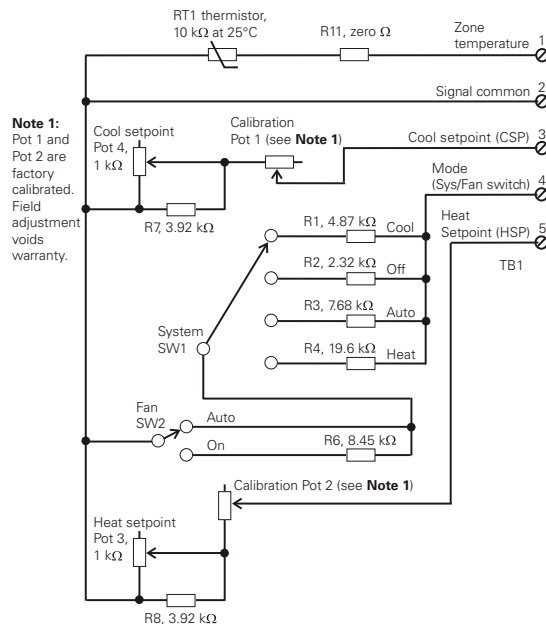
### BAYSENS108A/ASYSTAT108A

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

Figure 35. BAYSENS108A/ASYSTAT108A



Part Number – SEN01513



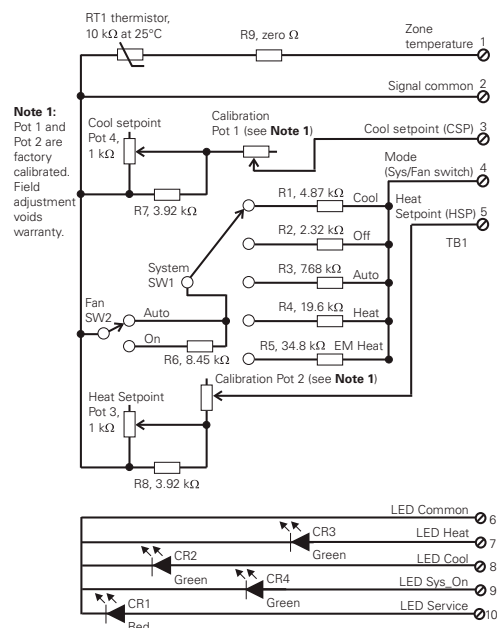
### BAYSENS109A/ASYSTAT109A

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

Figure 36. BAYSENS109A/ASYSTAT109A



Part Number – SEN01523



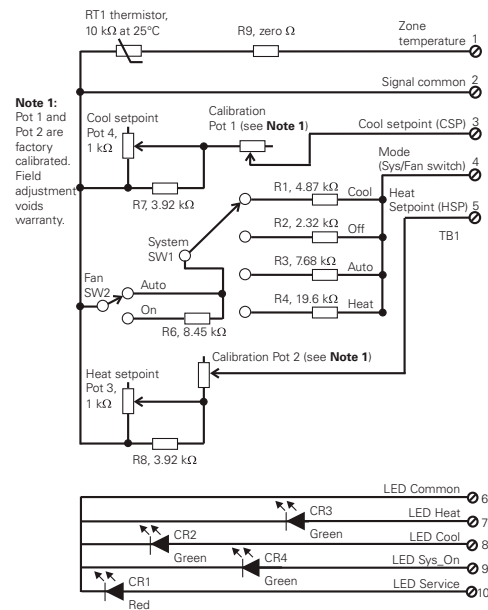
## BAYSENS110A/ASYSTAT111A

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

**Figure 37. BAYSENS110A/ASYSTAT111A**



Part Number – SEN01522



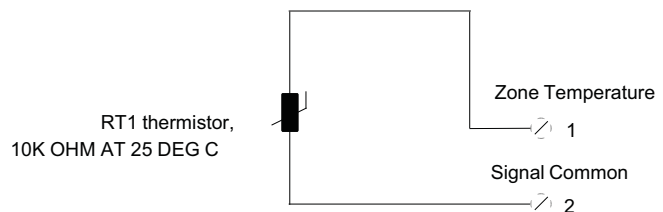
## BAYSENS077A

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

**Figure 38. BAYSENS077A**



Part Number – SEN01448



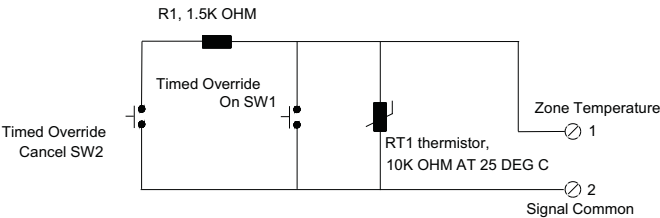
**BAYSENS073A**

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

**Figure 39. BAYSENS073A**



Part Number – SEN01450



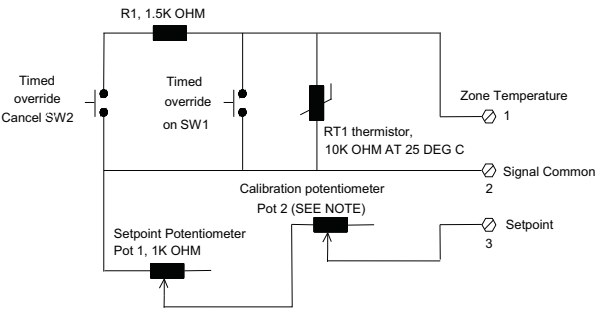
**BAYSENS074A**

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

**Figure 40. BAYSENS074A**



Part Number – SEN01447





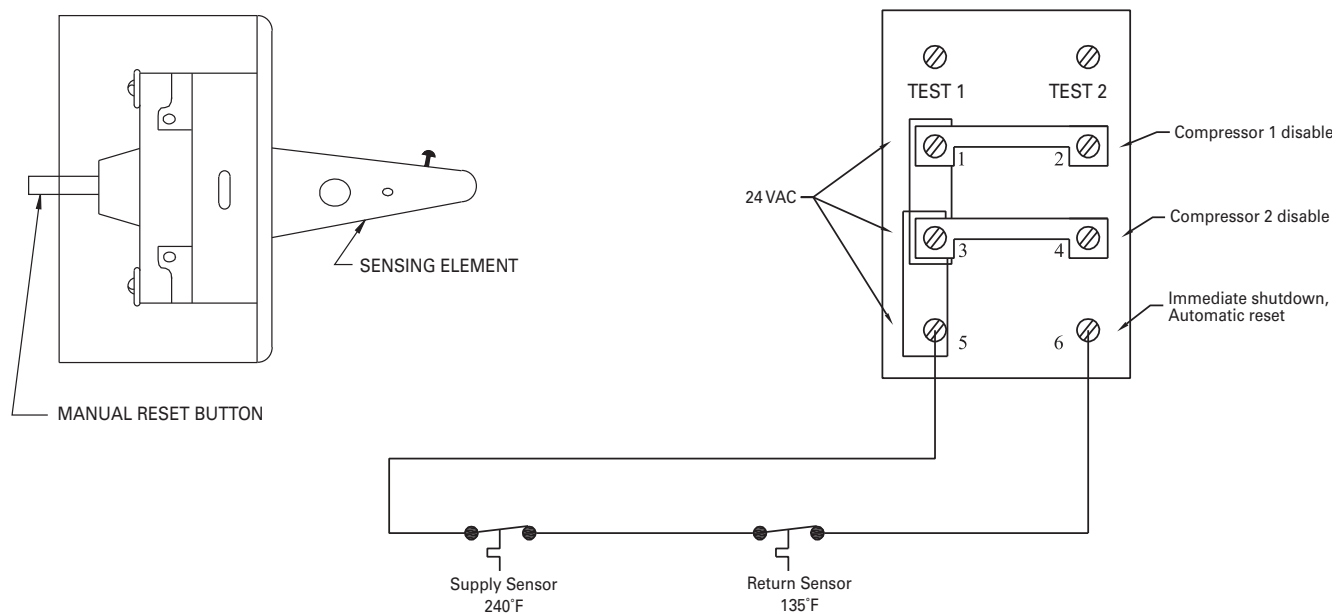
# High Temperature sensor Diagram

## High Temperature Sensor

The high temperature sensor accessory (BAYFRST001A) 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 41. High Temperature Sensor Diagram



### Component Description

BAYFRST001A

### Part Number

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 to 50 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.

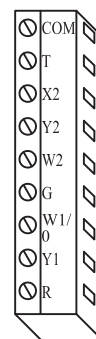
In addition, non-Trane Building Controllers typically provide an interface to HVAC equipment based on a conventional thermostat interface. Units applied with this type of controller need to accept conventional thermostat inputs.

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. 61](#) for a flow chart outlining operation with a conventional thermostat.



## Operation with a Conventional Thermostat (Constant Volume)

**Table 13. Thermostat signals**

R	24VAC power to thermostat
Y1	Call for compressor 1 or first stage cooling
Y2	Call for compressor 2 or 2 <sup>nd</sup> stage cooling
G	Call for supply fan
W1	Call for heat 1 (for modulating gas, see <a href="#">Figure 42, p. 61</a> )
W2	Call for heat 2
<b>Heat pump only:</b>	
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 14. 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 #1 compressor runs while economizing
W1 (gas / electric heat first stage)	1 <sup>st</sup> stage heat
W2 (gas / electric heat 2nd stage)	2 <sup>nd</sup> stage heat (if available)

**Table 15. Conventional thermostat – Heat Pump**

Input/connection	Function when energized
<b>Cooling mode:</b>	
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 (2 <sup>nd</sup> stage cool)	Compressor #2 also runs, or #1 compressor runs while economizing.
<b>Heating mode:</b>	
G (fan)	Fan runs continuously except during unoccupied mode (see below)
Y1 (both compressors 1st stage heat)	Both compressors run
Y2 (during heating – nothing happens)	No change
W2 (electric heat 2nd stage)	2nd stage (electric) heat
X2 (electric heat only)	Electric heat only – no compressors

**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 16. 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 follows:

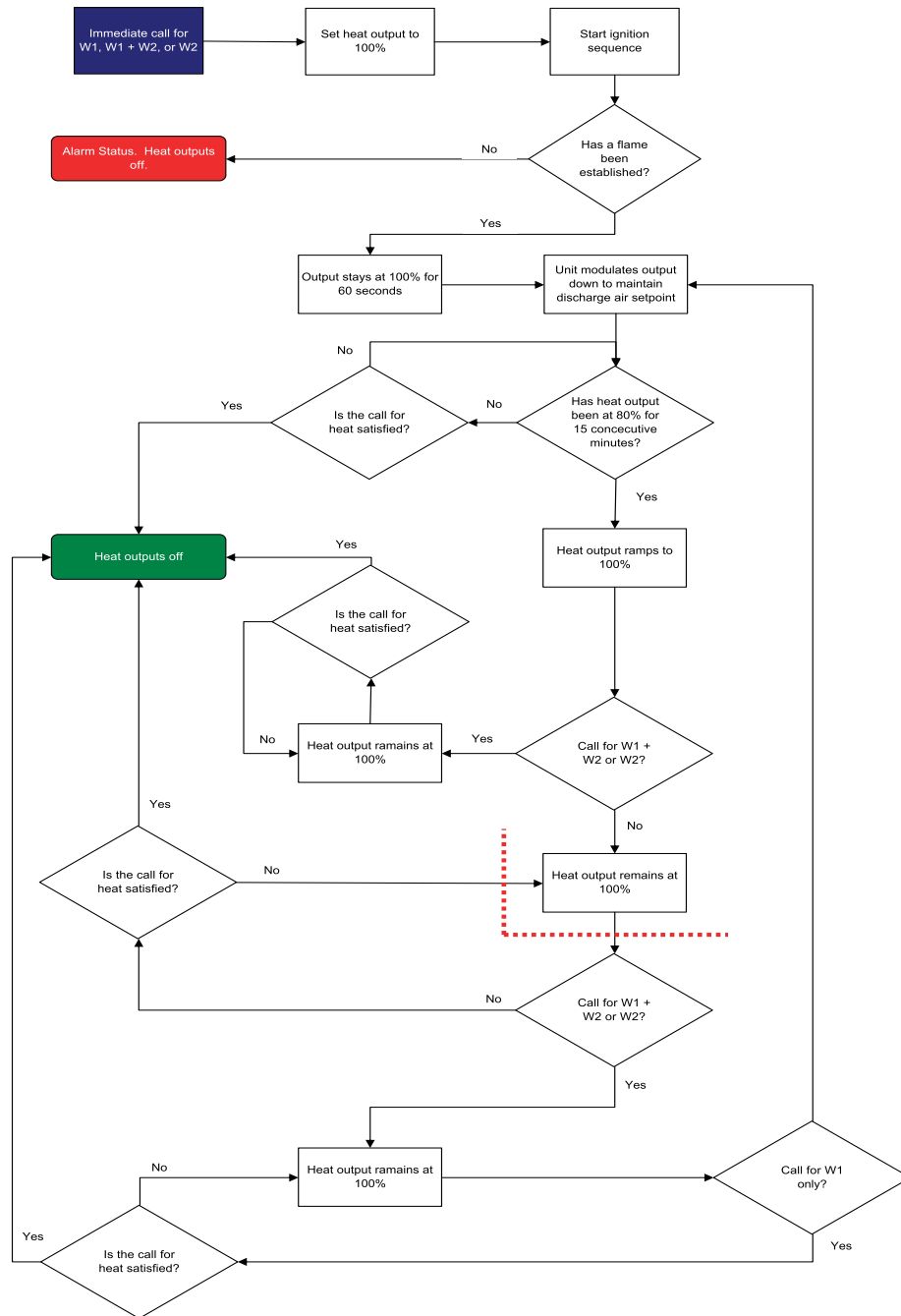
Y1 = 1st stage

Y1 + Y2 = 3rd stage

VAV

Thermostat inputs are ignored on VAV units.

**Figure 42. Modulating Gas Heat Control Process**  
Thermostat Control



# Zone Sensor Module Testing

## BAYSENS006-11, 14, 17/AYSTAT661-664

### 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

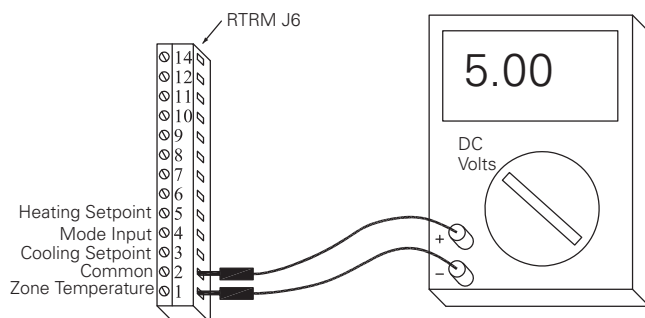
### Problems to look for:

- Miswire/short/open
- Excessive resistance in circuit (corroded or loose connection)
- Sensor inaccurate (should be  $\pm 2^\circ\text{F}$  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 43. ZSM Testing/voltmeter display**

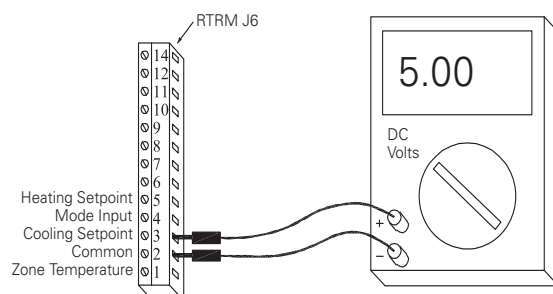


**Table 17. Temperature Input**

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

## Mechanical Zone Sensor Module BAYSENS006-11, 14, 17, 031A, 135A, ASYSTAT661-664

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 18. BAYSENS006-11, 14, 17, 031A, 035A, AYSTAT661-664**

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:

- Miswire/short/open
- Excessive resistance in circuit (corroded or loose connection)
- Setpoint lever inaccurate (should be  $\pm 2^\circ\text{F}$  of chart)
- Induced voltage (high voltage wires in same conduit)

**Table 19. Setpoint Inputs**

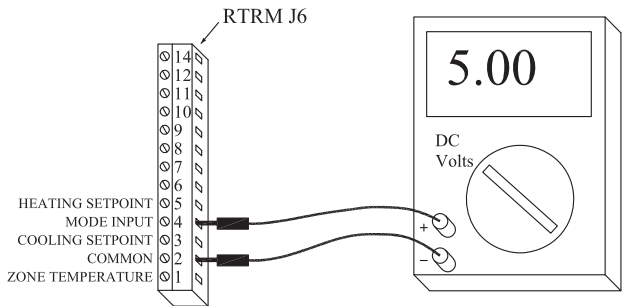
Temp °F	Resistance (K ohms)	DC Volts	Temp °F	Resistance (K ohms)	DC Volts	Temp °F	Resistance (K ohms)	DC Volts	Temp °F	Resistance (K ohms)	DC Volts
	open	5.00 (open circuit)	53	0.8373	2.278	67	0.5584	1.792	81	0.2858	1.111
40	1.0841	2.601	54	0.8166	2.247	68	0.5390	1.751	82	0.2663	1.051
41	1.0656	2.579	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			

# Zone Sensor Module Testing

## Mode Input

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



### Problems to look for:

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

Table 20.

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



### BAYSENS019B,C/AYSTAT666B,C- Programmable Zone Sensor

The BAYSENS019B, C 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 3-25 tons
- Voyager UCP 27.5-50 tons CV
- Precedent ReliaTel 3-10 tons
- Voyager ReliaTel 12.5-25 tons
- Voyager ReliaTel 27.5-50 tons CV
- IntelliPak Rooftop 20-130 tons CV
- Odyssey ReliaTel 7.5-20 tons

For programming information, refer to literature ACC-SVN28A-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. Steps 2 through 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.

## Zone Sensor Module Testing

**Table 21. 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) 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 — RTRM J2-3, J2-4

**Note:** These are RTRM, RTOM inputs only. Economizer inputs (MAS, RAS, OHS, RHS, CO<sub>2</sub>) 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:

- Miswire / 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 22. 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

## RTRM/RTOM (Temperature Inputs)

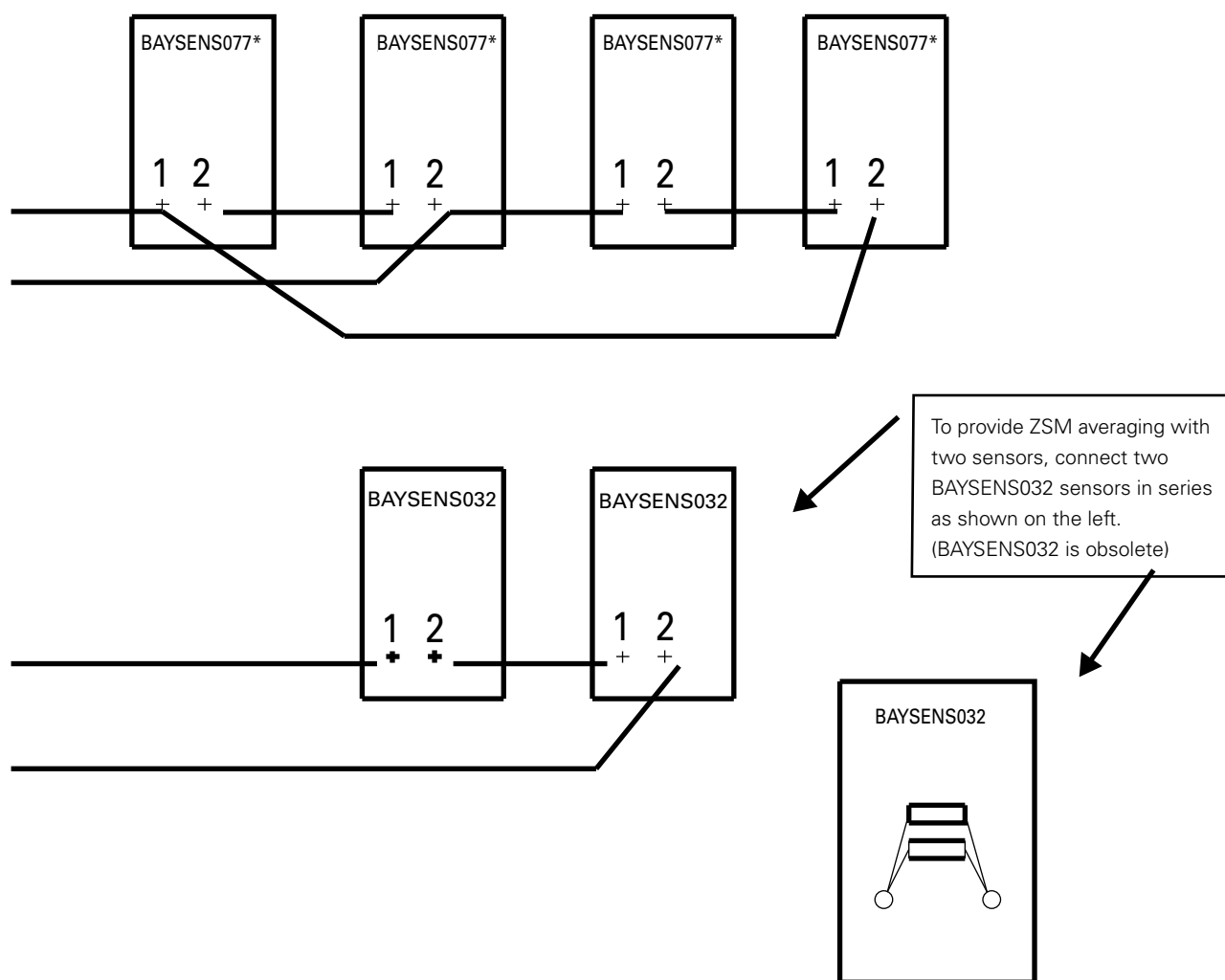
Table 22. Temperature Input (continued)

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
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
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 BAYSENS106A-BAYSENS111A/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 44. 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.

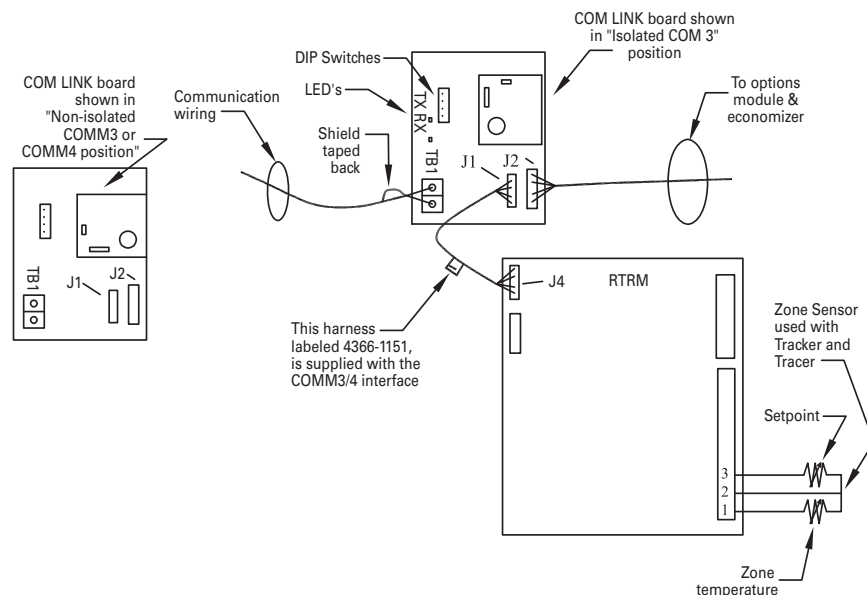
## LED's:

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 45. Troubleshooting Outline**



### Won't communicate with Tracker 3-25 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:**

#### **3-25 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.

#### **27½-50 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. There is no diagnostic output when this occurs.
- 27.5-50 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, 3-10 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 23. 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 24. 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 3-10 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 3-10 tons units only)
Seven blinks	W1& W2 swapped (electromechanical 3-10 tons units). ReliaTel module will communicate a heat fail diagnostic back to the RTRM.



# Direct Spark Ignition Control (Sequence of Operation, 3-10 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 (TCO 1) 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 (TCO 1 & TCO 2) for closed contacts, the pressure switch (PS) for open contacts, flame rollout (FR) for closed contacts.

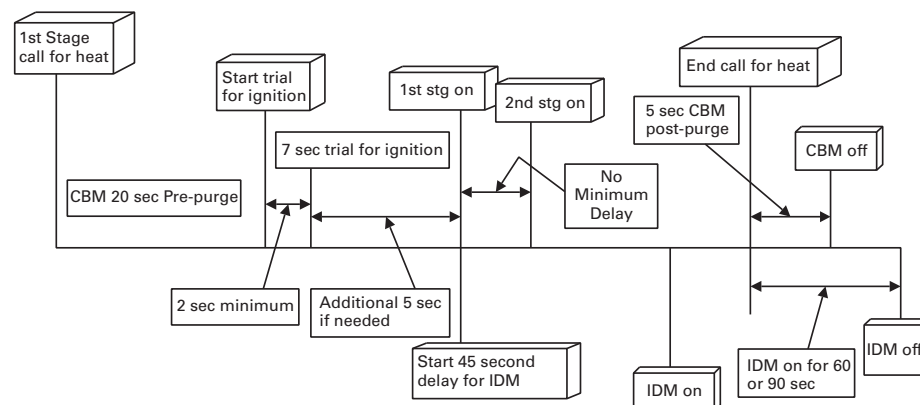
IGN energizes inducer blower on high speed. When PS closes, 20 second (15 seconds on high, 5 seconds on low) pre-purge begins. After 20 seconds, the IGN energizes the spark and gas valve at the same time. The spark will stay energized for at least 2 seconds attempting to establish flame. If a flame is 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 2<sup>nd</sup> 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 46. Direct Spark Ignition Control Sequence of Operation**



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

This microprocessor base, 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. 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 25. 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 26. 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 30 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:

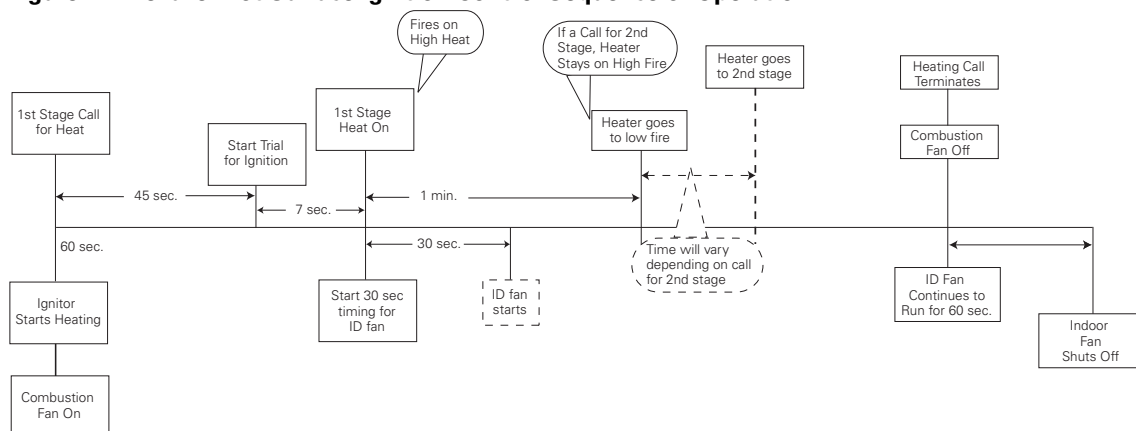
4. Opening for 3 seconds and closing the main power disconnect switch,
5. By switching the "Mode" switch on the zone sensor to "OFF" and then to the desired position, or
6. Allowing the ignition control module to reset automatically after one hour.

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

**Figure 47. ReliaTel Hot Surface Ignition Control Sequence of Operation**



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

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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 27. 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 3-10 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 35°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.

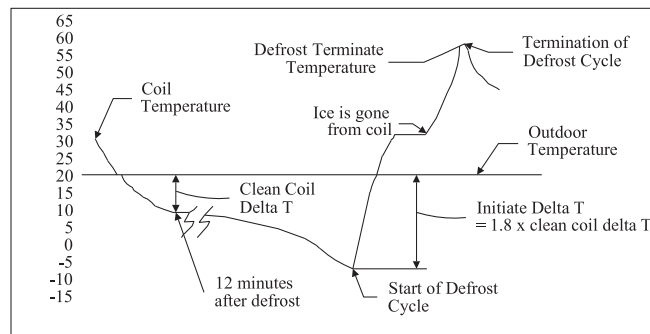
Over time, as moisture and frost accumulate on the coil, the coil temperature will drop, increasing the temperature difference. When the temperature difference reaches double the dry coil temperature differential (delta T), a defrost cycle is initiated. While defrosting, the reversing valve is in the 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
- Outdoor ambient <52°F
- Outdoor coil <33

**Figure 48. 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.

## 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 or Low-Pressure Cutout event, 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 doubled to become the new Initiate Value. Figure 38 presents a graphical representation of a typical demand defrost cycle.

## Heat Pump Demand Defrost

### 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 52F, coil temperature must be below 33F, 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 initiates a defrost 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 turns the outdoor fan motor (ODM) 'Off' by energizing the (K8) relay, which energizes the (ODF) relay. 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) +27F. The defrost termination temperature (DTT) will typically be between 37F and 52F.

### 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.

### Diagnostic Information

Demand Defrost also tracks failures and operating problems as follows.

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 sensor (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 compressor heating operation.

**Table 28. 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 <sub>T</sub> is below Minimum Value 12 minutes after defrost is terminated	Low D <sub>T</sub>	If > 2 hours, activate Defrost Fault Reset timer if D <sub>T</sub> 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 <sub>Δ</sub> is above Maximum Value 12 minutes after defrost is terminated	High D <sub>T</sub>	Initiate Defrost After 16 consecutive High D <sub>T</sub> Initiations activate Defrost Fault.
D <sub>Δ</sub> does not change by 2 degrees in an hour's time starting 12 minutes after defrost is terminated and D <sub>T</sub> is less than or equal to 4 degrees 12 minutes after defrost is terminated	Unchanging D <sub>T</sub>	Initiate Defrost and activate Defrost Activate Defrost Fault

Defrost Termination Temperature (DTT) = Outdoor Air Temperature (OAT) + 47°F

57°F ≤ DDT ≤ 72°F

DT = Outdoor Air Temperature (OAT) – Outdoor Coil Temperature (OCT)

Defrost Initiate Temperature = 1.8 \* (DT) 12 Minutes After Defrost Mode is terminated)

# ReliaTel Economizer Module Layout

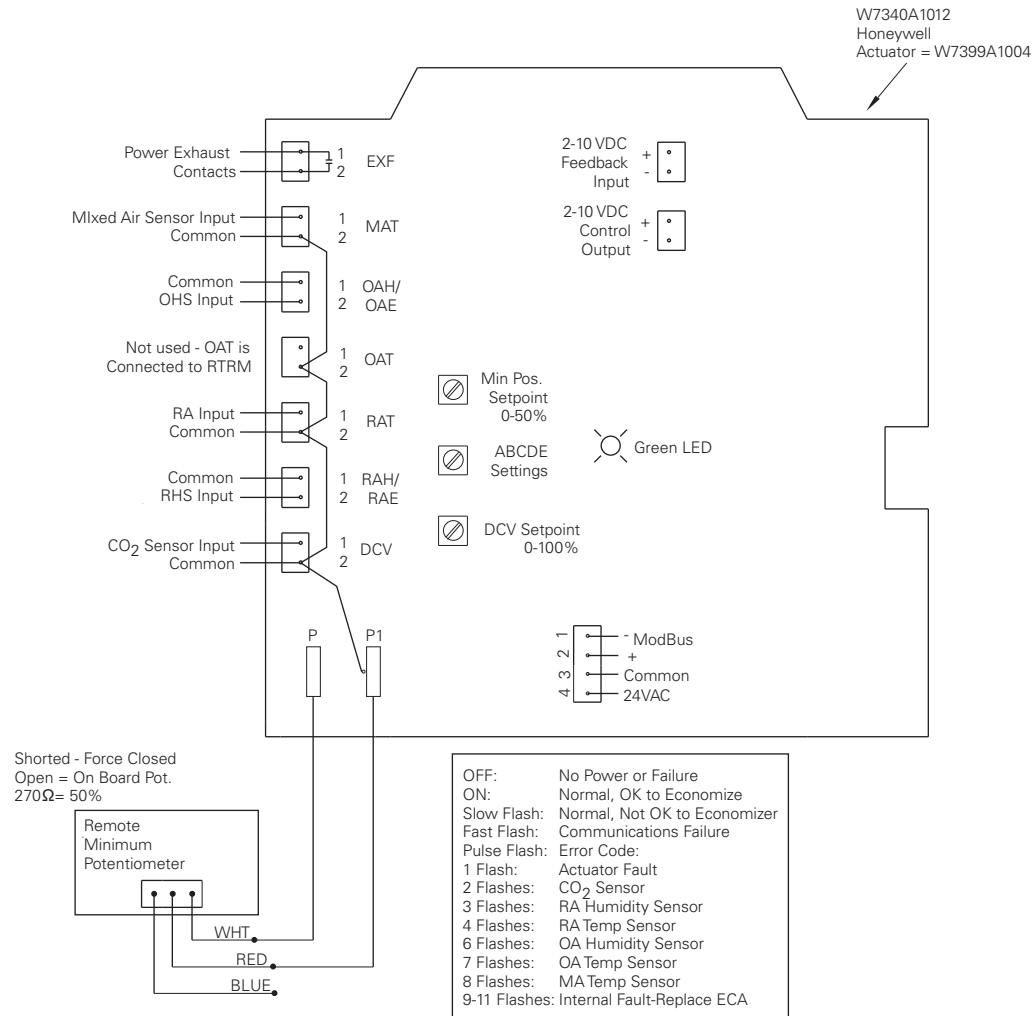
The economizer module plugs directly onto the actuator. It has a diagnostic LED, which under normal operation is either ON (OK to economize) or FLASHING (Not OK to economize). It communicates via MODBUS with the RTRM, and receives outside air temperature input from the RTRM. Mixed air sensor (MAS), return 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<sub>2</sub> 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<sub>2</sub>. 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 50, p. 80](#).

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

**Figure 49. ReliaTel Economizer Module Layout**



# ReliaTel Economizer Actuator Layout

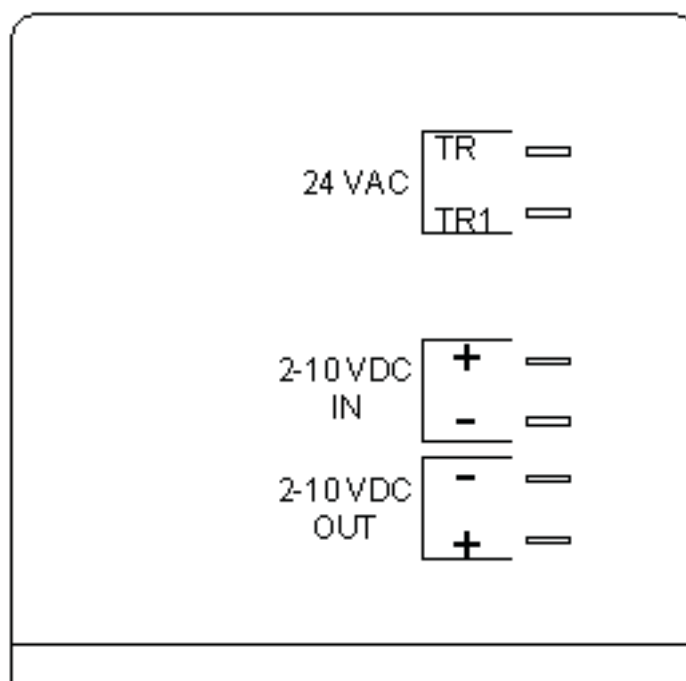
Remove the screw in the center of the actuator module. Remove the actuator module (this will not be used). Then, remove the wiring from the module.

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 50. 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 ( $\pm 3^\circ\text{F}$ ) 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 cooling, 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 is (ESP) is derived from the Cooling and Heating setpoints (CSP and HSP) so that ESP is the higher of 1)  $CSP - 1.5^{\circ}F$  or 2)  $HSP + 1.5^{\circ}F$ .

When enabled, the economizer will modulate between minimum position and 100% to maintain a mixed air temperature of  $53 \pm 3^{\circ}F$ . If the mixed air temperature starts to fall below  $53^{\circ}F$ , the economizer starts closing; and at  $50^{\circ}F$ , the damper will be at minimum position.

If the economizer is not able to satisfy the cooling setpoint, 1<sup>st</sup> stage cooling will be energized. Should the cooling setpoint not be satisfied with 1<sup>st</sup> stage cooling, 2<sup>nd</sup> stage cooling will be energized. Most often, the economizer and 1<sup>st</sup> stage cooling will be adequate to satisfy the load. 1<sup>st</sup> stage cooling will not start until the economizer has been full open for five minutes 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  $53 \pm 3^{\circ}F$  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 1<sup>st</sup> stage cooling will be the economizer. The damper will modulate between minimum position and 100% to maintain mixed air temperature at  $53 \pm 3^{\circ}$ . At  $50^{\circ}F$  the damper will be at minimum position. If the economizer is enabled, a Y2 call for 2<sup>nd</sup> stage cooling will start the first compressor only if the economizer damper is at 100% open continuously for 5 minutes.

If the economizer is disabled, 1<sup>st</sup> stage (Y1) will be the first compressor. If the unit has two compressors, a call for 2<sup>nd</sup> 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.

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.

### 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 note

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 55°F 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:** *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%

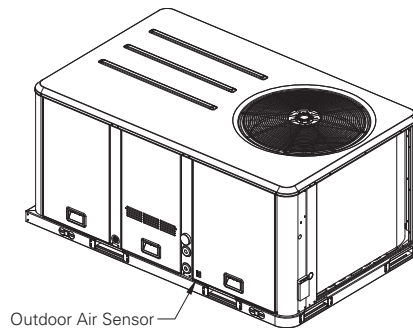
### **The following inputs are used:**

#### **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 3 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.

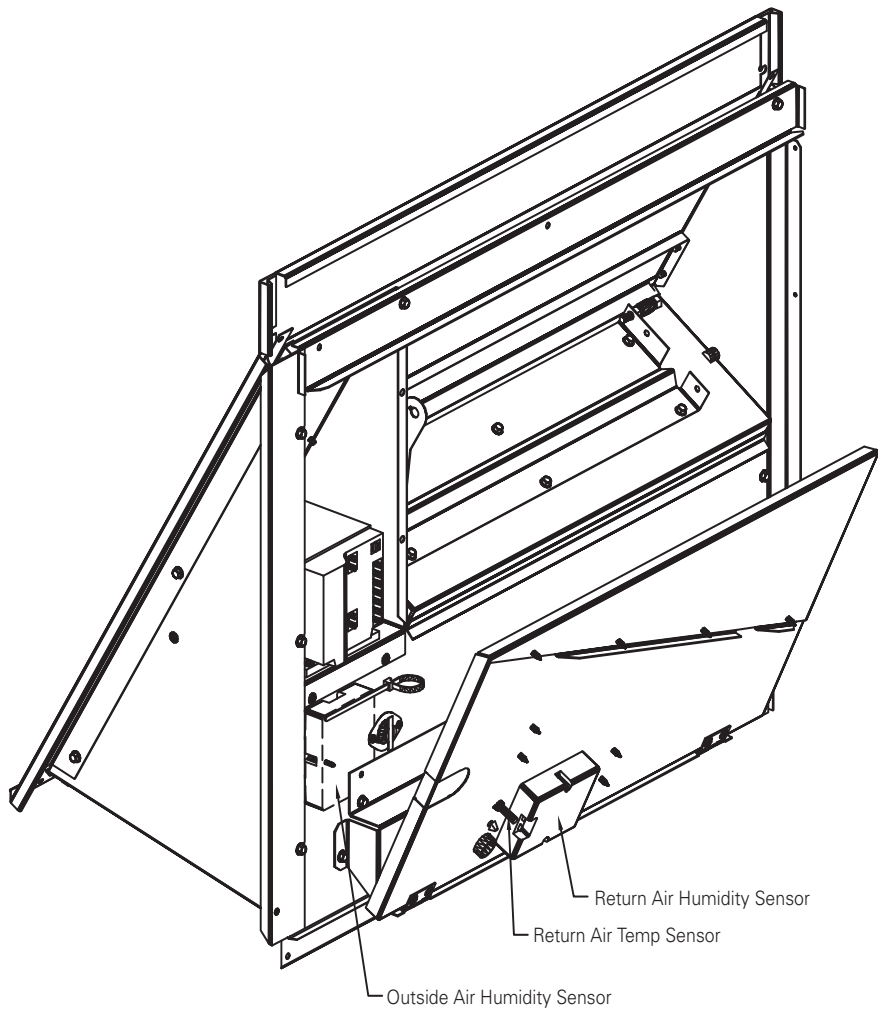
The RAT is plugged into the ECA. Return Humidity Sensor (RHS) measures the relative humidity of the return air. It is located on the return air damper of the economizer. The RHS is plugged into the ECA.

# Economizer Damper Enthalpy Layout

**Table 29. 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 51. 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	55°F	19 BTU/lb

\*factory setting

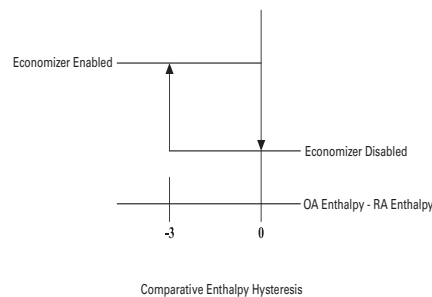
## Comparative Enthalpy Method

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.

## Reference Enthalpy Method

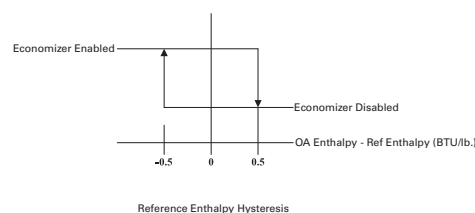
Figure 52. Comparative Enthalpy Enable



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 53. Reference Enthalpy Enable

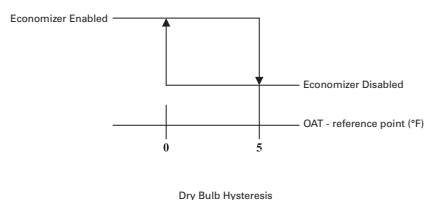


### Reference Dry Bulb Method

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 54. Dry Bulb Enthalpy Enable**



### Internal Calculations

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

$$\text{Enthalpy} = 0.24 \times \text{O.A.Temp(deg. F)} + h(\text{R.H.,OAT})$$

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

$$H = 0.24 \times T + W \times H_v$$

Where

T= dry bulb temperature, deg. F

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

$$W = 0.622 \times P / (14.696 - P)$$

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

$$H_v = 1062.1 + 0.43 \times T$$

Also,

P= partial pressure of water at T, psia

$$P = (0.421 - 0.01503 \times T + 0.000202 \times T^2) \times RH$$

# ReliaTel Economizer Operation & Inputs

## ReliaTel Economizer Inputs

Terminals to read voltage:

Mixed Air Sensor      ECA      MAT  
                                    Module

Return Air Sensor      ECA      RAT  
                                    Module

**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 30. 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 (starting on 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 31. 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

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.

## Sensor faults

A sensor fault will occur if a sensor fails during normal operation. However, when power is freshly applied to the unit, there is a 3 minutes boot-up period in which the ECA recognizes 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 the 3 minute "configuration" time has passed, and one of those sensors are 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<sub>2</sub> 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 ECA Module.

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<sub>2</sub> 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

Modbus Communication voltage when measured at ECA — P7-1 and P7-2 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 (BAYENTH005A) and comparative (BAYENTH006A) enthalpy control. Operates from 10-90% RH, 32°F – 90°F.

Figure 55. 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 (BAYENTH006A) 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 ECA module should be approximately 15 or 20VDC (depending on the ECA version). If so, and all connections are intact, replace the sensor. If 15VDC (or 20 VDC) is not present, yet the ECA green LED is on, the ECA module has failed.

### ECA Module Voltages

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

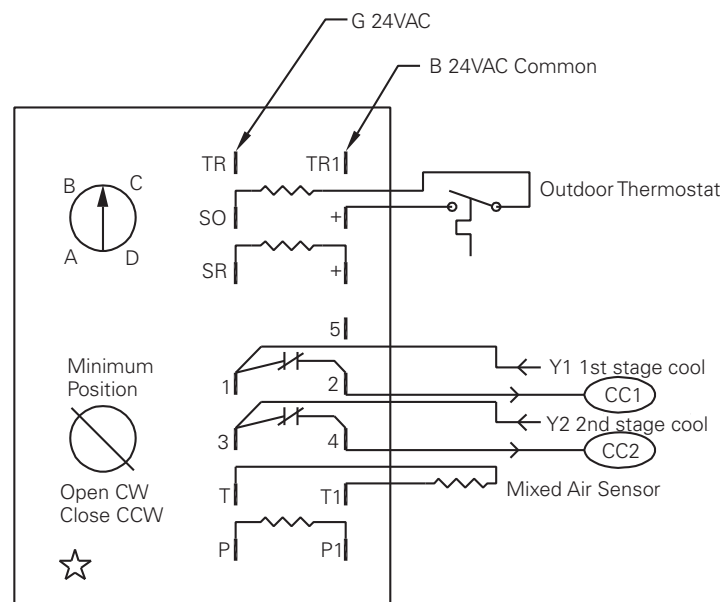
W7340B1002 (Production part since 8/1/2005) - 15.0 VDC

**Table 32.**

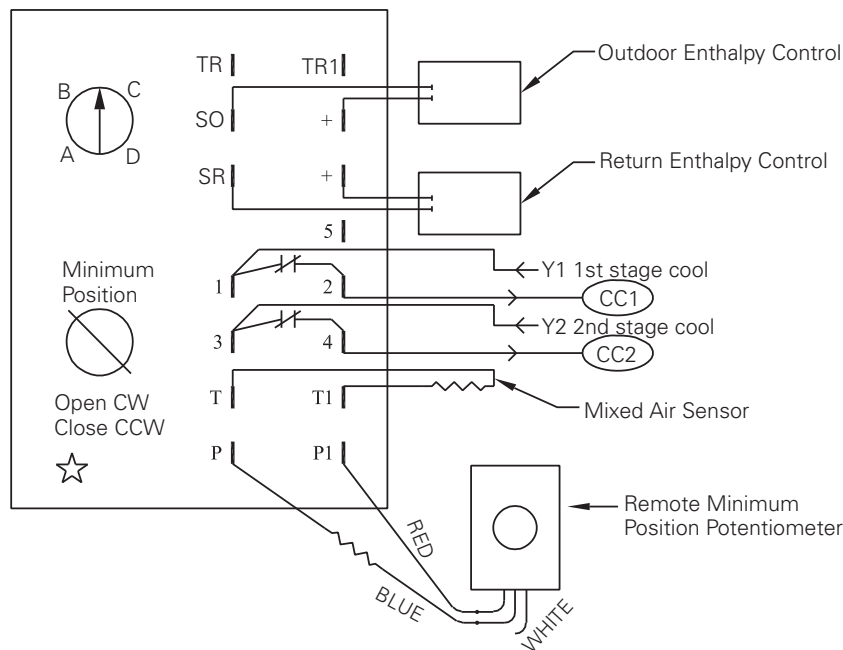
RH%	DCma	RH%	DCma	RH%	DCma
100%	20.000	52.6	12.414	31.2	9.000
97.7	19.636	51.7	12.273	30.8	8.926
95.5	19.286	50.8	12.135	30.3	8.852
93.4	18.947	50.0	12.000	29.9	8.780
91.4	18.621	49.2	11.868	29.4	8.710
89.4	18.305	48.4	11.739	29.0	8.640
87.5	18.000	47.6	11.613	28.6	8.571
85.7	17.705	46.8	11.489	28.1	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		

# Electromechanical Economizer Functions

**Figure 56. Economizer Actuator (ECA) connected to the unit**



**Figure 57. 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 33. 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)

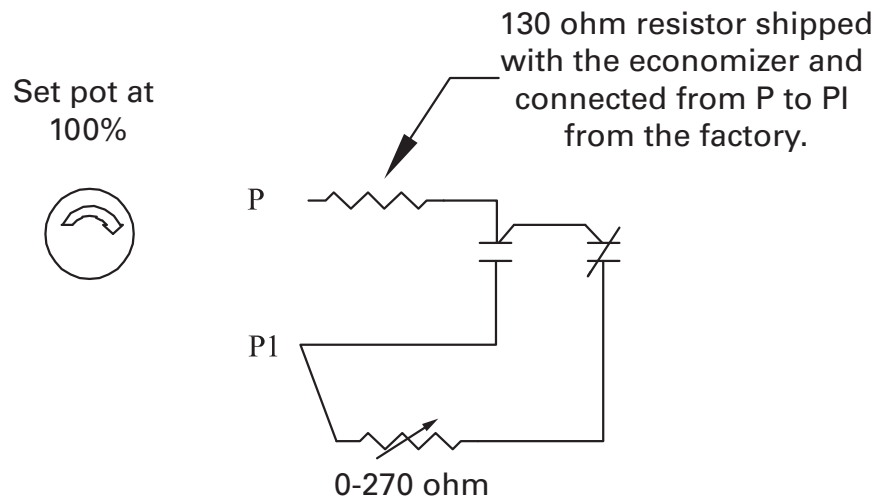
Full open economizer minimum position is accomplished by setting the ECA 50% minimum position potentiometer to 100% and installing a set of contacts in series with the existing 130 ohm resistor to terminals P and P1 on the ECA.

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 58. Electromechanical Economizer**

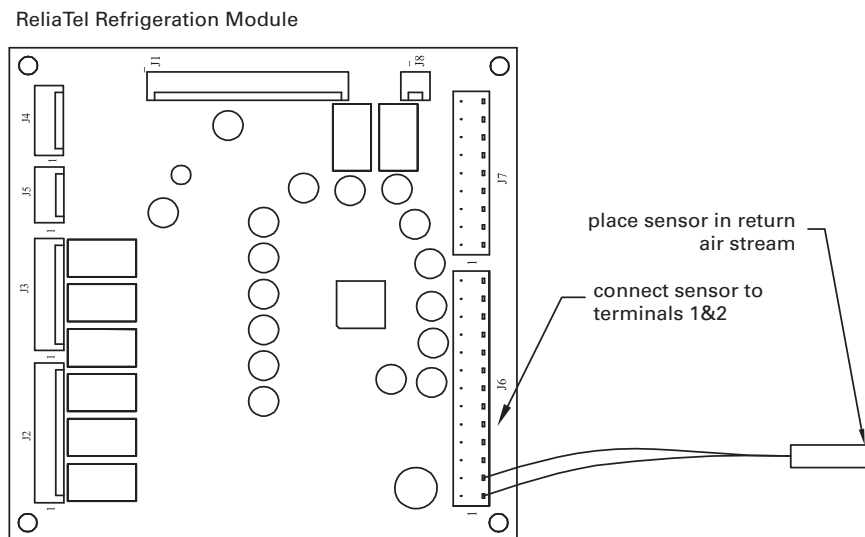


# ReliaTel Control Temporary Operation 3-25 tons

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 59. 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:** 27½-50 ton units - the outdoor air sensor should not be used for this purpose.



# ReliaTel Supply Air Tempering Control (CV units only)

Supply air tempering maintains the supply air temperature above a lower limit during minimum ventilation periods when in heat mode. Supply air tempering is available when using a BAYSENS019\*/AYSTAT666\* Programmable Zone Sensor, BAYSENS006-11/AYSTAT661-664 Mechanical Zone Sensor, or Trane ICS system. It is only active in the Heating mode.

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 (CV only)

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: Supply air tempering is not available. The RTOM J3-1 and J3-2 jumper is ignored.

## Sequence of Operation

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 1-2°F, Supply Air Tempering will cease until another normal heating cycle resumes.

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

# 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 3-25 tons units). The discharge sensor will be located in the discharge opening of the unit

## 3-25 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.*

## 27.5-50 Tons 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<sub>2</sub> 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<sub>2</sub>) sensors, which monitor the concentration of CO<sub>2</sub> 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<sub>2</sub>-Based, Demand-Controlled Ventilation.

The CO<sub>2</sub> DCV function is only available for units with economizers; the 50% motorized damper option will not operate with a CO<sub>2</sub> system. 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<sub>2</sub> option does not require an RTOM (3-25 tons) board.

The CO<sub>2</sub> 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<sub>2</sub> level increases, the voltage output increases accordingly.

**Table 34. CO<sub>2</sub> levels and associated voltage outputs.**

CO <sub>2</sub> 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

The DCV setpoint potentiometer located on the ReliaTel economizer module should be adjusted to the desired indoor CO<sub>2</sub> upper limit. The adjustment range is 0% to 100%, where:

- 0%= 500 ppm
- 50%= 1000ppm
- 100%= 1500pm

## Operation

When the indoor CO<sub>2</sub> level rises above the DCV setpoint (upper limit), a PID control loop modulates the position of the outdoor-air damper to bring in more outdoor air to maintain indoor CO<sub>2</sub> 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<sub>2</sub> level drops back below this limit, the outdoor-air damper is allowed to return to its minimum position.

The deadband for the CO<sub>2</sub> input is 40 PPM.

**Note:** When using CO<sub>2</sub>-based demand controlled ventilation with the ReliaTel controller, the minimum OA damper position should set to be less than the code required design ventilation rate for the system. See HVAC Knowledge Center case #4144 for guidance on determining the indoor CO<sub>2</sub> setpoint and minimum OA damper position for a given application.

## CO<sub>2</sub> Sensor Connections (ReliaTel units with Demand Controlled Ventilation)

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 tons units).

### CV Unit Note

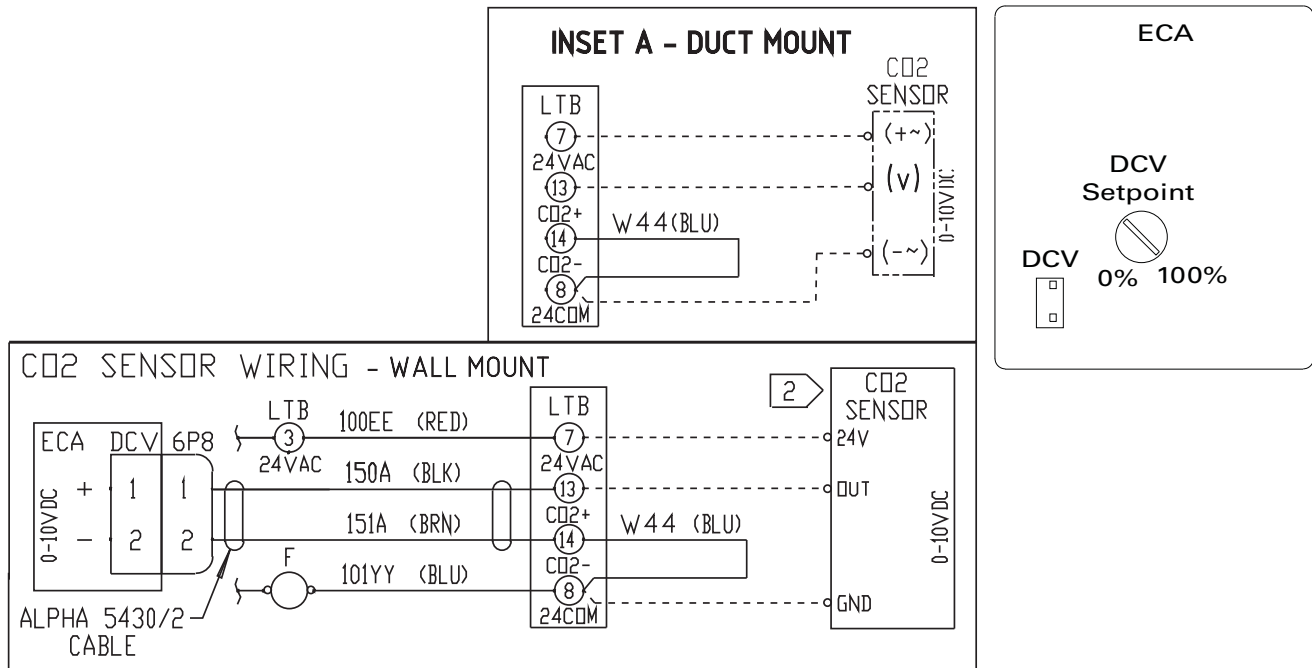
During normal unit operation, if the unit is not actually heating or cooling, and the fan switch is set to auto, the supply fan will be off. However, if the DCV setpoint is exceeded during this condition, the supply fan will be forced on and the outdoor air damper will open as needed. Once the DCV setpoint is satisfied, the unit will resume normal operation.

During unoccupied mode, the DCV setpoint is ignored.

### Voyager 27.5 - 50 tons VAV Notes

- During morning warm-up (MWU), the DCV setpoint is ignored for the first 60 minutes.
- During unoccupied mode, the DCV setpoint is ignored.
- During occupied cooling or daytime warm-up (DWU) mode, DCV control is allowed.

Figure 60. Wiring Connections using CO<sub>2</sub> Accessory



# 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.

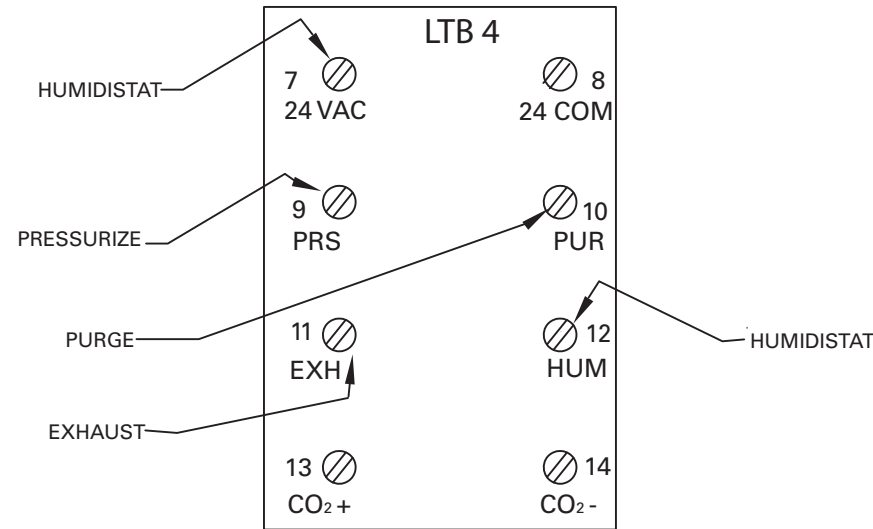
Ventilation override inputs override smoke detector inputs through the RTOM. (3-25 tons only).

Table 35.

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

\*Voyager 27.5 - 50 tons VAV

Figure 61. LTB Layout



# Dehumidification with Hot Gas Reheat (3-25 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 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.

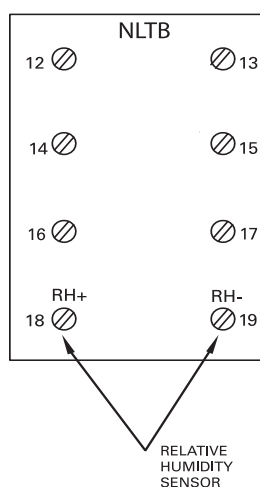
For reliability reasons, a purge time function was added to ensure that adequate oil is being returned to the compressor.

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.

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

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 36.**

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.

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

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**Table 37.**

<b>mA</b>	<b>%</b>	<b>mA</b>	<b>%</b>
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:

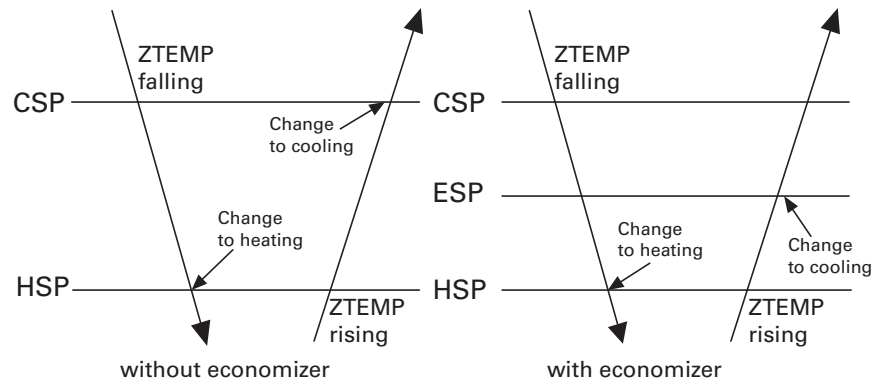
- Active Unit Mode = Off with Zone Sensor
- Humidistat Active OPEN from Humidity Stat
- Active Humidity < Active Humidity Set Point -5%
- Outdoor Air temperature < 40° F or Invalid or > 100°F and 1 compressor
- Compressor 1 (or 2 for multi-compressor units) Auto or Manual Reset lockout
- Active call 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.



# 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.

**Figure 62. Heating/Cooling Changeover**



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 equal to or less than the heating set point. For systems without economizers, 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 equal to or greater than the cooling set point. For systems with economizers, 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 equal to or greater than the economizer set point.

# 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 condenser fan units (3 through 10 ton), and 40° F for dual condenser fan unit (12 1/2 through 25 ton). 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 evaporate 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 – 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 RTM 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 as well.

## 27.5 – 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 38, p. 107](#) 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 63, p. 108](#) 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 38. Condenser Fan/Compressor Sequence**

Unit Size (Tons)	Compressor Staging Sequence			Condenser Fan Output		O/A Temp. (°F)
	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

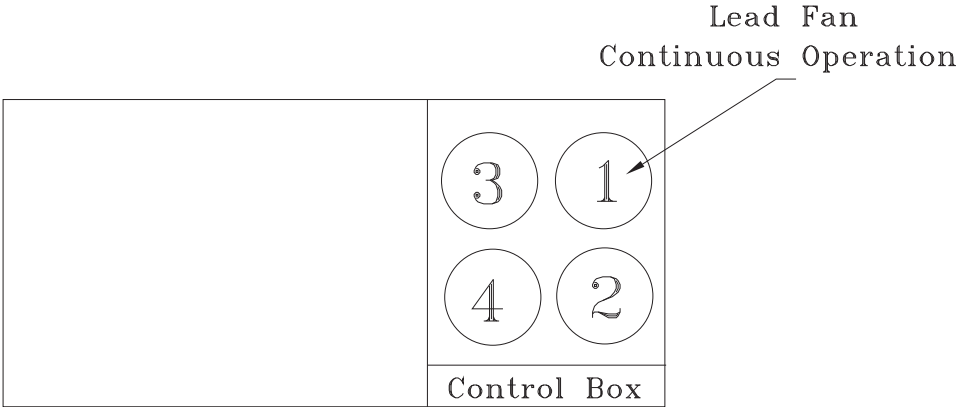
# ReliaTel Condenser Fan Control Logic

**Table 38. Condenser Fan/Compressor Sequence**

Unit Size (Tons)	Compressor Staging Sequence			Condenser Fan Output		O/A Temp. (°F)
	Step 1	Step2	Step 3	Output A	Output B	Fans "Off"
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
						-30

- The Compressor(s) listed under each step are the operating compressors. On 27.5 to 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.
  - 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.

**Figure 63. Condenser Fan Location**



# Phase Monitor

## 3 – 25 Ton ReliaTel Units

Phase monitors are installed on all 3-25 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.

# 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 64. Transformer and Thermostat Layout

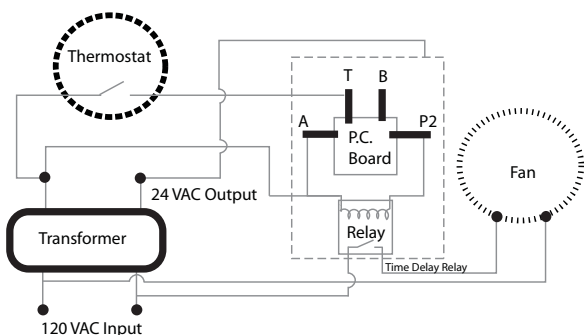


Figure 65. Time Delay Relay

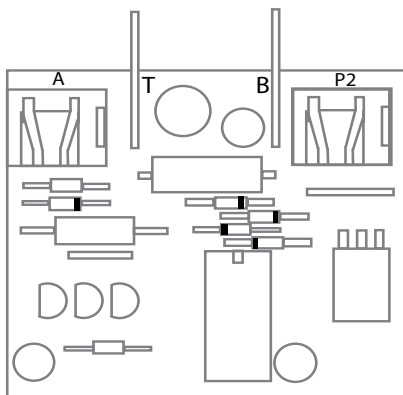
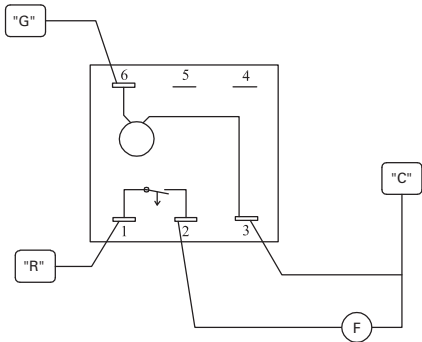


Figure 66. Electromechanical Time Delay Solid State



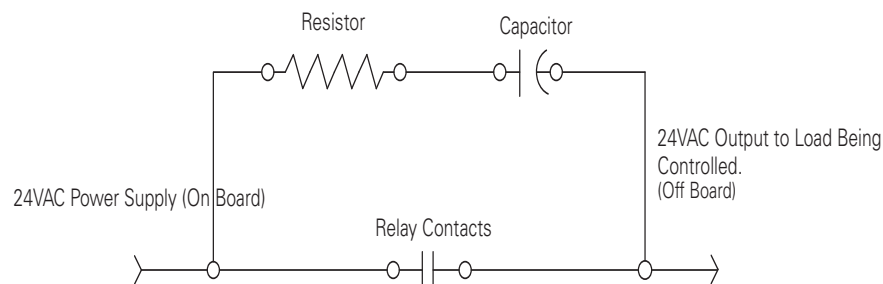
# Snubber Circuits

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 67. 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 68. Transformer Chart

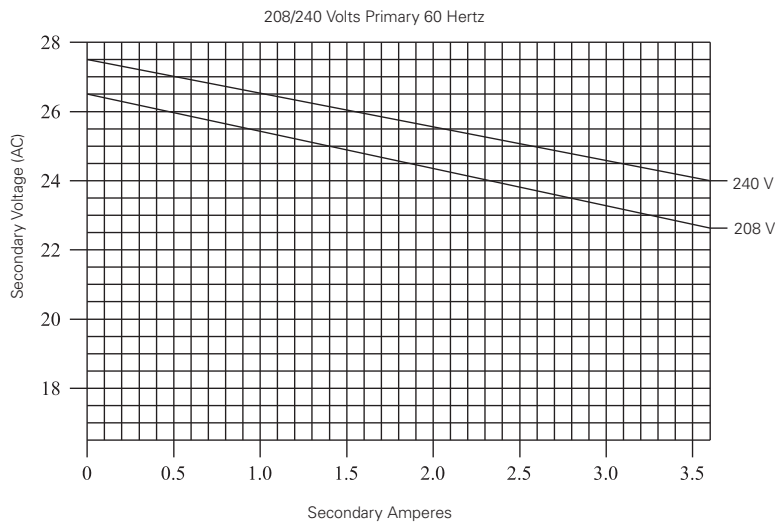
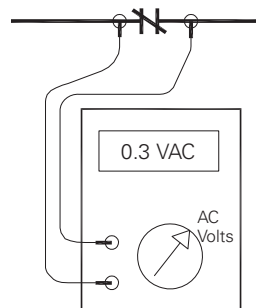


Figure 69. Transformer Troubleshooting





# 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 40F, the timing is one minute. If OA Temp is 40F or above, timing is 30 seconds.

## LPC Sequence of Operation

On a call for cooling, there is a 30 seconds or 60 seconds 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 30 (or 60) seconds to build up pressure.

If the switch is closed after 30 (or 60) seconds, 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 30 (or 60) seconds, 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.

## 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.

#### Nightmode 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 Nightmode 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

7. 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.

## Novar Controls (Sequence of Operation)

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8. Verify proper power connection and that it is connected to a 24VAC source with at least a 10VA consumption rating.
9. Apply Power to the unit.
10. 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.
11. Check the 1-amp fuse on the Novar ETM (located next to the NightMode output relay) for integrity.
12. Verify all inputs are connected according to the ETM installation instructions.
13. Other than economizer connection verification, for all jumper locations and short connections refer to the ETM.
14. 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.
15. 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.
16. To verify proper economizer operation, place a short across the jumper tabs on the Fan output relay and the NightMode 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 NightMode output relay. The damper should close completely. Disconnect the short and verify the damper opens back to minimum position.
17. 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 NightMode Damper relay and the P and P1 connections.
18. 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.
19. 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.
20. 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.

21. 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.
22. 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.
23. 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.
24. 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.
25. 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.
26. 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.
27. 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 to 50 Tons CV and VAV

## Overview

As of April 19, 2004, all 27½ to 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 3-25 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 3-25 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 27.5-50 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 - 50 ton units regardless of configuration (VAV, CV). The unit is configured by wire harness inputs. See the 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, optional on CV)

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<sub>2</sub> 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
V3	GND	
V2, Precedent	Open	
Non Heat Pump		Jumper

Cond Fan Cycling	RTOM J3-4
27.5-30 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
27.5-35 Ton	Open
40-50 Ton	GND

Lead/Lag	RTRM J3-8
Disabled	GND
Enabled	Open



<b>Modulating Gas</b>	<b>RTOM J3-3</b>
No Modulating Gas	Open
Modulating Gas	Ground

<b>High Heat (2 Heat Exchangers)</b>	<b>IGN #2 J1-5</b>
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 39. 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)
<b>Occupied Cooling</b>	No	Yes	Yes	Yes	Yes
<b>Daytime Warm-up</b>	No	No	Yes	Yes	Yes
<b>Morning Warm-up</b>	No	No	Yes	Yes	Yes
<b>Indoor Blower (occupied mode)</b>	Off	On	On	On	On
<b>Indoor Blower (unoccupied mode)</b>	N/A	Off	Auto	Auto	Auto
<b>Unoccupied Cooling</b>	N/A	No	No	No	Yes
<b>Unoccupied Heating</b>	N/A	No	Yes	Yes	Yes
<b>Short Across RTRM J6-11&amp;12 creates an unoccupied mode (Night setback)</b>	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 IGTV or VFD output will increase if the supply pressure goes below 1.3".

The IGTV or VFD output will decrease if the supply pressure goes above 1.7".

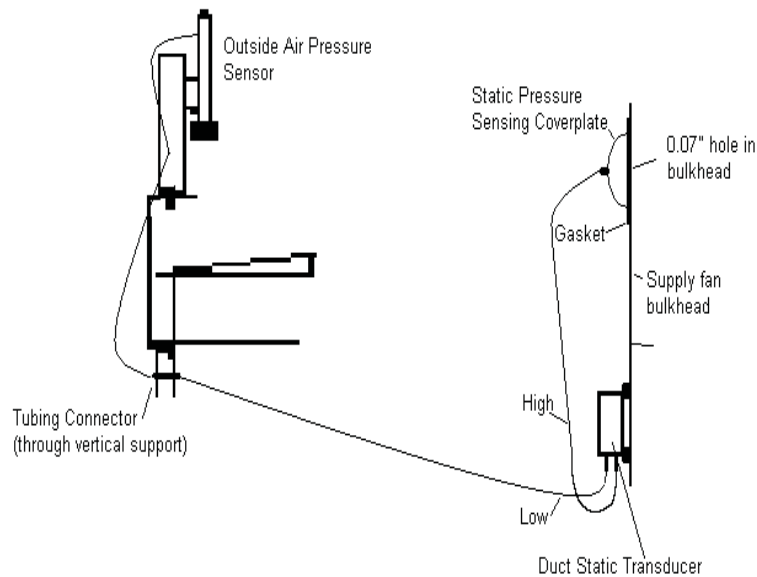
The IGTV or VFD output will not change if the supply pressure stays between 1.3" and 1.7".

DIP switch settings for this function are as follows:

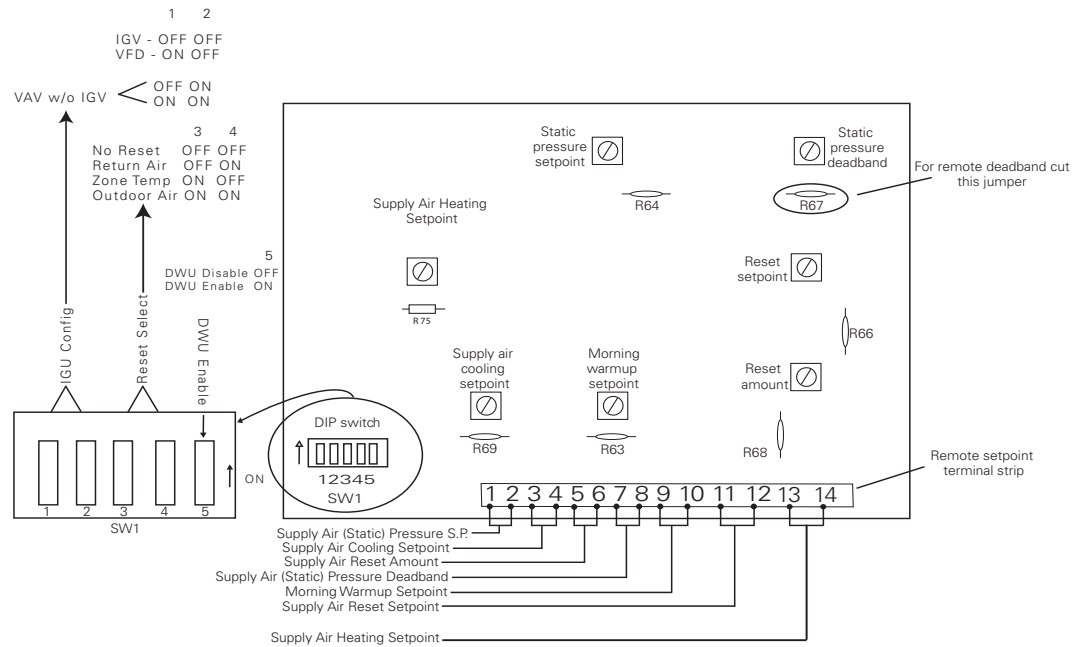
RTAM SW1 switch 1 OFF for IGTV, ON for VFD.

RTAM SW1 switch 2 OFF for VAV, ON for "VAV without IGTV".

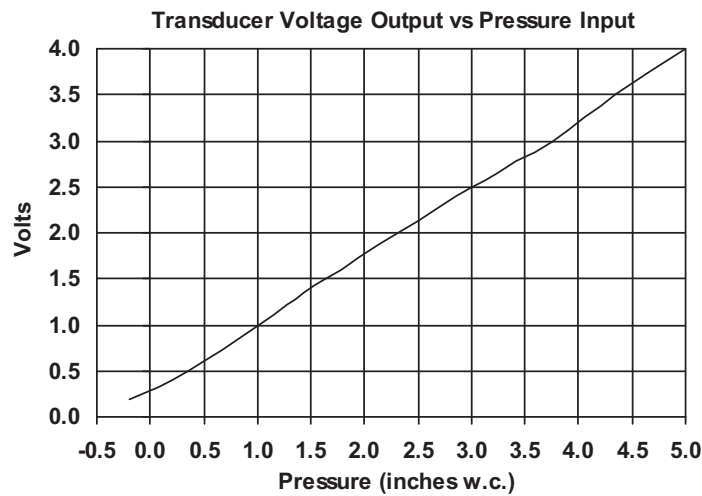
**Figure 70. Supply Duct Static Pressure Control**



**Figure 71. RTAM Module**



**Figure 72. 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 warmup, daytime warmup 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 Fig. 59. 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 VC-1. Some applications with extreme winds could require mounting the sensor in an area less affected by wind.

## BAYSENS021A 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 40.

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	2.38	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			

## Voyager Commercial 27½ to 50 Tons CV and VAV

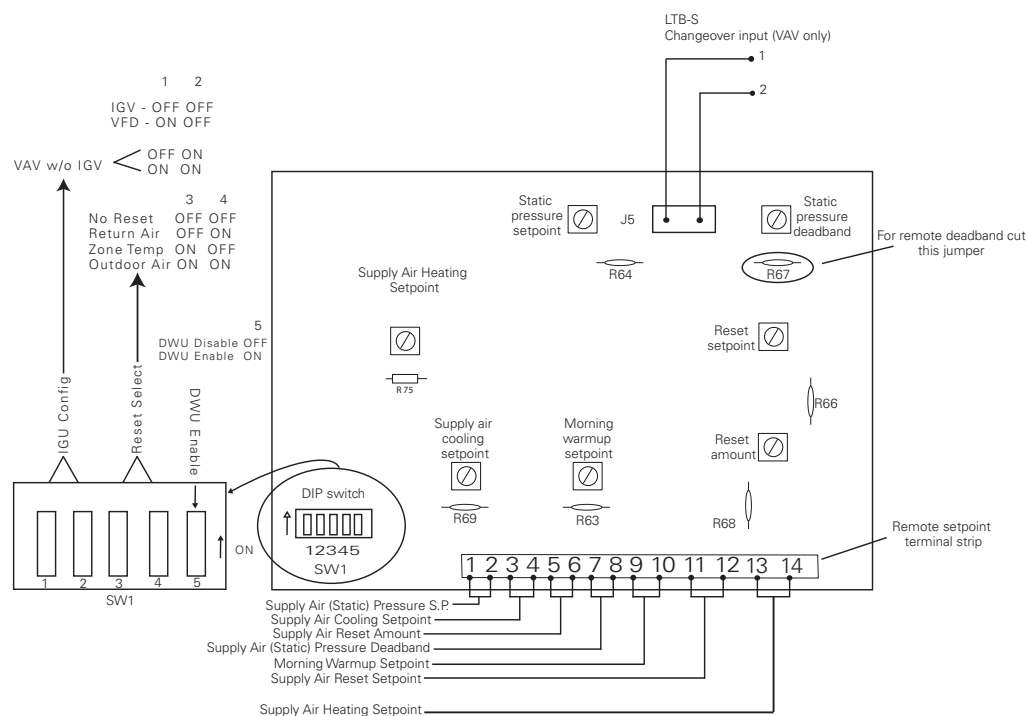
This chart lists setpoint/voltage/resistance for VAV setpoints on the RTAM module in the control compartment. The chart can be used for troubleshooting the RTAM module or for applying a remote setpoint to the unit.

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 drawing below.

### 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 73. 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 41. VAV Setpoints**

		Supply Air <sup>①</sup> Pressure Setpoint (see note)	Supply Air Cooling Setpoint	Supply Air Reset Amount	Supply Air <sup>②</sup> Pressure Deadband	Morning Warm-up Setpoint	Supply Air Reset Setpoint Outdoor	Supply Air Reset Setpoint Zone or Return Air
		J7-1,2	J7-3,4	J7-5,6	J7-7,8	J7-9,10	J7-11,12	J7-11,12
Resistance (Ohms)	DC Volts	"WC	Deg F	Deg F	"WC	Deg F	Deg F	Deg F
0	0.00	0.00	40.00	0.00	0.00	50.00	0.00	50.00
10	0.05	0.02	40.27	0.13	0.01	50.27	0.67	50.27
20	0.10	0.05	40.81	0.40	0.02	50.81	20.02	50.81
30	0.15	0.08	41.29	0.65	0.03	51.29	3.23	51.29
40	0.19	0.11	41.23	0.91	0.05	51.23	4.57	51.83
50	0.24	0.14	42.31	1.16	0.06	52.31	5.78	52.31
60	0.28	0.17	42.79	1.40	0.07	52.79	6.99	52.79
70	0.33	0.20	43.28	1.64	0.08	53.28	8.19	53.28
80	0.37	0.24	43.76	1.88	0.09	53.76	9.40	53.76
90	0.41	0.27	44.24	2.12	0.11	54.24	10.61	54.24
100	0.45	0.30	44.73	2.36	0.12	54.73	11.82	54.73
110	0.50	0.32	45.16	2.58	0.13	55.16	12.89	55.16
120	0.54	0.35	45.59	2.79	0.14	55.59	13.97	55.59
130	0.58	0.38	46.02	3.01	0.15	56.02	15.04	56.02
140	0.61	0.40	46.45	3.22	0.16	56.45	16.12	56.45
150	0.65	0.43	46.88	3.44	0.17	56.88	17.19	56.88
160	0.69	0.46	47.31	3.65	0.18	57.31	18.26	57.31
170	0.73	0.48	47.68	3.84	0.19	57.68	19.20	57.68
180	0.76	0.51	48.11	4.06	0.20	58.11	20.28	58.11
190	0.80	0.53	48.49	4.24	0.21	58.49	21.22	58.49
200	0.83	0.55	48.86	4.43	0.22	58.86	22.16	58.86
210	0.87	0.58	49.24	4.62	0.23	59.24	23.10	59.24
220	0.90	0.60	49.62	4.81	0.24	59.62	24.04	59.62
230	0.93	0.62	49.99	5.00	0.25	59.99	24.98	59.99
240	0.97	0.65	50.37	5.18	0.26	60.37	25.92	60.37

## Voyager Commercial 27½ to 50 Tons CV and VAV

**Table 41. VAV Setpoints**

		Supply Air <sup>①</sup> Pressure Setpoint (see note)	Supply Air Cooling Setpoint	Supply Air Reset Amount	Supply Air <sup>②</sup> Pressure Deadband	Morning Warm-up Setpoint	Supply Air Reset Setpoint Outdoor	Supply Air Reset Setpoint Zone or Return Air
		J7-1,2	J7-3,4	J7-5,6	J7-7,8	J7-9,10	J7-11,12	J7-11,12
Resistance (Ohms)	DC Volts	"WC	Deg F	Deg F	"WC	Deg F	Deg F	Deg F
250	1.00	0.67	50.69	5.34	0.27	60.69	26.72	60.69
260	1.03	0.70	51.26	5.63	0.28	61.26	28.14	61.26
270	1.06	0.73	51.74	5.87	0.29	61.74	29.35	61.74
280	1.09	0.77	52.30	6.15	0.31	62.30	30.76	62.30
290	1.12	0.80	52.79	6.39	0.32	62.79	31.97	62.79
300	1.15	0.83	53.27	6.63	0.33	63.27	33.17	63.27
310	1.18	0.86	53.75	6.88	0.34	63.75	34.38	63.75
320	1.21	0.89	54.24	7.12	0.36	64.24	35.59	64.24
330	1.24	0.92	54.72	7.36	0.37	64.72	36.80	64.72
340	1.27	0.95	55.12	7.56	0.38	65.12	37.81	65.12
350	1.30	0.98	55.61	7.80	0.39	65.61	39.01	65.61
360	1.32	1.01	56.09	8.04	0.40	66.09	40.22	66.09
370	1.35	1.03	56.49	8.25	0.41	66.49	41.23	66.49
380	1.38	1.06	56.89	8.45	0.42	66.89	42.24	66.89
390	1.40	1.09	57.38	8.69	0.43	67.38	43.45	67.38
400	1.43	1.11	57.78	8.89	0.44	67.78	44.45	67.78
410	1.45	1.14	58.18	9.09	0.45	68.18	45.46	68.18
420	1.48	1.16	58.59	9.29	0.46	68.59	46.47	68.59
430	1.50	1.19	58.99	9.49	0.47	68.99	47.47	68.99
440	1.53	1.21	59.39	9.70	0.48	69.39	48.48	69.39
450	1.55	1.24	59.80	9.90	0.49	69.80	49.49	69.80
460	1.58	1.26	60.20	10.10	0.50	70.20	50.50	70.20
470	1.60	1.29	60.60	10.30	0.52	70.60	51.50	70.60
480	1.62	1.31	61.00	10.50	0.53	71.00	52.51	71.00
490	1.64	1.33	61.33	10.66	0.53	71.33	53.32	71.33
500	1.67	1.36	61.73	10.86	0.54	71.73	54.32	71.73
510	1.69	1.39	62.25	11.12	0.56	72.25	55.62	72.25
520	1.71	1.43	62.81	11.41	0.57	72.81	57.03	72.81
530	1.73	1.45	63.26	11.63	0.58	73.26	58.16	73.26
540	1.75	1.49	63.83	11.91	0.60	73.83	59.57	73.83
550	1.77	1.52	64.28	12.14	0.61	74.28	60.70	74.28
560	1.79	1.55	64.73	12.36	0.62	74.73	61.82	74.73
570	1.82	1.57	65.18	12.59	0.63	75.18	62.95	75.18
580	1.84	1.60	65.63	12.82	0.64	75.63	64.08	75.63
590	1.86	1.63	66.08	13.04	0.65	76.08	65.21	76.08
600	1.88	1.67	66.65	13.32	0.67	76.65	66.62	76.65
610	1.89	1.69	66.99	13.49	0.67	76.99	67.46	76.99
620	1.91	1.71	67.44	13.72	0.69	77.44	68.59	77.44
630	1.93	1.74	67.89	13.94	0.70	77.89	69.72	77.89



## Voyager Commercial 27½ to 50 Tons CV and VAV

**Table 41. VAV Setpoints**

		Supply Air <sup>①</sup> Pressure Setpoint (see note)	Supply Air Cooling Setpoint	Supply Air Reset Amount	Supply Air <sup>②</sup> Pressure Deadband	Morning Warm-up Setpoint	Supply Air Reset Setpoint Outdoor	Supply Air Reset Setpoint Zone or Return Air
		J7-1,2	J7-3,4	J7-5,6	J7-7,8	J7-9,10	J7-11,12	J7-11,12
Resistance (Ohms)	DC Volts	"WC	Deg F	Deg F	"WC	Deg F	Deg F	Deg F
640	1.95	1.77	68.34	14.17	0.71	78.34	70.85	78.34
650	1.97	1.80	68.79	14.40	0.72	78.79	71.98	78.79
660	1.99	1.83	69.24	14.62	0.73	79.24	73.10	79.24
670	2.01	1.85	69.58	14.79	0.74	79.58	73.95	79.58
680	2.02	1.88	70.03	15.02	0.75	80.03	75.08	80.03
690	2.04	1.91	70.48	15.24	0.76	80.48	76.21	80.48
700	2.06	1.93	70.82	15.41	0.77	80.82	77.05	80.82
710	2.08	1.95	71.27	15.64	0.78	81.27	78.18	81.27
720	2.09	1.98	71.61	15.81	0.79	81.61	79.03	81.61
730	2.11	2.00	72.06	16.03	0.80	82.06	80.15	82.06
740	2.13	2.02	72.40	16.20	0.81	82.40	81.00	82.40
750	2.14	2.05	72.74	16.37	0.82	82.74	81.85	82.74
760	2.16	2.08	73.29	16.65	0.83	83.29	83.23	83.29
770	2.18	2.11	73.75	16.87	0.84	83.75	84.36	83.75
780	2.19	2.14	74.20	17.10	0.85	84.20	85.49	84.20
790	2.21	2.17	74.65	17.32	0.87	84.65	86.62	84.65
800	2.22	2.20	75.25	17.62	0.88	85.25	88.12	85.25
810	2.24	2.23	75.70	17.85	0.89	85.70	89.25	85.70
820	2.25	2.26	76.15	18.08	0.90	86.15	90.38	86.15
830	2.27	2.29	76.60	18.30	0.92	86.60	91.51	86.60
840	2.28	2.32	77.05	18.53	0.93	87.05	92.63	87.05
850	2.30	2.34	77.50	18.75	0.94	87.50	93.76	87.50
860	2.31	2.37	77.96	18.98	0.95	87.96	94.89	87.96
870	2.33	2.40	78.41	19.20	0.96	88.41	96.02	88.41
880	2.34	2.43	78.86	19.43	0.97	88.86	97.15	88.86
890	2.35	2.46	79.31	19.65	0.98	89.31	98.27	89.31
900	2.37	2.49	79.76	19.88	0.99	89.76	99.40	89.76
910	2.38	2.50	80.00	20.00	1.00	90.00	100.00	90.00
920	2.40	2.50	80.00	20.00	1.00	90.00	100.00	90.00
930	2.41	2.50	80.00	20.00	1.00	90.00	100.00	90.00
940	2.42	2.50	80.00	20.00	1.00	90.00	100.00	90.00
950	2.44	2.50	80.00	20.00	1.00	90.00	100.00	90.00
960	2.45	2.50	80.00	20.00	1.00	90.00	100.00	90.00
970	2.46	2.50	80.00	20.00	1.00	90.00	100.00	90.00
980	2.47	2.50	80.00	20.00	1.00	90.00	100.00	90.00
990	2.49	2.50	80.00	20.00	1.00	90.00	100.00	90.00
1000	2.50	2.50	80.00	20.00	1.00	90.00	100.00	90.00

① Supply Air Pressure Setpoint valid range is .3"-2.5".

② Supply Air Pressure Deadband valid range is .2"-1".

# Outdoor Air Flow Compensation for VAV Units

## Outdoor Airflow Compensation (27½ - 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<sub>2</sub> 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.

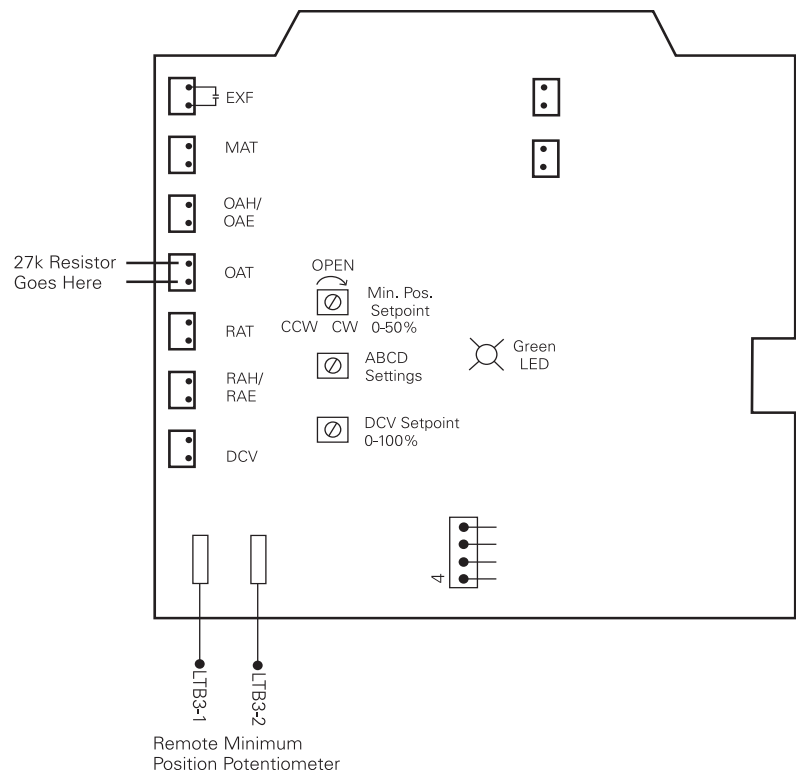
### Operation

The potentiometers MIN POS and DCV SETPOINT 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.

**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<sub>2</sub> sensor input at the DCV input or if a building management system (ICS, Tracer, LonTalk) is providing a CO<sub>2</sub> sensor input to the unit.

The DCV 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 to 100%. This chart shows the effect of DCV input vs. MIN POS when the IGV/VFD is at 0%.

Outdoor Air Flow Compensation for VAV Units



OA damper minimum position when IGV is closed /VFD at min. HZ			
	MIN POS 0% (CCW)	MIN POS 25%	MIN POS 50% (CW)
DCVSP 0%	0 (closed)	25%	50%
DCVSP 50%	25%	37.5%	50%
DCVSP 100%	50%	50%	50%

# Software Change History

**Table 42.**

<b>RTRM</b>			
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 -Revise test mode logic for heating and cooling. -Revise fan cycling when changing from economizer to mechanical cooling -Correct LPC2 diagnostic not to show on single circuit unit. -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. -Fix all outdoor fans to run if outdoor sensor fails. -Fix indoor fan on gas heat to run only if heat fires. -Change Timed Override (TOV) bit for Tracer from two hours two minutes. -If outdoor sensor fails, fix so that unit will still do default defrost. -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. -Add ICS communication failure if comm. stops for 2 minutes. -Fix stages of heat & cool to report correctly on ICS. -Fix ICS Lead/Lag hardware to work if in remote control -Correct algorithm Heat proportional gain to stop heat cycling. -Fixed ICS cool and heat stage reporting. -Fixed supply fan lockout to reset with ICS. -Fixed supply fan lockout so zone sensor mode setting to off will reset. -Fixed default defrost without call for heat.
V2.9	4/1/02	X13650867020	-Fix unit mode with remote. -Fix defrost function to halt defrost if call for heat is removed or switched to cooling. -Added stage 1 electric heat to defrost service test. -Added 15 second delay before RTRM talks to TCI to prevent economizer false diagnostic. -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 -Fixed false diagnostic reports on COMM5 without RTOM. -Correct invalid economizer MAS from 65.4 to 53 F. -Change hardware initialization to stop false diagnostics on Tracker 10
V3.0	3/15/03	X13650867030	-Feature Enhancement: Add Dehumidification/Reheat Control. Bug fixes: -Fix unit mode when going from off to auto. -Fix supply fan to not wait 20 seconds at power-up if test mode is activated. -Fix RTRM to ignore ICS compressor disable during service test mode. -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. -Changed LPC startup bypass time from two minutes to ten seconds. -Turn off electric heat if defrost terminates on HPC. -Fix reheat with zone sensor, override reheat with cooling call. -Ignore-40F MAT if compressor is running.

## Software Change History

V4.0	1/13/04	X13650867040	<p>Feature Enhancement:</p> <ul style="list-style-type: none"> <li>-Add Voyager III control functions.</li> <li>-Added two flash diagnostic code and steady light.</li> </ul> <p>Bug fixes:</p> <ul style="list-style-type: none"> <li>-Fix service test to lock out after power reset with resistance.</li> <li>-Fix outdoor fan operation on one compressor unit during Service Test with dehumidification/reset.</li> <li>-Fix to disable Dehumidification if either compressor/circuit becomes disabled.</li> <li>-Fix Defrost Default A timing issues.</li> <li>-Add 30 second delay before looking at Mixed Air and Return Air temperature.</li> </ul>
V5.0	4/21/04	X13650867050	<ul style="list-style-type: none"> <li>-Added dehumidification purge cycle.</li> <li>-Fixed Fan Fail input to normally open input for Voyager III.</li> </ul>
V5.1	1/1/05	X13650867050	<ul style="list-style-type: none"> <li>-Fix compressor staging in test mode.</li> </ul>
V6.0	10/15/06	X13650867060	<p>Bug Fixes:</p> <ul style="list-style-type: none"> <li>-Fix RTRM to revert to local control if Modbus Comm lost TCI/LCI for &gt; 2 min.</li> <li>-Fix dual gas ignition module configs to lockout both modules if either one has a failure.</li> <li>-Fix VAV units to disable MWU/DWU on cooling only units.</li> <li>-Fix VAV gas heat units only to shut off supply fan on high duct static trip in CV heating modes.</li> <li>-Fix service test to hold economizer closed when at the "econ open" step and a supply fan fail is present.</li> <li>-Implemented range limits for ICS Zone Temp value from TCI/LCI. Range is -40F to 150F.</li> <li>-Fix compressor disable inputs to lock out individual compressor (27.5-30 tons)</li> </ul> <p>Feature Enhancements:</p> <ul style="list-style-type: none"> <li>-Extended LPC delay at compressor start from 10 seconds to 30 sec. when OAT &gt; or = to 40F and 60 sec. when below 40F.</li> <li>-Extended supply fan off delay after compressor cycle in cooling and mechanical heating from 60 seconds to 80 seconds.</li> <li>-Removed coordinated shut off of Comp 1 on a comp 2 Disable event on single-circuit V3 units. (Allows demand limiting of Comp2 w/o affecting Comp)</li> <li>-Dehumidification is now disabled in Slave Mode when the slave state requested is "Fan On".</li> <li>-"Heat fail" diagnostic can be cleared now with an ICS Diagnostic Reset command.</li> <li>-New unit type supported: International V3 Heat pump units w/2-step mechanical heating. (China &amp; France production only)/ This unit is configured by setting 2-step cooling, heat pump, and Voyager 3 configuration inputs.</li> </ul>
V7.0	12/1/07	X13650864-867-07	<p>Bug Fixes:</p> <ul style="list-style-type: none"> <li>-Added 1-Comp Dehumidification unit using Thermostat with econ cooling enabled</li> <li>-Implemented range limits for ICS OA Temp value from TCI/LCI. Range is -40F to 150F.</li> <li>-Eliminated the "Inhibit Mechanical Cooling" limitation when ECA "actuator fault" is present.</li> <li>-Corrected Compressors not staging intermittently in Service Test with Thermostat</li> <li>-Correct Demand Defrost Initiate sequence with Thermostat</li> <li>-CO2 disable from Rover causing supply fan on continuous</li> <li>-Fix defect in Reheat Disable from BAS (setting Dehumid Setpoint = 0%)</li> <li>-Fix Frost trip in Heat Pump heating mode</li> </ul> <p>Feature Enhancement:</p> <ul style="list-style-type: none"> <li>-Added 2-Stage Single-circuit Voyager 3 Mechanical Heating for Heat Pump</li> <li>-Added Resistance Test Support</li> <li>-Changed Compressor Staging Order for 3-Step Cooling on non-Voyager Commercial units</li> <li>-Supported for New Binary Input to Disable Windmilling</li> <li>-Supported for new Binary Input to Disable EDC (Indoor Coil Frost)</li> <li>-Added an additional Analog Input</li> <li>-Added Modulating Gas Heat Feature and VAV Heating Mode on Voyager 3</li> <li>-Expanded Voyager 3 Heat Pump feature to 2-circuit functionality with 2-steps mechanical heating</li> <li>-Implemented new max Delta-T temps for the Voy3 configured heat pumps</li> <li>-Prevented configuration of lead/lag on 3 step cool units that are not Voy 3 and those with reheat installed</li> <li>-Implemented binary input for 2-step mechanical heating</li> <li>-Added supply air heating setpoint input to RTAM</li> <li>-Implement a low-ambient auto-reset LPC diagnostic reporting bypass feature</li> </ul>

## Software Change History

<b>RTOM</b>			
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 -Add Voyager 3 Control Function
<b>ECA</b>			
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. -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.
<b>TCI</b>			
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. -Added code to fix VAV lockup.
<b>LCI-SCC</b>			
V1.02	4/16/01	X13650870010	-First production release.
V2.06	10/01/03	X13650870020	-Fixed to allow stand-alone operation without communication link.
<b>LCI-DAC</b>			
V1.0	4/01/04	X1365106601	-LCI for VAV Voyager 3
<b>LCI-SSC</b>			
2.06	3/10/04	X13650870-02	Feature Enhancement: -Add support for nviSpaceRH - Communicated SpaceRH -Add support for nviOutdoor Temp - Communicated Outdoor Air Temperature -Add support for nviOutdoorRH - Communicated Outdoor RH -Add support for nviTraneVar1401 - Communicated Service Test -Add support for nviBldgStatPress - Not Supported in RTRM -Add support for nvoMixedAirTemp - Reports Mixed Air temperature -Add support for nvoBldgStatPress - Not Supported in RTRM -Add support for nciSpaceRHSetpt - Communicated Space RH Set Point -Add support for nciExhaustConfig - Communicated Exhaust Fan Start Position -Add support for nciBldgStaticSP - Not Supported in RTRM Bug Fix: -Fixed bug to allow communicated Emergency Heat Mode
2.07	11/1/04	X13650870-02	Bug Fix: -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: -Fix the ApplicMode to change if the unit is in dehumidification when using a BAS in optimal start & nite purge

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The manufacturer has a policy of continuous product and product data improvement and reserves the right to change design and specifications without notice. Only qualified technicians should perform the installation and servicing of equipment referred to in this literature.