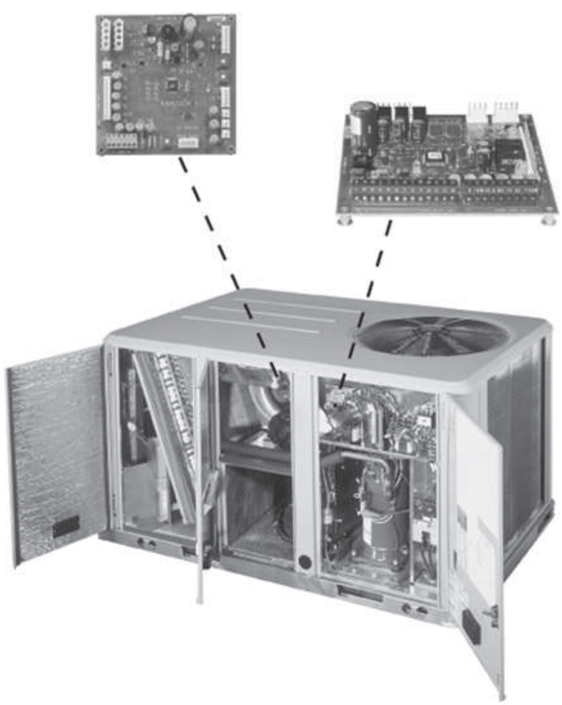
Service & Diagnostic Support Manual

ReliaTel™ Microprocessor Controls



⚠ SAFETY WARNING

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

August 2018

RT-SVD03L-EN

Ingersoll Rand

Introduction

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 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.

Read this manual thoroughly before operating or servicing this unit.

Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

⚠WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.
NOTICE	Indicates a situation that could result in equipment or property-damage only accidents.

Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants-including industry replacements for CFCs and HCFCs such as saturated or unsaturated HFCs and HCFCs.

Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified according to local rules. For the USA, the Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

⚠ WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury.
All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Material Safety Data Sheets (MSDS)/Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate MSDS/SDS and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

⚠ WARNING

Follow EHS Policies!

Failure to follow instructions below could result in death or serious injury.

- **All Ingersoll Rand personnel must follow Ingersoll Rand Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. All policies can be found on the BOS site. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Ingersoll Rand personnel should always follow local regulations.**

Copyright

Trademarks

Revision History

- Updated J inputs descriptions for RTOM and RTVM.
- Added Precedent eFlex 6–10 Tons data.
- Additional running changes.

Table of Contents

General Information

ReliaTel™

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

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

ReliaTel™ controls were first used in the 3 to 10 ton convertible packaged cooling with electric heat, gas/ electric, and heat pumps. ReliaTel™ has been added to other commercial products. In April 2003, Voyager™ 12.5 to 25 tons dedicated units were converted to ReliaTel™ controls. In April 2004, ReliaTel™ controls were added to Voyager™ Commercial 27.5 to 50 tons dedicated units.

Precedent™ 3 to 10 Tons and Voyager™ 12.5 to 50 Tons Dedicated Packaged Rooftops

Precedent™ 3 to 10 ton cooling only and gas/electric convertible packaged units can be built with either electromechanical or ReliaTel™ controls. Voyager™ 12.5 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.

Odyssey™

Odyssey™ 6 to 20 ton heat pumps are available with ReliaTel™ controls. Odyssey™ 6 to 25 ton cooling only units can be built with either electromechanical or ReliaTel™ controls.

ReliaTel™ vs. Electromechanical

Note: *Each ReliaTel™module is a communicating control.*

Precedent™ 3 to 10 tons packaged gas/electric (YSC, YHC) and cooling only (TSC, THC) are available without microprocessor controls. With electromechanical controls, zone sensors cannot control the units, nor can building automation systems communicate with it. Electromechanical units require the use of a thermostat or relay based control system to directly control relays, contactors, etc. The ignition control and economizer are different than the ones used with ReliaTel™. Service information for these components are handled separately in this book.

- ReliaTel™ controls: 9th digit “R”
- Electromechanical controls: 9th digit “E”
- 27.5 to 50 tons: ReliaTel™ controls 10th digit “M” or greater

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:

- Mechanical Zone Sensor Module (ZSM) BAYSENS106-111*, AYSTAT106*-109*
- Programmable Zone Sensor (BAYSENS119*, 20*, AYSTAT666*)
- Conventional thermostat BAYSTAT036-038* (or similar, ASYSTAT701-703*)

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

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

- Outdoor air sensor (OAS)
- Coil temperature sensor (CTS) heat pump only
- Smoke detector (unless it is factory installed) or other shutdown device

ReliaTel™ Air Handler Module (RTAM)

The RTAM is the module required for unit with multi-zone VAV function. The RTAM gets power from and communicates with the RTRM via RS-485 bus. Any of the following options to the ReliaTel™ control devices will require the use of a RTAM.

ReliaTel™ Air Handler Module (RTAM) (Standard on VAV)

This module contains the VAV setpoint potentiometers as well as the following inputs and outputs:

- DIP switch inputs for supply air reset, daytime warm-up enable and IGV/VFD configuration
- Supply pressure transducer input inlet guide vane (IGV) or variable frequency drive (VFD) output
- Ventilation heat relay (VHR) output

ReliaTel™ Option Module (RTOM)

Note: *RTOM is standard on 27.5 to 50 Tons units.*

The RTOM gets power from and communicates with the RTRM.

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

- Condensate overflow switch (COS)
- Clogged filter switch (CFS)
- Discharge air sensor (DAS) used for supply air tempering and ICS input data
- Fan failure switch (FFS)
- Factory-installed smoke detector

  Note: *A factory-installed smoke detector provides instant shutdown and ICS alarm output.*
- Frostat™ (FOS)

ReliaTel™ Ventilation Module (RTVM) — 27.5 to 50 Tons Units

The RTVM is a module required for units configured with space pressure control with Statitrac™. The module controls the exhaust damper position 0-10Vdc output as well as the space pressure sensor calibration routine. The module accepts the following inputs:

- Statitrac™ configuration
- Space pressure input
- Space pressure setpoint
- Space pressure setpoint deadband
- Traq™ (Voyager™ Commercial 27.5 to 50 tons)

ReliaTel™ Ventilation Module (RTVM) — 3 to 25 Tons Units

The RTVM is a module for Demand Control Ventilation (DCV) on multi-speed and Single-Zone Variable Air Volume (SZVAV) units.

ReliaTel™ Dehumidification Module (RTDM)

Note: *Available on 27.5 to 50 Tons units only.*

The RTDM is a module required for units configured with modulating dehumidification. The module controls modulating cooling and reheat valves as well as the reheat circuit pumpout solenoid. The module accepts the following inputs:

- Reheat circuit entering evaporator temperature
- Reheat circuit low pressure cutout input

Economizer Actuator with Module (ECA or RTEM)

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

The ECA accepts the following inputs:

- Mixed air sensor (MAS)
- Return air sensor (RAS) for comparative enthalpy or ICS input data
- Outdoor humidity sensor (OHS) for reference or comparative enthalpy
- Return air humidity sensor (RHS) for comparative enthalpy
- CO_2 sensor 0-10 VDC input (DCV)
- Remote minimum potentiometer (RMP)
- Active/passive DCV configuration input (RTEM only)
- The power exhaust relay is connected to the ECA module

ReliaTel™ Electromechanical Economizer Module (RTEM-EM)

- The RTEM-EM is an economizer module configured to support electro-mechanical HVAC units. The module will require 24Vac input power and provide control for an outdoor air damper actuator. The module features 6 pots on for potentiometers onboard. The potentiometers control building design and demand control ventilation (DCV) minimum damper positions, DCV and CO_2 setpoints and limits, and dry bulb and enthalpy settings. The module supports the following inputs:
- Return air temperature sensor (RAS)
- Outside air temperature sensor (OAS)
- Mixed air temperature sensor (MAS)
- Return air humidity sensor (RHS) for comparative enthalpy
- Outside air humidity sensor (OHS) for comparative enthalpy
- CO_2 sensor 0-12VDC input (DCV)
- Remote minimum position potentiometer

Variable Speed Module (VSM)

- The VSM allows communication between ReliaTel™ controls platform and a variable speed condenser fan (ECM) motor and variable speed compressor drive for Precedent™ and Voyager™ light commercial products. The VSM controller is applied to the following units:
- Precedent™ 3 to 5 ton units to control a variable speed condenser fan and variable speed compressor drive
- Voyager™ light commercial 12.5 and 17.5 ton units to control a variable speed condenser fan and variable speed compressor drive

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

General Information

The communication interface board allows ReliaTel™ controls to communicate on a LonTalk® network at the unit level. This product is intended to be installed by a qualified system integrator properly trained and experienced in LonTalk® networks. Network variables are based on the LonMark® functional profile template. The LCI-R utilizes a Free Topology transceiver FTT-10A. The FTT-10A transceiver supports non-polarity sensitive, free topology wiring, allowing the system installer to utilize star, bus, and loop architecture.

Storage

When the LCI-R board must be stored for a period of time prior to being installed, it must be protected from the elements. The temperature of the storage location should be between -40°C and 65.6°C (-40°F and 150°F) and the relative humidity should be 10 to 90 percent, non-condensing

Mounting and Wiring

The LCI-R board mounts directly in the unit control box.

Shipment and Inspection - LCI-R

The LCI-R kit includes the following items:

- 1 - LCI-R communications board
- 1 - Wire harness
- 4 - LCI-R board mounting screws
- 1 - Pop-in wire tie (BAYLTCI002*)

ReliaTel™ BACnet® Communication Interface (BCI-R)

General Information

The building automation and control network (BACnet® and ANSI/ASHRAE Standard 135-2004) protocol is a standard that allows building automation systems or components from different manufacturers to share information and control functions. The BACnet® communication interface for ReliaTel™ supports Trane® ReliaTel™ rooftop units that function as part of a BACnet® MS/TP communications network. It allows ReliaTel™ equipment to communicate with a building automation system (BAS) by using BACnet® protocol over an RS-485 MS/TP communications link. The BCI-R module implements all the required BACnet® capabilities for a BACnet® Application Specific Controller (B-ASC). This product is intended to be installed by a qualified system integrator properly trained and experienced in BACnet® networks. The BCI-R supports three product families that use the ReliaTel™ controls platform: Precedent™, Voyager™, and Odyssey™.

BCI-R Shipment and Inspection

BCI-R kits include the following items:

- 1 - BCI-R communications board
- 1 - Wire harness
- 4 - BCI-R board mounting screws
- 1 - Pop-in wire tie

Storage

When the BCI-R board must be stored for a period of time prior to being installed, it must be protected from the elements. The temperature of the storage location should be between -40°C and 65.6°C (-40°F and 150°F) and the relative humidity should be 10 to 90 percent, non-condensing.

Module Flow Diagram

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

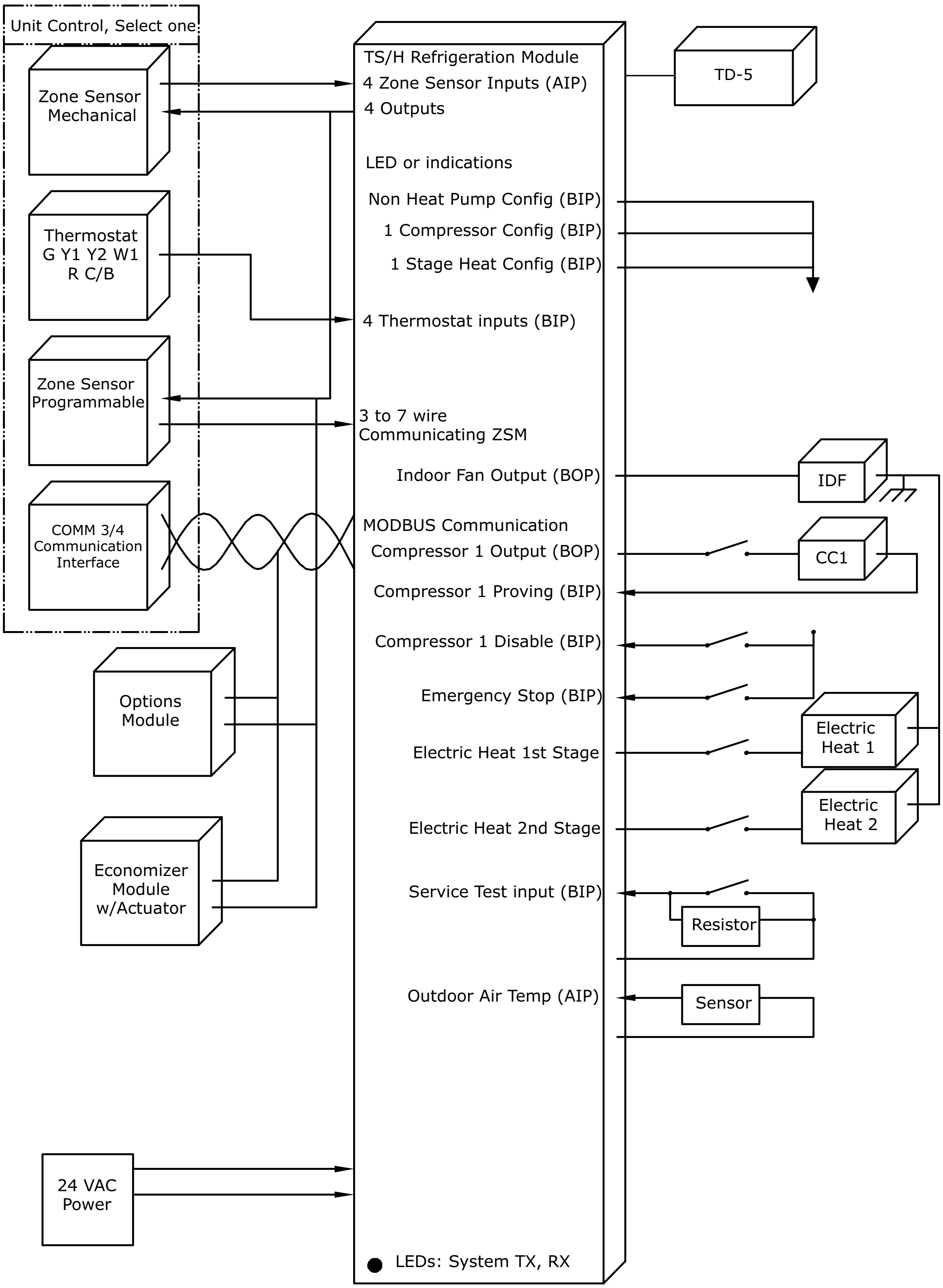


Figure 2. Precedent™ (YSC/YHC) refrigeration module (RTRM) gas heating

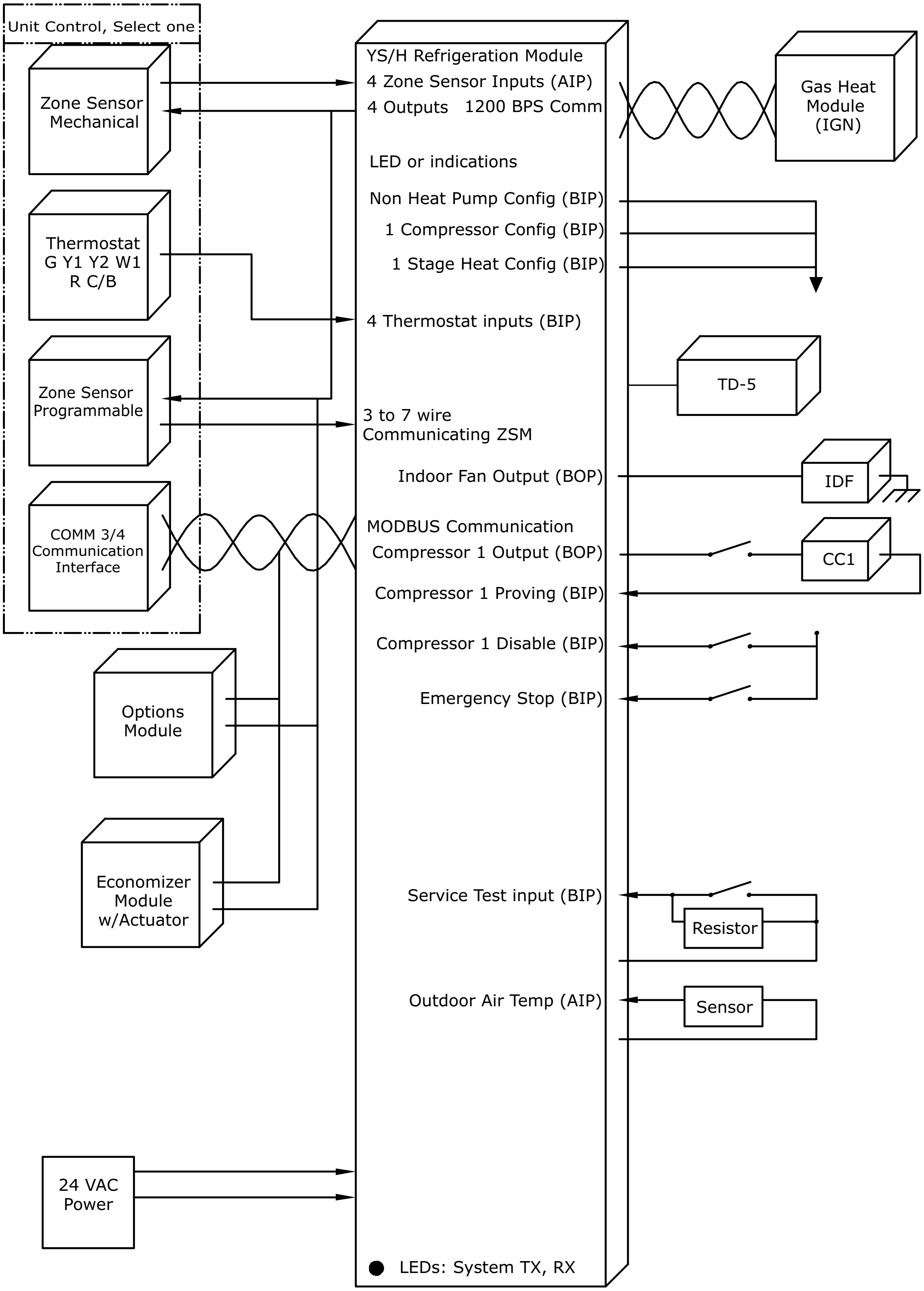


Figure 3. Precedent™ (WSC) refrigeration module (RTRM) heat pump

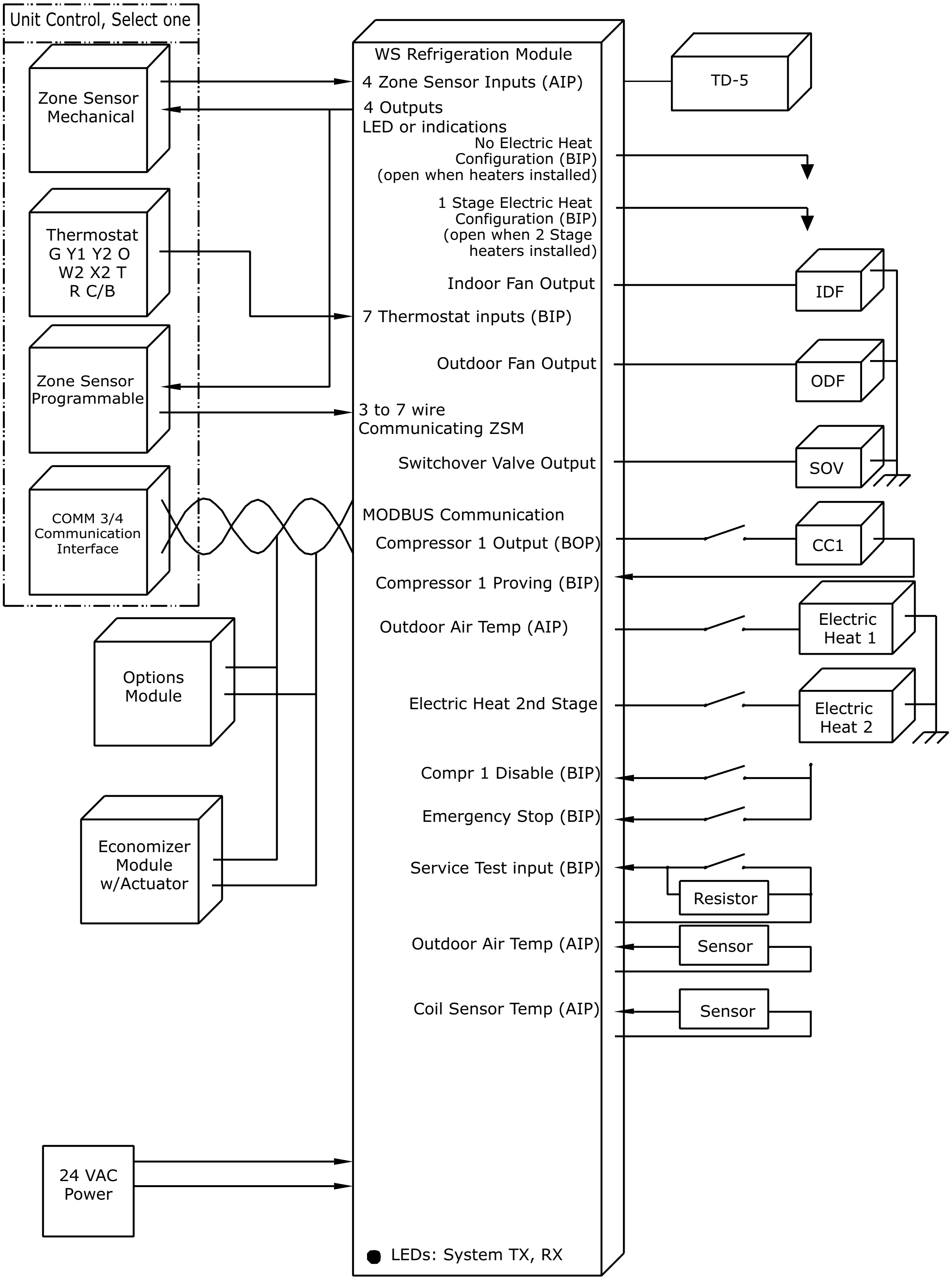


Figure 4. Options module (RTOM)

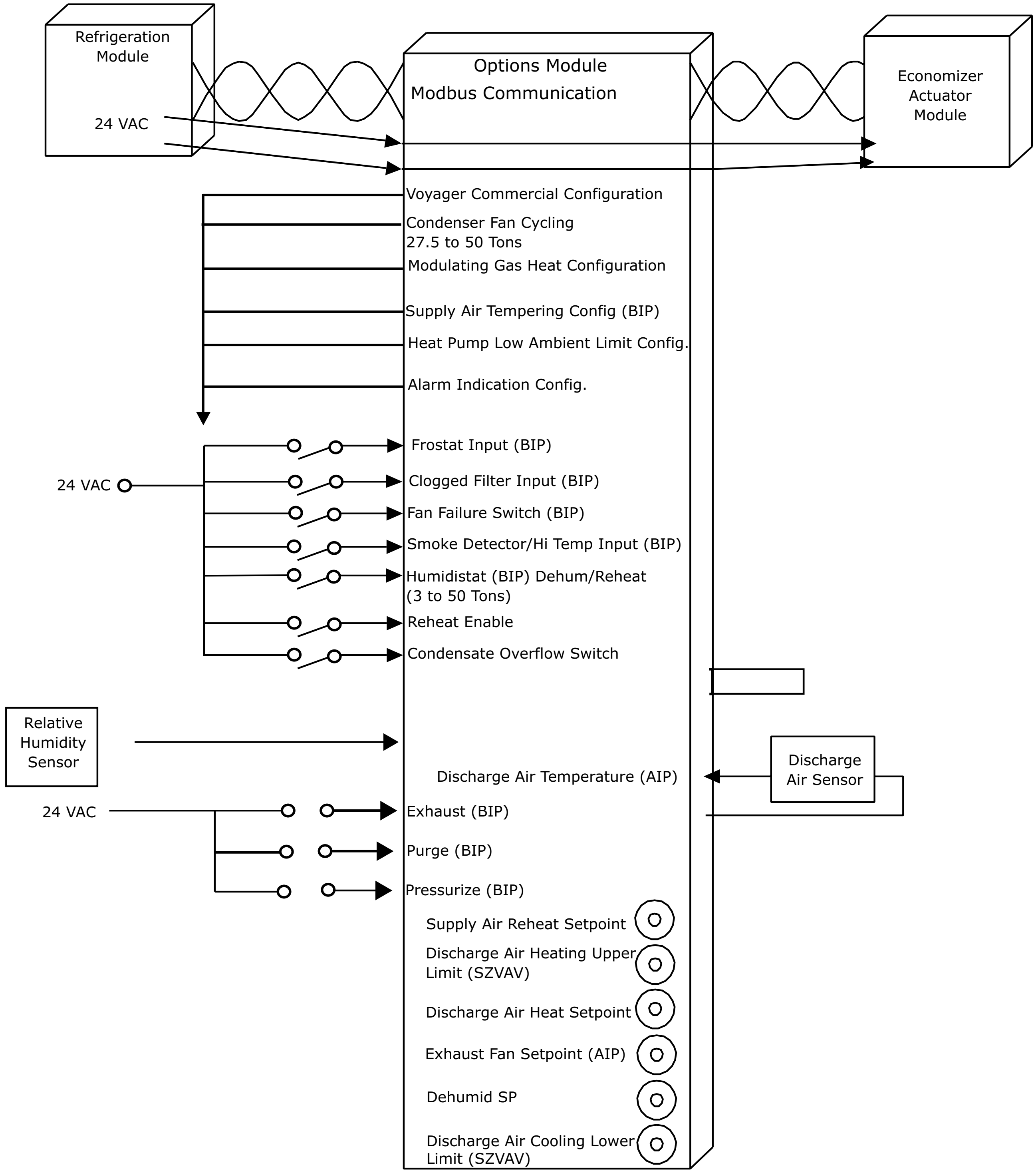
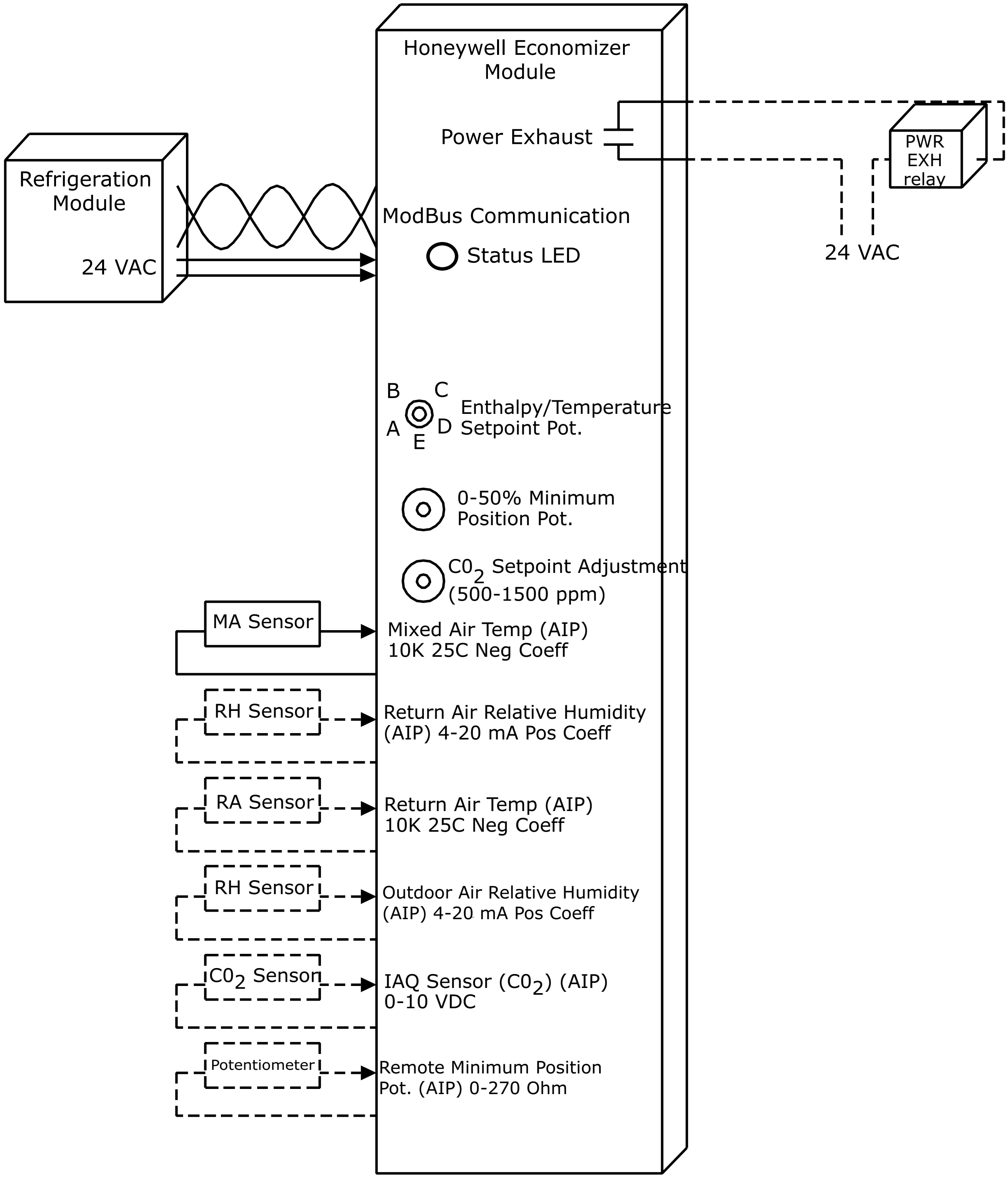


Figure 5. Honeywell economizer module (ECA)



Note: *Not available to order (obsolete).*

Figure 6. Economizer module (RTEM)

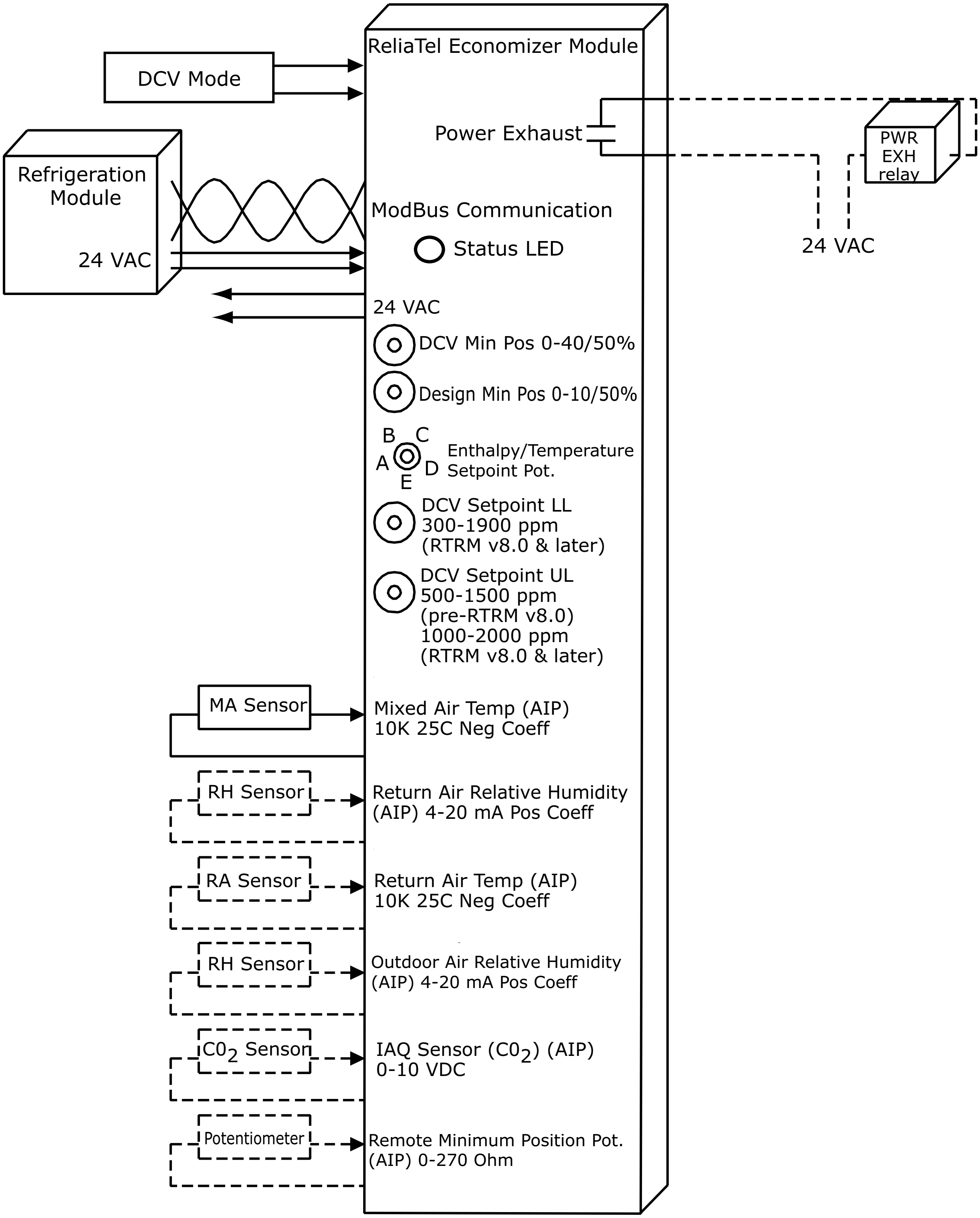


Figure 7. COMM 3/4 module for ICS communication/ LonTalk® Communication Interface (LCI/TCI), BACnet™ (BCI)

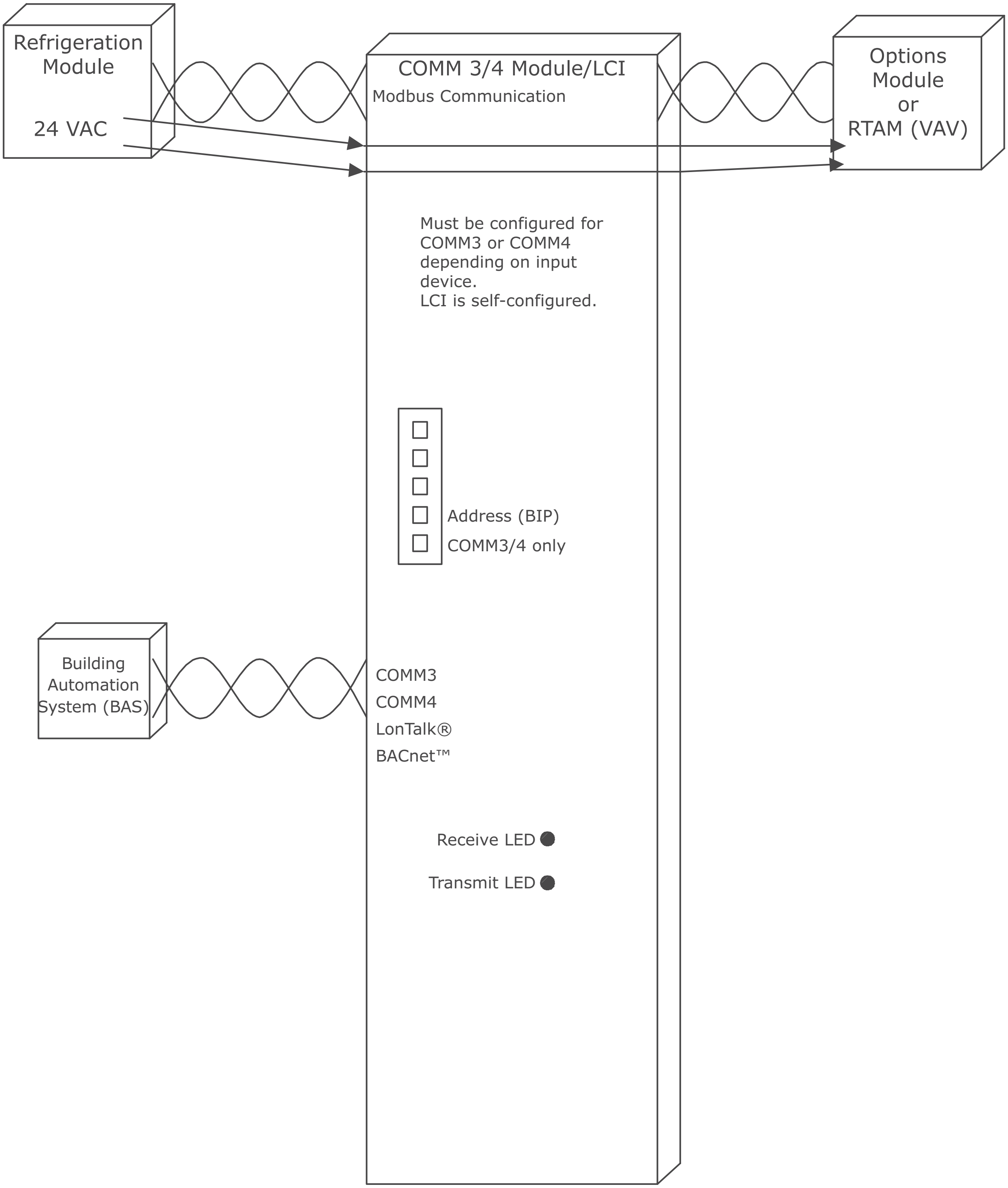


Figure 8. Air control module (RTAM)

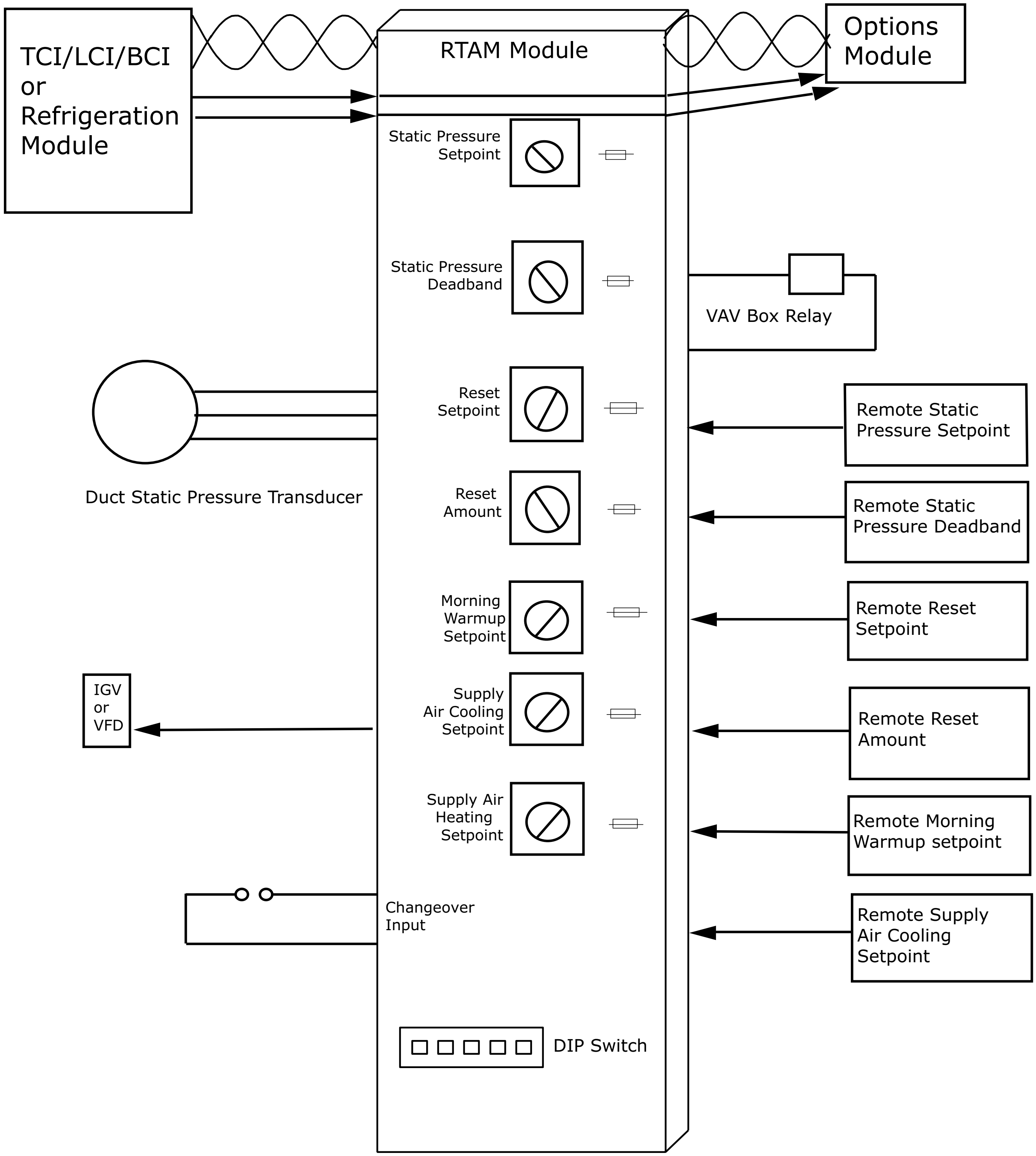


Figure 9. ReliaTel™ ventilation module (RTVM) - 3 to 25 Tons

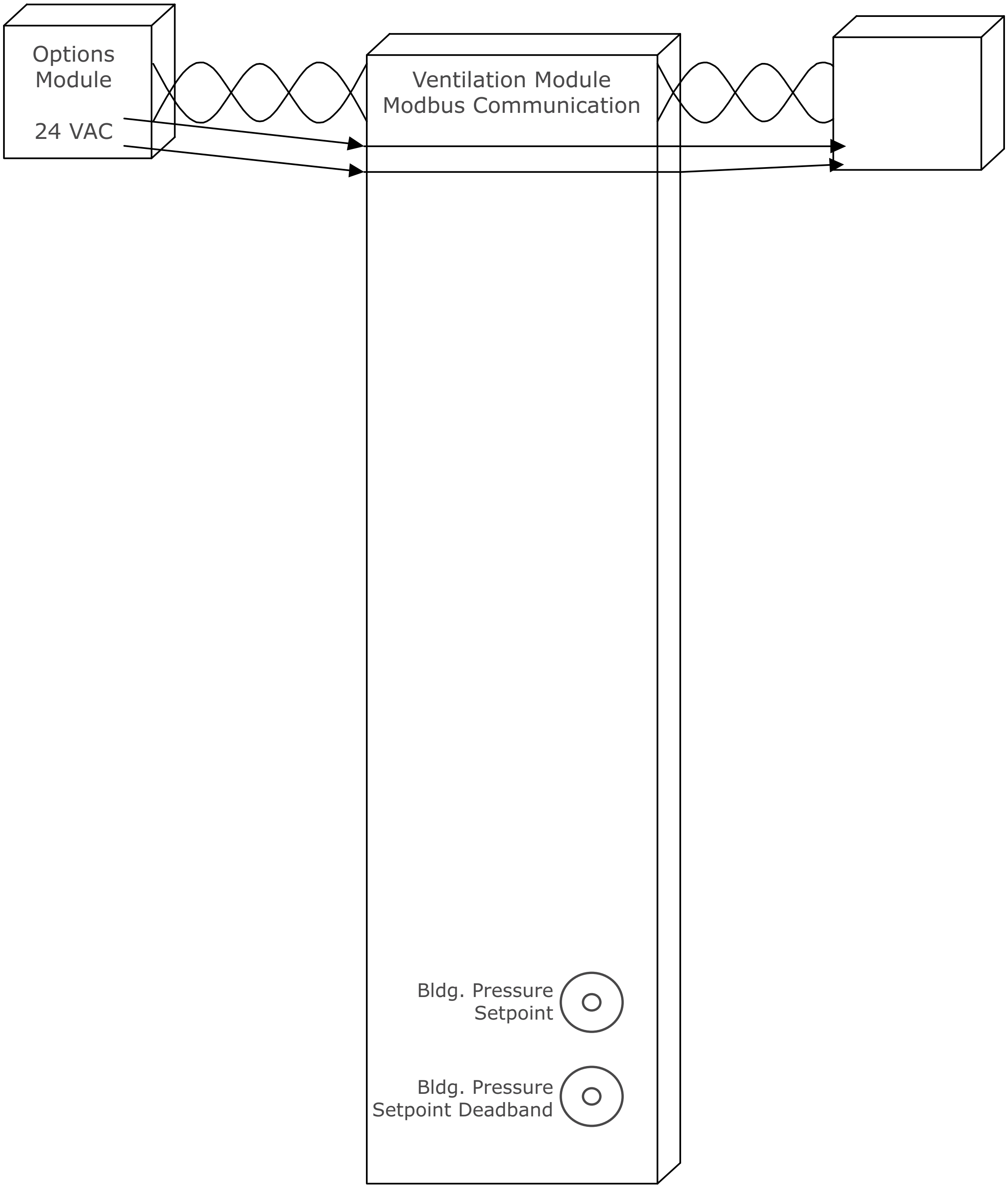


Figure 10. ReliaTel™ ventilation module (RTVM) - 27.5 to 50 Tons

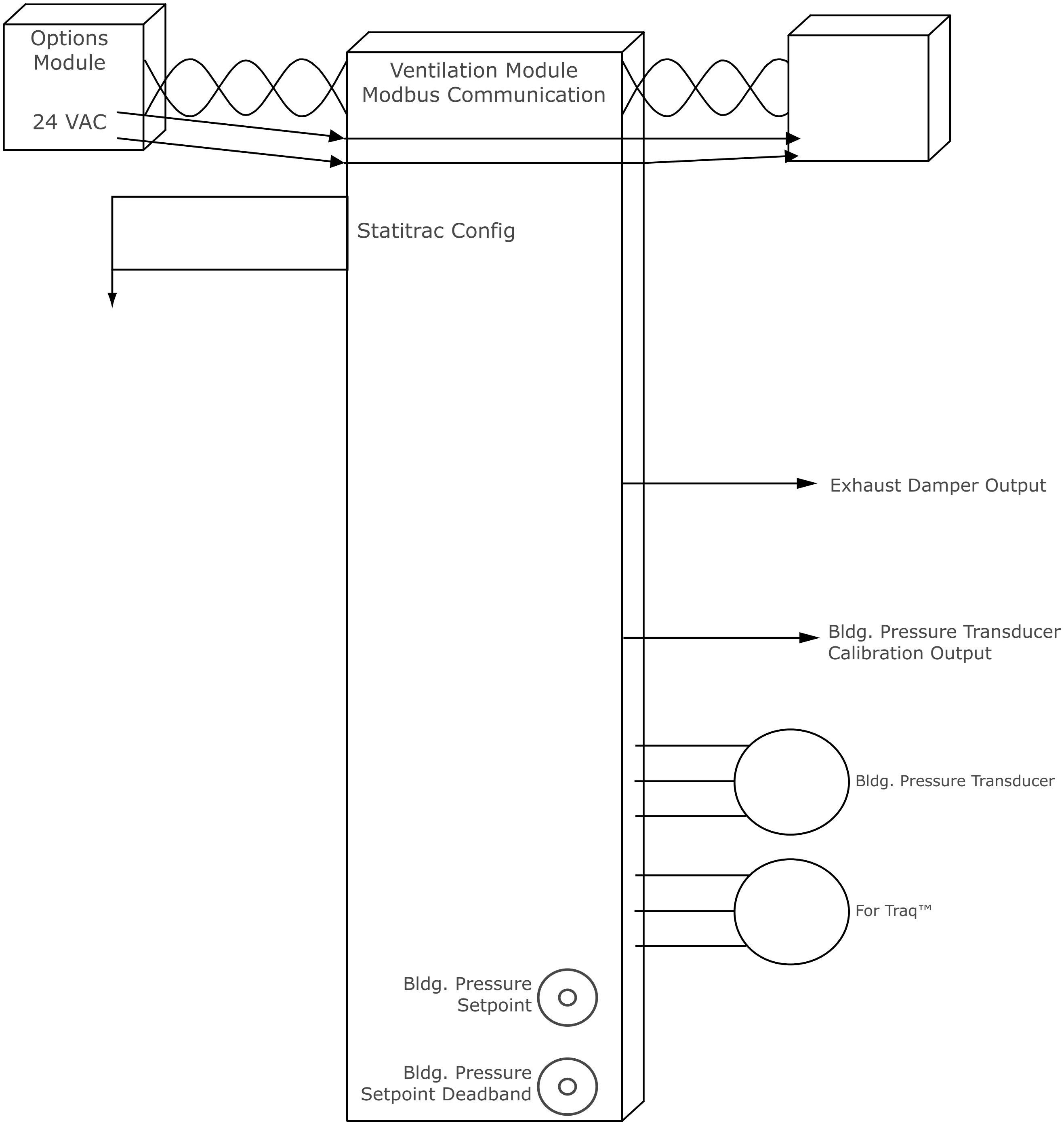


Figure 11. ReliaTel™ dehumidification module (RTDM) - 27.5 to 50 tons only

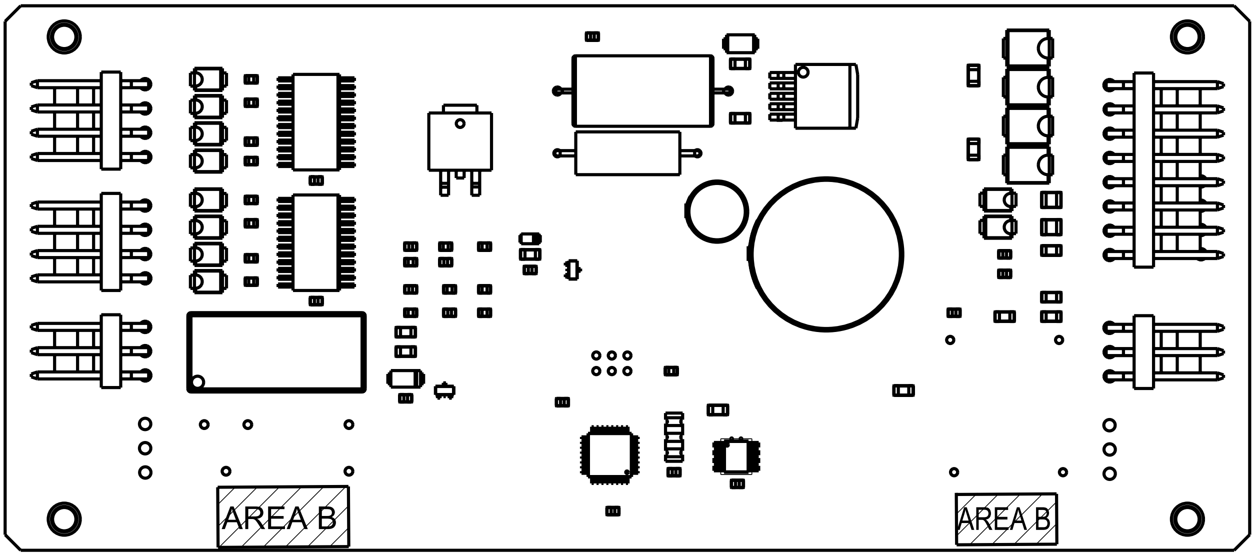
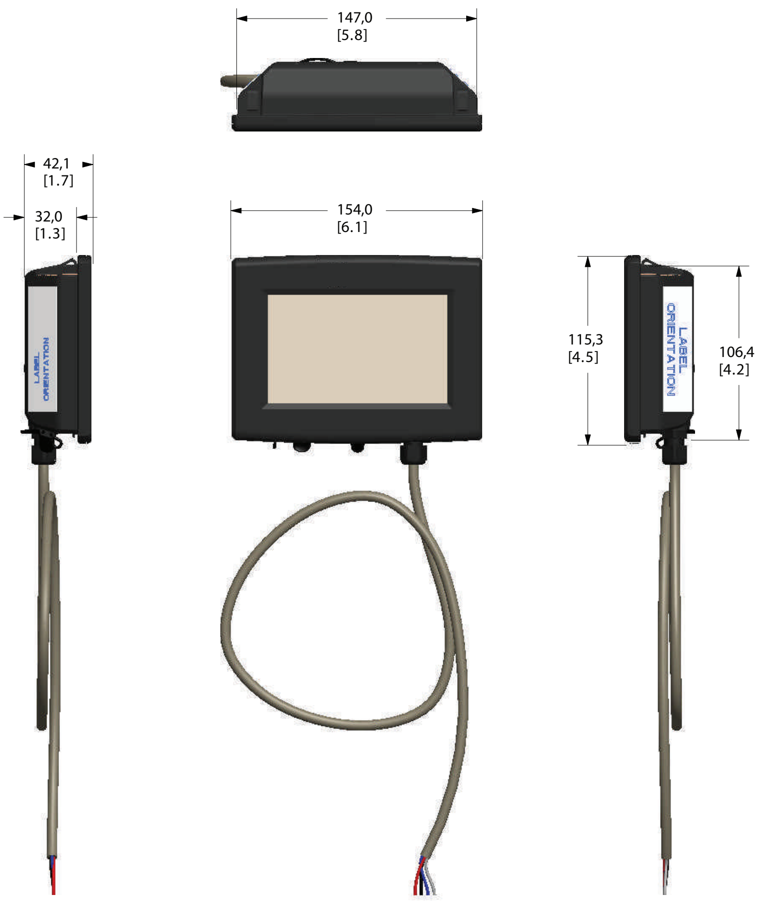
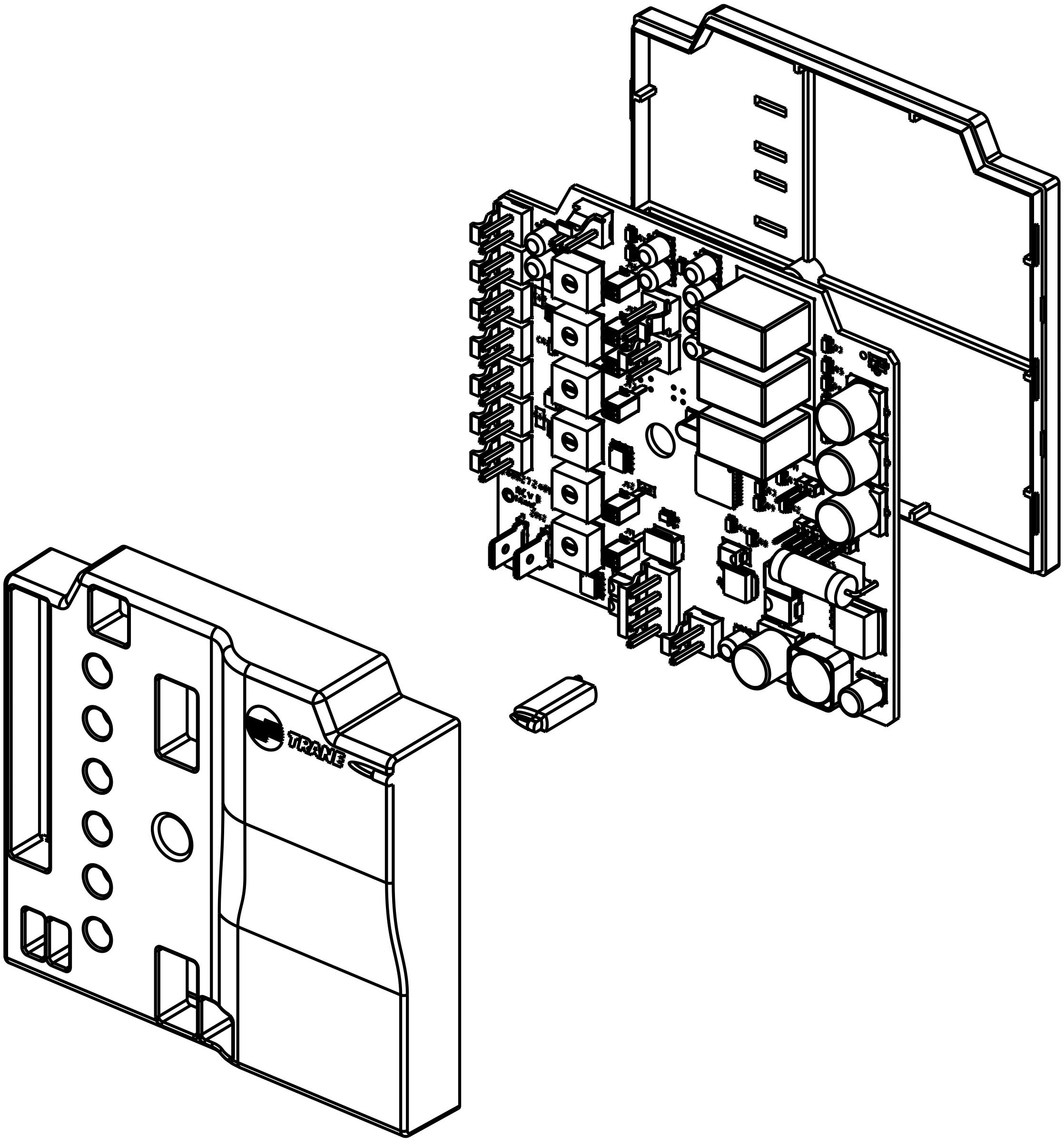


Figure 12. ReliaTel™ TD-5 Human Interface



Note: *For further information, please see literature number RT-SVX49*-EN.*

Figure 13. Electromechanical logic module - RTEM-EM



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 "ReliaTel™ Test Mode," p. 79 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 14. Low voltage terminal strip

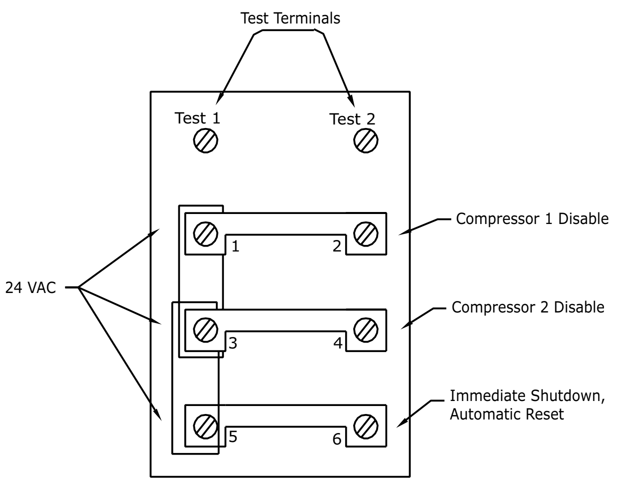


Figure 15. Low voltage terminal strip

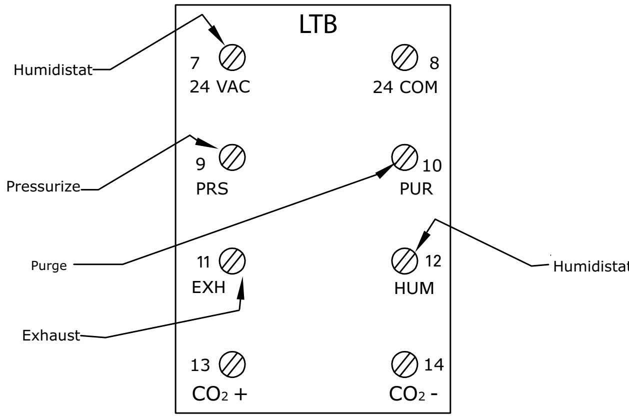
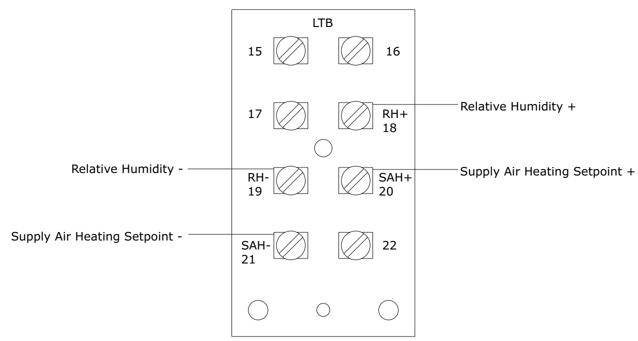


Figure 16. Low voltage terminal strip



Typical Control Box Layout

Figure 17. Typical control box layout (3 to 5 Tons)

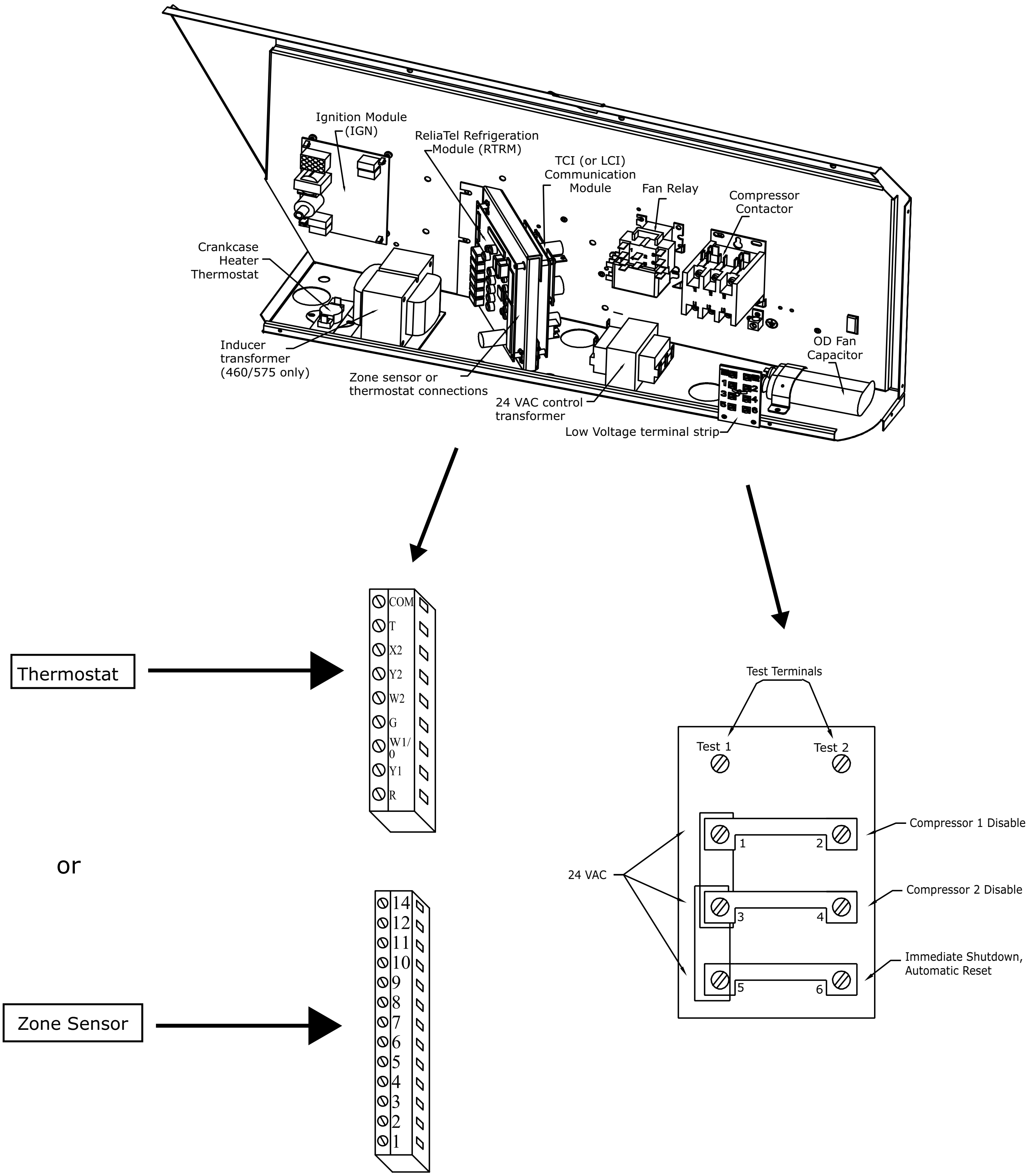


Figure 18. Typical control box layout (T/YSC072-102*, T/YHC048-072*, & WSC060-090*)

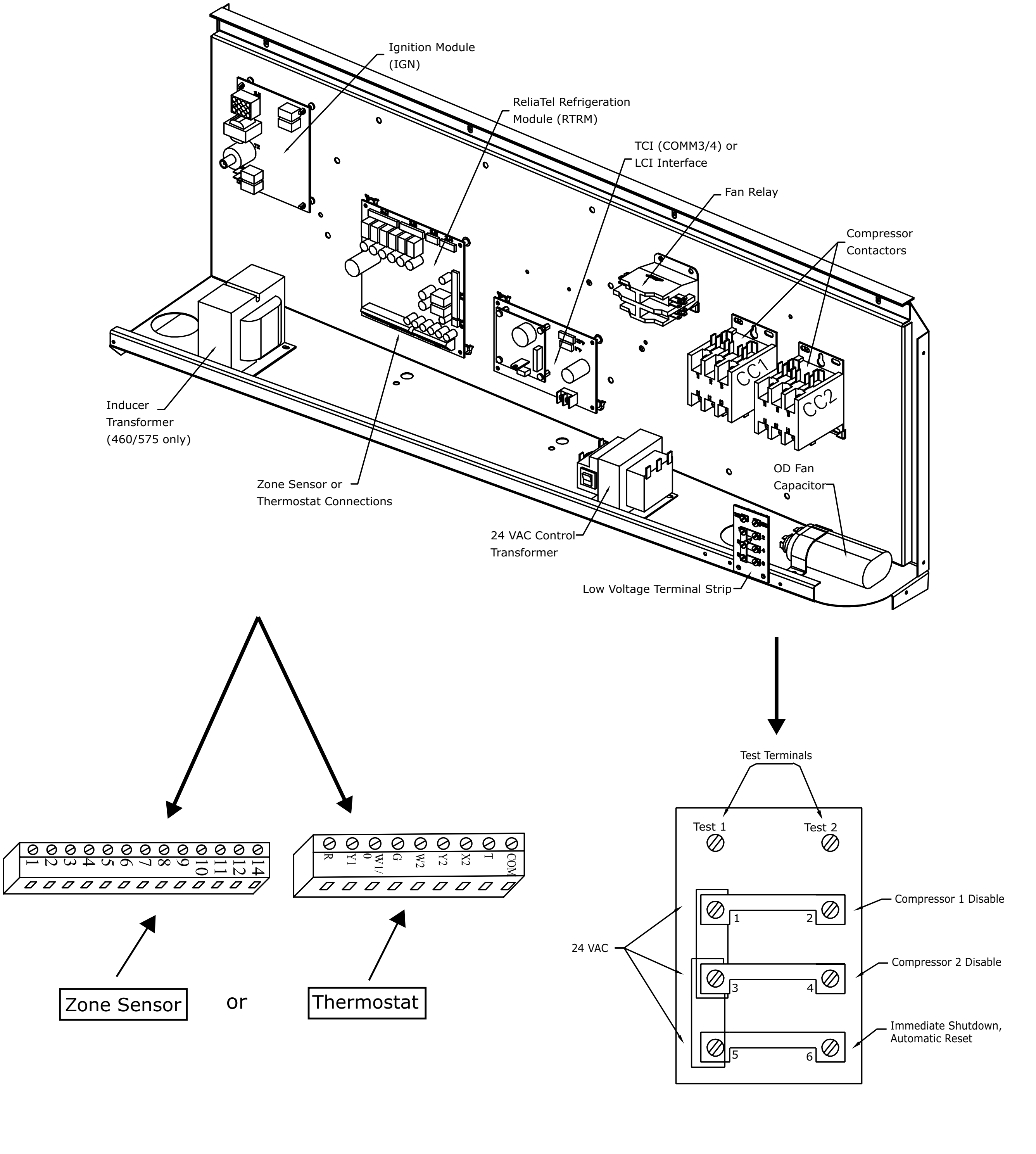


Figure 19. Typical control box layout (T/YSC120*, T/YHC092-120*, & WSC120*)

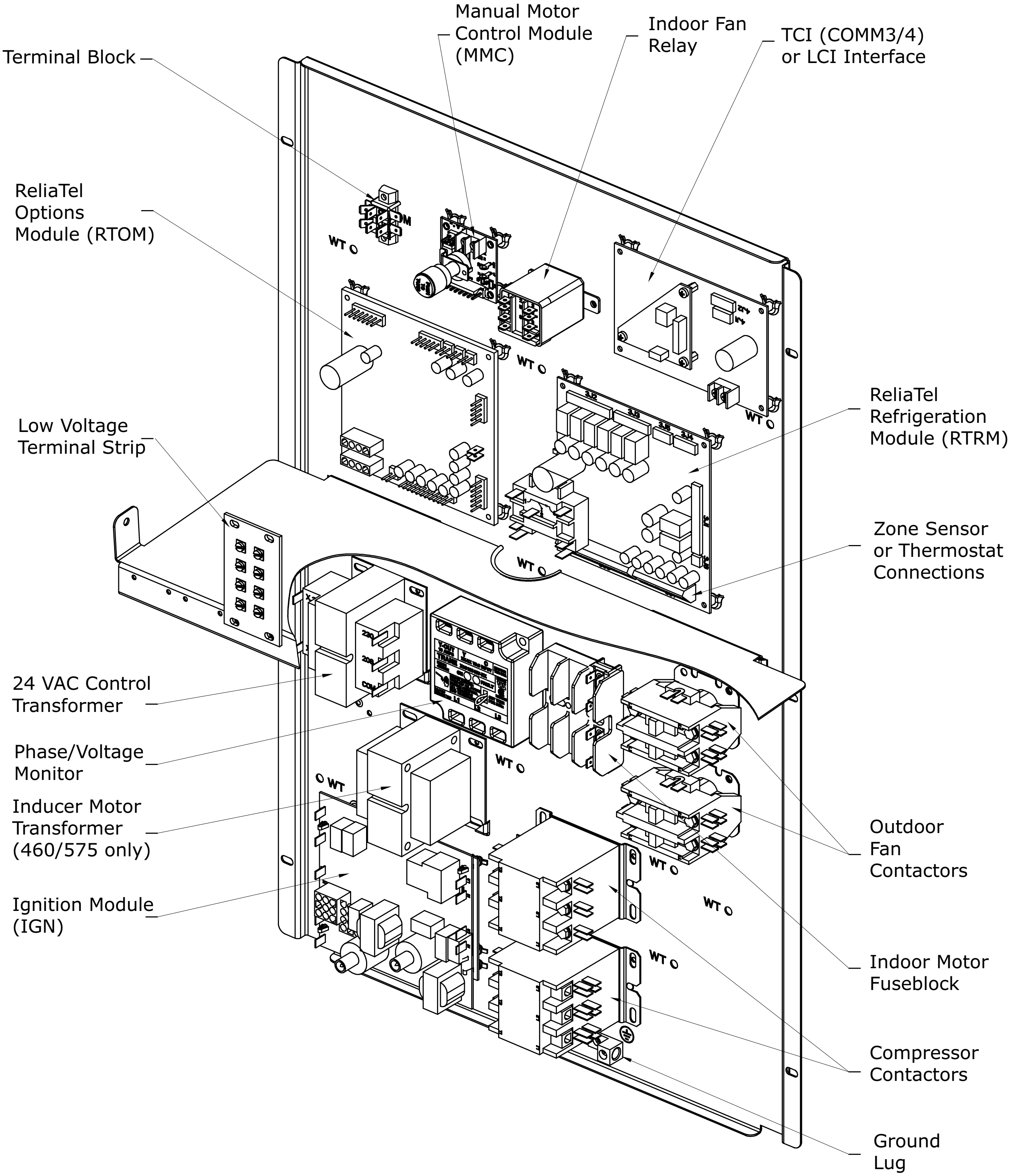


Figure 20. Typical control box layout (12.5 to 25 Tons)

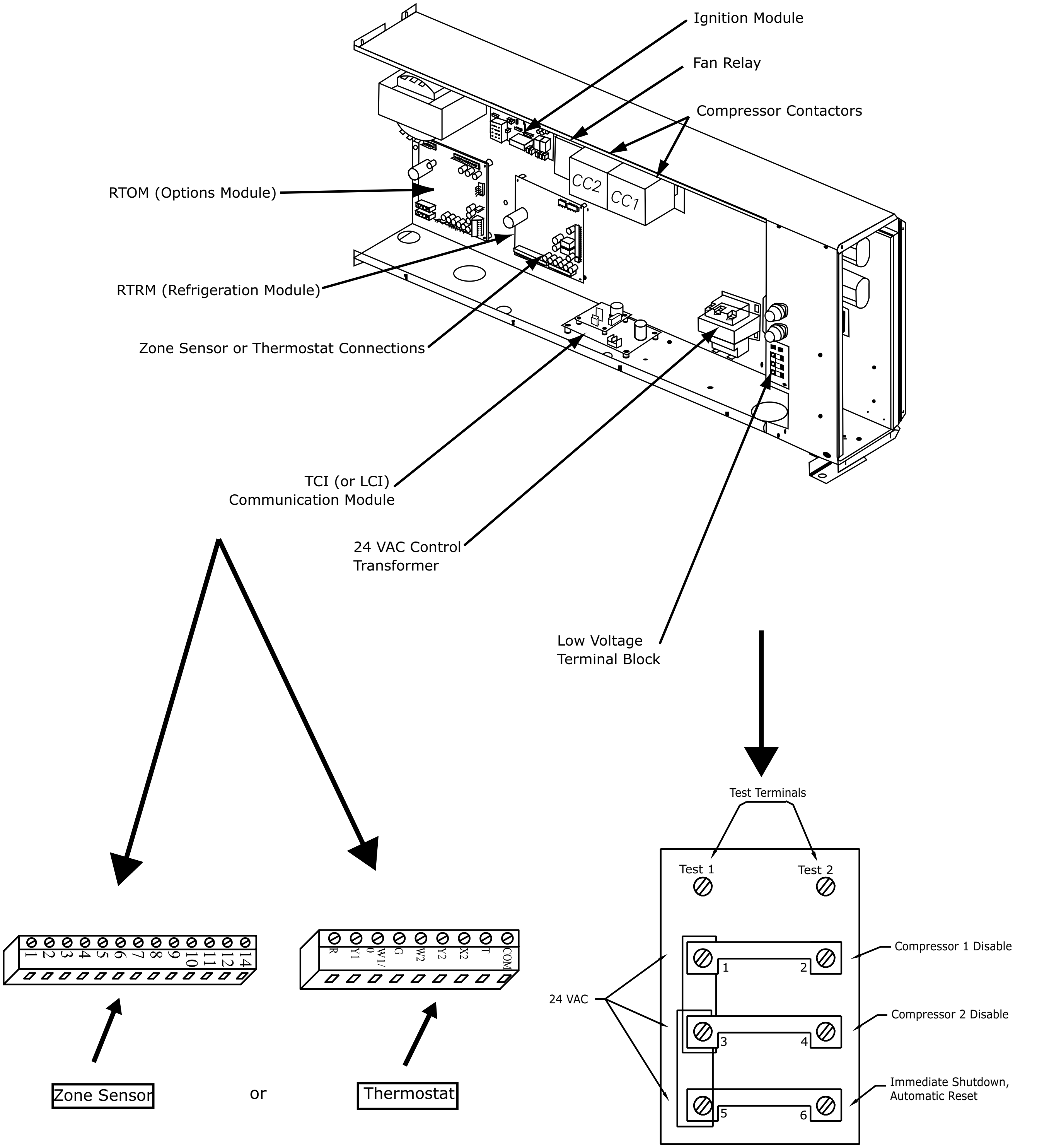


Figure 21. Optional control box layout (12.5 to 25 Tons)

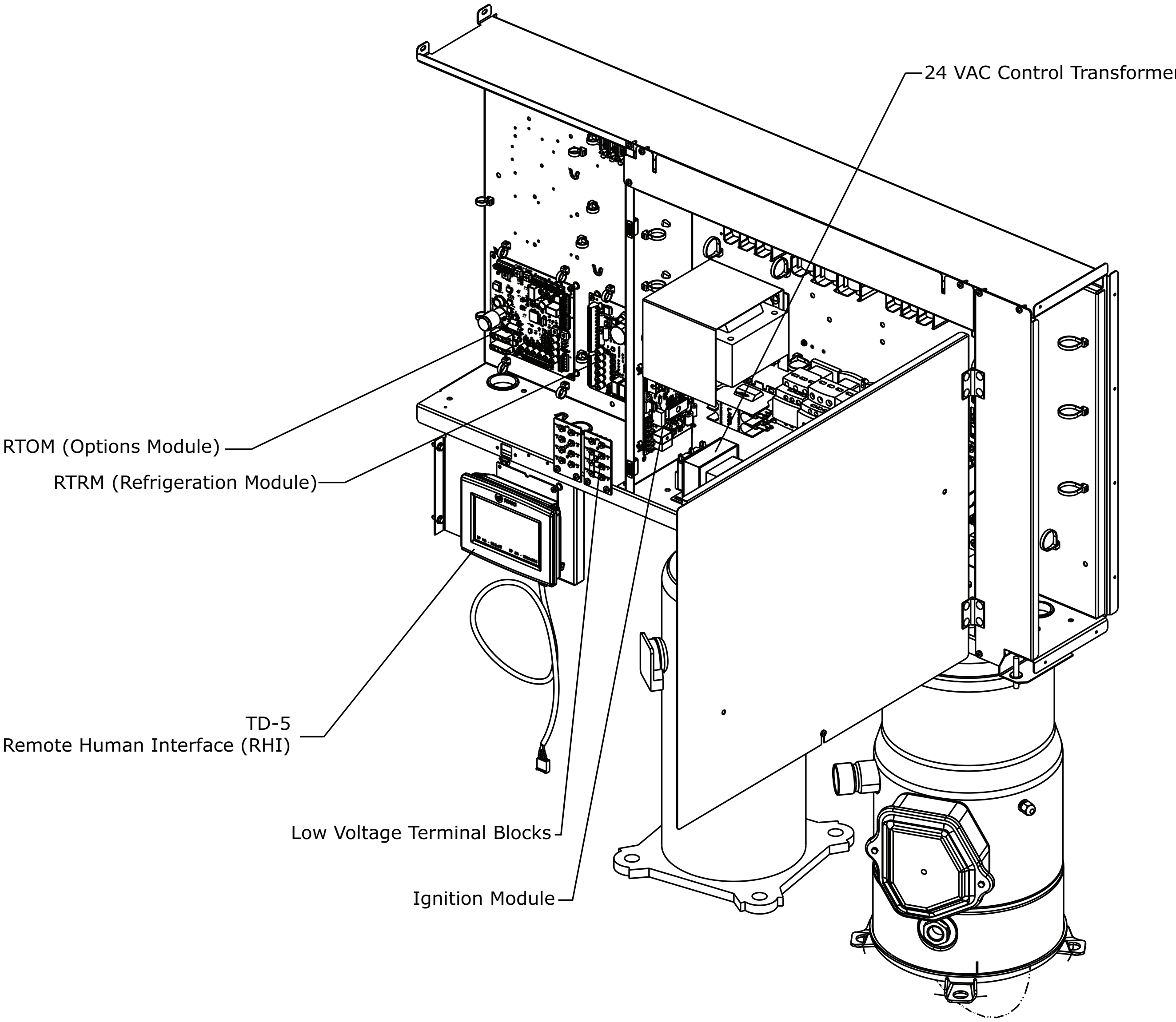
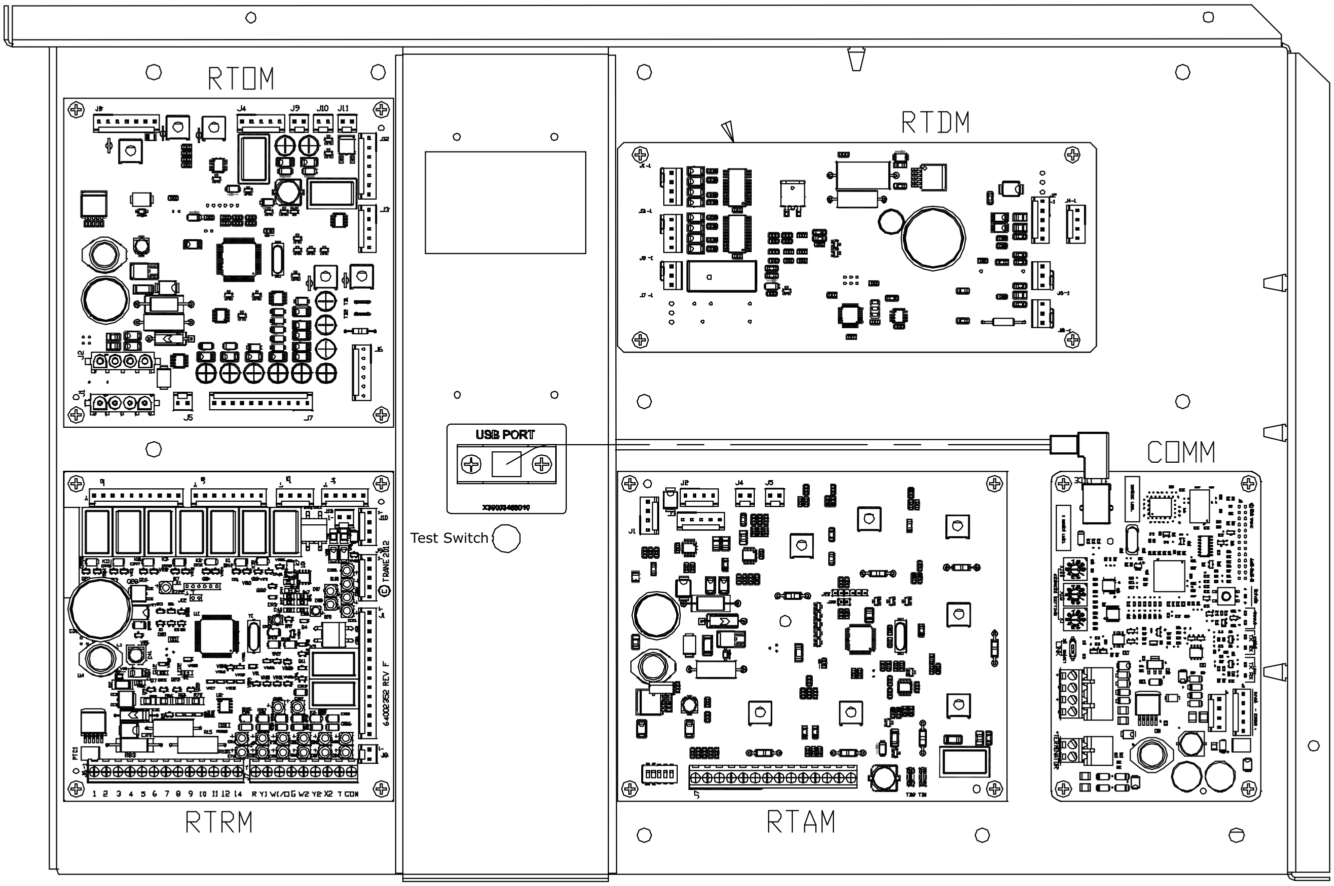
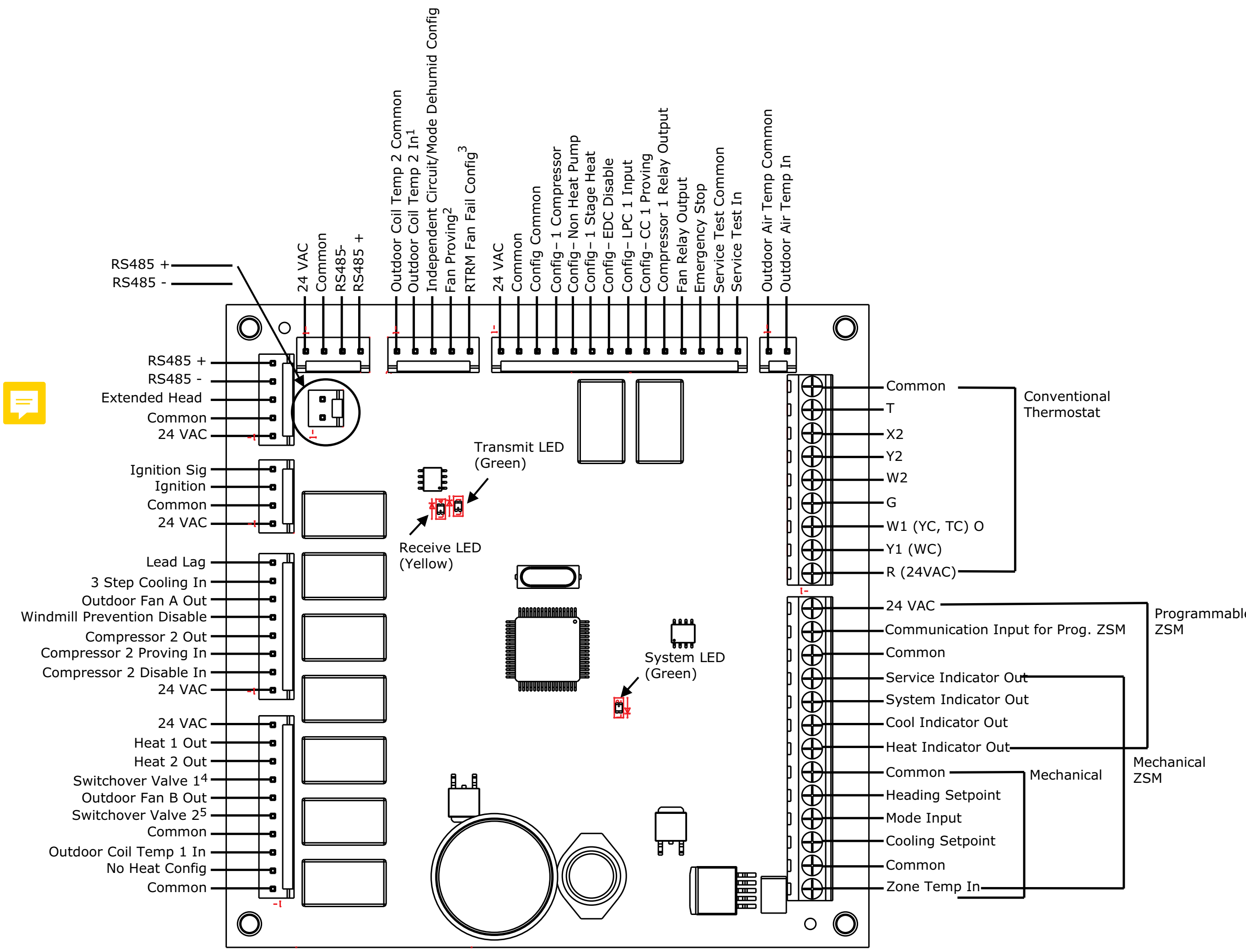


Figure 22. Typical control box layout (27.5 to 50 Tons)



ReliaTel™ Refrigeration Module (RTRM)

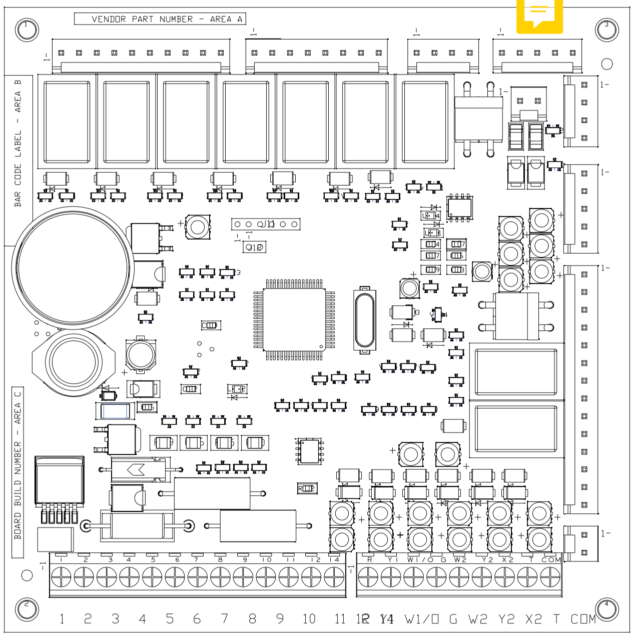
Figure 23. ReliaTel Refrigeration Module (RTRM) - layout



Notes:

1. Also used as 2-Speed Indoor Fan config or Condensing Temperature Input on 6-10 ton eFlex™ configurations.
2. Also used for compressor 3 Proving Input on Voyager 3 and 25 ton Voyager 2 units.
3. Used on SZVAV and Multi-Speed Fan units to configure for Minimum Speed Supply Fan during Economizer Only Operation.
4. Used as compressor 3 out on 4-stage Voyager 2 units.
5. Used as compressor 3 out on 5-stage DX units.

Figure 24. ReliaTel™ refrigeration module (RTRM)



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:

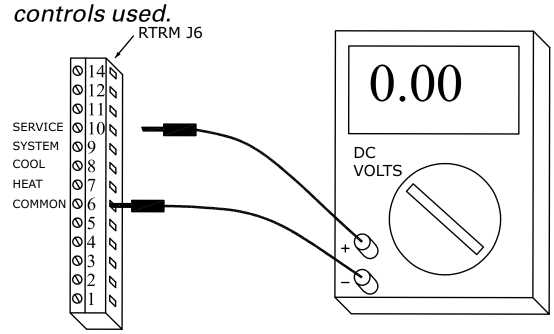
- Supply fan fail
- Zone temperature sensor input failure on CV units
- Programmable ZSM communication failure
- Manual compressor lockout (one or both circuits)
- Outdoor coil temp sensor failure (heat pumps only)
- Defrost fault condition (heat pumps only)
- Gas heat failure
- Discharge air temperature failure on modulating heat and modulating reheat units
- Frostat™ active
- Outdoor air temperature sensor failure
- Smoke detector active
- Entering evaporator temperature failure (on modulating reheat units)
- RTOM communication failure
- RTDM communication failure (on modulating reheat units)
- RTVM communication failure
- Space pressure sensor failure
- Dehumidification mis-configuration
- Reheat circuit entering evaporator temperature failure
- Zone temperature sensor failure during unoccupied mode and on units with modulating reheat (VAV only)
- Static pressure transducer output failure (VAV only)
- High duct static pressure trip (VAV only)
- Discharge air sensor failure (VAV only)

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

Note: *Since constant volume (CV) units 3 to 50 Tons 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

Service - RTRM-J6-10

What the Readings Mean

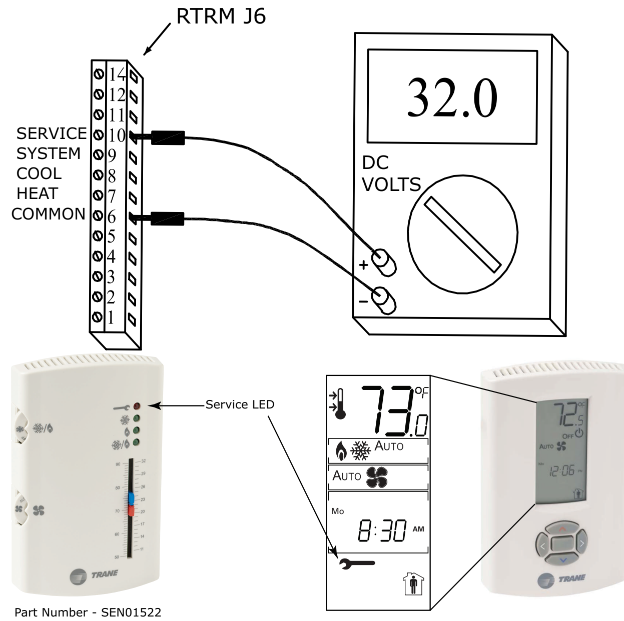
- **ON**

  Clogged filter switch has been closed for at least 2 minutes, indicating a clogged filter. This example illustrates what would be seen if the unit did not have a zone sensor with indicator LEDs, such as would be the case with an ICS system. Table 1, p. 34 lists voltages seen if a zone sensor is attached. Volt meter readings should be within 10%.

- **OFF**
  - Clogged filter switch is in open position or no switch is installed.
  - Fan fail switch (if installed) has opened (3 to 25 Tons) or closed (27.5 to 50 Tons) 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 to 25 Tons) or closed (27.5 to 50 Tons) 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.
  - Freezestat active
  - Smoke detector active

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



System- RTRM-J6-9

What the Readings Mean

- **ON**

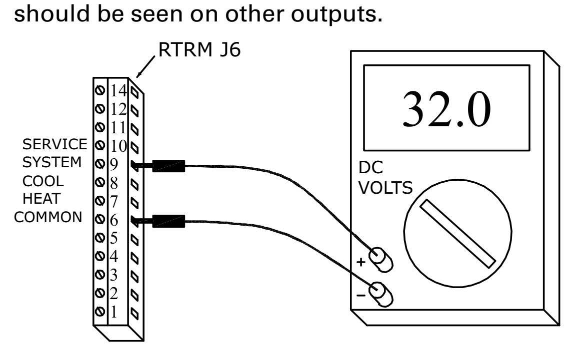
  System is powered up. This output should be on whenever the green RTRM System LED is on. Incidentally, this LED may flicker as part of its normal function on older version boards.

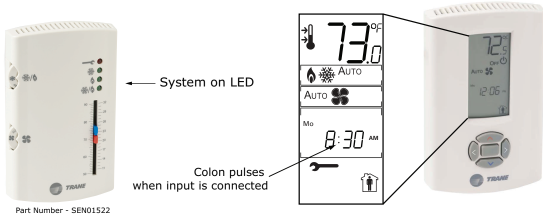
- **OFF**

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

- **PULSING**

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





Cooling-RTRM-J6-8

What the readings mean

- **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**

  Note: *Any controls.*

This indicator can mean one or more of the following:

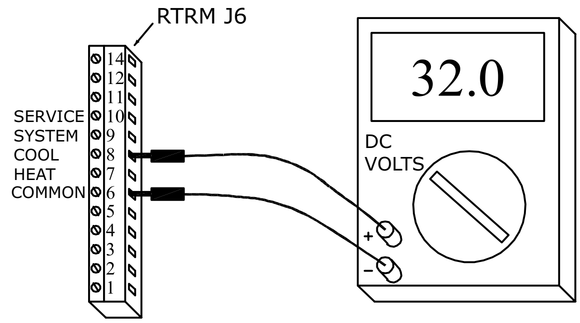
- CC1 or CC2 opens during cooling, or is open when a call for compressor occurs. The unaffected circuit will still run. With RTRM version 4.0 or greater, CC1 or CC2 circuit must open on 3 consecutive cycles. On the 4th trip, the unit will lockout.
- CPR1 disable or CPR 2 disable input has opened during 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.
- Supply air temperature is invalid and unit is VAV or CV with modulating reheat.

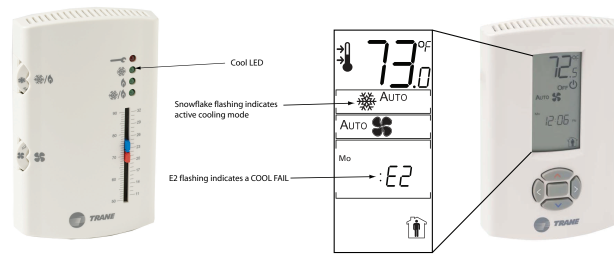
Mechanical ZSM

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

Programmable ZSM

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





Heating-RTRM-J6-7

What the readings mean

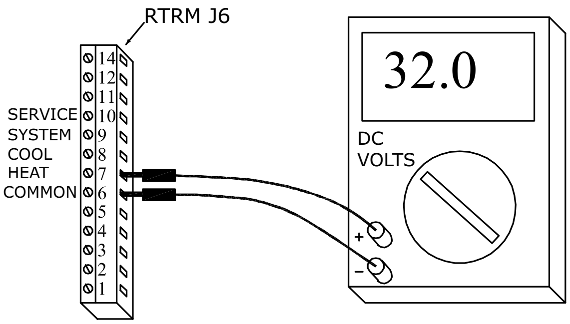
- **ON**

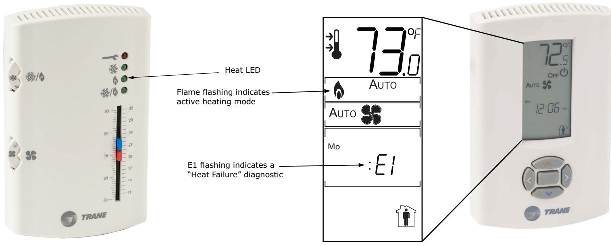
  System is actively heating.

- **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: Unit is in the **“EMERGENCY HEAT”** mode. If the compressor disable circuit or CC1, CC2 circuits create a lockout during **“heating”** mode, a COOL FAIL (pulsing) indication will occur, not a HEAT FAIL (pulsing) indication. See COOL indications for details.
  - Any unit: Supply air temperature sensor failure and unit is CV with modulating heat or modulating reheat.

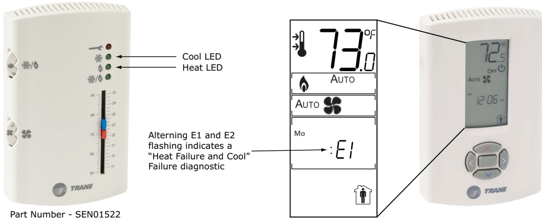




HEAT FAIL and COOL FAIL at the Same Time, RTRM-J6-7 & 8 Pulsing Voltage

What the Readings Mean

- Coil temperature sensor is open or shorted (heat pump only).
- Unit has failed to defrost properly (see heat pump section for further details).
- Outdoor air sensor is open or shorted (RTRM version 4.0 or greater).
- Dehumidification unit - RTOM disconnected or not communicating. RTOM will flash once every few seconds.
- Emergency stop input is open.
- Factory installed phase monitor is indicating a fault.
- Frostat™ input active.
- Smoke detector active.
- Entering evaporator temperature failure (on modulating reheat units).
- RTDM communication failure (on modulating reheat units.

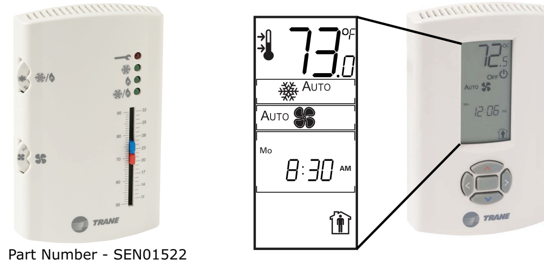


Part Number - SEN01522

Compressor Will not Run, no Diagnostics

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

Supply Fan OFF, no Diagnostic



Part Number - SEN01522

Unit is in **"OFF"** mode locally or through TCI/LCI

Heat Pump - Compressors Will not Run

- 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.

27.5 to 50 Tons 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)

- TCO1, TCO2, or TCO3 has opened.
- IGN module lockout (see gas heat section for troubleshooting).
- Supply air temperature sensor has failed if configured for modulating heat.

COOL

- Discharge air sensor (DTS) is open, shorted, or has failed.
- 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.
- CC1 or CC2 24 VAC control circuit has opened three times during a **"cooling"** mode. Check CC1, CC2 coils or any control in series with the coils (winding thermostat, HPC, circuit breaker auxiliary contacts).

- LPC 1 or LPC 2 has opened during the 3 minute minimum “on” time during 4 consecutive compressor starts. Check LPC 1 circuit by measuring voltage from RTRM J1-8 to chassis ground. Check LPC 2 circuit by measuring voltage from RTRM J3-2 to chassis ground. If 24 VAC is not present, the circuit is open. 24 VAC should present at these terminals at all times.

SERVICE

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

COOL + SERVICE

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

- 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.
- Outdoor air sensor (OAS) input is open, shorted, or has failed.
- RDTM communication failure.
- Entering air temperature evaporator temperature sensor failure.

HEAT + COOL + SERVICE

- Static pressure high duct static trip. The static pressure has exceeded 3.5" W.C. three consecutive times.
- Ground wire on transducer is open.

LonTalk® Communication Interface (LCI)

- 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.
- The MWU terminate setpoint is identified as NCI (network configuration Input) nciSetpoints. occupied heat. The default setpoint is 71F.
- 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) BAYSENS106-111*, AYSTAT106*-109*
- Programmable Zone Sensor BAYSENS119*, 20*, AYSTAT666*
- Conventional thermostat BAYSTAT036-038* (or similar, ASYSTAT701-703*)
- ICS systems – Tracer®, Tracker®, VariTrac®

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

BACnet® Operations

Note: *Reference BACnet® Integration Guide: BAS-SVP09*-EN.*

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 setpoint (CSP)	HSP + 3F if local unit mode is Auto, otherwise local HSP
J6-5*- heating setpoint (HSP)	Local CSP - 3F if local unit mode is Auto, otherwise, local CSP
J6-3&5 - no CSP or HSP from ZSM	74F CSP, 71F HSP
J6-4- mode input from ZSM	Auto changeover with continuous fan
J6-6*- common terminal for 7-10	LEDs 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

Note: * these connections are only on certain model ZSMs

Table 3. Default operation for programmable ZSM

J6 input/connection	if no input/connection this happens:
J6-7- heat indication from RTRM to ZSM	"Heat" will not be displayed while heating "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

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

Note: *Version 1.1 and 1.3 RTRM do not provide heat, cool, service, cool fail, heat fail indications for programmable ZSM. Later versions (with a higher number) do.*

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

Table 4. Default operation for ICS control:

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

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

Table 5. Conventional ZSM thermostat default operation

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

Note: See section on conventional thermostat operation for more on this.

Table 6. 3 to 50 Tons VAV units

Input/connection (3 to 50 Tons 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™ Temporary Operation

3 to 25 Tons

Note: *Does not apply to MZVAV.*

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.

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).

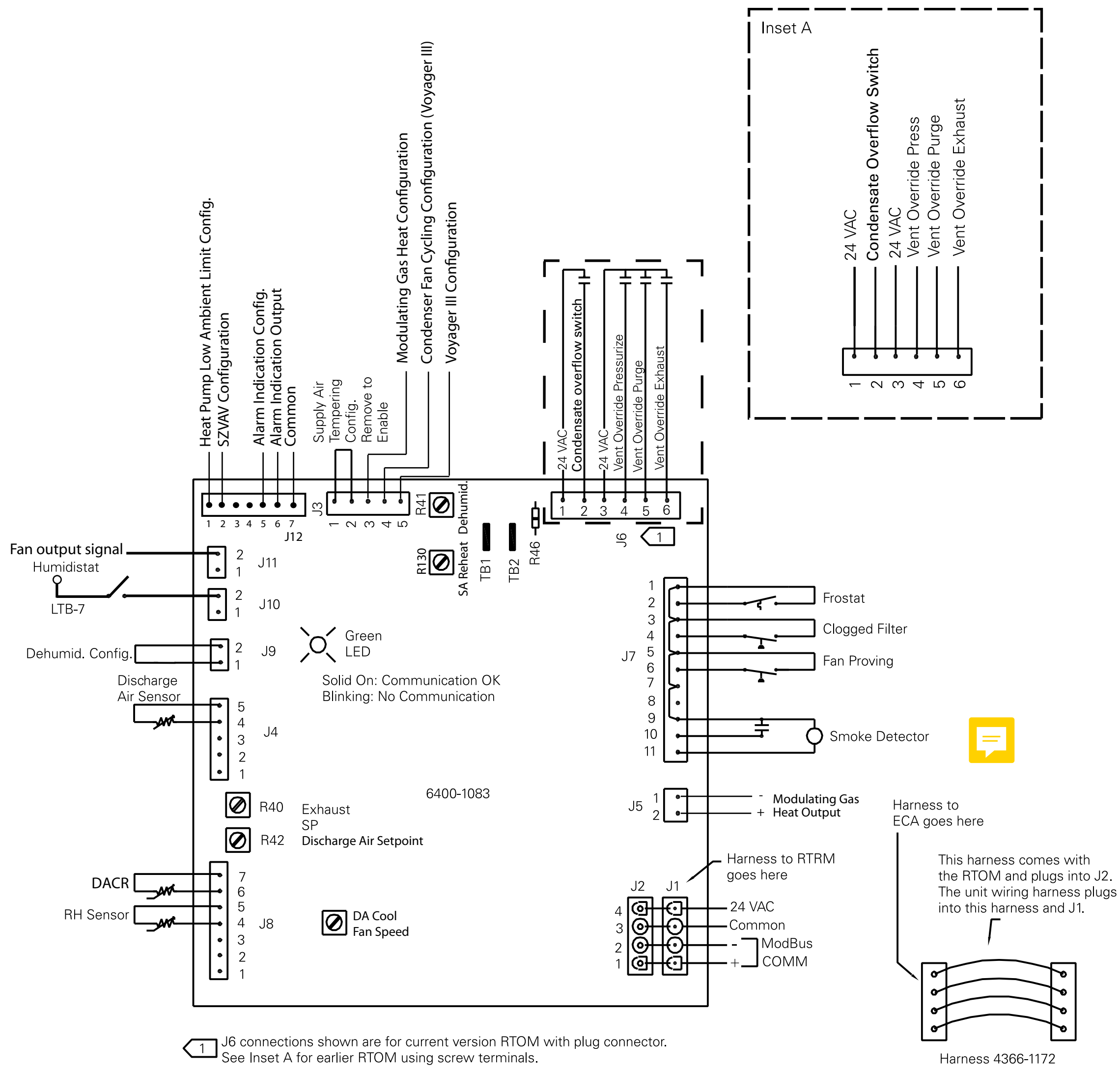
Temporary Sensor (Thermistor) Attached to J6-1 and J6-2 Only

- Continuous fan
- Auto changeover
- 74°F cooling, 71°F heating

  Note: *27.5 to 50 tons - the outdoor air sensor should not be used for this purpose.*

ReliaTel™ Option Module (RTOM)

Figure 25. ReliaTel™ option module (RTOM)



RTOM Location

3 to 10 Tons

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.

12.5 to 50 Tons

The RTOM is installed in the control panel.

RTOM Inputs

J1, J2 Inputs

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

J3 Inputs

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

- J3-3 is modulating gas heat config. input J3-4 is used with 27.5 to 50 ton units to configure condenser fan control type.
- J3-5 is used to configure the unit as a Voyager™ Commercial unit. (27.5 to 50 ton units only).

Input is also used on 25 ton high efficiency Voyager™ Light Commercial products to indicate 4 stages of cooling are required.

J4 Output

The Precedent™ 6-10 Tons High Efficiency Heat Pump units utilize a J4 output for compressor staging.

J4 Input

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.

J7 Inputs

- **Frostat™**

3 to 25 tons	Closes 10F ±2º Opens 50F ±2º
27.5 to 50 tons	Closes 30F ±2º Opens 40F ±2º

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

- **Clogged filter switch** is factory set to close at 0.45", however is adjustable from 0.05" to 12.0". A 7/32" allen wrench is required for this adjustment. When the switch is closed for 2 minutes, the service indicator on the ZSM will be on (see diagnostics section for details). When the switch opens, the indicator is off (auto reset).
- **Fan proving switch (3 to 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 (27.5 – 50 tons)** is factory set to close at 0.15", and is adjustable from 0.05" to 12.0", though adjustment is not recommended. If the switch does not close within 40 seconds after the fan starts, the unit stops, requiring manual reset from the zone sensor or BAS system, or by resetting power to the unit. The SERVICE indicator on the ZSM will pulse during fan fail mode.
- **Smoke detector** contacts are open during normal operation. When closed, the unit shuts down immediately. When the contacts are re-opened, the unit will automatically restart.

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

J8 Input

DACR potentiometer for SZVAV use or configuration jumper for multi speed use. **Relative humidity sensor** provides input to reheat for dehumidification.

J9 Input

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

J10 Input

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

J11 Output

Fan control output for Multi-speed and SZVAV.

J12 Input

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

Precedent™ High Efficiency Heat Pumps low ambient limit provides a configuration input to disable compressor heating on heat pumps when the outdoor temperature falls below 30°F. It is user adjustable with a BAS or a TD5.

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

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

Setpoint Potentiometers

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

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

SA reheat setpoint potentiometer - For 27.5 to 50 ton Voyager™ Commercial units, used to set the Supply Air Reheat setpoint for units with Modulating Dehumidification.

Dehumid. setpoint - For units with reheat (on/off and modulating) installed, used to set the space humidity setpoint used for dehumidification control.

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

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

Table 7. RTOM discharge air heat setpoint

Voltage (Vdc)	Setpoint (ºF)
0	50
0.09	51
0.13	52
0.16	53
0.2	54
0.24	55
0.28	56
0.31	57
0.35	58
0.42	60
0.46	61
0.5	62
0.53	63
0.57	64
0.61	65
0.65	66
0.68	67
0.72	68
0.76	69
0.79	70
0.83	71
0.87	72
0.9	73
0.94	74
0.98	75
1	76
1.03	77
1.06	78
1.08	79
1.11	80
1.13	81
1.16	82
1.18	83
1.21	84
1.23	85
1.26	86
1.28	87
1.31	88
1.33	89
1.36	90
1.38	91
1.41	92
1.43	93
1.46	94
1.48	95
1.51	96
1.53	97
1.56	98
1.58	99
1.61	100
1.63	101
1.66	102
1.69	103
1.71	104
1.72	105
1.74	106
1.76	107
1.78	108
1.79	109
1.81	110
1.83	111
1.84	112
1.86	113
1.88	114
1.89	115
1.91	116
1.93	117
1.95	118
1.96	119
1.98	120
2	121
2.01	122
2.03	123
2.05	124
2.06	125
2.08	126
2.09	127
2.11	128
2.12	129
2.13	130
2.13	131
2.14	132
2.16	133
2.17	134
2.19	135
2.2	136
2.21	137
2.23	138
2.24	139

Table 7. RTOM discharge air heat setpoint (continued)

Voltage (Vdc)	Setpoint (°F)
2.25	140
2.26	141
2.28	142
2.29	143
2.3	144
2.32	145
2.33	146
2.34	147
2.36	148
2.37	149
2.4	150

Table 8. RTOM supply air reheat setpoint

Voltage (Vdc)	Setpoint (°F)
0.002	65
0.169	65.5
0.317	66
0.395	66.5
0.552	67
0.672	67.5
0.785	68
0.915	68.5
1.028	69
1.114	69.5
1.206	70
1.275	70.5
1.365	71
1.445	71.5
1.525	72
1.61	72.5
1.683	73
1.766	73.5
1.822	74
1.887	74.5
1.94	75
1.998	75.5
2.064	76
2.118	76.5
2.175	77
2.196	77.5
2.234	78
2.275	78.5
2.318	79
2.368	79.5
2.415	80

Table 9. RTOM dehumidification setpoint

Voltage (Vdc)	Setpoint (%)
0.002	40
0.238	41
0.445	42
0.539	43
0.677	44
0.811	45
0.984	46
1.117	47
1.245	48
1.349	49
1.428	50
1.552	51

Table 9. RTOM dehumidification setpoint (continued)

Voltage (Vdc)	Setpoint (%)
1.625	52
1.745	53
1.824	54
1.853	55
1.929	56
1.978	57
2.07	58
2.136	59
2.184	60
2.259	61
2.268	62
2.324	63
2.397	64

Discharge Air (DA) Cooling - Setpoint Lower Limit

Voyager™ Light Commercial

eFlex™ units will utilize a discharge air cool limit potentiometer located on the RTOM (R-136).

Note: *This is not a DA setpoint, but a DA setpoint lower limit.*

Adjust the limit potentiometer by measuring the R-136 potentiometer test point loop to ground and comparing it to the chart shown here.

Note: *50° to 55°F for most applications.*

Table 10. Voyager™ DA cool limit temp/voltage

°F	VDC
40	0.1
41	0.2
42	0.3
43	0.4
44	0.55
45	0.7
46	0.8
47	0.95
48	1.05
49	1.15
50	1.25
51	1.3
52	1.35
53	1.45
54	1.55
55	1.65
56	1.7
57	1.75
58	1.83
59	1.9
60	1.95
61	2
62	2.05
63	2.1
64	2.13
65	2.17
66	2.21

Precedent™

Table 11. Precedent™ DA cool limit temp/voltage

°F	VDC
40	0.1
41	0.2
42	0.3
43	0.4
44	0.55
45	0.7
46	0.8
47	0.95
48	1.05
49	1.15
50	1.25
51	1.3
52	1.35
53	1.45
54	1.55
55	1.65
56	1.7
57	1.75
58	1.83
59	1.9
60	1.95
61	2
62	2.05
63	2.1
64	2.13
65	2.17
66	2.21

Figure 26. DC volts measured from TP to GND

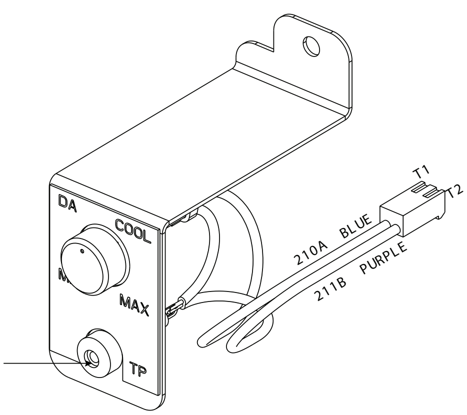


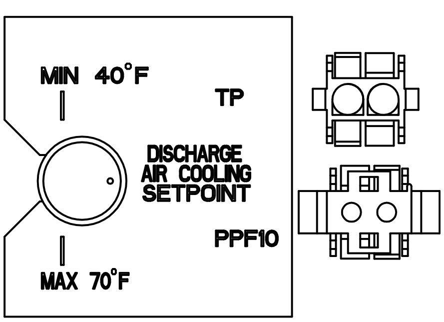
Table 12. Odyssey™ DA cool setpoint (mounted above keyboard)

°F	VDC
40	<0.1
41	0.2
42	0.3
43	0.45
44	0.55
45	0.7
46	0.8
47	0.95
48	1.05
49	1.15
50	1.25
51	1.3
52	1.35
53	1.45
54	1.55
55	1.65
56	1.7
57	1.75
58	1.83
59	1.9
60	1.95
61	2
62	2.05
63	2.1
64	2.13
65	2.17
66	2.21
67	2.27
68	2.3
69	2.35
70	>2.40

Note: The potentiometer voltage readings can be verified via the provided test points located next to each potentiometer. Use a DC voltmeter to the Vdc reading between those points and common.

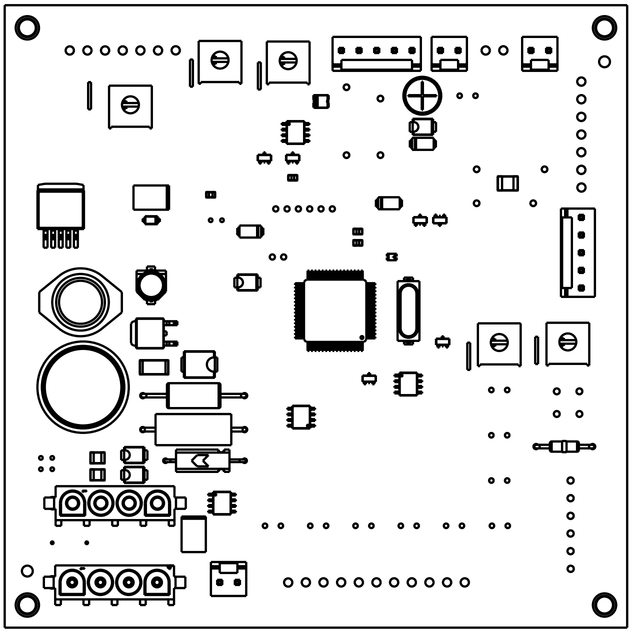
Odyssey™

Figure 27. Odyssey™ DA cooling setpoint lower limit



ReliaTel™ Ventilation Module (RTVM)

Figure 28. ReliaTel™ ventilation module (RTVM) - 3 to 50 Tons



The light commercial RTVM is used with 17 Plus, multispeed evaporator fan and SZVAV units with demand controlled ventilation (DCV/CO_2).

- BAYRTVM001* KIT for Voyager™ 12.5 to 25 tons
- BAYCO2K101* / ASYSTAT721* 17 Plus, multi-speed and SZVAV Precedent™ (wall mount)
- BAYCO2K103* / ASYSTAT721* 17 Plus, multi-speed and SZVAV Precedent™ (duct mount)

RTVM Location - 27.5 to 50 Tons

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

Light Commercial RTVM Inputs

J1, J2 Inputs

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

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

RTVM Inputs

J1, J2 Inputs

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

J2 provides 24VAC power and MODBUS communication downstream to the ECA.

J3 Inputs

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

Note: *Precedent™ Eflex units with modulating gas heat use the RTVM for additional hardware. The J3-1 and 4 inputs are closed to configure the RTVM for mod gas usage.*

J4 Inputs

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

Note: *Precedent Eflex units with modulating gas heat use the J4-3 input for an Airflow Monitoring Transducer (AFT) for the heat exchanger.*

J5 Output

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

J11 Output

J11 - 1, 2 provides a 23Vdc output and common for space pressure transducer calibration. This output is energized once every 60 seconds.

Setpoint Potentiometers

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

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

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

Table 13. RTVM space pressure setpoint

Voltage (Vdc)	Setpoint (IWC)
0.04	-0.2
0.118	-0.19
0.196	-0.18
0.274	-0.17
0.352	-0.16
0.43	-0.15
0.508	-0.14
0.586	-0.13

Table 13. RTVM space pressure setpoint (continued)

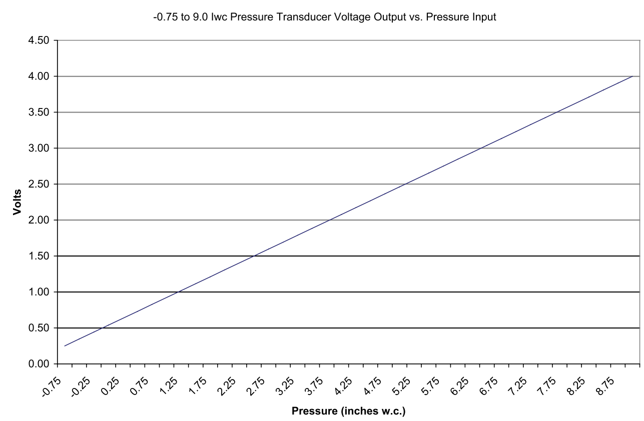
Voltage (Vdc)	Setpoint (IWC)
0.664	-0.12
0.742	-0.11
0.82	-0.1
0.898	-0.09
0.976	-0.08
1.02	-0.07
1.08	-0.06
1.129	-0.05
1.178	-0.04
1.227	-0.03
1.276	-0.02
1.325	-0.01
1.374	0
1.423	0.01
1.472	0.02
1.521	0.03
1.57	0.04
1.619	0.05
1.668	0.06
1.72	0.07
1.759	0.08
1.798	0.09
1.82	0.1
1.8565	0.11
1.893	0.12
1.9295	0.13
1.966	0.14
2.0025	0.15
2.039	0.16
2.0755	0.17
2.112	0.18
2.1485	0.19
2.15	0.2
2.17	0.21
2.19	0.22
2.22	0.23
2.25	0.24
2.275	0.25
2.3	0.26
2.325	0.27
2.35	0.28
2.375	0.29
2.42	0.3

Table 14. RTVM space pressure setpoint deadband

Voltage (Vdc)	Setpoint (IWC)
0.2	0.02
0.35	0.03
0.53	0.04
0.71	0.05
0.91	0.06
1.1	0.07
1.235	0.08
1.37	0.09
1.505	0.1
1.65	0.11
1.75	0.12
1.85	0.13
1.95	0.14
2.05	0.15
2.13	0.16
2.21	0.17
2.28	0.18
2.35	0.19
2.42	0.2

DCV Setpoints - Traq™

Figure 29. Statitrac™ transducer voltage output vs. pressure - RTVM - 27.5 to 50 Tons

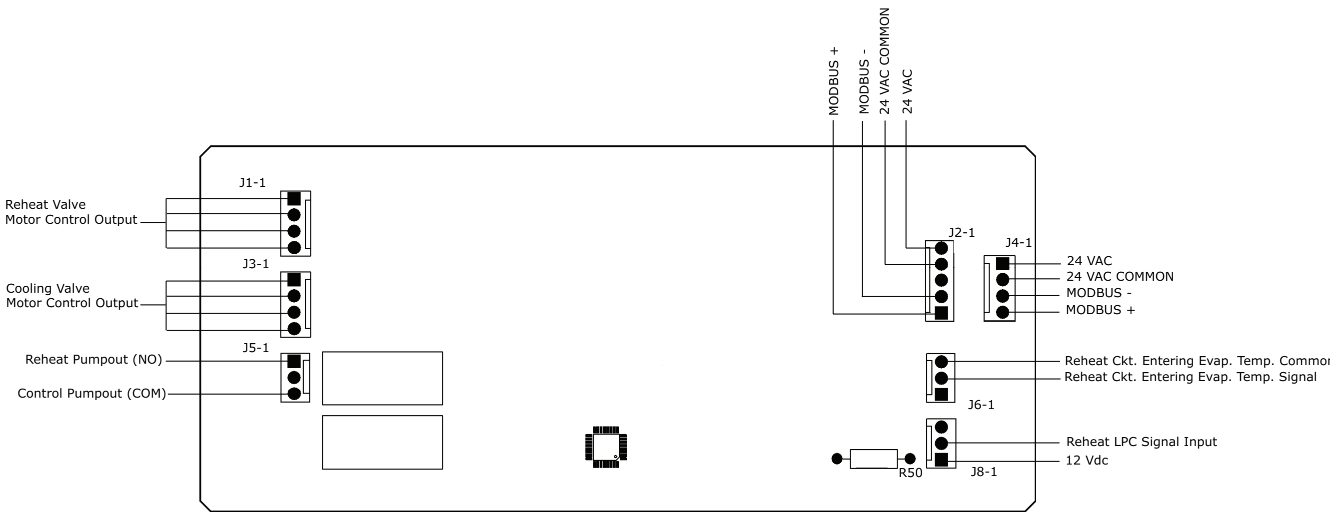


ReliaTel™ Dehumidification Module (RTDM)

RTDM Layout - 27.5 to 50 Tons

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

Figure 30. ReliaTel™ dehumidification module (RTDM) layout



RTDM Inputs/Outputs

J4, J2 Inputs

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

J2 provides 24VAC power and MODBUS communication to the RTOM.

J6 Inputs

J6 - 2, 3 provides a temperature input for the reheat circuit entering evaporator temperature.

J8 Inputs

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

J1 Output

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

J3 Output

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

J5 Output

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

Single Zone VAV, Multi-Speed and 17 Plus

Features and Operation - Voyager™ Light Commercial, Precedent™ and Odyssey™

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

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

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

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

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

Enhanced Dehumidification

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

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

General Sequence of Evaporator Fan Operation

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

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

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

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

Indoor Fan Control Description; Precedent™ 17 SEER (17 Plus) - Unit Identification

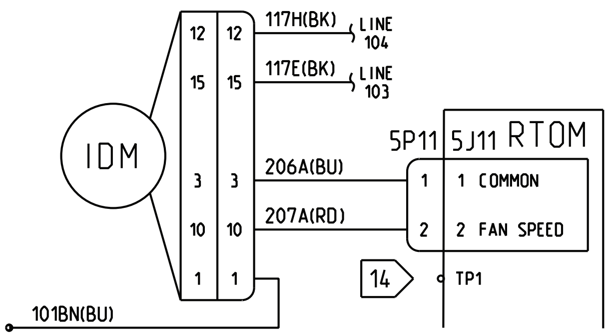
- The "7" in the 6th digit indicates the unit is a 17 Plus unit.

- YHC067E4RHA03D0A1000000000 - the 15th digit (0) indicates this model is a multi-speed evaporator fan unit.
- YHC067E3RHA03D6B0C1B0B000 - the 15th digit (6) indicates this is a SZVAV unit.

Wiring and Configuration

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

Figure 31. 17 Plus 3-5 Tons airflow control configuration



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

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

Figure 32. 17 Plus SZVAV configuration

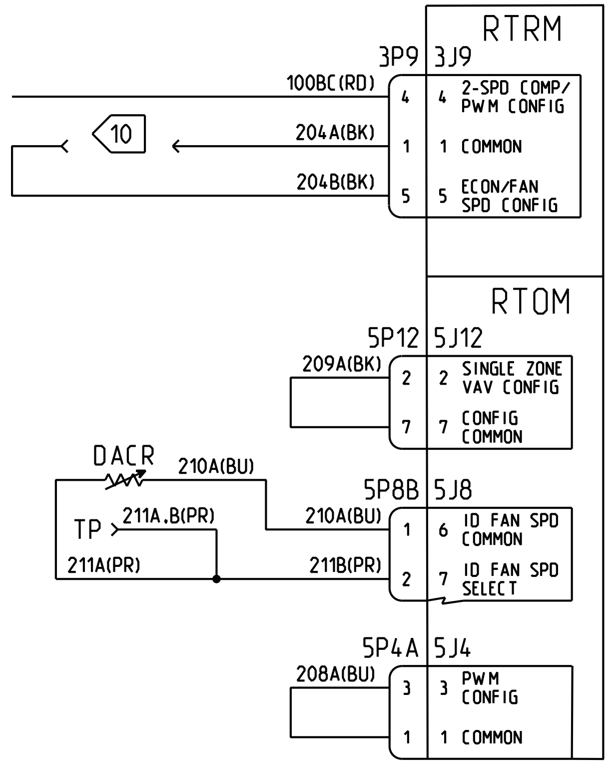
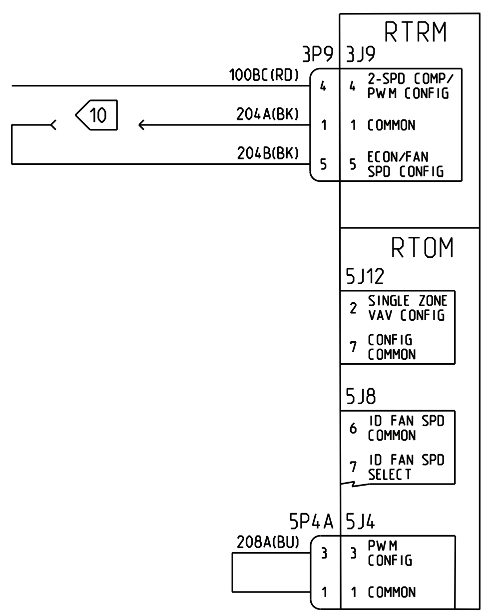


Figure 33. 17 Plus standard (multi-speed) configuration



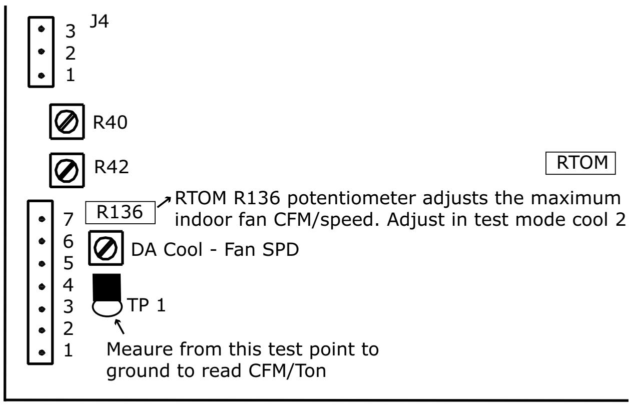
Adjusting Maximum Unit Airflow

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

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

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

Figure 34. Adjusting airflow



To verify the proper cfm setting, measure the DC voltage on the test point (TP1) next to R-136 and compare it to the "cfm vs. vdc chart". The cfm vs. vdc chart is located on a sticker on the fan housing itself and in the unit Installation, Operations, and Maintenance manual (IOM).

Indoor Fan Control Description; Backwards Curved (BC) Plenum Fan Control - Unit Identification

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

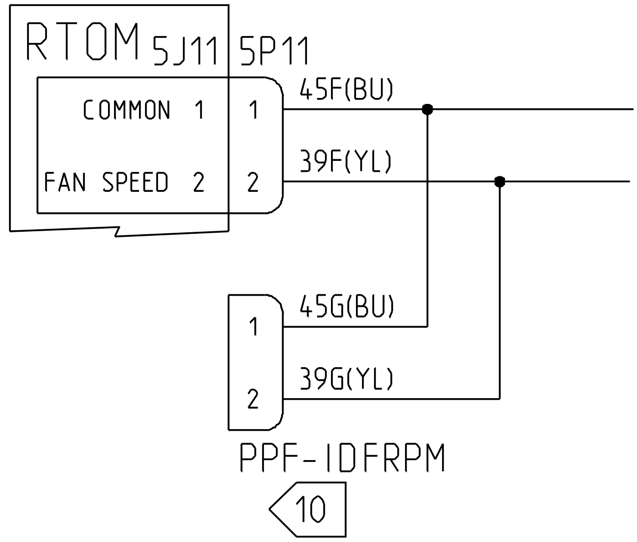
Examples:

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

Wiring and Configuration

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

Figure 35. 17 Plus 7.5-10 Tons airflow configuration



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

Proper wiring configuration is required for correct unit operation. Wiring harness plugs should be configured as shown below for 7.5 to 10 ton Precedent™ units.

Figure 36. Precedent™ 7.5 to 10 tons SZVAV configuration

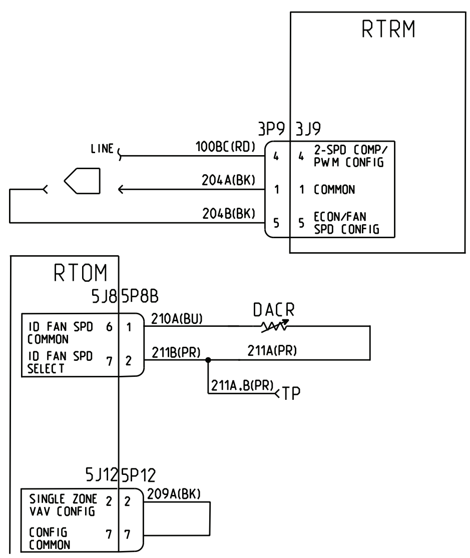


Figure 37. Precedent™ 7.5 to 10 tons multi-speed configuration

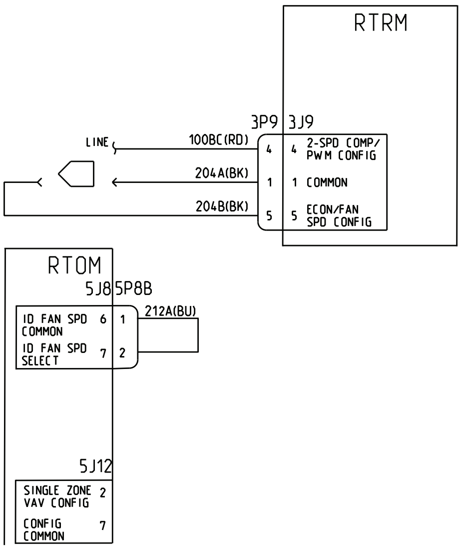
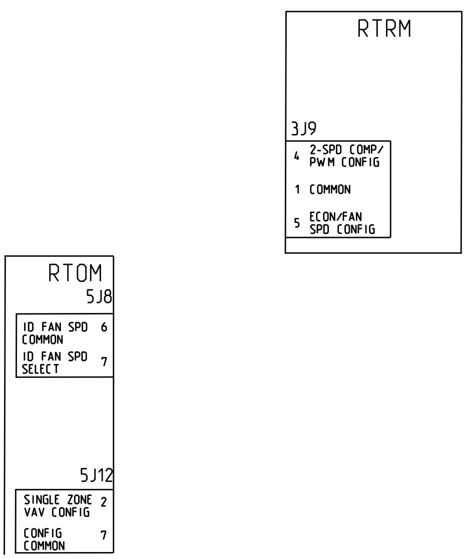


Figure 38. Precedent™ 7.5 to10 tons standard configuration



Adjusting Maximum Unit Airflow

Adjust the R-136 potentiometer on the RTOM (same as with 17 Plus) to change the potentiometer voltage (J-11 output) and thus change maximum fan speed. BC Plenum fan units will output a 0-10 vdc signal from the RTOM J-11. The potentiometer voltage chart is located on a sticker on the fan housing itself and in the unit Installation, Operations, and Maintenance manual (IOM).

Indoor Fan Control Description; Voyager™ Multi Speed and SZVAV VFD Controlled Evaporator Fan Motor - Unit Identification

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

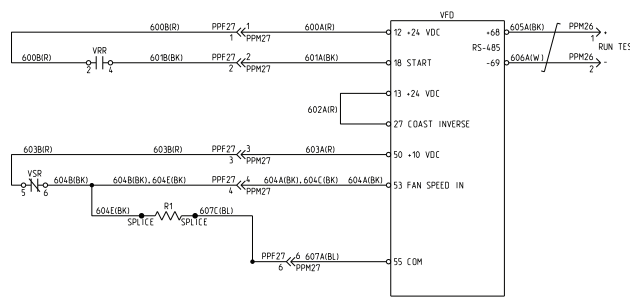
Fan type	Standard	Multi-speed	SZVAV
No heat (TC*, WC*)	0 (zero)	A	F
Low heat	L	B	G
High heat	H	C	H
Mod heat	V	D	K

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

Wiring and Configuration

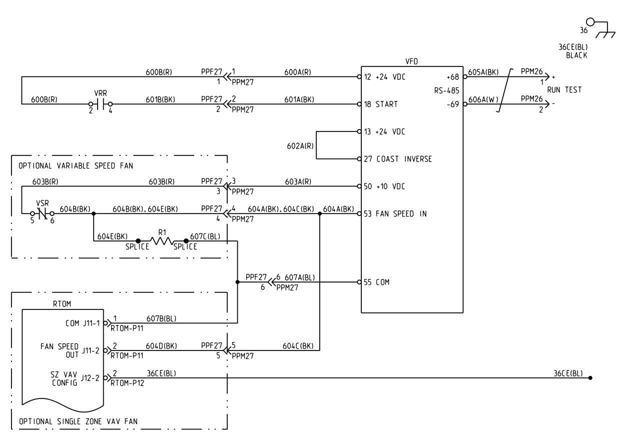
Multi-speed units use two relays located in the control box to switch speeds at the VFD.

Figure 39. Multi-speed



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

Figure 40. Single zone VAV



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

Figure 41. Voyager™ SZVAV configuration

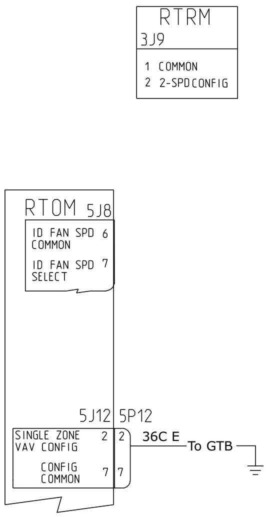


Figure 42. Voyager™ multi-speed configuration

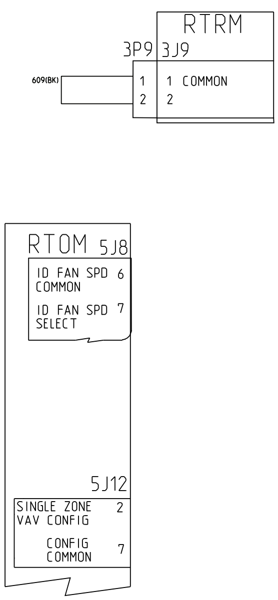
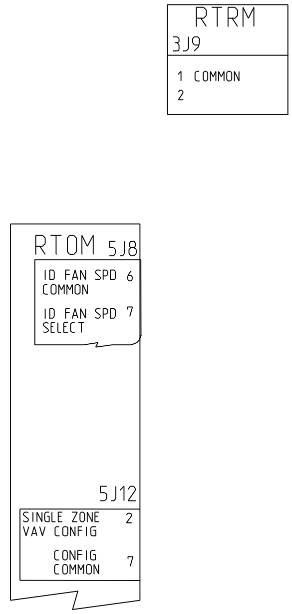


Figure 43. Voyager™ standard configuration



Adjusting Maximum Unit Airflow - Voyager™ Light Commercial

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

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

Indoor Fan Control Description; Odyssey™ Multi-Speed and SZVAV VFD Controlled Evaporator Fan Motor - Unit Identification

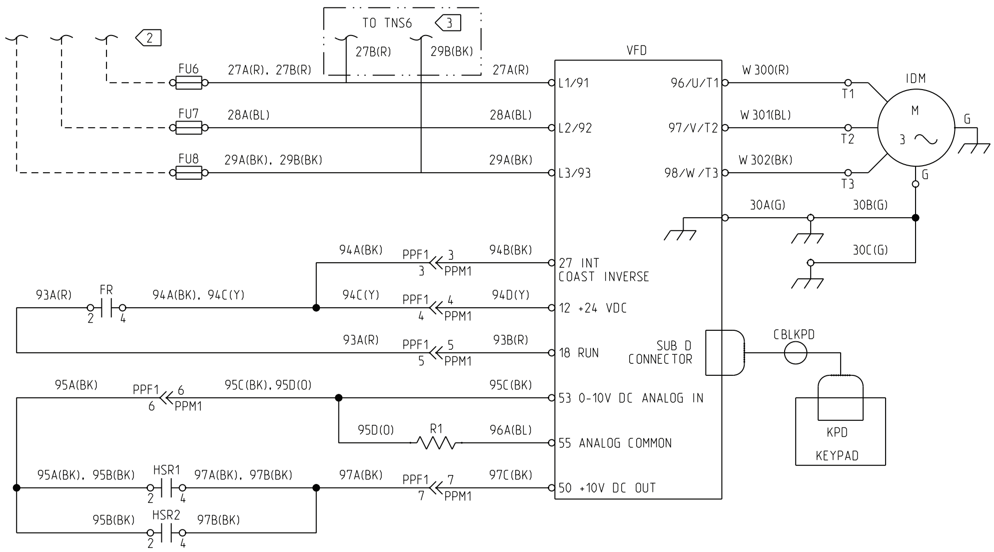
Digits 9 and 10 of the TWE air handler identify the air handler as standard constant volume, multi-speed or SZVAV.

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

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

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

Figure 44. Wiring and configuration - multi speed wiring (electromechanical only) - Odyssey™

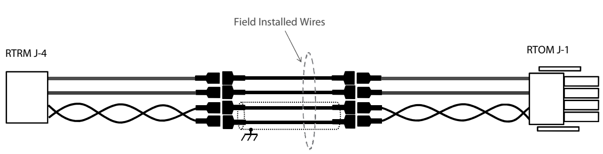


24 volt signals from the thermostat (Y, W, and G etc.) energize relays that command the VFD to the appropriate speed.

SZVAV (ReliaTel™ Only) - Odyssey™

Field wiring **must** be provided between the RTRM in the outdoor unit and the RTOM in the air handler.

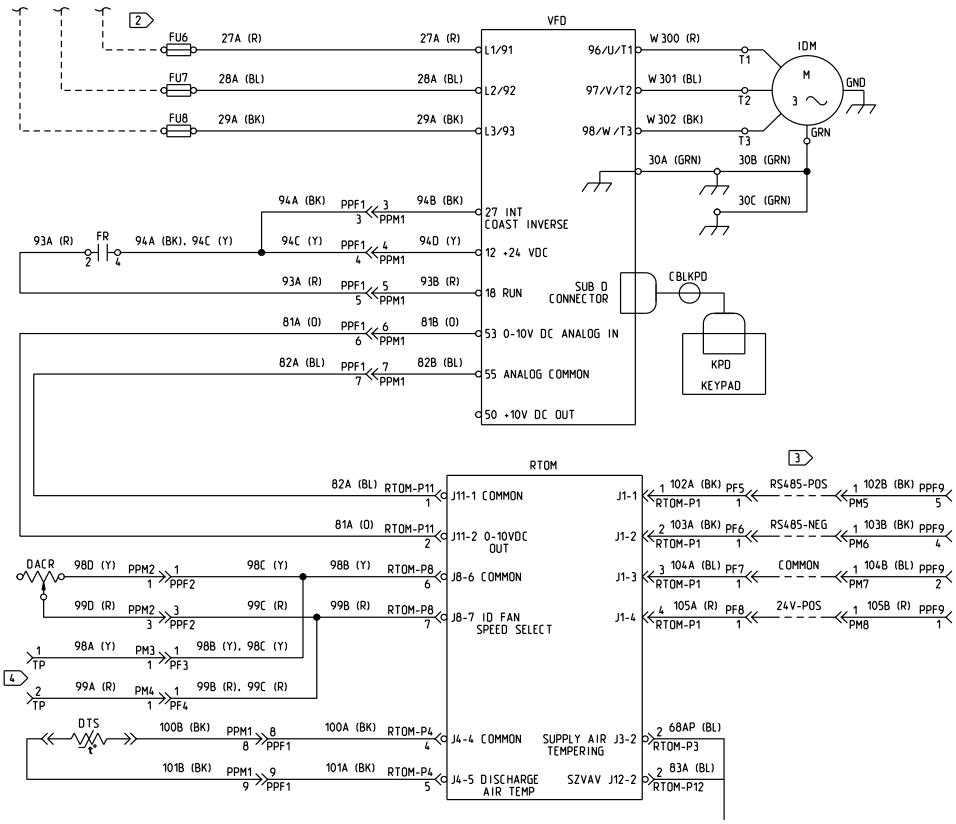
Figure 45. SZVAV wiring (electromechanical only)



Communication wiring from the RTRM to the RTOM **must** be shielded and grounded at the outdoor unit **only**.

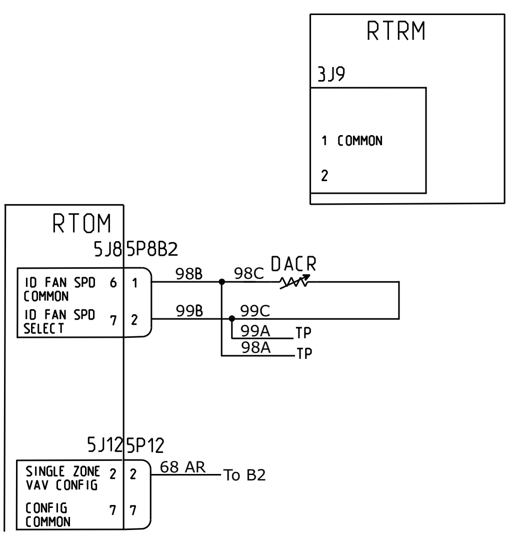
The RTRM communicates information to the RTOM regarding evaporator fan modulation. The RTOM then sends a 0-10 volt dc signal from the J-11 plug to the VFD to modulate the fan speed.

Figure 46. Odyssey™ RTOM



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

Figure 47. Odyssey™ SZVAV units



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

Adjusting Maximum Unit Airflow

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

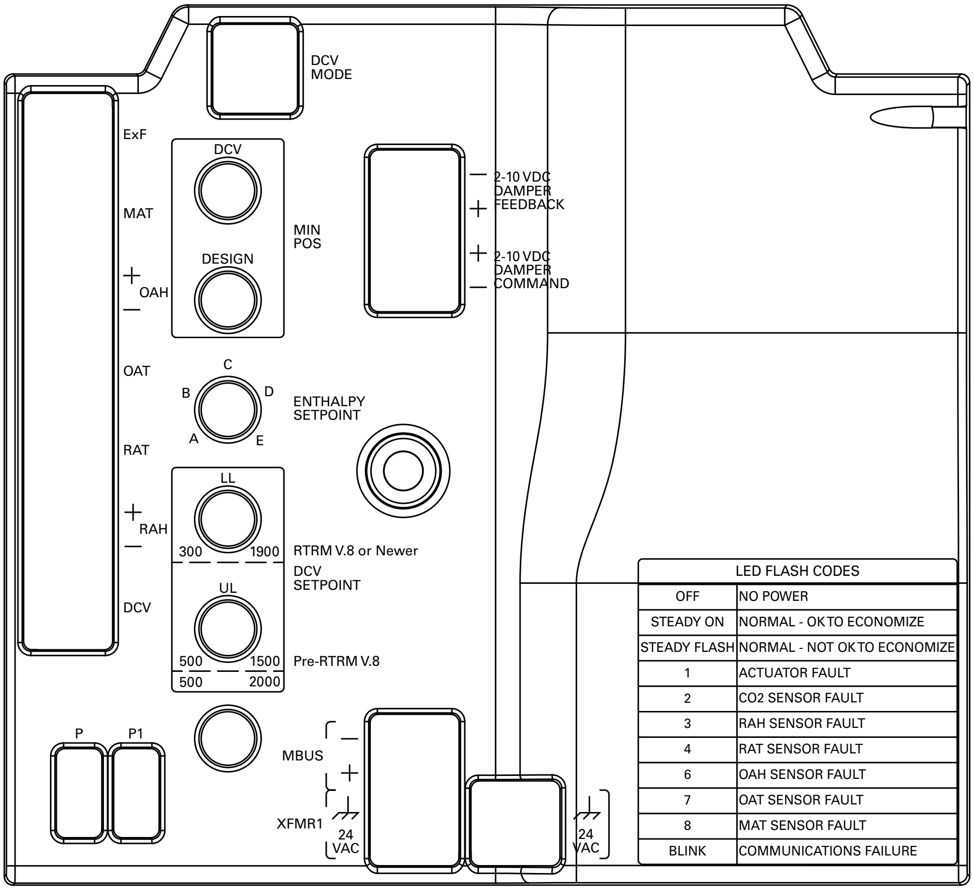
SZVAV air handlers use a combination of adjusting the R-136 potentiometer on the RTOM (similar to Precedent™) and frequency parameter adjustment in the VFD. Refer to the unit IOM for specific instructions on airflow adjustment.

SZVAV, Multi-Speed and 17 Plus Unit Outdoor Air Compensation and Economizer Minimum Position

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

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

Figure 48. Setup of economizer minimum position



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

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

BAS setpoints override any local potentiometer adjustments.

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

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

It is not recommend using a motorized damper with multi-speed or single zone VAV units.

Condensate Drain Pan Overflow Switch

A condensate overflow condition will be detected by a condensate overflow float switch. When the condensate level reaches the trip point, the diagnostic condition will be detected. When the condensate overflow input CLOSES for 6 continuous seconds, the following actions will be taken by the ReliaTel™ controls:

- An auto-reset diagnostic will be generated. All compressor or heating operations will be disabled immediately. Condenser fans and compressors will be de-energized. Supply fan operation will be shutdown.

- Once the overflow condition has been cleared and the input is OPEN for 6 seconds, all diagnostic conditions will be cleared. The unit will return to normal operation. Auto-reset clearing will occur twice each time the unit is powered up. On the third occurrence, the unit will initiate a lock-out and require manual reset. If an auto-reset overflow occurs once, but does not occur again for 72 hours, the trip counter will reset allowing more auto-resets to occur.
- If overflow occurs during morning warm up (MWU) or daytime warm up (DWU), the unit will not return to warm up once diagnostic has been cleared. However, if the zone temperature remains lower than the initiate setpoint for DWU, the unit will enter DWU upon reset.
- If overflow trip occurs during a purge cycle on dehumidification, purge will discontinue, but will resume with a full 3 minute counter upon reset of the trip.
- If unit power cycle is used to reset a trip, the unit will not carry forward any previous mode.
- During manufacturing test mode, the overflow trip indication will be reflected in the Modbus/BAS data packets, but will not result in shutdown of any unit components. The lockout trip counter will also be continually reset to zero to allow unlimited trips during this mode.

Fresh Air Measurement and Control

Fresh air measurement and control function measures the airflow through the outdoor air damper. Using this measurement and comparing it with the desired temperature, this function can vary the position of the damper to keep the fresh air flow within the specified range to maintain the desired temperature.

Service Test - Traq™ control functionality will be active during service test in all steps where the outside air (OA) damper is held in the minimum position. This would be all steps except the “economizing” step which forces the damper open to 100%.

Sensor calibration adjustment - To make a minor correction to the Traq™ airflow reading that is calculated internally by the ReliaTel™ system an adjustment pot is available on the RTVM. This pot can be used to correct for static local factors such as altitude. Variable factors such as drift, temperature, humidity and other changing atmospheric conditions are corrected as part of the conversion calculation.

Sequence for Setting Calibration

1. Adjust the minimum OA flow setpoint on the RTVM to desired flow rate for minimum ventilation. Use voltage vs CFM chart.
2. Initiate service test and step to the minimum ventilation step. This will set the unit into a constant ID fan speed and OA damper request to minimum position. Minimum position will be from the Traq™ calculation to maintain the OA flow at the setpoint in “Step 1,” p. 56.
3. Wait for the damper position to settle to the desired flow rate set by the setpoint, it should take about one minute.
4. Measure OA flow rate via an air balancing instrument.
5. Adjust calibration pot clockwise or counter-clockwise to dial-in the flow to match instrument in “Step 4,” p. 56.

Table 15. Design minimum OA flow setpoints

Design Min OA Flow Setpoint (R130)	DCV Min OA Flow Setpoint (R41)	Voltage Reading
Airflow CFM	Airflow CFM	Voltage Vdc
1000	1000	0.2
1100	1100	0.22
1200	1200	0.24
1300	1300	0.26
1400	1400	0.28
1500	1500	0.3
1600	1600	0.32
1700	1700	0.34
1800	1800	0.36
1900	1900	0.38
2000	2000	0.4
2100	2100	0.42
2200	2200	0.44
2300	2300	0.46
2400	2400	0.48
2500	2500	0.5
2600	2600	0.52
2700	2700	0.54
2800	2800	0.56
2900	2900	0.58
3000	3000	0.6
3100	3100	0.62
3200	3200	0.64
3300	3300	0.66
3400	3400	0.68
3500	3500	0.7
3600	3600	0.72
3700	3700	0.74
3800	3800	0.76
3900	3900	0.78
4000	4000	0.8
4100	4100	0.82
4200	4200	0.84
4300	4300	0.86
4400	4400	0.88
4500	4500	0.9
4600	4600	0.92
4700	4700	0.94
4800	4800	0.96
4900	4900	0.98
5000	5000	1
5100	5100	1.01
5200	5200	1.02

Table 15. Design minimum OA flow setpoints (continued)

Design Min OA Flow Setpoint (R130)	DCV Min OA Flow Setpoint (R41)	Voltage Reading
Airflow CFM	Airflow CFM	Voltage Vdc
5300	5300	1.03
5400	5400	1.04
5500	5500	1.05
5600	5600	1.06
5700	5700	1.07
5800	5800	1.08
5900	5900	1.09
6000	6000	1.1
6100	6100	1.11
6200	6200	1.12
6300	6300	1.13
6400	6400	1.15
6500	6500	1.17
6600	6600	1.18
6700	6700	1.19
6800	6800	1.2
6900	6900	1.22
7000	7000	1.23
7100	7100	1.24
7200	7200	1.25
7300	7300	1.26
7400	7400	1.27
7500	7500	1.28
7600	7600	1.29
7700	7700	1.3
7800	7800	1.31
7900	7900	1.32
8000	8000	1.34
8100	8100	1.36
8200	8200	1.38
8300	8300	1.39
8400	8400	1.4
8500	8500	1.41
8600	8600	1.42
8700	8700	1.43
8800	8800	1.44
8900	8900	1.45
9000	9000	1.46
9100	9100	1.47
9200	9200	1.48
9300	9300	1.5
9400	9400	1.52
9500	9500	1.53
9600	9600	1.54
9700	9700	1.55
9800	9800	1.57
9900	9900	1.58
10000	10000	1.59
10100	10100	1.6
10200	10200	1.61
10300	10300	1.63
10400	10400	1.65
10500	10500	1.67
10600	10600	1.68
10700	10700	1.69
10800	10800	1.7
10900	10900	1.71
11000	11000	1.72
11100	11100	1.73

Table 15. Design minimum OA flow setpoints (continued)

Design Min OA Flow Setpoint (R130)	DCV Min OA Flow Setpoint (R41)	Voltage Reading
Airflow CFM	Airflow CFM	Voltage Vdc
11200	11200	1.74
11300	11300	1.74
11400	11400	1.75
11500	11500	1.76
11600	11600	1.77
11700	11700	1.78
11800	11800	1.79
11900	11900	1.8
12000	12000	1.81
12100	12100	1.82
12200	12200	1.83
12300	12300	1.84
12400	12400	1.85
12500	12500	1.86
12600	12600	1.87
12700	12700	1.88
12800	12800	1.89
12900	12900	1.89
13000	13000	1.89
13100	13100	1.9
13200	13200	1.91
13300	13300	1.92
13400	13400	1.93
13500	13500	1.94
13600	13600	1.95
13700	13700	1.96
13800	13800	1.97
13900	13900	1.98
14000	14000	1.99
14100	14100	2
14200	14200	2.01
14300	14300	2.02
14400	14400	2.03
14500	14500	2.04
14600	14600	2.05
14700	14700	2.06
14800	14800	2.07
14900	14900	2.08
15000	15000	2.09
15100	15100	2.1
15200	15200	2.11
15300	15300	2.12
15400	15400	2.13
15500	15500	2.14
15600	15600	2.15
15700	15700	2.16
15800	15800	2.17
15900	15900	2.18
16000	16000	2.19
16100	16100	2.2
16200	16200	2.21
16300	16300	2.22
16400	16400	2.23
16500	16500	2.24
16600	16600	2.25
16700	16700	2.26
16800	16800	2.27
16900	16900	2.28
17000	17000	2.29

Table 15. Design minimum OA flow setpoints (continued)

Design Min OA Flow Setpoint (R130)	DCV Min OA Flow Setpoint (R41)	Voltage Reading
Airflow CFM	Airflow CFM	Voltage Vdc
17100	17100	2.3
17200	17200	2.31
17300	17300	2.32
17400	17400	2.33
17500	17500	2.34
17600	17600	2.35
17700	17700	2.36
17800	17800	2.37
17900	17900	2.38
18000	18000	2.39
18100	18100	2.4
18200	18200	2.41
18300	18300	2.42
18400	18400	2.43
18500	18500	2.44
18600	18600	2.45
18700	18700	2.46
18800	18800	2.47
18900	18900	2.48
19000	19000	2.49

Table 16. OA flow adjustment setpoints

OA Flow Adjustment (R136)	Voltage Reading
Multiplier/ Adjustment	Vdc
0.8	0
0.81	0.05
0.82	0.14
0.83	0.22
0.84	0.3
0.85	0.35
0.86	0.43
0.87	0.51
0.88	0.57
0.89	0.64
0.9	0.72
0.91	0.78
0.92	0.88
0.93	0.94

Table 16. OA flow adjustment setpoints (continued)

OA Flow Adjustment (R136)	Voltage Reading
Multiplier/ Adjustment	Vdc
0.94	1
0.95	1.06
0.96	1.1
0.97	1.18
0.98	1.22
0.99	1.25
1	1.3 - 1.84
1.01	1.86
1.02	1.89
1.03	1.92
1.04	1.96
1.05	2
1.06	2.03
1.07	2.06
1.08	2.1
1.09	2.12
1.1	2.14
1.11	2.16
1.12	2.18
1.13	2.2
1.14	2.24
1.15	2.26
1.16	2.28
1.17	2.3
1.18	2.34
1.19	2.36
1.2	2.4

Economizer Fault Detection and Diagnostics

Fault detection of the outdoor air damper will be evaluated based on the commanded position of the damper compared to the feedback position of the damper. The damper is commanded to a position based on a 2-10 Vdc signal.

Note: *In table below, 'not economizing when should' and 'economizing when should not be' have been determined.*

Table 17. Economizer fault detection and diagnostics for units with or without Traq™

Cooling Request	Enthalpy Decision	Indoor Fan - (Ventilation Requested)	Damper Command VS Feedback	Not Economizing When It Should Be	Economizing When It Should Not Be	Outdoor Air Damper Not Modulat-ing	Excessive Outdoor Air
N/A	N/A	N/A	Feedback - 10% <= Setpoint <= Feedback + 10%	(no fault)	(no fault)	(no fault)	(no fault)
N/A	N/A	OFF	Feedback High				FAULT
NO[(a)]	N/A	ON	Feedback High				FAULT
NO[(a)]	N/A	ON	Feedback Low			FAULT	
YES	Enabled	ON	Feedback High		FAULT		
YES	Enabled	ON	Feedback Low	FAULT			

Table 17. Economizer fault detection and diagnostics for units with or without Traq™ (continued)

Cooling Request	Enthalpy Decision	Indoor Fan - (Ventilation Requested)	Damper Command VS Feedback	Not Economizing When It Should Be	Economizing When It Should Not Be	Outdoor Air Damper Not Modulating	Excessive Outdoor Air
YES	Disabled	ON	Feedback High				FAULT
YES	Disabled	ON	Feedback Low			FAULT	

(a) Dehumidification mode and heating mode are considered minimum ventilation.

When an economizer fault has been detected, the unit controller will latch an Auto-Reset Diagnostic and report it through the TD-5. It will also generate a diagnostic through BAS (LCI/BCI if installed). Reset Auto-Reset Diagnostic when the economizer returns to the valid range or if the unit leaves Active Cooling Mode.

Mixed Air Temperature Low Limit Diagnostic

In all conditions on all ReliaTel™ controlled units, if the mixed air temperature falls below 45°F, mixed air temperature low limit is active and the economizer actuator will close to the active minimum position. On Title 24 compliant units, ReliaTel™ will set an auto-reset diagnostic to be used by BAS and TD-5 when the mixed air temperature low limit is active.

The RTEM will revert to normal operation when the mixed air temperature rises above 48°F. The diagnostic will be reset when the mixed air temperature low limit is inactive.

BACnet® Communications Interface (BCI)

Refer to the list below for a list of objects in the BCI interface that require specific handling in regards to economizer fault detection and diagnostics:

- Diagnostic: Unit Not Economizing When It Should Be
- Diagnostic: Unit Economizing When It Should Not Be
- Diagnostic: Outdoor Air Damper Not Modulating
- Diagnostic: Excessive Outdoor Air
- Diagnostic: Mixed Air Temperature Low Limit Active

LonTalk™ Communications Interface (LCI)

Refer to the list below for the variables in the LCI interface that require specific handling in regards to economizer fault detection and diagnostics:

- nvoAlarmMessage.Unit Not Economizing
- nvoAlarmMessage.Unit Economizing
- nvoAlarmMessage.OA Damper Not Modulating
- nvoAlarmMessage.Excessive Outdoor Air
- nvoAlarmMessage.Mixed Air Temperature Low Limit Active

Failure and Overriding Conditions

Economizer FDD will continue to be in effect during the following cases:

- Service Test Mode
- Ventilation Override
- OFF or Stop Mode

Multi-Speed Indoor Fan

There will be two types of multi-speed indoor fan control: the first type will control discrete fan speeds based on active heating or cooling stages and the second will be a modulating type control based on various inputs.

Two-Speed Fan Control

This control scheme will cover all unit operation for units configured for two-speed fan operation. Units requiring discrete relay outputs or voltage signals (5 Vdc & 10 Vdc) will fall under this form of control.

Table 18. Control scheme - two speed fan control

Unit Configuration	Low Speed Output	High Speed Output
2-Speed Relay Controlled	RTRM Supply Fan Output + RTRM J2-5 Output	RTRM Supply Fan Output
2-Speed 5Vdc/10Vdc Output	RTRM Supply Fan Output + RTOM Indoor Fan Speed @ 50% of maximum	RTRM Supply Fan Output + RTOM Indoor Fan Speed @ 100% of maximum

Unit Operation for Two-Speed Fan Control

Standard unit operation for cooling, heating, and dehumidification will continue on units equipped with a two-speed indoor fan and all unit functions will operate normally, except for the control of the indoor fan speed. All units configured with any type of heating or reheat/dehumidification will operate as normal utilizing full speed indoor fan by energizing the appropriate output(s) as described above. The two-speed indoor fan unit will only utilize two speeds during the modes described below.

Cooling Operation

For cooling operation, the unit will utilize low fan speed during fan only and economizer only unit modes. When the unit receives a call for cooling, if the economizer is enabled, the unit will energize the fan at low speed and begin to modulate the OA damper open above minimum position up to 100% as necessary to meet the mixed air setpoint. If the OA damper reaches 100% the supply fan will increase to high speed and if it remains there for 5 minutes, the unit will begin to stage up compressors and the supply fan will remain at high speed for the remainder of the call for cooling.

For 2-step cool units, when the unit enters Cool 1 with economizer disabled, the supply fan will energize at low speed for the duration of Cool 1. When the unit determines that the 2nd compressor is necessary to meet cooling demands, the unit will energize the 2nd compressor and the supply fan will switch to high speed. For 3-step cool units the unit will utilize low fan speed during requests for Cool 1 and Cool 2 during cooling operation. High fan speed will be utilized only for Cool 3.

The unit will stage down compressors for cooling in reverse order that they were staged and the supply fan will follow the unit mode transitions. Once it is determined through normal cooling control that the 2nd compressor is no longer necessary to meet cooling demand, the 2nd compressor will be staged back and the supply fan will switch to low speed until the unit stages all cooling off or receives a call for Cool 2 again. Once the supply fan is no longer requested ON after a cooling call is cleared, the supply fan will remain energized at low speed for 60 seconds.

Economizer Minimum Position Handling for Two-Speed Fan

Due to the low and high speeds of the indoor fan, When the unit is in Fan Only, Cool 1, or Economizer Only modes the control will require the setting of two economizer minimum positions. The economizer minimum position that will be utilized while the supply fan is at low speed will be set with the RTEM DCV minimum position pot (0-100%) and the minimum position that will be utilized while the supply fan is at high speed will be set with the RTEM Building Design minimum position pot (0-50%). If the Building Design minimum position is set to be higher than the DCV min Position, the setpoints will be capped at the DCV min position and the setpoint for the min position at low and high fan speed will be the DCV min position.

Demand Controlled Ventilation Operation

DCV for units with two-speed supply fans will require an additional module (RTVM) for the 2 additional setpoint potentiometers necessary.

The new DCV scheme will require the user to select 4 OA damper minimum position setpoints in addition to the Design and DCV CO2 setpoints:

- Design Min Position @ Low Fan Speed Command (RTVM R130)
- Design Min Position @ High Fan Speed Command (RTEM Design Min)
- DCV Min Position @ Low Fan Speed Command (RTVM R41)
- DCV Min Position @ High Fan Speed Command (RTEM DCV Min)

The speed at which the supply fan operates will dictate which design and DCV minimum position setpoint is used.

Space Pressure Control (Powered Exhaust/ Statitrac™)

For two-speed supply fan units, the user will select an exhaust enable setpoint during the full fan speed command. Once selected, the exhaust enable setpoint for low fan speed operation will be calculated.

Failure and Override Modes

- Supply Fan Proving - If there is a supply fan failure condition all outputs associated with the supply fan output control will be de-energized.
- Ventilation Override Mode - For all VOM modes that require supply fan operation (Purge and Pressurize), the supply fan will operate at high speed.
- All failure modes that require the Supply Fan to operate, the Supply Fan will energize at high speed.

Fan Speed Selection for Two-Speed Analog Output Units

For units equipped with an analog speed controlled motor for two-speed indoor fan control, the user will have the ability to fine tune the high and low fan speeds by adjusting the potentiometer provided on the RTOM board (R136 DACOOL-FAN SPD) to get the desired output voltage for high fan speed. The RTOM will provide 50% and 100% of this user selected output voltage for the low and high fan speeds respectively. During service test mode when the RTOM indoor fan speed output is set to 100% for Cool 2, Reheat, and all Heating steps, the user can adjust the RTOM potentiometer to provide the appropriate 0-10Vdc input signal to the analog speed controlled motor for high speed. For all other steps in which the RTOM indoor fan speed output is providing 50%, the motor will receive ½ of the adjusted voltage for low speed.

Multi-Speed PWM Controlled Indoor Fan with Dual Capacity Compressor

This control scheme will cover 17 SEER 3 to 5 ton Precedent™ units equipped with a PWM controlled indoor fan motor for multi-speed control and a dual capacity compressor.

Configuration

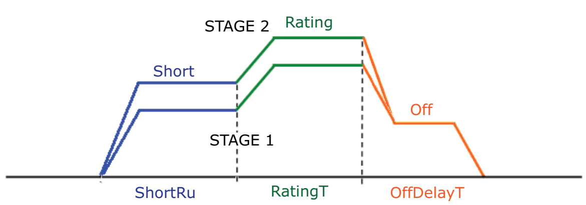
Units equipped with a PWM controlled indoor fan motor and a dual capacity compressor will be configured uniquely within the ReliaTel™ system by being configured as a non-heat pump, two compressor unit with two step cooling and the RTRM J9-4 closed to 24VAC. Also, the RTOM J4-3 will be closed to ground for PWM control.

Unit Operation for Multi-Speed PWM Controlled Indoor Fan

Unit operation for Multi-Speed PWM controlled indoor fan units will be similar to the control of standard two compressor, two step cooling units with the exception of the multi-speed characteristics of the PWM controlled indoor fan motor and special handling required for the dual capacity compressor. For indoor fan control, the supply fan will follow the airflow profiles as described in the following sections during all active cooling modes. During all active heating modes, the unit will utilize full indoor fan speed based on the selected maximum fan speed.

Airflow Profiles

Figure 49. Airflow staging



The following airflow profile table will be used in determining the PWM output signal for the associated cooling stages.

Table 19. Airflow profiles

PWM Mode	Short Run Time	Short Run Fan Out-put%	Rating Run Time	Rating Out-put%	Off Delay Time	Off Delay Signal %
Stage 1 Operation						
1st Stage Airflow	7.5 mins	57%	Any	70%	160 secs	50%
Compressor Output at 1st Stage	7.5 mins	67%	Any	67%		0%
Stage 2 Operation						
2nd Stage Airflow	7.5 mins	82%	Any	100%	160 secs	50%
Compressor Output at 2nd Stage	7.5 mins	100%	Any	100%		0%

Note: The rating output % refers to the maximum fan speed signal as a percentage of the user selected unit maximum airflow that will be applied to the indoor fan for the duration of time that the unit runs at the associated compressor stage.

High Fan Speed Selection

Each motor program will include an upper CFM setpoint and the user will then have the ability to adjust the DACSP onboard potentiometer located on the RTOM to select the proper unit/application specific maximum airflow. At the maximum (full clockwise on the potentiometer), ReliaTel™ will output 100% of the maximum PWM signal from the RTOM indoor fan speed output (J11 - 2,1) for control. At the minimum (full counterclockwise), ReliaTel™ will output 70% of the maximum PWM signal for control. Once a maximum value is selected via the onboard potentiometer, ReliaTel™ will control the indoor fan speed to the previously described airflow profiles utilizing the maximum set value as the reference point (100% rating) for all percentages.

Fan Only Operation

When the RTRM receives a call for fan only mode, the unit will energize the RTRM supply fan output and the RTOM will begin to output a PWM signal at 50% of the high stage airflow PWM signal and remain there for the duration of the call.

Fan Off Delay (from Cooling)

When the supply fan is commanded off due to no call, the supply fan will ramp down to a signal that is 50% of the high stage airflow PWM signal and will remain energized at that speed for a total of 160 seconds.

Cooling Operation

For cooling operation the unit will utilize normal ReliaTel™ cooling control schemes for a two compressor unit, but instead of each compressor output being connected to an independent compressor, they will be connected to the dual capacity compressor for control. The compressor 1 output signal will energize the dual capacity compressor and operate it at 67% of its total capacity. The compressor 2 output signal is connected to a solenoid on the compressor that when energized allows the compressor to operate at full capacity.

When the unit receives a call for cooling, if the economizer is enabled, the unit will energize the supply fan at low speed and begin to modulate the OA damper open above minimum position up to 100% as necessary to meet the mixed air temperature setpoint. If the OA damper reaches 100% the supply fan will increase to maximum speed and remain there for 5 minutes. The unit will then begin to energize the compressor outputs to meet cooling demand.

If the economizer is not enabled and the unit enters Cool 1 due to normal cooling control schemes, the supply fan will energize and will start operation at the low speed of 1st stage airflow profile. If no other calls for stage 2 of cooling are present, the unit will remain in the 1st stage airflow profile and the fan will only operate up to 70% of the maximum output signal per user selection.

After the minimum 3 minute inter-stage timer has expired from the compressor 1 output being energized, the RTRM will energize the compressor 2 output if requested, and will shift the airflow profile vertically into the 2nd stage airflow profile until the call reduces to Stage 1.

The unit will stage down compressors and modulate the economizer back to minimum position in the reverse order that they were staged and the supply fan will follow the unit mode transitions based on the defined airflow profiles. Once the supply fan is no longer requested ON after a cooling call is cleared, the supply fan will remain energized at low speed for 160 seconds.

Compressor Protection

Special handling of the compressor protection inputs on the RTRM is necessary for this unit due to the dual capacity compressor. The compressor 1 proving and disable inputs will be honored and the associated counters incremented when the inputs go active. Once active, both compressor outputs on the RTRM will be de-energized and inhibited from running until the fault clears. The compressor 2 disable input will be honored so customers can disable the high stage operation of the compressor if desired. No compressor operation will be locked out based on compressor 2 disable events.

The evaporator defrost control scheme will be initiated at an OA temperature of 55°F.

Outdoor Fan Control

This unit control scheme will require no changes in existing outdoor fan control logic for ReliaTel™. The unit design currently only supports a single outdoor fan so the Outdoor Fan B output from the RTRM will be utilized.

Economizer Min Position Handling (w/o DCV)

Economizer minimum positions will be handled similarly to how they are handled on other multi-speed indoor fan units.

The following setpoint potentiometers will be used on the RTEM:

- Design min at min fan speed PWM command (RTEM DCV min)
- Design min at medium fan speed PWM command (RTEM DCV setpoint LL)
- Design min at max fan speed PWM command (RTEM design min)

The controller will calculate the active OA damper minimum position linearly between the user-selected setpoints based on the supply fan speed command. The range for 'RTEM DCV Min' and 'RTEM DCV Setpoint LL' setpoints will be 0-100% while the range for the 'RTEM Design Min' setpoint will be 0-50%.

As the supply fan speed ramps between its minimum and maximum output signal (based on cooling or heating modes/steps), the active economizer minimum position target will be calculated in a linear fashion, similarly to the OA CFM compensation function, in order to help maintain a constant OA flow through the unit and not over/under-ventilate.

Demand Controlled Ventilation

DCV for this unit control will require an additional module (RTVM) for the 3 additional setpoint potentiometers necessary with the varying supply fan speed. The basic control strategy integrates 2 existing functions which on traditional units are mutually exclusive: OA CFM Compensation and DCV.

Note: *For all DCV operation, the supply fan will remain at minimum speed unless requested higher for heating or cooling operation.*

This new scheme will require the setting of 5 OA damper position setpoints; 3 more than on traditional units which will be located on the required RTVM:

- Design Min Position @ Min Fan Speed PWM Command (RTVM R130)
- Design Min Position @ Medium Fan Speed PWM Command (RTVM R136)
- Design Min Position @ Max Fan Speed PWM Command (RTEM Design Min Position)
- DCV Min Position @ Min Fan Speed PWM Command (RTVM R41)
- DCV Min position @ Max Fan Speed PWM Command (RTEM DCV Min Position)

As the supply fan speed tracks between the minimum and maximum % of the user selected setpoint, the active building design and DCV minimum positions will be calculated linearly between the user selected setpoints. These will be used to determine the active OA damper position target based on the space CO2 level in relation to the design and DCV CO_2 setpoints.

Space Pressure Control (Powered Exhaust)

For units with a PWM controlled supply fan, the user will select an exhaust enable setpoint during the 100% fan speed command. Once selected, the difference between the exhaust enable setpoint and design OA damper minimum position at 100% fan speed will be calculated. The difference calculated will be used as an offset to be added to the active building design OA minimum position target to calculate the dynamic exhaust enable target to be used throughout the supply fan speed/OA damper position range.

Ventilation Override Mode

During ventilation override modes in which the supply fan is commanded to run, the RTRM supply fan output will be energized and the PWM signal provided by the RTOM will correspond to 100% of the high speed selection.

Dehumidification Control

Units configured with a PWM controlled indoor fan and a two-speed compressor will utilize two forms of dehumidification: Normal staged, hot gas reheat dehumidification and enhanced dehumidification without reheat.

Enhanced Dehumidification

Enhanced dehumidification (EDh) will be available on all units equipped with a space humidity (SH) sensor, regardless of whether the unit is configured with traditional hot gas reheat (HGRH).

EDh will be accomplished on these units by utilizing a SH sensor and selecting a dehumidification setpoint (DhSp) on the RTOM and allowing ReliaTel™ to determine when there is a need for dehumidification. Once the SH value exceeds the DhSp and dehumidification is enabled the unit will energize one stage of compressor operation at 80% of the maximum stage 1 airflow rating.

As with traditional HGRH, EDh will override the request for 1st stage of cooling, but if there is a request for the 2nd stage of cooling, EDh will be disabled. If the cooling request drops back below Cool 2, the unit will transition back into EDh if the dehumidification call is still present. If the dehumidification call is no longer present, the unit will transition into Cool 1 and track back into the Stage 1 airflow profile.

If during active EDh the SH falls below the DhSp - 2%, dehumidification will be terminated and the unit will transition back to normal cooling or heating control. Once EDh terminates and there is no request for heating, cooling, or ventilation, there will be a 60 second supply fan off delay in which the supply fan will continue to run at the EDh speed.

Traditional Dehumidification with Hot Gas Reheat

Traditional dehumidification with HGRH will also be a supported option for this unit type. Units with this option will include a reheat coil as on traditional dehumidification units and will be controlled like a true two-compressor system.

Units configured with a traditional HGRH coil will utilize EDh as described above as the first stage of dehumidification control if the SH is only marginally high. If the unit is running in EDh and the SH drops below the DhSp, EDh will be terminated and the unit will transition out of the mode as described above. If the unit is operating in EDh and the SH is not recovering toward the DhSp, the unit will transition into full HGRH until the SH falls below the SH setpoint.

During HGRH dehumidification both compressor outputs will be energized simultaneously for full capacity operation and the supply fan will be at the user selected maximum speed. All existing overrides and functional operations for dehumidification will function as on units not configured for PWM signal fan speed control. Note that a 60 second supply fan off delay in which the supply fan will continue to run at the user selected maximum speed will also be implemented.

For units configured with traditional HGRH, SH and Humidistat operations will be supported. However, only units equipped with a SH sensor will utilize EDh as the first step of dehumidification control. If the unit is configured for HGRH under humidistat control, only full HGRH dehumidification will be utilized; normal dehumidification rules will be in effect for these units.

Service Test

For these units, troubleshooting of the motor control can be performed by using the standard service test mode as is currently offered on ReliaTel™ controlled units. Refer to the table below for details about the fan speeds associated with each step of service test:

Table 20. Service test

Test Step	PWM Output[a]
Fan On	50%
Econ[b]	50%
Cool 1	82%
Cool 2	100%
Heat 1	100%
Heat 2	100%
Dehumid / Reheat[c]	100%

(a) The PWM output is in reference to the user selected maximum unit fan speed.
(b) Regardless of the economizer Mode configuration, the unit will run the supply fan at the minimum speed during the economizer step of service test.

Table 20. Service test (continued)

(c) Units with enhanced dehumidification only will not perform this step during service test.

Failure and Override Modes

- Supply fan proving - If there is a supply fan failure condition all outputs associated with the supply fan output control will be de-energized and the PWM output will be at 0%.
- The supply fan will energize at high speed as a result of all failure modes that require the supply fan to operate.

Single Zone VAV

ReliaTel™controls platform will support Single Zone VAV (SZVAV) as an optional unit control type in order to meet ASHRAE 90.1 in addition to other multi-speed indoor fan configurations. Basic control will be a hybrid VAV configured unit that provides discharge temperature control to a varying discharge air temperature setpoint based on space temperature. Concurrently, the unit will control and optimize the supply air fan speed to maintain the Zone Temperature (ZT) to a zone temperature setpoint.

Supply Fan Output Control - VFD Equipped Units

Normal SZVAV units will be equipped with a VFD controlled supply fan. The fan is controlled via the 0-10 Vdc RTOM J11-2 and the RTRM J1-11. The control will scale the output from the RTOM to adjust between the minimum and maximum range of the VFD.

Direct Drive Backwards Curve Plenum Fan Equipped Units

For SZVAV units configured with an BC Plenum (Precedent™), the control outputs a 2.4-7.6 Vdc signal from the RTOM J11-2 to cover the range of the application designed airflow. This output is adjustable via the RTOM R136 pot for adjusting CFM/ton. The adjustable range for max speed output is from 3.4 Vdc at full counter-clockwise to 7.6 Vdc at full clockwise.

PWM Controlled Motor Equipped Units

For SZVAV units configured with a PWM controlled motor, the duty cycle of the PWM signal will be controlled in order to vary the speed of the supply fan. The range of the duty cycle for the PWM output will be 50-100% of user selected maximum.

Supply Fan Mode Operation

SZVAV units will utilize supply fan mode selection using ReliaTel™ controls for normal zone control and will be selectable between AUTO and ON via a connected zone sensor module or through BAS/ Network controllers.

Ventilation Control

Units configured for SZVAV control will require special handling of the OA damper minimum position. Refer to each section below for details on each configurable ventilation control method.

Demand Controlled Ventilation

Units configured with DCV will invoke a new scheme which allows variable building design and DCV minimum positions and OA damper position target setpoints based on the supply fan speed and space CO_2 requirements.

This new scheme will require the setting of 5 OA damper position setpoints which will be located on the required RTVM:

- Design Min Position @ Min Fan Speed Command (RTVM R130)
- Design Min Position @ Medium Fan Speed Command (RTVM R136)
- Design Min Position @ Max Fan Speed Command (RTEM Design Min Position)
- DCV Min Position @ Min Fan Speed Command (RTVM R41)
- DCV Min position @ Max Fan Speed Command (RTEM DCV Min Position)

As the supply fan speed varies between 0-100%, the building design and DCV minimum position targets will be calculated between the user selected setpoints based on the instantaneous supply fan speed. The building design and DCV minimum position targets will be used to calculate the active OA damper minimum position target, based on the space CO_2 relative to the Design and DCV CO_2 setpoints.

The range for the design minimum and DCV minimum OA damper position setpoints at minimum and medium be 0-100%, while the range at maximum fan speed will be 0-50%.

Outside Air Damper Minimum Positions without DCV

For units not configured with DCV, additional minimum position setpoints to increase outdoor airflow accuracy will be required. The operation will be similar to OA CFM compensation on traditional VAV units with the addition of a design minimum position setpoint at medium fan speed. The following setpoint potentiometers will be used on the RTEM:

- Design Min at Min Fan Speed Command (RTEM DCV Min)
- Design Min at Medium Fan Speed Command (RTEM DCV Setpoint LL)
- Design Min at Max Fan Speed Command (RTEM Design Min)

The controller will calculate the active OA damper minimum position between the user-selected setpoints based on the supply fan speed command. The range for the design minimum setpoints at minimum and medium fan speed will be 0-100% while the range for the design minimum at maximum fan speed setpoint will be 0-50%.

Space Pressure Control

For units configured with an exhaust fan with or without Statitrac™ , the new schemes implemented for economizer minimum position handling require changes to the existing space pressure control scheme in order to prevent over/under pressurization. The overall scheme will remain very similar to non-SZVAV units with space pressure control utilizing the user selected exhaust enable setpoint to calculate a dynamic exhaust enable setpoint.

Discharge Air Setpoint (ReliaTel™ Controlled Not User Adjustable)

For occupied cooling, heating (modulating only), and dehumidification the unit will utilize a varying discharge air setpoint (DASP) that is calculated based on zone conditions. DASP will be used as the active control point for controlling cooling (DACSP), heating (DAHSP), and dehumidification capacity. In general, as the ZT rises above the zone cooling setpoint (ZCSP), DACSP will be calculated down and as the ZT falls below the zone heating setpoint (ZHSP), DAHSP will be calculated upward.

For cooling, heating, and reheat output control the DASP calculation will be limited between user selectable setpoints and will be calculated higher and lower based on ZT.

If the controller determines that a discharge air temperature higher than the user selected upper limit, or lower than the user selected lower limit, is required for space conditioning, then fan output will be increased.

Economizer Cooling

Economizer Enabled for Cooling

Once the unit has a request for economizer cooling and the unit has met all the cool mode transition requirements, the economizer will open beyond minimum position in order to meet the calculated DACSP value. If the economizer reaches 100% before DACSP falls below the DACSP lower limit (LL) and the air temperature is greater than the DACSP, the control will create a temporary DACSP LL that will be used to determine fan speed output control. The temporary DACSP will not be allowed to be less than the user selected DACSP LL. As DACSP falls below the temporary DACSP LL, the supply fan speed will be increased proportionally up to 100% as necessary.

Once the supply fan speed reaches 100% with the economizer at 100% for 3 minutes (5 if non V-3), compressors will be allowed to energize to meet the calculated DACSP value as necessary. Once compressors have been energized, the supply fan speed and economizer will be forced to 100%.

Economizer Enabled to Disabled

If the unit is actively cooling with the economizer and then the economizer becomes disabled, the economizer will be closed to the active minimum position and compressors will be allowed to stage. At the point in which the economizer becomes disabled, the temporary DACSP LL will be set back to the user selected DACSP LL. The supply fan speed will be adjusted accordingly based on active cooling stage and DACSP value.

Economizer Disabled to Enabled

If compressors are energized for cooling and the economizer was disabled, but becomes enabled, the economizer and supply fan speed will be forced to 100%.

Compressor (DX) Cooling

Cooling Sequence

If the control determines that there is a need for active cooling capacity in order to meet the calculated DACSP, once supply fan proving has been made, the unit will begin to stage compressors accordingly.

Once the DACSP calculation has reached its bottom limit and compressors are being utilized to meet the demand, as the DACSP value continues to calculate below the DACSP LL, the supply fan speed will begin to ramp up toward 100%.

As the cooling load in the zone decreases, the compressors begin to de-energize and the supply fan will fall back to the cooling stage's associated minimum speed.

Cooling Stages Minimum Fan Speed

As the unit begins to stage compressors to meet the cooling demand, the following minimum supply fan speeds will be utilized for each corresponding cooling stage.

Table 21. Minimum supply fan speeds

Unit Mode	VFD, BC Plenum, non-17 SEER Minimum Fan Speed	17 SEER Minimum Fan Speed
Fan Only	33%	57%
Economizer Cooling	33%	57%
Stage 1	33%	57%

Table 21. Minimum supply fan speeds (continued)

Unit Mode	VFD, BC Plenum, non-17 SEER Minimum Fan Speed	17 SEER Minimum Fan Speed
Stage 2	50%	82%
Stage 3 (if available)	50%	82%

Mode Transitions

Auto-Changeover - The following auto-changeover rules will be implemented:

- At power-up, when the local unit mode is set to Auto, or after a unit reset, the active unit mode is set to Heat if the active ZT < CSP, or Cool if the active ZT > CSP.
- If the active unit mode is Cool, the active unit mode is switched to Heat when both the active ZT < HSP and it has been 5 minutes since last active call for cooling was terminated.
- If the active unit mode is Heat, the active unit mode is switched to Cool when both the active ZT > greater of CSP and [HSP + 3 F] and it has been 5 minutes since last active call for heating was terminated.

Occupied Heating Operation

Occupied heating operation on units configured with SZVAV control will utilize two separate control methodologies based on heating configurations.

Staged Heating Operation

For units configured with staged heat once a request for active heating capacity has been determined and the unit has met all auto-changeover requirements, the unit will energize the supply fan and ramp up to full speed. Heating stages will be energized/de-energized to meet the zone heating demand.

Modulating Heat Operation with SZVAV Heating

Units configured with a modulating heat type will utilize true SZVAV control. DAHSP will be used in order to determine heating capacity demand and a fan speed.

Heating Sequence

Once the unit has met all auto-changeover requirements and the unit is requesting active heating capacity (ZT < ZHSP) the unit will transition into zone heating.

Once the DAHSP calculation has reached its Upper Limit (UL) and the modulating heat output is being utilized, the supply fan speed will begin to ramp up toward 100%. Note that the supply fan speed will remain at the minimum value until the DAHSP value is calculated above the DAHSP UL.

As the heating load in the zone decreases the fan speed will decrease down to minimum and the heat output will modulate as necessary. As the load in the zone continues to drop the fan speed will be maintained at this minimum airflow and the algorithm will continue to calculate the DASP down toward the zone neutral state (ZHSP<DASP<ZCSP) and control the mod. heat output accordingly. Once the modulating heat output reaches 0% and the heating demand in the space is satisfied, the unit will de-energize all heating outputs.

Modulating Heat Operation with Traditional Constant Volume Fan Operation

Units configured with a modulating heat type will also support a user configurable input to select traditional constant volume (TCV) heating control. The RTOM modulating heat 1st input will be utilized for this configuration.

If configured to utilize TCV, the unit will perform normal heating control utilizing full airflow and a modulating heat output.

Supply Air Tempering Operation

Supply air tempering operation on units configured with SZVAV control will utilize two separate control methodologies based on heating configurations.

For all staged heating types, the unit will utilize the same supply air tempering scheme as is used on TCV units.

For units configured with a modulating heat type and for true SZVAV heating, tempering is an extension of normal heating control which allows a transition from Auto-Cool mode to heating based on discharge temperature if the ZT is in control. The following conditions must be true to allow the unit to enter Supply Air Tempering:

- Supply Fan is ON
- Unit is in occupied mode
- Unit is operating in Auto-Cool mode
- Cooling has been inactive for 5 minutes
- Unoccupied cooling and heating operation

For SZVAV controlled units, the unit will control during unoccupied periods using the heating and cooling SZVAV algorithm. The following will be true during unoccupied periods:

- Unit will utilize setback/modified zone setpoints.
- Minimum OA damper position will be overridden to 0.
- Fan mode will be overridden to Auto as on normal CV units.

Dehumidification Operation

SZVAV units will support both traditional staged and modulating dehumidification configurations. Most functions will be identical to traditional dehumidification control.

Modulating Dehumidification - Entering Dehumidification

At startup a ZT value greater than the active ZCSP, or below the active ZHSP, will prevent dehumidification operation. At this point the unit will perform normal sensible cooling or heating control until the respective setpoint is satisfied.

After startup, the unit will monitor the Space Humidity (SH), OA temperature, ZT, and unit status to determine when to enter and leave dehumidification mode. As long as the unit is not actively heating or cooling with more than half the mechanical cooling capacity or the unit is not disabled, it will enter dehumidification mode when there is a call for dehumidification.

When dehumidification mode is entered the unit will:

- Energize the supply fan, if not already ON, and ramp the fan speed up to 80% airflow.
- Stage up all compressors with approximately 2 seconds between stages.
- Command the OA damper to minimum position.
- The supply air reheat setpoint will be mapped to the active maximum SZVAV heat setpoint which will be the maximum value of DASP during active reheat.
- Begin to control the reheat valve and cooling valve to maintain the discharge air temperature to meet the DASP.

Once the unit is actively dehumidifying, DASP will continue to calculate and will be used as the Supply Air Reheat setpoint that the cooling and reheat valves will be modulated to meet. The user adjustable Supply Air Reheat setpoint will be used as an UL for DASP during active dehumidification and will be limited to the normal range of 65-80°F.

Leaving Dehumidification

On a call to leave dehumidification mode the unit will perform the following:

- Mechanical cooling will stage back to 50% of the available capacity then will be released to normal SZVAV control to meet the load demand.
- The economizer will be released to normal control.
- The supply fan will ramp down to minimum speed.
- The cooling valve will be driven to 100% and the reheat valve will be driven to 0%.
- The reheat pumpout relay will be energized if the reheat circuit is requested or de-energized if the reheat circuit de-energizes.

Staged (On/Off) Dehumidification w/HGRH for Non-17 SEER SZVAV

Dehumidification Transitions (Zone Overrides)

At startup, a ZT value greater than the ZCSP, or below the ZHSP, will prevent dehumidification operation. At this point the unit will perform normal sensible cooling or heating control until the respective setpoint is satisfied. Once the zone is satisfied and there are no other overrides in effect, the following transition rules shall be followed:

If (HSP+1°F)< ZT < (CSP+1°F) and less than 50% available mechanical cooling capacity is energized, then dehumidification is enabled and the following actions will be performed when transitioning into Cool +Reheat:

- Energize the supply fan, if not already ON, and ramp the fan speed up to 80% airflow for VFD, BC plenum, and non-17 SEER PWM controlled supply fan units.
- Stage up all compressors with approximately 2 seconds between stages
- Energize the reheat solenoid
- Command the OA damper to minimum position

If ZT <(HSP+0.5?F) or ZT >(CSP+1°F), or ZT < (CSP+1°F) with more than 50% available mechanical cooling capacity energized, then dehumidification is disabled and the following actions will be performed when transitioning out of Cool+Reheat:

- If ZT >(CSP+1°F), stage back to Cool 1 in normal SZVAV cooling
- If ZT <(HSP+0.5°F), leave reheat, de-energize all compressors and allow the unit to transition into heat/cool mode based on ZT.
- If ZT >(CSP-0.5°F) and SH < Dehumidification Setpoint (DhSp) - 5%, stage back to Cool 1 and wait 3 minutes.
- If ZT < (CSP- 0.5°F) and SH < DhSp - 5%, leave reheat, de-energize all compressors and allow the unit to transition into heat/cool mode based on ZT.

Staged Dehumidification w/ HGRH and Enhanced Dehumidification for 17 SEER SZVAV

Enhanced Dehumidification - 17 SEER SZVAV units will perform Enhanced Dehumidification (EDh) in all cases in which the unit is equipped with a SH sensor or a valid SH value is being communicated from a BAS and the active DhSp is less than the active SH value.

Dehumidification Transitions for 17 SEER Enhanced Dehumidification - At startup, a ZT value greater than the active ZCSP, or below the active ZHSP will prevent dehumidification operation. At this point the unit will perform normal sensible cooling or heating control until the respective setpoint is satisfied. Once the zone is satisfied and there are no other overrides in effect, the following transition rules shall be followed:

If (HSP+1°F) < ZT < (CSP+1°F) and SH > DhSp and the unit is operating at Stage 1 or less of compressor cooling, then EDh is enabled and the unit will perform the following:

- Energize the supply fan, if not already ON, and ramp the Fan Speed output to 56% airflow.
- Energize Stage 1 of the compressor operation.
- Command the OA damper to minimum position.

If ZT > (HSP+0.5°F) or ZT > (CSP+1.5°F) or SH < DhSp - 2%, then EDh is disabled and the unit will perform the following when transitioning out of EDh:

Stage back to normal SZVAV cooling if ZT > (CSP+1.5° F). Fall back to SZVAV cooling control with Stage 1 compressor operation energized and initialize DASP Fan control to normal cooling operation.

Stage back to normal control:

- If ZT < (HSP+0.5°F), leave dehumidification and de-energize all compressor outputs immediately and allow the unit to transition into heat/cool mode based on ZT. Release fan control and initialize DASP based on active unit mode.
- If ZT > (CSP-0.5°F) and SH < DhSp - 2%, stage back to Cool 1 and initialize DASP to active DAT.
- If ZT < (CSP-0.5°F) and SH < DhSp - 2%, leave reheat, de-energize all compressors immediately and allow the unit to transition into heat/cool mode based on ZT. Initialize DASP based on active unit mode.

If no request for active heating/cooling or fan operation is present, the supply fan will remain energized at 56% for 60 seconds after the compressor de-energizes.

Enhanced Dehumidification + Staged (On/Off) HGRH

For 17 SEER SZVAV, the option will be available to have traditional staged dehumidification with Hot Gas Reheat (HGRH) in addition to EDh. A valid SH value will be required, and the unit will need to be hardwired configured for Reheat (RTOM J9-2) and the non-heat pump configuration will need to be OPEN (RTRM J1-5) in order to use the RTRM J2-7 output for reheat operation

Dehumidification Transitions for Enhanced Dehumidification + Staged HGRH

Units configured for traditional HGRH will utilize EDh as described above as the first stage of dehumidification control if the SH is only marginally high (DhSp < SH < DhSp + 2%). If the unit is running in EDh and the SH drops to > DhSp - 2%, EDh will be terminated and the unit will transition out of the mode as described above. If the unit is operating in EDh and the SH is not recovering toward the DhSp - 2%, the unit will transition into full HGRH until the SH falls below the DhSp - 5%. If at any time the SH value rises above the DhSp + 2%, the unit will also transition into full HGRH until the SH falls below the DhSp - 5%.

The mode transition details into full HGRH, as described above for EDh, will be in effect for 17 SEER units with HGRH when only EDh is being utilized. However, if the unit is utilizing full HGRH, the following transitional details will be enforced:

If DhSp < SH < DhSp + 2% and the SH is not recovering toward the DhSp - 2%RH or, if the SH value rises above the DhSp + 2%, or if the humidistat input is active, then the unit will transition into full HGRH if (HSP+1°F) < ZT < (CSP+0.5?F) and the unit is operating at Stage 1 of compressor cooling. The unit will perform the following when transitioning into HGRH:

- Energize the supply fan, if not already ON, and ramp the fan speed up to 100% of the application airflow.
- Energize Stage 1 and Stage 2 of the compressor operation with the reheat solenoid.
- Command the OA damper to minimum position.

If SH < DhSp - 5% or ZT < (HSP+0.5°F) or ZT > (CSP+1° F) or ZT < (HSP+0.5°F) and the unit is operating at > Stage 1 of compressor operation, then HGRH is disabled. The unit will perform the following when transitioning out of HGRH:

- Stage back to normal SZVAV Cooling:
- If ZT > (CSP+1°F), stage back to Cool 1, de-energize the solenoid, release fan control and initialize DASP to active DAT after a 3 minute delay.
- Stage back to normal control:
- If ZT < (HSP+0.5°F), leave dehumidification, de-energize all compressor outputs and the reheat solenoid immediately, and allow the unit to transition into heat/cool mode based on ZT. Initialize DASP based on active unit mode and release Fan Control.
- If ZT > (CSP-0.5°F) and SH < DhSp - 5%, stage back to Cool 1, de-energize the reheat solenoid, and initialize DASP to active DAT after a 3 minute delay.
- If ZT < (CSP - 0.5°F) and SH < DhSp - 5%, leave reheat, de-energize all compressors immediately, and allow the unit to transition into heat/cool mode based on ZT. Initialize DASP based on the active unit mode.

If no request for active heating/cooling or fan operation is present, the supply fan will remain energized at 100% for 60 seconds after the compressor de-energizes.

Dehumidification Overrides

Sensible cooling or heating control overrides dehumidification control. Any heating request will terminate dehumidification control. If heating is active at the time a call for dehumidification control is received the heating operation must complete and an additional 5 minutes from the time heat is terminated must elapse before dehumidification will be allowed.

Purge Mode (Comfort and Dehumidification)

Purge cycle operation will operate identically to purge on non-SZVAV dehumidification units. If the Reheat Circuit operates in one mode (dehumidification or cooling) for a cumulative 90 minutes the unit will initiate a 3-minute Purge cycle exactly as on non-Single Zone VAV units with staged dehumidification.

During an active Purge Cycle the Supply Fan Speed will operate at the appropriate speed based on the active compressor step. If a dehumidification purge is initiated, the unit will run at appropriate dehumidification airflow and if performing a cooling purge the supply fan will track based on the appropriate minimum speed for the associated number of compressors energized. After the Purge Cycle is complete, the Supply Fan will be released to normal control based on the Cooling/Dehumidification demand.

Dehumidification - Humidistat Operation

For SZVAV units configured with modulating dehumidification and are utilizing a Humidistat for control, the unit will function as described above, but instead of making an internal decision when to perform dehumidification based on a SH value, the unit will take requests for dehumidification from the Humidistat input. If the Humidistat input goes active and all conditions described above are met to allow dehumidification, the unit will enter dehumidification as described in "Entering Dehumidification" above. All other normal overrides will be in effect. Once the Humidistat input goes inactive, the unit will transition out of dehumidification as described above in "Leaving Dehumidification".

Other Considerations

- Any heating request will terminate dehumidification control. If heating is active at the time a call for dehumidification control is received the heating operation must complete and an additional 5 minutes from the time heat is terminated must elapse before any form of dehumidification will be allowed.
- Enhanced Dehumidification will not be available with a Humidistat; however, full HGRH will.

Variable Speed (VSPD) Compressor Control (eFlex™)

Unit Operation

The following sections describe hardware output requirements as well as unit control sequence of operations.

Compressor Requirements

For ReliaTel™ systems, the VSPD compressor will require two signals for proper control:

- Run/Start-Stop Command (VSM Binary Output)
- Speed Signal (VSM Analog Output)

Table 22. Normal run: 3 to 5 ton units

Model	Running Frequency		Voltage Range		SZVAV Supply Fan Speed		MZVAV Supply Fan Speed	
	Min Hz	Max Hz	Min	Max	Min-Min PWM	Max-Min PWM	Min-Min PWM	Max-Min PWM
3	15	60	2.4	5.7	53	80	53	80
4	15	60	2.4	5.7	53	80	53	80
5	15	62	2.4	5.85	53	80	53	80

Table 23. Normal run: 6 to 10 ton units

Model	Variable Speed Compressor				SZVAV Supply Fan Speed		MZVAV Supply Fan Speed	
	Freq. Min (Hz)	Freq. Max (Hz)	Vdc Min	Vdc Max	Min-Min V	Max-Min V	Min-Min V	Max-Min V
6	17	82	1.42	6.83	50	82	50	82
7½	22	63	1.83	5.25	50	82	50	82
8½	22	68	1.83	5.67	50	82	50	82
10	22	80	1.83	6.67	50	82	50	82

Table 24. Normal run: 12½ to 17½ ton units

Model	Variable Speed Compressor				SZVAV Supply Fan Speed		MZVAV Supply Fan Speed	
	Freq. Min (Hz)	Freq. Max (Hz)	Vdc Min	Vdc Max	Min-Min V	Max-Min V	Min-Min V	Max-Min V
Fan Only	0	0	0	0	1.6	1.6	1.6	1.6
12½	15	75	2.4	6.8	1.6	7.6	1.6	7.6
15T	15	70	2.4	6.36	1.6	7.6	1.6	7.6
17½	15	75	2.4	6.36	1.6	7.6	1.6	7.6

Economizing Supply Fan Speeds on VSPD Compressor Configured Units

This subsection covers expected supply fan (indoor fan) speeds during economizing-only based cooling efforts. When economizing is available and economizing-based cooling efforts are able to meet cooling demands without staging up compressor-based cooling, compressor operation is inhibited.

When a call for cooling exceeds the available cooling capacity that can be provided by the economizing-based cooling alone, compressor based cooling operation may be leveraged. When compressors are enabled, the required minimum supply fan speeds for compressor-based cooling have priority over supply fan speeds covered in this subsection.

The DX inhibited (compressors off) economizing supply fan speeds for all supported eFlex™ variable speed compressors are to be as defined in the following table below.

Table 25. Fan speeds

Relia-Tel™-Product Family	Tons	Supply Fan Control Type (s):	Economizing Active Supply Fan Speed (with DX Cooling Inhibited):
Prece-dent™	3, 4, 5	SZVAV and MZVAV	53% Airflow (PWM Duty Cycle: 53%)
Prece-dent™	6, 7½, 8½, 10	SZVAV and MZVAV	50% Airflow (0-10Vdc signal: 50%)
Voyager™-Light Commer-cial	12½, 15, 17½	SZVAV and MZVAV	37% Airflow (VFD Command: 1.6Vdc)

Ventilation Supply Fan Speeds on VSPD Compressor Configured Units

This subsection covers expected supply fan (indoor fan) speeds during active ventilation efforts. Active ventilation supply fan speeds for all supported eFlex™ variables speed compressors are to be as defined in the following table below:

Table 26. Supply fan speeds

Relia-Tel™ Product Family	Tons	Supply Fan Control Type (s)	Active Ventilation Supply Fan Speed (with no active call for cooling/ heating/ dehumidifica-tion)
Prece-dent™	3, 4, 5	SZVAV and MZVAV	53% Airflow (PWM Duty Cycle: 53%)
Voyager™ Light Commer-cial	12½, 15, 17½	SZVAV and MZVAV	37% Airflow (VFD Command: 1.6Vdc)

Note: *The above required supply fan speeds are the expected speeds while there is only a call for ventilation, and while there are no calls for cooling, heating or dehumidification. When cooling, heating or dehumidification calls do exist, the required fan speeds for those efforts have priority over the supply fan speeds documented within this subsection.*

Multi-Zone VAV Cooling (Traditional VAV)

Occupied DX & Economizing Cooling Control

For normal cooling operation, the total cooling capacity will be modulated in order to meet the user selected Discharge Air Cooling Setpoint (DACSP).

If enabled, economizer cooling will be utilized as the first stage of cooling prior to energizing the DX capacity. Economizer cooling will modulate the Outdoor Air (OA) damper to maintain the DACSP - as on standard fixed speed compressor equipped units.

Once all economizing requirements have been met, compressor operation will be enabled if the economizer alone cannot meet the demand. Once compressor operation is started, the VSPD compressor will startup, following all startup requirements, and will then be modulated to maintain the discharge air temperature to the DACSP.

For Voyager™ light commercial units, if there is additional demand for cooling once the VSPD compressor has reached its maximum speed for Stage 1, the controller will energize the first fixed speed compressor on circuit 2. Once the first fixed speed compressor is energized, the VSPD compressor speed will be reduced to its minimum speed for Stage 2 of compressor operation and then will be released back to discharge air temperature control. This process will be repeated for the transition between Stages 2 and 3.

Once the active cooling demand has been satisfied for Voyager™ light commercial units, compressors will begin staging down in reverse order from the stage up sequence. Once the VSPD compressor has reached its minimum speed for any given stage of cooling, if the cooling demand continues to decrease, the last fixed speed compressor to energize will be de-energized. Once a fixed speed compressor is de-energized, the VSPD compressor will be increased to its maximum value for the active stage of compressor operation and will then be released back to normal control. After the unit has staged down all fixed compressors, then only the VSPD compressor will be left operating and the following information applies to both Voyager™ light commercial and Precedent™ units: Once there is no longer a demand for the VSPD compressor, the VSPD compressor will modulate down to its minimum speed and then will be de-energized, while adhering to all shutdown requirements. Once all compressors have de-energized, the economizer, if enabled, will be allowed to close back to minimum position if there is no longer a demand.

Note: *In all cases, during normal compressor operation, the VSPD compressor will be subject to a 3-minute minimum ON/OFF time and the supply fan will continue to be controlled by the supply air pressure.*

Unoccupied DX & Economizer Cooling Control

For unoccupied DX and economizer cooling control, the unit will operate as a standard fixed-speed compressor unit1. During all requests for cooling operation during unoccupied mode, the unit will operate the VSPD compressor at 100% of the available capacity 2. When compressor operation is requested, the VSPD compressor will be started first and its speed will be increased up to 100%, based on the unit configuration. If in the case of the multi-compressor unit, the VSPD compressor alone cannot meet the space demand; the unit will begin to stage up additional compressors to meet the demand.

Note: *Light commercial units do not support unoccupied mode without a BAS system or programmable zone sensor to support the needed unoccupied heat/cool setpoints.*

Demand limits, restricting available compressor capacity, are to have higher priority over the commanded compressor capacity staging level due to occupancy status.

Dehumidification is not currently supported on multi-zone VAV.

Single Zone VAV Cooling - Supply Fan Output Signal Control

No new supply fan technology is required to support the VSPD compressor application - existing supply fan types will be utilized. While no new fan technology is required, a change will be required to optimize the unit control with a VSPD compressor. Modifications will be made to the minimum fan speed based on active compressor capacity.

Discharge Air Temperature Control

Occupied DX & Economizer Cooling Control

For normal cooling operation, the total cooling capacity will be modulated and staged in order to meet the calculated DACSP, as standard fixed speed compressor units.

Unoccupied DX & Economizer Cooling Control

For unoccupied DX and economizer cooling control, the unit will operate as during normal occupied mode - compressor capacity will be varied to maintain the discharge air temperature requirements and the supply fan will remain in control based on the active compressor capacity and space demand.

Enhanced Dehumidification

Enhanced dehumidification on ReliaTel™ SZVAV VSPD compressor units will use a slower minimum indoor fan speed at a constant compressor stage to achieve dehumidification.

Active Cooling Mode Operation

When the unit is in active cooling mode, the unit is allowed to enter enhanced dehumidification if space humidity > dehumidification setpoint and the zone temperature conditions are satisfied.

When the unit enters enhanced dehumidification, the compressor staging will be held at current conditions and fan will drop to the minimum speed operating range. Enhanced dehumidification will continue to run until space humidity > dehumidification setpoint - 2% and the zone temperature is approaching either the cooling or heating setpoint.

Idle Mode Operation

If unit is in idle mode and dehumidification conditions are met, the compressors and supply fan will be started to a predetermined point and run until the above termination conditions are met.

Condenser Fan Control

For single compressor units with a VSPD compressor, the unit will also be equipped with a variable speed VSM condenser fan motor.

The condenser fan shall be controlled based on the following tables:

Table 27. Condenser fan control data 3 – 5 tons

OAT Condition	VSPD Comp. Speed	3 Tons			4 Tons			5 Tons		
		RPM	% Cond. Airflow	Duty Cycle	RPM	% Cond. Airflow	Duty Cycle	RPM	% Cond. Airflow	Duty Cycle
OAT>95F	Min<Hz<Max	894	100%	73%	1013	100%	84%	1076	100%	89%
45F<OAT<90F	<23Hz	383	40%	29%	473	40%	37%	524	40%	41%
	25Hz<Hz<50Hz	691	70%	56%	743	70%	60%	800	70%	65%
	>52Hz	894	100%	73%	1013	100%	84%	1076	100%	89%
<40F	Startup	290	32%	21%	311	22%	23%	358	22%	27%
25F<OAT<40F	Min<Hz<Max && ! Startup	236	26%	16%	311	22%	23%	358	22%	27%
OAT<20F	Min<Hz<Max && ! Startup	236	26%	16%	311	22%	23%	358	22%	27%

Note: A 2 Hz hysteresis around the VSPD compressor speed will be implemented when transitioning from high speed to low speed.

Table 28. Condenser fan control data 6 – 10 tons

OAT Condition	VSPD Comp. Speed	6 Tons			10 Tons		
		RPM	% Cond. Airflow	Duty Cycle	RPM	% Cond. Airflow	Duty Cycle
OAT>95F	Min<Hz<Max	1001	100	83%	1130	100%	94%
45F<OAT<90F	<48Hz	473	40	31%	532	40%	37%
	50Hz<Hz<70Hz	733	70	56%	831	70%	65%
	>72Hz	1001	100	83%	1130	100%	94%
25F<OAT<40F	Min<Hz<Max	312	22	16%	352	22%	20%
OAT<20F	Min<Hz<Max	312	22	16%	352	22%	20%
OAT Condition	**VSPD Comp. Speed**	**7.5 Tons**			**8.5 Tons**		
		RPM	**% Cond. Airflow**	**Duty Cycle**	**RPM**	**% Cond. Airflow**	**Duty Cycle**
OAT>95F	Min<Hz<Max	1111	100%	92%	1116	100%	92%
45F<OAT<90F	<23Hz	465	40%	31%	465	40%	31%
	25Hz<Hz<53Hz	790	70%	61%	790	70%	61%
	>55Hz	1111	100%	92%	1116	100%	92%
25F<OAT<40F	Min<Hz<Max	300	22%	15%	300	22%	15%
OAT<20F	Min<Hz<Max	300	22%	15%	300	22%	15%

Note: A 2Hz hysteresis around the VSP compressor speed will be implemented when transitioning from high speed to low speed.

Table 29. Condenser fan control data 12.5 – 17.5 tons

OAT Condition	VSPD Comp. Speed	Fixed Comp 1	Fixed Comp 2	12.5 to 15 Tons RPM	12.5 to 15 Tons % Cond. Airflow	12.5 to 15 Tons VSM Duty Cycle	17.5 Tons RPM	17.5 Tons % Cond. Airflow	17.5 Tons VSM Duty Cycle
OAT>95F	<30Hz	OFF	OFF	1140	100%	95%	1080	100%	90%
OAT>95F	>30Hz	OFF	OFF	1140	100%	95%	1080	100%	90%
OAT>95F	<30Hz	ON	OFF	1140	100%	95%	1080	100%	90%
OAT>95F	>30Hz	ON	OFF	1140	100%	95%	1080	100%	90%
OAT>95F	<30Hz	ON	ON	1140	100%	95%	1080	100%	90%
OAT>95F	>30Hz	ON	ON	1140	100%	95%	1080	100%	90%
45F<OAT<90F	<30Hz	OFF	OFF	533	45%	43%	530	45%	43%
45F<OAT<90F	>30Hz	OFF	OFF	753	65%	62%	754	65%	62%
45F<OAT<90F	<30Hz	ON	OFF	753	65%	62%	754	65%	62%
45F<OAT<90F	>30Hz	ON	OFF	863	75%	71%	866	75%	72%
45F<OAT<90F	<30Hz	ON	ON	863	75%	71%	866	75%	72%
45F<OAT<90F	>30Hz	ON	ON	1140	100%	95%	1080	100%	90%
25F<OAT<40F	<30Hz	OFF	OFF	309	25%	24%	303	25%	24%
25F<OAT<40F	>30Hz	OFF	OFF	309	25%	24%	303	25%	24%
25F<OAT<40F	<30Hz	ON	OFF	309	25%	24%	303	25%	24%
25F<OAT<40F	>30Hz	ON	OFF	533	45%	43%	530	45%	43%
25F<OAT<40F	<30Hz	ON	ON	533	45%	43%	530	45%	43%
25F<OAT<40F	>30Hz	ON	ON	533	45%	43%	530	45%	43%
OAT<20F	<30Hz	OFF	OFF	250	20%	21%	245	20%	21%
OAT<20F	>30Hz	OFF	OFF	250	20%	21%	245	20%	21%
OAT<20F	<30Hz	ON	OFF	309	25%	24%	303	25%	24%
OAT<20F	>30Hz	ON	OFF	533	45%	43%	530	45%	43%
OAT<20F	<30Hz	ON	ON	533	45%	43%	530	45%	43%
OAT<20F	>30Hz	ON	ON	533	45%	43%	530	45%	43%

Note: A 2 Hz hysteresis around the VSPD compressor will be implemented when transitioning from a high speed to a lower speed.

Test Modes

VSPD compressor equipped units will require handling for two test mode sequences. See below for additional information on each mode.

Failure and Protection Conditions

Certain failure and overriding conditions require special handling of the VSPD compressor. Refer to the following sections for details on each failure mode associated with the VSPD compressor and the unit response.

Supply Air Temperature on SZVAV

If the supply air temperature sensor value is out of range/invalid on a unit configured for SZVAV, the unit will fall back to traditional constant volume control and the VSPD compressor will be controlled at 100% capacity for all requests for compressor operation. All startup, shutdown, and oil recovery requirements will remain in effect for the VSPD compressor.

Outside Air Temperature

If the OA temperature sensor value is out of range/ invalid, an "Outside Air Temperature Invalid/Out of Range" diagnostic shall be generated. Condenser fan operation will default to 100% during all requests for compressor operation. This will remain consistent between single and multi-compressor configured units. The VSPD compressor will operate as a fixed speed compressor, being limited to 40Hz (2400 RPM) to protect against high ambient OAT operation. The "Outside Air Temperature Invalid/Out of Range" diagnostic shall automatically reset if a valid value is received by the controller.

Evaporator Coil Frost Protection

When the OA temperature is less than 55°F (single compressor) 40° F (multi-compressor) the unit will enable the evaporator coil frost protection function. This function will cycle all compressors off every 10 minutes of continuous operation. For the variable speed compressor the shutdown and startup sequences will be incorporated into the timing extending the total variable speed compressor ON time to 10 minutes + shutdown sequence time before shutting off.

Extended Time at Compressor Low Speed (Oil Recovery Mode)

- For 3–5T & 12.5–17.5T units: If the VSPD compressor operates for 19 continuous minutes with active compressor speed < 40Hz, the VSPD compressor shall ramp to 40Hz for minimum of 1 minute and then will be released back to normal operation.
- For 6–10T units: If the VSPD compressor operates for 19 continuous minutes with active compressor speed < 45Hz, the VSPD compressor shall ramp to 45Hz for minimum of 1 minute and then will be released back to normal operation.

High Ambient Operation Protection (3–5T & 12.5–17.5T eFlex™ Units)

If the OA temperature reaches temperature in excess of 100°F, ReliaTel™ controls will implement minimum and maximum compressor speed limits. The limits are shown in the following table.

Table 30. Speed limits

Entering Outdoor Ambient (deg F)	RPM Lower Limit (RPM)	RPM Lower Limit (Hz)	RPM Lower Limit (V)	RPM Upper Limit (RPM)	RPM Upper Limit (Hz)	RPM Upper Limit (V)
100	1100	18	2.7	4500	75	6.8
107	1300	22	2.9	4500	75	6.8
112	1500	25	3.2	4200	70	6.4
118	1800	30	3.5	3600	60	5.7
124	2100	35	3.9	3000	50	5
127	2400	40	4.3	2400	40	4.3

Note: As OAT decreases, leaving each condition occurs at an OAT of 2°F below the entering OAT temperature specified in the table.

Precedent™ 6T-10T eFlex™ Emerson Compressor Enabled Units

On eFlex units incorporating an Emerson compressor, a condensing temperature sensor and evaporator temperature sensor will be used to control the minimum compressor speed within the limits of the compressor operating map. This operating map control will not be active during AHRI test mode. These minimum compressor speed limitations are defined in the following table.

Table 31. Compressor speed limit — Precedent™ eFlex™ 6–10 Tons

Unit	Evap Temp (deg F)	Cond Temp (deg F)	RPM Lower Limit (RPM)	RPM Lower Limit (Hz)	RPM Lower Limit (V)	RPM Upper Limit (RPM)	RPM Upper Limit (Hz)	RPM Upper Limit (V)
6 Tons	Temp > 65F	any	2700	45	3.75	5000	83	6.92
	20F ≤ Temp < 65F[a]	temp ≥ 125F	2700	45	3.75	5000	83	6.92
		95F ≤ temp < 125F[b]	1680	28	2.33	5000	83	6.92
		temp < 95F[b]	1020	17	1.42	5000	83	6.92
7.5 to 10 Tons	Temp > 60F	any	2640	44	3.67	6000	100	8.33
	Temp < 60F[a]	temp ≥ 130F	2220	37	3.08	6000	100	8.33
		95F ≤ temp < 130F[b]	1800	30	2.5	7200	120	10
		temp < 95F[b]	1320	22	1.83	7200	120	10

Note: If any of the EvapTemp and CondTemp senor fails, operation outside the limitations of the operating map cannot be guaranteed. The compressor will not operate.

[a] As the EvapTemp decreases, leaving each condition occurs at a temperature of 8 deg F below the entering EvapTemp specified in the table.

[b] CondTemp decreases, leaving each condition occurs at a temperature of 5 deg F below the entering CondTemp temperature specified in the table.

Compressor Protection

The connections for compressor proving and low pressure cutout for the VSPD compressor are on the VSM module. On multi-compressor units, each compressor will have its own compressor proving input, but will have one compressor disable input per refrigeration circuit.

If the case of compressor failure the following sequences will be used based on the compressor(s) failed:

- Variable speed compressor failed, fixed compressor circuit available:
- The system will revert to the staged compressor control.
- If compressor 2 disable input is active, only one fixed speed compressor is to be available during compressor stage-up efforts.
- Variable speed compressor available, fixed compressor circuit failed:
- The system will utilize the variable speed algorithm to stage the variable speed compressor as normal. The fixed compressor will not be able to respond to control requests.
- If compressor 2 disable input is active, up to 100% of the variable speed compressor capacity is to be available during compressor stage-up efforts.

Compressor VFD Alarm Output Lockout

During a HPC event, there is a possibility that the compressor VFD drive will trip on an overcurrent condition before the high pressure switch is active. To prevent a cycling condition with the compressor VFD drive, the following operation will be implemented.

If the HPC input on the VSM indicates a high pressure condition on the VSPD compressor circuit, the system will react identically the same as today's operation.

In the event that the system encounters the issue described in the above problem statement, the following logic will be used

- If the compressor VFD alarm is received in the first 3 minutes of ReliaTel™ compressor request, the compressor will shut down (as expected).
- The VSPD compressor will not be allowed to restart until the compressor VFD alarm has cleared.
- If the compressor VFD alarm is received in the first 3 minutes of ReliaTel™ compressor request 4 consecutive times, then the VSPD compressor will be locked out on a manual diagnostic.
- If the VSPD compressor runs longer than 3 minutes, the counter will be set to zero.

VSM Module Communication Failure

If the VSM module loses communication with the rest of the ReliaTel™ system, the unit will disable all VSPD compressor operation and will generate a "VSM Module Communication Failure" diagnostic. On units with fixed speed compressors all compressors will be disabled due to OD fan being controlled through the VSM module.

Verifying Proper Air Flow

Units with Direct Drive Indoor Fan

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

ReliaTel™ Control

Momentarily jump across the Test 1 & Test 2 terminals on LTB1 one time to start the minimum ventilation test.

Electromechanical Control

Perform the proper test mode connections.

Total System Airflow (ReliaTel™/Electromechanical)

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

1. Measure the DC voltage across pins Vt and com on MMC board or note the DC voltage shown on the ECM board display. Using the fan rpm table shown on the power diagram or in the unit Service Facts, determine RPM correlated to measured voltage.
2. Measure the amperage at the supply fan contactor and compare it with the full load amp (FLA) rating for the evaporator motor stamped on the unit nameplate.
   a. Calculate the theoretical BHP using (actual motor amps/motor nameplate amps) X motor HP.
   b. Using the fan performance tables in the unit Service Facts, plot the actual RPM (step 1) and the BHP (step 2a) to obtain the operating CFM.
3. If the required CFM is too low, (external static pressure is high causing motor HP output to be below table value):
   a. Relieve supply and/or return duct static.
   b. Change indoor fan speed and repeat step 1 and 2. Refer to the following section for fan speed adjustment.
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 step 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.

Fan Speed Adjustment

MMC Board

1. To increase or decrease fan RPM push and turn knob counter-clockwise or clockwise respectively.
2. measure the DC voltage across pins Vt and com on the MMC.
3. Using the fan rpm table in the unit Service Facts, determine RPM correlated to measured voltage.

ECM Board

1. Push and hold the SET button for 3 sec. Board will display motor 1 parameter name: Hi 1.
2. Slow push SET again to display the parameters current value =7.50 volts.
3. Push on + or – button to adjust parameter to desired value = XXX volts.
4. Push and hold SET button for 3 sec to "save" the value. After save is complete, Hi 1 will show again.
5. After the voltage Hi 1 is successfully changed, the display sequence will be: MTR 1—> XXX ———> MTR2 ———> 0.00———>FST1——>ON/OFF——— >FST2————>ON/OFF—————>EhEn——— >ON/OFF And the motor will ramp up or down to adjust to the input signal.
6. Using the fan rpm table in the unit Service Facts, determine RPM correlated to displayed voltage

ReliaTel™ LED Functions

Modules and Codes

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 “RTRM System LED Diagnostic Indicator,” p. 33 for a list of diagnostics]
- Continuous ¼ 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 0.5 second, off 1.5 second: Normal communication
- 1/4 second wink every 2 seconds: Not communicating with any other module
- Off: Board failure

ReliaTel™ Options Module (RTOM)

Green system LED

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

ReliaTel™ Ventilation Module (RTVM)

Green system LED

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

ReliaTel™ Air Handling Module (RTAM)

Green system LED

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

ReliaTel™ Dehumidification Module (RTDM)

- NA - No Onboard LED

Economizer Actuator Module (ECA), (RTEM)

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 – CO_2 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 System LED

- 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

    ***Note:** 6 flash not applicable to 12.5 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®)

LED 1 Green MODBUS LED

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

LED 2 Red Service LED

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

LED3 Yellow Comm RX

- Flashing intermittently: normal operation.

Table 32. Interpreting the LEDs

LED type	LED activity	Indicates
Service LED	Solid green	The controller is in boot mode. The controller will be placed into boot mode if the service pin is held in when power is applied. In boot mode, the controller is non-operational and is waiting for a new main application to be downloaded. While in boot mode, the system will not run any applications.
	Not illuminated	Application code is running; operating normally
Status LED	Solid green	Normal operation
	Blinking green	The controller is updating the flash
	Solid red	The controller has malfunctioned
	Blinking red	Alarms or point faults are present
	Not illuminated	The controller is off
Link Tx/Rx	TX blinks green	Data is being transferred, received, or transmitted
	RX blinks yellow	Blinks at the data transfer rate when the unit receives data from other devices on the link ON solid yellow; indicates there is reverse polarity
	Not illuminated	No activity is occurring
Modbus Tx/Rx	Blinking	Data is being transferred, received, or transmitted
	Not illuminated	No activity is occurring
Link LEDs	BACnet® is illuminated	The Link Switch has been set to wired communication
	IMC is illuminated	The Link Switch has been set to wireless communication

LED4 Green COMM 5 status LED

- Steady on: Normal operation.

ReliaTel™ Test Mode

Note: *See specific service fact(s) to verify test sequence.*

Protocol, Modes and Tests

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® Summit, 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)

It is possible to connect multiple devices. Doing so increases the chance for error in application and troubleshooting.

Note: *27.5 to 50 tons 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 **"Economizer close"**, **"Cool 1"**, **"Cool 2"**, **"Cool 3"**, **"Reheat Valve"** (for Staged Dehumidification), **"Modulating Reheat"** and **"Cooling Valves"**, **"Reheat Circuit Pumpout Solenoid"**, **"Heat 1"**, **"Heat 2"**, **"Emergency Heat "**(heat pumps only), and **"Outdoor Coil Defrost"** (heat pump only). If a unit does not have a component, such as an economizer, that test stage is skipped. There are 3 ways to use the **"TEST"** mode. In each case, the unit can be running in any mode or not running at all. Service **"TEST"** mode can be initiated any time the unit is powered and an open condition has been detected on the Test Terminals at some time since power-up.

Auto-Cycle Test

Place a jumper from TEST 1 to TEST 2. The unit will run in each mode for 30 seconds, scrolling through all modes, then exiting the **"TEST"** mode automatically. To go through **"TEST"** mode again, remove and 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.

Table 33. Resistance test

Operating Mode		Resistance
1	Indoor fan on	2.2k ohms
2[(a)]	Economizer open	3.3k ohms
3	Cool 1	4.7k ohms
4[(a)]	Cool 2	6.8k ohms
5[(a)]	Cool 3	8.2k ohms
5	Heat 1	10k ohms
6[(a)]	Heat 2	15k ohms
7[(a)]	Heat 3	22k ohms
9[(a)]	Heat 4	27k ohms
8[(b)]	Defrost cycle/reheat	33k ohms
9[(a)]	Emergency heat	47k ohms

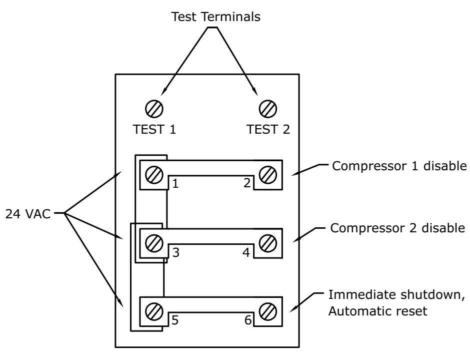
(a) Optional components
(b) Defrost cycle in test mode runs for at least 1 minute, up to 10 minutes, depending on outdoor ambient and outdoor coil temperature. Reheat step is valid only with dehumidification option and will be step 5 of the test.

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 to 50 tons units see test mode chart and following figure.*

Figure 50. LTB layout with jumpers



Test Modes

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 to 50 tons units as the Voyager™ Commercial configuration will be lost.
- Some test functions do not work with LCI installed. Remove LCI from the circuit before entering the **"TEST"** mode.

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

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

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

Fan Proving input, 5J7-6 on RTOM

The indoor fan will run in the **"TEST"** mode for 40 seconds and then stop if this input fails to open (3- through 25-ton) or close (27.5 to 50 tons) within 40 seconds. The diagnostic for this failure is SERVICE (pulsing 1.5 – 2.5VDC from RTRM J6-6 to J6-10).

Compressor Disable Inputs, 3J1-8, 3J3-2 (2 Compressor units) on RTRM

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

Compressor Proving Circuits, 3J1-9, 3J3-3 (2 Compressor Units) on RTRM

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

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

Ventilation Override Mode (VOM), J6 on the RTOM

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

CO_2 Option Through DCV Input on ECA

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

ECA Minimum Position Adjustment

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

Frostat™ Input

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

Test Mode Tables

Table 34. Precedent™ 3 to 10 tons standard efficiency heat pump CV (w/ unloading compressor)

Mode	C1 Unloaded	C2 Loaded	CFA	CFB	Heat 1	Heat 2	SOV1	Econ	S Fan	S Fan Speed Command (PWM)	S Fan Speed Command (ECM)	Resistance
1. Fan On	Off	Off	Off	Off	Off	Off	Off	Min.	On	Min Speed	100%	2.2K
2. Econ	Off	Off	Off	Off	Off	Off	On	100%	On	Min Speed	100%	3.3K
3. Cool 1	On	Off	Norm[a]	Norm[a]	Off	Off	On	Min.	On	57% or 70%[b]	100%	4.7K
4. Cool 2	On	On	Norm[a]	Norm[a]	Off	Off	On	Min.	On	82% or 100%[b]	100%	6.8K
5. Heat 1	On	Off	Off	On	Off	Off	Off	Min.	On	100%	100%	10K
6. Heat 2	On	On	Off	On	Off	Off	Off	Min.	On	100%	100%	15K
7. Heat 3	On/Off[c]	On/Off[c]	Off	On/Off[c]	On	Off	Off	Min.	On	100%	100%	22K
8. Heat 4	On/Off[c]	On/Off[c]	Off	On/Off[c]	On	On	Off	Min.	On	100%	100%	27K
9. Defrost	On	On	Off	Off	On	Off	On	Min.	On	100%	100%	33K
10. Em Heat	Off	Off	Off	Off	On	On	Off	Min.	On	100%	100%	47K

(a) Normal Condenser Fan staging shall remain in effect during Service Test mode
(b) Dependent on the short run timer
(c) Dependent on auxiliary heat being Electric Heat (On) or Gas Heat (Off)

Table 35. Precedent™ 3 to 10 tons standard efficiency heat pump 2-speed (w/ unloading compressor)

Mode	C1 Unloaded	C2 Loaded	CFB	Heat 1	Heat 2	SOV1	Econ	S Fan	S Fan Speed Command (PWM)	S Fan Speed Command (ECM)	Resistance
1. Fan On	Off	Off	Off	Off	Off	Off	Min.	On	50%	68%	2.2K
2. Econ	Off	Off	Off	Off	Off	On	100%	On	50%	68%	3.3K
3. Cool 1	On	Off	Norm[a]	Off	Off	On	Min.	On	50%	68%	4.7K
4. Cool 2	On	On	Norm[a]	Off	Off	On	Min.	On	50%	68%	6.8K
5. Heat 1	On	On	Off	Off	Off	Off	Min.	On	50%[b]	68%	10K
6. Heat 2	On	On	Off	Off	Off	Off	Min.	On	100%[b]	100%	15K
7. Heat 3	On/Off[c]	On/Off[c]	Off	On	Off	Off	Min.	On	100%	100%	22K
8. Heat 4	On/Off[c]	On/Off[c]	Off	On	On	Off	Min.	On	100%	100%	27K
9. Defrost	On	On	Off	On	Off	On	Min.	On	100%	100%	33K
10. Em Heat	Off	Off	Off	On	On	Off	Min.	On	100%	100%	47K

(a) Normal Condenser Fan staging shall remain in effect during Service Test mode
(b) Depends on if Heat mode has a higher maximum fan speed then cool mode
(c) Dependent on auxiliary heat being Electric Heat (On) or Gas Heat (Off)

Table 36. Precedent™ 3 to 10 tons standard efficiency heat pump SZVAV (w/ unloading compressor)

Mode	C1 Unloaded	C2 Loaded	CFA	CFB	Heat 1	Heat 2	SOV1	Econ	S Fan	S Fan Speed Command (PWM)	S Fan Speed Command (ECM)	Resistance
1. Fan On	Off	Off	Off	Off	Off	Off	Off	Min.	On	50%	68%	2.2K
2. Econ	Off	Off	Off	Off	Off	Off	Off	100%	On	50%	68%	3.3K
3. Cool 1	On	Off	Norm[a]	Norm[a]	Off	Off	On	Min.	On	70%	79%	4.7K
4. Cool 2	On	On	Norm[a]	Norm[a]	Off	Off	On	Min.	On	100%	100%	6.8K
5. Heat 1	On	Off	Off	On	Off	Off	Off	Min.	On	70%	79%	10K
6. Heat 2	On	On	Off	On	Off	Off	Off	Min.	On	100%	100%	15K
7. Heat 3	On/Off[b]	On/Off[b]	Off	On/Off[b]	On	Off	Off	Min.	On	100%	100%	22K
8. Heat 4	On/Off[b]	On/Off[b]	Off	On/Off[b]	On	On	Off	Min.	On	100%	100%	27K
9. Defrost	On	On	Off	Off	On	Off	On	Min.	On	100%	100%	33K
10. Em Heat	Off	Off	Off	Off	On	On	Off	Min.	On	100%	100%	47K

(a) Normal Condenser Fan staging shall remain in effect during Service Test mode
(b) Dependent on auxiliary heat being Electric Heat (On) or Gas Heat (Off)

Table 37. Precedent™ 3 to 10 tons standard efficiency heat pump MZVAV (w/ unloading compressor)

Mode	C1	C2	CFA	CFB	Heat 1	Heat 2	SOV1	Econ	S Fan	S Fan Speed Command (PWM & ECM)	Resistance
1. IGV/VFD Open	Off	Off	Off	Off	Off	Off	Off	Closed	Off	Min Speed	NA
2. IGV/VFD Closed	Off	Off	Off	Off	Off	Off	Off	Closed	Off	Min Speed	NA
3. Fan On / Min Vent	Off	Off	Off	Off	Off	Off	Off	Min.	On	Min Speed	2.2K
4. Econ	Off	Off	Off	Off	Off	Off	On	100%	On	In Control[a]	3.3K
5. Cool 1	On	Off	Norm[b]	Norm[b]	Off	Off	On	Min.	On	In Control[a]	4.7K
6. Cool 2	On	On	Norm[b]	Norm[b]	Off	Off	On	Min.	On	In Control[a]	6.8K
7. Heat 1	On	Off	Off	On	Off	Off	Off	Min.	On	100%	10K
8. Heat 2	On	On	Off	On	Off	Off	Off	Min.	On	100%	15K
9. Heat 3	On/Off[c]	On/Off[c]	Off	On/Off[c]	On	Off	Off	Min.	On	100%	22K
10. Heat 4	On/Off[c]	On/Off[c]	Off	On/Off[c]	On	On	Off	Min.	On	100%	27K
11. Defrost	On	On	Off	Off	On	Off	On	Min.	On	100%	33K
12. Em Heat	Off	Off	Off	Off	On	On	Off	Min.	On	100%	47K

(a) Supply Fan Speed controlled to duct static pressure
(b) Normal Condenser Fan staging shall remain in effect during Service Test mode
(c) Dependent on auxiliary heat being Electric Heat (On) or Gas Heat (Off)

Table 38. Precedent™ 6 to 10 tons high efficiency heat pump CV (w/ unloading compressor)

Mode	C1 Unloaded	C2 Loaded	EMAIR Fan Spd (Fixed Spd)	CFB	Heat 1	Heat 2	SOV 1	Econ	S Fan	S Fan Speed Command (ECM)	Resistance
1. Fan On	Off	Off	Off	Off	Off	Off	Off	Min.	On	100%	2.2K
2. Econ	Off	Off	Off	Off	Off	Off	On	100%	On	100%	3.3K
3. Cool 1	On	Off	Off	Norm[a]	Off	Off	On	Min.	On	100%	4.7K
4. Cool 2	On	On	Off	Norm[a]	Off	Off	On	Min.	On	100%	6.8K
5. Cool 3	On	On	On	Norm[a]	Off	Off	On	Min	On	100%	8.2K
6. Heat 1	On	On	Off	Off	Off	Off	Off	Min.	On	100%	10K
7. Heat 2	On	On	On	Off	Off	Off	Off	Min.	On	100%	15K
8. Heat 3	On/Off[b]	On/Off[b]	On/Off[b]	Off	On	Off	Off	Min.	On	100%	22K
9. Heat 4	On/Off[b]	On/Off[b]	On/Off[b]	Off	On	On	Off	Min.	On	100%	27K
10. Defrost	On	On	On	Off	On	Off	On	Min.	On	100%	33K
11. Em Heat	Off	Off	Off	Off	On	On	Off	Min.	On	100%	47K

(a) Normal Condenser Fan staging shall remain in effect during Service Test mode
(b) Dependent on auxiliary heat being Electric Heat (On) or Gas Heat (Off)

Table 39. Precedent™ 6 to 10 tons high efficiency heat pump multi-speed fan (w/ unloading compressor)

Mode	C1 Unloaded	C2 Loaded	EMAIR Fan Spd (Fixed Spd)	CFB	Heat 1	Heat 2	SOV 1	Econ	S Fan	S Fan Speed Command (ECM)	Resistance
1. Fan On	Off	Off	Off	Off	Off	Off	Off	Min.	On	68%	2.2K
2. Econ	Off	Off	Off	Off	Off	Off	On	100%	On	68%	3.3K
3. Cool 1	On	Off	Off	Norm[a]	Off	Off	On	Min.	On	68%	4.7K
4. Cool 2	On	On	Off	Norm[a]	Off	Off	On	Min.	On	50%	6.8K
5. Cool 3	On	On	On	Norm[a]	Off	Off	On	Min	On	100%	8.2K
6. Heat 1	On	On	Off	Off	Off	Off	Off	Min.	On	68%[b]	10K
7. Heat 2	On	On	On	Off	Off	Off	Off	Min.	On	100%[b]	15K
8. Heat 3	On/Off[c]	On/Off[c]	On/Off[c]	Off	On	Off	Off	Min.	On	100%	22K
9. Heat 4	On/Off[c]	On/Off[c]	On/Off[c]	Off	On	On	Off	Min.	On	100%	27K
10. Defrost	On	On	On	Off	On	Off	On	Min.	On	100%	33K
11. Em Heat	Off	Off	Off	Off	On	On	Off	Min.	On	100%	47K

(a) Normal Condenser Fan staging shall remain in effect during Service Test mode
(b) Depends on if Heat mode has a higher maximum fan speed than cool mode
(c) Dependent on auxiliary heat being Electric Heat (On) or Gas Heat (Off)

Table 40. Precedent™ 6 to 10 tons high efficiency heat pump SZVAV (w/ unloading compressor)

Mode	C1 Unload-ed	C2 Loaded	EMAIR Fan Spd (Fixed Spd)	CFB	Heat 1	Heat 2	SOV 1	Econ	S Fan	S Fan Speed Com-mand (ECM)	Resistance
1. Fan On	Off	Off	Off	Off	Off	Off	Off	Min.	On	68%	2.2K
2. Econ	Off	Off	Off	Off	Off	Off	On	100%	On	68%	3.3K
3. Cool 1	On	Off	Off	Norm(a)	Off	Off	On	Min.	On	68%	4.7K
4. Cool 2	On	On	Off	Norm(a)	Off	Off	On	Min.	On	68%	6.8K
5. Cool 3	On	On	On	Norm(a)	Off	Off	On	Min	On	100%	8.2K
6. Heat 1	On	On	Off	Off	Off	Off	Off	Min.	On	68%(b)	10K
7. Heat 2	On	On	On	Off	Off	Off	Off	Min.	On	100%(b)	15K
8. Heat 3	On/Off(c)	On/Off(c)	On/Off(c)	Off	On	Off	Off	Min.	On	100%	22K
9. Heat 4	On/Off(c)	On/Off(c)	On/Off(c)	Off	On	On	Off	Min.	On	100%	27K
10. Defrost	On	On	On	Off	On	Off	On	Min.	On	100%	33K
11. Em Heat	Off	Off	Off	Off	On	On	Off	Min.	On	100%	47K

(a) Normal Condenser Fan staging shall remain in effect during Service Test mode
(b) Depends on if Heat mode has a higher maximum fan speed than cool mode
(c) Dependent on auxiliary heat being Electric Heat (On) or Gas Heat (Off)

Table 41. Precedent™ 6 to 10 tons high efficiency heat pump MZVAV (w/ unloading compressor)

Mode	C1 Unload-ed	C2 Loaded	EMAIR Fan Spd (Fixed Spd)	CFB	Heat 1	Heat 2	SOV 1	Econ	S Fan	S Fan Speed Com-mand (ECM)	Resistance
1. IGV/VFD Open	Off	Off	Off	Off	Off	Off	Off	Closed	Off	Min Speed	NA
2. IGV/VFD Close	Off	Off	Off	Off	Off	Off	Off	Closed	Off	Min Speed	NA
3. Fan On	Off	Off	Off	Off	Off	Off	Off	Min.	On	Min Speed	2.2K
4. Econ	Off	Off	Off	Off	Off	Off	On	100%	On	Min Speed	3.3K
5. Cool 1	On	Off	Off	Norm(a)	Off	Off	On	Min.	On	Min Speed	4.7K
6. Cool 2	On	On	Off	Norm(a)	Off	Off	On	Min.	On	In Control (b)	6.8K
7. Cool 3	On	On	On	Norm(a)	Off	Off	On	Min	On	In Control (b)	8.2K
8. Heat 1	On	On	Off	Off	Off	Off	Off	Min.	On	100%(c)	10K
9. Heat 2	On	On	On	Off	Off	Off	Off	Min.	On	100%(c)	15K
10. Heat 3	On/Off(d)	On/Off(d)	On/Off(d)	Off	On	Off	Off	Min.	On	100%(c)	22K
11. Heat 4	On/Off(d)	On/Off(d)	On/Off(d)	Off	On	On	Off	Min.	On	100%(c)	27K
12. Defrost	On	On	On	Off	On	Off	On	Min.	On	100%	33K
13. Em Heat	Off	Off	Off	Off	On	On	Off	Min.	On	100%	47K

(a) Normal Condenser Fan staging shall remain in effect during Service Test mode
(b) Supply Fan Speed controlled to duct static pressure
(c) Depends on if Heat mode has a higher maximum fan speed than cool mode
(d) Dependent on auxiliary heat being Electric Heat (On) or Gas Heat (Off)

Table 42. Voyager™ & Precedent™ gas/electric units 3 to 25 tons

Step	Mode	IDM	Econ	CPR1	CPR2	HT1	HT2	Mod Gas	ODM1	ODM2
1	Fan On	On/Low[a]	Min	Off	Off	Off	Off	Off	Off	Off
2[a]	Econ.	On/Low[a]	Open	Off	Off	Off	Off	Off	Off	Off
3	Cool 1	On/Low[a]/Medium[a]	Min	On	On[b]	Off	Off	Off	On	[c]
4	Cool 2	On/Low[a]/Medium[a]/High[a]	Min	On	On[d]	Off	Off	Off	On	[c]
5	Cool 3	On/High[a]	Min	On	On	Off	Off	Off	On	[c]
6[a]	Reheat	On/High[a]	Min	On	On	Off	Off	Off	On	[c]
7[a]	Heat 1	On/Low[a]/High[a]	Min	Off	Off	On	Off	50%	Off	Off
8[a]	Heat 2	On/High[a]	Min	Off	Off	On	On	100%	Off	Off

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

(a) With optional accessory
(b) CPR2 ON during Cool 1 if configured for 3-step cooling; CPR1 OFF.
(c) "Off" if OAT falls below 60°F, "On" if OAT rises above 65°F. During Reheat, if the unit is configured with 1 compressor, ODM2 is "Off" if the OAT falls below 70F, "On" if the OAT rises above 75F.
(d) CPR2 OFF during Cool 2 on a 3-step cooling unit.

Table 43. Voyager™ & Precedent™ electric/electric units 3 to 25 tons

Step	Mode	IDM	Econ	CPR1	CPR2	HT1	HT2	ODM1	ODM2
1	Fan On	On/Low[a]	Min	Off	Off	Off	Off	Off	Off
2[a]	Econ.	On/Low[a]	Open	Off	Off	Off	Off	Off	Off
3	Cool 1	On/Medium[a]	Min	On	On[b]	Off	Off	On	[c]
4	Cool 2	On/Low[a]/Medium[a]/High[a]	Min	On	On[d]	Off	Off	On	[c]
5	Cool 3	On/High[a]	Min	On	On	Off	Off	On	[c]
6[a]	Reheat	On/High[a]	Min	On	On	Off	Off	On	[c]
7[a]	Heat 1	On/High[a]	Min	Off	Off	On	Off	Off	Off
8[a]	Heat 2	On/High[a]	Min	Off	Off	On	On	Off	Off

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

(a) With optional accessory
(b) CPR2 ON during Cool 1 if configured for 3-step cooling; CPR1 OFF.
(c) "Off" if OAT falls below 60°F, "On" if OAT rises above 65°F. During Reheat, if the unit is configured with 1 compressor, ODM2 is "Off" if the OAT falls below 70F, "On" if the OAT rises above 75F.
(d) CPR2 OFF during Cool 2 on a 3-step cooling unit.

Table 44. Voyager™ & Precedent™ heat pump units 3 to 20 tons

Step	Mode	IDM	Econ	CPR1	CPR2	HT1	HT2	SOV1	ODM1	ODM2
1	Fan On	On/Low[(a)]	Min	Off	Off	Off	Off	Off	Off	Off
2[(a)]	Econ.	On/Low[(a)]	Open	Off	Off	Off	Off	Off	Off	Off
3	Cool 1	On/Low[(a)]/Medium[(a)]	Min	On	On[(b)]	Off	Off	On	On	[(c)]
4	Cool 2	On/Low[(a)]/Medium[(a)]/High[(a)]	Min	On	On[(d)]	Off	Off	On	On	[(c)]
5	Cool 3	On/High[(a)]	Min	On	On	Off	Off	On	On	[(c)]
6[(a)]	Reheat	On/High[(a)]	Min	On	On[(e)]	Off	Off	Off	On	On
7[(a)]	Heat 1	On/High[(a)]	Min	On	On	On[(f)]	Off	Off	On	On
8[(a)]	Heat 2	On/High[(a)]	Min	On	On	On	On[(g)]	Off	On	On
9[(a)]	Heat 4	On/High[(a)]	Min	On	On	On	On	Off	On	On
10[(h)]	Defrost	On/High[(a)]	Min	On	On	On	On	On	Off	Off
11	Em Heat	On/High[(a)]	Min	Off	Off	On	On	Off	Off	Off

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

(a) With optional accessory
(b) CPR2 ON during Cool 1 if configured for 3-step cooling; CPR1 OFF.
(c) "Off" if OAT falls below 60°F, "On" if OAT rises above 65°F. During Reheat, if the unit is configured with 1 compressor, ODM2 is "Off" if the OAT falls below 70°F, "On" if the OAT rises above 75°F.
(d) CPR2 OFF during Cool 2 on a 3-step cooling unit.
(e) CPR2 OFF during Heat 1 if configured for 2-Step mechanical heating.
(f) HT1 OFF during Heat 2 if the unit is configured for 2-Step mechanical heating.
(g) HT2 OFF during Heat 3 if the unit is configured for 2-Step mechanical heating.
(h) Defrost cycle in test mode runs for at least 1 minute, up to 10 minutes, depending on outdoor ambient and outdoor coil temperature.

Table 45. Precedent™ electric/electric — 17 SEER

Test Step	Mode	Fan	Econ	Comp 1	Comp 2	Heat 1	Heat 2	Resistance	Output	Multi-Speed Fan Output
1	Fan	On	Minimum Position Setpoint 0%	Off	Off	Off	Off	2.2KΩ	50%	low
	Minimum Ventilation	On	Selectable	Off	Off	Off	Off			
2	Economizer Test Open	On	Open	Off	Off	Off	Off	3.3KΩ	50%[(a)]	low
3	Cool Stage 1	On	Minimum Position	On[(b)]	Off	Off	Off	4.7KΩ	82%	low
4[(c)]	Cool Stage 2	On	Minimum Position	On[(b)]	On[(b)]	Off	Off	6.8KΩ	100%	High (2-step cooling) Low (3-step cooling)
5[(c)]	Cool Stage 3	On	Minimum Position	On[(b)]	On[(b)]	Off	Off	8.2KΩ	100%	High
6[(c)]	Reheat	On	Minimum Position	On	On	Off	Off	33KΩ	100%[(d)]	High
7[(c)]	Heat Stage 1	On	Minimum Position	Off	Off	On	Off	10KΩ	100%	High
8[(c)]	Heat Stage 2	On	Minimum Position	Off	Off	On	On	15KΩ	100%	High

Notes:

1. The exhaust fan will turn on anytime the economizer damper position is equal to or greater than the exhaust fan setpoint.
2. The modulating output is in reference to the user selected maximum unit fan speed.

(a) Regardless of the economizer mode configuration, the unit will run the supply fan at the minimum speed during the economizer step of the service test.
(b) The condenser fans will operate any time a compressor is 'On' providing the outdoor air temperatures are within the operating values.
(c) Steps for optional accessories and non-applicable modes in unit will be skipped.
(d) Units with enhanced dehumidification only will not perform this step during service test.

Table 46. Precedent™ gas/electric — 17 SEER

Test Step	Mode	Fan	Econ	Comp 1	Comp 2	Heat 1	Heat 2	Resistance	PWM Output
1	Fan	On	Minimum Position Setpoint 0%	Off	Off	Off	Off	2.2KΩ	50%
	Minimum Ventilation	On	Selectable	Off	Off	Off	Off		
2	Economizer Test Open	On	Open	Off	Off	Off	Off	3.3KΩ	50%[a]
3	Cool Stage 1	On	Minimum Position	On[b]	Off	Off	Off	4.7KΩ	82%
4[c]	Cool Stage 2	On	Minimum Position	On[b]	On[b]	Off	Off	6.8KΩ	100%
5[c]	Cool Stage 3	On	Minimum Position	On[b]	On[b]	Off	Off	8.2KΩ	100%
6[c]	Reheat	On	Minimum Position	On	On	Off	Off	33KΩ	100%[d]
7[c]	Heat Stage 1	On	Minimum Position	Off	Off	On	Off	10KΩ	100%
8[c]	Heat Stage 2	On	Minimum Position	Off	Off	On	On	15KΩ	100%

Notes:

1. The exhaust fan will turn on anytime the economizer damper position is equal to or greater than the exhaust fan setpoint.
2. The modulating output is in reference to the user selected maximum unit fan speed.

(a) Regardless of the economizer mode configuration, the unit will run the supply fan at the minimum speed during the economizer step of the service test.
(b) The condenser fans will operate any time a compressor is 'On' providing the outdoor air temperatures are within the operating values.
(c) Steps for optional accessories and non-applicable modes in unit will be skipped.
(d) Units with enhanced dehumidification only will not perform this step during service test.

Table 47. Voyager™ 12.5 to 25 tons eFlex™

Test Step	Mode	Supply Fan % Output	VSPD Compressor Capacity Output	Fixed Compressor 1	Fixed Compressor 2	Outdoor Fan PWM Output
1	Fan On	0%/25%	0%	OFF	OFF	0%
2	Econ	0%/25%	0%	OFF	OFF	0%
3	Cool 1	67%/75%	50%	OFF	OFF	(a)
4	Cool 2	100%	100%	ON	OFF	(a)
5	Cool 3	100%	100%	ON	ON	(a)
6	Heat 1	100%	0%	OFF	OFF	0%
7	Heat 2	100%	0%	OFF	OFF	0%

Notes:

1. The supply fan % output is in reference to the user selected maximum unit fan speed. Unit will operate at 100% fan speed during heating.
2. First % shown is the control signal percentage. Second % is the actual fan speed percentage.
3. The supply fan and compressor outputs shall follow all startup and shutdown requirements prior to moving through test mode steps that change the states of the compressor output from ON to OFF or OFF to ON.
4. All compressor % outputs are in reference to the 100% capacity point per unit tonnage.

(a) Condenser fan operation will be controlled based on the active OAT and compressor speed as during normal operation.

Table 48. Odyssey™ 10 and 20 tons condenser - CV (w/ unloading compressor)

Mode	C1 Unloaded	C2 Unloaded	CFA	CFB	Heat 1	Heat 2	SOV2 Comp 1&2 Loaded	Econ	S Fan	Resistance Test
1. Fan On	Off	Off	Off	Off	Off	Off	Off	NA	On	2.2KΩ
2. Econ	Off	Off	Off	Off	Off	Off	Off	NA	On	3.3 KΩ
3. Cool 1	On	On	Norm[a]	Norm[a]	Off	Off	Off	NA	On	4.7 KΩ
4. Cool 2	On	On	Norm[a]	Norm[a]	Off	Off	On	NA	On	6.8 KΩ
7. Heat 1	Off	Off	Off	Off	On	Off	Off	NA	On	10 KΩ
8. Heat 2	Off	Off	Off	Off	On	On	Off	NA	On	15 KΩ

(a) Normal Condenser Fan staging shall remain in effect during Service Test mode

Table 49. Odyssey™ 10 and 20 tons condenser - 2-speed (w/ unloading compressor)

Mode	C1 Unload-ed	C2 Unload-ed	CFA	CFB	Heat 1	Heat 2	SOV2 Comp 1&2 Loaded	Econ	S Fan	S Fan	Resist-ance Test
1. Fan On	Off	Off	Off	Off	Off	Off	Off	NA	On	Low Speed	2.2KΩ
2. Econ	Off	Off	Off	Off	Off	Off	Off	NA	On	Low Speed	3.3 KΩ
3. Cool 1	On	On	Norm[a]	Norm[a]	Off	Off	Off	NA	On	Low Speed	4.7 KΩ
4. Cool 2	On	On	Norm[a]	Norm[a]	Off	Off	On	NA	On	High Speed	6.8 KΩ
7. Heat 1	Off	Off	Off	Off	On	Off	Off	NA	On	High Speed	10 KΩ
8. Heat 2	Off	Off	Off	Off	On	On	Off	NA	On	High Speed	15 KΩ

(a) Normal Condenser Fan staging shall remain in effect during Service Test mode

Table 50. Odyssey™ 10 and 20 tons condenser - SZVAV (w/ unloading compressor)

Mode	C1 Unload-ed	C2 Unload-ed	CFA	CFB	Heat 1	Heat 2	SOV2 Comp 1&2 Loaded	Econ	S Fan	S Fan	Resist-ance Test
1. Fan On	Off	Off	Off	Off	Off	Off	Off	NA	On	Min Speed	2.2KΩ
2. Econ	Off	Off	Off	Off	Off	Off	Off	NA	On	Min Speed	3.3 KΩ
3. Cool 1	On	On	Norm[a]	Norm[a]	Off	Off	Off	NA	On	Mid Speed	4.7 KΩ
4. Cool 2	On	On	Norm[a]	Norm[a]	Off	Off	On	NA	On	High Speed	6.8 KΩ
7. Heat 1	Off	Off	Off	Off	On	Off	Off	NA	On	High Speed	10 KΩ
8. Heat 2	Off	Off	Off	Off	On	On	Off	NA	On	High Speed	15 KΩ

(a) Normal Condenser Fan staging shall remain in effect during Service Test mode

Table 51. Odyssey™ independent circuit heat pump units 15 to 20 tons

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

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

(a) With optional accessory
(b) Defrost cycle in test mode runs for at least 1 minute, up to 10 minutes, depending on outdoor ambient and outdoor coil temperature.

Table 52. Test modes for Voyager™ Commercial VAV units with IGV/VFD

Test Step	Mode	IGV/ VFD	Fan	Econ	EXH Fan	Power Exhaust Damper	Comp 1	Comp 2	HT 1	HT 2	Mod. Heat	Cool Valve	Re-heat Valve	Reheat Pump Out	VHR Relay	OHMS
1	IGV/VFD Test	Open/ 100%	Off	Closed	Off	Min	Off	Off	Off	Off	0%	100%	0%	Off	On	2.2k
2	IGV/VFD Test	Closed/ 0%	OFF	Closed	Off	Min	Off	Off	Off	Off	0%	100%	0%	Off	On	3.3k
3	Minimum Ventilation	In Control	On	Min	Off	Min	Off	Off	Off	Off	0%	100%	0%	Off	On	4.7k
4	Econo-mizer	In Control	On	100%	On	100%	Off	Off	Off	Off	0%	100%	0%	Off	On	6.8k
5	Cool Stage 1	In Control	On	Min	Off	Min	On	Off	Off	Off	0%	100%	0%	On/Off[(a)]	On	10k
6	Cool Stage 2	In Control	On	Min	Off	Min	Off[(b)]	On[(b)(c)]	Off	Off	0%	100%	0%	On	On	15k
7	Cool Stage 3	In Control	On	Min	Off	Min	On[(c)]	On[(c)]	Off	Off	0%	100%	0%	On	On	22k
8	Reheat	In Control	On[(d)]	Min	Off	Min	On[(c)]	On[(c)]	Off	Off	0%	50%	50%	Off	On	27k
9	Heat Stage 1	Open/ 100%[(e)]	On[(d)]	Min	Off	Min	Off	Off	On[(e)]	Off	50%	100%	0%	Off	On	33k
10	Heat Stage 2	Open/ 100%[(e)]	On	Min	Off	Min	Off	Off	On[(e)]	On[(e)]	100%	100%	0%	Off	On	47k
11	Reset															

Notes:

1. The IGV/VFD will be controlled to the supply pressure setpoint unless test mode has been running for six minutes or longer. After six minutes, the IGV damper will be allowed to drive to 100% for step nine and ten.
2. The exhaust fan will turn on anytime the economizer damper position is equal to or greater than the exhaust fan setpoint. It will not turn off until the economizer damper position is at the exhaust enable setpoint - 10% or lower.
3. The VHR relay output will be energized at the start of the test mode to allow time for the VAV boxes to open. It takes six minutes for the boxes to drive from the full closed position to the full open position. The timing cannot be changed in the field.
4. Economizer, Power Exhaust Damper, HT1, HT2, Mod. Heat, Cool Valve, Reheat Valve, and Reheat Pump Out = with optional feature

(a) 27½ to 35 (On), 30 to 50 (Off)
(b) 27½ to 35 ton units have two stages of mechanical cooling. Both compressors run during cool stage two.
(c) The condenser fan will operate any time a compressor is ON providing the outdoor temperatures are within normal operating range.
(d) The supply fan will not be allowed to go from an off state to an on state until the IGV are fully closed.
(e) The heat outputs will not be allowed to come on until the unit has been in test mode for at least six minutes and the IGV/VFD is at 100%.

Table 53. CV Test modes (also VAV w/o IGV) 27.5 to 50 tons without reheat

Test Step	Mode	SF	Econ.	Exh Fan	Power Exh Damper	Comp 1	Comp 2	Heat 1	Heat 2	Mod Heat	Ohms
1	Minimum Ventilation	On	Min	Off	Min	Off	Off	Off	Off	0%	4.7k
2	Economizer Test Open	On	100%	On	100%	Off	Off	Off	Off	0%	6.8k
3	Cool Stage 1	On	Min	Off	Min	On[(a)]	Off	Off	Off	0%	10k
4	Cool Stage 2	On	Min	Off	Min	Off[(b)]	On[(a)(b)]	Off	Off	0%	15k
5	Cool Stage 3	On	Min	Off	Min	On[(a)]	On[(a)]	Off	Off	0%	22k
6	Heat Stage 1	On	Min	Off	Min	Off	Off	On	Off	50%	33k
7	Heat Stage 2	On	Min	Off	Min	Off	Off	On	On	100%	47k
8	Reset										

Notes:

1. Steps for optional accessories and modes not present in unit will be skipped.
2. Economizer, Power Exhaust Damper, Heat 1 & 2, and Modulating Heat = with optional feature.
3. The exhaust fan will turn on anytime the economizer damper position is equal to or greater than the exhaust fan setpoint. It will not turn off until the economizer damper position is at exhaust enable setpoint - 10% or lower.

(a) The condenser fans will operate any time a compressor is ON providing the outdoor air temperatures are within normal operating range.
(b) 27.5 to 35 ton units have two stages of mechanical cooling. Both compressors run during cool stage two.

Table 54. CV Test modes 27.5 to 50 tons with reheat

Test Step	Mode	Fan	Econ.	Exh Fan	Power Exh Damper	Comp 1	Comp 2	Heat 1	Heat 2	Mod Heat	Cool Valve	Reheat Valve	Reheat Pump Out	Ohms
1	Minimum Ventilation	On	Min	Off	Min	Off	Off	Off	Off	0%	100%	0%	Off	2.2k
2	Economizer Test Open	On	100%	On	100%	Off	Off	Off	Off	0%	100%	0%	Off	3.3k
3	Cool Stage 1	On	Min	Off	Min	On[(a)]	Off	Off	Off	0%	100%	0%	Off	4.7k
4	Cool Stage 2	On	Min	Off	Min	Off[(b)]	On[(a)(b)]	Off	Off	0%	100%	0%	On[(c)]	6.8k
5	Cool Stage 3	On	Min	Off	Min	On[(a)]	On[(a)]	Off	Off	0%	100%	0%	On[(c)]	8.2k
6	Heat Stage 1	On	Min	Off	Min	Off	Off	On	Off	50%	100%	0%	Off	10k
7	Heat Stage 2	On	Min	Off	Min	Off	Off	On	On	100%	100%	0%	Off	15k
8	Reheat	On	Min	Off	Min	On[(a)]	On[(a)]	Off	Off	0%	50%	50%	Off	33k
9	Reset													

Notes:

1. Steps for optional accessories and modes not present in unit will be skipped.
2. Economizer, Exhaust Fan, Power Exhaust Damper, Heat 1 & 2, Modulating Heat, Cool Valve, Reheat Valve, and Reheat Pumpout = with optional feature.
3. The exhaust fan will turn on anytime the economizer damper position is equal to or greater than the exhaust fan setpoint. It will not turn off until the economizer damper position is at exhaust enable setpoint - 10% or lower.

(a) The condenser fans will operate any time a compressor is ON providing the outdoor air temperatures are within normal operating range.
(b) 27½ to 35 tons units have two stages of mechanical cooling. Both compressors run during cool stage two.
(c) The reheat pumpout output will be energized whenever the reheat circuit (circuit 2 for 40 to 50 tons) is energized for cooling operation.

Table 55. Test mode states for Voyager™ Commercial traditional VAV units with modulating dehumidification and staged heat

Test Step	Mode	Fan	VFD Command	Econ.	Comp 1	Comp 2	Comp 3	Heat 1	Heat 2	Pumpout	Cool Valve	Reheat Valve	VAV Box
1	VFD SIGNAL 100%	OFF	100% (10VDC)	CLOSED	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
2	VFD SIGNAL 0%	OFF	0% (0 VDC)	CLOSED	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
3	MIN VENT	ON	IN-CONTROL	MIN	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
4	ECON TEST OPEN	ON	IN-CONTROL	OPEN	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
5	COOL 1	ON	IN-CONTROL	MIN	ON	OFF	OFF	OFF	OFF	IN-CONTROL	100%	0%	ON
6	COOL 2	ON	IN-CONTROL	MIN	ON	ON	OFF	OFF	OFF	IN-CONTROL	100%	0%	ON
7	COOL 3	ON	IN-CONTROL	MIN	ON	ON	ON	OFF	OFF	IN-CONTROL	100%	0%	ON
8	REHEAT	ON	IN-CONTROL	MIN	ON	ON	ON	OFF	OFF	IN-CONTROL	50%	50%	ON
9	HEAT 1	ON	IN-CONTROL	MIN	OFF	OFF	OFF	ON	OFF	OFF	100%	0%	ON
10	HEAT 2	ON	IN-CONTROL	MIN	OFF	OFF	OFF	ON	ON	OFF	100%	0%	ON
11	RESET												

Notes:

1. 2 & 3 stage standard efficiency units: For Traditional VAV units, the VFD Command when "In-Control" will be controlled based on supply air pressure requirements. For SZVAV units, the VFD command will be at discrete points during Test Mode.
2. 2 & 3 stage standard efficiency units: For 27½ to 35 ton units, both compressors will be energized during the Cool 2 Step. For 40-50T units, only Compressor 2 will be energized during the Cool 2 Step.
3. 2 & 3 stage standard efficiency units: The reheat pumpout relay will be energized any time the reheat circuit is energized in active Cooling Mode.
4. 2 & 3 stage standard efficiency units: For units with Statitrac™ installed, the exhaust damper will track the Economizer position during Service Test Mode and the Exhaust Fan will be energized once the economizer rises above the exhaust enable setpoint.
5. 2 & 3 stage standard efficiency units: Heating will not be energized during Service Test until the 6 minute VAV box ON timer has expired.
6. 5 stage high efficiency units: Compressor 1 is the smaller compressor on the circuit.
7. 5 stage high efficiency units: Condenser fans are controlled as defined for normal operation.
8. 5 stage high efficiency units: Exhaust fan operates as defined for normal operation based on economizer position.
9. 5 stage high efficiency units: When compressor 1 is energized with either C1, C2, or with both for 30 minutes continuously, C3 will be required to de-energize for 30 seconds.

Table 56. Test mode states for Voyager™ Commercial CV units with modulating dehumidification and staged heat

Test Step	Mode	Fan	Econ.	Comp 1	Comp 2	Comp 3	Heat 1	Heat 2	Pumpout	Cool Valve	Reheat Valve	VAV Box
1	FAN ON	ON	MIN	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
2	ECONO-MIZER	ON	OPEN	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
3	COOL 1	ON	MIN	ON	OFF	OFF	OFF	OFF	IN-CONTROL	100%	0%	ON
4	COOL 2	ON	MIN	ON	ON	OFF	OFF	OFF	IN-CONTROL	100%	0%	ON
5	COOL 3	ON	MIN	ON	ON	ON	OFF	OFF	IN-CONTROL	100%	0%	ON
6	REHEAT	ON	MIN	ON	ON	ON	OFF	OFF	IN-CONTROL	50%	50%	ON
7	HEAT 1	ON	MIN	OFF	OFF	OFF	ON	OFF	OFF	100%	0%	ON
8	HEAT 2	ON	MIN	OFF	OFF	OFF	ON	ON	OFF	100%	0%	ON
9	RESET											

Notes:

1. 2 & 3 stage standard efficiency units: For 27.5 to 35 ton units, both compressors will be energized during the Cool 2 Step. For 40-50T units, only Compressor 2 will be energized during the Cool 2 Step.
2. 2 & 3 stage standard efficiency units: The reheat pumpout relay will be energized any time the reheat circuit is energized in active Cooling Mode.
3. 2 & 3 stage standard efficiency units: For units with Statitrac™ installed, the exhaust damper will track the Economizer position during Service Test Mode and the Exhaust Fan will be energized once the economizer rises above the exhaust enable setpoint.
4. 2 & 3 stage standard efficiency units: Heating will not be energized during Service Test until the 6 minute VAV box ON timer has expired.
5. 5 stage high efficiency units: Compressor 1 is the smaller compressor on the circuit.
6. 5 stage high efficiency units: Condenser fans are controlled as defined for normal operation.
7. 5 stage high efficiency units: Exhaust fan operates as defined for normal operation based on economizer position.
8. 5 stage high efficiency units: When compressor 1 is energized with either C1, C2, or with both for 30 minutes continuously, C3 will be required to de-energize for 30 seconds.

Table 57. Test mode states for Voyager™ Commercial SZ VAV units with modulating dehumidification and staged heat

Test Step	Mode	Fan	VFD Command	Econ.	Comp 1	Comp 2	Comp 3	Heat 1	Heat 2	Pumpout	Cool Valve	Reheat Valve
1	FAN ON	ON	45% (0 VDC)	MIN	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%
2	ECONO-MIZER	ON	45% (0 VDC)	OPEN	OFF	OFF	OFF	OFF	OFF	OFF	100%	0%
3	COOL 1	ON	80% (6.67 VDC)	MIN	ON	OFF	OFF	OFF	OFF	IN-CONTROL	100%	0%
4	COOL 2	ON	IN-CONTROL	MIN	ON	ON	OFF	OFF	OFF	IN-CONTROL	100%	0%
5	COOL 3	ON	IN-CONTROL	MIN	ON	ON	ON	OFF	OFF	IN-CONTROL	100%	0%
6	REHEAT	ON	73% (5.24 VDC)	MIN	ON	ON	ON	OFF	OFF	IN-CONTROL	50%	50%
7	HEAT 1	ON	100% (10 VDC)	MIN	OFF	OFF	OFF	ON	OFF	OFF	100%	0%
8	HEAT 2	ON	100% (10 VDC)	MIN	OFF	OFF	OFF	ON	ON	OFF	100%	0%
9	RESET											

Notes:

1. 2 & 3 stage standard efficiency units: For Traditional VAV units, the VFD Command when "In-Control" will be controlled based on supply air pressure requirements. For SZVAV units, the VFD command will be at discrete points during Test Mode.
2. 2 & 3 stage standard efficiency units: For 27.5 to 35 ton units, both compressors will be energized during the Cool 2 Step. For 40-50T units, only Compressor 2 will be energized during the Cool 2 Step.
3. 2 & 3 stage standard efficiency units: The reheat pumpout relay will be energized any time the reheat circuit is energized in active Cooling Mode.
4. 2 & 3 stage standard efficiency units: For units with Statitrac™ installed, the exhaust damper will track the Economizer position during Service Test Mode and the Exhaust Fan will be energized once the economizer rises above the exhaust enable setpoint.
5. 5 stage high efficiency units: Compressor 1 is the smaller compressor on the circuit.
6. 5 stage high efficiency units: Condenser fans are controlled as defined for normal operation.
7. 5 stage high efficiency units: Exhaust fan operates as defined for normal operation based on economizer position.
8. 5 stage high efficiency units: When compressor 1 is energized with either C1, C2, or with both for 30 minutes continuously, C3 will be required to de-energize for 30 seconds.

Table 58. Test mode states for traditional Voyager™ Commercial VAV units with modulating dehumidification and modulating heat

Test Step	Mode	Fan	VFD Command	Econ.	Comp 1	Comp 2	Comp 3	Heat Output	Pumpout	Cool Valve	Reheat Valve	VAV Box
1	VFD SIGNAL 100%	OFF	100% (10VDC)	CLOSED	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
2	VFD SIGNAL 0%	OFF	0% (0 VDC)	CLOSED	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
3	MIN VENT	ON	IN-CONTROL	MIN	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
4	ECON TEST OPEN	ON	IN-CONTROL	OPEN	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
5	COOL 1	ON	IN-CONTROL	MIN	ON	OFF	OFF	OFF	IN-CONTROL	100%	0%	ON
6	COOL 2	ON	IN-CONTROL	MIN	ON	ON	OFF	OFF	IN-CONTROL	100%	0%	ON
7	COOL 3	ON	IN-CONTROL	MIN	ON	ON	ON	OFF	IN-CONTROL	100%	0%	ON
8	REHEAT	ON	IN-CONTROL	MIN	ON	ON	ON	OFF	IN-CONTROL	50%	50%	ON
9	HEAT 1	ON	IN-CONTROL	MIN	OFF	OFF	OFF	50%	OFF	100%	0%	ON
10	HEAT 2	ON	IN-CONTROL	MIN	OFF	OFF	OFF	100%	OFF	100%	0%	ON
11	RESET											

Notes:

1. 2 & 3 stage standard efficiency units: For Traditional VAV units, the VFD Command when "In-Control" will be controlled based on supply air pressure requirements. For SZVAV units, the VFD command will be at discrete points during Test Mode.
2. 2 & 3 stage standard efficiency units: For 27½ to 35 ton units, both compressors will be energized during the Cool 2 Step. For 40-50T units, only Compressor 2 will be energized during the Cool 2 Step.
3. 2 & 3 stage standard efficiency units: The reheat pumpout relay will be energized any time the reheat circuit is energized in active Cooling Mode.
4. 2 & 3 stage standard efficiency units: For units with Statitrac™ installed, the exhaust damper will track the Economizer position during Service Test Mode and the Exhaust Fan will be energized once the economizer rises above the exhaust enable setpoint.
5. 2 & 3 stage standard efficiency units: Heating will not be energized during Service Test until the 6 minute VAV box ON timer has expired.
6. 5 stage high efficiency units: Compressor 1 is the smaller compressor on the circuit.
7. 5 stage high efficiency units: Condenser fans are controlled as defined for normal operation.
8. 5 stage high efficiency units: Exhaust fan operates as defined for normal operation based on economizer position.
9. 5 stage high efficiency units: When compressor 1 is energized with either C1, C2, or with both for 30 minutes continuously, C3 will be required to de-energize for 30 seconds.

Table 59. Test mode states for Voyager™ Commercial CV units with modulating dehumidification and modulating heat

Test Step	Mode	Fan	Econ.	Comp 1	Comp 2	Comp 3	Heat Output	Pumpout	Cool Valve	Reheat Valve	VAV Box
1	FAN ON	ON	MIN	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
2	ECONOMIZER	ON	OPEN	OFF	OFF	OFF	OFF	OFF	100%	0%	ON
3	COOL 1	ON	MIN	ON	OFF	OFF	OFF	IN-CONTROL	100%	0%	ON
4	COOL 2	ON	MIN	ON	ON	OFF	OFF	IN-CONTROL	100%	0%	ON
5	COOL 3	ON	MIN	ON	ON	ON	OFF	IN-CONTROL	100%	0%	ON
6	REHEAT	ON	MIN	ON	ON	ON	OFF	IN-CONTROL	50%	50%	ON
7	HEAT 1	ON	MIN	OFF	OFF	OFF	50%	OFF	100%	0%	ON
8	HEAT 2	ON	MIN	OFF	OFF	OFF	100%	OFF	100%	0%	ON
9	RESET										

Notes:

1. 2 & 3 stage standard efficiency units: For 27½ to 35 ton units, both compressors will be energized during the Cool 2 Step. For 40-50T units, only Compressor 2 will be energized during the Cool 2 Step.
2. 2 & 3 stage standard efficiency units: The reheat pumpout relay will be energized any time the reheat circuit is energized in active Cooling Mode.
3. 2 & 3 stage standard efficiency units: For units with Statitrac™ installed, the exhaust damper will track the Economizer position during Service Test Mode and the Exhaust Fan will be energized once the economizer rises above the exhaust enable setpoint.
4. 2 & 3 stage standard efficiency units: Heating will not be energized during Service Test until the 6 minute VAV box ON timer has expired.
5. 5 stage high efficiency units: Compressor 1 is the smaller compressor on the circuit.
6. 5 stage high efficiency units: Condenser fans are controlled as defined for normal operation.
7. 5 stage high efficiency units: Exhaust fan operates as defined for normal operation based on economizer position.
8. 5 stage high efficiency units: When compressor 1 is energized with either C1, C2, or with both for 30 minutes continuously, C3 will be required to de-energize for 30 seconds.

Table 60. Test mode states for Voyager™ Commercial SZVAV units with modulating dehumidification and modulating heat

Test Step	Mode	Fan	VFD Command	Econ.	Comp 1	Comp 2	Comp 3	Heat Output	Pumpout	Cool Valve	Reheat Valve
1	FAN ON	ON	45% (0 VDC)	MIN	OFF	OFF	OFF	OFF	OFF	100%	0%
2	ECONO-MIZER	ON	45% (0 VDC)	OPEN	OFF	OFF	OFF	OFF	OFF	100%	0%
3	COOL 1	ON	80% (6.67 VDC)	MIN	ON	OFF	OFF	OFF	IN-CONTROL	100%	0%
4	COOL 2	ON	IN-CONTROL	MIN	ON	ON	OFF	OFF	IN-CONTROL	100%	0%
5	COOL 3	ON	IN-CONTROL	MIN	ON	ON	ON	OFF	IN-CONTROL	100%	0%
6	REHEAT	ON	73% (5.24 VDC)	MIN	ON	ON	ON	OFF	IN-CONTROL	50%	50%
7	HEAT 1	ON	100% (10 VDC)	MIN	OFF	OFF	OFF	50%	OFF	100%	0%
8	HEAT 2	ON	100% (10 VDC)	MIN	OFF	OFF	OFF	100%	OFF	100%	0%
9	RESET										

Notes:

1. 2 & 3 stage standard efficiency units: For Traditional VAV units, the VFD Command when "In-Control" will be controlled based on supply air pressure requirements. For SZVAV units, the VFD command will be at discrete points during Test Mode.
2. 2 & 3 stage standard efficiency units: For 27.5 to 35 ton units, both compressors will be energized during the Cool 2 Step. For 40-50T units, only Compressor 2 will be energized during the Cool 2 Step.
3. 2 & 3 stage standard efficiency units: The reheat pumpout relay will be energized any time the reheat circuit is energized in active Cooling Mode.
4. 2 & 3 stage standard efficiency units: For units with Statitrac™ installed, the exhaust damper will track the Economizer position during Service Test Mode and the Exhaust Fan will be energized once the economizer rises above the exhaust enable setpoint.
5. 5 stage high efficiency units: Compressor 1 is the smaller compressor on the circuit.
6. 5 stage high efficiency units: Condenser fans are controlled as defined for normal operation.
7. 5 stage high efficiency units: Exhaust fan operates as defined for normal operation based on economizer position.
8. 5 stage high efficiency units: When compressor 1 is energized with either C1, C2, or with both for 30 minutes continuously, C3 will be required to de-energize for 30 seconds.

Table 61. Sequence of operation reference

Product Family	Publication Number	Short Description
Odyssey™	SSA-SVX06*-EN	Split System Air Handlers 5 to 25 Tons
Odyssey™	SS-SVX10*-EN	Split System Cooling Condensers 6 to 25 Tons
Odyssey™	SSP-SVX14*-EN	Split System Heat Pump Condensers, R-410A 6 to 20 Tons
Odyssey™	SSP-SVX15*-EN	Split System Heat Pump Condensers R-22 Dry Charge 7.5 and 10 Tons, 60 Hz
Odyssey™	SS-SVX12*-EN	Split System Cooling Condensers R-22 Dry Charge 7.5 and 10 Tons, 60 Hz
Precedent™	Refer to Product Service Facts	
Voyager™ Light Commercial	Refer to Product Service Facts	
Voyager™ Commercial	RT-SVX34*-EN	Voyager™ Commercial - 27.5 to 50 Tons, 60 Hz

Units with Two Heat Exchangers (High Heat Models)

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

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

ReliaTel™ Service Test

Table 62. Single zone VAV heat pump units w/ staged and modulating auxiliary heating

Step	Description	RTRM Supply Fan Output	RTOM Fan Speed Output (VFD/ERM BC Plenum/ Standard PWM)	RTOM Fan Speed Output (17 SEER)
1	Fan On	ON	MIN	NA[a]
2	Econ	ON	MIN	
3	Cool 1	ON	67% (82% for ERM)	
4	Cool 2[b]	ON	MAX (100%)	
5	Cool 3	ON	MAX (100%)	
6	Heat 1	ON	MAX (100%)	
7	Heat 2	ON	MAX (100%)	
8	Heat 3	ON	MAX (100%)	
9	Heat 4	ON	MAX (100%)	
10	Defrost	ON	MAX (100%)	
11	Em Heat	ON	MAX (100%)	

Note: For all of the service test steps in which the fan speed output is at "MIN", the fan speed will be at the minimum speed for the associated step.

(a) 17 SEER units cannot be configured as heat pumps.
(b) For units configured with two steps of mechanical cooling, the unit will energize the supply fan and ramp the output up to 100% for the associated "Cool 2" step in service test.

Table 63. Single zone VAV non-heat pump units w/ staged heating

Step	Description	RTRM Supply Fan Output	RTOM Fan Speed Output (VFD/ Standard PWM)	RTOM Fan Speed Output (17 SEER PWM/ERM BC Plenum)
1	Fan On	ON	MIN	MIN
2	Econ	ON	MIN	MIN
3	Cool 1	ON	67%	82%[a]
4	Cool 2[b]	ON	MAX (100%)	100%
5	Cool 3[c]	ON	MAX (100%)	NA
6	Reheat[d]	ON	80%	MAX (100%)
7	Heat 1	ON	MAX (100%)	MAX (100%)
8	Heat 2	ON	MAX (100%)	MAX (100%)

Note: For all of the service test steps in which the fan speed output is at "MIN", the fan speed will be at the minimum speed for the associated step.

(a) 82% chosen in order to give the user the ability to have a Service Test step for setting up proper OA damper position setpoints.
(b) For units configured with two steps of mechanical cooling, the unit will energize the supply fan and ramp the output up to 100% for the associated "Cool 2" step in service test.
(c) 17 SEER units cannot have 3-step cooling.
(d) Reheat step only performed on units configured for HGRH, not for enhanced dehumidification only.

Table 64. Single zone VAV non-heat pump units w/ modulating heat types

Step	Description	RTRM Supply Fan Output	RTOM Fan Speed Output (VFD/ Standard PWM)	RTOM Fan Speed Output (17 SEER PWM/ERM BC Plenum)
1	Fan On	ON	MIN	MIN
2	Econ	ON	MIN	MIN
3	Cool 1	ON	67%	82%[a]
4	Cool 2[b]	ON	MAX (100%)	MAX (100%)
5	Cool 3[c]	ON	MAX (100%)	NA
6	Reheat[d]	ON	80%	MAX (100%)
7	Heat 1 (Mod Heat = 50%)[e]	ON	MIN	MIN[f]
8	Heat 2 (Mod Heat = 100%)	ON	MAX (100%)	MAX (100%)

Note: For all of the service test steps in which the fan speed output is at "MIN", the fan speed will be at the minimum speed for the associated step.

[a] 82% chosen in order to give the user the ability to have a Service Test step for setting up proper OA damper position setpoints.
[b] For units configured with two steps of mechanical cooling, the unit will energize the supply fan and ramp the output up to 100% for the associated "Cool 2" step in service test.
[c] 17 SEER units cannot have 3-step cooling.
[d] Reheat step only performed on units configured for HGRH, not for enhanced dehumidification only.
[e] The minimum speed output may be 100% if the unit is configured for CV heating control.
[f] Precedent™ 17 SEER units do not currently support modulating heat as a heating type, so the minimum speed has not been defined based on product requirements.

The following table shows the unit operation during normal test mode. As on non-VSPD compressor equipped units, service test mode can be initiated by shorting the service test pins on the RTRM or by applying the appropriate resistor value for the modes listed below.

Table 65. Precedent™ 3 to 10 tons SZVAV eFlex™

Test Step	Fan On/OFF	Supply Fan% Output	Econ.	VSPD Compressor Capacity Output	Outdoor Fan PWM Output	Test Step Resistance (Ohms)
Fan On	ON	50%	MIN	0%	0%	2.2K
Econ	ON	50%	OPEN	0%	0%	3.3K
Cool 1	ON	82%	MIN	50%	[a]	4.7K
Cool 2	ON	100%	MIN	100%	[a]	6.8K
Heat 1	ON	100%	MIN	0%	0%	10K
Heat 2	ON	100%	MIN	0%	0%	15K

Notes:

1. The supply fan % output is in reference to the user selected maximum unit fan speed. Unit will operate at 100% fan speed during heating unless configured for SZVAV heating operation.
2. The supply fan and compressor outputs shall follow all startup and shutdown requirements prior to moving through test mode steps that change the states of the compressor output from ON to OFF or OFF to ON.
3. All compressor% outputs are in reference to the 100% capacity point per unit tonnage.

[a] Condenser fan operation will be controlled based on the active OAT as during normal operation.

Table 66. Precedent™ 3 to 10 tons MZVAV eFlex™

Test Step	Fan ON/ Off	Supply Fan % Output	IGV Output	Econ	VSPD Comp Capacity Output	Outdoor Fan PWM Output	VAV Box	Test Step Resist- ance (Ohms)
IGV Open Test	OFF	0% Duty Cycle	0%[(a)]	Closed	0%	0%	ON	2.2K
IGV Close Test	OFF	0% Duty Cycle	0%	Closed	0%	0%	ON	3.3K
Fan On	ON	IN-CONTROL[(b)]	N/A	MIN	0%	0%	ON	4.7K
Econ	ON	IN-CONTROL[(b)]	N/A	OPEN	0%	0%	ON	6.8K
Cool 1	ON	IN-CONTROL[(b)]	N/A	MIN	50%	[(c)]	ON	10K
Cool 2	ON	IN-CONTROL[(b)]	N/A	MIN	100%	[(c)]	ON	15K
Heat 1	ON	100%[(d)]	N/A	MIN	0%	0%	ON	33K
Heat 2	ON	100%[(d)]	N/A	MIN	0%	0%	ON	47K

Notes:

1. The supply fan % output is in reference to the user selected maximum unit fan speed.
2. The supply fan and compressor outputs shall follow all startup and shutdown requirements prior to moving through test mode steps that change the states of the compressor output from ON to OFF or OFF to ON.
3. All compressor % outputs are in reference to the 100% capacity point per unit tonnage.

(a) During step 1 of the short-circuit based service test sequence; the IGV output is driven to 0%. However, for the 2.2kOhm resistance based service test step approach - the IGV output is driven to 100%.
(b) For multi-zone VAV units, the VFD command when "In-Control" will be controlled based on supply air pressure requirements for the unit.
(c) Condenser fan operation will be controlled based on the active OAT as during normal operation.
(d) VAV boxes are commanded to an open position during service test. However, six minutes must be allowed for the VAV boxes to reach a fully opened position. During these 1st six minutes, duct static pressure control has control priority over the supply fan command of 100%.

Table 67. Voyager™ Light Commercial 12.5 to 17.5 tons SZVAV eFlex™

Test Step	Fan On/ OFF	Supply Fan % Output	Econ	VSPD Compr Capacity Output	Fixed Comp 1	Fixed Comp 2	Outdoor Fan PWM Output	Test Step Resistance (Ohms)
Fan On	ON	0%/25%[(a)]	MIN	0%	OFF	OFF	0%	2.2K
Econ	ON	0%/25%[(a)]	OPEN	0%	OFF	OFF	0%	3.3K
Cool 1	ON	67%/75%[(a)]	MIN	50%	OFF	OFF	[(b)]	4.7K
Cool 2	ON	100%	MIN	100%	ON	OFF	[(b)]	6.8K
Cool 3	ON	100%	MIN	100%	ON	ON	[(b)]	8.2K
Heat 1	ON	100%	MIN	0%	OFF	OFF	0%	10K
Heat 2	ON	100%	MIN	0%	OFF	OFF	0%	15K

Notes:

1. The supply fan % output is in reference to the user selected maximum unit fan speed. Unit will operate at 100% fan speed during heating unless configured for SZVAV heating operation.
2. The supply fan and compressor outputs shall follow all startup and shutdown requirements prior to moving through test mode steps that change the states of the compressor output from ON to OFF or OFF to ON.
3. All compressor % outputs are in reference to the 100% capacity point per unit tonnage.

(a) First % shown is the control signal percentage. Second % is the actual fan speed percentage.
(b) Condenser fan operation will be controlled based on the active OAT as during normal operation.

Table 68. Voyager™ Light Commercial 12.5 to 17.5 tons MZVAV eFlex™

Test Step	Supply Fan % Output	IGV Output	Econ	VSPD Comp Capacity Output	Fixed Comp 1	Fixed Comp 2	Outdoor Fan PWM Output	VAV Box	Test Step Resistance (Ohms)
IGV Open Test	0% (Fan State: Off)	0%[a]	Closed	0%	OFF	OFF	0%	ON	2.2k
IGV Close Test	0% (Fan State: Off)	0%	Closed	0%	OFF	OFF	0%	ON	3.3k
Fan On	In-Control[b]	N/A	MIN	0%	OFF	OFF	0%	ON	4.7k
Econ	In-Control	N/A	OPEN	0%	OFF	OFF	0%	ON	6.8k
Cool 1	In-Control	N/A	MIN	50%	OFF	OFF	[c]	ON	10k
Cool 2	In-Control	N/A	MIN	100%	ON	OFF	[c]	ON	15k
Cool 3	In-Control	N/A	MIN	100%	ON	ON	[c]	ON	22k
Heat 1	100%[c]	N/A	MIN	0%	OFF	OFF	0%	ON	33k
Heat 2	100%[c]	N/A	MIN	0%	OFF	OFF	0%	ON	47k

Notes:

1. The supply fan % output is in reference to the user selected maximum unit fan speed. Unit will operate at 100% fan speed during heating unless configured for MZVAV heating operation.
2. The supply fan and compressor outputs shall follow all startup and shutdown requirements prior to moving through test mode steps that change the states of the compressor output from ON to OFF or OFF to ON.
3. All compressor % outputs are in reference to the 100% capacity point per unit tonnage.

[a] During step 1 of the short-circuit based service test sequence; the IGV output is driven to 0%. However, for the 2.2kOhm resistance based service test step approach - the IGV output is driven to 100%.

[b] For multi-zone VAV units, the VFD command when "In-Control" will be controlled based on supply air pressure requirements for the unit.

[c] VAV boxes are commanded to an open position during service test. However, six minutes must be allowed for the VAV boxes to reach a fully opened position. During these 1st six minutes, duct static pressure control has control priority over the supply fan command of 100%.

Service Test Mode for units with two-speed indoor fan control will control the indoor fan as is controlled during normal unit operations during its corresponding step in Service Test Mode. Refer to the table below for additional information on unit operation during Service Test.

Table 69. Unit operation during service test

Test Step	Fan Speed Output
Fan On	Low
Econ	Low
Cool 1	Low
Cool 2	Low

Table 69. Unit operation during service test (continued)

Test Step	Fan Speed Output
Cool 3	High
Heat 1	High
Heat 2	High
Heat 3	High
Heat 4	High
Defrost or Dehumidification/ Reheat	High
Em. Heat	High

Thermostats and Sensors

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®, Summit, VariTrac®) - 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)

It is possible to connect multiple devices. Doing so increases the chance for error in application and troubleshooting.

Note: *27.5 to 50 tons 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.

Table 70. Thermostat and sensor descriptions

Accessory Model #	Zone Sensor Module Description	Required # Conductors	Terminal Connections at J6
Heat/Cool			
BAYSENS106*/ASYSTAT106*	Single Set Point/Manual change Over	4	1,2,3,4
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
BAYSENS135*/ASYSTAT709A	Digital Dual Setpoint with Manual /Auto Changeover	11	1,2,3,4,5,6,7,8,9,10
Heat Pump			
BAYSENS107*/ASYSTAT107*	Single Set Point Manual Changeover	6	1,2,3,4,5,6,7
BAYSENS109*/ASYSTAT109*	Dual Set Point with LEDs Manual/Auto Changeover	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
BAYSENS031*	Digital Heat Pump Dual Setpoint with Manual/Auto Changeover	11	
MZVAV 27.5 to 50 tons			
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
Tracer®/Tracker® ICS			
BAYSENS073*	Override Sensor with Override / Cancel	2	1,2
BAYSENS074*	Override Sensor with Setpoint and Override / Cancel	3	1,2,3

BAYSENS016* Sensor with plug; 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 to 10 tons - 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.

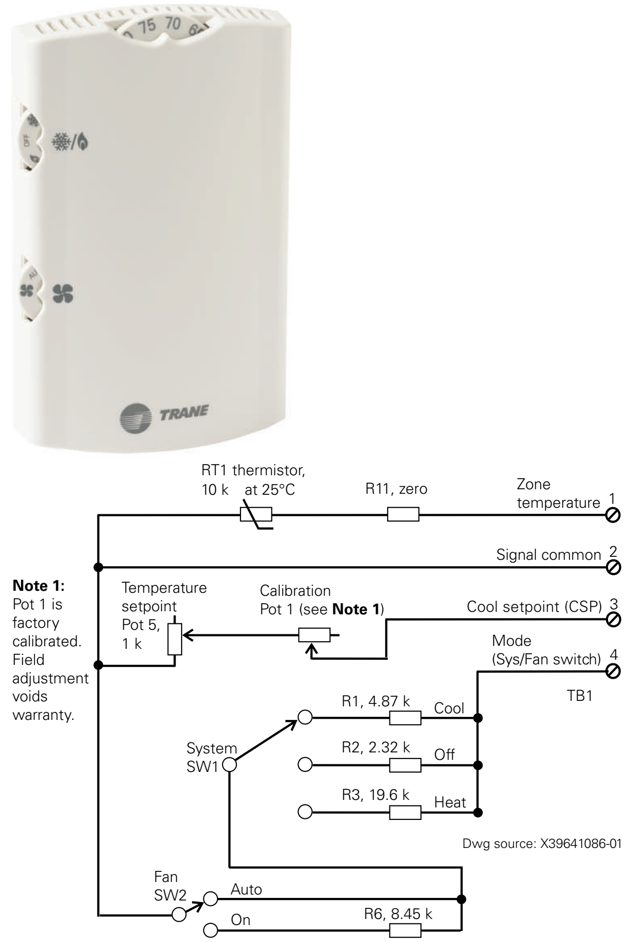
Figure 51. Thermistor sensor

BAYSENS106*/ASYSTAT106*

Note: *Part number SENS01515*

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

Figure 52. BAYSENS106*/ASYSTAT106*

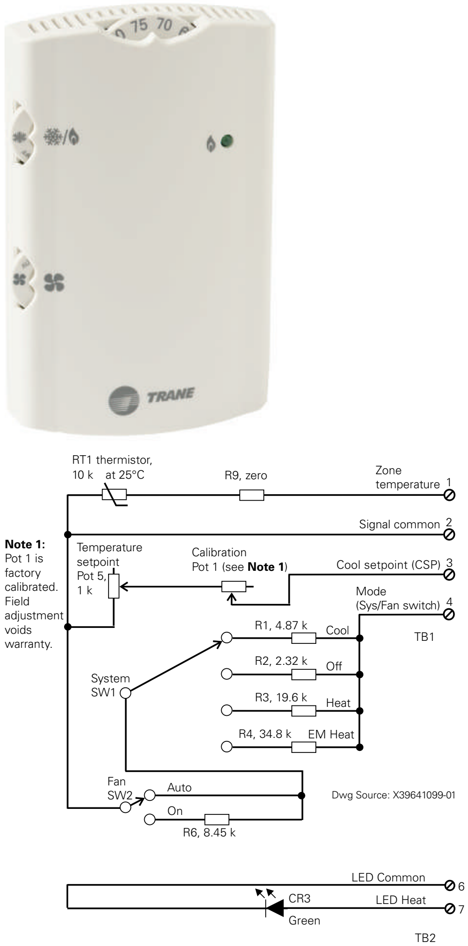


BAYSENS107*/ASYSTAT107*

Note: *Part Number - SEN01528*

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

Figure 53. BAYSENS107*/ASYSTAT107*

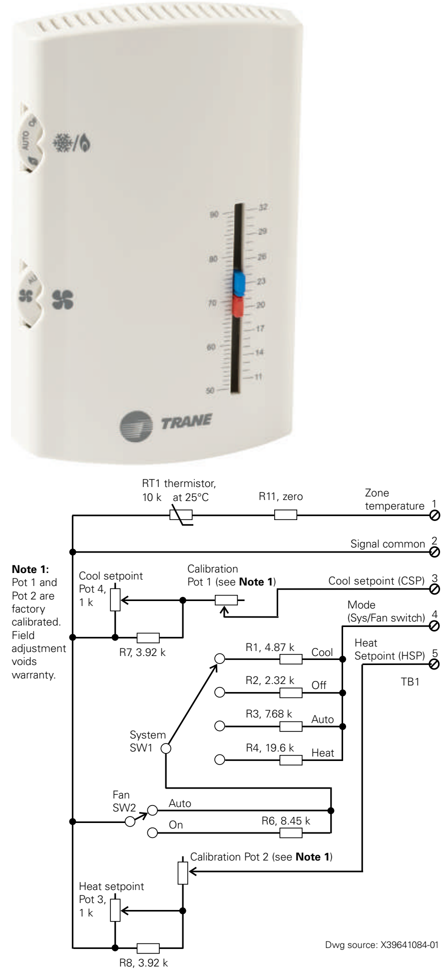


BAYSENS108*/ASYSTAT108*

***Note:** Part Number - SEN01513*

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

Figure 54. BAYSENS108*/ASYSTAT108*

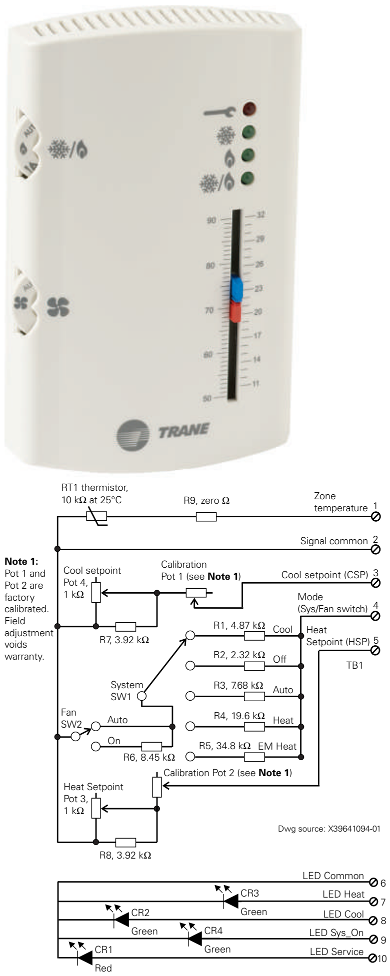


BAYSENS109*/ASYSTAT109*

***Note:** Part Number - SEN01523*

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

Figure 55. BAYSENS109*/ASYSTAT109*

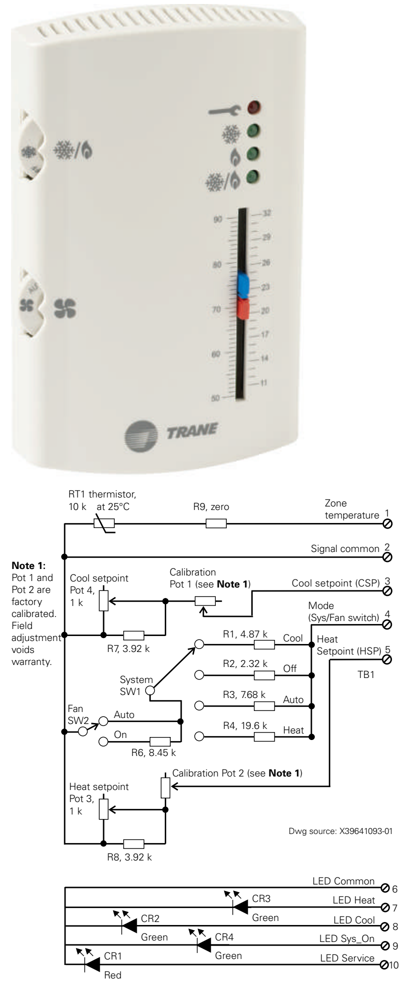


BAYSENS110*

Note: *Part Number - SEN01522*

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

Figure 56. BAYSENS110*/ASYSTAT110*

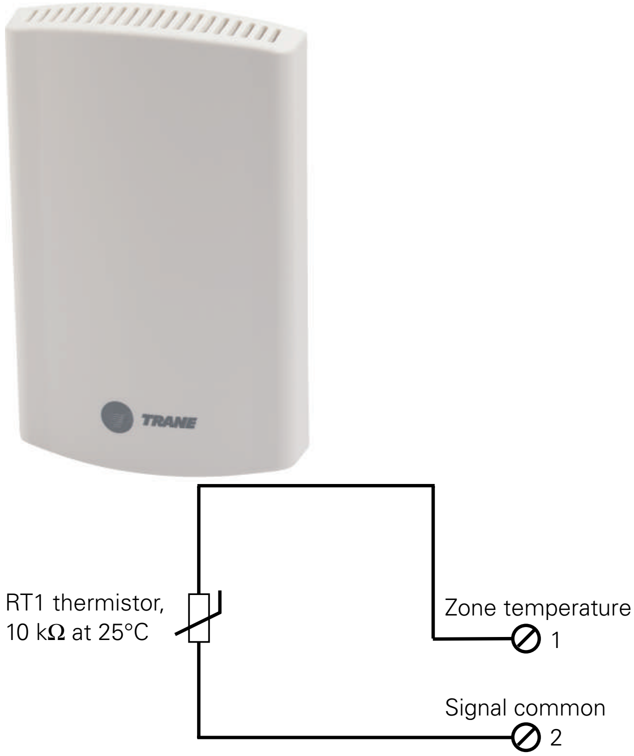


BAYSENS077*

Note: *Part Number - SEN01448*

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

Figure 57. BAYSENS077*



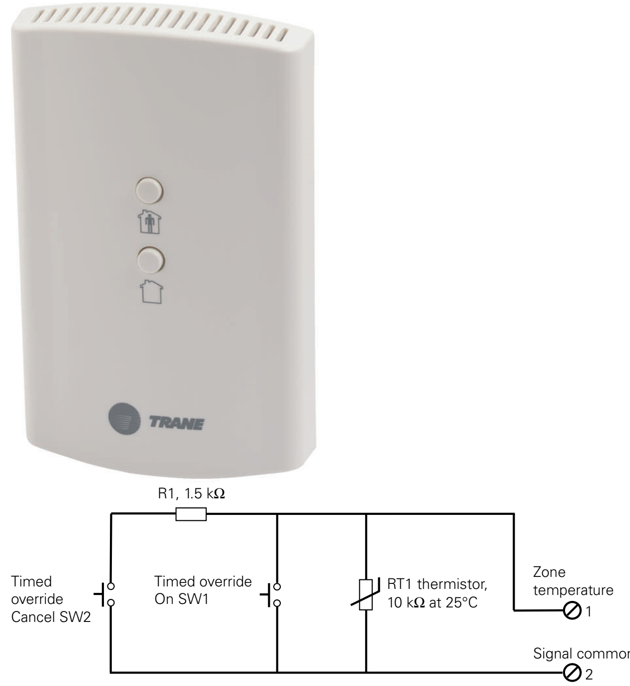
Dwg source: 3270 3436

BAYSENS073*

Note: *Part Number - SEN01450*

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

Figure 58. BAYSENS073*



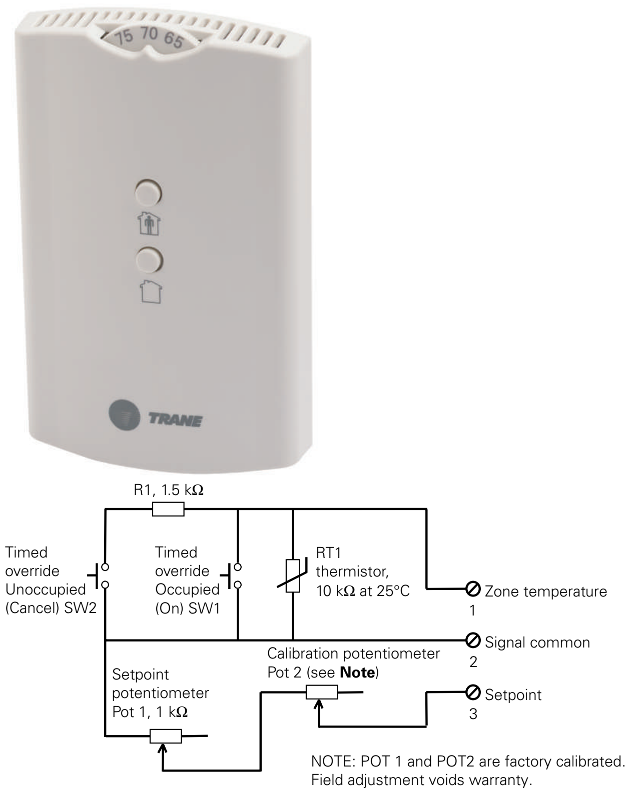
Dwg source: 3270 3438

BAYSENS074*

Note: *Part Number - SEN01447*

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

Figure 59. BAYSENS074*



Dwg. source: 3270 3435 B

BAYSENS119* Programmable Zone sensor

Figure 60. BAYSENS119*

The BAYSENS119* supersedes the BAYSENS019C. The BAYSENS119* has the same programming options and capabilities as the BAYSENS019C but also has improved thermistors that increases sensing accuracy and is still compatible with all equipment using either UCP or ReliaTel™ micro controls. The BAYSENS119* can be used with VAV, constant volume or heat pump equipment.

Figure 61. Display with all the symbols showing

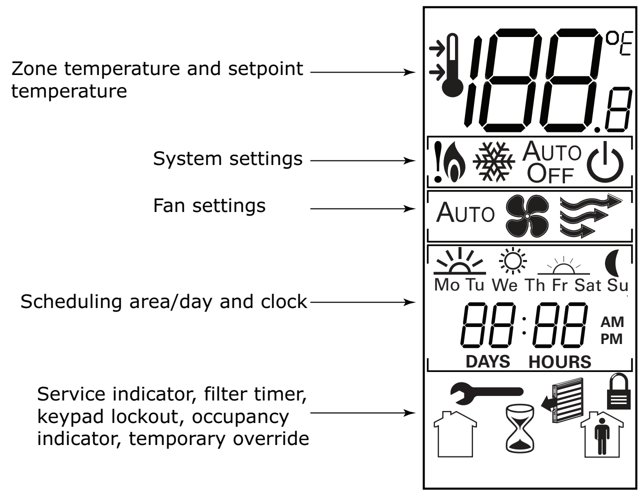


Table 71. ReliaTel™ and UCP wiring locations

Sensor		3 to 25 ton packaged rooftops *CD/*CH/*SC/*HC		3 to 25 ton split system units TTA/TWA	27.5 to 50 ton packaged rooftops YC*/TC*/TE*	
		UCP control LTB	ReliaTel™ Control J6	ReliaTel™ Control J6		ReliaTel™ Control J6
Remote Sensor input[a]	S2	Optional remote sensor				
Remote Sensor Input[a]	S1	Optional remote sensor				
24 VAC Input[b]	14	14[c]	14	14	14	14
Communications	12	12	12	12	12	12
Common[d]	11	11	11	11	11	11
Service Status (UCM Input)	10	10	10	10	10	10
System Status (On/Off Input)	9	9	9	9	9	9
Cool Status (UCM Input)	8	8	8	8	8	8
Heat Status (UCM Input)	7	7	7	7	7	7
Aux Relay (Closed - Unoccupied)	A3	The auxiliary relay on the sensor is form C, rated for 1.25 A at 30 Vac. It is energized during occupied periods.				
Aux Relay (Common)	A2					
Aux Relay (Closed - Occupied)	A1					

Note: LTB and LTB1 refer to low-voltage terminal boards with numbers 1–20 and two test terminals.

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

Table 72. Error codes

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

Notes:
1. On the display, error codes toggle with the clock.
2. An error code indicates that technical assistance may be required.

BAYSENS135* Non-Programmable Zone Sensor

Figure 62. BAYSENS135*

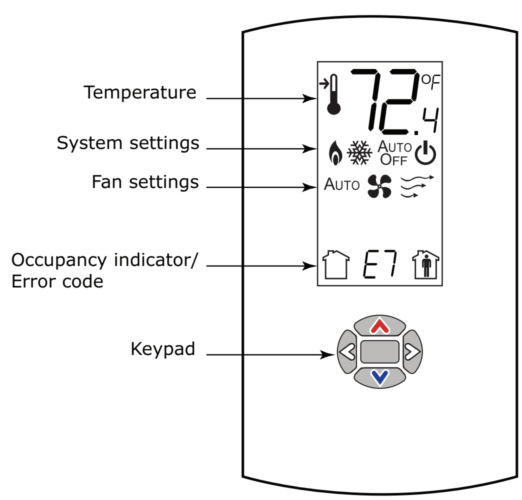


Table 73. BAYSENS135* ReliaTel™ and UCP wiring locations

Feature Description	BAYSENS135*	ReliaTel™ RTRM terminal block (J6) position	UCP LTB screw terminal position
Zone Temperature	1	1	1
5 Volt Common	2	2	2
Cooling Setpoint	3	3	3
System/Fan Mode	4	4	4
Heating Setpoint	5	5	5
COMM+	6 (not used)	N/A	N/A
COMM-	7 (not used)	N/A	N/A
S1	8 (remote sensor)	N/A	N/A
S2	9 (remote sensor)	N/A	N/A
Ground (24 VAC Common)	10	11	20
24 VAC	11	14	14

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

Figure 63. BAYSENS135* terminal block

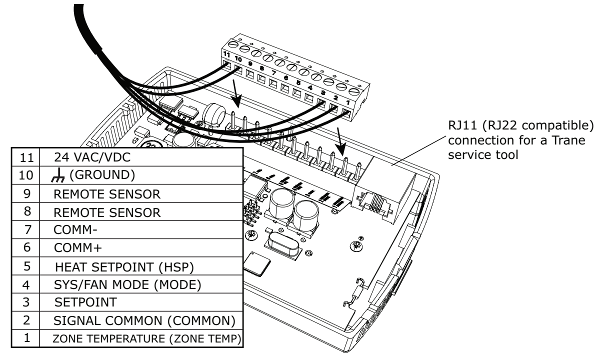


Table 74. Error codes

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

Table 75. Lock symbol

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

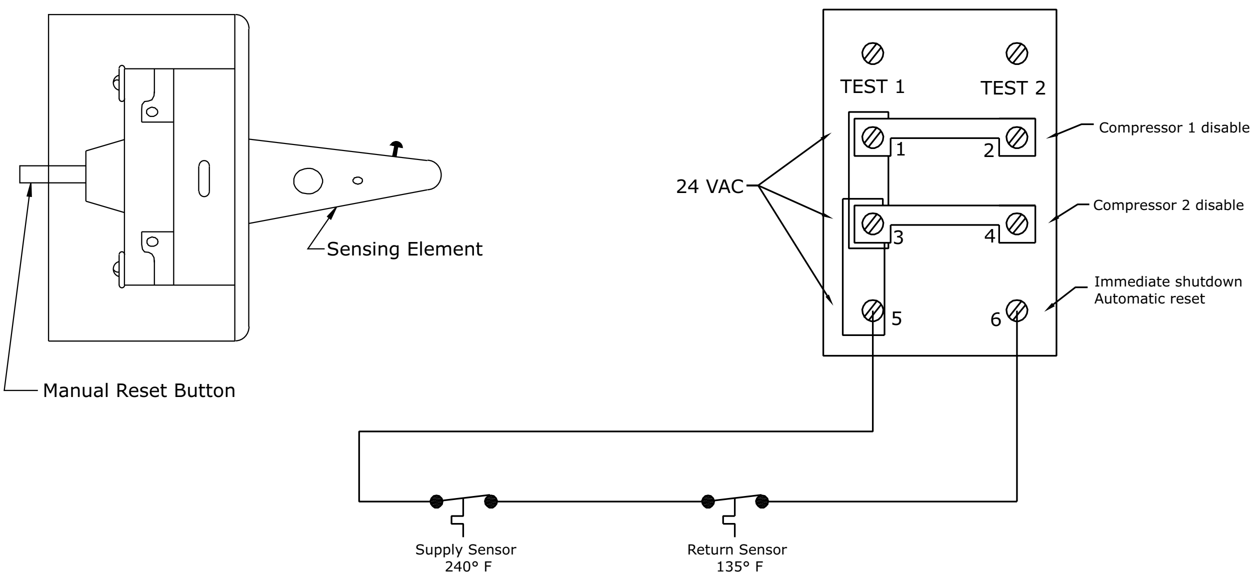
High Temperature Sensor Diagram

High Temperature Sensor

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

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

Figure 64. 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°F.

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

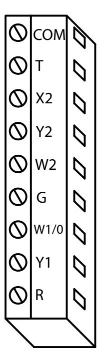
Operation with a Conventional Thermostat (Constant Volume)

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: *27.5 to 50 ton VAV -conventional thermostat input terminals are inactive.*

Figure 65. RTRM - J7



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 Figure 66, p. 108for a flow chart outlining operation with a conventional thermostat.

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

Table 76. Thermostat signals

R	24VAC power to thermostat
Y1	Call for compressor 1 or first stage cooling
Y2	Call for compressor 2 or 2nd stage cooling
G	Call for supply fan
W1	Call for heat 1 (for modulating gas, see Figure 66, p. 108)
W2	Call for heat
Heat pump only:	
X2	Call for emergency heat

Table 76. Thermostat signals (continued)

O	Switchover valve On = cooling, Off = heating
T	Bias for heat anticipation for those mechanical thermostats that use this function

Table 77. Conventional thermostat – gas/electric, electric heat

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

Table 78. Conventional thermostat – heat pump

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

(a) For units configured with 2-step mechanical heating (Odyssey™ Independent Circuit Heat Pump), Y1 will correspond to a request for Compressor 1 operation and Y2 will correspond to a request for Compressor 2 operation.

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

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

- **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

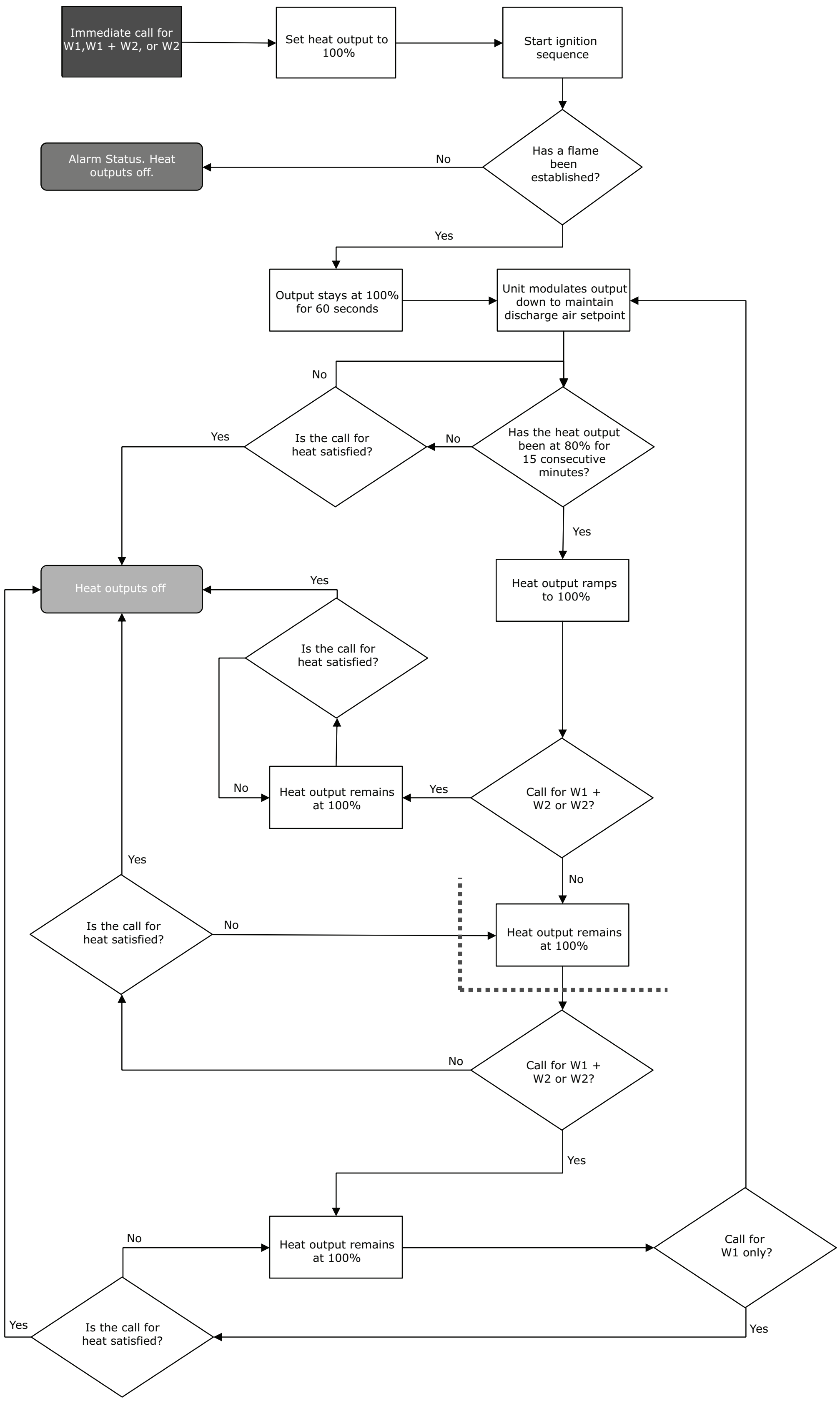
If unit does not have an economizer, the Cool/Econ Stage 1 and Stage 2 will call directly for mechanical cooling (compressor) stages. If the unit has an economizer, the Cool/Econ stages will function as follows:

Table 79. Cooling/economizer operation with thermostat

OK to Econo-mize	Thermo-stat Y1	Call for Thermo-stat Y2	Econo-mizer 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

Notes:
1. 40 to 50 ton CV only.
2. This unit has 3 stages of cooling if using a zone sensor or binary inputs.
3. Y1 = 1st stage, Y1 + Y2 = 3rd stage
4. Thermostat inputs are ignored on VAV units.

Figure 66. Modulating gas heat control process — thermostat control



Zone Sensor Module Testing

Mechanical Zone Sensor Module

Temperature Input

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

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

Problems to Look for:

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

Service Tips

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

Figure 67. Temperature input / voltmeter display

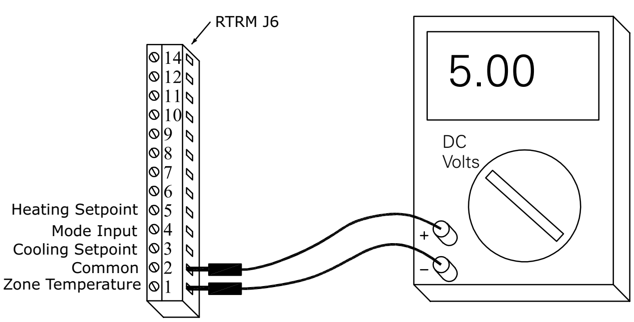


Table 80. Temperature input

Temp °F	Resistance (K ohms)	DC Volts
40	26.097	3.613
41	25.383	3.585
42	24.69	3.557
43	24.018	3.528
44	23.367	3.5
45	22.736	3.471
46	22.123	3.442
47	21.53	3.412
48	20.953	3.383
49	20.396	3.353
50	19.854	3.324
51	19.33	3.294
52	18.821	3.264
53	18.327	3.233
54	17.847	3.203

Table 80. Temperature input (continued)

Temp °F	Resistance (K ohms)	DC Volts
55	17.382	3.173
56	16.93	3.142
57	16.491	3.111
58	16.066	3.08
59	15.654	3.05
60	15.253	3.019
61	14.864	2.988
62	14.486	2.957
63	14.119	2.926
64	13.762	2.895
65	13.416	2.864
66	13.078	2.832
67	12.752	2.801
68	12.435	2.77
69	12.126	2.739
70	11.827	2.708
71	11.535	2.677
72	11.252	2.646
73	10.977	2.616
74	10.709	2.58
75	10.448	2.554
76	10.194	2.523
77	9.949	2.493
78	9.71	2.462
79	9.477	2.432
80	9.25	2.402
81	9.03	2.372
82	8.815	2.342
83	8.607	2.312
84	8.404	2.283
85	8.206	2.253
86	8.014	2.224
87	7.827	2.195
88	7.645	2.166
89	7.468	2.137
90	7.295	2.109
91	7.127	2.08
92	6.963	2.052
93	6.803	2.024
94	6.648	1.996
95	6.497	1.969

Setpoint Input

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

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

Figure 68. Setpoint input / voltmeter display

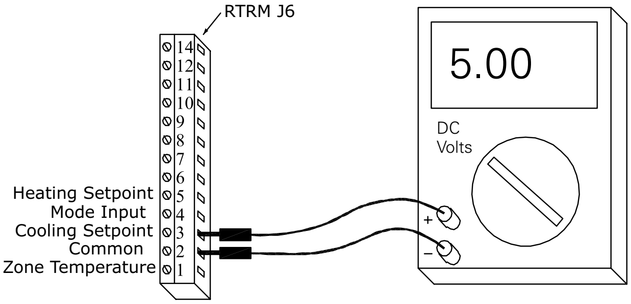


Table 81. Setpoint input

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

Problems to Look for:

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

Table 82. Setpoint inputs

Temp °F	Resistance (K ohms)	DC Volts
	open	5.00 (open circuit)
40	1.0841	2.601
41	1.0656	2.579
42	1.0472	2.557
43	1.0287	2.535
44	1.0102	2.513
45	0.9918	2.49
46	0.9733	2.466
47	0.9548	2.442
48	0.9363	2.418
49	0.9179	2.393
50	0.8994	2.368
51	0.8787	2.338
52	0.858	2.309
53	0.8373	2.278
54	0.8166	2.247
55	0.7958	2.216
56	0.7751	2.183
57	0.7544	2.15
58	0.7337	2.116
59	0.7142	2.083
60	0.6948	2.05
61	0.6753	2.015
62	0.6558	1.98
63	0.6363	1.944
64	0.6169	1.908
65	0.5974	1.87
66	0.5779	1.831

Table 82. Setpoint inputs (continued)

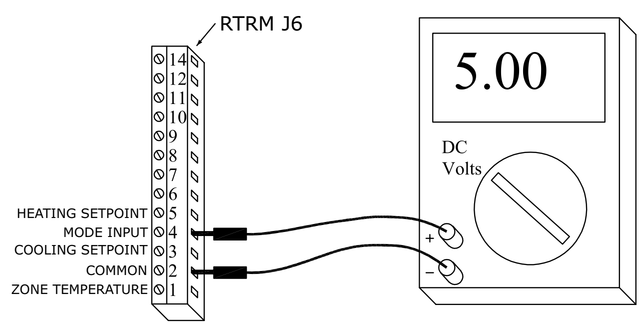
Temp °F	Resistance (K ohms)	DC Volts
67	0.5584	1.792
68	0.539	1.751
69	0.5195	1.709
70	0.5	1.667
71	0.4805	1.623
72	0.461	1.578
73	0.4416	1.532
74	0.4221	1.484
75	0.4026	1.435
76	0.3832	1.385
77	0.3637	1.333
78	0.3442	1.28
79	0.3247	1.226
80	0.3053	1.169
81	0.2858	1.111
82	0.2663	1.051
83	0.2468	0.99
84	0.2273	0.926
85	0.2079	0.86
86	0.1884	0.793
87	0.1689	0.723
88	0.1495	0.65
89	0.1301	0.575
90	0.1106	0.498
(shorted/no power)		0

Mode Input

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

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

Figure 69. Mode input / Voltage reading



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

Problems to Look for:

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

Table 83. Zone sensor readings

System switch	Fan switch	Ohms Rx1K	Volts DC +- 5%
Short to common		0	0
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	3.3
HEAT	ON	27.93	3.68
EM HEAT	AUTO	35	3.88
EM HEAT	ON	43.45	4.06
Open circuit			5

Programmable Zone Sensor BAYSENS119* and BAYSENS019C (Obsolete)

The BAYSENS119* 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 to 25 tons
- Voyager™ UCP 27.5 to 50 tons CV
- Precedent™ ReliaTel™ 3 to 10 tons
- Voyager™ ReliaTel™ 12.5 to 25 tons
- Voyager™ ReliaTel™ 27.5 to 50 tons CV
- IntelliPak™ Rooftop 20 to 130 tons CV
- Odyssey™ ReliaTel™ 6 to 20 tons

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

Testing the Programmable Zone Sensor (PZS)

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

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

Troubleshooting the Programmable Zone Sensor

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

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

Table 84. 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

Table 84. Troubleshooting (continued)

Symptom	Probable Cause and solution
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 "oP" and 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.

Table 84. Troubleshooting (continued)

Symptom	Probable Cause and solution
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 1 — RTRM J2-3, J2-4

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

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

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

Service Tips

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

Problems to Look for

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

Table 85. Temperature input

Temp °F	Resistance (K ohms)	DC Volts
-40	345.684	4.856
-39	333.237	4.851
-38	321.274	4.845
-37	309.777	4.84
-36	298.724	4.834
-35	288.097	4.828
-34	277.879	4.823
-33	268.053	4.816
-32	258.603	4.81
-31	249.523	4.804
-30	240.81	4.797
-29	232.425	4.79
-28	224.355	4.783
-27	216.59	4.776

Table 85. Temperature input (continued)

Temp °F	Resistance (K ohms)	DC Volts
-26	209.114	4.768
-25	201.918	4.76
-24	194.991	4.752
-23	188.32	4.744
-22	181.904	4.736
-21	175.738	4.727
-20	169.798	4.718
-19	164.076	4.709
-18	158.562	4.7
-17	153.248	4.69
-16	148.127	4.68
-15	143.192	4.67
-14	138.435	4.66
-12	129.449	4.638
-11	125.199	4.627
-10	121.1	4.615
-9	117.146	4.603
-8	113.331	4.591
-7	109.652	4.579
-6	106.102	4.566
-5	102.676	4.553
-4	99.377	4.54
-3	96.197	4.526
-2	93.127	4.512
-1	90.163	4.498
0	87.301	4.483
1	84.537	4.468
2	81.868	4.453
3	79.291	4.437
4	76.802	4.421
5	74.403	4.404
6	72.087	4.388
7	69.849	4.371
8	67.687	4.353
9	65.597	4.336
10	63.577	4.317
11	61.624	4.299
12	59.737	4.28
13	57.913	4.261
14	56.153	4.241
15	54.452	4.221
16	52.807	4.201
17	51.216	4.18
18	49.677	4.159
19	48.188	4.138
20	46.748	4.116
21	45.354	4.094
22	44.007	4.072
23	42.705	4.049
24	41.446	4.026
25	40.226	4.002
26	39.046	3.978
27	37.904	3.954
28	36.797	3.929
29	35.726	3.904
30	34.689	3.879
31	33.686	3.853
32	32.72	3.827
33	31.797	3.801

Table 85. Temperature input (continued)

Temp °F	Resistance (K ohms)	DC Volts
34	30.903	3.775
35	30.037	3.749
36	29.198	3.722
37	28.386	3.695
38	27.599	3.668
39	26.836	3.641
40	26.097	3.613
41	25.383	3.585
42	24.69	3.557
43	24.018	3.528
44	23.367	3.5
45	22.736	3.471
46	22.123	3.442
47	21.53	3.412
48	20.953	3.383
49	20.396	3.353
50	19.854	3.324
51	19.33	3.294
52	18.821	3.264
53	18.327	3.233
54	17.847	3.203
55	17.382	3.173
56	16.93	3.142
57	16.491	3.111
58	16.066	3.08
59	15.654	3.05
60	15.253	3.019
61	14.864	2.988
62	14.486	2.957
63	14.119	2.926
64	13.762	2.895
65	13.416	2.864
66	13.078	2.832
67	12.752	2.801
68	12.435	2.77
69	12.126	2.739
70	11.827	2.708
71	11.535	2.677
72	11.252	2.646
73	10.977	2.616
74	10.709	2.585
75	10.448	2.554
76	10.194	2.523
77	9.949	2.493
78	9.71	2.462
79	9.477	2.432
80	9.25	2.402
81	9.03	2.372
82	8.815	2.342
83	8.607	2.312
84	8.404	2.283
85	8.206	2.253
86	8.014	2.224
87	7.827	2.195
88	7.645	2.166
89	7.468	2.137
90	7.295	2.109
91	7.127	2.08
92	6.963	2.052
93	6.803	2.024
94	6.648	1.996
95	6.497	1.969

Table 85. Temperature input (continued)

Temp °F	Resistance (K ohms)	DC Volts
96	6.35	1.942
97	6.207	1.915
98	6.067	1.888
99	5.931	1.861
100	5.798	1.835
101	5.668	1.809
102	5.543	1.783
103	5.42	1.757
104	5.3	1.732
105	5.184	1.707
106	5.07	1.682
107	4.959	1.658
108	4.851	1.633
109	4.745	1.609
110	4.642	1.585
111	4.542	1.562
112	4.444	1.539
113	4.349	1.516
114	4.256	1.493
115	4.165	1.47
116	4.076	1.448
117	3.99	1.426
118	3.906	1.405
119	3.824	1.383
120	3.743	1.362
121	3.665	1.341
122	3.589	1.321
123	3.514	1.301
124	3.442	1.281
125	3.371	1.261
126	3.302	1.241
127	3.234	1.222
128	3.169	1.204
129	3.104	1.185
130	3.041	1.166
131	2.98	1.148
132	2.919	1.13
133	2.861	1.113
134	2.804	1.095
135	2.748	1.078
136	2.693	1.061
137	2.64	1.045
138	2.587	1.028
139	2.536	1.012
140	2.486	0.996
141	2.438	0.981
142	2.39	0.965
143	2.343	0.95
144	2.298	0.935
145	2.253	0.92
146	2.21	0.906
147	2.167	0.891
148	2.125	0.877
149	2.085	0.863
150	2.044	0.849
151	2.006	0.836
152	1.967	0.823
153	1.93	0.81
154	1.894	0.797
155	1.859	0.784
156	1.823	0.772
157	1.789	0.759

Table 85. Temperature input (continued)

Temp °F	Resistance (K ohms)	DC Volts
158	1.756	0.747
159	1.723	0.736
160	1.691	0.724
161	1.659	0.712
162	1.629	0.701
163	1.599	0.69
164	1.57	0.688
165	1.541	0.679
166	1.512	0.658
167	1.485	0.647
168	1.458	0.637
169	1.432	0.627
170	1.406	0.617
171	1.38	0.607
172	1.356	0.598
173	1.331	0.588
174	1.308	0.579
175	1.284	0.57
176	1.261	0.561
177	1.239	0.552
178	1.217	0.543
179	1.196	0.535
180	1.174	0.526

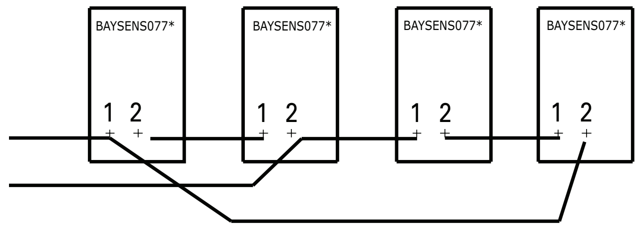
Table 85. Temperature input (continued)

Temp °F	Resistance (K ohms)	DC Volts
181	1.154	0.518
182	1.133	0.51
183	1.113	0.502
184	1.094	0.494
185	1.076	0.487
186	1.057	0.479
187	1.038	0.471
188	1.02	0.464
189	1.003	0.457
190	0.986	0.45
191	0.969	0.443
192	0.952	0.436
193	0.937	0.429
194	0.92	0.422
195	0.905	0.416
196	0.89	0.41
197	0.875	0.403
198	0.86	0.397
199	0.846	0.391
200	0.831	0.385
Shorted or no power		0

Zone Sensor Averaging

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

Figure 70. 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.

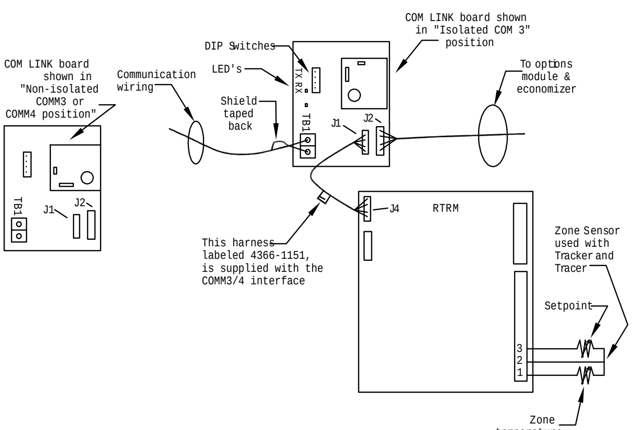
LED's

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 71. Troubleshooting outline



Won't Communicate with Tracker® - 3 to 25 Tons 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 Runs in TEST Mode for 40 Seconds Only (but no Heating or Cooling)

- 3 to 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.

- 27.5 to 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.

Direct Spark Ignition Control

Texas Instruments, 3 to 10 Tons 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 86. Ignition module specifications

Voltage range	18-32 VAC, 50/60Hz
Power consumption	350mA @ 24 VAC
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 87. 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 to 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 to 10 tons units only)
Seven blinks	W1& W2 swapped (electromechanical 3 to 10 tons units). ReliaTel™ module will communicate a heat fail diagnostic back to the RTRM.

Sequence of Operation, 3 to 10 Tons Only

1-Stage Units

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

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

2-Stage Units

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

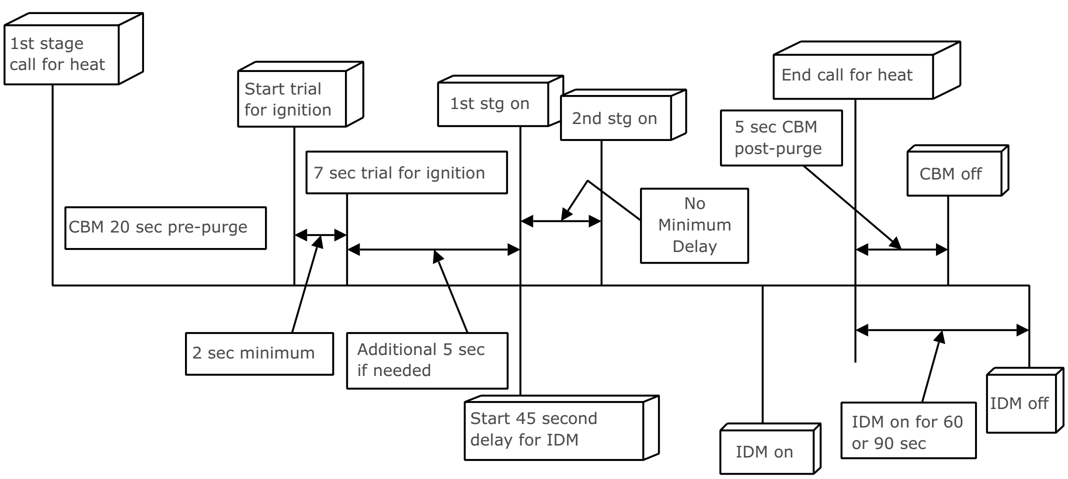
IGN energizes inducer blower on high speed. When PS closes, 20 second (15 seconds on high, 5 seconds on low) pre-purge begins. After 20 seconds, the IGN energizes the spark and gas valve at the same time. The spark will stay energized for at least 2 seconds attempting to establish flame. If a flame is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

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

- Opening for 3 seconds and closing the main power disconnect switch.
- By switching the 'Mode' switch on the zone sensor to 'OFF' and then to the desired position, or
- 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 72. Direct spark ignition control sequence of operation



Precedent™ 6 to 10 Tons Modulating Gas Heat Units

When there is a call for heat, ReliaTel™ will send a command to the ignition module to fire and open the modulating valve to 100% (10.0Vdc) while also commanding the gas inducer motor to High speed (Valve 2 binary output on the ignition module) and controlling the fan speed to normal algorithm control.

After operating at this condition for the 60 second start-up period, the modulating heat control will be released to normal algorithm control and the valve will begin modulating in the Modulating Gas Heat Output Operating Range between the unit preferred Min-Fire voltage and the unit Max-Fire voltage. The Modulating Gas Heat Output Operating Range is determined by the Supply Airflow measurement.

To keep the heat exchangers from getting too hot or cold, the supply fan airflow is calculated by measuring the differential pressure between the fresh air section and a peizo-electric ring (the transducer is a 0”-5” iwc Kavlico transducer) on the supply fan discharge orifice. The resulting airflow will then be standardized to get CFM/Ton and used to determine the Modulating Gas Heat Output Operating Range for the valve operation according to the following table.

Table 88. Precedent 6 to 10 tons — modulating gas heat operating range

Airflow (CFM/T):	Min Valve Pos %	Max Valve Pos %	Min Valve Command %	Max Valve Command %	Min Fire Voltage	Max Fire Voltage
175	40	68	0	47	2	5.76
200	40	70	0	49	2	5.92
225	40	71	0	52	2	6.16
250	40	73	0	55	2	6.4
275	40	75	0	58	2	6.64
300	40	77	0	61	2	6.88

Table 88. Precedent 6 to 10 tons — modulating gas heat operating range (continued)

Airflow (CFM/T):	Min Valve Pos %	Max Valve Pos %	Min Valve Command %	Max Valve Command %	Min Fire Voltage	Max Fire Voltage
325	40	78	0	64	2	7.12
350	42	80	3	66	2.24	7.28
375	45	82	8	69	2.64	7.52
400	48	83	14	72	3.12	7.76
425	51	85	19	75	3.52	8
450	55	87	24	78	3.92	8.24
475	58	89	29	81	4.32	8.48
500	61	90	35	84	4.8	8.72
525	64	92	40	86	5.2	8.88
550	67	94	45	89	5.6	9.12
575	70	96	51	92	6.08	9.36
600	73	97	56	95	6.48	9.6
625	77	99	61	98	6.88	9.84
650	80	100	66	100	7.28	10
675	83	100	72	100	7.76	10
700	86	100	77	100	8.16	10
725	89	100	82	100	8.56	10
750	92	100	87	100	8.96	10
775	96	100	93	100	9.44	10
800	99	100	98	100	9.84	10
825	100	100	100	100	10	10

ReliaTel™ Hot Surface Ignition Control

12.5 to 50 Tons, 1 Stage, 2 Stage, and Modulating Gas Heat

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

Table 89. 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 90. 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
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 12.5-through 50-ton packaged units use a drum and tube heat exchanger with a negative pressure gas valve and hot surface ignition. This design is the same as was used with the UCP micro controls, but the control circuitry for ignitions has changed to take advantage of ReliaTel™ MODBUS communications.

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

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

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

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

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

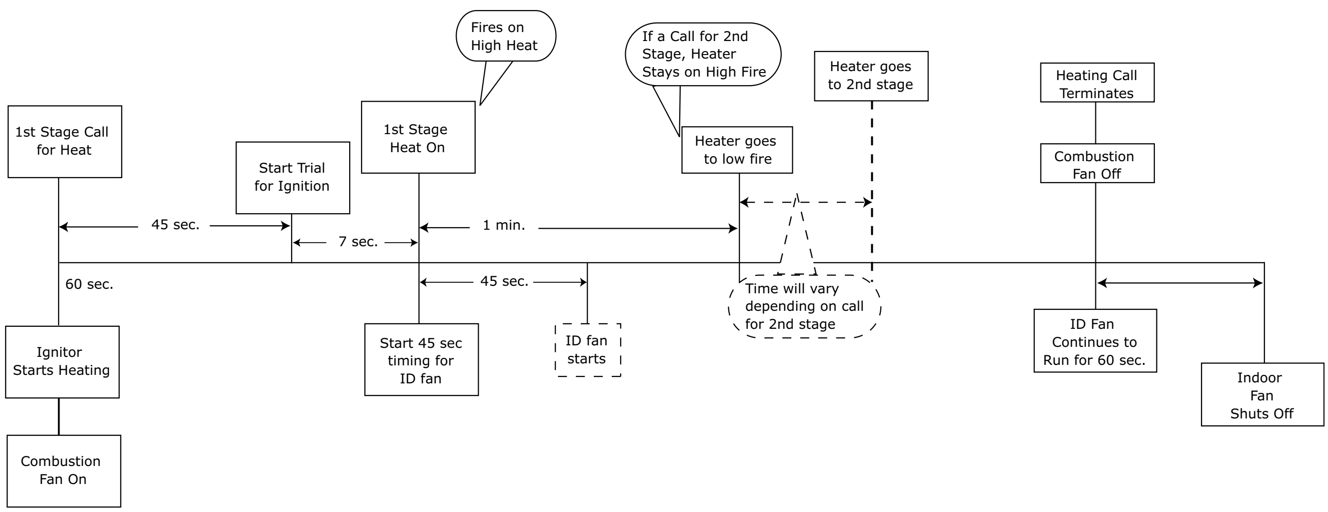
- Opening for 3 seconds and closing the main power disconnect switch,
- By switching the "Mode" switch on the zone sensor to "OFF" and then to the desired position, or
- Allowing the ignition control module to reset automatically after one hour.

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

Figure 73. ReliaTel™ hot surface ignition control sequence of operation



Modulating heat units utilize a variable speed combustion blower motor that enables the motor to operate at the necessary speed required to provide the amount of heat required to satisfy the current heating load of the building.

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 to 10 ton convertible packaged heat pumps use demand defrost.

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

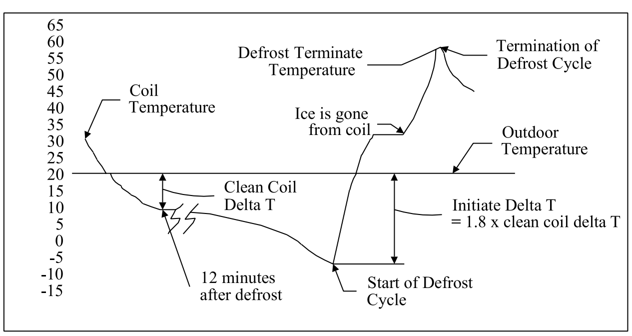
Over time, as moisture and frost accumulate on the coil, the coil temperature will drop, increasing the temperature difference. When the temperature difference reaches 1.8 times the dry coil temperature differential (Δ T), a defrost cycle is initiated. While defrosting, the reversing valve is in the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

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

There are three conditions that must be met for demand defrost to operate:

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

Figure 74. Typical demand defrost cycle



Defrost Service Test

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

Defrost Mode Operation

Defrost mode shall remain active until the outdoor coil temperature (OCT) exceeds the defrost termination temperature (DTT) or until ten (10) minutes have passed, whichever occurs first. If all compressor outputs turn off during the defrost cycle, such as during a high pressure cutout, defrost mode will terminate.

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

Sequence of Operation

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

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

Emergency Heat Operation

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

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 sensors (CTS).

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

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

Table 91. 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
DT is below Minimum Value 12 minutes after defrost is terminated	Low DT	If> 2 hours, activate Defrost Fault Reset timer if DT returns within bounds.

Table 91. Demand defrost fault designation (continued)

Symptom	Diagnostic	Response
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.
DT is above Maximum Value 12 minutes after defrost is terminated	High DT	Initiate Defrost. After 16 consecutive High DT Initiations activate Defrost Fault.
DT does not change by 2 degrees in an hour’s time starting 12 minutes after defrost is terminated and DT is less than or equal to 4 degrees 12 minutes after defrost is terminated	Unchanging DT	Initiate Defrost and activate Defrost Activate Defrost Fault

Notes:

1. Defrost Termination Temperature (DTT) = Outdoor Air Temperature (OAT) + 47ºF
2. 57ºF <= DTT <= 72ºF
3. Defrost Temperature (DT) = Outdoor Air Temperature (OAT) – Outdoor Coil Temperature (OCT)
4. Defrost Initiate Temperature = 1.8 x DT (only initiates after a minimum of at least 12 minutes after the previous defrost mode has ended)

Independent Circuit Defrost Operation

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

Economizer

ReliaTel™

Economizer Module Layout

Note: *Honeywell (obsolete - not available to order).*

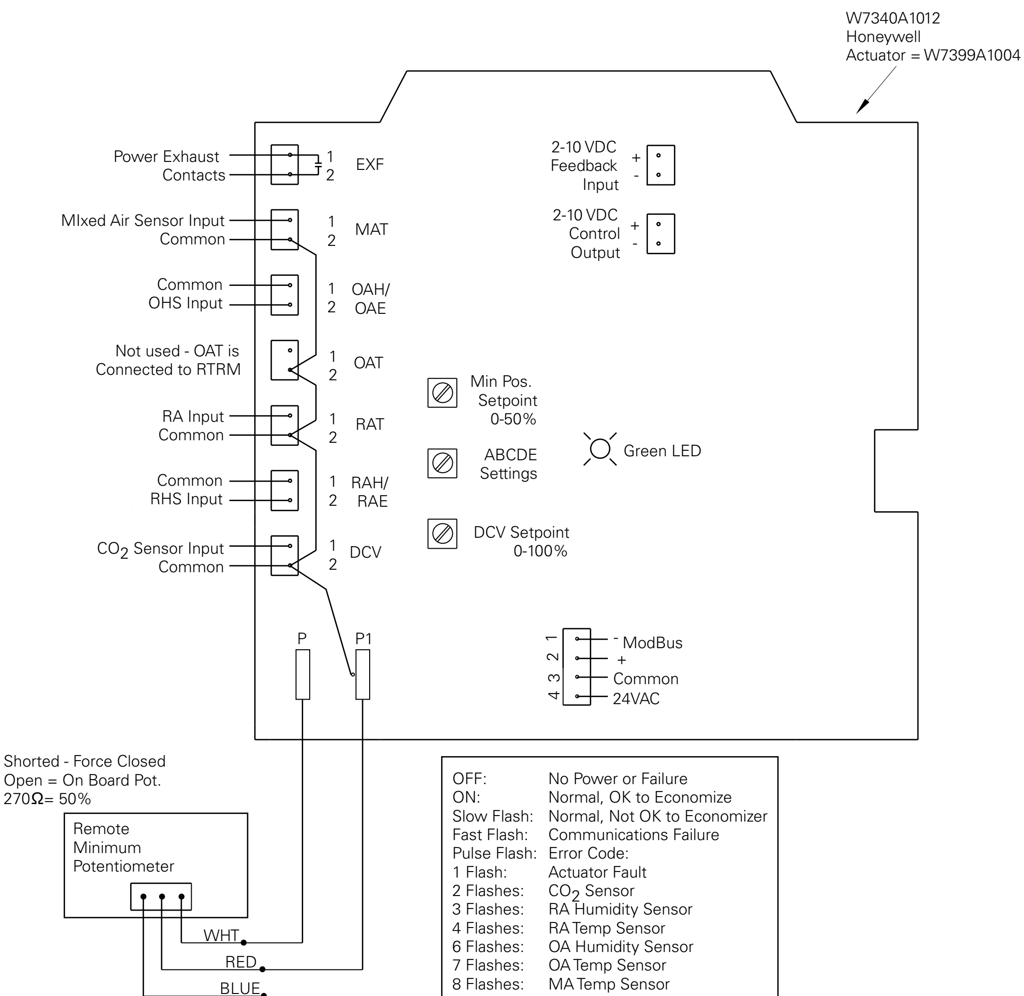
The economizer module plugs directly onto the actuator. It has a diagnostic LED, which under normal operation is either ON (OK to economize) or FLASHING (Not OK to economize). It communicates via MODBUS with the RTRM, and receives outside air temperature input from the RTRM. Mixed air sensor (MAS), return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

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

- To read the actual damper position, read the DC voltage at the '2-10 vdc feedback input' terminals. 2 vdc is closed, 10 vdc is 100% open.
- To drive 2 actuators with 1 control, connect field wiring as shown in Figure 75, p. 126.

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

Figure 75. ReliaTel™ economizer module layout (Honeywell)



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

ReliaTel™ Economizer Layout - RTEM

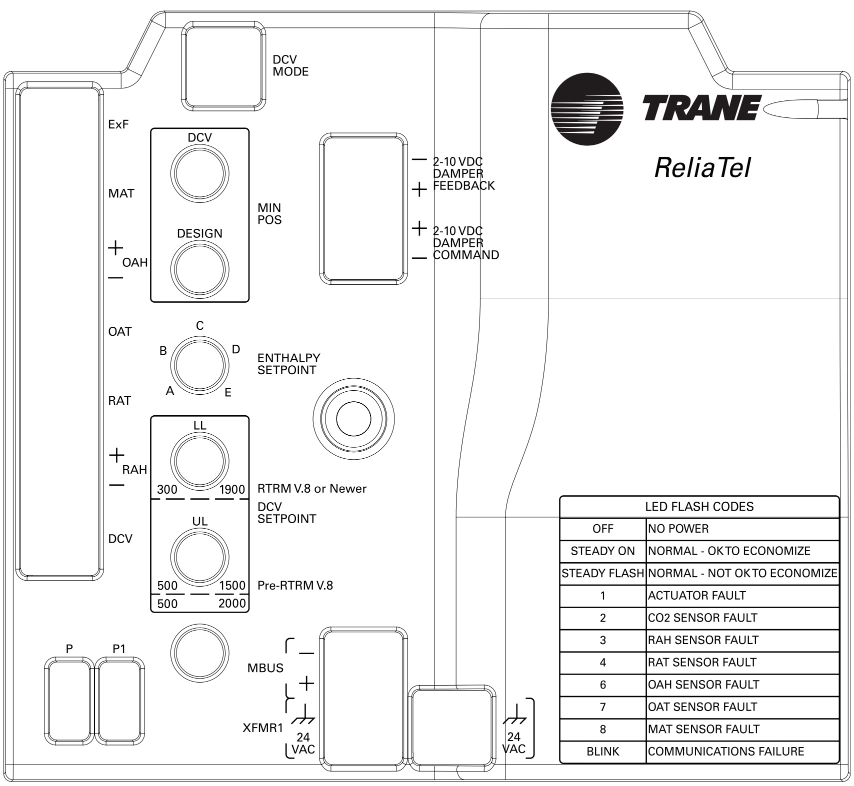
The RTEM Module plugs directly onto the actuator. It has a diagnostic LED, which under normal operation is either ON (OK to economize) or FLASHING (not OK to economize). It communicates via MODBUS with the RTRM, and receives an outside air temperature input from the RTRM. Mixed air sensor (MAS), return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

A stripped down version of the RTEM, which only contains the MAT input, Design min. pos. adjustment, Remote Min Position input, Enthalpy Setpoint, and the wire plug for power and ModBus communications, is also available. This module will only be applied on units that are supplied from the factory without any economizer options such as, Reference Enthalpy, Comparative Enthalpy or CO_2. Options installed in the field will require the "full-up" version in order to operate properly.

- To read the actual damper position, read the DC voltage at the '2-10 vdc Damper Position' input terminals; 2 vdc is closed, 10 vdc is 100% open.
- To drive 2 actuators with 1 control, connect field wiring as shown in Figure 76, p. 127.

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

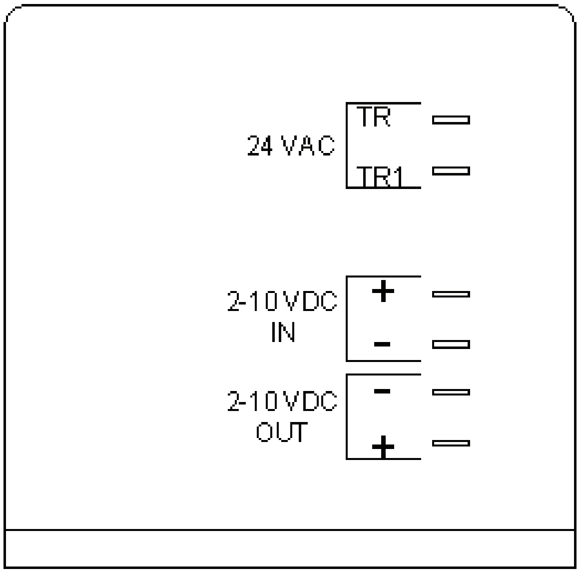
Figure 76. ReliaTel™ economizer module layout (RTEM)



Economizer Actuator Layout - Electromechanical

Electromechanical economizers since August 2014 (gray) use the ReliaTel™ actuator.

Figure 77. ReliaTel™ economizer terminals



Note: *Used on electromechanical Foundation™ and Precedent™.*

VAV Economizer Cooling Operation

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

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

Economizer Operation with Zone Sensor, Programmable Zone Sensor or ICS

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

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

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

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

Economizer Operation with Conventional Thermostat (CV Only)

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

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

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

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

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

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

Barometric Relief

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

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

Power Exhaust

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

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

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

Economizer Control Methods

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

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

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

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

Thermostat Notes

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

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

The damper can be in four different states.

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

  Note: *When making minimum position adjustments, allow 30-45 seconds for actuator to respond.*
- Modulating — Algorithms control the damper to meet cooling demand. When modulating, the damper's range of motion is between Active Minimum Position and 100%.
- Night Setback — During NSTS, the damper drives to full closed position. If there is a call for cooling, the damper opens to satisfy the cooling requirement. The damper stays closed during heating mode.

During unoccupied mode, the minimum position is 0%.

The following Inputs Are Used

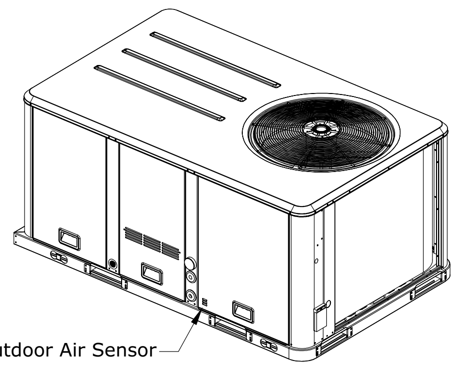
Mixed Air Sensor (MAS)

MAS measures the dry bulb temperature of the air leaving the evaporator coil while economizing. Return air, outdoor air and cooling caused by any compressor cooling make up the mixed air input. The MAS is plugged into the economizer actuator module (ECA).

Outdoor Air Sensor (OAS)

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

Figure 78. Outdoor air sensor



Outdoor Humidity Sensor (OHS)

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

Return Air Temperature Sensor (RAT)

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

Return Humidity Sensor (RHS)

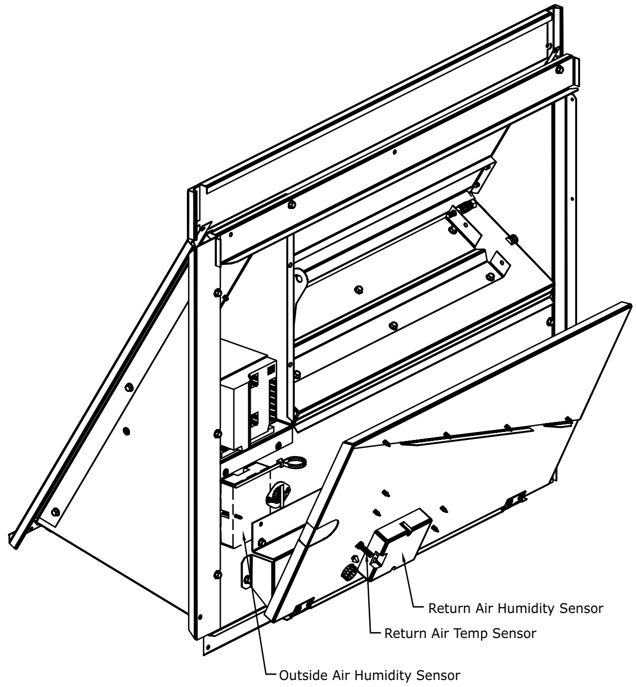
The RHS measures the relative humidity of the return air. It is located on the return air damper of the economizer. The RHS is plugged into the ECA.

Economizer Damper Enthalpy Layout

Table 92. 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 79. Economizer - sensors location



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.

Table 93. Potentiometer settings

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

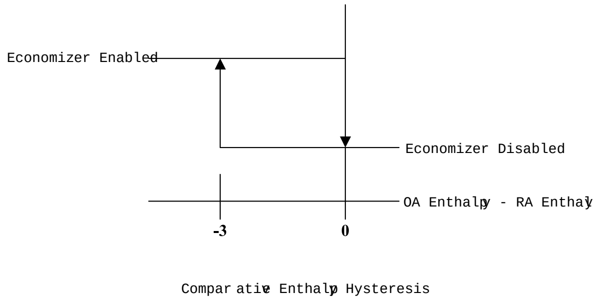
[a] Factory setting

Comparative Enthalpy Method

OA enthalpy is compared with RA enthalpy.

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

Figure 80. Comparative enthalpy enable

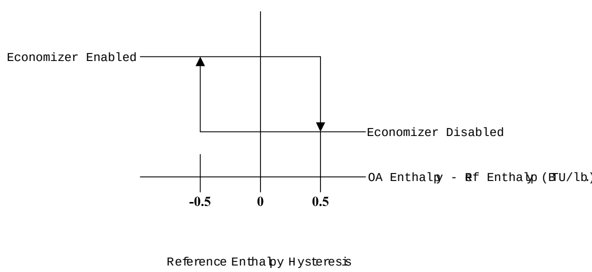


Reference Enthalpy Method

OA Enthalpy is compared with a reference enthalpy point.

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

Figure 81. Reference enthalpy enable

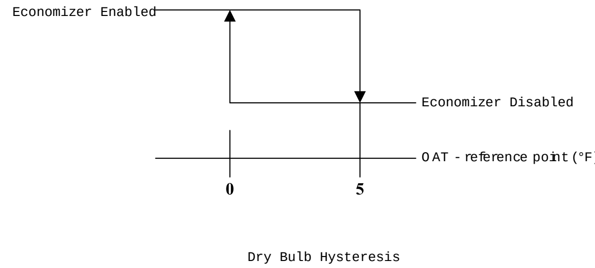


Reference Dry Bulb Method

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 + 5.0ºF), the economizer enable/disable status is not changed.

Figure 82. Dry bulb enthalpy enable



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

Internal Calculations

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

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

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

H = 0.24 * T + W * Hv

Where

T= dry bulb temperature, deg. F

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

W = 0.622 * P/ (14.696 - P)

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

Hv= 1062.1 + 0.43 * T

Also,

P= partial pressure of water at T, psia

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

ReliaTel™ Economizer Operation & Inputs

ReliaTel™ Economizer Inputs

Terminals to read voltage:

Mixed Air Sensor	ECA Module	MAT
Return Air Sensor	ECA Module	RAT

Note: *These are economizer inputs only. RTRM, RTOM inputs (zone temp, setpoints, OAS, DAS) are in the ReliaTel ™temperature inputs section.*

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 94. W7340A1004 used before August 1st, 2005

Temp °F	Resistance (K ohms)	DC Volts
40	26.105	1.853
41	25.393	1.839
42	24.703	1.826
43	24.033	1.812
44	23.385	1.799
45	22.756	1.785
46	22.146	1.771
47	21.554	1.757
48	20.98	1.743
49	20.424	1.728
50	19.884	1.714
51	19.36	1.699
52	18.852	1.685
53	18.359	1.67
54	17.88	1.656
55	17.415	1.641
56	16.964	1.626
57	16.527	1.611
58	16.102	1.596
59	15.689	1.581
60	15.288	1.566
61	14.899	1.551
62	14.521	1.536
63	14.154	1.52
64	13.797	1.505
65	13.451	1.49
66	13.114	1.475
67	12.787	1.46
68	12.469	1.444
69	12.16	1.429

Table 94. W7340A1004 used before August 1st, 2005 (continued)

Temp °F	Resistance (K ohms)	DC Volts
70	11.86	1.413
71	11.568	1.398
72	11.284	1.383
73	11.008	1.367
74	10.74	1.352
75	10.479	1.337
76	10.225	1.321
77	9.978	1.306
78	9.738	1.291
79	9.505	1.276
80	9.278	1.261

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

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

Table 95. W7340B1002 used August 1, 2005 and later

Temp °F	Resistance (K Ohms)	DC Volts
10	63.577	4.317
11	61.624	4.299
12	59.737	4.28
13	57.913	4.261
14	56.153	4.241
15	54.452	4.221
16	52.807	4.201
17	51.216	4.18
18	49.677	4.159
19	48.188	4.138
20	46.748	4.116
21	45.354	4.094
22	44.007	4.072
23	42.705	4.049
24	41.446	4.026
25	40.226	4.002
26	39.046	3.978
27	37.904	3.954
28	36.797	3.929
29	35.726	3.904
30	34.689	3.879
31	33.686	3.853
32	32.72	3.827
33	31.797	3.801
34	30.903	3.775
35	30.037	3.749
36	29.198	3.722
37	28.386	3.695
38	27.599	3.668
39	26.836	3.641
40	26.097	3.613
41	25.383	3.585
42	24.69	3.557
43	24.018	3.528
44	23.367	3.5

Table 95. W7340B1002 used August 1, 2005 and later (continued)

Temp °F	Resistance (K Ohms)	DC Volts
45	22.736	3.471
46	22.123	3.442
47	21.53	3.412
48	20.953	3.383
49	20.396	3.353
50	19.854	3.324
51	19.33	3.294
52	18.821	3.264
53	18.327	3.233
54	17.847	3.203
55	17.382	3.173
56	16.93	3.142
57	16.491	3.111
58	16.066	3.08
59	15.654	3.05
60	15.253	3.019
61	14.864	2.988
62	14.486	2.957
63	14.119	2.926
64	13.762	2.895
65	13.416	2.864
66	13.078	2.832
67	12.752	2.801
68	12.435	2.77
69	12.126	2.739
70	11.827	2.708
71	11.535	2.677
72	11.252	2.646
73	10.977	2.616
74	10.709	2.585
75	10.448	2.554
76	10.194	2.523
77	9.949	2.493
78	9.71	2.462
79	9.477	2.432
80	9.25	2.402
81	9.03	2.372
82	8.815	2.342
83	8.607	2.312
84	8.404	2.283
85	8.206	2.253
86	8.014	2.224
87	7.827	2.195
88	7.645	2.166
89	7.468	2.137
90	7.295	2.109
91	7.127	2.08
92	6.963	2.052
93	6.803	2.024
94	6.648	1.996
95	6.497	1.969
96	6.35	1.942
97	6.207	1.915
98	6.067	1.888
99	5.931	1.861
100	5.798	1.835
101	5.668	1.809
102	5.543	1.783
103	5.42	1.757
104	5.3	1.732
105	5.184	1.707

Table 95. W7340B1002 used August 1, 2005 and later (continued)

Temp °F	Resistance (K Ohms)	DC Volts
106	5.07	1.682
107	4.959	1.658
108	4.851	1.633
109	4.745	1.609
110	4.642	1.585
111	4.542	1.562
112	4.444	1.539
113	4.349	1.516
114	4.256	1.493
115	4.165	1.47
116	4.076	1.448
117	3.99	1.426
118	3.906	1.405
119	3.824	1.383
120	3.743	1.362

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

Note: *Actuator fault Honeywell (Obsolete - Not Available to Order)*

An actuator fault will occur when the economizer position signal to the actuator is 25% different than the feedback signal from the actuator.

Note: *If the economizer is not attached to the motor, you will get an actuator fault only after the economizer would tell the motor to drive to at least 25% open.*

Actuator Fault (RTEM)

An actuator fault will occur when the economizer position signal to the actuator is 10% different than the feedback signal from the actuator for 4 continuous minutes.

Note: *If the economizer is not attached to the motor, you would get an actuator fault only after the economizer would tell the motor to drive to at least 10% open for at least 4 minutes.*

Sensor Faults

A sensor fault will occur if a sensor fails during normal operation. When power is freshly applied to the unit, the ECA and RTEM recognize which sensors are installed.

Note: *If only the MAT is hooked up, the economizer control action will be dry bulb. If the OAH/OAE and MAT are hooked up, the economizer control action will be in reference enthalpy.*

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

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

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

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

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

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

On: OK to economize

Slow flash: Not OK to economize

½ second on, 2 seconds off: no communication

OFF: No power or system failure

Error codes — ½ second on, ¼ second off

1 flash — Actuator fault

2 flash — CO_2 sensor

3 flash — RA humidity sensor

4 flash — RA temp sensor

6 flash — OA humidity sensor

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

8 flash — MA temp sensor

9-11 flash — Internal fault (Honeywell only - obsolete; not available to order)

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

Electromechanical Economizer

Note: *Obsolete - Not Available to Order.*

Figure 83. Economizer actuator (ECA) connected to the unit

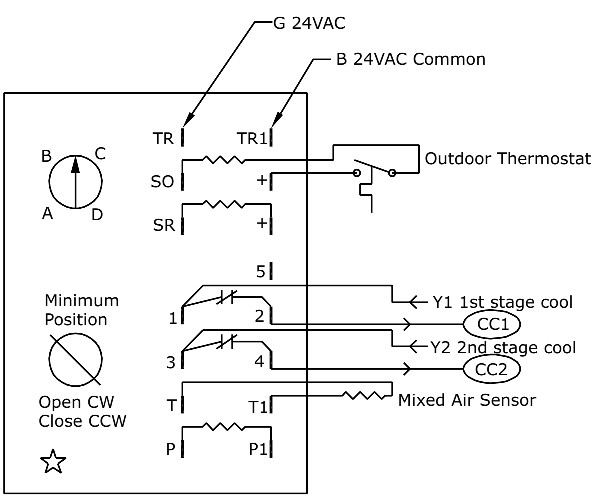
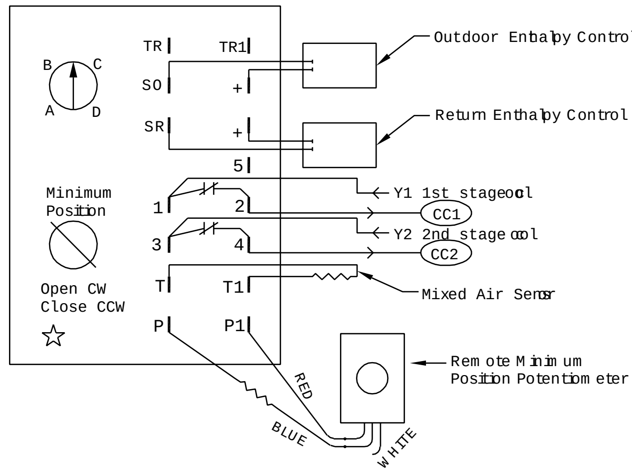


Figure 84. Economizer actuator (ECA) connected to the unit



Electromechanical Economizer Testing

Note: *Obsolete - Honeywell only*

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 96. Temperature input

Temp F	Temp C	R(K OHMS)	DC Volts
33.8	1	9.576	3.91
35.6	2	9.092	3.882
37.4	3	8.636	3.894
39.2	4	8.204	3.863
41	5	7.796	3.829
42.8	6	7.412	3.79
44.6	7	7.048	3.749
46.4	8	6.705	3.713
48.2	9	6.38	3.674
50	10	6.073	3.634
51.8	11	5.782	3.59
53.6	12	5.507	3.55
55.4	13	5.247	3.507
57.2	14	5	3.42
59	15	4.767	3.373

Table 96. Temperature input (continued)

Temp F	Temp C	R(K OHMS)	DC Volts
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	3.18
68	20	3.769	3.157
69.8	21	3.599	3.118
71.6	22	3.437	3.08
73.4	23	3.284	3.034
75.2	24	3.138	3.007
77	25	3	2.971
78.8	26	2.869	2.932
80.6	27	2.744	2.896
82.4	28	2.625	2.86
84.2	29	2.512	2.824
86	30	2.404	2.787
87.8	31	2.301	2.75
89.6	32	2.204	2.714
91.4	33	2.111	2.676
93.2	34	2.023	2.639
95	35	1.938	2.6
96.8	36	1.858	2.561
98.6	37	1.781	2.526
100.4	38	1.708	2.484

Note: Obsolete - not available to order - Honeywell Electromechanical

3 Position Damper

Note: *Obsolete - Honeywell only*

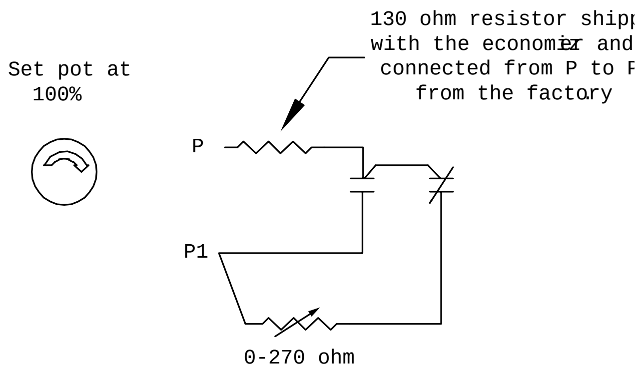
Full open economizer minimum position is accomplished by setting the ECA 50% minimum position potentiometer to 100% and installing a set of contacts in series with the existing 130 ohm resistor to terminals P and P1 on the ECA.

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 85. Electromechanical economizer - 3 position damper

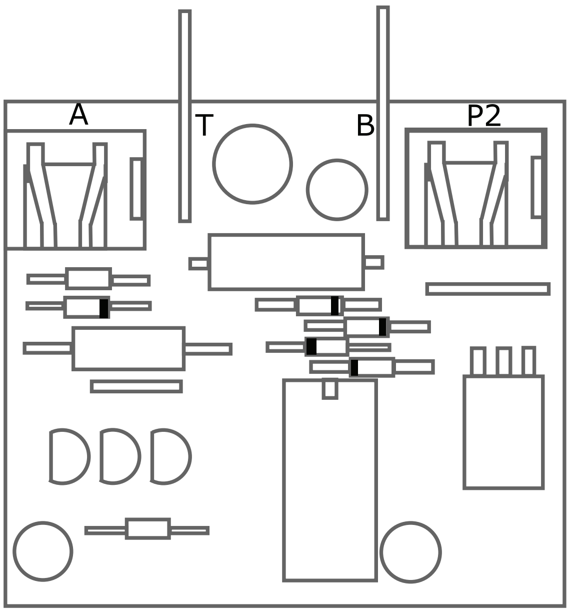


Electromechanical Units

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.

Figure 86. Time delay relay



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 87. Transformer and thermostat layout

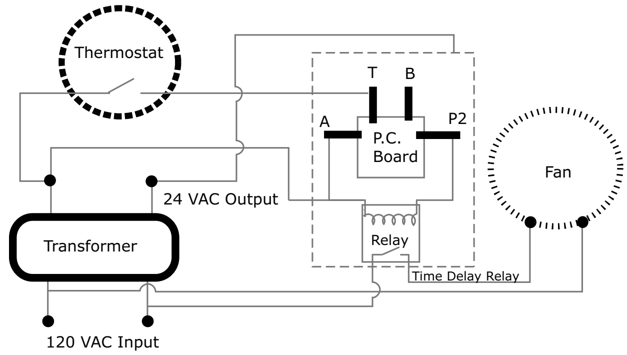
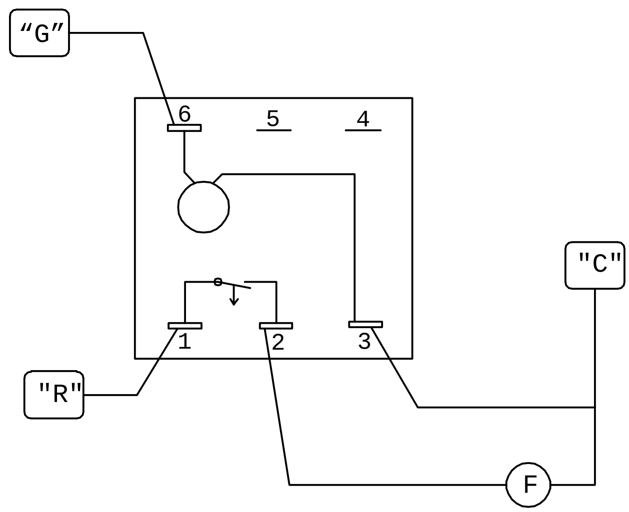


Figure 88. Electromechanical time delay solid state

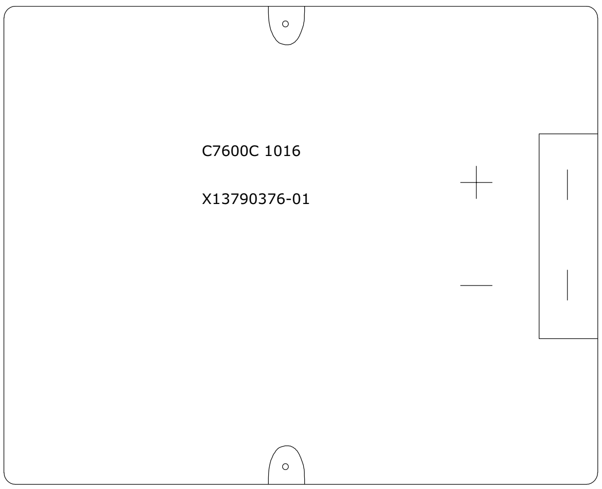


ReliaTel™ - Humidity Sensors

Outdoor Humidity Sensor

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

Figure 89. Humidity sensor



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

Return Humidity Sensor

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

To Test Humidity Sensors

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

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

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

Table 97. Module voltage compared to return humidity

RH%	DCma
100%	20
97.7	19.636
95.5	19.286
93.4	18.947
91.4	18.621
89.4	18.305
87.5	18
85.7	17.705
83.9	17.419
82.1	17.143
80.5	16.875
78.8	16.615
77.3	16.364
75.7	16.119
74.3	15.882
72.8	15.652
71.4	15.429
70.1	15.211
68.8	15
67.5	14.795
66.2	14.595
65	14.4
63.8	14.211
62.7	14.026
61.5	13.846
60.4	13.671
59.4	13.5
58.3	13.333
57.3	13.171
56.3	13.012
55.4	12.857
54.4	12.706
53.5	12.558
52.6	12.414
51.7	12.273
50.8	12.135
50	12
49.2	11.868
48.4	11.739
47.6	11.613
46.8	11.489
46.1	11.368
45.3	11.25
44.6	11.134
43.9	11.02
43.2	10.909
42.5	10.8
41.8	10.693
41.2	10.588
40.5	10.485
39.9	10.385
39.3	10.286
38.7	10.189
38.1	10.093
37.5	10
36.9	9.908
36.4	9.818
35.8	9.73
35.3	9.463

Table 97. Module voltage compared to return humidity (continued)

RH%	DCma
34.7	9.558
34.2	9.474
33.7	9.391
33.2	9.31
32.7	9.231
32.2	9.153
31.7	9.076
31.2	9
30.8	8.926
30.3	8.852
29.9	8.78
29.4	8.71
29	8.64
28.6	8.571
28.1	8.504
27.7	8.438
27.3	8.372
26.9	8.308
26.5	8.244
26.1	8.182
25.8	8.12
25.4	8.06
25	8
24.6	7.941
24.3	7.833

Table 97. Module voltage compared to return humidity (continued)

RH%	DCma
23.9	7.826
23.6	7.77
23.2	7.714
22.9	7.66
22.5	7.606
22.2	7.552
21.9	7.5
21.6	7.448
21.2	7.397
20.9	7.347
20.6	7.297
20.3	7.248
20	7.2

ECA Module Voltages

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

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

RTEM Module Voltage

X13651513 - 23Vdc

ReliaTel™ - Supply Air Tempering Control

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

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

Enable Supply Air Tempering

Mechanical Zone Sensor BAYSENS006-11/AYSTAT661-664

Remove the jumper from RTOM J3-1 and J3-2.

Programmable Zone Sensor BAYSENS019*/AYSTAT666*

Change Option 4 in the options menu to 1=enabled. Or, remove the jumper from RTOM J3-1 and J3-2.

COMM 3/4 (TCI)

Enable through appropriate menu. Supply air tempering can also be enabled by removing the jumper from RTOM J3-1 and J3-2.

LonTalk® (LCI)

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

Voyager™ 27.5 to 50 tons VAV with Staged Heat

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

Sequence of Operation

Constant Volume Units with Staged Heat

When supply air tempering is enabled, the fan mode is on, active mode is heat or emergency heat, and with the unit not actively heating. Stage 1 of heat is turned ON when the supply air temperature is 10°F below the active heating setpoint.

Stage 1 of heat is turned OFF when the supply air temperature is 10°F above the active heating setpoint or the mode is no longer heat or emergency heat. Should the zone temperature exceed the active heating setpoint by 1-2F, supply air tempering will cease until another normal heating cycle resumes.

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

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

Variable Air Volume Units

For VAV units configured with a modulating heat type if the unit is operating in occupied supply air cooling mode, but the unit is not actively cooling, the unit will energize and modulate the modulating heat output to prevent the supply air from falling below the SA cool setpoint deadband low end (SACSP – 3.5°F) once the unit has de-energized all mechanical cooling (if energized). Upon satisfying the SA tempering requirements a five-minute 'SA tempering delay' timer will start whenever the modulating heat is commanded to 0%. This timer will be reset to 5 minutes whenever there is an active call for heat to meet SA tempering demands.

Tempering will be discontinued whenever the five-minute 'SA tempering delay' timer has timed-out and there is an active cooling request from the VAV occupied mechanical cooling function.

TCI Comm 3/4

Discharge Air Sensing

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 to 25 ton units). The discharge sensor will be located in the discharge opening of the unit.

3 to 25 Tons 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 to 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.

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.*

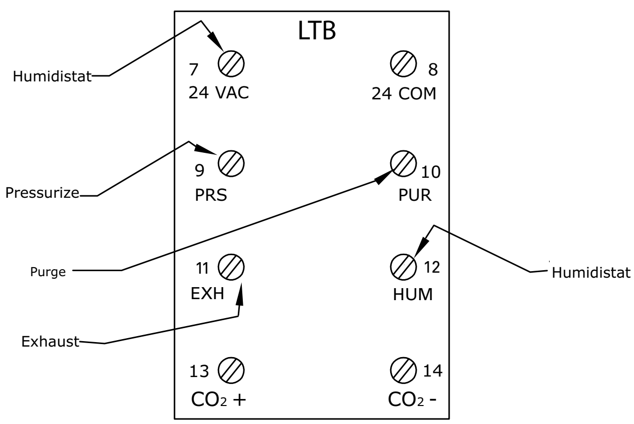
Emergency shutdown from the LTBI 5&6 will override any ventilation override mode. Ventilation override inputs override smoke detector inputs through the RTOM. (3-25 tons only).

Table 98. Ventilation modes

Supply Fan Forced		IGV/VFD [a]	Com-pressors ay run?	OK to heat (gas/elec)?	Econo-mizer position?	Power Exhaust?	Exhaust Damper [b]	VHR Relay[a]
Pressurization	ON	100%	No	No	100%	Off	0%	ON
Purge	ON	100%	No	No	100%	On	100%	ON
Exhaust	OFF	100%	No	No	0%	On	100%	ON

(a) Voyager 27.5 - 50 tons VAV
(b) Exhaust Damper is controlled on units with Power Exhaust w/ Statitrac.

Figure 90. Low voltage terminal strip



Demand Control Ventilation (DCV)

$C0_2$ Sensor Connections

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

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

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

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

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

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

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

Table 99. CO_2 levels and associated voltage outputs

CO2 Level (ppm)	Voltage Output (vdc)
0	0
200	1
400	2
600	3
800	4
1000	5
1200	6
1400	7
1600	8
1800	9
2000	10

RTEM Operation

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

RTEM w/ RTRM v8.0 and Later

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

CO_2 Setpoints

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

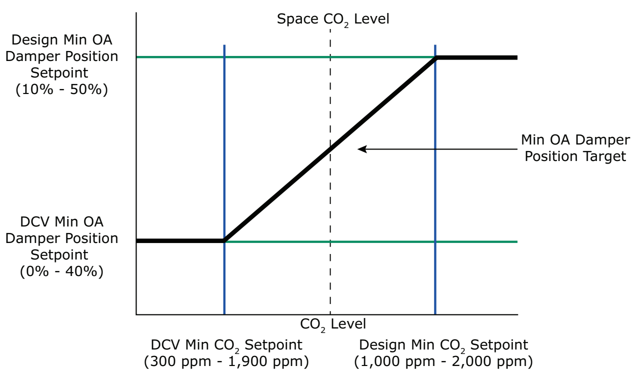
OA Damper Min Position Setpoints

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

Sequence of Operation

When the unit is in the occupied mode, the outdoor-air (OA) damper opens to the DCV min position setpoint. If the space CO_2 level is less than or equal to the lower limit CO_2 setpoint, the OA damper will close to the DCV min position setpoint. If the space CO_2 level is greater than or equal to the upper level CO_2 setpoint, the OA damper will open to the design min position Setpoint. If the space CO_2 level is greater than the lower limit CO_2 setpoint and less than the upper limit CO_2 setpoint, the OA damper position is modulated proportionally between the DCV min and the design min position setpoints. If there is a call for economizer cooling, the outdoor air damper may be opened further to satisfy the cooling request.

Figure 91. Damper position



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

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

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

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

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

RTEM w/ RTRM v7.0 and Earlier

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

Setpoint Selection

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

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

Sequence of Operation

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

Supply Fan Mode = ON

When the unit is in the occupied mode, the outdoor-air (OA) damper opens to the DCV min position setpoint. If the space CO_2 level rises above the CO_2 setpoint, the OA damper will open to the Bldg Design Min Position Setpoint. If the space CO_2 level drops below the CO_2

Setpoint, but is not yet 50 ppm below the setpoint, the OA damper will stop modulating (holding its current position). If the space CO_2 level drops below the CO_2 setpoint minus 50 ppm, the OA damper will close to the DCV min position setpoint. If there is a call for economizer cooling, the outdoor air damper may be opened further to satisfy the cooling request.

Supply Fan Mode = AUTO (from Zone Sensor or all T-stat Inputs Inactive)

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

When the supply fan is de-energized, if the space CO_2 level rises above the CO_2 setpoint, DCV control will energize the supply fan and open the OA damper to the design min position setpoint. When the space CO_2 level drops below the CO_2 setpoint, the supply fan will be de-energized and the OA damper will close to 0%.

Failure and Override Conditions

- If the CO_2 value goes invalid while DCV is enabled:
- A CO_2 sensor failure diagnostic is called out.
- DCV is disabled.
- Design min position setpoint will be used for the damper min position
- After power is cycled to the unit, the CO_2 sensor failure diagnostic is cleared and DCV is disabled.
- For all configurations, (RTEM, RTRM 8.0, Honeywell, etc.) if a CO_2 sensor value becomes valid at any point during unit operation the unit will utilize the value and perform demand controlled ventilation.
- If a ventilation override mode goes active it will take priority over DCV.
- If an emergency override mode goes active it will take priority over DCV.
- Any BAS economizer minimum position request takes priority over DCV.
- The remote minimum position input will be used as the design minimum position setpoint when connected.

Honeywell Operation

Note: *Obsolete - Honeywell only.*

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

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

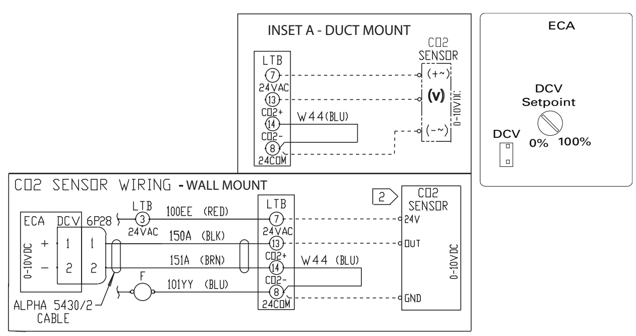
As a safety precaution, if the mixed air temperature drops to 40° F, the mixed air sensor overrides DCV control and closes the outdoor-air damper to its minimum position to protect the gas heat exchanger (or to prevent water coils, if installed, from freezing). When the mixed air temperature rises to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

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

Voyager™ 27.5 to 50 Tons VAV Notes

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

Figure 92. Wiring connections using CO_2 accessory



Demand Controlled Ventilation (CO_2) Setup for Single Zone VAV, Multi-Speed and 17 Plus units

Because of the need to maintain the same outdoor cfm during different fan speeds, set up of demand controlled ventilation is different than for constant volume units.

There are 3 fan speed reference points which will be referred to as low, medium, and high fan speeds.

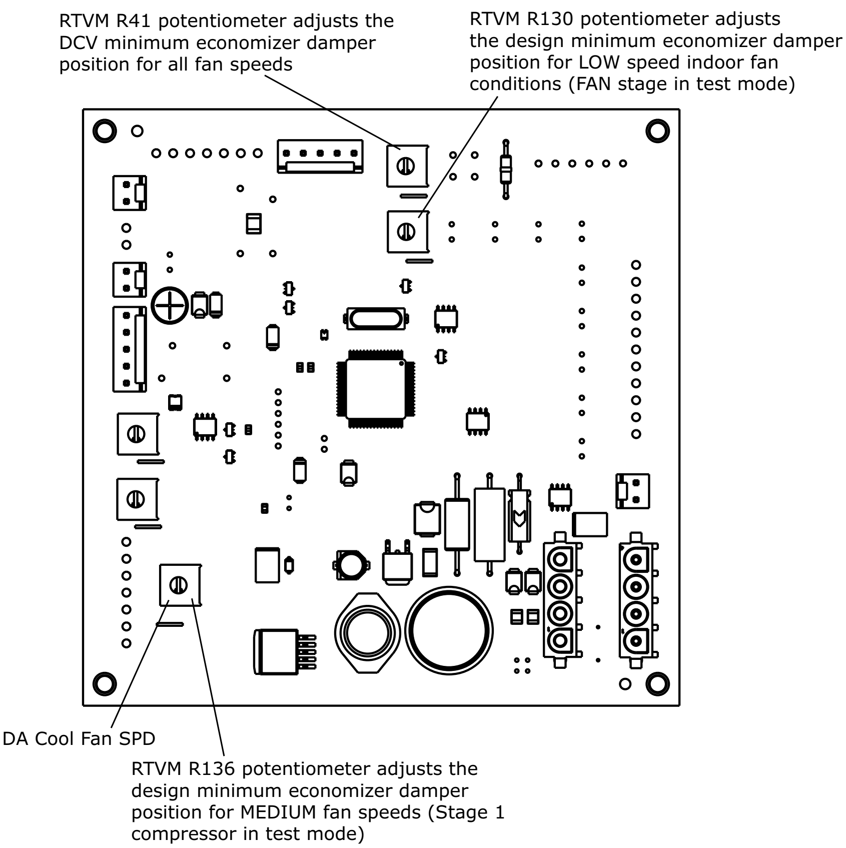
The DCV set up procedure should be done in test mode.

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

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

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

Figure 93. RTVM callouts



Initial Set Up

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

Set Up the LOW Fan Speed Damper Positions

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

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

Set Up the MEDIUM Fan Speed Damper Position

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

Set Up the HIGH Fan Speed Damper Positions

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

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

RTVM modules for light commercial units are different than RTVM modules for large commercial units and are not interchangeable.

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

Communicated BAS set points override any local potentiometer setting.

Dehumidification

Hot Gas Reheat 3 to 25 Tons

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

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

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

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

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

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

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

Sequence of Operation

Single Compressor Units

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

Dual Compressor Units

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

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

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

Refer to appropriate unit wiring diagrams for control connections.

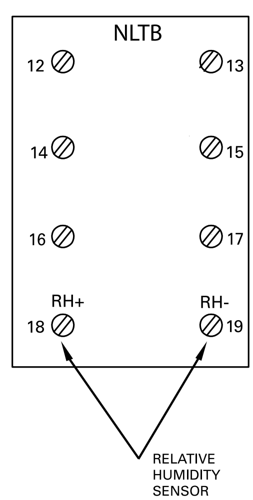
For reliability reasons, a purge time function was added to ensure that adequate oil is being returned to the compressor.

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

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

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

Figure 94. Relative humidity sensor locations



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 100. Verification of humidity setpoint

Setpoint (%)	Voltage (vdc)
40	0
41	0.238
42	0.455
43	0.652
44	0.833
45	1
46	1.15
47	1.3
48	1.43
49	1.55
50	1.67
51	1.77
52	1.88
53	1.97
54	2.06
55	2.14
56	2.22
57	2.3
58	2.37
59	2.44
60	2.5

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

4mA = 0%

20mA = 100%

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

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

Table 101. Humidity sensor measurements

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

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

- Active unit mode = Off with zone sensor
- Humidistat active OPEN from humidity stat
- Active humidity < Active humidity set point –5%
- Outdoor air temperature < 40° F or Invalid or > 100°F and 1 compressor
- Compressor 1 (or 2 for multi-compressor units) Auto or manual reset lockout
- Active call for heating
- Slave mode is active and requesting the supply fan off.
- Dehumidification setpoint is set to 0% (Tracer® Override)
- If using a zone sensor and unit mode is set to manual/heat and active zone temp > or equal to active zone cool setpoint
- If using a zone sensor and unit mode is set to manual/cool and active zone temp < active zone heat setpoint + 0.5° F.

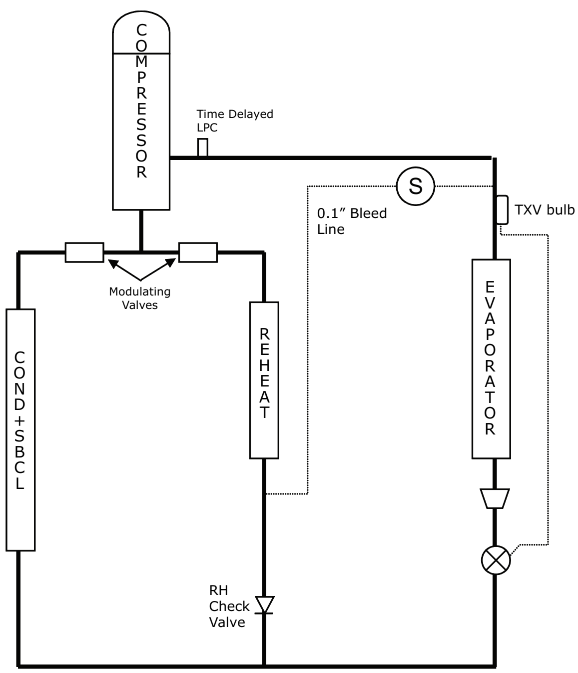
Modulating Dehumidification with Hot Gas Reheat (27.5 to 50 Tons)

Controls Overview

- Reheat LPC (RTDM input)
- Manual lockout after four trips.
- Additional 60# low pressure cutout ignored for the first 10 minutes of compressor run time in reheat mode.
- Will also be active during service test.
- Two modulating valves are controlled by the leaving unit temperature sensor
- Cooling mode: Cooling valve 100% open, Reheat valve 0% open.
- Reheat mode: Cooling and reheat valves open/close inverse of each other. Reheat valve allowed to operate from 15 to 85% open.
- Reheat pump out solenoid
- Energized when in cooling mode. It is inactive in all other modes.
- A three minutes purge cycle will take place after one continuous hour (hard coded) of operation in reheat or cooling mode.
- Entering evaporator temperature (overrides Frostat™ during reheat)
- During reheat operation if the temp is below 35° F for 10 minutes the control will shed compressors (or circuits).
- The unit will not be allowed to stage up until leaving reheat.

- If the temp is below 35° F for 10 more continuous minutes all compressors will stage off and the ID fan will continue to run.
- Once reaching 45° F the compressor (circuit) will be re-enabled.
- The condenser fans will be staged differently in reheat mode than cooling mode.
- Single circuit units (3 total condenser fans): A maximum of 2 outdoor fans above 85°F and a maximum of 1 outdoor fan below 80°F.
- Dual circuit units (4 total condenser fans): A maximum of 4 outdoor fans above 85°F and a maximum of 2 outdoor fans below 80°F.
- Service mode operation
- Reheat step will follow the last cooling step in service test mode.
- All compressors energized.
- Reheat/cooling modulating valve positions are 50%.
- Pump out solenoid de-energized.
- 60 minute service test interval timer will be in control.

Figure 95. Voyager™ Commercial modulating hot gas reheat



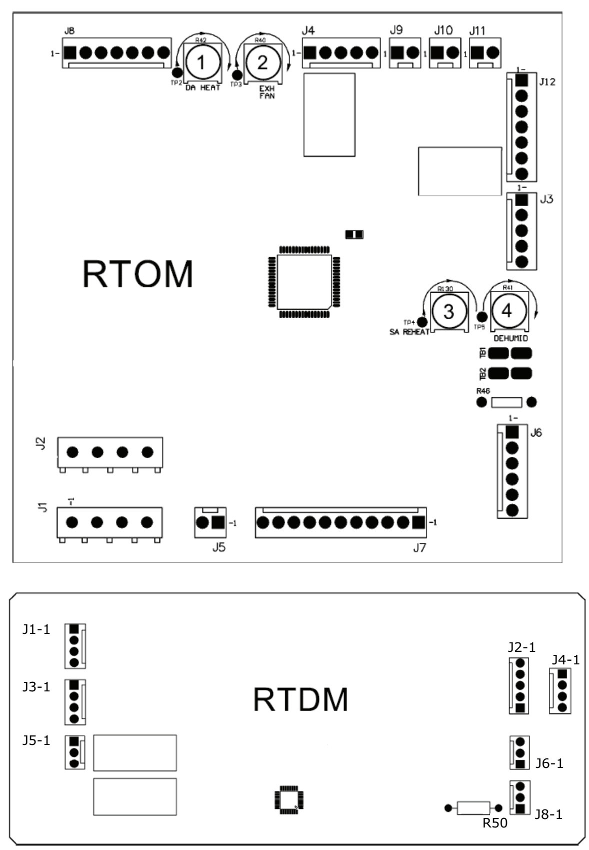
- RTRM handles the main dehumidification logic.
- RTOM contains the humidity and supply air set point.
- RTDM (new module) handles the reheat/cooling valve and pump out relay control.

- Customer adjustable set points
- Supply air reheat set point located on RTOM (65-80°F default 70°F)
- Dehumidification (humidity) set point located on RTOM (40-65% default 50%)
- VAV dehumidification override zone cooling and heating setpoints (75°F cooling, 68°F heating). A customer can adjust them if a CV remote zone sensor is connected to the RTRM or by using resistors.

Figure 96. Modulating hot gas reheat control boards

SETPOINT LEGEND

1. Discharge Air Heat SP
   - 50-150° F
2. Exhaust Fan Enable SP
   - 0 to 100%
3. Supply Air Reheat SP
   - 65-80° F
4. Dehumidification SP (%)
   - 40 to 65% RH

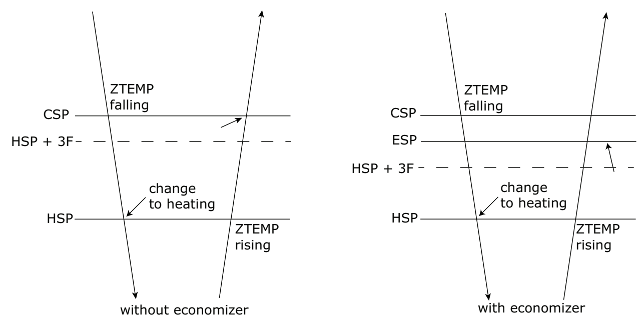


Heating/Cooling Changeover

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

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

Figure 97. Heating/cooling changeover



Low Ambient Mechanical Cooling Operation (3 to 25 Ton Units)

Evaporator Defrost Control (EDC) Function

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

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

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

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

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

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

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

ReliaTel™ - Condenser Fan

Control Logic - 12.5 to 25 Tons

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

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

Sequence for eFlex™ Units

The same signal from the VSM that controls the compressor speed also controls the speed of the condenser fans. The condenser fan speed is determined by the variable speed compressor speed and the outdoor air temperature.

Sequencing Control - 27.5 to 50 Tons

The condenser fans are cycled according to the outdoor air temperature and the number of cooling steps that are operating. 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 98, p. 152 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.

Figure 98. Condenser fan location

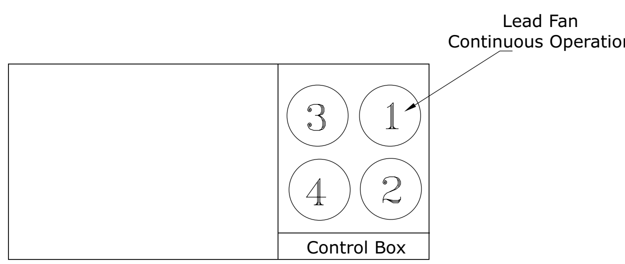


Table 102. Condenser fan/compressor sequence - standard efficiency

Unit Size (Ton)	Compressor Staging Sequence			Condenser Fan Output		O/A Temp. (°F)
	Step 1	Step2	Step 3	Output A	Output B	Fans "Off"
27.5 - 30	CPR1[a]		NA	Fan #2		70
					Fan #3	90
		CPR1, 2		Fan #2		-10
					Fan #3	60
35	CPR1[a]		NA	Fan #2		65
					Fan #3	85
		CPR1, 2		Fan #2		-20
					Fan #3	55
40	CPR1[b]			Fan #2		50
					Fan #3, 4	70
		CPR2[c]		Fan #2		20
					Fan #3, 4	60
			CPR1, 2	Fan #2		-30
					Fan #3, 4	50
50	CPR1[b]			Fan #2		20
					Fan #3, 4	60
		CPR2, 3[d]		Fan #2		-10
					Fan #3, 4	55
			CPR1, 2, 3	Fan #2		-30
					Fan #3, 4	50

Notes:

1. 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.
2. Conventional thermostat sequence: Y1=CPR1, Y2=CPR2 (40 CPR 2 & 50 CPR 2,3), Y1 + Y2 = CPR1,2 (40 CPR 1,2 & 50 CPR 1,2,3)
3. During active dehumidification all compressors will be staged "On". For units equipped with four condenser fans (40 and 50 Ton), the condenser fan output states will be controlled based on the O/A temperature. If O/A is above 85°F, all condenser fan outputs will be energized. If O/A falls below 80°F, Output B will de-energize and will not re-energize again until the O/A rises above 85°F. For units configured with three condenser fans (27.5 to 35 Ton), a maximum of two condenser fans will energize. Output A will energize above 85°F and de-energize when the O/A falls below 80°F; Output B will remain de-energized during active dehumidification. If O/A falls below 80°F, Output A will de-energize and will not re-energize again until O/A rises above 85°F.

(a) Single circuit, manifolded compressors pair.
(b) First Stage, Number one refrigeration circuit, Standalone compressor is "On".
(c) First Stage is "Off", Number two refrigeration circuit, standalone compressor is "On".
(d) First stage is "Off", Number two refrigeration circuit, manifolded compressor pair is "On" operating simultaneously.

Table 103. Condenser fan/compressor sequence - high efficiency

27.5-35 Ton High Efficiency									
Compressor Stage 1					Compressor Stage 2				
Fan #1	Fan #2	Fan #3	Ambient Range (F)	# Cond Fans On	Fan #1	Fan #2	Fan #3	Ambient Range (F)	# Cond Fans On
	OFF	OFF	0-70	1		OFF	OFF	0-58	1
	OFF	OFF	70-75	1 or 2		OFF	OFF	58-63	1 OR 2
ON	ON	OFF	75-80	2	ON	ON	OFF	63-70	2
	ON	OFF	80-85	2 or 3		ON	OFF	70-75	2 OR 3
	ON	ON	85-115	3		ON	ON	75-115	3
27.5-35 Ton High Efficiency									
Compressor Stages 3 or 4					Compressor Stage 5				
Fan #1	Fan #2	Fan #3	Ambient Range (F)	# Cond Fans On	Fan #1	Fan #2	Fan #3	Ambient Range (F)	# Cond Fans On
	OFF	OFF	0-60	1		OFF	OFF	0-50	1
	OFF	OFF	60-65	1 OR 2		OFF	OFF	50-55	1 OR 2
ON	ON	OFF	65-70	2	ON	ON	OFF	55-60	2
	ON	OFF	70-75	2 OR 3		ON	OFF	60-65	2 OR 3
	ON	ON	75-115	3		ON	ON	65-115	3
40 Ton High Eff. and Std Eff. CV									
Compressor Stages 1 & 2					Compressor Stages 3 & 4				
Fan #1	Fan #2	Fan #3 & 4	Ambient Range (F)	# Cond Fans On	Fan #1	Fan #2	Fan #3 & 4	Ambient Range (F)	# Cond Fans On
	OFF	OFF	0-65	1		OFF	OFF	0-40	1
	OFF	OFF	65-70	1 or 2		OFF	OFF	40-45	1 OR 2
ON	ON	OFF	70-80	2	ON	ON	OFF	45-75	2
	ON	OFF	80-85	2 or 4		ON	OFF	75-80	2 OR 4
	ON	ON	85-115	4		ON	ON	80-115	4
40 Ton High Eff. and Std Eff. CV					50 Ton High Eff. and Std Eff. CV				
Compressor Stage 5					Compressor Stages 1 & 2				
Fan #1	Fan #2	Fan #3 & 4	Ambient Range (F)	# Cond Fans On	Fan #1	Fan #2	Fan #3 & 4	Ambient Range (F)	# Cond Fans On
	OFF	OFF	0-40	1		OFF	OFF	0-60	1
	OFF	OFF	40-45	1 OR 2		OFF	OFF	60-65	1 or 2
ON	ON	OFF	45-65	2	ON	ON	OFF	65-75	2
	ON	OFF	65-70	2 OR 4		ON	OFF	75-80	2 or 4
	ON	ON	70-115	4		ON	ON	80-115	4
50 Ton High Eff. and Std Eff. CV									
Compressor Stages 3 & 4					Compressor Stage 5				
Fan #1	Fan #2	Fan #3 & 4	Ambient Range (F)	# Cond Fans On	Fan #1	Fan #2	Fan #3 & 4	Ambient Range (F)	# Cond Fans On
	OFF	OFF	0-35	1		OFF	OFF	0-35	1
	OFF	OFF	35-40	1 OR 2		OFF	OFF	35-40	1 OR 2
ON	ON	OFF	40-70	2	ON	ON	OFF	40-60	2
	ON	OFF	70-75	2 OR 4		ON	OFF	60-65	2 OR 4
	ON	ON	75-115	4		ON	ON	65-115	4

Notes:

1. Condenser fan will de-energize at 5ºF below the energizing temperature
2. Compressor Stage 1 = CPR1
3. Compressor Stage 2 = CPR2 or CPR3 depending on staging sequence
4. Compressor Stage 3 = CPR1 & CPR2 or CPR2 & CPR3 depending on staging sequence
5. Compressor Stage 4 = CPR2 & CPR3
6. Compressor Stage 5 = CPR1 & CPR2 & CPR3
7. Conventional three stage thermostat sequence: Y1=CPR1 (Stage 1), Y2=CPR1&2 (Stage 3), Y1 + Y2 = CPR1,2,3 (Stage 5)
8. During active hot gas reheat all compressors will be staged "On". For units equipped with four condenser fans (40 and 50 Ton), the condenser fan output states will be controlled based on the O/A temperature. If O/A is above 85°F, all condenser fan outputs will be energized. If O/A falls below 80°F, Output B will de-energize and will not re-energize again until the O/A rises above 85°F. For units configured with three condenser fans (27.5 to 35 Ton), a maximum of two condenser fans will energize. Output A will energize above 85° F and de-energize when the O/A falls below 80°F; Output B will remain de-energized during active hot gas reheat. If O/A falls below 80°F, Output A will de-energize and will not re-energize again until O/A rises above 85°F.

Independent Circuit Heat Pump - Odyssey™

For Odyssey™ independent heat pump units, the outdoor fan B output will be energized whenever compressor circuit 1 is energized. The outdoor fan A output will be energized whenever compressor circuit 2 is energized. These statements hold true for active heating and cooling modes except during active defrost.

Phase Monitor

ReliaTel™ 3 to 25 Tons

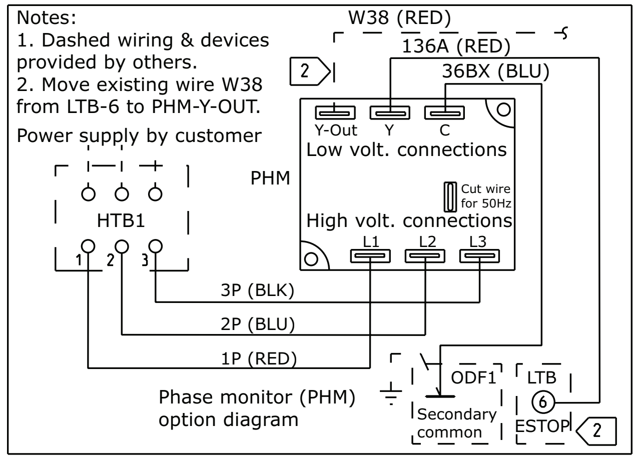
Phase monitors are installed on all 3 to 25 ton products with three-phase power. The main purpose of the phase monitor is to ensure that the scroll compressors are rotating in the proper direction. A green LED on the phase monitor indicates proper phasing.

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

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

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

Figure 99. Phase monitor wiring diagram



Circuits

Snubber Circuits

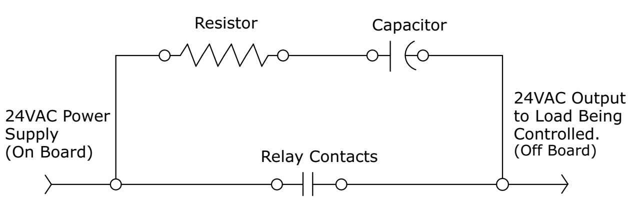
Note: *Obsolete - Not Available to Order.*

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 100. Snubber circuits



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

For RTRM version 8.0 + the timing has been revised and is still dependent on outdoor ambient temperature. If the outdoor temperature is less than 40ºF the LPC bypass delay will be set to 60 seconds. When the outdoor temperature is between 40 to 49.9°F the delay will be set to 30 seconds. For all outdoor temperatures 50°F and above, there will be no delay in setting a LPC. These delays will apply to all units.

LPC Sequence of Operation

On a call for cooling, there is an LPC bypass delay period (depending on OA Temp) where the LPC switch is ignored. If there is a low charge condition or low pressure condition due to extreme cold ambient conditions, the unit is allowed to run for the delay period to build up pressure.

If the switch is closed after the LPC bypass delay time, the compressor will continue to run. If the switch is open, the compressor will shut down immediately. After three minutes, if there is still an active call for cooling, the unit will once again start. If the switch is still open after the initial LPC bypass delay time, the compressor will again shutdown. The unit will try to start four times. If the switch is still open after the fourth try, the unit will shut down and be locked out, and will require a manual reset to start the unit again.

If the switch is closed and the compressor continues to run for three minutes, the counter is reset and the logic sequence starts over.

If the call for cooling goes away at any time during the routine, the counter is reset and the logic sequence starts over.

Note: *If the unit is configured as a heat pump and is actively heating with the outdoor ambient temperature at or below 0ºF, or the unit is in an active defrost mode, the LPC inputs will be ignored.*

LPC Operation for 27.5 to 50 Ton Units with Modulating Reheat

Units configured with modulating dehumidification will control compressors in regards to the compressor 1 and 2 disable inputs slightly different than traditional units and will also include an extra LPC switch connected to the RTDM. The following describes the implementation of this function for these units:

- RTRM compressor 1 disable input will function as today's units function.
- If active on a dual circuit unit, only circuit 1 will de-energize after the appropriate delays during active cooling. Both circuits will de-energize during active reheat (circuit 2 after its minimum on timer expires).

- If active on a single circuit dual compressor unit, compressor 1 and compressor 2 will de-energize after the appropriate delays during active cooling and active reheat.
- RTRM compressor 2 disable input will function as follows:
- If active on a dual circuit unit, only circuit 2 will de-energize during active cooling. Both circuits will de-energize after the appropriate delays during active reheat (circuit 1 after its minimum on timer expires).
- If active on a single circuit dual compressor unit, only compressor 2 will de-energize during active cooling and active reheat. Reheat will not be disabled in the case of the compressor 2 disable input going OPEN on these units. This is to ensure that a customer who chooses to utilize the demand limit (load shedding) capabilities of the compressor 2 disable input will still have some reheat functionality. The LPC lockout incremental counter will not increment if this input goes active since it is not actually in the refrigeration system.
- RTDM low pressure cutout input:

  The RTDM low pressure cutout input will be ignored for the first 10 minutes of compressor run time on the reheat circuit (or compressor 1 if on a single circuit, dual compressor unit). Once active (OPEN), the associated circuit/output will de-energize and not be allowed to re-energize until the 3 minute off timer is expired and the input has cleared. If the reheat LPC trips 4 times in any mode after the circuit has been energized for 10 minutes, dehumidification will be disabled (all compressors off) and the reheat circuit will be locked out.

  Note: *For dual circuit units, a lockout on the reheat circuit will not disable cooling for the opposite circuit.*

  The reheat LPC input will function in addition to the normal LPC input(s) located on the RTRM. For units with modulating reheat, the RTRM LPC for the reheat circuit will cause the unit to de-energize the appropriate circuit(s) and the total LPC count will be incremental. For these units, a total of 4 LPC events on the reheat circuit (any combination from the RTRM or the RTDM reheat circuit LPC inputs) will cause the unit to lock out the appropriate circuit(s). For dual circuit units, the RTRM LPC input for circuit 2 will function as on normal, non-reheat units. See below for unit configuration specific details:
- For Voyager™ Commercial dual circuit units if the RTDM low pressure cutout input goes active (OPEN) after the reheat circuit has been active for 10 minutes, the reheat circuit (compressor 2 output) will de-energize along with circuit 1 (after its minimum on time) during active reheat. For dual circuit units, if the unit is in active cool mode, the non-reheat circuit will remain energized if the reheat LPC goes active. Once this input clears, the unit will allow dehumidification and cooling as necessary to meet demands and the inactive circuit (s) will be allowed to re-energize after the 3 minute minimum off timer expires if necessary.
- For Voyager™ Commercial single circuit (dual compressor) units if the RTDM low pressure cutout input goes active after 10 minutes of run time on compressor 1, both compressors will de-energize during active reheat or active cooling. Once this input clears, the unit will allow dehumidification and cooling as necessary to meet demands and the inactive circuit(s) will be allowed to re-energize after the 3 minute minimum off timer expires if necessary.

  There is no requirement to differentiate between the RTRM LPC inputs and the RTDM LPC input for BAS/Network systems. If the unit has either the RTRM LPC input go active for the reheat circuit or the RTDM LPC input go active, the control should just report an LPC event for that circuit, regardless of which input is reflecting the condition. Also, the counter for RTDM LPC events will not be reset unless power is cycled to the unit controller independent of how much time has passed since the last RTDM LPC event.

  Note: *This function will also be active during service test.*

HPC Logic

High pressure cutout (HPC) is similar to the LPC in that the unit may be given up to four tries to operate. Like the LPC, the HPC provides reliability protection for compressors, but it is also used for safety protection due to the high operating pressures that the unit may see.

Note: *At no time should the HPC be removed or disabled in order to maintain unit operation.*

HPC Sequence of Operation

On a call for cooling, if the HPC switch is closed, the compressor will be allowed to start. If at any time the HPC opens, the unit will shut down immediately. After a 15 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 15 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.

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.

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 101. Transformer chart

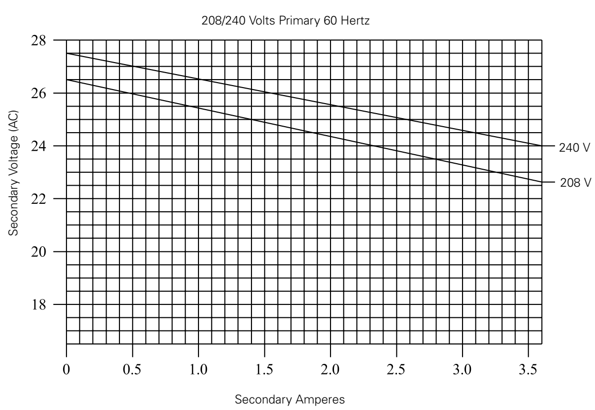
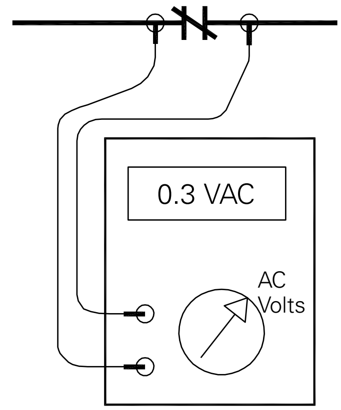


Figure 102. Transformer troubleshooting



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.

General

Novar control units use a hybrid ReliaTel™ Novar control scheme. The ReliaTel™ system is controlled using the RTRM thermostat inputs connected to a Novar electronic thermostat controller that serves as a master unit controller and BAS network communication device.

In addition to basic thermostat operation control, a Novar unit includes some additional relay connections that provide master control of economizer operation.

Cooling with an Economizer

On a Novar controlled system the master controller initiates control requests to the RTRM through its indoor fan, cool, and heat command outputs and the RTRM thermostat inputs.

The economizer control actuator **(ECA)** is wired to a **Damper** relay and a **Night mode** damper relay as described in the economizer set-up section. To enter an economizer-cooling only mode, the master controller will energize its **Fan** (G) output activating the supply fan and close the contacts on the **Damper** relay allowing a valid signal from the mixed air sensor.

The unit will then modulate the outdoor air damper open if the mixed air sensor reading is high compared to the mixed air setpoint of 53° F. If the damper relay is not energized when the supply fan is on the ECA will maintain the outdoor air damper at default minimum position.

When the Novar controller senses conditions that require additional cooling greater than that provided from economizing, it will energize its **Cool 1** (Y1) output calling for compressor operation.

If additional cooling is required above that provided by the first stage of compressors the second stage will be activated by energizing the **Cool 2** (Y2) output.

Compressors will respond to these calls independent of the position or status of the economizer, but they will continue to adhere to minimum on, off, and inter-stage timing.

Note: *When compressors are activated and the indoor coil begins to cool down the temperature of the mixed air sensor may drop below the mixed air setpoint causing the ECA to close the outdoor air damper to minimum position.*

Cooling without an Economizer

The Novar controller uses its zone temperature input and setpoint input to determine when to initiate requests for compressors or heat. Calls for cooling are interpreted by the ReliaTel™ controller as thermostat requests. When the zone temperature is sufficiently greater than the setpoint, the Novar will energize its **Cool 1** (Y1) output to turn compressors on. It will also close the contacts on its **Fan** (G) output to call for the supply fan to turn on.

The first compressor will energize after its minimum 3-minute off time has expired. If additional cooling capacity is required above that provided by the first stage the second stage of compressors will be activated by energizing the **Cool 2** (Y2) output.

Once the zone temperature falls below the setpoint sufficiently the compressor and fan outputs on the Novar controller will be deactivated and the RTRM will respond appropriately and deactivate its respective outputs. As with normal thermostat control the Supply Fan will remain on for a period of 60 seconds after the compressor output is de-energized for free cooling.

Economizer Set-up

The economizer function on a Novar controlled unit is controlled more directly than in normal operation. The economizer is wired with additional inputs from the Novar controller to provide this control:

Manual Enthalpy Override

The economizer control actuator (ECA) is configured for Novar operation by placing a 100K resistor across the normally unused outdoor air temp input on the ECA. This signals the economizer to enter manual enthalpy override which enables economizer cooling operation at all times regardless of outdoor or indoor conditions.

Damper Relay

A relay output on the Novar controller is that signals a relay placed in-line with the mixed air temperature sensor. It is used to interrupt the mixed air sensor signal to the ECA indicating when to modulate for economizing or to go to minimum position. If an open is detected on the mixed air temperature input the ECA will hold the damper at minimum position.

Night Mode Damper Relay

A relay on the Novar controller is connected across the remote minimum position potentiometer inputs (P and

P1) on the ECA. When the relay contacts are closed for night mode operation the ECA uses a default damper minimum position of 0%. When they are not closed it uses the standard minimum position adjustment on the ECA as default.

[Gas/Electric] Heating

The Novar controller uses its zone temperature input and setpoint input to determine when to initiate requests for compressors or heat. Calls for heating are interpreted by the ReliaTel™ controller as thermostat requests. When the zone temperature is sufficiently lower than the setpoint the Novar will energize its **Heat 1** (W1) output to turn the first stage of heat on. It will also close the contacts on its Fan (G) output to call for the supply fan to turn on.

The first stage of [Gas/Electric] heat will energize. If additional heating capacity is required above that provided by the first stage the second stage of [Gas/Electric] will be activated by energizing the **Heat 2** (W2) output.

Once the zone temperature rises above the setpoint sufficiently the heat and fan outputs on the Novar controller will be deactivated and the RTRM will respond appropriately and deactivate its respective outputs.

On gas heat units the supply fan will remain on for a period of 90 seconds after heat is deactivated for free heating and heat exchanger cool down.

Novar Controls Checkout/ Troubleshooting Procedure

General

The Novar electronic thermostat module (ETM) includes an installation manual that describes the basic connections and checkout of the Novar controller. This manual should be consulted during installation, checkout, or troubleshooting.

If problems are encountered with unit operation after consulting the Novar ETM installation manual, the following checkout procedures may help to determine and isolate the cause of the problem.

Checkout Procedure

1. If the Novar controller is connected to the BAS network, check for any failure messages related to the controller in question. Take appropriate actions if messages exist.
2. Verify proper power connection and that it is connected to a 24VAC source with at least a 10VA consumption rating.
3. Apply power to the unit.
4. Verify all installed boards are energized by checking the status LED's on each. On the Novar board the Status LED will either be OFF if in Scheduled On mode and blink ON when network communications are exchanged, or be ON steady and blink OFF during communications if in scheduled ON mode. The status lights on the main ReliaTel™ control modules will be on steady if the boards are powered up and properly communicating on the inter-module bus.
5. Check the 1-amp fuse on the Novar ETM (located next to the night mode output relay) for integrity.
6. Verify all inputs are connected according to the ETM installation instructions.
7. Other than economizer connection verification, for all jumper locations and short connections refer to the ETM.
8. Apply a short across the jumper tabs on the fan output relay on the ETM. Verify the supply fan energizes within a few seconds. Remove the short. The supply fan should turn off within a few seconds. If the supply fan does not energize, verify proper connection of the Fan output relay to the RTRM thermostat-G input and verify the supply fan relay on the RTRM is properly connected.
9. To completely check economizer (if installed) operation, the conditions at the mixed air temperature sensor must be at least 55° F or warmer. The mixed air temp sensor is located downstream of the indoor coil so this test should be performed in the absence of active compressor operation. This would produce sub-cooled air across the mixed air sensor that would prevent the economizer from opening. Mixed air sensor resistance should be less than 20K.
10. To verify proper economizer operation, place a short across the jumper tabs on the fan output relay and the night mode output relay. Ensure that the 100K resistor is in place on the Outdoor Air Temp (OAT) input on the economizer module. Verify the supply fan energizes and the outdoor air damper opens to the minimum position set by the on-board economizer module potentiometer.

    Once the damper reaches minimum position apply a short across the night mode output relay. The damper should close completely. Disconnect the short and verify the damper opens back to minimum position.
11. If the outdoor air damper does not actuate as described above, verify proper operation and connection of the economizer actuator as described in the ReliaTel™ controls installation guide. Also verify proper connection between the night mode damper relay and the P and P1 connections.
12. To continue the economizer operation check, place a short across the jumper tabs on the damper output relay. If conditions are warm enough at the mixed air sensor the economizer actuator should begin opening the damper toward fully open.

The travel time is dependent on the temperature of the air flowing across the sensor. If the mixed air sensor temperature falls below the 53° F economizer setpoint the damper will stop opening and begin to close back to minimum position.

13. If incoming air conditions are warmer than the setpoint and the damper is not opening, check the damper relay connection in the mixed air sensor circuit and verify the proper sensor and sensor wiring. Also measure the 100K resistor and verify correctness and that it is connected to the proper input.
14. To check out compressor operation from the Novar ETM connect a short across the jumper tabs on the cool 1 output relay. Verify that the 1st stage of compressors activates within 3 minutes. Each stage of compressors will be forced off for a minimum of 3 minutes at power up and after a period of operation.

    Be aware that the compressor will remain on for a minimum of 3 minutes even if the short is removed. To immediately discontinue compressor operation disconnect unit power. Verify that the unit is producing cool, conditioned air.

    Keep in mind that the outdoor air damper will close to minimum position when the discharge air cools below the economizer setpoint.
15. If compressors do not activate within 3 minutes of placing the short verify the cool 1 relay output is properly connected to the thermostat-Y1 input on the RTRM and that compressor circuit 1 is properly connected according to the ReliaTel™ installation guide. Verify the compressor(s) has properly connected line power and that all in-line safety limits and contactors are functioning correctly.
16. Follow the same procedure as above to check proper operation of the 2nd stage of compressors by placing a short across the cool 2 output relay. Keep in mind that the cool 1 and cool 2 thermostat controls operate independently of each other and must adhere to a 3-minute delay between stage additions.

    If problems are encountered complete the checks above except verify proper connection between the cool 2 output relay and the RTRM thermostat-Y2 input.
17. After verifying proper operation of both refrigeration circuits remove all shorts. Compressors should deactivate immediately if they have been running for at least 3 minutes. The supply fan will remain on for 60 seconds, and the outdoor damper will close after the supply fan shuts off.
18. For heating checks (if installed) place a short across the jumper tabs on the heat 1 output relay. If the unit is a gas heat unit the gas modules will begin the approximately 45 seconds cycle initiation. The supply fan will remain off until the gas heat has successfully initiated and operated for approximately 60 seconds.

    If the unit is an electric heat unit the 1st stage of electric heat will be energized and the supply fan will come on immediately. The unit should be discharging warm air.
19. If heat does not activate after placing the short, verify proper connection of the heat 1 output relay to the RTRM thermostat-W1 input. Verify proper ReliaTel™ module heater connections and function using the ReliaTel™ installation guide.
20. To activate the second stage of heat (if applicable) place a short across the jumper tabs on the heat 2 output relay. A similar process as described with the 1st stage of heat will take place. Verify, if possible, the 2nd stage of heat activates.

    If the 2nd stage of heat does not activate, verify proper connection of the heat 2 output relay to the RTRM thermostat-W2 and verify proper ReliaTel™ heat module output connections. Also verify line power connections to the heating units.
21. If heat operation is correct, disconnect all shorts from the jumper tabs on the relays. All heat will deactivate within a few seconds. Supply fan will deactivate when electric heat deactivates or 90 seconds after gas heat deactivates.

Constant Volume (CV) and Variable Air Volume (VAV)

Constant Volume (CV)

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.

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 sections contain 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 for your unit.

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).

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 to 50 ton units regardless of configuration (VAV, CV). The unit is configured by wire harness inputs. See the unit wiring diagram for details.*

RTOM - ReliaTel™ Options Module - (Standard)

This module has inputs for the following:

- Ventilation override (LTB4)
- Frostat™ input
- Clogged filter switch (optional)
- Discharge air sensor (optional on CV, standard on VAV)

Note: *Discharge air sensor required with CCP/ICS*

RTAM - ReliaTel™ Air Handler Module - (Standard on VAV)

This module contains the VAV setpoint potentiometers as well as the following inputs and outputs:

- DIP switch inputs for supply air reset, daytime warm-up enable, and IGV/VFD configuration.
- Supply pressure transducer input inlet guide vane (IGV) or variable frequency drive (VFD) output.
- Ventilation heat relay (VHR) output.

ECA - Economizer Actuator - (Optional)

If the unit has an economizer this module is present. It is screwed to the top of the economizer actuator motor in the economizer section of the unit. The ECA has the following inputs and outputs:

- Mixed air sensor - this sensor is located in the supply air section of the unit.
- Return air sensor (optional) - This sensor is used when the unit has comparative enthalpy.
- Return humidity sensor (optional) - this sensor is used when the unit has comparative enthalpy.
- Outdoor humidity sensor (optional) - this sensor is used when the unit has reference enthalpy or comparative enthalpy.
- Exhaust fan relay output.

- CO_2 sensor input (optional).
- Remote minimum position potentiometer (optional).

TCI - Trane® Communication Interface - (Optional)

Input and output for communication to Tracer® Summit (COMM4) or CCP (COMM4).

Note: *ReliaTel™ TCI does support communication from earlier versions of Tracker®, Tracer® 100 or ComforTrac™.*

LCI - LonTalk® Communication Interface (optional)

Input and output for LON communication with Tracer® Summit, Tracker® Version 10+, or 3rd party LonTalk® building management systems.

IGN - Ignition Control Module (YC* only)

This module has the following inputs and outputs:

- TCO 1, TCO 2, TCO 3 input (limit switches)
- Hot Surface Ignitor output / flame sensor input
- Combustion blower motor output
- Gas valve output

Configuration Input

Note: *The unit is hard wired with specific inputs as indicated below. These inputs cause the unit to respond with the appropriate outputs. Configuration inputs are only recognized at unit power-up.*

Where "GND" is indicated below, the input is connected to chassis ground. Where "JUMPER" is indicated below, both connection points are shown.

Unit Type	RTOM J3-5	RTRM J1-3,J1-5
Voyager™ Commercial	GND	
Voyager™ Light Commercial, Precedent™	Open	
Non Heat Pump		Jumper

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

SA Tempering (CV Units Only)	RTOMJ3-1,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 to 35 Tons	Open
40 to 50 Tons	GND

Lead/Lag	RTRM J3-8
Disabled	GND
Enabled	Open

Modulating Gas	RTOM J3-3
No Modulating Gas	Open
Modulating Gas	Ground

High Heat (2 Heat Exchangers)	IGN #2 J1-5
High Heat	Ground

Unit functions are determined by the inputs on RTRM J6 as follows. The possible inputs are shown in the top (horizontal) row. The functions available are shown in the vertical columns below each input.

Table 104. VAV default mode input

	No Inputs on RTRM J6	Jumper RTRM J6-2&4	BAYSENS077* w/ RTRM J6-2&4 Jumper	BAYSENS021* or BAYSENS077* w/ 7.68k resistor between RTRM J6-2&4	BAYSENS020* or ICS™ system (Tracer® Summit)
Occupied Cooling	No	Yes	Yes	Yes	Yes
Daytime Warm-up	No	No	Yes	Yes	Yes
Morning Warm-up	No	No	Yes	Yes	Yes
Indoor Blower (occupied mode)	Off	On	On	On	On
Indoor Blower (unoccupied mode)	N/A	Off	Auto	Auto	Auto
Unoccupied Cooling	N/A	No	No	No	Yes
Unoccupied Heating	N/A	No	Yes	Yes	Yes
Short Across RTRM J6-11&12 creates an unoccupied mode (Night setback)	No	No	Yes	Yes	N/A

Note: * Means 'B' or 'C'

Supply Duct Static Pressure Control

The supply duct static pressure is measured by using a 0 to 5VDC transducer. The transducer is mounted on the supply fan bulkhead on the motor side of the supply fan section. The transducer is comparing the supply duct pressure (actually the pressure of the heat section of the unit) to outdoor air pressure. The high port of the transducer is connected to the static pressure sensing cover plate located on the supply fan bulkhead. The low port of the transducer is connected to a tubing connector on a vertical support of the unit and is field-connected to the outside air pressure sensor as pictured below. The transducer is wired to the RTAM and the decision to modulate the IGV or VFD is made at the RTRM.

Modes of Operation

Setpoints are provided by using the potentiometers on the RTAM, through remote potentiometers, or through ICS. The setpoint range is 0.3" WC to 2.5" WC. The deadband range is 0.2" WC to 1.0" WC.

The control band is the setpoint plus or minus .5 of the deadband.

For example:

Setpoint 1.5"

Deadband 0.4"

The IGV or VFD output will increase if the supply pressure goes below 1.3".

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

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

DIP switch settings for this function are as follows:

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

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

Figure 103. Supply duct static pressure control

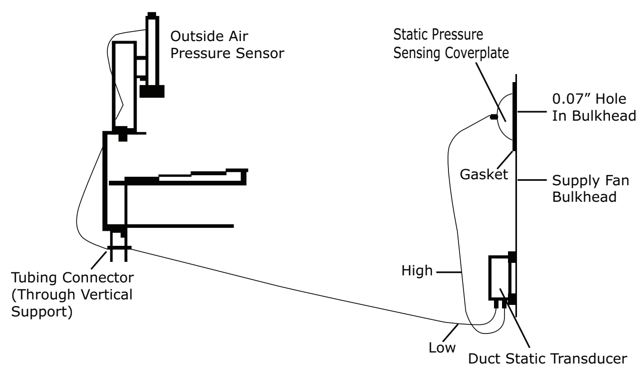
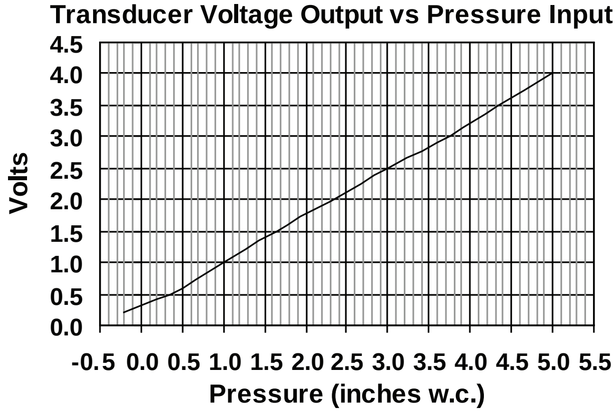


Figure 104. Transducer voltage output vs. pressure

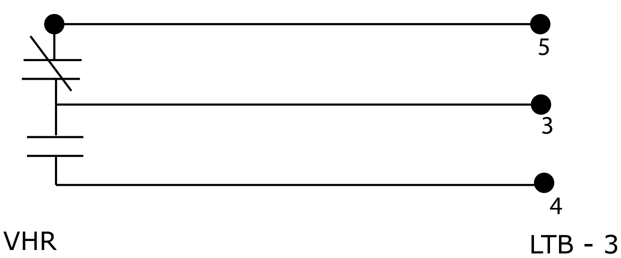


The transducer has a 0 to 5VDC range with a 0.25 to 2.125 VDC valid output range. The output is proportional. The chart illustrates the measured output voltage at typical supply duct pressures.

VHR Relay

When the unit transitions from occupied mode to morning warm-up, daytime warm-up or unoccupied mode, the VHR relay is energized, as long as the unit has a valid zone temperature input at RTRM J6 1&2, or through a BAYSENS020* zone sensor.

Figure 105. VHR relay



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.

- When RTAM DIP SW1-1 is on, the output voltage range is approximately 0 to 10.5VDC.
- When RTAM DIP SW1-1 is off, the output voltage range is approximately 2.5 to 8.5VDC.
- IGV: When the supply fan is on and the output is 0%, the IGV are closed.
- VFD: When the supply fan is on and the output is 0%, the VFD runs at 35hz.
- 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.
- 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.
- During the heating modes; Daytime Warm-up, Morning Warm-up, and Unoccupied, the IGV or VFD output is always 100%.

Troubleshooting Tips

If the transducer output voltages do not seem right, connect a 0-5" manometer in parallel with the transducer. This way you can see the same pressure the transducer is seeing. Many transducers get replaced in error when the real culprit is a loose tube or clogged fitting.

The polyethylene tubing in the transducer circuit does not readily go back to its original shape after use. Therefore, if a tube is removed from a fitting it should be cut back to a fresh end prior to reattaching.

Measure the transducer output voltage at RTAM terminal J1-3 to chassis ground.

When the supply fan is off, the transducer output voltage should be approximately 0.25VDC. If the voltage output is high or low, unplug the transducer tubing to see if the voltage increases or decreases. If it does, a tube is probably clogged.

The input voltage to the transducer is measured between RTAM J1-4 and chassis ground. It should be 5VDC. If it is low, unplug the transducer and measure the voltage again. If OK now, the transducer or transducer wiring is shorted to common or ground.

The outdoor air pressure sensor must be mounted as shown in Figure 103, p. 166. 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 103, p. 166. Some applications with extreme winds could require mounting the sensor in an area less affected by wind.

BAYSENS021* Setpoint Input

This chart lists setpoint /voltage/resistance for the VAV supply air cooling setpoint on the RTRM module. The chart can be used for troubleshooting units that have a remote setpoint at this input.

The typical remote setpoint input device is a BAYSENS021* zone sensor.

The connection points are RTRM J6-2 and RTRM J6-3.

If a remote setpoint is used, clip jumper R69 on the RTAM module. If the jumper is not clipped, the unit will ignore the RTRM setpoint.

Note: *A remote setpoint can also be applied to the RTAM supply air cooling setpoint input. However, the RTAM inputs use different temperature/ resistance inputs. See VAV setpoint inputs for input values.*

Table 105. Supply air cooling setpoint

Supply Air Cooling Setpoint (°F)	Resistance (ohms)	DC Volts
40	1084	2.6
41	1065	2.58
42	1045	2.56
43	1026	2.53
44	1006	2.51
45	987	2.48
46	967	2.46
47	948	2.43
48	928	2.41
49	909	238
50	889	2.35
51	870	2.33
52	850	2.3
53	831	2.27
54	812	2.24
55	792	2.21
56	773	2.18
57	753	2.15
58	734	2.12
59	714	2.08
60	695	2.05
61	675	2.02
62	656	1.98
63	636	1.94
64	617	1.91
65	597	1.87
66	578	1.83
67	558	1.79
68	539	1.75
69	519	1.71
70	500	1.67
71	481	1.62
72	461	1.58
73	442	1.53
74	422	1.48
75	403	1.44
76	383	1.39

Table 105. Supply air cooling setpoint (continued)

Supply Air Cooling Setpoint (°F)	Resistance (ohms)	DC Volts
77	364	1.33
78	344	1.28
79	325	1.23
80	305	1.17

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 Table 105, p. 168.

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

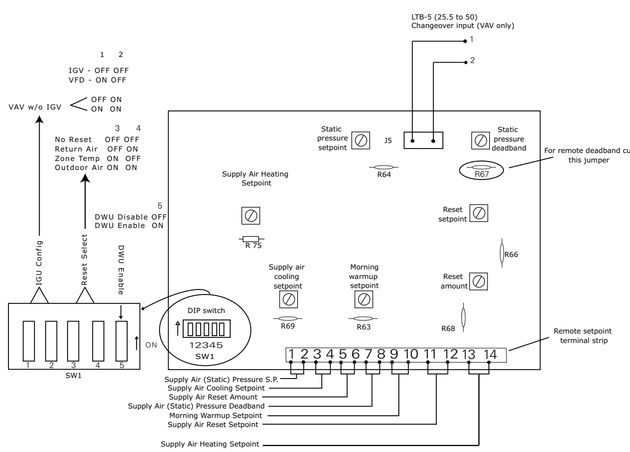
J7-7, 8 Supply air pressure Deadband

J7-9, 10 Morning warm-up setpoint

J7-11, 12 Supply air reset setpoint

J7-13, 14 Supply air heating setpoint

Figure 106. 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 J7-3, 4 (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°F +/- 2°F
- 5 minute changeover heat/cool input
- Changeover input required

Table 106. VAV setpoints

		Supply Air Pressure Setpoint	Supply Air Cooling Setpoint	Supply Air Reset Amount	Supply Air Pressure Deadband	Morning Warm-up Setpoint	Supply Air Reset Setpoint Outdoor	Supply Air Reset Setpoint Zone or Return Air	RTAM Supply Air Heat Setpoint
		J7-1,2	J7-3,4	J7-5,6	J7-7,8	J7-9,10	J7-11,12	J7-11,12	J7 - 13, 14
Resist-ance (Ohms)	DC Volts	WC	Deg F	Deg F	WC	Deg F	Deg F	Deg F	Deg F
0	0	0	40	0	0	50	0	50	40
10	0.05	0.02	40.27	0.13	0.01	50.27	0.67	50.27	40.7
20	0.1	0.05	40.81	0.4	0.02	50.81	20.02	50.81	42.2
30	0.15	0.08	41.29	0.65	0.03	51.29	3.23	51.29	43.6
40	0.19	0.11	41.23	0.91	0.05	51.23	4.57	51.83	45.1
50	0.24	0.14	42.31	1.16	0.06	52.31	5.78	52.31	46.4
60	0.28	0.17	42.79	1.4	0.07	52.79	6.99	52.79	47.8
70	0.33	0.2	43.28	1.64	0.08	53.28	8.19	53.28	49.1
80	0.37	0.24	43.76	1.88	0.09	53.76	9.4	53.76	50.4
90	0.41	0.27	44.24	2.12	0.11	54.24	10.61	54.24	51.8
100	0.45	0.3	44.73	2.36	0.12	54.73	11.82	54.73	53.1
110	0.5	0.32	45.16	2.58	0.13	55.16	12.89	55.16	54.3
120	0.54	0.35	45.59	2.79	0.14	55.59	13.97	55.59	55.5
130	0.58	0.38	46.02	3.01	0.15	56.02	15.04	56.02	56.7
140	0.61	0.4	46.45	3.22	0.16	56.45	16.12	56.45	57.9
150	0.65	0.43	46.88	3.44	0.17	56.88	17.19	56.88	59.1
160	0.69	0.46	47.31	3.65	0.18	57.31	18.26	57.31	60.3
170	0.73	0.48	47.68	3.84	0.19	57.68	19.2	57.68	61.3
180	0.76	0.51	48.11	4.06	0.2	58.11	20.28	58.11	62.5
190	0.8	0.53	48.49	4.24	0.21	58.49	21.22	58.49	63.6
200	0.83	0.55	48.86	4.43	0.22	58.86	22.16	58.86	64.6
210	0.87	0.58	49.24	4.62	0.23	59.24	23.1	59.24	65.7
220	0.9	0.6	49.62	4.81	0.24	59.62	24.04	59.62	66.7
230	0.93	0.62	49.99	5	0.25	59.99	24.98	59.99	67.8
240	0.97	0.65	50.37	5.18	0.26	60.37	25.92	60.37	68.8
250	1	0.67	50.69	5.34	0.27	60.69	26.72	60.69	69.7
260	1.03	0.7	51.26	5.63	0.28	61.26	28.14	61.26	71.3
270	1.06	0.73	51.74	5.87	0.29	61.74	29.35	61.74	72.6
280	1.09	0.77	52.3	6.15	0.31	62.3	30.76	62.3	74.2
290	1.12	0.8	52.79	6.39	0.32	62.79	31.97	62.79	75.5
300	1.15	0.83	53.27	6.63	0.33	63.27	33.17	63.27	76.9
310	1.18	0.86	53.75	6.88	0.34	63.75	34.38	63.75	78.2
320	1.21	0.89	54.24	7.12	0.36	64.24	35.59	64.24	79.5
330	1.24	0.92	54.72	7.36	0.37	64.72	36.8	64.72	80.9
340	1.27	0.95	55.12	7.56	0.38	65.12	37.81	65.12	82
350	1.3	0.98	55.61	7.8	0.39	65.61	39.01	65.61	83.3
360	1.32	1.01	56.09	8.04	0.4	66.09	40.22	66.09	84.7
370	1.35	1.03	56.49	8.25	0.41	66.49	41.23	66.49	85.8
380	1.38	1.06	56.89	8.45	0.42	66.89	42.24	66.89	86.9
390	1.4	1.09	57.38	8.69	0.43	67.38	43.45	67.38	88.3
400	1.43	1.11	57.78	8.89	0.44	67.78	44.45	67.78	89.4

Table 106. VAV setpoints (continued)

		Supply Air Pressure Setpoint	Supply Air Cooling Setpoint	Supply Air Reset Amount	Supply Air Pressure Deadband	Morning Warm-up Setpoint	Supply Air Reset Setpoint Outdoor	Supply Air Reset Setpoint Zone or Return Air	RTAM Supply Air Heat Setpoint
		J7-1,2	J7-3,4	J7-5,6	J7-7,8	J7-9,10	J7-11,12	J7-11,12	J7 - 13, 14
Resist-ance (Ohms)	DC Volts	WC	Deg F	Deg F	WC	Deg F	Deg F	Deg F	Deg F
410	1.45	1.14	58.18	9.09	0.45	68.18	45.46	68.18	90.5
420	1.48	1.16	58.59	9.29	0.46	68.59	46.47	68.59	91.6
430	1.5	1.19	58.99	9.49	0.47	68.99	47.47	68.99	92.7
440	1.53	1.21	59.39	9.7	0.48	69.39	48.48	69.39	93.9
450	1.55	1.24	59.8	9.9	0.49	69.8	49.49	69.8	95
460	1.58	1.26	60.2	10.1	0.5	70.2	50.5	70.2	96.1
470	1.6	1.29	60.6	10.3	0.52	70.6	51.5	70.6	97.2
480	1.62	1.31	61	10.5	0.53	71	52.51	71	98.3
490	1.64	1.33	61.33	10.66	0.53	71.33	53.32	71.33	99.2
500	1.67	1.36	61.73	10.86	0.54	71.73	54.32	71.73	100.4
510	1.69	1.39	62.25	11.12	0.56	72.25	55.62	72.25	101.8
520	1.71	1.43	62.81	11.41	0.57	72.81	57.03	72.81	103.4
530	1.73	1.45	63.26	11.63	0.58	73.26	58.16	73.26	104.6
540	1.75	1.49	63.83	11.91	0.6	73.83	59.57	73.83	106.2
550	1.77	1.52	64.28	12.14	0.61	74.28	60.7	74.28	107.4
560	1.79	1.55	64.73	12.36	0.62	74.73	61.82	74.73	108.7
570	1.82	1.57	65.18	12.59	0.63	75.18	62.95	75.18	109.9
580	1.84	1.6	65.63	12.82	0.64	75.63	64.08	75.63	111.2
590	1.86	1.63	66.08	13.04	0.65	76.08	65.21	76.08	112.5
600	1.88	1.67	66.65	13.32	0.67	76.65	66.62	76.65	114
610	1.89	1.69	66.99	13.49	0.67	76.99	67.46	76.99	115
620	1.91	1.71	67.44	13.72	0.69	77.44	68.59	77.44	116.2
630	1.93	1.74	67.89	13.94	0.7	77.89	69.72	77.89	117.5
640	1.95	1.77	68.34	14.17	0.71	78.34	70.85	78.34	118.7
650	1.97	1.8	68.79	14.4	0.72	78.79	71.98	78.79	120
660	1.99	1.83	69.24	14.62	0.73	79.24	73.1	79.24	121.2
670	2.01	1.85	69.58	14.79	0.74	79.58	73.95	79.58	122.2
680	2.02	1.88	70.03	15.02	0.75	80.03	75.08	80.03	123.4
690	2.04	1.91	70.48	15.24	0.76	80.48	76.21	80.48	124.7
700	2.06	1.93	70.82	15.41	0.77	80.82	77.05	80.82	125.6
710	2.08	1.95	71.27	15.64	0.78	81.27	78.18	81.27	126.9
720	2.09	1.98	71.61	15.81	0.79	81.61	79.03	81.61	127.8
730	2.11	2	72.06	16.03	0.8	82.06	80.15	82.06	129.1
740	2.13	2.02	72.4	16.2	0.81	82.4	81	82.4	130
750	2.14	2.05	72.74	16.37	0.82	82.74	81.85	82.74	130.9
760	2.16	2.08	73.29	16.65	0.83	83.29	83.23	83.29	132.5
770	2.18	2.11	73.75	16.87	0.84	83.75	84.36	83.75	133.7
780	2.19	2.14	74.2	17.1	0.85	84.2	85.49	84.2	135
790	2.21	2.17	74.65	17.32	0.87	84.65	86.62	84.65	136.2
800	2.22	2.2	75.25	17.62	0.88	85.25	88.12	85.25	137.9
810	2.24	2.23	75.7	17.85	0.89	85.7	89.25	85.7	139.2
820	2.25	2.26	76.15	18.08	0.9	86.15	90.38	86.15	140.4
830	2.27	2.29	76.6	18.3	0.92	86.6	91.51	86.6	141.7
840	2.28	2.32	77.05	18.53	0.93	87.05	92.63	87.05	142.9
850	2.3	2.34	77.5	18.75	0.94	87.5	93.76	87.5	144.2
860	2.31	2.37	77.96	18.98	0.95	87.96	94.89	87.96	145.4
870	2.33	2.4	78.41	19.2	0.96	88.41	96.02	88.41	146.7
880	2.34	2.43	78.86	19.43	0.97	88.86	97.15	88.86	147.9
890	2.35	2.46	79.31	19.65	0.98	89.31	98.27	89.31	149.2
900	2.37	2.49	79.76	19.88	0.99	89.76	99.4	89.76	150
910	2.38	2.5	80	20	1	90	100	90	150
920	2.4	2.5	80	20	1	90	100	90	150
930	2.41	2.5	80	20	1	90	100	90	150
940	2.42	2.5	80	20	1	90	100	90	150
950	2.44	2.5	80	20	1	90	100	90	150

Table 106. VAV setpoints (continued)

		Supply Air Pressure Setpoint	Supply Air Cooling Setpoint	Supply Air Reset Amount	Supply Air Pressure Deadband	Morning Warm-up Setpoint	Supply Air Reset Setpoint Outdoor	Supply Air Reset Setpoint Zone or Return Air	RTAM Supply Air Heat Setpoint
		J7-1,2	J7-3,4	J7-5,6	J7-7,8	J7-9,10	J7-11,12	J7-11,12	J7 - 13, 14
Resist-ance (Ohms)	DC Volts	WC	Deg F	Deg F	WC	Deg F	Deg F	Deg F	Deg F
960	2.45	2.5	80	20	1	90	100	90	150
970	2.46	2.5	80	20	1	90	100	90	150
980	2.47	2.5	80	20	1	90	100	90	150
990	2.49	2.5	80	20	1	90	100	90	150
1000	2.5	2.5	80	20	1	90	100	90	150

Notes:

1. Supply air pressure setpoint valid range is 0.3”-2.5”.
2. Supply air pressure deadband valid range is 0.2”-1”.

Outdoor Air Flow Compensation for MZVAV Units

3 to 50 Tons

When a VAV unit is modulating supply airflow, the pressure drop across the outdoor air damper changes. This usually means that the quantity of outside air will drop as the IGV closes or the VFD slows down. VAV units have a feature called outside air (OA) flow compensation to help maintain consistent OA flow regardless of supply airflow.

Note: *OA flow compensation mode is disabled if the unit has a CO_2 sensor, min position input from ICS, or remote min position input at LTB3-1 and LTB3-2. It is also overridden during all ventilation override modes. Also, the minimum position can only be adjusted from 0 to 50% damper position regardless of OA flow setpoints.*

Setup

Once set up, the OA damper position will increase as the IGV closes or VFD slows down. The 27K resistor with plug in KIT#PLU00970 provides a signal to the unit to enable this function. The resistor must be plugged to the "OAT" input (this is an otherwise unused input) on the economizer module (ECA) and power reset to the unit.

Operation for RTRM 7.0 and Earlier with RTEM or Any RTRM with Honeywell ECA

The potentiometers MIN POS and DCV SETPOINT (DCV UL setpoint if RTEM) must now each be set in order to control the OA damper position. The MIN POS setpoint determines the OA damper position (from 0 to 50%) when the IGV / VFD is at 100% regardless of DCV SETPOINT (DCV UL Setpoint).

Note: *This function is disabled if a building management system (ICS, Tracer®, LonTalk®) is providing a OA damper minimum position setpoint to the unit. This function is disabled if the unit is using a CO_2 sensor input at the DCV input or if a building management system (ICS, Tracer®, LonTalk®) is providing a CO_2 sensor input to the unit.*

The DCV SETPOINT (DCV UL Setpoint) determines the percentage increase of the OA damper position when the IGV / VFD is at 0%. The percentage of OA damper increase between 0 and 100% IGV / VFD is linear. To have no effect on the OA damper position when the IGV/VFD output is 0%, set the DCV SETPOINT to 0%. To have the maximum effect on the OA damper position when the IGV/VFD output is 0%, set the DCV SETPOINT (DCV UL Setpoint) to 100%. This chart shows the effect of DCV input vs. MIN POS when the IGV/VFD is at 0%.

Figure 107. Outdoor airflow compensation

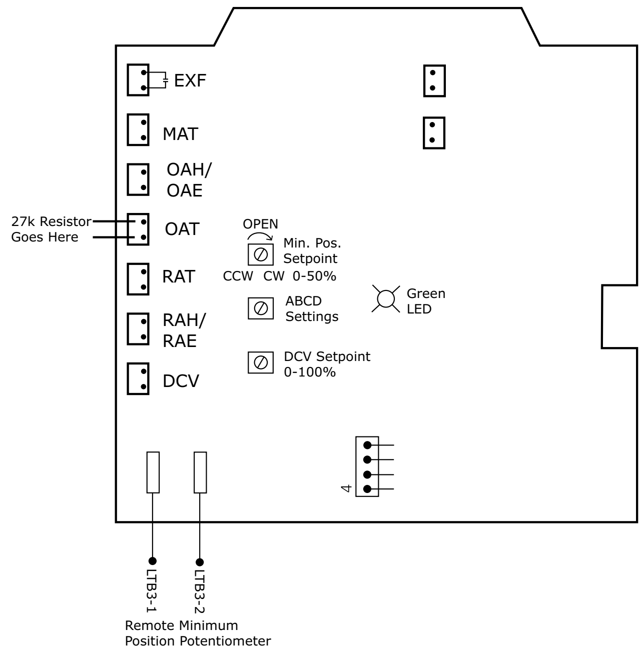


Table 107. OA damper minimum position when IGV is closed /VFD at min. HZ

	MIN POS 0% (CCW)	MIN POS 25%	MIN POS 50% (CW)
DCVSP (DCV UL SP)0%	0 (closed)	25%	50%
DCVSP (DCV UL SP) 50%	25%	37.5%	50%
DCVSP (DCV UL SP) 100%	50%	50%	50%

Operation for RTRM 8.0 and Later with RTEM

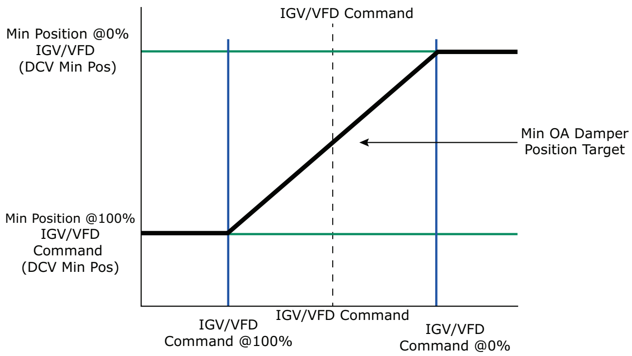
Once configured appropriately as described above, the potentiometers "Design Min Pos" and "DCV Min Pos" must each be set in order to control the OA damper position. The Design Min Pos potentiometer determines the OA damper position (from 0 to 50%) when the IGV / VFD is at 100%. The DCV Min Pos potentiometer determines the OA damper position (from 0 to 50%) when the IGV / VFD is at 0%.

Note: *This function is disabled if a building management system (ICS, Tracer®, LonTalk®) is providing an OA damper minimum position setpoint to the unit. This function is disabled if the unit is using a CO_2 sensor input at the DCV input or if a building management system (ICS, Tracer®, LonTalk®) is providing a CO_2 sensor input to the unit.*

The active economizer minimum position will be computed as a linear function, based on reported inlet vane or VFD position, given the two endpoints:

- Minimum position with IGV @ 100%
- Minimum position with IGV @ 0%

Figure 108. OA damper minimum position with IGV/ VFD at 0% and 100%



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