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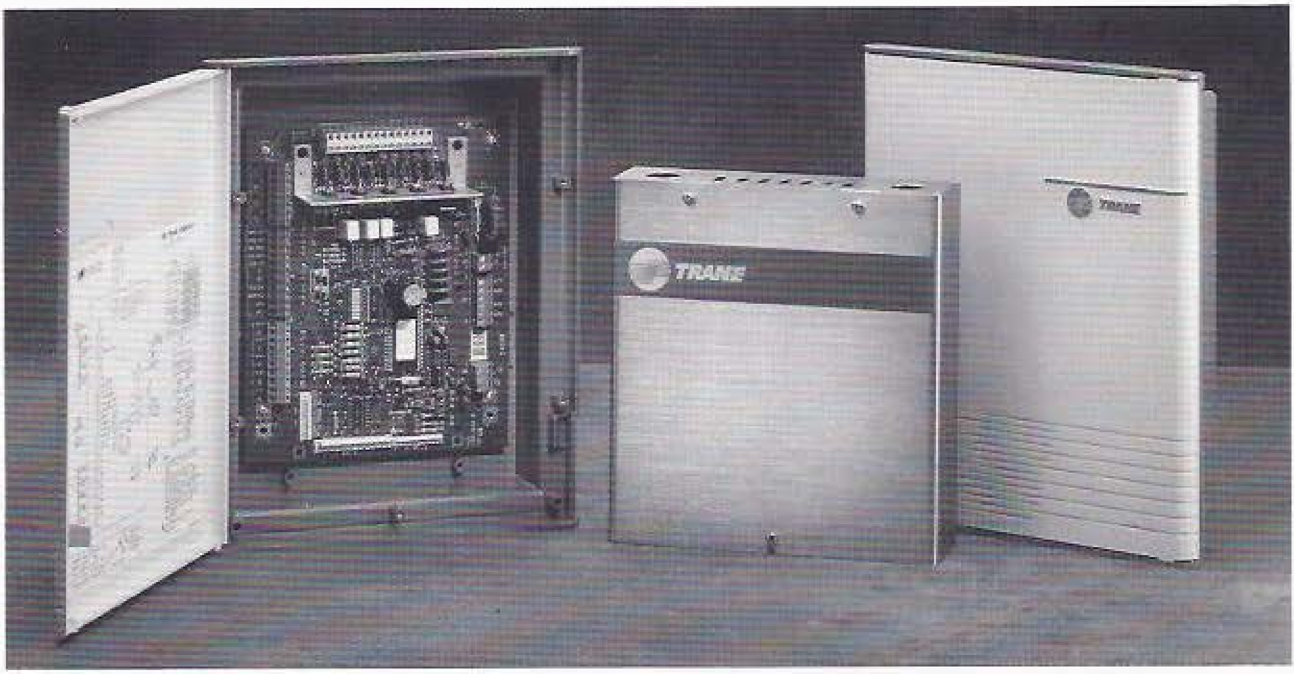

Terminal Unit Controller (TUC)

Including installation, operation, and programming of TUCs

Since The Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice.

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Introduction

This guide contains information about the Terminal Unit Controller (TUC). The TUC is a microprocessor-based direct digital controller (DDC). You can configure the TUC from a list of predefined features. Configure the TUC according to unit type, end devices, and control functions.

This guide describes the capabilities of the TUC. The operation of the TUC and the location of input and output point wiring connections depends on the configuration of the TUC.

There are two physically different TUC circuit boards. One is the factory-installed TUC with pin/plug connections. The other TUC is a controller intended for field installation. This TUC includes screw terminals for all field connections.

For complete information on installing the field-installed TUC in existing equipment, see ***EMTX-IN-24***.

For more information about specific operation and configuration of the TUC, see the Unit Operation section of this guide.

In this document, TUC refers to the Terminal Unit Controller (main circuit board). Add-on boards, including the two below, provide extended capabilities when used with the TUC:

- Input/Output Expansion board (only used with multi-compressor water source heat pumps).
- Auxiliary module (used to provide five additional binary inputs to the TUC and one additional binary output).

For TUCs pre-installed in Trane air conditioning equipment, Trane configures TUC software control options at the factory. It is possible to modify the TUC through a Tracer or by using Everyware. Field-installed TUCs require on-site software configuration based on the controllable HVAC unit.

The information in this manual applies only to Revision 12 TUCs.

Note *You can view the TUC firmware version from both Tracer and Everyware or check the last two digits of the part number on the TUC microprocessor.* ***Example:*** *6200-0028-12.*

Overview

Equipment

Use the TUC to control terminal products, including the following:

- fan coils
- unit ventilators
- water source heat pumps
- blower coil air handling units

The TUC is factory mounted in several different types of Trane air conditioning equipment. See Table 1 for a list of Trane manufacturing facilities and equipment.

Field mounting is also an option. Trane's Building Automation Systems Division in St. Paul, handles field-mounted TUCs. BASD's version of the TUC includes screw terminals for all customer connections.

The software control options in the field-installed TUC are identical to the software control options in the factory-installed TUC.

Table 1 TUC Manufacturing Facilities

Manufacturing Facility	Equipment
Macon	Fan Coils
	Force-Flow™ Cabinet Heaters
Waco	Unit Ventilators
	Water Source Heat Pumps
	Self-contained Unit Ventilators
Rushville	Blower Coil Air Handlers
BASD	Field-installed TUCs

Architecture

Apply the TUC to one of the following environments:

- Standalone
- Tracer 100i or Tracer L
- Tracer Summit system

Standalone

TUCs can operate as standalone controllers. Configure the binary inputs of the TUC to utilize control inputs such as run/stop (referred to as external interlock) or occupied/unoccupied. Use Everyware software to monitor, configure, and communicate with a standalone TUC. Everyware communicates with all terminal unit controllers, regardless of their configuration.

You can wire a communication link between several standalone TUCs to allow Everyware access to any TUC on the link from a single location. For more information about Everyware, see the Everyware section on page 5. Figure 1 shows an example of a single TUC and Everyware connection.

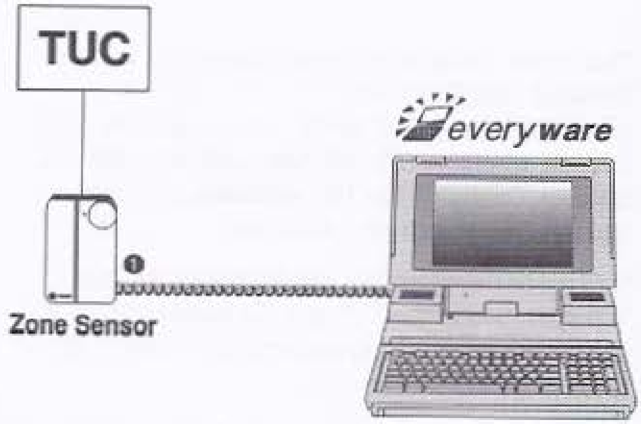
Tracer 100i or Tracer L

Use TUCs with Tracer 100i or Tracer L (version 14.0 or higher). For a Tracer to communicate with a TUC, you must install the Comm4 communications card in the Tracer panel. The total number of TUCs cannot exceed 64 per Tracer. You can connect a maximum of 64 TUCs to either communications link A or B on the Tracer.

Note *You cannot use TUCs with Tracer 100 panels (card cage), Tracer Chiller Plant Manager (CPM), or Tracer Monitor.*

For expanded TUC monitoring and editing capabilities, use Everyware service software with the Tracer 100i or Tracer L. Connect Everyware to any TUC on the Comm4 link. Once you establish a connection to the Comm4 link, Everyware can communicate with any TUC on the link. Figure 2 shows a typical connection between Everyware and a Tracer 100i or Tracer L system.

Figure 1 Single TUC with Everyware



1 Wire the Comm4 communication link to the sensor to connect to the link with Everyware through the sensor.

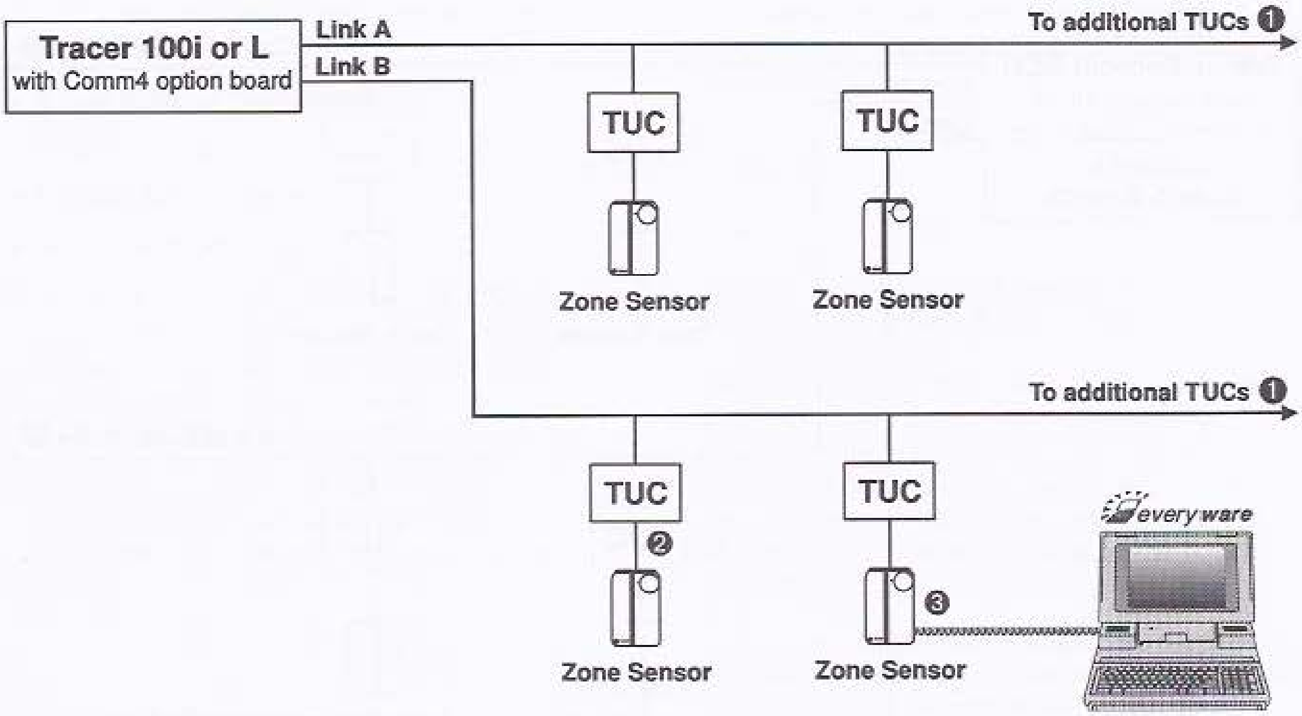
Tracer Summit

Use TUCs with Tracer Summit systems (version 3.0 or higher). For the Tracer Summit Building Control Unit (BCU) to communicate with a TUC, the BCU must include a Comm4 communications card.

For Tracer Summit Version 4.0, you can connect up to 64 TUCs to each BCU, with a maximum of 64 TUCs per communication link. Each connected device must have a unique address on each link.

For expanded TUC monitoring and editing capabilities, use Everyware service software with the Tracer Summit system. Connect Everyware to any TUC on the Comm4 link. Once you establish a connection to the Comm4 link, Everyware can communicate with any TUC on the link. Figure 3 shows the connection between Everyware and a Tracer Summit system.

Figure 2 Tracer 100i or Tracer L TUC system with Everyware



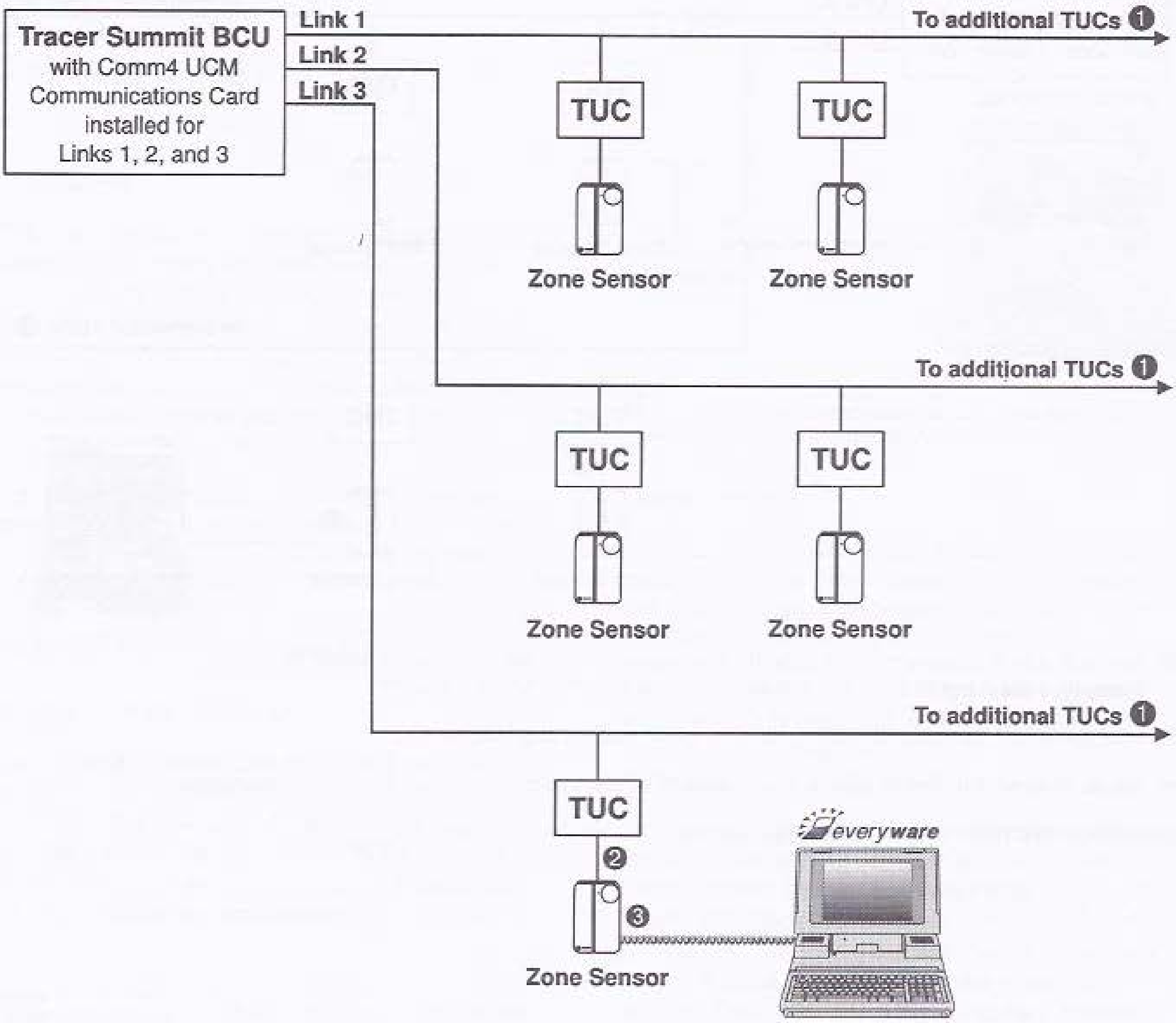
❶ Each link (A or B) supports up to 64 TUCs. The total number of TUCs per Tracer cannot exceed 64.
Example: If link A has 24 TUCs, link B cannot have more than 40 TUCs. 24 + 40 = 64

❷ Wire the Comm4 communication link to the zone sensor terminal strip from the TUC.

❸ Use the Everyware telephone cable and a notebook PC to plug into the zone sensor via an RJ-11 connection.

Note: Tracer 100, Tracer Chiller Plant Manager, and Tracer Monitor do not support TUCs.

Figure 3 Tracer Summit TUC system with Everyware



❶ Each link (1, 2, or 3) supports up to 64 TUCs. The total number of TUCs per Version 4 Tracer Summit BCU cannot exceed 64. **Example:** If link 1 has 15 TUCs, and link 2 has 34 TUCs, link 3 cannot have more than 15 TUCs. 15 + 34 + 15 = 64

❷ Wire the Comm4 communication link to the zone sensor terminal strip from the TUC.

❸ Use the Everyware telephone cable and a notebook PC to plug into the zone sensor via an RJ-11 connection.

Inputs and Outputs

The TUC includes the following total input and output connections:

- 5 analog inputs (thermistors only)
- 4 binary inputs
- 9 binary (triac) outputs
- 4 modulating analog outputs

Some of the inputs and outputs on the TUC are configurable from a fixed list of choices. You can attach add-on boards to the TUC for additional inputs and outputs. Some inputs and outputs on the add-on boards are also configurable.

Depending on the TUC and add-on board configurations, the location of the wiring connections for the various inputs and outputs may vary.

Human Interface

The TUC's human interface is a combination of light emitting diodes (LEDs), DIP switches, and the test input on the TUC board. The human interface allows for extended commissioning and troubleshooting. Use the human interface to perform the following functions:

- Set the ICS address for the TUC
- Read the ICS address of the TUC
- Perform auto cycle test of all unit end devices
- Read the TUC diagnostics
- Read the operating state of the TUC
- Read the operating control mode of the TUC

For complete information, see the Human Interface section of this guide beginning on page 79.

Everyware

Trane developed Everyware service software to provide a way to monitor and edit the following Comm4 devices:

- VAV II
- VAV III
- the TUC

Everyware is comprised of hardware and software. The Everyware Comm4 adapter connects to the serial port of a personal computer (386 minimum). The RJ-11 telephone style cable allows for an easy connection to the Comm4 device through the communication jack found on most Trane zone sensors. If a communication jack is not available, the Everyware kit includes an alligator clips adapter for easy access anywhere on the Comm4 communication link.

Use Everyware software to monitor the controller operation, configure the device, edit setpoints, and save and restore the controller's configuration information. **Everyware is required to effectively commission terminal unit controller jobs.**

Physical Specifications

This section describes the TUC's physical specifications, plus mounting and wiring information.

Field-installed Enclosure Types

- Standard resin enclosure (NEMA 1 rated)
- Extended ambient steel enclosure (NEMA 1 rated)

Circuit Board Dimensions of the Factory-installed TUC

Height: 8" (203 mm)

Width: 5" (127 mm)

Depth: 2" (49 mm) maximum

Circuit Board Dimensions of the Field-installed TUC with Screw Terminals

Height: 8 ½" (216 mm)

Width: 7" (178 mm)

Depth: 2" (49 mm) maximum

Mounting

The field-installed TUC is wall-mounted in its enclosure. In some cases, space limitations may require a TUC without an enclosure. Please contact Trane regarding the availability of the circuit board only option. If the TUC is mounted as the circuit board only, mount the printed circuit board vertically on a sheet metal surface. Do not mount the heat sink at the low end. Mount the TUC in such a way to avoid dust and debris—which may accumulate on the printed circuit board surface.

You can mount add-on boards in any vertical orientation. Always use Trane-supplied wiring harnesses for connections between the TUC and add-on boards. Route add-on board electrical connections away from the power wiring.

Wiring

Wires for temperature sensors, communication lines, 24 VAC, and contact closure sensing inputs should not be bundled with or run near high voltage wiring. Separate power wiring from the TUC and all low voltage wires. Run external input wires in separate conduits from high voltage wires.

Wires connected to pin headers should be formed and routed to reduce strain to a minimum on the TUC connector. A minimum 1.5" clearance (from the pin center line) for wires up to 16 AWG is necessary for bending and forming wires.

All sensor and input circuits are normally at or near ground potential. Do not connect any sensor or input circuits to an external ground connection.

Table 2 shows TUC wiring requirements.

Table 2 TUC Wiring Requirements

Application	Wire Type	Length
Binary Inputs	18-22 AWG	Up to 1000 feet
Binary Outputs	18-22 AWG	Up to 1000 feet
Analog Inputs	18-22 AWG	Up to 200 feet
Analog Outputs	18-22 AWG	Up to 200 feet
24 VAC Power	16-22 AWG	Up to 1000 feet
Zone Sensor	16-22 AWG	Up to 200 feet
Communications	18 AWG	Up to 5000 feet

ICS Communication Link Requirements

The TUC can communicate with Tracer building communication systems (Tracer 100i, Tracer L, and Tracer Summit Building Control Units) over the ICS communication link. A 9600 baud Comm4 communication link is required for communication between a TUC and a Tracer 100i, Tracer L, or Tracer Summit panels. To allow for Comm4 communication, you must install a Comm4 communication card in the Tracer 100i or L panel, or the Tracer Summit Building Control Unit.

Enclosure and Circuit Board Details

Field-installed Terminal Unit Controller

Figure 4 Dimensions of the Steel Enclosure Backplane

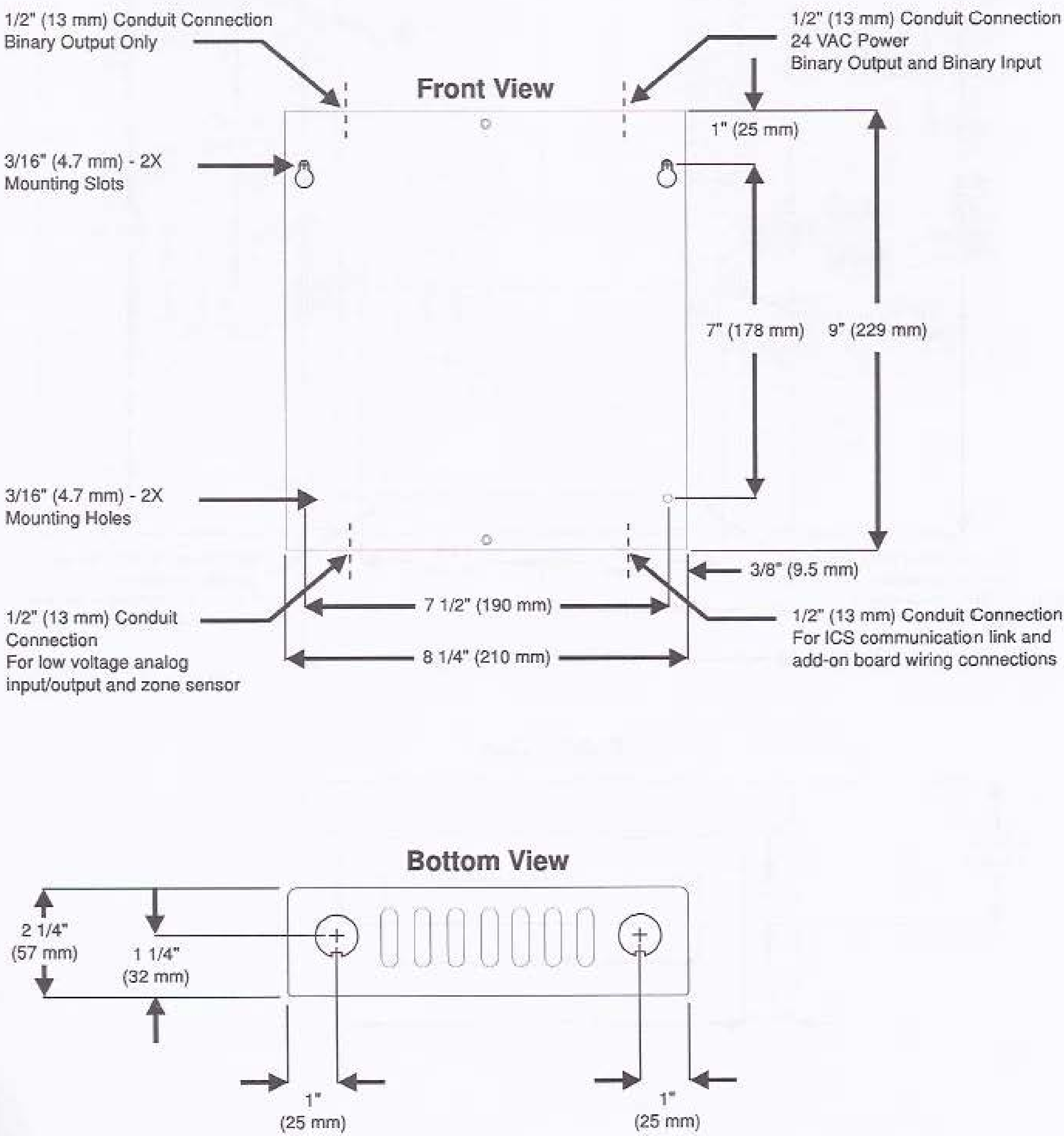
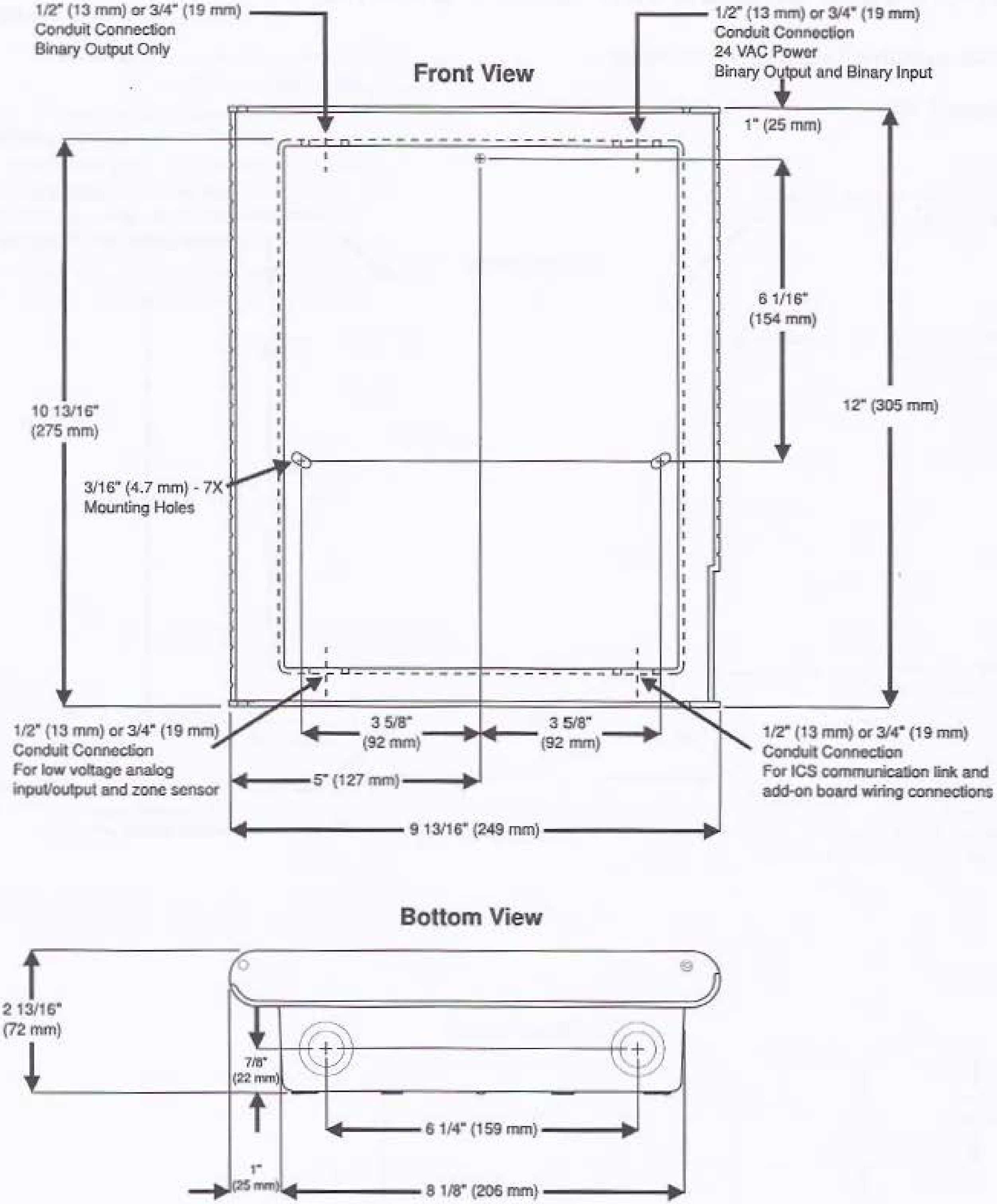
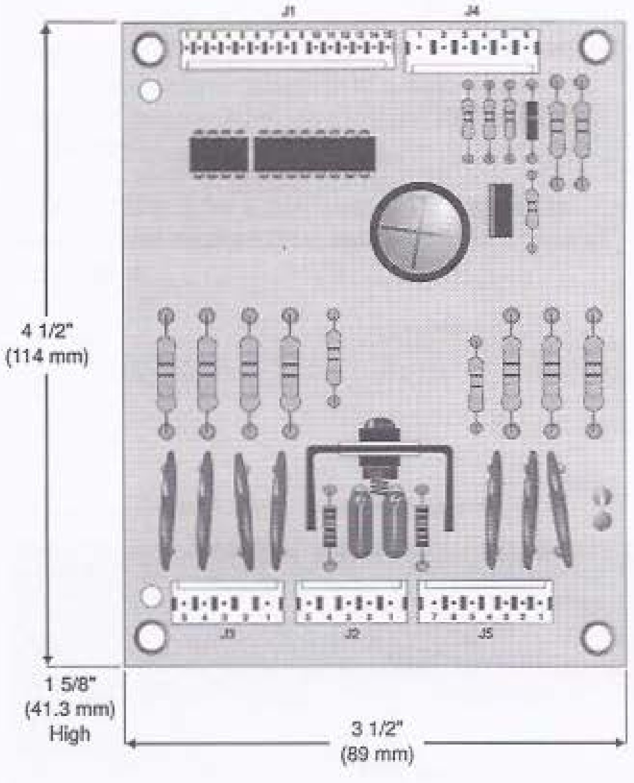


Figure 5 Dimensions of the Resin Enclosure



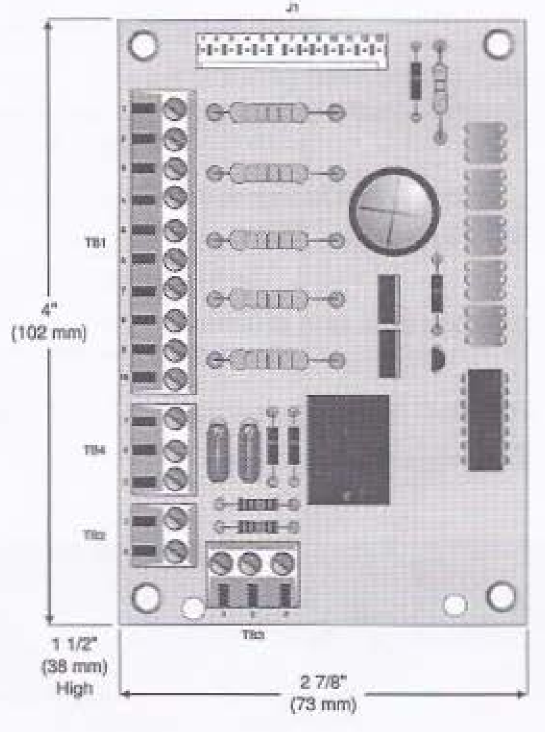
Input/Output Expansion Board

Figure 6 Example of the I/O Expansion board



Auxiliary Board

Figure 7 Example of the Auxiliary board



Unit Operation

This section explains the various unit operation possibilities of the TUC. The configuration of the TUC and the presence or absence of a zone sensor and supply air temperature sensor affect the operation of the TUC.

Refer to Table 3 for a summary of TUC operation based on the configuration and which zone sensors are present.

Control Sequences

The TUC uses the following three general control algorithms incorporating proportional/integral control loops:

- zone temperature control of unit capacity
- discharge air temperature control of unit capacity (See note ❶ in the table below.)
- cascaded loop control of both zone and discharge air temperature control

Use Table 3 to determine the control mode for a unit.

Table 3 Control Mode Determination

Zone temperature sensor present?	Discharge temperature sensor present?	Discharge air control enabled?	Tracer discharge air setpoint?	Control Mode
No	No	No	No	Fan only (no heat/cool control)
No	No	No	Yes	Fan only (no heat/cool control)
No	No	Yes	Yes	Fan only (no heat/cool control)
No	No	Yes	No	Fan only (no heat/cool control)
No	Yes	No	No	Discharge air control, zone temperature setpoint ❶
No	Yes	No	Yes	Discharge air control, discharge air temperature setpoint ❶
No	Yes	Yes	Yes	Discharge air control, discharge air temperature setpoint ❶
No	Yes	Yes	No	Discharge air control, zone temperature setpoint ❶
Yes	Yes	No	No	Zone temperature control, zone temperature setpoint
Yes	Yes	No	Yes	Zone temperature control, zone temperature setpoint
Yes	Yes	Yes	Yes	Discharge air control, discharge air temperature setpoint ❶
Yes	Yes	Yes	No	Cascade control, zone temperature setpoint
Yes	No	No	No	Zone temperature control, zone temperature setpoint
Yes	No	No	Yes	Zone temperature control, zone temperature setpoint
Yes	No	Yes	Yes	Zone temperature control, zone temperature setpoint
Yes	No	Yes	No	Zone temperature control, zone temperature setpoint

❶ Only use discharge air control in the TUC as a failure recovery mode for units utilizing cascade control (if the zone temperature sensor fails). Currently, the TUC does not support discharge air control as a standard control offering.

Zone Air Temperature Control

Zone air temperature control operates the unit capacity according to zone temperature conditions. The TUC compares the active temperature setpoint to the measured zone temperature to produce a control error. The TUC uses the control error in a proportional/integral control algorithm to produce a unit capacity requirement. The end devices (valves, dampers, compressors, etc.) operate based on the unit capacity (heat or cool, 0 to 100%).

Discharge Air Temperature Control

The TUC uses discharge air temperature control when no zone temperature input is available or the supply air needs to be maintained at a fixed value. The discharge air temperature setpoint comes from a zone sensor or Tracer communication. The TUC compares the active discharge air temperature setpoint to the measured discharge air temperature to produce a control error. The TUC uses the control error in a proportional/integral control algorithm to produce a unit capacity requirement. The end device (valves, dampers, compressors, etc.) operate based on the unit capacity (heat or cool, 0 to 100%).

Units configured to utilize cascade control use discharge air temperature control whenever the zone temperature sensor is not present.

Note *The use of discharge air temperature control is not supported at this time.*

Cascade Zone/Discharge Air Temperature Control

Cascade temperature control uses both the zone and discharge air temperatures to more accurately calculate the required unit capacity. The TUC compares the active zone temperature setpoint to the measured zone temperature to produce a control error. The TUC uses the control error in a proportional/integral control algorithm to produce a unit discharge temperature setpoint.

The TUC discharge air temperature setpoint is bound by a high and low limit. You may edit the discharge air temperature high and low limit. The TUC compares the discharge temperature setpoint to the measured discharge air temperature to produce a control error. The control error is input to a proportional/integral control algorithm to produce a unit capacity requirement. The end devices (valves, dampers, compressors, etc.) operate based on the unit capacity (heat or cool, 0 to 100%).

Note *For discharge or cascade air temperature control, the supply air temperature setpoint is set equal to the measured supply air temperature after five minutes of unit operation at maximum capacity. Usually this indicates that the TUC is not detecting an expected capacity. The TUC allows the supply air temperature setpoint to drift towards the correct setpoint if the capacity becomes available.*

Occupied/Unoccupied Operation

While in the occupied mode, the TUC controls the zone temperature according to the proportional/integral control algorithm based on the current occupied setpoints. For additional information on setpoints, see the Setpoint Operation section of this guide.

While in the unoccupied mode, the TUC controls the zone temperature according to the control algorithm based on the unoccupied setpoints stored in the TUC's EEPROM memory, regardless of the presence of a Tracer or a local zone sensor setpoint.

Note *You can edit the locally stored unoccupied setpoints.*

There are four ways to control the TUC's occupancy:

- Tracer system
- Local occupied/unoccupied binary input to the TUC
- Timed override input from the zone sensor
- Default operation (occupied)

A description of each method follows:

Tracer system - The Tracer system, if the system is communicating and ICS (Tracer) Control is edited as **Yes**, can control the occupancy mode of the TUC. Typically, the occupancy of the TUC is determined by using time-of-day scheduling in the Tracer system.

If communications are lost while the Tracer is successfully communicating and in control of the TUC, the TUC reverts back to default operating mode (occupied) after 15 minutes of communication loss.

Note *For complete information about TUC setup and Tracer applications, see the Tracer 100i, Tracer L, or Tracer Summit literature.*

Local occupied/unoccupied binary input - Configure binary input #3 of the TUC as an occupied/unoccupied input. If the binary input is configured as normally open, open contacts place the TUC in occupied mode. When the contacts close for the binary input, the TUC switches to unoccupied mode.

Timed override input from the zone sensor - Some Trane zone sensors include timed override (On) and cancel timed override (Cancel) buttons. By pressing the On button, you can place the TUC in occupied mode (if presently unoccupied). The TUC remains in occupied mode for the configured amount of time—typically 120 minutes. You can edit the amount of time on setpoint screens in Tracer 100i or L, Tracer Summit, and Everyware.

Once you press the timed override or On button, press the Cancel button to place the TUC back into the unoccupied mode.

Default operation (occupied) - If no Tracer is present and you have not configured binary input #3 as an occupied/unoccupied input, the default operation of the TUC is occupied. In this configuration, the TUC always remains in the occupied mode.

Setpoint Operation

The heat/cool setpoint source for the TUC depends on several conditions. You can provide the TUC with heat/cool setpoints from any of the following:

- a local zone sensor with adjustable setpoint wheel or dual slide setpoints
- a Tracer system
- by allowing the TUC to use locally stored default setpoints

Table 4 shows the setpoint sources for the TUC.

The TUC uses setpoints sent from the Tracer in the following situations:

- when the Tracer is present and in control and the setpoint source is edited as the Tracer
- when the Tracer is present and in control and the setpoint source is edited as local, yet the local zone sensor setpoint is unavailable

The TUC uses setpoints from the local zone sensor in the following situations:

- when the Tracer loses communication with the TUC or the Tracer is not present
- when the Tracer is present and in control but the setpoint source is edited as local

The TUC uses the locally stored default setpoints (editable) in the following situations:

- when the TUC is edited to use the setpoint from the zone sensor and the setpoint fails or does not exist
- if the TUC is edited to use the Tracer setpoint and both the Tracer and the local setpoint do not exist
- when the TUC is edited to use its locally stored default setpoints

Note *If the TUC is edited to use its locally stored default setpoints, through Tracer 100i, Tracer L, or Everyware, it will use those setpoints regardless of the presence of a Tracer or a local setpoint.*

Important *In the unoccupied mode, the TUC always uses locally stored default unoccupied heating and cooling setpoints. To modify these setpoints, use the Tracer 100i or L (setpoints screen) or Everyware software.*

Table 4 Setpoint Sources for the TUC

Tracer present and in control?	Local zone sensor setpoint adjustment present?	Local sensor setpoint enabled? ❶	Occupied or unoccupied?	Setpoint Source
No	No	No	Unoccupied ❸	Stored in TUC (Unoccupied Setpoints)
No	Yes	No	Unoccupied ❸	Stored in TUC (Unoccupied Setpoints)
No	Yes	No	Occupied	Local ❷ (Occupied Setpoints)
No	No	No	Occupied	Stored in TUC (Default Occupied Setpoints)
No	No	Yes	Unoccupied ❸	Stored in TUC (Unoccupied Setpoints)
No	Yes	Yes	Unoccupied ❸	Stored in TUC (Unoccupied Setpoints)
No	Yes	Yes	Occupied	Local ❷ (Occupied Setpoints)
No	No	Yes	Occupied	Stored in TUC (Default Occupied Setpoints)
Yes	No	Yes	Unoccupied ❸	Stored in TUC (Unoccupied Setpoints)
Yes	Yes	Yes	Unoccupied ❸	Stored in TUC (Unoccupied Setpoints)
Yes	Yes	Yes	Occupied	Local ❷ (Occupied Setpoints)
Yes	No	Yes	Occupied	Stored in TUC (Default Occupied Setpoints)
Yes	No	No	Unoccupied ❸	Stored in TUC (Unoccupied Setpoints)
Yes	Yes	No	Unoccupied ❸	Stored in TUC (Unoccupied Setpoints)
Yes	Yes	No	Occupied	Tracer ❷ (Occupied Setpoints)
Yes	No	No	Occupied	Tracer ❷ (Occupied Setpoints)

❶ If the Heat/Cool Setpoint source is edited as Local, the local setpoint is Enabled. (See Tracer 100i, Tracer L, and Everyware setpoint screens, and the Tracer Summit Configuration screen.)

❷ If the TUC is configured to use default setpoints, the TUC uses the default setpoints instead of the Tracer or local setpoints.

❸ During the unoccupied mode, the TUC always controls to the unoccupied heating/cooling setpoints stored in the TUC. These setpoints are editable through Tracer 100i or L panels and Everyware.

Setpoint Selection

If a zone sensor with a thumbwheel provides a single setpoint (the cooling setpoint), the TUC uses the setpoint offset to calculate the heating setpoint. See the equation below:

Heating Setpoint = Cooling Setpoint - Setpoint Offset

A Trane zone sensor with a thumbwheel adjustment (also may be internal/concealed) provides a cooling setpoint by using the setting on the thumbwheel. For Trane zone sensors with a thumbwheel, the heating setpoint is calculated based on the cooling setpoint and the zone sensor heating setpoint offset (adjustable stored value). If dual setpoints are available, the TUC uses both.

Both heating and cooling setpoints are subject to occupied maximum and minimum heating and cooling setpoint limits. A Tracer, when present and in control, always provides both a heating and cooling setpoint.

Local Zone Sensor Setpoint Calibration

By using Tracer 100i, Tracer L, or Everyware, you can calibrate the local zone sensor setpoint value. The TUC first reads the value from the zone sensor potentiometer as the initial zone setpoint (cooling setpoint). Next, the TUC applies the calibration offset (-12.5° to 12.5° F) to determine the new cooling setpoint. Finally, the TUC applies the zone sensor heating setpoint offset to the calibrated cooling setpoint to determine the heating setpoint.

Setpoint Operation from a Tracer System

Information about Tracer setpoints is unique and extensive for Tracer 100i, Tracer L, and Tracer Summit systems. For details on sending setpoints to the TUC from Tracer 100i, Tracer L, or Tracer Summit, see the manuals for each individual product.

Heat/Cool Control Mode Operation

There are three ways to determine the heat/cool control mode of the TUC:

- Local zone sensor (if a system switch exists)
- Tracer system (if present and in control)
- Automatically by the TUC (with a local system switch, the Tracer, both, or neither)

Table 5 identifies the system switch source for occupied and unoccupied conditions.

Table 6 describes the unit operation based on the relationship between the fan switch and system command.

To determine the mode of operation, the TUC first calculates—based on the zone temperature and the active setpoints, whether to operate in the heat or cool mode. Next, the TUC runs the zone air temperature control loop, discharge air temperature control loop, or the cascaded zone/discharge air temperature control loops to determine the heat/cool capacity (0 to 100%). The TUC heat/cool mode must be auto for a mode change to take place, either from heat to cool or cool to heat.

Before changing to a mode, the TUC checks for the existence of the desired capacity. For example, if heating is desired, the TUC checks to see if any heat capacity is available in the unit.

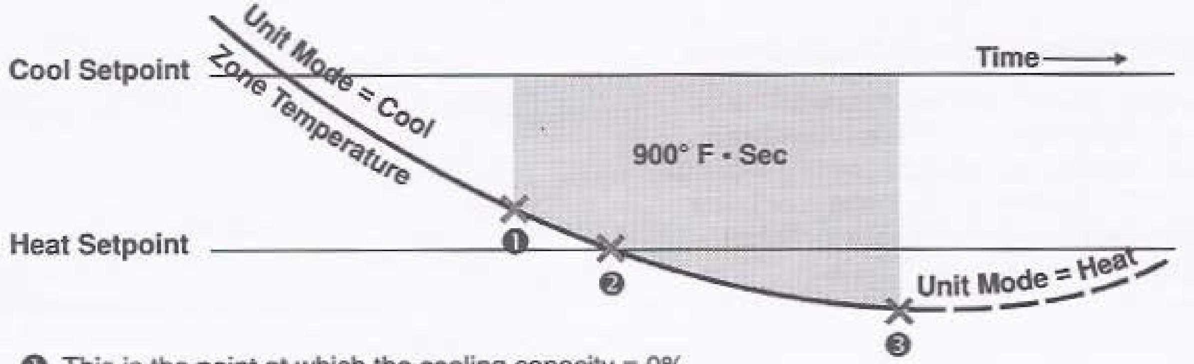
Example *Based on zone requirements, the TUC needs to change to heat mode. First the TUC checks to see if heating capacity is available. If heating is possible, the TUC changes to the heat mode. If the TUC cannot make a mode change due to the lack of desired capacity, the TUC mode appears as* **Standby**. *As soon as the TUC detects the desired capacity, the unit switches to the desired mode.*

The TUC switches over from cool to heat, or from heat to cool, when the error (integrated over time) between the active setpoint and the zone temperature is 900° F • Sec. See Figure 8.

Note *The zone temperature must be lower than the heat setpoint before the TUC can switch to the heat mode. Similarly, the zone temperature must be higher than the cool setpoint before the TUC can switch to the cool mode.*

If the TUC mode is heat, the heating capacity varies between 0 and 100% and the cooling capacity is zero. If the mode is cool, the cooling capacity varies between 0 and 100% and the heating capacity is zero. A Tracer system may limit both the heating and cooling capacities.

Figure 8 Heat/Cool Switchover Logic



❶ This is the point at which the cooling capacity = 0%.

❷ The zone temperature must fall below the active heat setpoint to allow the TUC to change to the Heat mode. For the TUC to allow a change to the Cool mode, the zone temperature must rise above the active cool setpoint.

❸ The TUC switches to Heat (from Cool) after the error of 900° F • Sec has been exceeded.

When the measured zone temperature is between the active cooling and heating setpoints, the capacity for both cooling and heating will approach zero. If the measured zone temperature falls outside the active setpoint range, the control loop uses both the temperature error and time to determine the heat/cool mode and the associated heating/cooling capacity.

Both types of modulating capacity (such as modulating valves and economizers) and staged capacity (such as compressors or electric heat) use the heat/cool mode in conjunction with the unit capacity request to determine the end device operation.

Auto Changeover

Auto changeover refers to the use of the main coil for both heating and cooling. Auto changeover is required only in a hydronic system intended to use the main unit water coil (Valve/Coil 1) for both heating and cooling. If auto changeover is enabled, the TUC may use the entering water temperature for control decisions. If auto changeover is disabled, the TUC uses the entering water temperature for information only.

If the entering water temperature sensor fails or does not exist, the TUC bases the unit heat/cool decision on the information in Table 17 on page 33.

Table 5 System Switch Source for Occupied and Unoccupied Conditions

System switch present?	Fan switch present?	Tracer present and manually controlling Heat/Cool mode? Local switch enabled or disabled?	System Mode
No	No	No Not Applicable	Auto
Yes	No	No Not Applicable	❶
No	Yes	No Not Applicable	❷
Yes	Yes	No Not Applicable	❶
No	Yes	Yes Enabled	❸
Yes	Yes	Yes Enabled	❶
No	No	Yes Enabled	❸
Yes	No	Yes Enabled	❶
No	No	Yes Disabled	❸
Yes	No	Yes Disabled	❸

Auto The TUC determines the heat/cool mode based on the zone temperature/setpoints algorithm.

❶ The TUC determines the heat/cool mode based on the position of the system switch on the local zone sensor (cool, off, auto, heat, or emergency heat). **During the unoccupied mode, only off and auto are functional settings.**

❷ The TUC determines the heat/cool mode based on the position of the fan switch (off or auto). See Table 6 on page 20.

❸ The TUC determines the heat/cool mode based on the mode edited in the TUC setup of the Tracer (cool, off, auto, or heat).

Table 6 System and Fan Switch Commands

System Switch \ Fan Switch	None	Fan Off	Fan Auto	Fan Low	Fan Med	Fan High or On
None	Heat/Cool Auto, Fan High	Unit Off	Heat/Cool Auto, Fan Auto	Heat/Cool Auto, Fan Low	Heat/Cool Auto, Fan Med	Heat/Cool Auto, Fan High
Off	Unit Off	Unit Off	Unit Off	Fan Low, No Heating or Cooling, Outdoor Air Damper Closed, Exhaust Off	Fan Med, No Heating or Cooling, Outdoor Air Damper Closed, Exhaust Off	Fan High, No Heating or Cooling, Outdoor Air Damper Closed, Exhaust Off
Auto	Heat/Cool Auto, Fan Auto	Unit Off	Heat/Cool Auto, Fan Auto	Heat/Cool Auto, Fan Low	Heat/Cool Auto, Fan Med	Heat/Cool Auto, Fan High
Cool	Cooling Only, Fan Auto	Unit Off	Cooling Only, Fan Auto	Cooling Only, Fan Low	Cooling Only, Fan Med	Cooling Only, Fan High
Heat	Heating Only, Fan Auto	Unit Off	Heating Only, Fan Auto	Heating Only, Fan Low	Heating Only, Fan Med	Heating Only, Fan High
Emergency Heat	Emergency Heat Only, Fan Auto	Unit Off	Emergency Heat Only, Fan Auto	Emergency Heat Only, Fan Low	Emergency Heat Only, Fan Med	Emergency Heat Only, Fan High

Tracer Functions related to Heat/Cool Mode

A building operator using a Trane Building Automation System, such as Tracer 100i, Tracer L, or Tracer Summit, has the ability to control the TUC heat/cool mode and associated maximum heating and cooling operating capacity. The Tracer can manually place the TUC into either the heat or cool mode.

When the TUC is manually placed in the heat mode, the cooling capacity for the TUC is zero. While in the manual heat mode, the unit cannot cool (hydronic, economizer, and compressor).

When the TUC is manually placed in cool mode, the heating capacity for the TUC is zero. While in the manual cool mode, the unit cannot heat (hydronic, electric heat, and compressor).

The Tracer can individually disable the following TUC functions:

- Compressor
- Economizer
- Electric Heat
- Heating
- Cooling

The heating disable point disables all heating. The cooling disable point disables all cooling, except economizer. Seasonal systems use the heat/cool disable points to indicate to the TUCs that they can no longer hydronic heat (based on the season and because the boilers are not on) or hydronic cool (because the chillers are not on).

Fan Operation

The supply air fan operates continuously at the appropriate speed (low, medium, or high) during occupied mode. A list of exceptions follows:

- Warm up mode (high speed)
- Cool down mode (high speed)
- Off or shutdown mode (off)
- When the fan is configured to cycle with unit capacity, the fan cycles between off and the appropriate speed during the occupied mode. In unoccupied mode, the fan cycles between off and high. Fan coils cycle between high and off in the unoccupied mode.

In unoccupied mode, the TUC normally controls the unit supply fan off. If the zone temperature drops 1.5 degrees (F) or more below the unoccupied heating setpoint, the TUC turns on the supply fan. The supply fan remains on at maximum heating capacity until the zone temperature is 1.5 degrees (F) above the unoccupied heating setpoint.

If the zone temperature rises 1.5 degrees (F) or more above the unoccupied cooling setpoint, the TUC turns on the supply fan. The fan remains on at maximum cooling capacity until the zone temperature is 1.5 degrees (F) below the unoccupied cooling setpoint.

If the TUC is configured for automatic fan speed control (auto), the unit operates the supply fan at the lowest speed possible while maintaining zone control conditions. Automatic fan speed control conserves fan energy and reduces fan noise in the conditioned space.

Note *Automatic fan speed control is not supported with discharge or cascade air control. See Table 3 on page 13 for more information. For discharge air control, the fan operates at high speed when running. Fan coils are the exception. They run at medium speed.*

Note *Some units only have single speed fan motors and they are configured as* ***auto,*** *they will not change fan speeds.*

The TUC is configured for the appropriate number of fan speeds based on the actual fan motor present. Depending on the unit and zone sensor options, the TUC may be capable of controlling the following fan speed options:

- 1-speed fan (off and on)
- 2-speed fan (off, low, high, and possibly auto)
- 3-speed fan (off, low, medium, high, and possibly auto)

For auto fan speed selection, the TUC determines the desired fan speed based on temperature error and capacity/flow requirements. Tables 7 and 8 define the absolute switch points for the fan speed based on the temperature difference between the zone temperature and either the cooling or heating setpoint.

When a compressor is present and the supply fan is configured to cycle with unit capacity, the TUC turns off the supply fan 90 seconds after the compressor shuts off (for occupied and unoccupied modes).

If no outdoor air damper is present, or if the outdoor air damper is closed, the 90 second delay is present in heating if there is no supply air temperature sensor.

For hydronic or electric heat applications and compressor heating, the fan shutdown is delayed from the heat capacity shutdown to cool the coil or electric heat elements. The delay occurs when the discharge air temperature falls below 85° F or 90 seconds after capacity shutdown if no discharge air sensor is present. There is no fan shutdown delay for cooling applications. Whenever the TUC shuts off the supply fan, the outdoor air damper is closed.

Table 7 3-speed Fan Absolute Switch Points

Fan Speed Change	Absolute Temperature Error
Low to Medium	2.00° F
Medium to High	3.00° F
High to Medium	2.25° F
Medium to Low	1.25° F

Table 8 2-speed Fan Absolute Switch Points

Fan Speed Change	Absolute Temperature Error
Low to High	2.00° F
High to Low	1.25° F

Fan Control Source

The supply fan speed control is determined by either the switch on the zone sensor (if a switch exists) or by the Tracer. If no switch exists on the zone sensor or a Tracer is not present, the fan operates at high speed. Macon fan coils are the exception. The fan runs at medium speed. Table 9 shows the fan switch source options.

Valve Operation

The TUC uses the main hydronic valve/coil (Valve/Coil 1) for either heating or cooling. The auxiliary valve/coil (Valve/Coil 2) only provides heating.

Typical 2-pipe configurations allow for both cooling (summer mode) and heating (winter mode) from a TUC with auto changeover enabled. However, you can configure the TUC as either a 2-pipe cooling only or heating only unit. If the TUC is configured to be either a 2-pipe cooling only or heating only unit, you must disable auto changeover and purge.

Typical 4-pipe configurations utilize the main valve/coil as the cooling source and the auxiliary valve/coil as the heating source (auto changeover disabled). However, enabling auto changeover on the 4-pipe unit allows a winter mode in which the primary valve/coil provides heating and the auxiliary valve/coil provides auxiliary heating.

2-pipe Operation

If the controlled space requires heating or cooling, the TUC first verifies that heating or cooling is possible based on the temperature of the entering water. To cool, the entering water temperature must be five degrees (F) or more colder than the zone temperature. To heat, the entering water temperature must be five degrees (F) or more warmer than the zone temperature.

Table 9 Fan Switch Source

Tracer control?	Local Switch		Occupied or unoccupied?	Fan Selection
	Present?	Enabled?		
No	No	No	Unoccupied	Default ❶
No	Yes	No	Unoccupied	Local Switch ❷
No	Yes	No	Occupied	Local Switch
No	No	No	Occupied	Default ❸
No	No	Yes	Unoccupied	Default ❶
No	Yes	Yes	Unoccupied	Local Switch ❷
No	Yes	Yes	Occupied	Local Switch
No	No	Yes	Occupied	Default ❸
Yes	No	Yes	Unoccupied	Tracer
Yes	Yes	Yes	Unoccupied	Tracer
Yes	Yes	Yes	Occupied	Local Switch
Yes	No	Yes	Occupied	Tracer
Yes	No	No	Unoccupied	Tracer
Yes	Yes	No	Unoccupied	Tracer
Yes	Yes	No	Occupied	Tracer
Yes	No	No	Occupied	Tracer

❶ Off, High (called **Auto**)
❷ You cannot force the fan to run during the unoccupied mode. Auto and off are the only valid selections.
❸ High speed except Fan Coil, which is medium.

Note *Table 17 on page 33 defines how the TUC determines whether or not the unit can use the entering water to heat and cool.*

If the entering water temperature is in the correct range for heating or cooling, the TUC modulates the valve to control the zone temperature at the heating setpoint in heat mode or at the cooling setpoint in cool mode. Units with economizing capability utilize the outdoor air prior to using hydronic means to control the space temperature.

4-pipe Operation

4-pipe unit configurations normally provide cold water in the primary coil and hot water in the auxiliary coil, except when a 4-pipe unit has auto changeover enabled. If auto changeover is enabled, the TUC must verify the water temperature in the primary coil before it heats or cools.

The TUC modulates the cooling valve (Valve 1) to control the zone temperature at the cooling setpoint in cool mode after first modulating the economizer. The TUC modulates the heating valve (Valve 2) to keep the zone temperature at the heating setpoint in heat mode.

During normal unit operation, the TUC will never open both the heating valve and the cooling valve at the same time.

Water Source Heat Pump Isolation Valve

In water source heat pumps that utilize a water isolation valve, the TUC energizes the isolation valve in conjunction with compressor operation. There is no delay between compressor operation and valve opening.

Valve Configurations

This section covers TUCs with hydronic (water) valves. The following valve configuration options are available:

- No valve present
- Solenoid on/off (2-position)
- Modulating analog
  - 2 to 10 VDC
  - 6 to 9 VDC
  - 0 to 10 VDC
- 3-wire floating point

In all configurations, except 3-wire floating point, you can configure the valve output to be either normally open (N.O.) or normally closed (N.C.).

Note *3-wire floating point configurations do not use the normally open (N.O.) or normally closed (N.C.) options.*

Table 10 summarizes the output control for the various voltage combinations.

Table 10 Valve Configurations

Valve Type	Normally Closed Operation	Normally Open Operation
Solenoid On/Off	Actuate to open	Actuate to close
Modulating	Increase output to open	Increase output to close

Heat/Cool Capacity and Valve/Coil Relationship

The TUC determines the valve position (modulating and floating point valves) in the following manner:

1. Using the current zone temperature and the heating/cooling setpoints, the TUC determines the heat/cool mode.
2. Using the temperature control algorithms, the TUC determines the heat/cool capacity (0 to 100%) for the unit.
3. From the valve/coil configuration values, the TUC calculates the flow necessary to yield the desired heat/cool capacity.
4. Using the valve/coil and valve drive time configuration values, the TUC determines the valve position to maintain the desired flow.

2-position Valves

For unit configurations with 2-position valves, the valves utilize PWM (pulse width modulation) logic for their control. The control of the 2-position valves is based on three different sequential control stages:

Stage 1 - This stage controls the 2-position valve to off or no flow.

Stage 2 - This stage controls the valve according to PWM logic. The TUC calculates the valve on/off times based on heating/cooling cycles per hour values and the heating/cooling capacities.

Example *When the TUC configuration is three cycles per hour (the Trane recommended value), the TUC controls the valve according to three 20-minute periods. If the TUC capacity is 40%, the valve opens for about eight minutes and closes for 12 minutes.*

Stage 3 - This stage controls the valve as always on or 100% of capacity.

Valve Calibration

At power up, the TUC drives closed 3-wire floating point actuators. The TUC overdrives the actuators (110% of drive time) to make certain the device is driven fully closed.

Note *Whenever the TUC generates an output position request of zero or 100%, the unit calibrates modulating outputs by overdriving the valves.*

Calibration of the modulating valve is a normal and ongoing process. The valve position for a 3-wire floating point valve is based on the TUC's triac output drive time. Whenever the TUC requests a valve position of either zero or 100%, the TUC overdrives the output by 110% of the stroke time to make sure the valve drives to the end position.

For a modulating analog valve the TUC, determines the position of the valve by accurately controlling the output signal to the actuator. For a 6 to 9 VDC actuator, the TUC overdrives the valves by producing an output signal of 0 VDC instead of 6 VDC and 10 VDC instead of 9 VDC. By overdriving the valves, the TUC makes sure the motor drives to each end position.

Freeze Avoidance

The TUC provides a freeze avoidance sequence in which the unit drives the valves full open during the unoccupied or stop modes whenever the outdoor air temperature is less than the freeze avoidance setpoint. A local outdoor air sensor or the Tracer communicates the outdoor air temperature to the TUC. The freeze avoidance setpoint is adjustable, but is commonly set near 40° F. For additional coil protection, the TUC disables economizing and drives the outdoor air damper closed during the freeze avoidance mode.

Compressor Operation

This section covers TUC units with DX (direct expansion) capability, water source heat pumps, and self-contained unit ventilators. A description of each TUC unit follows:

DX Capability - DX units use a remote condensing unit with the compressor. The indoor unit has a DX coil that provides cooling capacity. The TUC generates a call for cooling, then operates the compressor and remote condensing unit to supply cooling capability.

Water Source Heat Pumps - Water source heat pumps may have one or more compressors with individual refrigerant circuits. When multiple circuits exist, the circuits have approximately equal heating and cooling capacity. You can configure the units as heating/cooling or only cooling.

Self-contained Unit Ventilators - Self-contained unit ventilators include an air-cooled condenser. You can configure the ventilator as either heating/cooling or only cooling.

General Compressor Operation

The TUC uses minimum on/off timers to maintain proper oil distribution in the refrigerant system. The TUC enforces minimum on/off times in all control operations except the following:

- Compressor refrigerant high pressure cutout
- Compressor refrigerant low pressure cutout
- All system **Off** commands
- Water source heat pump low condenser leaving water temperature (or leaving water temperature sensor fail)
- Condensate overflow

Single Compressor Operation

Single compressor units cycle the compressor on and off to meet heating or cooling zone temperature needs. If the compressor fails, compressor heating or cooling capacity is not available for temperature control. Single compressor units use the unit capacity and the compressor cycles per hour value to determine the on and off times for the compressor. See Appendix A for more information.

The compressor cycles per hour value does not limit the compressor to that number of cycles per hour. The TUC uses the cycles per hour value to determine the approximate on/off time for the compressor.

Multiple Compressor Operation

As heating or cooling capacity requirements increase or decrease, the TUC operates two or three compressor units in a fixed sequence. The TUC cycles individual compressors on and off to provide some modulation of unit capacity. At any one time, the TUC cycles only one compressor. See Appendix A for more information.

If the TUC senses a compressor failure, it logically removes the compressor from the control sequence. Control operation continues with any available compressors.

Note *Multiple compressor control requires the use of the add-on Input/Output Expansion board.*

Economizer Operation

Economizing with a TUC is only possible through the use of a modulating analog or 3-wire floating point economizer. Economizing is not possible with a 2-position outdoor air damper.

When the TUC enables the economizer and the unit is in occupied mode, the outdoor air damper modulates between its minimum position (editable) and the full open position to maintain space setpoint. If economizer operation is disabled or the unit is in heating mode, the outdoor air damper adjusts to its minimum position.

The TUC controls the outdoor air damper to the full closed position in the following instances:

- when the TUC is in unoccupied mode and not economizing
- during warm up mode
- when the unit supply fan is off due to a latching diagnostic or fan cycling
- when the TUC loses power (spring return actuators return to the full closed position)

To enable economizer operation for a TUC, use one of the following methods:

- Building Automation System
- Temperature Differential
- Dry Bulb Temperature
- Reference Enthalpy

A description of each economizer operation follows:

Building Automation System - The Tracer system can send an economizer mode of auto, enable, or disable. A description of each mode follows:

- **Auto** - The economizer auto mode allows the TUC to make its own economizer enable decision.
- **Enable** - When the Tracer enables economizing, the TUC economizes as necessary regardless of its own economizing feasibility decision.
- **Disable** - The economizer disable mode keeps the TUC from economizing, yet maintains minimum position, regardless of the TUCs outdoor air requirements.

Temperature Differential - If the economizer enable control is temperature differential, the TUC enables the economizer operation when the outdoor air temperature (either local or sent from a Tracer) is more than 10 degrees (F) (adjustable) below the zone temperature. The TUC disables economizer operation when the outdoor air temperature is five degrees (F) or more above the enable temperature.

Example *If the economizer enable control value is 10° F and the zone temperature is 72° F, economizer operation is enabled below 62° F and disabled above 67° F.*

Temperature differential range for the economizer enable control value is 6° to 18° F.

Dry Bulb Temperature - If the economizer enable control is dry bulb temperature, the TUC enables the economizer operation when the outdoor air temperature (either local or sent from a Tracer) is below the economizer enable control value (adjustable). The TUC disables economizer operation when the outdoor air temperature is five degrees (F) or more above the enable temperature. Dry bulb temperature range for the economizer enable control value is 31° to 100° F.

Reference Enthalpy - If the economizer enable control is reference enthalpy, the TUC enables the economizer operation when the outdoor air enthalpy (either local or sent from Tracer) is below the economizer enable control value (adjustable). Reference enthalpy range for the economizer enable control value is 19 to 30 Btu/lbm.

Note *Currently, the TUC does not support reference enthalpy. If the TUC is configured with an economizer enable control value in the range of 19 to 30, the unit uses 18 degrees temperature differential.*

Economizer Configurations

This section covers TUC units with outdoor air dampers. The following outdoor air damper configurations are available for the TUC:

- No economizer present
- 2-position outdoor air damper (not an economizer)
- Modulating analog
  - 2 to 10 VDC
  - 6 to 9 VDC
  - 0 to 10 VDC
- 3-wire floating point

In all configurations, except 3-wire floating point, you can configure the economizer to be either normally open (N.O.) or normally closed (N.C.). Table 11 summarizes the output control for the various voltage combinations.

Note *3-wire floating point configurations do not use the normally open (N.O.) or normally closed (N.C.) options.*

Table 11 Output Control for Economizer Configurations

Outdoor Air Damper Type	Normally Closed Operation	Normally Open Operation
2-position (On/Off)	Actuate to open	Actuate to close
Modulating	Increase output to open	Increase output to close

ASHRAE Cycle I Conformance

ASHRAE Cycle I admits 100% outdoor air at all times except during a warm up cycle. To implement Cycle I, set the occupied outdoor air minimum damper position to 100% open. Enabling damper closure during warm up (occupied preheat damper position closed) allows the TUC to achieve ASHRAE Cycle I conformance. If no heating capacity is present and the zone temperature drops three degrees (F) below the heating setpoint, the TUC closes the outdoor air damper regardless of the occupied preheat damper position.

ASHRAE Cycle II Conformance

To meet ASHRAE Cycle II, edit the occupied preheat damper position to closed to allow the outdoor air damper to close during the warm up mode. If ventilation requirements supersede temperature recovery, the TUC can open the damper during preheat. If no heating capacity is present and the zone temperature drops three degrees (F) below the heating setpoint, the TUC closes the outdoor air damper regardless of the occupied preheat damper position.

If ASHRAE Cycle II is enabled (occupied preheat damper position closed), the outdoor air damper remains closed during the transition from unoccupied to occupied until the zone temperature is within two degrees (F) of the heating setpoint. If the zone temperature falls three degrees (F) or more below the heating setpoint during the occupied mode, the TUC reinitiates ASHRAE Cycle II until the zone temperature is within two degrees (F) of the heating setpoint.

Table 12 Relationship between Outdoor Air Temperature Sensors and Damper Position

Operation	2-position Outdoor Air Damper		Modulating Outdoor Air Damper	
	Occupied	Unoccupied	Occupied	Unoccupied
No outdoor air temperature	Open	Closed	Open to minimum position	Closed
Failed outdoor air sensor	Open	Closed	Open to minimum position	Closed
Outdoor air temperature present and economizing feasible	Open	Open during unit operation - otherwise closed	Economizing	Open and economizing during unit operation - otherwise closed
Outdoor air temperature present and economizing not feasible	Open	Closed	Open to minimum position	Closed

Similar to the ASHRAE Cycle II warm up sequence, the TUC can initiate a cool down sequence during the transition from unoccupied to occupied. If ASHRAE Cycle II is enabled, the outdoor air damper remains closed during the transition from unoccupied to occupied until the zone temperature is within two degrees (F) of the cooling setpoint (maximum duration of one hour). The TUC does not reinitiate the cool down sequence during the occupied mode.

ASHRAE Cycle III Conformance

The TUC does not accommodate ASHRAE Cycle III conformance.

Outdoor Air Sensor Failure Operation

A valid outdoor air temperature is required for normal economizer operation. If no outdoor air temperature sensor exists and no value is communicated from the Tracer, economizing is not possible. Also, if no outdoor air value exists and freeze avoidance is enabled, the TUC assumes a cold outdoor air temperature.

Economizer Minimum Position

For 2-position outdoor air dampers, the damper remains fully open during the occupied mode (when the supply fan is on) and fully closed during the unoccupied mode. If night purge requires outdoor air during unoccupied operation, the TUC operates the damper to full open position.

For modulating outdoor air dampers, the Tracer communicates the minimum damper position or when no Tracer is present, the TUC uses the default minimum damper position. If the Tracer is present and in control, the TUC uses the minimum damper position sent from the Tracer. If a Tracer is not present or not in control (standalone TUC), the TUC uses the locally stored default minimum outdoor air damper position (editable).

Economizer Calibration

Calibration of the modulating outdoor air damper is a normal and ongoing process. The economizer position for a 3-wire floating point economizer is based on the TUC's triac output drive time.

When the TUC requests an economizer position of either zero or 100%, the TUC overdrives the output by 110% of the stroke time to make sure the damper has reached the end position.

Whenever the TUC generates an output position request of zero or 100%, the unit calibrates modulating outputs by overdriving the economizer.

For a modulating analog economizer, the TUC determines the position of the economizer by accurately controlling the output signal to the actuator. For a 6 to 9 VDC actuator, the TUC overdrives the economizer by producing an output signal of 0 VDC instead of 6 VDC and 10 VDC instead of 9 VDC. By overdriving the economizer, the TUC makes sure the motor drives to each end position.

Face and Bypass Damper Operation

2-pipe Heating or Cooling

Note *Hot water means the entering water temperature is five degrees (F) or more above the zone temperature. Cold water means the entering water temperature is five degrees (F) or more below the zone temperature.*

If the TUC is in heating mode and there is hot water available, the face and bypass damper modulates to maintain the heating setpoint. If the TUC is in cooling mode, there is cold water available, and the economizer fails to satisfy comfort requirements, the TUC modulates the face and bypass damper to maintain the cooling setpoint. If the available water is too cold to heat or too hot to cool, the TUC controls the face and bypass damper to full bypass.

Example *If the TUC is in heating mode and there is cold water in the pipe, the face and bypass damper is controlled to full bypass. If the TUC is in cooling mode and only hot water is in the pipe, the face and bypass damper is controlled to full bypass.*

4-pipe Heating or Cooling

In heating mode, the face and bypass damper modulates to maintain the heating setpoint and fully closes the cooling valve.

In cooling mode, the TUC first attempts to control the space to the zone setpoint by using the economizer (if there is an economizer). Next, the TUC modulates the face and bypass damper to maintain the zone temperature cooling setpoint and closes the heating valve.

Note *For face and bypass operation, you must configure Valve 1 and Valve 2 as* ***Solenoid On/Off****. For all configurations utilizing the entering water temperature sensor, if the sensor fails or is not present, the assumed water temperature is based on Table 17 on page 33.*

Reversing Valve Operation

The TUC uses a binary output to control the reversing valve state. The reversing valve output is energized in cooling mode. For cooling, the reversing valve is energized at the same time the compressor is controlled on. The reversing valve remains energized until the TUC initiates a heating cycle.

After compressor shutdown, the TUC avoids immediate reversing valve operation to reduce noise due to refrigeration migration. The reversing valve changes state only when the TUC controls the compressor to the on state.

For cooling, the TUC energizes the compressor output and the reversing valve output simultaneously.
For heating, the TUC energizes the compressor output at the same time the reversing valve output is de-energized. When a power failure occurs, the reversing valve output defaults to the heating (de-energized) mode.

Electric Heat Operation

Each TUC may have up to three stages of electric heat. See the tables below.

Table 13 Electric Heat Percentages for Equally Sized Elements

Unit Description	Stage 1 Element Size	Stage 2 Element Size	Stage 3 Element Size
Two Stages	50%	50%	None
Three Stages	33%	33%	33%

Note: For equally sized electric heat elements, select **Sequential** as the staging algorithm.

Table 14 Electric Heat Percentages for Progressively Sized Elements

Unit Description	Stage 1 Element Size	Stage 2 Element Size	Stage 3 Element Size
Two Stages	33%	66%	None

Note: For progressively sized electric heat elements, select **Progressive** as the staging algorithm.

For a summary of the electric heat operation for zone temperature based capacity control, see Table 15 and Appendix A.

The TUC controls PWM (pulse-width modulation) outputs by calculating the output on or off time based in the capacity request and the electric heat cycles per hour value.

Example *If the electric heat cycles per hour is configured for six cycles, as Trane recommends, the TUC bases the output on or off time on six 10-minute periods. If the capacity request is 40%, the TUC controls the electric heat output on for approximately four minutes each period.*

The TUC uses the electric heat cycles per hour value only to calculate the approximate on/off times for the electric heat. The TUC does not prevent the electric heat from cycling on and off more times than the cycles per hour value.

For a summary of electric heat control for discharge air temperature control, see Table 16 and Appendix A.

For the TUC to correctly control its outputs for electric heat control, configure electric heat in the TUC as either the primary source of heat or as a secondary source of heat. For complete information on configuring the electric heat outputs, see the Configuration section of this guide.

Table 15 Zone Temperature Control for Electric Heat

Number of Physical Stages	Staging Algorithm	Capacity Increment	General Staging Criteria	State 0	State 1	State 2	State 3	State 4	State 5	State 6
1	Sequential or Progressive	100%	PWM	Off	1 PWM	1 On				
2	Sequential	50% (50%, 50%)	0 to 50% PWM1 60 to 100% 1 and PWM2	Off	1 PWM 2 Off	1 On 2 Off	1 On 2 PWM	1 On 2 On		
2	Progressive	33% (33%, 66%)	0 to 33% PWM1 33 to 66% PWM1 and PWM2 66 to 100% 2 and PWM1	Off	1 PWM 2 Off	1 On 2 Off	1 PWM 2 PWM ❶	1 Off 2 On	1 PWM 2 On	1 On 2 On
3	Sequential	33% (33%, 33%, 33%)	0 to 33% PWM1 33 to 66% 1 and PWM2 66 to 100% 1, 2, and PWM3	Off	1 PWM 2 Off 3 Off	1 On 2 Off 3 Off	1 On 2 PWM 3 Off	1 On 2 On 3 Off	1 On 2 On 3 PWM	1 On 2 On 3 On

❶ Simultaneous PWM is done by inverting the logic sense to the smaller electric heater. While the 66% heater changes from 0% to 100% as demand increases, the 33% heater changes from 100% to 0%. Both outputs are never on at the same time.

Table 16 Discharge Air Temperature Control enabled with Electric Heat

Number of Physical Stages	Staging Algorithm	Capacity Increment	State 0	State 1	State 2	State 3
1	Sequential or Progressive	100%	1 Off	1 On		
2	Sequential	50% (50%, 50%)	1 Off 2 Off	1 On 2 Off	1 On 2 On	
2	Progressive	33% (33%, 66%)	1 Off 2 Off	1 On 2 Off	1 Off 2 On	1 On 2 On
3	Sequential	33% (33%, 33%, 33%)	1 Off 2 Off 3 Off	1 On 2 Off 3 Off	1 On 2 On 3 Off	1 On 2 On 3 On

Exhaust Fan or Damper Operation

Coordinate exhaust fan or damper operation with the unit fan and outdoor air damper position. When the outdoor air damper position exceeds an adjustable exhaust setpoint, the TUC energizes the exhaust output. During unoccupied periods, the exhaust fan output is only energized when the TUC is economizing.

If the outdoor air damper position is greater than the exhaust setpoint (adjustable), the TUC energizes the exhaust output to on. When the outdoor air damper position is 10% or more below the exhaust setpoint or the outdoor air damper position equals zero, the TUC de-energizes the exhaust output to off.

For unit configurations utilizing the maximum number of TUC outputs, exhaust operation is not available. See the Configuration section of this guide for more information on configuring the TUC for an exhaust output.

Hydronic Purge Operation

The TUC uses hydronic purge in conjunction with auto changeover units by periodically opening the primary water valve (Valve 1) when the entering water temperature is not appropriate for the desired heat or cool mode.

Note *Appropriate entering water temperature for heating is five degrees (F) or more warmer than the zone temperature. For cooling, the entering water temperature must be at least five degrees (F) cooler than the zone temperature.*

When the valve is closed, 2-way valves do not guarantee the correct sensing of the entering water temperature. When the sensed water conditions seem inappropriate for the desired heat or cool mode, the TUC relies on a periodic hydronic purge of the system water. Hydronic purge allows the TUC to accurately sense the entering water temperature. When the TUC enables hydronic purge, the unit opens the valve for three out of every 60 minutes allowing the unit ample time to accurately measure the entering water temperature.

In a Tracer system, the Tracer has the capability of communicating the system water temperature information to the TUCs. If the Tracer communicates a system water temperature to the TUC, purge must be disabled.

For TUCs used in a non-Tracer system, the TUC uses the hydronic purge in the following ways:

- To sample and test entering water temperature for use in waterside economizer (cooling) operation in an attempt to save energy. If a condenser valve is present, the TUC uses the valve to eliminate water economizer operation if the water temperature is too high.
- To make sure entering water temperature has been sampled before the TUC starts a compressor to run heat (for boilerless operation in water source heat pumps).
- To determine if the TUC should disable compressor heating operation due to low water temperature and allow electric heating.
- To determine if the TUC should run the compressor to provide heating. See below:
  - If the entering water temperature is less than the compressor heating disable setpoint, the TUC disables compressor operation
  - If the entering water temperature is greater than the compressor heating disable setpoint, minus four degrees (F), the TUC enables compressor operation.
- To determine if the TUC should run the compressor to provide cooling. See below:
  - If the entering water temperature is greater than the compressor cooling disable setpoint, the TUC disables the compressor.
  - If the entering water temperature is less than the compressor cooling disable setpoint, minus four degrees (F), the TUC enables compressor operation.

Table 17 shows coil temperatures based on unit configurations.

Freeze Avoidance

The freeze avoidance function prevents unit shutdown due to a freeze protection trip during unoccupied or unit shutdown conditions. The TUC compares the active outdoor air temperature to the freeze avoidance setpoint (adjustable). The active outdoor air temperature can come from either a local outdoor air temperature sensor or a Tracer. When the outdoor air temperature is less than the freeze avoidance setpoint, the TUC disables economizing and opens the valves to their full open position.

If the TUC has no active outdoor air temperature value, the TUC assumes cold outdoor air and invokes freeze avoidance (if the freeze avoidance setpoint is 20° F or higher).

The TUC exits freeze avoidance mode when the outdoor air temperature rises three degrees (F) above the freeze avoidance setpoint.

Freeze Protection

Freeze protection is generally provided by a low limit capillary tube present across the water coil face. Cold spots (typically 38° F) below the mechanical trip point of the capillary tube result in a unit shutdown. If a discharge air temperature sensor exists, a discharge air temperature low limit violation can force a unit shutdown. Either shutdown requires a manual reset of the latching diagnostic.

Discharge Air Tempering

The TUC automatically initiates the discharge air tempering function whenever the discharge air temperature falls below the discharge air control minimum, while in the Cool mode.

Discharge air tempering applies enough heat to bring the discharge air temperature up to an acceptable level. Typically, the TUC activates discharge air tempering when the outdoor air temperature is very cold and the outdoor air damper allows enough outdoor air into the unit to cause the discharge air temperature to drop below the discharge air control minimum. In this instance, the TUC supplies enough heat to bring the discharge air temperature above the control minimum.

Table 17 Assumed Water Temperature

Configuration				ICS Control		Operation		
Unit/Valve Type	Auto Changeover	Purge	Local Entering Water Temp.	ICS Entering Water Temp.	ICS Control Mode	Main Coil Control	Main Coil Water Temp.	Auxiliary Coil Water Temp.
2-pipe heat only - Any	Enable/Disable	Enable/Disable	No	No	None/All	Heating	❶	N/A
2-pipe heat only - Any	Disable	Enable/Disable	Yes/No	Yes/No	None/All	Heating	❶	N/A
2-pipe heat only - Any	Enable	Enable/Disable	Yes/No	Yes	None/All	Heating	❷	N/A
2-pipe heat only - 3 Way	Enable	Disable	Yes	No	None/All	Heating	❸	N/A
2-pipe heat only - 2 Way	Enable	Enable	Yes	No	None/All	Heating	❹	N/A
2-pipe cool only - Any	Enable/Disable	Enable/Disable	No	No	None/All	Cooling	❺	N/A
2-pipe cool only - Any	Disable	Enable/Disable	Yes/No	Yes/No	None/All	Cooling	❺	N/A
2-pipe cool only - Any	Enable	Enable/Disable	Yes/No	Yes	None/All	Cooling	❷	N/A
2-pipe cool only - 3 Way	Enable	Disable	Yes	No	None/All	Cooling	❸	N/A
2-pipe cool only - 2 Way	Enable	Enable	Yes	No	None/All	Cooling	❹	N/A
2-pipe heat/cool - Any	Enable	Enable/Disable	No	No	None/Auto	Heating	❶	N/A
2-pipe heat/cool - Any	Enable/Disable	Enable/Disable	No	No	Heating	Heating	❶	N/A
2-pipe heat/cool - Any	Enable/Disable	Enable/Disable	No	No	Cooling	Cooling	❺	N/A
2-pipe heat/cool - Any	Disable	Enable/Disable	Yes/No	Yes/No	None/Auto	Cooling	❺	N/A
2-pipe heat/cool - Any	Disable	Enable/Disable	Yes/No	Yes/No	Heating	Heating	❶	N/A
2-pipe heat/cool - Any	Disable	Enable/Disable	Yes/No	Yes/No	Cooling	Cooling	❺	N/A
2-pipe heat/cool - Any	Enable	Enable/Disable	Yes/No	Yes	None/All	Heat/Cool	❷	N/A
2-pipe heat/cool - 3 Way	Enable	Disable	Yes	No	None/All	Heat/Cool	❸	N/A
2-pipe heat/cool - 2 Way	Enable	Enable	Yes	No	None/All	Heat/Cool	❹	N/A
4-pipe heat/cool - Any	Enable	Enable/Disable	No	No	None/Auto	Heating	❶	Hot
4-pipe heat/cool - Any	Enable	Enable/Disable	No	No	Heating	Heating	❶	Hot
4-pipe heat/cool - Any	Enable/Disable	Enable/Disable	No	No	Cooling	Cooling	❺	Hot
4-pipe heat/cool - Any	Disable	Enable/Disable	Yes/No	Yes/No	None/Auto	Cooling	❺	Hot
4-pipe heat/cool - Any	Disable	Enable/Disable	Yes/No	Yes/No	Heating	Cooling	❺	Hot
4-pipe heat/cool - Any	Disable	Enable/Disable	Yes/No	Yes/No	Cooling	Cooling	❺	Hot
4-pipe heat/cool/heat - Any	Enable	Enable/Disable	Yes/No	Yes	None/All	Heat/Cool	❷	Hot
4-pipe heat/cool/heat - 3 Way	Enable	Disable	Yes	No	None/All	Heat/Cool	❸	Hot
4-pipe heat/cool/heat - 2 Way	Enable	Enable	Yes	No	None/All	Heat/Cool	❹	Hot

Note: Columns with two options mean either choice is possible. If a configuration does not appear in this table, the configuration is not recommended.

❶ Entering water temperature assumed **HOT**.
❷ Entering water temperature provided by ICS system.
❸ Entering water temperature provided by the local entering water temperature sensor.
❹ Entering water temperature checked via the hydronic purge function and local water sensor.
❺ Entering water temperature assumed **COLD**

Power Up Sequence

The power up sequence for a TUC depends on the TUC's configuration. At power up, the TUC may do the following:

1. Perform internal tests.
2. Wait two minutes for ICS (Tracer) communications (selectable).
3. Apply a random start—a three to 32 second delay (selectable).
4. Follow a calibration sequence for the 3-wire floating point actuators (if present) for a length of time approximately equal to the drive time of the 3-wire floating point actuators.

After performing all the above steps (as selected), if properly configured, the TUC performs normal control functions.

If the TUC requests fan operation, the unit fan begins to operate after the random start period expires. If ICS delay or random start delay is not selected (in the unit configuration), the unit fan begins to operate immediately after power up, if commanded on.

If the random start feature is selected, the TUC applies the random time on each transition from unoccupied to occupied before transitioning to normal occupied operation.

At power up, the TUC checks all sensor inputs to verify which inputs have a valid reading. A valid reading means that the sensor input falls in the expected range. See Appendix A for a table of sensor ranges.

If a sensor diagnostic exists, the TUC recognizes a normal sensor reading. When a failed sensor returns to normal, the TUC automatically clears the diagnostic.

After the TUC completes the input verification, the TUC reports a diagnostic anytime one of the sensors is out of range. At power up, the TUC checks for sensors. If a sensor does not exist at power up, the TUC does not report any diagnostics for that sensor.

Night Setback Operation

When the TUC is in unoccupied mode, the unit uses locally stored default unoccupied heating and cooling setpoints (editable). During night setback (unoccupied mode), the TUC controls the unit supply fan off. The TUC controls the unit supply fan on whenever the zone temperature falls outside the unoccupied heating and cooling setpoints.

Warm Up

The TUC enables warm up only when ASHRAE Cycle II is enabled (occupied preheat damper is closed). The TUC initiates warm up at a transition from unoccupied to occupied. In the warm up mode, the TUC disables ventilation, controls the fan to high speed (if the unit has a multiple speed fan), and controls the heating control valve to full open.

The unit continues to deliver its maximum heat capacity to the space until the zone temperature approaches the occupied heating setpoint. When the zone temperature is within two degrees (F) of the heating setpoint, the TUC enables ventilation and normal occupied operation begins.

If the zone temperature falls below the heating setpoint by more than three degrees (F) and the ASHRAE Cycle II is enabled, the TUC automatically reinitiates warm up.

Cool Down

The TUC is capable of a cool down sequence during the transition from unoccupied to occupied. This is similar to the ASHRAE Cycle II warm up sequence.

If ASHRAE Cycle II is enabled, the TUC keeps the outdoor air damper closed during the transition from unoccupied to occupied until the zone temperature is within two degrees (F) of the cooling setpoint. The outdoor air damper remains closed a maximum of one hour. The TUC does not reinitiate the cool down sequence during occupied mode.

Night Purge

Night purge occurs when the Tracer communicates a night purge command to the TUC. The Tracer uses an economizer mode of enable to force the TUC to allow economizing. The supply fan operates at high speed during night purge.

Motion Detection

You can configure a binary input on the TUC for motion detection. When the binary input is configured as a motion detection input, the TUC uses alternate heating and cooling setpoints and an alternate outdoor air minimum damper position whenever the binary input detects no motion in the zone.

Boilerless Operation

In boilerless operation, the water source heat pump uses a sensor to measure the entering water temperature. When the entering water temperature falls below an adjustable setpoint, the unit turns off the compressor. If the zone temperature is still below the heating setpoint, the fan remains on and the water source heat pump energizes a single stage of electric heat.

Indoor Coil Defrost

For DX units, the binary input designated as freezestat is used as a defrost input. Ten minutes after tripping in the cooling mode, the input is treated like a freezestat in hydronic units. If, during cooling, the defrost input trips, compressor cooling is disabled. The binary input remains a freezestat input in the heating mode (for hydronic units only).

Emergency Heat

The purpose of emergency heat is to provide the occupant with an override command to respond to unit capacity limits, recovery, or low space temperatures. Configuration of the TUC allows control of the heating capacity that runs under normal heating commands, plus control of emergency heating commands. With the emergency heat sequence, the TUC invokes the correct combination of electric heat or compressor operation as required by the application. Table 18 summarizes the TUC emergency heat operation.

Table 18 Emergency Heat Operation

Number of Electric Heat Stages (in Normal Heat)	Run compressor in emergency heat?	Normal Heat Staging	Emergency Heat Staging
0	No	Compressor	Compressor
0	Yes	Compressor	Compressor
1	No	Compressor, Electric Heat 1	Electric Heat 1
1	Yes	Compressor, Electric Heat 1	Compressor, Electric Heat 1
2	No	Compressor, Electric Heat 1, Electric Heat 2	Electric Heat 1, Electric Heat 2
2	Yes	Compressor, Electric Heat 1, Electric Heat 2	Compressor, Electric Heat 1, Electric Heat 2

Manual Overrides

By using the Tracer, Everyware service software, or the TUC auto cycle test, you can override the valves and damper outputs on the TUC. The only time you should override these outputs is during the commissioning phase of the job. The overrides should not be present during normal unit operation.

Note *During output override operation, a valve or damper override will terminate normal unit operation (operating mode listed as* **Standby***). Upon release of the override control, normal TUC operation resumes.*

Tracer and Everyware provide the capability to override Valve 1, Valve 2, and the outdoor air damper either open or closed. Also, you can override the exhaust fan on or off. The auto cycle test allows for a manual test of all TUC outputs.

Auto Cycle Test

The auto cycle test allows you to use the DIP switches and the test input on the TUC to manually drive the TUC outputs. The only time you should use this feature is during the commissioning phase of the job to verify end device operation prior to automatic TUC control. For additional information on auto cycle test, see the Human Interface section of this guide.

Zone Sensor Options

Trane zone sensors include the following features:

Temperature Measurement - Each zone sensor uses a 10k Ω thermistor to measure the zone temperature. For unit-mounted zone sensors, the zone temperature thermistor is placed in a remote location, usually near the return air on the unit.

Internal Setpoint Adjustment - Zone sensors with internal setpoint adjustment provide the TUC with a cooling setpoint (50° to 85° F). The setpoint adjustment is concealed under the cover of the zone sensor. To adjust the setpoint, first remove the zone sensor cover.

External Setpoint Adjustment - Zone sensors with external setpoint adjustment provide the TUC with a cooling setpoint (50° to 85° F). The setpoint adjustment is the thumbwheel on the face of the zone sensor.

Fan Switch - The zone sensor fan speed switch provides the TUC with an occupied fan speed request signal (off, low, medium, high, or auto). If the Tracer controls the fan speed, the TUC ignores any adjustments to the fan speed switch.

System Switch - The zone sensor system switch provides the TUC with a system request (Cool, Off, Auto, Heat, or Emergency Heat).

On/Cancel - During unoccupied mode, use the timed override (on) button to place the TUC in occupied (override) mode. To place the TUC in occupied mode for 120 minutes (adjustable), momentarily press the **On** button. The TUC returns to unoccupied mode when 120 minutes expires.

To cancel the timed override request any time during the override period, press the **Cancel** button. You can cancel the timed override any time after you press the **On** button.

Note *For more information about placing the TUC in occupied mode, see the Unit Operation section of this guide.*

Communication Jack - Use the communication jack with Everyware service software to configure and monitor all terminal unit controllers. Wire the RJ-11 communication jack on the zone sensor to the ICS (Tracer) communication terminals on the TUC. The RJ-11 communication jack provides easy access for communication to the TUC and the entire Comm4 link.

Location and Mounting

Locate one zone sensor in the most critical area of each zone, but not in direct sunlight or in the zone supply air stream. You may need to subdivide the zone to ensure adequate control and comfort.

Avoid mounting zone sensors in the following areas:

- near drafts or dead spots
- in corners or behind doors
- near hot or cold air ducts
- near radiant heat from appliances or the sun
- near concealed pipes or chimneys
- in air flows from adjacent zones or other units

Connect each TUC to a single zone sensor; one designed to be compatible with the unit. Make sure field wiring meets the following requirements:

- Wire must be 16 to 22 AWG, copper twisted shielded pair, not to exceed 1000 feet.
- Connect the shield to the ground terminal provided on the TUC (TB3-5 or 6).
- If local codes require enclosed conductors, install the zone sensor wires in conduit.

Note *Do not install zone sensor wires in conduit that contains 24 VAC or high power wires.*

Refer to individual zone sensor wiring diagrams for connection instructions. See Table 19 on page 38 for complete information on zone sensors offered from each Trane manufacturing facility.

Table 19 Zone Sensors from Trane Manufacturing Facilities

Product (Facility)	Zone Sensor	Temperature Measurement	Internal Setpoint Adjustment	External Setpoint Adjustment	Fan Switch	TOV /Cancel	Comm. Jack	Refer to Figure
Water Source Heat Pump (Waco)	X13510628010	X	X				X	9
	X13510606010	X		X			X	9
	X13510606020	X		X		X	X	9
	X13510621010	X		X	1-speed	X	X	10
Unit Ventilator (Waco)	X13510621010	X		X	1-speed	X	X	10
	X13510622010	X		X	2-speed	X	X	10
	X13510630010	X	X		1-speed		X	10
	X13510631010	X	X		2-speed		X	10
	X13510606010	X		X	❷		X	9
	X13510628010	X	X		❷		X	9
	X13510627010	X	X		❷	X	X	9
	X13510606020	X		X	❷	X	X	9
Fan Coil (Macon)	SEN-0376 ❶ X13510601010	X		X	1-speed	X	X	10
	SEN-0392 X13510616010	X		X	1-speed	X	X	10
	SEN-0393 X13510607020	X		X		X	X	9
	SEN-0396 X13510607030	X				X	X	9
Blower Coil Air Handler (Rushville)	SNR1	X		X	1-speed	X	X	10
	SNR2	X		X	2-speed	X	X	10
	SNR3	X		X		X	X	9
	SNR4	X				X	X	9
	SNR5	X						11
Building Automation Systems (St. Paul)	4190 1087	X						11
	4190 1088	X				X	X	9
	4190 1090	X		X		X	X	9

❶ Unit-mounted

❷ The fan switch is mounted at the unit ventilator.

Figure 9 Connections for a 5-wire Terminal Block

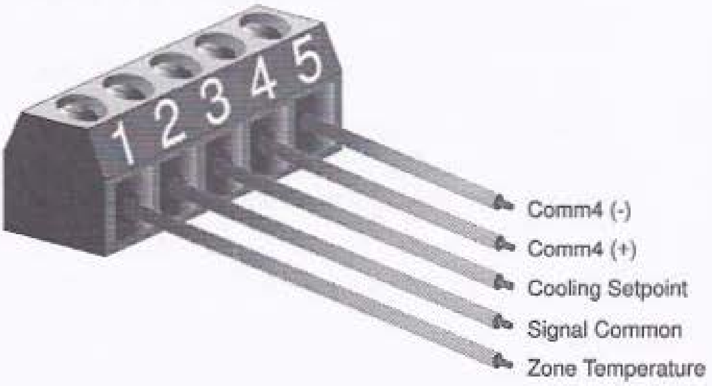


Figure 10 Connections for a 6-wire Terminal Block

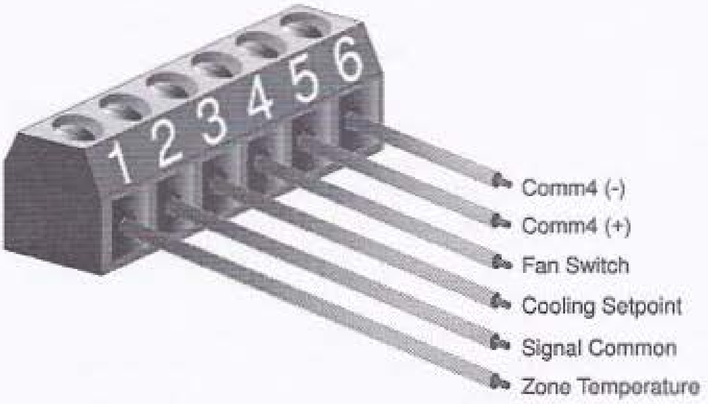
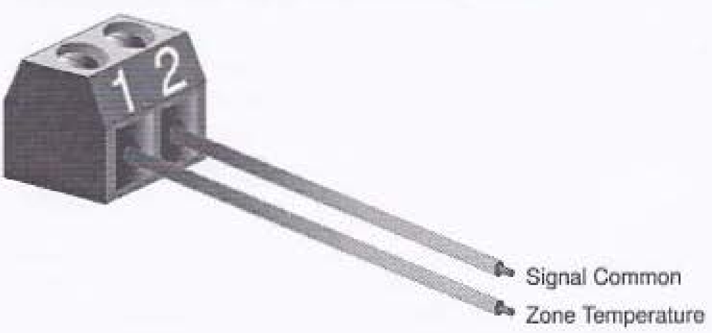


Figure 11 Connections for a 2-wire Terminal Block



Note *Terminate the shield wire for the zone sensor connection on the TUC. Refer to* ***EMTX-IN-24*** *for complete wiring details related to the zone sensor for all TUCs.*

Configuration

Unit Configurations

The TUC is a configurable controller you can use on a variety of Trane and non-Trane terminal products. The TUC consists of the following total inputs and outputs:

- 5 analog inputs (See the note below.)
- 4 binary inputs
- 9 binary (triac) outputs (See the note below.)
- 4 modulating analog outputs

Note *Water source heat pumps are the only configurations that use all five analog inputs. All other units only use analog inputs 1 through 4.*

Note *No unit configuration permits all nine binary outputs to be used concurrently with all four analog outputs. Based on the TUC configuration, the unit uses some combination of binary and analog outputs, but never all of both.*

Some of the inputs and outputs on the TUC are configurable from a fixed list of choices. You can attach add-on boards to the TUC for additional inputs and outputs. Some inputs and outputs on the add-on boards also are configurable.

Depending on the TUC and add-on board configurations, the location of the various inputs and outputs may vary. This section of the guide gives a description of the possible TUC and add-on board configurations, plus a description of how the configuration affects the location of the inputs and outputs.

Note *For an example of wiring connections, see the Wiring Diagrams section of this guide.*

The following descriptions outline the various configuration possibilities for the general product classifications the TUC is capable of controlling.

Unit Type

Configure the TUC as one of the following unit types:

- Fan Coil A (standard fan coil or blower coil air handler)
- Fan Coil B (not used in the United States)
- Unit Ventilator
- Water Source Heat Pump
- Blower Coil Air Handler

Unit Configuration

Set up the TUC using one of the following unit configurations:

- 2-pipe Heating/Cooling Valve (changeover)
- 4-pipe Heat and Cool Valves
- 2-pipe Heat Valve with DX Cooling
- DX Cooling Only
- 2-pipe Face and Bypass Damper
- 4-pipe Face and Bypass Damper
- 2-pipe Cooling Only Valve
- Water Source Heat Pump (heat and cool)
- Face and Bypass with DX Cooling
- 2-pipe Heat Only Valve
- Water Source Heat Pump (cooling only)

Fan Type

Select one of the following fan types for the TUC:

- 1-speed Fan
- 2-speed Fan
- 3-speed Fan
- Modulating Fan (Currently, Trane does not support this function.)

Valve 1 Type

Valve 1 is the primary valve. In 4-pipe units, Valve 1 is typically the cooling valve. If a 4-pipe unit has auto changeover enabled, Valve 1 changes over between cooling and heating. In 2-pipe heat/cool units, Valve 1 is the only valve present. To change the coil (in 2-pipe units) between heating and cooling, enable auto changeover.

For 2-pipe cooling only units, Valve 1 is the cooling valve. You must disable auto changeover. For 2-pipe heating only units, Valve 1 is the heating valve. You must disable auto changeover.

Valve 1 Selections
No valve present
Solenoid on/off (Use for all face and bypass units.)
Modulating analog: 2 to 10 VDC 6 to 9 VDC 0 to 10 VDC
3-wire floating point (drive open/close)

Valve 2 Type

Valve 2 is the auxiliary valve. In 4-pipe units, Valve 2 is always the heating valve. Auto changeover does not affect the configuration of Valve 2. If a 4-pipe unit has auto changeover enabled, Valve 2 operates as the auxiliary heating source. If auto changeover is disabled, Valve 2 operates as the primary heating source. Two-pipe units do not have a Valve 2.

Valve 2 Selections
No valve present
Solenoid on/off (Use for 4-pipe face and bypass units.)
Modulating analog: 2 to 10 VDC 6 to 9 VDC 0 to 10 VDC
3-wire floating point (drive open/close)

Economizer Type

The TUC support the following outdoor air dampers:

- 2-position
- modulating (analog or 3-wire floating point)

Two-position outdoor air dampers cannot economize. Use 2-position outdoor air dampers to provide fresh outdoor air to the space, typically during occupied periods and during night purge. Modulating outdoor air dampers, both modulating analog and 3-wire floating point, can operate as economizers.

Economizer Selections
No economizer present
2-position outdoor air damper (not an economizer)
Modulating analog: 2 to 10 VDC 6 to 9 VDC 0 to 10 VDC
3-wire floating point (drive open/close)

Face and Bypass Type

Face and bypass dampers are available in both 2-pipe and 4-pipe configurations. If a 2-pipe unit has a face and bypass damper, configure Valve 1 as solenoid on/off. If a 4-pipe unit has a Face and Bypass damper, configure valves 1 and 2 as solenoid on/off. The TUC controls the face and bypass damper on the same physical output as Valve 1.

Note *Many configuration items for the face and bypass damper are referred to as Valve 1/Face and Bypass damper.*

Face and Bypass Damper Selections
No Face and Bypass damper present
Modulating analog: 2 to 10 VDC 6 to 9 VDC 0 to 10 VDC
3-wire floating point (drive open/close)

Number of Compressors

The TUC can control up to one compressor on the main TUC board. The unit requires an I/O expansion board if the unit contains two or three compressors.

Compressor Selections			
None	One	Two	Three

Electric Heat Type

Control electric heat from the TUC in one, two, or three stages. Also, you can configure electric heat as the primary source of heat or as the secondary source of heat. Select the electric heat staging algorithm (sequential or progressive) based on the physical configuration of the electric heat in the unit.

Use a sequential staging algorithm for equally sized electric heat stages (two stages, each 50% or three stages, each 33%). Use a progressive staging algorithm for unequally sized electric heat stages (two stages, 33% and 66%). Both staging algorithms work the same for a single stage of electric heat.

Electric Heat Type Selections			
Not present	1 stage	2 stages	3 stages

Electric Heat Source Selections	
Primary (primary electric heat)	Secondary (supplementary electric heat)

Electric Heat Staging Algorithm Selections	
Sequential (equally sized stages)	Progressive (unequally sized stages)

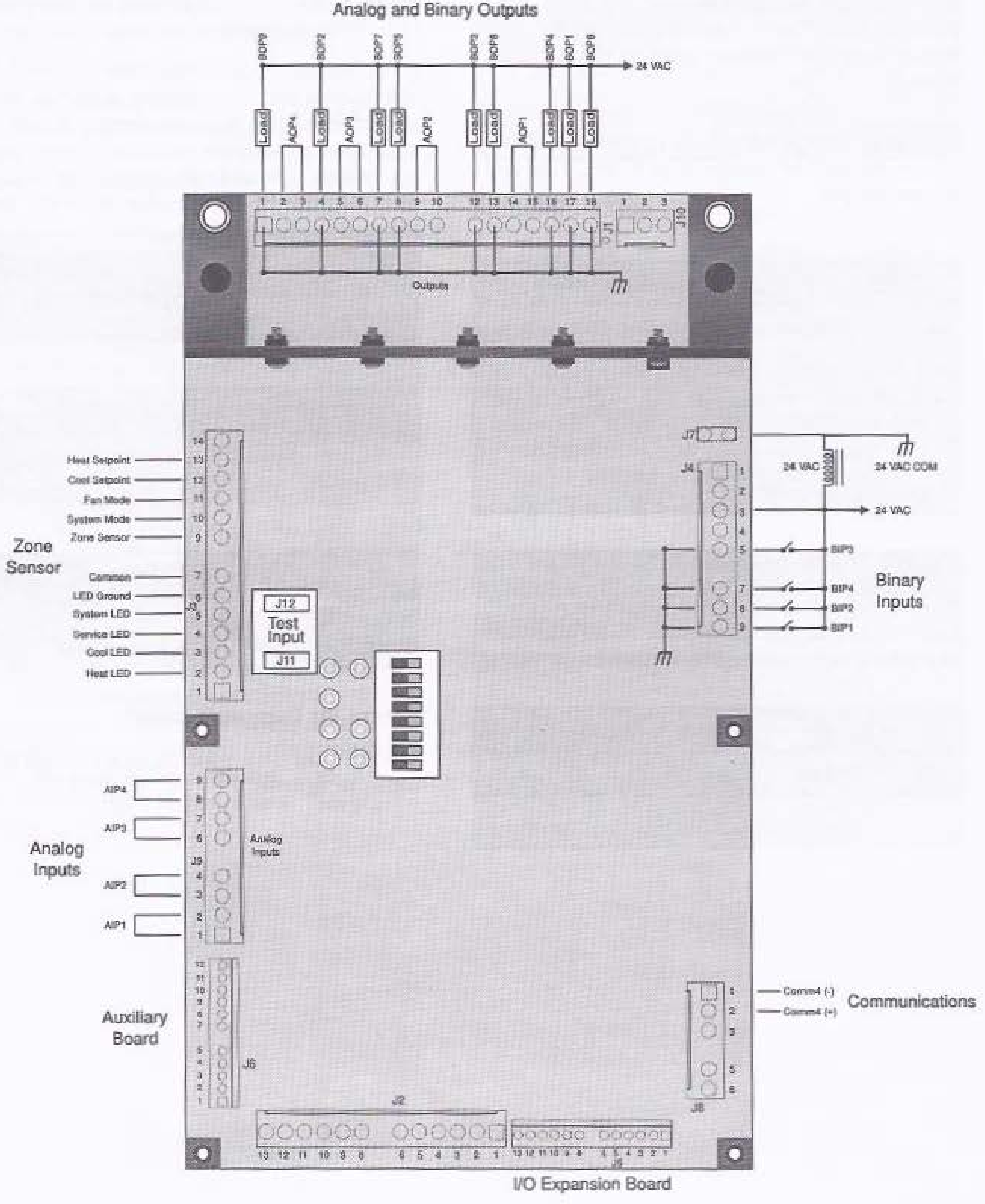
Return Air Damper Present?

The TUC does not support functions related to a return air damper.

Wiring Diagrams

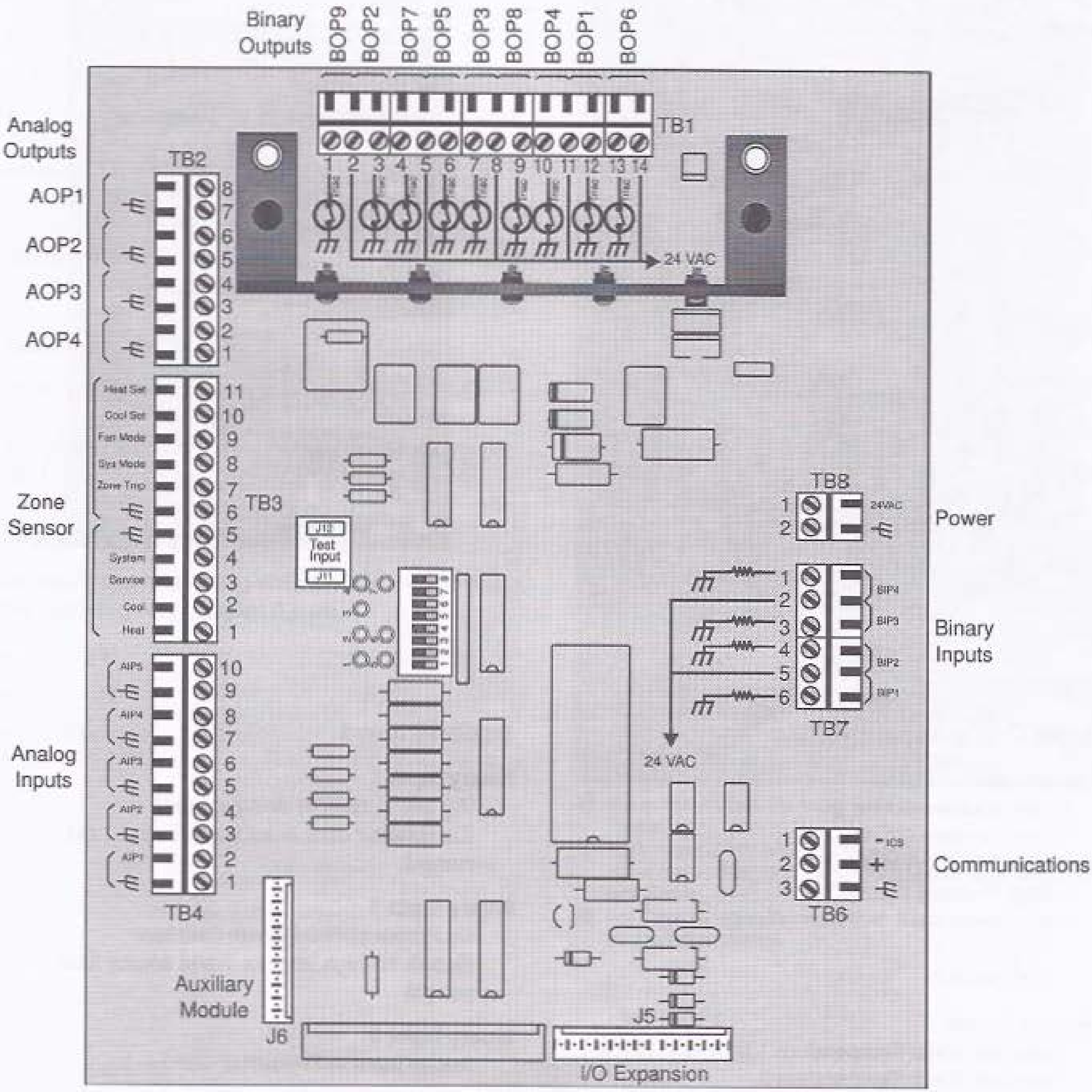
Terminal Unit Controller

Figure 12 Factory-installed Terminal Unit Controller



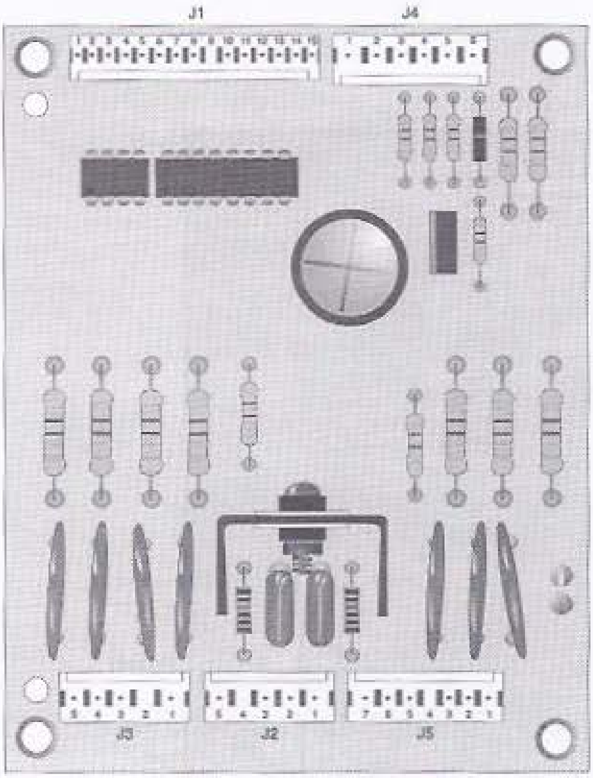
Field-installed Terminal Unit Controller

Figure 13 Field-installed Terminal Unit Controller



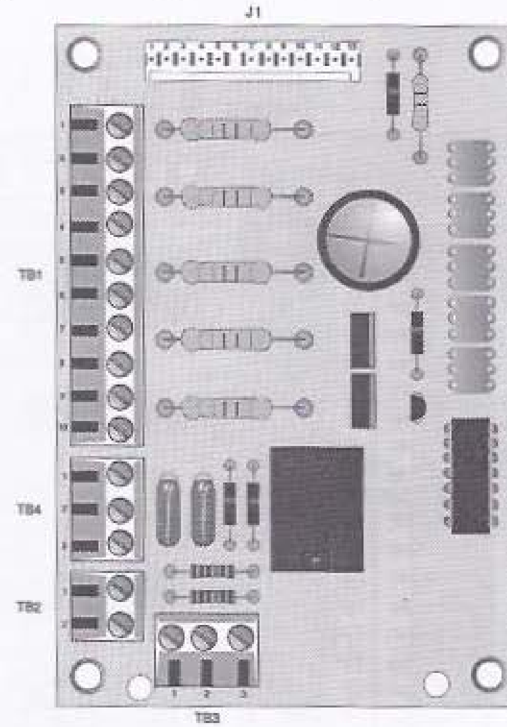
Input/Output Expansion Board

Figure 14 Example of the Input/Output Board



Auxiliary Board

Figure 15 Example of the Auxiliary Board



Input/Output Expansion Board

Binary Inputs

- Low Pressure Cutout 2
- Low Pressure Cutout 3
- High Pressure Cutout 2
- High Pressure Cutout 3
- Freezestat 1
- Freezestat 2
- Freezestat 3

Analog Inputs

- Leaving Water Temperature 1 (See note below.)
- Leaving Water Temperature 2
- Leaving Water Temperature 3

Binary Outputs

- Compressor 2
- Compressor 3

Note *LWT1 normally is connected to the TUC (main board). However, if you use the Input/Output Expansion board, LWT1 is wired to the I/O board.*

Auxiliary Board

Binary Input 1

IAQ Stat (future) or Occupant Call (Compressor disable for water source heat pumps)

Binary Input 2

Occ/Unocc or Condensate Overflow (Return air high limit for water source heat pumps)

Binary Input 3

Smoke Input or Freezestat

Binary Input 4

External Interlock or Fan Status

Binary Input 5

Motion Detection Input or Dirty Filter

Binary Output

Electric Heat, Exhaust, or Slave (Controllable through Tracer)

The TUC consists of the following inputs and outputs:

- 5 analog inputs
- 4 binary inputs
- 9 binary (triac) outputs
- 4 modulating analog outputs

The function of the TUC's inputs and outputs varies depending on the configuration of the TUC. The following tables (Tables 20 - 35) define the binary and analog output functions for the various unit configurations, including zone sensor and Tracer communication information. The tables also provide TUC terminal block wiring connection points.

Triac Outputs

When energized, the TUC provides power to the connected device via triac outputs. A separate 24 VAC power input to the connected device cannot be used, unless that device requires external power.

Modulating Analog Outputs

Configure the modulating analog outputs to provide the following output signal ranges:

- 0-10 VDC
- 2-10 VDC
- 6-9 VDC

Table 20 2-pipe Heat or Cool Valve (Triac and Modulating Outputs)

Triac Output	Factory Installed TUC	Field Installed TUC	Description
1	J1-17	TB1-11, 12	Fan Low
2	J1-4	TB1-2, 3	Fan Medium (Exhaust output if one or two speed fan)
3	J1-12	TB1-7, 8	Fan High (Fan on if one speed fan)
4	J1-16	TB1-10, 11	Valve Open ❶
5	J1-8	TB1-5, 6	Valve Close
6	J1-18	TB1-13, 14	Electric Heat #1
7	J1-7	TB1-4, 5	Outdoor Air Damper Close/Alarm ❷
8	J1-13	TB1-8, 9	Outdoor Air Damper Open ❸
9	J1-1	TB1-1, 2	Electric Heat #2
Analog Output	**Factory Installed TUC**	**Field Installed TUC**	**Description**
1	J1-14, 15	TB2-7, 8	Not used
2	J1-9, 10	TB2-5, 6	Modulating Valve
3	J1-5, 6	TB2-3, 4	Not used
4	J1-2, 3	TB2-1, 2	Modulating Outdoor Air Damper ❷

❶ Use output 4 when the valve is configured for 2-position control.
❷ Triac output 7 is a latching diagnostic indication output when the outdoor air damper is configured as analog modulating.
❸ Use output 8 when the outdoor air damper is configured for 2-position control.

Table 21 4-pipe Heat and Cool Valve (Triac and Modulating Outputs)

Triac Output	Factory Installed TUC	Field Installed TUC	Description
1	J1-17	TB1-11, 12	Fan Low
2	J1-4	TB1-2, 3	Fan Medium (Exhaust output if one or two speed fan)
3	J1-12	TB1-7, 8	Fan High (Fan on if one speed fan)
4	J1-16	TB1-10, 11	Main Cool Valve Open ❶
5	J1-8	TB1-5, 6	Main Cool Valve Close
6	J1-18	TB1-13, 14	Auxiliary Heat Valve Open ❷
7	J1-7	TB1-4, 5	Outdoor Air Damper Close/Alarm ❸
8	J1-13	TB1-8, 9	Outdoor Air Damper Open ❹
9	J1-1	TB1-1, 2	Auxiliary Heat Valve Close
Analog Output	**Factory Installed TUC**	**Field Installed TUC**	**Description**
1	J1-14, 15	TB2-7, 8	Not used
2	J1-9, 10	TB2-5, 6	Main Cool Modulating Valve
3	J1-5, 6	TB2-3, 4	Auxiliary Heat Modulating Valve
4	J1-2, 3	TB2-1, 2	Modulating Outdoor Air Damper ❸

❶ Use output 4 when the main valve is configured for 2-position control.
❷ Use output 6 when the auxiliary valve is configured for 2-position control.
❸ Triac output 7 is a latching diagnostic indication output when the outdoor air damper is configured as analog modulating.
❹ Use output 8 when the outdoor air damper is configured for 2-position control.

Table 22 2-pipe Heat Valve with DX Cooling (Triac and Modulating Outputs)

Triac Output	Factory Installed TUC	Field Installed TUC	Description
1	J1-17	TB1-11, 12	Fan Low
2	J1-4	TB1-2, 3	Fan Medium (Exhaust output if one or two speed fan)
3	J1-12	TB1-7, 8	Fan High (Fan on if one speed fan)
4	J1-16	TB1-10, 11	Valve Open ❶
5	J1-8	TB1-5, 6	Valve Close
6	J1-18	TB1-13, 14	DX Cooling
7	J1-7	TB1-4, 5	Outdoor Air Damper Close/Alarm ❷
8	J1-13	TB1-8, 9	Outdoor Air Damper Open ❸
9	J1-1	TB1-1, 2	Electric Heat #1
Analog Output	**Factory Installed TUC**	**Field Installed TUC**	**Description**
1	J1-14, 15	TB2-7, 8	Not used
2	J1-9, 10	TB2-5, 6	Modulating Valve
3	J1-5, 6	TB2-3, 4	Not used
4	J1-2, 3	TB2-1, 2	Modulating Outdoor Air Damper ❷

❶ Use output 4 when the valve is configured for 2-position control.
❷ Triac output 7 is a latching diagnostic indication output when the outdoor air damper is configured as analog modulating.
❸ Use output 8 when the outdoor air damper is configured for 2-position control.

Table 23 DX Cooling (Triac and Modulating Outputs)

Triac Output	Factory Installed TUC	Field Installed TUC	Description
1	J1-17	TB1-11, 12	Fan Low
2	J1-4	TB1-2, 3	Fan Medium (Exhaust output if one or two speed fan)
3	J1-12	TB1-7, 8	Fan High (Fan on if one speed fan)
4	J1-16	TB1-10, 11	Electric Heat #1
5	J1-8	TB1-5, 6	Electric Heat #2
6	J1-18	TB1-13, 14	DX Cooling
7	J1-7	TB1-4, 5	Outdoor Air Damper Close/Alarm ❶
8	J1-13	TB1-8, 9	Outdoor Air Damper Open ❷
9	J1-1	TB1-1, 2	Electric Heat #3
Analog Output	**Factory Installed TUC**	**Field Installed TUC**	**Description**
1	J1-14, 15	TB2-7, 8	Not used
2	J1-9, 10	TB2-5, 6	Not used
3	J1-5, 6	TB2-3, 4	Not used
4	J1-2, 3	TB2-1, 2	Modulating Outdoor Air Damper ❶

❶ Triac output 7 is a latching diagnostic indication output when the outdoor air damper is configured as analog modulating.
❷ Use output 8 when the outdoor air damper is configured for 2-position control.

Table 24 2-pipe Face and Bypass Damper (Triac and Modulating Outputs)

Triac Output	Factory Installed TUC	Field Installed TUC	Description
1	J1-17	TB1-11, 12	Fan Low
2	J1-4	TB1-2, 3	Fan Medium (Exhaust output if one or two speed fan)
3	J1-12	TB1-7, 8	Fan High (Fan on if one speed fan)
4	J1-16	TB1-10, 11	Face and Bypass Damper Open (Face) ❶
5	J1-8	TB1-5, 6	Face and Bypass Damper Close (Bypass)
6	J1-18	TB1-13, 14	Main Valve Open/Close
7	J1-7	TB1-4, 5	Outdoor Air Damper Close/Alarm ❷
8	J1-13	TB1-8, 9	Outdoor Air Damper Open ❸
9	J1-1	TB1-1, 2	Electric Heat #1
Analog Output	**Factory Installed TUC**	**Field Installed TUC**	**Description**
1	J1-14, 15	TB2-7, 8	Not used
2	J1-9, 10	TB2-5, 6	Modulating Face and Bypass Damper
3	J1-5, 6	TB2-3, 4	Not used
4	J1-2, 3	TB2-1, 2	Modulating Outdoor Air Damper ❷

❶ Use output 4 when the face and bypass damper is configured for 2-position control.
❷ Triac output 7 is a latching diagnostic indication output when the outdoor air damper is configured as analog modulating.
❸ Use output 8 when the outdoor air damper is configured for 2-position control.

Table 25 4-pipe Face and Bypass Damper (Triac and Modulating Outputs)

Triac Output	Factory Installed TUC	Field Installed TUC	Description
1	J1-17	TB1-11, 12	Fan Low
2	J1-4	TB1-2, 3	Fan Medium (Exhaust output if one or two speed fan)
3	J1-12	TB1-7, 8	Fan High (Fan on if one speed fan)
4	J1-16	TB1-10, 11	Face and Bypass Damper Open (Face) ❶
5	J1-8	TB1-5, 6	Face and Bypass Damper Close (Bypass)
6	J1-18	TB1-13, 14	Main Coil Open/Close
7	J1-7	TB1-4, 5	Outdoor Air Damper Close/Alarm ❷
8	J1-13	TB1-8, 9	Outdoor Air Damper Open ❸
9	J1-1	TB1-1, 2	Auxiliary Coil Open/Close
Analog Output	**Factory Installed TUC**	**Field Installed TUC**	**Description**
1	J1-14, 15	TB2-7, 8	Not used
2	J1-9, 10	TB2-5, 6	Modulating Face and Bypass Damper
3	J1-5, 6	TB2-3, 4	Not used
4	J1-2, 3	TB2-1, 2	Modulating Outdoor Air Damper ❷

❶ Use output 4 when the face and bypass damper is configured for 2-position control.
❷ Triac output 7 is a latching diagnostic indication output when the outdoor air damper is configured as analog modulating.
❸ Use output 8 when the outdoor air damper is configured for 2-position control.

Table 26 2-pipe Cool Valve (Triac and Modulating Outputs)

Triac Output	Factory Installed TUC	Field Installed TUC	Description
1	J1-17	TB1-11, 12	Fan Low
2	J1-4	TB1-2, 3	Fan Medium (Exhaust output if one or two speed fan)
3	J1-12	TB1-7, 8	Fan High (Fan on if one speed fan)
4	J1-16	TB1-10, 11	Valve Open ❶
5	J1-8	TB1-5, 6	Valve Close
6	J1-18	TB1-13, 14	Electric Heat #1
7	J1-7	TB1-4, 5	Outdoor Air Damper Close/Alarm ❷
8	J1-13	TB1-8, 9	Outdoor Air Damper Open ❸
9	J1-1	TB1-1, 2	Electric Heat #2
Analog Output	**Factory Installed TUC**	**Field Installed TUC**	**Description**
1	J1-14, 15	TB2-7, 8	Not used
2	J1-9, 10	TB2-5, 6	Modulating Valve
3	J1-5, 6	TB2-3, 4	Not used
4	J1-2, 3	TB2-1, 2	Modulating Outdoor Air Damper ❷

❶ Use output 4 when the valve is configured for 2-position control.
❷ Triac output 7 is a latching diagnostic indication output when the outdoor air damper is configured as analog modulating.
❸ Use output 8 when the outdoor air damper is configured for 2-position control.

Table 27 2-pipe Heat Valve (Triac and Modulating Outputs)

Triac Output	Factory Installed TUC	Field Installed TUC	Description
1	J1-17	TB1-11, 12	Fan Low
2	J1-4	TB1-2, 3	Fan Medium (Exhaust output if one or two speed fan)
3	J1-12	TB1-7, 8	Fan High (Fan on if one speed fan)
4	J1-16	TB1-10, 11	Valve Open ❶
5	J1-8	TB1-5, 6	Valve Close
6	J1-18	TB1-13, 14	Electric Heat #1
7	J1-7	TB1-4, 5	Outdoor Air Damper Close/Alarm ❷
8	J1-13	TB1-8, 9	Outdoor Air Damper Open ❸
9	J1-1	TB1-1, 2	Electric Heat #2
Analog Output	**Factory Installed TUC**	**Field Installed TUC**	**Description**
1	J1-14, 15	TB2-7, 8	Not used
2	J1-9, 10	TB2-5, 6	Modulating Valve
3	J1-5, 6	TB2-3, 4	Not used
4	J1-2, 3	TB2-1, 2	Modulating Outdoor Air Damper ❷

❶ Use output 4 when the valve is configured for 2-position control.
❷ Triac output 7 is a latching diagnostic indication output when the outdoor air damper is configured as analog modulating.
❸ Use output 8 when the outdoor air damper is configured for 2-position control.

Table 28 Face and Bypass with DX Cooling (Triac and Modulating Outputs)

Triac Output	Factory Installed TUC	Field Installed TUC	Description
1	J1-17	TB1-11, 12	Fan Low
2	J1-4	TB1-2, 3	Fan Medium (Exhaust output if one or two speed fan)
3	J1-12	TB1-7, 8	Fan High (Fan on if one speed fan)
4	J1-16	TB1-10, 11	Face and Bypass Damper Open (Face) ❶
5	J1-8	TB1-5, 6	Face and Bypass Damper Close (Bypass)
6	J1-18	TB1-13, 14	DX Cooling
7	J1-7	TB1-4, 5	Outdoor Air Damper Close/Alarm ❷
8	J1-13	TB1-8, 9	Outdoor Air Damper Open ❸
9	J1-1	TB1-1, 2	Valve Open/Close
Analog Output	**Factory Installed TUC**	**Field Installed TUC**	**Description**
1	J1-14, 15	TB2-7, 8	Not used
2	J1-9, 10	TB2-5, 6	Modulating Face and Bypass Damper
3	J1-5, 6	TB2-3, 4	Not used
4	J1-2, 3	TB2-1, 2	Modulating Outdoor Air Damper ❷

❶ Use output 4 when the face and bypass damper is configured for 2-position control.
❷ Triac output 7 is a latching diagnostic indication output when the outdoor air damper is configured as analog modulating.
❸ Use output 8 when the outdoor air damper is configured for 2-position control.

Table 29 Water Source Heat Pump - Heating and Cooling (Triac and Modulating Outputs)

Triac Output	Factory Installed TUC	Field Installed TUC	Description
1	J1-17	TB1-11, 12	Fan Low
2	J1-4	TB1-2, 3	Fan Medium (Exhaust output if one or two speed fan)
3	J1-12	TB1-7, 8	Fan High (Fan on if one speed fan)
4	J1-16	TB1-10, 11	Water Regulating Valve/Water Pump /Condenser Water
5	J1-8	TB1-5, 6	Reversing Valve
6	J1-18	TB1-13, 14	Compressor #1
7	J1-7	TB1-4, 5	Outdoor Air Damper Close/Alarm ❶
8	J1-13	TB1-8, 9	Outdoor Air Damper Open ❷
9	J1-1	TB1-1, 2	Electric Heat #1
Analog Output	**Factory Installed TUC**	**Field Installed TUC**	**Description**
1	J1-14, 15	TB2-7, 8	Not used
2	J1-9, 10	TB2-5, 6	Not used
3	J1-5, 6	TB2-3, 4	Not used
4	J1-2, 3	TB2-1, 2	Modulating Outdoor Air Damper ❶

❶ Triac output 7 is a latching diagnostic indication output when the outdoor air damper is configured as analog modulating.
❷ Use output 8 when the outdoor air damper is configured for 2-position control.

Table 30 Water Source Heat Pump - Cooling Only (Triac and Modulating Outputs)

Triac Output	Factory Installed TUC	Field Installed TUC	Description
1	J1-17	TB1-11, 12	Fan Low
2	J1-4	TB1-2, 3	Fan Medium (Exhaust output if one or two speed fan)
3	J1-12	TB1-7, 8	Fan High (Fan on if one speed fan)
4	J1-16	TB1-10, 11	Water Regulating Valve/Water Pump /Condenser Water
5	J1-8	TB1-5, 6	Not used
6	J1-18	TB1-13, 14	Compressor #1
7	J1-7	TB1-4, 5	Outdoor Air Damper Close/Alarm ❶
8	J1-13	TB1-8, 9	Outdoor Air Damper Open ❷
9	J1-1	TB1-1, 2	Electric Heat #1
Analog Output	**Factory Installed TUC**	**Field Installed TUC**	**Description**
1	J1-14, 15	TB2-7, 8	Not used
2	J1-9, 10	TB2-5, 6	Not used
3	J1-5, 6	TB2-3, 4	Not used
4	J1-2, 3	TB2-1, 2	Modulating Outdoor Air Damper ❶

❶ Triac output 7 is a latching diagnostic indication output when the outdoor air damper is configured as analog modulating.
❷ Use output 8 when the outdoor air damper is configured for 2-position control.

Analog and Binary Inputs

The TUC only uses 10k Ω thermistor inputs for temperature detection on each of the analog inputs. The TUC senses binary inputs open/close by checking for the absence or presence of 24 VAC.

The factory installed TUC (pin/plug) requires an externally supplied 24 VAC source for the binary inputs. The field installed TUC (screw terminals) provides the necessary power on the unit, so only open/close contacts need to be provided.

Table 31 shows a list of analog inputs and Table 32 shows binary inputs. Table 33 shows the recommended configuration for each binary input.

Table 31 Analog Inputs

Analog Input	Factory Installed TUC	Field Installed TUC	Fan Coil/Unit Vent/Blower Coil	Water Source Heat Pump
AIP1	J9-1, 2	TB4-1, 2	Supply Air Temperature	Supply Air Temperature
AIP2	J9-3, 4	TB4-3, 4	Entering Water Temperature	Leaving Water Temperature
AIP3	J9-6, 7	TB4-5, 6	Outdoor Air Temperature	Entering Water or Return Air Temperature (Configurable)
AIP4	J9-8, 9	TB4-7, 8	Mixed Air Temperature	Mixed Air or Return Air Temperature (Configurable)
AIP5	J2-5, 11 ❶	TB4-9, 10	Not Applicable	Outdoor Air Temperature

❶ J2-9, 10 must be shorted.

Table 32 Binary Inputs

Binary Input	Factory Installed TUC	Field Installed TUC	Fan Coil/Unit Vent/Blower Coil	Water Source Heat Pump
BIP1	J4-9 ❶	TB7-5, 6	Fan Status or External Interlock (Configurable)	High Pressure Cutout #1
BIP2	J4-8 ❶	TB7-4, 5	Dirty Filter or Motion Detection (Configurable)	Dirty Filter or Occupied/Unoccupied (Configurable)
BIP3	J4-5 ❶	TB7-2, 3	Condensate Overflow or Occupied/Unoccupied (Configurable)	Condensate Overflow or Occupied/Unoccupied (Configurable)
BIP4	J4-7 ❶	TB7-1, 2	Freezestat or Smoke (Configurable)	Low Pressure Cutout #1

❶ 24 VAC is provided externally.

Table 33 Recommended binary configuration for commonly applied contact closure devices

Input Function	Input Configuration	Contact Closure	Contact Open
Fan Status	Normally Open	Normal Operation	Fan Failure
Freezestat	Normally Closed	Normal Operation	Shutdown
Dirty Filter	Normally Open	Dirty Filter	Filter Clean
Occupied/Unoccupied	Normally Open	Unoccupied	Occupied
Compressor Disable	Normally Open	Compressor Disable	Compressor Enable
High Return Air Temperature	Normally Closed	Normal Operation	Shutdown
External Interlock	Normally Closed	Normal Operation	Stop Unit
Motion Detector	Normally Open	Motion Detected	No Motion
Smoke Input	Normally Closed	Normal Operation	Smoke Detected
Condensate Overflow	Normally Closed	Normal Operation	Shutdown
Occupant Call	Normally Open	Occupant Call	Normal Operation
IAQ Stat	Normally Open	Start IAQ Function	Normal Operation
High Pressure Cutout	Normally Closed	Normal Operation	High Pressure
Low Pressure Cutout	Normally Closed	Normal Operation	Low Pressure

Zone Sensor and Tracer Communication

The number of terminations required for a zone sensor depends on the selected sensor. A variety of zone sensors exist, ranging from a sensor only option to a fully-populated zone sensor with setpoint adjustment, LEDs, and fan and system switches.

Use the ICS (Tracer) communication terminals to connect the TUC to either a Tracer 100i or Tracer L Comm4 communication link or a Tracer Summit Comm4 communication link.

Table 34 shows the connection information for ICS communication to the TUC. Table 35 shows the list of zone sensor termination details.

Table 34 Tracer Communication

Link	Factory Installed TUC	Field Installed TUC
Comm4 (-)	J8-1	TB6-1
Comm4 (+)	J8-2	TB6-2
Comm4 (Shield)	Chassis Ground	TB6-3 ❶

❶ Tape back the shield at the Tracer end.

Table 35 Zone Sensor Terminations

Termination	Factory Installed TUC	Field Installed TUC	Description
Heat Setpoint	J3-13	TB3-11	Heating setpoint provided by zone sensor
Cool Setpoint	J3-12	TB3-10	Cooling setpoint provided by zone sensor
Fan Mode	J3-11	TB3-9	Supply fan mode provided by zone sensor
System Mode	J3-10	TB3-8	System mode provided by zone sensor
Zone Sensor	J3-9	TB3-7	Zone temperature provided by zone sensor
Common (GND)	J3-7	TB3-6	Common ground for all above terminations
Common (GND)	J3-6	TB3-5	Common ground for all following terminations ❶
System LED	J3-5	TB3-4	System LED, on whenever TUC is powered ❶
Service LED	J3-4	TB3-3	Service LED ❶
Cool LED	J3-3	TB3-2	Cool LED, on in Cool, blinking if latching diagnostic ❶
Heat LED	J3-2	TB3-1	Heat LED, on in Heat, blinking if latching diagnostic ❶

❶ Only valid for zone sensor configurations with LEDs (light emitting diodes).

Input/Output Configuration

You can configure many of the TUCs inputs and outputs based on the unit capability and the desired application. This section describes each of the input and output configuration items for the main TUC board and the appropriate add-on boards.

Fan Voltage Selection

Fan voltage selection relates to modulating analog supply fan control. Currently, the TUC does not support this feature.

Valve 1 Drive Voltage

Configuration of the primary valve (Valve 1) as modulating analog is possible. If you configure Valve 1 as modulating analog, the Valve 1 drive voltage determines the output range for the Valve 1 output. The TUC does not use the Valve 1 drive voltage when Valve 1 is configured as any of the following:

- not present
- 2-position
- 3-wire floating point

Valve 1 Drive Voltage Selections		
2 to 10 VDC	6 to 9 VDC	0 to 10 VDC

Valve 1 Output Normally Selections	
Open	Closed

See the Valve Damper Configuration Note.

Valve/Damper Configuration Note *Three-wire floating point actuators are not configured as normally open or normally closed. The TUC ignores the* ***Valve Output Normally*** *field for 3-wire floating point valves.*

For modulating analog actuators, typically applied to valves and dampers, normally open means that at 0 volts, the actuator is full open or full face. Normally closed means that at 0 volts the actuator is full closed or full bypass.

For binary solenoid (2-position) type actuators, typically applied to valves and dampers, normally open means when the output is off, the actuator is open allowing flow or heating or cooling capacity. Normally closed means when the output is off, the actuator is closed allowing no flow, or heating or cooling capacity.

For relays applied to binary outputs, electric heat, or an auxiliary binary output, normally open means when the output is off, the relay contacts are open (no current). Normally closed means when the output is off, the relay contacts are closed (allowing current flow).

Valve 2 Drive Voltage

Configuration of the auxiliary valve (Valve 2) as modulating is possible. If you configure Valve 2 as modulating analog, the Valve 2 drive voltage determines the output range for the Valve 2 output. The TUC does not use the Valve 2 drive voltage when Valve 2 is configured as any of the following:

- not present
- 2-position
- 3-wire floating point

Valve 2 Drive Voltage Selections		
2 to 10 VDC	6 to 9 VDC	0 to 10 VDC

Valve 2 Output Normally Selections	
Open	Closed

See the Valve/Damper Configuration Note above.

Electric Heat Output 1 Normally, Electric Heat Output 2 Normally, and Electric Heat Output 3 Normally

For relays, typically applied to electric heat or an auxiliary binary output, normally open means when the output is off, the relay contacts are open (no current) producing no heat. Normally closed means when the output is off, the relay contacts are closed (allowing current flow) and producing heat.

Electric Heat Output 1-3 Normally Selections	
Normally Open	Normally Closed

Economizer Drive Voltage

It is possible to configure the economizer as modulating analog. If you configure the economizer as modulating analog, the economizer drive voltage determines the output range for the economizer output. The TUC does not use the economizer drive voltage when the economizer is configured as any of the following:

- not present
- 2-position
- 3-wire floating point

Economizer Drive Voltage Selections		
2 to 10 VDC	6 to 9 VDC	0 to 10 VDC

Outdoor Air Damper Normally Selections	
Normally Open	Normally Closed

See the Valve/Damper Configuration Note on page 56.

Water Source Heat Pump Analog Input 3

If you configure the TUC as a water source heat pump (WSHP), select either entering water temperature or return air temperature for analog input 3. If you configure the TUC as a fan coil or a unit ventilator, analog input 3 must be outdoor air temperature.

WSHP Analog Input 3 Selections	
Entering water temperature	Return air temperature

Water Source Heat Pump Analog Input 4

If you configure the TUC as a water source heat pump (WSHP), select either mixed air temperature or return air temperature for analog input 4. If you configure the TUC as a fan coil or unit ventilator, analog input 4 must be mixed air temperature.

WSHP Analog Input 4 Selections	
Mixed air temperature	Return air temperature

Binary Input 1

If you configure the TUC as a fan coil or unit ventilator, select either fan status or external interlock for binary input 1. As a fan status input, the binary input works with a differential pressure switch across the fan to determine whether or not the fan is on when the TUC commands it to operate.

As an external interlock, a remote open/close signal connected to the binary input determines whether to place the unit in a run mode or a stop mode.

If you configure the TUC as a water source heat pump, the binary input must be a high pressure cutout (HPC) input for the first compressor circuit.

Type of Unit	Binary Input 1 Selections	
Fan Coil	Fan status	External interlock
Unit Ventilator	Fan status	External interlock
WSHP	High pressure cutout (only)	

Binary Input 1 Normally Selections	
Open	Closed

See Table 33 for more information.

Binary Input 2

If you configure the TUC as a fan coil or unit ventilator, select either dirty filter or motion detection for binary input 2. As a dirty filter input, the TUC's binary input works with a differential pressure switch across the filter to detect when the filter becomes clogged for normal air flow.

As a motion detection input, the TUC's binary input works with a motion detector (supplied by a vendor other than Trane) to detect when the space is occupied or unoccupied. When an occupied space is determined to have no motion, you can apply alternate heating/cooling setpoints and an alternate ventilation.

For water source heat pumps, configure binary input 2 as either a dirty filter input or as an occupied/unoccupied input. If you configure binary input 2 as an occupied/unoccupied input, an open or close signal indicates whether or not the space is occupied.

Binary Input 2 Selections	
Dirty filter	Motion detector

Binary Input 2 Normally Selections	
Open	Closed

See Table 33 for more information.

Binary Input 3

For all TUCs, you can configure binary input 3 as either a condensate overflow input or as an occupied/unoccupied input. As a condensate overflow input, the TUC's binary input works with a condensate overflow switch to detect an unacceptable level of condensation in the unit drain pan. When an unacceptable level of condensation occurs, the unit shuts down on a latching diagnostic.

As an occupied/unoccupied input, an open or close signal sent to the input device detects whether or not the space is occupied.

Binary Input 3 Selections	
Condensate overflow	Occupied/Unoccupied

Binary Input 3 Normally Selections	
Open	Closed

See Table 33 for more information.

Binary Input 4

If you configure the TUC as a fan coil or unit ventilator, select either freezestat or smoke detection for binary input 4. As a freezestat input, the binary input works with a mechanical freezestat (low temperature detection device) to detect low temperature conditions. When a low temperature occurs, the unit shuts down on a latching diagnostic.

As a smoke detection input, the binary input works with a smoke detector (supplied by a vendor other than Trane) to detect the presence of smoke. The smoke detection input signal does not affect unit operation. Normally, the unit communicates this information to the Tracer system so the system can issue a system-wide shut down command. You can configure the smoke input to shut down the unit on a latching diagnostic when smoke is detected.

If the TUC is a water source heat pump, binary input 4 only can be a low pressure cutout (LPC) input for the first compressor circuit. Pick up LPC for circuits 2 and 3 on the water source heat pump with the Input/Output Expansion board.

Type of Unit	Binary Input 4 Selections	
Fan Coil	Freezestat	Smoke detector
Unit Ventilator	Freezestat	Smoke detector
WSHP	Low pressure cutout (only)	

Binary Input 4 Normally Selections	
Open	Closed

See Table 33 for more information.

Auxiliary Board Options

The installation of the auxiliary board allows you to select from an extended list of binary inputs, plus one binary output. If all binary inputs on the main TUC board are in use, the auxiliary board allows for up to five additional binary inputs. Use the binary output when all main TUC board outputs are in use and you need an additional binary output, such as electric heat, exhaust, or slave binary output.

Auxiliary Binary Input 1

Configure auxiliary binary input 1 as either an occupant call input or an IAQ stat input. As an occupant call input, the binary input signal does not affect the TUC control sequence. Instead, the TUC communicates the binary input signal to the Tracer system to indicate that the occupant requests assistance (possibly a momentary pushbutton). Currently, the TUC does not support the IAQ stat input.

Auxiliary Binary Input 1 Selections	
Occupant call	IAQ stat

For units configured as water source heat pumps, configure auxiliary binary input 1 as a compressor disable input.

Auxiliary Binary Input 1 Normally Selections	
Open	Closed

See Table 33 for more information.

Auxiliary Binary Input 2

Configure auxiliary binary input 2 as either an occupied/unoccupied input or as a condensate overflow input. As an occupied/unoccupied input, an open or close signal to the input detects whether or not the space is to be occupied.

As a condensate overflow input, the auxiliary binary input works with a condensate overflow switch to detect an unacceptable level of condensation in the unit drain pan. When an unacceptable level of condensation occurs, the unit shuts down on a latching diagnostic.

Auxiliary Binary Input 2 Selections	
Occupied/Unoccupied	Condensate overflow

For units configured as water source heat pumps, configure auxiliary binary input 2 as a high return air temperature input.

Auxiliary Binary Input 2 Normally Selections	
Open	Closed

See Table 33 for more information.

Auxiliary Binary Input 3

Configure auxiliary binary input 3 as either a smoke detector input or as a freezestat input. As a smoke detection input, the binary input works with a smoke detector (supplied by a vendor other than Trane) to detect the presence of smoke. The smoke detection input signal does not affect unit operation. Normally, the unit communicates this information to the Tracer system so the system can issue a system-wide shut down command. You can configure the smoke input to shut down the unit on a latching diagnostic when smoke is detected.

As a freezestat input, the binary input works with a mechanical freezestat (low temperature detection device) to detect low temperature conditions. When a low temperature occurs, the unit shuts down on a latching diagnostic.

Auxiliary Binary Input 3 Selections	
Smoke detector	Freezestat

Auxiliary Binary Input 3 Normally Selections	
Open	Closed

See Table 33 for more information.

Auxiliary Binary Input 4

Configure auxiliary binary input 4 as either an external interlock input or a supply fan status input. As an external interlock, an open or close signal to the binary input determines whether the unit goes into run mode or stop mode.

As a fan status input, a differential pressure switch across the fan communicates to the binary input whether or not the fan is on when the TUC commands the fan to operate.

Auxiliary Binary Input 4 Selections	
External interlock	Fan status

Auxiliary Binary Input 4 Normally Selections	
Open	Closed

See Table 33 for more information.

Auxiliary Binary Input 5

Configure auxiliary binary input 5 as either a motion detection input or as a dirty filter input. As a motion detection input, the binary input works with a motion detector (supplied by a vendor other than Trane) to detect when the space is occupied or unoccupied. When an occupied space is determined to have no motion, you can apply alternate heating/cooling setpoints and an alternate ventilation.

As a dirty filter input, a differential pressure switch across the fan communicates to the binary input to determine when the filter becomes clogged preventing normal air flow.

Auxiliary Binary Input 5 Selections	
Motion detection	Dirty filter

Auxiliary Binary Input 5 Normally Selections	
Open	Closed

See Table 33 for more information.

Auxiliary (Binary) Output Type

Configure the binary output on the auxiliary board as one of the following:

- a Tracer-controlled generic auxiliary output
- an exhaust fan or damper auxiliary output
- an alarm auxiliary output

If the TUC configuration requires an additional output to control all available electric heat stages, the unit uses the auxiliary binary output for electric heat regardless of the configuration.

Auxiliary (Binary) Output Selections			
Generic (controllable from the Tracer)	Exhaust fan or damper output	Alarm output (on if any latching diagnostic is present in the TUC, except fan/filter)	Water-side economizer (currently not supported)

Note *The TUC may use the auxiliary (binary) output for electric heat, if required, regardless of the output configuration.*

Auxiliary (Binary) Output Normally Selections	
On/Off	Modulate (Not supported)

Note: The TUC does not use this entry.

Auxiliary Board (Binary) Output Normally Selections	
Open	Closed

Auxiliary Board Drive Voltage

Currently, the TUC does not use this entry.

The TUC uses the EQ board (formerly known as the Economizer Quality board and now referred to as the VEM - Ventilation Effectiveness Module) for some extended ventilation control sequences. Currently, the TUC does not support functions related to this board.

EQ Binary Input 1 and Input 2 Normally Selections	
Open	Closed

EQ Output Type

Currently, the TUC does not use this entry.

EQ Output Normally

Currently, the TUC does not use this entry.

Fan Speed Modulation Function

Currently, the TUC does not use this entry.

Motion Detection?

Configure the binary input as motion detection, on either the main TUC board or the auxiliary board, and use the input to enable an alternative setpoint or ventilation sequence when the motion detector no longer detects motion in the space.

If motion detection is selected as yes, the TUC enables the alternate sequence whenever no motion is detected in the zone (while occupied). The alternate sequence (based on no motion in the zone) allows the TUC to apply the value of the *unoccupied zone setpoint offset* to the active occupied heating and cooling setpoints. Also, the alternate sequence utilizes the *alternate minimum damper position* for the outdoor air damper. If motion detection is selected as no, the TUC uses the motion detection input only as information (communicated to the Tracer system).

Motion Detection Selections	
No	Yes

DX Condensing Unit Alarm?

Currently, the TUC does not use this entry.

Smoke Status Alarm?

Configure the binary input as a smoke detector on either the main TUC board or the auxiliary board, and use the input as either a non-latching diagnostic or a latching diagnostic. If you use the input as a latching diagnostic, whenever the smoke input detects smoke, the unit shuts down and requires a manual reset.

If smoke status alarm is configured as no, the binary input results in a non-latching diagnostic whenever the binary input detects the smoke signal.

Smoke Status Alarm Selections	
No (non-latching diagnostic)	Yes (latching diagnostic)

Fan Status Alarm?

Configure the binary input as a fan status alarm on either the main TUC board or on the auxiliary board, and use the input to shut down the unit on a latching diagnostic. If you use the input as a latching diagnostic, whenever the fan input detects a fan failure, the unit shuts down and requires a manual reset.

If fan status is configured as no, the binary input results in a diagnostic whenever the binary input detects a fan failure. This diagnostic remains *latched* in the TUC until a manual reset occurs. However, the unit operates normally while the diagnostic is present.

If fan status is configured as yes, the binary input results in a latching diagnostic (unit shutdown) when the unit detects a fan failure.

Fan Status Selections	
No (special diagnostic with normal unit operation, yet requires manual reset)	Yes (latching diagnostic)

Main Board Exhaust?

An exhaust fan or damper output is possible in one of the following two places on the TUC and its add-on boards:

- the main TUC board on output 2
- the auxiliary board on output 1

Based on available configurations of these outputs, the TUC makes its own determination on which output to control for exhaust. To correctly display the exhaust status on Tracer 100i or L status screens, you must make a selection for main board exhaust.

Main Board Exhaust Selections	
No	Yes

Normal Auto Fan Speed Control?

Currently, the TUC does not use this entry.

Configuration of Operating Functions

The TUC contains several independent control functions that require configuration—based on both the unit capabilities and the desired application. Functions such as random start and auto changeover can be configured based on the unit type and intended operation.

Random Start

Random start is a feature that affects the power up sequence of the TUC. When random start is enabled, the unit delays three to 32 seconds (time randomly chosen) after power before continuing the power up sequence. The random start feature evenly distributes the power requirements for the building at the time when multiple units power up simultaneously.

Random Start Selections	
Random (Random start enabled)	No Random (Random start disabled)

Supply Air Temperature Control

Supply air temperature control, together with zone air temperature control and cascade zone/discharge air temperature control make up the three control sequence options in the TUC.

Note *Supply air temperature control is also referred to as discharge air temperature control.*

If supply air temperature control is enabled and both a discharge air and zone air temperature sensor exist, the TUC operates according to the cascade zone/discharge air temperature control sequence. If supply air temperature control is enabled and only the discharge air sensor fails or is not present, the TUC operates according to the zone air temperature control sequence.

If only the zone air sensor fails or is not present, the TUC operates according to the discharge air temperature control sequence. If supply or discharge air temperature control is disabled, the TUC operates according to the zone air temperature control sequence.

Supply Air Temperature Control Selections	
Enable	Disable (The TUC uses zone air temperature control.)

Supply Air Temperature High Alarm

The supply air temperature high alarm is a diagnostic for the TUC. Configure the alarm as information only (to pass to a Tracer system) or as a latching diagnostic to shut down the unit. If the high alarm shuts down the unit, you must perform a manual reset. When the measured discharge air temperature exceeds the supply air high limit (adjustable), the TUC generates a supply air temperature high alarm.

Supply Air Temperature High Alarm Selections	
No (Use the alarm as information only.)	Yes (Latching diagnostic)

Occupied Preheat Damper Position

The position of the outdoor air damper during the transition from unoccupied mode to occupied mode (known as preheat) may be configured based on ASHRAE Cycle I and Cycle II conformance requirements.

If the TUC sets the occupied preheat damper position to open, the unit immediately opens the outdoor air damper to its minimum position when the TUC transitions from unoccupied mode to occupied mode.

If the occupied preheat damper position is configured to closed, the unit keeps the outdoor air damper closed during the transition from unoccupied mode to occupied mode—until the zone temperature is within two degrees (F) of the heating setpoint.

Whether the occupied preheat damper position is open or closed, the TUC closes the outdoor air damper any time the zone temperature is three degrees (F) or more below the heating setpoint when no heating capacity is available. The outdoor air damper returns to its minimum position when the zone temperature is within two degrees (F) of the heating setpoint.

Occupied Preheat Damper Position Selections	
Open	Closed (ASHRAE Cycle II enabled)

Purge Mode Control

Hydronic purge works with auto changeover by periodically opening the primary water valve (Valve 1) when the entering water temperature is not appropriate for the desired heat or cool mode.

With 2-way valves, correct sensing of the entering water temperature is not always guaranteed due to the lack of water flowing near the entering water temperature sensor. When the sensed water conditions are inappropriate for the desired heat or cool mode, the TUC relies on a periodic hydronic purge of the system water to more accurately sense the entering water temperature.

When enabled, the hydronic purge mode causes the TUC to open the valve for three out of every 60 minutes or until a satisfactory entering water temperature is sensed.

If a Tracer system is present and the distributed water temperature is available, Trane recommends using the communicated water temperature in place of the hydronic purge mode and disabling purge.

Note *Appropriate entering water temperature for heating is five degrees (F) or more warmer than the zone temperature. For cooling, the entering water temperature must be at least five degrees (F) cooler than the zone temperature.*

Purge Mode Control Selections	
Enable	Disable

Auto Changeover

Use auto changeover to configure the function of the primary valve/coil (Valve 1). If the TUC uses the primary valve (Valve 1) for heating and cooling, enable auto changeover. If the unit is a 4-pipe unit, where the TUC uses the primary coil for cooling and the auxiliary coil for heating, disable auto changeover. For a 2-pipe heating only or cooling only unit, disable auto changeover.

Auto Changeover Selections	
Enable (Allow Valve/Coil 1 to changeover between heat and cool.)	Disable

Humidity Control

Currently, the TUC does not support humidity control (dehumidification).

Occupied Fan Cycle

You can configure the TUC to control the unit supply fan in the occupied mode in one of two different control schemes:

- Continuous fan operation
- Cycling fan operation based on unit capacity

If you configure the occupied fan cycle as continuous, the unit supply fan operates continuously during the occupied mode. In the unoccupied mode, the TUC cycles the supply fan to maintain the unoccupied setpoints.

If you configure the occupied fan cycle as capacity, the TUC controls the unit supply fan on whenever the TUC control algorithm requests any heating or cooling capacity. Regardless of the occupied fan cycle configuration, the unit supply fan cycles with unit capacity during the unoccupied mode.

Occupied Fan Cycle Selections	
Continuous (The TUC operates the fan continuously when the TUC is occupied.)	Capacity ❶ (The TUC cycles the fan based on unit capacity when occupied.)

❶ The Capacity selection is not recommend with modulating control, such as 3-wire floating point or modulating analog heating and cooling valves. Only use the Capacity selection with binary valves, electric heat, or compressors.

Power Up Control Wait (Two Minutes)?

At power up, the TUC uses the power up control wait feature to wait up to two minutes for Tracer control information before starting the unit supply fan. This feature allows the TUC to avoid unnecessary fan starts prior to receiving Tracer control requests.

Power Up Control Wait Selections	
No	Yes (Wait two minutes at power up before normal unit operation.)

Number of Electric Heat Stages in Normal Heating

Based on the electrical design of the unit, the number of electric heat stages the TUC may operate under normal heating conditions may be less than the actual number of electric heat stages present in the unit.

Number of Electric Heat Stages in Normal Heating Selections			
None	1 stage	2 stages	3 stages

Compressor Enabled in Emergency Heat?

Based on the unit design and the emergency heat sequence, the unit compressor may or may not be able to run when the TUC requests emergency heat.

Compressor Enabled in Emergency Heat Selections	
No	Yes

Setpoint Configuration

Occupied Heating/Cooling Setpoint Source

The TUC attempts to use the configured setpoint source for its heating and cooling setpoints. After the unit determines the setpoints, the TUC applies the setpoint limits to determine the active heating and cooling setpoints.

Occupied Heating/Cooling Setpoint Source Selections		
Tracer	Local (zone sensor thumbwheel or slide bar setpoint adjustment)	Default (locally stored TUC default setpoints)

Note *See the Setpoint Operation section on page 15 of this guide for complete information about occupied heating/cooling setpoint source.*

Occupied Cooling Setpoint

The TUC stores its own default occupied cooling setpoint. If either a Tracer or a local zone sensor does not determine an occupied cooling setpoint, the TUC uses its locally stored occupied setpoints (adjustable). The cooling setpoint must always be equal to or greater than the heating setpoint.

Range: 40° to 110° F
(limited by Cooling Setpoint Low/High Limit)

Occupied Heating Setpoint

The TUC stores its own default occupied heating setpoint. If either the Tracer or a local zone sensor setpoint does not determine an occupied heating setpoint, the TUC uses its locally stored occupied setpoints (adjustable). The cooling setpoint must always be equal to or greater than the heating setpoint.

Range: 40° to 110° F
(limited by Heating Setpoint Low/High Limit)

Unoccupied Cooling Setpoint and Unoccupied Heating Setpoint

Regardless of the setpoint source, when the TUC is in unoccupied mode, it uses its locally stored unoccupied setpoints as the active heating and cooling setpoints. The cooling setpoint must always be equal to or greater than the heating setpoint.

Range: 40° to 110° F

Cooling Setpoint Low Limit

The cooling setpoint low limit defines the lowest cooling setpoint the TUC allows during occupied conditions.

Range: 40° to 110° F

Cooling Setpoint High Limit

The cooling setpoint high limit defines the highest cooling setpoint the TUC allows during occupied conditions.

Range: 40° to 110° F

Heating Setpoint Low Limit

The heating setpoint low limit defines the lowest heating setpoint the TUC allows during occupied conditions.

Range: 40° to 110° F

Heating Setpoint High Limit

The heating setpoint high limit defines the highest heating setpoint the TUC allows during occupied conditions.

Range: 40° to 110° F

Zone Sensor Heating Setpoint Offset

When the local zone sensor supplies the TUC with a cooling setpoint, the unit subtracts the zone sensor heating setpoint offset from the cooling setpoint to determine the heating setpoint.

If the zone sensor supplies both a cooling and heating setpoint, the TUC does not use the zone sensor heating setpoint offset value.

Range: 0° to 20° F

Unoccupied Zone Sensor Offset

When a binary input on the TUC is configured as a motion input and the TUC is occupied, the TUC adds the value of the unoccupied zone sensor offset to the occupied cooling setpoint and subtracts that value from the occupied heating setpoint when no motion is detected in the zone.

Zone Temperature/Calibration Offset

To calibrate the zone temperature measured either from the thermistor on the zone sensor or the unit-mounted zone temperature sensor, apply a calibration offset value to the measured zone temperature.

Range: -10.0° to 10.0° F (0.1 degree increments)

Cooling Setpoint/Calibration Offset

To calibrate the local cooling setpoint measured either from a unit- or wall-mounted potentiometer, apply a calibration offset value to the cooling setpoint.

Range: -10.0° to 10.0° F (0.1 degree increments)

Heating Setpoint/Calibration Offset

To calibrate the local heating setpoint measured either from a unit- or wall-mounted potentiometer, apply a calibration offset value to the heating setpoint. Zone sensors with both a heating and cooling setpoint are not common.

Range: -10.0° to 10.0° F (0.1 degree increments)

Return Air Relative Humidity/Calibration Offset

Currently, the TUC does not use this value.

Outdoor Air Damper Minimum Position

The TUC determines the outdoor air damper minimum position for occupied operation of modulating analog and 3-wire floating point economizers in one of the following ways:

- by the Tracer communicating a value to the TUC
- by the locally stored default outdoor air damper minimum position (editable)

The TUC uses this entry only if the Tracer is not communicating a value to the unit.

Range: 0 to 100%

Alternate Minimum Damper Position

When a binary input on the TUC is configured as motion input and no motion is detected in the zone (occupied only), the TUC uses the alternate minimum damper position.

Range: 0 to 100%

Economizer Enable Control

The TUC enables economizer control when one of the following occurs:

- the Tracer communicates the enable command
- a local economizer enables control decisions based on temperature differential between the outdoor and zone air temperatures
- by the value of the dry bulb outdoor air temperature

Note *Currently, the TUC does not support the option for economizer enable based on reference enthalpy.*

If temperature differential is configured for the economizer control and the outdoor air temperature is less than the zone temperature minus the economizer enable control value, the TUC enables economizing.

If dry bulb outdoor air temperature is configured for the economizer control, the TUC enables economizing whenever the outdoor air dry bulb temperature is less than the economizer enable control value.

In both cases, the TUC may disable economizing if the outdoor air temperature gets too cold (freeze avoidance setpoint).

Economizer Enable Control Selections		
Temperature differential	Reference enthalpy	Dry bulb (outdoor air temperature)

Economizer Enable Control Value

The economizer enable control value works with the economizer enable control selection to determine when the TUC should enable economizing.

Ranges: 0 to 3 (economizing disabled)
4 to 18 (degrees (F), temperature differential)
19 to 30 (btu/lbm, reference enthalpy)
31 to 100 (degrees (F), dry bulb outdoor air temperature)

Note *Currently, the TUC does not support the option for economizer enable based on reference enthalpy.*

Exhaust Setpoint

When the outdoor air damper position is greater than the exhaust setpoint, the TUC controls on the exhaust fan or damper output. When the outdoor air damper position is 10% or more below the exhaust setpoint, the TUC controls off the exhaust fan or damper. The TUC also controls off the exhaust output whenever the outdoor air damper position is zero percent.

Range: 0 to 100%

Humidity Control Start Setpoint

Currently, the TUC does not use this value.

Humidity Control Stop Setpoint

Currently, the TUC does not use this value.

Supply (Discharge) Air Control Minimum

If the TUC is operating under either the discharge air temperature control sequence or the cascade zone/discharge air control sequence, the control algorithm generates a setpoint no lower than the supply (discharge) air control minimum.

Range: 38° to 150° F

Supply (Discharge) Air Control Maximum

If the TUC operates under either the discharge air temperature control sequence or the cascade zone/discharge air control sequence, the control algorithm generates a setpoint no higher than the supply (discharge) air control maximum.

Range: 38° to 150° F

Supply (Discharge) Air Low Limit

If the TUC has a discharge air temperature sensor, the unit shuts down on a latching diagnostic whenever the measured discharge air temperature is less than the supply (discharge) air low limit for at least three minutes.

Range: 30° to 50° F

Supply (Discharge) Air High Limit

If the TUC has a discharge air temperature sensor, the TUC generates either a non-latching or a latching diagnostic (configurable) whenever the discharge air temperature is greater than the supply (discharge) air high limit for at least three minutes.

Range: 70° to 200° F

Supply (Discharge) Air Temperature Control Band

The TUC uses the supply (discharge) air temperature control band as an input to the specified control sequence. Trane recommends the following values:

- Discharge air temperature control (6° F)
- Cascade zone/discharge air temperature control (2° F)

Note *The TUC does not use this value when using zone temperature control.*

Supply Fan System Control

The TUC can receive a supply fan mode request and system mode switch request from either a local zone sensor (if the necessary switches are present and enabled as the source) or from a Tracer.

If you select the Tracer option and a Tracer does not exist, the TUC attempts to use its local switch settings. If no local switch exists, the TUC operates in a default condition (fan high, auto heat/cool, fan medium for fan coils).

If you select the local (zone sensor) option and no local switch exists, the TUC operates in a default condition (fan high, auto heat/cool). There is one exception. If a Tracer exists, the TUC uses the Tracer request.

Supply Fan System Control Selections	
Tracer	Local

DX Cooling Outdoor Air Low Limit

The function of this setpoint is based on the unit configuration. If the unit is configured as a fan coil or unit ventilator, the TUC disables compressor cooling (and heat pump cooling for self-contained units) when the outdoor air temperature falls below this setpoint. The TUC enables compressor cooling (and heat pump cooling for self-contained units) when the outdoor air temperature rises at least four degrees (F) above the DX cooling outdoor air low limit setpoint.

For water source heat pumps, the TUC disables compressor cooling whenever the entering water temperature rises above the DX cooling outdoor air low limit setpoint. The TUC enables compressor cooling whenever the entering water temperature is at least four degrees (F) below this setpoint.

Range: 30° to 140° F

Compressor Heat Disable Setpoint

The function of this setpoint is based on the unit configuration. If the unit is configured as a fan coil, unit ventilator or blower coil, the TUC disables compressor heating when the outdoor air temperature falls below the compressor heat disable setpoint. The TUC enables compressor heating when the outdoor air temperature rises at least four degrees (F) above this setpoint.

For water source heat pumps, the TUC disables compressor heating whenever the entering water temperature falls below the compressor heat disable setpoint. The TUC enables compressor heating when the entering water temperature rises at least four degrees (F) above this setpoint.

Range: 0° to 70° F

Freeze Avoidance Setpoint

Freeze avoidance is a unit protection sequence in the TUC—based on the outdoor air temperature, (either sensed locally or communicated from a Tracer) during the unoccupied or stop modes.

If the outdoor air temperature falls below the freeze avoidance setpoint during the unoccupied or stop modes, the TUC disables economizing and opens all control valves.

If the outdoor air sensor fails, the TUC assumes low outdoor air temperature and invokes freeze avoidance during the unoccupied or stop modes. If no outdoor air sensor ever existed, the TUC disables freeze avoidance.

Ranges: 0° to 19° (The TUC disables freeze avoidance.)
20° to 60° (The TUC invokes freeze avoidance when the outdoor air temperature falls below the freeze avoidance setpoint during the unoccupied or stop modes.)

Freezestat Temperature Setpoint

For TUCs configured as water source heat pumps, the unit locks out compressor operation whenever the leaving water temperature falls below the freezestat temperature setpoint. The lock out requires a manual reset.

Range: 15° to 60° F

Water Loop Economizer Enable

Currently, the TUC does not support this feature.

Standalone Unoccupied Override Time

Standalone TUCs utilize the unoccupied override time whenever they are unoccupied and you momentarily press their timed override buttons. This action places the TUC in occupied mode for the duration of the override time (adjustable) or until you press the cancel button.

Range: 0 to 255 minutes

Configuration of Gains and Control Values

In addition to the various unit, function, and input/output configurations, the TUC can support several control gains–based on the application. Many of the gains are control sequence dependent. Trane recommended values appear in Tables 37 and 38, whether the selected control sequence is zone air temperature control, discharge air temperature control or cascade zone/discharge air temperature control.

Currently, the TUC does not use the following values:

- Face and Bypass Configuration
- Economizer Configuration
- Zone Setpoint Reset Control Algorithm
- Modulating Fan High Speed Definition
- Modulating Fan Medium Speed Definition
- Zone Setpoint Reset Outdoor Air Cool Reference
- Zone Setpoint Reset Cool Factor
- Zone Setpoint Reset Outdoor Air Heat Reference
- Zone Setpoint Reset Heat Factor

Valve/Coil 1 (Cooling) Configuration

Use the actual valve/coil configuration of the unit to edit the valve/coil configuration value. Typically, the factory loads this value for factory-installed TUC units. See Table 36 for a list of components and valve types.

Valve/Coil 2 (Heating) Configuration

Use the actual valve/coil configuration of the unit to edit the valve/coil configuration value. Typically, the factory loads this value for factory-installed TUC units. See Table 36 for a list of components and valve types.

Table 36 Valve/Coil Configuration by Component

Component	Valve Type	Valve/Coil 1 Configuration	Valve/Coil 2 Configuration
Generic Equal Percentage ❶	Equal Percentage	75	139
Erie M 1.4 Cv	Linear 1	106	170
Erie M 2.6 Cv	Linear 1	109	173
Erie M 4.0 Cv	Linear 2	117	181
Johnson Controls, Inc.	Equal Percentage	75	139
Erie T 0.7 Cv	Equal Percentage	68	132
Erie T 1.5 Cv	Equal Percentage	64	128
Erie T 2.5 Cv	Equal Percentage	75	139
Erie T 4.0 Cv	Quick Open	81	145

❶ Use Generic Equal Percentage for any field-installed valve/damper actuators that do not appear in this table.

Linear 1 valves provide a linear increase of Cv with opening position.

Linear 2 valves provide a linear increase of Cv with opening position (slightly more complex flow/capacity curve shape than Linear 1.

Equal Percentage valves are characterized by a low rate of Cv increase upon initial opening and a rapid increase in Cv as position increases. This characteristic offsets the flow/capacity characteristic in coils.

Quick Open valves provide a rapid increase in Cv upon initial opening followed by a slower rate of increase.

Face and Bypass dampers (generic equal percentage) utilize gains of 75 and 139.

Table 37 Gain and Control Values for Supply (Discharge) Air Temperature Control

Gain or Control	Recommended Value
Supply Air Temperature Auxiliary Heat Proportional Gain	12 (modulating auxiliary heat), 6 (staged auxiliary heat)
Supply Air Temperature Auxiliary Reset Time	27 (modulating auxiliary heat), 41 (staged auxiliary heat)
Supply Air Temperature Electric Heat Proportional Gain	6
Supply Air Temperature Electric Heat Reset Time	41
Supply Air Temperature Cooling Proportional Gain	12 (modulating auxiliary heat), 6 (staged auxiliary heat)
Supply Air Temperature Cooling Control Reset Time	27 (modulating auxiliary heat), 41 (staged auxiliary heat)
Supply Air Temperature Heating Proportional Gain	12 (modulating auxiliary), 6 (staged auxiliary heat)
Supply Air Temperature Heating Control Reset Time	27 (modulating auxiliary heat), 41 (staged auxiliary heat)
Supply Air Temperature Economizer Proportional Gain	12
Supply Air Temperature Economizer Reset Time	27

Table 38 Gain and Control Values

Gain or Control	Recommended Value	Range
Electric Heat Cycles Per Hour ❶	6	2 to 17 cycles per hour
Pan K Factor	0	0 (maximum economy operation) to 15 (maximum comfort operation)
Cooling Cycles Per Hour ❶	3 for compressors 6 for valves	2 to 17 cycles per hour
Heating Cycles Per Hour ❶	3 for compressors 6 for valves	2 to 17 cycles per hour
Compressor Minimum On Time	3 minutes	1 to 15 minutes
Compressor Minimum Off Time	3 minutes	1 to 15 minutes
Valve 1 or Face and Bypass Damper Stroke Time	Value must match physical value associated with the actuator installed in the unit.	1 to 255 seconds
Valve 2 Stroke Time	Value must match physical value associated with the actuator installed in the unit.	1 to 255 seconds
Economizer Stroke Time	Value must match physical value associated with the actuator installed in the unit.	1 to 255 seconds
Cooling Proportional Gain	60 (supply air temperature control disabled), 24 (supply air temperature control enabled)	**Not applicable**
Heating Proportional Gain	40 (supply air temperature control disabled), 20 (supply air temperature control enabled)	
Economizer Proportional Gain	80 (supply air temperature control disabled, 30 (supply air temperature control enabled)	
Electric Heat Proportional Gain	40 (supply air temperature control disabled), 20 (supply air temperature control enabled)	
Cooling Reset Time	44 (supply air temperature control disabled), 66 (supply air temperature control enabled)	
Heating Reset Time	52 (supply air temperature control disabled or enabled)	
Economizer Reset Time	66 (supply air temperature control disabled or enabled)	
Electric Heat Reset Time	66 (supply air temperature control disabled), 52 (supply air temperature control enabled)	

❶ The TUC does not use this value during discharge and cascade control.

Tracer Interface

Tracer Control Information

This section contains descriptions of the control items the Tracer system (either Tracer 100i, Tracer L, or Tracer Summit) can communicate to the TUC.

Valid selections and valid ranges (for numerical entries) appear for each control item. Because the Tracer 100i, Tracer L, and Tracer Summit screens differ, the location of each of these items varies between each interface. The Tracer 100i or L items are located on the Input/Output Editor for the TUC (point type 39, version 14.0 or higher). The Tracer Summit items are located throughout the TUC editor in the Tracer Summit software (version 3.0 or higher).

ICS (Tracer) Control

Selections: No, Yes

Select **No** if you do not want the Tracer to send control information to the TUC.

Select **Yes** to make the Tracer send control information to the TUC. Examples of control information include:

- heating and cooling setpoints
- outdoor air temperature
- occupied/unoccupied mode requests

Heat/Cool Control

Selections: Auto, Manual

Select **Auto** to have the TUC make its own heat/cool mode decision. If you select auto, the TUC selects the heat/cool mode based on the comparison between the space temperature (measured by the zone temperature sensor) and the active heating and cooling setpoints. The TUC algorithms use the measured zone temperature and the heating and cooling setpoints to determine the heat/cool mode and other values.

Select **Manual** to have the Tracer send the results of the heat/cool mode to the TUC.

Note *For Tracer 100i or L, heat/cool mode is called manual heat/cool point.*

Heat/Cool Mode

Selections: Heat, Cool

If the entry for heat/cool control is **Manual**, the Tracer sends the heat/cool mode selection to the TUC as its control mode.

If the entry for heat/cool control is **Auto**, the Tracer ignores the heat/cool mode selection.

When the TUC control mode is **Cool**, the TUC only cools, either by mechanical cooling or economizer. When the control mode is **Heat**, the TUC only heats, either by mechanical heat or electric heat.

Important *When the TUC is in the manual heat mode, the unit does not allow economizer operation. Manual heat mode means heat/cool control is **Manual** and heat/cool mode is **Heat**. In the manual heat mode, the control mode remains in heat. To economizer cool, the heat/cool mode must be **Cool**.*

Exhaust Control

Selections: Disable, Auto

Select **Auto** if you want the TUC to energize the unit exhaust output (typically controlling an exhaust fan or damper), as required by the normal exhaust control sequence.

Select **Disable** and the TUC disables or locks out the unit exhaust operation.

Heat Type

Selections: Normal, Emergency

Currently, the TUC does not use this field.

Reset Latching Diagnostics

Selections: No, Yes

If the TUC is latched off due to a unit diagnostic, or a compressor is locked out due to a compressor diagnostic, you must initiate a manual reset to restore normal unit operation. The Tracer 100i or L interface provides two ways to reset latching diagnostics. See below:

1. Use the Reset Failure Point in the TUC editor (point type 39). If a Reset Failure Point is defined, the TUC resets the latching diagnostics when the point is toggled from on to off. A calculated binary point may be defined and manually toggled to perform the reset.
2. On the TUC Service Summary (Tracer version 14.4 or higher), use "+ enter" to reset manual diagnostics.

The Tracer Summit interface offers one method to reset latching diagnostics. The Diagnostics page of the TUC editor displays all current latching and non-latching diagnostics. If diagnostics are present, use the Reset radio button/referencer to initiate a reset command.

Occupancy

Selections: Unoccupied, Occupied

Whenever the ICS (Tracer) Control selection is **Yes**, the Tracer system sends the TUC an occupancy control request. By default, the Tracer sends an occupied request for the control mode. Typically, editing a time-of-day schedule in the Tracer results in the desired TUC operation.

For Tracer 100i or L applications, the time-of-day schedule controls a Tracer zone that has one or more TUCs as a member. Tracer zone control communicates the occupancy request to the TUC based on the zone time-of-day schedule (typically either occupied or unoccupied).

For Tracer Summit applications, you can program the TUC to be a member of an area. Make sure the area is a member of a time-of-day schedule. Or, you can directly control the TUC occupancy by assigning the TUC directly to the time-of-day schedule. If the TUC is not a member of an area, optimal start/stop functions are not possible for the TUC.

Override Commands Note *If simultaneous override commands exist for valves or the outdoor air damper, an open command takes priority over a closed command. For the exhaust output, if simultaneous on and off commands exist, an on command takes priority over an off command.*

Outdoor Air Damper Override Open Control

Selections: Auto, Open

Select **Open** to control the outdoor air damper to its full open position (100%).

Select **Auto** to operate the outdoor air damper normally according to the control sequence in the TUC.

See the Override Commands note above.

Important *If any override is present in the TUC, the unit terminates normal unit operation during the override. Unit status/present value appears as* ***Standby****.*

Outdoor Air Damper Override Closed Control

Selections: Auto, Closed

Select **Closed** to control the outdoor air damper to its full closed position (0%).

Select **Auto** to operate the outdoor air damper normally according to the control sequence in the TUC.

See the Override Commands note above.

Important *If any override is present in the TUC, the unit terminates normal unit operation during the override. Unit status/present value appears as* ***Standby****.*

Valve 1 Override Open Control

Selections: Auto, Open

Select **Open** to control Valve 1 to its full open position (100%).

Select **Auto** to operate Valve 1 normally according to the control sequence in the TUC.

See the Override Commands note on page 74.

Important *If any override is present in the TUC, the unit terminates normal unit operation during the override. Unit status/present value appears as* ***Standby****.*

Valve 1 Override Closed Control

Selections: Auto, Closed

Select **Closed** to control Valve 1 to its full closed position (0%).

Select **Auto** to operate Valve 1 normally according to the control sequence in the TUC.

See the Override Commands note on page 74.

Important *If any override is present in the TUC, the unit terminates normal unit operation during the override. Unit status/present value appears as* ***Standby****.*

Valve 2 Override Open Control

Selections: Auto, Open

Select **Open** to control Valve 2 to its full open position (100%).

Select **Auto** to operate Valve 2 normally according to the control sequence in the TUC.

See the Override Commands note on page 74.

Important *If any override is present in the TUC, the unit terminates normal unit operation during the override. Unit status/present value appears as* ***Standby****.*

Valve 2 Override Closed Control

Selections: Auto, Closed

Select **Closed** to control Valve 2 to its full closed position (0%).

Select **Auto** to operate Valve 2 normally according to the control sequence in the TUC.

See the Override Commands note on page 74.

Important *If any override is present in the TUC, the unit terminates normal unit operation during the override. Unit status/present value appears as* ***Standby****.*

Exhaust Override On Control

Selections: Auto, On

Select **On** to control on the exhaust output.

Select **Auto** to operate the exhaust output normally according to the control sequence in the TUC.

See the Override Commands note on page 74.

Important *If any override is present in the TUC, the unit terminates normal unit operation during the override. Unit status/present value appears as* ***Standby****.*

Exhaust Override Off Control

Selections: Auto, Off

Select **Off** to control off the exhaust output.

Select **Auto** to operate the exhaust output normally according to the control sequence in the TUC.

See the Override Commands note on page 74.

Important *If any override is present in the TUC, the unit terminates normal unit operation during the override. Unit status/present value appears as* ***Standby****.*

Compressor Disable

Selections: Disable, Auto

Select **Disable** to disable or lock out all compressor operation for the TUC.

Select **Auto** to permit normal compressor operation according to the control sequence in the TUC.

Unit Disable

Selections: No, Yes

To communicate a TUC unit disable command from the Tracer system to the TUC, select **Yes** by controlling the mode of the TUC to shutdown. Normally, the unit disable request from the Tracer is **No.** For more details on controlling a TUC to the shutdown mode, refer to the literature for the Tracer 100i, Tracer L, and Tracer Summit systems.

Supply Fan Control

Selections: On, Auto, High, Medium, Low, Off

You can edit the occupied supply fan control mode at the Tracer. Depending on the actual unit capabilities, some selections may not apply.

Select **On** for units with single speed supply fans.

Select **Low** or **High** for 2-speed supply fans.

Select **Low, Medium**, or **High** for 3-speed supply fans.

Select **Auto** for 2-speed and 3-speed applications. Auto allows the unit fan speed to vary depending on the heat/cool capacity request of the TUC.

Select **Off** to control off the unit supply fan during occupied operation.

Economizer Control

Selections: Auto, Enable, Disable

Select **Disable** to disable all outdoor damper operation for the TUC. When you disable the outdoor damper operation, the damper remains at the minimum position during the occupied mode. During the unoccupied mode, the damper remains closed.

Select **Auto** to allow the TUC to enable economizing based on the outdoor air temperature. If you allow economizing, the outdoor air damper operates between minimum position and 100% (based on economizing requirements) in the occupied mode. In the unoccupied mode, the TUC closed the outdoor air damper—unless the Tracer system requests night purge (night economizer).

Select **Enable** to allow the TUC to economize regardless of the local economizer enable decision.

Generic Auxiliary Binary Output

Selections: Off, On

If the configurable binary output on the auxiliary module is generic, you can control the binary output from the Tracer system.

Select **Off** to control the auxiliary binary output off. Select **On** to control the auxiliary binary output on.

Electric Heat Control

Selections: Auto, Disabled

Select **Disable** to disable all electric heat operation for the TUC.

Select **Auto** to permit normal electric heat operation according to the control sequence in the TUC.

Tracer Occupied Cooling Setpoint

Selections: 40° to 110° F

The Tracer system always sends an occupied cooling setpoint to the TUC. If the TUC is edited to use Tracer setpoints, the TUC uses the Tracer value for its occupied cooling setpoint. If the TUC is edited to use local setpoints, the TUC ignores the Tracer value and instead uses the local value. The TUC determines the local value from the setpoint adjustment on the zone sensor.

Tracer Occupied Heating Setpoint

Selections: 40° to 110° F

The Tracer system always sends an occupied heating setpoint to the TUC. If the TUC is edited to use Tracer setpoints, the TUC uses the Tracer value for its occupied heating setpoint. If the TUC is edited to use local setpoints, the TUC ignores the Tracer value and instead uses the local value. The TUC determines the local value from the setpoint adjustment on the zone sensor and the setpoint offset.

Cooling Control Offset Value

Selections: 0° to 20° F

The Tracer system always sends a cooling control offset value (typically zero degrees) to the TUC. The TUC adds this value to the occupied cooling setpoint which results in a higher occupied cooling setpoint. This setpoint adjustment decreases the demand for unit operation.

Heating Control Offset Value

Selections: 0° to 20° F

The Tracer system always sends a heating control offset value (typically zero degrees) to the TUC. The TUC subtracts this value from the occupied heating setpoint which results in a lower occupied heating setpoint. This setpoint adjustment decreases the demand for unit operation.

Economizer Minimum Position

Selections: 0 to 100%

The Tracer system always sends an economizer minimum position to the TUC. The TUC uses this value as the minimum position for the economizer during the occupied mode. During the unoccupied mode, the economizer minimum position is zero. If no Tracer is present, the TUC uses its locally stored default economizer minimum position.

Maximum Mechanical Cooling Limit

Selections: 0 to 100%

The Tracer system always sends a maximum mechanical cooling limit to the TUC, typically 100%. This value is the maximum cooling capacity the TUC allows during unit operation.

Maximum Mechanical Heating Limit

Selections: 0 to 100%

The Tracer system always sends a maximum mechanical heating limit to the TUC, typically 100%. This value is the maximum heating capacity the TUC allows during unit operation.

Tracer Outdoor Air Temperature

Each TUC can receive an outdoor air temperature value from either a local outdoor air temperature sensor or from the Tracer. If a local sensor exists and the Tracer sends an outdoor air temperature, the TUC uses the Tracer value as its active outdoor air temperature.

Supply Air Temperature Setpoint

Currently, the TUC does not support this setpoint.

Entering Water Temperature

Each TUC can receive an entering water temperature value from either a local entering water temperature sensor (auto changeover sensor) or from the Tracer. If a local sensor exists and a Tracer sends the entering water temperature, the TUC uses the Tracer value as its active entering water temperature.

Human Interface

This section explains how to use the human interface of the TUC. The human interface is a combination of DIP switches and LEDs. Instructions for the following procedures appear in this section:

- Setting the ICS address
- Reading the ICS address
- Testing the unit using auto cycle test
- Reading diagnostics
- Reading the machine state
- Reading the control mode

Figure 16 shows an example of the TUC DIP switches.

Note *When the DIP switches are up (pressed toward the numbers) they are on. When the DIP switches are pressed toward the* ***Open*** *position they are off. Figure 16 shows all DIP switches off. For slide DIP switches, the switch is on when it is pressed toward the* ***On*** *designation.*

Figure 16 TUC DIP Switches

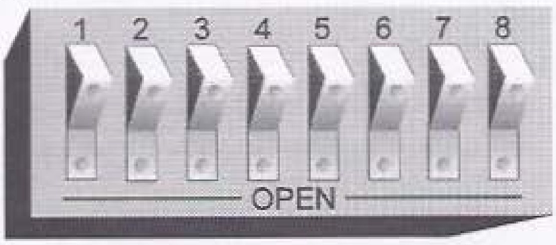
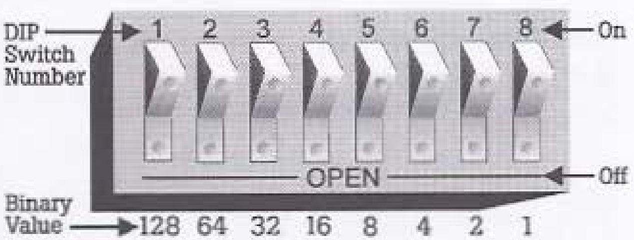


Figure 17 shows the DIP switches and their corresponding binary value.

Figure 17 DIP Switch and Binary Input Numbers



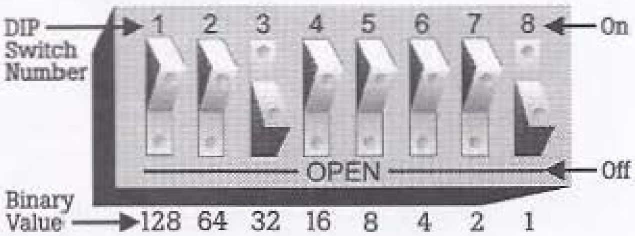
Setting the ICS Address

TUCs connected to a Comm4 communication link must be assigned a unique address number. Use the TUC's eight DIP switches to set the ICS address. The ICS address must be in the valid range of 33 to 96. See Figure 16 for an example of the DIP switches. Valid address settings appear in Table 39 on page 80.

To set the ICS address, follow the steps below:

1. Set the DIP switches to the correct address. For example, to set the address as 33, use a pencil or pen to flip DIP switch 3 and 8 on. Figure 18 shows an example of how the DIP switches look when set for address 33.

Figure 18 TUC DIP Switches set for Address 33



2. Short and hold the test input until all LEDs are on. Then, remove the test input signal. Figure 19 shows an example of the test input. Use a coin or other object to short the test input. Or, set the DIP switches with power off to the TUC, then apply power. The TUC will read the DIP switches at power up (Rev 12 TUC or higher).

Note *Cycling power to the TUC forces the TUC to read the DIP switch settings (Rev 12 TUC or higher).*

Note *You can view the TUC firmware version from both Tracer and Everyware or check the last two digits of the part number on the TUC microprocessor.* ***Example:*** *6200-0028-12.*

Figure 19 Example of Test Input

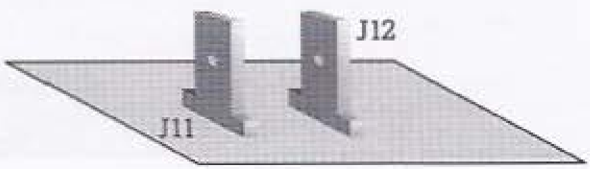


Table 39 Valid ICS Addresses

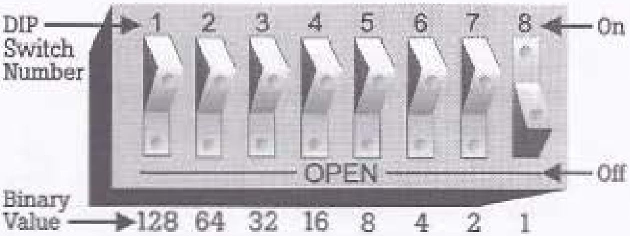
Position → Address ↓	1	2	3	4	5	6	7	8
33	Off	Off	On	Off	Off	Off	Off	On
34	Off	Off	On	Off	Off	Off	On	Off
35	Off	Off	On	Off	Off	Off	On	On
36	Off	Off	On	Off	Off	On	Off	Off
37	Off	Off	On	Off	Off	On	Off	On
38	Off	Off	On	Off	Off	On	On	Off
39	Off	Off	On	Off	Off	On	On	On
40	Off	Off	On	Off	On	Off	Off	Off
41	Off	Off	On	Off	On	Off	Off	On
42	Off	Off	On	Off	On	Off	On	Off
43	Off	Off	On	Off	On	Off	On	On
44	Off	Off	On	Off	On	On	Off	Off
45	Off	Off	On	Off	On	On	Off	On
46	Off	Off	On	Off	On	On	On	Off
47	Off	Off	On	Off	On	On	On	On
48	Off	Off	On	On	Off	Off	Off	Off
49	Off	Off	On	On	Off	Off	Off	On
50	Off	Off	On	On	Off	Off	On	Off
51	Off	Off	On	On	Off	Off	On	On
52	Off	Off	On	On	Off	On	Off	Off
53	Off	Off	On	On	Off	On	Off	On
54	Off	Off	On	On	Off	On	On	Off
55	Off	Off	On	On	Off	On	On	On
56	Off	Off	On	On	On	Off	Off	Off
57	Off	Off	On	On	On	Off	Off	On
58	Off	Off	On	On	On	Off	On	Off
59	Off	Off	On	On	On	Off	On	On
60	Off	Off	On	On	On	On	Off	Off
61	Off	Off	On	On	On	On	Off	On
62	Off	Off	On	On	On	On	On	Off
63	Off	Off	On	On	On	On	On	On
64	Off	On	Off	Off	Off	Off	Off	Off
65	Off	On	Off	Off	Off	Off	Off	On
66	Off	On	Off	Off	Off	Off	On	Off
67	Off	On	Off	Off	Off	Off	On	On
68	Off	On	Off	Off	Off	On	Off	Off
69	Off	On	Off	Off	Off	On	Off	On
70	Off	On	Off	Off	Off	On	On	Off
71	Off	On	Off	Off	Off	On	On	On
72	Off	On	Off	Off	On	Off	Off	Off
73	Off	On	Off	Off	On	Off	Off	On
74	Off	On	Off	Off	On	Off	On	Off
75	Off	On	Off	Off	On	Off	On	On
76	Off	On	Off	Off	On	On	Off	Off
77	Off	On	Off	Off	On	On	Off	On
78	Off	On	Off	Off	On	On	On	Off
79	Off	On	Off	Off	On	On	On	On
80	Off	On	Off	On	Off	Off	Off	Off
81	Off	On	Off	On	Off	Off	Off	On
82	Off	On	Off	On	Off	Off	On	Off
83	Off	On	Off	On	Off	Off	On	On
84	Off	On	Off	On	Off	On	Off	Off
85	Off	On	Off	On	Off	On	Off	On
86	Off	On	Off	On	Off	On	On	Off
87	Off	On	Off	On	Off	On	On	On
88	Off	On	Off	On	On	Off	Off	Off
89	Off	On	Off	On	On	Off	Off	On
90	Off	On	Off	On	On	Off	On	Off
91	Off	On	Off	On	On	Off	On	On
92	Off	On	Off	On	On	On	Off	Off
93	Off	On	Off	On	On	On	Off	On
94	Off	On	Off	On	On	On	On	Off
95	Off	On	Off	On	On	On	On	On
96	Off	On	On	Off	Off	Off	Off	Off

Reading the ICS Address

To read the ICS address of the TUC, follow the steps below:

1. Set the DIP switches to address 1 (DIP switch 8 on). Figure 20 shows an example of how the DIP switches look when set for address 1.

Figure 20 TUC DIP Switches set for Address 1



2. Short and hold the test input. Figure 19 shows an example of the test input. Use a coin or other object to short the test input.
3. Continue holding the test input and watch for the LEDs to blink in the following sequence:

Sequence 1 shows all LEDs off. When you short and hold the test input, all LEDs go off for one second.

In **Sequence 2**, LEDs 1 through 4 display what the state of DIP switches 1 through 4 was when the address was set. For this example (address 33), DIP switch 3 was on when the address was set and LED 3 was on in sequence 2. LED 5 is on to indicate you are in sequence 2.

In **Sequence 3**, LEDs 1 through 4 display what the state of DIP switches 5 through 8 was when the address was set. For this example (address 33), DIP switch 8 was on when the address was set and LED 4 was on in sequence 3. LED 6 is on to indicate you are in sequence 3.

To read the TUC address, add the binary input value of sequence 2 and sequence 3:

$$32 + 1 = 33$$

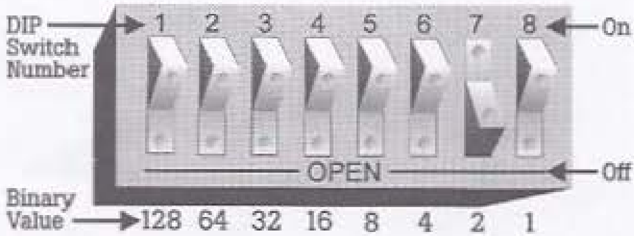
Using Auto Cycle Test

The auto cycle test allows you to manually exercise each TUC output by sequentially stepping through the 16 stages of the auto cycle test.

To place the TUC in auto cycle test mode, follow the steps below:

1. Set the DIP switches to address 2 (DIP switch 7 on). Figure 21 shows an example of how the DIP switches look when set for address 2.

Figure 21 TUC DIP Switches set for Address 2



2. To have the TUC automatically go through the test cycles, short and hold the test input. Continue holding the test input and the unit cycles to the next stage every 30 seconds.

   If you want to manually step through the test cycles, momentarily short the test input each time you want to advance to the next test stage.

   LEDs 1 through 4 display the current step of the auto cycle test (in binary form - LED#1 = 8, LED#2 = 4, LED#3 = 2, and LED#4 = 1). For example, if the auto cycle test is in step 5, LEDs 2 and 4 appear on. See Figure 22.

Figure 22 LEDs for Auto Cycle Test #5

3. When you complete the auto cycle test, return the DIP switches to their correct address.

Table 40 shows a list of the 16 auto cycle tests.

Note *During the auto cycle test, the TUC ignores all unit safety diagnostics.*

Note *If you leave the TUC in auto cycle test mode, it automatically returns to normal unit operation after one hour.*

Table 40 Auto Cycle Tests

Step	Fan Coil/Unit Vent Function/Blower Coil		Water Source Heat Pump Function
0	Off	B	Off
1	Fan Low	B	Fan Low
2	Fan Medium	B	Condenser Water
3	Fan High	B	Fan High
4	Economizer/Exhaust	B	Economizer/Exhaust
5	Cool	F	Reversing Valve Cool
6	Heat	F	Compressor Stage 1
7	Heat Stage 1	B	Compressor Stage 2
8	Heat Stage 2	B	Compressor Stage 3
9	Heat Stage 3	B	Reversing Valve Heat
10	Reheat	B	Compressor Stage 1
11	Not used		Compressor Stage 2
12	Not used		Compressor Stage 3
13	Not used		Heat Stage 1
14	Not used		Heat Stage 2
15	Not used		Reheat

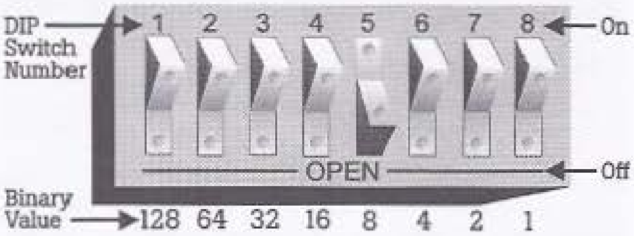
F or B For units with a face and bypass damper, this is the position of the damper during the auto cycle test. (F = Face and B = Bypass)

Reading Diagnostics

Use the human interface to read the current unit diagnostic. If no diagnostics are present, the last diagnostic appears. Follow the steps below:

1. Set the DIP switches to address 8 (DIP switch 5 on). Figure 23 shows an example of how the DIP switches look when set for address 8.

Figure 23 TUC DIP Switches set for Address 8



2. Short and hold the test input. Figure 19 shows an example of the test input. Use a coin or other object to short the test input.
3. The LEDs blink to define a diagnostic code. See Table 41 for a translation of the diagnostic codes. The information appears in three sequences. See the example below:

Sequence 1 shows all LEDs off. When you short and hold the test input, all LEDs go off for one second.

In **Sequence 2**, the illuminated LEDs represent the first part of the diagnostic code. In the example above, LEDs 3 and 4 are off.

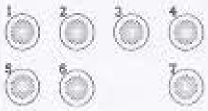
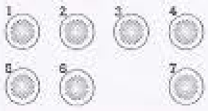
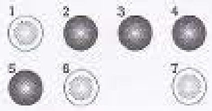
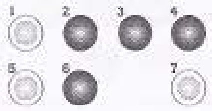
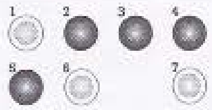
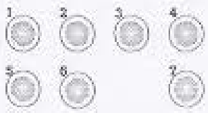
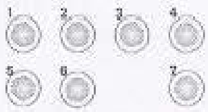
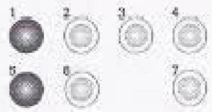
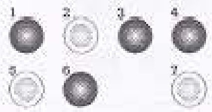
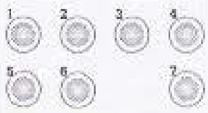
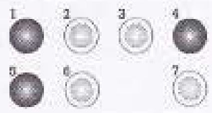
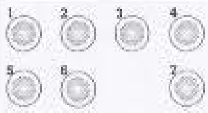
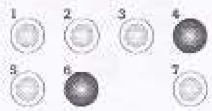
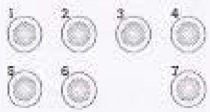
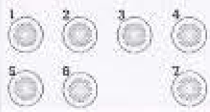
In **Sequence 3**, the illuminated LEDs represent the second part of the diagnostic code. In the example, LEDs 1, 2, 3, and 4 are on.

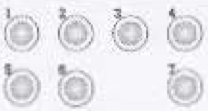
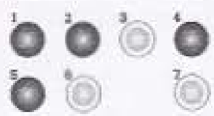
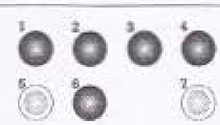
Together, sequence 2 and 3 make up the eight bits which define the diagnostic code. To read the diagnostic code, combine sequence 2 and 3:

On On Off Off On On On On

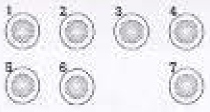
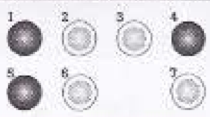
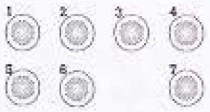
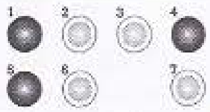
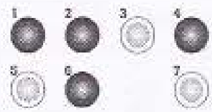
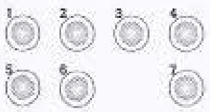
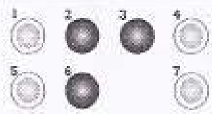
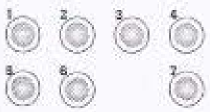
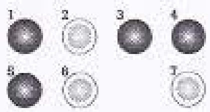
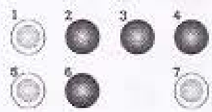
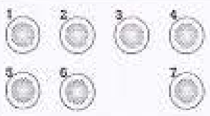
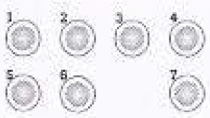
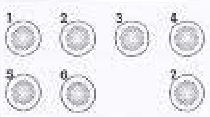
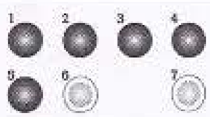
When you compare the LEDs in the example above to the LEDs in Table 41 on page 82, the diagnostic code is low coil entering air temperature (freeze).

Table 41 Diagnostic LED Sequences and Codes

Sequence 1	Sequence 2	Sequence 3	Code	Diagnostic	Latch
			None	Power failure	None
			None	Controller failure	None
			00	None	None
			77	DX defrost	No
			7E	Compressor shutdown by binary input	None
			7F	Compressor disable by Tracer	No
			8B	Condensate overflow	Yes
			9B	Leaving water temperature sensor 1 failure	No
			A0	Zone and supply temperature sensor failure	No
			A1	Electric heat inhibited by fan status	No
			B5	Low pressure cutout	Yes
			C8	High entering water temperature	No
			C9	Low leaving water temperature (freeze) Compressor 1	Yes

Sequence 1	Sequence 2	Sequence 3	Code	Diagnostic	Latch
			CA	Slave shutdown by master	No
			CB	Low entering water temperature	No
			CE	Fan status	Yes/No ❶
			CF	Low coil entering air temperature (freeze)	Yes
			D3	Low discharge air temperature (freeze)	Yes
			D4	Smoke alarm	Yes/No ❶
			D5	High discharge air temperature	Yes/No ❶
			DD	Low outdoor air temperature (DX)	No
			EF	NOVRAM error	None
			F8	Bad configuration	No
			F5	High pressure cutout 1	Yes
			FE	Return air high limit	Yes

❶ Configure Yes/No entries as either Yes (latching diagnostic) or No (non-latching diagnostic reported only as status).

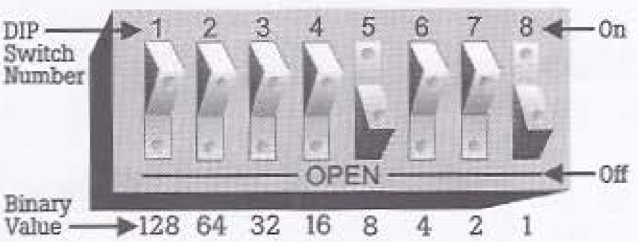
Sequence 1	Sequence 2	Sequence 3	Code	Diagnostic	Latch
			9C	Leaving water temperature sensor 2 failure	No
			9D	Leaving water temperature sensor 3 failure	No
			B6	Low pressure cutout 2	Yes
			B7	Low pressure cutout 3	Yes
			C6	Low leaving water temperature (freeze), Compressor 2	Yes
			C7	Low leaving water temperature (freeze), Compressor 3	Yes
			F6	High pressure cutout 2	Yes
			F7	High pressure cutout 3	Yes

Reading the Operating Machine State

Use the human interface to read the operating machine state. Follow the steps below:

1. Set the DIP switches to address 9 (DIP switches 5 and 8 on). Figure 24 shows an example of how the DIP switches look when set for address 9.

Figure 24 TUC DIP Switches set for Address 9



2. Short and hold the test input. Use a coin or other object to short the test input.
3. LEDs 1, 2, 3, and 4 define a two digit machine state code. See Table 42 for a translation of the machine state codes. The information appears in three sequences. See the example below:

Sequence 1 shows all LEDs off. When you short and hold the test input, all LEDs go off for one second.

In **Sequence 2**, the illuminated LEDs represent the first part of the machine state code. In the example above, LEDs 1, 2, 3, and 4 are off.

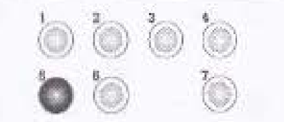
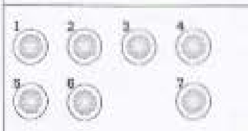
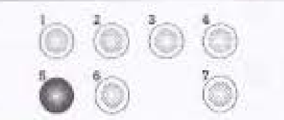
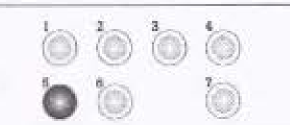
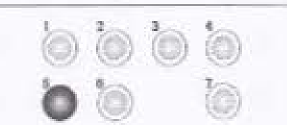
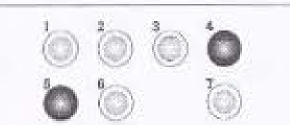
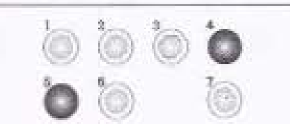
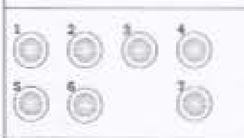
In **Sequence 3**, the illuminated LEDs represent the second part of the machine state code. In the example, LED 2 is on.

Together, sequence 2 and 3 make up the eight bits which define the machine state code. To read the machine state, combine sequence 2 and 3:

Off Off Off Off Off On Off Off

When you compare the LEDs in the example above to the LEDs in Table 42 on page 87, the machine state is auto cycle test.

Table 42 Operating Machine State LED Sequences and Codes

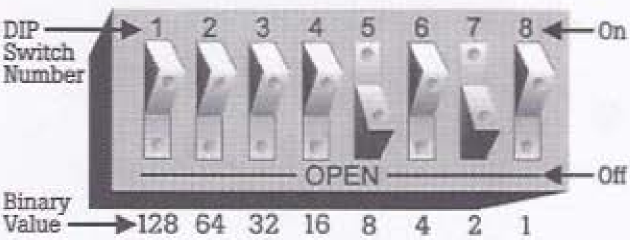
Sequence 1	Sequence 2	Sequence 3	Code	Diagnostic
			0	Manufacturing test
			2	Bad configuration
			4	Auto cycle test
			6	Disable
			8	Stop
			10	Calibration
			12	Latching Diagnostic
			14	Freeze shutdown
			16	Soft reset
			18	Standby
			20	Cooling
			22	Heating

Reading the Operating Control Mode

Use the human interface to read the operating control mode. Follow the steps below:

1. Set the DIP switches to address 10 (DIP switches 5 and 7 on). Figure 25 shows an example of how the DIP switches look when set for address 10.

Figure 25 TUC DIP Switches set for Address 10



2. Short and hold the test input. Use a coin or other object to short the test input.
3. LEDs 1, 2, 3, and 4 define a control mode. The information appears in three sequences. See the example below:

Sequence 1 shows all LEDs off. When you short and hold the test input, all LEDs go off for one second.

In **Sequence 2**, the illuminated LEDs represent the higher order binary bits for the control mode. In the example above, LED 4 is on.

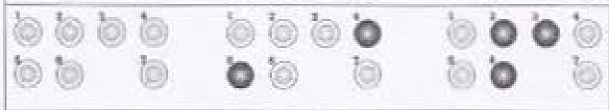
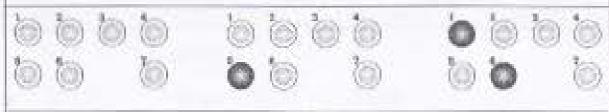
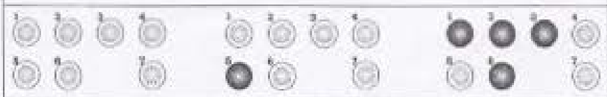
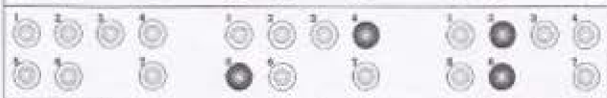
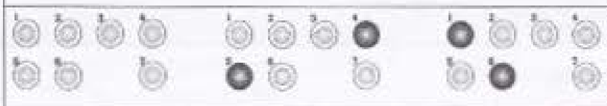
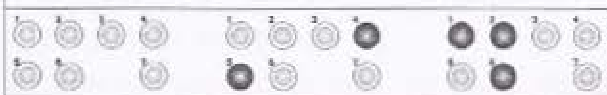
In **Sequence 3**, the illuminated LEDs represent the lower order binary bits for the control mode. In the example, LEDs 1, 2, and 4 are off.

Together, sequence 2 and 3 make up the eight bits which define all control modes. To read the control mode, combine sequence 2 and 3:

Off Off Off On Off Off On Off

When you compare the LEDs in the example above to the LEDs in Table 43 on page 89, the operating control mode is cool (occupied cooling with water or compressor).

Table 43 Operating Control Mode LED Sequences and Codes

Sequence 1	Sequence 2	Sequence 3	Code	Diagnostic	Definition
			0	Stop	Diagnostic, user switch, Tracer command, or interlock has stopped the machine.
			2	Purge	Incorrect entering water temperature. The TUC cannot meet the demand. There is no other capacity available.
			4	Tracer override	The TUC received a Tracer override. Follow Tracer output commands.
			6	Slave mode	The TUC received a slave message from a master. Follow master commands.
			8	Precool	Unoccupied cooling with economizer, water, or compressor; occupied cooling feasibility check.
			10	Precool purge	Unoccupied cooling with economizer while purging for cold water.
			12	Precool cool	Unoccupied cooling with 100% economizer with water or compressor augmentation.
			14	Economizer	Occupied cooling with economizer.
			16	Economizer purge	Occupied cooling with economizer while purging for cold water.
			18	Cool	Occupied cooling with water or compressor.
			20	Cool economize	Occupied cooling with water or compressor and 100% economizer.
			22	Preheat	Unoccupied heating with hot water (main or auxiliary), electric heat, or compressor.
			24	Preheat purge	Two-pipe only - Unoccupied heating with electric heat while purging for hot water.
			26	Preheat electric heat	Unoccupied heating with 100% hot water (main or auxiliary) or compressor with electric heat augmentation. Or, unoccupied heating with 100% main coil hot water with auxiliary coil hot water augmentation.
			28	Heat	Occupied heating with hot water (main or aux) or compressor.

Sequence 1	Sequence 2	Sequence 3	Code	Diagnostic	Definition
			30	Electric heat	Occupied heating with electric heat
			32	Heat electric heat	Electric heat available: occupied heating with 100% hot water (main or auxiliary) or compressor with electric heat augmentation. Electric heat not available: occupied heating with 100% main coil hot water with auxiliary coil hot water augmentation.
			34	Electric heat purge	Two-pipe only - Occupied heating with electric heat while purging for hot water.

Table 44 Normal Status of TUC LEDs

LED #	Description	Status
1	System LED	Always on.
2	Heat LED	**On** when in the Heat mode. **Blinking** if a diagnostic is present. ❶
3	Cool LED	**On** when in the Cool mode. **Blinking** if a diagnostic is present. ❶
4	Dirty Filter LED	**On** when a dirty filter diagnostic is present. ❷
5	High Pressure Cutout or Freezestat LED	**On** when a high pressure cutout (Water Source Heat Pump) or freezestat (Fan Coil or Unit Ventilator) diagnostic is present. ❸
6	Low Pressure Cutout or Condensate Overflow LED	**On** when a low pressure cutout (Water Source Heat Pump) or condensate overflow (Fan Coil or Unit Ventilator) diagnostic is present. ❸
7	Communication LED	**Steady off** - There is no ICS connection or no communication link activity. **Steady on** - There is incorrect wiring to the ICS link. Check for shorted wires or incorrect polarity. **Slow blink** - The TUC recognizes ICS communication link activity. ❹ **Rapid blink** - There is active communication with a Tracer system or Everyware. ❹

❶ The heat or cool LED blinks to show the last state in which the diagnostic occurred.
❷ The dirty filter diagnostic does not affect unit operation, but requires a manual reset.
❸ The high pressure cutout, freezestat, low pressure cutout, and the condensate overflow diagnostics require a manual reset.
❹ Slow blink equals 0.5 seconds on and 1.5 seconds off. Rapid blink equals 0.2 seconds on and 0.2 seconds off.

Abnormal LED Operation

Abnormal LED operation is any not described in the previous sections. Consult the appropriate Trane factory for additional information about specific LED operation. See Table 1 on page 1 for details on the appropriate Trane factory based on equipment type.

Troubleshooting

Resetting Unit Latching Diagnostics (Unit/Compressor Shutdown)

The TUC diagnostics in Table 45 cause unit latching diagnostics. Perform a manual reset to resume normal unit operation.

There are several ways to reset latching diagnostics. See the list below:

- If the zone sensor has a fan speed or system mode switch and the switch is enabled, to reset the TUC latching diagnostics, slide the switch to the off position (momentarily) and then return the switch to a position other than off.
- Use Everyware service software. Log on and reset diagnostics from the diagnostic page of the TUC screens. To view the diagnostics, press the ENTER key from the status section of service summary screens whenever **Diagnostics** flashes on the screen.
- Cycle power to the TUC.
- For a Tracer 100i or L TUC system, the Reset Failure point on the TUC editor, allows you to reset the diagnostics. Also, Tracer Versions 14.4 and higher provide a "+ enter" option from the TUC Service Summary screens which allows you to reset latching diagnostics.
- In Tracer Summit, reset the unit diagnostics using the button on the diagnostics page of the editor.

Unit Mode Listed as Standby

The following conditions place the TUC in standby mode:

- Tracer override present.
- During the power-up sequence or any time the TUC is calibrating its end devices.
- In the occupied mode when the desired capacity (heat or cool) is not available. For example, if the TUC requests a 2-pipe unit to heat, yet no hot water or electric heat is present, the TUC lists **Standby** as the unit mode. Auto changeover should only be edited as *Enabled* when the main coil has the capability of heating and cooling (like many 2-pipe units).
- In the unoccupied mode while the TUC is not running any capacity.

Table 45 TUC Latching Diagnostics

Diagnostic	Latching Diagnostic
Dirty filter	Normal unit operation, filter diagnostic requires manual reset
Condensate overflow	Unit shutdown, including fan
Leaving water temperature sensor fail (WSHPs)	Lockout compressor operation, normal fan operation
Low pressure cutout (WSHPs)	Lockout compressor operation, normal fan operation
Low leaving water temperature	Lockout compressor operation, normal fan operation
Supply fan failure (if configured as alarm = yes)	Unit shutdown, including fan
Supply fan failure	Normal unit operation, fan failure diagnostic requires manual reset
Low coil entering air temperature	Unit shutdown, including fan, valves controlled full open (freeze avoidance)
Low discharge air temperature	Unit shutdown, including fan, valves controlled full open (freeze avoidance)
Smoke alarm (if configured as smoke status alarm = yes)	Unit shutdown, including fan
High discharge air temperature	Unit shutdown, including fan
High pressure cutout	Lockout compressor operation, normal fan operation
Return air high limit	Unit shutdown, including fan

Problem	Cause	Solution
TUC doesn't communicate	TUC is not addressed correctly	Verify the ICS address according to Appendix A. Each TUC on the link must have a unique address in the range of 33 to 96. Be sure to momentarily short the test input on the TUC once the DIP switches have been set or modified.
	Incorrect wiring	Verify that the link is twisted pair—as specified in the Physical Specifications of this guide. TUC (Comm4) wiring is polarity sensitive throughout the communication link. If possible, isolate the TUC from the rest of the ICS link to determine if the problem exists in the wiring or in the TUC board.
	Defective TUC board	If the previous solutions do not fix the problem, you may need to replace the TUC board.
Fan outputs not energizing	Random start enabled	When enabled, the random start feature of the TUC delays the startup of the unit by three to 32 seconds after power up.
	Power up control wait	When enabled, the power up control wait feature delays the startup of the TUC by two minutes after power up. This gives the Tracer system ample time to communicate its fan control request.
	Fan operation configured for cycling	It is possible to configure the supply for continuous operation (when occupied) or for cycling operation (when occupied) based on the unit capacity.
	TUC is unoccupied	During the unoccupied mode, the supply fan only operates when the unit capacity requests fan operation. When the TUC uses normal unoccupied setpoints, the supply only fan operates to maintain those setpoints. The TUC may be in the unoccupied mode either via a Tracer system or by binary input 3 (when configured as occupied/unoccupied).
	Latching diagnostic present	The supply fan may be off due to a unit latching diagnostic—which requires a manual reset. Refer to Table 0 for instructions to reset latching diagnostics.
	Unit disabled	A Tracer system (via the shutdown mode) or binary input 1 (when configured as external interlock) may disable the TUC.
	Local fan switch enabled and off	When the zone sensor fan switch (Local) determines the unit supply fan operation, the **Off** position controls the unit fan off.

Problem	Cause	Solution
Fan outputs not energizing (Continued)	No power to the TUC	The TUC must have power (24 VAC) for the unit control to operate normally.
	Auto cycle test	The auto cycle test allows you to manually test each TUC output. Some stages of the auto cycle test cause the unit fan to stop operating. For more information about auto cycle test, see the Human Interface section of this guide.
	Wiring	Make sure the fan outputs are correctly connected to the fan relays. See the Unit Configuration section of this guide for more fan output information.
Valves closed	Normal operation	The valves open and close to meet unit capacity requirements.
	Unit disabled	Either a Tracer system (via the shutdown mode) or binary input 1 (when configured as external interlock) may disable the TUC. During the stop modes, the valves remain closed unless freeze avoidance is enabled and the outdoor air temperature falls below the freeze avoidance setpoint. If the outdoor air temperature falls below the freeze avoidance setpoint, the valves open. The TUC enables freeze avoidance whenever the freeze avoidance setpoint is not zero.
	Override present	The valves may be overridden closed by either the Tracer system or by Everyware software. Whenever any override is active, the TUC drives the valves closed, unless they are concurrently overridden open.
	Latching diagnostic present	The valves may be closed due to a unit latching diagnostic–which requires a manual reset. Refer to Table O for instructions to reset latching diagnostics.
	Auto cycle test	The auto cycle test allows you to manually test each TUC output. Some stages of the auto cycle test cause the valves to close. For more information about auto cycle test, see the Human Interface section of this guide.
	Maximum heating/cooling capacity of zero	The Tracer may limit the maximum heating/cooling capacity of the TUC from 0% to 100%. When the maximum cooling capacity is zero, the cooling valve remains closed. When the maximum heating capacity is zero, the heating valve remains closed.
	Unit configuration	The TUC cannot control any valve outputs if the unit is configured for no valves. Also, if the valve type is incorrectly configured (on/off, modulating analog, or 3-wire floating point), the valve may not operate properly.

Problem	Cause	Solution
Valves closed (Continued)	No power to the TUC	The TUC must have power (24 VAC) for the unit control to operate normally.
	Wiring	Make sure the valve outputs are correctly connected to the valves. See the Unit Configuration section of this guide for more valve output information.
Valves open	Normal operation	The valves open and close to meet unit capacity requirements.
	Override present	The valves may be overridden open by either the Tracer system or by Everyware software. Whenever any override is active, the TUC drives the valves closed, unless they are concurrently overridden open.
	Auto cycle test	The auto cycle test allows you to manually test each TUC output. Some stages of the auto cycle test cause the valves to open. For more information about auto cycle test, see the Human Interface section of this guide.
	Unit configuration	The TUC cannot control any valve outputs if the unit is configured for no valves. Also, if the valve type is incorrectly configured (on/off, modulating analog, or 3-wire floating point), the valve may not operate properly.
	Freeze avoidance	When freeze avoidance is enabled (only possible during stop modes), the TUC controls the valves open whenever the outdoor air temperature is less than the freeze avoidance setpoint. If the freeze avoidance setpoint is zero, this feature is disabled.
	Wiring	Make sure the valve outputs are correctly connected to the valves. See the Unit Configuration section of this guide for more valve output information.
Outdoor air damper closed	Normal operation	The two-position outdoor air damper opens under normal unit operation during occupied mode. The two-position outdoor air damper normally closes during unoccupied mode. Modulating analog and three-point floating point economizers open to minimum position (when occupied) and modulate to meet unit capacity requirements. If the minimum damper position is zero, the damper may close for extended periods. During the unoccupied mode, the normal outdoor air damper position is closed.
	Unit disabled	Either a Tracer system (via the shutdown mode) or binary input 1 (when configured as external interlock) may disable the TUC. During the stop modes, the outdoor air damper remains closed.

Problem	Cause	Solution
Outdoor air damper closed (Continued)	Override present	The outdoor air damper may be overridden closed by either the Tracer system or by Everyware software. Whenever any override is active, the TUC drives the outdoor air damper closed, unless the damper is concurrently overridden open.
	Latching diagnostic present	The outdoor air damper may be closed due to a unit latching diagnostic–which requires a manual reset. Refer to Table 0 for instructions to reset latching diagnostics.
	Auto cycle test	The auto cycle test allows you to manually test each TUC output. Some stages of the auto cycle test cause the outside air damper to close. For more information about auto cycle test, see the Human Interface section of this guide.
	Unit configuration	The TUC cannot control outdoor air damper outputs if the unit is configured for no outdoor air damper. Also, if the outdoor air damper type is incorrectly configured (on/off, modulating analog, or 3-wire floating point), the outdoor air damper may not operate properly.
	Warm up mode	When the occupied preheat damper position is closed, the unit closes the outdoor air damper whenever the zone temperature is three or more degrees (F) below the active heating setpoint. The outdoor air damper remains closed until the zone temperature is within two degrees (F) of the active heating setpoint.
	Local fan switch enabled and off	When the zone sensor fan switch (Local) determines the unit supply fan operation, the **Off** position controls the unit fan off and closes the outdoor air damper.
	No power to the TUC	The TUC must have power (24 VAC) for the unit control to operate normally.
	Wiring	Make sure the outdoor air damper outputs are correctly connected to the outdoor air damper actuator. See the Unit Configuration section of this guide for more outdoor air damper output information.
	Motion detection feature	The TUC may have the motion detection feature enabled. If motion detection is enabled and no motion is detected in the space (detected by a motion sensor and a binary input), the TUC can apply an alternate outdoor air minimum damper position.

Problem	Cause	Solution
Outdoor air damper open	Normal operation	The two-position outdoor air damper opens under normal unit operation during occupied mode. The two-position outdoor air damper normally closes during unoccupied mode. Modulating analog and three-point floating point economizers open to minimum position (when occupied) and modulate to meet unit capacity requirements. If the minimum damper position is zero, the damper may close for extended periods. During the unoccupied mode, the normal outdoor air damper position is closed.
	Override present	The outdoor air damper may be overridden open by either the Tracer system or by Everyware software. Whenever any override is active, the TUC drives the outdoor air damper closed, unless the damper is concurrently overridden open.
	Auto cycle test	The auto cycle test allows you to manually test each TUC output. Some stages of the auto cycle test cause the outside air damper to open. For more information about auto cycle test, see the Human Interface section of this guide.
	Unit configuration	The TUC cannot control outdoor air damper outputs if the unit is configured for no outdoor air damper. Also, if the outdoor air damper type is incorrectly configured (on/off, modulating analog, or 3-wire floating point), the outdoor air damper may not operate properly.
	Wiring	Make sure the outdoor air damper outputs are correctly connected to the outdoor air damper actuator. See the Unit Configuration section of this guide for more outdoor air damper output information.
Face and bypass damper closed (full bypass)	Normal operation	The face and bypass damper opens and closes to meet unit capacity requirements.
	Unit disabled	Either a Tracer system (via the shutdown mode) or binary input 1 (when configured as external interlock) may disable the TUC. During the stop modes, the face and bypass damper remains in the full bypass position.
	Override present	The face and bypass damper may be overridden closed (full bypass) by either the Tracer system or by Everyware software. To override the face and bypass damper, use the valve 1 override points. Whenever any override is active, the TUC drives the face and bypass damper closed, unless the damper is concurrently overridden open (full face).

Problem	Cause	Solution
Face and bypass damper closed (full bypass) (Continued)	Latching diagnostic present	The face and bypass damper may be closed (full bypass) due to a unit latching diagnostic—which requires a manual reset. Refer to Table O for instructions to reset latching diagnostics.
	Auto cycle test	The auto cycle test allows you to manually test each TUC output. Some stages of the auto cycle test cause the face and bypass damper to close (full bypass). For more information about auto cycle test, see the Human Interface section of this guide.
	Maximum heating/cooling capacity of zero	The Tracer may limit the maximum heating/cooling capacity of the TUC from 0% to 100%. When both the maximum cooling capacity and maximum heating capacity are zero, the face and bypass damper remains closed (full bypass).
	Unit configuration	The TUC cannot control face and bypass damper outputs if the unit is configured for no face and bypass damper. Also, for the face and bypass damper to operate properly, valve 1 type must be configured as on/off.
	No power to the TUC	The TUC must have power (24 VAC) for the unit control to operate normally.
	Wiring	Make sure the face and bypass damper outputs are correctly connected to the face and bypass damper actuator. See the Unit Configuration section of this guide for more face and bypass damper information.
Face and bypass damper open (full face)	Normal operation	The face and bypass damper opens and closes to meet unit capacity requirements.
	Override present	The face and bypass damper may be overridden open (full face) by either the Tracer system or by Everyware software. To override the face and bypass damper, use the valve 1 override points. Whenever any override is active, the TUC drives the face and bypass damper closed, unless the damper is concurrently overridden open (full face).
	Auto cycle test	The auto cycle test allows you to manually test each TUC output. Some stages of the auto cycle test cause the face and bypass damper to open (full face). For more information about auto cycle test, see the Human Interface section of this guide.
	Unit configuration	The TUC cannot control face and bypass damper outputs if the unit is configured for no face and bypass damper. Also, for the face and bypass damper to operate properly, valve 1 type must be configured as on/off.

Problem	Cause	Solution
Face and bypass damper open (full face) (Continued)	Wiring	Make sure the face and bypass damper outputs are correctly connected to the face and bypass damper actuator. See the Unit Configuration section of this guide for more face and bypass damper information.
Compressor(s) not running	Normal Operation	Normal compressor operation means that the unit compressor cycles on and off every couple minutes, depending on the unit capacity requirements. Refer to the Compressor Operation section of this manual for a description of the compressor operation.
	Compressor Lockout/Disable	The compressor will be locked out if any of the following conditions exist: - High pressure cutout - Low pressure cutout - Freezestat - Leaving water temperature sensor failure - Compressor disable (from Tracer) For each of the above conditions, except compressor disable, the compressor diagnostic must be manually reset to resume normal unit operation.
	DX (Compressor) Cooling Disable	For water source heat pumps, compressor cooling is disabled whenever the entering water temperature rises above the *DX Cooling Outdoor Air Low Limit.* Compressor operation is enabled when the entering water temperature falls at least four degrees (F) below this setpoint.
	Compressor Heat Disable	For water source heat pumps, compressor heating is disabled whenever the entering water temperature falls below the *Compressor Heating Disable Setpoint.* Compressor operation is enabled when the entering water temperature rises four degrees (F) or more above this setpoint.
Zone temperature too warm	Active heating/cooling setpoints	Make sure the active heating/cooling setpoints are reasonable. Either the zone sensor or the Tracer may send heating and cooling setpoints to the TUC.
	Wiring	Verify the wiring of all end devices, such as valves and dampers. Use the manual overrides or the auto cycle test to verify the operation of these end devices.
	Manual heat mode (from Tracer)	If the Tracer places the TUC in manual heat mode, the TUC cannot switch to cool mode. Therefore, the TUC cannot cool while in manual heat mode.

Problem	Cause	Solution
Zone temperature too warm (Continued)	Location of the zone sensor	Locate the zone sensor in an area where the temperature is representative of the average space temperature. **Example:** If the zone sensor is near drafts, the control of the TUC may vary.
Zone temperature too cold	Active heating/cooling setpoints	Make sure the active heating/cooling setpoints are reasonable. Either the zone sensor or the Tracer may send heating and cooling setpoints to the TUC.
	Wiring	Verify the wiring of all end devices, such as valves and dampers. Use the manual overrides or the auto cycle test to verify the operation of these end devices.
	Manual cool mode (from Tracer)	If the Tracer places the TUC in manual cool mode, the TUC cannot switch to heat mode. Therefore, the TUC cannot heat while in manual cool mode.
	Location of the zone sensor	Locate the zone sensor in an area where the temperature is representative of the average space temperature. **Example:** If the zone sensor is near drafts, the control of the TUC may vary.

Appendix A: Miscellaneous Information

TUC Index Values for UCM

Index Number	TUC Analog Inputs	Digits Right of Decimal
1	Active Zone Temperature (Degrees)	1
2	Active Zone Cooling Setpoint (Degrees)	1
3	Active Zone Heating Setpoint (Degrees)	1
4	Local Zone Cooling Setpoint (Degrees)	1
5	Local Zone Heating Setpoint (Degrees)	1
6	Supply (Discharge) Air Temp. (Degrees)	1
7	Active Outside Air Temp. (Degrees)	1
8	Local Outside Air Temeprature (Degrees)	1
9	Mixed Air Temperature (Degrees)	1
10	Return Air Temperature (Degrees)	1
11	Entering Water Temperature (Degrees)	1
12	Outside Air Damper Position (Percent)	0
13	Valve 1 Cooling Water Valve Position (Percent)	0
14	Valve 2 Heating Water Valve Position (Percent)	0
15	Hydronic Cooling Capacity (Percent)	0
16	Hydronic Heating Capacity (Percent)	0
17	Electric Heat On Time (Percent)	0
18	Compressor On Time (Percent)	0
19	Face & Bypass Damper Position (Percent)	0
20	Outdoor Coil Temperature (Degrees) ❶	1
21	Waterside Econo Valve Position (Percent) ❶	0
22	Leaving Water Temp. 1 (Degrees) ❶	1
23	Leaving Water Temp. 2 (Degrees) ❶	1
24	Leaving Water Temp. 3 (Degrees) ❶	1
25	Supply Air Temp. Setpoint (Degrees)	1
26	Return Air Relative Humidity (Percent)	0
27	Active Humidity Control Start (Percent)	0
28	Active Humidity Control Stop (Percent)	0
29	VOC Data	0
30	CO_2 Data	0
31	Auxil. Board Generic Analog Input (Percent)	0
32	Modulating Fan Speed (Percent)	0

❶ Water Source Heat Pump Only

Note *Range and offset entries for all TUC UCM analog inputs are 0.*

Note *The timed override (TOV) building control program input can be any UCM analog input from the TUC. This UCM analog input carries the timed override on and cancel status.*

TUC Index Values for UCM Binary Inputs

Index Number	TUC Binary Inputs	Descriptors
0	UCM Communicating	No/Yes
1	Latching Diagnostic Present	No/Yes
2	Non-latching Diagnostic Present	No/Yes
3	Bad UCM Configuration?	No/Yes
4	Low Air Flow	Normal/Alarm
5	Dirty Filter	Normal/Alarm
6	Condensate Overflow	Normal/Alarm
7	Heat/Cool Control	Auto/Manual
8	Zone Temp. too far from Setpoint	No/Yes
9	Electric Heat Output 1	Off/On
10	Electric Heat Output 2	Off/On
11	Electric Heat Output 3	Off/On
12	External Interlock	Closed/Open
13	Motion detector/Motion?	No/Yes
14	Smoke detector/Smoke?	No/Yes
15	Occupancy input/Occupied?	No/Yes
16	Occupant call?	No/Yes
17	DX Condensing Unit Fault	Normal/Alarm
18	Smoke Status Alarm	Normal/Alarm
19	Freezestat (Fan Coil low air temp.)	Normal/Alarm
20	Defrost request (coil frost protect)	No/Yes
21	WSHP Enable/Disable	Enable/Disable
22	Heat/Cool Request	No/Yes
23	Compressor Disable	No/Yes
24	Reversing Valve	Heat/Cool
25	Actual Supply Fan Status	Off/On
26	Exhaust Status	Off/On
27	Outdoor Fan Status	Off/On
28	Return Air Temp. High Limit	Normal/Alarm
29	Cmp 1 - High Pressure Cutout	Normal/Alarm
30	Cmp 2 - High Pressure Cutout	Normal/Alarm

Index Number	TUC Binary Inputs	Descriptors
31	Cmp 3 - High Pressure Cutout	Normal/Alarm
32	Cmp 1 - Low Pressure Cutout	Normal/Alarm
33	Cmp 2 - Low Pressure Cutout	Normal/Alarm
34	Cmp 3 - Low Pressure Cutout	Normal/Alarm
35	Cmp 1 - Compressor Lockout	Normal/Alarm
36	Cmp 2 - Compressor Lockout	Normal/Alarm
37	Cmp 3 - Compressor Lockout	Normal/Alarm
38	Cmp 1 - Status	Off/On
39	Cmp 2 - Status	Off/On
40	Cmp 3 - Status	Off/On
41	Cmp 1 - Freezestat	Normal/Alarm
42	Cmp 2 - Freezestat	Normal/Alarm
43	Cmp 3 - Freezestat	Normal/Alarm
44	Supply Air Temp. Low Limit	Normal/Alarm
45	Supply Air Temp. High Limit	Normal/Alarm
46	Entering Water Temp. too Low	Normal/Alarm
47	Entering Water Temp. too High	Normal/Alarm
48	Low Evap. Refrigerant Temp.	Normal/Alarm
49	Purge Indicator	No/Yes
50	Dehumidifying	No/Yes
51	IAQ Status	Normal/Alarm
52	Waterside Economizing	Closed/Open
53	VEM Input, Reheat Fail	Normal/Alarm
54	Dehumidification Mode	Disable/Enable
55	Reheat Status	Off/On
56	VEM Board Present	No/Yes
57	Heat Wheel Status	Off/On
58	Heat Wheel Present	No/Yes
59	SCUV Compressor Status	Normal/Alarm
60	Auxiliary Board Present	No/Yes
61	I/O Expansion Board Present	No/Yes

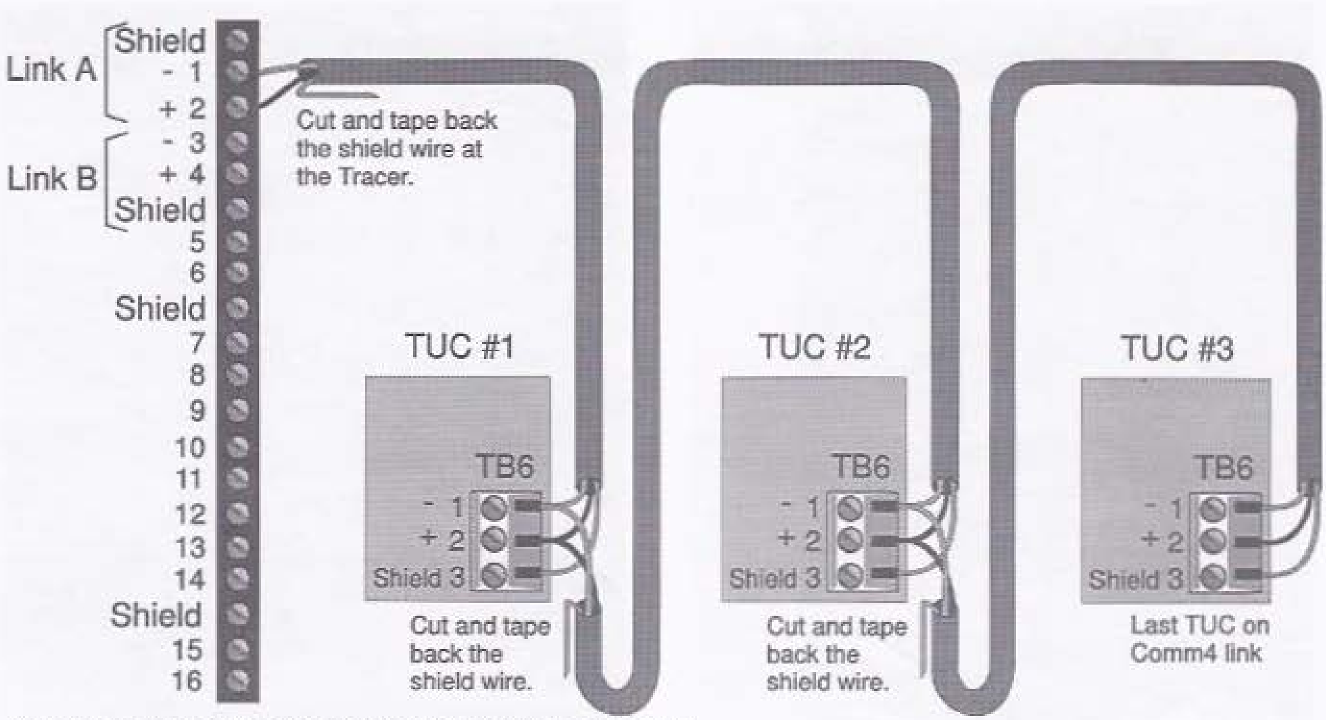
Thermistor Values

Temperature (F)	Value (ohms)
-20°	170,040
-10°	121,326
0°	87,510
10°	63,769
20°	46,919
30°	34,839
40°	26,221
50°	19,955
60°	15,333
65°	13,486
70°	11,889
75°	10,502
77°	10,000
80°	9297
85°	8247
90°	7330
100°	5824
110°	4661
120°	3757

Sensor Ranges

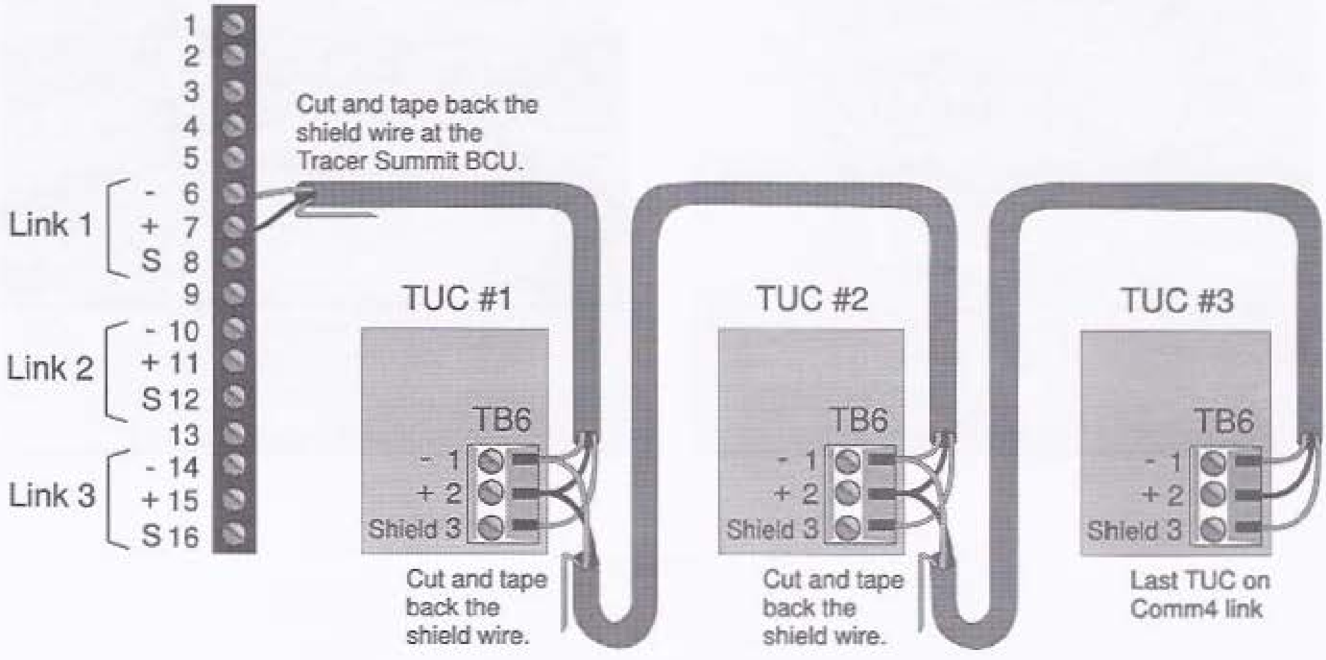
All Products	Minimum	Maximum
Zone Temperature	-40° F (-40° C)	150° F (65° C)
Cooling Zone Setpoint	50° F (10° C)	90° F (32° C)
Heating Zone Setpoint	50° F (10° C)	90° F (32° C)
Supply Air Temperature	-20° F (-28° C)	215° F (103° C)
Outdoor Air Temperature	-40° F (-40° C)	158° F (70° C)
Mixed Air Temperature	-40° F (-40° C)	158° F (70° C)
Fan Coil, Unit Vent, SCUV DX	**Minimum**	**Maximum**
Entering Water Temperature	-20° F (-28° C)	215° F (103° C)
Water Source Heat Pump	**Minimum**	**Maximum**
Leaving Water Temperature 1, 2, and 3	-20° F (-28° C)	215° F (103° C)
WSHP and SCUV Heat Pump	**Minimum**	**Maximum**
Entering Water Temperature	-40° (-40° C)	158° F (70° C)
Return Air Temperature	-40° (-40° C)	158° F (70° C)

TUC Connections with Tracer 100i or L



Note: On the TUC without screw terminals, J8-1 is "-" and J8-2 is "+".

TUC Connections with Tracer Summit BCU



Note: On the TUC without screw terminals, J8-1 is "-" and J8-2 is "+".

Staged Capacity

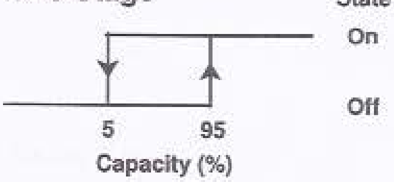
Compressors, DX, 2-position Valves, Electric Heat with Cascade or Supply Air Temperature Control

Each stage of capacity has two possible states:

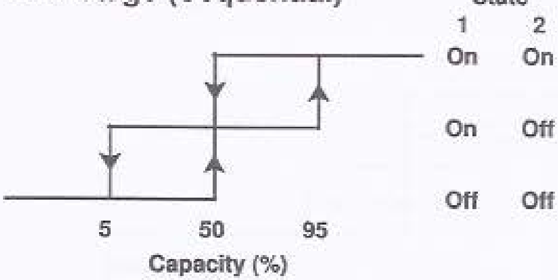
- Off continuously
- On continuously

The figures on this page show staged capacity details for cascade or supply air temperature control.

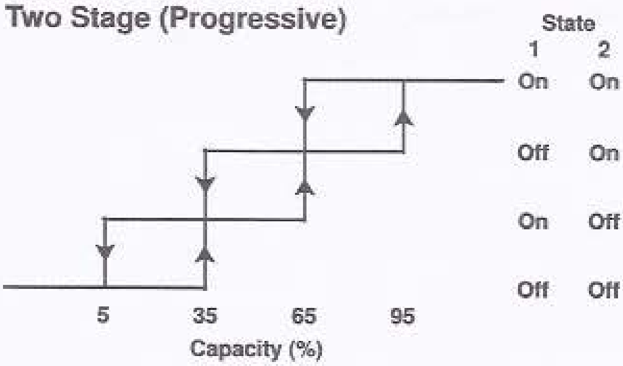
One Stage



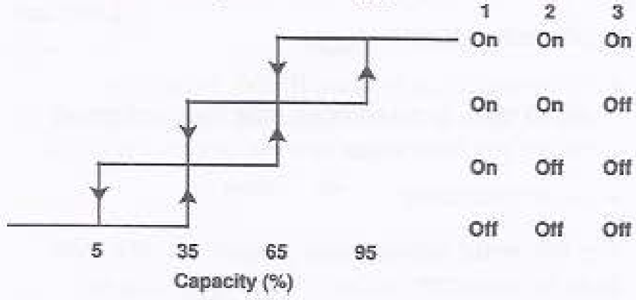
Two Stage (Sequential)



Two Stage (Progressive)



Three Stage (Sequential Only))



Staged Capacity with Zone Temperature Control

Each stage of capacity has three possible states:

- Off continuously.
- Pulse width modulating (PWM), where the on/off state is determined from the configured cycles per hour value and the desired capacity.
- On continuously.

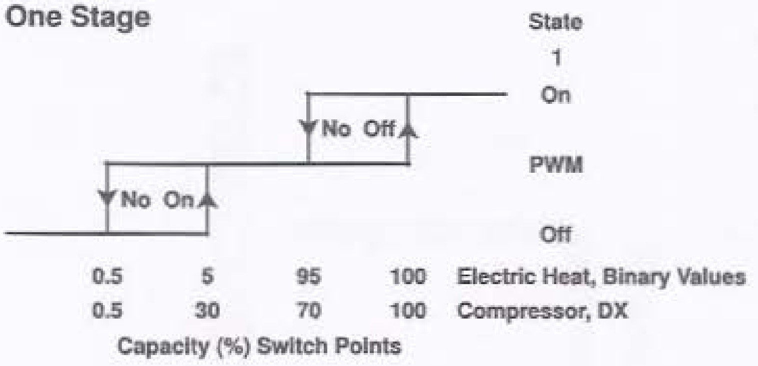
The following figures show staged capacity with zone temperature control. The figures include information about No On and No Off.

A description of No On and No Off follows:

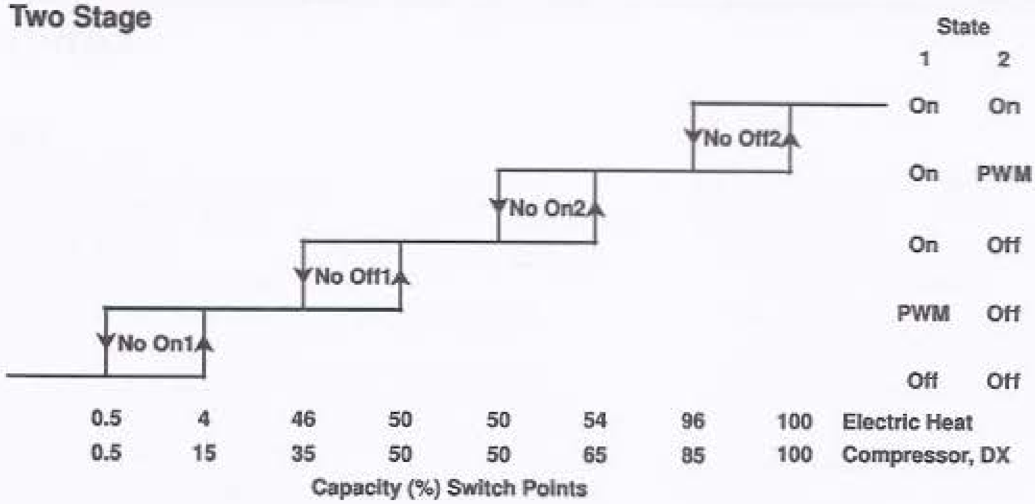
No On - This is a transitional area between off continuously and PWM. If the stage is on during a transition into the area, it stays on. If the stage is off when it enters the area, it stays off until the capacity moves out of the area.

No Off - This is a transitional area between on continuously and PWM. If the stage is off during a transition into the area, it stays off. If the stage is on when it enters the area, it stays on until the capacity moves out of the area.

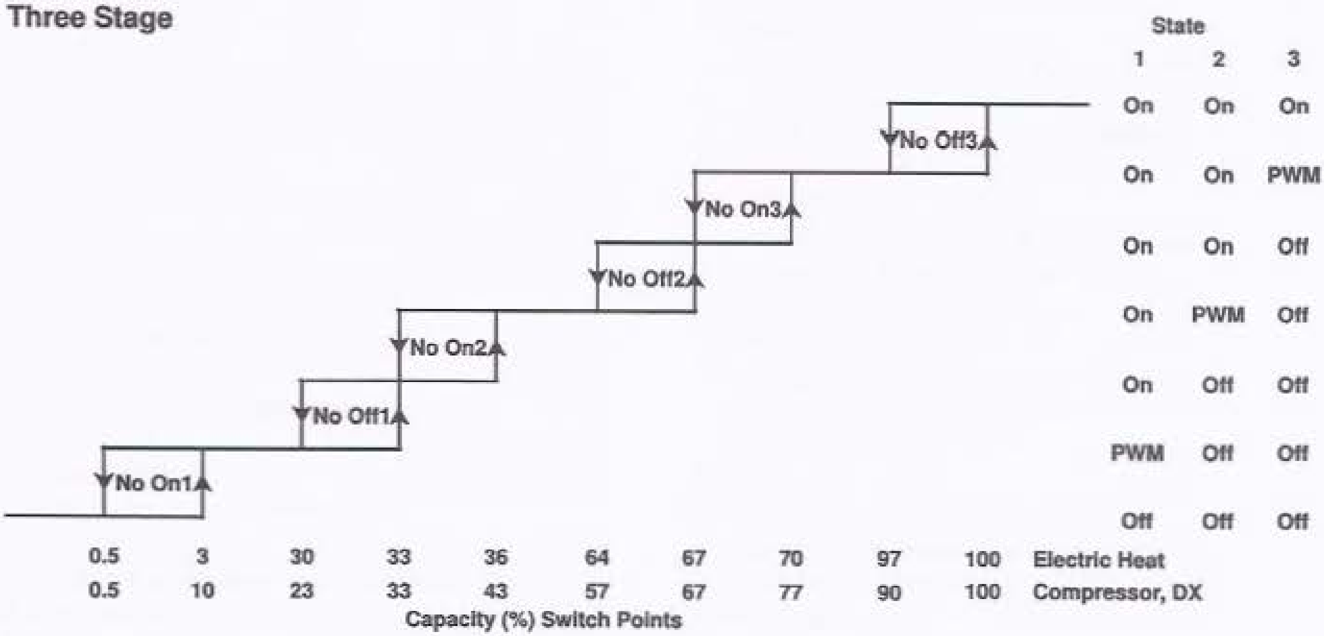
One Stage



Two Stage



Three Stage



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