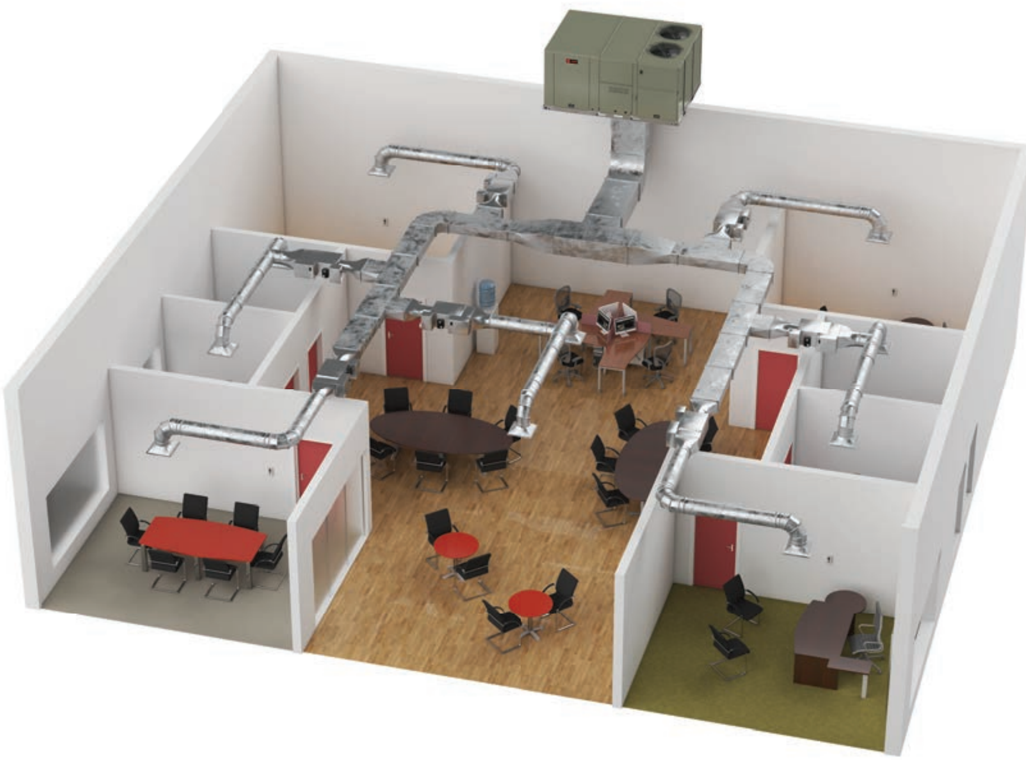
Application Guide

Tracer Concierge™ Controls

for Zoned Rooftop Systems using Precedent™ or Voyager™ 3 Rooftops enabled by Symbio™



⚠ SAFETY WARNING

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

June 2023

BAS-APG051A-EN

Introduction

Tracer Concierge systems are comprised of a number of common HVAC and control components, generally providing space comfort control with packaged rooftop (air conditioning) units (RTUs) and, in many applications, variable air volume (VAV) boxes. Depending on the application and design, these components can be selected and associated in a number of configurations to deliver varied system types. This guide defines several system types and explains the differences of each. It also provides guidance for the setup and configuration of the Tracer Concierge system for each application variation.

The different Concierge system types outlined in this guide include:

- Single-zone two-speed
- Single-zone VAV
- Changeover hybrid
- Changeover VAV
- Multiple-zone VAV with terminal electric heat
- Multiple-zone VAV with terminal hot water heat

Objectives

This document provides guidance for efficiently selecting the components needed for common Concierge systems. The document will help you to successfully select and install a Concierge system that is easy to set up, works well from the outset, and requires minimal adjustment later.

Note: *Because this application guide focuses on standardizing and simplifying the process for the most common system types, it does not address more complex applied systems that require customization, especially those requiring custom programming.*

This guide covers:

- Application considerations when designing a Concierge systems project
- Identifying and selecting the necessary components
- Setting up the equipment and configuring the control system
- Setting up the standard functions of the control system

Warnings, Cautions, and Notices

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

The three types of advisories are defined as follows:

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

Important Environmental Concerns

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

Important Responsible Refrigerant Practices

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

⚠ WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury.

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

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury.

Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

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

⚠ WARNING

Follow EHS Policies!

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

- **All Trane personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/ tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Trane personnel should always follow local regulations.**

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Table of Contents

Tracer Concierge System Components

This guide focuses on six different Concierge system configurations:

- Single-zone two-speed
- Single-zone VAV
- Changeover hybrid
- Changeover VAV
- Multiple-zone VAV with terminal electric heat
- Multiple-zone VAV with terminal hot-water heat

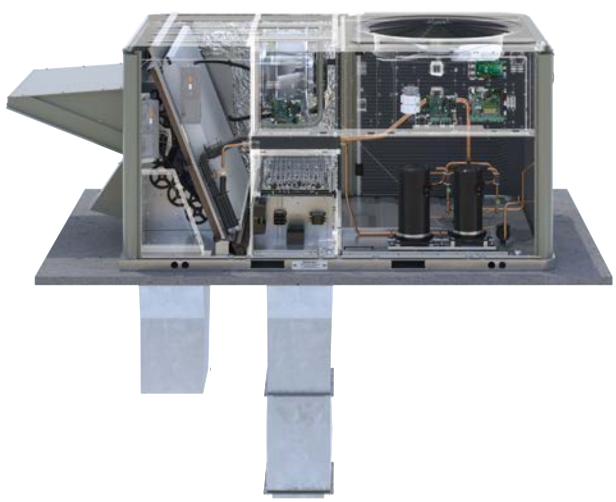
While some buildings include a wide variety of applied and specialized systems, many buildings can be serviced with simpler unitary systems. Each of the systems described in this guide are comprised of some/all of these components:

Rooftop Unit

The primary function of the rooftop unit (RTU) is to supply cold or hot air to the building depending on the configuration of the unit and the requirements within the zones at any given time. The "packaged" RTU always has a cooling source, specifically a direct expansion (DX) refrigeration circuit (fixed stages or variable capacity). The unit may also have the option to use outdoor air for cooling (economizing).

The RTU typically has a source of outdoor air for ventilation purposes. It may also have a heat source used to temper the supply air and/or to provide additional heat for special control sequences such as morning warm-up and unoccupied heating. Heating options for some RTUs include natural gas (staged or modulating), hydronic (hot water), heat pump or electric (staged or modulating). The RTU may have either a two-speed supply fan or a variable speed supply fan.

Figure 1. Packaged rooftop unit



Trane Rooftop Portfolio

Trane offers a variety of rooftop unit models, each with an extensive list of standard and optional capabilities. For Tracer Concierge systems, the rooftop of choice is typically selected in the 3-50 ton range.

Compressor Options

Compressor options include the following:

- Fixed-stage (manifolded on/off scroll compressors)
- eStage™ (staged scroll compressor technology)
- eFlex™ (variable speed compressor technology).

Modulating vs. Staged Heat

Depending on the type of Trane RTU selected, the available heating sources vary. For each unit type, consider the fan speed control as it pertains to the applicable heating source.

Variable-speed fan control is used for modulated heating sources:

- Modulated natural gas heat
- Modulated electric heat
- Hot water heat

Constant-speed (or two-speed) fan control is used for staged heating sources:

- Staged gas heat
- Staged electric heat
- Heat pump heating

RTU Controls

Symbio 700 Controller

The majority of Tracer Concierge projects include one or more packaged rooftop units in the size range of 3-50 tons. The factory-integrated controller on most applicable rooftop units is the Symbio™ 700 controller.

The controller is a microprocessor-based, modular solution that offers tested, proven control of the entire packaged rooftop unit. It enables seamless integration into both Trane and non-Trane building automation systems, by leveraging open standard protocols such as BACnet® MS/TP, BACnet IP, Modbus RTU, Modbus TCP/IP, or LonTalk. For additional information on the Symbio 700 controller, refer to the application guide (ACC-APG002*-EN) provided with the unit.

BACnet Communication

The Building Automation and Control Network (BACnet) and ANSI/ASHRAE Standard 135-2016 protocol is a standard that allows building automation systems or components from different manufacturers to share information and control functions. BACnet provides building owners the capability to connect various types of building control systems or subsystems together for a variety of reasons. In addition, multiple vendors can use this protocol to share information for monitoring and supervisory control between systems and devices in a multi-vendor interconnected system.

Symbio 700 includes native BACnet communications which allows the unit to communicate directly with a Trane or non-Trane building automation system via open protocol BACnet MS/TP or BACnet IP.

Best Practice

Select the Advanced Controller with BACnet capability when BACnet communication is needed for the Symbio 700 controller.

LonTalk® Communication

The optional LonTalk® communications module allows the Symbio™ 700 controller to communicate directly with a Trane or non-Trane building automation system via open protocol LonTalk.

Best Practice

Select the Advanced Controller with LonTalk capability when LonTalk communication is needed for the Symbio 700 controller.

Air-Fi™ Wireless Communication

Trane Air-Fi wireless systems provide significant advantages to better meet customer requirements by providing ease of installation for faster construction cycles and reduced risk, increased reliability and flexibility for easier problem solving, and fewer maintenance issues for worry-free operation and cost savings over the life of the system.Trane Air-Fi ® wireless systems help save time and money with industry-leading technology and performance.

The optional Air-Fi communications module allows the Symbio 700 controller to communicate directly with a Trane or non-Trane building automation system via open protocol BACnet over Zigbee wireless.

Best Practice

Select the Advanced Controller with Air-Fi Wireless capability when Air-Fi wireless communication is needed for the Symbio 700 controller.

Return Air Temperature Sensor

Depending on the application, a hardwired space/return air temperature sensor may be needed. For example, when Air-Fi wireless communication is selected, a hardwired sensor may not have been chosen or installed. Regardless of the intended application, even wireless, consider including a hardwired temperature sensor for the construction phase of the project. Because wireless communication may not be readily available during the construction phase, including a hardwired sensor and installing it in the return air plenum will allow the rooftop unit to operate during all phases of the project.

Best Practice

Select and install a hardwired return air temperature sensor with the rooftop unit to enable operation during all phases of the project, including the construction phase.

VAV Terminal Units and Controls

Systems where the RTU serves multiple zones (changeover hybrid, changeover VAV, and multiple-zone VAV with terminal heat) require a VAV box for each zone. Variable Air Volume (VAV) terminal units, also referred to as VAV boxes, contain an airflow damper, an airflow sensor, a fan (optional), and a heat source (optional). While some projects may use only one type of VAV box throughout the installation, others may include a variety of VAV boxes, each installed for specific purposes depending on their application or location in the building or zone.

As they pertain to Concierge systems, there are four basic types of VAV boxes.

Round In, Round Out VAV Box

The Round In, Round Out (RIRO) VAV box is ideal for both new construction and retrofit applications where heat is not required in the VAV box (as may be the case in either a changeover hybrid or changeover VAV system). The shut-off style box includes an integral flow ring for air flow measurement. The box is offered with control enclosure, electrical components, and factory-commissioned Symbio™ 210 controller.

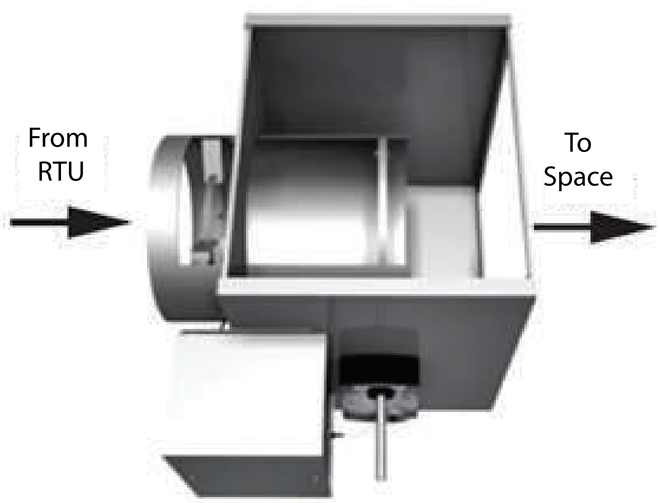
Note: *The RIRO product is not available with either electric or hot water reheat.*

Figure 2. Round-in, round-out VAV box

Shutoff VAV Box

Shutoff VAV boxes control the flow of supply air to maintain zone temperature at the desired setpoint. Each VAV box is associated with a space temperature sensor, either wired or connected wirelessly. These VAV boxes are typically used in cooling-only applications that do not require heat during occupied hours or in changeover systems where they vary the flow of either cold or warm air to the zone. The box is offered with control enclosure, electrical components, and factory-commissioned Symbio™ 210 controller.

Figure 3. Shutoff VAV box



VAV Box with Reheat

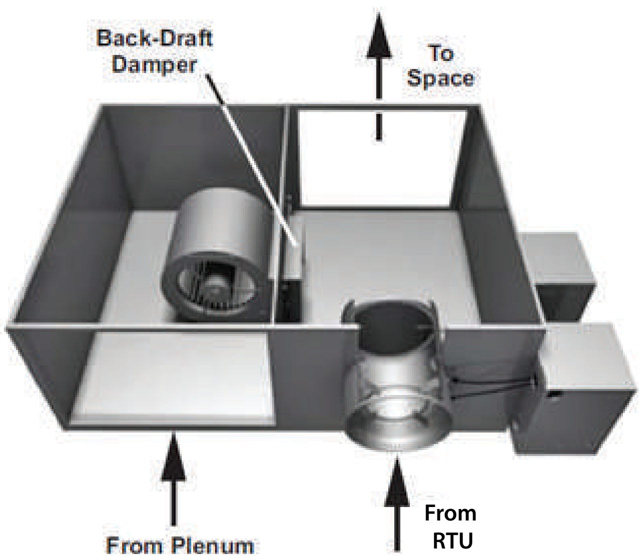
VAV boxes with reheat are similar to a shutoff box, with the addition of a heat source. The heat source is typically located at the box's outlet and can be hot water or electric. The air damper inside the VAV box has an adjustable minimum flow setting to ensure sufficient airflow to a zone in the heating operation mode. These VAV boxes are typically used when system-installed cost is a primary consideration and space heating is required during occupied hours. The box is offered with control enclosure, electrical components, and factory-commissioned Symbio™ 210 controller.

Figure 4. VAV box with reheat

VAV Box with Parallel Fan

A parallel fan-powered VAV box has an air damper similar to a shutoff box. In addition, it has a fan (constant-speed or variable-speed), backdraft damper, and an optional heat source. When reheat or heating is not required, the fan is off and a back-draft damper is closed to prevent cool air from entering the return plenum. Using warm plenum air as the first stage of heat in the VAV box may reduce operating costs over electric or hot water reheat alone. The box is offered with control enclosure, electrical components, and factory-commissioned Symbio™ 210 controller.

Figure 5. VAV box with parallel fan

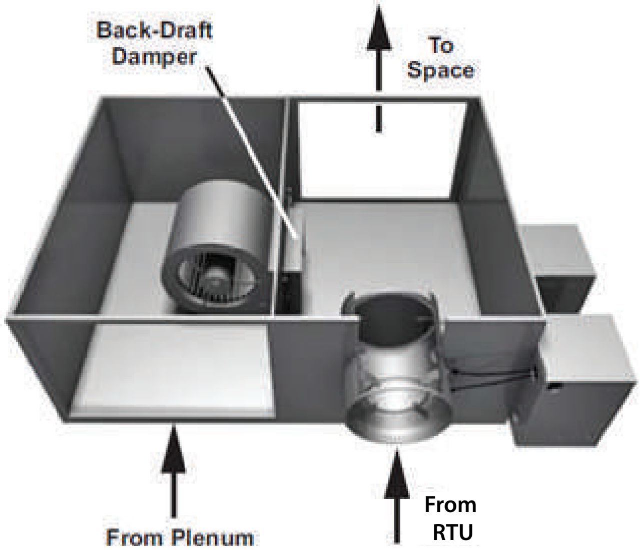


VAV Box with Series Fan

The series fan operates continuously, either constant-speed or variable-speed, while the damper modulates to vary the ratio of warm plenum air to cool supply air. The result is a variable temperature air flowing into the space. Additional reheat may also be available from an optional heating source located at the VAV box outlet. The box is offered with control enclosure, electrical components, and factory-commissioned Symbio™ 210 controller.

Series fan-powered VAV boxes are often selected by designers who wish to increase air delivery to the zone, while still benefiting from the energy savings associated with a VAV system. Series fan-powered VAV boxes may be used throughout the entire building or they may be applied selectively in areas such as restrooms, entrance ways, and hallways.

Figure 6. VAV box with series fan

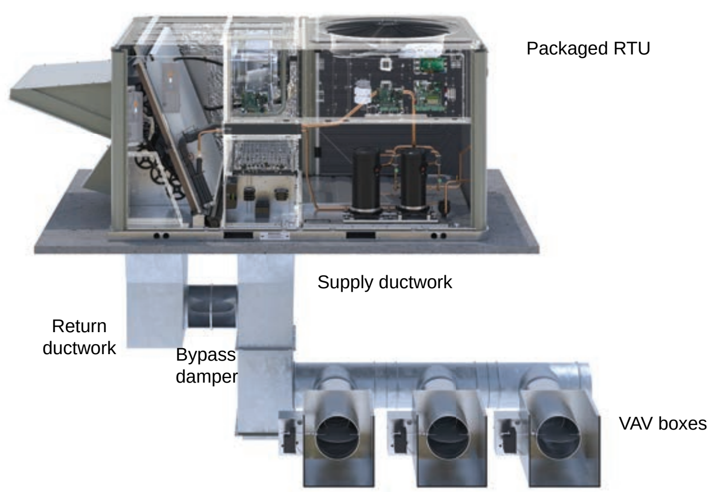


Bypass Damper

The purpose of the bypass damper is to provide a path for excess supply airflow. For changeover hybrid systems, the RTU supply fan operates at constant speed in heating mode. The associated VAV boxes modulate to provide more or less warm air to the space based on demand. Any excess air from the RTU not delivered to the spaces by the VAV boxes must be bypassed.

The bypass damper is a shut-off VAV damper, configured in the factory to specifically function as a bypass damper. When the bypass damper is fully closed, all of the conditioned air from the RTU is provided to the VAV boxes of the associated system. As the bypass damper is controlled open, more conditioned air bypasses the system and is immediately returned to the RTU. The bypass damper modulates to maintain a static pressure setpoint in the duct system, automatically responding to the VAV box changes based on each space demand for more or less heating.

Figure 7. Bypass Damper



For changeover hybrid systems, when the RTU was selected with either electric or staged gas heat or as a heat pump, the supply fan will be controlled to operate at maximum speed whenever the heater is activated, to ensure sufficient airflow across the heater. In this mode, the associated VAV boxes are not able to handle the maximum airflow from the RTU, resulting in the need for a bypass damper.

The bypass damper is either a Round In, Round Out (RIRO) damper () or shut-off VAV damper (), configured in the factory to specifically function as a bypass damper. Beginning at Tracer Concierge V5.2, changeover hybrid systems are supported as standard, allowing users to easily configure systems without the need for custom programming.

In either a changeover VAV system or multiple-zone VAV system, if the RTU is equipped with a modulating gas heater, a bypass damper may be required if the system airflow is expected to drop below the minimum threshold for the heater. (This minimum airflow data can be found in the Trane Zoned Rooftop Systems catalog, APP-PRC009*-EN.) In this case, the bypass damper is a shut-off VAV damper that must be controlled to ensure minimum airflow through the RTU whenever the modulating gas heater is activated. The VAS application in system controller includes the bypass damper coordination necessary with changeover VAV systems.

Figure 8. Round in, round out applied as the bypass damper

Figure 9. VariTrane shutoff VAV box applied as the bypass damper

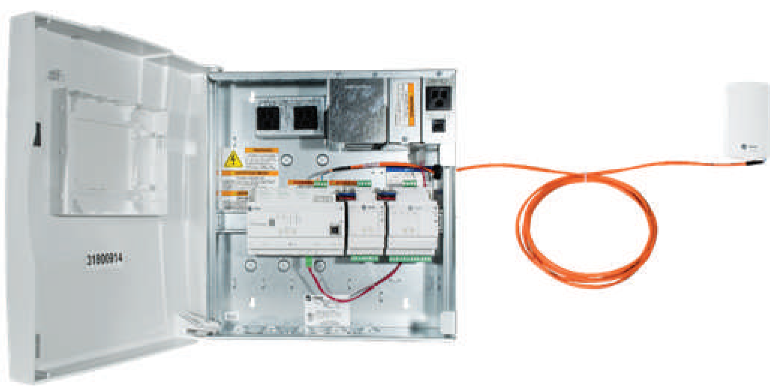
Controls

Tracer Concierge Panel

Tracer Concierge system control panel includes the following components:

- Control enclosure, power transformer, and door
- Tracer Concierge system controller
- Air-Fi Wireless Communication Interface (WCI)
- Tracer XM30 and/or XM32 input/output expansion modules (optional)
- Tracer LonTalk Adapter (optional, not shown)

Figure 10. Tracer concierge panel



Control Enclosure

The sturdy control enclosure is pre-engineered for convenience and ease of installation. The enclosure includes the necessary power transformer (120 VAC/24 VAC), convenience outlet, DIN rail, and door.

Tracer Concierge System Controller

The system controller is a pre-engineered, pre-programmed controller that includes all system coordination functions. System setup is normally accomplished with the Tracer 10-inch Display, though the web browser interface can also be used. The system controller includes built-in functions for overrides, temperature setpoint changes, monitoring, and scheduling. In multiple-zone systems, where coordination of the central RTU and VAV boxes is necessary, a pre-engineered application in the controller is responsible for that functionality.

Wireless Communication Interface (WCI)

The Trane Air-Fi WCI is included in case wireless communication is desired between the Tracer Concierge system controller and the other devices in the system. The WCI is provided with a coiled cable to allow installation above the panel or in the ceiling plenum.

Figure 11. Wireless Communication Interface (WCI)

Tracer XM30

The Tracer XM30 Expansion Module provides additional points when needed for Tracer Concierge applications. Each expansion module has a total of 4 points that can be configured using any combination of inputs/outputs.

Figure 12. Tracer XM30

The XM30 module is normally selected when the outside air temperature is wired to the Tracer Concierge control panel. Additional monitoring points can also be wired to the XM30 module.

Best Practice:

Select the XM30 module when the outside air temperature is to be wired to the Tracer Concierge system control panel.

Tracer XM32

The Tracer XM32 Expansion Module provides additional points when needed for Tracer Concierge applications. Each expansion module has a total of four (4) relay outputs.

Figure 13. Tracer XM32

The XM32 is normally selected when binary output control from the Tracer Concierge panel is desired, especially when lighting control, exhaust fan control, or other general purpose points are scheduled through the system controller.

Best Practice:

Select the XM32 module when one or more lighting, exhaust fan control, or other general purpose control points are to be scheduled from the Tracer Concierge system control panel.

U60 LonTalk Adapter

When LonTalk communication is required in the Tracer Concierge system, select the optional U60 LonTalk Adapter for the control panel. The adapter mounts directly on the DIN rail of the control enclosure, immediately next to the system controller.

When only hardwired BACnet or wireless Air-Fi communication is selected, the U60 LonTalk Adapter is not needed.

Tracer 10–inch Display

An intuitive local interface makes the system easy to use. One simplified control saves time in making changes to the system. The touch-screen display has standard screens that can be changed to reflect your building, allowing you to best fit the system to your specific needs. See exactly the information you want to see about your building at a glance.

The touch-screen interface is included with every Tracer Concierge control system. While connection to and navigation across the control system can also be accomplished via web browser, the touch-screen display offers a simplified interface solution that accomplishes most tasks needed to manage the system.

The Tracer 10-inch display provides the ability to group multiple rooms, components and HVAC and lighting equipment in your building, so you can manage your building the way that you use it, controlling areas versus individual rooms. Program multiple rooms on the same schedule and update them all together as needed, from one interface — a capability that programmable thermostats don't offer — giving you the flexibility to manage your entire building instead of just the space.

The Tracer 10-inch display offers a single point of control to complete many of the functions you use to manage your building. The single point of control eliminates the need to go from location to location in your building to program multiple thermostats, saving time and money. A range of built-in functions helps maximize building performance including overrides, temperature setpoint changes and daily monitoring.

The Tracer 10-inch display also includes installation and service capabilities for the technician or contractor. Most projects can be installed and serviced leveraging only the standard features of the touch-screen display.

Figure 14. Tracer 10-inch display

Mobile Access

BAS Occupant Mobile App

The BAS Occupant Mobile App allows users to manage their building from a smart phone, tablet, or other mobile device. From the app, users can manage schedules and adjust setpoints.

Available for both Apple and Android devices, the BAS Occupant Mobile App connects to the Tracer Concierge system either through a Wi-Fi network connection or through Trane Connect Remote Access.

Figure 15. BAS Occupant Mobile App

Single and Dual Setpoint Functionality

Selecting any of the spaces displayed on the BAS Occupant Mobile App allows adjustment to the occupied heating/cooling setpoint(s). Once selected, the application displays the active space temperature and both the occupied heating setpoint and occupied cooling setpoint for that selected space. The active setpoint is highlighted in the applicable color: red for the heating setpoint, blue for the cooling setpoint.

Figure 16. Setpoint widget

Figure 17. BAS Occupant setpoint adjustment

For controllers configured for single setpoint adjustment, increasing/decreasing the requested setpoint will adjust both the heating and cooling setpoints simultaneously while maintaining the configured offset between those setpoints.

Some controllers can be configured for dual setpoint adjustment, which allows independent adjustment of the heating and cooling setpoints. In those cases, pressing the increase/decrease buttons will affect the active (highlighted) setpoint. To edit the other setpoint, press the setpoint to highlight that value, then press the up/down buttons to edit the value. The active setpoint will again be highlighted after a few seconds of inactivity.

BAS Operator Mobile App

The BAS Operator Mobile App is a trouble shooting tool for contractors and installers. Intended for users with installer/programmer access, it provides access to the Tracer Concierge system from anywhere. From the BAS Operator Mobile App, users can view and override:

- Setpoints
- Occupancy
- RTU and VAV graphics
- Schedules
- Alarms
- Status

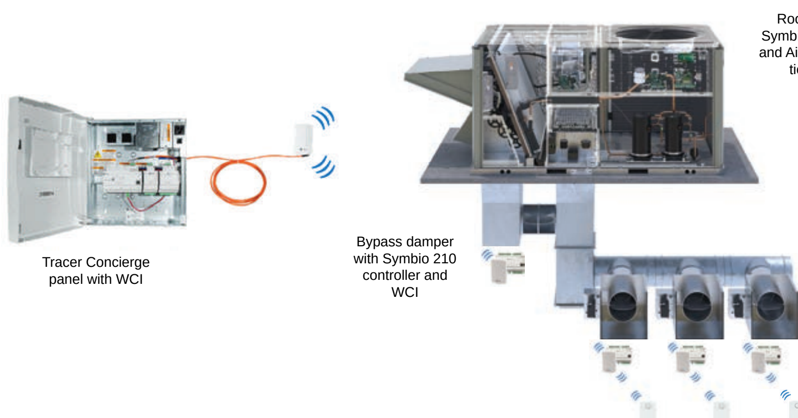
Figure 18. BAS Operator Mobile App

Air-Fi Wireless Communications and Sensors

Trane Air-Fi wireless communications provides easier installation to save time and reduce risk, increased reliability and flexibility for easier problem solving, and fewer maintenance issues for worry-free operation and cost savings over the life of the system.

Air-Fi Wireless uses BACnet protocol over ZigBee® Building Automation (ZBA) wireless communication standards. Wireless communication is accomplished by associating one or more Air-Fi Wireless Communicating Sensors (WCS) with the Wireless Communication Interface (WCI) installed on a rooftop or a VAV box and the WCI that has been factory installed in the Tracer Concierge control panel. The WCS in each space communicates the temperature and optional relative humidity in that space to the associated rooftop or VAV box controller and to the Tracer Concierge system controller.

Figure 19. Air-Fi wireless communication example

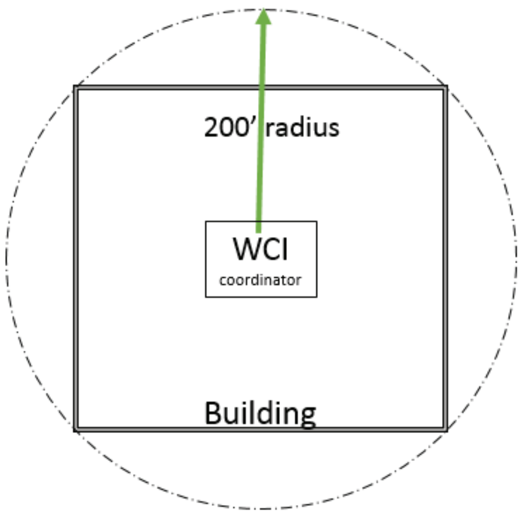


The Wireless Communication Interface (WCI) is always factory installed in the Tracer Concierge system control panel regardless of the communication type selected. When wireless communication is desired, a WCI must be installed for each wirelessly connected controller. Wireless Communication Sensors (WCS) have Air-Fi wireless communication integral to the sensor.

Most Tracer Concierge installations of 30 devices or less can be covered with a single network because of the Air-Fi wireless range. Place the WCI coordinator in a central location of the floor plan for best performance. WCI placement considerations include:

- 200 foot optimal range in typical sheet rock construction (other constructions might vary)
- Avoid solid metallic surfaces that block the signal
- A WCI factory installed on the RTU has a 100 foot range in typical sheet rock construction
- A repeater WCI can be used to extend the range
- Multiple floors need a WCI coordinator per floor

Figure 20. WCI radius



When placing the WCS keep these points in mind:

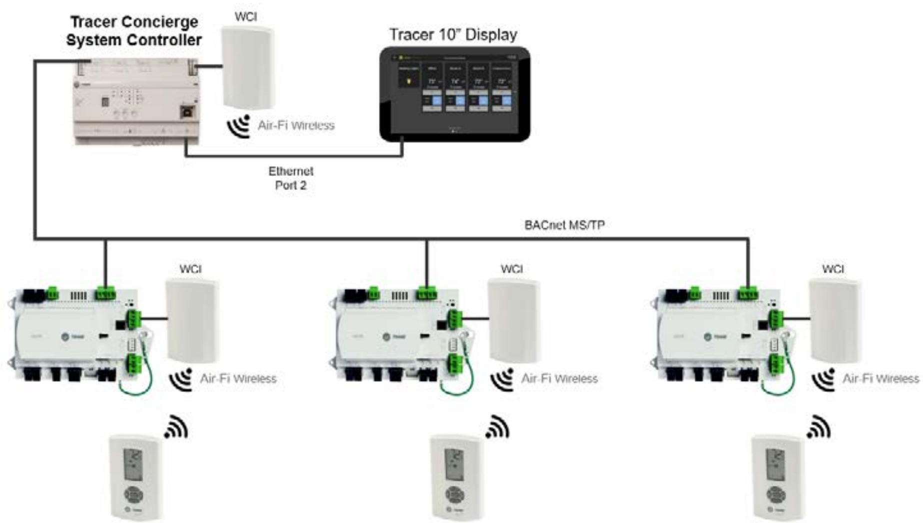
- Avoid direct sunlight
- Avoid exterior walls
- Avoid areas close to heat sources
- Avoid areas with high vibration

Refer to Air-Fi Network Design Best Practices (BAS-SVX55*–EN) for additional product and installation information on Air-Fi wireless communications.

Air-Fi Wireless Sensors

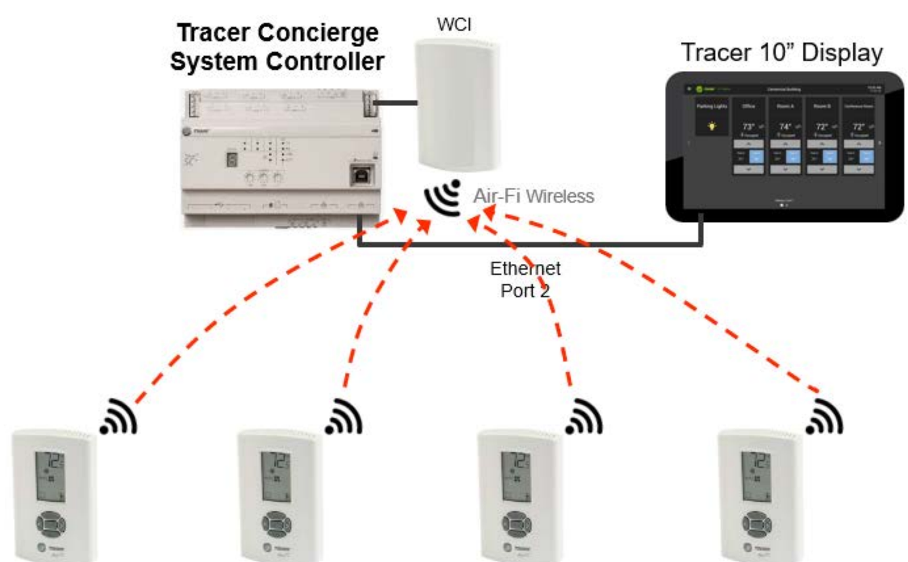
Apply Air-Fi Wireless sensors with or without Trane unit controllers. For applications with Trane unit controllers, add the Wireless Communication Interface (WCI) to each unit controller to enable wireless communication capability. With wireless capability added, apply Air-Fi Wireless sensors with each unit controller, maximum 6 per unit controller (for space temperature averaging applications).

Figure 21. Air-Fi Sensors with Trane controllers



Air-Fi Wireless sensors can also be applied directly to the WCI coordinator at the system control panel. The Tracer Concierge system controller supports up to 8 WCIs and 6 wireless sensors per WCI, or 48 total Air-Fi Wireless sensors for this use case. Those Air-Fi sensors can be configured as either "monitoring" for status only or as a "device" sensor, allowing Tracer SC+ to pass the wireless sensor information to a specific controller in the network, including third-party devices.

Figure 22. Air-Fi Sensors applied directly to the WCI

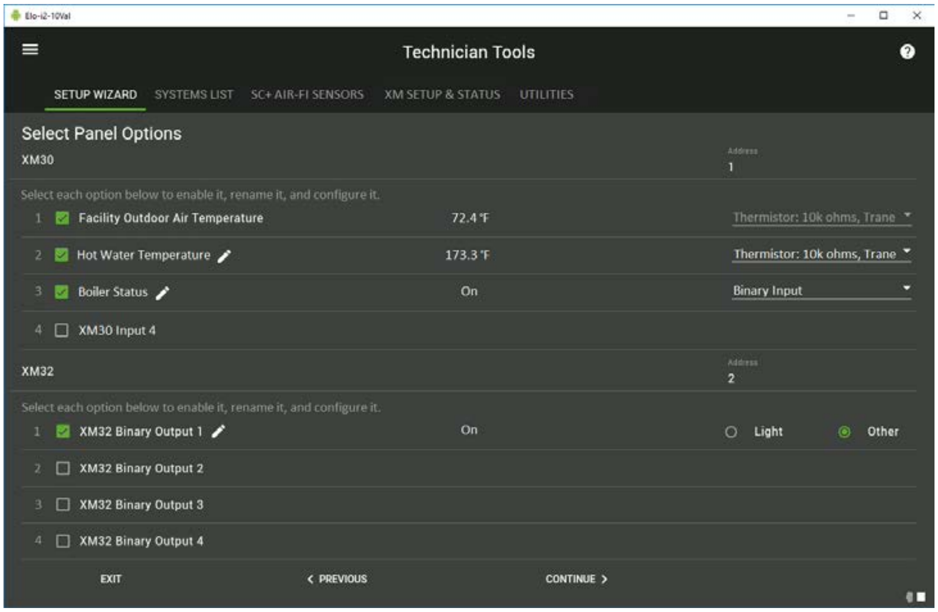


Generic Hardwired Sensors

Use the Setup Wizard in the Technician Tools of the Tracer 10-inch display to configure additional inputs of the XM30 expansion module. Input 1 of the XM30 module is pre-defined for the facility outdoor air temperature (10k-Ohm thermistor).

Use the checkbox on inputs 2-4 to enable the use of the input. Once enabled, use the dropdown to select either binary input or thermistor input.

Figure 23. Technician Tools Select Panel Options



Rooftop Unit Controls

Trane Symbio 700 Controller

Trane rooftop units most commonly used with Tracer Concierge systems are available with the factory-integrated Symbio™ 700 controller. This is a microprocessor-based, modular solution that offers tested, proven control of the entire packaged rooftop unit.

Best Practice:

Select the “Advanced Controller with Communications Interface” for Trane rooftop units used with Tracer Concierge systems.

Symbio 500 RTU/HP Controller

When the rooftop unit does not include a Trane factory-integrated control solution, such at the Symbio™ 700 controller, the Symbio 500 is a programmable BACnet unit controller that is designed to work with Tracer Concierge systems. When the Rooftop Unit / Heat Pump (RTU/HP) configuration is selected, the Symbio 500 may be applied to Trane or non-Trane rooftop equipment as the general-purpose unit controller. The RTU/HP configuration is used to control rooftop equipment with up to two stages of cooling (direct expansion compressors) and up to two stages of heat (staged gas furnace). The configuration also supports a modulating economizer damper and optional variable speed fan operation. It also has functionality that allows it to be applied in applications governed by California Title 24.

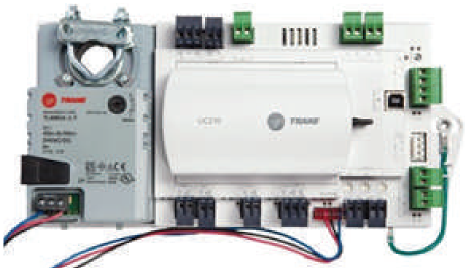
Best Practice:

Select the Symbio 500 RTU/HP controller when a general-purpose controller is required for either Trane or non-Trane rooftop air conditioning equipment.

VAV Box Controls

Trane VAV boxes are offered with a wide range of size and capability options. Depending on the type of box selected, optional electric or hot water reheat may be offered. In all cases, the VAV can be selected with factory-integrated controls. For all of the system types defined in this manual, intelligent, communicating factory-provided controls are essential. The sequences and algorithms described assume the VAV controls are provided by Trane.

Figure 24. Symbio 210 VAV box controls



When selected, Trane provides the Symbio™ 210 controller with the VAV box, factory-commissioned specifically for each box. The setup and configuration of the controller match the ordered selections. The controller and box are fully tested in the factory prior to shipment. Adjustments to the necessary parameters can be made in the field based on application, test and balance results, and user preference.

Best Practice:

Select Trane VAV boxes with factory-installed and factory-commissioning Symbio 210 controllers, including factory-addressed WCIs for Air-Fi Wireless communications.

Bypass Damper Controllers

The Symbio™ 210 is a programmable VAV controller that is designed to work with Tracer Concierge systems. For Tracer Concierge applications, the Symbio 210 is factory-configured for either conventional VAV box control or control of the bypass damper.

Best Practice:

Select the factory-provided Symbio 210 controls solution when a bypass damper is required for the Tracer Concierge system. Note that this may still be considered a "design special."

Sensors

Figure 25. Air-Fi space sensor options

Air-Fi Wireless Communicating Sensors (WCS) are available with the following options

- Temperature only
- Temperature and display
- Temperature and occupancy
- Temperature, occupancy, and CO2
- Optional relative humidity plug-in module (works with any Air-Fi sensor option)

Space Temperature

For Concierge systems with VAV boxes, each VAV box is associated with a space temperature sensor. For Concierge projects, these are normally selected as wireless Air-Fi sensors from Trane. These wireless sensors offer the greatest installation and application flexibility.

Single-zone RTUs (used in either a two-speed or single-zone VAV system) also require a space temperature sensor. Air-Fi wireless sensors are the preferred solution.

Best Practice:

Select an Air-Fi wireless space temperature sensor for each VAV box and for each single-zone rooftop unit.

Space Humidity

Each of the Air-Fi space temperature sensors can be enhanced with the addition of the optional relative humidity (RH) module. The RH module can be plugged directly into the sensor circuit board, expanding the capability of the sensor to measure and report the space relative humidity.

Best Practice:

Select and install the optional relative humidity module into a space temperature sensor whenever measurement of the humidity is important to the customer.

CO_2 Concentration

Depending on the application, it may be necessary to measure the CO_2 in one or more spaces in the building. This is used to implement demand-controlled ventilation.

Best Practice:

Select and install a CO_2 sensor in any space that requires demand-controlled ventilation.

Discharge Air Temperature

RTUs installed in either a single-zone VAV, changeover hybrid, changeover VAV, or multiple-zone VAV (with terminal heat) system require a discharge air temperature sensor as part of the normal control strategy. By design, those units maintain a specific discharge air temperature dependent on the mode of operation. RTUs with SZVAV or MZVAV Symbio™ 700 controls will have a factory-installed discharge air temperature sensor.

Best Practice:

For systems that use a bypass damper, be sure to install the discharge air temperature sensor that ships factory-wired to the Symbio 210 bypass damper controller.

Duct Static Pressure

All multiple-zone systems that use variable-speed fan control and have VAV boxes installed downstream of the RTU require a duct static pressure sensor to control the supply fan. RTUs with MZVAV Symbio™ 700 controls will have a factory-installed duct static pressure sensor. For systems that use a bypass damper (such as changeover hybrid), a duct static pressure sensor is wired to the Symbio 210 bypass damper controller and is included in the kit from the factory.

Best Practice:

For systems that use a bypass damper, be sure to install the duct static pressure sensor that ships factory-wired to the Symbio 210 bypass damper controller.

Return Air Temperature

For systems that use Air-Fi wireless communication, consider also a hardwired return air temperature sensor for the unit. At the completion of project installation the space temperature will be measured and communicated to the RTU or VAV box controller by the Air-Fi sensor. However, during the construction phase of the project the Air-Fi sensor may not yet be installed/communicating. By adding a hardwired return air temperature sensor to the RTU, the unit can provide temporary heating/cooling until the remaining wireless sensors are installed and commissioned.

Once the wireless sensors for the project are installed and commissioned, the hardwired return air temperature sensor will serve only as a backup to the wireless solution.

Best Practice:

When using Air-Fi wireless communications, select and install a hardwired RTU return air temperature sensor so that the unit can provide temporary heating/cooling during the construction phase of the project.

Trane Connect Remote Access

There are three options for setting up secure remote access to Tracer Concierge systems:

- Customer network
- Dedicated IP line
- Cellular router

Each of these methods can be used with Trane Connect Remote Access. They are described in more detail below.

Customer Network

Installing Tracer Concierge on a customer network when IT staff is present is the preferred solution. The customer's IT staff will have a firewall, saving the additional expense of purchasing and configuring a firewall.

When using the customer network, request a separate Virtual Local Area Network (VLAN) for all HVAC traffic. VLANS are a way of separating traffic on a network, and provide an additional level of security.

Speak with the IT staff, inform them you will need remote access to the Tracer Concierge system controller. The majority of IT staff will already have VPN access configured and will simply set up another account and provide instructions on how to connect. If the customer does not have, or is not willing to provide a VPN, the other option for remote access is Trane Connect Remote Access. Trane Connect Remote Access does not require any inbound ports, so IT staff will not need to open any inbound ports on their firewall.

Best Practice:

Work with the customer's IT staff to establish a secure remote connection to the Tracer Concierge system residing on the customer's network. Alternately, work with the customer to introduce Trane Connect Remote Access as an alternative to a virtual private network (VPN) connection

Dedicated IP Line

The dedicated IP line is designated for environments where the Tracer Concierge system will use an independent internet connection such as a DSL or cable modem. Typically, this is for customer environments where no IT staff is present, or the IT staff will not allow HVAC on the corporate network.

Not all internet carriers provide a firewall with their internet. There will be equipment on site, typically a cable modem which will be easy to identify because it will have a coax cable and a CAT 5/6 cable attached. The firewall will only have CAT 5/6 cables connected to it. If no firewall is present, you will need to include a firewall for security and accessibility. See Trane Firewall Router Solution BAS-SVX069-EN for more information on ordering and configuration.

Once the Trane firewall router is in place, connect it to system controller with a CAT 5/6 cable. Customers will access the Tracer Concierge system through Trane Connect Remote Access.

Best Practice:

For more simple networks, consider the use of a dedicated IP line for secure remote connection to the Tracer Concierge system. If no firewall is provided, select the Trane Firewall Router solution. Connect to the dedicated network using Trane Connect Remote Access.

Cellular Router

A cellular router provides an independent, wireless method to connect the Tracer Concierge system to the internet. Trane has available a pre-configured cell router option with an integral firewall and cellular data service on an annual basis.Typically, this is for customer environments where no IT staff is present, or the IT staff will not allow HVAC on the corporate network.

Best Practice:

Select the Cellular Router for secure remote connection when no IT staff is present and the use of a dedicated IP line is not an option. Refer to the Tracer Concierge IOM, (BAS-SVX074), for connection details.

Trane Connect Remote Access

Your Trane account representative can assist you with setting up a Trane Connect account for secure remote access. Once the setup is initiated, the customer administrator (either the installing contractor or the building owner) will receive an email to start the initial account authorization process, including setting up user login credentials. Trane Connect is compatible with various internet browsers as well as with the BAS Occupant and BAS Operator mobile apps.

Tracer Concierge System Summary

System Type	RTU Control Type	RTU Supply Fan	Duct Status Pressure Control	Discharge Air Temperature Control	RTU Heat Type	Bypass Damper	VAV Box	VAV Box Reheat Type
Single-zone two-speed	Multi-speed	Two-speed	Not applicable	Not applicable	Normally staged gas or electric heat or heat pump	Not applicable	Not applicable	Not applicable
Single-zone VAV	SZVAV	Variable speed	Not applicable	By the RTU controller	Staged gas or electric heat or mod gas heat or heat pump	Not applicable	Not applicable	Not applicable
Changeover hybrid	MZVAV	Variable speed (constant speed in heating mode)	Cooling mode: By the RTU Heating mode: By the bypass damper controller	By the RTU controller	Staged gas or electric heat or heat pump	Required	Varitrane[a] Round in round out (RIRO)	None or Electric heat[b]
Changeover VAV	MZVAV	Variable Speed	By the RTU controller	By the RTU controller	Mod gas heat or SCR electric (modification)	Typically not required[c]	Varitrane[a] Round in round out (RIRO)	None or Electric heat[b]
Multiple-zone VAV w/Terminal Electric Heat	MZVAV	Variable speed	By the RTU controller	By the RTU controller	No Heat or Mod gas heat or Staged gas or electric heat or Heat Pump	Typically not required [c]	Varitrane[a]	Electric heat
Multiple-zone VAV w/Terminal Hot Water Heat	MZVAV	Variable speed	By the RTU controller	By the RTU controller	No Heat or Mod gas heat or Staged gas or electric heat or Heat Pump	Typically not required[c]	Varitrane[a]	Hot water heat[d]

(a) The VAV boxes are equipped with flow measurement capability
(b) A VariTrane VAV box can be ordered with optional electric heat. Optional hot water heat is also available, but use of electric heat is more typical for these system types.
(c) Depending on the minimum airflow of the RTU, the addition of a bypass damper may be necessary. See Bypass Damper, p. 15
(d) Control of the boiler and hot water system must be provided by others or with custom programming

Tracer Concierge System Types

For each of the following system types, a description is provided of the mechanical components and associated control details that distinguish the systems from one another.

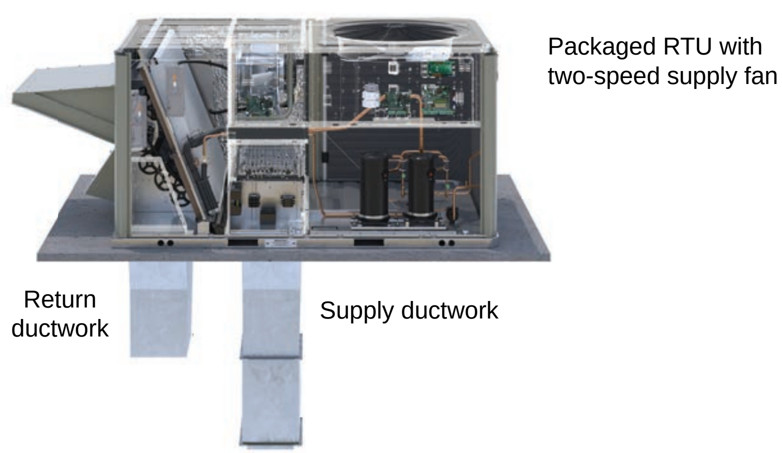
Single-Zone Two-Speed

System Description

The single-zone two-speed system comprises one or more RTUs that includes a two-speed fan. Heating is typically provided with staged gas or electric heat in the RTU, or by reversing the refrigeration system to operate as a heat pump. Mechanical cooling is provided with manifolded scroll compressors in the RTU.

Conditioned air is delivered by the RTU directly into a single zone. Each RTU is associated with a temperature sensor to measure the temperature in the space served by that RTU. Cooling and heating are controlled to maintain the space temperature at the active cooling or heating setpoint, while the fan switches between minimum and full (maximum) speed.

Figure 26. Single-zone two-speed system



Components

RTU Type	Multi-speed
RTU supply fan	Two-speed
RTU cooling	Staged DX
RTU heating	Staged gas, electric heat, or heat pump
Bypass damper	Not applicable
VAV box type	Not applicable
Duct static pressure control	Not applicable
Discharge air temperature control	Not applicable
VAV box reheat type	Not applicable

Advantages

- It is a simple system that is well-known by many industry professionals and customers.
- It is a good solution for large, open spaces, including cafeteria, auditorium, gymnasium, retail stores, and warehouse.
- It can be used to separate systems for multiple small tenants – such as a retail strip mall.
- Multiple units can be grouped into Areas for ease of managing larger spaces.

Limitations

- Comfort complaints are more likely if dissimilar spaces are served by a single-zone system due to control by a single zone temperature sensor.
- The number of temperature control zones is limited by the number of RTUs.
- Many small RTUs can be expensive to install – roof penetrations, utilities, etc.
- It has a higher energy cost than VAV system options.

Application Considerations

- Although many systems utilize one RTU to serve a zone, other systems combine two or more RTUs to accomplish control of a large open area.
- These multiple-RTU scenarios are typically found with spaces such as a warehouse, auditorium or gymnasium.
- The standard application programs included with the Tracer Concierge system are used to ensure all units operate in the same mode (cooling or heating) to prevent them from fighting each other.
- RTU sizing is important. Oversized units can create control issues, including poor humidity control.

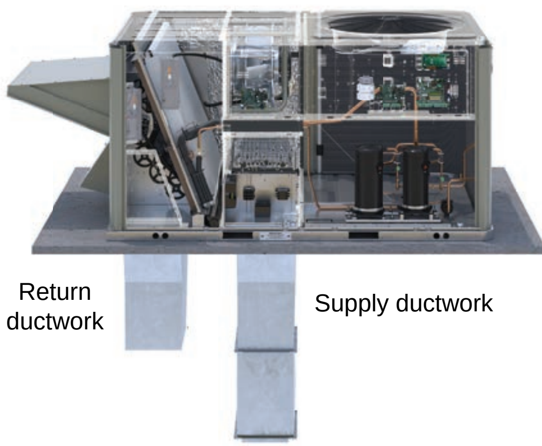
Single-Zone VAV

System Description

The Single-zone VAV system typically consists of a single RTU that includes a variable-speed supply fan. Heating is typically provided with modulating gas heat (or staged gas or electric heat) in the RTU, or by reversing the refrigeration system to operate as a heat pump. Mechanical cooling is provided with either manifolded scroll compressors or variable-speed compressors in the RTU.

Conditioned air is delivered by the RTU directly into a single zone. Each RTU is associated with a temperature sensor to measure the temperature in the zone served by that RTU. As the load in the zone changes, the variable-speed fan is modulated to maintain zone temperature at setpoint, while cooling or heating capacity is staged or modulated to maintain the discharge-air temperature at setpoint. When the fan has turned down to its minimum operating speed, this discharge-air temperature setpoint is reset to prevent overcooling or overheating.

Figure 27. Single-zone VAV system



Components

RTU Type	Single-zone VAV (SZVAV)
RTU supply fan	Variable speed
RTU cooling	Staged DX or Variable speed DX
RTU heating	Staged gas or electric heat or Modulating gas heat (recommended) or heat pump
Bypass damper	Not applicable
VAV box type	Not applicable
Duct static pressure control	Not applicable
Discharge air temperature control	Enabled (by RTU controller)
VAV box reheat type	Not applicable

Advantages

- It is a good solution for large, open spaces, including cafeteria, auditorium, gymnasium, retail store, and warehouse.
- It can be used to separate systems for multiple small tenants – such as a retail strip mall.
- Multiple units can be grouped into areas for ease of managing larger spaces.
- It has a lower energy cost than either Constant Volume or Two-Speed systems.
- It is a quieter system than Constant Volume due to reduced airflow under most conditions.

Limitations

- Comfort complaints are more likely if dissimilar spaces are served by a single-zone system due to control by a single zone temperature sensor.
- The number of temperature control zones is limited by the number of RTUs.
- Many small RTUs can be expensive to install – roof penetrations, utilities, etc.

Application Considerations

- RTU sizing is important. Oversized units can create control issues, including poor humidity control.

Changeover Hybrid

System Description

The Changeover Hybrid system comprises one RTU with variable-speed fan and two or more VAV boxes. System heating is provided with staged gas or electric heat in the RTU, or by reversing the refrigeration system to operate as a heat pump. Mechanical cooling is provided with manifolded scroll compressors in the RTU.

The RTU provides either cooled or heated air to the distribution (duct) system. VAV boxes are modulated to provide more or less conditioned air to the space based on the space demand and temperature of the air being supplied by the RTU. The VAV heat/cool mode is based on the comparison between the measured space temperature and heating/cooling setpoints of that zone. When the VAV heat/cool mode matches the system heat/cool mode, the VAV box air damper is modulated to maintain space temperature at setpoint. When the VAV heat/cool mode does not match the system heat/cool mode, the VAV box is controlled to the minimum flow setpoint for the current VAV box heating/cooling mode.

When the measured space temperature for the VAV box is greater than the occupied cooling setpoint, the VAV heat/cool mode status will be COOL. The mode remains in COOL until the space temperature drops below the occupied heating setpoint. When the space temperature of the VAV box is less than the occupied heating setpoint, the VAV heat/cool mode status will be HEAT. The mode remains in HEAT until the space temperature rises above the occupied cooling setpoint.

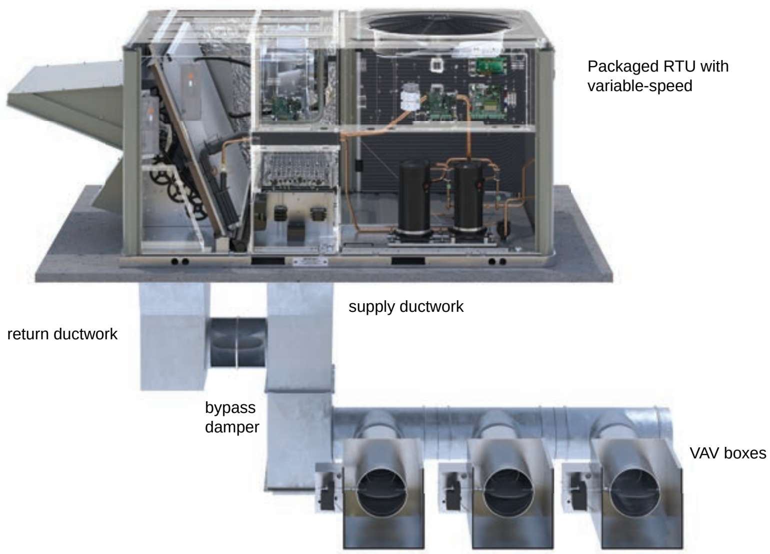
When the system is in cooling mode, the variable-speed supply fan in the RTU is modulated to maintain the duct static pressure at setpoint while cooling capacity is staged or modulated to maintain the discharge-air temperature at cooling setpoint. When the system changes over to heating mode, because the rooftop unit is either a heat pump or is equipped with a staged gas or electric heater, the supply fan in the RTU will operate at full airflow whenever the heater is activated, thus requiring a bypass damper between the supply and return air paths to allow excess supply airflow to recirculate to the rooftop unit (see “Bypass Damper,” p. 15).

Changeover Hybrid systems include two or more VAV boxes, which may or may not include electric heat. When available, the local electric heat allow the VAV box to handle the heating load in the space even when the RTU is in the cooling mode and providing cold air (see “VAV Electric Heat in Changeover Systems,” p. 45).

To further minimize the system mode changes between heating and cooling, the discharge air reset function can be easily enabled and configured in the Tracer Concierge system controller, allowing the discharge air temperature setpoint of the RTU to vary (see “Discharge Air Temperature Reset,” p. 45).

Important: *When staged gas or electric heat in the RTU is operating, the supply fan will be controlled at constant (full) speed to ensure proper airflow across the heat exchanger. Therefore, a bypass damper must be installed for proper system airflow management (see* *“Bypass Damper,” p. 15**).*

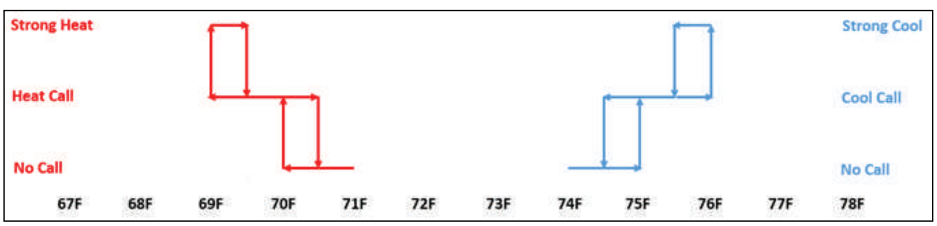
Figure 28. Changeover hybrid system



Important: *Beginning at Tracer Concierge v5.2, changeover hybrid systems are supported as standard, allowing users to easily configure systems without the need for custom programming.*

Each VAV box "votes" toward the overall system heat/cool mode based on the differential between the current space temperature and active setpoint. When the space temperature exceeds the active setpoint by at least 1° F, the box becomes a normal caller – a vote for the desired heat/cool mode. When the differential is at least 2° F, the vote strength severity increases to a strong caller. Assuming occupied cooling setpoint of 74° F and occupied heating setpoint of 71° F, the following table summarizes the voting logic used in each VAV box.

Figure 29. Changeover voting logic

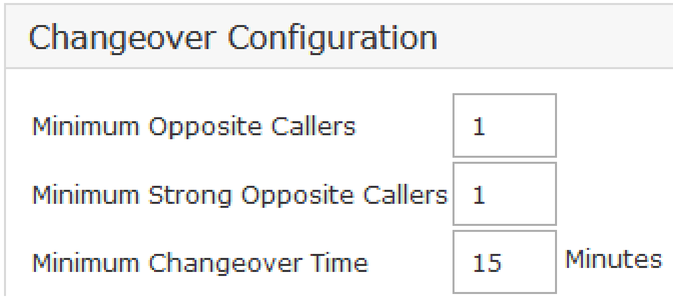


All of the heating and cooling callers are tallied to determine the overall heat/cool mode of the system. In the VAV Air System (VAS) setup of the system controller, the number of opposite and strong opposite callers can be edited. Additionally, the user may edit the minimum amount of time before changeover is permitted.

When the total number of opposite callers is one or more (editable), the system switches to the opposite mode, assuming the minimum changeover time has been satisfied.

Important: *To allow changeover, all boxes in the current heat/cool mode must be satisfied (identified as "No Call"). The system will **immediately** changeover when the minimum number of **strong** callers has been met, assuming the minimum changeover time is satisfied.*

Figure 30. Changeover hybrid strong callers



Components

RTU Type	Multiple-zone VAV (MZVAV)
RTU supply fan	Variable speed
RTU cooling	Staged DX or variable speed DX
RTU heating	Staged gas or electric heat or heat pump
Bypass damper	Required
VAV box type	VariTrane or Round in, round out (RIRO)
Duct static pressure control	Enabled (by the RTU in cooling mode, by the bypass damper in heating mode)
Discharge air temperature control	Enabled
VAV box reheat type	Electric or hot water heat (optional)

Advantages

- It adds additional zones of temperature control to a single RTU unit.
- It can be more economical than installing a larger number of small, single-zone RTUs.
- Typically has lower energy use, and operates quieter, than the old changeover bypass system, which used a constant-speed supply fan in both cooling and heating modes.
- A staged heater is less expensive than the modulating heater required for a changeover VAV system

Limitations

- Although it provides additional zones of temperature control, there can still be comfort issues the zones being served have dissimilar loads, such as interior and exterior zones served by the same RTU.
- A bypass damper must be supplied to allow excess supply airflow to recirculate to the rooftop unit (during heating mode only).

Application Considerations

- This system works better with smaller RTU sizes. As the size of the RTU increases, the number of zones and the diversity of the zones will typically increase as well, which can lead to comfort issues.
- The overall zoning of the RTUs to the building layout is important. If both interior and exterior zones are on the same RTU, diversity and comfort issues are likely – especially in shoulder seasons where exterior zones need heat and interior zones still need cooling. Properly zoning the RTUs to serve spaces with similar load profiles will improve overall comfort.
- Adding electric heat to some of the VAV boxes can greatly increase overall comfort. For example, when both interior and exterior zones are served by the same RTU, adding some heat to the exterior zones will provide better overall comfort. The electric heat only needs to be sized for assisting during

moderate weather. In very cold weather, the system can change over to heat and use heat in the RTU.

- Discharge Air Reset can be used to minimize overcooling or overheating spaces and reduce the frequency of system changeover. Discharge air setpoint reset is now included in Tracer Concierge, allowing the user to easily enable and configure the function as needed.
- Because the RTU is either a heat pump or has staged gas or electric heat, the RTU will operate in a Constant Volume mode (100% fan speed) during heating modes. This requires both a Bypass Damper to handle the excess airflow and control logic in the Tracer Concierge System Control Panel to control the heat staging. The necessary logic to coordinate bypass damper control in these applications is now included as standard in the VAS application.

Changeover VAV

System Description

The Changeover VAV system comprises one RTU with variable speed fan and two or more VAV boxes. System heating is normally provided with modulating gas heat in the RTU, although modulating (SCR) electric heat is sometimes used. Mechanical cooling is normally provided with manifolded scroll compressors or variable-speed compressors.

The RTU provides either cooled or heated air to the distribution (duct) system. VAV boxes are modulated to provide more or less conditioned air to the space based on the space demand and temperature of the air being supplied by the RTU. The VAV heat/cool mode is based on the comparison between the measured space temperature and heating/cooling setpoints of that zone.

When the VAV heat/cool mode matches the system heat/cool mode, the VAV box air damper is modulated to maintain space temperature at setpoint. When the VAV heat/cool mode does not match the system heat/cool mode, the VAV box is controlled to the minimum flow setpoint for the current VAV box heating/cooling mode.

When the measured space temperature for the VAV box is greater than the occupied cooling setpoint, the VAV heat/cool mode status will be COOL. The mode remains in COOL until the space temperature drops below the occupied heating setpoint. When the space temperature of the VAV box is less than the occupied heating setpoint, the VAV heat/cool mode status will be HEAT. The mode remains in HEAT until the space temperature rises above the occupied cooling setpoint.

Each VAV box “votes” toward the overall system heat/cool mode based on the differential between the current space temperature and active setpoint.

In cooling mode, the variable-speed fan is modulated to maintain the duct static pressure at setpoint while cooling capacity is staged or modulated to maintain the discharge-air temperature at cooling setpoint. In heating mode, since the rooftop unit is equipped with a modulating gas (or in some cases modified with a modulating SCR electric) heater, the variable-speed fan is modulated to maintain the duct static pressure at setpoint while heating capacity is modulated to maintain the discharge-air temperature at heating setpoint. Therefore, a bypass damper is typically not needed (see “Bypass Damper,” p. 15).

In the system controller setup of each VAV box, the configuration is such that the VAV boxes are allowed to modulate when the system mode is heating.

If the VAV boxes were selected with optional electric heat, the system controller must be configured to give priority to the local heat. This allows the VAV boxes to utilize local heat before requesting that the system mode change to heating. In this application and setup the system heat/cool mode changes are minimized (see “VAV Electric Heat in Changeover Systems,” p. 45).

Best Practice:

If the RTU is equipped with a modulating gas heater, a bypass damper may be required if the system airflow is expected to drop below the minimum threshold for the heater (see “Bypass Damper,” p. 15).

Changeover VAV systems include two or more VAV boxes, which may or may not include electric heat. Ideally, some/all of the VAV boxes in the Changeover VAV system would be selected with electric heat. When available, the local electric heat allow the VAV box to handle the heating load in the space even when the RTU is in the cooling mode and providing cold air. In those cases, the VAV boxes are normally positioned at their heating minimum position for ventilation purposes while the electric heat in the VAV box is controlled to maintain space temperature.

When electric heat has not been selected for the VAV box, the air damper is positioned at the heating minimum position when heating is desired but the system is cooling. This allows the box to satisfy the ventilation requirements of the space while reducing unnecessary cooling to the space. When the demand in the space is heating, the VAV box continues to 'vote' for heating as either a normal heating caller or strong heating caller. When enough heating calls have been tallied at the system level, the mode of the RTU is switched to heating.

When the mode of the RTU changes to heating, the electric heat in the VAV box is controlled off and the VAV air damper is modulated to maintain space temperature.

Best Practice:

For increased flexibility and comfort with Changeover VAV systems, include the optional electric heat when selecting the VAV box capabilities, especially for colder perimeter zones. This allows the box to handle the heating demand while the system mode is cooling.

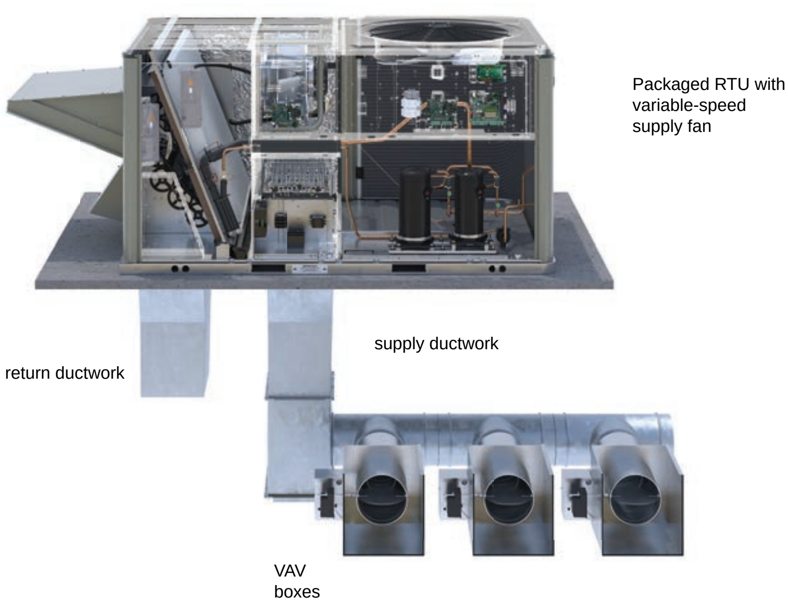
To further minimize the system mode changes between heating and cooling, the discharge air reset function can be easily enabled and configured in the Tracer Concierge system controller, allowing the discharge air temperature setpoint of the RTU to vary. Discharge reset can be defined based on the outdoor air temperature or based on the heating/cooling demand in each space maximum deviation (from setpoint). As less cooling is needed, the program begins to reset the setpoint from minimum (typically 55° F) toward maximum (typically 65° F). This function extends the time between system mode changes, generally improving comfort in the associated spaces.

Important: *Beginning at Tracer Concierge v5.2, discharge air setpoint reset is supported as standard, allowing users to easily enable and configure the function without the need for custom programming.*

Best Practice:

To reduce system mode changes and improve overall comfort in the space, use discharge air reset in the system controller to vary the RTU setpoint in cooling.

Figure 31. Changeover VAV system



Components

RTU Type	Multiple-zone VAV (MZVAV)
RTU supply fan	Variable speed

RTU cooling	Variable capacity DX or Staged DX
RTU heating	Modulating gas heat or modulating (SCR) electric heat
Bypass damper	Typically not required (see note above)
VAV box type	VariTrane or Round in, round out (RIRO)
Duct static pressure control	Enabled
Discharge air temperature control	Enabled
VAV box reheat type	Electric or hot water heat (optional)

Advantages

- It adds additional zones of temperature control to a single RTU unit.
- It can be more economical than installing a larger number of small, single-zone RTUs.
- It has a lower energy cost than the old Changeover Bypass systems, which used a constant-speed supply fan, and less fan energy use in heating mode than a Changeover Hybrid system. It is often the lowest energy cost system type because of modulating fan airflow during both cooling and heating modes.
- It typically has lower sound levels due to the modulating airflow.
- It typically does not require a Bypass Damper – making it simpler and easier to install.
- It does not require heat in the VAV boxes, although optional heat in at least some of the VAV boxes can enhance system performance.

Limitations

- Although it provides additional zones of temperature control, there can still be comfort issues if the zones being served have dissimilar loads, such as interior and exterior zones served by the same RTU.
- It requires the RTU to have MZVAV controls – including Variable-speed Supply Fan, Duct Static Pressure control and Discharge Air Temperature control. It is not practical to upgrade existing Constant Volume RTUs for this system type.
- It is a relatively new system type in the industry, and is therefore not well understood by a large population of industry professionals.

Application Considerations

- This system is designed with Modulating Gas Heat (or Modulating SCR Electric Heat) in the RTU. This allows the airflow to modulate while heating and the RTU will control to the Discharge Air Temperature in heating.
- If the RTU has modulating gas heater, a bypass damper might still be desired if the system airflow is expected to drop below the minimum limit for the heater (see “Bypass Damper,” p. 15).
- This system works better with smaller RTU sizes. As the size of the RTU increases, the number of zones and the diversity of the zones will typically increase as well, which can lead to comfort issues.
- The overall zoning of the RTUs to the building layout is important. If both interior and exterior zones are on the same RTU, diversity and comfort issues are likely – especially in shoulder seasons where exterior zones need heat and interior zones still need cooling. Properly zoning the RTUs to serve spaces with similar load profiles will improve overall comfort.
- Adding electric heat to some of the VAV boxes can greatly increase overall comfort. For example, when both interior and exterior zones are served by the same RTU, adding some heat to the exterior zones will provide better overall comfort. The electric heat only needs to be sized for assisting during moderate weather. In very cold weather, the system can change over to heat and use the gas heat in the RTU.

- Discharge Air Reset can be used to minimize overcooling or overheating spaces and reduce the frequency of system changeover. Discharge air setpoint reset is now included in Tracer Concierge, allowing the user to easily enable and configure the function as needed.

Multiple-Zone VAV with Terminal Electric Heat

System Description

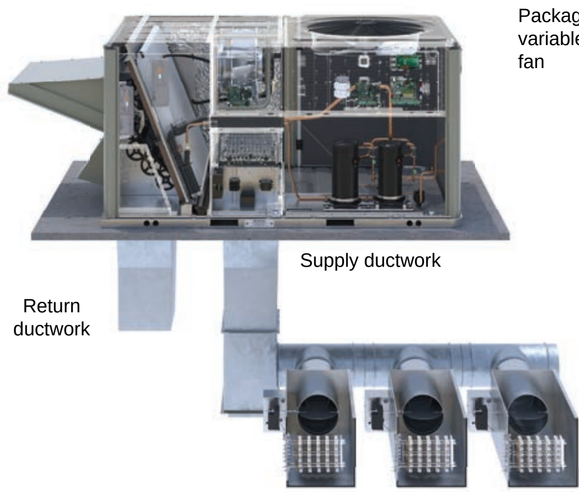
For the multiple-zone VAV with Terminal Electric Heat system, the VAV RTU is coupled with two or more VAV boxes to provide conditioned air to the spaces. Space temperature sensors are associated with each VAV box. The space temperature sensor may be either wired to the VAV controller or wireless. The system controller is used to schedule system operation and coordinate the RTU and associated VAV boxes.

When selected, RTU heating is normally provided with staged gas or electric heat in the RTU that is used exclusively for morning and daytime warm-up. Alternatively, the RTU can be equipped with modulating gas or electric heat which can be used for tempering the supply air during cold weather. Mechanical cooling is provided with manifolded scroll compressors or variable-speed compressors in the RTU.

The RTU supply fan speed is normally modulated to maintain duct static pressure at setpoint. Regardless of the RTU heating type selected, by default the system controller is set up to command the VAV boxes to maximum flow when the RTU is heating – morning and daytime warm-up modes.

In normal daytime operation, the RTU will make cold air with the fan modulating to maintain duct static pressure. Heat to the spaces is provided by the electric heat in the VAV boxes.

Figure 32. Multiple-zone VAV system with terminal electric heat



Components

RTU Type	Multiple-zone VAV (MZVAV)
RTU supply fan	Variable speed
RTU cooling	Variable capacity DX or Fixed-stage DX
RTU heating	No heat Staged gas or electric heat Modulating gas heat
Bypass damper	Typically not required

VAV box type	VariTrane
VAV box reheat type	Electric heat

Advantages

- It adds additional zones of temperature control to a single RTU unit.
- It allows heating and cooling simultaneously, which provides a high degree of comfort in individual zones.
- It can be more economical than installing a larger number of small RTUs.
- It has a lower energy cost than the old Changeover Bypass systems. It is often an intermediate energy cost system type because of the modulating fan and airflow and the use of electricity as the heating source. (Electric Heat is often higher energy cost than gas heat.)
- It typically has lower sound levels due to the modulating airflow.
- It does not typically require a Bypass Damper – making it simpler and easier to install.
- It is a system type that has been in use for many years and is understood by many industry professionals.

Limitations

- It requires the RTU to have MZVAV controls – including Variable-speed Supply Fan, Duct Static Pressure control and Discharge Air Temperature control. It is not practical to upgrade existing Constant Volume RTUs for this system type.
- It requires the VAV boxes to have Electric Heat installed.

Application Considerations

- Utilize VariTrane VAV boxes with Electric Heat. RIRO boxes cannot be used.
- If the RTU is equipped with a modulating gas heater, a bypass damper might desired if the system airflow is expected to drop below the minimum limit for the heater (see “Bypass Damper,” p. 15).

Multiple-Zone VAV with Terminal Hot Water Heat

System Description

For the Multiple-Zone VAV with Terminal Hot Water Heat system, the VAV RTU is coupled with two or more VAV boxes to provide conditioned air to the spaces. Space temperature sensors are associated with each VAV box. The space temperature sensor may be either wired to the VAV controller or wireless. The system controller is used to schedule system operation and coordinate the RTU and associated VAV boxes.

When selected, RTU heating is normally provided with staged gas or electric heat in the RTU that is used exclusively for morning and daytime warm-up. Alternatively, the RTU can be equipped with modulating gas or electric heat (or can be modified for a hot-water coil) which can be used for tempering the supply air during cold weather. Mechanical cooling is provided with manifolded scroll compressors or variable-speed compressors in the RTU.

The RTU supply fan speed is normally modulated to maintain duct static pressure at setpoint. Regardless of the RTU heating type selected, by default the system controller is set up to command the VAV boxes to maximum flow when the RTU is heating – morning and daytime warm-up modes.

For normal daytime operation, the RTU provides cold air and the fan modulates to maintain duct static pressure. Heat in the spaces is provided by the HW heat in the VAV boxes. Unlike electric heat, the use of hot water heat in the VAV box requires additional control of the pump(s) and boiler(s) to be field provided.

Components

RTU Type	Multiple-zone VAV (MZVAV)
RTU supply fan	Variable speed
RTU cooling	Variable capacity DX or Fixed-stage DX
RTU heating	No heat Staged gas or electric heat Modulating gas heat Modulating hot-water coil (modification)
Bypass damper	Typically not required
VAV box type	VariTrane
VAV box reheat type	Hot water heat

Advantages

- It adds additional zones of temperature control to a single RTU unit.
- It allows heating and cooling simultaneously, which provides a high degree of comfort in individual zones.
- It can be more economical than installing a larger number of small RTUs.
- It has a lower energy cost than the old Changeover Bypass systems. It is often one of the lowest cost system types because of the modulating fan and airflow and the use of natural gas as the heating source.
- It typically has lower sound levels due to the modulating airflow.
- It does not typically require a Bypass Damper – making it simpler and easier to install.
- It is a system type that has been in use for many years and is understood by many industry professionals.

Limitations

- It requires the RTU to have MZVAV controls – including Variable-speed Supply Fan, Duct Static Pressure control and Discharge Air Temperature control. It is not practical to upgrade existing Constant Volume RTUs for this system type.
- It requires the VAV boxes to have Hot Water Heat installed.
- It requires some form of control for the Hot Water System, including Boilers and Pumps.

Application Considerations

- Utilize VariTrane VAV boxes with Hot Water Heat. RIRO boxes cannot be used.
- Hot Water System controls can vary. On the simple end, it can be an Outdoor Air Thermostat that turns on a Boiler and a Pump when Outdoor Air Temps fall below a certain level (typically 45° F). On larger and/or more complex systems, this may require an additional controller to sequence multiple Boilers and Pumps – which requires a qualified technician to program and commission the Hot Water System controls.
- If the RTU is equipped with a modulating gas heater, a bypass damper might desired if the system airflow is expected to drop below the minimum limit for the heater (see “Bypass Damper,” p. 15).

System Control Coordination

VAV Heating/Cooling Operation for Changeover Hybrid and Changeover VAV Systems

Each VAV box has two primary functions during occupied operation – 1) to provide the prescribed amount of ventilation air while 2) controlling the space temperature at the active setpoint. There are several adjustable setpoints in the VAV box controller associated with each of those two functions. The VAV box modulates the air damper to control the space temperature at the active heating or cooling setpoint while maintaining at least the minimum air flow for ventilation purposes. Depending on the control mode of the box and the selected features, the operation will vary.

VAV Heat/Cool Mode Status

The occupied heating and cooling space temperature setpoints are normally separated by at least 3° F. When the space temperature is higher than the occupied cooling setpoint, the heat/cool mode status of the VAV box is COOL. When the temperature is less than the occupied heating setpoint, the heat/cool mode status switches to HEAT. When the space temperature is between these two occupied setpoints, the current heat/cool mode status is maintained.

VAV Box Control Action

The ability of the VAV to provide cooling and heating to the space is largely dependent on the mode of the associated RTU, that is, whether the RTU is delivering cool or warm air down the duct. As the demand in each space varies, so will the heat/cool mode status of the associated VAV box. While some of the boxes may demand cooling from the RTU, other may require heating. For applications where no local heat was selected for the VAV box, those boxes are completely dependent on the RTU to provide heating when required.

A discharge air temperature sensor is installed to measure the temperature of the air being provided to the associated VAV boxes. The VAS application in system controller is used to communicate the current discharge air temperature to each box associated with that RTU. When the RTU discharge temperature is cold, say 55° F, the control action of the VAV box is COOL. By contrast, when the RTU discharge air temperature is warm, say 100° F, the control action of the box is HEAT. The control action of the box and the heat/cool mode status of the box are both considered as part of the temperature control algorithm in the VAV box.

VAV Control Action = COOL and the VAV Heat/Cool Mode Status = COOL

In the occupied mode, when the VAV control action and heat/cool mode status are both COOL, the air damper is modulated to maintain the space temperature at the cooling setpoint. The minimum damper position is defined by the *Air Flow Setpoint Minimum*.

VAV Control Action = COOL and the VAV Heat/Cool Mode Status = HEAT

For VAV boxes with no local heat capability in the occupied mode, when the VAV control action is COOL and heat/cool mode status is HEAT, the air damper is controlled to the *Air Flow Setpoint Minimum* and the VAV controller begins to “vote” for the rooftop unit to switch to heating mode. Opening the damper any further would introduce additional cold air into a space already demanding heating.

For a VAV box selected with hot water or electric heat, the air damper is instead controlled to the *Air Flow Setpoint Minimum Local Heat* position and local heat is controlled to maintain the space temperature at the occupied heating setpoint. The VAV controller will not “vote” for the rooftop unit to switch to heating mode unless the local heater is no longer able to maintain the space temperature at the occupied heating setpoint (referred to as Priority Local Heat).

VAV Control Action = HEAT and the VAV Heat/Cool Mode Status = COOL

In the occupied mode when the VAV control action is HEAT and the heat/cool mode status is COOL, the air damper is controlled to the *Air Flow Setpoint Minimum Heat* position, and the VAV controller begins to “vote” for the rooftop unit to switch to cooling mode. Opening the damper any further would introduce additional warm air into a space already demanding cooling.

VAV Control Action = HEAT and the VAV Heat/Cool Mode Status = HEAT

In the occupied mode, when the VAV control action and heat/cool mode status are both HEAT, the air damper is modulated to maintain the space temperature at the heating setpoint. The minimum damper position is defined by the *Air Flow Setpoint Minimum Heat*.

Zoning of RTUs in Changeover Systems

Consideration should be given to the type and location of the spaces served by the VAV boxes and RTU in a changeover system. Where possible, establish areas defined by a group of VAV boxes that share similar characteristics. The heating/cooling demand normally varies depending on the location in the building. For example, spaces near the northern exposure of the building can expect different load profiles compared to the south-facing exposure. Similarly, interior spaces have different load profiles than exterior spaces. Finally, consider those spaces that may have a very different load profile compared to most other spaces. For example, server room normally experience very high heat loads. Including those types of spaces with other more typical occupant spaces will create unnecessary system diversity and system control challenges.

Best Practice:

Plan to group an area of VAV boxes that share similar use and location with a single RTU for changeover systems. For example, group the VAV boxes on the southern exposure of the building as those boxes can expect very similar load profiles.

VAV Electric Heat in Changeover Systems

The RTU for a changeover system provides either cool air or warm air to the associated VAV boxes. As loads vary in the spaces, the VAV box controller modulate to deliver more or less of the air supplied by the RTU to the box. When the VAV box desires supply air of the opposite mode, a vote is counted in the VAS application of Tracer Concierge. When enough opposite votes are tallied, the mode of the RTU changes.

When electric heat is selected for some/all VAV boxes, those boxes are capable of providing local heat even when the mode of the RTU is cooling. The VAV boxes can be configured to leverage local electric heat to prevent overcooling spaces when cold air is supplied by the RTU. The result of adding electric heat capability to the VAV box is improved temperature control for the conditioned space. In cases where no local electric heat is available in the VAV box, the air damper of that box is controlled to the *Air Flow Setpoint Minimum* while the RTU continues to provide cool air to the system. Once enough opposite callers are tallied, the system will eventually switch to the heating mode. Adding electric heat capability to the VAV box gives greater temperature control to that box.

Best Practice:

Select electric heat capability for the VAV boxes in a changeover system to improve the overall temperature control capability of that box, which will result in improved comfort for the occupants of the served space. These boxes should be configured for Priority Local Heat.

Adding electric heat to the VAV box also improves the ability to dehumidify with changeover systems. For those applications, the RTU maintains cold DX coil temperature in cooling, effectively handling the latent load. Selecting electric heat in the VAV boxes allows spaces to independently provide reheat to maintain temperature control in each space.

Discharge Air Temperature Reset

When enabled, discharge air temperature reset automatically adjusts the calculated discharge air setpoint of the RTU based on either the outside temperature or satisfaction of the spaces (maximum deviation). When the user selects reset based on outside air temperature, the wizard presents the low and high limits for editing. By default, the discharge temperature will be reset from 55° F to 65° F (linearly) as the outside air temperature decreases from 70° F (adjustable) to 60° F (adjustable).

When the user selects reset based on maximum deviation range, the wizard presents the minimum and maximum values for the deviation, representing the deviation at which the discharge air temperature is reset between 55° and 65° F. As the zones become more satisfied, the maximum deviation will continue to decrease. As the maximum deviation decreases from 0.0° F (adjustable) toward –1.5° F (adjustable), VAS resets the discharge temperature setpoint from 55° F toward 65° F. See “Appendix B: Discharge-Air Temperature (DAT) Reset,” p. 88.

VAV Heating/Cooling Operation for Multiple-Zone VAV Systems with Electric or Hot Water Heat

RTU Cooling Mode

RTUs for multiple-zone VAV systems normally deliver 55° F (adjustable) to the associated VAV boxes. For the spaces demanding cooling, the air damper of that VAV box is modulated to maintain the space temperature at the occupied cooling setpoint. The minimum damper position is defined by the *Air Flow Setpoint Minimum*. For spaces demanding heating, the VAV boxes have been selected with local heating capability, either electric or hot water heat. In those cases, the air damper is positioned at the *Air Flow Setpoint Minimum Local Heat* (for units equipped with a staged heater) or *Air Flow Setpoint Reset Minimum Local Heat* (for units equipped with a modulating heater) while the heat is controlled to maintain the space temperature at the occupied heating setpoint.

Daytime and Morning Warm-up Modes

While normally delivering cool air down the duct, the RTU in a multiple-zone VAV system can provide warm air down the duct in the daytime and morning warm-up modes. In those modes, coordination of the RTU mode and VAV boxes is automatically handled by the VAS application of Tracer Concierge. In the daytime and morning warm-up modes the VAV boxes are driven to the position defined by the *Air Flow Setpoint Maximum Heat*. Once the warm-up mode terminates, the boxes return to their normal heating or cooling mode.

Discharge Air Temperature Reset

When enabled, discharge air temperature reset automatically adjusts the calculated discharge air setpoint of the RTU based on either the outside temperature or satisfaction of the spaces (maximum deviation). When the user selects reset based on outside air temperature, the wizard presents the low and high limits for editing. By default, the discharge temperature will be reset from 55° F to 65° F (linearly) as the outside air temperature decreases from 70° F (adjustable) to 60° F (adjustable).

When the user selects reset based on maximum deviation range, the wizard presents the minimum and maximum values for the deviation, representing the deviation at which the discharge air temperature is reset between 55° and 65° F. As the zones become more satisfied, the maximum deviation will continue to decrease. As the maximum deviation decreases from 0° F (adjustable) toward –1.5° F (adjustable), VAS resets the discharge temperature setpoint from 55° F toward 65° F.

VAV Box Sizing

It is important to properly select the VAV box size for each VAV zone to be controlled. The VAV box should have adequate capacity to meet the cooling needs of the zone, but should NOT be oversized. While it may be desired to use a larger VAV box for sound or pressure drop considerations, an oversized VAV box will not be able to control airflow properly and can lead to a number of operational problems. A VAV box can only measure and control airflow down to 10% of the factory nominal airflow rating. In general, any VAV box that is applied where the actual required maximum flow setting is less than 50% of the factory nominal airflow rating is likely to have some flow-related problems.

A rule-of-thumb for VAV box sizing is 1 CFM per square foot of conditioned space. If you have done a more detailed design, you may have a more accurate CFM requirement. Select the smallest VAV box size that meets the CFM requirement. For example, if you are sizing for an area of 450 square feet (assuming 450 CFM max flow) then you would select a 6-inch VAV box (nominal 600 CFM) for proper control. If you selected an 8-inch VAV box (nominal 1050 CFM), then the maximum flow would be less than 50% of the factory nominal airflow rating and potential control issues may be experienced.

Best Practice:

Select the smallest VAV box size that meets the maximum flow requirements of the zone. Avoid applying VAV boxes where the maximum flow setting is less than 50% of the factory nominal flow.

Selective use of Minimum Flow Settings to Address Diversity

Each VAV box includes minimum flow settings for both cooling and heating. These settings are particularly important for changeover systems when the VAV Control Action and the VAV Heat/Cool Mode Status do not match, especially when no heat was selected for the box. For example, assume the system mode is cooling and the majority of the spaces require cooling. If a few zones demand heating, the system mode remains in cooling due to the voting logic for changeover. In those colder spaces demanding heating, the VAV boxes will be positioned at their *Air Flow Setpoint Minimum* position, so as not to further cool the space with the cold air being provided by the RTU. Lowering *Air Flow Setpoint Minimum* of the box is one way to manage the diversity of the system. Consider such action for spaces that are typically colder compared to others, such as exterior spaces in the building, especially those on the northern exposure.

Best Practice:

Consider lowering the Air Flow Setpoint Minimum for spaces that are consistently cooler than desired. Be sure to also consider the ventilation requirements for that space as part of the change as not to under-ventilate.

Conversely, consider spaces that are typically warmer than most others, such as warm interior spaces. For those spaces, consider lowering the ***Air Flow Setpoint Minimum Heat*** to prevent the excessive delivery of warm air provided by the RTU when the system mode is heating.

Best Practice:

Consider lowering the Air Flow Setpoint Minimum Heat for spaces that are consistently warmer than desired. Be sure to also consider the ventilation requirements for that space as part of the change as not to under-ventilate.

To balance the overall system flow, consider raising the minimum of some boxes whenever lowering the minimums of other boxes. Actively managing the minimum flows will tend to improve the overall comfort in each space.

Ventilation Control

There are several strategies to consider for providing adequate ventilation to the zone(s). This provides flexibility, allowing the customer or design team to select the ventilation strategy that is most appropriate for the specific project. For some zones, delivering a fixed (constant) quantity of outdoor air may be desired. For other zones, demand-controlled ventilation (DCV) may be desired. DCV is a control strategy that dynamically adjusts the ventilation airflow delivered to a zone based on the changing population in that zone, thereby reducing the energy needed to condition excess outdoor air.

Table 1. Ventilation control strategies for Zoned Rooftop Systems (if DCV is not required)

	Single-Zone Systems		Multiple-Zone Systems		
	Two-Speed	Single-Zone VAV	Changeover Hybrid	Changeover VAV	VAV with Terminal Heat
Control Strategy in Rooftop Unit					
Fixed minimum OA damper position	not recommended[2]	not recommended[2]	not recommended[2]	not recommended[2]	not recommended[2]
Reset minimum OA damper position based on supply fan speed	recommended[3]	recommended[4]	recommended[4]	recommended[4]	recommended[4]
Control Strategy in VAV Terminal Unit					
Fixed zone ventilation airflow setpoint	not applicable	not applicable	recommended[5]	recommended[5,6]	recommended[5,6]

Notes:

1. Pre-engineered in the Symbio 700 rooftop unit controller. Requires installer to configure one minimum OA damper position setpoint.
2. Use of a fixed minimum OA damper position is not recommended in a system that uses two-speed or variable-speed supply fan control.
3. Pre-engineered in the Symbio 700 rooftop unit controller for units equipped with two-speed supply fan control. Requires installer to configure two minimum OA damper position setpoints (at high fan speed and at low fan speed).
4. Pre-engineered in the Symbio 700 rooftop unit controller for units equipped with variable-speed supply fan control (referred to as “Supply Fan Compensation”). Requires installer to configure three minimum OA damper position setpoints.
5. Pre-engineered in the Symbio 210 VAV terminal unit controller. Requires the installer to configure one ventilation airflow setpoint for each zone.
6. Use this VAV terminal unit control strategy in conjunction with the “Reset minimum OA damper position based on supply fan speed” strategy at the rooftop unit controller.

Table 2. Demand-controlled ventilation (DCV) strategies for Zoned Rooftop Systems

	Single-Zone Systems		Multiple-Zone Systems		
	Two-Speed	Single-Zone VAV	Changeover Hybrid	Changeover VAV	VAV with Terminal Heat
Control Strategy in Rooftop Unit					
Reset minimum OA damper position based on CO_2 concentration	recommended[1]	recommended[1]	recommended[2]	recommended[2]	recommended[2]
Reset minimum OA flow setpoint based on CO_2 concentration	requires OA flow measurement[3]	requires OA flow measurement[3]	requires OA flow measurement [2,3]	requires OA flow measurement [2,3]	requires OA flow measurement [2,3]
Control Strategy in VAV Terminal Unit					
Reset zone minimum primary airflow setpoint based on CO_2 concentration (or sensed occupancy)	not applicable	not applicable	recommended[4,5]	recommended[4,5]	recommended[4]
Reset zone ventilation airflow setpoint based on CO_2 concentration (or sensed occupancy)	not applicable	not applicable	requires OA flow measurement[6]	requires OA flow measurement[6]	requires OA flow measurement[6]

Notes:

1. Pre-engineered in the Symbio 700 rooftop unit controller (referred to as "DCV") when equipped with either a wall-mounted or duct-mounted (return air) CO_2 sensor. Requires installer to configure four or five minimum OA damper position setpoints and two CO2 limits (high and low).
2. Using a single CO_2 sensor in the common return-air duct measures the average concentration of all zones served by the RTU, so use of this approach should be limited to a) where all the zones served by the system are similar, or b) when used in conjunction with the "Reset zone minimum primary airflow setpoint based on CO2 concentration" strategy at the VAV terminal unit controllers.
3. Requires field installation of a V-TRAQ airflow measurement accessory in the Precedent® rooftop unit or equipping the Voyager® 3 rooftop unit with the Traq™ Outside Air Measurement System.
4. Pre-engineered in the Symbio 210 VAV terminal unit controller and Tracer® Concierge™ (referred to as "Ventilation Optimization"). Requires the installer to configure two ventilation airflow setpoints, and possibly two CO_2 limits (high and low), for each zone. Use this VAV terminal unit control strategy in conjunction with the "Reset minimum OA damper position based on CO_2 concentration" strategy at the rooftop unit controller.
5. To improve comfort in a zone where this DCV strategy is being implemented, equip that zone's VAV terminal unit with electric or hot-water heat.
6. Pre-engineered in the Symbio 210 VAV terminal unit controller and Tracer Concierge (referred to as "Ventilation Optimization"). Requires the installer to configure two ventilation airflow setpoints, and possibly two CO2 limits (high and low), for each zone. Requires field installation of a V-TRAQ outdoor airflow measurement accessory in the Precedent® rooftop unit or equipping the Voyager® 3 rooftop unit with the Traq™ Outside Air Measurement System.

Ventilation Control Strategies Implemented Using Symbio 700 Rooftop Unit Controllers

The following strategies are used to define the minimum OA damper position needed for sufficient ventilation. When airside economizing is enabled, the OA damper will be allowed to modulate further open. These control strategies can be combined with the use of the ventilation control strategies in the Symbio™ 210 VAV terminal unit controller.

Reset Minimum OA Damper Position Based on Supply Fan Speed

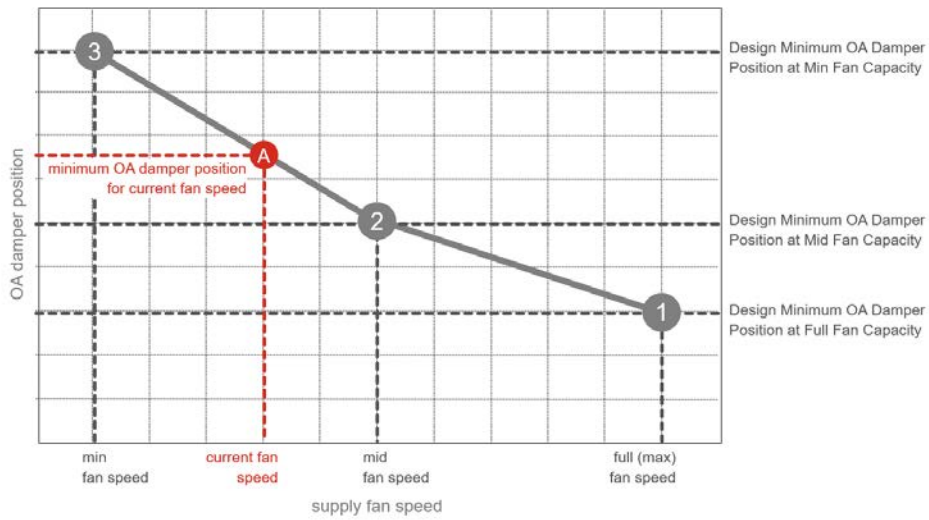
This strategy is recommended for rooftop units equipped with either two-speed or variable-speed supply fan control—single-zone VAV, changeover hybrid, changeover VAV, or multiple-zone VAV systems—when DCV is not required.

When two-speed or variable-speed supply fan control is used, to ensure that the same quantity (cfm) of outdoor air enters the system, the OA damper needs to be opened further when the supply fan speed is reduced. During occupied mode, the minimum position of the OA damper is dynamically adjusted in proportion to the changing supply fan speed.

When the rooftop unit is equipped with two-speed fan control, this pre-engineered sequence (referred to as "Supply Fan Compensation") requires the installer to configure two minimum OA damper position setpoints in the Symbio™ 700 rooftop unit controller —(**1**) the OA damper position required to bring in “design” outdoor airflow at maximum fan speed and (**3**) the position that brings in this same CFM of outdoor airflow at minimum fan speed.

When the rooftop unit is equipped with variable-speed fan control, the installer needs to configure an additional setpoint —(**2**) the OA damper position to bring in this same CFM of outdoor airflow at middle fan speed. Based on the current supply fan speed, the controller then calculates the current OA damper position—example position (**A**) in Figure 33, p. 49.

Figure 33. Reset minimum OA damper position based on supply fan speed



Reset Minimum OA Damper Position Based on CO_2 Concentration

This strategy is recommended for rooftop units that serve a single zone—single-zone two-speed or single-zone VAV systems—when DCV is required. Also, it may have application in rooftop units that serve more than one zone—changeover hybrid, changeover VAV, or multiple-zone VAV systems. However, installing a single CO_2 sensor in the common return-air duct measures the average concentration of all zones served by the rooftop unit. So use of this approach should be limited to either a) applications in which all the zones served by the rooftop unit have similar population, activity levels, and occupancy schedules, or b) systems that also use the “Reset zone minimum primary airflow setpoint based on CO_2 concentration” strategy at the VAV terminal unit controllers.

During occupied mode, the minimum position of the OA damper is dynamically adjusted based on the CO_2 concentration measured by a sensor installed in either the zone or return-air duct.

When the rooftop unit is equipped with **two-speed fan control**, this pre-engineered sequence requires the installer to configure four minimum OA damper position setpoints and two CO_2 concentration limits in the Symbio™ 700 rooftop unit controller

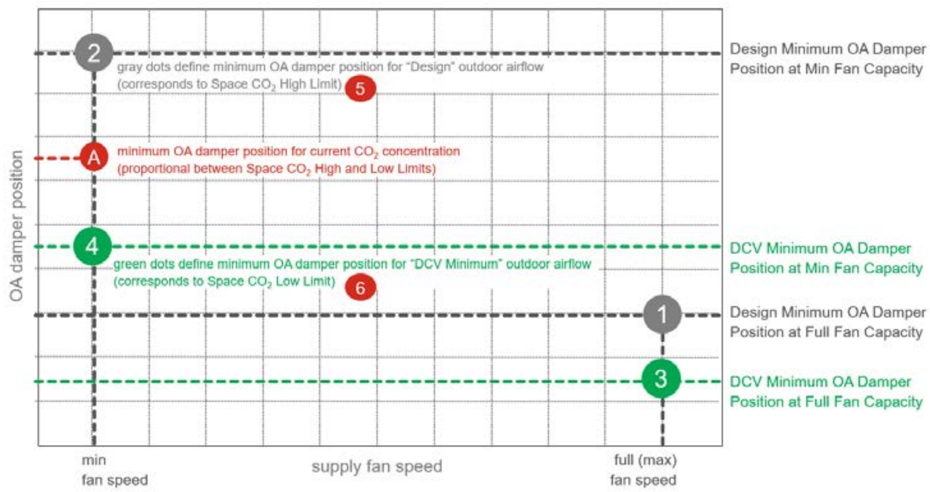
The first two OA damper positions are set to bring in the required “design” outdoor airflow, at either full (maximum) and minimum fan speed (**1** and **2**); and are used when the measured CO_2 concentration is equal to the Space CO_2 High Limit (**5**). The other two OA damper positions are set to bring in the “DCV minimum” outdoor airflow, at either full (maximum) and minimum fan speed (**3** and **4**); and are used when the measured CO_2 concentration is equal to the Space CO_2 Low Limit (**6**).

If the current measured CO_2 concentration is equal to (or greater than) the Space CO_2 High Limit (**5**), the controller uses either the Design Minimum OA Damper Position at Full Fan Capacity (**1**) when the fan is operating at full (maximum) speed, or the Design Minimum OA Damper Position at Min Fan Capacity (**2**) when the fan is operating at minimum speed.

If the current measured CO_2 concentration is equal to (or less than) the Space CO2 Low Limit (**6**), the controller uses either the DCV Minimum OA Damper Position at Full Fan Capacity (**3**) when the fan is operating at full (maximum) speed, or the DCV Minimum OA Damper Position at Min Fan Capacity (4) when the fan is operating at minimum speed.

If the current measured CO2 concentration is between the Space CO_2 High Limit and Space CO_2 Low Limit, the Symbio 700 controller calculates the current minimum OA damper position setpoint proportionally between positions (**1**) and (**3**), when the fan is operating at full (maximum) speed, or between positions (**2**) and (**4**), when the fan is operating at minimum speed—as depicted by example position (**A**) in Figure 34, p. 50

Figure 34. RTU with two-speed fan control: Reset minimum OA damper position based on CO_2 concentration



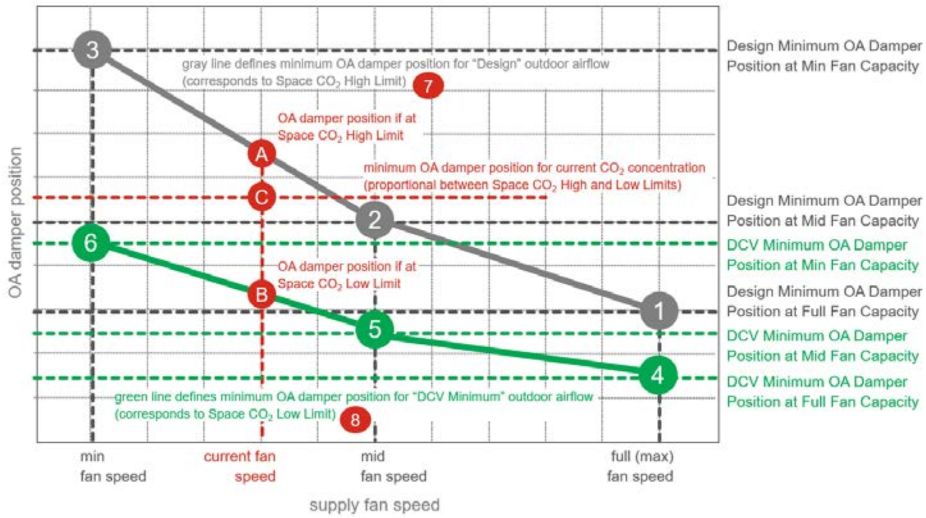
When the rooftop unit is equipped with **variable-speed fan control**, the installer needs to configure six OA damper position setpoints and two CO_2 concentration limits in the Symbio™ 700 rooftop unit controller. The first three OA damper positions are set to bring in the required "design" outdoor airflow, at either full (maximum), middle, or minimum fan speed (**1**, **2**, and **3**); and are used when the measured CO_2 concentration is equal to the Space CO_2 High Limit (**7**). The other three OA damper positions are set to bring in the "DCV minimum" outdoor airflow, at either full (maximum), middle, or minimum fan speed (**4**, **5**, and **6**); and are used when the measured CO_2 concentration is equal to the Space CO_2 Low Limit (**8**).

Based on the current supply fan speed, the controller calculates (**A**) the current OA damper position that would be used if the measured CO_2 concentration was equal to (or greater than) the Space CO_2 High Limit (**7**), proportionally between the first three OA damper position setpoints (**1**, **2**, and **3**)—depicted by gray line in Figure 35, p. 51.

The controller then calculates (**B**) the current OA damper position that would be used if the measured CO_2 concentration was equal to (or less than) the Space CO_2 Low Limit (**7**), proportionally between the second three OA damper position setpoints (**4**, **5**, and **6**)—depicted by green line in Figure 35, p. 51.

If the current measured CO_2 concentration is equal to (or greater than) the Space CO_2High Limit (**7**), the controller uses (**A**) for minimum OA damper position; if the concentration is equal to (or less than) the Space CO_2 Low Limit (**8**), the controller uses (**B**) for minimum OA damper position; and if the concentration is between Space CO_2 High Limit and Space CO_2 Low Limit, the controller calculates the minimum OA damper position proportionally between positions (**A**) and (**B**)—example position (**C**) in Figure 35, p. 51.

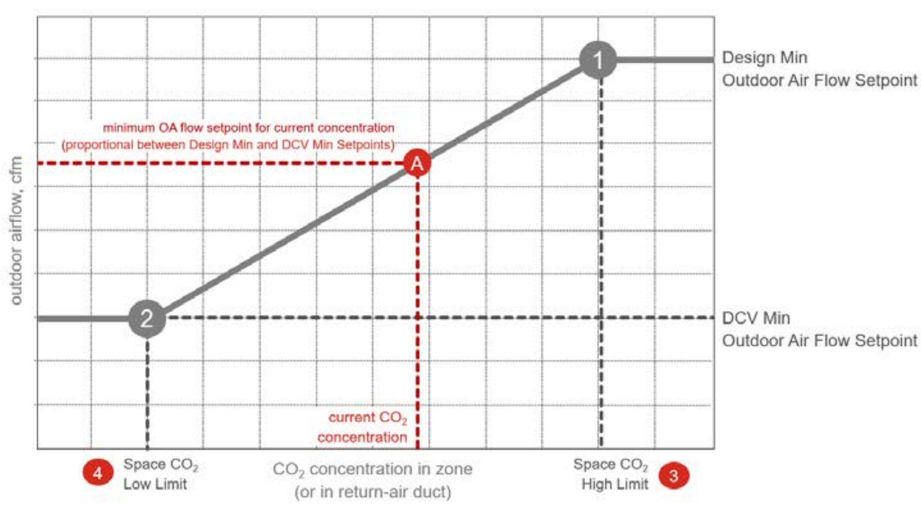
Figure 35. RTU with variable-speed fan control: Reset minimum OA damper position based on CO_2 concentration



Reset Minimum OA Flow Setpoint Based on CO_2 Concentration

This strategy can be used if the rooftop unit is equipped with a means to directly measure outdoor airflow, such as the V-TRAQ airflow measurement (for Precedent™ rooftop models) accessory from Trane Creative Solutions or the Traq™ OA measurement option in Voyager™ 3 rooftop units. During occupied mode, the minimum OA flow setpoint is dynamically adjusted based on the CO_2 concentration measured by a sensor installed in either the zone or return-air duct. This sequence requires the installer to configure two minimum outdoor airflow setpoints and two CO_2 concentration limits—(**1**) the "design" outdoor airflow setpoint to use when the measured CO_2 concentration is equal to the Space CO_2 High Limit (**3**) and (**2**) the "DCV minimum" outdoor airflow setpoint to use when the measured CO_2 concentration is equal to the Space CO_2 Low Limit (**4**). If the current measured CO_2 concentration is equal to (or greater than) the Space CO_2 High Limit, the damper opens to maintain OA flow at setpoint (**1**); if the concentration is equal to (or less than) the Space CO_2 Low Limit, the damper closes to maintain OA flow at setpoint (**2**); and if the concentration is between the Space CO_2 High Limit and Space CO_2 Low Limit, the controller calculates the current OA flow setpoint proportionally between flow setpoints (**1**) and (**2**), as depicted with example position (**A**) in Figure 36, p. 51.

Figure 36. Reset minimum OA flow setpoint based on CO_2 concentration



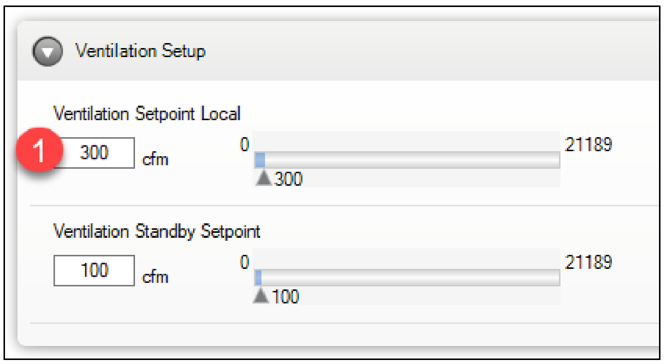
Ventilation Control Strategies Implemented Using Symbio 210 VAV Terminal Unit Controllers

Fixed Zone Ventilation Airflow Setpoint:

This strategy is recommended for VAV terminals serving zones in which DCV is not required.

Whenever the zone is scheduled to be occupied, the VAV terminal unit controller enforces a fixed ventilation airflow. This pre-engineered sequence requires the installer to configure one ventilation airflow setpoint - the “design” outdoor airflow required for the zone - in the Symbio™ 210 VAV terminal unit controller (see below). If the primary airflow being delivered to the zone drops below this ventilation airflow setpoint, the controller will modulate the VAV damper further open to enforce the higher airflow setpoint.

Figure 37. Fixed zone ventilation airflow setpoint



Callout number	Definition
1	"Design" zone ventilation airflow (Tracer TU = "Ventilation Setpoint Local")

This strategy should be used in conjunction with the “Reset minimum OA damper position based on supply fan speed” strategy in the Symbio 700 rooftop unit controller.

Reset Zone Minimum Primary Airflow Setpoint Based on CO_2 Concentration

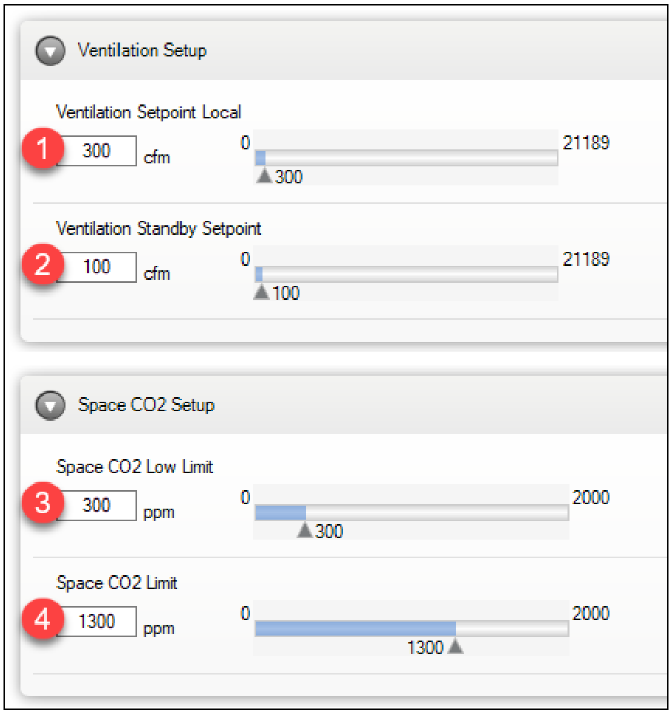
This strategy is recommended for VAV terminals serving zones in which DCV is required.

Whenever the zone is scheduled to be occupied, the Symbio™ 210 VAV terminal unit controller dynamically calculates the zone’s current ventilation airflow setpoint based on the CO_2 concentration measured by a sensor installed in the zone. In addition, the controller also calculates the current primary airflow setpoint required to maintain zone temperature at setpoint. If the current ventilation airflow setpoint is higher than the primary airflow being delivered, the controller will modulate the VAV damper further open to enforce the higher of these two airflow setpoints.Increasing primary airflow results in more outdoor air delivered to the zone; but increasing this flow of cool air causes the zone to over-cool. To improve comfort in any zone where this DCV strategy is being implemented, consider equipping that zone’s VAV terminal unit with either electric or hot-water heat.

To cause primary airflow to increase in response to an elevated CO_2 concentration, the ventilation airflow setpoints in the Symbio 210 controller should be set as follows:

- Ventilation Setpoint Local = 50 percent of Maximum Airflow (“Air Flow Setpoint Maximum”)
- Ventilation Standby Setpoint = 50 percent of Minimum Airflow (“Air Flow Setpoint Minimum”)
- Space CO_2 (High) Limit = Space CO_2 High Limit (see “Guidance on DCV Settings,” p. 55)
- Space CO_2 Low Limit = Space CO_2 Low Limit (see “Guidance on DCV Settings,” p. 55)

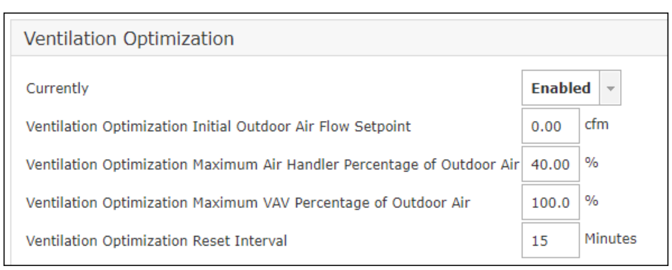
Figure 38. Ventilation Setup



Callout number	Definition
1	"Design" zone ventilation airflow (Tracer TU = "Ventilation Setpoint Local")
2	"DCV Minimum" zone ventilation airflow (Tracer TU = "Ventilation Standby Setpoint")
3	Minimum CO_2 concentration limit (Tracer TU = "Space CO2 Low Limit")
4	Maximum CO_2 concentration limit (Tracer TU = "Space CO2 Limit")

The Ventilation Optimization function should be set to “Enabled,” the “Maximum VAV Percentage of Outdoor Air” should be entered as 100, and the “Include in Ventilation Optimization” box should be checked for every VAV terminal:

Figure 39. Ventilation Optimization



This strategy should be used in conjunction with the “Reset Minimum OA Damper Position Based on CO_2 Concentration,” p. 49 in the Symbio 700 rooftop unit controller to ensure there is an adequate quantity of outdoor air in the primary air delivered by the rooftop unit.

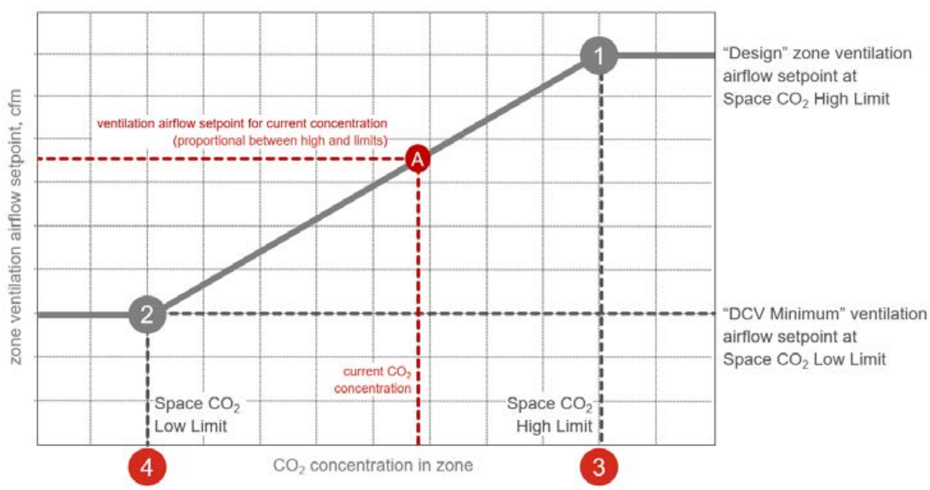
Reset Zone Ventilation Airflow Setpoint Based on CO_2 Concentration (or Sensed Occupancy)

This strategy can be used if the rooftop unit is equipped with a means to directly measure outdoor airflow, such as the V-TRAQ airflow measurement accessory for Precedent™ rooftops, from Trane Creative Solutions of the Traq™ OA measurement option for Voyager™ 3 rooftops.

Whenever the zone is scheduled to be occupied, the VAV terminal unit controller dynamically calculates the zone's current ventilation airflow setpoint based on the CO_2 concentration (or occupancy status) measured by a sensor installed in the zone it serves.

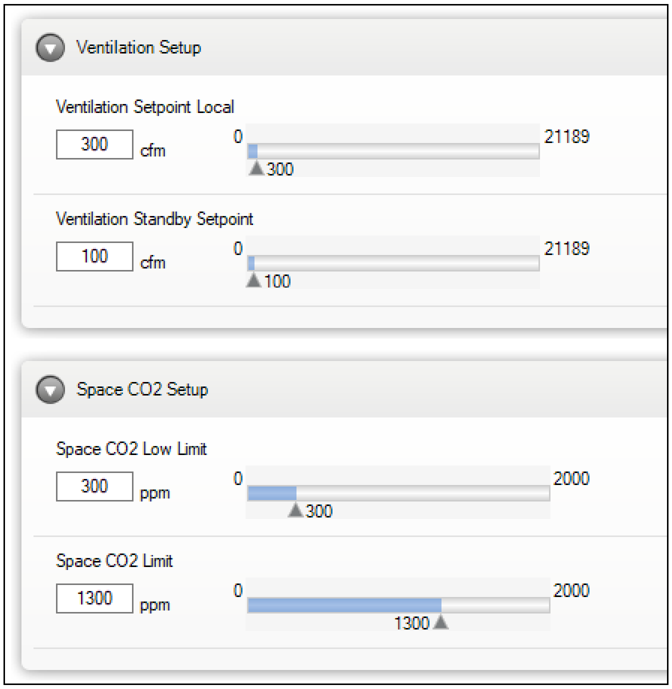
If a *CO2 sensor* is installed, this pre-engineered sequence requires the installer to configure two ventilation airflow setpoints and two CO_2 concentration limits in the Symbio™ 210 VAV terminal unit controller (see below)—(**1**) the "design" ventilation airflow setpoint to use at when the measured CO_2 concentration is equal to the Space CO2 (High) Limit (**3**) and (**2**) the "DCV minimum" ventilation airflow setpoint to use at when the measured CO2 concentration is equal to the Space CO_2 Low Limit (**4**). If the current measured CO_2 concentration is equal to (or greater than) the Space CO2 (High) Limit, the current ventilation airflow is equal to setpoint (**1**); if the concentration is equal to (or less than) the Space CO2 Low Limit , the current ventilation airflow is equal to setpoint (**2**); and if the concentration is between Space CO2 (High) Limit and Space CO2 Low Limit, the Symbio 210 controller calculates the current ventilation airflow setpoint proportionally between setpoints (**1**) and (**2**)—example position (**A**) in Figure 40, p. 54

Figure 40. Reset zone ventilation airflow setpoint based on CO_2 concentration



Callout number	Definition
1	"Design" zone ventilation airflow (Tracer TU = "Ventilation Setpoint Local")
2	"DCV minimum" zone ventilation airflow (Tracer TU = "Ventilation Standby Setpoint")
3	Maximum CO_2 concentration limit (Tracer TU = "Space CO_2 Limit")
4	Minimum CO_2 concentration limit (Tracer TU = "Space CO_2 Low Limit")

Figure 41. Tracer TU Ventilation Setup



If an occupancy sensor is installed, this pre-engineered sequence requires the installer to configure only the two ventilation airflow setpoints in the Symbio 210 VAV terminal unit controller—(**1**) the "design" ventilation airflow setpoint to use when occupancy is detected and (**2**) the "DCV minimum" ventilation airflow setpoint to use when the occupancy sensor indicates that the zone is currently unoccupied.

In addition to dynamically calculating the current ventilation airflow setpoint for the zone, each Symbio 210 controller also measures the current primary airflow being delivered to the zone and calculates its current ventilation ratio—the current ventilation airflow setpoint divided by the current primary airflow being delivered.

Then Tracer Concierge periodically gathers this data from all the VAV controllers and—using the equations prescribed in ASHRAE Standard 62.1—calculates the quantity of outdoor air that must be brought in at the centralized rooftop unit to satisfy all the zones that it serves. Finally, Tracer Concierge communicates this new OA flow setpoint (writes this value to analog value point "Minimum Outdoor Air CFM Setpoint) to the controller provided with the V-TRAQ accessory (for Precedent rooftops) or the Symbio 700 controller (for Voyager 3 rooftops equipped with Traq OA measurement), which then modulates a flow-measuring OA damper to maintain outdoor airflow at this new setpoint.

Guidance on DCV Settings

When demand-controlled ventilation is to be implemented:

- The "design" outdoor/ventilation airflow is based on the peak population and floor area of the zone, typically using the minimum ventilation rates prescribed by ASHRAE Standard 62.1.
- The "DCV minimum" outdoor/ventilation airflow is usually based on the floor area of the zone, again using the minimum per-unit-floor-area ventilation rate prescribed by ASHRAE 62.1, but this airflow may be higher if needed to replace exhaust air.
- The Space CO_2 High Limit is based on the rate at which occupants generate carbon dioxide, which is a function of their physical activity level.
- The Space CO_2 Low Limit is typically equal to the outdoor CO_2 concentration.

For information on how to calculate these outdoor airflow setpoints and CO_2 concentration limits for a specific application, refer to the Trane *Engineers Newsletter* titled "CO_2-Based Demand-Controlled Ventilation with ASHRAE Standard 62.1" (ADM-APN017-EN).

The table below estimates the maximum and minimum CO_2 concentration limits for common space types, using defaults and assumptions.:

Table 3. Estimated CO_2 Concentration Levels

Occupancy category	Assumed occupant Activity Level, Met [(a)]	Space CO_2 High Limit, ppm [(b)]	Space CO_2 Low Limit, ppm ppm [(c)]
office space	seated, typing (1.1 Met)	950	400
conference room	seated, quiet (1.0 Met)	1800	400
break room	seated, filing (1.2 Met)	1850	400
reception area	seated, filing (1.2 Met)	1850	400
bank lobby	walking (2.0 Met)	1800	400
K-12 classroom	seated, filing (1.2 Met)	1050	400
multi-use assembly	seated, quiet (1.0 Met)	1450	400
auditorium	seated, quiet (1.0 Met)	2100	400
library	seated, typing (1.1 Met)	950	400
retail sales floor	walking (2.0 Met)	1450	400

(a) Assumed occupant activity level for listed occupancy category, using Met values from 2017 ASHRAE Handbook–Fundamentals (Chapter 9, Table 4).

(b) Space CO_2 High calculated assuming CO_2 generation rate equals 0.0084 cfm/Met/person, minimum ventilation rates and default occupant density from ASHRAE Standard 62.1-2016 (Table 6.2.2.1), and outdoor CO_2 concentration equal to 400 ppm.

(c) Assuming outdoor CO_2 concentration equal to 400 ppm.

Product Selection

Depending on the system type, the components selected will vary. Consider the following options when selecting the specific components for the Tracer Concierge system. Refer to "Tracer Concierge System Summary," p. 31 for additional guidance.

Table 4. Packaged rooftop unit selection criteria in Trane Select Assist™ (www.traneselectassist.com)

	System Type	Supply Fan or System Control	Heating Capacity	Fresh Air Selection	Communications	Zone Temperature Sensor	Return Air Temperature Sensor
single-zone systems	two-speed	multi-speed motor multi-speed fan	any choice	Econ required for DCV[(a)] or SF Comp.[(b)]	Air-Fi (for wireless) or BACnet BAS (for wired)	required[(c)]	recommended[(d)]
	single-zone VAV	single-zone VAV SZVAV (variable-speed fan)	any choice	Econ required for DCV[(a)] or SF Comp.[(b)]		required[(e)]	recommended[(d)]
multiple-zone systems	changeover hybrid	multiple-zone VAV VAV	staged gas staged electric heat pump	Econ required for DCV[(a)] or SF Comp.[(b)]		not applicable	recommended[(d)]
	changeover VAV	multiple-zone VAV VAV	modulating gas SCR electric (modification)	Econ required for DCV[(a)] or SF Comp.[(b)]		not applicable	recommended[(d)]
	VAV with electric heat	multiple-zone VAV VAV	any choice	Econ required for DCV[(a)] or SF Comp.[(b)]		not applicable	recommended[(d)]
	VAV with hot-water heat	multiple-zone VAV VAV	any choice	Econ required for DCV[(a)] or SF Comp.[(b)]		not applicable	recommended[(d)]

(a) The rooftop unit must be equipped with an economizer to implement demand-controlled ventilation.
(b) The rooftop unit must be equipped with an economizer to reset outdoor-air damper position based on supply fan speed (referred to as "Supply Fan Compensation").
(c) A zone temperature sensor is recommended for communication with Tracer Concierge, but a conventional thermostat can be used for this system.
(d) If using Air-Fi wireless, a hard-wired return air temperature sensor is recommended for providing temporary heating/cooling during construction and then to serve as a backup to the wireless sensor.
(e) A zone temperature sensor (not a thermostat) is required to enable variable-speed fan control; otherwise the unit will operate with two-speed fan control

Table 5. VAV terminal unit selection criteria in Trane Select Assist™ (www.traneselectassist.com)

	System Type	Product/Model	Trane Supplied Controls	Wireless Sensor Options	Zone Temperature Sensor	Discharge Air Temperature Sensor (DTS)
single-zone systems	two-speed	not applicable				
	single-zone VAV	not applicable				
multiple-zone systems	changeover hybrid	VAV Round Terminal Units (model VRRF) or VAV Single-Duct Terminal Units (model VCCF)	SY210 Basic (cooling only)[a]	Air-Fi wireless communication module (if wireless)[a]	required	recommended[b]
	changeover VAV	VAV Round Terminal Units (model VRRF) or VAV Single-Duct Terminal Units (model VCCF)	SY210 Basic (cooling only)[a]		required	recommended[b]
	VAV with electric heat	VAV Single-Duct Terminal Units (model VCEF)	SY210 Basic (cooling only) or SY210 Basic (staged electric) or SY210 Basic (electric - mod SCR)[a]		required	recommended[b] or required[c]
	VAV with hot water heat	VAV Single-Duct Terminal Units (model VCWF)	SY210 Basic (cooling only) or SY210 Basic (2-pos. hot water, NC) or SY210 Basic (2-pos. hot water, NO) or SY210 Basic (modulating hot water)[a]		required	recommended[b] or required[c]

[a] Preset addressing of Symbio 210 controllers and Air-F Wireless sensors is available as an option.
[b] Equipping each VAV terminal unit with a DAT sensor is recommended for monitoring and troubleshooting.
[c] If the VAV terminal unit is equipped with either an SCR electric heater (SY210 Basic – electric modulating SCR) or a modulating hot-water valve (SY210 Basic – modulating hot water), it must be equipped with a DAT sensor to enable the dual maximums control sequence.

Table 6. Trane bypass damper selection criteria in Trane Select Assist™ (www.traneselectassist.com)

<table>
<tr><th></th><th>System Type</th><th>Bypass Damper Required?</th><th>Product/Model</th><th colspan="2">Trane Supplied Controls</th><th>Duct Temperature Sensor (DTS)</th><th>Factory-Installed Wireless Receiver</th></tr>
<tr><td rowspan="2">single-zone systems</td><td>two-speed</td><td colspan="6">not applicable</td></tr>
<tr><td>single-zone VAV</td><td colspan="6">not applicable</td></tr>
<tr><td rowspan="4"></td><td>changeover hybrid (with staged heat in rooftop)</td><td>required</td><td rowspan="2"></td><td>SY210 DDC Basic – Cooling Only</td><td>design special to maintain duct static pressure[a]</td><td>required</td><td rowspan="2">Air-Fi wireless communication module (if wireless)[b]</td></tr>
<tr><td>changeover VAV (with modulatig gas heat in rooftop)</td><td>may be required</td><td>SY210 DDC Basic – Cooling Only</td><td></td><td>not required</td></tr>
<tr><td>VAV with terminal electric heat</td><td colspan="6">typically not required</td></tr>
<tr><td>VAV with terminal hot water heat</td><td colspan="6">typically not required</td></tr>
</table>

(a) The bypass damper programming is a “design special” order that controls to maintain duct static pressure. Contact your Trane sales representative for assistance.
(b) Preset addressing of Symbio210 controller is available as an option.

Table 7. Controls selections

Controls Selections	Concierge System Type: Single-zone two-speed	Single-zone VAV	Changeover Hybrid	Changeover VAV	Multiple-zone VAV w/Elec Heat	Multiple-zone VAV w/HW Heat
Concierge Panel	Required	Required	Required	Required	Required	Required
Tracer 10-inch Display	Required	Required	Required	Required	Required	Required
Cellular Router	Select as needed	Select as needed	Select as needed	Select as needed	Select as needed	Select as needed
Wi-Fi Router	Select as needed	Select as needed	Select as needed	Select as needed	Select as needed	Select as needed
Wireless Communication Interface (WCI)	Required[1]	Required[1]	Required[1]	Required[1]	Required[1]	Required[1]
Sensors						
Space Temperature (RTU)[3]	Required	Required	Not applicable	Not applicable	Not applicable	Not applicable
Space Temperature (VAVs)[3]	Not applicable	Not applicable	Required	Required	Required	Required
Space Relative Humidity	Select as needed	Select as needed	Select as needed	Select as needed	Select as needed	Select as needed
Space CO2	Select as needed	Select as needed	Select as needed	Select as needed	Select as needed	Select as needed
Discharge Air Temperature (RTU/bypass)	Not applicable	Not applicable	Required[2 4]	Required[4]	Required[4]	Required[4]
Duct Static Pressure	Not applicable	Required[4]	Required[2 4]	Required[4]	Required[4]	Required[4]
Return Air Temperature	Recommended[5]	Recommended[5]	Recommended[5]	Recommended[5]	Recommended[5]	Recommended[5]
XM30 (OA Temp, Misc)	Select as needed	Select as needed	Select as needed	Select as needed	Select as needed	Select as needed
XM32 (Lights, Exhaust Fans, Misc)	Select as needed	Select as needed	Select as needed	Select as needed	Select as needed	Select as needed
Field Installed Symbio 210 Bypass Damper Controller	Not applicable	Not applicable	Select as needed	Select as needed	Not applicable	Not applicable
Rooftop by Others (non-Trane)						
Symbio 500 RTU/HP Controller	Select as needed	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

Notes:

1. Select additional WCIs as needed. Each field-installed controller will require a WCI. A second network will require a WCI.
2. Discharge Temp and Duct Static Sensors are included with Symbio controller bypass damper kit
3. Space Temperature Sensor can be ordered with Equipment or separately
4. Discharge Temp Sensor is included in SZVAV RTU controls;. Discharge Temp and Duct Static Sensors are included in MZVAV RTU controls
5. Return Air Temperature recommended to allow temporary operation during construction or system maintenance

Installation Instructions

The Tracer Concierge system controller supports six different system types. Depending on the system, the installation instructions vary slightly. The table below summarizes the different system types as well as the components used with each.

System Type	RTU Type	VAV Box	Bypass Damper
Single-zone two-speed	Multi-speed	Not applicable	Not applicable
Single-zone VAV	Single-zone VAV (SZVAV)	Not applicable	Not applicable
Changeover hybrid	Multiple-zone VAV (MZVAV)	VariTrane or RIRO[a]	Required
Changeover VAV	Multiple-zone VAV (MZVAV)	VariTrane or RIRO[a]	Optional for Changeover VAV [b]
Multiple-zone VAV with VAV box electric heat	Multiple-zone VAV (MZVAV)	VariTrane with electric heat	Not required
Multiple-zone VAV with VAV box hot water heat	Multiple-zone VAV (MZVAV)	VariTrane with hot water heat	Not required

(a) VariTrane boxes may or may not have local heat. Round In Round Out (RIRO) can be used when no VAV heat is needed.

(b) Bypass damper may be required if the RTU is equipped with modulating gas heat, and the minimum expected system airflow is less than the minimum threshold for the gas heater.

The installation instructions in this document provide guidance pertaining to the difference in installation steps based on the system type. For complete installation instructions, refer to the Tracer Concierge Installation, Operation, and Maintenance manual (BAS-SVX074*-EN).

Although the installation process is mostly automated and quite similar for most system types, there are a few notable differences and user adjustments necessary for some applications. All of the installation scenarios outlined below assume use of the Setup Wizard utility in the Tracer 10-inch display.

As part of the installation process, the Setup Wizard utility automatically scans the communication links for connected devices. In cases where one or more connected devices do not automatically appear in the list of discovered devices, the user can initiate another scan of the link to see if more devices appear. Once all of the system devices have been successfully discovered, the installation process can continue. It is also possible to complete installation without all devices, in which case the user is allowed to go back and add the remaining devices at a later time.

The Setup Wizard utility is designed as a wizard, guiding the user through a series of steps that simplifies the software installation and setup process. Before proceeding with the installation, the user should be familiar with the Concierge system types and components required for each.

Single-Zone Two-Speed

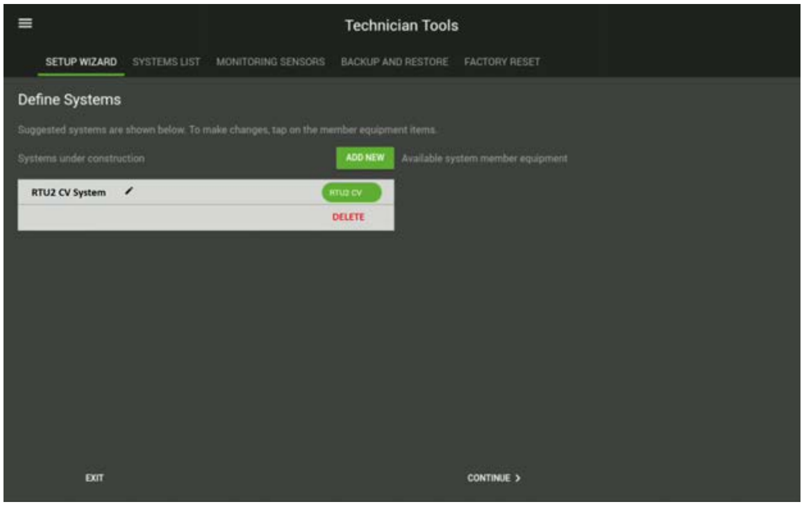
One of the simpler system types for Tracer Concierge is comprised of one or more two-speed rooftop units. This system is designed to deliver conditioned air to the space without VAV boxes or a bypass damper.

The Setup Wizard utility automatically detects the RTU unit type during the discovery and installation steps. Based on the unit type, the user is presented with system-specific setup screens, simplifying and streamlining the overall installation process.

System Members

For a single-zone two speed system, one or more RTUs exist in the building. When more than one RTU exists, the user has the option of adding additional RTUs to the default system or creating one or more additional systems, each with at least one RTU. Single-zone systems include no VAV boxes and no bypass damper.

Figure 42. Define systems



The remaining steps in the installation wizard are consistent with the other system types. For additional information on the detailed installation instructions, refer to the Tracer Concierge IOM,(BAS-SVX074).

Select VAV Settings

Because each RTU serves only a single zone, the user need not select any VAV settings with the Setup Wizard.

Advanced Settings in Tracer Concierge

Because there are no VAV boxes for this system type, the user should not normally need to adjust any of the (VAV box) advanced settings in the Tracer Concierge panel. Refer to the instructions provided in this manual if any adjustments are required for the RTU/system settings in the Tracer Concierge panel.

Single Zone VAV

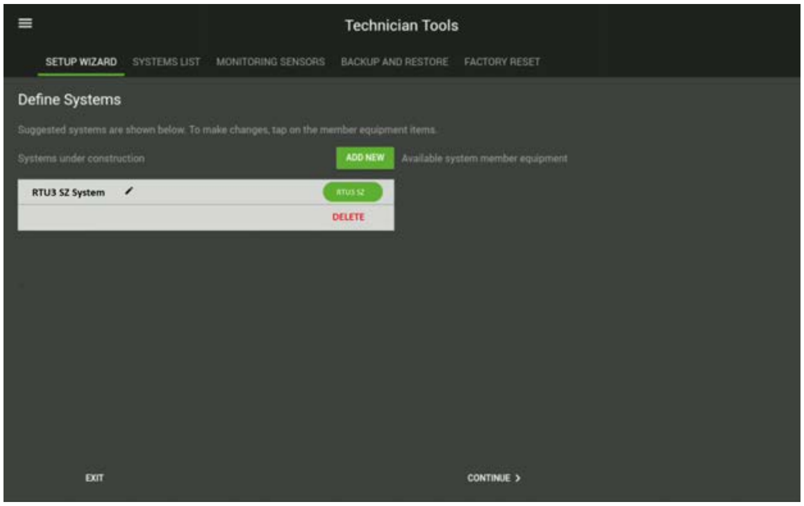
Another relatively simple system type for Tracer Concierge is comprised of one or more single zone VAV rooftop units. This system is designed to deliver a variable volume of conditioned air to the space without VAV boxes or a bypass damper.

The Setup Wizard automatically detects the RTU unit type during the discovery and installation steps. Based on the unit type, the user is presented with system-specific setup screens, simplifying and streamlining the overall installation process.

System Members

For a single zone VAV (SZVAV) system, one or more SZVAV RTUs exist in the building. When more than one RTU exists, the user has the option of adding additional RTUs to the default system or creating one or more additional systems, each with at least one RTU. SZVAV systems include no VAV boxes and no bypass damper.

Figure 43. Define systems



The remaining steps in the installation wizard are consistent with the other system types. For additional information on the detailed installation instructions, refer to the Tracer Concierge IOM (BAS-SVX074*-EN).

Select VAV Settings

You do not need to select any settings with the Setup Wizard as these settings are applicable to only multiple-zone VAV systems with associated VAV boxes.

Advanced Settings in Tracer Concierge System Controller

Because there are no VAV boxes for this system type, the user typically does not need to adjust any of the (VAV box) advanced settings in the Tracer Concierge panel. Refer to the instructions provided in this manual if any adjustments are required for the RTU/system settings in the Tracer Concierge panel.

Changeover Hybrid

Changeover Hybrid systems include a multiple-zone, variable air volume RTU (MZVAV). For this system type, VAV boxes must be associated with the RTU to define a ‘system’ in the Tracer Concierge system controller. Each Changeover VAV system must include a single RTU and the associated VAV boxes. The user must define separate systems for each RTU and the associated VAV boxes.

With staged heat units (hybrid systems), the supply fan speed is constant/maximum in the heating mode. As such, for staged heat RTUs, the addition of a bypass damper for these system types is necessary. The system controller automatically coordinates the changeover between cooling and heating, especially the duct static pressure control transition from RTU supply fan speed to the variable bypass damper position.

System Members

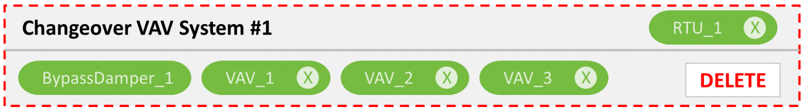
With discovery complete, all of the required components should be available for installation into the system controller. The Setup Wizard simplifies the process for the user by creating one or more systems based on the discovered components.

Important: *The wizard will prevent the user from removing the bypass damper from a system. The wizard also prevents the user from adding a bypass damper to a system with other components already defined. If necessary, delete the entire system to begin the definition of another system with different membership. Additionally, once the user defines a system with a bypass damper and rooftop unit, the installation wizard prevents the user from deleting either of the components individually. If necessary, delete the entire system to begin the definition of another system with different membership.*

Changeover Hybrid

Whenever the Setup Wizard identifies a bypass damper, the tool defines a changeover system and places the bypass damper in that system. Then the user can add a rooftop unit and any/all associated VAV boxes to that system. To add each component to the system, click on the component and select **Assign to…System**. Repeat the process until the assignment of all components and systems is complete.

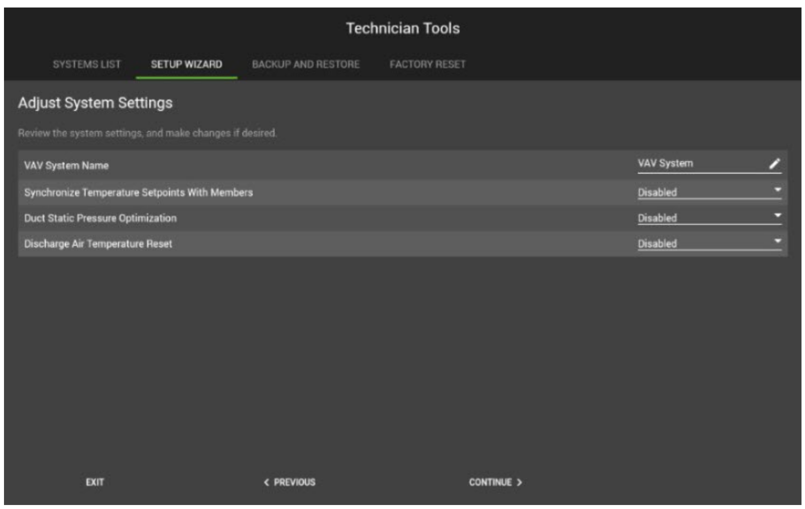
Figure 44. Changeover VAV with staged heat



Select VAV Settings

Because the RTU for this system type is variable volume, the user may optionally select VAV settings with the Setup Wizard. The user may elect to enable duct static pressure optimization for the RTU as well as edit the duct pressure setpoints and limits.

Figure 45. Adjust system settings



Changeover Hybrid System Name

The installation wizard automatically assigns a default name for each system. The user may edit the default name at any time.

Bypass Pressure Setpoint

The duct static pressure of a changeover bypass system is maintained by the bypass damper. The user may edit the duct static pressure setpoint with the Tracer 10-inch display.

Morning/Daytime Warmup Setpoint

VAS enables the RTU/AHU heat by automatically manipulating the space temperature to be less than the morning/daytime warm-up setpoint. Consult the factory before editing either value (default = 70° F).

Synchronize Temperature Setpoints with Members

When the user enables setpoint synchronization, temperature setpoints are sent by Area Control in the system controller to each VAV member. These setpoints include the space temperature setpoint, standby offset, occupied offset, and unoccupied cooling and heating setpoints.

With synchronization enabled, all setpoints for all VAV members can be controlled from a single location on the display. However, individual setpoints adjustment for the zones is not possible when synchronization is enabled. If occupants desire individualized setpoint control in their respective spaces, synchronization must remain disabled.

Duct Static Pressure Optimization

VAS can be configured to automatically adjust the duct static pressure setpoint of a changeover VAV/ hybrid system based on the position of the most open VAV box. When enabled, duct static pressure optimization reduces the energy consumption associated with the system fan.

Discharge Air Temperature Reset

When enabled, discharge air temperature reset automatically adjusts the calculated discharge air setpoint of the RTU/AHU based on either the ambient temperature or satisfaction of the spaces (user adjustable). When enabled, discharge air temperature reset reduces the energy consumption of the RTU/AHU by providing slightly more neutral air under certain conditions. See “Appendix B: Discharge-Air Temperature (DAT) Reset,” p. 88.

Advanced Settings in Tracer Concierge

Tagging

Each VAV box in a Tracer Concierge system normally votes for either RTU heating or cooling based on the difference between the space temperature and active occupied setpoint of the VAV box. When tagging is enabled and the space temperature is more than 3° F above the cooling setpoint or more than 3° F below the heating setpoint, the box becomes a tagging candidate. When tagged, the box no longer votes for system heating or cooling. This feature is intended to automatically eliminate spaces that could be considered control outliers.

If a specific box is determined to be a consistent control outlier, that box can be manually removed from consideration as part of the heat/cool mode voting process. Refer to the section in this manual pertaining to advanced setup and adjustments for detailed instructions on editing the **Enable Tagging** parameter associated with each VAV box.

Priority Local Heat

For this system type, the VAV boxes may or may not include local heat. When VAV heat capability exists, additional (advanced) setup is required following the completion of the Setup Wizard. The setup changes are required to allow the local heat the ability to control the space temperature (in heating) prior to having the VAV box vote for RTU heating. Refer to the section in this manual pertaining to advanced setup and adjustments for detailed instructions on editing the **Priority Local Heat** parameter associated with each VAV box.

Changeover VAV

Changeover VAV systems include a multiple-zone, variable air volume RTU (MZVAV). For this system type, VAV boxes must be associated with the RTU to define a ‘system’ in the Tracer Concierge system controller. Each Changeover VAV system must include a single RTU and the associated VAV boxes. The user must define separate systems for each RTU and the associated VAV boxes.

Because the supply fan speed varies for both heating and cooling operation with modulating heat units, the addition of a bypass damper is not normally necessary. The RTU maintains duct static pressure in both heating and cooling mode while the VAV terminals modulate to satisfy ventilation requirements and maintain space temperature in both system modes, heating and cooling.

System Members

With discovery complete, all of the required components should be available for installation into the system controller. The Setup Wizard simplifies the process for the user by creating one or more systems based on the discovered components.

Changeover VAV with Modulating Heat

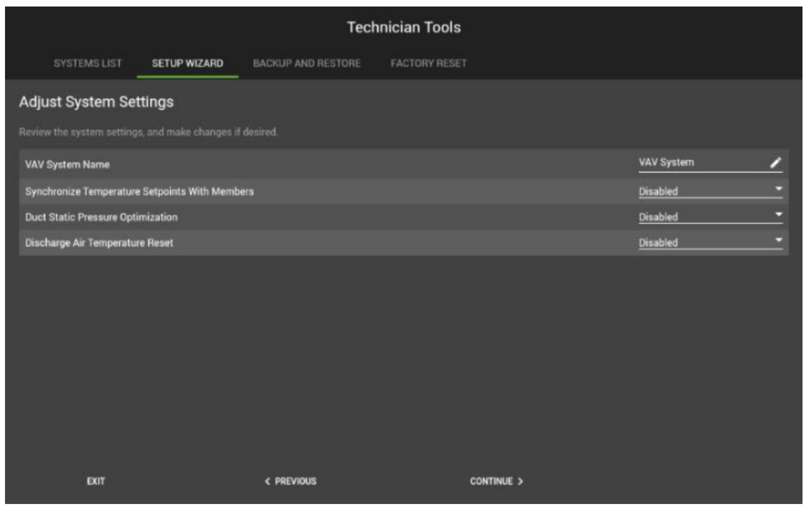
If the Setup Wizard identifies no bypass dampers upon initial discovery, but multiple-zone VAV rooftop units are present, the tool places each RTU into their own system container. The user must manually add the remaining components to the system container, or optionally create additional system containers. To add a new system, select the green "Add New" button. To add each component to a system, click on the component and select **Assign to…System**. Repeat the process until the completion of all system definition.

Figure 46. Changeover hybrid system

Select VAV Settings

Because the RTU for this system type is variable volume, the user may optionally select VAV settings with the Setup Wizard. The user may elect to enable duct static pressure optimization for the RTU as well as edit the duct pressure setpoints and limits.

Figure 47. Adjust system settings



Changeover VAV System Name

The installation wizard automatically assigns a default name for each system. The user may edit the default name at any time.

Bypass Pressure Setpoint

The duct static pressure of a changeover VAV system is maintained by the rooftop unit for both heating and cooling modes. The user may edit the duct static pressure setpoint with the Tracer 10-inch display.

Morning/Daytime Warmup Setpoint

VAS enables the RTU/AHU heat by automatically manipulating the space temperature to be less than the morning/daytime warm-up setpoint. Consult the factory before editing either value (default = 70° F).

Synchronize Temperature Setpoints with Members

When the user enables setpoint synchronization, temperature setpoints are sent by Area Control in the system controller to each VAV member. These setpoints include the space temperature setpoint, standby offset, occupied offset, and unoccupied cooling and heating setpoints.

With synchronization enabled, all setpoints for all VAV members can be controlled from a single location on the display. However, individual setpoints adjustment for the zones is not possible when synchronization is enabled. If occupants desire individualized setpoint control in their respective spaces, synchronization must remain disabled.

Duct Static Pressure Optimization

VAS can be configured to automatically adjust the duct static pressure setpoint of a changeover VAV system based on the position of the most open VAV box. When enabled, duct static pressure optimization reduces the energy consumption associated with the system fan.

Discharge Air Temperature Reset

When enabled, discharge air temperature reset automatically adjusts the calculated discharge air setpoint of the RTU/AHU based on either the ambient temperature or satisfaction of the spaces (user adjustable). When enabled, discharge air temperature reset reduces the energy consumption of the RTU/AHU by providing slightly more neutral air under certain conditions.

In a Changeover VAV system, the rooftop unit delivers either cool air or warm air to all the VAV terminal units. Resetting the discharge-air temperature (DAT) can be used to reduce the number of times the rooftop unit switches between cooling and heating modes and improve overall comfort in the building. When the rooftop unit is operating in cooling mode, resetting the Cooling DAT setpoint upward will help minimize the amount of over-cooling in those zone that require heating. When the rooftop unit is operating in heating mode, resetting the Heating DAT setpoint downward will help minimize the amount of over-heating in those zone that require cooling.

While there are many different approaches to implementing DAT reset, the following program demonstrates one way implement it on a changeover system to reduce heat/cool mode changes, improve occupant comfort, and reduce energy consumption. See “Appendix B: Discharge-Air Temperature (DAT) Reset,” p. 88.

Advanced Settings in Tracer Concierge

Tagging

Each VAV box in a Tracer Concierge system normally votes for either RTU heating or cooling based on the difference between the space temperature and active occupied setpoint of the VAV box. When tagging is enabled and the space temperature is more than 3° F above the cooling setpoint or more than 3° F below the heating setpoint, the box becomes a tagging candidate. When tagged, the box no longer votes for system heating or cooling. This feature is intended to automatically eliminate spaces that could be considered control outliers.

If a specific box is determined to be a consistent control outlier, that box can be manually removed from consideration as part of the heat/cool mode voting process. Refer to the section in this manual pertaining to advanced setup and adjustments for detailed instructions on editing the **Enable Tagging** parameter associated with each VAV box.

Priority Local Heat

For this system type, the VAV boxes may or may not include local heat. When VAV heat capability exists, additional (advanced) setup is required following the completion of the Setup Wizard. The setup changes are required to allow the local heat the ability to control the space temperature (in heating) prior to having the VAV box vote for RTU heating. Refer to the section in this manual pertaining to advanced setup and adjustments for detailed instructions on editing the **Priority Local Heat** parameter associated with each VAV box.

Multiple-Zone VAV Rooftop with VAV Electric Heat

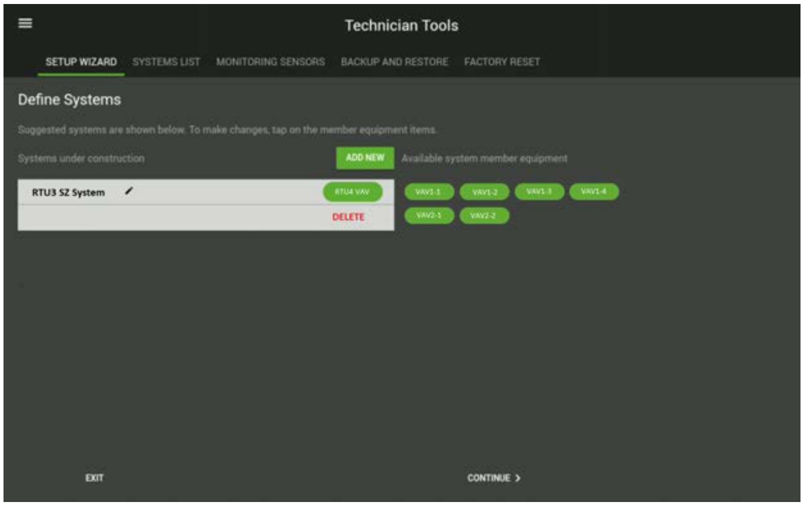
Multiple-zone variable air volume (VAV) RTU systems include a multiple-zone, variable air volume RTU (MZVAV). With this system type, VAV boxes are associated with the RTU to form a ‘system’ in Tracer Concierge. The RTU normally provides a variable amount of cool conditioned air to the VAV boxes. When space heating is required, the VAV box for that space utilizes local electric heat to provide the necessary heating. The exception is the morning/daytime warm-up mode, in which case the RTU temporarily provides warm air down the duct.

Other RTUs and their associated VAV boxes must be defined as separate systems.

System Members

With discovery complete, all of the required components should be available for installation into the Tracer Concierge system. By default, the Setup Wizard automatically recognizes the variable volume RTU and places it in the system container. The associated VAV boxes must be manually added to the system container by the user, or optionally added to another system container when more than one system exists for the building. To add each component to the system, click on the component and select **Assign to… System**. Repeat the process until all components are added to the system(s).

Figure 48. Define Systems

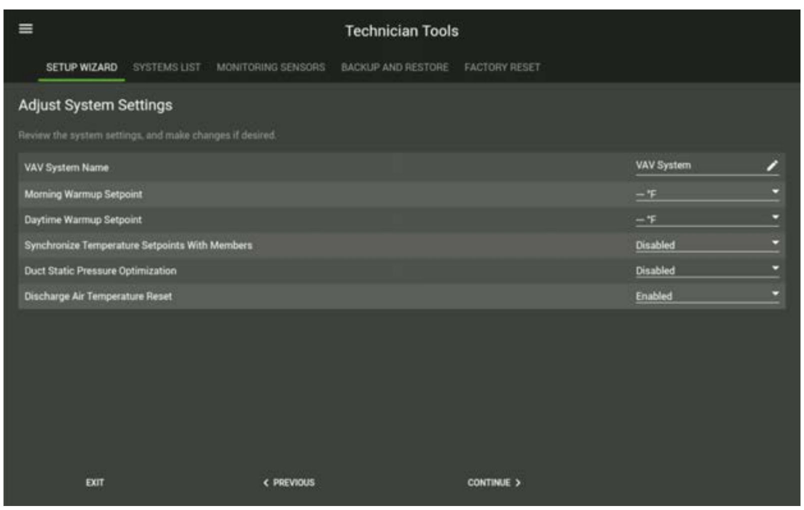


The Setup Wizard automatically defines the proper system type based on the members selected and added by the user. When the user defines only a multiple-zone VAV RTU and no bypass damper, the system type is defined as **VAV System**.

Select VAV Settings

Because the RTU for this system type is variable volume, the user may optionally select VAV settings with the Setup Wizard.

Figure 49. Adjust system settings



VAV System Name

The Setup Wizard automatically assigns a default name for each system. The user may edit the default name at any time.

Synchronize Temperature Setpoints with Members

When the user enables setpoint synchronization, temperature setpoints are sent by Area Control in the system controller to each VAV member. These setpoints include the space temperature setpoint, standby offset, occupied offset, and unoccupied cooling and heating setpoints.

With synchronization enabled, all setpoints for all VAV members can be controlled from a single location on the display. However, individual setpoints adjustment for the zones is not possible when synchronization is enabled. If occupants desire individualized setpoint control in their respective spaces, synchronization must remain disabled.

Duct Static Pressure Optimization

VAS can be configured to automatically adjust the duct static pressure setpoint of a VAV system based on the position of the most open VAV box. When enabled, duct static pressure optimization reduces the energy consumption associated with the system fan.

Discharge Air Temperature Reset

When enabled, discharge air temperature reset automatically adjusts the calculated discharge air setpoint of the RTU/AHU based on either the ambient temperature or satisfaction of the spaces (user adjustable). When enabled, discharge air temperature reset reduces the energy consumption of the RTU/AHU by providing slightly more neutral air under certain conditions.

Multiple-Zone VAV Rooftop with VAV Hot Water Heat

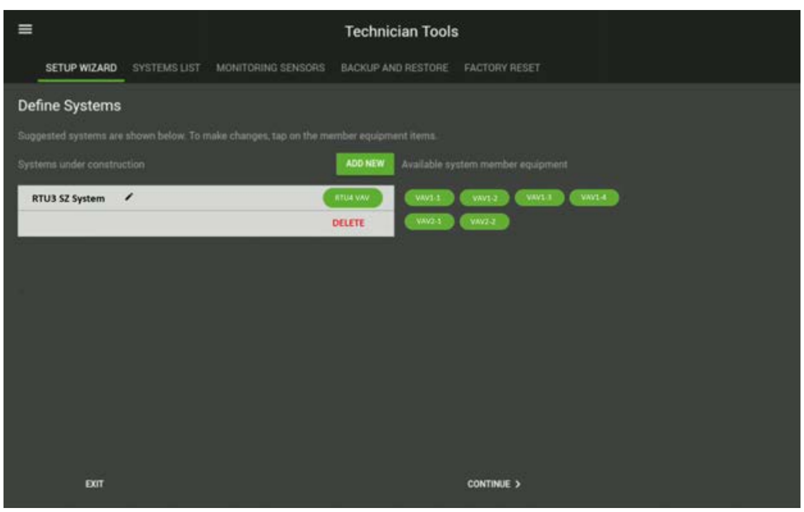
Multiple-Zone variable air volume (VAV) RTU systems include a multiple-zone, variable air volume RTU (MZVAV). With this system type, VAV boxes are associated with the RTU to form a 'system' in Tracer Concierge. The RTU normally provides a variable amount of cool conditioned air to the VAV boxes. When space heating is required, the VAV box for that space utilizes local hot water heat to provide the necessary heating. The exception is the morning/daytime warm-up mode, in which case the RTU temporarily provides warm air down the duct.

Other RTUs and their associated VAV boxes must be defined as separate systems.

System Members

With discovery complete, all of the required components should be available for installation into the Tracer Concierge system. By default, the Setup Wizard automatically recognizes the variable volume RTU and places it in the system container. The associated VAV boxes must be manually added to the system container by the user, or optionally added to another system container when more than one system exists for the building. To add each component to the system, click on the component and select **Assign to… System**. Repeat the process until all components are added to the system(s).

Figure 50. Define Systems

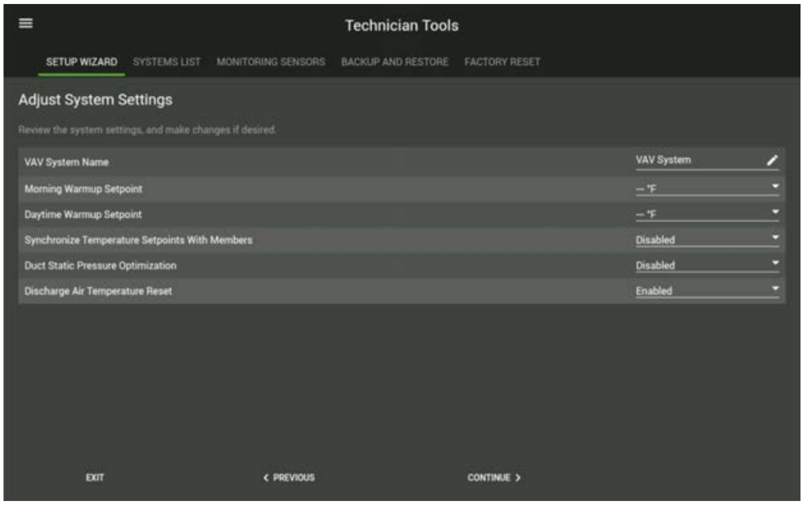


The System Wizard automatically defines the proper system type based on the members selected and added by the user. When the user defines only a multiple-zone VAV RTU and no bypass damper, the system type is defined as **VAV System**.

Select VAV Settings

Because the RTU for this system type is variable volume, the user may optionally select VAV settings with the System Wizard.

Figure 51. Adjust system settings



VAV System Name

The System Wizard automatically assigns a default name for each system. The user may edit the default name at any time.

Synchronize Temperature Setpoints with Members

When the user enables setpoint synchronization, temperature setpoints are sent by Area Control in the system controller to each VAV member. These setpoints include the space temperature setpoint, standby offset, occupied offset, and unoccupied cooling and heating setpoints.

With synchronization enabled, all setpoints for all VAV members can be controlled from a single location on the display. However, individual setpoints adjustment for the zones is not possible when synchronization is enabled. If occupants desire individualized setpoint control in their respective spaces, synchronization must remain disabled.

Duct Static Pressure Optimization

VAS can be configured to automatically adjust the duct static pressure setpoint of a VAV system based on the position of the most open VAV box. When enabled, duct static pressure optimization reduces the energy consumption associated with the system fan.

Discharge Air Temperature Reset

When enabled, discharge air temperature reset automatically adjusts the calculated discharge air setpoint of the RTU/AHU based on either the ambient temperature or satisfaction of the spaces (user adjustable). When enabled, discharge air temperature reset reduces the energy consumption of the RTU/AHU by providing slightly more neutral air under certain conditions.

Advanced Settings in Tracer Concierge

Custom Programming for Hot Water

The VAV boxes in this system include local hot water heating capability. The control of the hot water aspects of the system must be controlled and coordinated outside of the system control application. As such, custom programming may be required in the Tracer Concierge panel. Contact your Trane sales representative for additional support regarding custom programming for this application.

Advanced Setup and Adjustments

While normal interaction with the Tracer Concierge system is accomplished through the Tracer 10-inch display and/or mobile application, there may be instances where access to advanced setup parameters is necessary. In those cases, two alternatives are offered to accomplish those setup tasks, namely the web browser user interface and the Tracer TU software setup tool.

Connection to the Concierge System Controller

Physical connection to the Tracer Concierge system controller can be accomplished three ways:

- USB cable between the PC and controller
- Ethernet cable between the PC and controller
- Network connection to the controller

The system controller is equipped with multiple USB receptacles, including one USB type-b connector designated for easy access for PC connection. Connect the USB cable between the PC and USB type-b connector on the face of the controller to allow access for advanced setup and adjustments.

Important: *Never attempt to connect any external device to any of the USB connections other than the USB type-b connector on the face of the Concierge system controller. The other USB ports are only designed to support specific option modules, such as the LonTalk module.*

Alternately, connection to the controller can be accomplished with either direct Ethernet connection or network (LAN) connection. Depending on the connection method used, the target IP address needed for connection will vary.

Figure 52. Tracer SC+ system controller

Web User Interface

Accessing the Web User Interface

A browser-based web interface is provided to allow user advanced access to view and manage alarms, data logs, and schedules. The web interface also offers users the ability to change advanced settings of their system. While this is not normally necessary, there may be specific instances where special consideration must be given to the site/application.

There are three methods for connecting to the web interface:

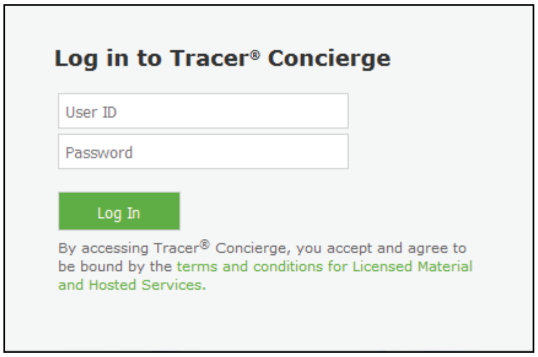
- **USB Cable**- Connect a USB cable between the PC and the system controller. Use a web browser to navigate to **198.80.18.1/hui/index.html**.
- **Ethernet Cable**- Connect an Ethernet cable between the PC and to the system controller. The default IP addresses on the two LAN ports are:
  – **LAN 1** – 192.168.1.10
  – **LAN 2** – 192.168.2.10
- **Network Connection**- Enter the IP address of the system controller.

  Note: *The IP address for networked controllers will vary from site to site. Contact the local IT personnel for IP address information as needed.*

Navigating the Web User Interface

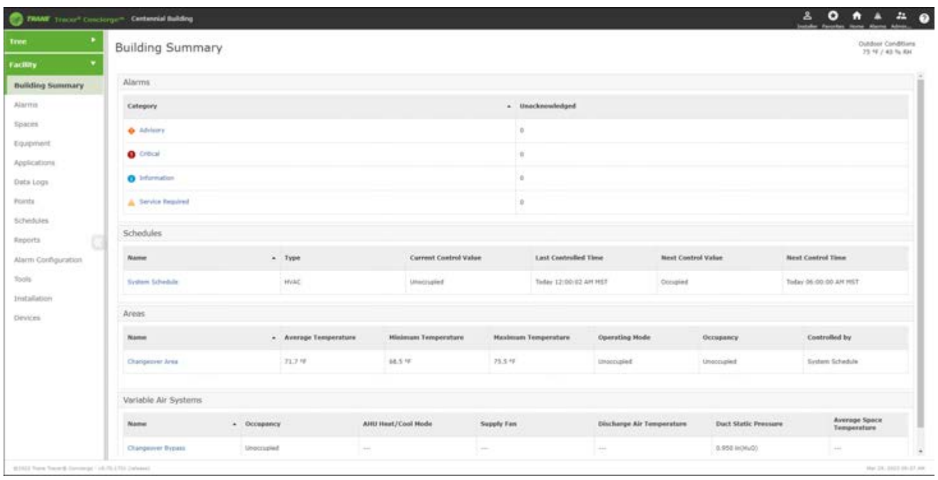
1. Once connected with the controller, enter a User ID and Password and click **Log In**.

Figure 53. Log In screen



2. The Building Summary and navigation tree display. The navigation tree on the left-hand side of the screen can be used for easy access to the various menus within the system.

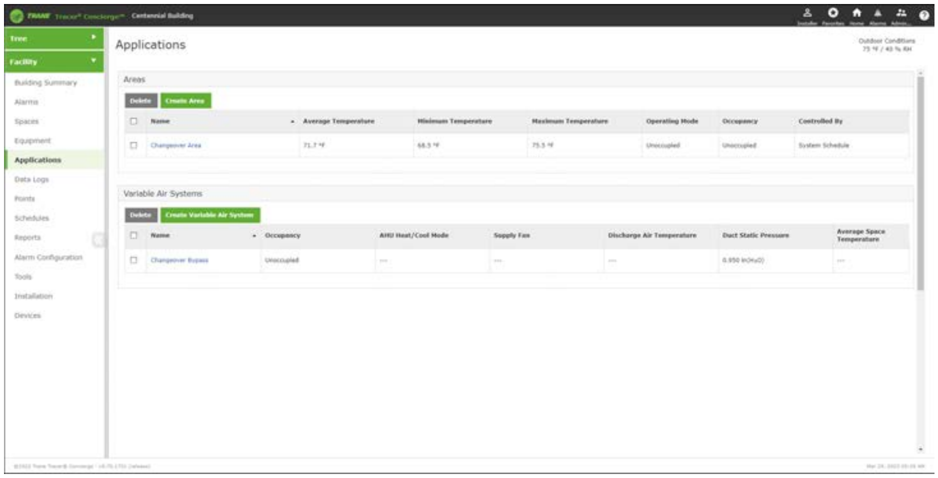
Figure 54. Building Summary page



Advanced Setup for Variable Air Systems (VAS)

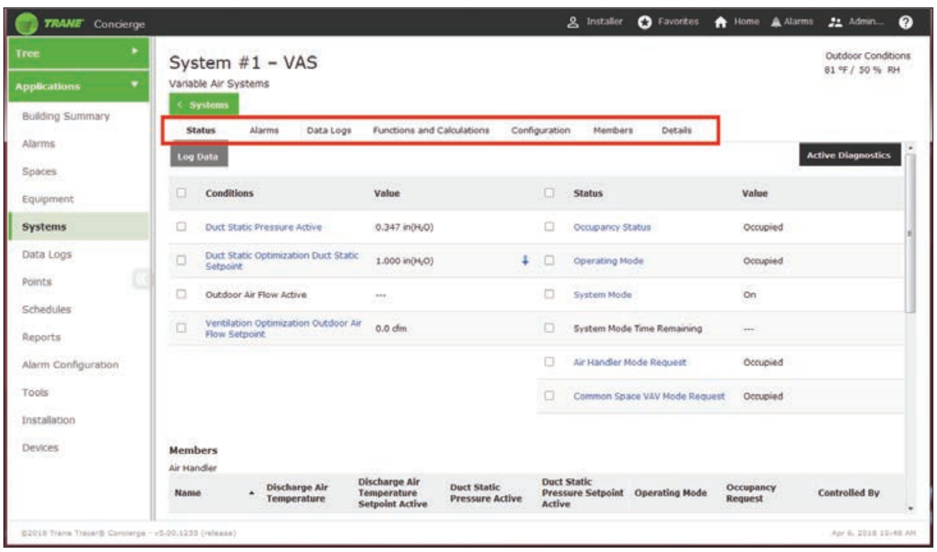
1. To access VAS application setup parameters, select **Systems** from the navigation tree.
2. From the Systems page, select the VAS to be viewed or edited. In this example, select **Systems #1 – VAS**.

Figure 55. Applications page



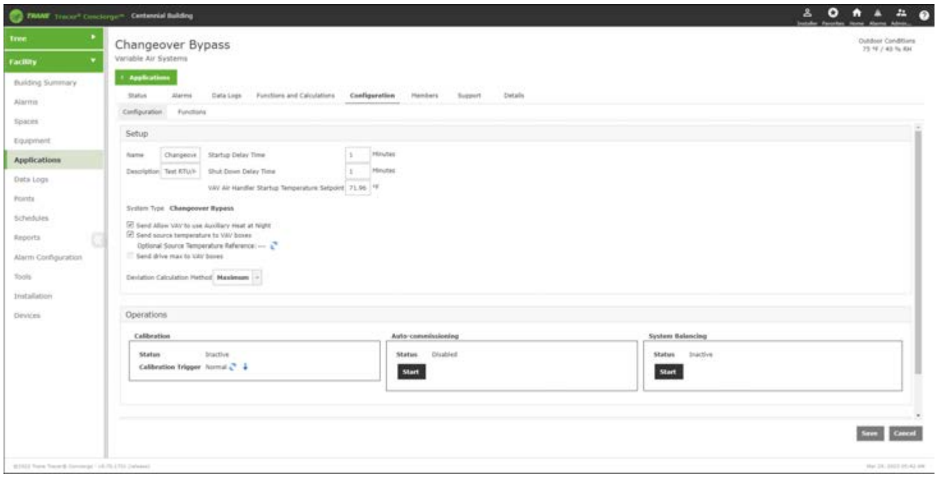
3. Select the **Configuration** menu to access additional setup parameters.

Figure 56. Variable Air System (VAS) page



4. Set the **Deviation Calculation Method**.

Figure 57. Configuration Menu



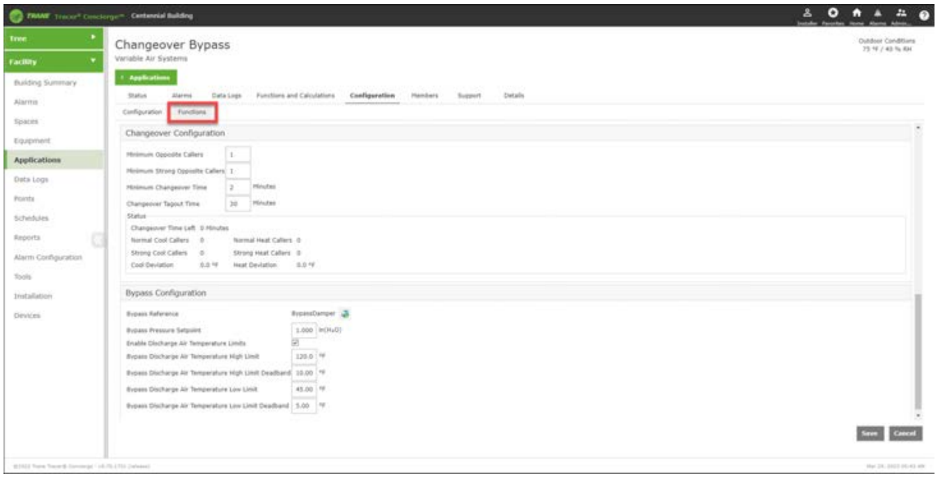
The Deviation Calculation Method defines the algorithm by which rooftop capacity is requested for changeover systems. For those systems, RTU capacity is based on the deviation from setpoint for each of the associated VAV members of the VAS. The deviation is defined as the difference between the space temperature and active space temperature setpoint, calculated independently for each member VAV. For the sake of determining RTU capacity, only the VAV members in the same heat/cool mode as the RTU are considered as part the algorithm.

- When **Maximum** deviation is selected, VAS uses the largest deviation of all VAV members in the same heat/cool mode as the RTU to determine RTU capacity. The resulting behavior is a system that is very responsive to the zones furthest from setpoint. The RTU may tend to cycle between heating and cooling more and run at maximum capacity more than a system configured for average deviation. Maximum deviation is the preferred setting for systems with one or more diverse zone loads, such as conference rooms, cafeterias and zones affected more significantly by solar load.
- For **Average** deviation, VAS considers the average deviation of all VAV members in the same heat/cool mode as the RTU. The RTU in these systems tends to cycle less, both mode and stages, compared to a RTU in a system configured for maximum deviation. However, systems configured for average deviation are slower to respond to zones far from setpoint because RTU capacity is based on the collective average deviation.

In either case, whether maximum or average deviation, the deviation calculation method affects only the capacity of the RTU once the mode has been determined (by voting). The voting logic and system mode determination is the same for both deviation types.

5. Select **Functions**.

Figure 58. Functions menu



6. Scroll down to the **Configuration Changeover** section.

   In this example, the minimum number of opposite callers is increased to reduce the frequency of rooftop unit (RTU) mode changes from heat to cool and cool to heat.

   For changeover systems, the mode of the RTU is determined based on the total number of heat and cool callers (voters). When the space temperature of a VAV box is more than 1° F above the cooling setpoint, that box is deemed a normal cooling caller. At 2° F above setpoint, the box becomes a strong caller. When the space temperature is more than 1° F below the heating setpoint, the box is a normal heating caller. At more than 2° F below the heating setpoint, the box is considered a strong heating caller.

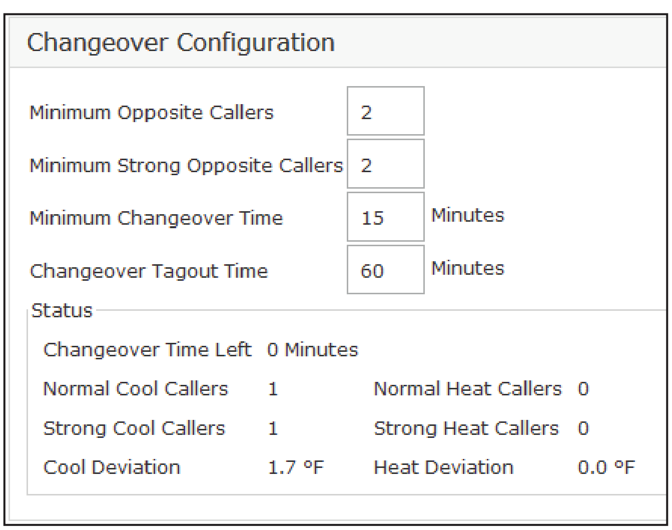
   To determine the heat/cool mode of the RTU, the heating and cooling callers are tallied. When enough opposite callers exist, the mode changes – assuming the callers of the current mode are satisfied and no longer calling/voting. By default, the number of opposite callers required for a mode change is 2. Increasing this number will reduce the frequency at which the requested RTU mode changes.

7. After editing the value, click **Save**.

Depending on the system/application, you may need to edit advanced configuration parameters. . Those most common of those parameters are contained in the Changeover Configuration and Bypass Configuration sections. These settings are described in the following sections.

Changeover Configuration Settings

Figure 59. Changeover Configuration



Important: *Always enable the Discharge Air Temperature Limits for Changeover systems.*

Table 8. Changeover Configuration fields

Field	Description
Minimum Opposite Callers	The minimum number of normal callers required for changeover. The default for Tracer Concierge systems is 1; valid range is 1 to 100. The system controller requires a minimum number of opposite calls to change over to either heat or cool mode. ***Note:*** *For mode change to be allowed, the minimum opposite caller requirement be met and all callers of the current mode must be satisfied (no call).*
Minimum Strong Opposite Callers	The minimum number of strong callers required for changeover. The default for Tracer Concierge systems is 1; valid range is 1 to 100. The system controller requires a minimum number of strong opposite calls to change over to either heat or cool mode. ***Note:*** *Even if the current mode callers have not been satisfied, the system will switch modes when enough opposite strong callers are totaled.*
Minimum Changeover Time	The minimum time the RTU must remain in either the heating or cooling mode (in minutes) before changeover to the opposite mode is allowed. The default value is 15 minutes; valid range is 1 to 100 minutes.
Changeover Tagout Time	When a VAV box is configured with tagging enabled, the VAV box will be ‘tagged’ whenever the space temperature is more than 3° F away from the active setpoint for at least the duration of the Changeover Tagout Time, 60 minutes (adjustable). When the VAV box has been tagged, that box is no longer considered as a caller for heat/cool mode RTU purposes. When tagging is disabled, the VAV box will always be considered in the voting logic, regardless of the space temperature.

Bypass Configuration

Figure 60. Bypass Configuration

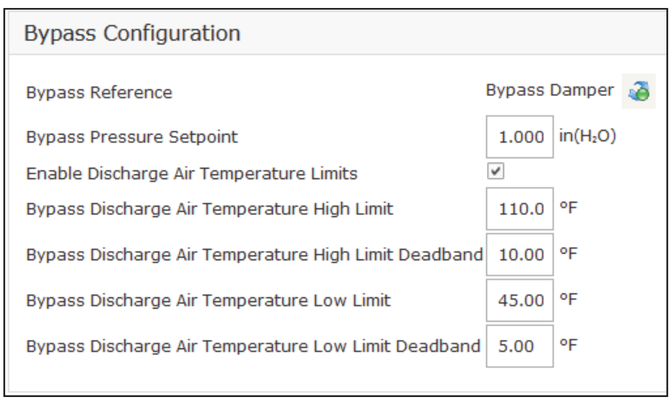


Table 9. Bypass Configuration fields

Field	Description
Bypass Reference	References the Tracer UC210 controller that manages the bypass damper. For systems that include a bypass damper, confirm that the reference is pointed to that controller for proper system operation. Select the reference icon next to the point to change the reference. For Tracer Concierge systems, this reference should normally be properly set by the installation wizard.
Bypass Pressure Setpoint	The setpoint that VAS will send to the associated bypass damper for the duct static pressure setpoint in the bypass duct. The default value is 1.000 in(H_2O).

Table 9. Bypass Configuration fields (continued)

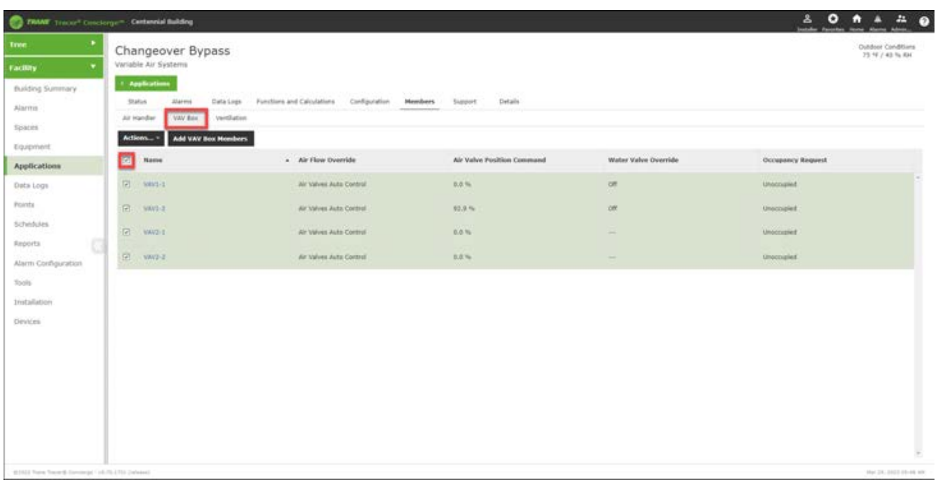
Field	Description
Enable Discharge Air Temperature Limits	Enabled by default, but as of V4.2 users are allowed to opt out of this feature. Doing so will disable the following four fields. If this feature is enabled and the discharge air temperature of the unit breaches the Discharge Air Temperature limits, VAS will put the air handler in “Fan Only” mode. Normal operation will resume when the discharge air temperature + - the deadband is within the limits. If the discharge air temperature is in fault, VAS will not use the value against the limits. ***Note:*** *If the air handler does not have a discharge air temperature sensor, use the Optional Source Temperature reference of VAS to reference the point that represents the discharge air temperature. The Discharge Air Temperature limit feature will use the value of the referenced point when determining a limit breach.*
Bypass Discharge Air Temperature High Limit	Configures the maximum temperature that the discharge air should reach. The default value is 110.0° F.
Bypass Discharge Air Temperature High Limit Deadband	Configures the maximum temperature deadband for the discharge air. The default value is 10.0° F. When the discharge air temperature falls below the high limit value minus the deadband, normal unit heating/cooling operation is possible.
Bypass Discharge Air Temperature Low Limit	Configures the minimum temperature that the discharge air should reach. The default value is 45.0° F.
Bypass Discharge Air Temperature Low Limit Deadband	Configures the minimum temperature deadband for the discharge air. The default value is 5.0° F. When the discharge air temperature rises above the low limit value plus the deadband, normal unit heating/cooling operation is possible.

Edit VAV Box Configuration

Depending on the specific Concierge system type, it may be necessary to edit one or more of the advanced configuration parameters of the VAV boxes.

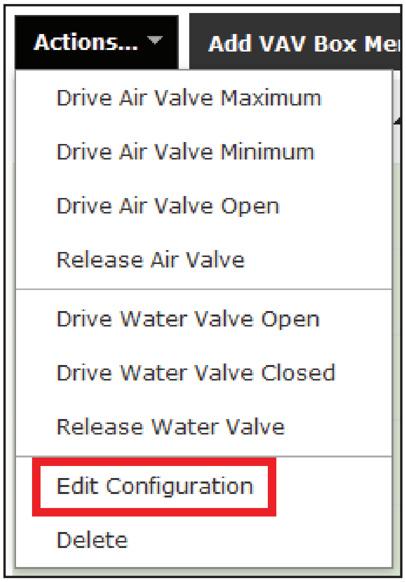
1. To access the advanced settings for the VAV boxes, select the **Members** tab on the VAS page.
2. Select **VAV Box** and select all VAV members.

Figure 61. Select all VAV members



3. Click **Actions...** and select **Edit Configuration**.

Figure 62. Actions drop-down menu



4. The Edit Configuration screen allows the user to view/edit the advanced settings for one or more VAV boxes.

Figure 63. Edit VAV box advanced settings

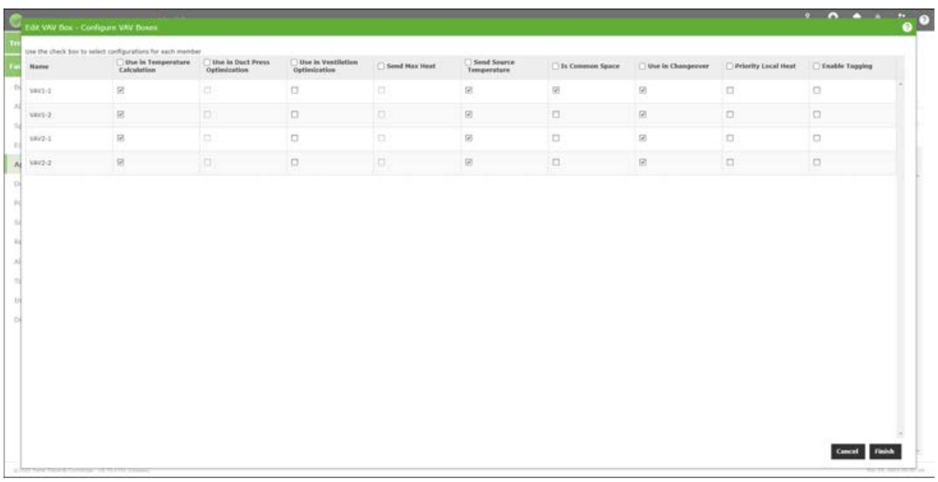


Table 10. VAV box advanced settings fields

Field	Description
Include in Temperature Calculation	Select this option to include this member in the following VAS calculations: Space Temperature Average, Space Temperature Minimum, and Space Temperature Maximum. For most Tracer Concierge systems, this option would normally be selected.
Include in Duct Pressure Optimization	The duct pressure optimization feature of VAS will automatically increase or decrease the duct pressure setpoint of the system based on the position of each VAV box damper. This feature will normally be disabled for most simple Tracer Concierge systems but may be enabled for VAV systems.
Include in Ventilation Optimization	The ventilation optimization feature of VAS varies the commanded outdoor damper position of the RTU based on the ventilation requirements of the associated spaces. This feature will normally be disabled for Tracer Concierge systems.

Table 10. VAV box advanced settings fields (continued)

Field	Description
Send Drive Max	The configuration for the Send Drive Max parameter is normally set by default based on the system type. In some cases it is necessary to drive the VAV boxes to their maximum flow position when staged cooling or heating capacity is used in the RTU. In other applications the VAV boxes are allowed to control fully regardless of the RTU configuration. ***Best Practice*** *For changeover systems, confirm that the Send Drive Max parameter for each VAV box is unchecked. For the VAV systems with VAV electric heat or hot water heat, the Send Drive Max parameter should be checked, unless modulating gas heat is used in the rooftop, in which case the Send Drive Max parameter should be unchecked for all VAV boxes.*
Send Source Temperature	Select VAV members that will receive and use the discharge air temperature of the RTU member as their source temperature. This feature is normally enabled for all Tracer Concierge systems.
Is Common Space	Select this option to define this member as a common space. VAV air handlers will produce approximately 20% airflow to the system at their minimum flow settings. To account for this, the VAS uses common space VAVs to prevent over-pressurization of the ductwork when the central fan is delivering minimum airflow to the system. By providing a path for excess air, the common space VAVs allow the air handler to run when it is asked to provide more airflow than the VAV boxes in an Area can deliver. Common spaces do not need to be scheduled because the VAS controls the common space VAV boxes to match the highest ranking operating mode of the non-common space VAV boxes. Where each tenant is defined by an Area and common spaces are shared, the common spaces are managed by the VAS and do not have to be members of either Area. By default, half of the VAV boxes are automatically defined as common in Tracer Concierge systems. To reduce the number of boxes defined as common, simply uncheck specific boxes and select **Finish**. ***Best Practice*** *For Tracer Concierge systems with multiple Areas defined for a VAS, consider reducing the number of common space boxes to approximately 20% of the total (default 50%).*
Include in Changeover	Select this option to automatically change between heating and cooling modes when the space goes above or below the configured setpoints. With this option selected for a given VAV box, that box will be considered in the voting and deviation calculations used to determine the operation of the RTU. If a VAV box is not checked it will not be included in the deviation calculations nor will it vote for heat or cool. When the selection is not checked, the VAV box's Changeover Mode will read "Do Not Include." This feature is normally selected for Changeover Hybrid and Changeover VAV system types. Only when a specific box is deemed to be consistently too hot or too cold would this box potentially be unchecked, at which point additional design consideration for that box may be necessary. ***Best Practice*** *For Changeover Hybrid and Changeover VAV systems, confirm that all VAV boxes are configured as 'Include in Changeover' unless a specific box is known to be a space temperature outlier and has been intentionally excluded from voting.*
Priority Local Heat	Select this option to give priority to the local hot water or electric heat of the VAV box when present. When the member box has local heating capability, that member needs to vote differently in the heating/cooling algorithm to allow the local heat the flexibility of being applied before requesting system (RTU) heat. A heating vote is only cast when the local heat is not able to meet the heating demand for that zone. By default, this selection is unchecked for all VAV boxes. This feature should be enabled for any VAV box with local heating capability. ***Best Practice*** *When the VAV box has local hot water or electric heat capability, configure the box for Priority Local Heat from the advanced setup screen in VAS (web user interface).*
Enable Tagging	When a VAV box is configured with tagging enabled, the VAV box will be 'tagged' whenever the space temperature is more than 3° F away from the active setpoint for at least the duration of the Changeover Tagout Time, 60 minutes (adjustable). When the VAV box has been tagged, that box is no longer considered as a caller for heat/cool mode RTU purposes. When tagging is disabled, the VAV box will always be considered in the voting logic, regardless of the space temperature. The recommended setting for all members is for tagging to be disabled (unchecked). ***Best Practice*** *Disable tagging in all VAV boxes in the Tracer Concierge system. With this feature disabled, all boxes will be able to vote normally for heat/cool mode control of the RTU.*

Tracer TU

In some cases, the Tracer™ TU service tool may be required for advanced setup changes to one or more controllers of the Tracer Concierge system. (Non-Trane personnel, contact your local Trane office for software purchase information.)

This portable PC-based service-tool software supports service and maintenance tasks, and is necessary for software upgrades, configuration changes, and advanced service tasks.

Connecting to the Concierge Controller

Physical connection between Tracer TU and the Tracer Concierge system controller can be accomplished three ways:

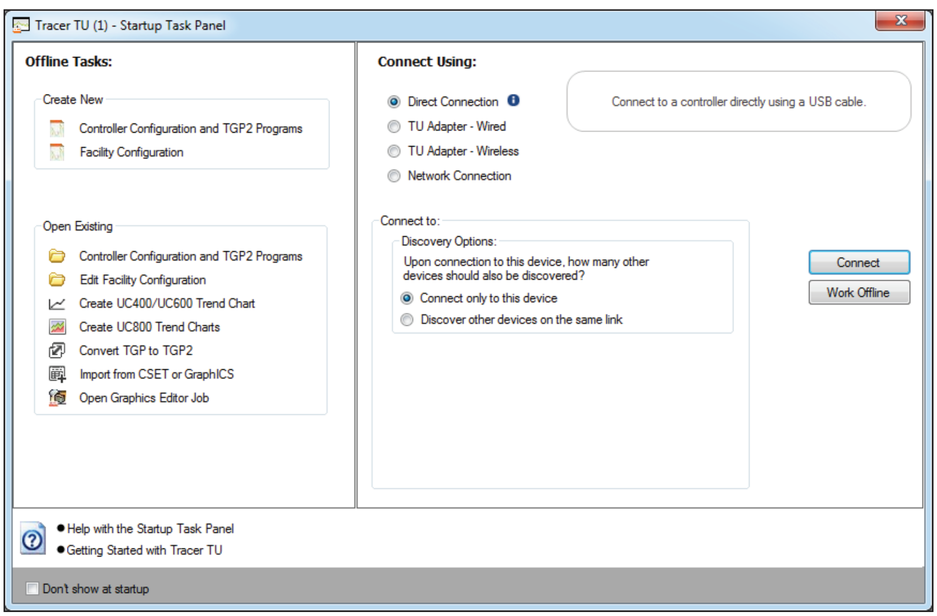
- USB cable between the PC and controller
- Ethernet cable between the PC and controller
- Network connection to the controller

Once connection to the system controller is established, connection to all other devices in the Tracer Concierge system is possible through the primary controller.

Accessing Tracer TU

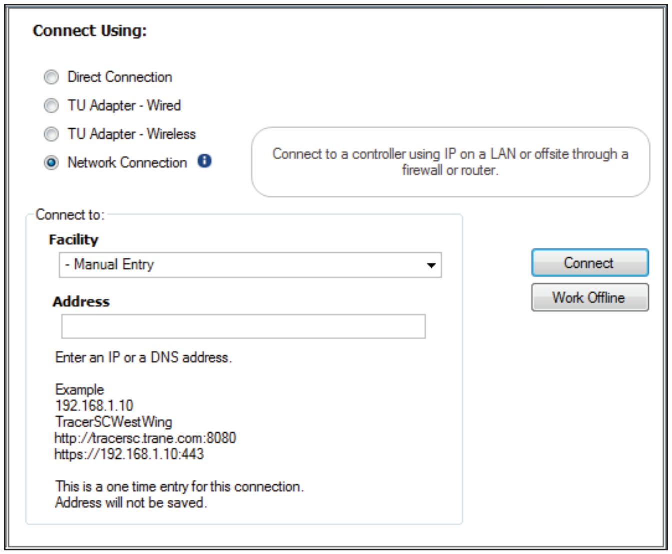
1. Start Tracer TU and select the appropriate connection method. For most Tracer Concierge systems, select either direct connection or network connection:
   - **Direct Connection**- With the USB cable connected between the PC and the USB port on the Concierge System Controller, select **Direct Connection**. Click **Connect**.

     Figure 64. Tracer TU Direct Connection

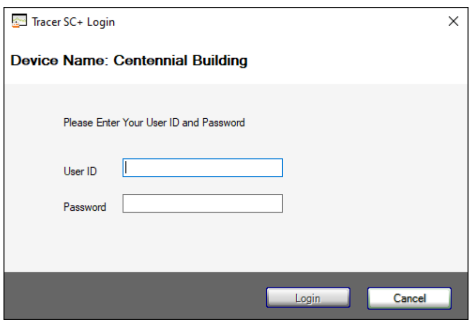
   - **Network Connection**- From the **Facility** drop-down menu, select **Manual Entry**. Enter the IP **Address** of the controller and click **Connect**. The controller can also be permanently added to the facility drop-down menu by selecting **Add New Facility Connection** and providing the necessary controller information, then **Save**.

Figure 65. Tracer TU Network Connection



2. Enter a **User ID** and **Password** and click **Login**.

Figure 66. Login screen

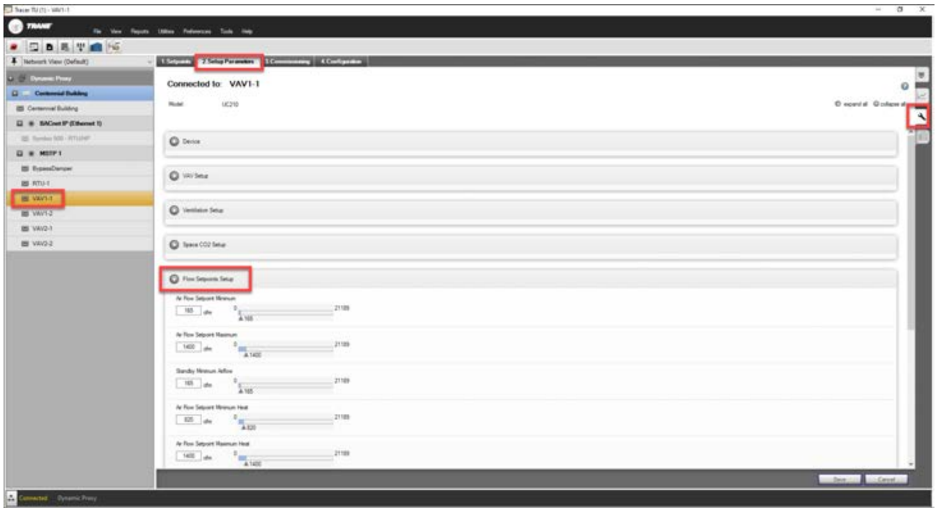


Editing Advanced Settings with Tracer TU

A wide variety of advanced settings can be viewed and edited using Tracer TU. One of the most common tasks is to verify/edit the airflow settings of one or more VAV boxes.

1. Navigate to the Tracer TU main menu.
2. From the navigation tree on the left-hand side of the screen, double click on a VAV box.

Figure 67. Tracer TU Advanced Settings



3. Click on the wrench on the right side of the screen to access the configuration menus.
4. Select the **Setup Parameters** menu.
5. Expand the **Flow Setpoints Setup** section.
6. View/edit the air flow settings for the VAV box.
7. Click **Save** when all edits are complete.

![TRANE logo]

Appendix A: Changeover Bypass

System Description

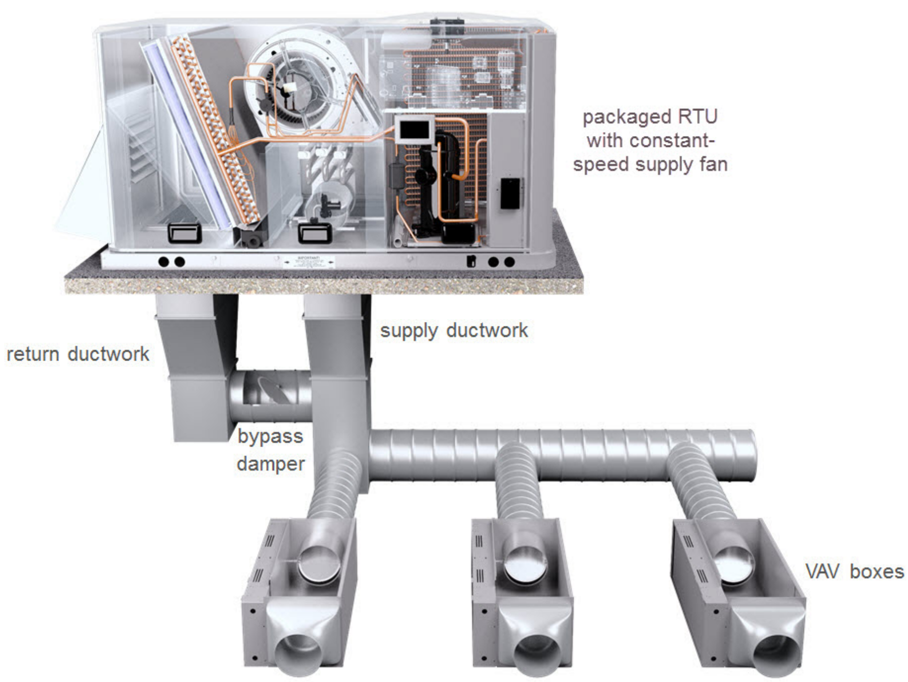
The Changeover Bypass system comprises one RTU with constant speed fan and two or more VAV boxes. System heating is normally provided with staged gas heat in the RTU. Mechanical cooling is provided with fixed stage DX cooling in the RTU.

A bypass damper is used to manage system airflow as the VAV box air dampers are modulated (see “,”). Because the RTU supply fan is constant speed, the bypass damper is used to allow excess airflow to bypass the duct system when the demand for conditioned air in the spaces is low.

The RTU provides either cooled or heated air to the distribution (duct) system. VAV boxes are modulated to provide more or less conditioned air to the space based on the space demand and temperature of the air being supplied by the RTU. The VAV heat/cool mode is based on the comparison between the measured space temperature and heating/cooling setpoints of that zone. When the VAV heat/cool mode matches the system heat/cool mode, the VAV box air damper is modulated to maintain space temperature at setpoint. When the VAV heat/cool mode does not match the system heat/cool mode, the VAV box is controlled to the minimum flow setpoint for the current VAV box heating/cooling mode.

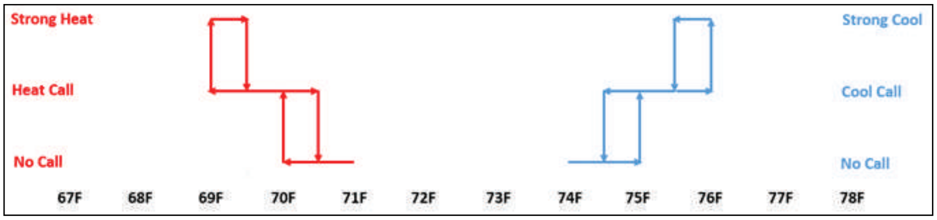
When the measured space temperature for the VAV box is greater than the occupied cooling setpoint, the VAV heat/cool mode status will be COOL. The mode remains in COOL until the space temperature drops below the occupied heating setpoint. When the space temperature of the VAV box is less than the occupied heating setpoint, the VAV heat/cool mode status will be HEAT. The mode remains in HEAT until the space temperature rises above the occupied cooling setpoint.

Figure 68. Changeover bypass system



Each VAV box “votes” toward the overall system heat/cool mode based on the differential between the current space temperature and active setpoint. When the space temperature exceeds the active setpoint by at least 1° F, the box becomes a normal caller – a vote for the desired heat/cool mode. When the differential is at least 2° F, the vote strength severity increases to a strong caller. Assuming occupied cooling setpoint of 74° F and occupied heating setpoint of 71° F, the following table summarizes the voting logic used in each VAV box.

Figure 69. Changeover bypass voting logic

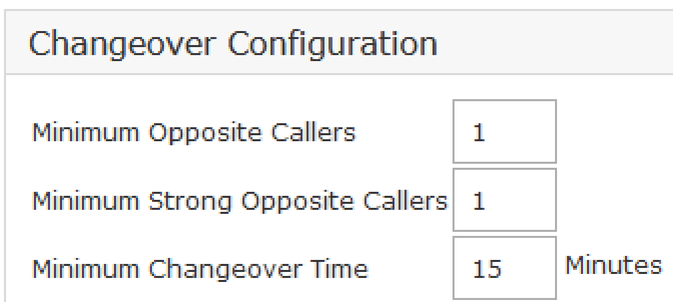


All of the heating and cooling callers are tallied to determine the overall heat/cool mode of the system. In the VAV Air System (VAS) setup of the system controller, the number of opposite and strong opposite callers can be edited. Additionally, the user may edit the minimum amount of time before changeover is permitted.

When the total number of opposite callers is one or more (editable), the system switches to the opposite mode, assuming the minimum changeover time has been satisfied.

Important: *To allow changeover, all boxes in the current heat/cool mode must be satisfied (identified as "No Call"). The system will* ***immediately*** *changeover when the minimum number of* ***strong*** *callers has been met, assuming the minimum changeover time is satisfied.*

Figure 70. Changeover bypass strong callers



Components

RTU Type	Constant Volume (CV)
RTU supply fan	Constant speed
RTU cooling	Staged DX
RTU heating	Staged gas or electric heat
Bypass damper	Required
VAV box type	VariTrane or Round in, round out (RIRO)
Duct static pressure control	Bypass damper (field installed)
Discharge air temperature control	Not applicable
VAV box reheat type	Electric or hot water heat (optional)

Advantages

- It adds additional zones of temperature control to a single RTU unit.
- It works with any Constant Volume RTU – new or existing.
- It can be more economical than installing a larger number of small RTUs.
- It is a system type that has been in use for many years and is understood by many industry professionals.

Limitations

- Although it provides additional zones of temperature control, there can still be comfort issues the zones being served have dissimilar loads, such as interior and exterior zones served by the same RTU.
- It has a higher energy cost than VAV system options.
- It can have higher sound levels due to the higher static pressure and the bypass damper.

Application Considerations

- This system works better with smaller RTU sizes. As the size of the RTU increases, the number of zones and the diversity of the zones will typically increase as well, which can lead to comfort issues.
- The overall zoning of the RTUs to the building layout is important. If both interior and exterior zones are on the same RTU, diversity and comfort issues are likely – especially in shoulder seasons where exterior zones need heat and interior zones still need cooling. Properly zoning the RTUs to serve spaces with similar load profiles will improve overall comfort.
- Adding electric heat to some of the VAV boxes can greatly increase overall comfort. For example, when both interior and exterior zones are served by the same RTU, adding some heat to the exterior zones will provide better overall comfort. The electric heat only needs to be sized for assisting during moderate weather. In very cold weather, the system can change over to heat and use gas heat in the RTU.

Changeover Bypass Installation

Unlike the CV and SZVAV systems, Changeover Bypass systems include components beyond just the RTU(s). For this system type, VAV boxes and a bypass damper are associated with the RTU to form a 'system' in the Tracer Concierge system controller. Other RTUs and their associated VAV boxes must be defined as separate systems.

System Members

With discovery complete, all of the required components should be available for installation into the Tracer Concierge system. By default, the Setup Wizard automatically recognizes the bypass damper and places it in the system container. The remaining components must be manually added to the system container by the user, or optionally added to another system container when more than one system exists for the building. To add each component to the system, click on the component and select **Assign to… System**. Repeat the process until all components are added to the system(s).

Figure 71. System members

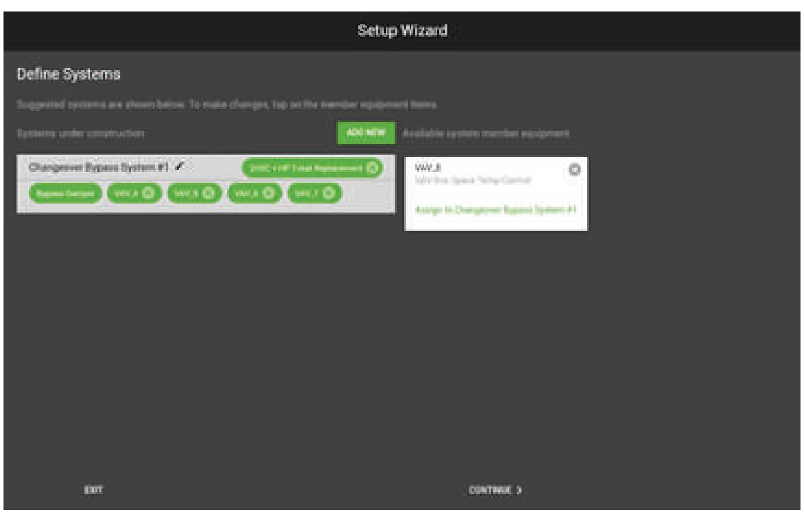
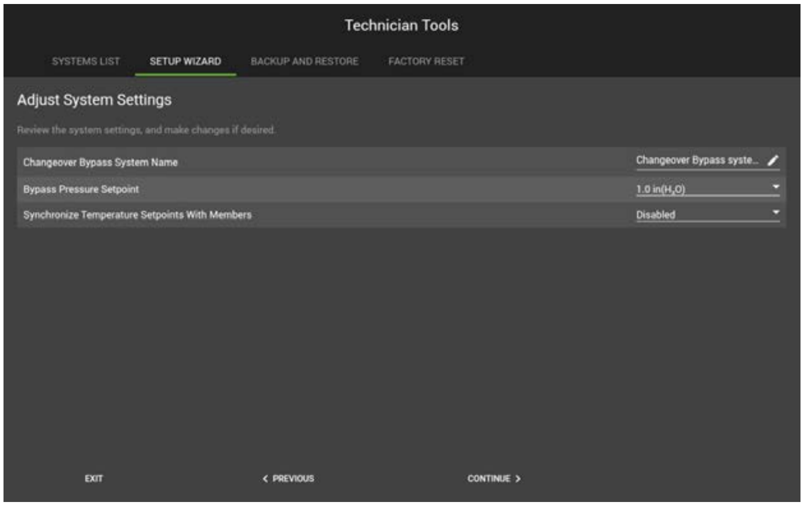


Figure 72. Adjust system settings



Changeover Bypass System Name

The Setup Wizard automatically assigns a default name for each system. The user may edit the default name at any time.

Bypass Pressure Setpoint

The duct static pressure of a changeover bypass system is maintained by the bypass damper. The user may edit the duct static pressure setpoint with the Tracer 10-inch display.

Synchronize Temperature Setpoints with Members

When the user enables setpoint synchronization, temperature setpoints are sent by Area Control in the system controller to each VAV member. These setpoints include the space temperature setpoint, standby offset, occupied offset, and unoccupied cooling and heating setpoints.

With synchronization enabled, all setpoints for all VAV members can be controlled from a single location on the display. However, individual setpoints adjustment for the zones is not possible when synchronization is enabled. If occupants desire individualized setpoint control in their respective spaces, synchronization must remain disabled.

Select VAV Settings

Because the RTU for this system type is constant volume, you do not need to select any VAV settings with the Setup Wizard.

Advanced Settings in Tracer Concierge

Tagging

Each VAV box in a Tracer Concierge system normally votes for either RTU heating or cooling based on the difference between the space temperature and active occupied setpoint of the VAV box. When tagging is enabled and the space temperature is more than 3° F above the cooling setpoint or more than 3° F below the heating setpoint, the box becomes a tagging candidate by default. When tagged, the box no longer votes for system heating or cooling. This feature is intended to automatically eliminate spaces that could be considered control outliers.

For changeover bypass systems, it is recommended that tagging be **disabled** for each VAV box. If a specific box is determined to be a consistent control outlier, that box can be manually removed from consideration as part of the heat/cool mode voting process. Refer to the section in this manual pertaining to advanced setup and adjustments for detailed instructions on editing the **Enable Tagging** parameter associated with each VAV box.

Common Spaces

During the installation process for Changeover Bypass systems, the Setup Wizard automatically defines a percentage of all VAV boxes as Common Spaces. This designation is used to define system functionality that ensures adequate airflow during occupant timed override sequences. Depending on the application, it may be necessary to change the designation of some of the VAV boxes by unchecking the common space feature for those boxes. Refer to the section in this manual pertaining to advanced setup and adjustments for detailed instructions on editing the **Is Common Space** parameter associated with each VAV box.

Priority Local Heat

For this system type, the VAV boxes may or may not include local heat. When VAV heat capability exists, additional (advanced) setup is required following the completion of the Setup Wizard. The setup changes are required to allow the local heat the ability to control the space temperature (in heating) prior to having the VAV box vote for RTU heating. Refer to the section in this manual pertaining to advanced setup and adjustments for detailed instructions on editing the **Priority Local Heat** parameter associated with each VAV box.

RTU Discharge Air Limits

Depending on the application, it may be necessary to edit the discharge air temperature high/low limits associated with the RTU. Refer to the section in this manual pertaining to advanced setup and adjustments for detailed instructions on editing the RTU limits.

Appendix B: Discharge-Air Temperature (DAT) Reset

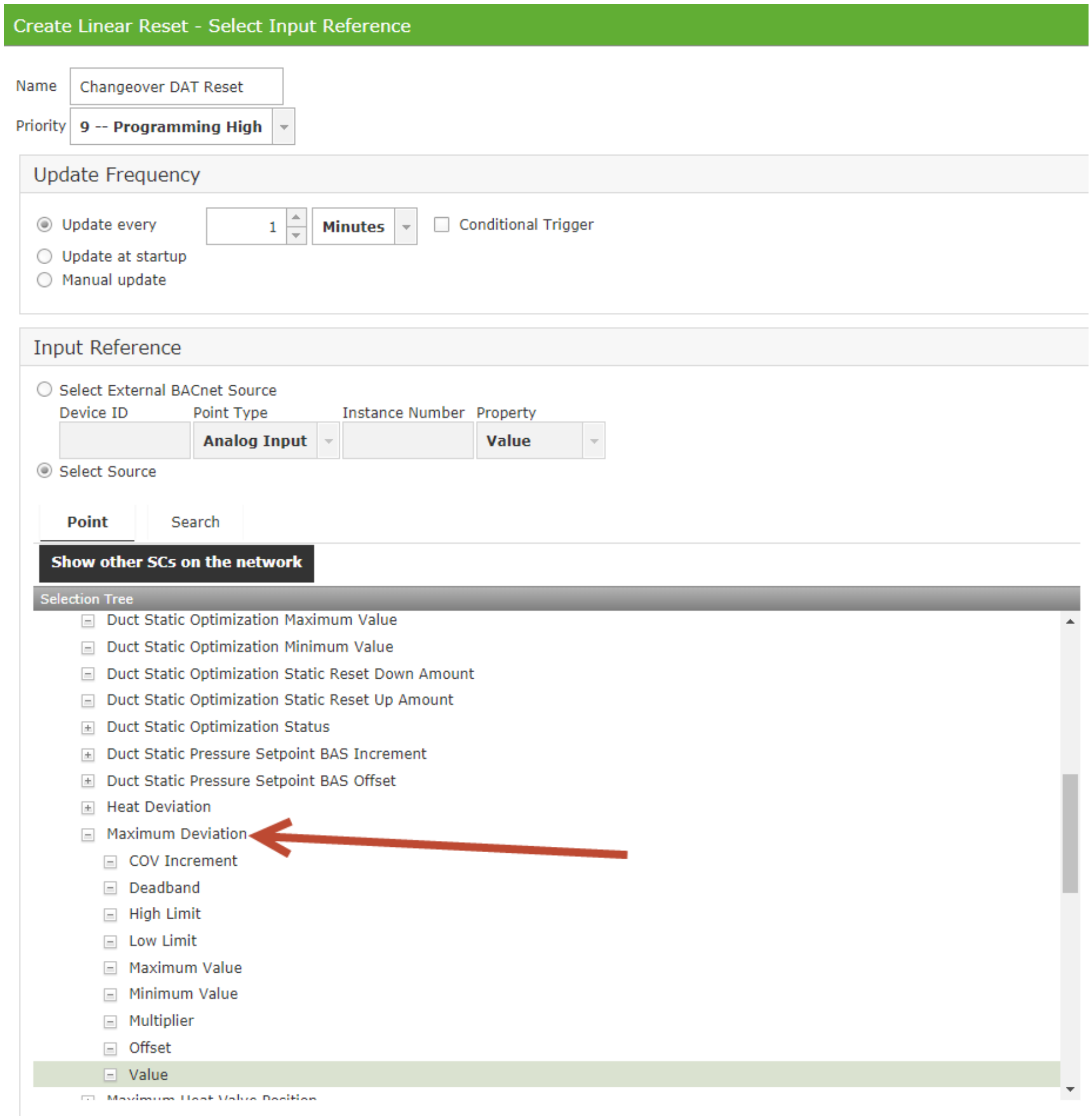
In a Changeover system, the rooftop unit delivers either cool air or warm air to all the VAV terminal units. Resetting the discharge-air temperature (DAT) can be used to reduce the number of times the rooftop unit switches between cooling and heating modes and improve overall comfort in the building. When the rooftop unit is operating in cooling mode, resetting the Cooling DAT setpoint upward will help minimize the amount of over-cooling in those zone that require heating. When the rooftop unit is operating in heating mode, resetting the Heating DAT setpoint downward will help minimize the amount of over-heating in those zone that require cooling.

While there are many different approaches to implementing DAT reset, the following program demonstrates one way implement it on a changeover system to reduce heat/cool mode changes, improve occupant comfort, and even reduce energy consumption.

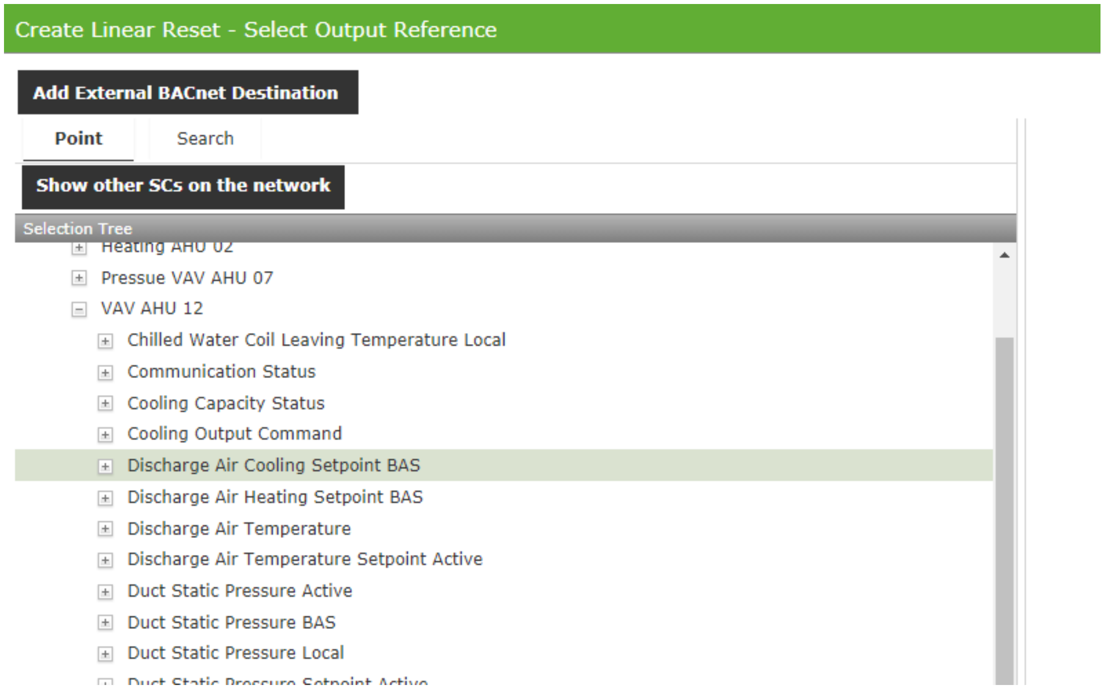
DAT Reset Setup in Tracer SC+ (requires Tracer SC+ v5.2)

To create a Linear Reset to control Cooling DAT setpoint:

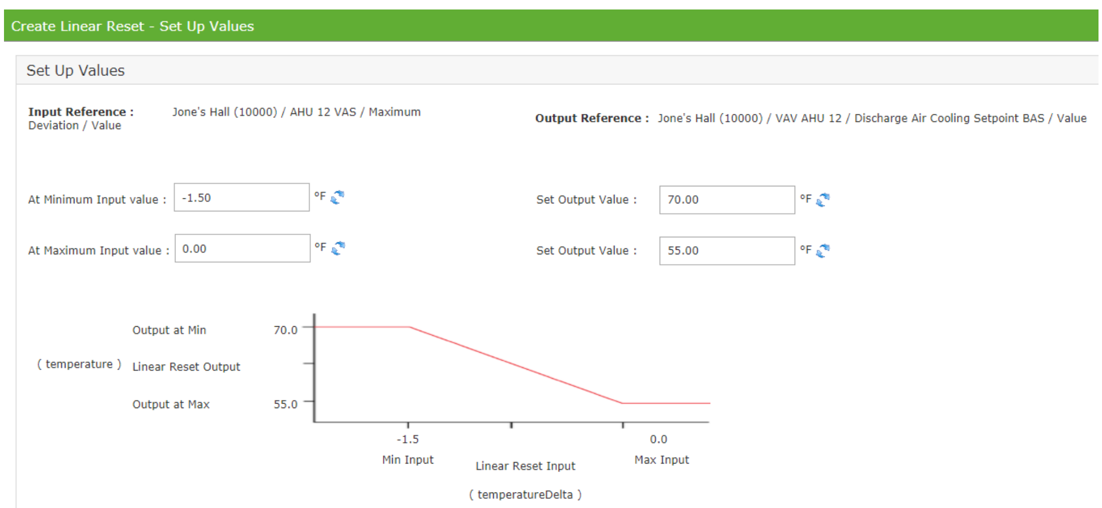
1. From the Applications page, select Create Linear Reset to open the creation wizard.
2. Provide a name for the linear reset, define Update Frequency, and select the Input Reference that will be used to reset the DAT.
3. For DAT reset in a changeover system, it is possible to use the Average or the Maximum Deviation value as the input for the reset. (In this example we will use the Maximum Deviation Value since that is the default selection for changeover systems.)



4. Select the output destination for linear reset. In this case, this linear reset will control the Discharge Air Cooling Setpoint BAS.



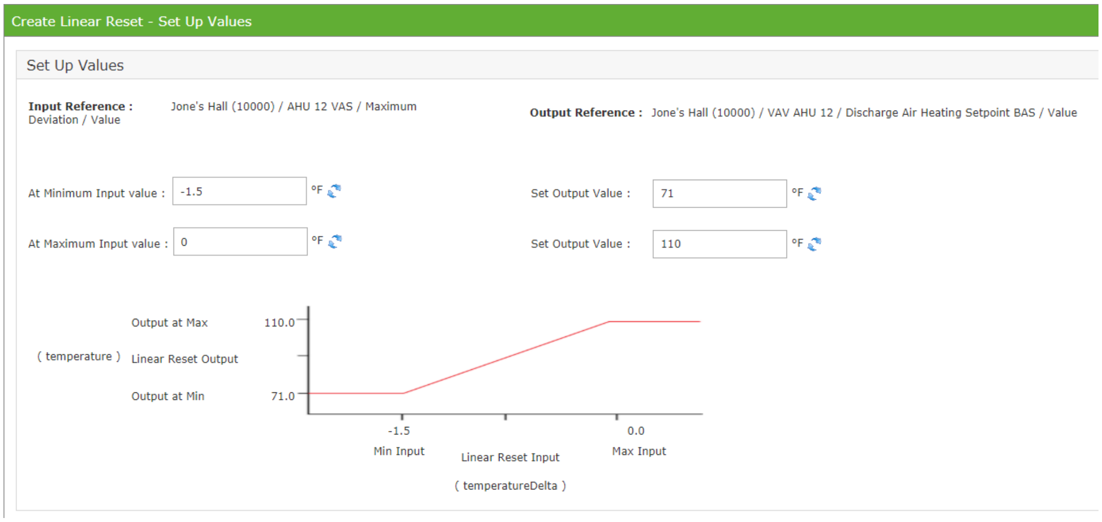
5. Lastly, define the parameters for the reset.



The Maximum Deviation is the current zone temperature minus its active setpoint. As depicted in the figure above, when the Maximum Deviation value is 0°F(adjustable) or larger, no reset takes place and the cooling DAT setpoint remains at the design value of 55°F (adjustable). When the Maximum Deviation value decreases below 0°F (the warmest zone has reached its cooling setpoint), the reset application will start to increase the cooling DAT setpoint, but no higher than 70°F (adjustable). By increasing the cooling DAT setpoint as zones become satisfied we prevent the system from over-cooling those zones that require little or no cooling. This also reduces how frequently the system must changeover between the heating and cooling modes.

To create a Linear Reset to Control Heating DAT Setpoint:

Follow steps 1 through 3 above. In step 4, select Discharge Air Heating Setpoint BAS as the output destination for linear reset. In step 5, define the following parameters:



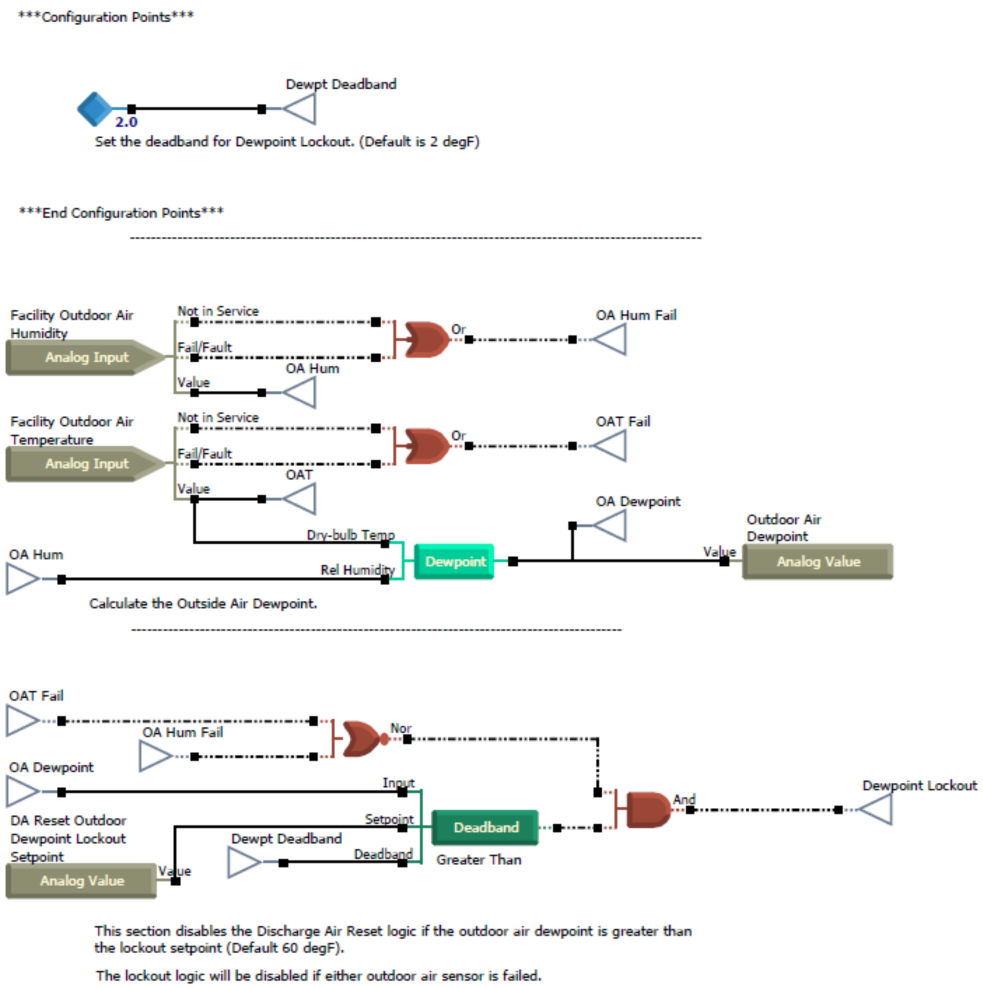
Humidity Override Programs

If higher zone humidity is a concern, consider disabling Cooling DAT reset whenever the outdoor dew point is too high and/or zone humidity is too high.

Lockout Cooling DAT reset based on outdoor dew point

The following add-on program calculates the current outdoor dew point based on the measured dry-bulb temperature and relative humidity. If the outdoor dew point is greater than 60°F (adjustable), the Dewpoint Lockout is turned on, which will cause the Cooling DAT setpoint to return to its minimum value (55°F, for example). When the outdoor dew point drops back to 2°F (adjustable) below this threshold, the Dewpoint Lockout is turned off and the program is again allowed to reset the Cooling DAT setpoint upward.

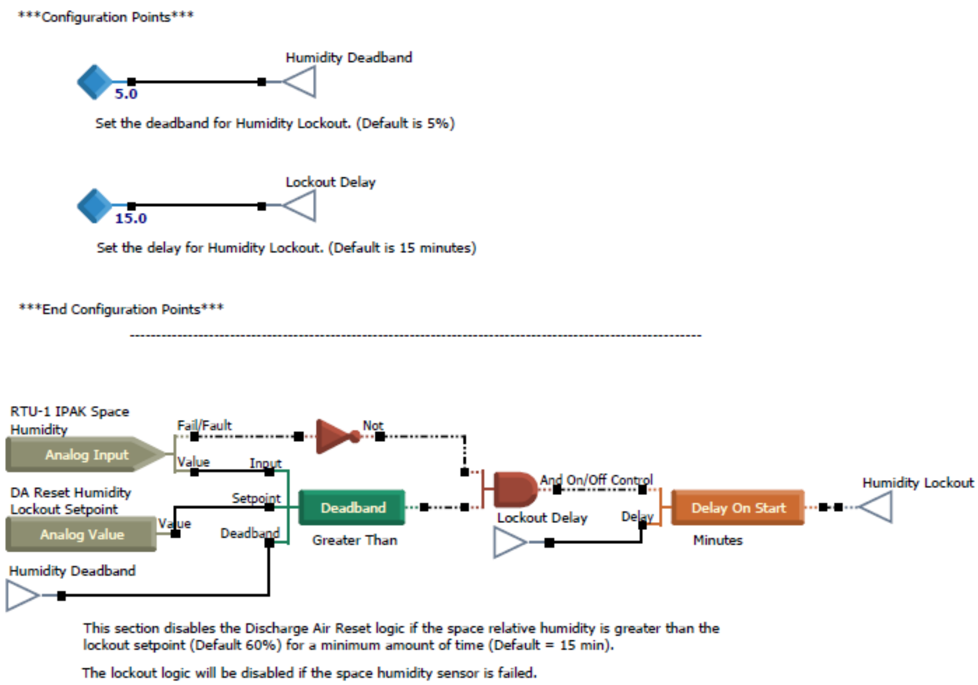
Figure 73. Lockout cooling DAT reset based on outdoor dew point



Lockout Cooling DAT reset based on zone humidity

In the following add-on program, if the current zone relative humidity is greater than 60% (adjustable) for at least 15 minutes (adjustable), the Humidity Lockout is turned on, which will cause the Cooling DAT setpoint to return to its minimum value (55°F, for example). If the zone relative humidity drops back to 5% (adjustable) below this threshold, the Humidity Lockout is turned off and the program is again allowed to reset the Cooling DAT setpoint upward.

Figure 74. Lockout cooling DAT reset based on zone humidity



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