Application Data

Part Numbers: 33ZCVVTZC-01, 33ZCBC-01, 33ZCVAVTRM, 33ZCFANTRM

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GENERAL

The 3V™ control system is a VVT® (Variable Volume and Temperature) zoning system for constant volume equipment. The 3V system is used to condition a space containing rooms or areas of diverse loading. One VVT zone controller may be configured to manage a group of linked zone controllers. This VVT zone controller is called the linkage coordinator. See Fig. 1. The linked zone controllers may be managed by either pressure dependent or pressure independent zone controllers. When configured as a 3V linkage coordinator, the zone controller decides what zones to condition by requesting the air conditioning equipment to provide heated or cooled air.

The VVT zone controller (33ZCVVTZC-01) is a component of Carrier's 3V system and is used to provide zone level temperature and ventilation control for Variable Volume and Temperature Applications. The VVT zone controller is a pressure dependent device that maintains space temperature by modulating the amount of supply airflow through its primary damper. Zone conditions are continuously monitored and electronically communicated to the VVT Linkage Coordinator.

All VVT zone controllers can be configured as the Linkage Coordinator, however only one is required per VVT system. The Linkage Coordinator is responsible for communicating with the other zones, determining the required system mode and providing the proper information to the air source.

When the option board is (33ZCOPTBRD-01) installed on a VVT zone controller, the zone controller is capable of controlling staged or modulating heat or a fan powered terminal.

VVT Zone Controllers are available factory-mounted to Carrier's round and rectangular VVT dampers. Round dampers are available in 6, 8, 10, 12, 14, and 16-in. sizes. Rectangular dampers are available in 8 x 10, 8 x 14, 8 x 18, and 8 x 24-in. sizes. All damper assemblies are equipped with an integrated duct temperature sensor.

The 3V bypass controller (33ZCBC-01) with integrated actuator is used to control the bypass damper for the system. The purpose of the bypass damper is to account for the fluctuations in the supply air pressure caused by zone dampers modulating to satisfy individual set points. The bypass system allows a constant volume HVAC (heating, ventilation and air conditioning) unit to supply variable volumes of air to the system. The bypass damper is installed in the supply ductwork.

Carrier's 3V control system provides seamless integration of pressure independent zones for use with VVT systems. Simply use Carrier's family of VAV zone controllers (ComfortID™) to regulate the flow of conditioned air into the space.

The VAV (variable air volume) Zone Controller (33ZCVAVTRM) provides dedicated pressure independent (PI) control functions for single duct terminals with modulating heat or up to 2 stages of heat.

The VAV Fan Terminal Zone Controller (33ZCFANTRM) provides dedicated pressure independent control functions for series fan or parallel fan powered terminals, single duct terminals with up to 3 stages of heat or modulating heat.

Carrier's 3V control system provides optimized equipment and component control through airside linkage. Linkage refers to the process through which data is exchanged between the air terminals and the air source that provides the supply air to those terminals. The process "links" the terminals and the air source to form a coordinated system. Linkage allows the air source to operate efficiently and reliably while responding to and satisfying changing conditions in the zones. Linkage also allows the terminals to respond properly to changes in the air source. A VVT zone controller configured as the Linkage Coordinator manages the flow of data between the air source and the VVT system zones.

Rooftop units, air handlers, fan coils, and water source heat pumps feature product integrated or factory-installed controls that are directly compatible with the 3V control system. The rooftop units, air handlers, fan coils, and water source heat pumps do not require any special hardware to be compatible with the Carrier linkage system. Consult your local Carrier representative for the complete list of compatible air source controllers.

Zone Controller Control Strategy — The primary goal of the zone controller control strategy is to satisfy the temperature and ventilation requirements of each zone in a timely and energy efficient manner. Secondary control strategies include high humidity control and demand controlled ventilation (DCV). The controllers provide pressure independent or pressure dependent operation. To achieve these goals, the control strategy is broken into two parts: local zone control and system control.

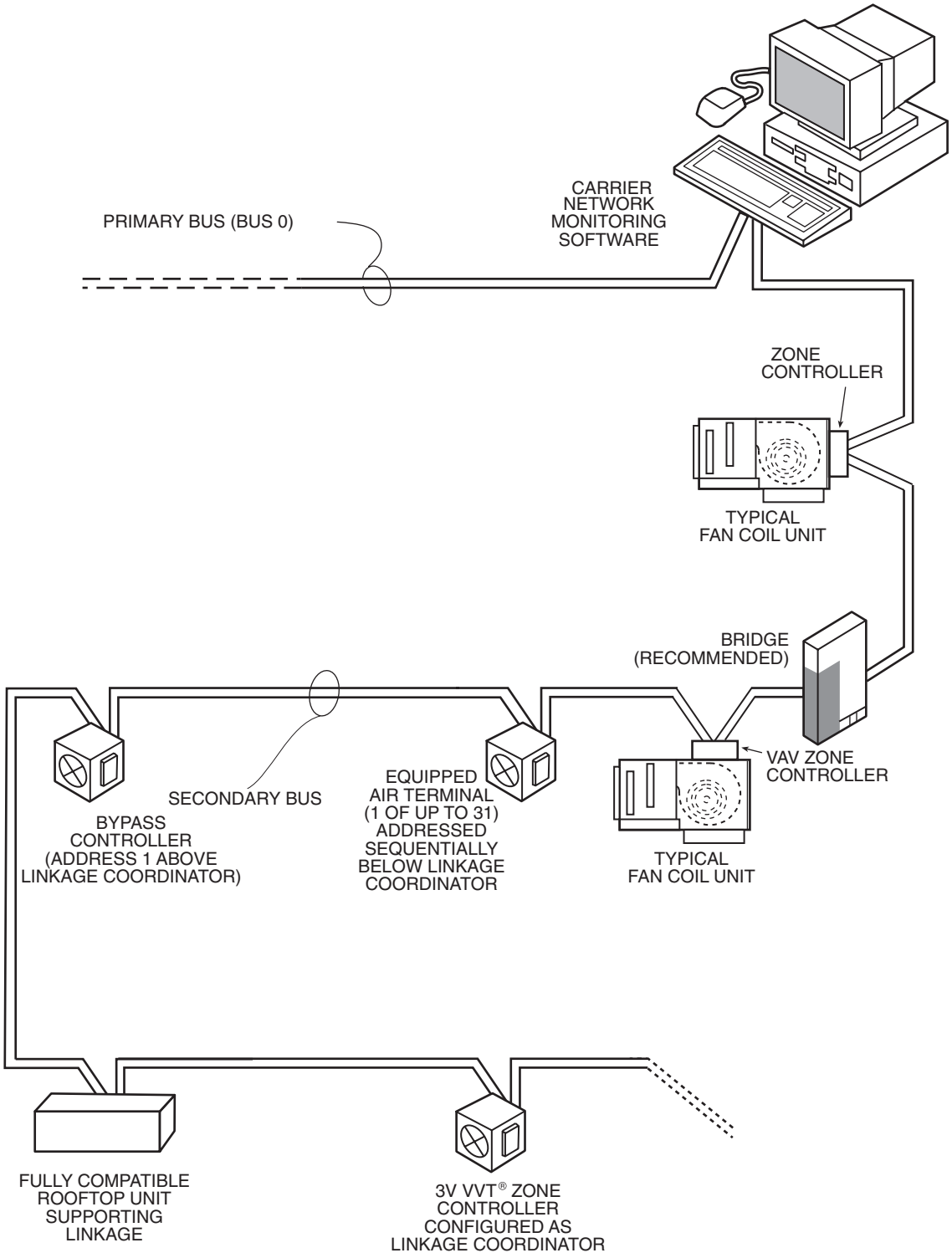
The method for achieving local zone control is through the use of an electronic control in each damper or air terminal (zone controller). The control functions of the zone controller are:

- temperature control of the space (cooling and optional heating)
- ventilation of the space
- fan control (for series and parallel type fan powered terminals)
- participation in the control of the entire air system

The method for achieving system control is to ensure that the air source operation is based on the demands of the occupied zones. In this concept, the air source produces only the amount of conditioned air (at a temperature and pressure) that is necessary to satisfy the current load requirements. It does this by varying either the amount of air it delivers, at a constant temperature, into the duct (maintaining duct pressure) or by varying the quality (temperature, humidity, quantity of outside air) of air it delivers into the duct. Its control parameters come from its own internal sources (configuration parameters, sensors) and from feedback information that it receives from the zones that it is supplying. The feedback allows the air source to adjust its quantity of outdoor air and occupancy schedule, which allows it to run in the most efficient manner.

In addition the air source shall provide its operating mode to the zone controllers to aid in the control of the dampers and air terminals. Specifically the system shall utilize the following functions in its control of the air source:

- Occupancy — Determining when the air source is operating based on the occupancy status of the zones. Override of zone occupancy is also available from space temperature sensor.
- Mode determination — Determining the air source operating mode based on the demands of the zones.



LEGEND

VAV — Variable Air Volume
VVT — Variable Volume and Temperature

Fig. 1 — Typical VVT® Application

PRODUCT DESCRIPTION

VVT® Zone Controller (33ZCVVTZC-01) — The VVT zone controller is a component of Carrier's 3V™ system and is used to provide zone level temperature and air quality control for Variable Volume and Temperature Applications. The VVT zone controller is a pressure dependent device that maintains space temperature by modulating the amount of supply airflow through its primary damper. Zone conditions are continuously monitored and electronically communicated to the VVT Linkage Coordinator.

All VVT zone controllers can be configured as the Linkage Coordinator, however only one is required per VVT System. The Linkage Coordinator is responsible for communicating with the other zones, determining the required system mode and providing the proper information to the air source.

Carrier's optional relay board (33ZCOPTBRD-01) may be used with VVT zone controllers to provide control functions for heat or fan air terminals. Heating capabilities include modulating heat, up to 3 stages of ducted heat or combination baseboard and ducted heat control.

The VVT zone controller control assembly contains an integral actuator assembly that is field mounted to the VVT terminal damper shaft, similar to the mounting of a standard actuator. The actuator is rated at 35 lb.-in. (3.95 N-m) torque, a 90-degree stroke, and provides a 90-second nominal time at 60 Hz. The actuator is suitable for mounting onto a $^{3}/_{8}$-in. (9.5 mm) square or round damper shaft, or onto a $^{1}/_{2}$-in. (13 mm) round damper shaft. The minimum damper shaft length is $1^{3}/_{4}$-in. (45 mm). The zone controller is designed for vertical or horizontal mounting.

The zone controller is provided with removable connectors for power and communications. The zone controller has non-removable screw type connectors for inputs. The removable connectors are designed so that they can be inserted one way so as to prevent installation errors. The zone controller also provides an RJ-11 modular phone jack for the Network Service tool connection to the module via the Carrier network communications.

The VVT zone controller operates on the 3V system network and is compatible with all Carrier communicating devices. A user interface is not required for everyday operation of the zone controller. The zone controller can be configured or operated through the Carrier network with optional interface tools including the System Pilot or Carrier software.

The zone controller provides the following features and benefits:

- Provides pressure dependent VVT control
- Supports zone level Demand Controlled Ventilation with field-installed CO_2 sensor.
- Capable of stand-alone operation with supply-air temperature sensor.
- Quick and easy commissioning and balancing process via a dedicated maintenance table for system wide air balancing.
- Communicates to all communicating 3V system devices
- Capable of Proportional Integral Derivative (PID) control
- Optional terminal fan control

  NOTE: Terminal fan control requires the VVT Zone Controller Option Board P/N 33ZCOPTBRD-01.
- Optional auxiliary heating control of: two-position hot water; one, two, or three-stage electric; modulating hot water valve; or combination radiant/ducted heat stages

  NOTE: Auxiliary heating requires the VVT Zone Controller Option Board P/N 33ZCOPTBRD-01.
- Provides a remote occupancy contact input for a field-supplied occupancy sensor
- Carrier linkage system capability
- Global set point and occupancy scheduling
- Sensor averaging
- Foreign language support for ASCII based character sets
- Capable of high-speed 38.4K baud communications network operation
- VVT control for terminals up to 2.7 sq ft inlet
- Up to 32 Zone Controllers per system
- System can include one or more Zone Controllers
- Dedicated port for System Pilot connection
- Uses thermistor type sensors
- Mounts directly onto pressure-dependent box damper shaft
- Can drive up to 4 linked damper actuators
- Designed for vertical or horizontal mounting
- Both controller housing and actuator are UL94-5V plenum rated
- Control complies with ASHRAE 62.1

FUNCTIONS — Functions of the VVT zone controller are:

- Pressure dependent space temperature control for single duct, series fan powered and parallel fan powered air terminals
- Auxiliary heat functions including two-position hot water valve, 3 stages of electric heat, modulating hot water valve and combination radiant/ducted heat stages
- Wall-mounted space temperature sensor interface
- Space temperature set point reset (slide potentiometer)
- Timed override (T55/T56 pushbutton) with one-minute granularity
- Space temperature and set point reset sharing
- Display of relative humidity based on local or remote sensor
- Local occupancy control
- Remote occupancy override
- Airside linkage
- Linkage function for multiple terminals with and without an air source
- Adaptive optimal start (AOS)
- Sensor grouping function
- Commissioning functions
- System-wide air balancing
- Damper calibration
- Sensor trim
- Carrier proprietary network tables and alarms
- Demand control ventilation
- Analog CO_2 monitoring and control
- Loadshed/redline response
- System Pilot interface

WIRING CONNECTIONS — Field wiring is 18 to 22 AWG (American Wire Gage). The zone controller is a NEC (National Electrical Code) Class 2 rated device.

INPUTS

- Space temperature sensor
- Wall-mounted space temperature sensor interface
- Space temperature set point reset (slide potentiometer)
- Optional supply air temperature sensor (required for reheat and stand alone operation)
- Optional primary air temperature sensor (one required per system that does not utilize a linkage compatible air source)
- Optional CO_2 sensor
- Optional relative humidity sensor (for monitoring only)
- Optional remote occupancy contact input

OUTPUTS

- Integrated factory-wired pressure dependent damper actuator
- Heating (requires VVT Zone Controller Option Board)
- Two-position hot water
- One to three stages of heat

- Modulating hot water valve
- Combination radiant/ducted heat stages
- Terminal fan (requires VVT® Zone Controller Option Board)
- Damper position output (0 to 10 v) for linked dampers

WIRING CONNECTIONS — Field wiring is 18 to 22 AWG (American Wire Gage). The VVT zone controller is a NEC (National Electronic Code) Class 2 rated device.

POWER SUPPLY — The 33ZCVVTZC-01 zone controller requires a 24 vac ± 10% at 40 va (60 Hz) power source.

COMMUNICATIONS — The number of controllers is limited to 128 devices maximum, with a limit of 8 systems (Linkage Coordinator configured for at least 2 zones). Bus length may not exceed 4000 ft (1219 m), with no more than 60 devices on any 1000 ft (305 m) section. Optically isolated RS-485 repeaters are required every 1000 ft (305 m).

At 19,200 and 38,400 baud, the number of controllers is limited to 128 maximum, with no limit on the number of Linkage Coordinators. Bus length may not exceed 1000 ft (305 m).

ENVIRONMENTAL RATINGS

Operating Temperature . . . . . 32 F to 131 F (0° C to 55 C)

Storage Temperature . . . . . 32 F to 158 F (0° C to 70 C)

Operating Humidity. . . . . .10% to 95%, non-condensing

Storage Humidity. . . . . 10% to 41% at 158 F, condensing

POWER CONSUMPTION — The power requirement sizing allows for accessory water valves and for the fan contactor. Water valves are limited to 15 va. The fan contactor is limited to 10 va (holding).

VIBRATION

Performance Vibration:

1.5 G measured at 20 to 300 Hz

CORROSION — Office environment. Indoor use only.

APPROVALS

- NEC Class 2
- UL 916-PAZX and UL 873
- Conforms to requirements per European Consortium standards EN50081-1 (CISPR 22, Class B) and EN50082-1 (IEC 801-2, IEC 801-3, and IEC 801-4) for CE mark labeling
- UL94-5V (actuator)

Bypass Controller (33ZCBC-01) — The VVT Bypass Controller is a component of Carrier's 3V™ system and is used to regulate the supply duct static pressure for Variable Volume and Temperature Applications. The Bypass Controller is an essential system component that allows constant volume HVAC equipment to provide zone level temperature control. The Bypass Controller provides the following features:

- System or stand-alone operation
- Integrated pressure sensor
- Determines system-operating mode
- Air source leaving air temperature lockouts

The bypass controller control assembly contains an integral actuator assembly that is field mounted to the VVT terminal damper shaft, similar to the mounting of a standard actuator. The actuator is rated at 35 lb.-in. (3.95 N-m) torque, a 90-degree stroke, and provides a 90-second nominal time at 60 Hz. The actuator is suitable for mounting onto a $^3/_8$-in. (9.5 mm) square or round damper shaft, or onto a $^1/_2$-in. (13 mm) round damper shaft. The minimum damper shaft length is $1^3/_4$-in. (45 mm). The bypass controller is designed for vertical or horizontal mounting.

The bypass controller is provided with removable connectors for power and communications. The bypass controller has non-removable screw type connectors for inputs. The removable connectors are designed so that they can be inserted one way so as to prevent installation errors. The bypass controller also provides an RJ-11 modular phone jack for the Network Service tool connection to the module via the Carrier network communications.

Field-installed actuators may also be used. Belimo Multi-Function technology actuators may be ordered direct from Belimo. The following accessory actuators may be used instead of the integrated actuator:

- NM24-MFT US P-30002 — 70 in.-lb actuators with floating point control and 0 to 10 vdc feedback.
- AM24-MFT US P-30002 — 160 in.-lb actuators with floating point control and 0 to 10 vdc feedback.

The following actuators may be used as linked actuators. Up to four actuators may be linked to the master actuator:

- LM24-MFT US P-10002 — 35 in.-lb actuators with 0 to 10 vdc control and 0 to 10 vdc feedback.
- NM24-MFT US P-10002 — 70 in.-lb actuators with 0 to 10 vdc control and 0 to 10 vdc feedback.
- AM24-MFT US P-10002 — 160 in.-lb actuators with 0 to 10 vdc control and 0 to 10 vdc feedback.

The Bypass Controller operates on the 3V system network and is compatible with all Carrier communicating devices. A user interface is not required for everyday operation of the bypass controller. The Bypass Controller can be configured or operated through the Carrier Network with optional interface tools including the System Pilot or Carrier software.

The bypass controller provides the following features and benefits:

- Primary air temperature and pressure sensors determine system operating mode to ensure proper operation in case of communication failure.
- Air Source leaving air temperature protection minimizes the occurrence of heating and/or cooling lockouts based on unacceptable discharge temperatures.
- Quick and easy commissioning and balancing process via a dedicated maintenance table.
- Stand-alone or linked system operation
- Carrier linkage system capability
- Foreign language support for ASCII based character sets
- Carrier communicating network
- High-speed (38.4K baud) communications network
- Thermistor type duct temperature sensor
- 0 to 2 in. wg pressure sensor
- UL94-5V plenum rated controller housing

FUNCTIONS — Functions of the bypass controller are:

- Auto pressure sensor zero calibration
- Manual pressure sensor calibration
- High end pressure transducer calibration
- Bypass damper calibration
- Bypass damper modulation
- Leaving air temperature protection
- Network tables and alarms
- System Pilot interface

INPUTS

- Duct temperature sensor
- Damper position feedback potentiometer (factory installed)
- System pressure (factory installed)

OUTPUTS

- Integrated factory-wired pressure dependent damper actuator

PHYSICAL CHARACTERISTICS

Dimensions. . . . . 2.36 in. H x 9.2 in. W x 4.84 in. D (60 mm x 233.7 mm x 123 mm)

ELECTRICAL CHARACTERISTICS — Input Volts 40 va at 24 vac + 10% (60 Hz)

The power requirement sizing allows for accessory water valves and for the fan contactor. Water valves are limited to 15 va. The fan contactor is limited to 10 va (holding).

ENVIRONMENTAL REQUIREMENTS

Operating Temperature . . . . . .32 F to 131 F (0° C to 55 C)

Storage Temperature . . . . . 32 F to 158 F (0° C to 70 C

Operating Humidity . . . . . 10% to 95% non-condensing

Storage Humidity . . . . . .10% to 41% at 158 F condensing

COMMUNICATIONS CHARACTERISTICS — Local communications between Carrier communicating network devices at up to 38.4 KB. Computer access available.

Remote access through modem at up to 38.4 KB. Computer access available.

WIRING REQUIREMENTS

Communication Bus — 3-Conductor, 18-Gage, Stranded, with Shield

Power — 2-Conductor, 18-Gage, Stranded, with Shield

VIBRATION

Performance Vibration:

1.5 G measured at 20 to 300 Hz

CORROSION — Office environment. Indoor use only.

AGENCY APPROVALS

NEC Class 2

UL 916-PAZX and UL 873

Conforms to requirements per European Consortium standards EN50081-1 (CISPR 22, Class B) and EN50082-1 (IEC 801-2, IEC 801-3, and IEC 801-4) for CE mark labeling.

UL94-5V (actuator)

System Pilot (33PILOT-01) — The System Pilot is a component of Carrier's 3V™ system and serves as the user-interface and configuration tool for all Carrier communicating devices. The System Pilot can be used to install and commission a 3V zoning system, linkage compatible air source, universal controller, and all other devices operating on the Carrier network.

Additionally, the System Pilot can serve as a wall-mounted temperature sensor for space temperature measurement. The occupant can use the System Pilot to change set points and cause occupancy overrides. A security feature is provided to limit access of features for unauthorized users.

The System Pilot consists of a backlit alphanumeric Liquid Crystal Display (LCD) with adjustable contrast and backlighting. It features six pushbuttons and two rotary knobs with pushbuttons that allow the user to navigate through the menus, select desired options, and modify data.

The System Pilot provides the following features and benefits:

ZONE OCCUPANT USER INTERFACE

- Modify zone operating set points during occupied and unoccupied modes
- Provide occupancy override capability
- Display local occupancy status
- Display current operating mode

USER INTERFACE

- Communicate with Carrier network devices
- Access configuration, maintenance, service, set point, time schedule, alarm history and status data in Carrier network devices
- Force and auto points in Carrier network devices
- Modify address of Carrier network devices
- Modify time/date in Carrier network devices
- Display metric or customary U.S. units
- Allow four security levels
- Support foreign language

CARRIER NETWORK SYSTEM

- Broadcast time/date and holiday status
- Support 30 holidays with holiday broadcast
- Generate network alarm messages for trouble conditions
- Provide capability to fully commission 3V zoning, air sources and Universal Controllers

CONTROL AND MONITORING

- Display or send space temperature to a specified Carrier network device
- Modify set points in Carrier network devices
- Allow display of bus scan information
- Display OAT as received from the network
- Provide two types of 3V Zone Controller access via dedicated local bus or via network bus.

MOUNTING — The System Pilot can be mounted into a standard 2 x 4-in. junction box. Optional wall plates are also available that allow for flush mounting or for retrofit applications.

SPECIFICATIONS

Power Requirements . . . . . 24 vac + 6 vac (18 to 32 vac) (60 Hz)
Dimensions . . . . . 6.0 in. H x 3.5 in. W x 1.25 in. D (150 mm x 87.5 mm x 31.25 mm)
Operating Temp . . . . . 32 F to 104 F (0° C to 40 C)
Storage Temp . . . . . –40 F to 140 F (–40 C to 60 C)
Operating Humidity . . . 10% to 95%, at 104 F, non-condensing
Storage Humidity . . . . . 10% to 41% at 140 F, condensing

VIBRATION

Performance Vibration:

1.5 G measured at 20 to 300 Hz

CORROSION — Office environment.

VAV Zone Controller (33ZCVAVTRM) — Carrier's 3V control system provides seamless integration of pressure independent zones for use with VVT systems. Simply use Carrier's family of VAV zone controllers (ComfortID™) to regulate the flow of conditioned air into the space. The VAV Zone Controller provides dedicated pressure independent control functions for single duct terminals with modulating heat or up to 2 stages of heat.

The 33ZCVAVTRM VAV Single Duct Zone Controller provides the following features and benefits:

- capable of demand control ventilation
- provides Pressure Independent (VAV) control
- uses Proportional Integral Derivative (PID) control
- mounts directly onto VAV box damper shaft
- for terminals up to 9000 cfm or 3.4 sq ft inlet (primary air)
- auxiliary heating control of modulating (floating) hot water, single or two-position hot water, single or two-stage electric, or zone perimeter heat
- quick and easy commissioning and balancing process
- automatic self calibration of airflow transducer
- capable of stand-alone operation
- actuator preassembled to housing
- capable of demand controlled ventilation support with field-installed IAQ (indoor air quality) sensor
- easy access to airflow sensor pneumatic connections
- capable of high-speed 38.4 kilobaud communications network operation
- 128 controller maximum system (must be located on same Carrier network bus segment)
- capable of zone humidity control (dehumidification) with field-installed humidity sensor
- Carrier Linkage System capability
- global set point and occupancy scheduling
- capable of local set point adjustment with field-installed temperature sensor (with temperature offset)
- both controller housing and actuator are UL94-5V plenum rated

The VAV zone controller is a single duct, variable air volume (VAV) terminal control with a factory-integrated actuator. The zone controller maintains precise temperature control in the space by regulating the flow of conditioned air into the space.

Buildings with diverse loading conditions can utilize reheat or supplemental heating control. The zone controller can support two position hot water, modulating hot water, 2-stage electric, or perimeter heat.

The VAV zone controller provides additional control features such as Occupied/Unoccupied scheduling initialized via the network. The zone controller offers override invoked from a wall sensor during unoccupied hours from 1 to 1440 minutes in 1-minute increments. Optional indoor air quality (IAQ) or relative humidity monitoring and control are also available. The Occupied Override function supports Carrier's Tenant Billing if the override time is set to values of 1, 2, 3, or 4 hours (60, 120, 180, or 240 minutes).

The VAV zone controller control assembly contains an integral actuator assembly that is field mounted to the VAV terminal damper shaft, similar to the mounting of a standard actuator. The actuator is rated at 35 in.-lb (3.95 N-m) torque, a 90-degree stroke, and provides a 90-second nominal time at 60 Hz. The actuator is suitable for mounting onto a $^3/_8$-in. (9.5 mm) square or round damper shaft, or onto a $^1/_2$-in. (13 mm) round damper shaft. The minimum damper shaft length is $1^3/_4$-in. (45 mm). The zone controller is designed for vertical or horizontal mounting.

The zone controller is provided with removable connectors for power and communications. The zone controller has non-removable screw type connectors for inputs. The removable connectors are designed so that they can be inserted one way so as to prevent installation errors. The zone controller also provides an RJ-11 modular phone jack for the Network Service tool connection to the module via the Carrier network communications.

An optional Conduit Box Cover (Part Number 33ZCCONBOX) allows field wiring connection via conduit. The conduit box is designed to accept two $^1/_2$-in. (13 mm) EMT conduits.

The 33ZCVAVTRM is designed to allow a service person or building owner to configure and operate the unit through the Carrier network user interfaces. A user interface is not required for day-to-day operation. All maintenance, configuration, setup, and diagnostic information is available through the Level II communications port to allow data access by the System pilot or an attached computer running Carrier software.

WIRING CONNECTIONS — Field wiring is 18 to 22 AWG (American Wire Gage). The zone controller is a NEC (National Electrical Code) Class 2 rated device.

INPUTS

- space temperature sensor
- primary air damper position (factory-installed)
- airflow sensor (factory-installed)
- remote wall sensor set point adjustment
- optional supply temperature sensor (required for ducted heat)
- optional primary air temperature sensor (required for systems which do not utilize a linkage compatible air source system)
- optional IAQ sensor or relative humidity sensor
- optional remote occupancy contact

OUTPUTS

- internally factory-wired damper actuator
- heating (ducted or non-ducted)
  - — modulating (floating) heat
  - — up to 2 stages of electric heat (if 3 stages are required, the 33ZCFANTRM should be used)
  - — two-position heat

POWER SUPPLY — The 33ZCVAVTRM zone controller requires a 24 vac ± 10% at 40 va (50/60 Hz) power source.

POWER CONSUMPTION — The power requirement sizing allows for accessory water valves or heat contactors. Water valves are limited to 15 va on both two-position and modulating hot water. The heat contactors are limited to 10 va (holding) each.

ACCURACY — Terminal airflow (nominal cfm) is rated at 1-in. wg (249 kPa) measured velocity pressure. The zone controller is capable of controlling to as low as 10% or as high as 125% of nominal airflow with an accuracy of ± 3% (nominal) at any point within the range.

HARDWARE (MEMORY)

FLASH EPROM

DIFFERENTIAL PRESSURE RANGE — 0 to 2.0 in. wg (0 to 498 kPa) maximum for the onboard flow sensor.

SPECIFIED SENSING TEMPERATURE RANGE — The zone controller space temperature, supply air temperature, and primary air temperature sensing range is –40 to 245 F (–40 to 118 C). The zone controller has an allowable control set point range from 40 to 90 F (4 to 32 C) for heating and 45 to 99 F (7 to 37 C) for cooling.

COMMUNICATIONS — The number of controllers is limited to 128 zones maximum, with a limit of 8 systems (Linkage Coordinator configured for at least 2 zones). Bus length may not exceed 4000 ft (1219 m), with no more than 60 devices on any 1000 ft (305 m) section. Optically isolated RS-485 repeaters are required every 1000 ft (305 m).

At 19,200 and 38,400 baud, the number of controllers is limited to 128 maximum, with no limit on the number of Linkage Coordinators.

ENVIRONMENTAL RATINGS

Operating Temperature: 32 to 140 F (0° to 60 C) at 10 to 90% RH (non–condensing)

Shipping Temperature: –40 to 185 F (-40 to 85 C) at 0 to 90% RH (non–condensing)

VIBRATION

Performance vibration:

- 0.014-in. (0.356 mm) Peak-to-Peak displacement measured at 5 to 31 Hz
- 0.75 G measured at 31 to 300 Hz

CORROSION — Office environment. Indoor use only.

VAV Fan Terminal Zone Controller (33ZCFANTRM) — Carrier's 3V™ control system provides seamless integration of pressure independent zones for use with VVT systems. Simply use Carrier's family of VAV zone controllers (ComfortID™) to regulate the flow of conditioned air into the space. The VAV Fan Terminal Zone Controller provides dedicated control functions for series fan or parallel fan powered terminals, single duct terminals with 3 stages of heat, or as a primary controller for dual duct or zone pressurization applications.

The 33ZCFANTRM VAV Fan Terminal Zone Controller provides the following features and benefits:

- provides Pressure Independent (VAV) control
- uses Proportional Integral Derivative (PID) control
- mounts directly onto VAV box damper shaft
- terminal fan control
- for terminals up to 9000 cfm or 3.4 sq ft inlet (primary air)
- auxiliary heating control of modulating (floating) hot water; two-position hot water; single, two, or three stage electric; or zone perimeter heat
- quick and easy commissioning and balancing process
- automatic self calibration of airflow transducer
- capable of stand-alone operation

- actuator preassembled to housing
- capable of demand controlled ventilation
- capable of individual zone pressure control for individual supply and exhaust control in conjunction with secondary terminal controller (required)
- easy access to airflow sensor pneumatic connections
- capable of high-speed 38.4 kilobaud communications network operation
- 128 controller maximum system (must be located on same Carrier communicating network bus segment)
- capable of zone humidity control (dehumidification)
- Carrier Linkage System compatibility
- global set point and occupancy scheduling
- capable of local set point adjustment with field-installed temperature sensor (with temperature offset)
- both controller housing and actuator are UL94-5V plenum rated

The zone controller is a single duct or fan powered, variable air volume (VAV) terminal control with a factory-integrated actuator. The zone controller maintains precise temperature control in the space by operating the terminal fan and regulating the flow of conditioned air into the space.

Buildings with diverse loading conditions can be supported by controlling reheat, ducted heat, or non-ducted supplemental heat. The zone controller can support two-position hot water, modulating hot water, or up to 3-stage electric heat.

With the addition of a secondary exhaust or return air terminal and the 33ZCSECTRM controller, zone pressurization applications can be supported.

Supply and exhaust airflow control is provided on an individual zone basis in order to maintain the desired zone pressure.

The 33ZCSECTRM in conjunction with the fan terminal zone controller are used to provide control for constant volume dual duct applications.

When linked to a Carrier Linkage System, the zone controller provides numerous features and benefits such as weighted average demand for system operation, intelligent supply air temperature reset, set point averaging, global set point schedule, and occupancy scheduling. Duct static pressure reset for the air source is provided, based on terminal requirements.

The zone controller provides additional control features such as Occupied/Unoccupied scheduling initialized via the network. The zone controller offers override invoked from a wall sensor during unoccupied hours from 1 to 1440 minutes in 1-minute increments. Optional indoor air quality (IAQ) or relative humidity monitoring and control are also available.

The zone controller assembly contains an integral VAV actuator that is field mounted to the VAV terminal damper shaft, similar to the mounting of a standard actuator. The actuator is rated at 35 in.-lb (3.95 Nm) torque, a 90-degree stroke, and provides a 90-second nominal running time at 60 Hz. The actuator is suitable for mounting onto a $^{3}/_{8}$-in. (9.5 mm) square or round damper shaft, or onto a $^{1}/_{2}$-in. (13 mm) round damper shaft. The minimum damper shaft length is $1^{3}/_{4}$ in. (45 mm). The zone controller is designed for vertical or horizontal mounting.

The zone controller is provided with removable connectors for power and communications. The zone controller has non-removable screw type connectors for inputs. The removable connectors are designed so that they can be inserted one way so as to prevent installation errors. The zone controller also provides an RJ-11 modular phone jack for the Network Service tool connection to the module via the Carrier network communications.

An optional conduit box cover (Part Number 33ZCCONBOX) allows field wiring connection via conduit. The conduit box is designed to accept two $^{1}/_{2}$-in. (13 mm) EMT (Electrical Metal Tubing) conduits.

The 33ZCFANTRM is designed to allow a service person or building owner to configure and operate the unit through the Carrier proprietary network user interfaces. A user interface is not required for day-to-day operation. All maintenance, configuration, setup, and diagnostic information is available through the Level II communications port to allow data access by an attached computer running Network Service Tool, ComfortVIEW™, or ComfortWORKS® software.

WIRING CONNECTIONS — Field wiring is 18 to 22 AWG (American Wire Gage). The zone controller is a NEC (National Electrical Code) Class 2 rated device.

INPUTS

- space temperature sensor
- primary air damper position (factory-installed)
- airflow sensor (factory installed)
- field-installed remote wall sensor set point adjustment
- optional supply temperature sensor (required for ducted heat and supply air monitoring)
- optional primary air temperature sensor (one per system is required for systems which do not utilize a linkage compatible air source)
- optional IAQ sensor or relative humidity sensor
- optional secondary airflow (zone pressure or dual duct)
- optional remote occupancy contact

OUTPUTS

- internally factory-wired damper actuator
- heating (ducted or non-ducted)
  - — modulating (floating) heat
  - — up to 3 stages of electric heat
  - — two-position heat
- fan start/stop
- secondary damper actuator

POWER SUPPLY — The 33ZCFANTRM requires a 24 vac ± 10% power source rated at 40 va (50/60 Hz).

POWER CONSUMPTION — The power requirement sizing allows for accessory water valves and for the fan contactor. Water valves are limited to 8 va on both two-position and modulating hot water. The fan contactor is limited to 11 va (holding).

NOTE: If a water valve or fan contactor exceeds these limits, or external contactors are required for electric heat, then it is recommended a 60 va transformer be used. The maximum rating for any output is 20 va.

ACCURACY — Terminal airflow (nominal cfm) is rated at 1 in. wg (249 kPa) measured velocity pressure. The zone controller is capable of controlling to as low as 10% or as high as 125% of nominal airflow with an accuracy of ± 3% (nominal) at any point within the range.

HARDWARE (MEMORY)

FLASH EPROM

DIFFERENTIAL PRESSURE RANGE — 0 to 2.0 in. wg (0 to 498 kPa) maximum for the onboard flow sensor.

SPECIFIED SENSING TEMPERATURE RANGE — The zone controller space temperature, supply temperature, and primary air temperature sensing range is –40 to 245 F (–40 to 118 C). The zone controller has an allowable control set point range from 40 to 90 F (4 to 32 C) for heating and 45 to 99 F (7 to 37 C) for cooling.

COMMUNICATIONS — The number of controllers is limited to 128 zones maximum, with a limit of 8 systems (Linkage Coordinator configured for at least 2 zones). Bus length may not exceed 4000 ft (1219 m), with no more than 60 devices on any 1000 ft (305 m) section. Optically isolated RS-485 repeaters are required every 1000 ft (305 m).

At 19,200 and 38,400 baud, the number of controllers is limited to 128 maximum, with no limit on the number of Linkage Coordinators.

ENVIRONMENTAL RATINGS

Operating Temperature: 32 to 140 F (0° to 60 C) at 10 to 90% RH (non-condensing)

Shipping Temperature: –40 to 185 F (–40 to 85 C) at 0 to 90% RH (non-condensing)

VIBRATION — Performance vibration: 0.014-in. (0.356 mm) peak to peak displacement, 5 to 31 Hz; 0.75 G, 31 to 300 Hz

CORROSION — Office environment. Indoor use only.

APPROVALS — Listed under UL 916-PAZX, UL 873, and UL94-5V.

Accessories

SUPPLY AIR TEMPERATURE SENSOR — The 33ZCSENSAT supply air temperature sensor is required for reheat applications or stand-alone operation. The sensor has an operating range of –40 to 245 F (–40 to 118 C) and includes a 6-in. stainless steel probe and cable.

DUCT AIR TEMPERATURE SENSOR — The 33ZCSENDAT Duct Air Temperature Sensor is required for cooling only applications on non-33CS or existing non-Carrier dampers. The sensor is used for supply air monitoring. The sensor has an operating range of –40 to 245 F (–40 to 118 C) and includes a mounting grommet and 75-in. cable.

PRIMARY AIR TEMPERATURE SENSOR — The 33ZCSENPAT Primary Air Temperature sensor is required on a master Zone Controller if the Zone Controller is not using a Carrier network, linkage compatible air source. The sensor is used to monitor the equipment's supply-air temperature. The temperature is broadcast to the system Zone Controllers which receive information from the linkage coordinator. The sensor has an operating range of –40 to 245 F (–40 to 118 C) and includes a 6-in. stainless steel probe with conduit box.

VVT® ZONE CONTROLLER OPTION BOARD — The 33ZCOPTBRD-01 VVT Zone Controller Option Board is required for use of auxiliary heat and fan control functions. The Option Board is field installed and provides four triac discrete outputs, three for supplemental heat and one for the fan output.

CONDUIT BOX — The 33ZCCONBOX conduit box provides two conduit connections to the VAV zone controller for installations requiring the use of conduit due to local electrical codes.

SPACE TEMPERATURE SENSOR WITH OVERRIDE BUTTON — The 33ZCT55SPT space temperature sensor with override button is required for all applications. The space temperature sensor monitors room temperature which is used by the zone controller to determine the amount of conditioned air that is allowed into the space.

SPACE TEMPERATURE SENSOR WITH OVERRIDE BUTTON AND SET POINT ADJUSTMENT — The 33ZCT56SPT space temperature sensor with override button and set point adjustment can be used in place of the 33ZCT55SPT space temperature sensor if local set point adjustment is required. A space temperature sensor is required for all applications. The space temperature sensor monitors room temperature which is used by the zone controller to determine the amount of conditioned air that is allowed into the space. The set point adjustment bar allows up to a ± 15° F (8° C) temperature adjustment by the room occupant.

RELATIVE HUMIDITY SENSOR — The 33ZCSENSRH-01 (indoor space) or 33ZCSENDRH-01 (duct) relative humidity sensor is required for zone humidity control (dehumidification) on pressure independent applications. The relative humidity sensor is used for monitoring only on pressure dependent applications.

NOTE: The relative humidity sensor and CO_2 sensor cannot be used on the same zone controller.

INDOOR AIR QUALITY SENSOR — Three different CO_2 sensors are available for optional demand control ventilation.

The 33ZCSENCO2 sensor is an indoor, wall-mounted sensor with an LED (light-emitting diode) display.

The 33ZCT55CO2 sensor is an indoor, wall-mounted sensor without display. The CO_2 sensor also includes a space temperature sensor with override button.

The 33ZCT56CO2 sensor is an indoor, wall-mounted sensor without display. The CO_2 sensor also includes a space temperature sensor with override button and temperature offset.

NOTE: The relative humidity sensor and CO_2 sensor cannot be used on the same zone controller.

Sensor Information

SPACE TEMPERATURE SENSORS — The sensor housing is plastic ABS. The connections are screw terminals. The weight is 0.18 lb See Fig. 2 for sensor dimensions.

The 33ZCT56SPT space temperature sensor has a set point potentiometer that provides a set point input. The set point potentiometer range for each sensor can be adjusted from –15° to 15° F. Adjustment direction is indicated by COOL and WARM on the sensor cover.

The temperature sensor uses a 10K ohm thermistor to sense ambient temperature. See Table 1 for resistance vs. temperature values for the thermistor.

The sensor is designed to be mounted in a vertical mounting position for proper operation.

33ZCT55SPT SENSOR — The 33ZCT55SPT space sensor is a basic space temperature sensor for use with the zone controller. It contains a thermistor to sense room temperature, override button for initiating a timed override, and an RJ11 jack for the connection of a CCN Network Service Tool. The sensor communications connection (RJ11) is concealed behind a removable cover. The sensor is field installed.

Space Temperature Sensor Wiring — In order to provide temperature sensing and override functions, the 33ZCT55SPT sensor must be connected to the zone controller using 20 AWG twisted pair cables. Pressing the timed override button on the 33ZCT55SPT sensor produces the required short-circuit signal. See Fig. 3 for internal schematic. The sensor has a screw terminal connector to facilitate wiring. All wiring from the zone controller to the sensor is field supplied.

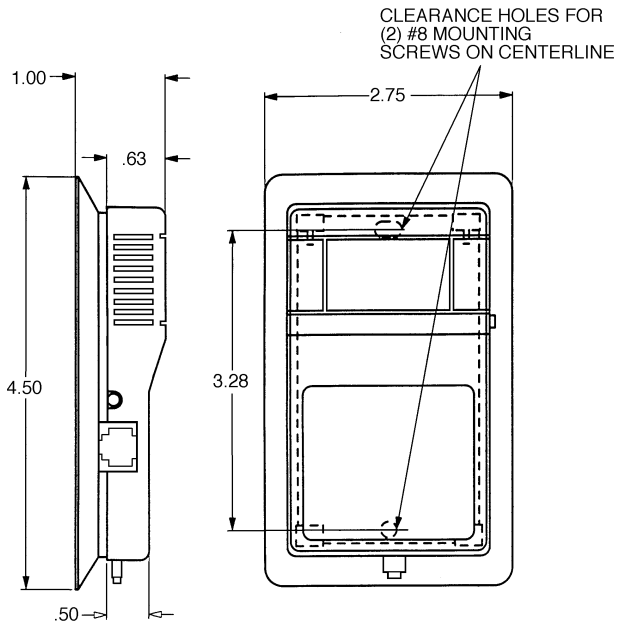


Fig. 2 — Space Temperature Sensor and Wall Mounted Humidity Sensor Dimensions

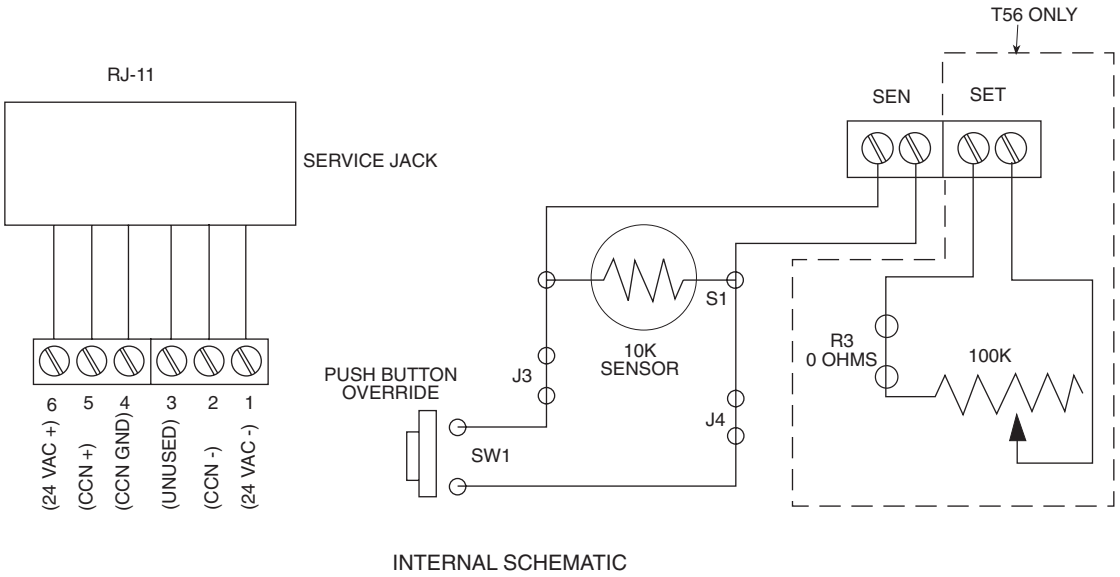


Fig. 3 — Temperature Sensor Internal Wiring

Sensor terminals 1 and 2 are used for space temperature sensing. The space temperature sensor range is 32 to 120 F, with a nominal resistance of 10,000 ohms at 77 F.

33ZCT56SPT SENSOR — The 33ZCT56SPT space temperature sensor is field-installed. The 33ZCT56SPT is a wall-mounted sensor capable of measuring the ambient temperature at its location, and is equipped with an override button. The override button (when pressed) provides a short across the internal thermistor. The sensor is also equipped with an RJ11 service jack with a 6-pin termination block for network connection. The sensor is equipped with a 100K ohm (nominal) linear slide potentiometer.

Space Temperature Sensor Wiring — In order to provide temperature sensing and the override functions, the 33ZCT56SPT sensor must be connected to the zone controller using 3-conductor, 18 to 20 AWG cables. (The network communication cable may be used.) Pressing the timed override button the 33ZCT56SPT sensor produces the required short-circuit signal. See Fig. 2 for internal schematic. The sensor has a screw terminal connector to facilitate wiring. All wiring from the zone controller to the sensor is field supplied. The sensor's thermistor has a range of 32 to 158 F with a nominal resistance of 10,000 ohms at 77 F.

Remote Timed Override — Pressing the timed override button on the 33ZCT55SPT or 33ZCT56SPT sensors initiates a timed override. If the override is activated in a zone that is using a network time schedule, then the override will be reported to the global schedule. When using a global schedule, all the zones assigned to that schedule will go occupied when any of the space temperature override buttons are pressed by the user. For zones that require individual override, those zones are required to use a local schedule.

If the mode is currently unoccupied and the override function is activated, the mode will change to occupied for the period of time configured. The control will interpret a 1 to 10 second button press as a user initiated timed override command.

If the override button is held for less than 1 second or more than 10 seconds, the control will not enter override. If the override button is held for more than 60 seconds, a Space Temperature alarm will be generated.

SUPPLY AIR TEMPERATURE SENSOR (33ZCSENSAT) — The supply air temperature sensor (SAT) is required for reheat applications or stand-alone operation. The SAT sensor consists of a thermistor encased within a stainless steel probe. The probe is 6-in. nominal length. See Fig. 4. The sensor has 114-in. of unshielded, plenum-rated cable (2 conductors, 22 AWG). The range of the sensor is –40 to 185 F with a nominal resistance of 10,000 ohms at 77 F. The sensor measures temperature with an accuracy of ± 0.36 F (0.2 C) from 0° to 70 C. The sensor is supplied with a gasket and two self-drilling mounting screws.

DUCT TEMPERATURE SENSOR (33ZCSENDAT) — The duct (supply) temperature sensor is required for cooling-only applications on non-33CS or existing non-Carrier dampers. The duct temperature sensor must be installed in the supply air duct. The 33ZCSENDAT is the recommended sensor. See Fig. 5 for sensor details.

The duct temperature sensor should be moved to a location which will provide the best sensing of the supply-air temperature during heating and cooling.

For systems using a ducted supply, the duct temperature sensor should be located in the supply duct downstream of the discharge of the air source and before the bypass damper to allow good mixing of the supply airstream.

The 33ZCSENDAT duct sensor is a small epoxy sensor that is $1^1/_4$-in. long. A grommet is provided for filling the hole around the sensor cable after the sensor is located in the duct.

PRIMARY AIR TEMPERATURE SENSOR (PAT) — The PAT sensor consists of a thermistor encased within a stainless steel housing with 5-in. of exposed length. See Fig. 6. The sensor has 2 Teflon insulated, stranded conductors (24 AWG). The range of the sensor is –40 to 185 F with a nominal resistance of 10,000 ohms at 77 F. The sensor measures temperature with an accuracy of ± 0.36 F (0.2 C) from 0° to 70 C.

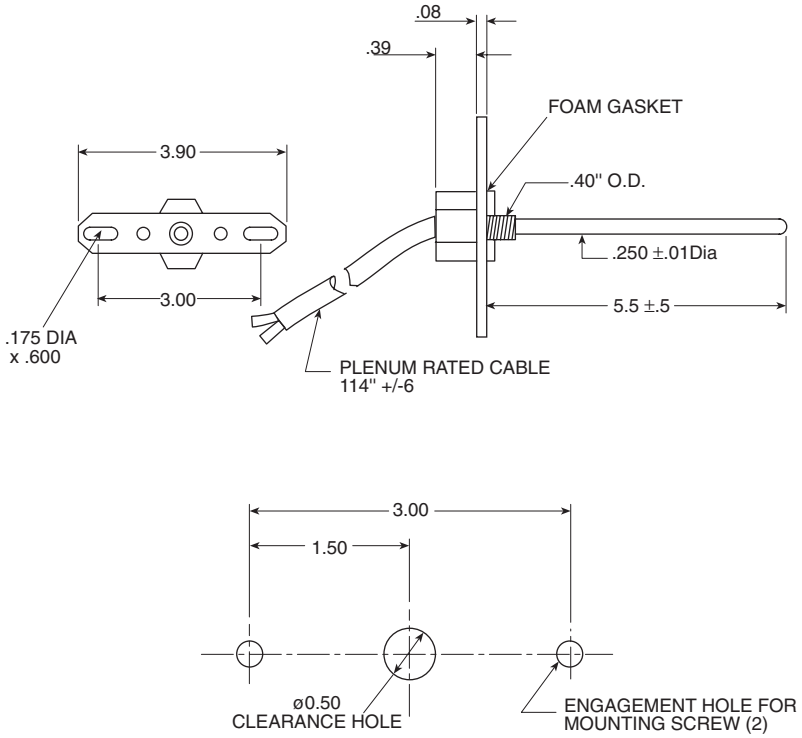
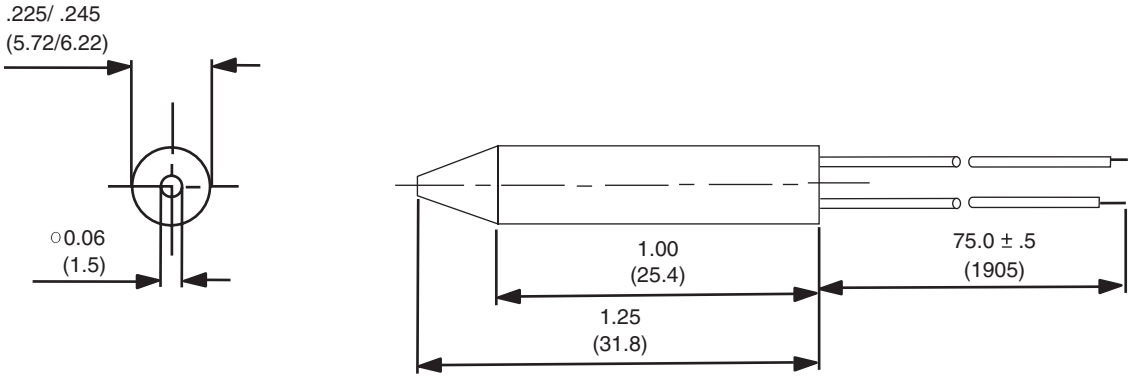


Fig. 4 — Supply Air Temperature Sensor Dimensions



NOTE: Dimensions are in inches (millimeters).

Fig. 5 — 33ZCSENSDAT Duct Sensor

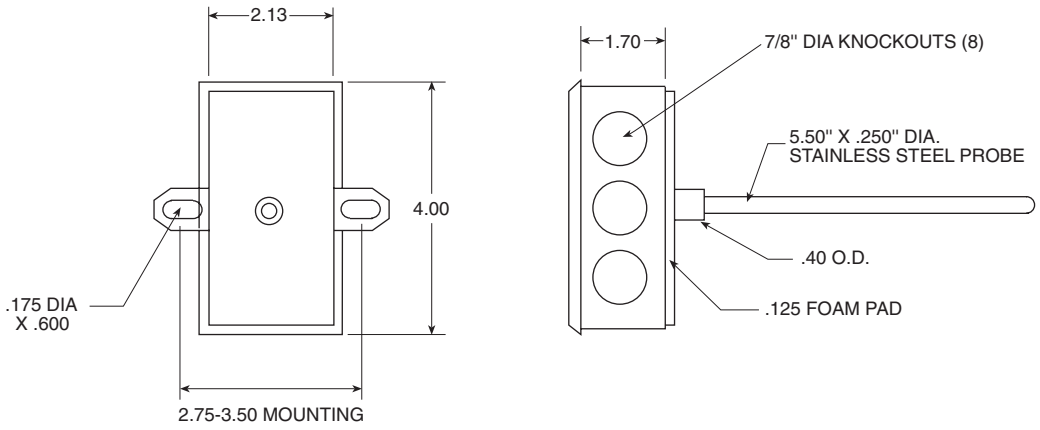


Fig. 6 — Primary Air Temperature Sensor Dimensions

Table 1 — Thermistor Resistance vs Temperature Values for Space Temperature Sensor, Return-Air Temperature Sensor, and Supply-Air Temperature Sensor

TEMP (C)	TEMP (F)	RESISTANCE (Ohms)
–40	–40	335,651
–35	–31	242,195
–30	–22	176,683
–25	–13	130,243
–20	–4	96,974
–15	5	72,895
–10	14	55,298
–5	23	42,315
0	32	32,651
5	41	25,395
10	50	19,903
15	59	15,714
20	68	12,494
25	77	10,000
30	86	8,056
35	95	6,530
40	104	5,325
45	113	4,367
50	122	3,601
55	131	2,985
60	140	2,487
65	149	2,082
70	158	1,752

INPUTS/OUTPUTS

The VVT® Zone Controller (33ZCVVTZC-01) inputs are shown in Table 2. The VVT Zone Controller (33ZCVVTZC-01) outputs are shown in Table 3. The Bypass Controller (33ZCBC-01) inputs are shown in Table 4 The Bypass Controller (33ZCBC-01) outputs are shown in Table 5. The VAV Zone Controller (33ZCVAVTRM) inputs are shown in Table 6. The VAV Zone Controller (33ZCVAVTRM) outputs are shown in Table 7. The VAV Fan Terminal Zone Controller (33ZCFANTRM) inputs are shown in Table 8. The VAV Fan Terminal Zone Controller (33ZCFANTRM) outputs are shown in Table 9.

Analog Inputs — The analog inputs consist of four thermistor type inputs and two 0 to 10 vdc inputs. The thermistor inputs conform to the nominal 10K thermistor values in Table 1.

Triac Outputs — The controllers have four 24-vac triac outputs on the baseboard. These outputs are capable of switching 24 vac at 1 amp with a power factor of 0.8. Two triacs control the primary output damper. One drives the damper clockwise and the other counterclockwise. The two other triacs are dedicated to the control of either proportional or two-position heat.

Relay Outputs (33ZCFANTRM Only) — These relays are designed to switch 24 vac as a maximum voltage at up to 1 amp with a power factor of 0.8. The relays provide fan off/on control and control a third stage of electric heat if used.

Table 2 — VVT Zone Controller (33ZCVVTZC-01) Inputs

CHANNEL NAME	TERMINATION	DESCRIPTION	DEVICE
REMTCIN	J4 1,2	Remote Time Clock Input	0/24 VAC
SAT	J4 6,8	Supply Air Temperature	10K Thermistor
SPT	J4 10,8	Space Temperature	10K Thermistor
SP_OFFST	J4 4,8	Setpoint Offset Adjust Input	100K Potentiometer
PATEMP	J4 5,3	Primary Air Temperature Input	10K Thermistor
RH/IAQ	J4 12 (24 vdc) J4 11 (+) J4 9 (–)	RH/IAQ Sensor Input	2-10 vdc
DMPPOS	J5 4 (10 vdc) J5 5 (W+) J5 6 (–)	Damper Position Input	0-10 vdc

Table 3 — VVT Zone Controller (33ZCVVTZC-01) Outputs

CHANNEL NAME	TERMINATION	DESCRIPTION	DEVICE
CHAN_10	J5 1,2	Damper CCW Output	24 vac 1A
CHAN_10	J5 3,2	Damper CW Output	24 vac 1A
V_OPEN	J7 1,2	Heat Open, 1st Stage Output	24 vac 1A
V_CLOSE	J7 3,4	Heat Close 2nd Stage Output	24 vac 1A
HEAT_3	J7 5,6	Heat 3rd Stage Output	24 vac 1A
FAN	J6 1,2	Fan Output	24 vac 1A

Table 4 — Bypass Controller (33ZCBC-01) Inputs

CHANNEL NAME	J4 TERMINATION	DESCRIPTION	DEVICE
DUCT_TMP	10, 12	Duct Temperature	10K Thermistor
DMP_POS	9 (10v), 7(W+), 5(–)	Damper Position	0-10 vdc
SP_SENSR	3, 1	System Pressure	0-5 vdc

Table 5 — Bypass Controller (33ZCBC-01) Inputs

CHANNEL NAME	J5 TERMINATION	DESCRIPTION	DEVICE
DMPR_CCW	1 (A), 2	Damper CCW	24 vac 1A
DMPR_CW	3 (A), 2	Damper CW	24 vac 1A

Table 6 — VAV Zone Controller Inputs (33ZCVAVTRM)

CHANNEL NAME	J4 TERMINATION	DESCRIPTION	DEVICE
SPT	14,12 (ground)	Space Temperature Sensor (33ZCT55SPT), field installed and wired	10K Thermistor
SAT	10,12 (ground)	Supply Air Temperature Sensor, required for heat, field installed and wired*	10K Thermistor
SP_OFFST	12 (ground), 8	Set Point Offset Adjust, requires the use of field-installed 33ZCT56SPT space temperature sensor	100K Potentiometer
PATEMP	4, 6 (ground)	Primary Air Temperature Factory option field installed and wired†	10K Thermistor
RH/IAQ**	16 (24v), 15 (+), 13 (–)	RH/IAQ Sensor Factory option, field installed and wired	0-10 vdc
DMPPOS	9 (10v), 7 (W+), 5 (–)	Primary Damper Position Factory Supplied and wired with zone controller	0-10 vdc
TEST	3, 1 (GND)	Used to test the output of the airflow transducer.	Airflow Sensor (1-5 vdc)
REMOTE	2 (24 vac), J1 Pin 1 (24 vac†)	Remote Occupancy Contact	Dry contact switch with 24 vac supplied by power connection

LEGEND

W — Wiper of Potentiometer

*Required whenever ducted heat is to be controlled. If monitoring of supply air is required the zone controller must be configured for heat even if the box does not contain heat. It is also required for stand-alone operation.

†Primary air sensor is required whenever unit is configured as a linkage coordinator zone controller and a non-Carrier proprietary network air source is used.

**24 v connection (J4-16) is required for RH sensor only.

Table 7 — VAV Zone Controller Outputs (33ZCVAVTRM)

CHANNEL (10-13)	J5 TERMINATIONS	DESCRIPTION
DMPR_CCW	1*,2	Primary Damper CCW (factory wired)
DMPR_CW	2,3*	Primary Damper CW (factory wired)†
HEAT_ST1	4, 5 (24 vac externally supplied)	Heat Open, First Stage (field wired)
HEAT_ST2	6, 5 (24 vac externally supplied)	Heat Close, Second Stage (field wired)

LEGEND

CCW — Counterclockwise
CW — Clockwise

*These terminals provide 24 vac-output power to the load.

†The zone controller comes wired and configured for clockwise closure of the primary air damper. Do not change wiring to change rotation. The installer should configure the rotation decision with Carrier software to ensure transducer calibration integrity.

Table 8 — VAV Fan Terminal Zone Controller Inputs (33ZCFANTRM)

CHANNEL NAME	J4 TERMINATION	DESCRIPTION	DEVICE
SPT	14,12 (ground)	Space Temperature Sensor (33ZCT55SPT), field installed and wired	10K Thermistor
SAT	10,12 (ground)	Supply Air Temperature Sensor, required for heat, field installed and wired*	10K Thermistor
SP_OFFST	12 (ground), 8	Set Point Offset Adjust, requires the use of field-installed 33ZCT56SPT space temperature sensor	100K Potentiometer
PATEMP	4, 6 (ground)	Primary Air Temperature Factory option field installed and wired†	10K Thermistor
RH/IAQ**	16 (24v), 15 (+), 13 (–)	RH/IAQ Sensor Factory option, field installed and wired	0-10 vdc
DMPPOS	9 (10v), 7 (W+), 5 (–)	Primary Damper Position Factory Supplied and wired with zone controller	0-10 vdc
TEST	3, 1 (GND)	Used to test the output of the airflow transducer.	Airflow Sensor (1-5 vdc)
SECFLO	9 (10v), 11 (+), 13 (–)	Secondary Airflow Sensor††	1-5 vdc
REMOTE	2 (24 vac), J1 Pin 1 (24 vac†)	Remote Occupancy Contact	Dry contact switch with 24 vac supplied by power connection

LEGEND

W — Wiper of Potentiometer

*Required whenever ducted heat is to be controlled. If monitoring of supply air is required the zone controller must be configured for heat even if the box does not contain heat. It is also required for stand-alone operation.

†Primary air sensor is required whenever unit is configured as a linkage coordinator zone controller and non-Carrier proprietary network air source is used.

**24v connection (J4-16) is required for RH sensor only.

††Option required on Constant Volume Dual Units for zone pressure control. 33ZCSECTRM is required.

Table 9 — VAV Fan Terminal Zone Controller Outputs (33ZCFANTRM)

CHANNEL (NUMBER)	J5 TERMINATION'S	DESCRIPTION
DMPR_ CCW	1*, 2	Primary Damper CCW (factory wired)
DMPR_CW	2, 3*	Primary Damper CW (factory wired)†
HEAT_ST1	4, 5 (24 vac externally supplied)	Heat Open or Heat First Stage (field wired)
HEAT_ST2	6, 5 (24 vac externally supplied)	Heat Close or Heat Second Stage (field wired)
FAN	J6-1(24 vac externally supplied), J6-2 (Common, N/O)	FAN Fan Start/Stop
HEAT_ST3	J7-1 (24 vac externally supplied), J7-3 (Common, N/O)	Heat Third Stage
2_DMP_CCW	J8-1, J8-2	Secondary Damper CCW
2_DMP_CW	J8-2, J8-3	Secondary Damper CW

LEGEND

CCW — Counterclockwise
CW — Clockwise

*These terminals provide 24 vac-output power to the load.

†The zone controller comes wired and configured for clockwise closure of the primary air damper. Do not change wiring to change rotation. The installer should configure the rotation decision with Carrier software to ensure transducer calibration integrity.

NETWORK SYSTEM DESIGN INFORMATION

Design Considerations — A 3V™ system consists of a number of dampers, air terminals, an air source, and one or more Carrier communicating network bus segments. The Carrier network bus is used by the terminals and air sources to exchange information. The information shared between the air source and the air terminals is called linkage information. The Carrier communicating network bus segments should follow all specifications for a Carrier network bus, except as noted within this application document.

Air terminals that make up a 3V system must be connected to the same Carrier network bus. If the entire Carrier network system consists only of these terminals and their air sources, then this bus may be the primary bus.

Typically there will be other devices on the network system. In this case, the terminals will be placed on a secondary bus. This secondary bus will be isolated from the primary bus by a network bridge device. Isolation of the secondary bus allows the 3V system to have complete access to the network bus without regard to bus traffic caused by other Carrier communicating devices that are outside of the 3V system. This is important since proper operation of the 3V system requires timely communications between the linkage coordinator and its linked dampers or terminals and the air source. Air sources (when Linkage compatible) may be connected to either the primary or secondary bus. Multiple VVT systems may occupy the same bus. The bus will operate at 9600, 19200, or 38400 baud.

Network Design

COMMUNICATION LIMITATIONS

At 9600 Baud — The number of controllers per bus are limited to 128 zones maximum, with a limit of 8 systems (Linkage Coordinators configured for at least 2 zones). There is a maximum of 32 zone controllers per linkage coordinator. Bus length is required not to exceed 4000 feet with any more than 60 devices on any 1000-foot section. Repeaters are required every 1000 feet with a maximum of 3 repeaters per bus.

At 19,200 and 38,400 Baud — The number of controllers are limited to 128 maximum. There is a maximum of 32 zone controllers per linkage coordinator. Bus length is required not to exceed 4000 feet with any more than 60 devices on any 1000-foot section. Repeaters are required every 1000 feet with a maximum of 3 repeaters per bus.

→COMMUNICATION ADDRESSING — The air terminal that has the linkage coordinator function enabled will be the highest addressed terminal within its linked group of terminals. All terminals within the linked group will be addressed with consecutive descending addresses starting from the linkage coordinator. The bypass controller must be addressed one address above the linkage coordinator. Each linkage coordinator will utilize broadcast to transmit data to all the zones in its system, therefore a single zone controller per bus, which is not the linkage or schedule coordinator, must be designated as the broadcast acknowledger. One broadcast acknowledger is required per bus.

Linkage coordinators are designed to synchronize the time to poll their associated zone controllers. This synchronization takes place every hour on the hour. Each linkage coordinator will calculate a time to start polling its associated zones based on its own element address. For this purpose it is recommended that the linkage coordinator addresses be spaced about 30 element numbers apart. This address spacing between linkage coordinators allows about seven seconds of separation between linkage coordinators starting to poll their associated zones. A full system of 32 zones will take slightly less than seven seconds to poll. If the systems are less than 32 zones, the linkage coordinator addresses can be closer to each other as long as enough time is given to poll devices without overlapping other linkage coordinators. The spacing of linkage coordinators 10 addresses or less apart has an undesirable effect on bus utilization, although the systems will function normally. It is simple to determine if linkage coordinators are overlapping by using the Bus Diagnostics Utility that is part of Service Pack. Bus utilization will increase at times when two or more linkage coordinators are polling and then drop off again in between. Proper spacing of linkage coordinators can keep bus utilization even. This also makes it easier to add future zones to a system if gaps of unused addresses are left in between systems.

Each controller will default to an address of 0, 140 when its application software is initially loaded. Since multiple controllers will be on the same bus, a unique address must be assigned to each controller before the system can operate properly. The assignment of controller addresses will be performed through the System Pilot or Carrier software.

OCCUPANCY SCHEDULING — Each zone controller is equipped with a software clock and is capable of performing its own occupancy scheduling once set up properly. If the control is configured to use a global occupancy schedule, a global schedule in an air terminal or networked device is used to determine occupancy status.

In order to provide occupancy status, the software clock needs to be initialized by a Carrier communicating device that contains a hardware clock. The software timeclock will require periodic updates from a time broadcaster in a networked device (with hardware clock). Devices such as System Pilot and PICs all have hardware clocks. A device with a hardware clock must be set up as a time broadcaster. If the software clock has not been initialized, the zone controller will default to the occupied mode.

The zone controller supports the broadcast function. The zone controller will broadcast its schedule occupancy status upon transition and every 5 minutes when configured with a global schedule (schedule number 65 or greater). Global schedule enables the global schedule zone controller to provide occupancy scheduling to all the zone controllers within a given system.

Global schedule may be set up independent of the Linkage Coordinator function. When global schedules are used, all the zone controllers and other devices that are part of that global schedule will become occupied, unoccupied and participate in occupancy override together. When individual schedules are used, each zone determines its own occupied and unoccupied times based on its internal schedule and clock and occupancy overrides occur on an individual basis. As the linkage coordinator scans its associated zones, it checks the occupancy status of each zone.

The software timeclock must be initialized after any power failure, either by receiving a Time Broadcast (the controller will request time from the network), or by a manually updating the time, through the controller time function.

Network Addressing — Use the following method when all the zone controllers are installed and powered, and the SPT sensors are wired and functioning properly. This method can be used if no addresses have been set previously. The address of an individual zone controller may be set by using the System Pilot. This is the standard method of setting the address.

Each zone controller will default to an address of 0, 140 when its application software is initially loaded. Since multiple controllers will be on the same bus, a unique address must be assigned to each controller before the system can operate properly. The assignment of controller addresses will be performed through the System Pilot, as follows:

1. The System Pilot recognizes that the Zone Controller's address, stored in the zone controller memory, has not been written yet (this will be true when the unit is first powered up on the job, or after a jumper-initiated reset).
2. Press the override button on the SPT (terminals J4-14 and J4-12 are shorted) for 1 to 10 seconds.
3. The zone controller address changes from 0, 140 to 239, 239 for a period of 15 minutes.
4. Use System Pilot to change the address from 239, 239 to a valid system address within 15 minutes.

NOTE: If the address is not changed from 239, 239 to a valid system address within 15 minutes, the controller will revert to address 0, 140 and use of the override button will cause the address function to repeat. The operator MUST actively set the address even if the final desired address is 0, 140.

Zone Controller User Interfaces — The Zone Controller is designed to allow a service person or building owner to configure and operate the unit through the System Pilot user interface. A user interface is not required for day-to-day operation. All maintenance, configuration, set up, and diagnostic information is available through the Level II communications port on the zone controller. The data port allows data access by a System Pilot or Carrier software.

LINKAGE

Linkage is defined as the process that links the terminals and air source to form a coordinated HVAC system. Linkage allows the air source to respond to changing conditions in the zones. Linkage also allows the terminals to respond properly to changes in the air source operating mode. Linkage operation is different between a Carrier communicating device that supports linkage (i.e., PIC controlled air handler or rooftop unit, *Air*Manager™, Universal Controller, *Comfort*Link™ controlled unit, PremierLink™ controlled unit), versus that which does not support Linkage.

Air Sources Which Support Linkage — All dampers and terminals that are serviced by an air source are linked together to form a single virtual load to the air source. As such, the linked system provides the following information to the air source equipped with a Carrier communicating control that supports linkage:

- reference zone temperature
- occupied temperature of occupied and biased occupied reference zone serviced by the air source
- the occupied and unoccupied heating and cooling space temperature set points for selected zones serviced by the air source
- composite occupancy information

To account for variations in the size of the space serviced by each zone, the space temperature and set point information provided to the air source is weighted. The weighting is proportional to the size of the zone and is determined by the configured damper size for each pressure dependent zone and maximum cooling capacity (cfm) for each pressure independent zone. Only those zones with a valid temperature are be included in the polling process.

In each linked system, one zone controller should be identified as the linkage coordinator. The linkage coordinator periodically polls the other zones in the group to acquire their temperature, set points, occupancy information, and damper position. The linkage coordinator processes this information into a composite view of the system and sends this information to the air source.

These modes determine the operating and control modes of the zone controller. The operating mode will be used to provide status information about the zone controller's operation. The control modes will be used to affect the operation of the corresponding control functions (airflow, heating, and fan control). The current operating and control modes will be based on the following inputs: the air source mode, the temperature control requirement of the zone, and the terminal type.

The air terminal operating mode will indicate the current HVAC mode of operation. The modes and their meanings are defined in Table 10.

AIR TERMINAL MODES — The heating mode will determine whether the heat function should be enabled or disabled. The fan control will control the fan as required for heat.

The air source mode is used by the zones to determine their terminal operating mode and which minimum and maximum airflow requirements to utilize. For stand-alone units without linkage, the supply air temperature sensor performs this function. The optimal start bias time will be used by the occupancy control in each terminal to adjust the terminal's occupied start time.

If the Linkage Coordinator zone controller is enabled, then that zone controller will poll the indicated number of zones, including itself. With the information obtained, the linkage coordinator will calculate the system control information and send them to the air source at the indicated address. The linkage coordinator computes the composite occupancy, set point, and zone temperature data.

Air Sources That Do Not Support Linkage — In systems with central air sources which do not support Linkage, the zone coordination function of Linkage can still be provided by the Linkage function contained within a linkage coordinator zone controller. In these cases, the zone configured as the Linkage Coordinator will determine the operational mode of the air source through its bypass pressure sensor and either a primary air temperature measurement or the bypass controller duct temperature sensor. A field-supplied primary air temperature sensor (33ZCSENPAT) may be used in place of the bypass controller duct sensor if no bypass controller is installed. The modes that can be determined are either Cooling, Heating, free cooling, or Off.

The Linkage Coordinator will determine if the air source is operational (the fan is on/off) by determining if bypass pressure can be measured. If no pressure is read at the bypass, then the linkage coordinator zone controller concludes that the air source is off. If pressure is measured, then the linkage coordinator concludes that the air source in on. If no bypass controller is present, then the system will be considered to be always on.

Once the air source is determined to be operational, the linkage coordinator will attempt to determine the air source mode (heating or cooling) by measuring the supply-air temperature from the air source. A primary air duct temperature sensor must be connected to the primary air temperature input of the linkage coordinator zone controller. The sensor should be placed in the supply air duct at a point where airflow is not dependent on any specific terminal. If a sensor is not installed, or the sensor fails, then the linkage coordinator will default the mode to cooling.

If the PAT sensor is installed and operational, the linkage coordinator determines the air source mode (Heating or Cooling On/Off) based on the temperature reading.

Table 10 — Air Terminal Operating Modes

AIR TERMINAL OPERATING MODE	AIR TERMINAL ACTION
OFF	No active control of temperature or cfm in the zone.
VENT	Temperature requirement of the zone is satisfied. Minimum cooling cfm or damper position is maintained.
VENT and FAN	Temperature requirement of the zone is satisfied and cfm is below fan ON limit (parallel fan only).
COOL	Zone Controller is attempting to cool the zone by using supply air.
DEHUMIDIFY	Zone Controller is attempting to dehumidify the zone by overriding temperature control cfm requirements.
IAQ	Zone Controller is attempting to increase zone ventilation by overriding temperature control cfm requirements.
HEAT	Zone Controller is attempting to heat the zone by using supply air or local heating.
WARMUP	Zone Controller is attempting to heat the space during the morning warm up period.
REHEAT	Zone Controller is attempting the heat the zone by locally re-heating the supply air (single duct only).
PRESSURE	Zone Controller is participating in the Pressurization mode of the system.
EVACUATION	Zone Controller is participating in the Evacuation mode of the system.

OFF MODE — When no pressure is determined at the bypass damper, then the linkage coordinator zone controller will declare the primary air source's fan OFF. The linkage coordinator will then issue the OFF mode to all zone controllers associated (linked) with that linkage coordinator.

If the pressure increases at least 10% above the bypass pressure set point, then the linkage coordinator zone controller will determine the primary air source's fan is on. Once the Master zone controller determines the fan is on, it then proceeds to determine if the equipment is operating in Heating, Cooling, or Free Cooling mode.

HEAT MODE — When the fan is determined to be on, the linkage coordinator zone controller reads the primary air temperature value. If the duct temperature is 5° F greater than the reference zone temperature and the reference zone is greater than 65 F, the mode is determined to be heating. If the reference zone is less than 65 F, and the duct temperature is 10° F greater than the reference zone temperature, then the mode is determined to be heating.

In Heating mode, the zone controller will modulate the primary air damper between the minimum and maximum Heating damper positions.

COOL MODE — When the fan is determined to be on, the linkage coordinator zone controller reads the primary air temperature value. If the temperature is less than the average occupied zone temperature, as calculated by the linkage coordinator zone controller, minus 2 degrees F, the mode is determined to be cooling.

FREE COOLING MODE — The following conditions must be present for Free Cooling mode:

- the fan is determined to be on by the linkage coordinator zone controller
- the average zone temperature value is greater than the average unoccupied zone cooling temperature set point, as determined by the linkage coordinator zone controller
- the current time is between 3:00 AM and 7:00 AM
- the equipment is providing cooling to the system

If the above conditions are true, then the mode is determined to be Free Cooling. This mode is then communicated to all the zone controllers associated (linked) with that linkage coordinator zone controller.

NOTE: For pressure independent operation, any time a zone controller is not receiving an update from a linkage coordinator zone controller, that zone controller will determine the air source mode based upon its supply air sensor. In this case, no determination for heat, cool and on/off modes is made until after the heating operation ceases. In other cases where a supply air temperature sensor is not used, the mode will default to cooling.

Communications Alarms with Linkage — If the linkage coordinator detects that a previously polled air terminal is no longer responding, then it will generate a network alarm message indicating the loss of communications with that terminal.

If a terminal that was previously polled by a linkage coordinator stops being polled, it will generate a network alarm message indicating a loss of communications from the linkage coordinator. It will then operate in stand-alone mode (Linkage in effect = NO). A return to normal will not be issued until successful communication updates have been received.

If the linkage coordinator fails to communicate with the configured network air source, then an air source communication alarm message will be generated. The linkage coordinator will operate as defined for a non-Carrier air source to determine the air source operating mode.

OCCUPANCY (LOCAL/GLOBAL)

Overview — Each zone controller has a software timeclock. The software timeclock must be initialized after any power failure, either by receiving a Time Broadcast (the controller will request time from the network), or by a manually updating the time, through the controller time function.

When designing a system with an air source (that has a PIC that supports linkage), the linkage coordinator zone controller will determine the system scheduling if local occupancy schedules are used at each zone controller.

NOTE: The PIC must be configured with a similar time schedule as the linkage coordinator, so in the event of a failure the PIC will automatically revert back to its configured schedule.

The system occupancy function will provide to the air source a composite view of the current occupancy status of all the zones. If any zone is occupied, the system will indicate to the air source that it should be in occupied mode. If no zones are occupied then the system will indicate to the air source that it should be in unoccupied mode. In addition the system will provide a composite view of the next occupied time, next unoccupied time, and last unoccupied time for the zones.

NOTE: If a single global occupancy schedule is used, it should be configured in the linkage coordinator or air source, although it is not required.

Local Occupancy — Each zone controller will have its own time schedule through which its occupancy state is controlled.

When the control is configured to use its local occupancy schedule, and the zone controller's software timeclock has been initialized, then the local schedule shall determine occupancy status.

The software timeclock will require periodic updates from a time broadcaster in a networked device (with hardware clock). If the software clock has not been initialized, the zone controller will default to the occupied state.

Global Occupancy — A zone controller's occupancy state can be controlled through the network. This will be referred to as global occupancy. Any zone can be configured to broadcast a global occupancy schedule to any zone controller on any bus with the same schedule number. Each Carrier system can support up to a maximum of 35 global occupancy schedules.

The schedule coordinator broadcasts its occupancy status upon transition and every 5 minutes, whenever it is configured as a global schedule (schedule number 65 to 99).

All the controllers on any Carrier communicating bus that are using the same global schedule need to be configured for the same schedule number.

Remote Occupancy Contact — The remote occupancy contact can be used to provide a room occupancy sensor input to the zone controller. If the remote occupancy contact input is in the off position the zone controller will transition to unoccupied. If the remote contact input is in the on position the zone controller will follow its local occupancy schedule.

If the zone controller is broadcasting a global schedule then all the zones following its schedule will also follow its occupancy state based on the remote occupancy contact.

Occupancy Override — The occupancy function will support a timed override function. The timed override will be activated through the space temperature sensor override button. If the override is activated in a zone that is receiving a global time schedule, then the override will be reported to the device issuing the global schedule. The device will then update the occupancy status of the zones receiving the schedule.

NOTE: All zones sharing a global occupancy schedule will be overridden to the occupied mode if any one of the space temperature sensors report an override. For zones that require individual overrides, those zones will have to use a local schedule.

Manual Occupancy Override Function — By using a Carrier network user interface, the user is able to command a timed override by entering the number of hours of override hours (0 to 4 hours). A manual entry greater than 0 will bring the zone controller schedule into the occupancy mode. This function is defined as manual override.

If the occupancy schedule is occupied when the manual override is downloaded, the current occupancy period will be extended by the number of hours downloaded. If the current occupancy period is unoccupied when the occupancy override is initiated, the mode will change to occupied for the duration of the number of hours downloaded.

If the occupancy override is due to end after the start of the next occupancy period, the mode will transition from occupancy override to occupied without becoming unoccupied, and the occupancy override timer will be reset.

An active manual occupancy override or a pending occupancy override may be canceled by downloading a zero to this configuration. Once a number other than zero has been downloaded to this configuration, any subsequent downloads of any value other than zero will be ignored by the zone controller.

Once the override period has expired, the value is reset to 0 and the manual override function is complete. If the override is activated in a zone utilizing local occupancy scheduling, then only that zone is affected. The override will occur for the time configured for that device.

Occupancy Table Format — The occupancy table is common to both a local and global occupancy function. For flexibility of scheduling the occupancy programming is split into eight separate periods. The configuration consists of eight fields corresponding to the seven days of the week and a holiday field in the following order: Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday, Holiday. The occupancy time is configured in hour and minutes in military time. See Table 11 for a typical example of the occupancy table.

Optimal Start Operation — For local occupancy, the occupancy function will factor in the occupancy bias time supplied by the linkage function. This bias time will cause the occupancy period to start earlier by the amount indicated by the bias time. The occupancy function will provide information so that the rest of the zone controller functions can differentiate between biased occupied periods and configured occupied periods.

The Start Bias Time (in minutes) is calculated by the air source as needed to bring the temperature up or down to meet the set point under the optimal start routine. This value will be sent to all associated zones for optimal start of zone controllers.

SYSTEM OVERRIDE MODES

The system will react to three override modes reported by the air source compatible with linkage: pressurization, evacuation, and nighttime free cooling (NTFC).

Pressurization — In Pressurization mode, the system will bring in as much outside air as possible in order to pressurize the area. This mode is used for smoke control and prevents smoke from entering into an area that is adjacent to an area of smoke.

Each zone controller will modulate its damper to provide maximum cooling airflow into the space. If the terminal contains a series fan, the fan will be turned on. If the terminal contains a parallel fan it will be turned off. If the terminal contains auxiliary heat, the heating will be controlled so as to maintain the current heating set point. Secondary dampers in a zone pressurization application will closed.

Evacuation — In Evacuation mode, the system will attempt to remove smoke from an area by creating a negative pressure. Either a return air fan in the air source, or some other fan mechanism will be used to exhaust the smoke filled return air from the space. The terminals will respond by closing their dampers and turning off all fans. Secondary dampers in a zone pressurization application will open.

Table 11 — Occupancy Configuration Table

DESCRIPTION	VALUE	UNITS	NAME
Manual Override Hours	**0**	hours	OVRD
Period 1: Day of Week	**11111111**		DOW1
Period 1: Occupied from	**00:00**		OCC1
Period 1: Occupied to	**24:00**		UNOCC1
Period 2: Day of Week	**00000000**		DOW2
Period 2: Occupied from	**00:00**		OCC2
Period 2: Occupied to	**24:00**		UNOCC2
Period 3: Day of Week	**00000000**		DOW3
Period 3: Occupied from	**00:00**		OCC3
Period 3: Occupied to	**24:00**		UNOCC3
Period 4: Day of Week	**00000000**		DOW4
Period 4: Occupied from	**00:00**		OCC4
Period 4: Occupied to	**24:00**		UNOCC4
Period 5: Day of Week	**00000000**		DOW5
Period 5: Occupied from	**00:00**		OCC5
Period 5: Occupied to	**24:00**		UNOCC5
Period 6: Day of Week	**00000000**		DOW6
Period 6: Occupied from	**00:00**		OCC6
Period 6: Occupied to	**24:00**		UNOCC6
Period 7: Day of Week	**00000000**		DOW7
Period 7: Occupied from	**00:00**		OCC7
Period 7: Occupied to	**24:00**		UNOCC7
Period 8: Day of Week	**00000000**		DOW8
Period 8: Occupied from	**00:00**		OCC8
Period 8: Occupied to	**24:00**		UNOCC8

Nighttime Free Cooling (NTFC) — In NTFC mode, the system is attempting to use cool nighttime (3 AM to 7 AM) outside air to cool down the space. In this mode, the air source will operate its fan and mixed air dampers to provide outside air to the system. The air terminals will act as if they are in the Occupied Cooling mode except that the temperature control set point will be the midpoint between the occupied cooling and heating set points rather than the occupied cooling set point.

SET POINT GROUPING

Each zone controller will contain a set point schedule. This schedule will contain temperature, humidity, and air quality set points. The set point data may be unique to the zone controller or multiple zone controllers may be grouped together to share the same temperature set points.

The controller contains a Set Point Group Number configuration parameter and a Set Point Group Master configuration parameter. When a zone controller is configured as Set Point Master, the zone controller will broadcast its set points to other zone controllers that are configured to accept the Broadcast Set Point Schedule. If a zone controller is not configured to use global set points, the zone controller will use its own onboard set point schedule. The Set Point Master is independent of the Master Linkage zone controller. There can be 16 Set Point Group functions per network bus. Global set points will not be transmitted through bridges.

SPACE TEMPERATURE SHARING

Each zone controller has the capability to share its local sensor and temperature offset with other zone controllers. Each zone controller can be configured as a broadcaster of its sensor or a receiver of another zone's sensor information. Zone controllers sharing a common sensor must all be installed on the same Carrier communicating bus. Sharing of sensor information cannot be accomplished through bridges.

SENSOR GROUPING

A zone controller that is set up as a Linkage linkage coordinator has the ability to poll its linked controllers and collect the high, low or average value of any variable within its linked controllers. Once the high, low or average is determined, the linkage coordinator can then transfer that value to a configured bus number, element number and point name. Typically this feature is used to determine a system's highest indoor air quality reading for use in a Demand Controlled Ventilation (DCV) system.

In order to utilize this feature, the Carrier network Variable Name being collected from the linked zone controllers must be supplied. Also the data transfer rate must be specified and whether the high, low or average value is being calculated. Finally, a valid point name and Carrier network address must be entered.

CALIBRATION

The zone controller provides a Commissioning mode that calibrates the damper position feedback sensor and the airflow sensor. This commissioning should be performed once when the terminal is installed. In addition, the zone controller will perform an ongoing auto-calibration of the airflow sensor to maintain airflow measurement accuracy. Refer to installation and start-up instruction for more details.

CARRIER NETWORK ALARMS

The zone controller will support the detection of alarm conditions and the reporting of those conditions through the Carrier network. No local indication of any alarms will be provided at the zone controller itself. Alarms will be routed to Carrier network devices as required by setting the appropriate routing bits in the alarm routing configuration. No alarms will be transmitted if alarm routing is set to 00000000 (default). The control implements and uses a standard alarm configuration table, specifying routing, re-alarm, etc. Alarms use level 6 (control) for limit-exceeded alarms, and level 2 (service) for all other alarms. Alarm activity is stored in an Alarm History Table, containing the 5 most recent alarm messages.

Space Temperature Limit Alarm — During occupied periods, an alarm value is used to define the allowable deviation from set points before an alarm condition is detected. This value is added to the occupied cooling set point and subtracted from the occupied heating set point during occupied periods. This allows the set points to be easily changed without having to change the alarm limits. During normal steady state operation, whenever the space temperature deviates outside of this defined range, a timer will begin. If after 5 minutes the alarm condition still exists, the alarm will be generated. An alarm value of 1 degree F (non-adjustable) is used to determine when the space temperature has returned to normal.

During unoccupied and biased start periods, the alarm set points are defined by two configured values (unoccupied low and unoccupied high). The alarm detection and return to normal operates as specified above for occupied conditions, except unoccupied alarm values are used.

To prevent false alarms during a transition from Unoccupied or Biased Occupied operation to Occupied operation (or if a set point is changed), an alarm delay is calculated each time the control set point changes. The value of the delay is equal to 15 minutes, plus 15 minutes per degree difference between the new heating or new cooling set point and the current space temperature. The alarm delay has a maximum value of 255 minutes.

Linkage Failure (Failure to Communicate With Linkage Coordinator) — If a terminal has established communications from a linkage coordinator, then the linkage coordinator will exchange information with each of the configured zones each minute. If a zone fails to receive updates from the linkage coordinator for 5 sequential times (greater than 5 minutes without successful communications), then a Linkage Failure communication alarm is generated. The alarm is generated from the zone that indicated loss of communication with Linkage Master. To determine when communications have returned to normal, the controller will continue to monitor the communication status. After 5 sequential successful communications, then a return to normal message is generated, although normal operation will resume after the first successful communication.

Linkage Failure (Failure to Communicate with Air Source) — If a zone controller has been configured as the linkage coordinator, and an air source address has been configured to a value other than the default, then the linkage coordinator zone controller will exchange information with the configured air source once each minute. The air source must be Linkage compatible.

If the air source fails to respond, then the linkage coordinator will attempt to retry communication. If unsuccessful, the linkage coordinator will log the attempt as a failure. If 5 sequential failures occur (more than 5 minutes without successful communication), then a Linkage Failure communication alarm is generated for the air source. The alarm indicates a Linkage Air Source Failure at address X, X (where X, X is the failed air source address). To determine when communications have returned to normal, the controller will continue to monitor the communication status. After 5 sequential successful communications occur, a return to normal message is generated.

Supply Air Temperature Sensor Failure — This alarm is generated only on pressure dependent applications when a SAT is present or on pressure independent applications where a ducted heat is configured. If the supply air temperature sensor fails then a Supply Air Temperature Sensor Failure alarm for that zone is generated. The zone controller will wait 2 minutes before generating the alarm. A return to normal (or reset of the time delay) occurs immediately upon the detection of a normal temperature or if the ducted heat is configured to No.

Primary Air Temperature Sensor Failure — For any linkage coordinator where the air source address is NOT configured (default value), if the primary air temperature sensor fails then a Primary Air Temperature Sensor Failure alarm is generated. The alarm is generated after a 2-minute delay. A return to normal (or reset of the time delay) occurs immediately upon the detection of a normal temperature or if an air source address is configured.

Pressure Sensor Low Airflow Pressure Alarm (PI Only) — Any time the value of the input channel voltage falls below a minimum acceptable value (0.89 V), then a Low Airflow Pressure alarm will be generated for that zone. For all control types except Dual Duct or Room Pressure Control, the alarm indicates an Airflow Sensor Low Pressure alarm.

For Dual Duct and Zone Pressure Control applications, both primary airflow and secondary airflow sensors are monitored for this condition. The appropriate alarm message is generated, based upon the sensor failure detected.

To determine when normal conditions have returned, the zone controller will continue to monitor the input. When the voltage rises to within tolerance (above 0.91 v), a return to normal message is generated.

NOTE: A value of 0.89 volts is the minimum acceptable 0 in. wg value.

Pressure Sensor High Velocity Pressure Alarm (PI Only) — Any time the calculated value of the measured velocity pressure exceeds the configured maximum value for more than 5 minutes, then a High Velocity Pressure alarm is generated for that zone. The range is 0.250 in. wg to 2.000 in. wg. The default is 1.200 in. wg. For Dual Duct and Room Pressure Control applications, both primary airflow and secondary airflow sensors are monitored for this condition. The appropriate alarm message is generated, based upon the appropriate sensor measurement.

The zone controller will continue to monitor the input, and when the pressure falls below the alarm limit minus 0.1 in. wg, a return to normal message is generated.

Relative Humidity Sensor Alarm

PRESSURE DEPENDENT APPLICATIONS — If the controller is configured for a relative humidity sensor for monitoring only, and the value is not within the range of 0 to 100% (a short or open), then a sensor failure alarm will be generated.

PRESSURE INDEPENDENT APPLICATIONS — If the controller is configured for Relative Humidity control and the value of the sensor exceeds the Relative Humidity High alarm limit or falls below the Relative Humidity Low alarm limit during occupied periods, then an alarm is generated. The condition must exceed the alarm limit for 5 minutes before the zone controller will issue the alarm.

The alarm will be generated only if Humidity Control is Enabled. A delay is applied whenever the control transitions to an occupied mode or if the control set point is changed in order to prevent false alarms. The delay is similar to the Space Temperature Alarm Limit Delay. The low Relative Humidity alarm has a configurable range from 0% to 100% and a default of 20%. The high Relative Humidity alarm has a configuration range from 0% to 100% and a default of 70%. A fixed hysteresis of 2% is used to determine when the conditions have returned to normal. Alarms can be generated during occupied and unoccupied times.

IAQ Sensor Alarm — If the zone controller is configured for IAQ control and the value of the sensor exceeds the IAQ High Alarm Limit or falls below the IAQ Low Alarm Limit during occupied periods, then an alarm is generated. The alarm condition has a delay of 5 minutes before the alarm to be generated.

The alarm is generated only if the IAQ control is Enabled. A 2-hour delay is applied whenever the zone controller transitions to an occupied mode, in order to prevent false alarms. The low IAQ alarm limit has a configuration range of 0 to 5000 (ppm) with a default of 0. The high IAQ alarm limit has a configuration range of 0 to 5000 (ppm) with a default of 2000. For flexibility, the limits for the IAQ alarm do not include units, but the IAQ sensor alarm descriptions (24-character text) include the default units ('PPM') as part of the description.

To determine when normal conditions have returned, the zone controller will apply a 2% hysteresis to the alarm limits, and generate a return to normal message when the sensor returns within range (2% of the alarm limit value).

Failure to Zero Calibrate Pressure Transducer (PI and Bypass Controller Only) — During the zero calibration procedure, if the airflow pressure input voltage fails to decrease to within the allowable zero pressure range, the zone controller will generate a Failure to Zero Calibrate Pressure Transducer alarm.

Damper Position and Actuator Installation — During the damper calibration procedure of the Commissioning Mode or during the zero calibration, after the damper is driven closed, the control will generate a Damper Actuator Failure to Close alarm if the corresponding damper position is not within the specified closed position range. The acceptable input voltage range is above 8.5 vdc for clockwise open and below 1.5 vdc for counterclockwise open. The damper position sensor has a 0 to 10 vdc range.

APPLICATION

General — The VVT® zone controller is a Carrier communicating device that conforms to standard Carrier communications protocol. The zone controller is capable of controlling Carrier and many non-Carrier air terminal units in networked or stand-alone applications. The zone controller includes an integrated modulating damper actuator.

Each zone controller can operate in a stand-alone mode based on the sensors installed.

If the supply air sensor is not installed, the controller will assume that the air source is on and that the air source's operating mode is cooling. The zone controller will operate using only its minimum and maximum cooling damper position configuration limits. If the zone controller is equipped with ducted type heat, then when local heating is not active, the temperature read from the SAT sensor will be used to determine if the air source is heating or cooling. The appropriate minimum and maximum cfm limits (heating or cooling) or damper position will be used based on the air source operating mode.

NOTE: In this mode of operation, the minimum heat and cool limits must NOT be set to zero.

Finally, a primary air temperature (PAT) sensor can be connected to any stand-alone zone controller and mounted in the supply air duct where it is not affected by the airflow of a specific zone. In this case, the zone controller is configured as a Linkage Coordinator zone with a system size of 1. In this configuration, the zone will determine the air source operating

mode (OFF, COOLING, HEATING, or FREE COOLING). Because the PAT sensor is not affected by airflow at the zone, minimum airflow limits may be set to 0 cfm.

Each zone controller supports the following set points:

- occupied cooling
- occupied heating
- unoccupied cooling
- unoccupied heating

NOTE: The minimum differential between the heating and cooling set points is 1.0 degree F.

For pressure independent applications and the bypass controller, to provide an accurate low-end airflow or pressure measurement, the control performs an automatic zero calibration (ZeroCal) feature. The controller does this to account for any offset, which may be inherent in the airflow sensor.

The ZeroCal procedure will be performed every time the air source mode transitions to OFF. Additionally, for systems which operate continuously, a ZeroCal procedure will be performed every 72 hours. To prevent all the dampers from closing simultaneously, an offset time delay based upon the zone controller address is used.

NOTE: When the Bypass Controller is requested to do a ZeroCal procedure, it will cause the Linkage Coordinator to send out unoccupied and satisfied zone conditions for 5 minutes so the air source will shut off the fan.

The zone controller can be used in the following applications:

1. Single duct terminal applications
   a. Cooling only
   b. Staged electric heat
   c. Hot water/steam heat (modulating or two-position)
   d. radiant/baseboard and ducted heat (pressure dependent only)
2. Series fan terminal applications
   a. Cooling only
   b. Staged electric heat
   c. Hot water/steam heat (modulating or two-position)
   d. radiant/baseboard and ducted heat (pressure dependent only)
3. Parallel fan terminal applications
   a. Cooling only
   b. Staged electric heat
   c. Hot water/steam heat (modulating or two-position)
   d. radiant/baseboard and ducted heat (pressure dependent only)

This section of the manual describes operating sequences for the zone controller in its various configurations and modes. It presents separate descriptions for single duct, series fan powered, and parallel fan powered air terminals in the following configurations: without local heat, with staged electric heat, and with hot water or steam heat (two-position or proportional). The system in which the zone controllers operate should also contain a control with linkage coordination or an air source with either linkage compatible controls.

Each description is accompanied by figures depicting the hardware configuration and the sequence of control events for the application being described. In the control sequence diagrams the vertical axis represents airflow and the horizontal axis represents space temperature. The sequence of events for cooling operation reads from right to left, and the sequence of events for heating operation reads from left to right.

The zone controller employs proportional/integral/derivative (PID) control routines to provide precise, efficient, and stable control. The PID calculations take into account both the space temperature deviation from set point and the rate at which the temperature is changing.

Typical VVT® System Overview — The VVT system is a control system designed to provide multiple zones of temperature control using a single, constant volume heating and cooling packaged unit. Traditionally, the VVT system has been primarily a pressure dependant system that adjusts damper position based on space temperature variation from set point.

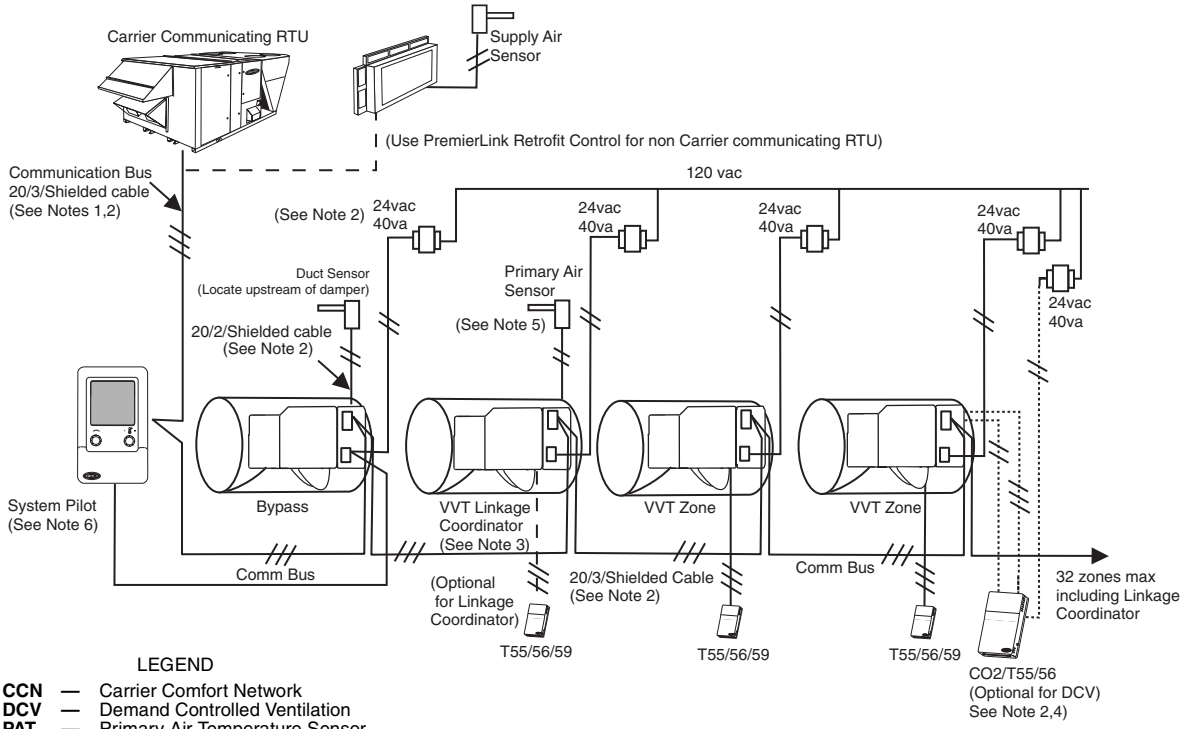
Typical VVT applications include medical and dental offices, 1 to 3 story commercial buildings, and strip mall and retail stores. See Fig. 7 and Table 12.

Table 12 — Typical VVT System Components
(Pressure Dependent Control Only)

REQUIRED COMPONENTS			OPTIONAL COMPONENTS		
Devices	**Part Number**	**Usage**	**Devices**	**Part Number**	**Usage**
VVT Zone Controller	**33ZCVVTZC-01**	1 per pressure dependent zone	**PremierLink™ Controller**	**33CSPREMLK**	1 required per system if non-communicating air source.
Bypass Controller	**33ZCBC-01**	1 per system	**Supply Air Temp Sensor**	**33ZCSENSAT**	1 required for bypass Option for zones
System Pilot	**33PILOT-01**	1 per system on com bus. Optional for space sensors	**CO_2 Sensors**	**33ZCT55CO2 33ZCT56CO2**	as required per zone for DCV
Space Sensor	**33ZCT55SPT 33ZCT56SPT 33ZCT59SPT**	1 per zone	**Relative Humidity Sensor**	**33ZCSENSRH-01 33ZCSENDRH-01**	Optional to Monitor RH only (if no DCV sensor).
Primary Air Temp Sensor	**33ZCSENPAT**	1 per Linkage Coordinator	**Outside Air Temp Sensor**	**HH79NZ039**	Required with field-installed PremierLink control

LEGEND

DCV — Demand Controlled Ventilation
RH — Relative Humidity



LEGEND

CCN — Carrier Comfort Network
DCV — Demand Controlled Ventilation
PAT — Primary Air Temperature Sensor
RTU — Rooftop Unit
VVT — Variable Volume/Variable Temperature

NOTES:
1. 239 devices maximum per bus. Repeater required every 1000 ft or 60 devices. Maximum of 3 repeaters per bus.
2. Communication bus and sensor wiring MUST be separate from AC power wiring.
3. Up to 32 total zones per system. Maximum of 8 Linkage Coordinators with a total of 128 devices per single bus.
4. Combination CO_2/T55/T56 sensor may be used in place of T55/T56/T59 on any zone requiring DCV. RTU must be capable of controlling economizer for DCV conditions.
5. Locate PAT in supply air duct from air source unit.
6. System Pilot can share power with Bypass Controller or VVT Zone Controller.

Fig. 7 — VVT Pressure Dependent System

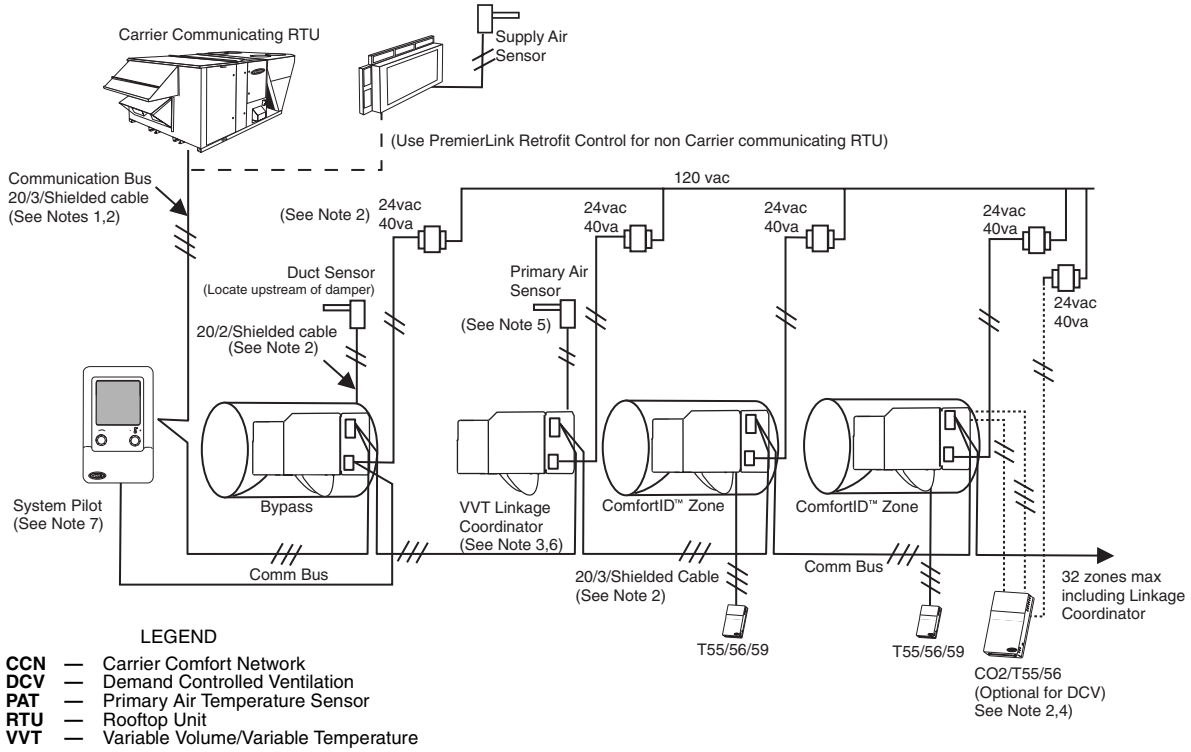
VVT® Pressure Independent System Overview — Pressure Independent VVT systems are used when the airflow into the zone is critical and must be maintained. With a pressure independent strategy, zone damper position is modulated to maintain zone airflow at a cfm flow rate calculated by the controller, based on space temperature variation from set point. Therefore, even though the supply duct static pressure changes, the airflow volume at the zone remains constant. See Fig. 8 and Table 13.

Table 13 — VVT Pressure Independent Only System Components
(Pressure Independent Control Only)

REQUIRED COMPONENTS			OPTIONAL COMPONENTS		
Devices	**Part Number**	**Usage**	**Devices**	**Part Number**	**Usage**
VVT Zone Controller	**33ZCVVTZC-01**	1 for Linkage Function Only	**PremierLink™ Controller**	**33CSPREMLK**	1 required per system if non-communicating air source.
VAV Zone Controller (ComfortID)	**33ZCVAVTRM**	1 per pressure independent zone	**Supply Air Temp Sensor**	**33ZCSENSAT**	1 required for bypass Option for zones
Bypass Controller	**33ZCBC-01**	1 per system	**CO_2 Sensors**	**33ZCT55CO2 33ZCT56CO2**	as required per zone for DCV
System Pilot	**33PILOT-01**	1 per system on com bus. Optional for space sensors	**Relative Humidity Sensor**	**33ZCSENSRH-01 33ZCSENDRH-01**	Optional to Monitor RH only (if no DCV sensor).
Space Sensor	**33ZCT55SPT 33ZCT56SPT 33ZCT59SPT**	1 per zone	**Outside Air Temp Sensor**	**HH79NZ039**	Required with field-installed PremierLink control
Primary Air Temp Sensor	**33ZCSENPAT**	1 per Linkage Coordinator			

LEGEND

DCV — Demand Controlled Ventilation



LEGEND

CCN — Carrier Comfort Network
DCV — Demand Controlled Ventilation
PAT — Primary Air Temperature Sensor
RTU — Rooftop Unit
VVT — Variable Volume/Variable Temperature

NOTES:
1. 239 devices maximum per bus. Repeater required every 1000 ft or 60 devices. Maximum of 3 repeaters per bus.
2. Communication bus and sensor wiring MUST be separate from AC power wiring.
3. Up to 32 total zones per system. Maximum of 8 Linkage Coordinators with a total of 128 devices per single bus.
4. Combination CO_2/T55/T56 sensor may be used in place of T55/T56/T59 on any zone requiring DCV. RTU must be capable of controlling economizer for DCV conditions.
5. Locate PAT in supply air duct from air source unit.
6. VVT zone controller is required for Linkage Coordinator functions if all zones are pressure independent.
7. System Pilot can share power with Bypass Controller or VVT Zone Controller.

Fig. 8 — VVT Pressure Independent System

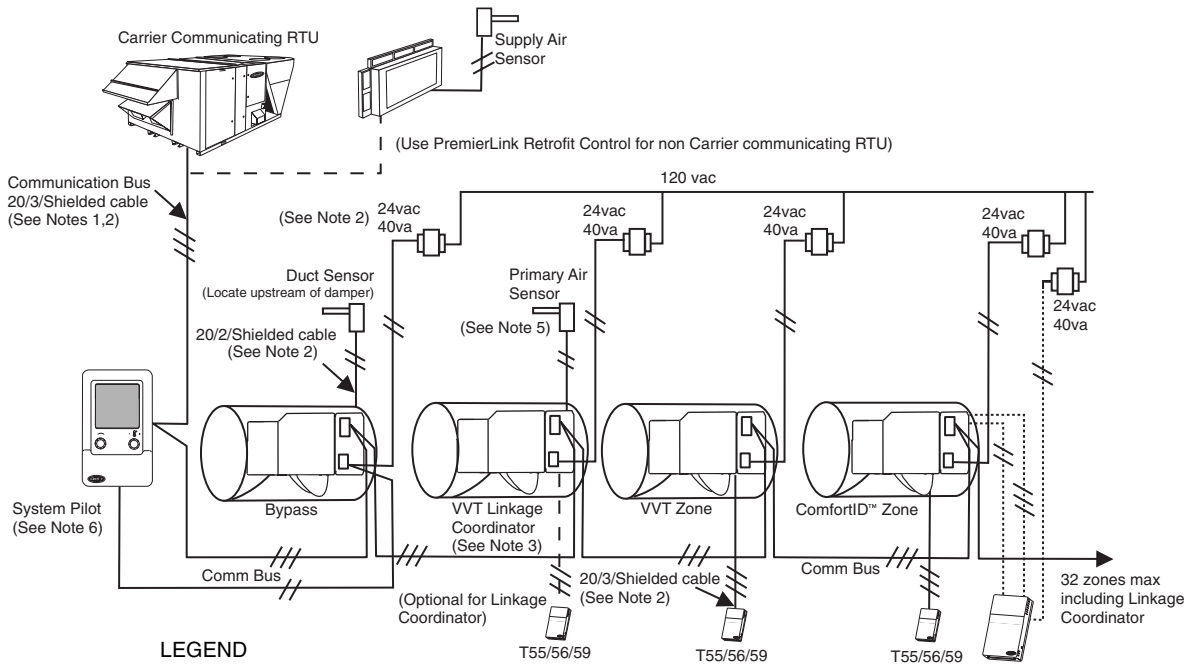
VVT® Pressure Dependent and Independent System Overview — In many applications VVT Systems require both pressure dependent and independent zone control. With 3V™ control system both forms of control are available. Simply use Carrier's VAV Zone Controller, to provide pressure independent control for critical airflow zones. See Fig. 9 and Table 14.

Table 14 — VVT Pressure Dependent and Independent System Components

REQUIRED COMPONENTS			OPTIONAL COMPONENTS		
Devices	**Part Number**	**Usage**	**Devices**	**Part Number**	**Usage**
VVT Zone Controller	**33ZCVVTZC-01**	1 per pressure dependent zone	**PremierLink™ Controller**	**33CSPREMLK**	1 required per system if non-communicating air source.
VAV Zone Controller (ComfortID)	**33ZCVAVTRM**	1 per pressure independent zone	**Supply Air Temp Sensor**	**33ZCSENSAT**	1 required for bypass Option for zones
Bypass Controller	**33ZCBC-01**	1 per system	**CO_2 Sensors**	**33ZCT55CO2 33ZCT56CO2**	as required per zone for DCV
System Pilot	**33PILOT-01**	1 per system on com bus. Optional for space sensors	**Relative Humidity Sensor**	**33ZCSENSRH-01 33ZCSENDRH-01**	Optional to Monitor RH only (if no DCV sensor).
Space Sensor	**33ZCT55SPT 33ZCT56SPT 33ZCT59SPT**	1 per zone	**Outside Air Temp Sensor**	**HH79NZ039**	Required with field-installed PremierLink control
Primary Air Temp Sensor	**33ZCSENPAT**	1 per Linkage Coordinator			

LEGEND

DCV — Demand Controlled Ventilation



LEGEND

CCN — Carrier Comfort Network
DCV — Demand Controlled Ventilation
PAT — Primary Air Temperature Sensor
RTU — Rooftop Unit
VVT — Variable Volume/Variable Temperature

NOTES:
1. 239 devices maximum per bus. Repeater required every 1000 ft or 60 devices. Maximum of 3 repeaters per bus.
2. Communication bus and sensor wiring MUST be separate from AC power wiring.
3. Up to 32 total zones per system. Maximum of 8 Linkage Coordinators with a total of 128 devices per single bus.
4. Combination CO_2/T55/T56 sensor may be used in place of T55/T56/T59 on any zone requiring DCV. RTU must be capable of controlling economizer for DCV conditions.
5. Locate PAT in supply air duct from air source unit.
6. System Pilot can share power with Bypass Controller or VVT Zone Controller.

Fig. 9 — VVT Pressure Dependent and Independent System

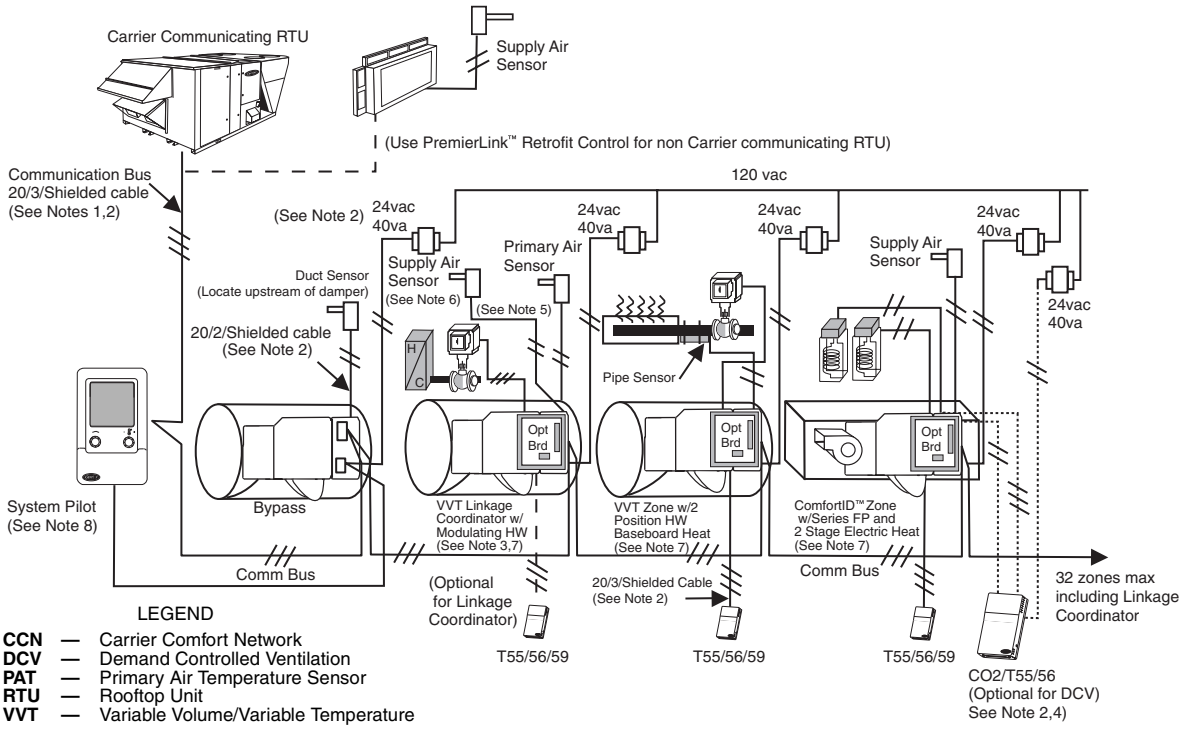
Fan Powered and Reheat VVT® Ssystem Overview — Adding supplemental heat and fan-powered terminals has never been simpler than with 3V™ control system. Simply add a stackable option board to any VVT zone controller and your system is ready. New reheat flexibility offers floating-point control for hot water valves and combination 2-position baseboard with ducted staged heat. See Fig. 10 and Table 15.

Table 15 — Fan Powered and Reheat VVT Systems Components
(Pressure Dependent and Independent Control Capability)

REQUIRED COMPONENTS			OPTIONAL COMPONENTS		
Devices	**Part Number**	**Usage**	**Devices**	**Part Number**	**Usage**
VVT Zone Controller	**33ZCVVTZC-01**	1 per pressure dependent zone	**PremierLink™ Controller**	**33CSPREMLK**	1 required per system if non-communicating air source.
VAV Zone Controller (ComfortID)	**33ZCFANTRM**	1 per pressure independent zone with fan or reheat	**Supply Air Temp Sensor**	**33ZCSENSAT**	1 required for bypass Option for zones
Bypass Controller	**33ZCBC-01**	1 per system	**CO_2 Sensors**	**33ZCT55CO2 33ZCT56CO2**	as required per zone for DCV
System Pilot	**33PILOT-01**	1 per system on com bus. Optional for space sensors	**Relative Humidity Sensor**	**33ZCSENSRH-01 33ZCSENDRH-01**	Optional to Monitor RH only (if no DCV sensor).
Space Sensor	**33ZCT55SPT 33ZCT56SPT 33ZCT59SPT**	1 per zone	**Strap-on Pipe Temp Sensor**	**33ZCSENCHG**	Optional if baseboard heat ONLY. (Not required with zone ducted heat)
Primary Air Temp Sensor	**33ZCSENPAT**	1 per Linkage Coordinator	**Outside Air Temp Sensor**	**HH79NZ039**	Required with field-installed PremierLink control
Fan/Reheat Option Board	**33ZCOPTBRD-01**	1 required per VVT Zone with Reheat			

LEGEND

DCV — Demand Controlled Ventilation
PD — Pressure Dependent
RH — Relative Humidity



NOTES:
1. 239 devices maximum per bus. Repeater required every 1000 ft or 60 devices. Maximum of 3 repeaters per bus.
2. Communication bus and sensor wiring MUST be separate from AC power wiring.
3. Up to 32 total zones per system. Maximum of 8 Linkage Coordinators with a total of 128 devices per single bus.
4. Combination CO_2/T55/T56 sensor may be used in place of T55/T56/T59 on any zone requiring DCV. RTU must be capable of controlling economizer for DCV conditions.
5. Locate PAT in supply air duct from air source unit.
6. Locate downstream of ducted reheat.
7. Option Board required for all VVT zones with heat and/or fan powered mixing box.
8. System Pilot can share power with Bypass Controller or VVT Zone Controller.

Fig. 10 — VVT Pressure Dependent/Pressure Independent with Fan Powered Zones and/or Reheat System

Compatibility of Carrier Systems

3V™ AND GEN-III VVT® PRODUCT COMPATIBILITY — Refer to Table 16 for the compatibility of Carrier's 3V control system and GEN-III VVT products.

VVT GEN II CONVERSION (Manufactured prior to July 1995) — There is no compatibility between VVT Gen II systems and 3V control systems. A complete change of system components is required with the exception of physical dampers which may remain in place. The existing 5-wire control wiring from the thermostat to the damper may be used for the System Pilot communication wire or for a T55, T56, or T59 space sensor. The wiring must be 18 to 20 AWG (American Wire Gage) stranded, shielded cable and conform to 3V control system and Carrier communicating network wiring guidelines. Any wiring that does not conform to these guidelines must be replaced.

Table 16 — 3V and GEN-III VVT Product Compatibility

GEN III PRODUCT	DESCRIPTION	COMPATIBLE FOR USE WITH 3V CONTROL SYSTEM
TEMP SYSTEMS		
Working Gen-III TEMP systems may reside on same bus with a 3V control system. If an existing Gen-III TEMP system needs component replacement, refer to the components below.		
33CSTM(T)-01	TEMP Monitor	No. Replace with PremierLink™ control
33CSUCE-06	TEMP System Relay Pack	No. Replace with PremierLink control
VVT GEN-III SYSTEM COMPONENTS		
Working Gen-III VVT systems may reside on same bus with a 3V control system. If an existing Gen-III system needs component replacement, refer to the components below.		
33CSVM(T)-32	VVT Monitor Thermostats	Yes for a 3V Zone(s)*
33CSBC-00	Bypass Controllers	Yes. †
33CSZC-01	Pressure Dependent Zone Controller	No. Use 33ZCVVTZC-01.**
33CSZC-PI	Pressure Independent Zone Controller	No. Use 33ZCVAVTRM-01.††
DAMPERS		
33CSDCDR	Round or Rectangular	Yes – *sheet metal only*
33CASDCARPL, M08	Damper Actuators	No
33CSDCA060,090	High Torque Damper Actuators	No
RELAY PACKS		
33CSZRP-06	Universal Damper Relay Pack	No
33CSUCE-06	Monitor-only Relay Pack	No
SENSORS		
920238 (HS)	Humidity Sensor	No, 3V system uses 2 to 10 vdc humidity sensor.
920247 (RAS)	Refrigerated Air (DX) Sensor	No. 3V system uses standard 10K sensors.
920076 (RDS)	Remote Duct Sensor	No. 3V system uses standard 10K sensors.
920077 (RDS)	Remote Room Sensor	No. 3V system uses standard 10K sensors.
920089 (OAS)	Outside Air Sensor	No. 3V system uses standard 10K sensors.
33CSPS-01	Pressure Sensor	No, 3V static pressure sensor is integrated into Bypass Controller. For PI zones, velocity pressure sensor is integrated into the VAV (ComfortID™) controller.
33CSPS-02	Pressure Sensor	No, 3V static pressure sensor is integrated into Bypass Controller. For PI zones, velocity pressure sensor is integrated into the VAV (ComfortID) controller.
33ZCSENCO2	CO_2 Sensor	Yes
	EXISTING WIRING	
	Non-Shielded device, bus or sensor wiring	No
	Shielded device, bus or sensor wiring	Yes
	24 VAC power wiring	Yes

LEGEND

DX — Direct Expansion
PI — Pressure Independent
VVT — Variable Volume/Variable Temperature

*A Gen-III VVT Monitor will scan new 3V zones. No special configuration is required. Address 3V zone within the Gen-III Monitor's scanning range. If the Gen-III VVT monitor needs replacement and components are not available, 3V zone controller(s) may be substituted for all zones with compatible sensors. Existing damper may be re-used, but with new 3V actuator(s).

†An Integrated Gen-III Bypass Controller and damper may remain in 3V system, but must be re-addressed out of the 3V system's scanning range, and must be configured for Standalone operation. If the Gen-III Bypass Controller needs replacement and components are not available, 3V bypass controller may be substituted with compatible sensors. Existing damper may be re-used, but with new 3V actuator.

**A Gen-III Pressure Dependent Zone Controller is not compatible in 3V system. However, a 3V zone controller is compatible in a Gen-III system. If the Gen-III Zone Controller needs replacement and components are not available, 3V zone controller may be substituted with compatible sensors. Existing damper may be re-used, but with new 3V actuator.

††A Gen-III Pressure Independent Zone Controller is not compatible with 3V systems. If the Gen-III PI Zone Controller needs replacement and components are not available, ComfortID controller may be substituted when configured for Standalone only out of Gen-III Monitors scanning range, and with compatible sensors. Existing damper may be re-used, but with new ComfortID actuator.

General Heating Information — Heating may be one of two types, ducted or non-ducted. In a ducted heat type system, the heating mechanism is located within the air terminal, upstream of the supply air temperature (SAT) sensor. The heating device may be either a hot water/steam heating coil or up to three stages of electric heat. Use of a air terminal heating coil will require that the zone controller be wired to a supply air temperature sensor. The SAT sensor will measure the supply air temperature into the zone. The SAT sensor will provide feedback to the auxiliary PID heating control loop and ensures that the supply air temperature does not exceed the configured maximum temperature.

NOTE: For pressure dependent applications, the option board is required for heat.

There are five types of heat a zone controller can be configured for use with:

- modulating hot water/steam valve (VAV) (pressure independent applications only)
- modulating hot water/steam valve (CV [constant volume])
- two-position hot water/steam valve
- electric heat (1 to 3 stages)
- radiant/baseboard and ducted heat (pressure dependent applications only)

If a Heating Type is configured, but Ducted Heating is NOT selected, the heating control algorithm will not utilize an SAT sensor. A two-position heating valve or single-stage electric heat are most common, although the zone controller can operate up to 3 non-ducted electric heat stages. The zone controller will maintain the space temperature at the heating set point. The zone controller will wait for the Heat On Delay to expire before energizing any heating device.

For non-ducted, modulating hot water baseboard applications, the zone controller requires a 10K ohm leaving water sensor which is attached to the baseboard heater and wired to the SAT sensor input. This device is field supplied. It is strongly recommended that the valve and sensor be installed on the leaving water side of the hydronic heater.

NOTE: A 33ZCENSCHG changeover sensor can be used as a leaving water sensor.

If the zone controller is configured as a parallel fan type terminal, the zone controller will utilize the fan as the first stage of heat, regardless of the heat type configured. The amount of time the fan will operate as the first heat stage is determined by the value configured for the Heat On Delay (10 to 20 minutes recommended).

The Heat On Delay is used to prevent mechanical heating from being operated for a configured period of time. For single duct type terminals, a delay of 2 minutes (default value) allows the zone controller to increase the airflow to the desired reheat cfm or desired reheat damper position before operating heat. For parallel fan type terminals, the default value is typically increased to 15 minutes to allow the fan to utilize heat from the ceiling plenum, before any additional mechanical heating is energized.

Disabling Reheat From Carrier Communicating Network — The zone controller provides a means to disable the reheat function from the Carrier network. This is used to prevent zones that use a central heat source from using local heat. When the central heating source is not producing hot water or steam heat to the terminals (the boiler is disabled for example), a system mode broadcast can prevent these terminals from entering reheat mode. By preventing reheat, the zone controller will control to the minimum cooling cfm or damper position rather than the higher reheat cfm or damper position. This will prevent more cool air from entering into the space when heating is actually required.

The HEAT ENABLED variable is located in the display table for each zone controller and can be forced from the Carrier network. Normally when the zone controller is in heating, this variable will indicate ENABLE. To disable heating when the central heat source is off, this variable must be forced to DISABLE. This force should occur at least once an hour and sent to all zone controllers that are supplied heat from the central source. This application will require the use of a Comfort Controller or data transfer module to accomplish this function.

Non-Ducted Heat Control (Single or Staged Heat) — Any zone controller can support the non-ducted heat function. The non-ducted heat function can be configured for either single duct units, fan powered parallel, or fan powered series applications. Non-ducted heat can also be used with constant volume dual duct applications where auxiliary perimeter heat is provided. Heat needs to be controlled within the zone that is controlled by the terminal unit. Non-ducted heat can be applied to zone controller units configured as Dual Duct Units which have additional perimeter heating.

In a non-ducted heat application, the heating controlled device is located within the space. The heating device is typically either a two position (On-Off) device like a hot water valve or electric baseboard heater. For this application, no heating control loop feedback is required. The installation of the supply air sensor is not required when the unit is configured for non-ducted heat.

Additionally, the zone controller can control a single stage, two-position, or multistage electric supplemental heat devices. The zone controller will only use space temperature as feedback into the temperature control loop to maintain the heating set point in these applications.

When the 33ZCVVTZC-01, 33ZCVAVTRM, or 33ZCFANTRM zone controllers are applied and configured for heat, and heating is being called for in the space, the zone controller reads the space sensor and the output is adjusted to satisfy conditions. The number of stages (if applicable) is determined by comparing space temperature with the current biased heating set point.

Configuration determines the logic output type for normally open or normally closed type two-position valves. Hysteresis is determined by the Heating Proportional Gain configured.

A terminal unit equipped with heating will provide the minimum heating cfm configured for the zone whenever the air source is in heat mode unless VAV central heating is enabled.

The heating control maintains the current heating set point (plus any offset from a 33ZCT56SPT sensor slide bar during occupied periods).

Modulating Baseboard Heating — The zone controller can provide control of modulating hot water (hydronic) baseboard heating which provides perimeter heating for a zone. The zone controller can be used with single duct, fan powered, or dual duct terminals using perimeter hydronic heating. A field-supplied modulating (floating point type) water valve is used to control the flow of water through the baseboard hydronic heating coil. A field-supplied accessory temperature sensor (33ZCSENCHG) attached to the leaving water side of the hydronic baseboard heating coil is required to properly modulate the hot water valve.

NOTE: It is strongly recommended to mount both the temperature sensor and the modulating water valve to the leaving side of the hydronic heater. This will minimize installation time and improve valve life.

Ducted Heat Control (Staged or Modulating Device) — The zone controller can support a ducted heat function. The ducted heat function can be configured for either single duct units, fan powered parallel, or fan powered series applications where heat needs to be controlled within the zone that is supplied by the terminal unit.

For this application, heating control loop feedback is required. The installation of the supply air sensor is required when the unit is configured for ducted heat.

The zone controller can control a single stage, two-position, multistage electric heat, or a modulating hot water valve.

When the 33ZCVVTZC-01, 33ZCVAVTRM, or 33ZCFANTRM zone controllers are applied and configured for heat, and heating is being called for in the space, the zone controller reads the space sensor and the output is adjusted to satisfy conditions. The number of stages (if applicable) is determined by comparing space temperature with the current biased heating set point.

Configuration determines the logic output type for normally open or normally closed type two-position valves.

A terminal unit equipped with heating will provide the minimum heating cfm configured for the zone whenever the air source is in heat mode unless VAV central heating is enabled.

The heating control maintains the current heating set point (plus any offset from a 33ZCT56SPT sensor slide bar during occupied periods).

Modulating Hot Water/Steam Valve CV — The Modulating Hot Water/Steam Valve CV mode is designed to use modulating heat valve with a constant volume airflow. This mode of operation allows all cfm set points to be set to the same cfm value. The zone reheat will temper the supply air to maintain proper zone temperature at the configured constant volume of air.

Central Heating — The use of the zone controller in a system allows for the application of heating utilizing the heat from a central air source. The zone controller provides the ability to add heat to a system during the occupied mode from a central source. Terminal units designed without any local heat (ducted or non ducted), should utilize heating. During heating, the zone controller modulates its primary air damper to provide heat when the air source is in Heat Mode. The airflow is controlled so that the zone achieves and maintains the desired heating set point.

NOTE: Central heating is always set to YES on VVT® zone controllers. No central heating configuration is available if it is changed to NO.

In central heating, the terminal provides a variable volume into the zone. The central supply air will be a source of heating when the air source is in the heating mode.

For pressure independent applications, the zone controller temperature control loop determines the airflow set point that is required to maintain space temperature at the heating set point. Each zone controller modulates between the minimum heating cfm and the maximum heating cfm during central heating. This cfm should be limited to a configured range of values that allows the air source to operate properly in the heating mode.

For pressure dependent applications, the minimum and maximum damper positions are used to maintain the space temperature during central heating.

⚠ CAUTION

When using central heating, it is the system designer's responsibility that the central apparatus is protected during heating to provide proper airflow over the central heating device. Ensure that there will be a minimum system airflow that will allow the air source to operate safely in the heating mode. The zone controller (pressure independent only) will allow for the option of disabling the central heating function in a given zone. This means that a central air source may provide heating for the entire system, or possibly only provide it for those terminals without heat at the zone level.

In a system with a Linkage compatible air source, the zone controller will notify the corresponding linkage coordinator zone controller that the unit is Heat mode.

In the case of a non-Linkage compatible air source, the zone controller should be set up as the linkage coordinator for that air source. The zone controller will determine if the primary-air temperature is greater than the weighted average space temperature, and if higher, then declares the central air source in heating.

VAV Central Heating with Ducted Zone Heat (PI Only) — When heating is available at the zone (ducted), and central heating is also available, the zone heat will work in parallel to provide heating to the space. This heating function provides the required volume of heated air from the central apparatus. This volume is determined by a PID airflow control, the space temperature, and the desired set point. In addition, the temperature of the air can be supplemented by the local heat source, if the current air temperature cannot meet zone requirements. Each zone controller configured for heat (ducted or non ducted) will operate its heating control loop when ever the space temperature is below the heating set point to determine a desired supply air discharge temperature that is necessary to maintain space temperature at the heating set point.

NOTE: Central heat with ducted zone heat requires a supply air sensor.

Damper Override — Damper Override mode is initiated by the air source in response to input from a field-supplied smoke control panel. When the air source enters an override mode the linkage coordinator signals the zone controllers to take corresponding action. The override can take either of two forms: pressurization or evacuation. In Pressurization mode, the zone controller commands the air terminal's supply air damper to maximum cool cfm. In Evacuation mode, it commands the damper completely closed.

Damper Override supersedes the cfm setting the zone controller would otherwise maintain based on space temperature. The smoke control panel that commands the override mode must be in accordance with local codes, as must its installation.

Nighttime Free Cooling — Nighttime Free Cooling (NTFC) is an air source cooling function that can be employed during unoccupied periods when conditions permit. If outside air is acceptable, based on temperature and enthalpy, during unoccupied early morning hours, the air handler will deliver the cool outside air to the air terminals. When the air source indicates that NTFC is operating, the zone controller at each air terminal controls to midway between the occupied heating and occupied cooling set points, rather than to the higher unoccupied cooling set point that would otherwise be in effect at that time.

For series fan terminal applications, the zone controller turns on the air terminal's fan during NTFC operation.

NOTE: This feature is only available to Carrier communicating systems where fully compatible linkage air source controls are used.

Single Duct Terminal Applications — When applying the 33ZCVVTZC-01 or 33ZCVAVTRM zone controller, ducted heat can only be used when the air source is on, since the air source is providing the only means of airflow into the zone.

⚠ CAUTION

The minimum airflow required by the heat at each terminal must be configured properly to protect and ensure proper heat transfer for the heating coil. If the minimum cooling cfm limit or damper position is below the terminal's recommended minimum value, use the reheat cfm limit for this configuration. The minimum heat cfm limit or damper position should also be set to this value.

All zone controllers types can support the Reheat function for single duct terminals.

With a single duct terminal application, if the central air source is on and in cooling mode and the terminal is equipped with heat, then the heat will be used to reheat the supply air to prevent over cooling of the space. Reheat will occur when the space temperature drops below the heating set point. The zone controller will enable the heating control algorithm. At this point the zone controller will provide primary airflow equivalent to the larger of either the minimum cooling damper position or cfm requirement (to satisfy the minimum air flow for the air source) or the reheat damper position or cfm requirement (to provide minimum airflow for the heating coil).

COOLING — The primary control function of zone controller is to provide cooling to the space by modulating the amount of supply airflow through its primary damper.

The Zone Controller uses pressure independent or pressure dependent operation to control the amount of cool air entering the space. The control variable is terminal airflow (cfm) for pressure independent applications or damper position for pressure dependent applications. A PID temperature control loop determines the airflow set point needed to maintain space temperature at the cooling set point.

The airflow set point is limited to a configured range of values that allow the air source to operate properly in the cooling mode. These configured limits are listed in the Installation Instructions for the zone controller. The minimum limit ensures that the sum of all air terminal minimum requirements fall within the minimum cooling operating range of the air source. The maximum limit ensures that airflow will not increase above the maximum design value and that the noise level generated at this maximum airflow will be acceptable to the occupants of the zone.

The sequence of operation is as follows: when the space temperature is above the cooling set point and the air source is in the cooling mode, the zone controller modulates the air terminal's damper to supply airflow between minimum and maximum cooling airflow limits or damper position. A temperature control loop that maintains space temperature determines the airflow set point. As the space temperature falls below the cooling set point, the PID loop will reduce the airflow. When the space temperature drops and remains below the cooling set point, the zone controller will hold the airflow at minimum cooling limit.

In its standard operating mode the zone controller follows the same control sequence for cooling during both occupied and unoccupied periods. The zone controller's Occupancy schedule determines which set point the zone controller will use.

HEATING — There are two ways to use local heat. Reheat operates when the zone controller's zone requires heat and the air source is supplying cool air to satisfy cooling demand in other zones. Heat is also used to supplement air source heating while the air source is supplying heated air, but the temperature is inadequate to maintain the desired set point.

When the space temperature is below the Heating set point and the air source is in the Heat mode, the zone controller modulates the air terminals damper to supply airflow between minimum and maximum heating cfm (if configured for VAV central heating) or damper position (for pressure dependent applications), otherwise the minimum heating airflow is maintained. During VAV heating, space temperature PID loop determines the airflow set point. As the space temperature goes above the heating set point, the PID loop will start reducing the airflow. When the space temperature remains above the heat set point, the zone controller will hold the airflow at minimum heating cfm.

Reheat — When the zone controller is applied to a Single Duct terminal unit and configured for heat, and heating is being called for in the space, the zone controller reads the space sensor and compares the temperature to the current heating set point. The zone controller then calculates the required supply-air temperature (submaster reference temperature) to satisfy conditions. The calculated value is compared to the actual temperature supply air and the output is adjusted to satisfy conditions. The reference temperature is determined by comparing space temperature with the current biased heating set point.

A Proportional/Integral/Derivative (PID) loop is used whenever the mode is heating (occupied, unoccupied, or warm-up).

The heating PID loop maintains the current heating set point (configured value plus any offset from a 33ZCT56SPT sensor slide bar).

In a single duct terminal unit equipped with heating, the terminal will provide sufficient airflow for heating (greater of cooling minimum or reheat values or damper positions) to the zone whenever heating is required, as determined by the space temperature sensor and the set point, if the equipment is supplying cool air. The reheat damper position or cfm is used to ensure that proper airflow across the heater is maintained, if the minimum cooling airflow is too low for safe heating operation.

NOTE: In a system, when the central air source fan is operating (detected by the linkage coordinator zone controller) ducted heat will be available to operate.

The zone controller performs reheat when the space temperature in its zone is below the heating set point and the air source is delivering cooled air.

During this process, the zone controller also uses the temperature deviation from the heating set point in a PID calculation to determine a supply-air temperature which will satisfy the heat demand in the space.

COOLING ONLY — Figure 11 shows the hardware configuration for a zone controller applied to a single duct air terminal that is not equipped with heat. The diagram in Fig. 12 shows how the zone controller controls this type of air terminal. The terminal provides cooling by modulating its primary air damper.

A single duct air terminal without local heat can only perform heating functions while its air source is delivering heated air. The control sequence for heating is similar to that for cooling. When the space temperature is below the Heating set point, the air source is in the Heat mode, and VAV heating is enabled (pressure independent only), the zone controller modulates the air terminal's damper to provide supply airflow between minimum and maximum heating set points. A temperature PID loop that maintains space temperature determines the damper position or airflow set point. As the space temperature goes above the heating set point, the PID loop will start to reduce the airflow. For pressure dependent applications, heating is always enabled.

As with cooling operation, the standard heating mode is the same for occupied and unoccupied periods, differing only in the set point that the zone controller uses.

Damper Override supersedes the cfm setting the zone controller would otherwise maintain based on space temperature. The smoke control panel that commands the override mode must be in accordance with local codes.

STAGED ELECTRIC HEAT AND COMBINATION HEAT — The zone controller can be configured to control up to three stages of electric heat. The zone controller can also be configured to control up to three stages of heat (first stage baseboard and second and third stages ducted heat). The heat source can be installed in the air terminal (ducted), or as perimeter heat. Figure 13 shows the hardware configuration for a zone controller applied to a single duct air terminal equipped with ducted staged electric heat. The diagram in Fig. 14 shows how the zone controller controls this type of air terminal.

The figures depict the electric heat source installed in the air terminal. When the zone controller is used to control perimeter heat it follows the same control routines that it uses for terminal heat. Heat is used in two ways. Heat operates when the zone controller's zone requires heating and the air source is supplying cool air to satisfy cooling demand in other zones (reheat). Heat can also be energized to supplement air source heating while the air source is supplying heated air.

Staged (electric) heating (1 or 2 stages) is provided by the 33ZCVAVTRM zone controller. Staged (electric) heating (3 stages) is provided by the 33ZCFANTRM zone controller. Three stages of heat with the 33ZCVVTZC-01 zone controller is provided by the zone controller and the option board (33ZCOPTBRD-01). The staging function compares the submaster reference with the supply-air temperature to calculate the required number of outputs to energize.

The percent output capacity for electric staged heat control is calculated and displayed.

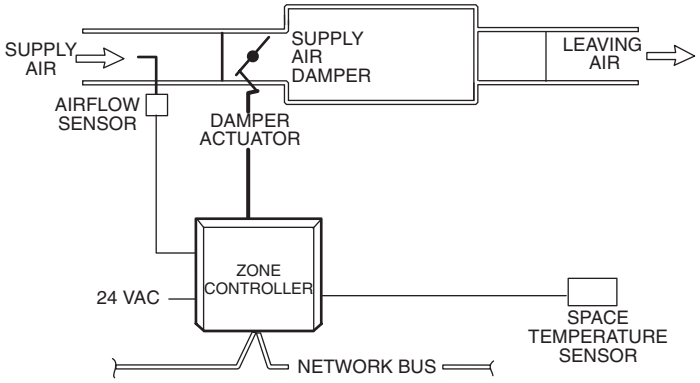
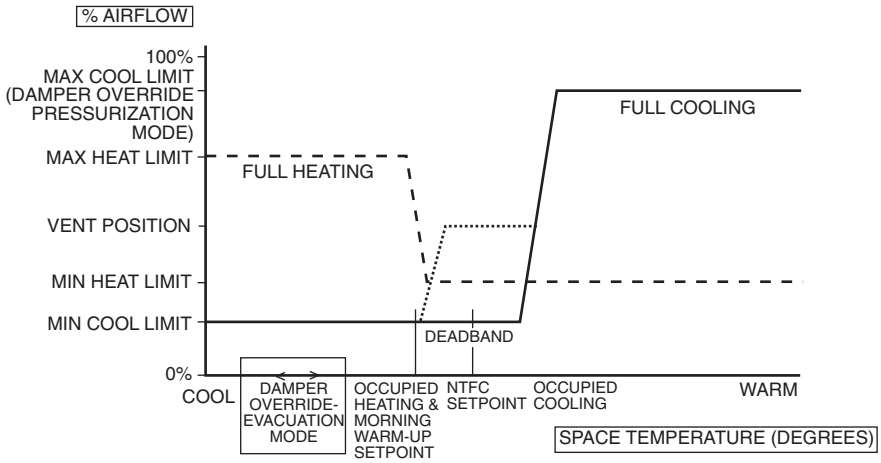


Fig. 11 — Single Duct Air Terminal — Cooling-Only

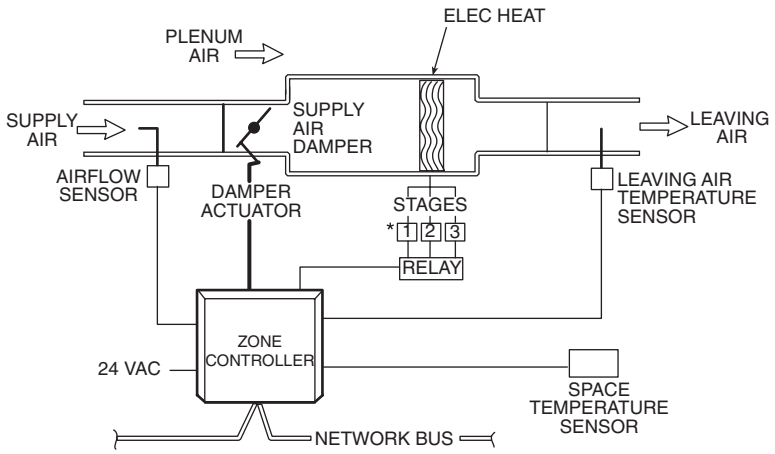


LEGEND

NTFC — Nighttime Free Cooling
– – – – Air Source Supplying Heated Air
——— Air Source Supplying Cooled Air
. . . . . Ventilation Mode

NOTE: Ventilation mode occurs when air source mode is in cooling and air source supply air temperature is above 65 F and below 75 F.

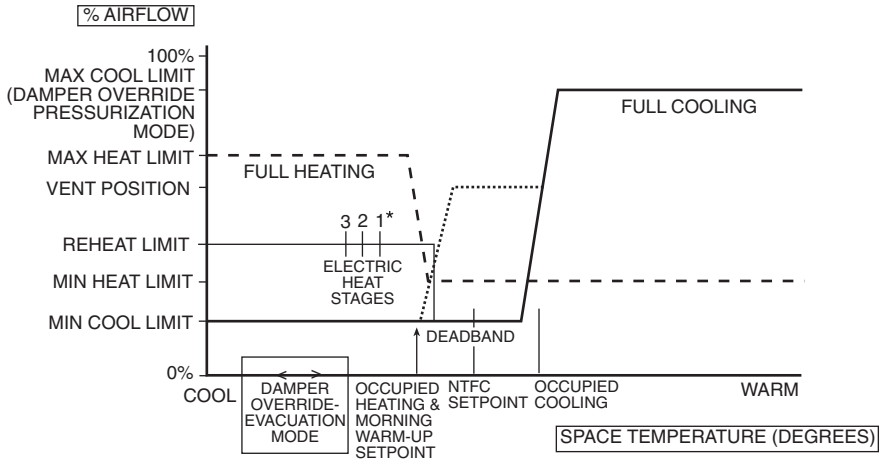
Fig. 12 — Sequence of Operation for Single Duct Air Terminal — Cooling-Only



*Stage 1 is radial or baseboard heat with combination heat.

NOTE: For 1 or 2 stage heat — use 33ZCVAVTRM. For 3-stage heat — use 33ZCFANTRM.

Fig. 13 — Single Duct Air Terminal with Staged Electric Heat



LEGEND

NTFC — Nighttime Free Cooling

– – – – Air Source Supplying Heated Air and Zone Controller is Configured for Central Heating Only

——— Air Source Supplying Cooled Air

. . . . . Ventilation Mode

NOTE: Ventilation mode occurs when air source mode is in cooling and air source supply air temperature is above 65 F and below 75 F.

*Stage 1 is radial or baseboard heat with combination heat.

Fig. 14 — Sequence of Operation for Single Duct Air Terminal with Staged Electric or Combination Heat

HOT WATER OR STEAM HEAT — The zone controller can be configured to control local heat provided by heating coils carrying hot water or steam, governed either by a two-position (on/off) valve or by a proportional (floating modulating) valve. The heating coils can be installed in the air terminal (ducted), or as perimeter heat. Figure 15 shows the hardware configuration for a zone controller applied to a single duct air terminal equipped with ducted hot water or steam heating coils. The diagram in Fig. 16 shows how the zone controller controls an air terminal equipped with two-position hot water or steam heat. The diagram in Fig. 17 shows how the zone controller controls an air terminal equipped with proportional hot water or steam heat.

The figures depict the heating coils installed in the air terminal. When the zone controller is used to control perimeter heat it follows the same control routines that it uses for terminal heat. Modulating perimeter heating must be hot water, but two-position may either be hot water or steam heat.

For modulating control, the supply air needed is compared to the actual supply air to either drive the valve open or closed. There is a deadband on the supply air deviation where the valve will be left at the current position until the error gets larger than the deadband.

For modulating type heat, the floating point function compares the submaster reference from the PID loop to the supply air temperature to calculate the direction and time to position the valve. The control prevents both outputs from operating simultaneously.

Configuration determines the logic output type for normally open or normally closed type two-position valves. Hysteresis is determined by the Heating Proportional Gain configured.

Heating with IAQ Control — A feature is provided for situations in which additional primary air is required for ventilation (IAQ).

The heating set point is calculated as the midpoint between the current heating and cooling set points.

The standard heating algorithm is used except the control set point is raised. The algorithm prevents the space temperature from falling below the set point before heating is activated. The air terminal must be in the cooling mode and the equipment must be providing cooling.

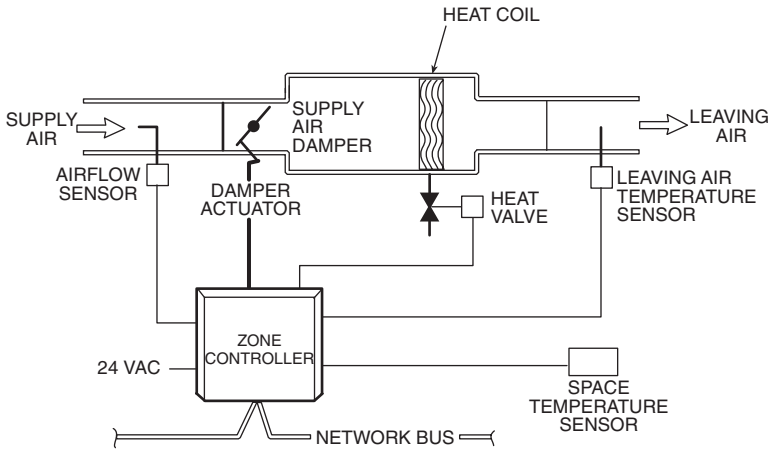
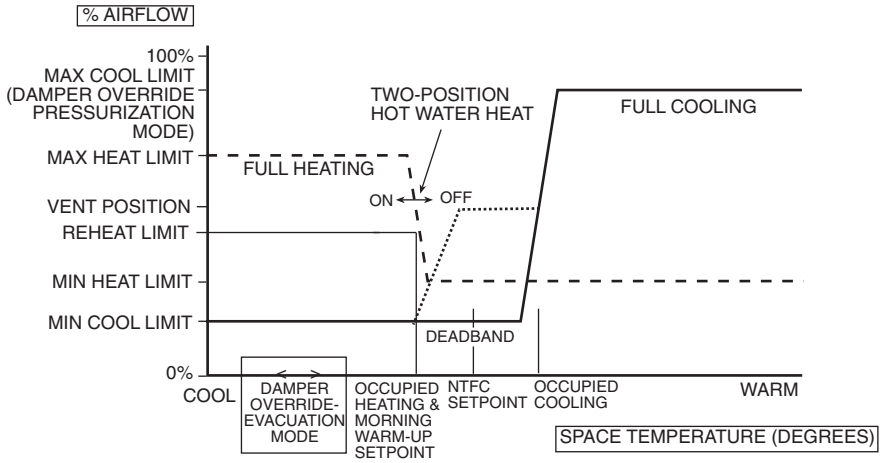


Fig. 15 — Single Duct Air Terminal with Hot Water or Steam Heat

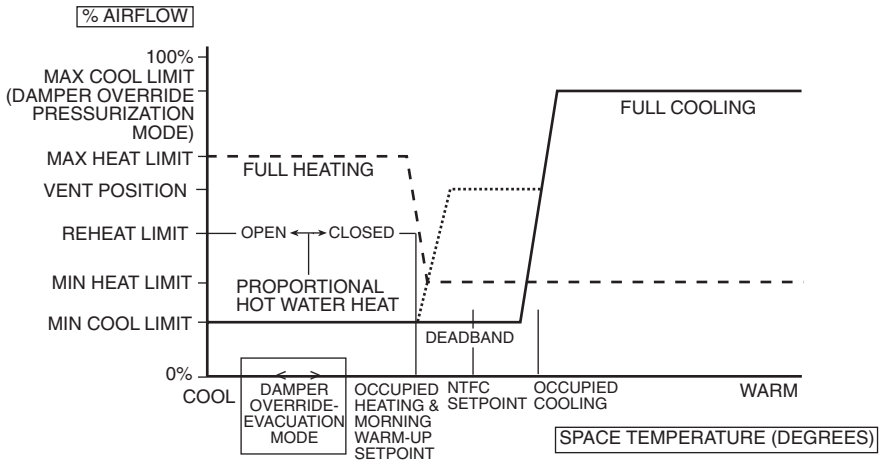


LEGEND

NTFC — Nighttime Free Cooling
– – – – Air Source Supplying Heated Air
——— Air Source Supplying Cooled Air
. . . . . Ventilation Mode

NOTE: Ventilation mode occurs when air source mode is in cooling and air source supply air temperature is above 65 F and below 75 F.

Fig. 16 — Sequence of Operation for Single Duct Air Terminal with Two-Position Hot Water or Steam Heat



LEGEND

NTFC — Nighttime Free Cooling
- - - - Air Source Supplying Heated Air
——— Air Source Supplying Cooled Air
. . . . . Ventilation Mode

NOTE: Ventilation mode occurs when air source mode is in cooling and air source supply air temperature is above 65 F and below 75 F.

Fig. 17 — Sequence of Operation for Single Duct Air Terminal with Proportional Hot Water or Steam Heat

33ZCVVTZC-01 VVT® Zone Controller and 33ZCFANTRM VAV Zone Controller Information — The zone controller will control the operation of the fan (start and stop), whenever the zone controller is configured for use with a series or parallel fan terminal. The control algorithm determines the required fan state, based on the local mode, equipment mode, and the terminal type configuration.

For parallel or intermittent fan powered terminals (type 2 configuration), the fan operates as follows:

1. The fan is energized:
   a. When ever SPT< current heating set point

      The primary air damper is set to the fully closed position if the air source mode is OFF and heating is required. After heating is disabled, or if the equipment begins to operate, the primary air damper returns to normal operation.
   b. If the Primary Damper Reference drops below the configured Parallel Fan On value
2. The fan is deenergized:
   a. Whenever SPT > current heating set point and heating is disabled
   b. If the Primary Damper Reference rises above the configured Parallel Fan ON value

For series or constant volume fan powered terminals (type 3 configuration), the fan operates as follows:

1. The fan is energized:
   a. During occupied periods
   b. Whenever SPT < current heating set point
   c. Whenever the air source mode is not off

      NOTE: Whenever the terminal fan transitions to ON, a fan start-up routine will run to ensure the fan rotates in the proper direction.
2. The fan is deenergized:
   a. If in Unoccupied mode and heating is not required, or if the air source is off
   b. During the fan start-up routine.

Series Fan Terminal Applications — In a series fan terminal, the fan is located in the primary airstream and, therefore, must be running in order to achieve proper airflow. The series fan terminal allows for a variable temperature, constant volume airflow. Maintaining constant volume airflow is not a function of the zone controller. The fan itself will maintain a constant airflow. Therefore, as the primary airflow is modulated to control temperature, more or less air will be induced from the return air plenum to maintain constant volume airflow.

The fan is turned on whenever the central air source is on, or whenever unoccupied heating is required. The zone controller will energize the fan. Since the fan is located in the primary air stream, the fan may be rotating even if the fan is not energized. Due to the nature of the fan blade geometry, the fan will actually rotate backwards. Energizing the fan motor while the blades are rotating backwards will cause the fan to run backwards. The zone controller handles this condition by closing the primary damper before starting the fan. Closing the damper will stop any airflow which may cause the fan to rotate in reverse. Once the fan is started, the damper will be controlled normally.

When the zone controller is controlling a series fan, if the air source transitions from OFF to any other mode, the zone controller will implement a series fan start-up sequence. In this sequence, the zone controller will cause the damper to be driven closed. Once the damper is closed, the zone controller will wait 30 seconds and then enable the fan. The zone controller will then allow the damper to modulate. Mode control will wait a number of minutes (between 0 and 20) before initiating the fan start-up sequence to prevent all series fan terminals from closing their dampers at once. The delay time is calculated from the zone controller's address and ensures that only two fans will turned off at one time.

In a series fan terminal, the fan must be able to deliver the zone's rated airflow and must be running whenever the air source is operating.

The 33ZCFANTRM and 33ZCVVTZC-01 Zone Controllers provide heating control in three different ways:

- positioning the primary air damper to a minimum airflow when the air source is in cooling mode to deliver maximum induced plenum air to the zone
- controlling an optional auxiliary heater mechanism to provide heating

- modulation of the primary air damper when the air source is in its heating mode (VAV Central Heating)

The 33ZCFANTRM and 33ZCVVTZC-01 (with option board) Zone Controllers support three methods to control heating. These methods are as follows:

- two-position (on/off) control using a normally open or normally closed heating valve
- modulating control using a normally open or normally closed floating point heating valve
- modulating control using up to 3 stages of electric heat

The series terminal fan operates based upon the air source mode (when it is in an operating mode other than OFF) or if the zone needs unoccupied heating.

If the space temperature drops below the unoccupied heating set point, the terminal fan will start unless it is already running due to the air source operating. With unoccupied cooling, the terminal fan will only start after the air source starts, based on the average space temperature exceeding the average unoccupied cooling set point.

COOLING — The primary control function of zone controller is to provide cooling to the space by modulating the amount of supply airflow through its primary damper.

The Zone Controller uses pressure independent or pressure dependent operation to control the amount of cool air entering the space. The control variable is terminal airflow for pressure independent and damper position for pressure dependent. A PID temperature control loop determines the airflow set point needed to maintain space temperature at the cooling set point.

The set point is limited to a range of values that allow the air source to operate properly in the cooling mode. These configured limits are listed in the Installation Instructions for the zone controller. The minimum limit ensures that the sum of all air terminal minimum airflow requirements fall within the minimum cooling operating range of the air source. The maximum limit ensures that airflow will not increase above the maximum design value and that the noise level generated at this maximum airflow will be acceptable to the occupants of the zone.

The sequence of operation is as follows: when the space temperature is above the cooling set point and the air source is in the Cooling mode, the zone controller modulates the air terminal's damper to supply airflow between the control minimum and maximum cooling airflow limits. A PID temperature control loop that maintains space temperature determines the airflow set point. As the space temperature falls below the cooling set point, the PID loop will start to reduce the airflow. When the space temperature drops and remains below the cooling set point, the zone controller will hold the airflow at minimum cooling limit.

In its standard operating mode the zone controller follows the same control sequence for cooling during both occupied and unoccupied periods. The zone controller's Occupancy schedule determines which set point the zone controller will use.

HEATING — There are two ways to use local heat. Heat operates when the zone controller's zone requires heat and the air source is supplying cool air to satisfy cooling demand in other zones. Heat is also used to supplement air source heating while the air source is supplying heated air, but the temperature is inadequate to maintain the desired set point.

If the space temperature in the zone falls below the zone controller's heating set point while the air source is supplying cooled air, the zone controller keeps the supply-air damper closed to the configured minimum cooling cfm. This enables plenum air, induced by the fan, to raise the space temperature of the zone.

A series fan powered air terminal without local heat can provide heating while its air source is delivering heated air. The control sequence for heating is similar to that for cooling, except that the heating set point is used.

When the space temperature is below the Heating set point and the air source is in the Heat mode, the zone controller modulates the air terminals damper to supply airflow between minimum and maximum heating set point (if configured for VAV central heating for pressure independent applications, always on for pressure dependent applications). A space temperature PID loop determines the airflow set point. As the space temperature rises above the heating set point, the PID loop will reduce the airflow.

As with cooling operation, the standard heating mode is the same for occupied and unoccupied periods, differing only in the set point that the zone controller works to satisfy. The zone controller turns on the air terminal's fan while working to satisfy the unoccupied heating set point.

The zone controller provides heat when the space temperature in its zone is below the heating set point and the air source is delivering cool air. To accomplish this, the zone controller closes its air terminal's supply-air damper to the configured minimum cooling cfm or damper position.

During this process, the zone controller also uses the temperature deviation from the heating set point in a PID calculation to determine a supply-air temperature which will satisfy the heat demand in the space (for optional ducted heat). If the supply air is not warm enough, another control loop calculates the required amount of heat to energize.

The configured Heat On Delay must expire (except if heat is energized during the Commissioning mode) before any mechanical heat is energized. The fan is energized (on) when the terminal is occupied and any time a call for heat from the space occurs during Unoccupied mode.

If VAV central heating is enabled, the PID loop that controls space temperature will maintain the current heating set point (configured value plus any offset from a 33ZCT56SPT sensor slide bar) whenever the central equipment is heating. It will modulate the damper between the minimum and maximum heating limits in order to maintain the desired heating set point.

When in unoccupied heating, the terminal's fan will be turned on to provide airflow to the zone. Also, in the unoccupied mode, the primary damper will be held in its last commanded position. If the air source becomes active (on) during this mode, the damper will be controlled normally.

NOTE: In a Linkage system, when the central fan is operating, the terminal fan will also be running.

COOLING WITH FAN — Figure 18 shows the hardware configuration for a zone controller applied to a series fan powered air terminal that is not equipped with local heat. The diagram in Fig. 19 shows how the zone controller controls this type of air terminal. The fan runs constantly in all modes during occupied periods.

STAGED ELECTRIC OR COMBINATION HEAT — The zone controller can be configured to control up to three stages of electric heat. The heat source can be installed in the air terminal (ducted), or as perimeter heat. Figure 20 shows the hardware configuration for a zone controller applied to a series fan powered air terminal equipped with staged electric heat. The diagram in Fig. 21 shows how the zone controller controls this type of air terminal. The fan runs constantly in all modes during occupied periods. During unoccupied periods the fan runs while the air terminal is operating to satisfy an unoccupied heating demand or if the air source is operating.

The percent output capacity for electric staged heat control is calculated and displayed.

Staged (electric) heating (1, 2, or 3 stages), is provided by the 33ZCFANTRM or 33ZCVVTZC-01 zone controller. The staging function compares the submaster reference with the supply-air temperature to calculate the required number of outputs to energize.

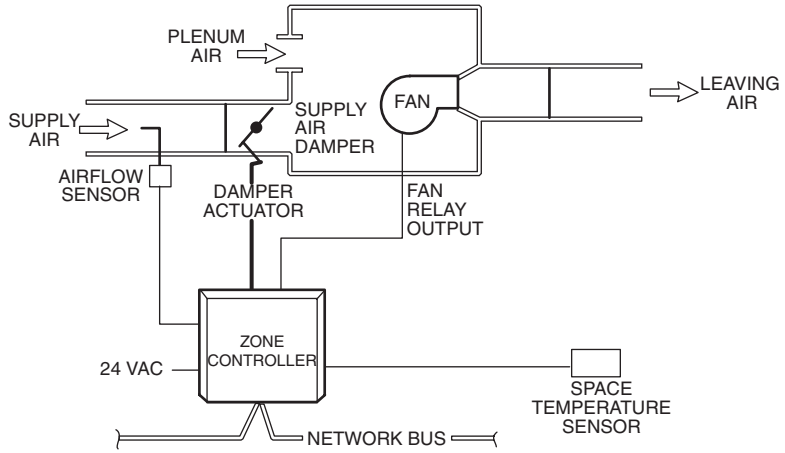
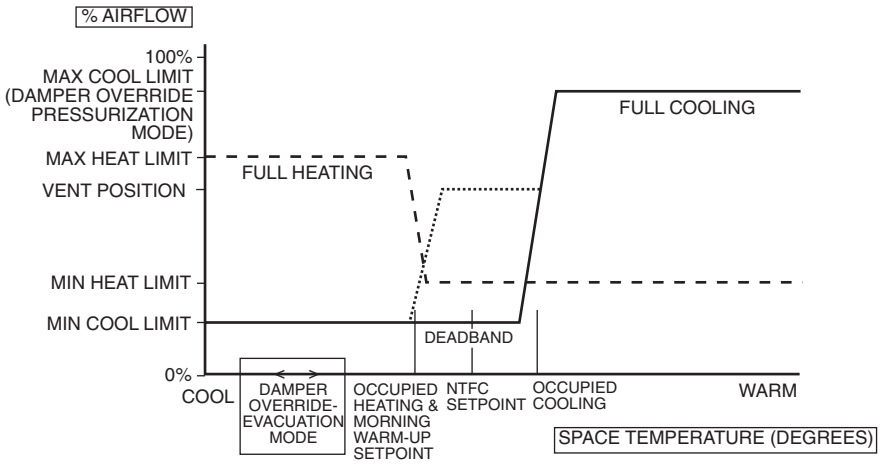


Fig. 18 — Series Fan Powered Air Terminal — Cooling-Only

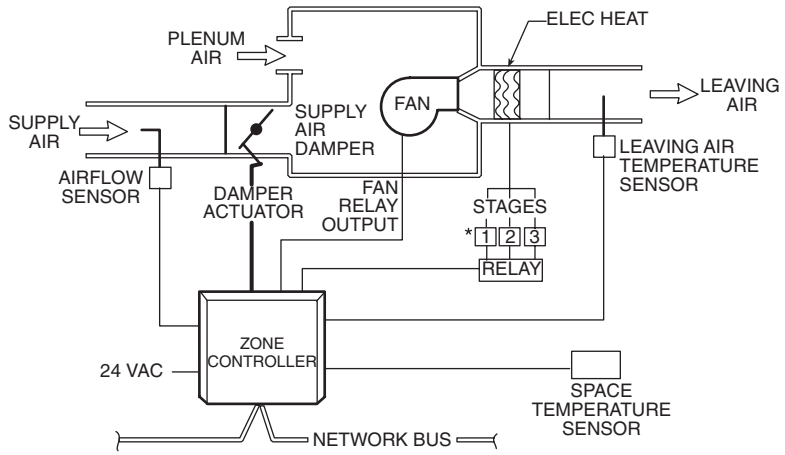


LEGEND

NTFC — Nighttime Free Cooling
– – – – Air Source Supplying Heated Air
——— Air Source Supplying Cooled Air
. . . . . Ventilation Mode

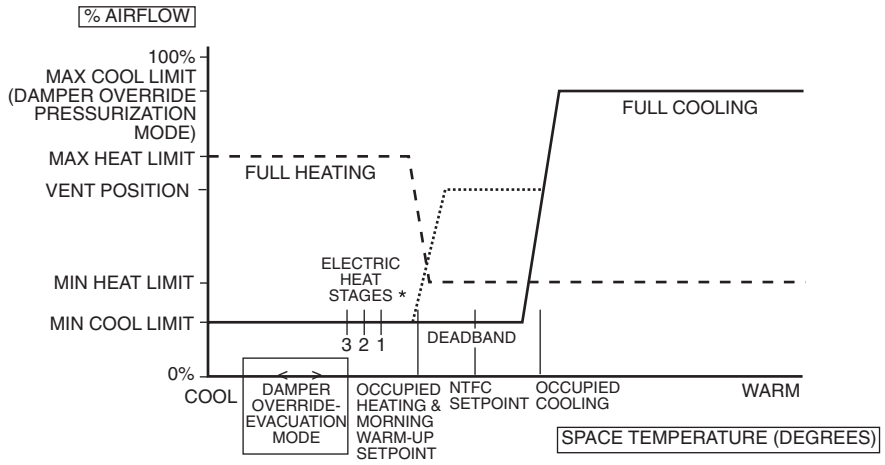
NOTE: Ventilation mode occurs when air source mode is in cooling and air source supply air temperature is above 65 F and below 75 F.

Fig. 19 — Sequence of Operation for Series Fan Powered Air Terminal — Cooling-Only



*Stage 1 is radial or baseboard heat with combination heat.

Fig. 20 — Series Fan Powered Air Terminal with Staged Electric or Combination Heat



LEGEND

NTFC — Nighttime Free Cooling
– – – – Air Source Supplying Heated Air
——— Air Source Supplying Cooled Air
. . . . . Ventilation Mode

NOTE: Ventilation mode occurs when air source mode is in cooling and air source supply air temperature is above 65 F and below 75 F.

*Stage 1 is radial or baseboard heat with combination heat.

Fig. 21 — Sequence of Operation for Series Fan Powered Air Terminal with Staged Electric Heat

HOT WATER OR STEAM HEAT — The zone controller can be configured to control local heat provided by heating coils carrying hot water or steam, governed either by a two-position (on/off) valve or by a proportional (floating modulating) valve. The heating coils can be installed in the air terminal (ducted), or as perimeter heat. If modulating baseboard is used, refer to the General Heating Information section for additional information. Figure 22 shows the hardware configuration for a zone controller applied to a series fan powered air terminal equipped with hot water or steam heating coils. The diagram in Fig. 23 shows how the zone controller controls an air terminal equipped with two-position hot water or steam heat. The diagram in Fig. 24 shows how the zone controller controls an air terminal equipped with proportional hot water or steam heat. The fan runs constantly in all modes during occupied periods.

For modulating control, the supply air needed is compared to the actual supply air to either drive the valve open or closed. There is a deadband on the supply air deviation where the valve will be left at the current position until the error gets larger than the deadband.

For modulating type heat, the floating point function compares the submaster reference from the PID loop to the supply air temperature to calculate the direction and time to position the valve. The control prevents both outputs from operating simultaneously.

Configuration determines the logic output type for normally open or normally closed type two-position valves.

Heating with IAQ Control — A feature is provided for situations in which additional primary air is required for ventilation (IAQ).

The heating set point is calculated from the midpoint between the current heating and cooling set points.

The standard heating algorithm is used. The algorithm prevents the space temperature from falling below the set point before heating is activated. The air terminal must be in the cooling mode and the equipment must be providing cooling.

When in unoccupied heating, the terminal's fan will be turned on to provide airflow to the zone. Also, in the unoccupied mode, the primary damper will be held in its last commanded position. If the air source becomes active (on) during this mode, the damper will be controlled normally.

NOTE: In a Linkage system the when the central fan is operating, the terminal fan will also be operating.

Parallel Fan Terminal Applications — The parallel fan terminal provides three capabilities to the zone. First, it allows for unoccupied heating if auxiliary heating is available. Secondly, it allows CV heating when occupied (the fan is on when ducted heating is on). Thirdly, it provides a means to prevent cold air from "dropping" into the zone during cooling mode.

The 33ZCFANTRM or 33ZCVVTZC-01 (with option board) Zone Controllers provide heating control in three different ways:

- positioning the primary air damper to a minimum airflow when the air source is in cooling mode and starting the fan to utilize plenum heat as a first stage
- controlling an optional auxiliary heater mechanism to provide heating
- modulation of the primary air damper when the air source is in its heating mode (VAV Central Heating)

The 33ZCFANTRM or 33ZCVVTZC-01 (with option board) Zone Controllers support three methods to control heating. These methods are as follows:

- two-position (on/off) control using a normally open or normally closed heating valve
- modulating control using a normally open or normally closed floating point heating valve
- modulating control using up to 3 stages of electric heat

COOLING — The primary control function of zone controller is to provide cooling to the space by modulating the amount of supply airflow through its primary damper.

The airflow set point is limited to a range of values that allow the air source to operate properly in the Cooling mode. These configured limits are listed in the Installation Instructions for the zone controller. The minimum limit ensures that the sum of all air terminal minimum airflow requirements fall within the minimum cooling operating range of the air source. The maximum limit ensures that airflow will not increase above the maximum design value and that the noise level generated at this maximum airflow will be acceptable to the occupants of the zone.

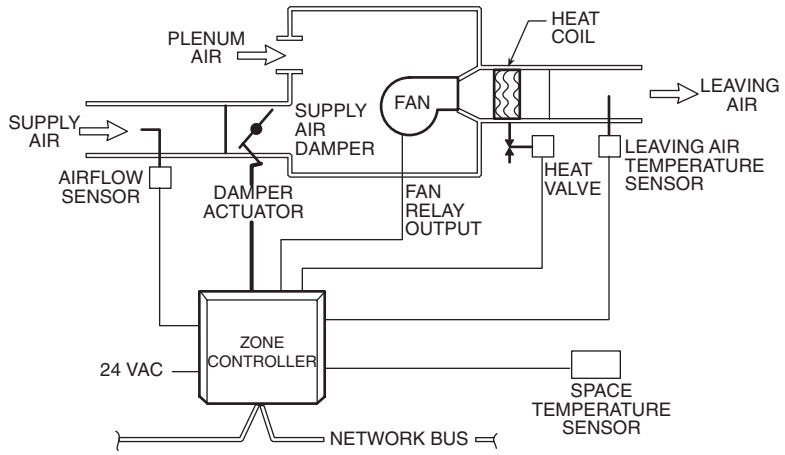
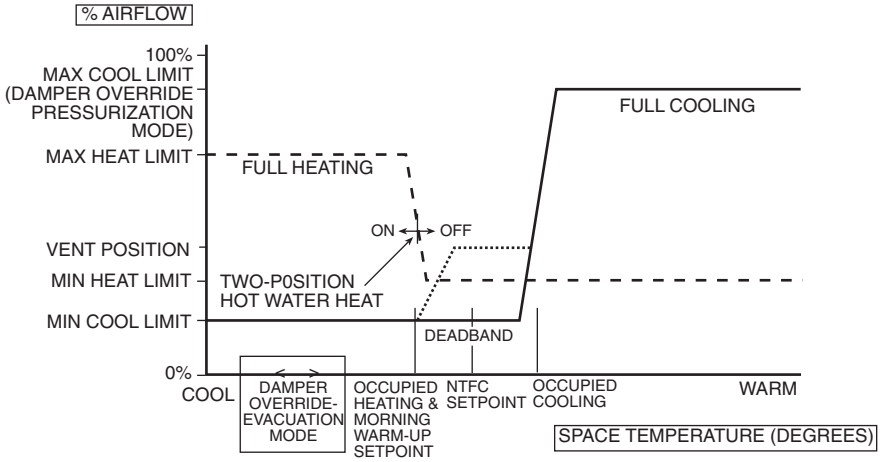


Fig. 22 — Series Fan Powered Air Terminal with Hot Water or Steam Heat



LEGEND

NTFC — Nighttime Free Cooling

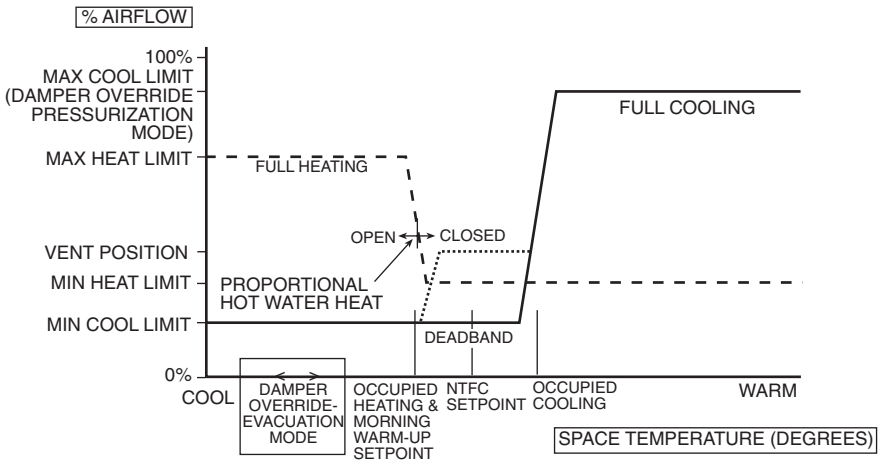
– – – – Air Source Supplying Heated Air

——— Air Source Supplying Cooled Air

. . . . . Ventilation Mode

NOTE: Ventilation mode occurs when air source mode is in cooling and air source supply air temperature is above 65 F and below 75 F.

Fig. 23 — Sequence of Operation for Series Fan Powered Air Terminal with Two-Position Hot Water or Steam Heat



LEGEND

NTFC — Nighttime Free Cooling

– – – – Air Source Supplying Heated Air

——— Air Source Supplying Cooled Air

. . . . . Ventilation Mode

NOTE: Ventilation mode occurs when air source mode is in cooling and air source supply air temperature is above 65 F and below 75 F.

Fig. 24 — Sequence of Operation for Fan Powered Air Terminal with Proportional Hot Water or Steam Heat

The sequence of operation is as follows: when the space temperature is above the cooling set point and the air source is in the Cooling mode, the zone controller modulates the air terminal's damper to supply airflow between the minimum and maximum cooling airflow limits. A PID temperature control loop that maintains space temperature and determines the airflow set point. As the space temperature falls below the cooling set point, the PID loop will start to reduce the airflow. When the space temperature drops and remains below the cooling set point, the zone controller will hold the airflow at minimum cooling limit. If the minimum cooling set point is below the Parallel Fan On set point, the fan will operate to improve air circulation.

In its standard operating mode the zone controller follows the same control sequence for cooling during both occupied and unoccupied periods. The zone controller's Occupancy schedule determines which set point the zone controller will use.

There are two ways to use local heat. Heat operates when the zone controller's zone requires heat and the air source is supplying cool air to satisfy cooling demand in other zones. Heat can also be energized to supplement air source heating while the air source is supplying heated air, but the temperature is inadequate to maintain the desired set point.

HEATING — If the space temperature in the zone served by a parallel fan powered air terminal falls below the zone controller's heating set point while the air source is supplying cool air, the zone controller keeps the supply-air damper closed to the configured minimum cooling cfm for pressure independent operation. For pressure dependent operation, the supply damper is closed. The zone controller also turns on the fan to induce warmer plenum air.

A parallel fan powered air terminal without local heat can perform heating functions while its air source is delivering heated air. When the space temperature is below the heating set point and the air source is delivering heated air the zone controller turns on the fan to induce plenum air. The zone controller modulates the air terminal's damper to supply airflow between the minimum and maximum heating limits (if configured for VAV central heating). A space temperature PID loop determines the airflow set point. As the space temperature rises above the heating set point, the PID loop will reduce the airflow. When heat is no longer required, the parallel fan will be turned off.

As with cooling operation, the standard heating mode is the same for occupied and unoccupied periods, differing only in the set point that the zone controller works to satisfy.

The zone controller provides heat when the space temperature in its zone is below the heating set point and the air source is delivering cool air. To accomplish this, the zone controller closes its air terminal's supply air damper to the configured minimum cooling cfm for pressure independent operation. For pressure dependent operation, the supply damper is closed. This minimizes the cool air entering its zone from the air source. The fan is turned on to induce plenum air. The zone controller induces plenum air for a configurable length of time in an attempt to satisfy the heating set point without turning on local heat. The amount of time is determined by the Heat ON Delay parameter.

During this process, the zone controller also uses the temperature deviation from the heating set point in a PID calculation to determine a supply air temperature which will satisfy the heat demand in the space. If the heated air is not warm enough, another control loop calculates the required number of outputs to energize. For all terminals, the configured Heat ON Delay must expire (except if heat is energized during the Commissioning Mode) before any mechanical heat is energized.

If VAV central heating is enabled, the PID loop that controls space temperature will maintain the current heating set point (this is a configured value plus any offset from a 33ZCT56SPT sensor slide bar). Whenever the central equipment is heating, it will modulate the damper between the minimum and maximum heating limits in order to maintain the desired heating set point.

NOTE: When applied on a parallel fan type terminal, the zone controller will utilize the fan as the first stage of heat even if no heat is configured. The amount of time the fan will operate as the first heat stage is determined by the value configured for the Heat On Delay (10 to 20 minutes recommended).

COOLING ONLY — Figure 25 shows the hardware configuration for a zone controller applied to a parallel fan powered air terminal that is not equipped with heat. The diagram in Fig. 26 shows how the zone controller controls this type of air terminal. The fan runs while the air terminal is heating.

STAGED ELECTRIC OR COMBINATION HEAT — The zone controller can be configured to control up to three stages of electric or combination heat. The heat source can be installed in the air terminal (ducted), or as perimeter heat. Figure 27 shows the hardware configuration for a zone controller applied to a parallel fan powered air terminal equipped with staged electric heat. The diagram in Fig. 28 shows how the zone controller controls this type of air terminal. The fan runs while the air terminal is heating.

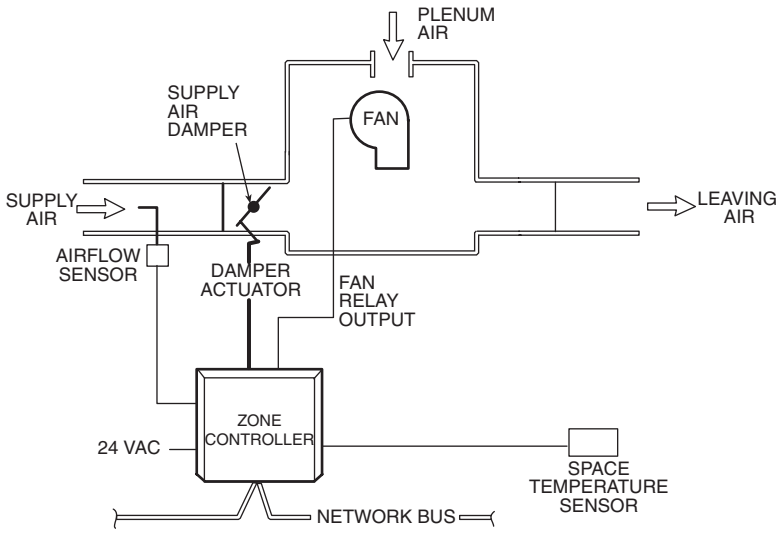
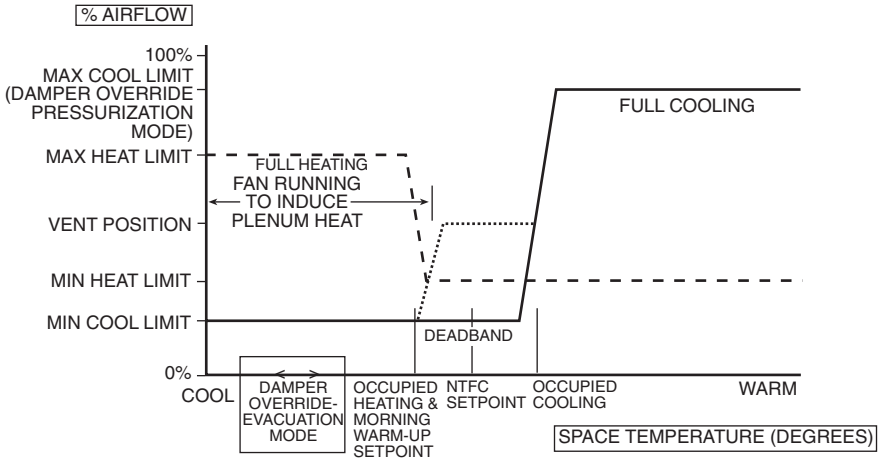


Fig. 25 — Parallel Fan Powered Air Terminal — Cooling-Only

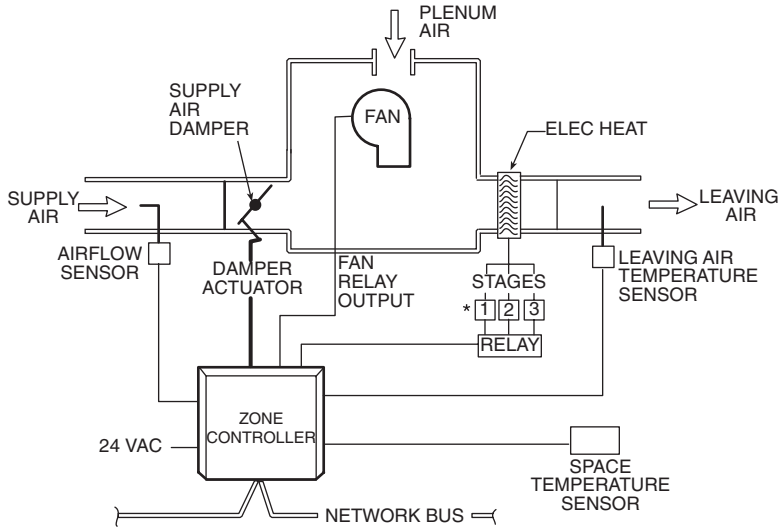


LEGEND

NTFC — Nighttime Free Cooling
– – – – Air Source Supplying Heated Air
——— Air Source Supplying Cooled Air
. . . . . Ventilation Mode

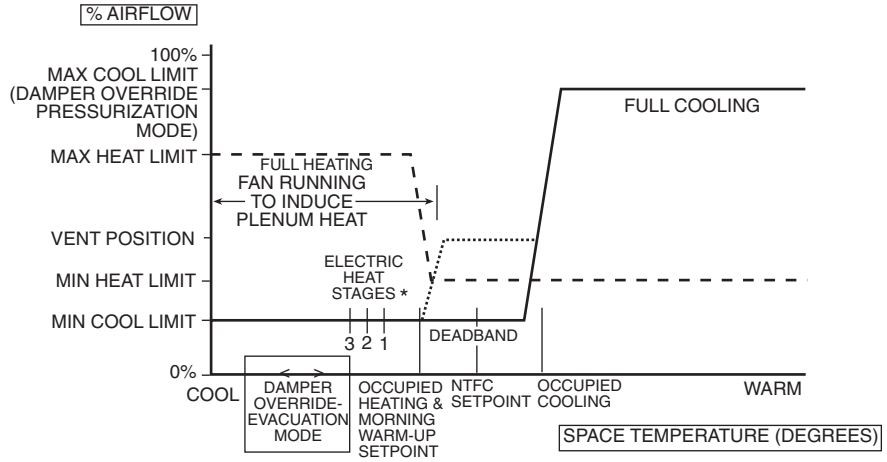
NOTE: Ventilation mode occurs when air source mode is in cooling and air source supply air temperature is above 65 F and below 75 F.

Fig. 26 — Sequence of Operation for Parallel Fan Powered Air Terminal — Cooling-Only



*Stage 1 is radial or baseboard heat for combination heat.

Fig. 27 — Parallel Fan Powered Air Terminal with Staged Electric or Combination Heat



LEGEND

NTFC — Nighttime Free Cooling
– – – – Air Source Supplying Heated Air
——— Air Source Supplying Cooled Air
. . . . . Ventilation Mode

NOTE: Ventilation mode occurs when air source mode is in cooling and air source supply air temperature is above 65 F and below 75 F.

*Stage 1 is radial or baseboard heat for combination heat.

Fig. 28 — Sequence of Operation for Parallel Fan Powered Air Terminal with Staged Electric Heat

The figures depict the electric heat source installed in the air terminal. When the zone controller is used to control perimeter heat it follows the same control routines that it uses for terminal heat.

The percent output capacity for electric staged heat control is calculated and displayed.

Staged (electric) heating (1, 2, or 3 stages), is provided by the 33ZCFANTRM or 33ZCVVTZC-01 (with option board) Zone Controller. The staging function compares the submaster reference with the supply-air temperature to calculate the required number of outputs to energize.

HOT WATER HEAT — The zone controller can be configured to control local heat provided by heating coils carrying hot water or steam, governed either by a two-position (on/off) valve or by a proportional (floating modulating) valve. The heating coils can be installed in the air terminal (ducted), or as perimeter heat. If modulating baseboard heat is used, refer to the General Heating Information section for additional information. Figure 29 shows the hardware configuration for a zone controller applied to a parallel fan powered air terminal equipped with hot water or steam heating coils. The diagram in Fig. 30 shows how the zone controller controls an air terminal equipped with two-position hot water or steam heat. The diagram in Fig. 31 shows how the zone controller controls an air terminal equipped with proportional hot water or steam heat. The fan runs while the air terminal is heating.

For modulating control, the supply air needed is compared to the actual supply air to either drive the valve open or closed. There is a deadband on the supply air deviation where the valve will be left at the current position until the error gets larger than the deadband.

Configuration determines the logic output type for normally open or normally closed type two-position valves.

Heating with IAQ Control — A feature is provided for situations in which additional primary air is required for ventilation (IAQ).

The heating set point is calculated from the midpoint between the current heating and cooling set points.

The standard heating algorithm is used. The effect is to prevent the space temperature from falling below the set point before heating is activated. The air terminal must be in the Cooling mode and the equipment must be providing cooling.

When in unoccupied heating, the terminal's fan will be turned on to provide airflow to the zone. Also, in the Unoccupied mode, a parallel fan terminal zone controller will keep the primary damper closed to prevent airflow back into the primary air duct. If the air source becomes active (on) during this mode, the damper will be controlled normally.

→ **Demand Controlled Ventilation (DCV) Control —** Each zone controller used in a single duct and fan powered application has the ability to provide DCV operation. The DCV function determines the zone ventilation airflow as a function of the DCV zone sensor reading or damper position. When the air quality control is enabled, the zone controller will override (increase) the primary airflow in order to provide Demand Controlled Ventilation if the airflow is insufficient to meet the ventilation set point.

The control algorithm uses a P/I algorithm to determine the required airflow in order to prevent the DCV sensor value from exceeding the desired Air Quality set point. The zone controller is designed to interface with the following DCV sensors that sense CO_2:

The 33ZCSENCO2 sensor is an indoor, wall mounted sensor with an LED (light-emitting diode) display. The sensor has an analog output (0 to 10 vdc) over a range of 0 to 2000 ppm. An SPDT (single-pole, double-throw) contact is provided to close at 1000 ppm with a hysteresis of 50 ppm.

The 33ZCT55CO2 sensor is an indoor, wall-mounted sensor without display. The CO_2 sensor also includes a space temperature sensor with override button.

The 33ZCT56CO2 sensor is an indoor, wall-mounted sensor without display. The CO_2 sensor also includes a space temperature sensor with override button and temperature offset.

The DCV function contains a provision to operate modulating type heat, if required and supplied, to maintain the space temperature at the midpoint between the heating and cooling set points during DCV operation. Operation is dependent upon the equipment mode of operation, so that the DCV function will only operate during Occupied periods when the outdoor-air damper is actively providing ventilation. A user-configured AQ Maximum % can be used to protect the zone from overcooling if local heating is not supplied. The DCV control is automatically suspended if the space temperature falls below the heating set point. The DCV control will be disabled if the DCV sensor status fails.

→ DEMAND CONTROLLED VENTILATION AND MINIMUM DAMPER POSITIONS — With 3V™ VVT® systems, the user has the capability to set both a heat and cool minimum damper position. The defaults for both are 0%. When the air source is cooling and the local mode of the damper is cooling, the zone controller can switch between vent control and minimum position control to maintain the space conditions

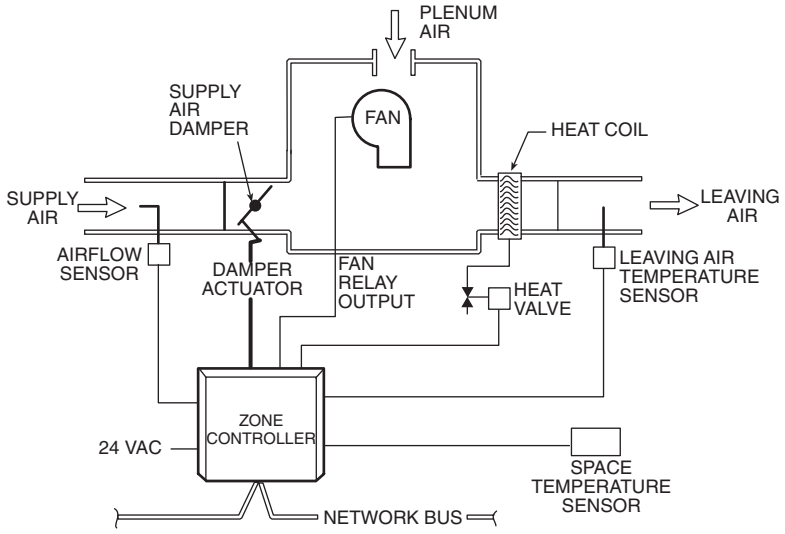
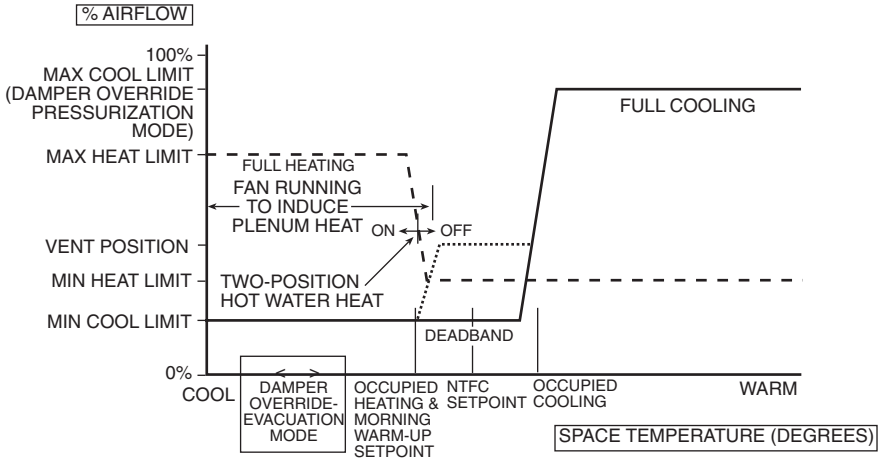


Fig. 29 — Parallel Fan Powered Air Terminal with Hot Water or Steam Heat

when the zone is satisfied. The desired damper position is determined by the temperature of the air being supplied. If the temperature is between 65 F and 75 F, the damper will be a vent position. If the temperature is below 65 F or above 75 F, the damper will go to minimum. This allows the system to provide adequate ventilation to meet the base ventilation rates for ASHRAE 62 without setting the cool minimum above 0%.

When the damper mode is (or has been) heating and the space temperature has not risen more than halfway between the occupied set points, then the local mode will be heat. In this case, if the air source switches modes to provide cooling, or if the air source is providing heat to satisfy another zone that is the reference zone, then the zone controller will close the damper to minimum position. During the heating season, some dampers in a system can stay at minimum position for extended periods of time. For this reason it is highly recommended that a heat minimum position other than 0% be used to ensure adequate ventilation per ASHRAE 62. Typically values from 5% to 10% will provide the base ventilation rate as required. A simple check of the fresh air entering the air source, while the dampers are all at minimum position and the bypass is modulating at an open position to maintain pressure, can tell if the system is moving enough air into the occupied space to cause the unit to draw in the appropriate fresh air.

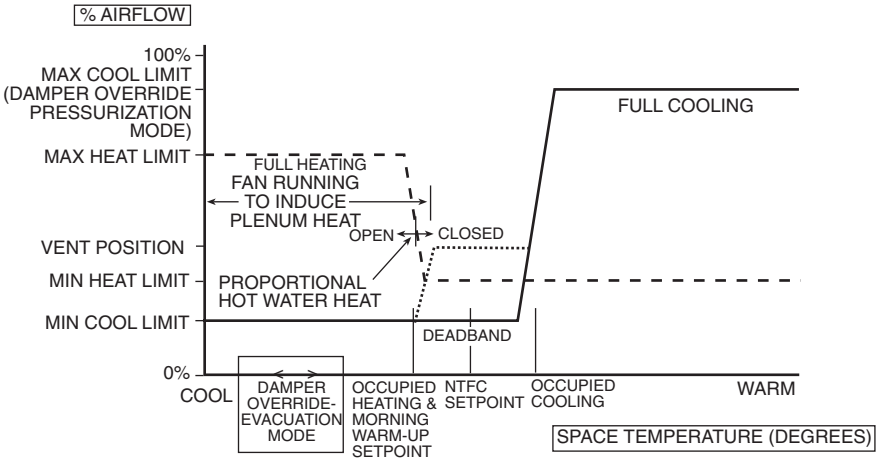


LEGEND

NTFC — Nighttime Free Cooling
– – – – Air Source Supplying Heated Air
——— Air Source Supplying Cooled Air
. . . . . Ventilation Mode

NOTE: Ventilation mode occurs when air source mode is in cooling and air source supply air temperature is above 65 F and below 75 F.

Fig. 30 — Sequence of Operation for Parallel Fan Powered Air Terminal with Two-Position Hot Water or Steam Heat



LEGEND

NTFC — Nighttime Free Cooling
– – – – Air Source Supplying Heated Air
——— Air Source Supplying Cooled Air
. . . . . Ventilation Mode

NOTE: Ventilation mode occurs when air source mode is in cooling and air source supply air temperature is above 65 F and below 75 F.

Fig. 31 — Sequence of Operation for Parallel Fan Powered Air Terminal with Proportional Hot Water or Steam Heat