



Constant Air Volume

Sequence of Operations

Effective April 2022



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Constant Air Volume Sequence

Constant air volume systems are designed to deliver constant temperature air at a constant air flow rate to maintain air temperature within a zone / space being conditioned.

System Start/Stop

The system is on when all enable points are set to the ON position. These enable points are as follows:

System ON/OFF: The System ON/OFF selector is found in the System ON/OFF menu of the controller's Main Menu using the unit's display terminal.

Remote ON/OFF: If a Remote ON/OFF switch is field wired into the unit controller, the remote ON/OFF input requires a voltage free dry contact closure to start unit operation. Terminal blocks are provided with a jumper installed to close the input if the function is not used.

BMS ON/OFF: (optional) System must be enabled through BMS. Default position is on.

Supply Air Blower

Once the optional Outdoor Air Damper is open, the output for the Supply Air Blower energizes the unit's Supply Air Fan Motors. The controller checks for proof of air movement 60 seconds after start of the blower. If there is no proof of airflow by the air proving switch, the modes of operation (cooling, heating and optional dehumidification or humidification) are locked out from operation to protect the system. The blower motor contactor is de-energized and a loss of air flow alarm is displayed on the controller.

Cooling Mode by Space Air Temperature

Cooling is based on Cooling Demand which is calculated by the Space Temperature sensor (SPAT), Space Temperature Set point, and Space Temperature Proportional Band. If the Space Air Temperature is greater than or equal to the Space Air Temperature Set point plus the Space Air Temperature Proportional Band Set Point, the Cooling Demand shall be 100%.

Fixed stage compressors are energized over the range of cooling demand based on start and hysteresis points. Each compressor has a start and a hysteresis point. A compressor starts when the cooling demand is greater than the com-

pressor's start point plus the compressor's hysteresis point. The same compressor stops when the cooling demand is less than the compressor's start point minus the hysteresis point. The start point and hysteresis points are broken down over the total amount of compressors in a unit. These points are calculated automatically based on the total number of compressor stages.

Heating Mode by Space Air Temperature

Heating is based on Heating Demand which is calculated by the Space Temperature sensor (SPAT), Space Temperature Set point, and Space Temperature Proportional Band. If the Space Air Temperature is less than or equal to the Space Air Temperature Set point minus the Space Air Temperature Proportional Band Set Point, the Heating Demand shall be 100%.

Fixed stage heaters are energized over the range of heating demand based on start and hysteresis points. Each heater stage has a start and a hysteresis point. A heater starts when the heating demand is greater than the heater's start point plus the heater's hysteresis point. The same heater stops when the heating demand is less than the heater's start point minus the hysteresis point. The start point and hysteresis points are broken down over the total amount of heaters provided. These points are calculated automatically based on the total number of heating stages.

Unoccupied Mode

During Unoccupied Mode, all outputs are de-energized. The Supply Air Blower has an option to operate continuously during the unoccupied period. The system also has the capability for setting up Unoccupied Control mode to maintain minimum conditions during unoccupied mode.

If the unit Schedule is enabled, the unit can be set up to follow Unoccupied Control which means the unit can follow a separate set of Temperature and Humidity set points to maintain space conditions. The outdoor air damper shall remain closed during Unoccupied Control mode.

Night Set-Back

If the unit Schedule is enabled, the unit can be set up to follow Night Set-Back Control which means the unit can

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follow a separate set of Temperature and Humidity set points to maintain space conditions. The Outdoor air damper shall remain open during Night Set-Back Control mode.

Unoccupied Override

There are three methods of Unoccupied Override that can be used to override the Unoccupied Mode. This will restart the unit in Occupied Mode to temporarily continue the conditioning process. These methods for Unoccupied Override are initiated 1) by User Interface (unit display and keypad), 2) by Digital Input, or 3) by BMS point interlock.

Unoccupied Override by User Interface

The User Interface has an Unoccupied Override trigger built in on the last page of the main System Status screens. Simply press the Up button one time and the Unoccupied Override screen appears. Set the Duration (Override Time) and Override position (on), to start the override process. Once the Elapsed time equals the Duration, the unit will return to unoccupied mode.

Unoccupied Override by Digital Input (Requires available digital input and a voltage free dry contact closure momentary push button)

A digital input can be set up to receive a momentary push-button contact closure to initiate the start period of the Unoccupied Override function. The Unoccupied Time period will follow the existing Duration (Override Time) that is set into the wall display just as it would by initiating it at the wall controller.

Unoccupied Override by BMS (Requires the BMS Communications option)

A BMS Point is available and requires the BMS Option to initiate the Unoccupied Override function. The Duration (Override Time) for Unoccupied Override mode is also adjustable through BMS. Simply set the unoccupied override time period in minutes. Then Enable/Disable the Unoccupied Override point to start the Unoccupied Override process. If terminating Unoccupied Override before time expiration is desired then a reset point is also available.

Airside Economizer Mode (option)

Airside Economizer is an optional feature for free cooling that requires a factory-provided duct mount type, field-installed, Outdoor Air Temperature and Humidity sensor, a factory provided wall or duct mountable Space Air Temperature and Humidity sensor, and a factory supplied duct mount Supply Air Temperature sensor. With the Airside Economizer Option, there is a minimum damper position set point to maintain a minimum amount of fresh outdoor air based on regional code requirements. Also with the Airside Economizer Option, there is a maximum damper position set point to maintain a maximum amount of outdoor air based on maximum outdoor air and airflow limits required. The minimum and maximum outdoor air damper set points are field adjustable under the Technician Menu - Economizer Setup.

If the Cooling Demand rises above minimum damper position set point, and the Outdoor Air Enthalpy is less than the Space Air Enthalpy, and the Outdoor Air Temperature is below the Outdoor Air Temperature Set Point minus the Outdoor Air Temperature Band Set Point, the unit will perform Airside Economizer mode of operation. The amount of demand for Airside Economizer can be viewed by looking at the System Demands screen for Air Side Economizer x%. When operating in airside economizer mode, the outdoor air dampers are modulated to the position that the Economizer demand is calling for. If the outdoor air temperature is less than the Mixed/Supply Air Temperature Set point, the system will regulate the Outdoor and Space Air Dampers to maintain the Mixed Air/Supply Air Temperature Set point.

Waterside Economizer (option)

Waterside Economizer Mode is an option available for a more energy efficient method of cooling when customers have cooling towers available that can periodically supply water at a temperature of 55.0°F or lower. The Waterside Economizer option requires a factory-provided, factory-installed, water temperature sensor to monitor the inlet water temperature to the unit. If the entering water temperature is below the Water Temperature Set Point minus the Water Temperature Band Set Point, the controller regulates the water valve position in an effort to maintain the cooling set point.

Waterside Economizer Mode will stop when the Cooling Demand is 0% or the entering water temperature rises above the Water Temperature Set Point plus the Water

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Temperature Band Set Point. When the Water Temperature rises above the Water Temperature Set Point plus the Water Temperature Band Set Point and there is still a demand for cooling, the unit will revert back to mechanical cooling with compressors to provide the required cooling to meet the cooling demand.

Sensors

OAT: A factory-supplied field-installed Outdoor Air Temperature sensor is used with the Airside Economizer option to calculate and compare outdoor air enthalpy to space air enthalpy. The OAT is a combination OAT/OAH sensor that is factory-supplied, field-installed duct mount type that is to be installed in the outdoor air stream.

OAH: A factory-supplied field-installed Outdoor Air Humidity sensor is used with the Airside Economizer option to calculate and compare outdoor air enthalpy to space air enthalpy. The OAH is a combination OAT/OAH sensor that is factory-supplied, field-installed duct mount type that is to be installed in the outdoor air stream.

SPAT: A factory-supplied field-installed Space Air Temperature sensor is used to determine the cooling or heating mode of operation. When the Airside Economizer option is ordered, it is also used to calculate the Space Air Enthalpy to compare to the Outdoor Air Enthalpy and determine if Airside Economizer is available to satisfy the cooling requirement.

SPAH: A factory-supplied field-installed Space Air Humidity sensor option is used to determine if dehumidification mode is required. When the Airside Economizer option is ordered, it is also used to calculate the Space Air Enthalpy to compare to the Outdoor Air Enthalpy and determine if Airside Economizer is available to satisfy the cooling requirement. If the space air humidity sensor is ordered, the space air temperature and humidity are a combination sensor.

SAT: Supply Air Temperature sensor is factory-supplied factory-installed on the supply air blower. This sensor is used for reference to compare space temperature to supply temperature to know that the unit is cooling or heating. If the Airside Economizer option is ordered, the supply air temperature sensor is used regulate outdoor damper position to maintain supply air temperature of 55.0°F leaving the unit.

WTS: A water temperature sensor is factory installed when the Water Economizer option is ordered. It is used to determine if the entering water temperature is less than the water temperature set point to allow Water Economizer Mode of operation.

NOTE: The factory provided standard is space temperature (SPAT) and humidity (SPAH) for controlling space conditions is wall mount SPAT and SPAH. Humidity sensors for humidity control is an option that must be specified at time of order. As an option, a Return Air Temperature and Return Air Humidity may be ordered instead of Space Air Temperature and Space Air Humidity. Terminology is automatically reflected on the wall controller based on which sensor is selected.

Global Alarm

As a standard, Interlock Terminal Blocks are provided for field connection to the Global Alarm dry contact closure output. Should the unit go into an alarm condition on any of the following items listed below, a relay will be energized to provide a dry contact closure to control a field provided alarm buzzer or indicator light to alert the customer of the alarm condition with the unit. The power required to drive the field provided device shall be 24VAC powering a device of less than 3 amps maximum through the factory provided relay.

- Loss of Airflow
- Drain Pan Overflow
- Dirty Air Filter
- Heater High Temperature Limit
- Fire/Smoke Detected
- Freeze Stat Alarm (with Freeze Stat option)
- Compressor High and Low Pressure
- Sensor Failure
- Temperature High or Low Alarms
- Humidity High or Low Alarms

STANDARD SYSTEM SAFETIES

Proof of Airflow (Air Flow Switch)

Each system has a switch to monitor for loss of airflow. The output for the Supply Air Blower must be energized for a minimum 60 seconds (field adjustable) before any modes of operation are enabled. Should the airflow switch remain open after the time delay expires or the airflow switch opens while any system modes are in operation, the system shuts down the modes of operation and the supply air blower and provides a loss of airflow alarm.

Fire/Smoke Detection

The Fire/Smoke Detection shut down is a factory standard feature with electrical termination points only. The digital input for Fire/Smoke alarm requires a voltage free normally closed dry contact (opens on alarm). If the Fire Stat/Smoke Detector goes into alarm, the normally closed contact opens and all functions of the system will be shut down, and the controller will provide a Fire/Smoke Alarm. The system will reset based on the setup for reset of the Fire/Smoke Alarm. There are two types of reset for a Fire/Smoke Alarm “Automatic or Manual”.

Automatic reset will automatically reset and restart the system when the Fire/Smoke alarm system is reset without resetting the audible or visual alarm so the customer knows when the unit tripped on a Fire/Smoke Detector Alarm. Manual reset requires the customer to manually reset the Fire Stat/Smoke Alarm condition before the unit will restart the functions of the system. The default setup for Fire/Smoke Alarm is to lock the system out from operation requiring a manual reset/restart at the unit’s Interface Controller. The field has the ability to set the unit to auto-reset/auto-restart once the Fire/Smoke Alarm resets.

Compressor High Pressure Switch

Each Compressor is protected with a high-pressure cutout switch. The switch may vary in pressure range based on the type of refrigerant within the refrigerant circuit. For ON/OFF type Compressors, the high-pressure switch is wired in series with the digital output that controls the ON/OFF function of the corresponding compressor.

The high-pressure switch will open if the refrigerant pressure is greater than the refrigerant pressure set point. The open Compressor 1 High Pressure Switch will de-energize the relay that energizes and de-energizes the Compressor 1 Contactor. One contact energizes and de-energizes the compressor contactor and the other relay contact sends the alarm signal back to the controller to let the controller know that Compressor 1 High Pressure switch tripped. The high-pressure switch will take the compressor offline as it is wired to the relay that controls the contactor for the compressor, but it will also allow the relay to provide the alarm signal.

Once the high-pressure Trip occurs, the compressor must be re-enabled under the System Enables menu in the controller.

NOTE: R410A Refrigerant Systems require a manual reset of the switch due to higher operating pressures within the system.

Compressor Low Pressure Switch

Each Compressor is protected by a low-pressure cutout switch. The switch may vary in pressure range based on the type of refrigerant within the refrigerant circuit. Unlike the high-pressure switch, the low-pressure switch is connected directly to a digital input on the controller. Should the Low Pressure Switch open during a compressor run cycle, the corresponding compressor will trip on low pressure safety. If this occurs, the controller will de-energize the corresponding digital output to the compressor contactor.

When a low-pressure trip occurs, the compressor must be manually re-enabled under the System Enables menu in the controller. Low pressure switches automatically reset once the pressure at switch rises above the switches reset point.

Heater High Temperature Cutout

Factory provided heating banks are supplied with a heater high temperature cutout switch that trips as the surrounding air temperature at the switch causes the temperature on the switch to rise above the cutout point. The switch is bimetallic auto reset type. Should the switch trip, an alarm will be displayed on the controller alerting the customer to Heater High Temperature Cutout. If a heater high temperature cutout occurs, the heaters automatically restart once the surrounding air temperature cools the surface of the switch enough to allow the switch to reset.

Sensor Failure

There are two methods for sensor failure. One method is when the reading is above or below minimum and maximum range of the sensor. With this method, the sensor should be displaying a value on the display of the controller. The other method is a mis-wired or sensor that simply was not installed during installation. This method will display a ###.# output for the failed sensor on the wall controller along with the label of the sensor.

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High and Low Limit Alarms

Each controller has adjustability for High and Low set point alarms for the following sensors. The High and Low Limit Set Points are available under the Alarm Set Points menu. The sensors must be enabled for the High and Low Alarm Set Point display screens to appear. The following sensors have high and low alarm set point capability:

- Space Air Temperature
- Space Air Humidity
- Supply Air Temperature
- Refrigerant Pressure

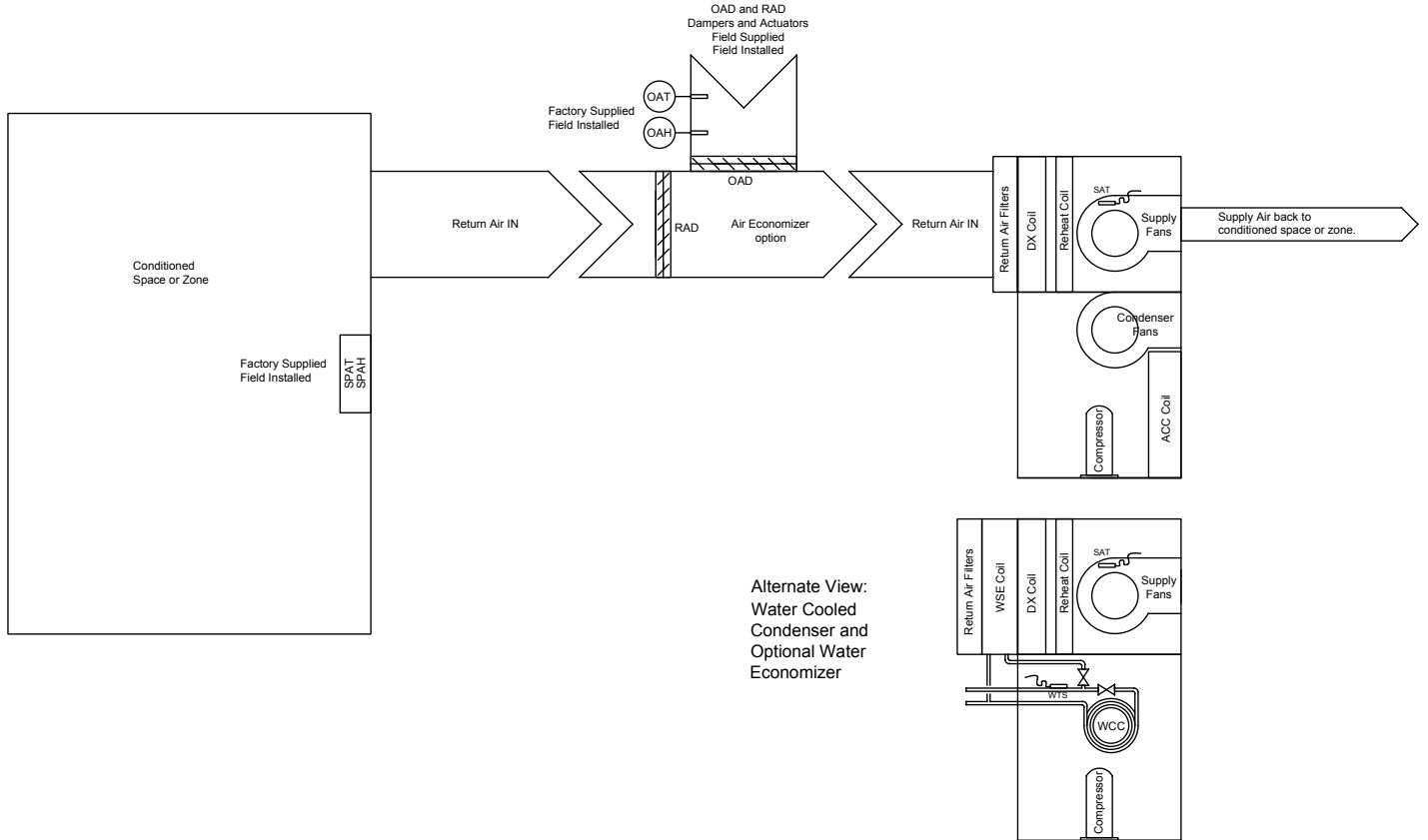
Drain Pan Overflow Switch

The drain pan overflow switch is a water level detection switch that opens when the water level is too high in the unit's condensate drain pan. If there is a blockage in the condensate line, the rising water level in the condensate drain

pan will open the drain pan switch creating an alarm at the controller. The drain pan overflow switch shuts down cooling preventing the condensate from overflowing the drain pan. The alarm will notify the customer of the drain pan overflow condition. Once the blockage is removed from the condensate drain line, the system must be manually reset at the controller's user interface.

Dirty Filter Switch

When the air filter(s) become clogged with dirt and debris, the contacts on the filter switch will open causing a Dirty Filter Alarm at the controller. The alarm will be in the form of a notification recommending that the air filter(s) be changed for preventive maintenance. No modes of operation are locked out during the Dirty Filter Alarm and the unit will continue operation in the presently operating mode. The alarm notification can be reset through the units user interface once the filter(s) are replaced.



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