

Constant Air Volume - CAV

Mode Enable Sensor Options

The temperature of this sensor will determine if the unit is in heating, cooling or vent mode during occupied operation. The following options are available:

- Space Air Temperature Sensor (CAV,)
- Return Air Temperature Sensor (CAV)

Occupied Operation

There are several ways to initiate the occupied mode of operation:

- Internal week schedule
- Remote Forced Occupied contact closure
- Pushbutton Override button on a Space Sensor (Override length is user adjustable)
- Monitoring an external Orion scheduling device

Scheduling

- Has an internal clock that provides 7 day scheduling with 2 start/stops per day.
- Allows scheduling of up to 14 holiday periods per year.

Unoccupied Operation

- The space sensor uses Night Setback Setpoints for heating and cooling calls. If Night Setback Setpoints are left at the default 30°, no Night Setback operation will occur and the unit will be off.
- Uses normal dehumidification setpoint for unoccupied dehumidification calls if Night Humidity Control is configured.
- Outdoor air damper will be closed except if unit is in unoccupied economizer free cooling mode.
- If there is no call for heating, cooling or dehumidification the unit will be in the Off Mode
- If this is a MUA unit that also has return air function, the unit can be configured to operate as a CAV unit in the Unoccupied Mode using space temperature night setbacks and/or a space dehumidification setpoint (See MUA Unoccupied Night Setback Operation section). The outside air damper remains closed. Otherwise the MUA unit will remain off in the Unoccupied Mode.

HVAC Modes of Operation

There are 6 possible HVAC Modes of Operation:

- *Cooling
- *Heating
- *Ventilation
- *Off

Cooling Mode with Digital Scroll Compressor and Optional Fixed Capacity Scroll Compressors

- Cooling is enabled when the temperature at the Mode Enable Sensor rises one deadband above the Cooling Setpoint. Cooling is disabled when the Mode Enable temperature falls one deadband below the Cooling Setpoint. The setpoint and deadband are user adjustable.
- Under normal VAV operation (Supply Air Control), the unit is in Cooling Mode anytime it is in the Occupied Mode.
- In the cooling mode, as the Supply Air Temperature (SAT) rises above the Active Supply Air Cooling Setpoint (see Supply Air Temperature Setpoint Reset section for explanation), the Digital Compressor will stage on and modulate to control to the Active Supply Air Cooling Setpoint.
- If additional cooling is required, fixed compressor stages can be staged on while the Digital Compressor continues to modulate.
- To stage up the extra compressor(s), the SAT needs to be above the Active Supply Air Cooling Setpoint and the Digital Compressor needs to be at 100% for a period of time equal to the Stage Up Delay. Once a fixed compressor is enabled the digital compressor signal will go to 10% and modulate up as needed. This will repeat as additional fixed compressors are staged up.

- For compressors to stage on, Minimum Off Times (adj.) must be satisfied as well as Stage Up Delays (adj.).
- To stage down the extra compressor(s), the SAT needs to be below the Active Supply Air Cooling Setpoint minus the Cooling Stage Control Window and the Digital Compressor needs to be at 0% for a period of time equal to the Stage Down Delay. Once a fixed compressor stages off the digital compressor will go to 100% and modulate down as needed. This will repeat as additional fixed compressors stage off.
- For compressors to stage down, Minimum Run Times (adj.) must be satisfied as well as Stage Down Delays (adj.). The digital compressor is always the last compressor to be deactivated.
- Mechanical cooling is disabled if the outdoor air temperature (OAT) falls 1° below the Cooling Lockout Setpoint and will remain disabled until the OAT rises 1° above the Cooling Lockout Setpoint. If the OAT disables mechanical cooling while it is currently operating, mechanical cooling will stage off as minimum run times and stage down delays are satisfied.
- If the economizer is enabled it will function as the first stage of cooling (see Economizer section).
- If this is a DPAC unit, the Return Air Bypass Damper remains closed during the cooling mode.

Heating Mode:

- Available heating option is Modulating Gas Heat.
- Heating is enabled when the temperature at the Mode Enable Sensor falls one deadband below the Heating Setpoint. Heating is disabled when the Mode Enable temperature rises one deadband above the Heating Setpoint.
- Once in the Heating Mode the unit will stage or modulate heating to maintain the Supply Air Temperature at the **Active Supply Air Heating Setpoint** (See Supply Air Temperature Setpoint Reset section for explanation).
- Multiple stages of heating can be configured subject to user adjustable minimum run times, minimum off times, staging up and staging down delays.
- Mechanical heating is disabled if the outdoor air temperature (OAT) rises 1° above the Heating Lockout Setpoint and will remain disabled until the OAT falls 1° below the Heating Lockout Setpoint. If the OAT disables mechanical heating while it is currently operating, mechanical heating will stage off as minimum run times and stage down delays are satisfied.

Ventilation Mode:

- This is only available in the Occupied Mode of operation on units configured for continuous fan operation and is generated anytime there is no demand for heating or cooling.

Off Mode:

- Occurs in the Unoccupied Mode when there is no heating, cooling or dehumidification demand.
- Can only occur in the Occupied Mode if the fan is configured to cycle with heating and cooling and there is no call for heating, cooling or dehumidification.
- Supply fan is off and the outside air damper is closed.

Economizer Operation

- Enabled when Outdoor Air (OA) drybulb or wetbulb temperature falls below the Economizer Enable Setpoint by 1° and the OA temperature is at least 5° below the return air temperature (if a return air temperature sensor is being used).
- Economizer operation is disabled when the OA temperature rises 1° above the Economizer Enable Setpoint.
- Wetbulb operation requires an Outdoor Humidity Sensor.
- Economizer acts as 1st stage of cooling and controls to the Active Supply Air Cooling Setpoint. If the economizer reaches 100% and the supply air temperature is still above setpoint, mechanical cooling is allowed to stage up while the economizer is held at the full open position.
- An Economizer Minimum Position can be programmed into the controller.
- A Economizer Damper is closed during Unoccupied Mode, except when unoccupied free cooling is used during night setback operation.

Space Sensor Operation

- Available as a Plain Sensor, Sensor with Override, Sensor with Setpoint Slide Adjust, and Sensor with Override and Setpoint Slide Adjust.
- Sensors with Setpoint Slide Adjust can be programmed to allow space setpoint adjustment of up to $\pm 10^{\circ}$ F.
- The Setpoint Slide Adjust will adjust the setpoints of whichever sensor is the mode controlling sensor, even if that sensor is not installed Space Temperature Sensor.
- If Space Temperature is being used to reset the Supply Air Temperature Setpoint, then the Slide Adjust will adjust the HVAC Mode Enable setpoints and the SAT/Reset Source setpoints simultaneously.
- For MUA applications the Space Sensor can be used as a reset sensor to reset the Supply Air Setpoint based on space conditions.
- During Unoccupied hours the Override Button can be used to force the unit back into the Occupied Mode (by pressing the button for less than 3 seconds) for a user-defined override duration of up to 8.0 hours. Pressing the button between 3 and 10 seconds cancels the override.

Supply Fan Operation

- Occupied Mode – Supply fan can be configured to run continuously (default) or to cycle with heating, cooling or dehumidification.
- Unoccupied Mode – Supply fan will cycle on a call for heating, cooling or dehumidification.
- Anytime the Supply Fan is requested to start, a 1 minute minimum off timer must be satisfied. If the timer is satisfied the Supply Fan relay is activated while all other outputs are held off for a period of 1-2 minutes to purge stagnate air from the ductwork before heating or cooling occurs.
- In fan cycle mode or when going unoccupied the supply fan is held on for 2 minutes after the last stage of heating or cooling stages off.

Dirty Filter Status

This input in uses a 24 VAC wet contact closure for Filter Status Indication. A differential pressure switch (by others) is required.

Duct Static Pressure Control for Filter Loading

- In order to maintain a constant CFM through the supply air ducts on MUA Unit or a mixed air CAV, PAC or DPAC Unit, a duct static pressure sensor can be used to monitor the discharge pressure.
- If the filters are getting dirty, the VCM-X will ramp up the VFD to compensate for the decrease in airflow.
- To utilize this feature the unit must be configured to use VFD fan control.
- This feature cannot be used if this is a VAV Unit with typical duct static pressure control.

Remote Forced Heating and Cooling

- These inputs (24 VAC wet contacts) allow another control system or a thermostat to force the unit into heating or cooling.
- To utilize these inputs, the heating and cooling setpoints in the VCM-X must be set to zero.
- Once in this force mode the unit will stage heating/cooling to maintain the appropriate heating/cooling leaving air setpoint until the force is removed.

Emergency Shutdown

- A 24 VAC wet contact input is available to be used with a N.C. Smoke Detector, Firestat, or other shutdown condition (all by others).
- If this contact opens it will initiate shutdown of the VCM-X and will generate an alarm condition. This contact closure does not produce an instantaneous shutdown.
- For instantaneous shutdown the device initiating the open condition on this contact should also be wired to cut the 24 V common to the VCM-X relay outputs.

Temperature Protection:

- Activated when the Supply Air Temperature (SAT) rises above the High Cutoff Temperature (immediate) or drops below the Low Cutoff Temperature (for 10 minutes) both of which are user adjustable. This mode shuts off the unit (with a 3 minute fan off delay) until the mode is cancelled.
- This mode is cancelled when the SAT drops 5 degrees below the High Cutoff Temperature Setpoint or rises 5 degrees above the Low Temp Cutoff Temperature Setpoint, or when the unit changes back into Occupied Operation.

Outdoor Air Lockouts

- Mechanical cooling is disabled when the Outdoor Air Temperature is below the Cooling Lockout Setpoint.
- Mechanical heating is disabled when the Outdoor Air Temperature is above the Heating Lockout Setpoint.
- For Air to Air Heat Pumps the Cooling Lockout also applies to Compressor Heating, so it will usually be a lower setting than on Cooling units that are not Air to Air Heat Pumps.

VCM-X Controller and Expansion Boards I/O Map

I/O Map

| VCM-X Controller | | | |
|---|---|--------------------------|------------------------|
| | Analog Inputs | Analog Outputs | Relays |
| 1 | Space temperature | Economizer | Supply Fan |
| 2 | Supply Temperature | Supply Fan VFD | Configurable |
| 3 | Return Temperature | | Configurable |
| 4 | Outdoor Temperature | | Configurable |
| 5 | Coil Temperature | | Configurable |
| 6 | Static Pressure | | |
| 7 | Space Sensor Slide Offset or Remote BAS Reset of SAT Setpoint | | |
| VCM-X Expansion Module | | | |
| | Analog Inputs | Analog Outputs | Binary Inputs |
| 1 | Outdoor Humidity | Building Pressure VFD | Emergency Shutdown |
| 2 | Space/RA Humidity | Modulating Heating | Dirty Filter |
| 3 | Not Used | Modulating Cooling | Proof of Flow |
| 4 | Building Pressure | Return Air Damper | Remote Forced Occupied |
| 5 | | Return Air Bypass Damper | Remote Forced Heating |
| 6 | | | Remote Forced Cooling |
| 7 | | | Exhaust Hood On |
| 8 | | | Remote Forced Dehum. |
| 4 Binary Input Expansion Module | | | |
| | Binary Inputs | | |
| 1 | Emergency Shutdown | | |
| 2 | Dirty Filter | | |
| 3 | Proof of Flow | | |
| 4 | Remote Forced Occupied | | |
| 12 Relay Output Expansion Module | | | |
| | Relay Outputs | | |
| 1-12 | Configurable | | |