

Variable Air Volume - VAV

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:

- Supply Air Temperature Sensor (VAV Cooling Only or VAV with Supply Air Tempering)

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.
- 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 the unit will be in the Off Mode

HVAC Modes of Operation

There are 5 possible HVAC Modes of Operation:

- *Cooling
- *Heating
- *Ventilation
- *Morning Warm-Up
- *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).

Heating Mode:

- 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**
- 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.

Morning Warm-up Mode:

- Only available for VAV operation
- This mode occurs when the unit goes from the Unoccupied to the Occupied Mode and the return air temperature is below the Morning Warm-up Setpoint.
- In this mode the unit operates as if in the heating mode
- All the VAV boxes are driven either to full open or to a fixed CFM position
- This mode is in effect until the Return Air Temperature rises above the morning warm up target temperature or a user adjustable time period elapses.

Off Mode:

- Occurs in the Unoccupied Mode when there is no heating, cooling 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.
- 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.
- 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 ± 10° 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.

- 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.
- Unoccupied Mode – Supply fan will cycle on a call for heating, cooling.
- 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.

Supply Air Temperature Setpoint Reset

- Various sources can be configured to reset the Supply Air Temperature (SAT) Setpoint. Since the Supply Air Temperature Setpoints are not fixed during reset, we refer to them as “**Active Supply Air Temperature Setpoints**”. The following Reset Source options are available.
 - Space Temperature
 - Return Air Temperature
 - Outdoor Air Temperature
 - Remote Voltage Signal
 - Fan VFD Percentage
- For whatever option is selected, a High and a Low Reset Source Setpoint must be configured that will correspond to configured Low and High SAT Setpoints. This must be done separately for the Cooling Mode setpoints and for the Heating Mode setpoints.
- When the Reset Source is at its highest configured setpoint the SAT Setpoint will be reset to its lowest configured setpoint. When the Reset Source is at its lowest configured setpoint the SAT Setpoint will be reset to its highest configured setpoint.
- The only exception to the above rule would be if doing reset based on the Supply Fan VFD Signal Percentage during the heating mode. In that case at the High Reset Source Setpoint the supply air setpoint would be reset to the configured High SAT Setpoint, etc.
- In all cases as the Reset Source value moves within its range established by the configured High and Low Reset Setpoints, the Supply Air Setpoint will be proportionally reset within its range established by the configured Low and High SAT Setpoints.

Building Pressure Relief

This can be used to maintain a user adjustable Building Relief Pressure Setpoint (requires a Building Pressure Sensor). Available controlling output options are:

- A relay output for On/Off operation
- A 0-10VDC modulating output

There are 2 possible methods of control:

- Direct Acting, meaning that on an **increase** in building static pressure, an on/off exhaust fan can be activated or a VFD exhaust fan can be ramped up.
- Reverse Acting, meaning that on a **decrease** in building static pressure, the outside air damper can be modulated opened (makes normal economizer and IAQ economizer operation unavailable) or a supply fan VFD can be ramped up (if not in a VAV application).

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.

Duct Static Pressure Control for VAV Units with VFD

- The Duct Static Pressure Setpoint, Deadband Limits and Controlling Interval are user adjustable.

- A modulating output signal is used to control a Supply Fan VFD.

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.

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.

Trend Logging

- Continuously maintains an Internal Trend Log in memory on the controller which records a fixed set of values at a user-defined interval.
- 120 log positions (timed retrievals) are available on the controller.
- Once these positions are full, it begins overwriting the oldest data.
- Values can be retrieved using the Prism II graphical front-end software program.
- With Prism running continuously, values can be saved to the computer hard drive at regular intervals to keep from losing data.

The following are the fixed items that can be logged:

Date	Indoor Air Humidity
Time	Duct Static Pressure
Mode	Building Static Pressure
Return Air Temperature	Economizer Signal Percentage
Outdoor Air Temperature	Supply Fan VFD/Bypass Damper Signal Percentage
Supply Air Temperature	Exhaust Fan VFD/Exhaust Damper Signal Percentage
Active Supply Air Setpoint	Modulating Heat Signal Percentage
Coil Suction Temperature	Modulating Cool Signal Percentage
Outdoor Air Dewpoint	On Board Relay Status
Space Temperature	Expansion Board Relay Status
Head Pressure	Condenser Fan Signal Percentage
Outdoor Air CFM	Return Air or Space CO2
Supply Air CFM	ModGas Module Signal Percentage
	Modulating Hot Gas Reheat Module Signal Percentage

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		