MC-2000V: Variable Air Volume (VAV) Control Sequence & Installation Schematic

MC-2000V VAV Control

The MC-2000V control sequence is a variable air volume sequence intended to provide a constant supply air temperature and vary fan speed according to the system static pressure. It serves multiple zones where each zone is provided with a VAV box with reheat.

Unit Operation

Unit operation is initiated when all points are in their run positions.

System Enable: The system enable is controlled at the unit's display terminal, within the system enable menu.

Remote Stop/Start: Remote stop/start NC contacts are provided on all units and ship from the factory jumpered for continuous operation.

BMS Control: The unit is provided with an optional point that may be written by a BMS to index unit operation.

Schedule Control: The unit is provided with a local schedule that may be set to operate the unit in Occupied or Unoccupied modes based on its time clock.

Fan Control

When the unit is indexed for operation and in its occupied mode, the supply fan shall be energized after a 30 second delay (adj.) to allow for optional control damper actuation. The fan shall run continuously. After an additional 15 second delay (adj.) to allow for air proving, the unit shall operate as described herein.

The system is provided with direct-drive, backwards inclined ECM impellers and static pressure sensor for fan speed control. The ECM shall vary the fan speed to maintain the system static pressure set point (1.0" w.g., adj.) as the VAV boxes modulate their dampers in response to zone conditions.

System Mode

The unit operates in a cooling mode to provide year-round cooling/dehumidification. Units may optionally utilize a separate heating set point if required. System mode is changed via a Manual or BMS switch over.

Cooling Operation

On a rise in supply air temperature by 1°F above the cooling set point (55°F, adj.), the unit shall energize its first compressor stage. The first compressor shall energize at 100% and modulate to meet the supply air set point. For dual circuit units, on a continued rise in return temperature by an additional 1°F (adj.), and a minimum delay of 3 minutes, the second compressor stage shall energize.

On a fall in supply air temperature, the second compressor stage (if applicable) shall de-energize. On a continued fall in return air temperature, the first compressor stage shall be de-energized.

Economizer (Air-Side Economizer, Optional)

If the outside air condition is below the economizer set point (69°F, adj.), the unit shall modulate the economizer dampers open. If the outdoor air temperature falls below 55°F (adj.), mechanical cooling shall be locked out and the dampers shall modulate to maintain 55°F into the unit.

On a fall in space temperature, the dampers shall return to their normal positions.

CO2 Damper Control (Optional): The economizer damper may also be set to respond to return CO2 level to provide demand control ventilation (<20% outdoor air). If the space CO2 level rises above the CO2 set point (700 ppm, adj.) by 50 ppm, the damper shall open to provide the unit's maximum outdoor air supply (<20%). On a fall in space CO2 level, the damper shall return to its minimum position. If both economizer and CO2 operation are required simultaneously, the damper shall open to satisfy the larger requirement.

Freecool (Water-Side Economizer, DX Water Cooled Only, Optional)

If the condenser water temperature is below the freecool set point (45°F, adj.), the unit shall energize its freecooling valve as its first stage of cooling in lieu of the first compressor stage. The valve shall modulate to meet the supply air set point.

On a fall in return air temperature, the freecool valve shall be de-energized.

On a continued rise in return air temperature by 12°F and a minimum delay of 3 minutes, the freecool valve shall be de-energized and the unit shall sequence its mechanical cooling stages to meet the temperature requirement.

Heating Operation
On a fall in supply air temperature by 1°F below the heating set point (70°F, adj.), the unit shall energize its first heating stage. The first heating stage shall modulate to meet the heating set point (SCR or modulating valves only). On a fall in supply air temperature by an additional 1°F and a minimum delay of 3 minutes, the second heat stage shall energize.

On a rise in supply air temperature, the second heat stage (if applicable) shall de-energize. On a continued rise in supply air temperature, the first heat stage shall be de-energized.

Head Pressure Control (Air-Cooled Units, ECM or VFD)
The condenser fan motor shall ramp up gently and operate continuously while the compressors are operating. The fan shall vary its speed to maintain the head pressure set point (325 psig, adj.), as controlled by the adjustable head pressure control PID loop.

Head Pressure Control (Air-Cooled Units, p266)
The condenser fan motor shall ramp up gently and operate continuously while the compressors are operating. The p266 controller shall vary the fan speed to maintain the head pressure set point.

Head Pressure Control (Water-Cooled Units, modulating valve)
On a call for compressor operation, the compressor start shall be delayed for 60 seconds (adj.) to allow the valve to fully open. After an initial modulation delay of 90 seconds (adj.), the valve shall modulate between its minimum and maximum operating positions based on the adjustable head pressure control PID loop and head pressure set point (325 psig, adj.).

Unoccupied Operation
If the unit utilizes the system schedule, then during unoccupied hours the unit shall be de-energized.

System Alarms
Air Proving: A differential pressure switch or current sensing switch (optional) closes to confirm airflow prior to the activation of other mechanical components. If the switch doesn't close after an adjustable time delay or opens during unit operation, the unit shall lock-out operation and enunciate an alarm.

Dirty Filter: An adjustable differential pressure switch shall open when the pressure drop across the filter exceeds the desired pressure drop and enunciates an alarm.

Condensate Alarm: A condensate pan switch, condensate pump overflow switch (optional), and water leak detector (optional) are connected in a NC series to detect high condensate. On a high condensate condition, the circuit will open and shut down all mechanical cooling or lock-out unit operation (optional) and enunciate an alarm.

High Refrigerant Pressure: The high refrigerant pressure (>600 psig, auto-reset) switch shall open on a high pressure condition and shut down compressor operation. If the switch resets, the system will attempt to restart the compressor up to 3 times in 10 minutes. If the switch does not reset within 90 seconds or on 3 failed start attempts, the system shall lock-out compressor operation, and enunciate an alarm.

Low Refrigerant Pressure: The low refrigerant pressure (<50 psig) shall open on a low pressure condition and after a time delay (90s, adjustable), shall lock-out compressor operation and enunciate an alarm.

Life Safety: A smoke detector (optional) and firestat (optional) or remote life safety system shall open a relay and break control power to the microprocessor. Unit operation shall cease. The Life Safety Alarm may optionally be routed through the controller to enunciate an alarm and signal the BMS.

Sensor Failure: If a sensor is reading out of range for 5 minutes, the unit shall enunciate an alarm to indicate an issue with the sensor.

High and Low Limit Alarms: Adjustable high and low limit alarms are user-adjustable for sensor points.

Waterflow Switch (Optional): A differential water pressure switch is factory installed on the water lines; if the differential pressure falls below the adjustable set point, compressor operation shall be locked out.

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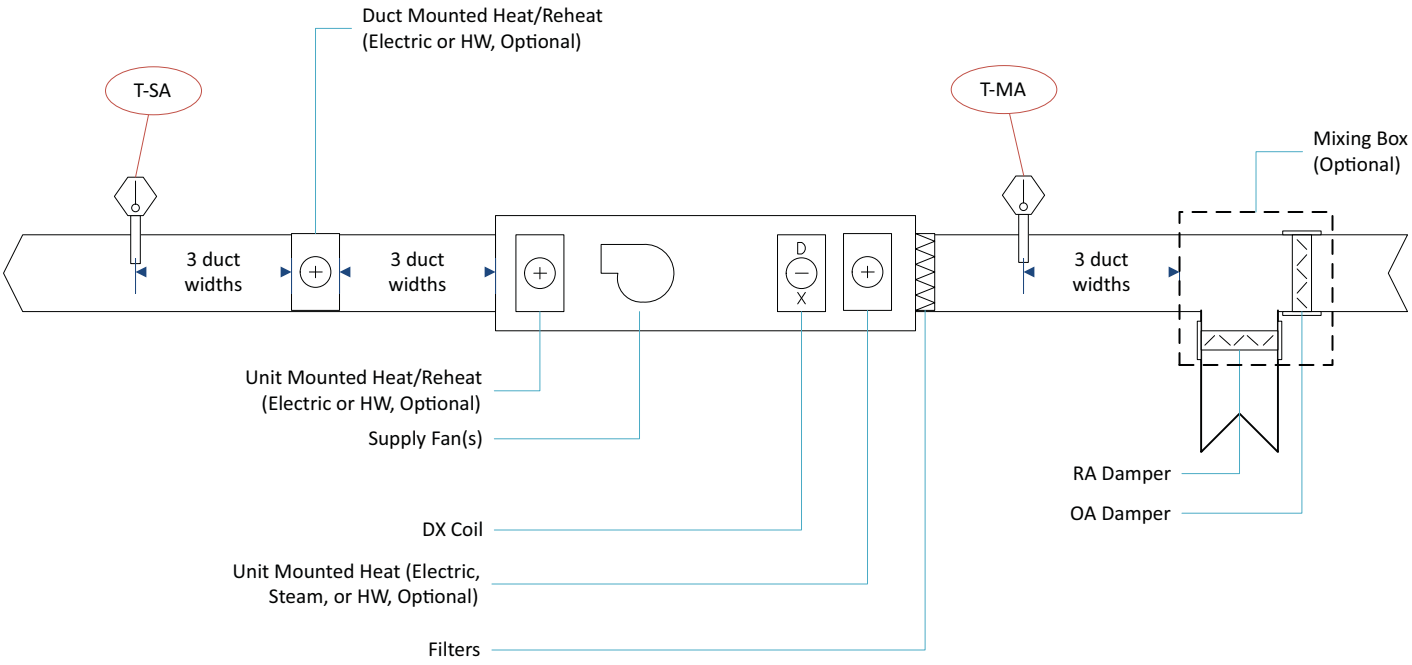
Sensor Installation Schematic



All sensors included with your unit must be installed prior to start-up or the unit will not operate. Sensors are typically either NTC type, 4-20mA, or 0-5 VDC.

Factory Installed Sensors

P-HEAD1(, 2) (Optional, Not Shown): The head pressure sensor(s) are factory installed on each circuit. Refer to piping diagrams for location detail.

Display

Unit Display: All units are shipped with a display terminal and a 50 foot (standard) up to 200 foot cable for connection. The display terminal does not contain any sensors. It may be mounted in the space, mechanical room, or left in the electrical box. MissionCritical units ship with the display terminal cabinet-mounted. This terminal is required for unit operation.

Field Installed Sensors

T-Supply: A supply air temperature sensor is provided for field installation. This sensor must be installed at least 3 duct-widths downstream of the unit and any optional duct mounted heaters.

T-MA: A mixed air dry bulb temperature sensor is provided with the unit. This sensor must be installed downstream of any mixing, immediately before the filter section of the unit.

P-SP (Not Shown): A duct mounted differential pressure sensor is provided with the unit. This sensor must be mounted in the supply air duct downstream of the unit. Install 2/3 of the way down the duct main, unless otherwise directed by the contract documents.

T-OA (Optional, Not Shown): An outdoor air dry bulb temperature sensor is provided when the air-side economizer option is purchased. This sensor must be installed in the outside air duct or plenum upstream of all air mixing.

T-FC (Optional, Not Shown): A condenser water temperature sensor is provided when the freecooling option is purchased. This sensor must be mounted on the condenser water feed to the unit, upstream of any control valves so it senses the current condenser water temperature.

A-CO2 (Optional, Not Shown): If the unit is purchased with the CO2 control option option, a space or duct-mounted CO2 sensor is provided with the unit for field mounting.