

SEQUENCE OF OPERATIONS

DDC CONTROLLER:

- Controller with integral LCD readout for changing set points and monitoring unit operation.
- Provided with required sensors and programming.
- Factory programmed, mounted, and tested.
- Integral USB and Ethernet ports for updating programs and retrieving log files.

BMS INTERFACE:

- [BACnet MS/TP]
- [BACnet IP]
- [Modbus RTU]
- [Modbus TCP]

GENERAL OPERATION

POWER UP:

- When the unit main disconnect is closed a delay of 10 seconds (adjustable) occurs for the controller to come online.

ERV UNIT START COMMAND:

- An input signal is required to enable the unit operation. The unit will be commanded on by:
 - [Digital input]
 - [BMS command]
 - [Internal time clock]
 - [Enable via controller display]
- All types of input that are enabled must be true before the unit will start.
- The exhaust fan starts after a 3 second delay (adjustable). The exhaust fan will not start until the damper actuator end switch closes.
- The supply fan starts after a 6 second delay (adjustable). The supply fan will not start until the damper actuator end switch closes.
- The supply fan, exhaust fan, economizer, [heating], [cooling] are controlled based on the chosen unit operating modes and air conditions.

ERV UNIT STOP COMMAND (OR DE-ENERGIZED):

- The unit can then be commanded off by:
 - [Digital input]
 - [BMS command]
 - [Internal time clock]
 - [Disable via controller display]
- Supply fan and exhaust fan are de-energized.
- All dampers are unpowered and spring return to their default position after a 10 second delay (adjustable).

SUPPLY FAN OPERATION:

- [The supply fan will operate at a constant speed.]
- [The supply fan speed will be controlled for:]
 - [Fixed percentage of max speed (0%-100%)]
 - [Supply air flow (CFM)]
 - [Supply duct static pressure]
 - [Room pressure]
 - [IAQ (TVOC)]
 - [Fixed CO₂]
 - [CO₂ flow]

- The unit will attempt to start the supply fan when the supply fan delay timer expires. When the supply fan starts the supply fan adjustable current switch should close and remain closed until the fan is turned off.

SUPPLY FAN STATUS:

Once the supply fan current switch closes [heating], [cooling] operation is allowed. After a delay of 90 seconds (adjustable) from supply fan start signal, if the supply fan current switch is still open the supply fan alarm should be set to true and [heating], [cooling] operation shall be prohibited. The supply fan status shall be set to true only when the supply fan output is on and supply fan current switch is closed. The supply fan status shall be false in all other circumstances.

FIXED FAN SPEED OPTION:

The analog voltage command to the supply fan VFD can be set from the unit controller display [or by the BMS]. The adjustable range of 0% to 100% correspond to the minimum and maximum fan operating speed. This supply fan operation mode can be used to field balance the supply air flow rate.

SUPPLY AIR FLOW CONTROL OPTION:

The controller will adjust the supply fan VFD command to maintain the supply air flow rate at a set point. The supply air flow rate set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for supply air flow rate set point are unit dependent. An adjustable PI (proportional & integral) loop will compare the measured supply air flow to the air flow rate set point and adjust the fan speed. If the measured supply air flow rate varies from the desired air flow rate by more than 10% (adjustable) for more than 60 seconds (adjustable) a supply air flow rate alarm will be set to true. This supply fan operation mode can be used to provide a constant supply air flow rate as the unit filters become loaded.

SUPPLY DUCT STATIC PRESSURE CONTROL OPTION:

The controller will adjust the supply fan VFD command to maintain the supply duct static pressure at a set point. The supply air duct static pressure set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for supply air duct static pressure set point are unit dependent. An adjustable PI (proportional & integral) loop will compare the measured supply air duct static pressure to the static pressure set point and adjust the fan speed. If the measured static pressure varies from the desired static pressure by more than 0.05 inches water gauge (adjustable) for more than 60 seconds (adjustable) a supply air static pressure alarm will be set to true. This supply fan operation mode can be used to provide a constant supply duct pressure for VAV systems.

ROOM STATIC PRESSURE CONTROL OPTION:

The controller will adjust the supply fan VFD command to maintain the room static pressure at a set point. The room static pressure measurement is typically a differential pressure measurement between the room and an adjacent space or outdoors. The room static pressure set point is entered and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI (proportional & integral) loop will compare the measured room static pressure to the static pressure set point and adjust the supply fan speed. If the measured static pressure varies from the desired static pressure by more than 0.05 inches water gauge (adjustable) for more than 60 seconds (adjustable) a supply air static pressure alarm will be set to true. This supply fan operation mode can be used to provide a constant static pressure in an area to control infiltration or exfiltration from an adjacent area or outdoors.

IAQ (TVOC) CONTROL OPTION:

The controller will adjust the supply fan VFD command to maintain the room or return air VOC level at a set point. The VOC set point is entered and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI (proportional & integral) loop will compare the measured VOC level to the VOC set point and adjust the fan speed. The minimum and maximum fan speed commands are adjustable. If the measured VOC level exceeds 1000 ppm (CO₂ equivalent, adjustable) for more than 60 seconds (adjustable) a VOC alarm will be set to true. This supply fan operation mode can be used to provide demand controlled ventilation of a space. The minimum fan speed will provide the required minimum outdoor air when the VOC level is at or below the VOC set point.

CO₂ CONTROL OPTION:

The controller will adjust the supply fan VFD command to maintain the room or return air CO₂ level at a set point. The CO₂ set point is entered and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI (proportional & integral) loop will compare the measured CO₂ level to the CO₂ set point and adjust the fan speed. The minimum and maximum fan speed commands are adjustable. If the measured CO₂ level exceeds 1000 ppm (adjustable) for more than 60 seconds (adjustable) a CO₂ alarm will be set to true. This supply fan operation mode can be used to provide demand controlled ventilation of a space. The minimum fan speed will provide the required minimum outdoor air when the CO₂ level is at or below the CO₂ set point.

CO₂ FLOW CONTROL OPTION:

The controller will adjust the supply fan VFD command based on the measured room or return air CO₂ level. The supply air flow set point is derived from the user entered minimum and maximum CO₂ levels and minimum and maximum desired air flow rates. When the CO₂ level is at or below the minimum CO₂ level the air flow set point is at the minimum and when the CO₂ level is at or above the maximum CO₂ level the air flow set point is at the maximum. Between the minimum and maximum CO₂ levels the air flow set point is linearly scaled. If the measured CO₂ level exceeds 1000 ppm (adjustable) for more than 60 seconds (adjustable) a CO₂ alarm will be set to true. This supply fan operation mode can be used to provide demand controlled ventilation of a space. The minimum fan speed will provide the required minimum outdoor air when the CO₂ level is at or below the CO₂ set point.

EXHAUST FAN OPERATION:

- [The exhaust fan will operate at a constant speed.]
- [The exhaust fan speed will be controlled for:]
 - [Fixed percentage of max speed (0%-100%)]
 - [Exhaust air flow (CFM)]
 - [Supply fan command tracking]
 - [Supply fan flow rate tracking]
 - [Room static pressure]
- The unit will attempt to start the exhaust fan when the exhaust fan delay timer expires. When the exhaust fan starts the exhaust fan adjustable current switch should close and remain closed until the fan is turned off.

EXHAUST FAN STATUS:

After a delay of 90 seconds (adjustable) from exhaust fan start signal, if exhaust fan current switch is still open the exhaust fan alarm should be set to true. The exhaust fan status shall be set to true only when the exhaust fan output is on and exhaust fan current switch is closed. The exhaust fan status shall be false in all other circumstances.

FIXED FAN SPEED OPTION:

The analog voltage command to the exhaust fan VFD can be set from the unit controller display [or provided by the BMS]. The adjustable range of 0% to 100% correspond to the minimum and maximum fan operating speed (0 VDC minimum to 10 VDC maximum, adjustable). This exhaust fan operation mode can be used to field balance the exhaust air flow rate.

EXHAUST AIR FLOW CONTROL OPTION:

The controller will adjust the exhaust fan VFD command to maintain the exhaust air flow rate at a set point. The exhaust air flow rate set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for the exhaust air flow rate set point are unit dependent. An adjustable PI (proportional & integral) loop will compare the measured exhaust air flow to the air flow rate set point and adjust the fan speed. If the measured exhaust air flow rate varies from the desired air flow rate by more than 10% (adjustable) for more than 60 seconds (adjustable) an exhaust air flow rate alarm will be set to true. This exhaust fan operation mode can be used to provide a constant exhaust air flow rate as the unit filters become loaded.

SUPPLY FAN COMMAND TRACKING CONTROL OPTION:

The controller will adjust the exhaust fan VFD command to track the supply fan command. The minimum (50%) and maximum (200%) tracking rates are adjustable. This exhaust fan operation mode can be used to maintain proportional supply and exhaust fan commands as the supply fan modulates.

SUPPLY FAN FLOW TRACKING CONTROL OPTION:

The controller will adjust the exhaust fan VFD command to track the supply fan air flow rate. The offset from the supply air flow rate is adjustable from -25% to +25%. An adjustable PI (proportional & integral) loop will compare the measured exhaust air flow to the air flow rate set point and adjust the fan speed. If the measured exhaust air flow rate varies from the desired air flow rate by more than 10% (adjustable) for more than 60 seconds (adjustable) an exhaust air flow rate alarm will be set to true. This exhaust fan operation mode can be used to maintain proportional supply and exhaust air flows as the supply fan modulates and as the unit filters become loaded.

ROOM STATIC PRESSURE CONTROL OPTION:

The controller will adjust the exhaust fan VFD command to maintain the room static pressure at a set point. The room static pressure measurement is typically a differential pressure measurement between the room and an adjacent space or outdoors. The room static pressure set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for the exhaust fan speeds are adjustable. An adjustable PI (proportional & integral) loop will compare the measured room static pressure to the static pressure set point and adjust the exhaust fan speed. If the measured static pressure varies from the desired static pressure by more than 0.05 inches water gauge (adjustable) for more than 60 seconds (adjustable) an exhaust air static pressure alarm will be set to true. This exhaust fan operation mode can be used to provide a constant static pressure in an area to control infiltration or exfiltration from an adjacent area or outdoors.

ECONOMIZER (BYPASS) OPERATION:

During normal operation the bypass damper shall remain closed and the face damper open to allow full energy recovery. During economizer operation the bypass damper will be open and the face damper will close to bypass the core. The economizer state can be controlled by temperature or enthalpy.

TEMPERATURE:

- The economizer will be locked out when:
 - The outside air temperature is less than the economizer adjustable low lockout.
 - The outside air temperature is greater than the economizer adjustable high lockout.

ENTHALPY:

- The economizer will be locked out when:
 - The outside air enthalpy is greater than return air enthalpy.
 - The outside air temperature is less than the economizer field adjustable low lockout.

COOLING OPERATION:

Cooling will be locked out if the outdoor air temperature is below 70 degrees (adjustable) or if heating is enabled. The temperature set point can be configured as constant (adjustable) or can be reset by the outside air temperature. Cooling will be controlled using the supply air temperature or return air temperature.

CONSTANT SUPPLY AIR TEMPERATURE OPTION:

The controller will adjust the 0 to 10 VDC analog output to the cooling device to maintain the air temperature at a set point. The air temperature set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for the supply air temperature set point are unit dependent and are adjustable. An adjustable PI (proportional & integral) loop will compare the measured supply air temperature to the supply air temperature set point and adjust the 0 to 10 VDC analog output. Digital outputs that indicate a call for up to 2 stages of cooling will also be provided. The analog and digital outputs can be used to control a chilled water valve, remote DX condensing units, or a heat pump.

RESET AIR TEMPERATURE OPTION:

The controller will adjust the 0 to 10 VDC analog output to the cooling device to maintain the air temperature at a set point. The air temperature set point is calculated based on the outdoor air temperature. The air set point is adjusted between the 70 degree F maximum (adjustable) and the 55 degree F minimum (adjustable) as the measured temperature varies from the 70 degree F minimum (adjustable) to the 90 degree F maximum (adjustable). These values are entered and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI (proportional & integral) loop will compare the measured air temperature to the air temperature set point and adjust the analog output. Digital outputs that indicate a call for up to 2 stages of cooling will also be provided. The analog and digital outputs can be used to control a chilled water valve, remote DX condensing units, or a heat pump. Coil freeze protection must be provided by others in the field.

HEATING OPERATION:

Heating will be locked out if the outdoor air temperature is above 70 degrees (adjustable). The temperature set point can be configured as constant (adjustable) or can be reset by the outside air temperature. Heating will be controlled using the supply air temperature or return air temperature.

CONSTANT TEMPERATURE OPTION:

The controller will stage the heaters or adjust the 0 to 10 VDC analog output to the heating device to maintain the air temperature at a set point. The air temperature set point is entered and adjusted from the unit controller display [or provided by the BMS]. The minimum and maximum values for the air temperature set point are unit dependent and are adjustable. An adjustable PI (proportional & integral) loop will compare the measured air temperature to the air temperature set point and adjust the analog output. A digital output that indicates a call for heating will also be provided. The analog and digital output can be used to control a hot water valve, electric heater, gas heater, or heat pump.

RESET AIR TEMPERATURE OPTION:

The controller will adjust the 0 to 10 VDC analog output to the heating device to maintain the air temperature at a set point. The air temperature set point is calculated based on the outdoor air temperature. The air set point is adjusted between the 100 degree F maximum (adjustable) and the 70 degree F minimum (adjustable) as the measured temperature varies from the 20 degree F minimum (adjustable) to the 70 degree F maximum (adjustable). These values are entered and adjusted from the unit controller display [or provided by the BMS]. An adjustable PI (proportional & integral) loop will compare the measured supply air temperature to the supply air temperature set point and adjust the 0 to 10 VDC analog output. A digital output that indicates a call for heating will also be provided. The analog and digital output can be used to control a hot water valve, electric heater, gas heater, or heat pump. Coil freeze protection must be provided by others in the field.