SIEMENS

Start-up Procedures for Application 2464

VAV with CO2 Alarming, HW Reheat and Radiation Valve Control

TEC-0194.11

Table of Contents

Before You Begin

CAUTION:

Application 2464 contains points with point numbers greater than 99. WINCIS 2.1.4 or greater must be used to view and configure these points. Point numbers greater than 99 are not available for display on Insight terminals.

At the job site, locate the major control system and the mechanical and electrical drawings. These components include valves and dampers and any other components working in conjunction with the TEC.

NOTES: Applications 2464 can be set up to operate without or without a discharge loop, and with or without perimeter radiation heating. Reheat may be configured as analog or floating. Since each option affects the wiring, verify that the controller's input/output (I/O) points are wired per the installation details that match the specific job requirements.

Update each controller at the field panel immediately after you have completed the controller start-up procedures and made all other changes to the controller's point database, including balancing, tuning, etc.

Verifying Power

Verify that the controller has 24 Vac power and that the Basic Sanity Test (BST) LED flashes once per second. See Figures 1 and 2.

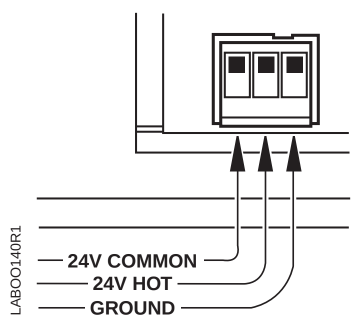

Figure 1. Trunk Connection.

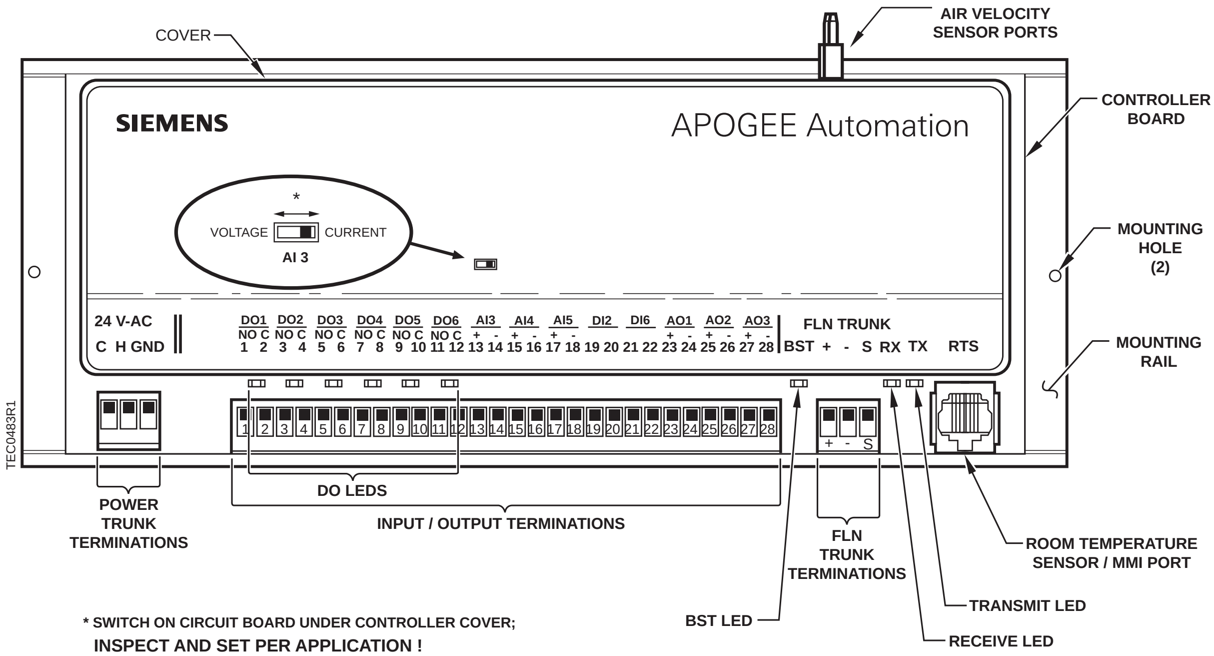

Figure 2. VAV with CO2 Alarming, HW Reheat and Radiation Valve Control.

Verifying Slave Mode Application Number

1. Plug the MMI into the Room Temperature Sensor port. See Figure 2.
2. Verify that Application 2499 (Slave Mode) is running at the controller.

Setting the Application

1. Set APPLICATION (Point 2) to **2464**
2. Set CTLR ADDRESS (Point 1) to the correct value obtained from the controller schedule. Each controller must have a unique address. Normal values are from 00 to 31, but the controller will accept values as high as 98.

Set the Mode of Operation

Set the desired Mode of operation:

Mode 1: VAV PRC with reheat controlled by room temperature. No discharge temperature sensor, no discharge loop, and no perimeter radiation heating. To operate in Mode 1:

1. Set DISCH P GAIN (Point 15) = 0 and set DISCH I GAIN (Point 10) = 0. (No gains being set implies no discharge loop).

Mode2: VAV PRC with reheat controlled by discharge loop. A discharge temperature sensor is required. Discharge reheat is modulated from discharge min to discharge max as heating load increases. There in no perimeter radiation. To operate in Mode 2:

1. Set either (or both) DISCH P GAIN (Point 15) or DISCH I GAIN (Point 10) to a non zero value. (Non zero gains imply a discharge loop is being used). The factory default gains are P gain = 2.0; I gain = 0.02.
2. Set RAD START (Point 77) and RAD END (Point 83) both = 0.

NOTE: Perimeter radiation is disabled when RAD START = RAD END. You can use any value from 0 to 100. Setting both of these points to 0 instead of another value just makes it a little easier to quickly “see” in the point list that they are equal and that there is zero radiation heat.

Mode 3: VAV PRC with reheat controlled by discharge loop, plus perimeter radiation heating. A discharge temperature sensor is required. As the room temperature loop calls for heat, discharge reheat is modulated from discharge min to discharge max and perimeter radiation is also controlled. Except for perimeter radiation, Mode 3 and Mode 2 are the same. To operate in Mode 3:

1. Set either (or both) DISCH P GAIN (Point 15) or DISCH I GAIN (Point 10) to a non zero value. (Non zero gains imply a discharge loop is being used). The factory default gains are P gain = 2.0; I gain = 0.02.
2. Set RAD END > RAD START. (The default values for RAD START and RAD END are 30 and 60 respectively. See the Perimeter Radiation Heating section for information on using different values for RAD START and RAD END.)

Specifying Motor Setup

NOTE: In Application 2464, MTR SETUP (Point 123) determines whether the reheat signal output from the controller is floating (DOs 3 and 4) or analog (AOV1). If Motor 2 is not enabled, the reheat signal is automatically converted to a 0-10V signal and routed to AOV1, and DOs 3 and 4 are spare (they are spare but they cannot be used as an additional motor). If MTR SETUP is set to a value that enables Motor 2 (DO3 and DO4), then the reheat signal is floating and AOV1 is spare.

Use the values in Table 1 to determine the value for MTR SETUP. The values are additive.

EXAMPLES

Say you want to have Motor 1 (DOs 1 and 2) enabled, and Motor 2 (DOs 3 and 4) enabled and reversed. In this case you would set MTR SETUP equal to 13. This is because the Motor 1 **enabled** value is 1, and the Motor 2 **enabled and reversed** value is 12. (1 + 12 = 13.)

Another example would be to have AOV control of reheat, and Motor 1 enabled (for the damper). In this case, you would set MTR SETUP equal to 1. This is because the Motor 1 **enabled** value is 1, and the Motor 2 **not used** value is 0. (1 + 0 = 1.) Remember that when Motor 2 is not used, the reheat signal is automatically routed to AOV1.

Table 1. Additive Values that Determine the Value of MTR SETUP (Point 123).

	Not Used	Enabled	Enabled and Reversed
Motor 1 (supply damper) (DO1 and DO2)	0	1	3
Motor 2 (reheat) (DO3 and DO4)	0* (AOV1)	4	12

*This is the Motor 2 additive value if reheat is to be controlled by AOV1.

Reheat Valve Setup

If reheat uses floating control (Motor 2), skip this section.

Refer to the reheat valve-actuator's technical literature for specific open/close voltages. Otherwise, try different voltages by entering them into AOV1 (Point 74) and checking the action of the actuator. You are looking for the correct open/close voltages, not just whether 0 volts closes the actuator and 10 volts opens it, or vice versa. If 1 volt drives the actuator full closed (or full open), and 8 volts drives it full open (or full closed), then those are the voltages you will enter into AOV1 OPEN and AOV1 CLOSE. (Note that 1 and 8 volts is just an example; actual voltages will depend upon the actuator.)

1. Set AOV1 OPEN (Point 81) to the correct voltage value.
2. Set AOV1 CLOSE (Point 82) to the correct voltage value.
3. Verify operation of the reheat valve. Override REHEAT CMD (Point 37) to 0 and verify that the valve closes. Set REHEAT CMD to 100% and verify that the valve opens.
4. Release REHEAT CMD.

Radiation Valve Setup

If the installation has no perimeter radiation, skip this section.

Refer to the perimeter radiation heating valve-actuator's technical literature for specific open/close voltages. Otherwise, try various voltages by entering them into AOV2 (Point 75) and checking the action of the valve actuator. You are looking for the correct open/close voltages, not just whether 0 volts closes the actuator and 10 volts opens it. If 1 volt drives the actuator to full closed (or full open), and 8 volts drives it full open (or full closed), then those are the voltages you will enter into AOV2 OPEN and AOV2 CLOSE. (Note that 1 and 8 volts are just examples; actual voltages will depend upon the actuator.)

1. Set AOV2 OPEN (Point 88) to the correct voltage value.
2. Set AOV2 CLOSE (Point 89) to the correct voltage value.
3. Verify operation of the radiation valve. Override RAD VALV CMD (Point 38) to 0 and verify that the valve closes. Set RAD VALV CMD to 100% and verify that the valve opens.

4. Release RAD VALV CMD.

MODHTG FLO

As a safety feature on jobs where reheat is an electric element, Application 2464 includes MODHTG FLO (Point 115) to ensure that adequate airflow is present before reheat is energized. The default value is 300, which means that the airflow must be at least 300 fpm before heating output is enabled. (Using fpm (feet per minute) rather than cfm (cubic feet per minute) makes the feature less dependant on duct size.)

A value of 300 fpm equates to the following cfm:

In a 12 inch diameter duct and a typical flow coefficient of .7, 300 fpm equates to 158 cfm.

12 inch diameter = .75 sq ft **.75 sq ft * 300 fpm * .7 = 158 cfm**

In an 8 inch diameter duct and a typical flow coefficient of .7, 300 fpm equates to 74 cfm.

8 inch diameter = .35 sq ft **.35 sq ft * 300 fpm * .7 = 74 cfm**

The default value of 300 fpm can be raised or lowered as required based on manufacturers minimum flow recommendation for a given electric reheat element. As the fpm changes by a certain percentage, the associated minimum cfm for a given duct size will also change by that same percentage.

If the application uses hot water heat rather than electric heat, then MODHTG FLO may be set lower than the default value of 300. This would allow reheating to occur even if for some reason the box is operating well below its designated minimum flow setting.

Note that this safety applies to the reheat heating only. The perimeter heating will continue to function as the application dictates even if the safety has disabled the reheat heating.

Wall Switch

If a wall switch will be used for day/night (occ/unocc) control, enable it by setting WALL SWITCH (Point 18) to YES.

Airflow Setpoints

Using values from the job specifications, program the following points:

1. CLG FLO MAX (Point 32). Set to the maximum flow for cooling mode.
2. CLG FLO MIN (Point 31). Set to the minimum flow for cooling mode. The value should be set no lower than the minimum ventilation required for the space.
3. HTG FLO MAX (Point 34). Set to the maximum flow for heating mode.
4. HTG FLO MIN (Point 33). Set to the minimum flow for heating mode. The value should be set no lower than the minimum ventilation required for the space.

Ventilation

Application 2464 does not have separate points for minimum ventilation. Verify that the values chosen for HTG FLO MIN and CLG FLO MIN have not been set below the minimum ventilation requirements.

Duct Areas

If provided, enter the duct area into SUPDUCT AREA (Point 97). Otherwise, use the table to determine duct area.

Area =	Round Duct	Rectangular Duct
Area in Sq. Ft. (Dimensions in inches)	(π × R2)/144	Length × Height/144
Area in Sq. M (Dimensions in centimeters)	(π × R2)/10,000	Length × Height/10,000

If entering a LCTLR point for the controller at the field panel, do not enter a duct area. (Choose N for none when prompted for the duct shape.) This controller does not send the value of air volume to the field panel in velocity (fpm). Instead, it uses volume (cfm) so a conversion is not necessary.

Setting Flow Coefficients

Follow the steps to set the supply and exhaust flow coefficients.

1. Set SUP FLO COEF (Point 36) to the appropriate value found in Table 2. This value is a starting point for the air balancer.
2. Compare the TEC volume shown in SUP VOL (Point 35) to the actual volume obtained from the balancer's measurements. The TEC volume should be within 5% of actual volume.
3. If necessary, adjust SUP FLO COEF until SUP VOL is within 5% of actual volume. If for example the balancer's measurements are 8% higher than the value shown in SUP VOL, then increase SUP FLO COEF by 8%. Repeat these steps as necessary until SUP VOL and actual volume are within 5%.

Table 2. Box Manufacturer Flow Coefficients.

Manufacturer	Sensor Type	Value
Anemostat	2-pipe without orifice 2-pipe with orifice Spider without orifice Spider with orifice	0.79 0.59 0.73 0.39
Carnes	2-pipe Flow cross	0.66 0.59
Carrier		0.59
E.H. Price / Siemens Building Technologies Lab Terminal Boxes		0.78
Environmental Technologies		0.79
Krueger		0.68
Metal Aire		0.72
Nailor Industries		0.69
Titus		0.60
Trane		0.66

Autozero Module

If an Autozero solenoid is wired to DO6, enable by setting CAL MODULE (Point 87) to YES.

For a controller **with** the Autozero function enabled, the damper is:

- Held still during calibration
- Driven towards closed for ½ of the actuator's configured Motor Timing at start-up or on return from power loss

For a controller **without** the Autozero function enabled, the damper is commanded closed:

- During calibration to get a zero airflow reading
- At start-up or on return from power loss

Automatic Calibration Option

To set CAL SETUP (Point 95), select the automatic calibration option that best meets the job's requirements from Table 3. It is highly recommended that option 4, the factory default mode, be used.

At the start of the calibration cycle, the controller automatically sets CAL AIR (Point 94) to YES. When the cycle is complete, it sets CAL AIR to NO.

The air velocity sensor must be calibrated at least once every 24 hours. Also, the sensor must be calibrated before balancing takes place, as this will affect the balancer's results.

Table 3. CAL SETUP (Point 95) Options.

Option (CAL SETUP value)	Description
0	Calibration occurs ONLY when CAL AIR is set to YES.
1	Calibration occurs when the field panel commands a day/night mode changeover. Actual calibration is subject to a time delay of 0, 1, 2, or 3 minutes. This delay is determined by CTLR ADDRESS divided by 4, with the remainder being the time delay in minutes. Example: If CTLR ADDRESS = 11, then the controller will wait 3 minutes (11 ÷ 4 = 2 R3) after it receives the day/night mode changeover command before beginning the calibration routine.
2	Calibration occurs immediately after the override switch is pressed.
4 (factory default value)	Calibration occurs on the time interval set in CAL TIMER (Point 96). For example, if CAL TIMER = 12, then the calibration period is 12 hours. Actual calibration is subject to a time delay based on the value of CTLR ADDRESS. Refer to the example in Option 1.
NOTE: Summing their numbers can combine Options. For example, to calibrate as in Options 1 and 2, set CAL SETUP to **3**.	

Tuning the Flow Loop

Change the flow by commanding SUP STPT (Point 93) and examine the response. If the airflow oscillates or overshoots significantly, or if the supply damper oscillates, reduce the gain. If it takes too long to reach the setpoint, increase the gain. Try different values—it should move accurately and with stability. When the desired performance is achieved, release the setpoint.

CAUTION:

Adjusting P gains (supply and/or exhaust) to values greater than 0.1 may cause system instability.

Discharge Temperature Control

If the application is configured for Mode 1(no discharge control), then skip this section. (The application operates in Mode 1 if DISCH P GAIN (Point 15) and DISCH I GAIN (Point 10) both equal 0.)

1. If the discharge temperature limits are called out in the specification, set DIS TEMP MIN (Point 65) and DIS TEMP MAX (Point 62) according to the specification. Otherwise, set the limits according to the desired HVAC system operation. (Typical values might be 55°F for the min and 80°F for the max.)

NOTES: DIS TEMP MIN (Point 65) should be set to match the temperature supplied by the air handler—that is, it should be set a degree or two lower than the air handler temperature. This will prevent undesired heating if there is some discrepancy between the sensor in the air handler and the one in the supply terminal.

DIS TEMP MAX (Point 62) should be set according to the heating function required. Many lab rooms do not need “heat,” meaning they never need supply air to come in above the room temperature setpoint. The reheat equipment only serves to reduce the cooling effect of the supply airflow. In this case, set DIS TEMP MAX a few degrees higher than the room temperature setpoint. Rooms with significant exposure to cold outside conditions may call for discharge temperatures significantly above the room temperature. In these rooms, DIS TEMP MAX should be set to the warmest discharge temperature desired for the heating function—for example, 90 degrees.

2. Check the operation of the discharge temperature loop by overriding DISCH STPT (Point 69) and observing the response of DIS TEMP AI5 (Point 64). Tune the discharge temperature loop if necessary. It is more sensitive at low airflow than at high airflow. Check tuning at a low flow (such as minimum) by overriding the setpoint and observing the response of the discharge temperature.

   Overshoot is acceptable as a suggested response (even 5 to 10 degrees), but it should dampen out within 1 or 2 cycles. Small sustained oscillations may be acceptable if they do not overwork the valve. If acceptable performance is achieved at low flow, then the system should be stable, but not too slow at high flow.

3. Release DISCH STPT (Point 69).

NOTE: Advanced PID algorithms have been implemented at and near setpoint to minimize actuator repositioning.

Room Temperature Control

To set room temperature control, enter the room temperature setpoint (RM STPT DIAL, Point 13) or set the thermostat dial. The room temperature should settle at the setpoint with very little oscillation within an hour. If it does not settle out or reach the setpoint, adjust the room temperature loop gains (Points 63 and 67). See the APOGEE Automation Service Procedures on InfoLink for additional information on room temperature control problems.

NOTE: Advanced PID algorithms have been implemented at and near the setpoint to minimize actuator repositioning.

Room Temperature Offset

NOTE: The Room Temperature Offset feature is optional.

When the room has stabilized to within 5°F, take a precision temperature reading at the room temperature sensor. Record any difference between this reading and the value of ROOM TEMP (Point 4) and set this difference value (to the nearest 0.25°F) into TEMP OFFSET (Point 66).

EXAMPLE: If the actual room temperature is 72.0°F, and the value of ROOM TEMP is 73.0°F, then the value entered into TEMP OFFSET is –1.0. In this case, the value of ROOM TEMP would read 73.0°F, but the value of CTL TEMP would read 72.0°F.

CTL TEMP (Point 78) = ROOM TEMP (Point 4) + TEMP OFFSET (Point 66)

RM STPT MIN and RM STPT MAX

NOTE: If CTL STPT (Point 92) is going to be controlled from a field panel, then you can skip this section. This is because when CTL STPT is overridden or controlled by a field panel, it ignores both RM STPT MIN and RM STPT MAX.

If the room temperature sensor has a setpoint dial that will be used, set RM STPT MIN (Point 11) and RM STPT MAX (Point 12) for the minimum and maximum allowable room temperature setpoint values, respectively. Common values for these points are 65°F (18°C) for RM STPT MIN and 80°F (27°C) for RM STPT MAX.

Override Time

If using night/unoccupied override, set OVRD TIME (Point 20) to the number of whole hours that an override should last. If OVRD TIME equals 0 (default), this feature is disabled.

HC.ENDIS

HC.ENDIS (Point 91) determines whether the application is heating only, cooling only, or if it uses both heating and cooling modes. The default value for HC.ENDIS is 3, both heating and cooling are enabled. 1 = heating only; 2 = cooling only.

Set HC.ENDIS to the desired value.

REHEAT START, REHEAT END, FLOW START, FLOW END (Optional)

In the heating mode, flow can be held constant while the heating is modulated, or can ramp from minimum flow to maximum flow before, during, or after the heat modulation.

The default application setting is for flow to be held at heating flow minimum while heat modulates form full off to full on. The default point values are as follows:

- REHEAT START (Point 50) = 0
  REHEAT END (Point 58) = 100

- FLOW START (Point 16) = 0
  FLOW END (Point 17) = 0

To increase flow from min to max in parallel with heat modulating from full off to full on, set:

- REHEAT START = 0
  REHEAT END = 100

- FLOW START = 0
  FLOW END = 100

To sequence flow so that it increases from min to max only after reheat has modulated from full off to full on, set:

- REHEAT START = 0
  REHEAT END = 50

- FLOW START = 50
  FLOW END = 100

To overlap the flow and reheat, so that heating begins modulating before flow starts increasing, and then heating reaches full on while flow is still increasing, set:

- REHEAT START = 0
  REHEAT END = 70

- FLOW START = 30
  FLOW END = 100

The above values are one set of typical examples only. Refer to the application guide TEC-0194.08 for complete information on how the FLOW START/END and REHEAT START/END points work together to coordinate heating flow and reheat modulation.

Perimeter Radiation Heating (optional)

If you understand how RAD START (Point 77) and RAD END (Point 83) function in Application 2464, then set them to desired values and skip the remaining text in this section. Otherwise, read the remainder of this section and then set RAD START and RAD END to desired values. Additional information on Perimeter Radiation is also available in the application guide (TEC-0194.08).

If necessary, refer to the section titled Set the Mode of Operation to determine the operating mode of the application.

If the application operates in Mode 1 or Mode 2, then RAD START (Point 77) and RAD END (Point 83) both = 0 and this section can be skipped because perimeter radiation is disabled.

If Mode 3 is active then perimeter radiation is controlled and the reheat signal (0-100) can be divided into three stages.

- **Stage 1** – Discharge temperature rises from discharge temp minimum (DIS TEMP MIN, Point 65) to room setpoint (CTL STPT, Point 92). Perimeter radiation is off.

- **Stage 2** – Discharge holds at room setpoint while perimeter radiation modulates from full off to full on.

- **Stage 3** – Perimeter radiation is full on while the discharge temperature modulates from room setpoint to discharge max (DIS TEMP MAX point 62).

The values of RAD START (Point 77) and RAD END (Point 83) establish the proportion of the heating effort allocated to stage 2, the radiation heating portion. For example, with the default values of RAD START = 30 and RAD END = 60, as the need for heat increases from 0 to 100, the first 30% of that need will be met with stage 1 (discharge increasing from min to room temperature setpoint, the next 30% of that need will be met with modulating perimeter radiation heating, and the last 40% will be met with discharge air increasing beyond room temperature setpoint as perimeter radiation remains full on.

NOTE: The values for RAD START and RAD END should be chosen based on the relative heat contribution by the box reheat compared to the radiation heating. If the room heating is predominately by radiation, then the radiation stage 2 should be allocated a higher percentage. This means a greater "range" between RAD START and RAD END (for example, instead of the default of RAD START = 30 and RAD END = 60, which is a range of 30 to 60, you could configure a range of 30 to 85, or 15 to 80—these are just examples). Similarly if box reheat is the predominant source of heat, then the radiation stage should be allocated a lower percentage.

One other consideration is the relative sizes of stage 1 versus stage 3.

For example, if…

- DIS TEMP MIN = 50
- CTL STPT (room setpoint) =70
- DIS TEMP MAX = 90

…then the difference from 50 to 70 is the same as 70 to 90. The percentage allocated to stage 1 should be about the same percentage as allocated to stage 3.

However, if…

- DIS TEMP MIN = 55
- CTL STPT (room setpoint) = 70
- DIS TEMP MAX = 110

…then the percentage allocated to stage 1 should be reduced and the percentage allocated to stage 3 should be increased.

AVS FAILMODE

AVS FAILMODE (Point 40) is an enumerated point that determines how the Supply Air Damper will respond if the Air Velocity Sensor fails. See Table 4.

Table 4. AVS FAILMODE (Point 40) Values.

AVS FAILMODE	Description
0 (default)	Supply damper holds position in the event of AVS sensor failure
3	Supply damper opens in the event of AVS sensor failure
4	Supply damper closes in the event of AVS sensor failure

Alarms

The controller is equipped with ventilation and pressurization alarms. It does not contain temperature alarms.

Ventilation Alarm

VENT ALM (Point 68) is turned on when SUP VOL (Point 35) stays below the currently active supply minimum for a time at least equal to VENT ALM DEL. (Point 125)

It is turned off when SUP VOL stays above the currently active supply minimum for a time at least equal to VENT ALM DEL.

Local Annunciation

ALARM ENA (Point 85) determines whether or not a ventilation alarm as described above will activate the ALARM DO5 (Point 45). If ALARM ENA = 1, then a ventilation alarm condition will activate DO5. If ALARM ENA = 0, then a ventilation alarm will not activate DO5.

Set ALARM ENA to desired value.

Network Alarms

If there are other alarms to be indicated in the local ALARM DO5 (Point 47), they may be programmed in the field panel to work through NET ALM CMD (Point 23). No setup is required at the TEC to enable this function. Regardless of how ALARM ENA is set, an external command via NET ALM CMD will energize DO5.

CAUTION:

DO NOT override ALARM DO5 or use it as a spare output point when ALARM ENA is not set to zero.

Setting the CO2 Parameters

1. Set CO2 SCALE (Point 54) to the value, in PPM, represented by the CO2 sensor's full 10V (or 20mA) output signal.

2. Confirm that the switch for AI3 (located on the circuit board) is set to either voltage or current as needed for the type of sensor used. The normal factory default position for this switch is voltage.
3. Set CO2 ALM LIM (Point 53) to the desired CO2 alarm threshold value in PPM. CO2 concentrations greater than CO2 ALM LIM will trigger CO2 ALARM (Point 52) to turn ON.

This module includes hysteresis (deadband). CO2 ALARM (Point 52) will not reset to OFF until the CO2 level has dropped to a value at least 25 PPM below the value of CO2 ALM LIM (Point 53).

NOTE: Setting CO2 ALM LIM to 0 will disable the alarm feature.

The Startup is complete.

NOTE: Update each controller at the field panel immediately after you have completed the controller start-up procedures and made all other changes to the controller's point database, including balancing, tuning, etc.