SIEMENS

Application 2464

VAV with CO2 Alarming, HW Reheat and Radiation Valve Control

TEC-0194p08

Overview

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.

Application 2464 controls room temperature in a room served by one single-duct supply terminal with a reheat coil.

To provide cooling, Application 2464 modulates the supply air damper. The way that Application 2464 provides heating depends on how it has been configured. Application 2464 has three mode configurations available:

- **Mode 1** - VAV with reheat controlled directly by the room temperature loop.
- **Mode 2** - VAV with reheat controlled by discharge loop (discharge temperature sensor required).
- **Mode 3** – VAV with reheat controlled by discharge loop (discharge temperature sensor required), plus additional perimeter radiation heating.

NOTE: In Mode 3, the heat demand is broken into three stages. In stage one, perimeter radiation heat is off and the discharge temperature rises from discharge min to room setpoint. If heat demand is still not met, the application enters stage two. In stage two, the discharge is held at room setpoint while the perimeter radiation heating modulates from full off to full on. If heat demand is still not met, the application enters stage three. In stage three, the perimeter radiation is full on while the discharge temperature modulates from room setpoint to discharge max. For more information, see *Heating Sequencer* section.

In Application 2464, airflow rates can be held constant or modulated. When flow is modulated, it can be sequenced, changed in parallel, or overlapped with heating.

This application uses floating control electronic actuators for supply damper control. A standard 0 to 10 Vdc actuator is used for the optional perimeter heating valve. The box reheat may be driven with either 0 to 10 Vdc or floating control. See Figure 1.

Secure Mode

Application 2464 includes Secure Mode. Secure Mode prevents unauthorized users from making changes to the controller through the MMI port or room sensor. This mode can only be enabled/disabled through an Insight® command. When Secure Mode is enabled, any attempts to make point changes in the controller will be rejected and result in a priority too low error message.

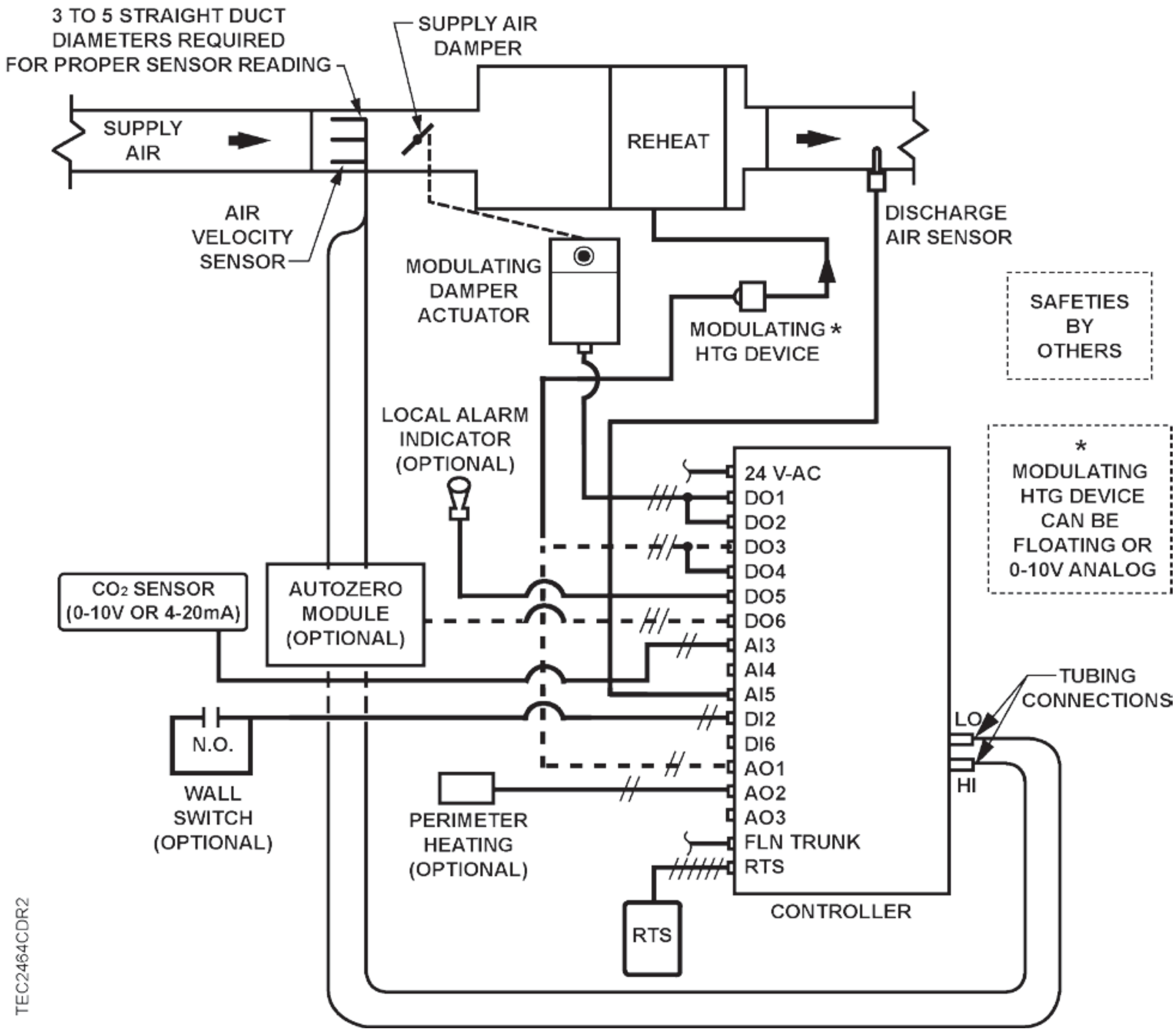
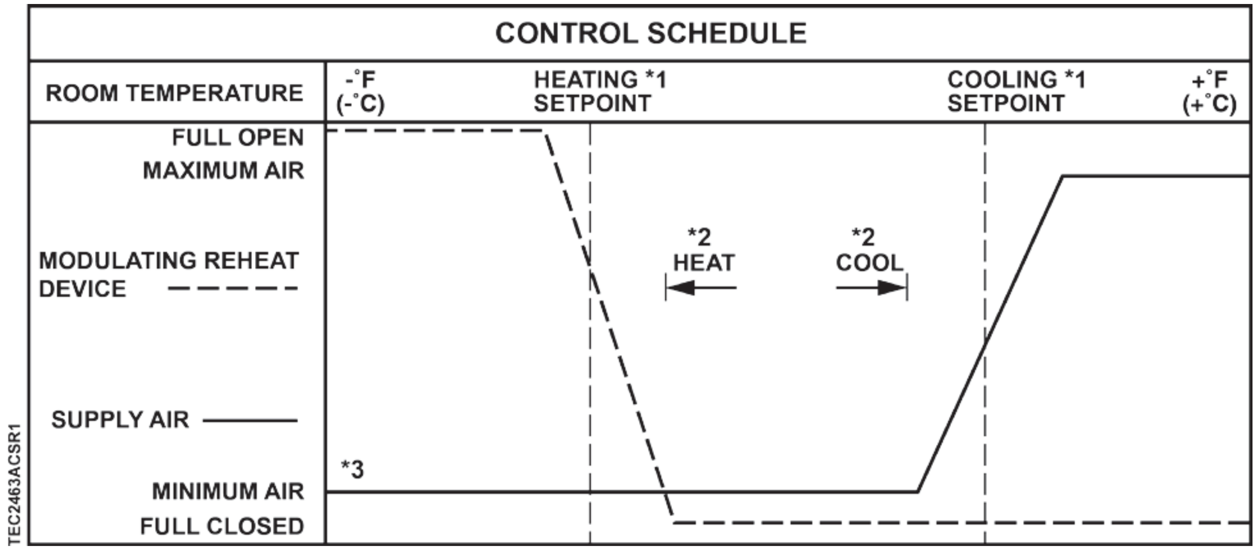
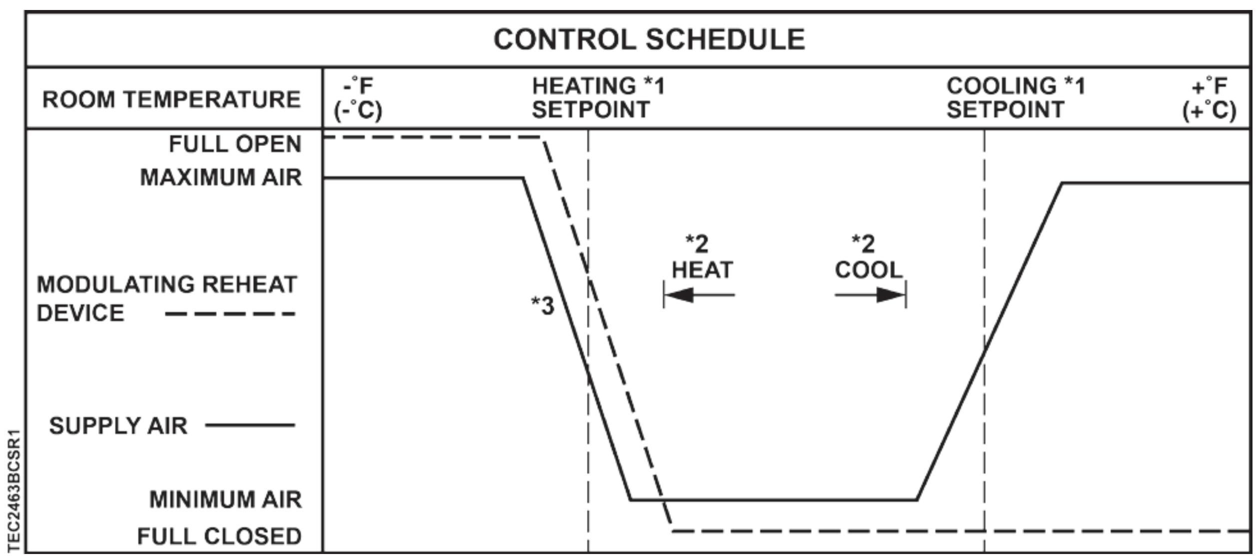


Figure 1. Application 2464 Control Drawing.



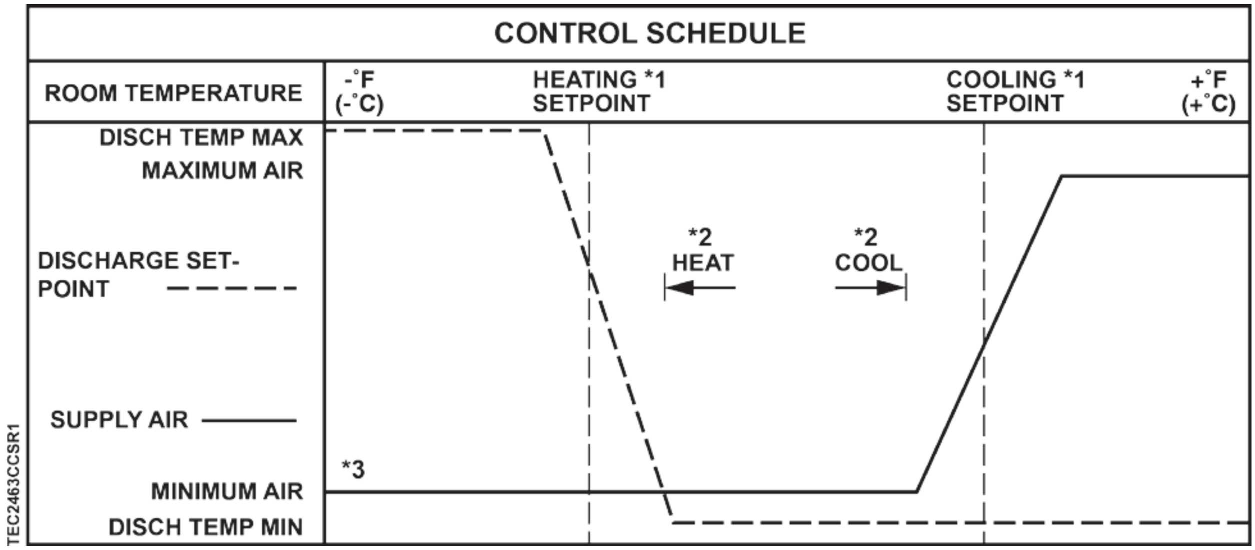
1. See *Control Temperature Setpoints* section.
2. See *Heating/Cooling Switchover* section.
3. The airflow is shown at minimum flow throughout the entire heating mode (default setting). The airflow can operate sequenced, parallel, or overlapping with the reheat valve (optional). See *Sequencing Logic* section.

Figure 2. Application 2464 Control Schedule — Mode 1.



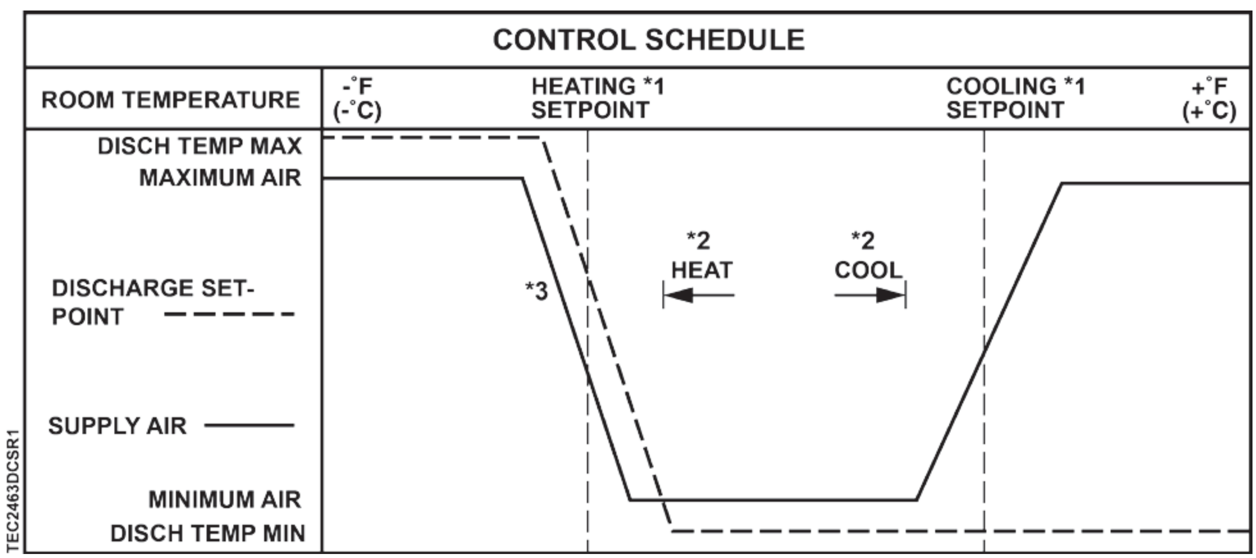
1. See *Control Temperature Setpoints* section.
2. See *Heating/Cooling Switchover* section.
3. The airflow is shown operating parallel with the reheat valve (optional). The airflow can operate at minimum flow throughout the entire heating mode (default setting). See *Sequencing Logic* section.

Figure 3. Application 2464 Control Schedule with Modulating Damper in Heating Mode — Mode 1.



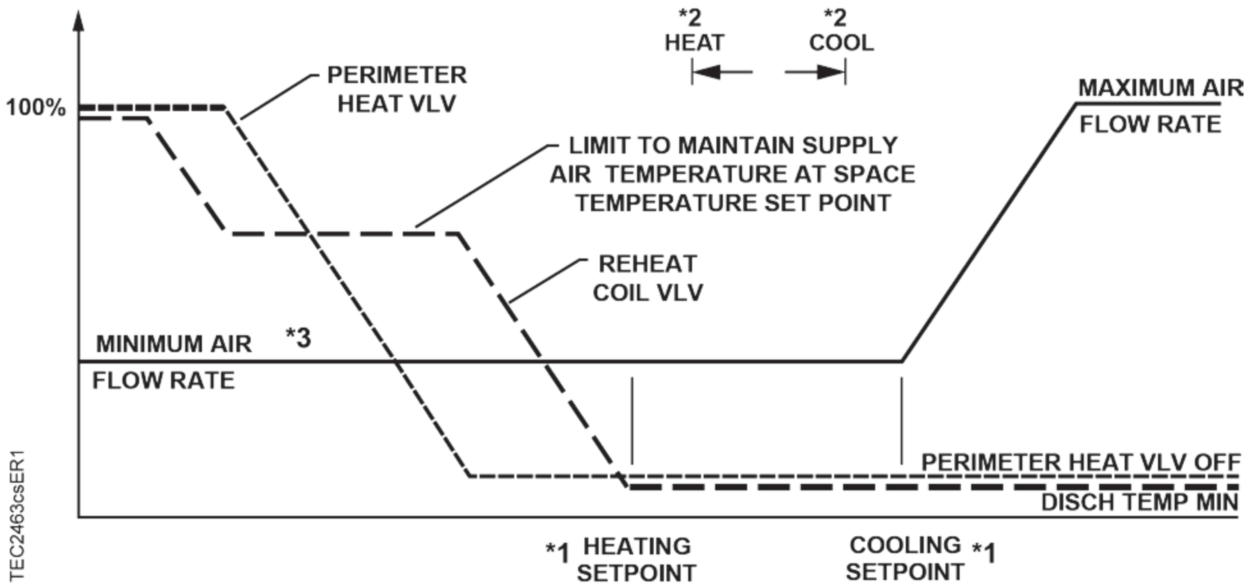
1. See *Control Temperature Setpoints* section.
2. See *Heating/Cooling Switchover* section.
3. The airflow is shown at minimum flow throughout the entire heating mode (default setting). The airflow can operate sequenced, parallel, or overlapping with the reheat valve (optional). See *Sequencing Logic* section.

Figure 4. Application 2464 Control Schedule — Mode 2.



1. See *Control Temperature Setpoints* section.
2. See *Heating/Cooling Switchover* section.
3. The airflow is shown operating parallel with the reheat valve (optional). The airflow can operate at minimum flow throughout the entire heating mode (default setting). See *Sequencing Logic* section.

Figure 5. Application 2464 Control Schedule with Modulating Damper in Heating Mode — Mode 2.



1. See *Control Temperature Setpoints* section.
2. See *Heating/Cooling Switchover* section.
3. The airflow is shown operating parallel with the reheat valve (optional). The airflow can operate at minimum flow throughout the entire heating mode (default setting). See *Sequencing Logic* section.

Figure 6. Application 2464 Control Schedule — Mode 3.

Hardware Inputs

Analog

- One air velocity sensor
- Room temperature sensor
- Optional CO2 sensing (0-10v or 0-20Ma) (AI3)
- Discharge temperature sensor (100K Ohm thermistor) (optional) (AI5)
- Spare (100K Ohm thermistor) (AI-4)
- Room temperature setpoint dial (optional)

Digital

- Occupancy button (option on room temperature sensor)
- Occupancy switch (optional)
- DI 3 (available only if AI3 not used)
- DI 4 (available only if AI4 not used)
- DI 5 (available only if AI5 not used)

Hardware Outputs

Analog

- AOV1 reheat valve – default (can use optional floating control (DO3, DO4) if desired)
- AOV2 perimeter radiation valve (optional)

Digital

- Supply damper (DO1, DO2)
- Floating Control of reheat valve (DO3, DO4) (optional alternative to default AOV1 control)
- AZM (DO6)
- Alarm (DO5) (optional)

Ordering Notes

540-865F	Application 2464 - VAV with CO2 Alarming, HW Reheat and Radiation Valve Control

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2464: *VAV with CO2 Alarming, HW Reheat and Radiation Valve Control.*

Ventilation

Application 2464 does not have separate points for minimum ventilation. Verify that the values chosen for HTG FLO MIN (Point 33) and CLG FLO MIN (Point 31) have not been set below the minimum ventilation requirements

Control Temperature Setpoints

The application has a number of different room temperature setpoints—DAY HTG STPT, NGT CLG STPT, RM STPT DIAL, etc. The application actually controls to CTL STPT (Point 92). CTL STPT is set to different values as explained in the following:

CTL STPT is Overridden - When CTL STPT is overridden it will equal its overridden value and the application will have no effect on the value of CTL STPT. Also when CTL STPT is overridden, it will always have a status of Normal, even if the Status of RM STPT DIAL (Point 13) is Failed.

Night Mode – In night mode, CTL STPT holds the value of NGT CLG STPT (Point 08) or NGT HTG STPT (Point 09). This is true whether or not a setpoint dial is being used. Also during night mode, CTL STPT will always have a status of Normal, even if the status of RM STPT DIAL is Failed.

Day Mode (setpoint dial not used) – In the day mode when a setpoint dial is not being used, then CTL STPT holds the value of DAY CLG STPT (Point 06) or DAY HTG STPT (Point 07). Also, CTL STPT will always have a Status of Normal, even if the Status of RM STPT DIAL is Failed.

Room Temperature Setpoint Dial

When STPT DIAL (Point 14) = NO, a room temperature setpoint dial is not being used. A setpoint dial is being used when STPT DIAL is YES. When a setpoint dial is present, it is only used when both of the following 2 conditions hold:

- The controller is in Day mode.
- CTL STPT is not overridden.

If these 2 conditions are both true, then:

- When RM STPT DIAL (Point 13) has a status of Normal, CTL STPT will have a status of Normal. The current value of RM STPT DIAL will be used to determine the value of CTL STPT.

- When RM STPT DIAL has a status of Failed and RM STPT DIAL is overridden, CTL STPT will have a status of Normal. The current value of RM STPT DIAL will be used to determine the value of CTL STPT.
- When RM STPT DIAL has a status of Failed and RM STPT DIAL is not overridden, CTL STPT will have a status of Failed. The last known good value of RM STPT DIAL will be used to determine the value of CTL STPT.

When a setpoint dial is being used, the actual value of CTL STPT will depend on whether or not a deadband (or zero energy band) is being used. The following 2 sections will explain this further. In both of these sections, the following assumptions are made:

- The controller is in Day mode.
- CTL STPT is not overridden.

Setpoint dial used without a deadband

When DAY HTG STPT equals DAY CLG STPT, a deadband is not being used. (A space where the deadband is not used may be more comfortable than a space where the deadband is being used.) If a deadband is not being used, then:

1. CTL STPT will equal RM STPT MAX (Point 12) if RM STPT DIAL > RM STPT MAX.
2. CTL STPT will equal RM STPT MIN (Point 11) if RM STPT DIAL < RM STPT MIN.
3. Otherwise, CTL STPT will equal RM STPT DIAL.

Setpoint dial used with a deadband

When DAY HTG STPT does not equal DAY CLG STPT, a deadband is being used. (A space where the deadband is used can be more energy efficient than a space where the deadband is not being used.) If a deadband is being used, then:

When HEAT.COOL (Point 5) equals HEAT

1. If RM STPT DIAL > than RM STPT MAX, then:
   a. If [RM STPT MAX – 0.5 * (DAY CLG STPT – DAY HTG STPT)] > RM STPT MAX, then CTL STPT will equal RM STPT MAX.
   b. If [RM STPT MAX – 0.5 * (DAY CLG STPT – DAY HTG STPT)] < RM STPT MIN, then CTL STPT will equal RM STPT MIN.
   c. Otherwise, CTL STPT will equal RM STPT MAX – 0.5 * (DAY CLG STPT – DAY HTG STPT).
2. If RM STPT DIAL < than RM STPT MIN, then:
   a. If [RM STPT MIN – 0.5 * (DAY CLG STPT – DAY HTG STPT)] > RM STPT MAX, then CTL STPT will equal RM STPT MAX.
   b. If [RM STPT MIN – 0.5 * (DAY CLG STPT – DAY HTG STPT)] < RM STPT MIN, then CTL STPT will equal RM STPT MIN.
   c. Otherwise, CTL STPT will equal RM STPT MIN – 0.5 * (DAY CLG STPT – DAY HTG STPT).
3. If RM STPT MAX > RM STPT DIAL > RM STPT MIN, then:
   a. If [RM STPT DIAL – 0.5 * (DAY CLG STPT – DAY HTG STPT)] > RM STPT MAX, then CTL STPT will equal RM STPT MAX.
   b. If [RM STPT DIAL – 0.5 * (DAY CLG STPT – DAY HTG STPT)] < RM STPT MIN, then CTL STPT will equal RM STPT MIN.

   c. Otherwise, CTL STPT will equal RM STPT DIAL – 0.5 * (DAY CLG STPT – DAY HTG STPT).

When HEAT.COOL (Point 5) equals COOL

1. If RM STPT DIAL > than RM STPT MAX, then:
   a. If [RM STPT MAX + 0.5 * (DAY CLG STPT – DAY HTG STPT)] > RM STPT MAX, then CTL STPT will equal RM STPT MAX.
   b. If [RM STPT MAX + 0.5 * (DAY CLG STPT – DAY HTG STPT)] < RM STPT MIN, then CTL STPT will equal RM STPT MIN.
   c. Otherwise, CTL STPT will equal RM STPT MAX + 0.5 * (DAY CLG STPT – DAY HTG STPT).
2. If RM STPT DIAL < than RM STPT MIN, then:
   a. If [RM STPT MIN + 0.5 * (DAY CLG STPT – DAY HTG STPT)] > RM STPT MAX, then CTL STPT will equal RM STPT MAX.
   b. If [RM STPT MIN + 0.5 * (DAY CLG STPT – DAY HTG STPT)] < RM STPT MIN, then CTL STPT will equal RM STPT MIN.
   c. Otherwise, CTL STPT will equal RM STPT MIN + 0.5 * (DAY CLG STPT – DAY HTG STPT).
3. If RM STPT MAX > RM STPT DIAL > RM STPT MIN, then:
   a. If [RM STPT DIAL + 0.5 * (DAY CLG STPT – DAY HTG STPT)] > RM STPT MAX, then CTL STPT will equal RM STPT MAX.
   b. If [RM STPT DIAL + 0.5 * (DAY CLG STPT – DAY HTG STPT)] < RM STPT MIN, then CTL STPT will equal RM STPT MIN.
   c. Otherwise, CTL STPT will equal RM STPT DIAL + 0.5 * (DAY CLG STPT – DAY HTG STPT).

Room Temperature, Temp Offset, and CTL TEMP

ROOM TEMP is the temperature that is being sensed by the room temperature sensor (the RTS). TEMP OFFSET (Point 66), is a user-adjustable offset that will compensate for deviations between the value of ROOM TEMP (Point 4) and the actual room temperature. CTL TEMP is the room temperature that is used for control purposes. In other words, what the application is trying to do is to maintain CTL TEMP at CTL STPT.

When CTL TEMP is not overridden, CTL TEMP and ROOM TEMP are related by the following equation: CTL TEMP (Point 78) = ROOM TMP (Point 4) + TEMP OFFSET (Point 66).

If CTL TEMP is not overridden, then:

If ROOM TEMP has a status of Normal, CTL TEMP will also have a status of Normal. The current value of ROOM TEMP will be used to determine the value of CTL TEMP. If ROOM TEMP has a status of Failed and ROOM TEMP is overridden, then CTL TEMP will have a status of Normal. The current value of ROOM TEMP will be used to determine the value of CTL TEMP.

If ROOM TEMP has a status of Failed and ROOM TEMP is not overridden, then CTL TEMP will have a status of Failed. The last known good value of ROOM TEMP will be used to determine the value of CTL TEMP.

If CTL TEMP is overridden then:

- CTL TEMP equals its overridden value and the points ROOM TEMP and TEMP OFFSET have no effect on the value of CTL TEMP.

- CTL TEMP will always have a status of Normal, even if ROOM TEMP is Failed.

Day and Night Modes

The day/night status of the space is determined by the status of DAY.NGT (Point 29). The control of this point differs depending on whether the controller is monitoring the status of a wall switch or connected to a field panel.

When a wall switch is physically connected to the termination strip on the controller at DI 2, and WALL SWITCH (Point 18) = YES, the controller monitors the status of DI 2. When DI 2 (Point 24) is ON (the switch is closed), DAY.NGT will be set to DAY indicating that the controller is in day mode. When DI 2 is OFF (the switch is open), DAY.NGT will be set to NIGHT indicating that the controller is in night mode.

When WALL SWITCH = NO, the controller does not monitor the status of the wall switch, even if one is connected to it. In this case, the controller is operating stand-alone, it stays in day mode all the time. If the controller is operating with centralized control (connected to a field panel), the field panel can send an operator or PPCL command to override the status of DAY.NGT. See *Powers Process Control Language (PPCL) User's Manual (125-1896)* and *Field Panel User's Manual (125-3000)* for more information.

Night Mode Override Switch

If an override switch is present on the room temperature sensor and a value (in hours) other than zero has been entered into OVRD TIME (Point 20), pressing the override switch will reset the controller to day mode for the time period set in OVRD TIME. The status of NGT OVRD (Point 21) changes to DAY. After the override time elapses, the controller returns to night mode and NGT OVRD changes back to NIGHT. The override switch on the room sensor will only affect the controller during night mode.

Heating/Cooling Switchover

This section describes how the heating/cooling switchover feature works when both heating and cooling are enabled (HC.ENDIS, Point 91 = 3).

If all of the following conditions are met for the length of time set in SWITCH TIME (Point 86), the controller switches from heating to cooling mode by setting HEAT.COOL (Point 5) to COOL:

- HTG LOOPOUT (Point 80) < SWITCH LIMIT (Point 111).
- CTL TEMP (Point 78) > CTL STPT (Point 92) by at least the value set in SWITCH DBAND (Point 90).
- CTL TEMP > the appropriate cooling setpoint minus SWITCH DBAND.

If all of the following conditions are met for the length of time set in SWITCH TIME, the controller switches from cooling to heating mode by setting HEAT.COOL to HEAT:

- CLG LOOPOUT (Point 79) < SWITCH LIMIT.

- CTL TEMP < CTL STPT by at least the value set SWITCH DBAND.
- CTL TEMP < the appropriate heating setpoint plus SWITCH DBAND.

Application 2464 performs heating/cooling switchover based on room load. To perform heating/cooling switchover based on some other criteria, such as time of year, outside air temperature or supply air temperature, unbundle the HEAT.COOL point at a field panel and use PPCL to control it.

- Heating only, set HC.ENDIS (Point 91)= 1.
- Cooling only, set HC.ENDIS = 2.

Modulate Damper During Heating Mode (optional)

CAUTION:

This heating/cooling switchover mechanism is not affected by the air temperature in the supply duct.

To change the value of HEAT.COOL (Point 5) based on the supply air temperature, you must command HEAT.COOL through PPCL. This is required when the flow loop will be used as a source of cooling in cooling mode and a source of heat in heating mode. If the flow loop is used in heating mode just to meet minimum air requirements, the heating/cooling switchover mechanism operates as described to control HEAT.COOL. See the section *Sequencing Logic (optional)* for more information.

Control Loops

Application 2464 is controlled by four Proportional, Integral, and Derivative (PID) control loops (three temperature loops and one flow loop).

Heating Temperature Loop — The Heating Temperature Loop uses CTL STPT (Point 92) and CTL TEMP (Point 78) to modulate the value of its loopout point HTG LOOPOUT (Point 80) from HTG FLO MIN to HTG FLO MAX.

Cooling Temperature Loop — The Cooling Temperature Loop uses CTL STPT (Point 92) and CTL TEMP (Point 78) to modulate the value of its loopout point CLG LOOPOUT (Point 79) from CLG FLO MIN to CLG FLO MAX.

In Application 2464, you can set CLG FLOW MIN equal to, but not greater than, CLG FLOW MAX, and set HTG FLOW MIN equal to, but not greater than, HTG FLOW MAX. If the minimum and maximum values are set equal, the flow loop becomes a constant volume loop and loses its ability to control temperature.

Discharge Temperature Loop – The Discharge Temperature Loop uses DIS TEMP AI5 (Point 64) and DISCH STPT (Point 69) to modulate the discharge air temperature between the limits of the minimum discharge air temperature DIS TEMP MIN (Point 65) and the maximum discharge air temperature DIS TEMP MAX (Point 62). Note that the discharge temperature loop is only used in Modes 2 and 3. In Mode 1, there is no separate discharge control loop since the reheat valve is directly controlled by the temperature loop.

Supply Flow Loop - SUP VOL (Point 35) as derived from the AVS1 supply velocity sensor is compared to the SUP STPT (Point 93) to generate the control signal SUP DMP CMD (Point 48). SUP DMP CMD (a value from 0 to 100) represents the required position of the damper in order to reach the desired setpoint. 0 represents fully closed and 100 represents full open.

Heating Safety

CAUTION:

Do not set HTG FLOW MIN (Point 33) to 0 CFM (0 LPS). Safeties provided by others should require a minimum airflow moving across the heating coils when the modulating heating device is open.

NOTE: As a safety feature, Application 2464 includes MODHTG FLO (Point 115) to ensure that adequate airflow is present before heating coils are energized. When the supply airflow (in fpm as derived from the supply air velocity sensor) is greater than MODHTG FLO then the internal point "ok_to_mod" is set to Yes and the modulating heating device is allowed to modulate.

The default value is 300, which means that the airflow over the heating coil must be at least 300 fpm.

Since CFM = FPM x Duct Area x Flow Coefficient, the default value of 300 fpm equates to the following cfm's:

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

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 the box is operating 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.

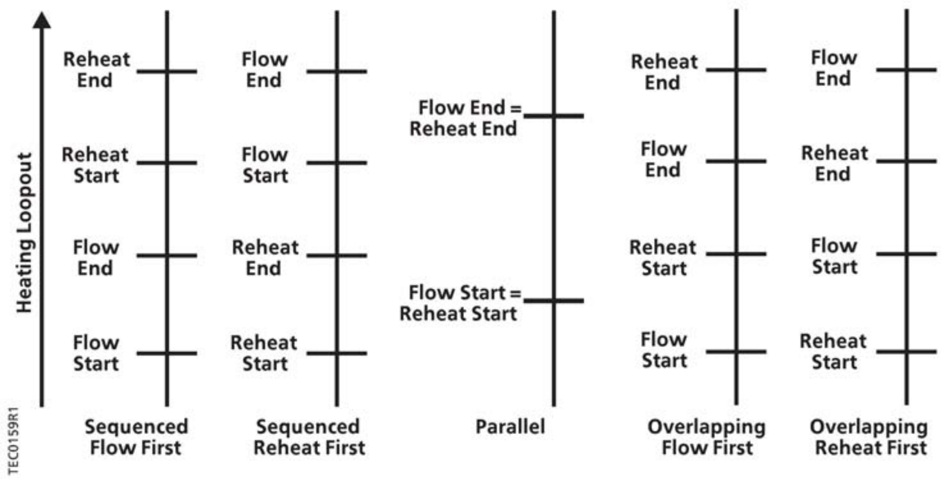
Using fpm flow rather than cfm makes the feature less dependant on duct size.

There is hysteresis (deadband) around the flow threshold. The heating turns off below a flow of MODHTG FLO, and does not turn back on until the measured flow rises to a level 50 fpm more than MODHTG FLO. Between MODHTG FLO and MODHTG FLO + 50, the internal point "ok_to_mod" will not change value.

Sequencing Logic (optional)

NOTE: The default setups for FLOW START (Point 16) and FLOW END (Point 17) are 0. This will provide minimum airflow during heating mode.

In heating mode, this application includes logic that allows the flow loop to operate in sequence, parallel, or overlapping with the modulating heating device. Portions of the output of the heating loop, HTG LOOPOUT (Point 80), will drive both the flow loop from min to max and the modulating heating device from 0 to 100%. See Figures 8 through 10. In the figures, "heat comd" (an internal point) represents the heating portion which varies from 0-100 before, during, or after the flow portion varies from min to max. See *Heating Sequencer* section to see how heat comd can control a reheat valve and a discharge loop with or without perimeter heating.



Vertical bars show heating loopout from 0 to 100%. Horizontal bars mark what happens when loop output rises above the horizontal bar. The relative positions shown on the graphs are for illustration purposes only.

Figure 7. Sequenced, Parallel, and Overlapping Flow Loop Operations with a Modulation Heating Device.

In the following examples, as the flow percentage increases from 0 to 100, the actual flow value TEMP CTL VOL will ramp from HTG FLO MIN to HTG FLO MAX.

CAUTION:

Be careful when configuring the FLOW START and REHEAT START points. If the air being supplied by the air handler is cold, and the flow is increasing with a call for heat, the room temperature could decrease while the controller is executing its configured logic as it tries to heat the room. See Figure 11 for the typical setup that can be used to prevent an increase in cold air upon a call for heat.

Example 1

Assume that your system has a modulating heating device that is to operate in *sequence* with the flow loop. In this example the flow goes from min to max in the first 50% of heating loopout and heating goes from min to max in the second 50% of heating loopout.

In this example,

- FLOW START (Point 16) = 0%
- FLOW END (Point 17) = 50%
- REHEAT START (Point 50) = 50%
- REHEAT END (Point 58) = 100%

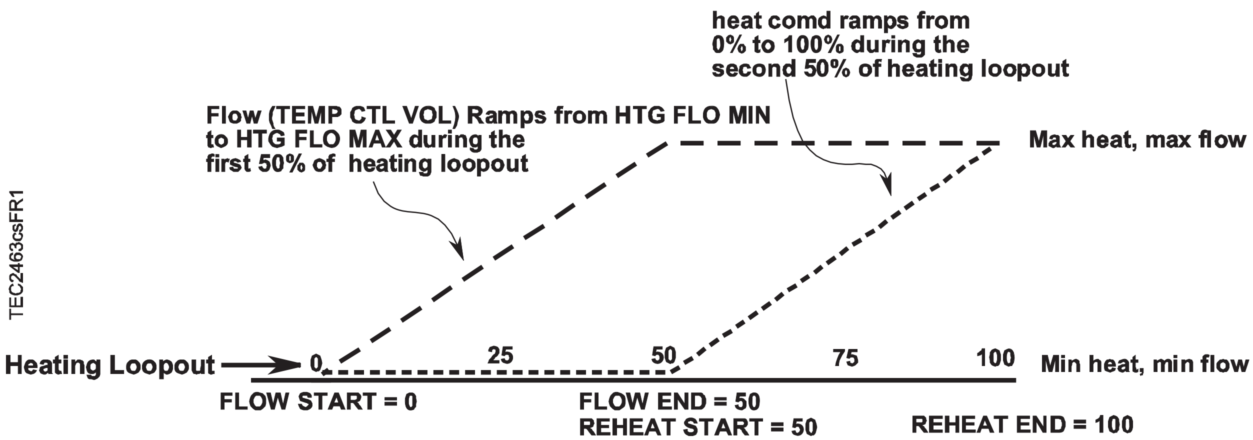


Figure 8. Modulating Heating Device Operating in Sequence with the Flow Loop.

Example 2

Assume that your system has a modulating heating device that is to operate in *parallel* with the flow loop.

In this example,

- FLOW START (Point 16) = 0%
- FLOW END (Point 17) = 100%
- REHEAT START (Point 50) = 0%
- REHEAT END (Point 58) = 100%

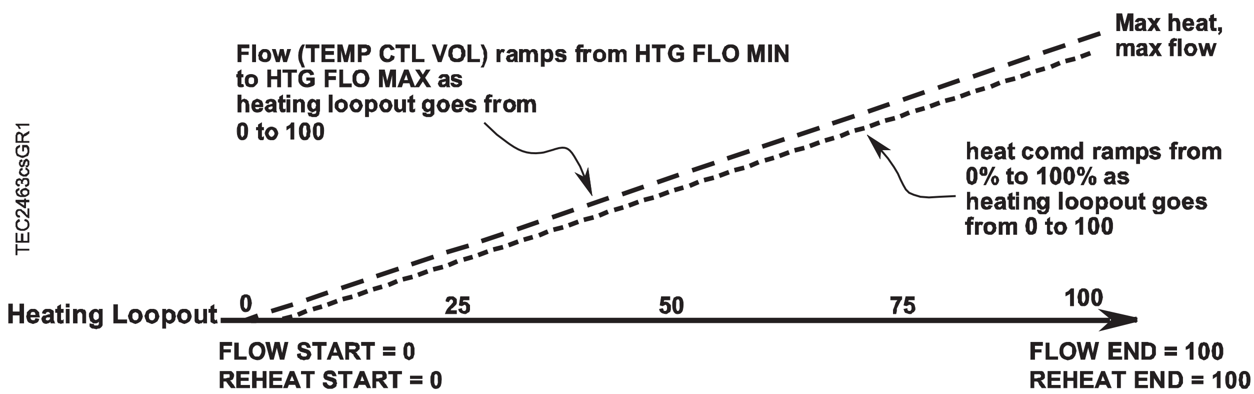


Figure 9. Modulating Heating Device Operating in Parallel with the Flow Loop.

Example 3

Assume that your system has a modulating heating device that is to operate *overlapping* with the flow loop.

In this example,

- FLOW START (Point 16) = 0%
- FLOW END (Point 17) = 75%
- REHEAT START (Point 50) = 25%
- REHEAT END (Point 58) = 100%

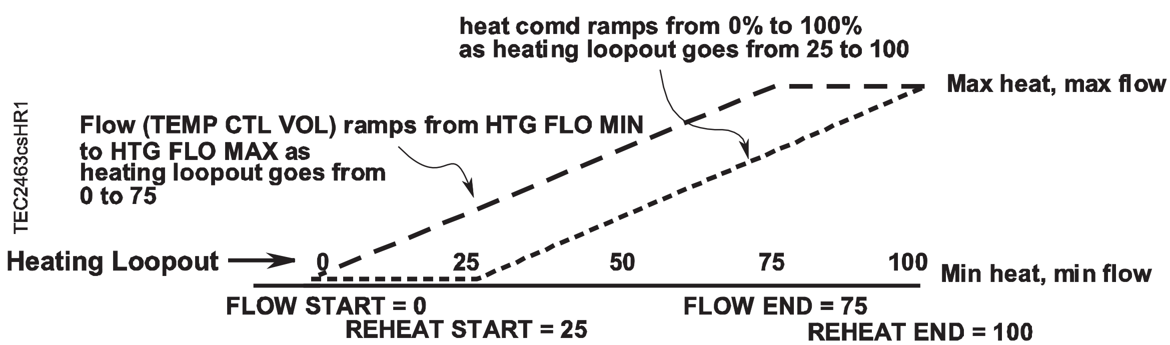


Figure 10. Modulating Heating Device Overlapping with the Flow Loop.

Example 4

Another option that the sequencing logic provides is to have the flow loop provide an airflow equal to HTG FLOW MIN throughout the heating mode with all of the temperature control being done by the modulating heating device. The airflow minimum will be maintained by setting the FLOW START and FLOW END to a value of 0%, resulting in the corresponding minimum flow throughout the entire heating mode, regardless of the value of HTG LOOPOUT.

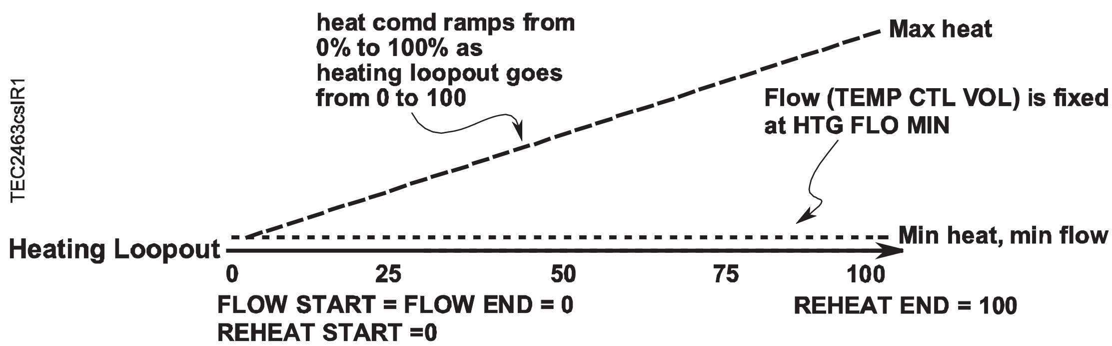


Figure 11. Modulating Heating Device with Airflow Fixed at Minimum.

Heating Sequencer

In application 2464, the actual heating control (0-100) as represented by the internal point *heat comd* can be used in three different ways.

Mode 1 - no discharge loop, no radiation heating

In the first mode, there is no discharge control loop or discharge control temperature sensor. *Heat comd* is used to directly drive the reheat valve. To configure Application 2464 for Mode 1 operation, set the p and I gains of the discharge loop to 0. (DISCH P GAIN Point 15, DISCH I GAIN, Point 10)

Mode 2 - with discharge loop, but no radiation heating

In the second mode, there is a discharge loop and a discharge sensor. In this mode, *heat comd* is used to set the setpoint for the discharge control loop. As *heat comd* increases from 0 to 100, the discharge setpoint is increased from minimum to maximum discharge temperature. To configure Application 2464 to use discharge control, set DISCH P GAIN and/or DISCH I GAIN to a non zero value. To indicate there is no control of radiation heating and that AO2 is spare, set both RAD START (Point 77) and RAD END (Point 83) to 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 - with discharge loop and radiation heating.

In the third mode, a discharge loop is active and there is perimeter radiation to be controlled. The *heat comd* portion of heating loopout is divided into three stages by the heating sequencer module.

1. **Stage One** - Perimeter radiation heat is off as the discharge temperature rises from discharge min to room setpoint. If heat demand is still not met, the application enters stage two.

2. **Stage Two** – The discharge is held at room setpoint while the perimeter radiation heating modulates from full off to full on. If heat demand is still not met, the application enters stage three.
3. **Stage Three** - Perimeter radiation is full on while the discharge temperature modulates from room setpoint to discharge max.

If either DISCH P GAIN or DISCH I GAIN is > 0 and RAD END > RAD START, then the application runs in this third mode.

The default values for RAD START (Point 77) and RAD END (Point 83) are 30 and 60 respectively. With these values, as the need for heat increases from 0 to 100, the first 30% of that need is met with stage 1 (discharge increasing from min to room temperature setpoint); the next 30% is met with stage 2 (modulating perimeter radiation heating), and the last 40% will be met with discharge air increasing beyond room temperature setpoint to discharge max as perimeter radiation remains full on.

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 mainly by radiation, then the radiation stage 2 should be made wider by using a lower value for RAD START and a higher value for RAD END. Similarly if box reheat is the main source of heat, then the radiation stage should be narrowed. (Setting RAD START = RAD END disables the sequencing altogether.)

The following diagram illustrates the relationship between heating loopout, REHEAT START, REHEAT END, RAD START and RAD END.

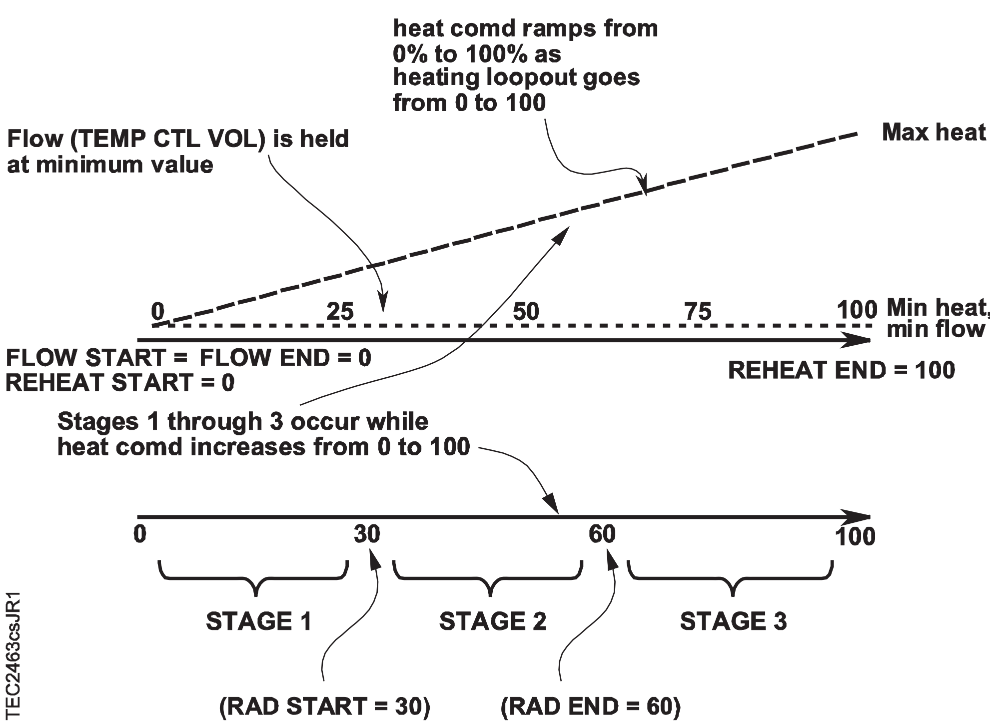


Figure12. Mode 3 with Discharge Loop and Radiation Heating.

Calibration

The air velocity sensor(s) must be calibrated at least once every 24 hours. 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.

When Autozero solenoid(s) from Offboard Air Module(s) are wired to D06 and CAL MODULE, Point 87 = YES, the Autozero function is enabled.

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

CAL SETUP (Point 95) is the calibration setup point which determines when calibration occurs and whether it takes place automatically. See Table 1.

NOTE: It is highly recommended that option 4, the factory default mode, be used.

Table 1. 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. See 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**.	

Damper Status Module

Under certain conditions when Autozero solenoid(s) from Offboard Air Module(s) are wired to D06 and CAL MODULE, Point 87 = YES, the physical damper position may vary from what the application's position point(s) are indicating. A Damper Status module is designed to detect and correct situations where airflow velocity is greater than 200 fpm and the following is true:

- SUP DMP POS = 100% and SUP VOL < SUP STPT

OR

- SUP DMP POS = 0% and SUP VOL > SUP STPT

When initiated, the firmware module sets DMPR STATUS (Point 84) from CAL to RECAL and decrements/increments the damper position (in a reiterative sequence up to four cycles in length) until sensed airflow matches setpoint.

NOTE: It is important to realize that while the Damper Status module runs, the damper position point (SUP DMP POS, Point 49) will change in value but the flow point (SUP VOL, Point 35) might not.

To change DMPR STATUS from RECAL back to CAL, set DMPR STATUS (Point 84) to CAL and then release it. (A status of RECAL will not prevent the recalibration sequence from running if needed.)

Alarms

The controller is equipped with a ventilation alarm. It does not contain temperature alarms. The controller's alarms are designed to:

- Inform room occupants of hazards. (via an alarm output as commanded from Insight)
- Inform building operation personnel that the ventilation system is not functioning correctly.
- Supply data for trending purposes.

These alarms can be annunciated locally and/or broadcast across a network.

Ventilation Alarm

NOTE: In the following discussion, the currently active supply flow minimum is assumed to be CLG FLO MIN (Point 31). The ventilation alarm point, VENT ALM (Point 68), indicates a problem with the ventilation to the room. An adjustable delay timer, VENT ALM DEL (Point 125), prevents nuisance alarms.

VENT ALM 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.

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) does not enable alarms. It only determines whether a particular alarm activates ALARM DO5 (Point 45). Table 2 shows what is enabled when ALARM ENA is at a particular value.

Table 2. ALARM ENA (Point 85) Values.

ALARM ENA	Description
0 (default)	ALARM D05 will not be activated
1	Vent Alarm activates ALARM D05

For ALARM ENA, the terms enabled and disabled do not mean that a particular alarm is enabled or disabled. It means whether or not a particular alarm will or will not activate ALARM DO5. For example, if ALAM ENA is set to 1 to be Vent Alarm Enabled, and a ventilation alarm occurs (VENT ALM = ON), then ALARM DO5 will turn on. However, if ALARM ENA is not Vent Alarm Enabled, then when a ventilation alarm occurs, VENT ALM will turn on but ALARM DO5 will not.

CAUTION:

DO NOT override ALARM DO5 or use it as a spare output point when ALARM ENA is set to 1.

ALARM DO5 is used to operate a local alarm annunciation device such as a light or horn in or near the room. Inputs can be set up to annunciate alarms from either or both off the following sources:

- Ventilation alarm point, VENT ALM (Point 68).
  To connect VENT ALM to DO 5, set ALARM ENA to a value of 1
- Network alarm point, NET ALM CMD (Point 23).
  NET ALM CMD is always enabled for local annunciation.

NET ALM CMD can be commanded with Insight® software or PPCL to send an alarm state from the field panel. This makes it possible to program unique alarm criteria and annunciate alarms in specific rooms.

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 3.

Table 3. 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

CO2 Monitoring and Alarming

Application 2464 is designed to work with 0-10V (or 0-20mA) CO2 sensors where the voltage (or current) output of the sensor is proportional to the CO2 concentration. CO2 SCALE (Point 54) must be set to the value in PPM that represents the CO2 sensor's full 10V (or 20mA) output signal. Note that the default value for CO2 SCALE is 2000, which may or may not need adjusting depending on the type of sensor used.

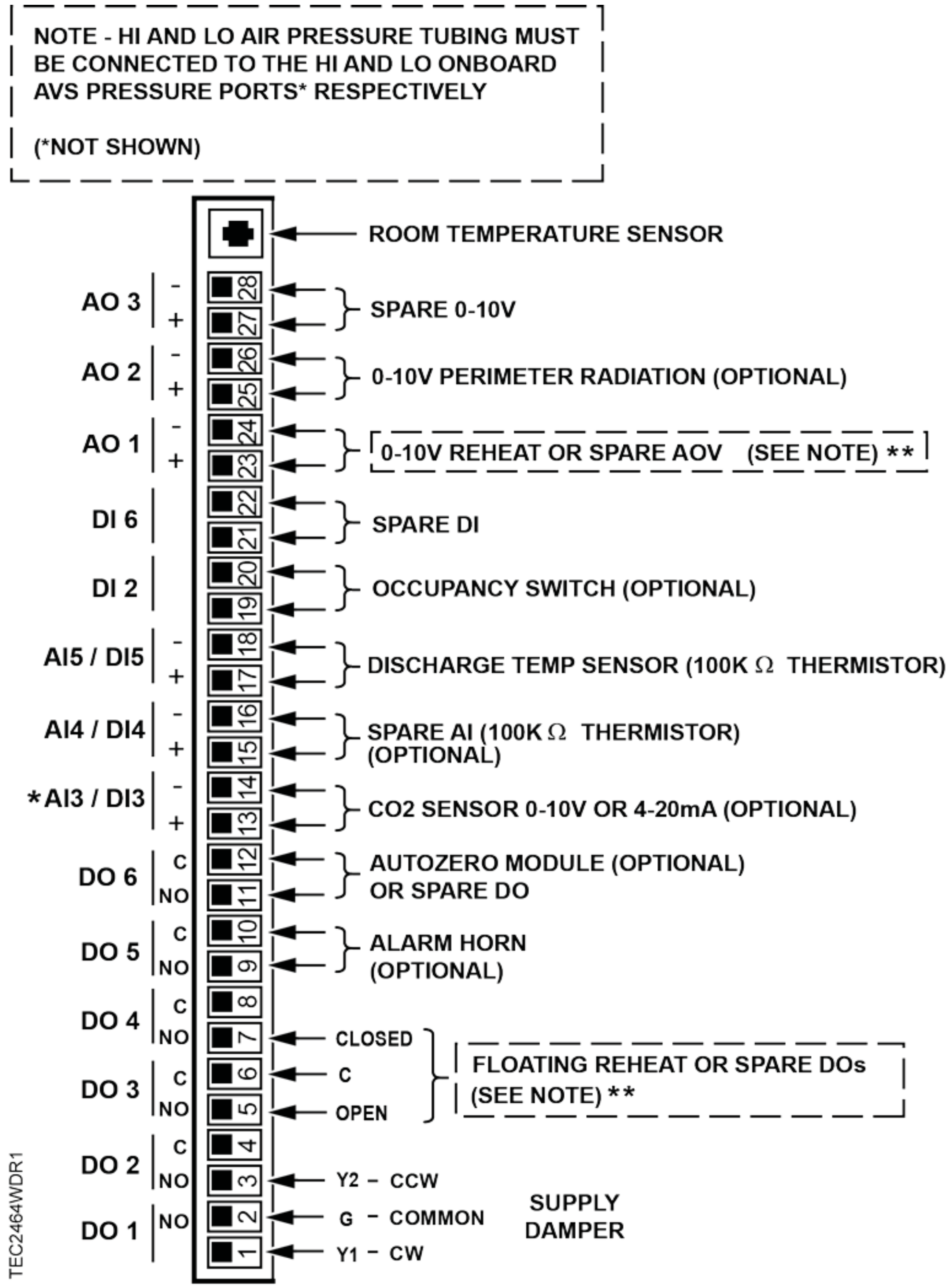
The sensor physically connects to AI3 and the associated CO2 room concentration is readable at CO2 (Point 3). The reading of CO2 will vary from 0 to CO2 SCALE as the CO2 sensor input on AI3 varies from 0 to 10V (or 0 to 20ma).

The CO2 alarm limit is set using CO2 ALM LIM (Point 53). 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.

Wiring Diagram



*AI3 COMES FROM FACTORY SET TO 0-10V. ON CIRCUIT BOARD UNDER CONTROLLER COVER, SWITCH FOR AI3 CAN BE SET TO 4-20mA IF DESIRED.

**REHEAT CAN BE FLOATING OR 0-10V ANALOG, BUT NOT BOTH. IF REHEAT IS FLOATING, AO1 IS SPARE; IF REHEAT IS 0-10V AOV, DO3 AND DO4 ARE SPARE (IF DO 3 AND DO 4 ARE SPARE, THEY CAN NOT BE USED AS A SPARE MOTOR).

Figure 12. Application 2464 Wiring Diagram.

Point Database

NOTE: See Table 5 for Slave Mode point database (application 2499).

Table 4. Application 2464 Point Database.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
01	CTLR ADDRESS	99	--	1	0	--	--
02	APPLICATION	2499	--	1	0	--	--
{03}	CO2	0	PPM	1	0	--	--
{04}	ROOM TEMP	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
{05}	HEAT.COOL	COOL	--	--	--	HEAT	COOL
06	DAY CLG STPT	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
07	DAY HTG STPT	70.0 (21.20888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
08	NGT CLG STPT	82.0 (27.92888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
09	NGT HTG STPT	65.0 (18.40888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
10	DISCH I GAIN	0.02 (0.036)	--	0.0002 (0.00036)	0.0	--	--
11	RM STPT MIN	55.0 (12.80888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
12	RM STPT MAX	90.0 (32.40888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
{13}	RM STPT DIAL	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
14	STPT DIAL	NO	--	--	--	YES	NO
15	DISCH P GAIN	2.0 (3.6)	--	0.05 (0.09)	0.0	--	--
16	FLOW START	0.0	PCT	0.4	0.0	--	--
17	FLOW END	0.0	PCT	0.4	0.0	--	--
18	WALL SWITCH	NO	--	--	--	YES	NO
{19}	DI OVRD SW	OFF	--	--	--	ON	OFF
20	OVRD TIME	0	HRS	1	0	--	--
{21}	NGT OVRD	DAY	--	--	--	NIGHT	DAY
{23}	NET ALM CMD	OFF	--	--	--	ON	OFF
{24}	DI 2	OFF	--	--	--	ON	OFF
{25}	AI 4	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
27	CLG I GAIN	0.01 (0.018)	--	0.001 (0.0018)	0.0	--	--
28	CLG D GAIN	0 (0.0)	--	2 (3.6)	0	--	--

Table 4. Application 2464 Point Database.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
{29}	DAY.NGT	DAY	--	--	--	NIGHT	DAY
31	CLG FLO MIN	220 (103.818)	CFM (LPS)	4 (1.8876)	0	--	--
32	CLG FLO MAX	2200 (1038.18)	CFM (LPS)	4 (1.8876)	0	--	--
33	HTG FLO MIN	220 (103.818)	CFM (LPS)	4 (1.8876)	0	--	--
34	HTG FLO MAX	2200 (1038.18)	CFM (LPS)	4 (1.8876)	0	--	--
{35}	SUP VOL	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
36	SUP FLO COEF	0.68	--	0.01	0.0	--	--
{37}	REHEAT CMD	0.0	PCT	0.4	0.0	--	--
{38}	RAD VALV CMD	0.0	PCT	0.4	0.0	--	--
40	AVS FAILMODE	0	--	1	0	--	--
{41}	DO 1	OFF	--	--	--	ON	OFF
{42}	DO 2	OFF	--	--	--	ON	OFF
{43}	DO 3	OFF	--	--	--	ON	OFF
{44}	DO 4	OFF	--	--	--	ON	OFF
{45}	ALARM DO5	OFF	--	--	--	ON	OFF
{46}	AZM DO6	OFF	--	--	--	ON	OFF
{48}	SUP DMP CMD	0.0	PCT	0.4	0.0	--	--
{49}	SUP DMP POS	0.0	PCT	0.4	0.0	--	--
50	REHEAT START	0.0	PCT	0.4	0.0	--	--
{51}	DI 6	OFF	--	--	--	ON	OFF
{52}	CO2 ALARM	OFF	--	--	--	ON	OFF
{53}	CO2 ALM LIM	1000	PPM	1	0	--	--
{54}	CO2 SCALE	2000	PPM	1	0	--	--
{55}	AOV3	0.0	VOLTS	0.01	0.0	--	--
58	REHEAT END	100.0	PCT	0.4	0.0	--	--
{59}	DI 3	OFF	--	--	--	ON	OFF
{60}	DI 4	OFF	--	--	--	ON	OFF
{61}	DI 5	OFF	--	--	--	ON	OFF
{62}	DIS TEMP MAX	90.0 (32.456)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
63	CLG P GAIN	20.0 (36.0)	--	0.25 (0.45)	0.0	--	--
{64}	DIS TEMP AI5	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{65}	DIS TEMP MIN	50.0 (10.056)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
66	TEMP OFFSET	0.0 (0.0)	DEG F (DEG C)	0.25 (0.14)	-31.75(-17.78)	--	--
67	HTG P GAIN	10.0 (18.0)	--	0.25 (0.45)	0.0	--	--
{68}	VENT ALM	OFF	--	--	--	ON	OFF
{69}	DISCH STPT	60.0 (15.656)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{70}	AI 3	0.0	PCT	0.4	0.0	--	--

Table 4. Application 2464 Point Database.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
71	SUP P GAIN	0.015	--	0.001	0.0	--	--
72	HTG I GAIN	0.01 (0.018)	--	0.001 (0.0018)	0.0	--	--
73	HTG D GAIN	0 (0.0)	--	2 (3.6)	0	--	--
{74}	AOV1	0.0	VOLTS	0.01	0.0	--	--
{75}	AOV2	0.0	VOLTS	0.01	0.0	--	--
77	RAD START	30.0	PCT	0.4	0.0	--	--
{78}	CTL TEMP	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
{79}	CLG LOOPOUT	0.0	PCT	0.4	0.0	--	--
{80}	HTG LOOPOUT	0.0	PCT	0.4	0.0	--	--
81	AOV1 OPEN	0.0	VOLTS	0.01	0.0	--	--
82	AOV1 CLOSE	10.0	VOLTS	0.01	0.0	--	--
83	RAD END	60.0	PCT	0.4	0.0	--	--
{84}	DMPR STATUS	CAL	--	--	--	RECAL	CAL
85	ALARM ENA	0	--	1	0	--	--
86	SWITCH TIME	10	MIN	1	0	--	--
87	CAL MODULE	NO	--	--	--	YES	NO
88	AOV2 OPEN	0.0	VOLTS	0.01	0.0	--	--
89	AOV2 CLOSE	10.0	VOLTS	0.01	0.0	--	--
90	SWITCH DBAND	1.0 (0.56)	DEG F (DEG C)	0.25 (0.14)	0.0	--	--
91	HC.ENDIS	3	--	1	1	--	--
{92}	CTL STPT	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
{93}	SUP STPT	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
{94}	CAL AIR	NO	--	--	--	YES	NO
95	CAL SETUP	4	--	1	0	--	--
96	CAL TIMER	12	HRS	1	0	--	--
97	SUPDUCT AREA	1.0 (0.09292)	SQ. FT (SQ M)	0.025 (0.002323)	0.0	--	--
98	LOOP TIME	5	SEC	1	0	--	--
{99}	ERROR STATUS	0	--	1	0	--	--
109	MTR1 ROT ANG	90	--	1	0	--	--
110	MTR2 ROT ANG	90	--	1	0	--	--
111	SWITCH LIMIT	5.2	PCT	0.4	0.0	--	--
112	MTR1 TIMING	95	SEC	1	0	--	--
113	MTR2 TIMING	130	SEC	1	0	--	--
115	MODHTG FLO	300 (1.524)	FPM (MPS)	1 (0.00508)	0	--	--
123	MTR SETUP	0	--	1	0	--	--
124	DO DIR.REV	0	--	1	0	--	--

Table 4. Application 2464 Point Database.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
125	VENT ALM DEL	30	SEC	1	0	--	--

1. Points not listed are not used in this application.
2. A single value in a column means that the value is the same in English units and in SI units.
3. Point numbers that appear in brackets { } may be unbundled at the field panel.

Table 5. Slave Mode Application 2499 Point Database.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
01	CTLR ADDRESS	99	--	1	0	--	--
02	APPLICATION	2499	--	1	0	--	--
{04}	ROOM TEMP	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
{13}	RM STPT DIAL	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
18	WALL SWITCH	NO	--	--	--	YES	NO
{19}	DI OVRD SW	OFF	--	--	--	ON	OFF
{23}	NET ALM CMD	OFF	--	--	--	ON	OFF
{24}	DI 2	OFF	--	--	--	ON	OFF
{25}	AI 4	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{29}	DAY.NGT	DAY	--	--	--	NIGHT	DAY
{35}	VOLUME 1	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
36	FLOW COEF 1	0.68	--	0.01	0.0	--	--
{37}	MTR2 COMD	0.0	PCT	0.4	0.0	--	--
{41}	DO 1	OFF	--	--	--	ON	OFF
{42}	DO 2	OFF	--	--	--	ON	OFF
{43}	DO 3	OFF	--	--	--	ON	OFF
{44}	DO 4	OFF	--	--	--	ON	OFF
{45}	DO 5	OFF	--	--	--	ON	OFF
{46}	DO 6	OFF	--	--	--	ON	OFF
{48}	MTR1 COMD	0.0	PCT	0.4	0.0	--	--
{49}	MTR1 POS	0.0	PCT	0.4	0.0	--	--
{51}	DI 6	OFF	--	--	--	ON	OFF
{55}	AOV3	0.0	VOLTS	0.01	0.0	--	--
{59}	DI 3	OFF	--	--	--	ON	OFF
{60}	DI 4	OFF	--	--	--	ON	OFF
{61}	DI 5	OFF	--	--	--	ON	OFF
{64}	AI 5	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
66	TEMP OFFSET	0.0 (0.0)	DEG F (DEG C)	0.25 (0.14)	-31.75(-17.78)	--	--
{70}	AI 3	0.0	PCT	0.4	0.0	--	--
{74}	AOV1	0.0	VOLTS	0.01	0.0	--	--
{75}	AOV2	0.0	VOLTS	0.01	0.0	--	--
{78}	CTL TEMP	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
87	CAL MODULE	NO	--	--	--	YES	NO

Table 5. Slave Mode Application 2499 Point Database.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
{94}	CAL AIR	NO	--	--	--	YES	NO
95	CAL SETUP	4	--	1	0	--	--
96	CAL TIMER	12	HRS	1	0	--	--
97	DUCT AREA 1	1.0 (0.09292)	SQ. FT (SQ M)	0.025 (0.002323)	0.0	--	--
{99}	ERROR STATUS	0	--	1	0	--	--
109	MTR1 ROT ANG	90	--	1	0	--	--
110	MTR2 ROT ANG	90	--	1	0	--	--
112	MTR1 TIMING	95	SEC	1	0	--	--
113	MTR2 TIMING	130	SEC	1	0	--	--
123	MTR SETUP	0	--	1	0	--	--
124	DO DIR.REV	0	--	1	0	--	--

1. Points not listed are not used in this application.
2. A single value in a column means that the value is the same in English units and in SI units.
3. Point numbers that appear in brackets { } may be unbundled at the field panel.