SIEMENS

Laboratory Room Controller Electronic Custom Solutions Application 2453
Dual Duct VAV/CV with BTU Compensation

TEC-0909.08

This document contains the following topics:

Overview

Application 2453 controls pressurization, ventilation, and room temperature in a laboratory room served by one dual-duct supply terminal with a hot deck and a cold deck, one general exhaust terminal, and up to four fume hoods (multiple fume hoods require a Fume Hood Flow Module (FFM). Heating is provided by modulating the hot deck damper. Cooling is provided by modulating the cold deck damper. To control pressurization, the LRC maintains a selected difference between supply and exhaust airflows.

Fast acting electronic actuators (with enclosed AO-E modules) are used for the general exhaust and cold deck dampers. For the hot deck damper, a standard 0-10 Vdc actuator is used.

VAV or CV temperature control is achieved as follows: the LRC uses a BTU Compensation algorithm and input from the Room Temperature Sensor to reset the discharge temperature setpoint and modulate the hot deck damper. In VAV mode, the discharge temperature setpoint is reset in sequence with the VAV flow. See Figure 2453-1.

The LRC controls pressure, ventilation, and temperature. When these functions conflict, the priorities are:

1. Pressurization
2. Ventilation (supply minimum can be overridden to maintain negative pressurization)
3. Temperature

NOTE: In Constant Volume mode, it is possible under certain conditions that temperature control could be being given a higher priority than keeping the volume constant 100% of the time. See *Discharge Air Temperature Loop Override* for more information.

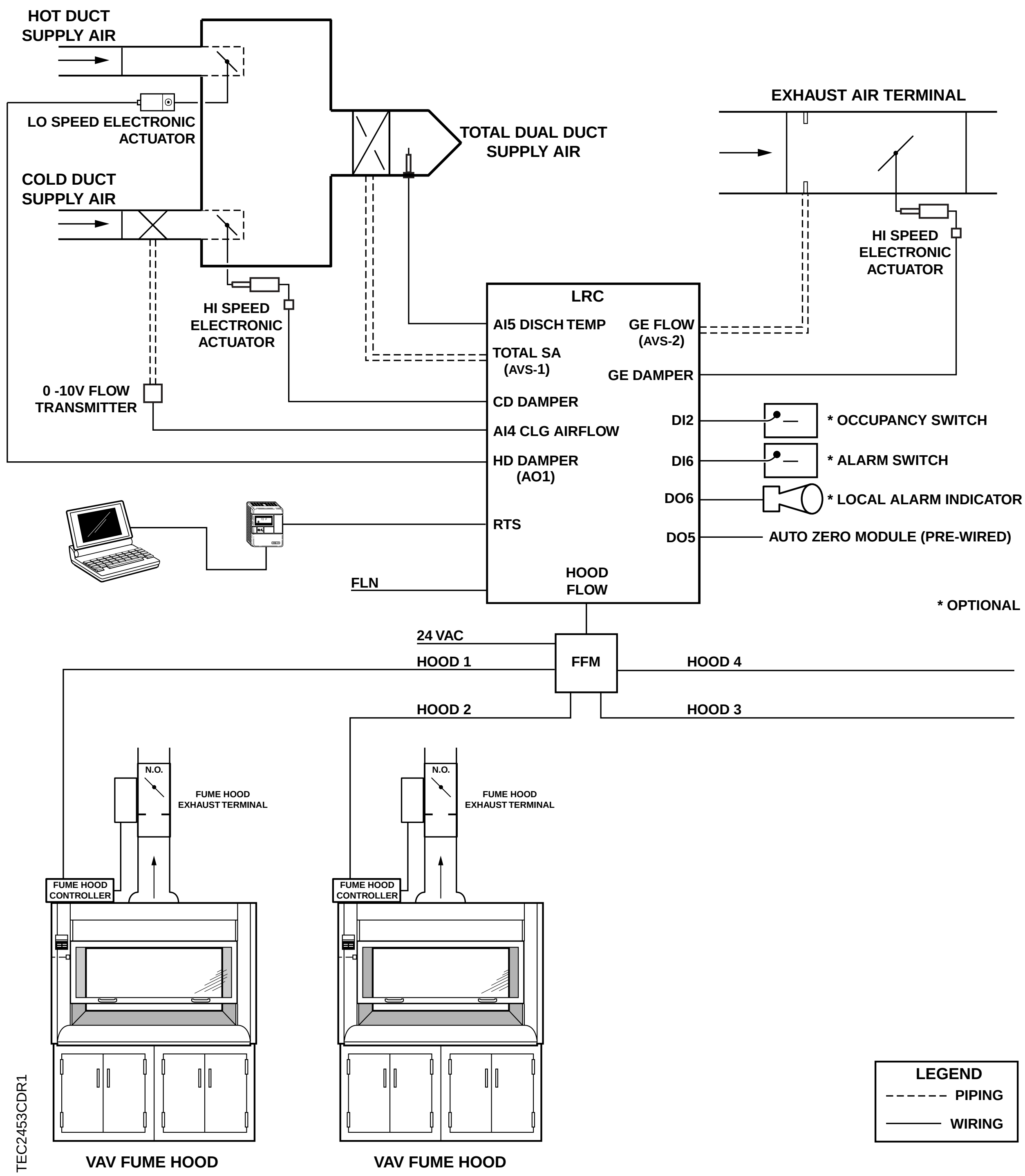


Figure 2453-1. Application 2453 Control Drawing.

Hardware Inputs

Analog

- Air velocity sensors – 3 required: AVS-1 (total dual duct supply volume); AVS-2 (general exhaust volume); AI4 (cold deck volume)
- Fume Hood Controller or FFM
- Room Temperature Sensor
- Discharge Temperature Sensor

Digital

- Occupancy button (option on Room Temperature Sensor)
- Occupancy switch (optional)
- Alarm switch (optional)

Hardware Outputs

Analog

- Hot Deck damper

Digital

- Cold Deck damper (two DOs)
- General exhaust damper (two DOs)
- Alarm (optional)

Ordering Notes

LRC Dual Duct with BTU Compensation: 550-751B.

You may also order this LRC as Custom Solution number 281.

Sequence of Operation

The following paragraphs present the sequence of operation for Application 2453, *LRC Electronic Dual Duct* VAV*/CV with BTU Compensation*.

NOTE: For the rest of the document the terms supply air temperature and discharge air temperature are used interchangeably, as are supply air temperature loop and discharge air temperature loop.

Pressurization Control

The goal of pressurization control is to maintain a fixed difference between total supply air and total exhaust air. The controller selects supply and exhaust setpoints to balance flows while meeting supply air requirements. Feedback loops control the supply and exhaust flows to meet those setpoints.

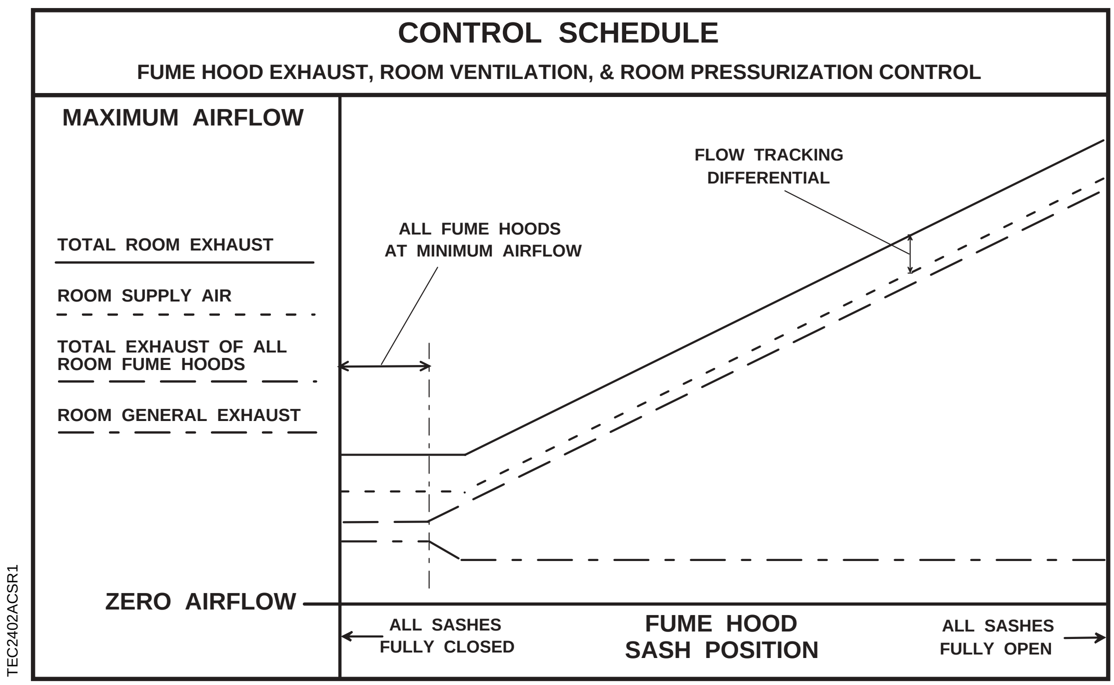


Figure 2453-2. Application 2453 Ventilation and Pressurization Control.

Room Airflow Balance

The difference between total supply flow and total exhaust flow is the room airflow balance as shown in these calculations:

VOL DIFFRNC = TOTL EXHAUST – TOTL SUPPLY

or

VOL DIFFRNC = (HOOD VOL + GEX AIR VOL + OTHER EXH) –
(TOT AIR VOL + OTHER SUP)

The controller uses these calculations to maintain VOL DIFFRNC (Point 83) at the value of VOL DIF STPT (Point 88).

NOTE: Because of this definition, VOL DIFFRNC and VOL DIF STPT are positive numbers in a room that is negatively pressurized and vice versa.

Calculating Exhaust Flow Setpoint

To calculate GEX FLO STPT (Point 85) in the VAV mode (VOLUME MODE (Point 65) equals VAV), the LRC determines the general exhaust flow needed to pressurize the room, assuming the total supply flow for the dual duct box is set to the value required for temperature control, TEMP CTL VOL + (TOT AIR VOL – CLG AIR VOL). (TEMP CTL VOL is (Point 9), TOT AIR VOL is (Point 35) and CLG AIR VOL is (Point 10)). If TEMP CTL VOL + (TOT AIR VOL – CLG AIR VOL). is less than the total supply minimum, then the LRC uses TOT MIN (Point 77). If GEX FLO STPT exceeds the exhaust minimum or maximum, the controller will be limited to the GEX MIN (Point 75) or GEX MAX (Point 74) values instead.

To calculate GEX FLO STPT (Point 85) in the constant volume mode (VOLUME MODE equals CV), the LRC determines the general exhaust flow needed to pressurize the room, assuming the total supply flow for the dual duct box is set to either TOT MIN or [TOT AIR VOL – CLG AIR VOL + CLG MIN (Point 47)], whichever is greater. (TEMP CTL VOL is not used in the constant volume mode.) If GEX FLO STPT exceeds the exhaust minimum or maximum, the controller will be limited to the GEX MIN (Point 75) or GEX MAX (Point 74) values instead.

Calculating Supply Flow Setpoint

In both VAV and CV modes, the LRC calculates TOT FLO STPT (Point 93) by determining the supply flow value needed to pressurize the room based on the values of:

- HOOD VOL (Point 51)
- OTHER EXH (Point 89)
- OTHER SUP (Point 61)
- VOL DIF STPT (Point 88)
- GEX FLOW STPT (Point 85)

The control algorithm will not allow TOT FLO STPT to be set greater than TOT MAX (Point 76).

External Flow Values

There may be other airflows not connected to the LRC that must be considered when pressurizing the room, including snorkels, canopies, and other supplies such as offices within the lab space controlled by constant volume controllers. Since these inputs are not connected to the LRC, the combination of their values must be entered by the user into OTHER SUP (Point 61) and
OTHER EXH (Point 89).

Ventilation in VAV and CV Modes

The following text explains ventilation and airflow setpoints.

Ventilation in VAV Mode

When VOLUME MODE (Point 65) equals VAV, the total supply minimum (TOT MIN, Point 77) is used to ensure that the room receives enough supply air for proper ventilation. If necessary, the LRC raises the general exhaust flow to keep the supply flow from dropping below the minimum. See *Calculating Exhaust Flow Setpoint* for more information.

Ventilation Setback

Ventilation setback allows the minimum and maximum flows (air change rate) for each VAV terminal to be specified separately based on occupied and unoccupied modes (OCC.UNOCC, Point 21). This allows several options for reducing ventilation in unoccupied periods, including:

- Lowering the minimum supply flow, which allows a lower air change rate but maintains cooling control.
- Lowering the maximum flow, which limits the air change rate and reduces cooling capacity.
- Closing the general exhaust, which lowers airflow but completely disables cooling.

Ventilation and Airflow Setpoints in CV Mode

When VOLUME MODE (Point 65) equals CV, the total supply minimum (TOT MIN, Point 77) is used to ensure that the room always receives enough supply air for proper ventilation. If necessary, the LRC raises the general exhaust flow to keep the supply flow from dropping below the minimum. See *Calculating Exhaust Flow Set Point* for more information.

However, when VOLUME MODE (Point 65) equals CV, TOT MIN is not only used to ensure that the room always receives enough supply air for proper ventilation, it is also used to help determine the desired constant air volume setpoint for the dual duct box.

When HOOD VOL (Point 51) remains constant in the constant volume mode, the air flow out of both the dual duct box and the general exhaust box will remain constant provided that both of the following conditions are true:

- The cold deck is able to provide an air flow that is equal to or greater than TOT MIN. (Therefore, TOT MIN can be maintained even when the hot deck damper is completely shut.)

- The value of TOT MIN is greater than the amount of hot deck air flow when the hot deck damper is wide open.

When both of the above conditions are true, TOT FLO STPT (Point 93) will equal TOT MIN and GEX FLO STPT (Point 85) will equal TOT MIN - HOOD VOL - OTHER EXH (Point 89) + OTHER SUP (Point 61) + VOL DIF STPT (Point 88).

If condition 1 fails, both TOT FLO STPT and GEX FLO STPT will be the same as in the previous paragraph. During high heating loads the air flow out of both the dual duct box and the general exhaust box will be at constant volume and the system will be operating normally. During low heating loads, TOT AIR VOL (Point 35) will be less than TOT FLO STPT even though the cold deck damper is wide opened. This will cause the room pressure to go more negative, and if positive room pressure is desired, can cause the room to go from positive to negative pressurization.

If condition 2 fails, the air flow out of both the dual duct box and the general exhaust box will vary during high heating loads and will be constant during low heating loads.

If both conditions 1 and 2 fail, the air flow out of both the dual duct box and the general exhaust box will vary during high heating loads, room pressurization could be adversely affected during low heating loads and (possibly) the air flow out of both the dual duct box and the general exhaust box will be constant during moderate heating loads.

NOTE: Regardless of whether or not the LRC is operating as a VAV or constant volume temperature controller, it will vary the air flow out of both the dual duct supply box and the general exhaust box as needed in order to maintain proper room pressurization whenever HOOD VOL changes.

When OCC.UNOCC (Point 21) equals OCC, TOT MIN equals OCC TOT MIN (Point 32). When OCC.UNOCC equals UNOCC, TOT MIN equals UOC TOT MIN (Point 72).

Occupancy

The controller keeps track of the occupancy status of the room and uses that information to select minimum and maximum flow rates for each air terminal. Occupancy status also affects the airflow level that triggers the ventilation alarm. The occupancy status is also indicated by OCC.UNOCC (Point 21). A digital room thermostat can read this point and display its value. It is not possible to override this point. If the occupancy status of the room is to be set manually, it is necessary to work through the command options described below.

The controller works in the occupied mode whenever at least one of the following occupancy signals indicates occupancy:

- Commands from a field panel, NET OCC CMD (Point 29)
- A dry contact switch in the room, OCC SWIT DI2 (Point 24)
- A push button on the thermostat, OCC BUTTON (Point 19)
- The airflow through the fume hoods, HOOD VOL (Point 51)

If all of the occupancy signals used in the lab indicate vacancy, then the controller works in the unoccupied mode.

NET OCC CMD (Point 29) – The NET OCC CMD may be set from a field panel by OCC and UNOCC commands to the LCTLR point. The commands may come from a time-of-day schedule, a PPCL program, or operator commands. These commands work on the LCTLR without unbundling.

NOTE: The displayed OCC/UNOCC status of the LCTLR point does not always match the occupancy status of the controller. To get an actual indication of occupancy status, OCC.UNOCC (Point 21) must be used.

If network commands are not required and occupancy will be set by sources in the room, set NET OCC CMD to UNOCC. If it is set to OCC, the controller will stay in occupied mode.

OCC SWIT DI2 (Point 24) – The occupancy switch (dry contact switch in the room) can be an output from an occupancy detection sensor, an extra contact on a light switch, or any other device that closes the switch when the room is occupied. The controller uses this input for occupancy if the setup point OCC SWIT ENA (Point 18) is set to YES. If it is set to NO, OCC SWIT DI2 will not affect occupancy. DI2 then becomes a spare DI available for other uses, and can be unbundled at a field panel to be used as part of a PPCL program, if desired.

OCC BUTTON (Point 19) – Some Siemens Building Technologies thermostats include a momentary switch with a push button. The controller can use this button as a source of occupancy commands if the setup point BUTTON ENA (Point 12) is set to YES.

NOTE: The controller will not use both the occupancy switch and the room sensor button. If the switch is enabled, then the room sensor button is ignored.

The controller interprets a push of the room sensor button as a request to change the occupancy status of the room. If the room is unoccupied, it changes to occupied. If it is occupied, it *may* switch to unoccupied, depending on the states of the other occupancy sources. The current request status of the room sensor button is indicated by BUTTON CMD (Point 25). This point is used to investigate the room sensor button's effect on the occupancy status of a room. OCC BUTTON does not provide that information because it is connected to a momentary switch.

HOOD VOL (Point 51) – It is also possible to relate occupancy status to the opening of fume hoods. If the hood is open, the room is occupied; if it is closed, the room *may* be unoccupied. "Open" means the flow is greater than HOOD OCC VOL (Point 55). "Closed" means the flow is less than HOOD UOC VOL (Point 56). The two levels should be used to set up a dead band so the room does not fluctuate between occupied and unoccupied operation. If you do not want to base occupancy on the fume hood sashes, set HOOD OCC VOL to zero. This disables the feature.

NOTE: If there are several hoods combined together with an FFM, it may be impossible to determine if any one hood is open because the FFM combines and averages the fume hood inputs.

Airflow Control

Total supply flow and general exhaust are controlled by feedback loops that operate control dampers so that measured flows maintain their setpoints. The feedback gains TOT P GAIN (Point 70) and GEX P GAIN (Point 26) are adjustable.

The general exhaust loop maintains GEX AIR VOL (Point 30) at GEX FLO STPT (Point 85). The total supply flow loop maintains TOT AIR VOL (Point 35) at TOT FLO STPT (Point 93). The hot deck's damper position, HD DMPR CMD (Point 49) also affects the value of TOT FLO STPT. However, the hot deck damper is controlled by the discharge temperature loop, not the total supply flow loop. Therefore, whenever the discharge temperature loop varies HD DMPR CMD for temperature control, the total supply flow loop must modulate the cold deck damper in order to maintain TOT AIR VOL at TOT FLO STPT.

The cold deck and general exhaust dampers move in response to electronic actuators that receive voltage signals from AO-E modules. The modules extend or retract the actuators, corresponding to the DOs that are pulsed according to damper command and direction. The command points for the cold deck and general exhaust dampers are clg dmpr cmd and gex dmpr cmd. These are internal points which cannot be commanded and are not visible in the point database. These points indicate the rate at which the dampers move, not their position. A value of:

- 100% indicates that the damper is being opened as quickly as possible.
- 10% indicates that the damper is being opened slowly.
- 0% indicates that the damper does not move at all.
- A negative number indicates that the damper is closing at a corresponding rate. For example, a value of –100% means the damper is closing at full speed.

The cold deck and general exhaust dampers may be set up for normally open or normally closed operation.

When the flow is slightly below setpoint, the LRC sets the damper command to a small positive number to open the damper gradually. If the flow is far below setpoint, the damper command is set to a large positive value to open the damper quickly. The feedback gains TOT P GAIN (Point 70) and GEX P GAIN (Point 26) are adjusted to tune the flow loops. The sample time for the flow loops is fixed at 0.2 seconds. I and D gain are inherent in the system and do not need adjustment.

Low Airflow

This application needs to know the hot duct airflow in order to do room pressurization control properly. However, this application does not come equipped with a hot duct airflow sensor. It calculates hot duct airflow as TOT AIR VOL (Point 35) – CLG AIR VOL (Point 10). Therefore, the application must be able to read CLG AIR VOL reliably in order to accurately calculate the value of the hot deck airflow. During low cooling and/or high heating loads most of the airflow from the dual duct terminal box will be coming from the hot duct. The volume of air from the cold duct might be so low that the LRC cannot get an accurate CLG AIR VOL reading. One way to deal with this is to make sure CLG AIR VOL can be accurately read, and this can be done by setting CLG MIN (Point 47) ≥ 300fpm * CLGDUCT AREA (Point 8). (The total supply flow loop will not let the airflow from the cold duct become less than CLG MIN.) On the other hand, if the job requirements require that CLG MIN be set to zero, then you will not be able to set CLG MIN ≥ 300fpm * CLGDUCT AREA. In this case, CLG FLO CHK (Point 66) should be set to YES. When CLG FLO CHK equals YES, the application closes the cold duct damper when less air is needed from the cold duct than can be read reliably. The cold duct damper returns to normal control when the application needs an amount of air from the cold duct large enough to be read reliably. When CLG FLO CHK equals NO, this cold duct damper override cannot occur.

NOTE: Setting CLG FLO CHK to NO can cause the value of CLG AIR VOL to be inaccurate if the cold duct air volume is very low, possibly resulting in pressurization problems.

The application will also close the cold duct damper when TOT FLO STPT (Point 93) is so low that TOT AIR VOL cannot be read reliably. The cold duct damper returns to normal control when TOT FLO STPT is high enough for TOT AIR VOL to be read reliably.

The application will also close the general exhaust damper when GEX FLO STPT (Point 85) is so low that GEX AIR VOL (Point 30) cannot be read reliably. The general exhaust damper returns to normal control when GEX FLO STPT is high enough for GEX AIR VOL to be read reliably.

Temperature Control Loops

Room Temperature Loop – The room temperature loop reads ROOM TEMP (Point 4) and generates TEMP LOOPOUT (Point 79) which maintains the room temperature at ROOM STPT (Point 13). In CV mode (VOLUME MODE, Point 65 equals CV) TEMP LOOPOUT is used in the BTU calculations to reset the discharge temperature setpoint (DISCH STPT, Point 3). In VAV mode (VOLUME MODE equals VAV) TEMP LOOPOUT is used in the BTU calculations to reset the discharge temperature setpoint in sequence with the VAV flow setpoint required for temperature control. See *BTU Calculations* for more information.

Discharge Air Temperature Loop – The discharge air temperature loop determines the value of the hot deck damper command point (HD DMPR CMD, Point 49). HD DMPR CMD drives the hot deck damper to maintain DISCH STPT (Point 3). See *BTU Calculations* for more information.

NOTE: The discharge air temperature loop is strictly a temperature loop. It is not concerned with how much airflow is coming out of the hot deck, but it can be overridden if the hot deck airflow is so high that pressurization could be affected. See *Discharge Temperature Loop Override* for more information.

BTU Calculations – VAV Mode

During VAV Mode (VOLUME MODE, Point65 equals VAV) the BTU Compensator operates as follows:

The controller adjusts the total supply airflow and the supply air temperature setpoint as necessary to maintain ROOM TEMP (Point 4) at ROOM STPT (Point 13). The room temperature PID loop calculates the value of TEMP LOOPOUT (Point 79). This value is used to sequence the cooling flow and the supply air temperature setpoint (see Figure 2453-3). The loop is tuned by adjusting the values of the feedback gain points, ROOM P GAIN (Point 63) and ROOM I GAIN (Point 64) and the sample interval point, LOOP TIME (Point 98).

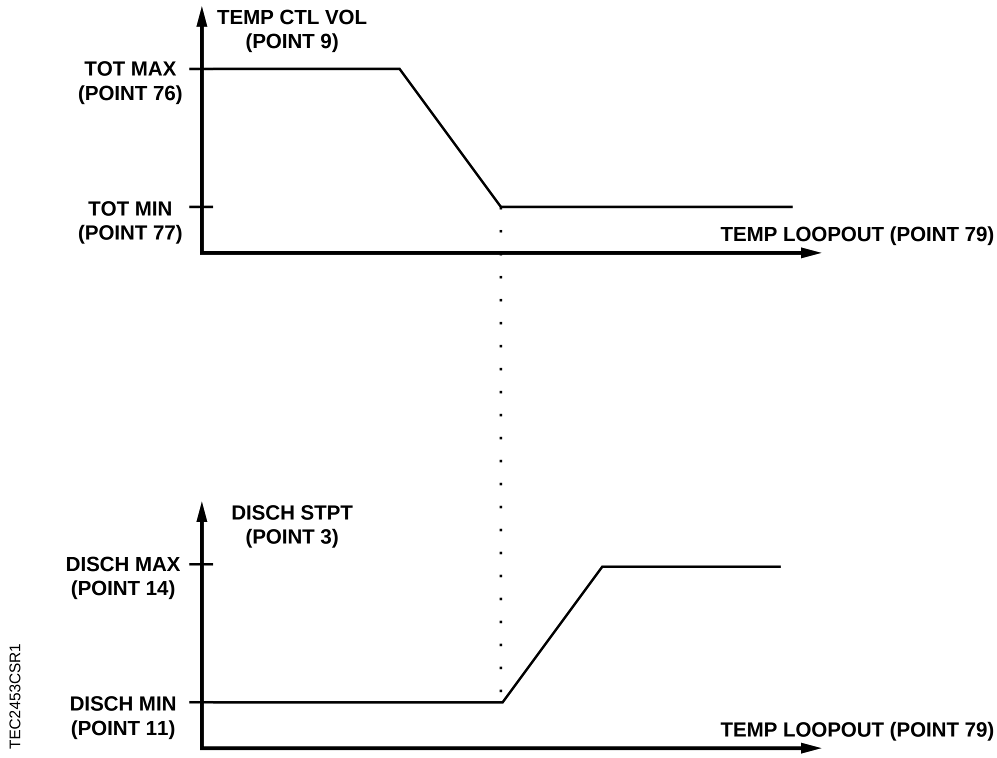


Figure 2453-3. Temperature Control Sequence.

TEMP LOOPOUT reflects temperature load requirements. TEMP LOOPOUT is a supply air temperature value expressed as "degrees above or below room temperature setpoint if the total supply flow is at 100%." If the total supply flow is less than 100%, DISCH STPT is adjusted to an amount greater than TEMP LOOPOUT by a corresponding percentage.

Examples (ROOM STPT, Point 13 = 70°F):

If **TEMP LOOPOUT (Point 79) =**	**and** **TOT AIR VOL (Point 35) =**	**then** **DISCH STPT (Point 3) =**	**Formula for DISCH STPT:** **ROOM STPT + (TEMP LOOPOUT × 100% ÷ TOT AIR VOL)**
10°F	TOT MAX (Point 76)	80°F	70° + (10° × 100% ÷ 100%)
10°F	0.5 × TOT MAX	90°F	70° + (10° × 100% ÷ 50%)
–5°F	0.25 × TOT MAX	50°F	70° + (–5° × 100% ÷ 25%)
0°F	any flow	70°F	70° + (0° × 100% ÷ x%)

While the actual number of BTUs is not explicitly calculated, DISCH STPT varies as the total supply flow varies in order to maintain a constant quantity of heat entering the room.

NOTE: This module limits TEMP LOOPOUT to a value that generates a supply air temperature setpoint less than DISCH MAX (Point 14).

As the demand for heating decreases (TEMP LOOPOUT drops), DISCH STPT eventually reaches DISCH MIN (Point 11). If TEMP LOOPOUT drops further, the value of TEMP CTL VOL (Point 9) begins to rise from TOT MIN (Point 77) to TOT MAX (Point 76) to provide more cool air to the space. If this value is compatible with correct room pressurization, then it is used as the total supply flow setpoint (TOT FLOW STPT, Point 93). If not, the actual setpoint may be higher or lower than TEMP CTL VOL.

BTU calculations – CV Mode

During CV Mode (VOLUME MODE, Point 65 equals CV) the BTU Compensator operates as follows:

The controller adjusts the supply air temperature setpoint as necessary to maintain ROOM TEMP (Point 4) at ROOM STPT (Point 13). The room temperature PID loop calculates the value of TEMP LOOPOUT (Point 79). This value is used to adjust the value of the supply air temperature setpoint. The loop is tuned by adjusting the values of the feedback gain points, ROOM P GAIN (Point 63) and ROOM I GAIN (Point 64) and the sample interval point, LOOP TIME (Point 98).

TEMP LOOPOUT reflects temperature load requirements. TEMP LOOPOUT is a supply air temperature value expressed as “degrees above or below room temperature setpoint if the total supply flow is at 100%”. If the total supply flow is less than 100%, DISCH STPT is adjusted to an amount greater than TEMP LOOPOUT by a corresponding percentage.

Examples (ROOM STPT, Point 13 = 70°F):

If **TEMP LOOPOUT (Point 79) =**	**and** **TOT AIR VOL (Point 35) =**	**then** **DISCH STPT (Point 3) =**	**Formula for DISCH STPT:** **ROOM STPT + (TEMP LOOPOUT × 100% ÷ TOT AIR VOL)**
10°F	TOT MAX (Point 76)	80°F	70° + (10° × 100% ÷ 100%)
10°F	0.5 × TOT MAX	90°F	70° + (10° × 100% ÷ 50%)
–5°F	0.25 × TOT MAX	50°F	70° + (–5° × 100% ÷ 25%)
0°F	any flow	70°F	70° + (0° × 100% ÷ x%)

While the actual number of BTUs is not explicitly calculated, DISCH STPT varies as the total supply flow varies in order to maintain a constant quantity of heat entering the room. (An example of when the total supply flow might vary in the constant volume mode is when the total supply flow varies as needed in order to maintain proper room pressurization when the fume hood sash position changes.)

NOTE: This module limits TEMP LOOPOUT to values that generate supply air temperature setpoints in the range DISCH MIN (Point 11) to DISCH MAX (Point 14).

Discharge Air Temperature Loop Override

The discharge air temperature loop override feature makes sure that the air volume coming out of the hot deck does not get too large.

The discharge air temperature loop is strictly a temperature loop. It modulates the hot deck damper in order to maintain the desired temperature of the total dual duct supply air. Under certain conditions, it might be possible for the discharge air temperature loop to open the hot deck damper so wide that airflow out of the hot deck becomes greater than TOT MAX (Point 76). Another possibility is that if the general exhaust box is undersized, the air volume out of the hot deck might at times be so large that the general exhaust box would have trouble keeping up with the hot deck air volume. If either of these events occurred, the total supply airflow loop might not be able to keep TOT AIR VOL (Point 35) low enough to maintain correct room pressurization. This is because the total supply airflow loop only controls the cold deck damper, not the hot deck damper, and the cold deck damper might be at a minimal or closed position already. To protect against this kind of situation, this application gives you the option of overriding the discharge temperature loop control of the hot deck damper, forcing this damper to close enough so that correct pressure is maintained.

Basically, the override feature works by establishing a hot deck hi flow limit value and comparing it to how much air is coming out of the hot deck, and then doing one of three things:

- If the hot deck airflow is on the verge of becoming too high, DIS LOOPOUT (Point 81) is prevented from increasing. This prevents the value of HD DMPR CMD (Point 49) from increasing.
- If the hot deck airflow is above the hot deck hi flow limit value, the discharge air temperature loop override repeatedly decrements the value of HD DMPR CMD (Point 49) by the value of HD ADJUST (Point 82) until the application determines that maintaining proper pressurization is no longer in danger. While HD DMPR CMD is being decremented, the discharge temperature PID loop is prevented from increasing DIS LOOPOUT.
- If airflow out of the hot deck poses no threat to pressurization, then the discharge air temperature loop override gives complete control of the hot deck damper back to the discharge air temperature loop.

NOTES: The hot deck hi flow limit is an internal point. It is used by the LRC for internal calculations, but it is not visible or commandable from the point database.

In order for the discharge air temperature loop override to operate, HD ADJUST (Point 82) must be set greater than zero (the default value is 3.2).

The exact manner in which the discharge air temperature loop override works is as follows:

First, the application must determine what the hot deck hi flow limit value should be. This value depends on whether the application is operating in VAV or CV mode, and can change depending on other circumstances as well.

CV Mode – When the application is in Constant Volume mode (VOLUME MODE, Point 65 = CV), and the general exhaust box is large enough to maintain proper room pressurization even when the total supply box's air volume is equal to TOT MAX, the maximum amount of air that can come from the hot deck will equal TOT MAX - CLG MIN (Point 47). However, in any given situation the maximum air volume that can come from the general exhaust box and still maintain room pressurization is equal to GEX MAX - HOOD VOL - OTHER EXH + OTHER SUP + VOL DIF STPT. The application subtracts CLG MIN from this value, compares the result to TOT MAX - CLG MIN and uses the smaller of the two as the value for the hot deck hi flow limit.

VAV Mode – When the application is in VAV mode (VOLUME MODE, Point 65 = VAV), and the general exhaust box is large enough to maintain proper room pressurization even when the total supply box's air volume is equal to TOT MAX, the maximum amount of air that can come from the hot deck will equal TOT MAX – TEMP CTL VOL (Point 09). However, in any given situation the maximum air volume that can come from the general exhaust box and still maintain room pressurization is equal to GEX MAX - HOOD VOL - OTHER EXH + OTHER SUP + VOL DIF STPT. The application subtracts TEMP CTL VOL from this value, compares the result to TOT MAX - TEMP CTL VOL and uses the smaller of the two as the value for the hot deck hi flow limit.

NOTE: Once the hot deck hi flow limit has been determined, the discharge air temperature loop override feature operates the same regardless of what mode the application is in (VAV or CV).

Once the application knows the hot deck hi flow limit value, it compares it to the amount of air coming from the hot deck (TOT AIR VOL, Point 35 – CLG AIR VOL, Point 10). If TOT AIR VOL – CLG AIR VOL is greater than the hot deck hi flow limit, then:

- HD DMPR CMD (Point 49) is decremented by the value of HD ADJUST.
- The discharge temperature PID loop is prevented from increasing the value of DIS LOOPOUT. The discharge temperature PID loop will still be allowed to decrease the value of DIS LOOPOUT.

If TOT AIR VOL – CLG AIR VOL is less than or equal to the hot deck hi flow limit but greater than 0.90 * (hot deck hi flow limit), then:

- The discharge temperature PID loop is prevented from increasing the value of DIS LOOPOUT. The discharge temperature PID loop will still be allowed to decrease the value of DIS LOOPOUT.
- HD DMPR CMD is set to a value that depends upon the value of DIS LOOPOUT:
  - If DIS LOOPOUT is equal to or greater than HD DMPR CMD, HD DMPR CMD remains unchanged.
  - If DIS LOOPOUT is less than HD DMPR CMD - HD ADJUST, HD DMPR CMD is set to HD DMPR CMD - HD ADJUST.
  - If DIS LOOPOUT is less than HD DMPR CMD but greater than or equal to HD DMPR CMD - HD ADJUST, HD DMPR CMD is set to DIS LOOPOUT.

If TOT AIR VOL – CLG AIR VOL is less than or equal to 0.90 * (hot deck hi flow limit) and DIS LOOPOUT is greater than HD DMPR CMD, then what happens next depends on how this happened:

- If TOT AIR VOL – CLG AIR VOL was greater than 0.90 * (hot deck hi flow limit) and then fell below 0.90 * (hot deck hi flow limit), and DIS LOOPOUT is greater than HD DMPR CMD, then:
  - The discharge temperature PID loop is prevented from increasing the value of DIS LOOPOUT. The discharge temperature PID loop is still allowed to decrease the value of DIS LOOPOUT.
  - HD DMPR CMD stays at its current value.

- If DIS LOOPOUT was less than or equal to HD DMPR CMD while TOT AIR VOL – CLG AIR VOL was less than or equal to 0.90 * (hot deck hi flow limit), and then DIS LOOPOUT rose above HD DMPR CMD while TOT AIR VOL – CLG AIR VOL remained less than or equal to 0.90 * (hot deck hi flow limit), then:
  - The discharge temperature PID loop is under normal control and DIS LOOPOUT is allowed to either increase or decrease in value.
  - HD DMPR CMD is set to a value that depends upon the value of DIS LOOPOUT:

    If DIS LOOPOUT is greater than HD DMPR CMD + HD ADJUST, then HD DMPR CMD is set to HD DMPR CMD + HD ADJUST.

    If DIS LOOPOUT is greater than HD DMPR CMD but less than or equal to HD DMPR CMD + HD ADJUST, then HD DMPR CMD is set to DIS LOOPOUT.

If TOT AIR VOL – CLG AIR VOL is less than or equal to 0.90 * (hot deck hi flow limit) and DIS LOOPOUT is less than or equal to HD DMPR CMD, then:

- The discharge temperature PID loop is under normal control and DIS LOOPOUT is allowed to either increase or decrease in value.
- HD DMPR CMD is set to a value that depends upon the value of DIS LOOPOUT:
  - If DIS LOOPOUT is less than HD DMPR CMD - HD ADJUST, HD DMPR CMD is set to HD DMPR CMD - HD ADJUST.
  - If DIS LOOPOUT is less than or equal to HD DMPR CMD but greater than or equal to HD DMPR CMD - HD ADJUST, HD DMPR CMD is set to DIS LOOPOUT.

The following logic will shut off the hot deck damper override when the air flow out of the hot deck is so low that overriding the hot deck damper position would be of little or no value. During this circumstance the total supply air flow loop is capable of maintaining the proper room pressurization by modulating the cold deck damper.

If TOT AIR VOL – CLG AIR VOL is less than or equal to 0.50 * (hot deck hi flow limit), then:

- The discharge temperature PID loop is under normal control and DIS LOOPOUT is allowed to either increase or decrease in value.
- HD DMPR CMD is set to a value that depends upon the value of DIS LOOPOUT:
  - If DIS LOOPOUT is less than HD DMPR CMD - HD ADJUST, HD DMPR CMD is set to HD DMPR CMD - HD ADJUST.
  - If DIS LOOPOUT is less than or equal to HD DMPR CMD but greater than or equal to HD DMPR CMD - HD ADJUST, HD DMPR CMD is set to DIS LOOPOUT.
  - If DIS LOOPOUT is greater than HD DMPR CMD + HD ADJUST, HD DMPR CMD is set to HD DMPR CMD + HD ADJUST.
  - If DIS LOOPOUT is greater than HD DMPR CMD but less than or equal to HD DMPR CMD + HD ADJUST, HD DMPR CMD is set to DIS LOOPOUT.

NOTES: 1. This override feature is provided so that room pressurization can be maintained regardless of supply mode (VAV or CV). It will not keep the volume constant during CV mode. If TOT AIR VOL – CLG AIR VOL is ≤ 0.90 * (hot deck hi flow limit) during CV mode, the application allows the discharge air temperature loop to position the hot deck damper wherever needed for temperature control, even if the airflow out of the dual duct box would be greater than the desired CV setpoint. This means that there could be a range of hot deck air flow values where the dual duct box effectively operates as a variable air volume box even though VOLUME MODE (Point 65) is set to CV. But if the value of TOT MIN (Point 77) is greater than the value of the hot deck airflow when the hot deck damper is wide open, then the air volume out of the dual duct box will stay at the desired CV setpoint.

2. One of the purposes of HD ADJUST is to prevent DIS LOOPOUT from changing the value of HD DMPR CMD faster than the hot deck damper actuator can physically move the hot deck damper. This helps to prevent room pressurization problems. However, if HD ADJSUT is too small, then the temperature control performance of the Discharge PID loop will be unnecessarily sluggish. Therefore, it is important that HD ADJUST is set correctly. The recommended value for HD ADJUST is dependent on both the end to end stroke time of the hot deck damper motor and on the value of LOOP TIME (Point 98). It is recommended that HD ADJUST be set to the largest value that satisfies the following equation:

HD ADJUST ≤ 70 * (LOOP TIME / end to end stroke time of hot deck damper motor)

In the equation, 70 is used rather than 100. Although this will slow the response of the hot deck damper to discharge temperature changes, it will improve room pressurization performance.

The end to end stroke time for the hot deck damper motor is not a TEC database point. Therefore, you must find out what the hot deck damper motor's end to end stroke time is before using this equation.

The default value of HD ADJUST is 3.2. This should be a suitable value for HD ADJUST whenever LOOP TIME is equal to 5 seconds and the end to end stroke time of the hot deck damper motor is between 90 and 100 seconds.

CAUTION:

If HD ADJUST equals 0, HD DMPR CMD will always equal DIS LOOPOUT. Setting HD ADJUST to 0 disables the discharge air temperature loop override and may cause room pressurization problems.

Alarms

The LRC is equipped with ventilation and pressurization alarms. It does not contain temperature alarms. The alarms can be annunciated locally and/or broadcast across a network. Alarms are designed to support the following functions:

- Inform room occupants of hazards.
- Inform building operation personnel that the system is not functioning correctly.
- Supply data for documenting laboratory safety records through trending.

Ventilation Alarm

The ventilation alarm point, VENT ALM (Point 92), indicates that there is not enough supply airflow to the room. There is an adjustable alarm level that may vary with the occupancy status of the room. An adjustable delay timer prevents nuisance alarms.

When TOTL SUPPLY (Point 69) is below the alarm level for a time greater than VENT ALM DEL (Point 16), the alarm turns ON. The alarm turns OFF when the TOTL SUPPLY stays above the alarm level for a time greater than the alarm delay. If VENT ALM is set to zero, the ventilation alarm never turns ON.

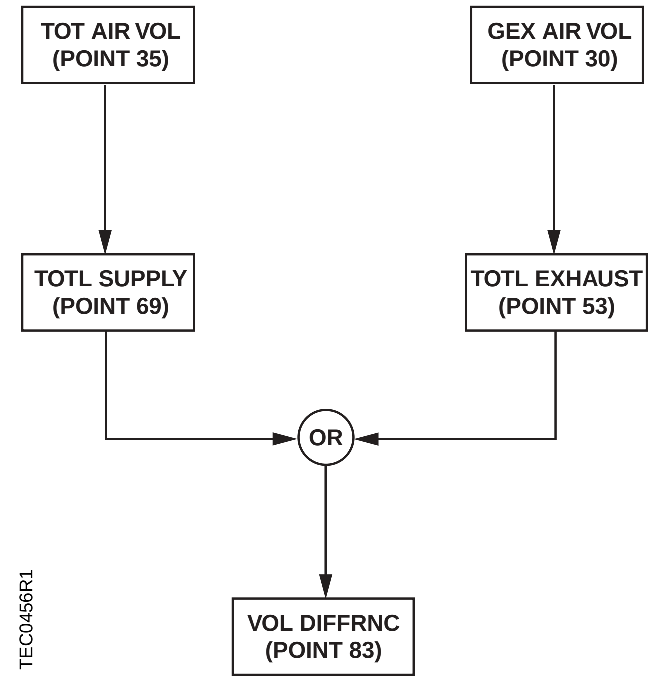
The alarm level depends on whether the room is occupied or unoccupied (OCC.UNOCC, Point 21). During occupied mode, OC V ALM LVL (Point 90) is used. During unoccupied mode, UC V ALM LVL (Point 91) is used. The two alarm levels may be the same or different. Setting either level to zero disables the ventilation alarm during that mode.

Pressurization Alarm

The pressurization alarm point, VOL DIF ALM (Point 22), indicates that the required difference between supply and exhaust flow is not being maintained or that the LRC cannot calculate the flow difference because it is not receiving airflow inputs. There is an adjustable alarm limit and an adjustable delay timer to prevent nuisance alarms.

VOL DIF ALM is ON if VOL DIFFRNC (Point 83) indicates “failed.” This happens whenever one of the input points used to calculate VOL DIFFRNC fails (See *Room Airflow Balance* and *Figure 2453-4*). The pressurization alarm will also turn ON if VOL DIFFRNC is below the alarm level (DIF ALM LVL, Point 38) for a time greater than or equal to DIF ALM DEL (Point 39).

The pressurization alarm point is OFF if VOL DIFFRNC indicates “normal” and the flow differential is greater than or equal to the alarm level for a time greater than or equal to the alarm delay.



VOL DIFFRNC will fail if any of the points leading up to it fails.

Figure 2453-4. VOL DIFFRNC Status.

Local Annunciation

ALARM DO6 (Point 46) 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 any combination of the following sources:

- The ventilation alarm point, VENT ALM (Point 92)
- The pressurization alarm point, VOL DIF ALM (Point 22)
- The DI connected to a switch in the room, ALM SWIT DI6 (Point 27)
- The network alarm point, NET ALM CMD (Point 23)

ALARM DO6 turns ON if any of the enabled alarm sources indicates an alarm. This point cannot be overridden.

To connect the VOL DIF ALM to DO6, set DIF ALM ENA (Point 37) to **YES**. VENT ALM ENA (Point 17) and ALM SWIT ENA (Point 28) enable VENT ALM and ALM SWIT DI6 respectively for local annunciation when they are set to **YES**. NET ALM CMD is always enabled for local annunciation.

When ALM SWIT ENA is set to NO, the alarm logic in this application does not use ALM SWIT DI6. DI6 then becomes a spare DI available for other uses. It can even be unbundled at a field panel be used as part of a PPCL program, if desired.

NET ALM CMD is used to send an alarm state from the field panel. This makes it possible to program unique alarm criteria and annunciate alarms in rooms.

Network Annunciation

If the LRC is connected to a field panel, alarms can be reported using Insight®, or using a printer set up in a building manager's office to receive alarms. Points in the LRC must be entered in a field panel's point database (referred to as unbundling) and defined as alarmable points.

For example, if the room pressurization alarm VOL DIF ALM is unbundled in a field panel and a pressurization alarm is triggered, the alarm will be displayed at the selected locations.

Fail-Safe Operation

If any of the LRC inputs fail, then a failure mode sequence is initiated.

Air velocity sensors – If at least one of the LRC air sensor signals (GEX AIR VOL, TOT AIR VOL and/or CLG AIR VOL) are out of range (for example, tubing not connected or connected backward), the hot deck and cold deck dampers either hold there current positions or close immediately depending on the value of FAIL MODE (Point 40). The general exhaust damper will hold its current position (regardless of FAIL MODE) because closing it might over pressurize the room and opening it might upset other exhaust devices on the system. (The general exhaust damper is only put in a fail-safe mode if GEX AIR VOL fails. If TOT AIR VOL or CLG AIR VOL fails, the general exhaust damper is still controlled normally.) Once GEX AIR VOL, TOT AIR VOL and CLG AIR VOL are normal, the general exhaust damper, hot deck damper, and cold deck damper return to normal operation.

Fume Hood Flow – If the LRC does not receive a valid fume hood flow signal (greater than 1 Vdc), the room maintains user defined pressurization, and the supply and exhaust loops operate as if the hood exhaust value is 0 CFM. If VOL DIF ALM, VOL DIFFRNC, or TOTL EXHAUST are unbundled in a field panel and characterized as alarmable, an alarm will be annunciated across the network.

If the FHC loses power or loses its flow sensor, HOOD VOL, TOTL EXHAUST and VOL DIFFRNC will fail. If VOL DIFFRNC is unbundled and alarmable, there will be an alarm printout.

Room Temperature Sensor – If the room temperature sensor fails, ROOM TEMP (Point 4) displays as failed and temperature control is suspended at the current value of TEMP LOOPOUT (Point 79). If ROOM TEMP is unbundled in a field panel and made alarmable, an alarm is sent across the network and printed out on a dedicated alarm printer.

Discharge Temperature Sensor – If DISCH TEMP (Point 80) fails, temperature control is lost and BTU calculations cease. This is because the temperature loop stops updating and the discharge loop stops operating.

AO-E Module – Failure of an AO-E module produces no direct indication. Typically, flow control is lost and alarms are triggered.

Upon loss of power or control signal to the AO-E module, the electronic actuator will fail based on the related DIP switch (SW2-4) position. (See the Start-up document for switch settings.) If set to Fail Retracted (default), the actuator fully retracts on power failure. If set to Fail Last Position, the actuator maintains the last position commanded.

Laboratory Room Controller – If the LRC power fails, all actuators default to their user-defined fail-safe states. Since there is no power to the controller, no LEDs are available.

Sizing Guidelines

In order to get the most out of this application in terms of pressure control and temperature control, follow these sizing guidelines:

General Exhaust Box – The general exhaust box must be large enough to allow GEX MAX to maintain proper room pressurization when the fume hood damper is completely shut and the air volume out of the total supply box is equal to TOT MAX.

Total Supply Box – The total supply box must be large enough to allow TOT MAX to maintain proper room pressurization when the fume hood damper is opened all the way and the air volume out of the general exhaust box is equal to GEX MIN.

Hot Duct – The hot duct must be large enough to provide air volume equal to TOT MAX – CLG MIN when the cold duct air volume is at CLG MIN. Plus, the air supplied to the hot duck must be hot enough to handle the heating load when the hot duct air volume is equal to or less than TOT MAX - CLG MIN.

Cold Duct – The cold duct must be large enough to provide an air volume equal to TOT MAX when the hot deck damper is completely shut. Plus, the air supplied to the cold duct must be cold enough to handle the cooling load when the cold duct air volume is equal to or less than TOT MAX.

Flow Tracking Note

Under normal circumstances the application can do a better job of room pressurization if TRACK METHOD (Point 84) is set to STPT rather than FLOW. The default for TRACK METHOD is STPT and normally should not need to be changed. The primary purpose of the FLOW value is for running the application in failsafe conditions, such as if the general exhaust box damper gets stuck in position.

Point Database

Point Database for Application 2453.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept s(SI Units)	On Text	Off Text
01	CTLR ADDRESS	99	--	1	0	--	--
02	APPLICATION	2472	--	1	0	--	--
{03}	DISCH STPT	60.0 (15.656)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{04}	ROOM TEMP	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
05	DISCH P GAIN	2.0 (3.6)	--	0.05 (0.09)	0.0	--	--
06	DISCH I GAIN	0.02 (0.036)	--	0.0002 (0.00036)	0.0	--	--
07	CLG FLO COEF	1.0	--	0.01	0.0	--	--
08	CLGDUCT AREA	1.0 (0.09292)	SQ. FT (SQ M)	0.025 (0.002323)	0.0	--	--
{09}	TEMP CTL VOL	4000 (1887.6)	CFM (LPS)	4 (1.8876)	0	--	--
{10}	CLG AIR VOL	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
11	DISCH MIN	55.0 (12.856)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
12	BUTTON ENA	NO	--	--	--	YES	NO
{13}	ROOM STPT	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
14	DISCH MAX	120.0 (49.256)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{15}	HOOD SIG AI3	0.0	VOLTS	0.04	0.0	--	--
16	VENT ALM DEL	30	SEC	1	0	--	--
17	VENT ALM ENA	NO	--	--	--	YES	NO
18	OCC SWIT ENA	NO	--	--	--	YES	NO
{19}	OCC BUTTON	OFF	--	--	--	ON	OFF
{21}	OCC.UNOCC	OCC	--	--	--	UNOCC	OCC
{22}	VOL DIF ALM	OFF	--	--	--	ON	OFF
{23}	NET ALM CMD	OFF	--	--	--	ON	OFF
{24}	OCC SWIT DI2	OFF	--	--	--	ON	OFF
{25}	BUTTON CMD	OCC	--	--	--	UNOCC	OCC
26	GEX P GAIN	0.05	--	0.001	0.0	--	--
{27}	ALM SWIT DI6	OFF	--	--	--	ON	OFF
28	ALM SWIT ENA	NO	--	--	--	YES	NO
{29}	NET OCC CMD	OCC	--	--	--	UNOCC	OCC
{30}	GEX AIR VOL	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
31	OCC TOT MAX	3400 (1604.46)	CFM (LPS)	4 (1.8876)	0	--	--
32	OCC TOT MIN	340 (160.446)	CFM (LPS)	4 (1.8876)	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.

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Point Database for Application 2453.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept s(SI Units)	On Text	Off Text
33	OCC GEX MAX	1100 (519.09)	CFM (LPS)	4 (1.8876)	0	--	--
34	OCC GEX MIN	600 (283.14)	CFM (LPS)	4 (1.8876)	0	--	--
{35}	TOT AIR VOL	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
36	TOT FLO COEF	1.0	--	0.01	0.0	--	--
37	DIF ALM ENA	NO	--	--	--	YES	NO
38	DIF ALM LVL	100 (47.19)	CFM (LPS)	4 (1.8876)	-8000(-3775.2)	--	--
39	DIF ALM DEL	30	SEC	1	0	--	--
40	FAIL MODE	HOLD	--	--	--	CLOSE	HOLD
{41}	CLG EXTN DO1	HOLD	--	--	--	EXTN	HOLD
{42}	CLG RETC DO2	RETC	--	--	--	HOLD	RETC
{43}	GEX EXTN DO3	HOLD	--	--	--	EXTN	HOLD
{44}	GEX RETC DO4	RETC	--	--	--	HOLD	RETC
{45}	AUTOZERO DO5	OFF	--	--	--	ON	OFF
{46}	ALARM DO6	OFF	--	--	--	ON	OFF
{47}	CLG MIN	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
{48}	HD DMPR AO1	0.0	VOLTS	0.01	0.0	--	--
{49}	HD DMPR CMD	0.0	PCT	0.4	0.0	--	--
{50}	AI 4	0.0	PCT	0.4	0.0	--	--
{51}	HOOD VOL	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
52	MAX HOOD VOL	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
{53}	TOTL EXHAUST	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
54	GEX FLO COEF	1.0	--	0.01	0.0	--	--
55	HOOD OCC VOL	600 (283.14)	CFM (LPS)	4 (1.8876)	0	--	--
56	HOOD UOC VOL	100 (47.19)	CFM (LPS)	4 (1.8876)	0	--	--
57	HD DMP CLOSE	10.0	VOLTS	0.01	0.0	--	--
58	HD DMP OPEN	1.0	VOLTS	0.01	0.0	--	--
59	GEX DMPR DIR	NOPEN	--	--	--	NCLOSE	NOPEN
60	GEXDUCT AREA	1.0 (0.09292)	SQ. FT (SQ M)	0.025 (0.002323)	0.0	--	--
{61}	OTHER SUP	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
62	CLG DMPR DIR	NOPEN	--	--	--	NCLOSE	NOPEN
63	ROOM P GAIN	2.0	--	0.05	0.0	--	--
64	ROOM I GAIN	0.001	--	0.0001	0.0	--	--
65	VOLUME MODE	VAV	--	--	--	CV	VAV

1. Points not listed are not used in this application.
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3. Point numbers that appear in brackets { } may be unbundled at the field panel.

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Point Database for Application 2453.

Point Number	Descriptor	Factory Default (SI Units)	Engr Units (SI Units)	Slope (SI Units)	Intercept s(SI Units)	On Text	Off Text
66	CLG FLO CHK	YES	--	--	--	YES	NO
67	UOC GEX MAX	1000 (471.9)	CFM (LPS)	4 (1.8876)	0	--	--
68	UOC GEX MIN	500 (235.95)	CFM (LPS)	4 (1.8876)	0	--	--
{69}	TOTL SUPPLY	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
70	TOT P GAIN	0.05	--	0.001	0.0	--	--
71	UOC TOT MAX	2200 (1038.18)	CFM (LPS)	4 (1.8876)	0	--	--
72	UOC TOT MIN	220 (103.818)	CFM (LPS)	4 (1.8876)	0	--	--
73	DO DIR.REV	0	--	1	0	--	--
{74}	GEX MAX	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
{75}	GEX MIN	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
{76}	TOT MAX	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
{77}	TOT MIN	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
{78}	CTL TEMP	74.0 (23.44888)	DEG F (DEG C)	0.25 (0.14)	48.0(8.88888)	--	--
{79}	TEMP LOOPOUT	0.0 (106.6667)	DEG F (DEG C)	0.1 (0.18)	-100.0(-73.3333)	--	--
{80}	DISCH TEMP	74.0 (23.496)	DEG F (DEG C)	0.5 (0.28)	37.5(3.056)	--	--
{81}	DIS LOOPOUT	0.0	PCT	0.4	0.0	--	--
82	HD ADJUST	3.2	PCT	0.4	0.0	--	--
{83}	VOL DIFFRNC	0 (0.0)	CFM (LPS)	4 (1.8876)	-8000(-3775.2)	--	--
84	TRACK METHOD	STPT	--	--	--	FLOW	STPT
{85}	GEX FLO STPT	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
86	GEX FAIL LMT	40 (18.876)	CFM (LPS)	4 (1.8876)	0	--	--
87	GEX FAIL TIM	60	SEC	2	0	--	--
{88}	VOL DIF STPT	400 (188.76)	CFM (LPS)	4 (1.8876)	-8000(-3775.2)	--	--
{89}	OTHER EXH	0 (0.0)	CFM (LPS)	4 (1.8876)	0	--	--
90	OC V ALM LVL	40 (18.876)	CFM (LPS)	4 (1.8876)	0	--	--
91	UC V ALM LVL	160 (75.504)	CFM (LPS)	4 (1.8876)	0	--	--
{92}	VENT ALM	OFF	--	--	--	ON	OFF
{93}	TOT FLO 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	TOTDUCT 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	--	--

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.