SIEMENS

BACnet LCM-OAVS Application 6729

VAV Room Pressurization with HW Reheat, BTU Compensation and Slow Damper Actuation (One Exhaust, One Supply)

Application Note

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Building Technologies

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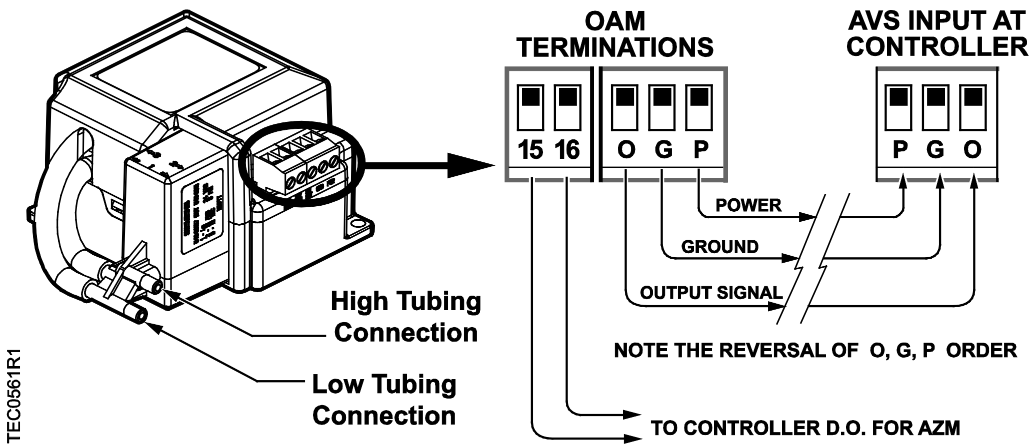
Overview

Application 6729 controls pressurization, ventilation, and room temperature in a laboratory room served by one single-duct supply terminal with a reheat coil, one general exhaust terminal, and up to six fume hoods (multiple fume hood flow signals must be averaged using a Fume Hood Flow Module (FFM). Pressurization is controlled by maintaining a selected difference between supply and exhaust airflows.

WARNING

LCM WILL BE DAMAGED/DESTROYED IF OFFBOARD AIR MODULE(S) ARE NOT WIRED CORRECTLY AND POWER IS APPLIED TO LCM.



This version of the LCM uses conventional supply and exhaust actuation (rather than high speed actuation). Therefore, it should be used only where rapid room response to fume hood volume changes is not required. Fume hoods used in conjunction with these applications should be constant volume or slow actuation.

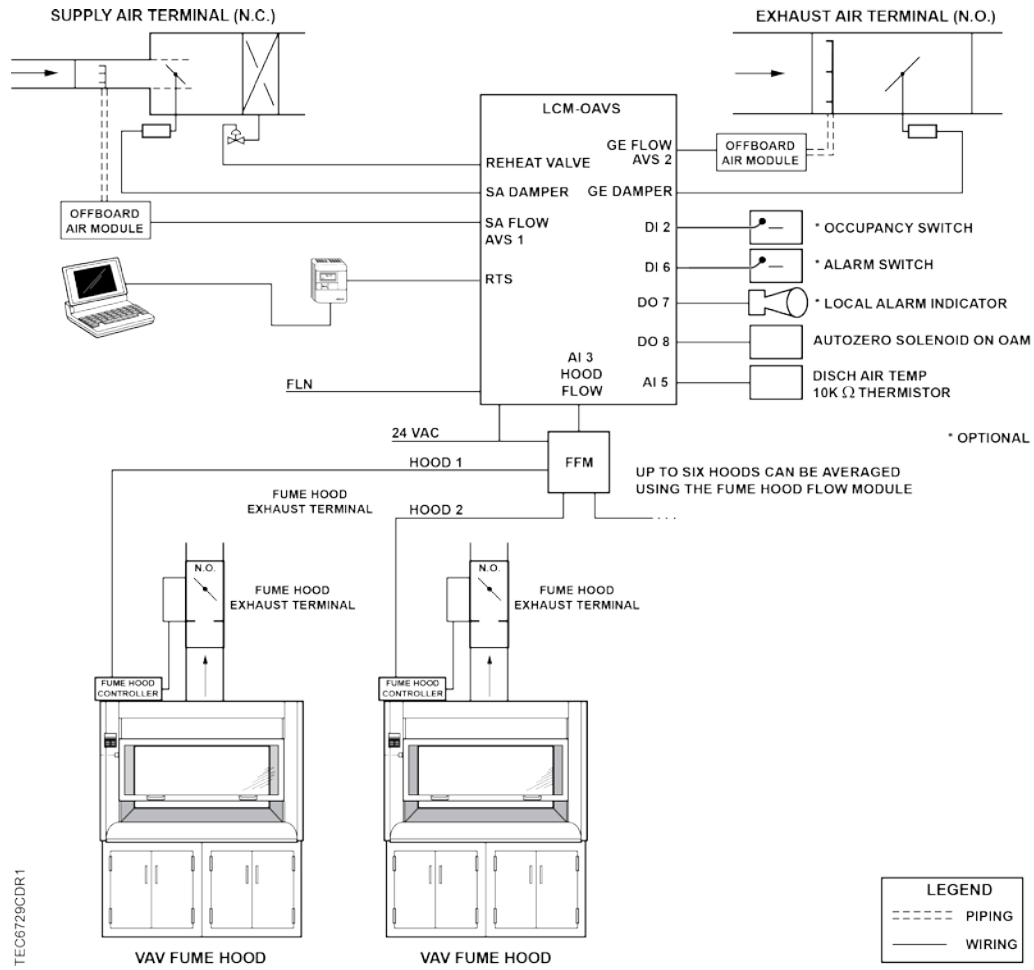
NOTE:
Application 6729 can be set up to operate without a supply box, or without a general exhaust box. See the *Application Notes* section for more information.

Application 6729 uses floating control electronic actuators for both supply and exhaust damper control. A standard 0 to 10 Vdc actuator is used for the hot water valve.

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

- Pressurization
- Ventilation (supply minimum may be overridden to maintain negative pressurization)
- Temperature

Temperature control is determined by input from the room temperature sensor. The discharge temperature setpoint is reset in sequence with the VAV flow to control the room temperature using a BTU Compensation algorithm. The discharge temperature is then controlled using the reheat coil.



Ventilation and Pressurization Control Drawing.

BACnet

The controller communicates using BACnet MS/TP protocol for open communications on BACnet MS/TP networks.

Product	Supported BIBBs	BIBB Name
BTEC	DS-RP-B B	Data Sharing-Read Property-B
	DS-RPM-B	Data Sharing-Read Property Multiple-B
	DS-WP-B	Data Sharing-Write Property-B
	DM-DDB-B	Device Management-Dynamic Device Binding-B

Product	Supported BIBBs	BIBB Name
	DM-DOB-B	Device Management-Dynamic Object Binding-B
	DM-DCC-B	Device Management-Device Communication Control-B
	DM-RD-B	Device Management-Reinitialize Device-B
	DM-BR-B	Device Management-Backup and Restore-B
	DM-OCD-B	Device Management-Object Creation and Deletion-B

Hardware Inputs

Analog

- Air velocity sensor (s) – (one or two depending on setup)
- Fume hood controller input or FFM
- Room temperature sensor
- Discharge Temperature Sensor (10K Ω thermistor)

Digital

- Occupancy button (option on room temperature sensor)
- Occupancy switch (optional)
- Alarm switch (optional)

Hardware Outputs

Analog

- Reheat valve

Digital

- Autozero Solenoid in Offboard Air Module (DO8)
- Alarm (optional)
- Supply damper (two DOs)
- General exhaust damper (two DOs)

Ordering Notes

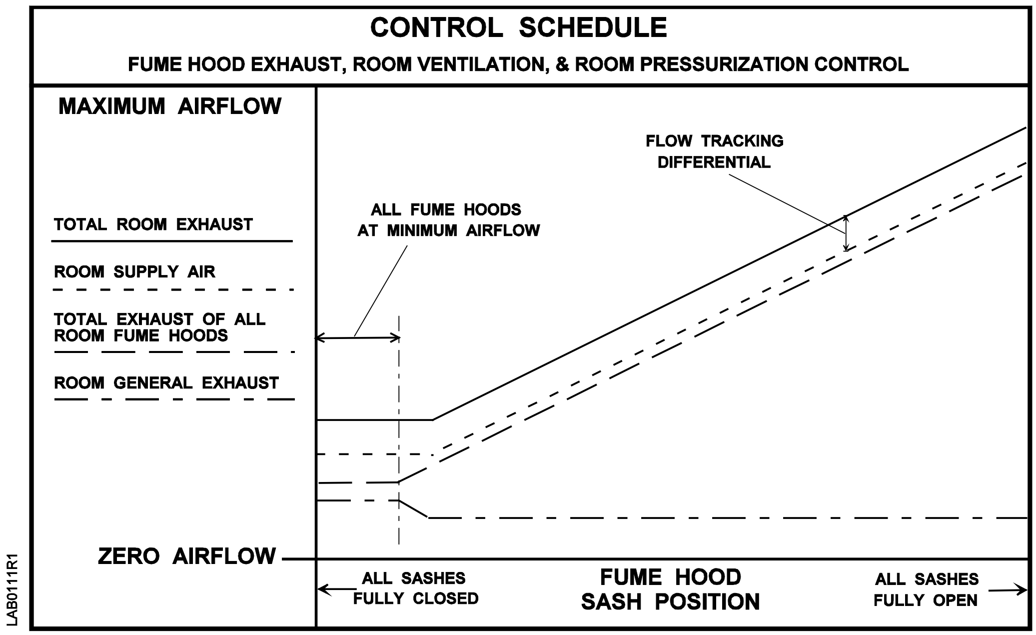
570-801P	BACnet LCM-OAVS VAV Room Pressurization with HW Reheat and Damper Actuation — One Exhaust, One Supply Requires Offboard Air Module(s) – order and ship separately
550-819B	Offboard Air Module (OAM) – order and ship separately

Sequence of Operation

The following paragraphs present the sequence of operation for BACnet LCM-OAVS VAV Room Pressurization with BTU Comp, HW Reheat and Slow Damper Actuation.

Pressurization Control

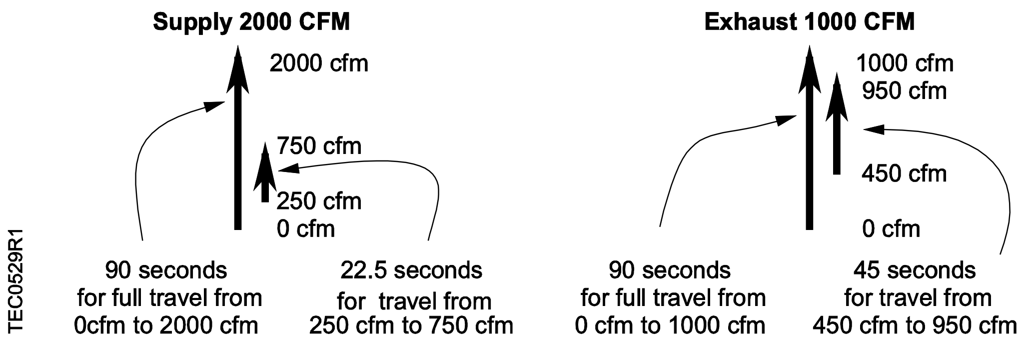
The goal of pressurization control is to maintain a fixed difference between the volumes of total supply air and total exhaust air (see the following Figure). The controller selects supply and exhaust setpoints to balance flows while meeting supply air requirements, and the supply and exhaust flows are individually controlled by their respective feedback loops in order to meet the setpoints.



Optional Rate Limiting of Actuators

Under specific circumstances, such as when operating open loop with setpoint tracking and differently sized supply and exhaust, it may be necessary to adjust the actuator travel rates to improve pressurization control.

The example below illustrates when a rate limit might be needed, such as when equal travel times for the supply and exhaust actuators yield large differences in their respective flow rates.



To deal with the possibility of unequal flow rate changes, the application includes two new points which allow field adjustment to slow down actuators. SUP MAX RATE is used to effectively limit the speed of the supply actuator; GEX MAX RATE is used to effectively limit the speed of the exhaust actuator.

SUP MAX RATE and GEX MAX RATE should be changed to values other than 0 only after a thorough analysis has been made of the job specific scenarios. For example, slowing down a given supply actuator to match a general exhaust actuator may actually be detrimental overall if the installation includes faster acting fume hoods.

To limit the rate of the actuator (supply or exhaust depending on your setup) that controls the larger and faster changing flow rate, do the following: Take the max flow cfm value of the box you want to slow down and divide by its actuator runtime in seconds, then divide the result by 4 and round to the nearest integer. Enter this final value in either SUP MAX RATE or GEX MAX RATE depending on which box you want to slow down.

Here is the formula in its simplest terms, where "max cfm" represents the maximum flow value of the box that you want to slow down:

(max cfm ÷ runtime) ÷ 4 = SUP (or GEX) MAX RATE

NOTE:
This value is a good starting point. If necessary, you can raise it (must be an integer) to speed up the rate of flow change, or lower it to further slow down the rate of flow change, while observing the overall stability of your setup.

To accommodate the largest variety of room configurations and pressurization needs, the rate limit will ONLY be applied when the actuator is moving in the direction that if left uncontrolled could cause pressurization reversal. See table below.

	SUPPLY	GENERAL EXHAUST
OCC DIF STPT (or **UOC DIF STPT**) <0 Maintain **positive** pressurization	The **SUP MAX RATE** is applied to supply closing but not to supply opening.	The **GEX MAX RATE** is applied to general exhaust opening but not to general exhaust closing.
OCC DIF STPT (or **UOC DIF STPT**) >=0 Maintain **negative** pressurization	The **SUP MAX RATE** is applied to supply opening but not to supply closing.	The **GEX MAX RATE** is applied to general exhaust closing but not to general exhaust opening.

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) – (SUP AIR VOL + OTHER SUP)

The controller uses these calculations to maintain VOL DIFFRNC at the VOL DIF STPT.

NOTE:
VOL DIFFRNC and VOL DIF STPT are positive numbers in a room that is negatively pressurized and negative in a positively pressurized room.

Application 6729 has the ability to maintain a different volume differential setpoint during occupied mode than during unoccupied mode. When OCC.UNOCC = OCC, VOL DIF STPT = OCC DIF STPT. When OCC.UNOCC = UNOCC, VOL DIF STPT = UOC DIF STPT.

Occupancy

The controller keeps track of the occupancy status of the room and uses that information for the following purposes:

- To select minimum and maximum flow rates for each air terminal.
- To select whether the controller is operating in the VAV or CV mode.
- To determine whether the controller is using Supply Tracks Exhaust (STE) or Exhaust Tracks Supply (ETS) flow tracking.
- To determine the value of VOL DIF STPT.
- To calculate the airflow level that triggers the ventilation alarm.

Occupancy status also affects the airflow level that triggers the ventilation alarm. The occupancy status of the room is indicated by OCC.UNOCC. A digital room thermostat can read OCC.UNOCC and display its value. This point cannot be overridden.

If the occupancy status of the room is set manually, it is necessary to work through the following command options.

The controller works in the occupied mode whenever **one or more** of the following occupancy signals indicates occupancy:

- Commands from a field panel, NET OCC CMD
- Dry contact switch in the room, OCC SWIT DI2
- Push button on the thermostat, OCC BUTTON

If **all** of these occupancy signals indicate vacancy, the controller works in the unoccupied mode.

NET OCC CMD – 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 must be used.

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

OCC ENA is an analog point whose value determines whether or not OCC BUTN DI1, or OCC SWIT DI2, is enabled.

The following table shows what is enabled when OCC ENA is at a particular value.

OCC ENA Values.	
OCC ENA (value)	**Description**
0 (default)	Both OCC BUTN DI1 and OCC SWIT DI2 are disabled.
1	Only OCC BUTN DI1 is enabled.
2	Only OCC SWIT DI2 is enabled.

NOTE:
OCC ENA does not allow both OCC BUTN DI1 and OCC SWIT DI2 to be enabled at the same time. If OCC ENA is set greater than 2, it will default to 0.

OCC SWIT DI2 – The occupancy switch (dry contact switch in the room) can be any device that closes the switch when the room is occupied (occupancy sensor, extra contact on light switch, etc.). The controller uses this input for occupancy if the setup point OCC ENA is set to **2**. Otherwise, OCC SWIT DI2 does not affect occupancy.

OCC BUTTON – Some 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, OCC ENA, is set to **1**.

When the room sensor button is pushed, the controller interprets this 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. 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.

Active Flow Minimums and Maximums

When OCC.UNOCC equals OCC:

- The active supply airflow minimum equals OCC SUP MIN.
- The active supply airflow maximum equals OCC SUP MAX.
- The active general exhaust airflow minimum equals OCC GEX MIN.

- The active general exhaust airflow maximum equals OCC GEN MAX.

When OCC.UNOCC equals UNOCC:

- The active supply airflow minimum equals UOC SUP MIN.
- The active supply airflow maximum equals UOC SUP MAX.
- The active general exhaust airflow minimum equals UOC GEX MIN.
- The active general exhaust airflow maximum equals UOC GEN MAX.

VAV vs. CV Control

In Application 6729, VAV means that the supply airflow can be varied to provide cooling. CV means the supply airflow is not a source of cooling. However, the supply and general exhaust can still change in CV mode to keep the volume differential setpoint constant. This may be necessary if HOOD VOL is varying. Application 6729 can do either Variable Air Volume control (VAV) or Constant Air Volume Control (CV). It can also change the type of air volume control based on which mode it is operating in (OCC or UNOCC).

- When OCC.UNOCC equals **OCC**, Application 6729 will perform VAV control provided that VOLUME STATE equals **1** or **3**. It will perform constant volume (CV) control provided that VOLUME STATE equals **0** or **2**.
- When OCC.UNOCC equals **UNOCC**, Application 6729 will perform VAV control provided that VOLUME STATE equals **2** or **3**. It will perform constant volume control provided that VOLUME STATE equals **0** or **1**.

Depending on how VOLUME STATE is configured, Application 6729 can operate as either a variable air volume (VAV) LCM or a constant volume (CV) LCM. Also, these operational modes can vary between the occupied and unoccupied periods, if desired.

The following table shows what the application does when VOLUME STATE is at a particular value.

VOLUME STATE Values.	
VOLUME STATE (value)	**Description**
0	Always Constant Volume.
1 (default)	VAV during occupancy, Constant Volume during unoccupied period.
2	Constant Volume during occupancy, VAV during unoccupied period.
3	Always VAV.

NOTE:
If VOLUME STATE is set greater than 3, it will default to 0.

Fume Hood Flow Input

This version of the LCM uses conventional supply and exhaust actuation (rather than high speed actuation). Therefore, it should be used only where rapid room response to fume hood volume changes is not required. Fume hoods used in conjunction with these applications should be constant volume or slow actuation.

A signal of 1 to 10 Vdc at AI 3 represents the volume of air that is exhausted through the fume hood(s). By using a Fume Hood Flow Module (FFM), you can connect up to six fume hoods to AI 3. Multiple fume hood flows must be averaged using a Fume Hood Flow Module. The resulting airflow is displayed in point HOOD VOL.

MAX HOOD VOL is set during start-up to indicate the flow in cubic feet per minute (cfm) that corresponds to an input signal of 10 Vdc. A signal of 1 Vdc indicates 0 cfm. If the signal drops below 1 Vdc, TOTL EXHAUST will fail.

MINHOODVOLTS is set during start-up to indicate the voltage input that represents the lower limit of the airflow range (such as 0 Vdc or 1 Vdc).

- If MINHOODVOLTS is set to 1Vdc or greater, and the actual voltage input drops below .4Vdc, a hood volume alarm is generated. The alarm will return to normal when the voltage increases above .6Vdc
- If the MINHOODVOLTS is set less than 1 Vdc (such as to 0 Vdc), then there is no alarm generated when crossing the .4 Vdc threshold. This disabling of alarm allows the use of input devices that use the full range of 0-10 Vdc.

NOTE:
If desired, the LCM can be used without any fume hoods attached. In this case, MAX HOOD VOL should be set to 0 cfm to disable the alarming that would occur if the fume hood flow input drops below 1 Vdc.

Flow Tracking – Supply Tracks Exhaust vs. Exhaust Tracks Supply

The Supply Tracks Exhaust (STE) and Exhaust Tracks Supply (ETS) feature is configured by setting TRACK MODE to STE or ETS to help the controller meet the pressurization needs of the controlled space, such as for negative or positive pressure. TRACK METHOD is used to determine what is being tracked – a flow value or a setpoint value. Regardless of the mode (STE or ETS) in which the controller is operating, the application will change the value of TRACK METHOD from STPT to FLOW (that is, from setpoint tracking to flow tracking) if necessary to maintain proper pressurization. This is important in situations where a room may lack sufficient supply or general exhaust capacity. The following paragraphs explain this in greater detail.

Supply Tracks Exhaust mode is useful when trying to maintain negative pressurization. During Supply Tracks Exhaust, the supply air volume "tracks" or follows the exhaust air volume. If the exhaust air is "broken" (for instance, if the general exhaust airflow control device is stuck open or stuck closed), the supply air volume will be adjusted so that VOL DIF STPT is maintained as much as possible. (The supply air volume cannot go lower than zero and the application will not allow it to go higher than OCC SUP MAX during occupied periods, or UOC SUP MAX during unoccupied periods.)

Exhaust Tracks Supply mode is useful when trying to maintain positive pressurization. During Exhaust Tracks Supply, the general exhaust air volume "tracks" or follows the supply air volume. If the supply air is "broken" (for instance, if the supply airflow control device is stuck open or stuck closed), the general exhaust air volume will be adjusted so that VOL DIF STPT is maintained as much as possible. (The general exhaust air volume cannot go lower than zero and the application will not allow it to go higher than

OCC GEX MAX during occupied periods, or UOC GEX MAX during unoccupied periods.)

The selected track mode is not affected by occupancy status (OCC or UNOCC), and is set by the value of TRACK MODE.

TRACK MODE Values.	
TRACK MODE (value)	**Description**
0 default	Always STE (Supply Tracks Exhaust), exhaust only.
1	STE during occupancy, ETS during the unoccupied period.
2	ETS during occupancy, STE during the unoccupied period.
3	Always ETS (Exhaust Tracks Supply), supply only.

NOTE:
If TRACK MODE is set greater than 3, it will default to 0.

TRACK METHOD

A point associated with TRACK MODE is TRACK METHOD. TRACK MODE determines which airflow (supply or general exhaust) gets tracked and which airflow does the tracking. TRACK METHOD determines how tracking is accomplished.

- If TRACK MODE is set to ETS and TRACK METHOD is set for FLOW tracking, the general exhaust flow setpoint is calculated according to the measured value, SUP AIR VOL.
- If TRACK METHOD is set for STPT tracking, the general exhaust flow setpoint is calculated according to the supply flow setpoint. However, this module changes over to FLOW tracking mode if the supply is unable to reach the setpoint.

This feature prevents the incorrect pressurization of rooms that lack the required supply capacity. The changeover is based on the error of the supply flow loop. If the error is greater than FAIL LIMIT, and stays that way for a time longer than FAIL TIME, then the module changes from STPT tracking to FLOW tracking. It stays in that mode until the error comes back to zero, then switches back to the STPT tracking mode.

- If TRACK MODE is set to STE and TRACK METHOD is set for FLOW tracking, the supply flow setpoint is calculated according to the measured value, GEX AIR VOL.
- If TRACK METHOD is set for STPT tracking, the supply flow setpoint is calculated according to the general exhaust flow setpoint. However, this module changes over to FLOW tracking mode if the general exhaust is unable to reach the setpoint.

This feature prevents the incorrect pressurization of rooms that lack the required general exhaust capacity. The changeover is based on the error of the general exhaust flow loop. If the error is greater than FAIL LIMIT, and stays that way for a time longer than FAIL TIME, then the module changes from STPT tracking to FLOW tracking. It stays in that mode until the error comes back to zero, then switches back to the STPT tracking mode.

Calculating Exhaust Flow Setpoint

When **Supply Tracks Exhaust** (STE) flow tracking is being used, the general exhaust airflow setpoint is calculated as follows:

- During VAV operation, the controller calculates GEX FLO STPT by looking at the value of TEMP CTL VOL and determining the general exhaust flow needed to pressurize the room. If TEMP CTL VOL is less than the active supply minimum, the controller ignores TEMP CTL VOL and calculates GEX FLO STPT based on the value of the active supply flow minimum.
- During CV operation, the controller ignores TEMP CTL VOL. Instead, it calculates GEX FLO STPT based on the value of the active supply flow minimum and the amount of general exhaust airflow needed to pressurize the room.

NOTE:
When Supply Tracks Exhaust (STE) flow tracking is being used, the controller does not allow GEX FLO STPT (or the actual general exhaust flow) to rise above the active general exhaust airflow maximum. **However, the general exhaust airflow minimum can be overridden in situations where doing so is necessary to maintain desired room pressurization.**

When **Exhaust Tracks Supply** (ETS) flow tracking is being used, the general exhaust airflow setpoint is calculated the same during both VAV and CV operation, as follows:

To calculate GEX FLO STPT, the controller determines the general exhaust airflow value that pressurizes the room based on the values of VOL DIF STPT, OTHER EXH, OTHER SUP and either SUP FLO STPT or SUP AIR VOL depending on the value of TRACK METHOD. GEX FLO STPT may not exceed the active general exhaust airflow maximum, but the currently active general exhaust airflow minimum (OCC GEX MIN or UOC GEX MIN) will be overridden if necessary to maintain the desired room pressurization.

Calculating Supply Flow Setpoint

When **Supply Tracks Exhaust (STE)** flow tracking is being used, the supply airflow setpoint is calculated the same during both VAV and CV operation, as follows:

To calculate SUP FLO STPT, the controller determines the supply flow value that pressurizes the room based on the values of VOL DIF STPT, OTHER EXH, OTHER SUP, and either GEX FLO STPT or GEX AIR VOL depending on the value of TRACK METHOD. SUP FLO STPT may not exceed the currently active supply airflow maximum.

When **Exhaust Tracks Supply (ETS)** flow tracking is being used, the supply airflow setpoint is calculated as follows:

- During VAV operation, the controller calculates SUP FLO STPT by looking at the value of TEMP CTL VOL and determining the supply flow needed to pressurize the room. If TEMP CTL VOL is less than the active supply minimum, the controller ignores TEMP CTL VOL and calculates SUP FLO STPT based on the value of the active supply flow minimum.

- During CV operation, the controller ignores TEMP CTL VOL. Instead, it calculates SUP FLO STPT based on the value of the active supply flow minimum and the amount of supply airflow needed to pressurize the room.

NOTE:
Regardless of the flow tracking method (STE or ETS) being used, the controller does not let the actual supply airflow rise above the currently active supply airflow maximum**. However, the currently active supply airflow minimum (OCC SUP MIN or UOC SUP MIN) will be overridden if necessary to achieve desired pressurization.**

External Flow Values

Airflows not connected to the controller must be taken into consideration 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 controller, the combination of their values must be entered into OTHER SUP and OTHER EXH so the controller can properly control the lab space.

NOTE:
If these airflow values change slowly or predictably (for example, VAV temperature control and/or occ/unoc differences), steps can be taken using PPCL to have the changes sent over the network to update OTHER EXH and OTHER SUP with the new values

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Ventilation – VAV Mode

During VAV operation, the ventilation works as follows:

The occupied supply minimum, OCC SUP MIN is used to ensure that the room receives enough supply air for proper ventilation during the occupied mode. UOC SUP MIN is used to ensure that the room receives enough supply air for proper ventilation during the unoccupied mode. If necessary, the application raises the general exhaust flow to keep the supply flow from dropping below the minimum. See *Calculating Exhaust Flow Setpoint* for more information.

NOTE:
Since Application 6729 places a higher priority on pressurization than it does on ventilation, the currently active supply minimum (OCC SUP MIN or UNOCC SUP MIN) may be overridden to maintain negative pressurization.

Ventilation Setback in VAV Mode

Ventilation setback allows the minimum and maximum flows (air change rate) for each VAV terminal to vary based on occupancy mode (OCC.UNOCC). This allows several options for reducing the ventilation for 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 and disables cooling completely.

Ventilation – Constant Volume Mode

During Constant Volume (CV) operation, the active supply airflow minimum is used to ensure that the room always receives enough supply air for proper ventilation. If necessary, the application raises the general exhaust flow to keep the supply flow from dropping below the minimum. See *Calculating Exhaust Flow Setpoint* for more information.

In CV mode the active supply minimum is the setpoint. The active supply airflow minimum is used to ensure that the room always receives enough supply air for proper ventilation.

During CV operation, the air volume out of the supply box will equal the active supply airflow minimum as long as this is sufficient to maintain proper room pressurization.

NOTE:
Regardless of the operation—VAV or CV temperature control—airflow out of both the supply and general exhaust box will vary as needed in order to maintain proper room pressurization whenever HOOD VOL changes.

AVS Calibration

Calibration of the air velocity transducer(s) is periodically required to maintain accurate air velocity readings. Depending on the value of CAL SETUP, calibration takes place either at fixed time intervals or whenever the application goes into unoccupied mode. When calibration is in progress, CAL AIR equals YES. After calibration, CAL AIR returns to NO.

Application 6729 uses Autozero Modules connected to AUTOZERO DO8. This means that the supply and general exhaust flow control devices do not close during calibration of the transducers.

NOTE:
The LCM does not monitor Fume Hood flow changes during AVS calibration.

Airflow Control

Both supply flow and general-exhaust flow are controlled with a feedback loop to operate the floating control damper motor (either supply or general-exhaust) so that the measured air velocity is maintained at setpoint. To enhance stable flow control, an advanced algorithm is used to calculate a controllable setpoint as the value approaches zero cfm (lps). This feedback loops works as follows:

When the flow is slightly below the setpoint, the LCM opens the floating control damper motor slowly, more and more until the airflow reaches the setpoint, at which time the air damper's position remains constant. If the flow is far below the setpoint, the LCM opens the floating control damper rapidly, more and more until the airflow reaches the setpoint, at which time the air damper's position remains constant. The feedback gains SUP P GAIN and GEX P GAIN are adjusted to tune the flow loops. The sample loop time for the flow loops is fixed at 2.0 seconds. I and D gain are inherent in the system and do not need adjustment.

The application has logic in it that prevents the feedback loops from trying to move the damper motors faster than they can actually go. This helps minimize airflow overshoots and undershoots whenever there is a large airflow setpoint change. The greatest amount of position change that the supply damper motor will be allowed to undergo during each execution of the supply airflow feedback loop is + (100% * flow loop execution speed) / MTR1 TIMING. Likewise, the greatest amount of position change that the general damper motor will be allowed to undergo during each execution of the general airflow feedback loop is + (100% * flow loop execution speed) / MTR2 TIMING. The flow loop execution speed is fixed in this application at 2.0 seconds.

NOTES:
1. Open the door to the controlled space or set VOL DIF STPT must be set to zero while the flow loops are being tuned.
2. The floating control damper motor command points are SUP DMP CMD and GEX DMP CMD. Each floating control damper motor may be set up for normally open or normally closed operation depending on the value of MTR SETUP. See the *Damper Configuration section of the Start-up document* for more information on motor setup.

Floating Control Actuation Auto-correct

In addition to the existing options for floating control actuator full stroke actions; all floating control actuators are provided with additional logic to fully drive open or closed when commanded to 100% or 0%.

Operating Without a Supply or Exhaust

It is possible to run this application without the supply or exhaust if the corresponding flow coefficient is set to zero. When the flow coefficient is zero and the offboard air module is not connected the air velocity sensor will not display a FAIL status and the flow loop will be allowed to run with a flow value of zero. See the *Application Notes* section for more information.

Heating Safety

CAUTION

Do not set UOC SUP MIN or OCC SUP MIN 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, these applications include MODHTG FLO 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 cfms:

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.

Using fpm flow rather than cfm makes the feature less dependent 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.

Room Temperature and Setpoint

The application uses the CTL STPT as the setpoint for the Room Temperature PID Loop. When CTL STPT is not overridden and not being controlled by a field panel, then ROOM STPT and CTL STPT are related to each other as follows:

- If ROOM STPT is greater than RM STPT MAX, then CTL STPT is set equal to RM STPT MAX.
- If ROOM STPT is less than RM STPT MIN, then CTL STPT is set equal to RM STPT MIN.
- If ROOM STPT is less than or equal to RM STPT MAX and greater than or equal to RM STPT MIN, then CTL STPT is set equal to ROOM STPT.

If CTL STPT is overridden or being controlled by a field panel, then RM STPT MIN and/or RM STPT MAX have no effect on CTL STPT.

The application also uses CTL TEMP as the temperature input for the Room Temperature PID Loop. When CTL TEMP is not overridden, then:

CTL TEMP = ROOM TEMP + TEMP OFFSET.

Room Temperature Offset

NOTE:
The Room Temperature Offset feature is optional.

TEMP OFFSET is a user-adjustable offset that will compensate for deviations between the value of ROOM TEMP and the actual room temperature. This corrected value is displayed in CTL TEMP.

CTL TEMP = ROOM TEMP + TEMP OFFSET

Example

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

Room Unit Operation

Stat Supervision

STAT SUPV is a configurable, enumerated point (values are additive). This point tells the controller what kind of room unit is connected and how to respond to a loss of communication between a Series 2200 and 3200 type Room Units, thermistor inputs, and the controller.

The default value for STAT SUPV using Series 2200 or 3200 units must be set to a value greater than 0 (zero), to define temperature sensing and thermistor inputs. See the *Start-up Procedures* for more information.

A value of 1 means that if communication is lost for at least one minute, CTL TEMP will have a status of Failed. A value of 3 means that both CTL TEMP and RM RH will be Failed and a value of 7 means CTL TEMP, RM RH and RM CO_2 will be Failed.

Value	Description
1	Temperature sensing only
2	Relative Humidity (RH) sensing
4	CO_2 sensing
8	To select a 10K (default) or 100K Ω software selectable thermistor on AI 5 (for long board), AI 3 (for short board)
16	To select a 10K (default) or 100K Ω software selectable thermistor

See *Sensors and Transducers Configuration and Sizing* for part numbers and ordering information.

CO2 Monitoring

RM CO2 displays the CO_2 value in units of parts-per-million (PPM). RM CO2 can be unbundled for monitoring purposes.

Room RH

RM RH displays the relative humidity value in percent. RM RH can be unbundled for monitoring purposes.

PPCL STATUS

PPCL STATUS displays LOADED or EMPTY.

LOADED = PPCL programming is present in the controller. A new application number must be assigned (12000 through 12999).

EMPTY = NO PPCL programming is present.

Temperature Control Loops

Room Temperature Loop

The room temperature loop operates in both heating and cooling modes. This loop reads the room temperature control point, CTL TEMP, and then controls the room temperature to the value of CTL STPT by generating TEMP LOOPOUT. TEMP LOOPOUT is then used in the BTU calculations in order to determine the value of the DISCH STPT and, during VAV operation, to determine the value of TEMP CTL VOL. See *BTU Calculations – VAV Mode* and *BTU Calculations – Constant Volume Mode*.

Supply Temperature Loop

The supply temperature loop is a heating loop which operates at all times. The heating loop generates the point VALVE CMD which drives the heating valve in order to maintain the discharge temperature set in DISCH STPT. See *BTU Calculations – VAV Mode* and *BTU Calculations – Constant Volume Mode*.

BTU Calculations

NOTE:
BTU Compensation vs. Room Temperature Sensor (RTS) Control – In applications that do not include BTU Compensation, the heating loop modulates the heating valve directly using RTS control.
In applications that do include BTU Compensation, the heating valve is controlled indirectly in that the BTU Compensator raises or lowers the discharge air temperature setpoint based on the temperature requirements of the room and supply/exhaust airflow quantities, followed by the modulation of the heating valve to meet the discharge setpoint. Although this may seem a slower and more involved method of temperature control, it can actually provide faster and more accurate response because it is a feedforward system instead of a feedback system. With BTU Compensation, some temperature error can be anticipated and corrected in advance.

BTU Calculations – VAV Mode

During VAV operation, the controller adjusts the supply airflow and the supply air temperature setpoint as necessary to maintain CTL TEMP at CTL STPT. The room temperature PID loop calculates the value of TEMP LOOPOUT. The Figure Temperature Control Sequence [→ 23] shows how this value is used to sequence the cooling flow and the supply air temperature setpoint. The loop is tuned by adjusting the values of the feedback gain points that are visible in the database (ROOM P GAIN; ROOM I GAIN), and the sample interval point, LOOP TIME.

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

Example

CTL STPT = 70°F: OCC.UNOCC = OCC

If TEMP LOOPOUT =	and SUP AIR VOL =	then DISCH STPT =	Formula for DISCH STPT: CTL STPT + (TEMP LOOPOUT x 100% ÷ SUP AIR VOL)
10°F	OCC SUP MAX	80°F	70° + (10° x 100% ÷ 100%)
10°F	0.5 ´ OCC SUP MAX	90°F	70° + (10° x 100% ÷ 50%)
–5°F	0.25 ´ OCC SUP MAX	50°F	70° + (–5° x 100% ÷ 25%)
0°F	any flow	70°F	70° + (0° x 100% ÷ x%)

CTL STPT = 70°F: OCC.UNOCC = UNOCC

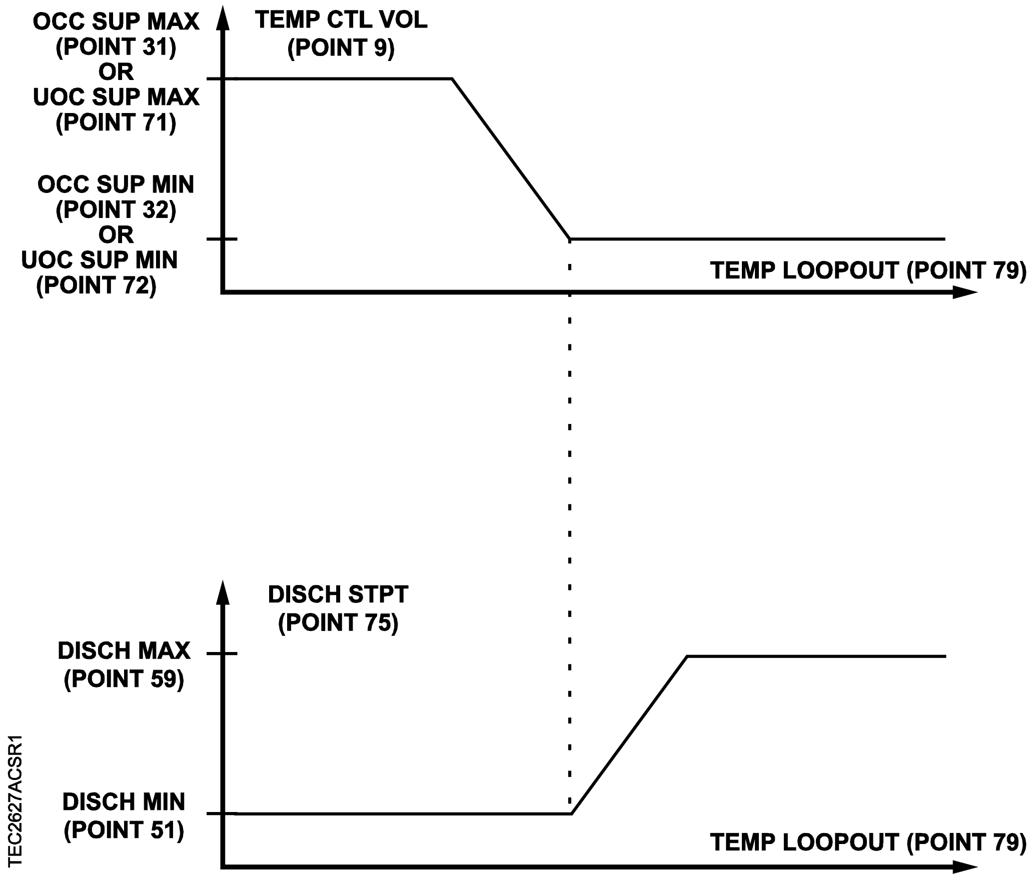
If TEMP LOOPOUT =	and SUP AIR VOL =	then DISCH STPT =	Formula for DISCH STPT: CTL STPT + (TEMP LOOPOUT x 100% ÷ SUP AIR VOL)
10°F	UOC SUP MAX	80°F	70° + (10° x 100% ÷ 100%)
10°F	0.5 ´ UOC SUP MAX	90°F	70° + (10° x 100% ÷ 50%)
–5°F	0.25 ´ UOC SUP MAX	50°F	70° + (–5° x 100% ÷ 25%)
0°F	any flow	70°F	70° + (0° x 100% ÷ x%)

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

This module also limits TEMP LOOPOUT to values that generate supply air temperature setpoints that are less than DISCH MAX.

As the demand for heating decreases (TEMP LOOPOUT drops), DISCH STPT eventually reaches DISCH MIN. If TEMP LOOPOUT drops further, then the value of

TEMP CTL VOL begins to rise from the currently active supply airflow minimum to the currently active supply airflow maximum to provide more cool air to the space. If this value is compatible with correct room pressurization, then it is used as the supply flow setpoint, SUP FLOW STPT. If not, the actual setpoint may be higher or lower than TEMP CTL VOL.



Temperature Control Sequence.

BTU Calculations – Constant Volume Mode

During the Constant Volume Mode, the BTU Compensator operates as follows:

During Constant Volume operation, the controller adjusts the supply air temperature set point as necessary to maintain CTL TEMP at CTL STPT. The room temperature PID loop calculates the value of TEMP LOOPOUT. This value is used to adjust the value of the supply air temperature set point. The loop is tuned by adjusting the values of the feedback gain points, ROOM P GAIN and ROOM I GAIN and the sample interval point, LOOP TIME.

The output of the room temperature loop, TEMP LOOPOUT, reflects the load requirements. The value of TEMP LOOPOUT is a supply air temperature expressed as “degrees above or below the room temperature set point if the supply flow is at 100%”. If the supply flow is less than 100% of the currently active air supply airflow maximum, DISCH STPT is adjusted to an amount greater than TEMP LOOPOUT by a corresponding percentage.

Example

CTL STPT = 70°F: OCC.UNOCC = OCC

If TEMP LOOPOUT =	and SUP AIR VOL =	then DISCH STPT =	Formula for DISCH STPT: CTL STPT + (TEMP LOOPOUT x 100% ÷ SUP AIR VOL)
10°F	OCC SUP MAX	80°F	70° + (10° x 100% ÷ 100%)
10°F	0.5 ´ OCC SUP MAX	90°F	70° + (10° x 100% ÷ 50%)
–5°F	0.25 ´ OCC SUP MAX	50°F	70° + (–5° x 100% ÷ 25%)
0°F	any flow	70°F	70° + (0° x 100% ÷ x%)

CTL STPT = 70°F: OCC.UNOCC = UNOCC

If TEMP LOOPOUT =	and SUP AIR VOL =	then DISCH STPT =	Formula for DISCH STPT: CTL STPT + (TEMP LOOPOUT x 100% ÷ SUP AIR VOL)
10°F	UOC SUP MAX	80°F	70° + (10° x 100% ÷ 100%)
10°F	0.5 ´ UOC SUP MAX	90°F	70° + (10° x 100% ÷ 50%)
–5°F	0.25 ´ UOC SUP MAX	50°F	70° + (–5° x 100% ÷ 25%)
0°F	any flow	70°F	70° + (0° x 100% ÷ x%)

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

This module also limits TEMP LOOPOUT to values that generate supply air temperature set points that are less than DISCH MAX and greater than DISCH MIN.

Alarms

The controller is equipped with ventilation and pressurization alarms. It does not contain temperature alarms. The controller’s alarms are designed to:

- 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.

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

Ventilation Alarm

The alarm level depends on whether the room is occupied or vacant. When the OCC.UNOCC point indicates occupancy, the OC V ALM LVL is used. When the OCC.UNOCC point indicates vacancy, the UC V ALM LVL is used.

NOTE:
In the following discussion, the currently active supply flow minimum is OCC SUP MIN during occupancy and UOC SUP MIN during the unoccupied period. Likewise, the currently active general exhaust box minimum is OCC GEX MIN during occupancy and UOC GEX MIN during the unoccupied period.

The ventilation alarm, VENT ALM, indicates that there is something wrong with the ventilation to the room. VENT ALM has an adjustable alarm level that can vary with the occupancy status of the room. An adjustable delay timer, VENT ALM DEL, prevents nuisance alarms.

VENT ALM is turned on when at least one of the following conditions is true:

- The supply flow to the room, TOTL SUPPLY, stays below the alarm level, for a time at least equal to VENT ALM DEL.
- SUP AIR VOL stays below the currently active supply minimum, for a time at least equal to VENT ALM DEL.
- GEX AIR VOL stays below the currently active general exhaust box minimum, for a time at least equal to VENT ALM DEL.

It is turned off only when all of the following conditions are true:

- The TOTL SUPPLY stays above the alarm level, for a time at least equal to the alarm delay.
- SUP AIR VOL stays above the currently active supply minimum, for a time at least equal to VENT ALM DEL.
- GEX AIR VOL stays above the currently active general exhaust box minimum, for a time at least equal to VENT ALM DEL.

If the current conditions will neither turn on the ventilation alarm nor shut off the alarm, then VENT ALM will keep its current value.

Setting the alarm level to zero means the ventilation alarm will not turn on just because of a low value for TOTL SUPPLY.

Even if the alarm level is set to zero, the ventilation alarm will still turn on if:

- SUP AIR VOL stays below the currently active supply minimum, for a time at least equal to VENT ALM DEL.

and/or

- GEX AIR VOL stays below the currently active general exhaust box minimum, for a time at least equal to VENT ALM DEL.

Pressurization Alarm

The pressurization alarm, VOL DIF ALM indicates that the difference between supply and exhaust flow is not what it should be, or that the controller can't calculate the flow difference, VOL DIFFRNC, because it has lost a flow signal. The *Failure Mode Sequence* figure lists reasons why VOL DIFFRNC may fail.

The pressurization alarm point is turned on when at least one of the following conditions occurs:

- VOL DIFFRNC has a status of Failed.
- VOL DIFFRNC stays below VOL DIF STPT – DIF ALM DBD for a time at least equal to DIF ALM DEL.

- VOL DIFFRNC stays above VOL DIF STPT + DIF ALM DBD for a time at least equal to DIF ALM DEL.

	⚠ WARNING
⚠	**To ensure that VOL DIF ALM turns on before the pressure in the room changes sign, DIF ALM DBD must be less than the absolute value of VOL DIF STPT.** For example, if negative pressure is desired and VOL DIF STPT equals 70 cfm and DIF ALM DBD is 200 cfm, then the room could go positive by almost 130 cfm without the pressure alarm turning on. In this case, if you want the alarm to turn on before the room changes sign, then you must set DIF ALM DBD to be less than 70 cfm.

The pressurization alarm point is turned off when all of the following conditions occur:

- VOL DIFFRNC has a status of Normal.
- VOL DIFFRNC stays above VOL DIF STPT – DIF ALM DBD for a time at least equal to DIF ALM DEL.
- VOL DIFFRNC stays below VOL DIF STPT + DIF ALM DBD, for a time at least equal to DIF ALM DEL.

DIF ALM DBD and DIF ALM DEL can be configured to prevent nuisance alarms.

Local Annunciation

ALARM ENA is an analog point whose value determines whether or not a particular alarm activates ALARM DO7.

For ALARM ENA, the terms enabled and not enabled do not mean that a particular alarm is enabled or not. It means whether or not a particular alarm will or will not activate ALARM DO7. For example, if ALARM ENA is set to **1** (Vent Alarm Enabled) and a ventilation alarm occurs, then both VENT ALM and ALARM DO7 will turn on. However, if ALARM ENA is not Vent Alarm Enabled and a ventilation alarm occurs, VENT ALM will turn on, but ALARM DO7 will not.

ALARM ENA Values.

	ALARM ENA
0 default	No alarms are enabled.
1	Vent Alarm is enabled.
2	Alarm Switch is enabled.
4	Dif Alarm is enabled.
5	Vent Alarm and Dif Alarm are enabled
6	Alarm Switch and Dif Alarm are enabled
7	Vent Alarm, Alarm Switch, and Dif Alarm are all enabled

NOTE:
If ALARM ENA is set greater than 7, it will default to 0.

ALM ENA is additive. For example, if ALM ENA equals 5, then either a ventilation or a pressurization alarm would activate ALARM DO7, but the alarm switch would not.

ALARM DO7 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:

- Pressurization alarm point, VOL DIF ALM
  (To connect VOL DIF ALM to DO 7, set ALM ENA to a value that enables the pressure alarm (4, 5, 6 or 7).)
- Ventilation alarm point, VENT ALM
  (To connect VENT ALM to DO 7, set ALM ENA to a value that enables the ventilation alarm (1, 3, 5 or 7).)
- DI connected to a switch in the room, ALM SWIT DI6
  (To connect ALM SWIT DI6 to DO 7, set ALM ENA to a value that enables the Alarm Switch (2, 3, 6 or 7).)
- Network alarm point, NET ALM CMD
  (NET ALM CMD is always enabled for local annunciation.)

ALARM DO7 turns ON if any of the enabled alarm sources indicate an alarm. ALARM DO7 cannot be overridden.

NET ALM CMD can be commanded with the workstation 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.

Network Annunciation

If the LCM is connected to a field panel, alarms can be reported using the workstation software, or by using a printer that is set up in a building manager's office to receive alarms. Points in the controller must be entered in the field panel's point database (referred to as unbundling) and defined as alarmable. If, for example, the room pressurization alarm (VOL DIF ALM) is unbundled in a field panel and a pressurization alarm is triggered, an alarm will be annunciated across the network.

Damper Position on Return from Power Failure

On a return from power failure, the damper-command DOs (DOs1 through 4) remain OFF for 5 seconds prior to resuming control. Because of this it is recommended that the Supply Damper Motor Setup be set to Enabled (normally closed) for rooms where negative or neutral pressurization is required and Enabled and Reversed (normally open, where the actuator is retracted) for positively pressurized rooms. Likewise, it is recommended that the General Exhaust Damper Motor Setup be set to Enabled and Reversed for rooms where negative or neutral pressurization is required and Enabled for positively pressurized rooms. The default for the Motor direction is direct (not reversed).

Use the values in the table to determine the value for MTR SETUP. The values are additive. For example, if you want to have Motor 1 (DOs 1 and 2) enabled, Motor 2 (DOs 3 and 4) enabled and reversed, you would set MTR SETUP equal to 13. (This is because the Motor 1 enable value is 1, the Motor 2 enabled and reversed value is 12, 1+12=13.)

	Not Used	Enabled	Enabled and Reversed
Motor 1 (supply damper) (DO 1 and DO 2)	0	1	3
Motor 2 (exhaust damper) (DO 3 and DO 4)	0	4	12

Operation of AVS FAILMODE

AVS FAILMODE is an enumerated point that describes how the supply Damper and the general exhaust Damper will respond if one or both Air Velocity Sensors (AVS) fail. It can handle positively pressurized rooms as well as negatively pressurized rooms.

The default value of AVS FAILMODE is **0**. This default causes both the supply and general exhaust to hold their current position when an AVS fails. Open Supply, Open Exhaust and Close Supply, Close Exhaust are not defined AVS FAILMODE states.

AVS failure and AVS FAILMODE values.	
	AVS FAILMODE
0 (default)	Hold Supply, Hold General Exhaust
1	Hold Supply, Open General Exhaust
2	Hold Supply, Close General Exhaust
3	Open Supply, Hold General Exhaust
4	Close Supply, Hold General Exhaust
5	Close Supply, Open General Exhaust
6	Open Supply, Close General Exhaust
7	VENTILATION
8	PRESSURE

AVS FAILMODE values are not additive. For example, if AVS FAILMODE equals **3**, this means to open the supply Damper and hold the general exhaust Damper if an AVS fails.

The first seven values of AVS FAILMODE (0 through 6) describe specific actions taken when an AVS fails. For example, if AVS FAILMODE equals **5**, then whenever an AVS fails, the supply Damper will always close and the general exhaust Damper will always open.

The last two values of AVS FAILMODE do not describe specific actions; that is, when an AVS fails, the supply and general exhaust will react differently depending on the circumstances.

If AVS FAILMODE equals **7**, the supply Damper will hold. The general exhaust Damper will also hold if a fume hood is present (that is, if MAX HOOD VOL > 0). If a fume hood is absent, then the general exhaust Damper will close if the room is being positively pressurized and open if the room is neutral or negatively pressurized (that is if VOL DIF STPT is equal to or greater than 0).

If AVS FAILMODE equals **8**, the supply Damper will open if the room is being positively pressurized and close if the room is neutral or negatively pressurized. The general exhaust Damper will hold if a fume hood is present. If a fume hood is absent, the general exhaust Damper will close if the room is being positively pressurized and open if the room is neutral or negatively pressurized.

NOTE:
If AVS FAILMODE is set greater than 8, it will default to 0.

Fail Mode Operation

If one of the controller's accessories (inputs) fails, a failure mode sequence is initiated that leads to the failure of VOL DIFFRNC. The figure shows the order in which points will fail.

Air Velocity Sensors – If one or both of the LCM air sensor signals (SUP AIR VOL, GEX AIR VOL) are out of range (for example, improper wiring to/from the Offboard Air Module(s), tubing not connected or connected backward), then the actions of the supply and general exhaust Dampers will depend on the value of AVS FAILMODE. Once GEX AIR VOL and SUP AIR VOL are normal, the supply and general exhaust Dampers return to normal operation.

See *Operation of AVS FAILMODE* for more information.

NOTE:
If desired, the LCM can be used without any fume hoods attached. In this case, MAX HOOD VOL should be set to 0 cfm to disable the alarming that would occur if the fume hood flow input drops below 1 Vdc.

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

Electronic Actuator – If the actuator fails, typically, flow control is lost and alarms are triggered.
Upon loss of power or control signal to the actuator, it will move to its fail-safe position.

Room Temperature Setpoint Dial – If the room temperature setpoint dial fails while CTL STPT is not overridden or is not being adjusted by a field panel, then ROOM STPT and CTL STPT both display as "Failed" and the last known good value of ROOM STPT is used to determine the current value of CTL STPT. The rest of the room temperature PID loop is unaffected by the setpoint dial failure. If ROOM STPT is unbundled in a field panel and defined as alarmable, an alarm will be annunciated across the network.

If the room temperature sensor fails while CTL STPT is overridden or is being adjusted by a field panel, then ROOM STPT displays as "Failed". CTL STPT will continue to be overridden or adjusted by the field panel and room temperature control proceeds as normal. CTL STPT will continue to have a status of NORMAL. If ROOM STPT is unbundled in a field panel and defined as alarmable, an alarm will be annunciated across the network.

NOTE:
When using a Series 2000 Room Thermostat:
During **unoccupied mode**, you cannot change the Room Setpoint using a Siemens Building Technologies Series 2000 thermostat. Any attempt to change Room Setpoints during unoccupied mode using a Series 2000 stat will be ignored.
During **occupied mode**, the Room Setpoint can be changed using a Series 2000 stat, but if it is, then the controller initial values should be uploaded to the field panel. Otherwise the LCM will not keep the adjusted Room Setpoint value upon return from a power failure.

Discharge Temperature Sensor – Temperature control is lost and BTU calculations cease if the discharge temperature analog input point, DISCH TEMP fails. This is because the temperature loop stops updating and the discharge loop stops operating.

Application Notes

Operating Without a General Exhaust Box

This application can operate without a general exhaust box. If a general exhaust box is not being controlled, set TRACK METHOD to FLOW and set the following points:

- TRACK MODE to 0.
  A value of 0 = STE (supply tracks exhaust) Flow Tracking, which should be used for both the occupied and unoccupied modes.
- GEX FLO COEF to 0.
  When GEX FLO COEF equals 0, GEX AIR VOL will always read 0, but will never show as Failed.
- OCC GEX MIN and UOC GEX MIN to 0.
  If these two points are not set to 0, GEX AIR VOL—which will read 0 since GEX FLO COEF was set to 0—will be less than the general exhaust box minimum, resulting in a false ventilation alarm.
- VOLUME STATE
  The application varies the supply airflow as the fume hood flow changes, in order to maintain the proper room pressurization. The supply airflow is not varied for cooling purposes; all temperature control is done by the reheat valve. Because of this, VOLUME STATE should be set to 0 to prevent the BTU Compensator from trying to use the supply airflow for cooling.

Because of this, START should be set to 100 to allow the reheat valve to be controlled by the full range of TEMP LOOPOUT and to prevent the room temperature PID Loop from winding up.

Operating Without a Supply Box

This application can operate without a supply box. If a supply box is not being controlled, set TRACK METHOD to FLOW and set the following points:

- TRACK MODE to 3.
  (a value of 3 = ETS Flow Tracking, which should be used for both the occupied and unoccupied modes).
- SUP FLO COEF to 0.
  When SUP FLO COEF equals 0, SUP AIR VOL will always read 0, but will never show as Failed.

- OCC SUP MIN and UOC SUP MIN to 0.
  If these two points are not set to 0, SUP AIR VOL—which will read 0 since SUP FLO COEF was set to 0—will be less than the supply box minimum, resulting in a false ventilation alarm.

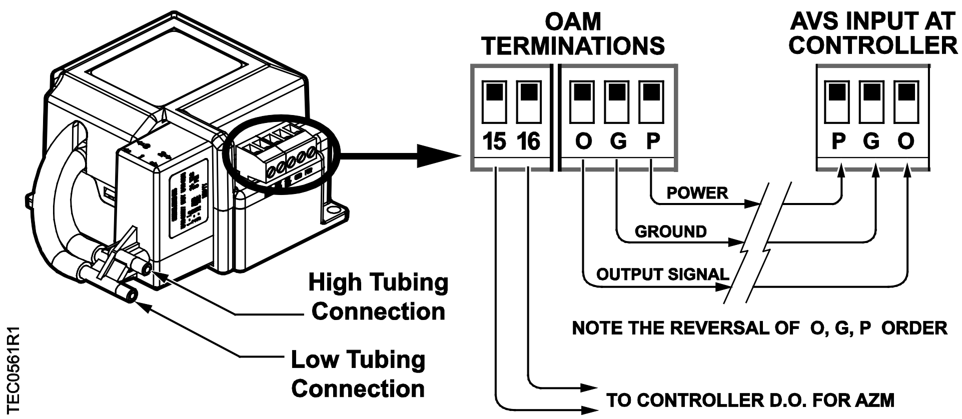
This setup is useful when the room has a constant source of supply air from other equipment or sources not connected to the controller. If you enter this constant supply air volume value into OTHER SUP, the application will vary the general exhaust airflow as the fume hood flow changes, in order to maintain the proper room pressurization.

Since all temperature control will be done by the reheat valve, VOLUME STATE should be set to 0 and both OCC SUP MAX and UOC SUP MAX should be set equal to OTHER SUP. This will prevent the BTU Compensator from trying to use the supply airflow as a source of cooling.

Wiring Diagrams

CAUTION

Controllers will be damaged/destroyed if offboard air module(s) are not wired correctly and power is applied.



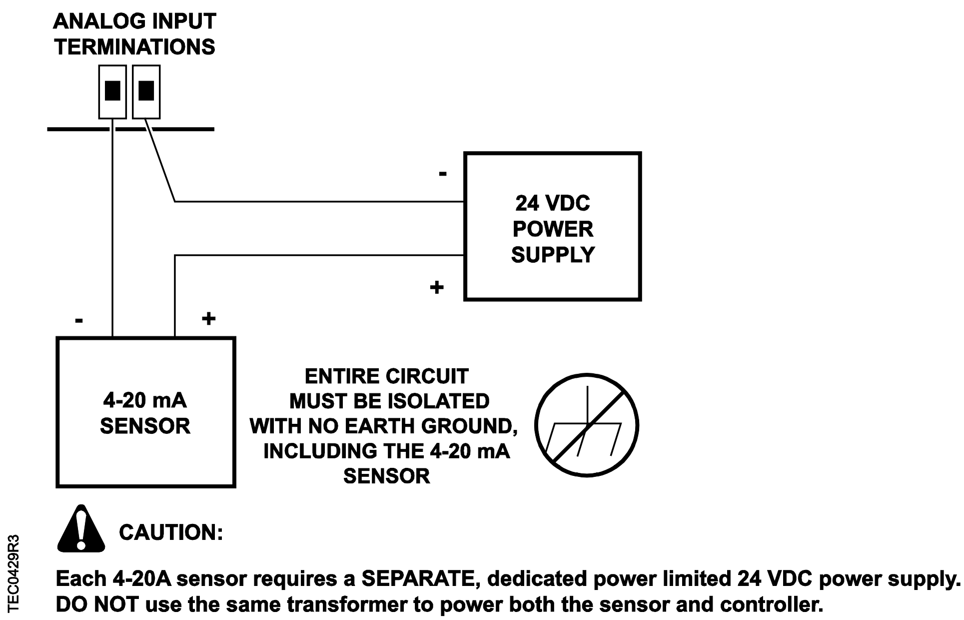
Offboard Air Module Wiring.

CAUTION

The LCM-OAVS has two terminal blocks with terminations numbered identically (terminations 1 through 16). DO NOT get these mixed up with each other.

If the LCM-OAVS is not connected as shown, it is not resistant to electrical surges. It is also susceptible to interference from other equipment.

	CAUTION
	A separate power supply is required if a 4-20 mA sensor is used. Failure to follow wiring precautions will result in equipment damage.

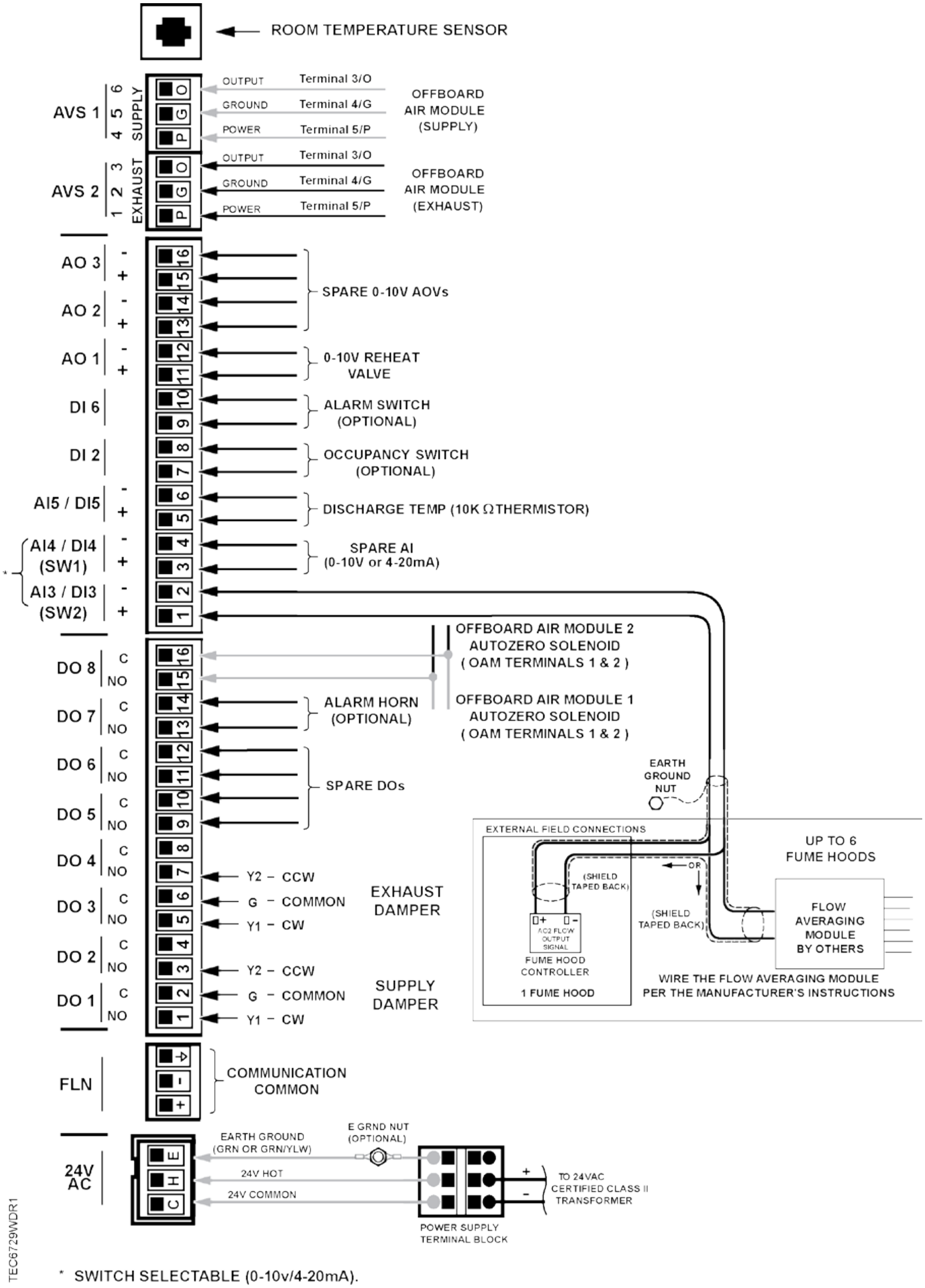


Wiring for AI with a 4 to 20mA Sensor.

NOTE:
If the voltage/current switch is set to current and a 4 to 20mA sensor is connected to an AI, then special wiring requirements must be followed.

	CAUTION
	The controller's DOs control 24 Vac loads only. The maximum rating is 12 VA for each DO. An external interposing relay is required for any of the following: • VA requirements higher than the maximum • 110 or 220 Vac requirements • DC power requirements • Separate transformers used to power the load (for example part number 540-147, Terminal Equipment Controller Relay Module)

NOTE:
Thermistor inputs are 10K (default) or 100K software selectable.



BACnet LCM-OAVS Slow Actuation Damper Supply/Damper Exhaust with BTU Compensation – Application 6729 Wiring Diagram.

Point Database Application 6729

Object Type	Object Number (Point Number)	Object Name Descriptor	Factory Default (SI Units)	Eng Units (SI Units)	Range	Active Text	Inactive Text
AO	1	CTLR ADDRESS	99	--	0-255	--	--
AO	2	APPLICATION	6797	--	0-32767	--	--
AO	3	TEMP OFFSET	0.0 (0.0)	DEG F (DEG C)	-31.75-32	--	--
AO	{04}	ROOM TEMP	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
AO	5	OCC DIF STPT	400 (188.7599)	CFM (LPS)	-8000-8380	--	--
AO	6	UOC DIF STPT	400 (188.7599)	CFM (LPS)	-8000-8380	--	--
AO	7	RM STPT MIN	55.0 (12.80888)	DEG F (DEG C)	48-111.75	--	--
AO	8	RM STPT MAX	90.0 (32.40888)	DEG F (DEG C)	48-111.75	--	--
AO	{09}	TEMP CTL VOL	0 (0.0)	CFM (LPS)	0-32764	--	--
AO	12	OCC ENA	0	--	0-255	--	--
AO	{13}	ROOM STPT	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
AI	{14}	AI 4	0	PCT	0-102	--	--
AI	{15}	HOOD SIG AI3	0	VOLTS	0-10.2	--	--
AO	16	VENT ALM DEL	30	SEC	0-255	--	--
AO	17	ALARM ENA	0	--	0-255	--	--
BO	{19}	OCC BUTTON	OFF	--	Binary	ON	OFF
BO	{21}	OCC.UNOCC	OCC	--	Binary	UNOCC	OCC
BO	{22}	VOL DIF ALM	OFF	--	Binary	ON	OFF
BO	{23}	NET ALM CMD	OFF	--	Binary	ON	OFF
BI	{24}	OCC SWIT DI2	OFF	--	Binary	ON	OFF
BO	{25}	BUTTON CMD	OCC	--	Binary	UNOCC	OCC
AO	26	GEX P GAIN	0.015	--	0-4.095	--	--
BI	{27}	ALM SWIT DI6	OFF	--	Binary	ON	OFF
AO	28	TRACK MODE	0	--	0-255	--	--
BO	{29}	NET OCC CMD	OCC	--	Binary	UNOCC	OCC
AI	{30}	GEX AIR VOL	0 (0.0)	CFM (LPS)	0-32764	--	--
AO	{31}	OCC SUP MAX	3400 (1604.46)	CFM (LPS)	0-32764	--	--

Object Type	Object Number (Point Number)	Object Name Descriptor	Factory Default (SI Units)	Eng Units (SI Units)	Range	Active Text	Inactive Text
AO	{32}	OCC SUP MIN	340 (160.446)	CFM (LPS)	0-32764	--	--
AO	{33}	OCC GEX MAX	1100 (519.09)	CFM (LPS)	0-32764	--	--
AO	{34}	OCC GEX MIN	600 (283.14)	CFM (LPS)	0-32764	--	--
AI	{35}	SUP AIR VOL	0 (0.0)	CFM (LPS)	0-32764	--	--
AO	36	SUP FLO COEF	0.73	--	0-2.55	--	--
AO	{37}	REHEAT AO1	0	VOLTS	0-10.23	--	--
AO	38	DIF ALM DBD	100 (47.19)	CFM (LPS)	0-4092	--	--
AO	39	DIF ALM DEL	30	SEC	0-255	--	--
AO	40	AVS FAILMODE	0	--	0-255	--	--
BO	{41}	DO 1	OFF	--	Binary	ON	OFF
BO	{42}	DO 2	OFF	--	Binary	ON	OFF
BO	{43}	DO 3	OFF	--	Binary	ON	OFF
BO	{44}	DO 4	OFF	--	Binary	ON	OFF
BO	45	TRACK METHOD	FLOW	--	Binary	FLOW	STPT
BO	{46}	DO 5	OFF	--	Binary	ON	OFF
BO	{47}	ALARM DO7	OFF	--	Binary	ON	OFF
BO	{48}	AUTOZERO DO8	OFF	--	Binary	ON	OFF
AO	{49}	VALVE CMD	0	PCT	0-102	--	--
AO	{50}	GEX DMP CMD	0	PCT	0-102	--	--
AO	51	DISCH MIN	55.0 (12.856)	DEG F (DEG C)	37.5-165	--	--
AO	52	MAX HOOD VOL	0 (0.0)	CFM (LPS)	0-32764	--	--
AI	{53}	TOTL EXHAUST	0 (0.0)	CFM (LPS)	0-32764	--	--
AO	54	GEX FLO COEF	0.73	--	0-2.55	--	--
AO	{55}	AO2	0	VOLTS	0-10.23	--	--
AO	{56}	AO3	0	VOLTS	0-10.23	--	--
AO	57	VALVE CLOSED	10	VOLTS	0-10.23	--	--
AO	58	VALVE OPEN	0	VOLTS	0-10.23	--	--
AO	59	DISCH MAX	120.0 (49.256)	DEG F (DEG C)	37.5-165	--	--
AO	60	GEXDUCT AREA	1.0 (0.09292)	SQ. FT (SQ M)	0-6.375	--	--
AO	{61}	OTHER SUP	0 (0.0)	CFM (	0-16380	--	--

Object Type	Object Number (Point Number)	Object Name Descriptor	Factory Default (SI Units)	Eng Units (SI Units)	Range	Active Text	Inactive Text
				LPS)			
AO	{62}	SUP DMP CMD	0	PCT	0-102	--	--
AO	63	ROOM P GAIN	2	--	0-1638.35	--	--
AO	64	ROOM I GAIN	0.001	--	0-3.2767	--	--
AO	{67}	UOC GEX MAX	1000 (471.9)	CFM (LPS)	0-32764	--	--
AO	{68}	UOC GEX MIN	500 (235.95)	CFM (LPS)	0-32764	--	--
AI	{69}	TOTL SUPPLY	0 (0.0)	CFM (LPS)	0-32764	--	--
AO	70	SUP P GAIN	0.015	--	0-4.095	--	--
AO	{71}	UOC SUP MAX	2200 (1038.18)	CFM (LPS)	0-32764	--	--
AO	{72}	UOC SUP MIN	220 (103.818)	CFM (LPS)	0-32764	--	--
AO	{73}	CTL STPT	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
AI	{74}	HOOD VOL	0 (0.0)	CFM (LPS)	0-32764	--	--
AO	{75}	DISCH STPT	60.0 (15.656)	DEG F (DEG C)	37.5-165	--	--
AO	76	VOLUME STATE	1	--	0-255	--	--
BO	{77}	DO 6	OFF	--	Binary	ON	OFF
AO	{78}	CTL TEMP	74.0 (23.44888)	DEG F (DEG C)	48-111.75	--	--
AO	{79}	TEMP LOOPOUT	0.0 (0.0)	DEG F (DEG C)	-100-104.7	--	--
AO	80	DISCH P GAIN	2.0 (3.6)	--	0-1638.35	--	--
AO	81	DISCH I GAIN	0.02 (0.036)	--	0-6.5534	--	--
AI	{83}	VOL DIFFRNC	0 (-0.0001)	CFM (LPS)	-8000-8380	--	--
AI	{84}	DISCH TEMP	74.0 (23.496)	DEG F (DEG C)	37.5-165	--	--
AO	{85}	GEX FLO STPT	0 (0.0)	CFM (LPS)	0-16380	--	--
AO	86	FAIL LIMIT	40 (18.876)	CFM (LPS)	0-32764	--	--
AO	{88}	VOL DIF STPT	400 (188.7599)	CFM (LPS)	-8000-8380	--	--
AO	{89}	OTHER EXH	0 (0.0)	CFM (LPS)	0-16380	--	--
AO	90	OC V ALM LVL	0 (0.0)	CFM (	0-32764	--	--

Object Type	Object Number (Point Number)	Object Name Descriptor	Factory Default (SI Units)	Eng Units (SI Units)	Range	Active Text	Inactive Text
				LPS)			
AO	91	UC V ALM LVL	0 (0.0)	CFM (LPS)	0-32764	--	--
BO	{92}	VENT ALM	OFF	--	Binary	ON	OFF
AO	{93}	SUP FLO STPT	0 (0.0)	CFM (LPS)	0-16380	--	--
BO	{94}	CAL AIR	NO	--	Binary	YES	NO
AO	95	CAL SETUP	4	--	0-255	--	--
AO	96	CAL TIMER	12	HRS	0-255	--	--
AO	97	SUPDUCT AREA	1.0 (0.09292)	SQ. FT (SQ M)	0-6.375	--	--
AO	98	LOOP TIME	5	SEC	0-255	--	--
AO	{99}	ERROR STATUS	0	--	0-255	--	--
AO	{104}	STAT SUPV	0	--	0-255	--	--
AO	106	MODHTG FLO	300 (1.524)	FPM (MPS)	0-4095	--	--
AO	107	DO DIR.REV	0	--	0-255	--	--
AO	{108}	RM RH	50	PCT	0-102	--	--
AO	109	FAIL TIME	60	SEC	0-510	--	--
AO	110	MTR SETUP	0	--	0-255	--	--
AO	{111}	SUP DMP POS	0	PCT	0-102	--	--
AO	112	MTR1 TIMING	95	SEC	0-511	--	--
AO	113	MTR1 ROT ANG	90	--	0-255	--	--
AO	{114}	GEX DMP POS	0	PCT	0-102	--	--
AO	115	MTR2 TIMING	95	SEC	0-511	--	--
AO	116	MTR2 ROT ANG	90	--	0-255	--	--
AO	117	MINHOODVOLTS	1	VOLTS	0-10.2	--	--
AO	{118}	RM CO2	1000	PPM	0-8191	--	--
AO	125	SUP MAX RATE	0 (0.0)	FPM (MPS)	0-4095	--	--
AO	126	GEX MAX RATE	0 (0.0)	FPM (MPS)	0-4095	--	--
BO	{127}	PPCL STATE	EMPTY	--	Binary	LOADED	EMPTY

1) Object Types are; Analog Input (AI), Analog Output (AO), Binary Input (BI) and Binary Output (BO).

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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