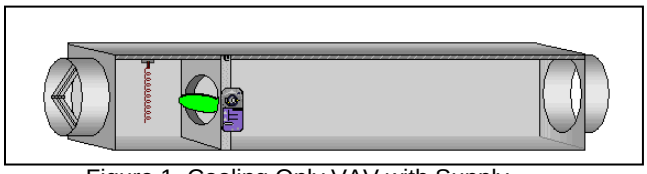


Figure 1. Cooling Only VAV with Supply

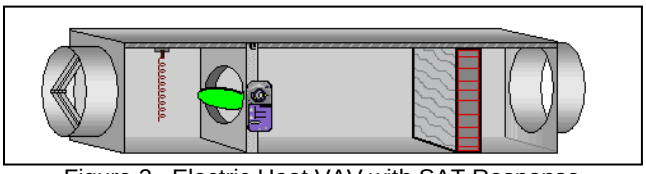


Figure 2. Electric Heat VAV with SAT Response
Air Temperature (SAT) Response

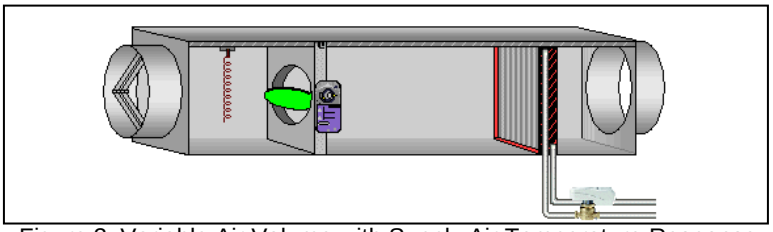


Figure 3. Variable Air Volume with Supply Air Temperature Response
For cooling only and electric or hot water reheat terminal units

Features

- LONMARK compliant with space-comfort controller functional profile (8502).
- Advanced thermal control sequence enhances comfort. Adjusts air flow as supply air temperature changes, maintaining cooling effect and eliminating disturbance to room temperature.
- Enhances operation of supply air temperature optimization strategies.
- Alleviates comfort problems associated with cycling DX systems.
- PID control minimizes offset and maintains tighter set point control.
- Standby mode enables energy savings during occupied hours for rooms that are not always used. When occupants are sensed the controller quickly responds to maintain comfort levels.
- Diversity control, through a demand limit input, maximizes comfort by maintaining even air distribution to all zones during morning warm-up or pre-cool operation.
- Downloadable applications provide flexibility to meet ever-changing needs.
- Conforms to the LONMARK interoperability guidelines, enabling information sharing with LONMARK products from other vendors.

Sequence of Operation

This application example describes the operation of the Predator VAV with Supply Air Temperature (SAT) Response with optional lighting control. The Predator monitors the room temperature, room setpoint, room override switch, and supply air flow. Similar to a standard VAV terminal, the controller adjusts the supply air flow to match the cooling effect with the load in the space. Additionally, when the supply air temperature changes, the controller applies the recognized heat transfer equation and adjusts the supply air flow directly to maintain the same cooling effect in the room.

If lighting control is installed, the zone will be illuminated according to the current operation mode of the Predator controller.

Occupied Control

Cooling Mode

When the supply air temperature is stable, the Predator Controller modulates the terminal box damper to regulate airflow between the “Cooling Flow Maximum” and “Cooling Flow Minimum” setpoints as required to maintain the “Occupied Cooling Setpoint” space temperature. Control is based on the occupied cooling setpoint and cooling demand PID loop, with the zone temperature supplied by the Predator Room Temperature Sensor. When the supply air temperature changes, the Predator immediately adjusts the supply air flow to maintain a constant cooling effect. This prevents disturbances to thermal comfort in the occupied space.

Lighting is on.

Heating Mode

The Predator Controller modulates the terminal box damper to regulate airflow between the “Heating Flow Maximum” and “Heating Flow Minimum” setpoints as required to maintain the “Occupied Heating Setpoint” space temperature. The reheat valve modulates as required to control the zone temperature. Control is based on the occupied heating setpoint and heating demand PID loop, with the zone temperature supplied by the Predator Room Temperature Sensor.

Lighting is on.

Standby Control

Spaces that are not occupied on a routine basis (conference rooms, etc.) can be placed into standby mode during normally scheduled occupancy times. This will save energy while still ensuring the comfort of the occupants. In Standby mode, the Predator Controller modulates the terminal box damper to regulate airflow between the “Cooling Flow Maximum” and “Standby Flow Minimum” values as required to maintain the “Standby Cooling Setpoint”. Once occupancy is detected, control reverts to the Occupied Mode as detailed above.

Lighting is off.

Unoccupied Control

The Predator Controller modulates the terminal box damper as required to maintain the temperature setpoint. At low load, the flow will be controlled to the “Unoccupied Flow Minimum”. When this value is set to a non-zero number and the AHU is off, the damper will open in an attempt to achieve the minimum flow setpoint. If the value is set to zero, the controller will drive towards the closed position.

The “Unoccupied Cooling Setpoint” value can be programmed to maintain a maximum space temperature. When the unoccupied cooling setpoint is used, the Predator Controller modulates the terminal box damper to regulate airflow between the “Cooling Flow Maximum” and “Unoccupied Flow Minimum” values to maintain the unoccupied cooling setpoint space temperature. If cooling is not needed, the controller will maintain airflow at the unoccupied flow minimum setpoint.

Lighting is off.

Bypass Mode

If the Predator Controller is in the Unoccupied or Standby mode, it can be put into Bypass mode for a configurable period of time (“Bypass Time”). The placement of the controller into Bypass mode is triggered via the bypass button on the room sensor or system command. Once placed into Bypass mode the Predator Controller will operate as detailed in the occupied section above.

Morning Warmup

The Predator Controller modulates the terminal box damper to regulate airflow between the maximum and heating minimum flow values as required to maintain the occupied heating temperature setpoint. Warm air must be supplied from a central AHU to the terminal unit for proper operation.

Systems that have been sized for normal operation may sometimes fall below the total maximum flow needs during morning warm-up (or pre-cool) operation. The demand limit input provides for stable start up. Selection of the appropriate percentage will allow all boxes to provide air flow to the space in equal proportions, thus eliminating starvation of zones.

Lighting is off.

Night Purge

The Predator Controller modulates the terminal box damper to regulate airflow between the occupied cooling maximum and minimum flow values as required to maintain the occupied cooling temperature setpoint. During night purge the AHU’s cooling is disabled and cooler outside air is used to pre-cool the space.

Lighting is off.

Test

In the test mode, the controller will close the damper fully and recalibrate the airflow sensor. Once commanded to test mode, the controller remains in this mode (even if it is commanded to another mode) until the recalibration is complete. This process takes approximately two times the damper travel time as determined by the value of “UCPT_FlowDmprMtr” (see table 2).

Off

In this mode, the damper will close fully.

Lighting is off.

Control Sequence Diagram

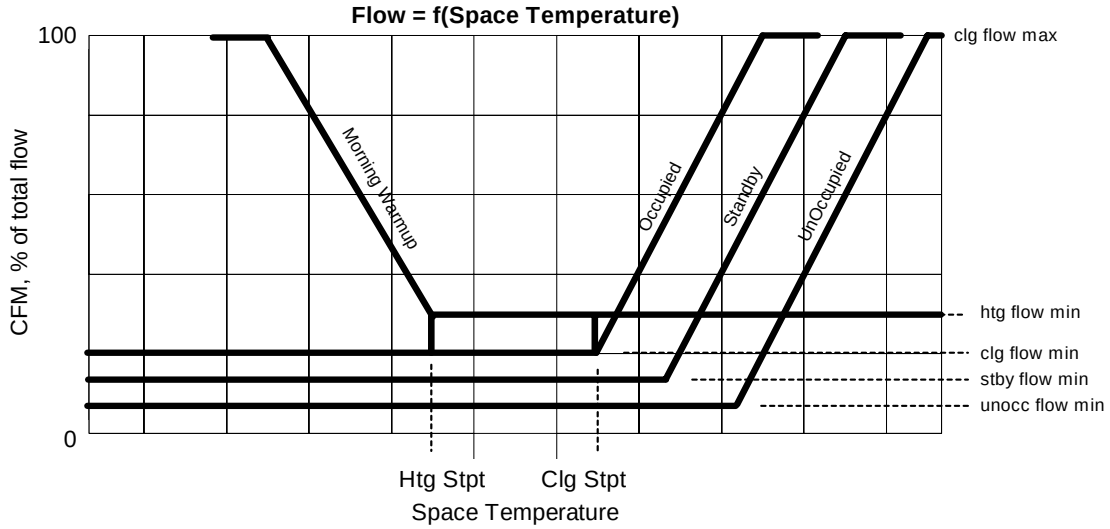


Figure 2. Control Sequence Diagram (Airflow).

Note: In the sequence of control section above there are numerous instances of text shown in quotes such as “Cooling Flow Maximum”. This is an indication of a configurable setting and you will find the text enclosed by the quotes in the column headed by the word “element” in the configuration table section of this document.

Occupancy Control

Occupancy Mode

The Predator controller defaults to the occupied mode of operation. Upon receipt of the 4-state LonMark occupancy override (nviOccManCmd), the controller will switch to the appropriate mode of operation. A brief summary of each mode follows below:

LonMark Occupancy State	Mode	Description
(0)	Occupied	Controller in Occupied mode and uses Occupied setpoints.
(1)	Unoccupied	Controller in Unoccupied mode and uses Unoccupied setpoints.
(2)	Bypass	Controller temporarily in Occupied mode and uses Occupied setpoints until the Bypass Time elapses. Controller then returns to previous occupancy state.
(3)	Standby	Controller in Standby mode and uses Standby setpoints.

If a LonMark compatible occupancy schedule input (nviOccSchedule) is used, the controller will use the modes and setpoints as shown above. This will allow the

Predator controller to utilize the scheduling properties of other devices on the LonTalk Network.

The occupancy signal could also come from a time clock, wall switch, or occupancy sensor physically wired to one of the inputs of the Predator controller. This occupancy signal could then be shared with other controllers via the Lon Network.

Bypass Mode

If enabled (through UCPT StatSwitchEn) and the Bypass button on the Predator room sensor is pressed, the controller will be placed in the Bypass mode for the amount of time specified by the controller's configuration parameters (default 60 min.). If the button is subsequently pressed again prior to the expiration of the Bypass time, the timer will reset to the initial value and resume counting down.

Priorities of Occupancy Control

Occupancy overrides are prioritized as follows (listed from highest to lowest):

- Wall Switch Input – Typically a physically operated switch used by room occupants.
- Operator Command – A valid occupied command sent from system operator.
- Bypass Button – Button on Talon room sensor, also utilized by room occupants.
- Occupancy Sensor – Locally connected or signal via the network.
- Occupancy Schedule – Sent from network.

Optional Functions

Room Temperature Sensor Sharing

The Predator Room Temperature Sensor may share its value with other controllers on the LonTalk network via a network binding. This is most commonly done when multiple terminal units serve a room or area.

Duct Temperature Sensor

An optional duct temperature sensor may be connected to the Predator controller for the purpose of monitoring the source temperature. This is useful for functions such as morning warm-up, when you want to be sure warm air is being provided to the box, or as an aid in troubleshooting space comfort problems.

Wall Switch

An optional maintained contact wall switch may be used to control the occupancy mode of a room. Rooms with variable occupancy (conference rooms, etc.) can use this device to control occupancy and the lights with one switch.

Occupancy Sensor

Another useful option is to utilize an occupancy sensor to control the occupancy mode of the Predator controller. The function of this device would be similar to the wall switch above, but an occupant entering the room would not perform any manual action to put the room into occupied mode. If the schedule is in the occupied mode and the occupancy sensor does not detect people in the room, the room will go into the standby mode enabling energy savings while maintaining occupant comfort.

Lighting Control Relay

The Predator controller can selectively operate with maintained contacts or pulsed contacts to switch lighting control relays. This is useful in those instances where lighting control is desired, but a lighting control panel with a LonTalk interface is either not present or not feasible.

Analog Damper Actuator

The standard application is setup to use a Siemens GDE actuator for air volume control. Alternatively, a Siemens Open Air™ actuator can be utilized on the Reduced Point platform if 0-10 VDC modulating control is desired.

Hardware Map – VAV with SAT Response

Termination Set	Parameter set in	Element Name	I/O Type	Factory I/O Setting
StatTemp	Inputs	statTemp	TEMP	spaceTemp
StatSetpt	Inputs	statSetpt	TEMP	spaceSetptTemp
StatOvrd	Inputs	statOvrd	DI	statSwitchDi
In1	Inputs	in1	DI, TEMP	sourceTemp
In2*	Inputs	in2	DI, TEMP	inUnused
In3	Inputs	in3	DI, PCT, TEMP	wallSwitchDi
In4*	Inputs	in4	DI, PCT, TEMP	occSensorDi
In6	Inputs	in6	PCT	onbdPressurePct
OutD1	Outputs	outD1	DO, FLT_MTR	flowDmprFltMtr
OutD2	Outputs	outD2	DO, FLT_MTR	flowDmprFltMtr
OutD3*	Outputs	outD3	DO, FLT_MTR	trmHCoilFltMtr
OutD4*	Outputs	outD4	DO, FLT_MTR	trmHCoilFltMtr
OutD5*	Outputs	outD5	DO, FLT_MTR	perimHCoilFltMtr
OutD6*	Outputs	outD6	DO, FLT_MTR	perimHCoilFltMtr

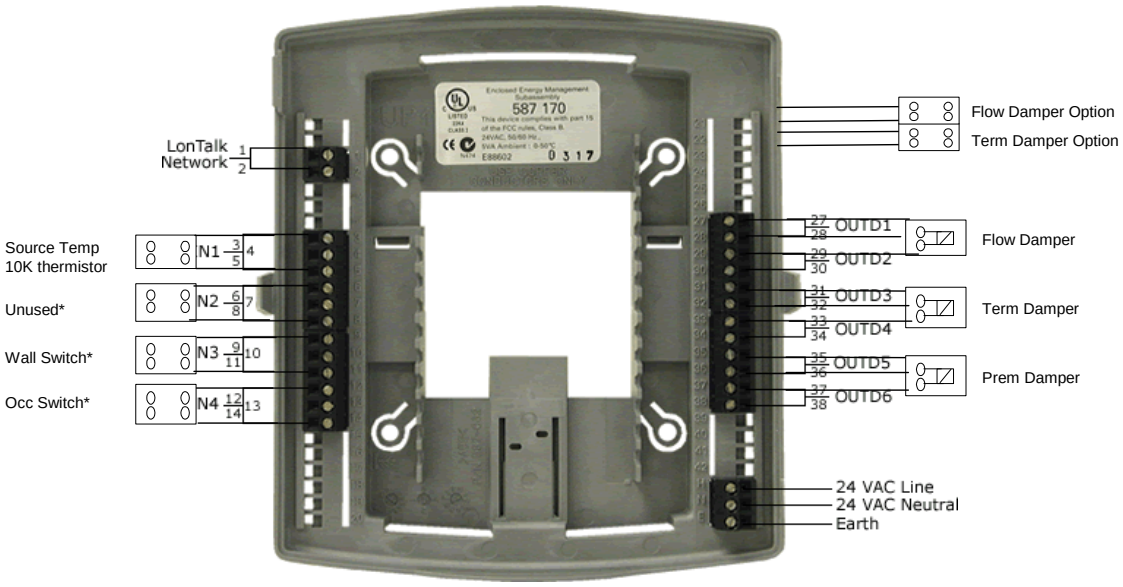
* Not available on Predator VAV Actuator platform

In1 through In4 can be used for digital or analog inputs, as follows:

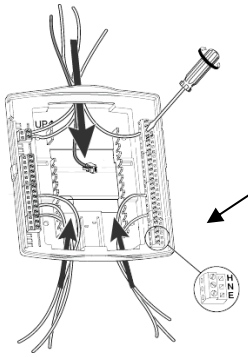
- In1 through In4 are dry contact inputs (with resistors)
- In1 and In2 also accept 10K ohm inputs
- In3 and In4 also accept current (4-20 mA) and voltage (0-10 volt) inputs

Table 1. Hardware Map

Wiring Diagram



*Not available on Predator VAV Actuator



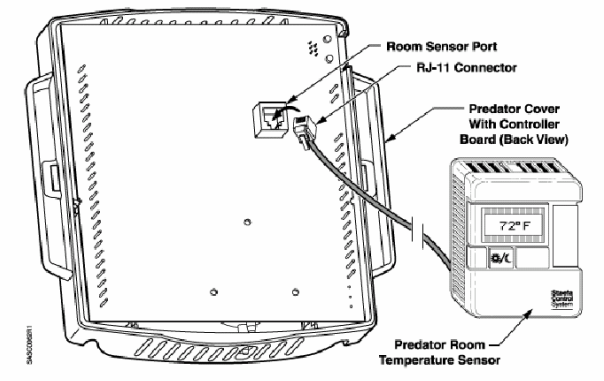
Note: Route wiring from either the bottom opening when using a J-box or from the base sides as shown in the picture when flat or din rail mounting. The image above is for illustrative purposes only

Wiring Recommendations:

IN and AO:	20 to 22 AWG
DO:	18 to 22 AWG
Power:	16 to 18 AWG
LON Network:	22 AWG Level 4

Transformer Requirements:

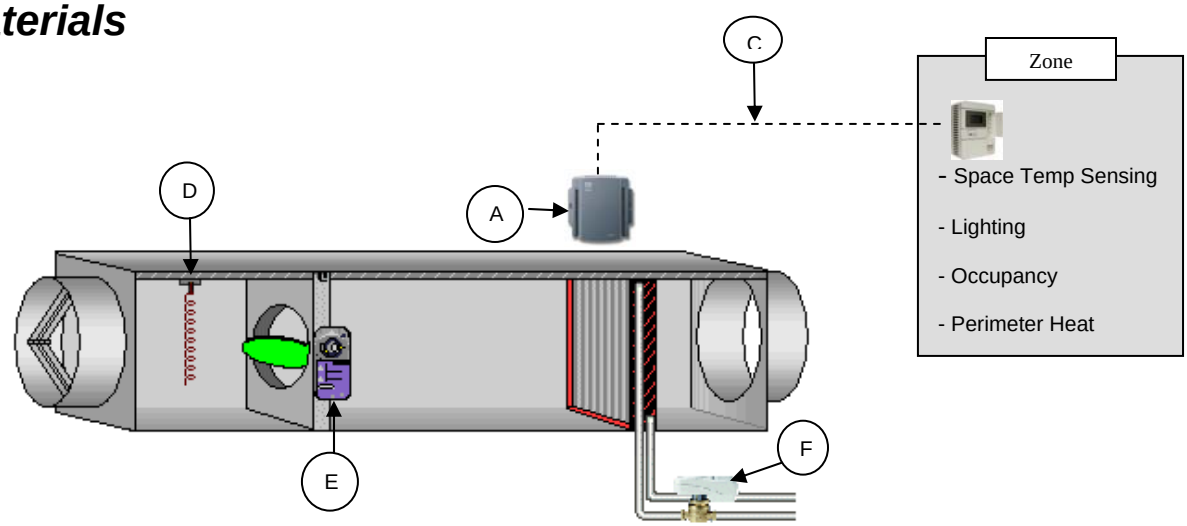
Type: Class 2, 24 VAC, 50/60Hz



RJ-11 6-Pin Connector from the Predator Room Temperature Sensor to the Controller.

Figure 3. Predator Wiring Diagrams

Bill of Materials



Tag	Description	Product #
A	Predator 10K VAV Actuator with SAT	588-507
	Predator VAV with Supply Air Response 4IN, 6DO, 1DP, 1RTS	588-512
	Predator Reduced Point Wiring Base	587-170
B	Predator Room Sensors:	
	Sensing Only	587-180
	Override	587-181
	Setpoint	587-182
	Temperature Display	587-183(1)
	Setpoint and Override	587-184
	Override and Temperature Display	587-185(1)
	Setpoint and Temperature Display	587-186(1)
	Setpoint, Override, and Temperature Display	587-187(1)
	Predator Room Sensors ***without*** Logo's:	
	No Logo Sensing Only	587-550B
	No Logo Setpoint	587-552B
	No Logo Setpoint and Override	587-554B
	No Logo Setpoint, Override, and Temperature Display	587-557B(1)
	Flush Mount Room Temp Sensor, 10K Thermistor, hardware connect	536-994B
	Mylar Tabs – 20 pack (***covers RJ-11 – use w/ 4 conductor cables***)	544-634B20
C	Predator Room Sensor 6-Conductor Plenum Rated Cables:	
	25 Foot	588-100A
	50 Foot	588-100B
	100 Foot	588-100C
	Predator Room Sensor 4-Conductor ***(no network connection)*** Plenum Rated Cables:	
	25 Foot	588-101A
	50 Foot	588-101B
	100 Foot	588-101C
D	Duct Temperature, Point – 4" probe, 10K Thermistor 40 to 150F	587-691
	Duct Temperature, Averaging – 24" flex, 10K Thermistor	587-694
E	Floating damper actuator 44 lb. In.	GDE.131.P
F	Floating valve actuator	SSB81U

Notes: (1) Sensor will display Fahrenheit or Celsius temperature

Configuration Tables

The application configuration tables below are for a typical VAV with SAT Response box. The JDE should be used to modify those items shown as optional or job specific.

Application Specific Parameters				
Application Component	**Configuration Item**	**Element**	**Factory Setting**	**Desired Setting**
VAV / CV Core	airTermType		NO_FAN	Job specific
	flowVav	enable	TRUE	Job specific
		dmdAtMin	0%	Job specific
		dmdAtMax	100%	Job specific
	htgClgSwit	dmdDeadband	1%	Job specific
		tmpDeadband	0.5 °C	Job specific
		timeDelay	3 min	Job specific
	nciSetPnts [SetPnts]	Unoccupied cooling setpoint	unoccupiedCool 23.0 °C	82.4 °F
		Standby cooling setpoint	standbyCool 25.0 °C	77.0 °F
		Occupied cooling setpoint	occupiedCool 28.0 °C	73.4 °F
		Occupied heating setpoint	occupiedHeat 21.0 °C	69.8 °F

		Standby heating setpoint	standbyHeat 19.0 °C	66.2 °F
		Unoccupied heating setpoint	unoccupiedHeat 16.0 °C	60.8 °F
Space Temp Sensing	stptDialEn	UNVT_boolean	FALSE	
	tempStptLim	minTemp	19.0 °C	66.2°F
		maxTemp	25.0 °C	77.0°F
Damper Control	flowDmprMtr	travelTime	90 sec	Job specific
		reverse	FALSE	Job specific
	flowFanRq	percentOn	110%	Job specific
		percentOff	100%	Job specific
Fan Control	htgDmdFanRq	percentOn	110%	Job specific
		percentOff	100%	Job specific
Terminal Reheat	hCoilFanRq	percentOn	3%	Job specific
		percentOff	0%	Job specific
	hStageCyc		10 min	Job specific
	htgSwitMeth		DEAD_BAND	Job specific
	numHStages		0	Job specific
	trmHtgCoil	enable	FALSE	Job specific
		dmdAtMin	0%	Job specific
		dmdAtMax	100%	Job specific
	trmHtgEnrgy		ELECTRIC	Job specific
	trmHtgMtr	travelTime	125 sec	Job specific
		reverse	FALSE	Job specific

Application Component	Configuration Item	Element	Factory Setting	Desired Setting
Perimeter Heat	hStageCyc		10 min	Job specific
	htgSwitMeth		DEAD_BAND	Job specific
	perimHtgCoil	enable	FALSE	Job specific
		dmdAtMin	0 %	Job specific
		dmdAtMax	100%	Job specific
	perimHtgMtr	travelTime	150 sec	Job specific
		reverse	FALSE	Job specific
	numPerimStgs		0	Job specific
SAT Response	supStableBand		0.50 °C	Job specific
	supChangeBand		0.50 °C	Job specific
	supStableDly		30 seconds	Job specific
	supAvgTime		120 seconds	Job specific
	supAdjustRamp		0 seconds	Job specific
	supAdjustDly		10 minutes	Job specific
	monitorEffSrc		TRUE	Job specific
Source Temp Sensing	sourceTempLim	neededToCool	18.0 °C	Job specific
		neededToHeat	25.0 °C	Job specific
Occupancy Control	bypassTime (min)		60 min	Job specific
	occSensorEn		FALSE	Job specific
	statSwitchEn		FALSE	Job specific
	wallSwitchEn		FALSE	Job specific
Lighting Control	lightsLag		10 min	Job specific
Spare Digital Output				
Spare Digital Reading				
Spare Analog Percent				
Spare Analog Temp				

Table 2. VAV with SAT Response – Application Specific Parameters

Balancing Parameters			
Configuration Parameter	**Element**	**Factory Setting**	**Desired Setting**
clgDmdatMax		50%	Job specific
ductArea		0.1000 m^2	Job specific
nciMaxFlowClg		1180 L/s	Job specific
nciMaxFlowHtg		401 L/s	Job specific
nciMinFlowClg		212 L/s	Job specific
nciMinFlowHtg		283 L/s	Job specific
nciMinFlowStby		212 L/s	Job specific
nciMinFlowUnoc		165 L/s	Job specific
nciPrOffset		0%	Job specific
nciSensConstVAV		1.000	Job specific

Table 3. VAV with SAT Response – Balancing Parameters

Tuning Parameters			
Configuration Parameter	**Element**	**Factory Setting**	**Desired Setting**
clgDmdCtrB	Pb	2.22°C	Job specific
	Ti	2000 sec	Job specific
	Td	0 sec	Job specific
htgDmdCtrB	Pb	5.56°C	Job specific
	Ti	1000 sec	Job specific
	Td	0 sec	Job specific
inStat	tempOffset	0 °C	Job specific
	setptOffset	0 °C	Job specific
trmFlowCtrB	Pb	4	Job specific
	Ti	12 sec	Job specific
	Td	0 sec	Job specific

Table 4. VAV with SAT Response – Tuning Parameters

Control Mode Interaction Table – VAV with SAT Response

	Heat		Warmup	Cool		PreCool Unocc	Off	Test	Emerg Heat Unocc	Fan Only
	Occ	Unocc	Unocc	Occ	Unocc					
Term Htg Coil	Heat Loop	Heat Loop	Heat Loop	Closed	Closed	Closed	Closed		Heat Loop	Closed
Perim Heat	Heat Loop	Heat Loop	Heat Loop	Closed	Closed	Closed	Closed		Heat Loop	Closed
Flow Dmpr	Heat Loop	Heat Loop	Heat Loop	Cool Loop	Cool Loop	Cool Loop	Closed	Closed	Heat Loop	Closed
Fan	S:ON P:F2	S:F1 P:F2	S:F1 P:F2	S:ON P:OFF	S:F1 P:OFF	S:F1 P:OFF	S:OFF P:OFF	S:ON P:ON	S:F1 P:F2	S:ON P:ON
Flow Limits	Htg Max Htg Min	Htg Max Unocc Min	Htg Max Unocc Min	Clg Max Clg Min	Clg Max Unocc Min	Clg Max Unocc Min	No Flow		Max Min	
Temp Stpt	Occ Heat	Unocc Heat	Occ Heat	Occ Cool	Unocc Cool	Occ Cool	N/A		Unocc	

F1 = OFF, unless high flow setpoint or open valve

F2 = OFF, unless heating demand request or low flow setpoint request and open valve

Color Key: Red = OFF (not used); Green = Active (fixed in application); Yellow = Selectable (configurable)

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