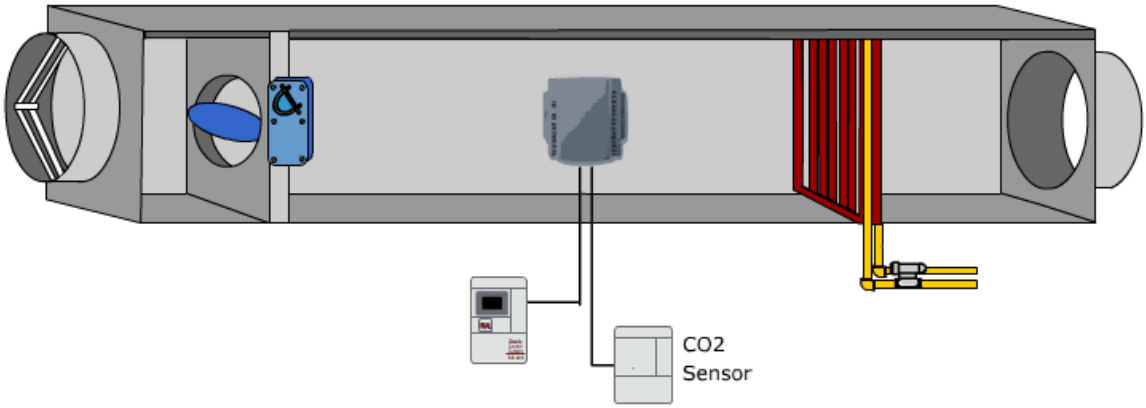
TALON

Predator VAV with CO2

Application Data Sheet



Predator VAV with CO2 Controller Configuration

Features

- Demand Ventilation Control that adapts to meet IAQ specification requirements
- Economizer control of outside air damper that provides energy savings
- LonMark compliant with space-comfort controller functional profile (8502)
- PID control minimizes offset and maintains tighter set point control to increase space comfort
- 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.
- Conforms to the LonMark interoperability guidelines, enabling information sharing with LonMark products from other vendors.

Sequence of Operation

In this core configuration, the Predator operates perimeter heat, the reheat coil and the primary air damper to maintain required room temperature and ventilation conditions.

Occupied Mode

The Predator applies occupied settings for the space temperature setpoints and the primary air flow minimum. The typical result is continuous ventilation, with heating or cooling automatically selected to maintain comfort.

Cooling

The cooling PID maintains the measured space temperature at the occupied cooling setpoint by modulating the primary air flow setpoint between the maximum cooling flow and the minimum cooling flow.

The ventilation PID calculates ventilation demand in occupied mode by measuring the space CO2 and comparing it to the configured CO2 setpoint. The ventilation demand is used by the flow component to generate a primary air flow setpoint between 0 and the configured maximum cooling flow.

If both the cooling and ventilation PIDs are generating demand values, then the component with the larger setpoint value will drive the primary air flow PID. The primary air flow PID maintains the measured air flow to the larger of these two setpoints by modulating the position of the primary air damper.

The reheat coil is off.

Perimeter heat is off.

Heating

The heating PID maintains the measured space temperature at the occupied heating setpoint by modulating perimeter heat, the reheat coil and the primary air flow setpoint. The setpoint varies between the maximum heating flow and the minimum heating flow. Relative sequencing of perimeter heat, the reheat coil, and the primary air flow is set according to site specific requirements.

The ventilation PID calculates ventilation demand in occupied mode by measuring the space CO2 and comparing it to the configured CO2 setpoint. The ventilation demand is used by the flow component to generate a primary air flow setpoint between 0 and the configured maximum cooling flow.

If both the heating and ventilation PIDs are generating demand values, then the component with the larger setpoint value will drive the primary air flow PID. The primary air flow PID maintains the measured air flow to the larger of these two setpoints by modulating the position of the primary air damper.

NOTE: Ventilation demand will only operate until the temperature falls a configurable number of degrees below heating setpoint. If the temperature falls below this configured value, then the ventilation loop will be disabled, causing the heating PID to be the sole input to the primary air flow PID.

Unoccupied Mode

The Predator applies unoccupied settings for the space temperature setpoints and the primary air flow minimum. The typical result is a wide operating band with no HVAC energy consumption, and heating or cooling applied only at extreme conditions.

Cooling

The cooling PID maintains the measured space temperature at the unoccupied cooling setpoint by modulating the primary air flow setpoint between the maximum cooling flow and the unoccupied minimum flow.

The primary air flow PID maintains the measured air flow at the varying setpoint by modulating the position of the primary air damper.

The reheat coil is off.

Perimeter heat is off.

Heating

The heating PID maintains the measured space temperature at the unoccupied heating setpoint. Operation of each HVAC device, in response to heating demand is selectable in the unoccupied mode. The behavior of primary air damper and reheat coil may be individually configured. They may be forced on, locked out, modulated or cycled according to the required sequence.

Bypass Mode

During unoccupied periods, an occupant can put the Predator in the bypass mode by pressing the bypass button on the room temperature sensor. This causes the controller to operate exactly as in the occupied mode, for an adjustable amount of time.

Standby Mode

Standby mode applies separately adjustable temperature and ventilation setpoints. These may be adjusted to conserve energy, but allow quicker recovery compared to the unoccupied mode. Otherwise, operation is the same as the unoccupied mode.

Morning Warmup

During unoccupied periods, if the Predator is commanded to warmup mode, it applies the occupied heating setpoint (to restore comfort conditions) and the unoccupied minimum flow (because occupants are not present). Operation of each HVAC device, in response to heating demand is selectable in the warmup mode. The behavior of perimeter heat, the primary air damper and the reheat coil may be individually configured. They may be forced on, locked out, modulated or cycled according to the required sequence.

Pre-cool

During unoccupied periods, if the Predator is commanded to pre-cool mode, it applies the occupied cooling setpoint (to restore comfort conditions) and the unoccupied minimum flow (because the occupants are not present).

The reheat coil is off.

Perimeter heat is off.

Calibrate (Test)

The Predator closes the primary air damper and calibrates the air flow 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 motor travel time.

The reheat coil is off.

If perimeter heat is active, it continues to operate.

Off

The Predator closes the primary air damper, and turns off the reheat coil, and turns off perimeter heat.

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 *stptDialEn*) 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. – see Table 2). 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):

- Operator Command – A valid occupied command sent from system operator.
- Bypass Button – Button on Talon room sensor, also utilized by occupants of room.
- Occupancy Sensor/Wall Switch – 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.

Occupancy Sensor/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.

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.

Analog Damper Actuator

The standard application is setup to use a Siemens GDE or GLB, or similar 3-point floating actuator for air volume control. Alternatively, A Siemens Open Air™ or similar damper actuator could be utilized if 0-10 VDC modulating control is desired.

Perimeter Heat

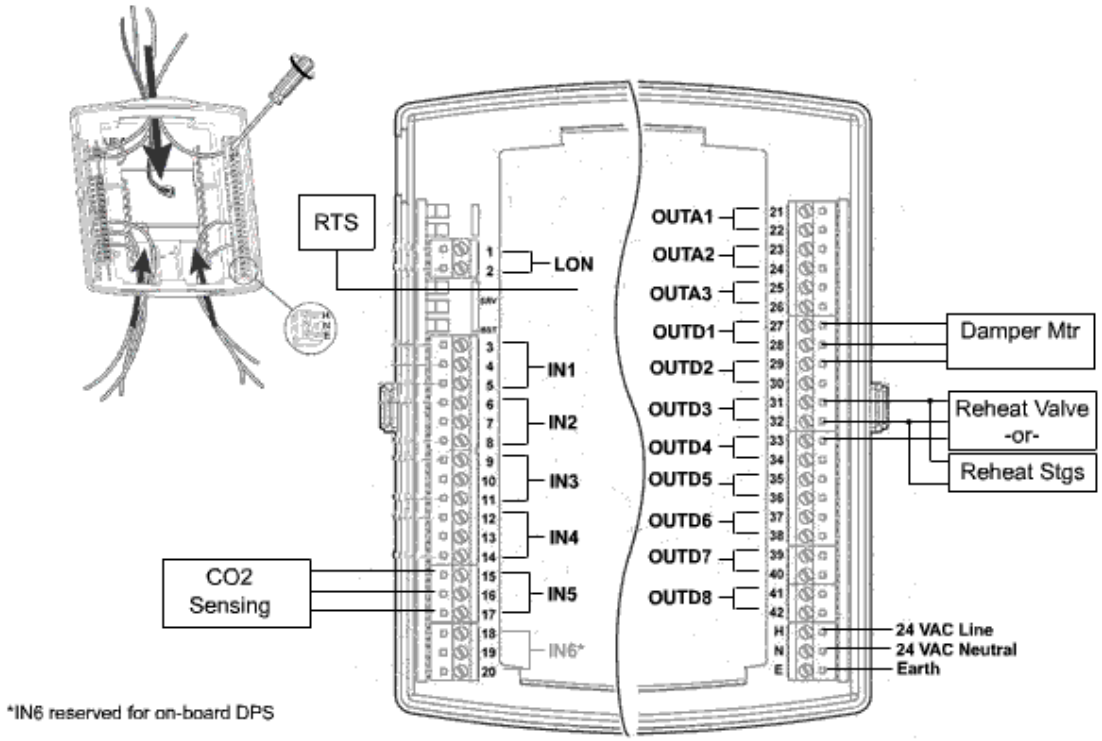
This application also supports the optional control of perimeter heat. The algorithm supports analog, 3-point floating, pulse width modulation, and on/off control of the perimeter heat. Perimeter heat operates independently of terminal airflow or the current state of the terminal fan.

Hardware Map – VAV with CO2

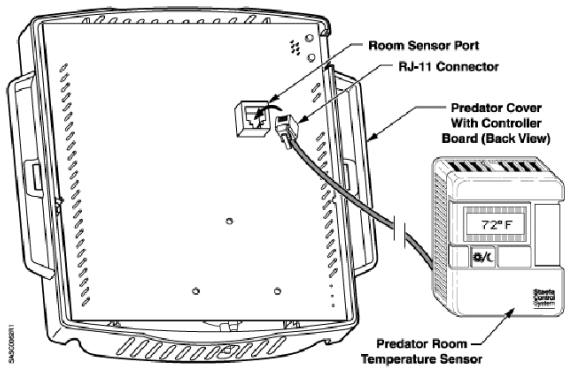
Sample Hardware Map for the VAV with CO2 Application Configuration

Configuration Property	**Element**	**Input/Output Type**	**Factory Hardware Setting**	**Desired Setting** Settings that **need to be changed** from the factory defaults are shown in **BOLD** face type.
inStat	statTempOffset	-	0°F 0°C	0°F 0°C
	statSetptOffset	-	0°F 0°C	0°F 0°C
Inputs	statTemp	TEMP	SPACE_TEMP	SPACE_TEMP
	statSetpt	TEMP	SPACE_SETPT_OFFSET_TEMP	SPACE_SETPT_OFFSET_TEMP
	statOvrd	DI	STAT_SWITCH_DI	STAT_SWITCH_DI
	IN1	DI, TEMP	SPARE2_IN	**IN_UNUSED**
	IN2	DI, TEMP	IN_UNUSED	IN_UNUSED
	IN3	DI, PCT, TEMP	OCC_SENSOR_DI	**IN_UNUSED**
	IN4	DI, PCT, TEMP	SPACE1_IN	**IN_UNUSED**
	IN5	DI, PCT, TEMP	SPACE_CO2_PCT	SPACE_CO2_PCT
	IN6	PCT	ONBD_PRESSURE_PCT	ONBD_PRESSURE_PCT
outputs	OUTA1	AO	FLOW_DMPR_AO	**OUT_UNUSED**
	OUTA2	AO	TRM_H_COIL_AO	**OUT_UNUSED**
	OUTD1	DO, FLT_MTR	FLOW_DMPR_FLT_MTR	FLOW_DMPR_FLT_MTR
	OUTD2	DO, FLT_MTR	FLOW_DMPR_FLT_MTR	FLOW_DMPR_FLT_MTR
	OUTD3	DO, FLT_MTR	TRM_H_COIL_FLT_MTR	TRM_H_COIL_FLT_MTR
	OUTD4	DO, FLT_MTR	TRM_H_COIL_FLT_MTR	TRM_H_COIL_FLT_MTR
	OUTD5	DO, FLT_MTR	PERIM_H_COIL_FLT_MTR	**OUT_UNUSED**
	OUTD6	DO, FLT_MTR	PERIM_H_COIL_FLT_MTR	**OUT_UNUSED**
	OUTD7	DO, FLT_MTR	TRM_FAN_DO	**OUT_UNUSED**
	OUTD8	DO, FLT_MTR	SPARE1_OUT	**OUT_UNUSED**

Sample Wiring Diagram for VAV with CO2 Application Configuration



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



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

Wiring Recommendations:

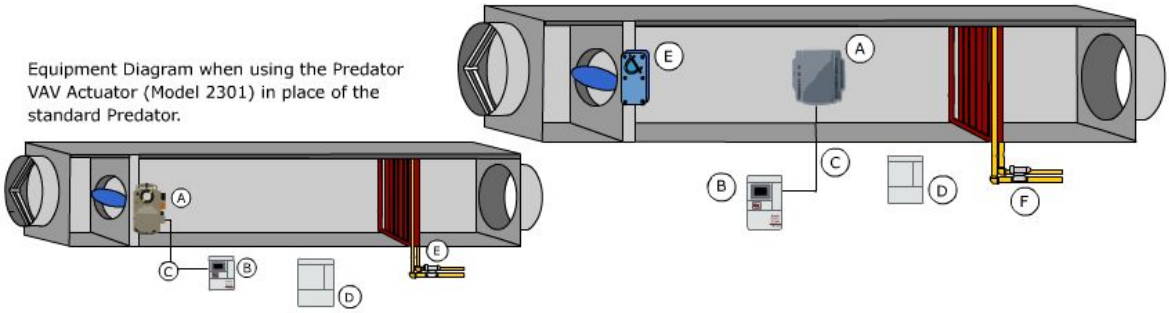
IN and AO:	20 to 22 AWG
DO:	18 to 22 AWG
Power:	16 to 18 AWG
LON Network:	22 AWG Level 4

Transformer Requirements:

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

Predator Wiring Diagrams (Full Point Board Shown)

Ideal Material Solution



Tag	Description	Product #
A	Predator VAV with CO2 5IN, 8DO, 2AO, 1 DPS, 1RTS Predator Full Point Wiring Base	588-518 587-175
	Predator VAV Actuator 2301*	588-524
B	Predator Room Sensors:	
	Sensing Only	587-180
	Override	587-181
	Setpoint	587-182
	Temperature Display**	587-183
	Setpoint and Override	587-184
	Override and Temperature Display**	587-185
	Setpoint and Temperature Display**	587-186
	Setpoint and Temperature Display**	587-187
	With terminal blocks and warmer/cooler setpoint adjustment	587-188
	With terminal blocks, warmer/cooler setpoint adjustment & occ. override	587-189
	With term. blocks, warmer/cooler stpt adjustment, occ. ovrd & LCD dsply	587-196
	Predator Room Sensors without Logos	
	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
	Mylar Tabs – 20 pack (covers RJ-11 opening for 4 conductor cables)	544-634P20
	Flush Mount 10K Room Sensor	536-994B
C	Predator Room Sensor RJ-11 Pre-terminated 6 Conductor Plenum Rated Cables	
	25 Foot	588-100A
	50 Foot	588-100B
	100 Foot	588-100C
	Predator RS RJ-11 Pre-terminated 4-Conductor (no network connection) Plenum Rated Cables	
	25 Foot	588-101A
	50 Foot	588-101B
	100 Foot	588-101C
D	IAQ Sensor for CO2 & VOC IAQ CO2/VOC Sensor with LED Display CO2 Sensor Duct Mounting Kit	QPA63.1 QPA63.2 ARG64
E	Floating damper actuator 44 lb. In.	GDE.131.P
F	Floating valve actuator	SSB81U
	Outside Air Temperature 10K Thermistor -40 to 120°F	587-692

* Predator VAV Actuator does not need separate wiring base.
** Sensors will display Fahrenheit or Celsius
*** Analog valve is only supported on Full Point 587-135

Configuration Table

The following table lists all of the configuration properties (CPs) available with this application. For more information on how to set these properties, please consult the *Predator VAV with CO2 Application Guide*.

Configuration Properties – VAV with CO2

Configuration Property ***Language-dependent Name***	**Element** ***Programmatic Name***	**Factory Value**
actDisplay *Actuator Display Selection*		command
airTermType *Type of Air Terminal*		no_Fan
bypassTime *Bypass Time*		60 minutes
clgDmdCtrB *PID Controller Gain of the Cooling Controller*		
	Pb	2.78°C (5.0°F)
	Ti	2000.0 seconds
	Td	0.0 seconds
cO2SensRng *Space CO2 Sensor Range*		0 ppm
ductArea *Trm Duct Area*		1.076 ft^2 (0.1 m^2)
fanUnoccHtg *Unocc Heat Fan Operation*		modulate
fanWarmup *Warmup Operation for Fan*		on
flowDmprMotr *Trm Flow Damper Motor*		
	TravelTime	90.0 sec
	Reverse	False
	SyncDirection	Close
flowDmprSat *Trm Flow Damper Saturation*		
	SaturationLoad	110%
	PrctDeadband	2%
	TimeDelay	10 min
flowFanRq *Flow Setpoint Deadband*		
	PercentOn	110.00%
	PercentOff	100.00%
flowUnoccHtg *Unoccupied Heat Flow Operation*		modulate
flowVav *Flow VAV Element*		
	Enable	TRUE
	DmdAtMin	0.00%
	DmdAtMax	100.00%
flowWarmup *Warmup Operation for Flow*		Off
hCoilFanRq *Heat Coil Fan Request*		
	PercentOn	3.00%

Configuration Property ***Language-dependent Name***	**Element** ***Programmatic Name***	**Factory Value**
	PercentOff	0.00%
hCoilUnocc *Unocc Operation for Htg Coil*		Cycle
hCoilWrmup *Warmup Operation for Htg Coil*		Cycle
hStageCyc *Staged Heat Cycle Time*		10 minutes
htgClgSwit *Heating Cooling Switchover Logic*		
	DmdDeadband	1.0%
	TmpDeadband	0.9°F (0.5°C)
	TimeDelay	3 minutes
htgDmdCtrB *PID Controller Gain of the Heating Controller*		
	Pb	10.0°F (5.56°C)
	Ti	1000.0 seconds
	Td	0.0 seconds
htgDmdFanRq *Heating Demand Fan Request*		
	PercentOn	110.00%
	PercentOff	100.00%
htgFanDelay *Staged Heat Fan Delay*		2 minutes
htgSwitMeth *Switching Method for Staged Heat*		deadBand
maxFlow *Trm Max Flow Clg*		1180 l/s (2500 cfm)
maxFlowHotPri *Trm Max Flow Htg w/Hot Primary*		1180 l/s (2500 cfm)
maxFlowHeat *Trm Max Flow Htg*		401 l/s (850 cfm)
minFlow *Trm Min Flow Clg*		212 l/s (450 cfm)
minFlowHeat *Trm Min Flow Htg*		283 l/s (600 cfm)
minFlowStby *Trm Min Flow Stby*		212 l/s (450 cfm)
minFlowUnoc *Trm Min Flow Unocc*		165 l/s (350 cfm)
numHStages *Number of Terminal Heat Stages*		0
numPerimStgs *Number of Perimeter Heating Stages*		0
occSensPrior *Occ Sensor Operating Priority*		unoccupied
occSensorEn *Local Occupancy Sensor Enable*		False
perimHUnocc *Unocc Operation Perim H Coil*		modulate
perimHWrmup *Warmup Operation Perim H Coil*		cycle
perimHtgCoil *Perimeter Heating Coil Element*		
	Enable	False

Configuration Property ***Language-dependent Name***	**Element** ***Programmatic Name***	**Factory Value**
	DmdAtMin	0.00%
	DmdAtMax	100.00%
perimHtgMotr *Perimeter Htg Coil Motor*		
	TravelTime	125 seconds
	Reverse	False
	SyncDirection	close
sensConstVAV *Trm Flow Gain*		1
seriesStDelay *Series Fan Start Delay*		0.0 seconds
sourceTempLim *Heating Cooling Limits*		
	NeededToCool	18.0°C (64.4°F)
	NeededToHeat	25.0°C (77.0°F)
spaceCO2Stpt *Space CO2 Setpoint*		0 ppm
spare1In **spare2In**		
spare1Out **spare2Out**		
statSwitchEn *Local Occupancy Switch Enable*		False
stptDialEn *Local Temperature Setpoint Dial Enable*		False
stptOffstSpan *Spc Temp Stpt Offset Span*		2.0°C
tempStptLim *Space Temperature Setpoint Dial Limits*		
	MinTemp	19.0°C (66.2°F)
	MaxTemp	25.0°C (77.0°F)
trmCoolSat *Terminal Cooling Saturation*		
	saturationLoad	110%
	tempDeadband	10°C (18°F)
	timeDelay	10 min
trmFlowCtrB *Trm Flow Cntr Band*		
	Pb	4
	Ti	12.0 seconds
	Td	0.0 seconds
trmHeatSat *Terminal Heat Saturation*		
	SaturationLoad	110%
	TempDeadband	2°C (3.6°F)
	TimeDelay	10 min
trmHtgCoil *Terminal Heating Coil Element*		
	Enable	False
	DmdAtMin	0.00%
	DmdAtMax	100.00%
trmHtgEnrgy *Energy Source for Terminal Heating Coil*		Hot Water

Configuration Property ***Language-dependent Name***	**Element** ***Programmatic Name***	**Factory Value**
trmHtgMotr *Terminal Heating Coil Motor*		
	TravelTime	125.0 seconds
	Reverse	False
	SyncDirection	Close
ventDmdCtrB *Ventilation Demand Cntr Band*		
	Pb	0.00
	Ti	0 seconds
	Td	0 seconds
ventTempDB *Ventilation Disable Temp DBand*		1.11°C

* Available on some models of the Predator Room Temperature Sensor.

Network Configuration Inputs (nci)

NV Name ***Language-dependent Name***	**Element** ***Programmatic Name***	**Factory Value**
nciPrOffset *Pressure Offset*		0.00%
nciSetPnts *Occupancy Temperature Setpoints*		
	Occupied Cooling Setpoint *(occupied_cool)*	73.4°F (23.0°C)
	Standby Cooling Setpoint *(standby_cool)*	77.0°F (25.0°C)
	Unoccupied Cooling Setpoint *(unoccupied_cool)*	82.4°F (28.0°C)
	Occupied Heating Setpoint *(occupied_heat)*	69.8°F (21.0°C)
	Standby Heating Setpoint *(standby_heat)*	66.2°F (19.0°C)
	Unoccupied Heating Setpoint *(unoccupied_heat)*	60.8°F (16.0°C)

Control Mode Interaction Table – VAV/CV

	Heat		Warmup	Cool		PreCool Unocc	Off	Test (Calibrate)	Emerg Heat Unocc	Fan Only
	Occ	Unocc	Unocc	Occ	Unocc					
Term Htg Coil	Heat Loop	Heat Loop Cycle Off Max	Heat Loop Cycle Off Max	Closed	Closed	Closed	Closed		Heat Loop	Closed
Perim Heat	Heat Loop	Heat Loop Cycle Off Max	Heat Loop Cycle Off Max	Closed	Closed	Closed	Closed	Heat Loop	Heat Loop	Closed
Flow Dmpr	Heat Loop	Heat Loop Cycle Off Max	Heat Loop Max Min	Cool Loop	Cool Loop	Cool Loop	Closed	Closed	Heat Loop	Closed
Series Fan	ON	Demand	Demand	ON	Demand	Demand	OFF	OFF	Demand	ON
Parallel Fan	Demand	Demand	Demand	Demand	OFF	OFF	OFF	OFF	Demand	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	No Flow	Max Min	No Flow
Temp Stpt	Occ Heat	Unocc Heat	Occ Heat	Occ Cool	Unocc Cool	Occ Cool	N/A	N/A	Unocc	N/A

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

* ClgMax if ventilation is in effect; MaxFlowHotPri if source is warm.

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