TALON

Low Flow Dual Duct VAV/CV with QVM

Application Data Sheet

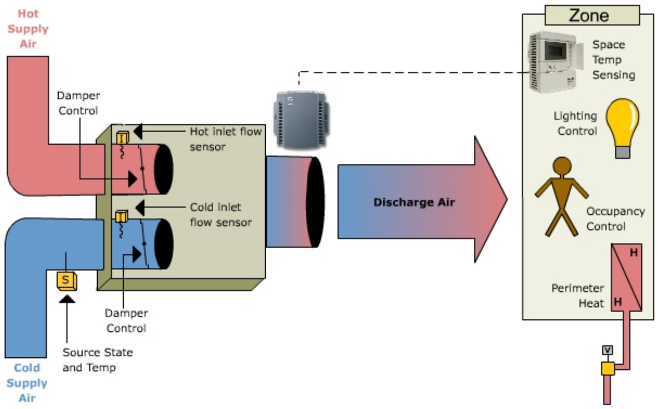


Figure 1. Dual Duct VAV Box with Two Inlet Flow Sensors.

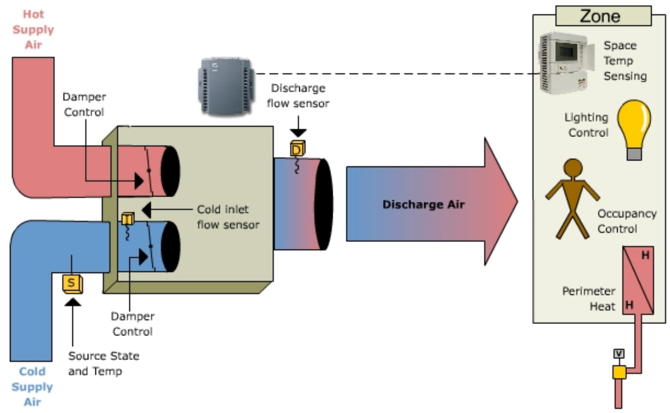


Figure 2. Dual Duct VAV Box with One Inlet and One Discharge Flow Sensor.

NOTE: The source temperature sensor can be mounted in either hot or cold depending upon application usage.

Features

- Flow sensors can be installed in cold duct and hot duct, or cold duct and discharge duct.
- Operates dual cold/dual hot sequence, when both supply ducts use same temperature air.
- Application control of zone lighting reduces installation costs and provides energy savings.
- Advanced PID control minimizes offset and maintains tight setpoint control.
- Unique damper logic minimizes damper repositions, extending life of actuators.
- 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.

Sequence of Operation

This application example describes the operation of the Predator VAV dual duct terminal unit controller with two inlet flow sensors and optional lighting control. The Predator monitors the room temperature, room setpoint, room override switch, and supply airflow. As the monitored conditions change, the control algorithm modulates the damper actuators and the perimeter heating valve to maintain the specified room setpoints. If lighting control is installed, the zone will be illuminated according to the current occupancy mode of the Predator controller.

Occupied Control

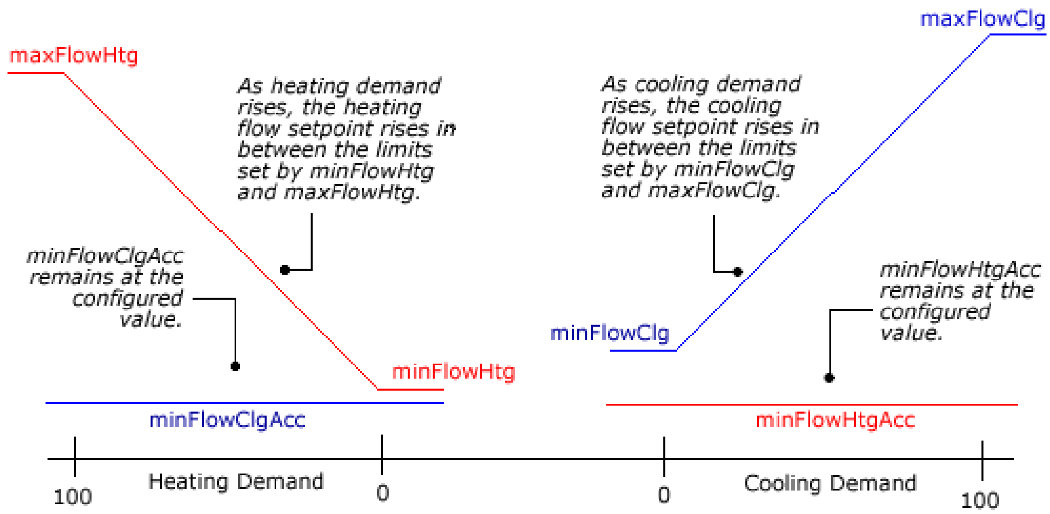


Figure 3. Occupied Control.

Cooling Mode

In Occupied Cooling Mode, the Predator Controller controls the space to the occupied cooling temperature setpoint. A cooling demand PID resets the cold duct flow setpoint within a configurable range to maintain space temperature. The hot duct maintains a configurable accessory flow, which can be used for ventilation.

Heating Mode

In Occupied Heating Mode, the Predator Controller controls the space to the occupied heating temperature setpoint. A heating demand PID resets the hot duct flow setpoint within a configurable range to maintain space temperature. The cold duct maintains a configurable accessory flow, which can be used for ventilation. The perimeter heating valve modulates as required to control the zone temperature. The airflow and perimeter heat can be configured to operate in sequence or unison.

Deadband

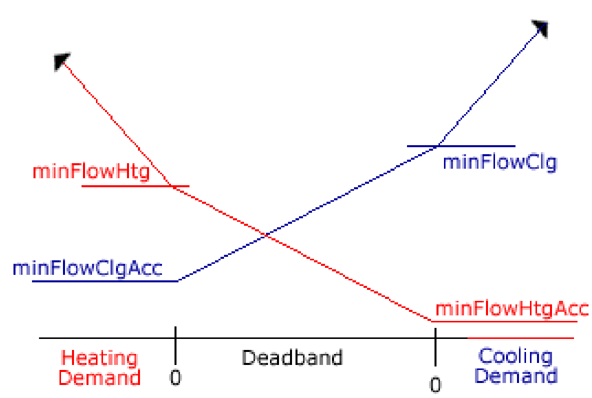


Figure 4. Deadband Control.

The operation of the application when the space temperature is between the heating and cooling temperature setpoints is configurable. By default, the controller performs a distinct switchover between minimum heating and minimum cooling conditions. If configured, the controller can perform a crossover process where the flow setpoints are gradually adjusted according to the space temperature between the heating and cooling setpoints.

Unoccupied Control

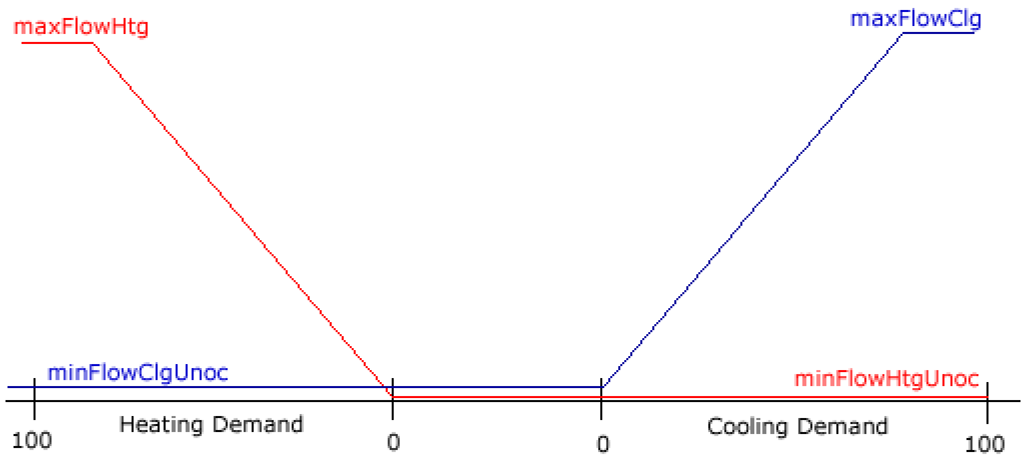


Figure 5. Unoccupied Control.

Cooling Mode
In Unoccupied Cooling Mode, the Predator Controller controls the space to the unoccupied cooling temperature setpoint. A cooling demand PID resets the cold duct flow setpoint within a configurable unoccupied range to maintain space temperature. The hot duct maintains a configurable unoccupied flow.

Heating Mode
In Unoccupied Heating Mode, the Predator Controller controls the space to the unoccupied heating temperature setpoint. A heating demand PID resets the hot duct flow setpoint within a configurable unoccupied range to maintain space temperature. The cold duct maintains a configurable unoccupied flow. The perimeter heating operation is configurable in unoccupied mode.

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.

Cooling Mode
The Predator Controller uses the same flow operation as Unoccupied Mode but controls the space temperature to the standby cooling setpoint. Once occupancy is detected, control reverts to the Occupied Mode as detailed above.

Heating Mode
The Predator Controller uses the same flow operation as Unoccupied Mode but controls the space temperature to the standby heating setpoint. The perimeter heating valve modulates as required to control the zone temperature. Once occupancy is detected, control reverts to the Occupied Mode as detailed above.

Dual Cold

In this mode, the air handler supplies both ducts with cold air. If the dual supply sequence is configured for series operation, the cold duct will supply air until it reaches its maximum. If additional cooling is necessary, the hot duct will begin to supply air. If the dual supply sequence is configured for parallel operation, the flow setpoints for both ducts will increase at the same time.

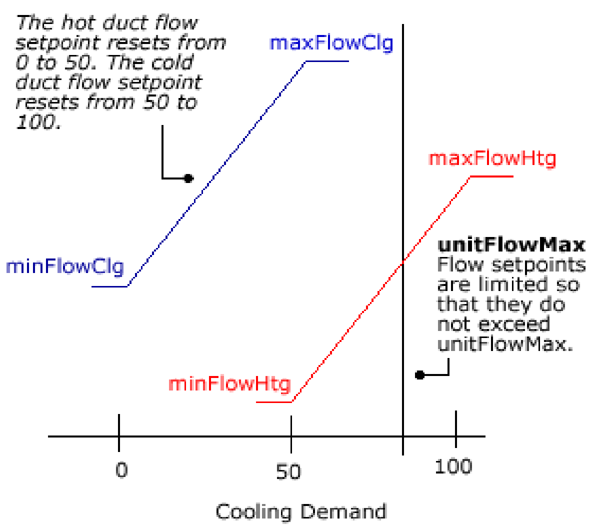


Figure 6. Dual Cold Serial Flow Configuration.

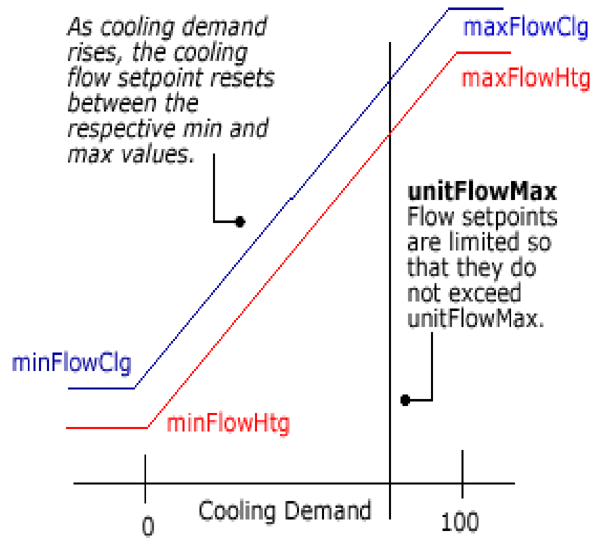


Figure 7. Dual Cold Parallel Flow Configuration.

Dual Hot

In this mode, the air handler supplies both ducts with hot air. If the dual supply sequence is configured for series operation, the hot duct will supply air until it reaches its maximum. If additional heating is necessary, the cold duct will begin to supply air. If the dual supply sequence is configured for parallel operation, the flow setpoints for both ducts will increase at the same time

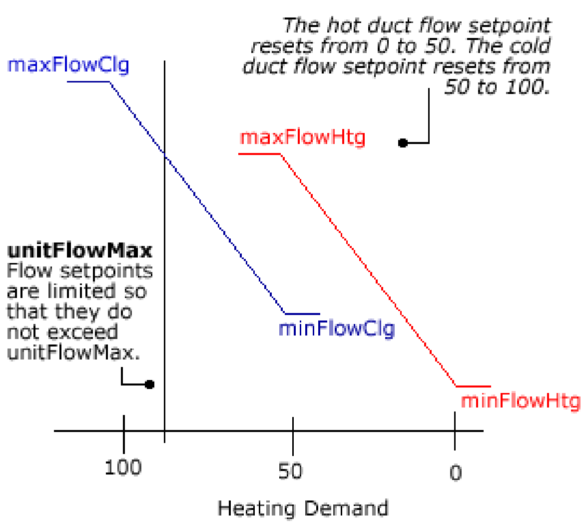


Figure 8. Dual Hot Serial Flow Configuration.

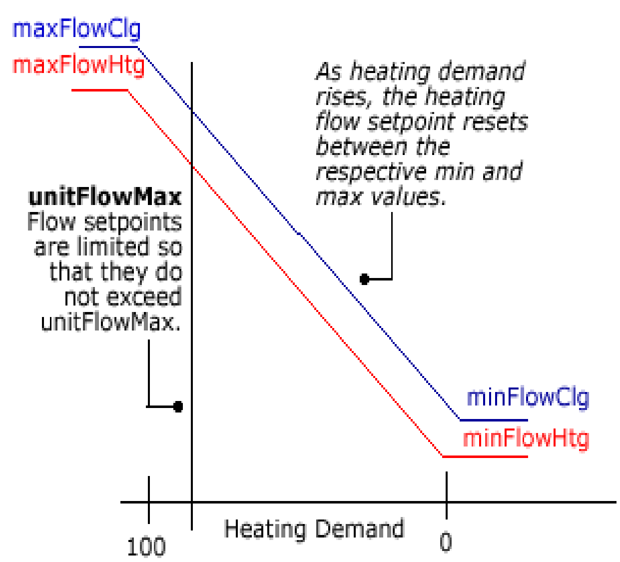


Figure 9. Dual Hot Parallel Flow Configuration.

Morning Warm-up/ Pre-Cool

In these pre-occupancy modes, the Predator Controller controls the space temperature to the occupied temperature setpoint using the unoccupied flow ranges. The perimeter heat operation is configurable in Warm-up Mode.

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 airflow to the space in equal proportions, thus eliminating starvation of zones.

Off

In this mode, the dampers will close fully and lighting is off.

Test/Calibrate

In the Test mode, the controller will close both dampers fully. The external sensors will be recalibrated if configured to do so. 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 twice the longest damper travel time.

Occupancy Control

Occupancy Mode

The Predator controller defaults to the Occupied Mode of operation. Upon receipt of the four-state LonMark occupancy override (nviOccManCmd), the controller will switch to the appropriate mode of operation. Following is a brief summary of each mode:

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 (see Figure 10). This occupancy signal could then be shared with other controllers via the LonTalk Network.

Bypass Mode

If enabled (through 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. – 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):

- 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.

Special Features

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 to monitor the source temperature. This can be used to detect transitions from normal operation to dual cold/dual hot operation. This is also 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. Lighting is on in Occupied and Bypass Modes and is off in Unoccupied and Standby Modes.

Analog Damper Actuator

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

Perimeter Heat

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

Hardware Map – Dual Duct VAV/CV

Table 1. Hardware Map.

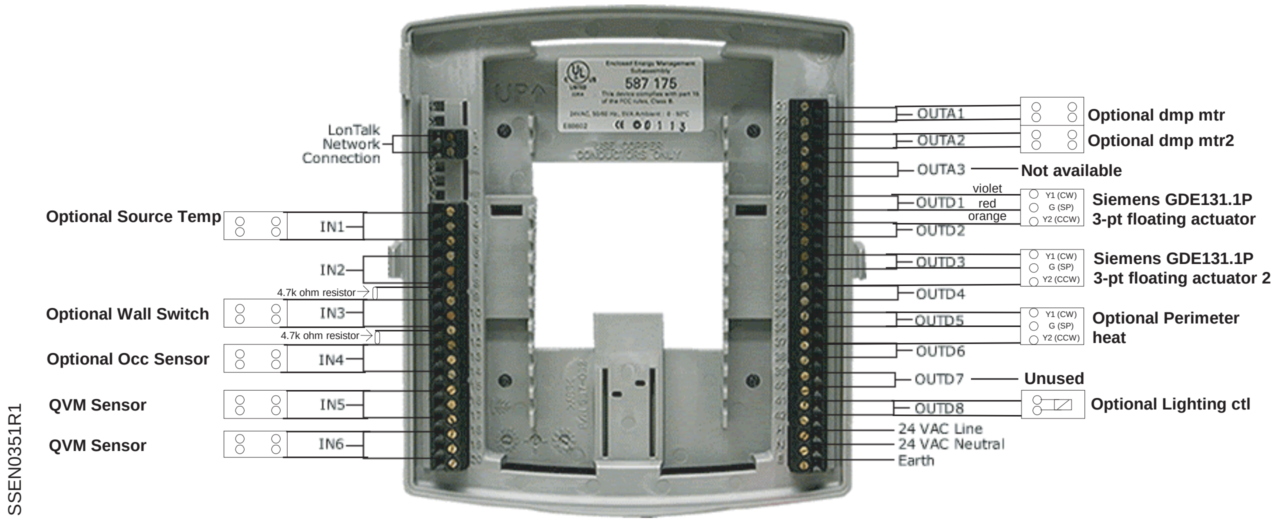
Termination Set	Element Name	I/O Type	Factory I/O Setting
StatTemp	statTemp	TEMP	SPACE_TEMP
StatSetpt	statSetpt	TEMP	SPACE_STPT_TEMP
StatOvrd	statOvrd	DI	STAT_SWITCH_DI
In1	in1	DI, TEMP	SOURCE_TEMP
In2	in2	DI, TEMP	SPARE1_TEMP
In3	in3	DI, PCT, TEMP	WALL_SWITCH_DI
In4	in4	DI, PCT, TEMP	OCC_SENSOR_DI
In5	in5	DI, PCT, TEMP	VELOCITY_EXT2_PCT
In6	in6	DI, PCT, TEMP	VELOCITY_EXT1_PCT
OutA1	outA1	AO	FLOW_DMPR_AO
OutA2	outA2	AO	FLOW_DMPR2_AO
OutA3	outA3	AO	OUT_UNUSED
OutD1	outD1	DO, FLT_MTR	FLOW_DMPR_FLT_MTR
OutD2	outD2	DO, FLT_MTR	FLOW_DMPR_FLT_MTR
OutD3	outD3	DO, FLT_MTR	FLOW2_DMPR_FLT_MTR
OutD4	outD4	DO, FLT_MTR	FLOW2_DMPR_FLT_MTR
OutD5	outD5	DO, FLT_MTR	PERIM_H_COIL_FLT_MTR
OutD6	outD6	DO, FLT_MTR	PERIM_H_COIL_FLT_MTR
OutD7	outD7	DO, FLT_MTR	OUT_UNUSED
OutD8	outD8	DO, FLT_MTR	SPC_LIGHTS_DO

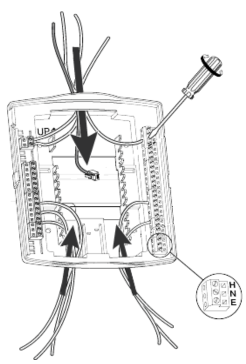
In1 through In6 can be used for digital or analog inputs, as follows:

- In1 through In6 are dry contact inputs (with resistors)
- In1 and In2 also accept 10K ohm inputs
- In3, In4, In5, and In6 also accept current (4 to 20 mA) and voltage (0 to 10 volt) inputs

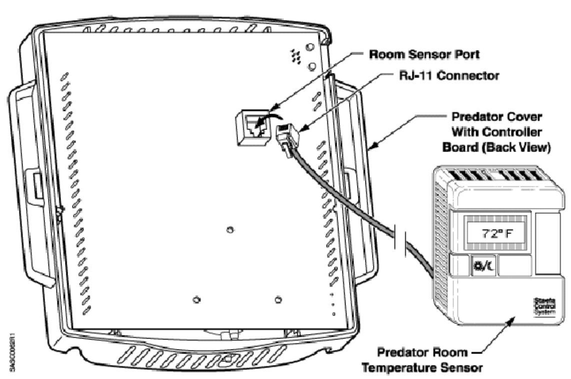
A1, A2, and A3 are 0 to 10 volt outputs only.

Wiring Diagram





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.



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

Wiring Recommendations:

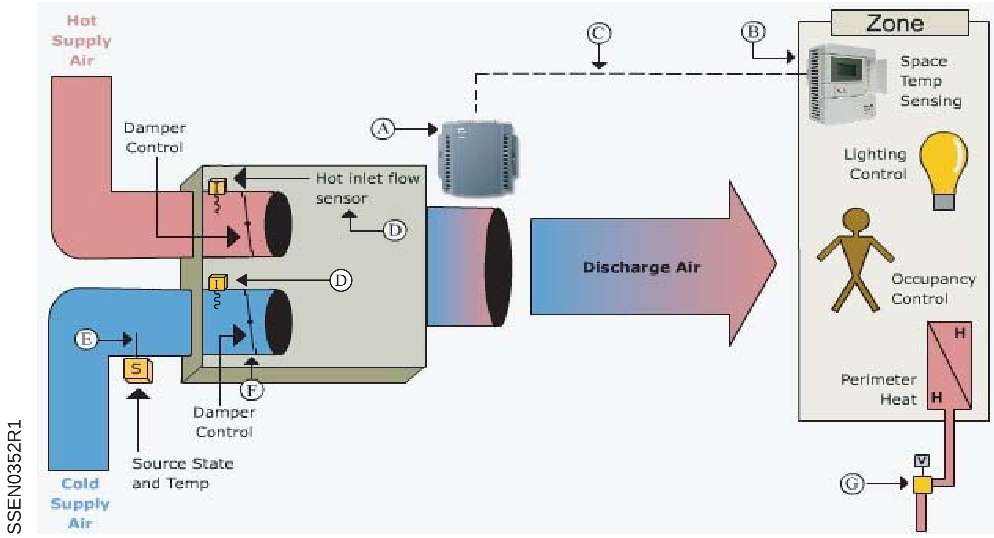
IN and AO:	20 to 22 AWG
DO:	18 to 22 AWG
Power:	16 to 18 AWG
LON Network:	22 AWG Level 4

Transformer Requirements:

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

Figure 10. Predator Wiring Diagrams.

Bill of Materials



Tag	Description	Product No.
A	Predator Dual Duct Controller 6IN, 8DO, 3AO, 1RTS Predator Full Point Wiring Base	587-527 587-175
B	Predator Room Sensors: Sensing Only Override Setpoint Temperature Display Setpoint and Override Override and Temperature Display Setpoint and Temperature Display Setpoint, Override, and Temperature Display Predator Room Sensors *without* Logo's: **No Logo** Sensing Only **No Logo** Setpoint **No Logo** Setpoint and Override **No Logo** Setpoint, Override, and Temperature Display	 587-180 587-181 587-182 587-183(1) 587-184 587-185(1) 587-186(1) 587-187(1) 587-550B 587-552B 587-554B 587-557B(1)
C	Predator Room Sensor 6-Conductor Plenum Rated Cables: 25-Foot 50-Foot 100-Foot Predator Room Sensor 4-Conductor (no network connection) Plenum Rated Cables: 25-Foot 50-Foot 100-Foot	 588-100A 588-100B 588-100C 588-101A 588-101B 588-101C
D	Air Velocity Sensor (quantity 2)	QVM62.1
E	Duct Temperature 100K thermistor 40 to 150°F	535-741
F	Floating damper actuator 44 lb. In.	GDE.131.1P
G	Floating valve actuator	SSB81U

1. Sensor will display Fahrenheit or Celsius.

Configuration Tables

The application configuration tables below are for a typical two sensor dual duct box. JDE should be used to modify those items shown as optional or job specific.

Table 2. QVM Dual Duct Box Application Application-Specific Parameters.

Application Component	VAV	CV	Configuration Item	Element	Factory Setting	Desired Setting
Core		X	cVTmpPriority		FALSE	False
	X		dualSupplySeq		SERIES	Job Specific
	X	X	flowVav	enable	TRUE	True for VAV
				dmdAtMin	0%	Job Specific
				dmdAtMax	100%	Job Specific
	X	X	setPnts	Unoccupied cooling setpoint	unoccupiedCool 28.0 °C	Job Specific
				Standby cooling setpoint	standbyCool 25.0 °C	Job Specific
				Occupied cooling setpoint	occupiedCool 23.0 °C	Job Specific
				Occupied heating setpoint	occupiedHeat 21.0 °C	Job Specific
				Standby heating setpoint	standbyHeat 19.0 °C	Job Specific
				Unoccupied heating setpoint	unoccupiedHeat 16.0 °C	Job Specific
Cool/Heat Switch	X	X	htgClgSwit	dmdDeadband tmpDeadband timeDelay	1.00% 0.90°F (0.50°C) 3.0 minutes	Job Specific Job Specific Job Specific
Space Temperature	X	X	stptDialEn		FALSE	Job Specific
			tempStptLim	MinTemp	66.2°F (19.0°C)	Job Specific
				MaxTemp	77.0°F(25.0°C)	Job Specific
Damper Control			flowDmprMtr	TravelTime	90 seconds	Leave as default
				Reverse	FALSE	Leave as default
			flowDmprHtMtr	TravelTime	90 seconds	Leave as default
				Reverse	FALSE	Leave as default
Flow Control			airflowAuxLoc		HOT_DUCT	Job Specific
			recalExtEn		FALSE	Job Specific
			dBandCrossOvr		FALSE	Job Specific
			VelRangeExt1		20.4 m/s	Job Specific
			VelRangeExt2		20.4 m/s	Job Specific
Lighting Control			lightsLag		10 minutes	Job Specific
Occupancy Control			bypassTime		60 minutes	Job Specific
			occSensorEn		FALSE	Job Specific
			statSwitchEn		FALSE	Job Specific
			wallSwitchEn		FALSE	Job Specific

Continued on next page

Table 2. QVM Dual Duct Box Application Application-Specific Parameters, Continued						
Application Component	**VAV**	**CV**	**Configuration Item**	**Element**	**Factory Setting**	**Desired Setting**
Perimeter Heat			hStageCyc		10 minutes	Job Specific
			htgSwitMeth		DEAD_BAND	Job Specific
			numPerimStgs		0	Job Specific
			perimHUnocc		MODULATE	Job Specific
			perimHWrmup		CYCLE	Job Specific
			perimHtgCoil	Enable	FALSE	Job Specific
				DmdAtMin	0%	Job Specific
				DmdAtMax	100%	Job Specific
			perimHtgMtr	TravelTime	125 seconds	Job Specific
				Reverse	FALSE	Job Specific
Source State and Temp			sourceTempLim	NeededToCool	64.4°F (18.0°C)	Job Specific
				NeededToHeat	77.0°F (25.0°C)	Job Specific
			sourceTempLoc		COLD_DUCT	Job Specific
Spare Analog Temp						
Spare Digital Reading						
Spare Analog Percent						

Table 3. QVM Dual Duct Box – Balancing Parameters.					
VAV	**CV**	**Configuration Parameter**	**Element**	**Factory Setting**	**Desired Setting**
X	X	ductArea		1.0764 ft^2 (0.1000 m^2)	Job Specific
X	X	ductAreaAux		1.0764 ft^2 (0.1000 m^2)	Job Specific
X		maxFlowClg		2500 cfm (1180 L/s)	Job Specific
X		maxFlowHtg		850 cfm (401 L/s)	Job Specific
X	X	minFlowClg		449 cfm (212 L/s)	Job Specific
X		minFlowClgAcc		449 cfm (212 L/s)	Job Specific
X		minFlowClUnoc		0 cfm (0 L/s)	Job Specific
X	X	minFlowHtg		600 cfm (283 L/s)	Job Specific
X		minFlowHtgAcc		0 cfm (0 L/s)	Job Specific
X		minFlowHtUnoc		0 cfm (0 L/s)	Job Specific
X	X	sensConstAux		1	Job Specific
X	X	sensConstVAV		1	Job Specific
	X	unitMaxFlow		2500 cfm (1180 L/s)	Job Specific
X		unitMinFlow		0 cfm (0 L/s)	Job Specific
	X	unitStbyFLow		1000 cfm (472 L/s)	Job Specific
	X	unitUnoccFlow		500 cfm (236 L/s)	Job Specific
X	X	nciPrOffset		0%	Job Specific
X	X	nciPrOffsetAux		0%	Job Specific

Table 4. QVM Dual Duct Box - Tuning Parameters			
Configuration Parameter	**Element**	**Factory Setting**	**Desired Setting**
clgDmdCtrB	Pb	(5.00°F) 2.78°C	Job Specific
	Ti	2000 sec	Job Specific
	Td	0 sec	Job Specific
htgDmdCtrB	Pb	(10.0°F) 5.56°C	Job Specific
	Ti	1000 sec	Job Specific
	Td	0 sec	Job Specific
trmFlowCtrB	Pb	4	Job Specific
	Ti	12 sec	Job Specific
	Td	0 sec	Job Specific
trmFlowHtCtrB	Pb	4	Job Specific
	Ti	12 sec	Job Specific
	Td	0 sec	Job Specific

Control Mode Interaction Table –Dual Duct VAV with QVM

Device	Cool		Heat		Morning Warmup	Precool	Dual Cold*		Dual Hot		Off
	Occ	Unoc	Occ	Unoc	Unoc	Unoc	Occ	Unoc	Occ	Unoc	
Cold Flow Stpt	Cool Loop	Cool Loop	Constant	Constant	Constant	Cool Loop	Cool Loop	Cool Loop	Heat Loop	Heat Loop	0 lps
Hot Flow Stpt	Constant	Constant	Heat Loop	Heat Loop	Heat Loop	Constant	Cool Loop	Cool Loop	Heat Loop	Heat Loop	0 lps
Perimeter Valve	Closed	Closed	Mod	Config	Config	Close	Mod	Config	Mod	Config	Close
Perimeter Stages	Off	Off	Stage	Config	Config	Off	Stage	Config	Stage	Config	Off
Cold Flow Limits	MaxClg MinClg	MaxClg MinClgUnoc	ClgAcc	MinClgUnoc	MinClgUnoc	MaxClg MinClgUnoc	MaxClg MinClg	MaxClg MinClgUnoc	MaxClg MinClg	MaxClg MinClgUnoc	0 lps 0 lps
Hot Flow Limits	HtgAcc	MinHtgUnoc	MaxHtg MinHtg	MaxHtg MinHtgUnoc	MaxHtg MinHtgUnoc	MinHtgUnoc	MaxHtg MinHtg	MaxHtg MinHtgUnoc	MaxHtg MinHtg	MaxHtg MinHtgUnoc	0 lps 0 lps

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

* Heat is only available in dual cold operation if perimeter heat is enabled.

NOTE: In TEST or CALIBRATE, perimeter heat will continue to operate based on the previous mode of the controller.

Control Mode Interaction Table –Dual Duct CV with QVM

	Cool			Heat**			Morning Wrmup	PreCool	Off
	Occ	Stby	Unocc	Occ	Stby	Unocc	Unocc	Unocc	
Cold Flow Stpt	Cool Loop	Cool Loop	Cool Loop	Constant Min	Constant Min	Constant Min	Cool Loop	Cool Loop	0 lps
Hot Flow Stpt*	Flow Loop	Flow Loop	Flow Loop	Constant Max	Constant Max	Constant Max	Flow Loop	Flow Loop	0 lps
Perimeter Valve	Closed	Closed	Closed	Mod	Mod	Config	Config	Closed	Closed
Perimeter Stages**	Off	Off	Off	Stage	Stage	Config	Config	Off	Off
CV Max	UnitMax	MaxStby	MaxUnoc	UnitMax	MaxStby	MaxUnoc	MaxStby	MaxStby	0 lps
Cold Min	MinClg	MinClgUnoc	MinClgUnoc	MinClg	MinClgUnoc	MinClgUnoc	MinClgUnoc	MinClgUnoc	0 lps
Hot Min	MinHtg	MinHtgUnoc	MinHtgUnoc	MinHtg	MinHtgUnoc	MinHtgUnoc	MinHtgUnoc	MinHtgUnoc	0 lps

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

* If application is configured for temperature priority, the hot damper will run based on the cooling loop.

** Heat is available only if perimeter heat is enabled.

NOTE: In TEST or CALIBRATE, perimeter heat will continue to operate based on the previous mode of the controller.

TALON

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