SIEMENS

Room Automation Station

Dual Duct Variable Volume with Two Inlet Sensors, 2-Stage Electric Heat, Chilled Ceiling and Hot Water Radiator (on DXR2.x18)

Template 14269

Application Note

A6V11692055
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Smart Infrastructure – Building Products

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Application Notes

This document should be used in conjunction with the VAV Start-up document (A6V10665935) and the "Application Help" in ABT Site. Application Help describes application types installed in the ABT Site library and lists all configuration items found in a specific template or type.

How to find Application help in ABT Site
To understand how to access Application Help, click the Help button in ABT Site (upper right) and go to Configuration > Application configuration. (see "Title and toolbar")

Templates
This application template is factory preloaded into the DXR2 automation station, or it can also be manually loaded using ABT Site. A template can be used as a starting point for the creation of other similar templates, using ABT-Site. Changing or adjusting parameters and setpoint values does not require a new template number, but if a physical input or output is changed, a new 5-digit template number should be assigned.

Application parameters and settings can be modified to meet specific jobsite requirements such as: room setpoints, room airflow rates, room operating modes, actuator timing, and so on. Important parameters fall into two main categories:
1) Individual BACnet configuration values such as setpoints for room temp and air quality.
2) ABT-Inside commissioning parameters such as those used for air component calibration or to tailor features of selected application functions.

If the default application does not meet job requirements, an application can be configured and modified to job specifications using ABT Site.

The Room / Room segment concept
Familiarity with the Room / Room segment concept will be helpful when reading this document. See the "Room/segment" topic under Technical principles in ABT Site help.

Overview
14269

Dual Duct Variable Volume with Two Inlet Sensors, 2-Stage Electric Heat, Chilled Ceiling and Hot Water Radiator: Template 14269 (on DXR2.x18).

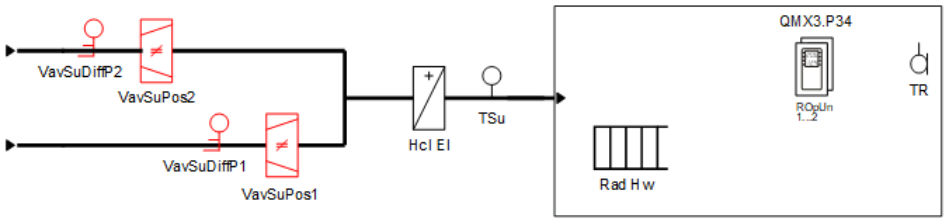
This application modulates the supply air dampers of the dual duct terminal box for cooling, heating, and ventilation. Terminal box airflow is maintained at the larger of ventilation airflow or the heating or cooling airflows.

A chilled ceiling device is active during cooling. When in heating, the 2-stage electric heating coils sequence with the hot duct supply damper to maintain room temperature at setpoint.

The analog outputs for damper control (1DMPR POS, 2DMPR POS) are modulated by respective airflow PID controllers. Two binary outputs activate the stages of electric heat (HTG EL 1ST, HTG EL 2ST). Additionally, a modulating output commands the hot water radiator (RAD V POS) and a modulating AO commands the chilled ceiling device (PANL C POS10).

Each duct can be configured to provide hot, cold (or both) airflow, and the source for ventilation air can be configured to come from cold duct, hot duct, or both. Additionally, the transition between heating and cooling is configurable for hot/cold airflow mixing control or snap acting control. See **Dual Duct Configurations** for detailed information on these topics.

Plant Diagram



VavSuPos1 VavSuPos2	Variable air volume supply air damper	TSu	Supply air temperature sensor (for monitoring and diagnostics)
VavSuDiffP1 VavSuDiffP2	Supply air VAV differential pressure sensor	TR	Room temperature (part of ROpUn)
HclEl	Electric heat coils (2-stage)	ROpUn	Room operating unit
Rad	Modulating HW radiator		

Description of Functions

Basic Functions

- Operating modes for room, plant and devices
- Each VAV duct can provide conditioned air for cooling or heating
- Ventilation air provided by either or both ducts
- Mixing control or snap action control, configurable
- Supply air VAV box, pressure sensor
- Electric heat coils (2-stage)
- Hot water radiator
- Supply chain coordination

Auxiliary Functions

- Green Leaf function
- Comfort button for occupant override

QMX3.P34 / QMX3.P74

Features		
T°	✔	
Room air quality sensor	✔	(P74 only)
LCD multi display	✔	
Green Leaf LED	✔	
Comfort Button	✔	
Heat/Cool Status	✔	
Room Operating Mode	✔	
Rapid Ventilation	✔	NOT AVAILABLE WITH DUAL DUCT
Present setpoint	✔	Displays Comfort or pre-Comfort setpoint – or last in effect.

	⚠ CAUTION
	Nominal air volume flow (AirFlNom) AirFlNom must be understood and set correctly. See Nominal Air Volume Flow in section **VAV Supply Air Damper**.

Dual Duct Sequence Configurations

Note

Default settings assign Duct 1 as cold duct and Duct 2 as hot duct, but these assignments are configurable / reversible if desired or required. The following examples use the default assignments for cold duct and hot duct (use case 4 is special case, see below).

Use case 1: VAV DD - Ventilation source in one duct

- 1a - Ventilation in cold duct (Duct 1)
- 1b - Ventilation in hot duct (Duct 2)

Use case 2: VAV DD - Ventilation in both ducts, with mixing control

- 2a - Cold duct ventilation in deadband
- 2b - Hot duct ventilation in deadband
- 2c - Last duct ventilation in deadband

Use case 3: VAV DD - Ventilation in both ducts, snap acting control

- 3a - Cold duct ventilation in deadband
- 3b - Hot duct ventilation in deadband
- 3c - Last duct ventilation in deadband

Use case 4: VAV DD - Dedicated duct for ventilation from DOAS (dedicated outside air system)

Use case 5: Constant volume DD option - Ventilation in both ducts, with mixing control

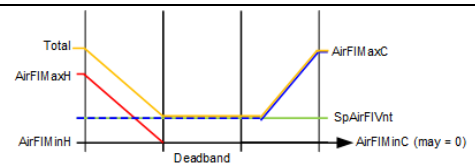
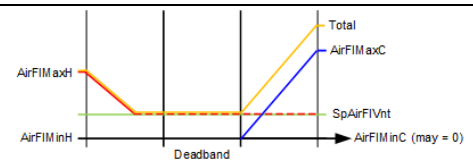
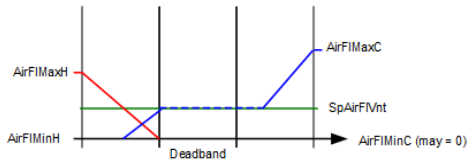
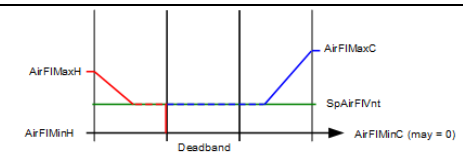
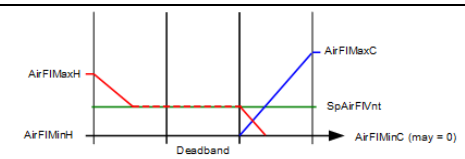
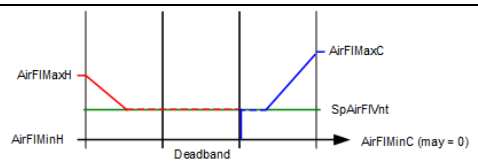
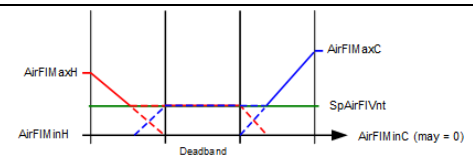
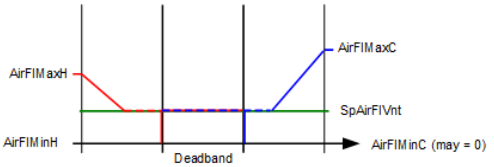
- 5a - Cold duct ventilation in deadband
- 5b - Hot duct ventilation in deadband

Main objects / parameters for dual duct use case configurations:

Name	Description	Available settings
VavSuChovrCnd1 (1VAV CHGVR)	Changeover object for Duct 1	1:Neither 2:Heating 3:**Cooling** (default) 4:Neutral
VavSuChovrCnd2 (2VAV CHGVR)	Changeover object for Duct 2	1:Neither 2:**Heating** (default) 3:Cooling 4:Neutral
VntDuctSprt	Parameter that defines which duct(s) provide ventilation air flow	1:No ventilation 2:Duct 1 3:Duct 2 4:Both ducts
CtlStrgy	Parameter that defines whether mixing control is supported by the dual duct configuration	1:Snap acting control 2:Mixing control
VntSprtDdband	Parameter that defines how ventilation is provided during temperature deadband	1:Duct 1 2:Duct 2 3:Last duct

Color legend for graphics:

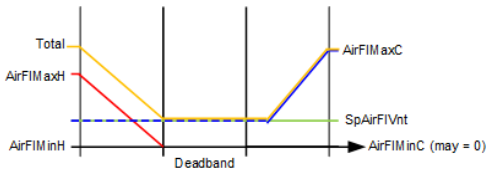
- Red = heating
- Blue = cooling
- Green = ventilation
- Yellow = total air flow

Ventilation source	Ventilation in deadband	Control strategy	Use case	Schedule
Cold duct only	Cold duct	- -	1a	
Hot duct only	Hot duct	- -	1b	
Both ducts	Cold duct	Mixing control	2a	
		Snap acting	3a	
	Hot duct	Mixing control	2b	
		Snap acting	3b	
	Last duct	Mixing control	2c	
		Snap acting	3c	

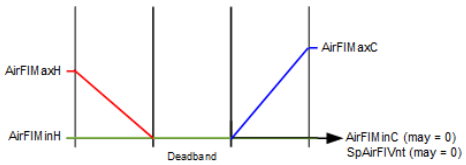
Use case 1: VAV DD - Ventilation source in one duct

In use case 1 configurations, the mechanical equipment consists of a multiple fan AHU with separate elements for heating and cooling air distribution. The hot and cold air streams are drawn from different sources and driven by separate fans. Outside air ventilation is provided in either the hot duct or the cold duct, not both.

Use Case 1a – VAV DD with ventilation in cold duct only (Duct 1):



Cold duct does not close if ventilation requirement remains constant.



Cold duct may close if ventilation requirement goes to zero.

Parameter configuration for use case 1a:

- VavSuChovrCnd1 = Cooling
- VavSuChovrCnd2 = Heating
- VntDuctSprt = Duct 1
- CtlStrgy = n/a [1)]
- VntSprtDdband = n/a [1)]

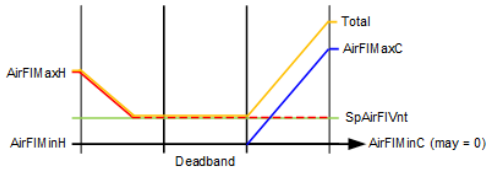
[1)] CtlStrgy and VntSprtDdband are ignored when VntDuctSprt does not equal "Both ducts".

In use case 1a, when the thermal load is in deadband the cold duct air flow will equal the current value of the ventilation flow demand (may vary per room operating mode or DCV); the hot duct air flow will be zero.

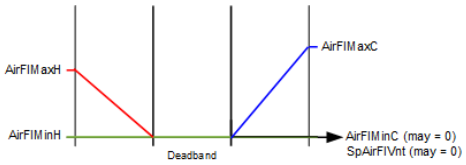
On an increase in cooling load, the cooling flow demand on the cold duct modulates from cooling flow min to cooling flow max. Cold duct air flow will be the greater of vent demand and cooling demand. Hot duct air flow will be zero.

On an increase in heating load, the heating flow demand on the hot duct modulates from heating flow min to heating flow max. Cold duct air flow will be the current value of ventilation flow demand. The total air flow during heating will be the sum of the ventilation air (from the cold duct) and the modulating heating flow.

Use Case 1b – VAV DD with ventilation in hot duct only (Duct 2):



Hot duct does not close if ventilation requirement remains constant.



Hot duct may close if ventilation requirement goes to zero.

Parameter configuration for use case 1b:

- VavSuChovrCnd1 = Cooling
- VavSuChovrCnd2 = Heating
- VntDuctSprt = Duct 2
- CtlStrgy = n/a [1)]
- VntSprtDdband = n/a [1)]

[1)] CtlStrgy and VntSprtDdband are ignored when VntDuctSprt does not equal "Both ducts".

In use case 1b, when the thermal load is in deadband the hot duct air flow will equal the current value of the ventilation flow demand (may vary per room operating mode or DCV); the cold duct air flow will be zero.

On an increase in heating load, the heating flow demand on the hot duct modulates from heating flow min to heating flow max. Hot duct air flow will be the greater of vent demand and heating demand. Cold duct air flow will be zero.

On an increase in cooling load, the cooling flow demand on the cold duct modulates from cooling flow min to cooling flow max. Hot duct air flow will be the current value of ventilation flow demand. The total air flow during cooling will be the sum of the ventilation air (from the hot duct) and the modulating cooling flow.

Use case 2: VAV DD - Ventilation in both ducts, with mixing control

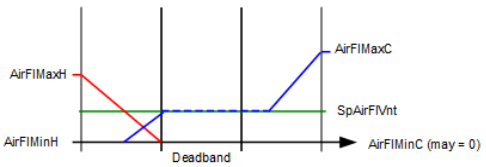
In use case 2 configurations, the mechanical equipment consists typically of a single fan AHU with separate elements for heating and cooling air distribution. The hot and cold air streams are drawn from the same source(s) and driven by the same fan. Outside air ventilation is provided using both ducts.

Ventilation in deadband – When ventilation is provided in both ducts, different possibilities exist for ventilation in deadband: cold duct (Duct 1), hot duct (Duct 2), and "Last duct". The dual duct can be configured ac-

cording to the relative costs of providing hot air or cold air. For example, if it takes more energy to provide hot air, then it makes sense to use cold air for ventilation in the deadband. If energy costs are approximately equal, then "last duct" configuration may be preferable.

Mixing control vs. Snap acting control – Some people associate mixing hot and cold air flows in the dual duct box with wasting energy. Others appreciate the gradual temperature modulation that comes with mixing. Snap action prevents the mixing of hot and cold air flows in the dual duct box. Select according to project specifications or end-user preference.

Use Case 2a – VAV DD with ventilation in both ducts, cold duct ventilation in deadband, with mixing control:



Cold duct will stay open in deadband to meet a ventilation requirement. As heating load ramps up, cold duct damper modulates to zero as hot duct damper modulates open (i.e., mixing control during ramp up of heating mode).

Ducts may close if ventilation requirement goes to zero.

Parameter configuration for use case 2a:

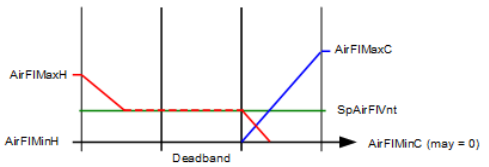
- VavSuChovrCnd1 = Cooling
- VavSuChovrCnd2 = Heating
- VntDuctSprt = Both ducts
- CtlStrgy = Mixing control
- VntSprtDdband = Duct 1

In use case 2a, with the thermal load in deadband the cold duct air flow will equal the current value of the ventilation flow demand (may vary per room operating mode or DCV); the hot duct air flow will be zero.

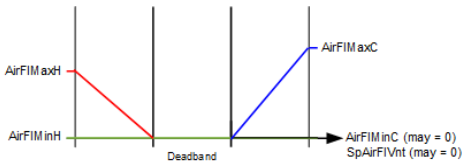
On an increase in cooling load, the cooling flow demand on the cold duct modulates from cooling flow min to cooling flow max. Cold duct air flow will be the greater of vent demand and cooling demand. Hot duct air flow will be zero.

On an increase in heating load, the heating flow demand on the hot duct modulates from heating flow min to heating flow max. Cold duct air flow will be the value of the difference between hot duct air flow and the current ventilation flow demand, provided that the ventilation flow demand is greater than hot duct air flow, otherwise cold duct air flow will be zero.

Use Case 2b – VAV DD with ventilation in both ducts, hot duct ventilation in deadband, with mixing control:



Hot duct will stay open in deadband to meet a ventilation requirement. As cooling load ramps up, hot duct damper modulates to zero as cold duct damper modulates open (i.e., mixing control during ramp up of cooling mode).



Ducts may close if ventilation requirement goes to zero.

Parameter configuration for use case 2b:

- VavSuChovrCnd1 = Cooling
- VavSuChovrCnd2 = Heating
- VntDuctSprt = Both ducts
- CtlStrgy = Mixing control
- VntSprtDdband = Duct 2

In use case 2b, with the thermal load in deadband the hot duct air flow will equal the current value of the ventilation flow demand (may vary per room operating mode or DCV); the cold duct air flow will be zero.

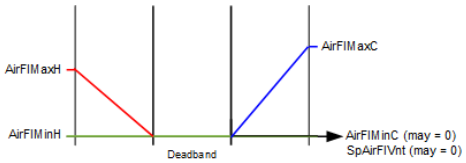
On an increase in heating load, the heating flow demand on the hot duct modulates from heating flow min to heating flow max. Hot duct air flow will be the greater of vent demand and heating demand. Cold duct air flow will be zero.

On an increase in cooling load, the cooling flow demand on the cold duct modulates from cooling flow min to cooling flow max. Hot duct air flow will be the value of the difference between cold duct air flow and the cur-

rent value of ventilation flow demand, provided that the ventilation flow demand is greater than cold duct air flow, otherwise hot duct air flow will be zero.

Use Case 2c – VAV DD with ventilation in both ducts, last duct ventilation in deadband, with mixing control:

Last active duct will stay open in deadband to meet a ventilation requirement. Outside of deadband, as the heating load (or the cooling load) ramps up, the ducts provide a hot/cold mixture to meet the ventilation requirement. See additional information below.



Ducts may close if ventilation requirement goes to zero.

Parameter configuration for use case 2c:

- VavSuChovrCnd1 = Cooling
- VavSuChovrCnd2 = Heating
- VntDuctSprt = Both ducts
- CtlStrgy = Mixing control
- VntSprtDdband = Last duct

In use case 2c, with the thermal load in deadband the air flow from the last active duct (heating or cooling) will equal the current value of the ventilation flow demand (may vary per room operating mode or DCV); the inactive duct air flow will be zero.

If the last active duct = cold duct, then when the system exits the temperature deadband the behavior is as follows:

- Exiting deadband on a call for cool when last duct is the cold duct and CtlStrgy = Mixing control;
  On an increase in cooling load, the cooling flow demand on the cold duct modulates from cooling flow min

to cooling flow max. Cold duct air flow will be the greater of vent demand and cooling demand. Hot duct air flow will be zero. (Cold duct remains the active duct.)

- Exiting deadband on a call for heat when last duct is the cold duct and CtlStrgy = Mixing control;
  On an increase in heating load, the heating flow demand on the hot duct modulates from heating flow min to heating flow max. Cold duct air flow will be the value of the difference between hot duct air flow and the current value of ventilation flow demand, provided that the ventilation flow demand is greater than hot duct air flow, otherwise cold duct air flow will modulate to zero. Once the cold duct flow modulates to zero, the hot duct becomes the active duct.

If the last active duct = **hot duct**, then when the system exits the temperature deadband the behavior is as follows:

- Exiting deadband on a call for heat when last duct is the hot duct and CtlStrgy = Mixing control;
  On an increase in heating load, the heating flow demand on the hot duct modulates from heating flow min to heating flow max. Hot duct air flow will be the greater of vent demand and heating demand. Cold duct air flow will be zero. (Hot duct remains the active duct.)

- Exiting deadband on a call for cool when last duct is the hot duct and CtlStrgy = Mixing control;
  On an increase in cooling load, the cooling flow demand on the cold duct modulates from cooling flow min to cooling flow max. Hot duct air flow will be the value of the difference between cold duct air flow and the current value of ventilation flow demand, provided that the ventilation flow demand is greater than cold duct air flow, otherwise hot duct air flow will modulate to zero. Once the hot duct flow modulates to zero, the cold duct becomes the active duct.

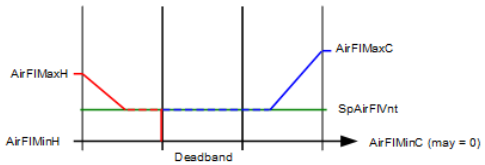
Use case 3: VAV DD - Ventilation in both ducts, snap acting control

In use case 3 configurations, the mechanical equipment consists typically of a single fan AHU with separate elements for heating and cooling air distribution. The hot and cold air streams are drawn from the same source(s) and driven by the same fan. Outside air ventilation is provided using both ducts.

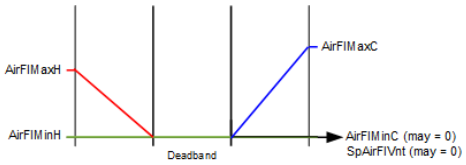
Ventilation in deadband – When ventilation is provided in both ducts, different possibilities exist for ventilation in deadband: cold duct (Duct 1), hot duct (Duct 2), and "Last duct". The dual duct can be configured according to the relative costs of providing hot air or cold air. For example, if it takes more energy to provide hot air, then it makes sense to use cold air for ventilation in the deadband. If energy costs are approximately equal, then "last duct" configuration may be preferable.

Mixing control vs. Snap acting control – Some people associate mixing hot and cold air flows in the dual duct box with wasting energy. Others appreciate the gradual temperature modulation that comes with mixing. Snap action prevents the mixing of hot and cold air flows in the dual duct box. Select according to project specifications or end-user preference.

Use Case 3a – VAV DD with ventilation in both ducts, cold duct ventilation in deadband, snap acting control:



Cold duct will stay open in deadband to meet ventilation requirement. On an exit to heating, the cold duct closes immediately and the hot duct takes over ventilation needs.



Ducts may close if ventilation requirement goes to zero.

Parameter configuration for use case 3a:

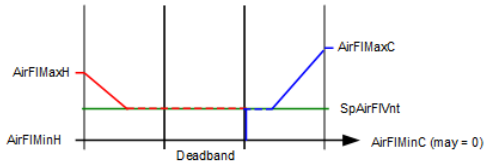
- VavSuChovrCnd1 = Cooling
- VavSuChovrCnd2 = Heating
- VntDuctSprt = Both ducts
- CtlStrgy = Snap acting control
- VntSprtDdband = Duct 1

In use case 3a, with the thermal load in deadband the cold duct air flow will equal the current value of the ventilation flow demand (may vary per room operating mode or DCV); the hot duct air flow will be zero.

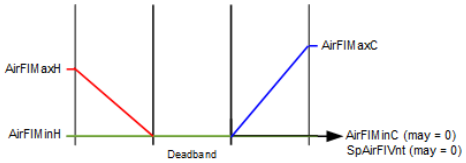
On an increase in cooling load, the cooling flow demand on the cold duct modulates from cooling flow min to cooling flow max. Cold duct air flow will be the greater of vent demand and cooling demand. Hot duct air flow will be zero.

On an increase in heating load, the cold duct closes and the hot duct will open (snap action) to take over any active ventilation flow rate. Heating flow demand on the hot duct modulates from heating flow min to heating flow max. Hot duct air flow will be the greater of vent demand and heating demand. Cold duct air flow will be zero.

Use Case 3b – VAV DD with ventilation in both ducts, hot duct ventilation in deadband, snap acting control:



Hot duct will stay open in deadband to meet ventilation requirement. On an exit to cooling, the hot duct closes immediately and the cold duct takes over ventilation needs.



Ducts may close if ventilation requirement goes to zero.

Parameter configuration for use case 3b:

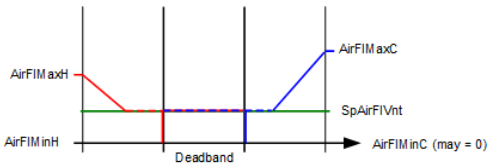
- VavSuChovrCnd1 = Cooling
- VavSuChovrCnd2 = Heating
- VntDuctSprt = Both ducts
- CtlStrgy = Snap acting control
- VntSprtDdband = Duct 2

In use case 3b, with the thermal load in deadband the hot duct air flow will equal the current value of the ventilation flow demand (may vary per room operating mode or DCV); the cold duct air flow will be zero.

On an increase in heating load, the heating flow demand on the hot duct modulates from heating flow min to heating flow max. Hot duct air flow will be the greater of vent demand and heating demand. Cold duct air flow will be zero.

On an increase in cooling load, the hot duct closes and the cold duct will open (snap action) to take over any active ventilation flow rate. Cooling flow demand on the cold duct modulates from cooling flow min to cooling flow max. Cold duct air flow will be the greater of vent demand and cooling demand. Hot duct air flow will be zero.

Use Case 3c – VAV DD with ventilation in both ducts, last duct ventilation in deadband, snap acting control:



Last active duct will stay open in deadband to meet ventilation requirement. For behavior outside of deadband see additional information below.

Ducts may close if ventilation requirement goes to zero.

Parameter configuration for use case 3c:

- VavSuChovrCnd1 = Cooling
- VavSuChovrCnd2 = Heating
- VntDuctSprt = Both ducts
- CtlStrgy = Snap acting control
- VntSprtDdband = Last duct

In use case 3c, with the thermal load in deadband the air flow from the last active duct will equal the current value of the ventilation flow demand (may vary per room operating mode or DCV); the inactive duct air flow will be zero.

If the last active duct = cold duct, then when the system exits the temperature deadband the behavior is as follows:

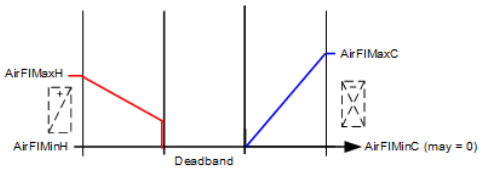
- Exiting deadband on a call for cool when last duct is the cold duct and CtlStrgy = Snap acting;
  On an increase in cooling load, the cooling flow demand on the cold duct modulates from cooling flow min to cooling flow max. Cold duct air flow will be the greater of vent demand and cooling demand. Hot duct air flow will be zero. (Cold duct remains the active duct.)
- Exiting deadband on a call for heat when last duct is the cold duct and CtlStrgy = Snap acting;
  On an increase in heating load, the cold duct closes (snap action) and the heating loop becomes the active loop / duct. As the heating flow demand on the hot duct modulates from heating flow min to heating flow max, the hot duct air flow will be the greater of vent demand and heating demand.

If the last active duct = **hot duct**, then when the system exits the temperature deadband the behavior is as follows:

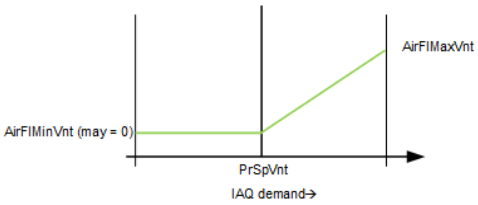
- Exiting deadband on a call for heat when last duct is the hot duct and CtlStrgy = Snap acting;
  On an increase in heating load, the heating flow demand on the hot duct modulates from heating flow min to heating flow max. Hot duct air flow will be the greater of vent demand and heating demand. Cold duct air flow will be zero. (Hot duct remains the active duct.)
- Exiting deadband on a call for cool when last duct is the hot duct and CtlStrgy = Snap acting;
  On an increase in cooling load, the hot duct closes (snap action) and the cooling loop becomes the active loop / duct. As the cooling flow demand on the cold duct modulates from cooling flow min to cooling flow max, the cold duct air flow will be the greater of vent demand and cooling demand.

Use Case 4: VAV DD - Dedicated duct for ventilation from DOAS (dedicated outside air system)

In use case 4 configurations, the mechanical equipment consists of a multiple fan AHU with DOAS, and separate elements (if present) for heating / cooling air distribution. When the thermal load is in deadband, air flow in the duct used for temperature control can be zero (Duct 1 in graphic).



Duct 1



Duct 2

Parameter configuration for use case 4:

- VavSuChovrCnd1 = Cooling
- VavSuChovrCnd2 = Neither
- VntDuctSprt = Duct 2
- CtlStrgy = n/a [1)]
- VntSprtDdband = n/a [1)]

[1)] CtlStrgy and VntSprtDdband are ignored when VntDuctSprt does not equal "Both ducts".

In use case 4, all ventilation is handled in Duct 2 by dedicated outside air system (DOAS). Minimum ventilation levels can be specified per room occupancy mode. When configured for DCV (demand control ventilation) an increase in ventilation flow is provided in response to room IAQ (CO_2) setpoints configured per occupancy mode.

Temperature control is provided by Duct 1 and may include optional heating or cooling coils. On an increase in cooling load, Duct 1 will modulate from cooling flow min to cooling flow max. In heating mode, Duct 1 will provide air flow to support heating coil(s) from heating flow min to heating flow max.

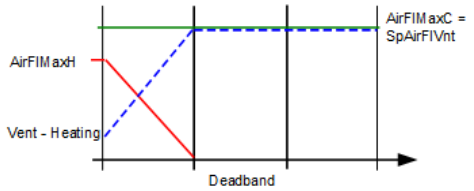
Use Case 5: Constant volume DD option with ventilation in both ducts, with mixing control

In use case 5 configurations, the mechanical equipment consists typically of a single fan AHU with separate elements for heating and cooling air distribution. The hot and cold air streams are drawn from the same source(s) and driven by the same fan. Outside air ventilation is provided using both ducts.

To achieve the constant volume option, the minimum ventilation parameter(s) located in the room AF for ventilation control (VavVntCtl) are set **equal or greater than the heating / cooling maximum flow setpoints** (VavSuAirFlMaxC, VavSuAirFlMaxH). When this is done, the terminal provides constant air flow in the Comfort mode, and may be configured to reduce flow in other room operating modes.

In constant volume configurations, temperature control is maintained at a single setpoint, either heating or cooling, depending on the setting of parameter VntSprtDdband (Ventilation support in deadband). See following examples.

Use Case 5a – Constant volume DD option, ventilation in both ducts, mixing control, with cold duct ventilation in deadband

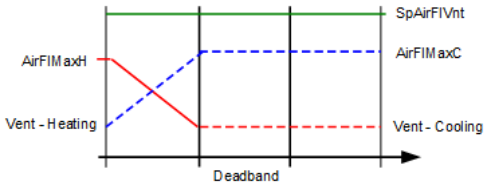


VntSprtDdband = Duct 1, example 1:

Cold duct stays at constant max volume during cooling and deadband to provide the elevated minimum ventilation setting.

At the heating setpoint, **mixing control occurs** to maintain constant volume dual duct air flow and room temperature control: as heating load ramps up, hot duct damper modulates open and cold duct damper modulates down.

Optional heat elements (e.g. hot water coil) can be configured to provide additional heating after the hot duct has reached maximum flow.



VntSprtDdband = Duct 1, example 2:

Cold duct stays at constant max volume during cooling and deadband with an additional level of supplemental ventilation air flow provided by hot duct. The air flows are summed to provide an elevated minimum ventilation setting larger than max cooling flow.

At the heating setpoint, **mixing control occurs** to maintain constant volume dual duct air flow and room temperature control: as heating load ramps up, hot duct damper modulates open and cold duct damper modulates down. When the total flow (ventilation setpoint) is larger than the max heating setpoint, the cold duct provides the additional supplemental ventilation air flow.

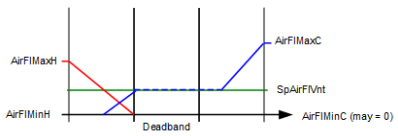
Optional heat elements (e.g. hot water coil) can be configured to provide additional heating after the hot duct has reached maximum flow.

Parameter configuration for use case 5a:

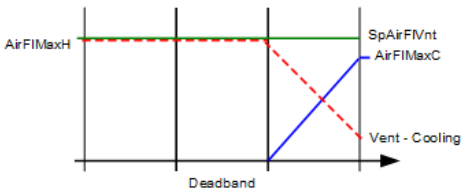
- VavSuChovrCnd1 = Cooling
- VavSuChovrCnd2 = Heating
- VntDuctSprt = Both ducts
- CtlStrgy = Mixing control
- VntSprtDdband = Duct 1 (mixing will occur at/during setpoint for Duct 2 hot duct)
- Minimum ventilation parameter(s)* = desired CV flow

*In the room AF for ventilation control (VavVntCtl) set min vent parameter for Comfort mode (AirFlMinRCmf) to desired CV flow; the min vent setpoint object in VavSuDuald11 (VavSuAflMinVnt) can be set to zero when the minimum ventilation parameters are used for min vent settings.

Note that if minimum ventilation parameter is not set high (for example during Economy mode) constant volume is not provided:



Use Case 5b – Constant volume DD option, ventilation in both ducts, mixing control, and hot duct ventilation in deadband

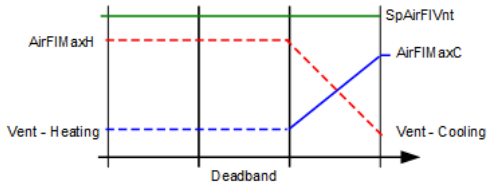


VntSprtDdband = Duct 2, example 1:

Hot duct stays at constant max volume during heating and deadband to provide the elevated minimum ventilation setting.

At the cooling setpoint, **mixing control occurs** to maintain constant volume dual duct air flow and room temperature control: as cooling load ramps up, cold duct damper modulates open and hot duct damper modulates down.

Optional cooling elements (e.g. chilled water coil) can be configured to provide additional cooling after the cold duct has reached maximum flow.



VntSprtDdband = Duct 2, example 2:

Hot duct stays at constant max volume during heating and deadband with an additional level of supplemental ventilation air flow provided by cold duct. The air flows are summed to provide an elevated minimum ventilation setting larger than max heating flow.

At the cooling setpoint, **mixing control occurs** to maintain constant volume dual duct air flow and room temperature control: as cooling load ramps up, cold duct damper modulates open and hot duct damper modulates down. When the total flow (ventilation setpoint) is larger than the max cooling setpoint, the hot duct provides the additional supplemental ventilation air flow.

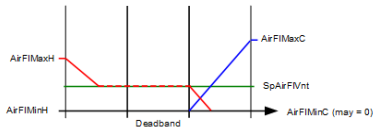
Optional cooling elements (e.g. chilled water coil) can be configured to provide additional cooling after the cold duct has reached maximum flow.

Parameter configuration for use case 5b:

- VavSuChovrCnd1 = Cooling
- VavSuChovrCnd2 = Heating
- VntDuctSprt = Both ducts
- CtlStrgy = Mixing control
- VntSprtDdband = Duct 2 (mixing will occur at/during setpoint for Duct 1 cold duct)
- Minimum ventilation parameter(s)* = desired CV flow

*In the room AF for ventilation control (VavVntCtl) set min vent parameter for Comfort mode (AirFlMinRCmf) to desired CV flow; the min vent setpoint object in Duald11 (VavSuAflMinVnt) can be set to zero when the minimum ventilation parameters are used for min vent settings.

Note that if minimum ventilation parameter is not set high (for example during Economy mode) constant volume is not provided:



Sequence of Operation – Summary

Overview

This application modulates the supply air dampers of the dual duct terminal box for cooling, heating, and ventilation. Terminal box airflow is maintained at the larger of ventilation airflow or the heating or cooling airflows.

A chilled ceiling device is active during cooling. When in heating, the 2-stage electric heating coils sequence with the hot duct supply damper to maintain room temperature at setpoint.

The analog outputs for damper control (1DMPR POS, 2DMPR POS) are modulated by respective airflow PID controllers. Two binary outputs activate the stages of electric heat (HTG EL 1ST, HTG EL 2ST). Additionally, a modulating output commands the hot water radiator (RAD V POS) and a modulating AO commands the chilled ceiling device (PANL C POS10).

Each duct can be configured to provide hot, cold (or both) airflow, and the source for ventilation air can be configured to come from cold duct, hot duct, or both. Additionally, the transition between heating and cooling is configurable for hot/cold airflow mixing control or snap acting control. See **Dual Duct Configurations** for detailed information on these topics.

PID controllers are provided for each of the following control elements:

- Room heating demand
- Room cooling demand
- VAV duct 1 airflow setpoint
- VAV duct 2 airflow setpoint
- Ventilation demand
  (basic ventilation and/or demand control)

Inputs

- Room temperature sensor
- Room temperature setpoint shift
- Temporary Comfort button
- GreenLeaf button
- Differential pressure sensor, Duct 1
- Differential pressure sensor, Duct 2
- Supply air temperature sensor
- Condensate monitor
- Heating coil overtemperature detector

Outputs

- Supply damper actuator, duct 1
- Supply damper actuator, duct 2
- Binary output for stage 1 electric heat
- Binary output for stage 2 electric heat
- Hot water radiator coil modulating valve
- Chilled ceiling modulating valve

Room operating modes

The operating mode of the controlled space is applied according to schedule or room occupant input. The room operating modes are:

- Comfort (occupied)
- Pre-Comfort (standby)
- Economy (unoccupied)
- Protection (e.g. extended holiday)

Comfort mode is applied per schedule via central command for each VAV box. A pushbutton ("Comfort button") is provided at each room operator unit to temporarily override the Economy mode and place the room into occupancy (Comfort) for a period of time (120 min configurable). Prior to occupancy a request for warm-up or cool down can be provided via central command.

Each room operating mode has a configurable ventilation mode (e.g. minimum ventilation, DCV) and a separate minimum room air volume flow (e.g. 150 cfm, configurable).

Related objects:

- RM OP MODE – Room operating mode (ROpMod)
- OP MOD CMD – Central operating mode command value (CenOpModCmdv)
- CMF BTN – Comfort button (CmfBtn)
- WARM UP REQ – Warm-up request (WarmUpReq)
- COOL DN REQ – Cool down request (CoolDwnReq)

Room temperature setpoint determination

a) The application evaluates operating modes, setpoints and offsets to calculate and determine the current ("effective") room temperature heating and cooling setpoints.

b) The heating and cooling setpoints can be separately configured for each room operating mode.

c) Setpoints can be commanded manually or via central command.

d) The room operator unit is configured to allow manual adjustment of Comfort and Pre-Comfort control setpoints. The shift limit is +/- 5.4° F, configurable. Manual adjustments at the room unit [RM TEMP SHFT] will shift the heating and cooling setpoints up or down together, keeping the width of the deadband constant.

e) Pre-Comfort heating and cooling setpoints are each based on a heating or cooling Comfort offset value; each Pre-Comfort setpoint has its own configurable offset differential (default 2° F).

f) During Comfort and Pre-Comfort modes, the room unit will display the current heating or cooling setpoint.

g) During Economy and Protection modes, the room unit will display the last Comfort or Pre-Comfort heating or cooling setpoint.

h) When in deadband (no heating or cooling) – during any mode – the room unit will display the last Comfort or Pre-Comfort heating or cooling setpoint.

i) The heating/cooling state is displayed as an icon on the room unit. When in deadband, the space for the icon is blank to indicate that heating and cooling are both off.

Related objects:

- OP MODE EFF – Present operating mode (PrOpMod)
- RM TEMP EVAL – Room temperature (RTemp)
- HTG STPT EFF – Present heating setpoint (PrSpH)

- CLG STPT EFF – Present cooling setpoint (PrSpC)
- RM TEMP STPT – Room temperature setpoint (SpTR)
- RM TEMP SHFT – Room temperature setpoint shift (SpTRShft)
- CMF CLG STPT – Cooling setpoint for comfort (SpCCmf)
- CMF HTG STPT – Heating setpoint for comfort (SpHCmf)
- STBY C DELTA – Delta cooling setpoint for pre-comfort (DSpCPcf)
- STBY H DELTA – Delta heating setpoint for pre-comfort (DSpHPcf)
- ECO CLG STPT – Cooling setpoint for economy (SpCEco)
- ECO HTG STPT – Heating setpoint for economy (SpHEco)
- PROT CLGSTPT – Cooling setpoint for protection (SpCPrt)
- PROT HTG SP – Heating setpoint for protection (SpHPrt)
- H.C STATE – Heating/cooling state (HCSta)

Supply airflow setpoints

Min and max supply airflow heating and cooling setpoints, separately configurable:

- HTG FLOW MIN – Supply air VAV minimum air volume flow for heating (VavSuAirFlMinH)
- HTG FLOW MAX – Supply air VAV maximum air volume flow for heating (VavSuAirFlMaxH)
- CLG FLOW MIN – Supply air VAV minimum air volume flow for cooling (VavSuAirFlMinC)
- CLG FLOW MAX – Supply air VAV maximum air volume flow for cooling (VavSuAirFlMaxC)

Min and max supply airflow ventilation setpoints:

- VENT FLO MIN – Supply air VAV minimum air volume flow for ventilation (VavSuAflMinVnt)
- VENT FLO MAX – Supply air VAV maximum air volume flow for ventilation (VavSuAflMaxVnt)

Additional ventilation parameters, separately configurable per occupancy mode:

- Room minimum ventilation flow setpoints

Dual Duct VAV Box Sequence with 2-Stage E-heat

a) Cooling – When the room temperature [RM TEMP EVAL] rises above the effective cooling setpoint [CLG STPT EFF], the chilled radiant ceiling device is activated and the cold duct supply damper modulates from the cooling or vent flow minimum (whichever is larger) to the cooling flow max to satisfy CLG STPT EFF.

b) Heating – When the room temperature is below the effective heating setpoint [HTG STPT EFF], the hot duct supply damper and 2-stage electric heat coils are controlled as follows:

- Electric radiator activates.
- The hot duct supply damper modulates to the larger of heating flow min or ventilation min as 1st stage E-heat activates. (Supply damper airflow interlock is used to enable electric heating coil operation.)
- If the effective heating setpoint cannot be maintained, 2nd stage E-heat activates.
- If the effective heating setpoint cannot be maintained using the minimum flow level, the supply damper will modulate to heating flow max as required to satisfy HTG STPT EFF.

c) Ventilation in deadband (configurable) – When the room temperature is between the effective heating and cooling setpoints, the assigned ventilation supply damper is positioned at the ventilation minimum flow setting.

d) Warm-up cycle (via central command) – Radiator activates, the assigned heating duct supply damper is positioned at heating flow max and the 2-stage E-heat coils are activated to satisfy the effective heating setpoint.

e) Cool down cycle (via central command) – The chilled radiant ceiling device is activated and the assigned cooling duct supply damper is positioned at cooling flow max and the heating coil(s) are closed / turned off to satisfy the effective cooling setpoint.

Room GreenLeaf

The GreenLeaf symbol on the room operator unit indicates that the room is operating in an energy-efficient manner (symbol glows green). A user-entered setpoint change to a non energy-efficient state will result in the leaf symbol turning red.

- Occupant can restore the room to energy efficiency by pressing the GreenLeaf button (direct press on leaf symbol). Pressing the GreenLeaf button when it is red removes the manual setpoint shift and restores the room to energy efficiency (symbol glows green).
- Setpoint shift tolerance before leaf symbol turns red is 4° F (2C), configurable.
- GreenLeaf status can be externally reset to green (e.g. schedule change). The behavior is configurable.

Central plant coordination

Collect demand from VAV supply air terminal boxes
The central plant collects and evaluates VAV supply airflow information to coordinate primary air demand requests from the terminal boxes with central AHU supply capacity.

Collect demand from room hot water valves (e.g., hot water radiators and heating coils)

The central plant collects and evaluates hot water demand requests for the primary hot water plant. In addition, central plant coordination provides for the following:

- Operates the hot water system responsive to room operating modes;
- Kick function (stroke the valves periodically to prevent sticking);
- Disable hot water consumers in hot weather;
- Permits valve position override for balancing or commissioning.

– **END OF SEQUENCE OF OPERATION SUMMARY** –

Room Automation Overview

To ensure building controls can be optimized by central systems, primary systems and individual room automation, it is essential that:

- Individual BACnet objects are grouped together to facilitate optimization of building systems.
- Room operating functions are governed by the following room automation operating modes: Room operating mode, Plant operating mode, and HVAC device mode.

Room and Room segments

An application type is composed of various modules (application functions, AF) that coordinate common functions and control devices. There are two general, large collections of these application function; one named *Room* and the other *Room segment*. This is helpful to know when you are trying to find and use various features.

Depending on the application being used and its supported features, the Room AFs provide coordination between various control devices and functions such as:

- Plant operation mode
- Room operation mode
- Setpoint determination
- Room cooling PID or Staged controller
- Room heating PID or Staged controller
- Room ventilation controller
- Dehumidification PID controller
- Heating/cooling state determination

The Room segment application functions control individual HVAC devices (for example, heating coil, supply damper, and so on). Although a room usually has only one room segment, multiple segments can be controlled and coordinated by a single room.

Grouping

To manage these many entities and to facilitate central control functions, a grouping mechanism has been applied to organize these functions by enabling group collaboration, (that is, the data exchange between the central control functions (group masters) and individual entities (group members).

Room and Room segment groups allow the central control and coordination of different building systems, zones, areas. Typical central control functions are:

- Central operating mode – from operating station or a scheduler, distributed to connected rooms.
- HVAC emergency – coordinates emergency functions in zones and controls the HVAC devices according to the emergency mode.
- Central HVAC functions – collects demand signals from rooms using grouping mechanism and provides the setpoint and supply chain demand to the central plants (for example, chilled water, hot water or air handling unit). DXRs can also be used without leveraging central functions by programming at the supervisory controller.

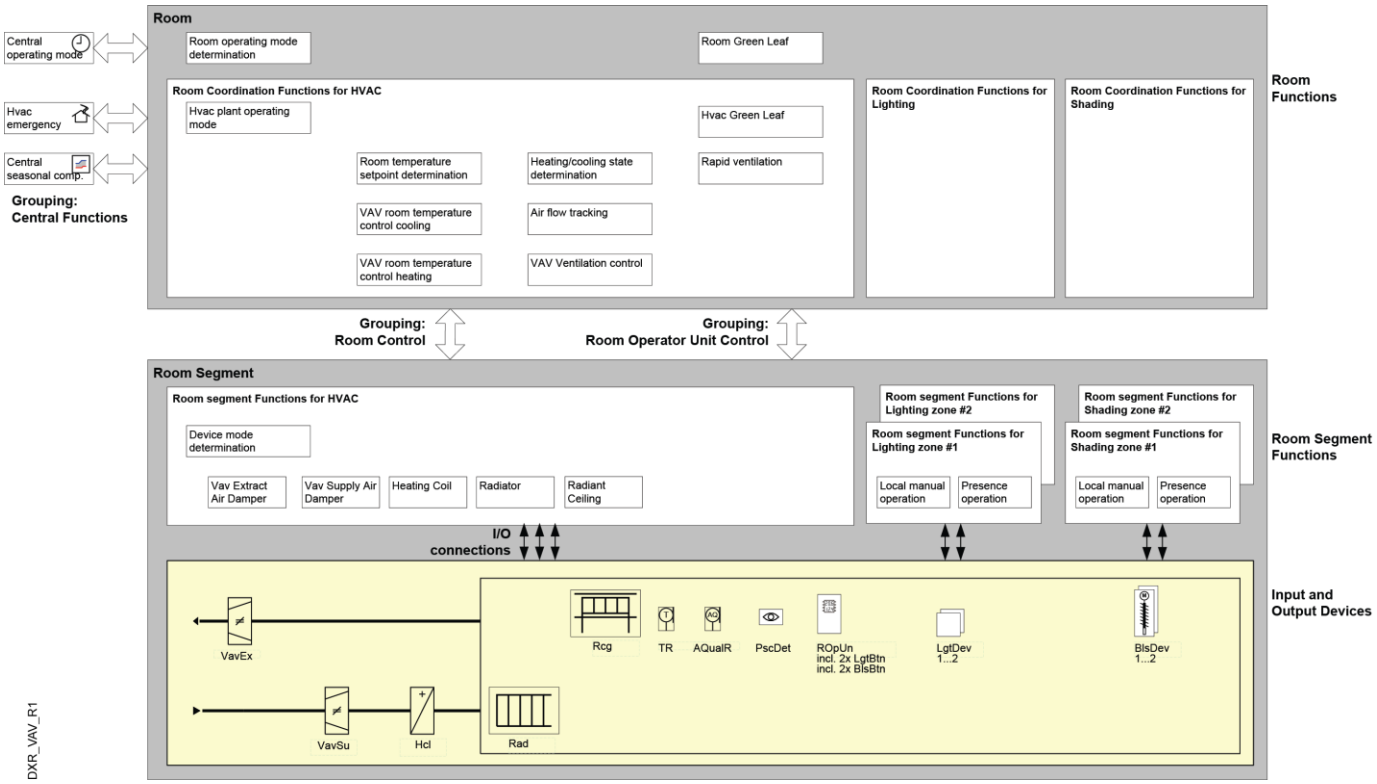
Operating Modes

Room operating mode (ROpMod) is determined by central functions (for example, scheduler) and can be overwritten by a local presence button on the room unit. The room operating mode is a multistate BACnet Object that supports the following room operating conditions:

- Comfort (occupied)
- Pre-Comfort (standby offset)
- Economy(unoccupied)
- Protection (extended unoccupied period)

Plant operating mode (PltOpMod) is determined by the room operating mode and can be overridden by central request for Warm-up, Cool down or Night cooling, and so on. The plant operating mode is a multistate BACnet Object that supports up to 17 different plant operating modes. Rooms typically use the following plant operating modes; Off, Comfort, Pre-Comfort, Economy, Warm-up and Cool down.

HVAC device mode determination – The plant operating mode is used to determine the device mode (the operating state) for each HVAC device controlled in the room segment. The HVAC device mode is a multistate BACnet object that supports the operating states of HVAC devices. Typically each device is assigned operating modes (for example, Off, Control mode, Fully Open). When the HVAC device is in Control mode it is under the control of the Room HVAC coordination functions. For additional information see *ABT Site Help, Technical principles > Operating modes*.



Example: VAV application including Lights and Blinds.

Room Functions

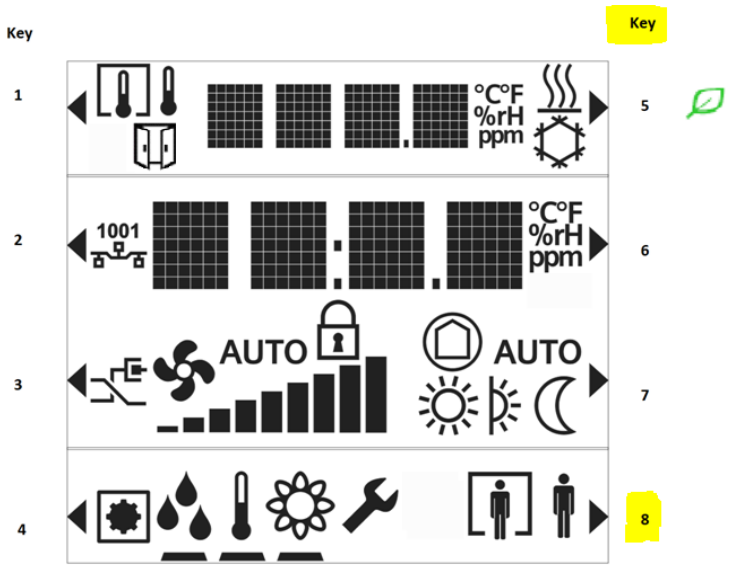
Room Operating Mode Determination

Overview

The **ROpModDtr** application function (AF) calculates the Room operating mode (ROpMod) and makes it available to the coordinated Room segment AFs.

Input	Functionality	Source	Related data point
Comfort button* Key 8 - temporary Comfort mode (default setting for preloaded templates)	• Manual On (trigger or re-trigger) (timer allows Comfort mode to time out)	• Room operator unit on PL-Link (e.g. QMX3.xx) using the AF for Room operator unit interface (ROpUn11) • Room operator unit on BACnet (e.g. QMX7.xx)	CmfBtn 0:Inactive 1:Active
Presence button* When configured, activates/deactivates Comfort mode when Key 8 is pressed.	• Manual On / Manual Off (timer allows Comfort mode to time out)		
Central room operation mode command (using Grouping)	• Manual • Auto (Auto equals relinquishing of prio13)	• Central manual operation • Central scheduler	ROpMod 1:Protection 2:Economy 3:Pre-Comfort 4:Comfort

*When configured, the **Comfort** button is activated by Key 8 on the room operator unit. If configured instead for "Presence", you can toggle Comfort mode on and off by pressing and re-pressing Key 8 (see Startup document for how to configure).



The **Comfort**/**Presence** button has an automatic delay-off delay timer (**TiCmfBtn**). The default is 120 minutes. TiCmfBtn (Time for comfort button) is in the application function for Room operating mode determination (ROpModDtr).

Setting TiCmfBtn to 0 will disable the **Comfort** button. If the **Presence** button is configured, setting TiCmfBtn to 0 only disables the timer; in this case, Comfort mode remains in effect until the next schedule change unless the **Presence** button is pressed again.

Outputs:

ROpModDtr outputs the following:

- ROpMod - The room operating mode is distributed to HVAC, lighting and shading AFs.
- PrOpMod - The present operating mode can be configured for display on the room operator unit.
- ManOpCnd - Manual operation condition can be configured / set to Locked (default = Unlocked). When Locked, manual attempts to adjust the setpoint are blocked during the operating mode(s) defined in the parameter for Manual operation lock configuration (**ManOpLockCnf**). The default for ManOpLockCnf = Protection & Economy – this means that manual attempts to increase comfort are blocked during Economy and Protection modes.
  Note: Setting ManOpCnd to Locked does not lock out manual changes to lighting or shading; it only locks out HVAC changes.
- CmfCndTrg / EefCndTrg (see Configuration)
  - Comfort condition trigger (**CmfCndTrg**) specifies transition of room mode from less comfort to more comfort.
  - Energy efficiency condition trigger (**EefCndTrg**) specifies transition of room mode away from comfort.
  - Central triggering

Manual setpoint adjustment & EefCndTrg

The default configuration will reset a user-entered setpoint adjustment when the room mode changes. To eliminate this reset, do the following:
- Set **Comfort/Pre-Comfort to Economy (CmfPcfToEco)** to "**None**"
- Set **Comfort to Pre-Comfort (CmfToPcf)** to "**None**"

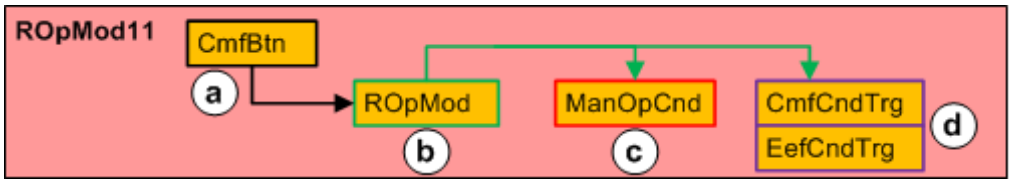
These parameters are in the AF, Room operating mode determination ROpModDtr. They are not BACnet objects, so ABT Site or SSA is required to access them.

Examples of trigger response:

Source / action	Trigger / value	Response (Example; results depend on configuration)
Comfort button / Eco → Cmf	CmfCndTrg / 3:Manual	HVAC: No impact
		Lighting: On (starts constant lighting control)
		Shading: Stops automatic function
Comfort button / Cmf → Eco	**EefCndTrg / 3:Manual**	**HVAC: Resets any previous manual setpoint adjustment. See note for how to eliminate reset.**
		Lighting: Immediately off (stops constant lighting control)
		Shading: Releases manual command and goes to automatic position
Central scheduler / Cmf → Eco	EefCndTrg / 2:Automatic	HVAC: Resets setpoint adjustment
		Lighting: Off with prior blinking (blinks, then stops constant lighting control)
		Shading: Releases manual command and goes to automatic position

Configuration

Parameters



Description	Parameter	Default value
(a) Comfort button		
Time for comfort button → Time period for temporary Comfort or presence button as triggered by CmfBtn (Key 8). Setting TiCmfBtn to 0 will disable the timer.	TiCmfBtn	2 [h]
Comfort button inactive configuration → Room operating mode after TiCmfBtn time elapses or after a manual Off command from a configured presence button. 1:Auto = Use value from central scheduler (Release priority 13) 2:Economy 3:Pre-Comfort	CmfBtnInactCnf	1:Auto
Operating command for energy efficiency condition trigger at automatic 1:None → Recommended if temporary Comfort is used. 2:Automatic = Release priority 13	OpCmdEefAuto	2:Automatic
(b) Operating mode display		
Source for present operating mode → This parameter defines what is written to PrOpMod for display on the room operator unit. 0:Room operating mode → HVAC, Lighting, and Shading. 1:Plant operating mode → HVAC only. The Plant operating mode is mapped to Protection / Economy /	PrOpModSrc	0:Room operating mode

Description	Parameter	Default value
Pre-Comfort / Comfort. All impacts to HVAC operation are considered (such as window contact, presence detector, manual fan and setpoint adjust).		
(c) Manual operation lock		
Manual operation lock configuration → During the indicated room operating modes, manual HVAC operation is locked and Comfort cannot be increased, therefore energy efficiency is maintained. 1:None 2:Protection 3:Protection / Economy 4:Protection / Economy / Pre-Comfort	ManOpLockCnf	3:Protection / Economy
(d) CmfCndTrg Configuration of trigger sent by AF for a change of room operating mode towards Comfort.		
Protection/Economy/Pre-Comfort to Comfort 1:None 2:Energy efficiency condition 3:Comfort condition	PrtEcoPcfToCmf	3:Comfort condition
Protection/Economy to Pre-Comfort Enumeration see PrtEcoPcfToCmf	PrtEcoToPcf	1:None
Protection to Economy Enumeration see PrtEcoPcfToCmf	PrtToEco	1:None
Repetition time energy efficiency trigger → Repeating the trigger wipes out local manual commands (applies to **automatic** trigger only).	RptTiEefTrg	60 [min]
Repetition number energy efficiency trigger (applies to **automatic** trigger only)	RptNumEefTrg	0
(d) EefCndTrg Configuration of trigger sent by AF for a change of room operating mode away from Comfort. **See note below.**		
Comfort/Pre-Comfort/Economy to Protection 1:None 2:Energy efficiency condition 3:Comfort condition	CmfPcfEcoToPrt	2:Energy efficiency condition
Comfort/Pre-Comfort to Economy Enumeration see CmfPcfEcoToPrt	CmfPcfToEco	2:Energy efficiency condition
Comfort to Pre-Comfort Enumeration see CmfPcfEcoToPrt	CmfToPcf	2:Energy efficiency condition

Manual setpoint adjustment & EefCndTrg

The default configuration will reset a user-entered setpoint adjustment when the room mode changes. To eliminate this reset, do the following:
- Set **Comfort/Pre-Comfort to Economy** (**CmfPcfToEco**) to "**None**"
- Set **Comfort to Pre-Comfort** (**CmfToPcf**) to "**None**"

These parameters are in the AF, Room operating mode determination ROpModDtr. They are not BACnet objects, so ABT Site is required to access them.

Room Operator Unit

The following display and operating functions are available based on device configuration. If multiple room operator units are used, the last input wins.

- Room temperature display
- Room temperature setpoint or setpoint shift
- Room operating mode (ROpMod) (display only)
- Comfort button
- Fan speed
- (optional) Rapid ventilation
- Heating/cooling state (display only)
- Green Leaf function (display only)
- *(Optional)* Room air quality
- *(Optional)* Relative humidity for room
- *(Optional)* Window contact
- *(Optional)* Outside air temperature

⚠ CAUTION

Make sure the Room operator unit installed at the jobsite matches the one configured in the application template.

If there is a mismatch, the ABT-SSA Field buses / KNX PL-Link bus will indicate the Room unit device is missing. The Application will NOT provide HVAC control to the room.

The following are configurable parameters for the room operating unit, plus descriptions of the possible settings.

✳ Indicates a Siemens proprietary property.

Room unit, display temperature ✳

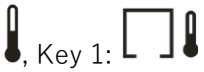
Room unit, display temperature defines which temperature values can be displayed.

None: Neither the room temperature nor the outside temperature is displayed.

Display room temperature: Only the room temperature is displayed. This setting is only meaningful if the room temperature sensor is enabled. The display is the average of all configured/valid room temperature sensors (PL-Link or hardwired) from all room segments combined into a Room configuration.

Navigation: , Key 1:

Display outside air temperature: Only the outside temperature is displayed.

Navigation:  , Key 1:

Display room & outside air temp.: The room temperature and the outside temperature are displayed. Toggling between the values is enabled. This setting is only meaningful if the room temperature sensor is enabled.

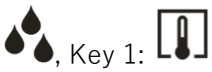
Navigation: , Key 1:

Room unit, display humidity ✳

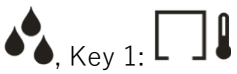
Room unit, display humidity defines which relative humidity values can be displayed.

None: Neither the room relative humidity nor the outside relative humidity is displayed.

Display room humidity: Only the room relative humidity is displayed. This setting is only meaningful if the sensor for relative room humidity is enabled. The display is the average of all configured/valid room humidity sensors (PL-Link or hardwired) from all room segments combined into a Room configuration.

Navigation:  , Key 1:

Display outside air humidity: Only the outside relative humidity is displayed.

Navigation:  , Key 1:

Display room & outside humidity: The room relative humidity and the outside relative humidity are displayed. Toggling between the values is enabled. This setting is only meaningful if the sensor for relative room humidity is enabled.

Navigation: , Key 1:

Room unit, display windows status ✳

Room unit, display windows status enables or disables the indication that a window is open. If a window is open, the connected window switch is active.

Yes: If a window is open, the icon for the open window is displayed.

No: If a window is open, no icon is displayed.

Room unit, display air quality ✳

Room unit, display air quality defines which air qualities can be displayed.

None: No air quality is displayed.

Display room air quality: The air quality of the room is displayed. This setting is only meaningful if the sensor for room air quality is enabled. The display is the average of all configured/valid room air quality sensors (PL-Link or hardwired)

from all room segments combined into a Room configuration.

Navigation: , Key 1:

Display outside air quality: The air quality of the outside is displayed.

Navigation: , Key 1:

Note: This setting is only meaningful if a value for the air quality of the outside is available.

Display room & outside air quality: The air quality of the room and of the outside are displayed. Toggling between the values is enabled.

Navigation: , Key 1:

Note: This setting is only meaningful if a value for the air quality of the outside is available.

Room unit, air quality display

Room unit, air quality display defines how the air quality is displayed.

Numeric, in ppm: The air quality is displayed as numeric value in ppm.

Symbolic: The air quality is displayed with the symbols --+, -++, and +++.

Textual: The air quality is displayed as Poor, Ok, or Good.

Room unit, display heating/cooling status

Room unit, display heating/cooling status enables or disables the display of the plant state.

Yes: Icons indicate if the plant is heating or cooling.

No: The plant state is not displayed.

Room unit, room temp. setpoint display

Room unit, room temp. setpoint display defines how the shift in the temperature setpoint is displayed.

Absolute temperature setpoint: The room temperature setpoint is displayed as absolute temperature value.

Relative setpoint shift: The value by which the temperature setpoint is changed is displayed.

Enable operation: room temperature setpoint

Enable operation: room temperature setpoint defines if the temperature setpoint or the shift of the temperature setpoint is displayed and if the user can change either.

Yes: The temperature setpoint or the shift of the temperature setpoint is displayed and the user can change it. This setting is only meaningful if the room temperature sensor is enabled.

Navigation:

No: Neither the temperature setpoint nor the shift for the temperature setpoint is displayed and they cannot be changed.

Enable operation: fan speed setpoint ✳

Enable operation: fan speed setpoint defines if the fan speed is displayed and if the user can change the fan speed.

Yes: The fan speed is displayed and you can change it.

Key 3:

No: The fan speed is not displayed and you cannot change it.

Enable operation: room humidity setpoint ✳

Enable operation: room humidity setpoint defines if the relative humidity setpoint is displayed and if the user can change it.

Yes: The relative humidity setpoint is displayed and you can change it. This setting is only meaningful if the sensor for relative room humidity is enabled.

Navigation:

No: The relative humidity setpoint is not displayed and you cannot change it.

Enable operation: air quality setpoint ✳

Enable operation: air quality setpoint defines if the air quality setpoint is displayed and if the user can change it.

Yes: The air quality setpoint is displayed and you can change it. This setting is only meaningful if the sensor for room air quality is enabled.

Navigation:

No: The air quality setpoint is not displayed and you cannot change it.

Enable operation: temporary comfort ✳

Enable operation: temporary comfort defines if the user can use Key 8 to set the room into temporary Comfort mode for a configurable time (120 minutes default).

Key 8:

Yes: The user can set the room into temporary Comfort mode. (this is the default configuration for preloaded templates)

No: The user cannot set the room into temporary Comfort mode.

Note
If configuring a completely new template in ABT Site, this parameter must be selected and enabled (set to Yes) if temporary Comfort mode by pressing Key 8 is the desired behavior. Note that since Key 8 is used for both temporary Comfort and also for Presence button, only one can be configured as active – see Startup document for how to configure.

Enable operation: presence button ✳

Enable operation: presence button defines if the user can confirm his presence by pressing key 8.

Key 8:

Yes: The user can confirm his presence by pressing key 8 (activates Comfort mode).
Presence can be toggled from On to Off by re-pressing Key 8 (deactivates Comfort mode).

If user does not manually press key 8 a second time, presence / Comfort expire after a configurable delay (default 120 minutes).

No: The user cannot confirm his presence by pressing Key 8.

Enable operation: room op.mode ✳

Enable operation: room op.mode defines if the room climate operating mode is displayed and if the user can change it.

Yes: The room climate operating mode is displayed and you can change it.

Key 7:

No: The room climate operating mode is not displayed and you cannot change it.

Enable operation: green leaf ✳

Enable operation: green leaf defines if the Green Leaf LED indicates if the conditions for the energy efficiency state are fulfilled and whether the user can reset the application to energy efficient parameter values.

Yes: The Green Leaf LED indicates if the conditions for the energy efficiency state are fulfilled, and you can reset the application to energy efficient parameter values by pressing the Green Leaf LED when it isn't green.

No: The Green Leaf LED does not indicate if the conditions for the energy efficiency state are fulfilled and you cannot reset the application to energy efficient parameter values.

Room GreenLeaf

The application function **Room green leaf, impact on room energy efficiency (RGrnLf)** calculates the energy efficiency state of the room (Undefined, Poor, Satisfactory, Good, Excellent) and makes this state available for display on the room operator unit, where energy efficient conditions can be restored by pressing the GreenLeaf button.

The GreenLeaf function signals to a room occupant whether the selected operating commands are energy efficient. Energy efficiency is indicated by a leaf icon on the room unit that turns green. If the leaf icon is red, the room occupant can reset the controller back to a normal, energy efficient operating state by pressing the GreenLeaf button on the room unit.

Each discipline has its own rules for determining the impact of energy efficiency and hands over the result to AF Room GreenLeaf function, where the overall room situation is evaluated.

- The AF reads the energy efficiency state of the discipline AFs for HVAC, lighting and shading as well as the reset request from the room operator unit.
- The room's energy efficiency state is indicated by the GreenLeaf icon on the room operator unit. The icon turns red as soon as manual intervention changes one of the disciplines to a non-energy-efficient state.
- Pressing the GreenLeaf icon / button on the room operator unit restores the room to an energy-efficient state. The AF sends a reset request to the disciplines for HVAC, lighting and shading
- Criteria for energy efficiency:

  - HVAC:
    The Maximum tolerance for manually shifting the room temperature setpoint can be configured. Fan speed and room operating mode: No configuration. Their values cannot exceed the automatic values.
  - Lighting and shading:
    No configuration. Lighting setpoints and shading positions cannot be less energy efficient than the automatic values.
- The manual changes and overrides initiated by the room occupant can be cleared, and the GreenLeaf status and GreenLeaf icon on the room operator unit can be externally reset to green by setting the multistate BACnet object **Energy efficiency indication room** (**REei**) to Excellent (5) at Priority 13.

Configuration

Parameters

Switch-on delay can be configured to smooth changes to the energy efficiency state:

Description	Parameter	Default value
Switch-on delay before energy efficiency indication → provides a delay before the LED GreenLeaf indicator changes color See also HVAC GreenLeaf [→ 42]	DlyOnEeiInd	5 [s]

Room Coordination Functions for HVAC

Plant Operating Mode for VAV

The application function selects the **HVAC plant operating mode** (**PltOpMod**) and considers the room operating mode, presence detection, HVAC presence mode and window contact. Warmup and cool down request signals are received using the central operating system (e.g., Scheduler).

The VAV application templates support 17 different plant modes. The plant modes are provided to cover a wide variety of room applications.

NOTE:
If a specific plant mode is not used, it should not be enabled.

Enum PltOpMod	Plant Mode	Purpose	Action of Mechanical Equipment	Trigger(s)
1	Off	Shutdown all heating, cooling and ventilation.	All mechanical equipment turns off.	manual command, or initial startup
2	Building Protection	Conserve energy in long term vacancy. To protect mechanical equipment from freezing or other adverse conditions.		manual command or schedule
3	Economy	Conserve energy during daily	Night setback/setup during unoccupied hours.	schedule/ occ sensor

Enum PltOpMod	Plant Mode	Purpose	Action of Mechanical Equipment	Trigger(s)
		unoccupied period.	Ventilation reduced or off selected by configuration.	
4	Pre-Comfort	Conserve energy for brief unoccupied periods.	Configurable. Example: Shut off ventilation for conference rooms that are unoccupied during the normally occupied daytime hours.	schedule/ occ sensor
5	Comfort	Provide room air conditions suitable for room occupancy.	All space conditioning equipment runs in “automatic” to maintain desired space conditions during occupancy.	schedule/ occ sensor or comfort button from room operating unit
6	Warm-up	Return to comfort conditions before occupancy	Mechanical heating equipment starts before occupancy period begins. Comfort setpoints apply for temperature. Ventilation may be off.	central command
7	Cool-down	Return to comfort conditions before occupancy	Cooling equipment starts before occupancy period begins. Comfort setpoints apply for temperature. Ventilation may be off.	central command
8	Room temp. (frost) prot.	Avoid damage in room by applying heat at high priority, overriding errant commands from outside the application	not used in VAV	
9	Equipment temperature protection	Avoid damage to equipment, such as frozen coils	not used in VAV	
10	Free cooling	Overcool past current demand to store energy	Pre-cool building or zones beyond current setpoint during advantageous periods, storing energy in the thermal mass to reduce the need for cooling later.	central command
11	Night cooling	Prevent build-up of heat in interior spaces during unoccupied hours.	Cooling using 100% outside air during night time.	central command
12	Rapid ventilation	Clear contaminated air with temporary high primary airflow	Supply air flow goes to the max ventilation value. Temp control continues according to room op mode.	manual command from room unit
14	Fire (EmgOff)	Isolate fire and smoke, preventing spread through the ventilation system	Supply air damper closes. Exhaust air damper closes.	External command to fire mode object.
15	Smoke Positive press.	Oppose infiltration of smoke to room from surrounding spaces	Supply flow goes to a configured level. Extract damper closes.	External command to fire mode object.
16	Smoke Negative press.	Oppose exfiltration of smoke from room to surrounding spaces	Extract flow goes to a configured level. Supply damper closes,	External command to fire mode object.
17	Smoke Purge	Clear smoke from the building after a fire	Supply flow goes to largest of configured limits. Extract tracks normally.	External command to fire mode object.

The Table below shows the different room and central BAS functions that determine the plant mode for the VAV application templates.

NOTE:
If an input is not configured in the application, it is NOT USED in determining the plant mode state.

IF						THEN
Room operating mode	**Presence detection** (**Room Comfort Button**)	**Window contact** (**Room**)	**Night cooling signal** (**from Scheduler**)	**Cool down signal** (**from Scheduler**)	**Warm-up signal** (**from Scheduler**)	**Plant mode**
-	-	Open	-	-	-	Protection
Protection	-	Closed	-	-	-	Protection
Economy	-	Closed	False	False	False	Economy
	-	Closed	True	False	False	Night cooling
	-	Closed	-	-	True	Warm-up
	-	Closed	-	True	False	Cool down
Pre-Comfort	-	Closed	-	True	-	Cool down
	-	Closed	-	False	-	Pre-Comfort
	Present	Closed	-	-	-	Comfort
	Absent	Closed	-	False	-	Pre-Comfort
	Absent	Closed	-	True	-	Cool down
Comfort	-	Closed	-	-	-	Comfort
	Present	Closed	-	-	-	Comfort
	Absent	Closed	-	False	-	Pre-Comfort
	Absent	Closed	-	True	-	Cool down
	Present	Closed	-	-	-	Rapid Ventilation

HVAC GreenLeaf

Overview

The application function **HVAC green leaf, energy efficiency** (**HvacGrnLf11**) determines if manual user operations influence HVAC energy efficiency, and manages the return to normal (energy efficient) state after receiving the reset request.

Inputs:

The main inputs for HVAC determining energy efficiency are:

- Setpoint shift configurable limit and heating/cooling status (using internal connection).
  - The leaf icon on the room operator unit turns red if the user shifts the setpoint greater than the maximum configurable tolerance (TRShft > TolMaxSpTRShft).
- Fan speed operation, fan speed control values (via internal connection).

– The leaf icon on the room operator unit turns red If the user sets a higher fan speed than is required by the automatic control.

Outputs:

This AF (HvacGrnLf11) provides the **Room energy efficiency indication HVAC (RHvacEei)** to the room operator unit via the Room green leaf (RGrnLf) AF.

If current settings are not energy efficient and a reset request (REeiRst)) is received from the room operator unit, then the system sets the multistate BACnet object **Energy efficiency indication room** (**REei**) to Excellent at Priority 13. This clears any manual changes and overrides initiated by room occupant(s) and resets the GreenLeaf status icon on the room operator unit back to green.

Configuration

Parameters

Description	Property	Default value
Maximum tolerance of room temperature setpoint shift	TolMaxSpTRShft	2 [K] 4 [° F]

Room Temperature Setpoint Determination

This application function provides the Comfort heating/cooling setpoints (either the setpoint (SpTR) or the setpoint shift (SpTRShft)) for the PID controllers in the room temperature control AFs (TCtlH, TCtlC).

Inputs:

- Absolute setpoint (SpTR) from room operator unit
- Setpoint shift (SpTRShft) from room operator unit
- Room temperature (TR) from room operator unit
- Present operating mode (PrOpMod) from the room operating mode AF, ROpModDtr

Outputs:

- TR (room temperature) displayed on room operator unit
- SpTR or SpTRShft displayed on room operator unit

When PrOpMod = Comfort, the Comfort heating or Comfort cooling setpoint displays depending on whether the heat/cool state (HCSta) = Heating, or Cooling. If the setpoint shift (SpTRShft) is commanded by a room operator unit, then the Comfort heating or cooling setpoint is overridden by the amount configured in SpTRShft.

When PrOpMod = Economy or Protection, the Pre-Comfort heating (or cooling) setpoint displays depending on whether HCSta = Heating, or Cooling. SpTRShft has no affect during Economy or Protection.

If HCSta = Neither, SpTR displays the last value.

NOTES:
The heating/cooling setpoints for Economy and Protection, as well as the delta heating/cooling setpoint for Pre-Comfort are located in the room temperature control AFs (TCtlH, TCtlC).

The room temperature AI object (TR) owned by the room operator unit has the property **Correction offset**. This property can be accessed via ABT SSA (tech-op) and configured to provide an offset in the temperature reading used to control the room.

Configuration

BACnet Objects

Description	Object	Preloaded value
Delta cooling setpoint for pre-comfort	DSpCPcf [STBY C DELTA]	1 [K] 2.0[° F]
Delta heating setpoint for pre-comfort	DSpHPcf [STBY H DELTA]	1 [K] 2.0 [° F]

Parameters

Description	Object	Preloaded value
Operating command for energy efficiency condition trigger at automatic 1:None 2:Automatic 3:Manual	OpCmdEefAuto	2:Automatic
Operating command for energy efficiency condition trigger at manual Enumeration (see OpCmdEefAuto)	OpCmdEefMan	1:None
Display absolute room temperature setpoint 1:Average value 2:Present value	SpTRAbsDspy	2:Present value

Heating/Cooling State Determination

The **Heating/cooling state determination (HCStaDtr)** compares room temperature to current setpoints and checks whether any HVAC devices are under active PID control. The heating / cooling state is identified (Heating, Cooling, or Neither) and supplied to the BACnet object **HCSta**. The H/C status is also displayed on the room operating unit. Additional relevant BACnet objects (owned by other AFs) are shown in the table below.

To change status by temperature, the room temperature heating/cooling controllers must be inactive and the room temperature must be appropriate (high enough or low enough) to activate the switch-on delay timer, DlyOnHCChovr (Switch-on delay for heat/cool.changeover). See Configuration.

Description	Object	Pre-loaded Values
Room temperature setpoint shift	SpTRShft [RM TEMP SHFT]	0.0
Present cooling setpoint for comfort	SpCCmf [CMF CLG STPT]	75°F (25°C)
Delta cooling setpoint for pre-comfort	DSpCPcf [STBY C DELTA]	2°F (1°C)
Present cooling setpoint for economy	SpCEco [ECO CLG STPT]	85°F (30°C)
Cooling setpoint for protection	SpCPrt [PROT CLG STPT]	104 °F (40°C)
Present heating setpoint for comfort	SpHCmf [CMF HTG STPT]	70°F (21°C)
Delta heating setpoint for pre-comfort	DSpHPcf [STBY H DELTA]	2°F (1°C)
Present heating setpoint for economy	SpHEco [ECO HTG STPT]	55°F (12°C)
Heating setpoint for protection	SpHPrt [PROT HTG STPT]	45 °F (7°C)
Present cooling setpoint	PrSpC [CLG STPT EFF]	----
Present heating setpoint	PrSpH [HTG STPT EFF]	----
Present operating mode	PrOpMod [OP MODE EFF]	Comfort
Room operating mode	ROpMod [RM OP MODE]	Comfort
Plant operating mode	PltOpMod [PLANT OPMODE]	Comfort
Room temperature setpoint (for display on room unit)	SpTR [RM TEMP STPT]	----
Room temperature	TR [RM TEMP EVAL]	----

Configuration

Parameters

Description	Object	Pre-loaded Values
Shift of switch-on point for heating state	ShftOnPtHSta	0.0 °F
Shift of switch-on point for cooling state	ShftOnPtCSta	0.0 °F
Switch-on delay for heating/cooling changeover	DlyOnHCChovr	2 mins

VAV Ventilation Control

There are different control modes for the ventilation control. The behavior is selectable by parameter and is dependent on if a room air quality sensor is available.

Ventilation mode (VentMod) can be set to the following:

- Off
- Minimum (Constant air flow)
- Dcv (Demand controlled ventilation) [1)]
- Dcv & Min (Demand controlled ventilation with a minimum flow) [1)]

[1)] DCV requires air quality sensor in the room

NOTE:
The VAV and FPB application templates have been pre-loaded with the ventilation mode (VentMod) and airflow minimum (AirFlMin) as shown in the table below. The parameters can be modified to meet job requirements.
If the default application does not meet job requirements, an application can be configured and modified to job specifications in ABT Site.

Parameters

Description	Parameter	Pre-loaded settings
Comfort configuration 1:Off 2:Minimum ventilation 3:Demand-controled ventilation 4:Minimum ventilation & Demand-controlled ventilation	CmfCnf	2:Minimum ventilation
Pre-Comfort configuration	PcfCnf	2:Minimum ventilation
Economy configuration	EcoCnf	1:Off
Protection configuration	PrtCnf	1:Off
Minimum room air volume flow for comfort	AirFlMinRCmf	150.0 ft3/min [75.0 l/s]
Minimum room air volume flow for pre-comfort	AirFlMinRPcf	150.0 ft3/min [75.0 l/s]
Minimum room air volume flow for economy	AirFlMinREco	0.0 ft3/min [0.0 l/s]
Minimum room air volume flow for protection	AirFlMinRPrt	0.0 ft3/min [0.0 l/s]

Air Volume Flow Tracking

The application function **Air volume flow tracking (AirFlTck)** collaborates with VAV supply and extract dampers to calculate the extract airflow setpoint.

NOTE:
Air volume flow tracking application function is NOT enabled in any Dual Duct, VAV or FPB terminal box application templates.

VAV Room Temperature Control for Cooling

VAV room temperature control for cooling (VavTRCtlC) is the basis for the sequencing of the room temperature PID controllers for VAV cooling. It determines the room cooling setpoint and the room cooling demand signals to maintain the room temperature at the cooling setpoint. The following devices are supported:

- Supply air VAV damper
- (Optional) Cooling coil
- (Optional) Chilled ceiling

NOTE:
The VAV application templates have been pre-loaded to support cooling with the Supply air VAV damper.
If the default application does not meet job requirements, an application can be configured and modified to job specifications in ABT Site.

This AF works in collaboration with the room segment HVAC device (the VAV supply air damper) to provide cooling. The cooling room temperature PID controller is enabled based on a signal that is read via the grouping function (from equipment in the room segment) indicating whether cooling is available.

Temperature sequence order: 1) Chilled ceiling, 2) Heating/Cooling coil, 3) Cooling coil, 4) VAV cooling (only for VAV serial fan operation)

VAV Room Temperature Control for Heating

Overview

The application function **VAV room temperature control for heating (VavTRCtlH)** is the basis for the sequencing of the room temperature controllers for VAV heating. It determines the room heating setpoint and the room heating demand signals to maintain the room temperature at the heating setpoint. The following devices are supported:

- Supply Air VAV damper
- (Optional) Heating/Cooling coil
- (Optional) Heating/Chilled ceiling
- Heating coil
- (Optional) Radiator

NOTE:
The VAV with hot water or electric heating coil application has been pre-loaded to support the Supply air VAV damper and the heating coil valve or stages of electric heat.
If the default application does not meet job requirements, an application can be configured and modified to job specifications in ABT Site.

This application function works in collaboration with a room segment temperature control AF. The heating room temperature PID or staged controller is enabled based on a signal that is read via the grouping function (from equipment in the room segment) indicating whether heating is available.

Temperature sequence order: 1) Radiator, 2) Heating ceiling, 3) Heating coil, 4) VAV heating (only for VAV serial fan operation).

Warm-up

When the room operating mode is Economy the central system scheduler can initiate warm-up mode. To do so the scheduler commands the VAV supply changeover condition point (VavSuChovrCnd) to Heating and the warm-up request point (WarmUpReq) to Active. When this happens the following occurs:

1. Plant operating mode goes go to 6:Warm-up and Room operating mode goes to 4:Comfort
2. Room temperature setpoint for heating returns to Comfort heating setpoint (SpHCmf, default = 70° F)
3. Radiator modulates to full-open
4. Heating coil is activated
5. Vav supply damper positioned to provide min heating airflow (e.g., 100 CFM)
6. Vav supply damper modulates to full-open, max heating airflow (e.g., 1200 CFM)

Due to length of sequencing/interlock times between the HVAC devices, it takes several minutes before the box is able to provide maximum airflow for heating (e.g., 1200 CFM).

Alternative Methods for Implementing Warm-up

Option 1
To avoid the sequencing/interlock delay times, the application can be configured using ABT-Site. The values for two Boolean parameters in the room application function for VAV heating can be changed as follows:

- **Coil: controller mode by warm-up** (CoilWarmUp) must be set to **2-position**
- **Radiant devices: ctr.mode by warm-up** (RadDevWarmUp) must be set to **2-position**

These parameters belong to the room application function for VAV heating (VavTRCtlH11 or VavTCasCtlH11).

Option 2
To avoid the sequencing/interlock delay times, the following can be commanded from the central workstation (e.g., Desigo CC using the scheduler) to place the room into warm-up mode:

1. VavSuChovrCnd = Heating
2. WarmUpReq = Active
3. VavSuDevMod = 3:Max. air volume flow
4. HclDevMod = 3:Full Open

5. RadDevMod = 3:Full Open

These data points are then released from warm-up once room temperature returns to the Comfort deadband (70° F to 75° F, default).

Rapid Ventilation

(Optional – requires additional configuration in ABT Site)

The fan speed button at the room operator unit allows the occupant to increase the ventilation rate in the room when the room operating mode (ROpMod) is in Comfort. A request is sent to the plant operating mode (PltOpMod) to start the **Rapid ventilation (RpdVnt)** and improve the room air quality. Rapid ventilation utilizes the maximum air volume flow setpoint value for ventilation (VavSuAflMaxVnt).

The application templates have been configured with a 15 minute run-time for rapid ventilation. This function can be configured to meet job site requirements.

The rapid ventilation option on the room unit is displayed and enabled as a **Fan**. Pressing the button activates the Rapid Ventilation mode.

Configuration

Parameters

Description	Parameter	Pre-loaded Value
Rapid ventilation runtime	TiRnRpdVnt	15 [min]
See Room Operator Unit [→ 35] to enable rapid ventilation (FanSpd1)		False

Frost Protection

Frost protection – VAV type

Plant mode 8 (Room low temperature protection) places VAV boxes in control mode and heat sources at 100%, but it is not used by any AFs. **If frost protection is required, a CFC chart specific to the project must be created (with a room temperature low and high limit) to command and release the device operating modes**.

Note

This feature does not rely on an outdoor air temperature signal. It uses temperature sensing in the room.

Coordinating Signals between Room and Room Segment

Information Shared	From	To
Room control functions request cooling, heating or ventilation from room segment devices.	Request is the output of the room control function PIDs in percent (%).	Request signal to room segment device.
Binary availability of Room segment devices to respond to request from room control function.	Room segment devices informs room control function that it is available for heating, cooling or ventilation.	Room control function is activated based on availability of room segment device.
Room plant operating mode (Multistate value).	Room plant operating room informs room segment device current plant operating mode.	Room segment.

Room Segment Functions

Device Mode Determination

Depending on the plant operating mode, each device is assigned a **device operating mode (DevOpMod)**. Examples include control, fully open, fully closed, and off.

Dual Duct VAV Supply Air Damper Device Mode

The **Supply VAV air damper device mode (VavSuDevMod)**, common for both dual duct supply dampers, is a multistate value that supports the following states for plant operating modes:

- Off
- Control mode (modulation) > Protection, Economy, Pre-Comfort, Comfort, Warm-up, Cool down
- Max.air vol.flow > Rapid Ventilation, Purge, Room low temperature protection
- Min.air vol.flow
- Smk.air vol.flow setp. → smoke air volume flow setpoint

Device mode	**Duct 1**	**Duct 2**
1:Off	Setpoint is zero	Setpoint is zero
2:Control mode	Follows demand	Follows demand
3:Max.air vol.flow	Select from h/c maximum according to VavSuChovrCnd1: - Neither (Vent max) - Cooling (Cooling max) - Heating (Heating max) - Neutral (max of Cooling max and Heating max)	Select from h/c maximum according to VavSuChovrCnd2: - Neither (Vent max) - Cooling (Cooling max) - Heating (Heating max) - Neutral (max of Cooling max and Heating max)
4:Min.air vol.flow	Select from h/c minimum according to VavSuChovrCnd1: - Neither (Vent min) - Cooling (Cooling min) - Heating (Heating min) - Neutral (max of Cooling min and Heating min)	Select from h/c minimum according to VavSuChovrCnd2: - Neither (Vent min) - Cooling (Cooling min) - Heating (Heating min) - Neutral (max of Cooling min and Heating min)
5:Smoke	Setpoint is smoke value	Setpoint is smoke value

Device mode	Duct 1	Duct 2
ctrl.air flow setp	(common setpoint for both ducts)	(common setpoint for both ducts)

Heating Coil Device Mode

The device mode for the **Heating coil position** (**HclDevMod**) is a multistate value that supports the following states:

- Off
- Control mode (modulation)
- Fully open

Device Control Functions HVAC

The following sections describe the main features of the room segment application functions in a preloaded template, and include the most important parameters and configuration objects for each AF. For the complete list of **all** configuration items found in a specific template or type, refer to the Application help in ABT Site.

Note
A small number of configuration objects/parameters in preloaded templates have values that are slightly different from raw factory default (that is, the values found in an unconfigured HVAC "type" in the ABT Site library).

Dual Duct VAV Supply Air Dampers with 2-inlet pressure sensors

For each supply duct, the application function uses a differential pressure sensor, duct area, and an internal airflow controller to separately modulate the VAV supply damper for temperature control and ventilation purposes. The main output is an analog output (in percent) for damper position (VavSuPos1 and VavSuPos2) that is generated by each PID airflow controller in this AF.

NOTE:
To calculate each air volume flow, this AF uses separate duct area calculations, airflow coefficients and inputs from differential pressure sensors.

Main features:

- VAV supply damper modulation (2) for dual duct temperature and ventilation control
- Two inlet flow sensors
- Air volume flow setpoint calculation (2)
- Air volume flow calculation (2)
- Selectable ducts for hot air or cold air (hot, cold, or neither)
- Mixing control or snap acting control
- Selectable duct(s) for ventilation air (one, both, or neither)
- Dedicated outdoor air system (DOAS) support
- Control coordination for extract duct calculation
- Air flow coefficient calculation for air balancing logic (2)
- Interlocks (box coils)
- Supply chain interface (2)

A VAV supply cooling (VavSuCReq), supply heating (VavSuHReq) or ventilation request (VavSuVntReq) is received from the room control function and processed into two output signals for VAV supply damper position (VavSuPos1, VavSuPos2).

Basic function: Accept request signal from associated room controller and map it to appropriate air volume flow setpoint; Compare setpoint to air volume flow in terminal box; Pass result through a device mode logic switch prior to outputting as a command to the object that controls the device.

Available status

When the VAV supply damper is available for cooling, heating or ventilation, the respective binary output signal(s) that indicate availability (VavSuAvlC, VavSuAflH, VavSuAvlVnt) will be "Yes" (available).

For the ventilation available status to be "Yes", device mode must equal "Control mode" (modulation). The cooling or heating available status signals additionally require their respective airflow request signals from the VAV box coil or changeover signals from the AHU.

The output signal VAV supply airflow provided for ventilation (VavSuAflPvdVnt) is the amount of airflow available for ventilation. When Supply air VAV available for ventilation (VavSuAvlVnt) is True, the maximum ventilation value (VavSuAflMaxVnt) is transferred to VavSuAflPvdVnt.

VavSuAflPvdVnt is the sum of maximal flow (in engineering units) from the supply VAV boxes. These values are set in each supply VAV for the maximum flow in the segment.

Dual Duct Supply Airflow PID Controllers

The **PID airflow controller (VavSuAirFlCtr1, VavSuAirFlCtr2)** compares the relative air volume flow of the terminal box to the current relative VAV supply airflow setpoint, and modulates VavSuPos1 or VavSuPos2 as necessary to keep the box flow at setpoint.

Interlocks

Interlocks are (typically) binary signals that ensure equipment protection. Additional signals help coordinate the interaction sequences between HVAC devices.

A signal's direction In / Out (and function, to some degree) depend on the HVAC device. For example, an airflow status (AirFlSta) interlock signal can be output from a supply damper or a fan, and sent as input to a coil or an OA damper. In the table that follows, descriptions of a signal's functionality reflect its usage by the specified HVAC device.

NOTE:
Signals in table are internal signals, not BACnet objects. For this reason they are not visible in the tool, but the parameters associated with them are. See comment column for hints on parameters that affect interlock functionality.

Signal	Type	Description	Comment
AirFlCReq	Boolean	Airflow cooling request → Initiates airflow (damper opens) to satisfy airflow support request from cooling coil.	Only if cooling coil is present in terminal unit
AirFlHReq	Boolean	Airflow heating request → Initiates airflow (damper opens) to satisfy airflow support request from heating coil.	Only if heating coil is present in terminal unit
AirFlHldH	Boolean	Airflow hold for heating → Interlock signal from electric heating coil indicating the coil needs equipment protection airflow support. The damper is prevented from closing for a period of time.	Uses equipment protection (Priority 5)
AirFlSta	Boolean	Airflow status → Interlock signal that keeps the coil locked at equipment protection (Priority 5) unless the supply damper provides airflow.	See C*onfiguration* section for parameters named AirFlSta
AirFlVavReq	%	Airflow VAV request → In a fan-powered box (FPB) application, the VAV damper sends a request signal (AirFlVavReq) requesting airflow, so that the box can meet an airflow support or ventilation demand.	Fan-powered box (FPB) application Setpoint is percent of nominal airflow configuration
FanSta	Boolean	Fan state → Interlock signal used in series fan-powered box applications: Fan state (FanSta) must be True (fan is running) before damper is allowed to open. This ensures that airflow from the damper does not rotate the series fan while at rest.	In series fan-powered box applications, parameter EnMonFanSta must = Yes.

Configuration

BACnet Objects

Description	Object	Object Type	Pre-loaded Value
Supply air VAV duct area 1 Supply air VAV duct area 2	VavSuDuctArea1 VavSuDuctArea2	ACnfVal	0.349 ft^2 (0.0xx m^2)
Supply air VAV duct shape 1 Supply air VAV duct shape 2	VavSuDuctShape1 VavSuDuctShape2	MCnfVal	Round

Description	Object	Object Type	Pre-loaded Value
Supply air VAV dimension A 1 Supply air VAV dimension A 2	VavSuDmsnA1 VavSuDmsnA2	ACnfVal	8.0 in.
Supply air VAV dimension B 1 Supply air VAV dimension B 2	VavSuDmsnB1 VavSuDmsnB2	ACnfVal	8.0 in.
Supply air VAV flow coefficient 1 Supply air VAV flow coefficient 2	VavSuFlCoef1 VavSuFlCoef2	ACnfVal	0.63 (0.63)
Nominal air volume flow 1 Nominal air volume flow 2	AirFlNom1 AirFlNom2	ACnfVal	100 ft^3/min (50 l/s)
Supply air VAV maximum air volume flow for cooling	VavSuAirFlMaxC [CLG FLOW MAX]	ACnfVal	1000 ft^3/min (500 l/s)
Supply air VAV maximum air volume flow for ventilation	VavSuAflMaxVnt [VENT FLOW MAX]	ACnfVal	1200 ft^3/m (600 l/s)
Supply air VAV ventilation request	VavSuVntReq [VAV VENT REQ]	ACalcVal	0%
Supply air VAV cooling request	VavSuCReq [VAV CLG REQ]	ACalcVal	0%
Supply air VAV setpoint for relative air volume flow 1 Supply air VAV setpoint for relative air volume flow 2	VavSuSpAflRel1 VavSuSpAflRel2 [FLOW REL SP]	ACalcVal	0%
Supply air VAV setpoint for air volume flow 1 Supply air VAV setpoint for air volume flow 2	VavSuSpAirFl1 VavSuSpAirFl2 [AIR VOL SP]	AO APrcVal	0 ft^3/m (0 l/s)
Supply air VAV effective air velocity 1 Supply air VAV effective air velocity 2	VavSuAirVEff1 VavSuAirVEff2 [AIR VEL EFF]	ACalcVal	0 ft^3/m (0 l/s)
Supply air VAV air volume flow deviation 1 Supply air VAV air volume flow deviation 2	VavSuAirFlDvn1 VavSuAirFlDvn2 [AIR VOL. DIFF]	ACalcVal	0%
Supply air VAV smoke control air volume flow setpoint	VavSuSpAflSmk	ACnfVal	800 ft^3/m (400 l/s)
Supply air VAV minimum air volume flow for cooling (can be set to zero and the ventilation flow required can be set per occupancy mode in the VAV Ventilation Control [➙ 46].)	VavSuAirFlMinC [CLG FLOW MIN]	ACnfVal	0.0 ft^3/min (0.0 l/s)
Supply air VAV maximum air volume flow for heating	VavSuAirFlMaxH [HTG FLOW MAX]	ACnfVal	150 ft^3/min (75 l/s)
Supply air VAV minimum air volume flow for heating (for units with heating elements and no fan, set the Heating minimum flow to required value for heat transfer from the coils)	VavSuAirFlMinH [HTG FLOW MIN]	ACnfVal	150 ft^3/min (75 l/s)
Supply air VAV minimum air volume flow for ventilation (can be set to zero and the ventilation configurations set per occupancy mode set in VAV Ventilation Control [➙ 46])	VavSuAflMinVnt [VENT FLOW MIN]	ACnfVal	0.0 ft^3/min

Parameters

Description	Parameter	Pre-loaded Value
Switch-on point for differential pressure (1 and 2)	SwiOnPtDiffP	4%
Hysteresis for differential pressure (1 and 2)	HysDiffP	2%
Setpoint selector for extract air VAV box (1 and 2)	SpSelVavEx	Supply airflow
Switch-on point for air volume flow state (1 and 2)	SwiOnAirFlSta	4%

Description	Parameter	Pre-loaded Value
Hysteresis for air volume flow state (1 and 2)	HysAirFlSta	2%
Enable monitoring for fan state → Must = 0:No for parallel fan powered box applications; must = 1:Yes for series fan powered box applications.	EnMonFanSta	No
Enable monitoring for missing air volume flow 0:No 1:Yes	EnMonNoAirFl	Yes

Minimum Ventilation Flow

In all installations (with or without demand control ventilation DCV), the Room ventilation function provides minimum primary airflow when configured ventilation is required. This can be set and enabled per operating mode. This provides additional flexibility and energy savings and effectively replaces the VAV minimum cooling and heating supply airflow setpoints. During heating (or cooling) when a minimum heating (or cooling) flow setpoint is configured, the larger value compared to ventilation will be used.

NOTE:
VAV and FPB have the **minimum room air volume flow** for the room operating modes configured and enabled in the **VAV Ventilation Control** application function, as follows:
- Minimum room air volume flow for comfort – 150 CFM
- Min. room air volume flow for pre-comfort – 150 CFM
- Minimum room air volume flow for economy – 0 CFM
- Min. room air volume flow for protection – 0 CFM

The minimum ventilation setting provides a low limit to the terminal box minimum ventilation parameter (VavSuAflMinVnt), preventing minimum ventilation from going below 150 CFM. For more information, see **Airflow Sequencing and Airflow Limits** (found under Air Volume Flow Setpoint Calculation section).

Nominal Air Volume Flow

Nominal air volume flow refers to the "nominal" flow rating of the terminal box, the maximum flow for which it is rated.

Default value of AirFlNom

- Standard preloaded VAV / FPB templates: AirFlNom default = 1200 ft3/min
- Raw factory value in unconfigured VAV or FPB type: AirFlNom default = 100 m3/h (59 ft3/min)
- Lab (CET) type: see Lab documentation

(Dual Duct standard preloaded templates)
AirFlNom is used to define the scaling value that converts physical flow values to their relative (percent) flow values. When AirFlNom is used, all of the application's air volume flow percent calculations are based on the value of AirFlNom. This means that the value of AirFlNom - when used - is crucial for the proper functioning of the automation station's air volume flow control algorithms.

Dual Duct applications have the option of setting AirFlNom to zero, in which case it is not used. See the following guidelines for specific information.

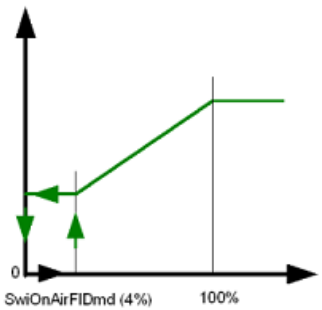
	⚠ CAUTION
	Duct size must be considered when setting AirFlNom For all application version numbers, when AirFlNom is used (i.e., set to a non zero value), duct size must be considered. **Example:** a 6-inch round duct (approx 0.2 sq ft) with a typical maximum velocity of 3000 ft/min suggests a nominal air volume flow of 600 cfm (3000 ft/min * 0.2 sq ft = 600 cfm (approximately 300 lps)). In this example, AirFlNom **must not** be left at the preloaded template default value of 1200 cfm! It requires a different value following the guidelines above. (AirFlNom is not a BACnet object. It is a configuration parameter that can only be set using ABT Site or ABT-SSA.)

Air Volume Flow Setpoint Calculation

In control mode the airflow setpoints (**VavSuSpAirFl1 and VavSuSpAirFl2**) are configured to provide cooling or heating demand and the configured ventilation demand.

Although request values are in percent, the comparison to select the max is made in physical airflow units. This is because the airflow limits (minimum flow and maximum flow) are different for each request type.

The mapping from percent to airflow units for cooling and ventilation includes a step-up at the low end, with a switch on point of 4% and a hysteresis of 2%. Thus, the request percent must rise above 4% before its corresponding airflow value rises from 0 to the request's minimum airflow.



Potential uses of the step-up include:

- Keeping the flow setpoint high enough to support heat transfer from a coil
- Keeping the flow setpoint high enough for effective sensing

Dual Duct Air Volume Flow Calculation

Air Volume Flow (**VavSuAirFl1, VavSuAirFl2**) and **Relative Air Flow** (**VavSuAirFlRel1, VavSuAirFlRel2**) are calculated values computed from logic that utilizes the following:

- Separate Velocity pressure from the differential pressure sensor or other flow sensing technology
- Units conversion constant to convert to air velocity

- Flow coefficient value for calibration at a specific airflow setpoint
- Duct area in units compatible with the units conversion constant
- Nominal airflow value (user entered)
- Hood air volume flow value to aid in calculating the correct flow coefficient value

First, air velocity is a calculated value computed from logic using the following formula:

$$AirV_{EngrgUnits} = K_{EngrgUnits} \times C_{SpanCal}\sqrt{P_{differential}}$$

Where:

- AirVEngrgUnits is the velocity of the air in engineering units that are compatible with the other units used in the airflow formulas above
- KEngrgUnits = constant for engineering unit correction [the “4005” (English units) or “1.29” (SI units)
- CSpanCal = constant to calibrate for sensor span (also called flow coefficient)
- Pdifferential = differential pressure sensor reading from duct

Next, Air Volume Flow in flow units (VavSuAirFl) is calculated by the formula:

$$AirFlow_{EngrgUnits} = AirV_{EngrgUnits} \times FlCnv \times Area$$

Where:

- Area = area of duct
- FlCnv = conversion constant for converting between box dimensional engineering units and desired flow engineering units

Air Volume Flow as a percentage of the nominal airflow (Relative Air Flow [VavSuAirFlRel]) is calculated by the formula:

$$AirFlowRel \quad = AirFlow_{EngrgUnits} \times \left(\frac{100}{AirFlNom}\right)$$

Where:

- AirFlNom is the nominal air volume flow of the VAV terminal box.

Pressure Dependent Control - Low airflow

If the box cannot satisfy airflow demands due to not having enough available airflow (or the airflow sensor object is invalid), then open loop operation begins. In open loop operation, damper position is controlled without using the measured air volume flow value from the sensor; instead, damper position = airflow setpoint in % of nominal airflow.

When the air volume flow setpoint falls below 5% of nominal or the measured air volume flow value rises above 7% of nominal, closed loop operation resumes.

Airflow Sequencing and Airflow Limits

The VAV airflow controller adjusts airflow to accomplish cooling and ventilation, and to support heating from the heating coil.

Each function has an operating range selected by the engineer to satisfy particular physical objectives. This design separates minimum cooling flow and minimum heating flow from the flow rate needed for ventilation.

The ventilation rate can be constant, vary with room occupancy mode, or vary according to IAQ measurements. These factors have no effect on the flow rate needed for the heating and cooling processes and devices (airflow through heating coil, airflow needed for ceiling louver, etc.).

The following table provides suggestions for setting parameters affecting airflow when the control system is in the cooling, ventilation and heating part of the control sequence. See *Operating Diagrams* in *Section 1* for a pictorial of the relationship of these parameters.

Object	Description	Most common use
VavSuAirFlMaxC	Supply air VAV maximum air volume flow for cooling	The highest flow rate for the terminal or space that corresponds to cooling load.
VavSuAirFlMinC	Supply air VAV minimum air volume flow for cooling	The lowest flow rate for the terminal or space that allows cooling to work properly.
VavSuAirFlMaxH	Supply air VAV maximum air volume flow for heating	The highest flow rate for the terminal or space and should be half of the cooling max to comply with standard codes.
VavSuAirFlMinH	Supply air VAV minimum air volume flow for heating	The lowest flow rate for the terminal or space that allows heating to work properly.
VavSuAflMaxVnt	Supply air VAV maximum air volume flow for ventilation	The highest flow rate that the DCV loop can request (can be equal to max cooling).
VavSuAflMinVnt	Supply air VAV minimum air volume flow for ventilation	The lowest flow rate for ventilation to work properly.
AirFlMinRCmf	Minimum room air volume flow for comfort	The primary airflow rate (not OA ventilation) required when the space is occupied.
AirFlMinRPcf	Minimum room air volume flow for pre-comfort	The primary airflow rate required when the space is in standby mode.
AirFlMinREco	Minimum room air volume flow for economy	The primary airflow rate required when the space is unoccupied. In many spaces this should be

Fan coasting feature

Note
The fan coasting feature applies to duct 1 and duct 2 separately: there is a fan coasting object for each duct (**FanSuCstVal1**, **FanSuCstVal2**).

The **fan coasting feature** (**FanSuCstVal**) prevents premature closing of the room supply damper while the AHU fan is coasting down. This might occur during a switch between operating modes (for example, switching from Comfort to Economy).

The fan coasting feature is active when:

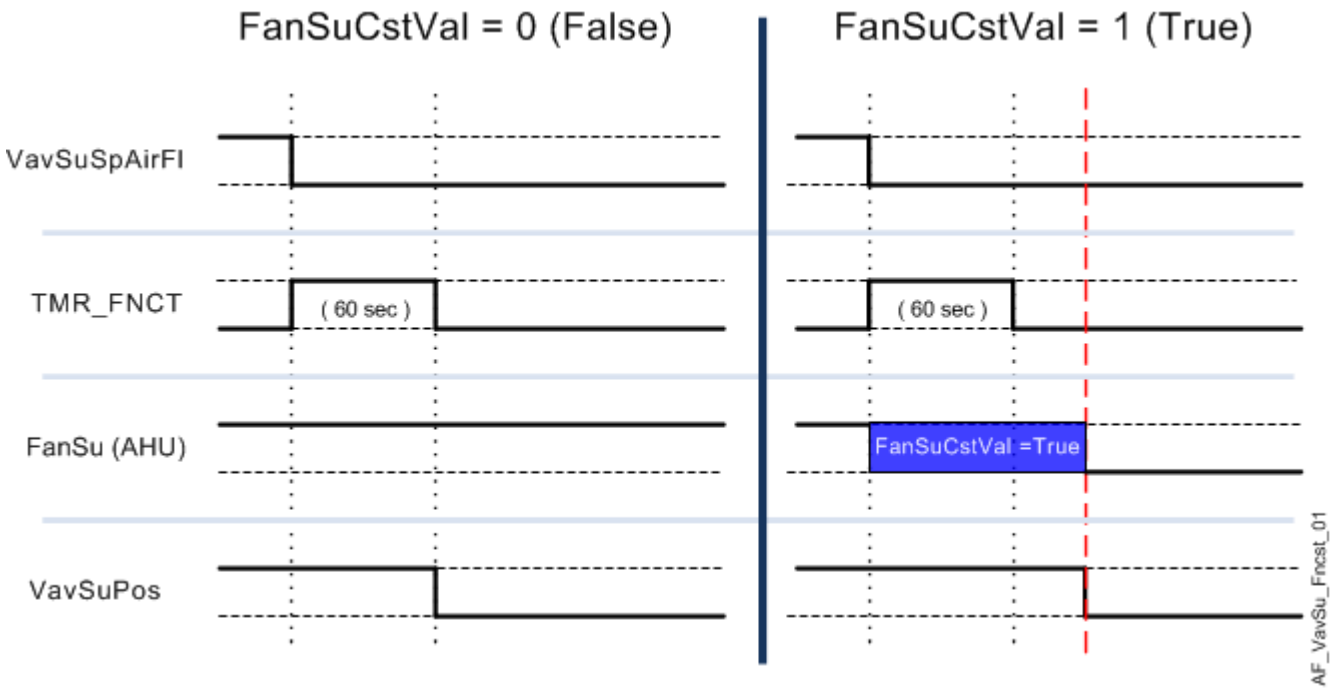
- The room supply air damper is the only damper that is open – all other VAV supply air dampers are closed.
- The AHU supply fan has been turned off and is coasting down.

- The airflow setpoint signal (VavSuSpAirFl), while on its way to zero, falls below the airflow demand hysteresis setting (HysAirFlDmd).

When these conditions are true, the boolean supply fan coasting signal (FanSuCstVal) will equal 1 (True) and the damper is reset to its last (previous) operating position / value. This keeps the damper open while the fan coasts down to prevent supply duct over-pressure.

In addition to the fan coasting signal freezing the damper in place, an internal timer function was activated when VavSuSpAirFl initially dropped below HysAFlSta. The fan coasting signal and the timer (60 seconds) must both finish (return to False) before the room supply damper can close. See the figure below.

NOTE:
The internal timer operates independently and regardless of FanSuCstVal. Once the timer is activated, the room supply air damper is frozen in place until the counter reaches zero, after which the damper may close.
Fan supply (FanSuCstVal) coast value comes from the primary AHU.



Configuration

Parameters

Description	Parameter	Preloaded value
Switch-on point for air flow demand	SwiOnAirFlDmd	4%
Hysteresis for air flow demand	HysAirFlDmd	2%

Electric Heating Coil, 2-Stage (HclEl14)

The application function **Electric heating coil two stage, two binary outputs** operates a pair of electric heating coils to provide 2-stage heating. The main outputs are two binary outputs that work together for two stage operation.

NOTE:
The Electric heating coil (2-Stage) receives the heating request signal from the room temperature control for heating PID controller. The room temperature heating controller (TRCtlH) is a BACnet Loop Object that supports either PID or Stage Control.

Electric heating coil has been preloaded with staged controller sets configured.

A demand signal of 0-100% is converted to binary output using hard coded switch-on, switch-off points.

Main features:

- Binary control of two electric heating coils for 2-stage operation
- Heating available status
- Over-temperature detection with high temperature cut-out switch (Optional)
- Airflow interlocks

Primary signal flow is summarized as follows:

Heating coil heating request (HclHReq) is received from the room and processed into binary output signals for the dual electric heating coil stage positions (HclEl1StPos, HclEl2StPos).

Basic function: Accept request signal from associated room controller and pass it through a device mode logic switch;

Output the result as a command to the BACnet object that controls the device. Binary control of two electric heating coils (HclEl1StPos / HclEl2StPos), staged on/off, to control the room temperature at setpoint. The stages also can be commanded in response to external trigger(s) for special modes such as warm-up or cool down, or safety conditions.

The electric heating coil AF receives the percentage value of the heating demand signal (HclHReq) and translates it into the number of stages that should be turned on. No stages turned on is approximately 0%, one stage approximately 50% and two stages approximately 100%.

NOTES:
There are NO minimum on or minimum off delay timers for turning the coils on and off.
The default interstage delay (staged controller, switch delay) for two stage coils turning on or off can be set as needed for room control.

Interlocks

Interlocks are (typically) binary signals that ensure equipment protection. Additional signals help coordinate the interaction sequences between HVAC devices.

A signal's direction In / Out (and function, to some degree) depend on the HVAC device. For example, an airflow status (AirFlSta) interlock signal can be output from a supply damper or a fan, and sent as input to a coil or an OA damper. In the table that follows, descriptions of a signal's functionality reflect its usage by the electric heating coil, two binary output.

NOTE:
Signals in table are internal signals, not BACnet objects. For this reason they are not visible in the tool, but the parameters associated with them are. See Comments column for hints on parameters that affect interlock functionality.

Signal	Type	Description	Comment
AirFlSta	Boolean	Air flow status → Interlock signal, from a fan or a supply damper, that keeps the coil locked unless that same fan or supply damper provides airflow.	No related parameters in electric coils. AirFlSta is hard-coded.
AirFlHReq	Boolean	Air flow heating request → Initiates airflow (fan turns on or VAV supply damper provides airflow) to satisfy airflow support request for heating. Signal is sent to fan or VAV supply damper depending on application.	See Configuration section for parameters named "...AirFlHReq".
AirFlHldH	Boolean	Air flow hold for heating → Interlock signal to fan or supply damper requesting equipment protection airflow support for a period of time, such as when the electric heating coil has just turned off.	See Configuration section for parameters named "...AirFlHldH".

Available Status

When the heating coil is available for heating, the binary output signal for **Heating coil available for heating (HclAvlH)** will be "Yes" (available). HclAvlH is used by the system to regulate heating resources. For example, if there is a call for heating but the heating coil is not available because it is already at maximum capacity (because device mode is fully open), then HclAvlH will signal "No" and the next available heating resource in the temperature control sequence will be activated.

For heating available status to be "Yes", device mode must equal "Control mode" (modulation).

Equipment Safety - High Temperature Cut-out Switch

The electric heating coil control logic is configured for **heating coil over-temperature detection input (HclOvrTDet)** from a high temperature cut-out switch.

When the switch activates, the coil is commanded off at equipment protection priority and a signal is sent to the source of airflow to hold / maintain airflow. A timer prevents the source of airflow from stopping until after the timer expires.

NOTE:
This equipment safety is optional and NOT IMPLEMENTED in this application template.

Monitor Electric Power Usage

The nominal electric power usage of the electric heating coil(s) is provided for energy monitoring and coordination with other devices. When the coil is ON at 100%, the heating coil electric power (HclElPwr) is equal to the Nominal Electric Power (NomElPwr) of the coil; when the heating coil is ON at 50% the heating coil electric power (HclElPwr) is equal to the 50% of the Nominal Electric Power [NomElPwr] of the coil.

Configuration

Description	Parameter	Preloaded value
Enable overtemperature detector input	EnOvrTDetIn	0:No
Nominal electric power	NomElPwr	0.4 [kW]
Switch-on point for air volume flow hold heating	SwiOnAirFlHldH	33 [%]
Hysteresis for air volume flow hold heating	HysAirFlHldH	16 [%]
Switch-off delay for hold signal for air volume flow heating	DlyOffAflHldH	30 [s]
Switch-on point for air volume flow heating request	SwiOnAirFlHReq	33 [%]
Hysteresis for air volume flow heating request	HysAirFlHReq	16 [%]
Switch-on delay for air volume flow heating request	DlyOnAirFlHReq	0 [s]

Radiator Hot Water (RadHw11)

This application function operates a hot water valve for radiator(s) and supports downdraft compensation. The main output is a modulating output for valve position.

Main features:

- Analog control of hot water radiator(s), configurable for power modulation (SCR) or pulse width modulation
- Multiple radiator control (1...n)
- Downdraft compensation
- Heating available status
- Supply chain interface

Function

Radiator heating request (**RadHReq**) is received and processed into the output signal for radiator valve position (**RadVlvPos**).

Hot water valve modulation: In response to heating demand, the heating valve is modulated to control the room temperature at setpoint. It can also be 2-positioned in response to external trigger(s) for special modes such as warm-up or cool down, or safety conditions.

Note
This AF does not perform loop control; its main purpose is to execute commands. Loop control processes (for this AF) are managed in the "room" AF(s) that collaborate with this AF to command the end device.

Multiple radiator control: The radiator valve position collection object (RadVlvPosCol) can reference and control multiple radiators.

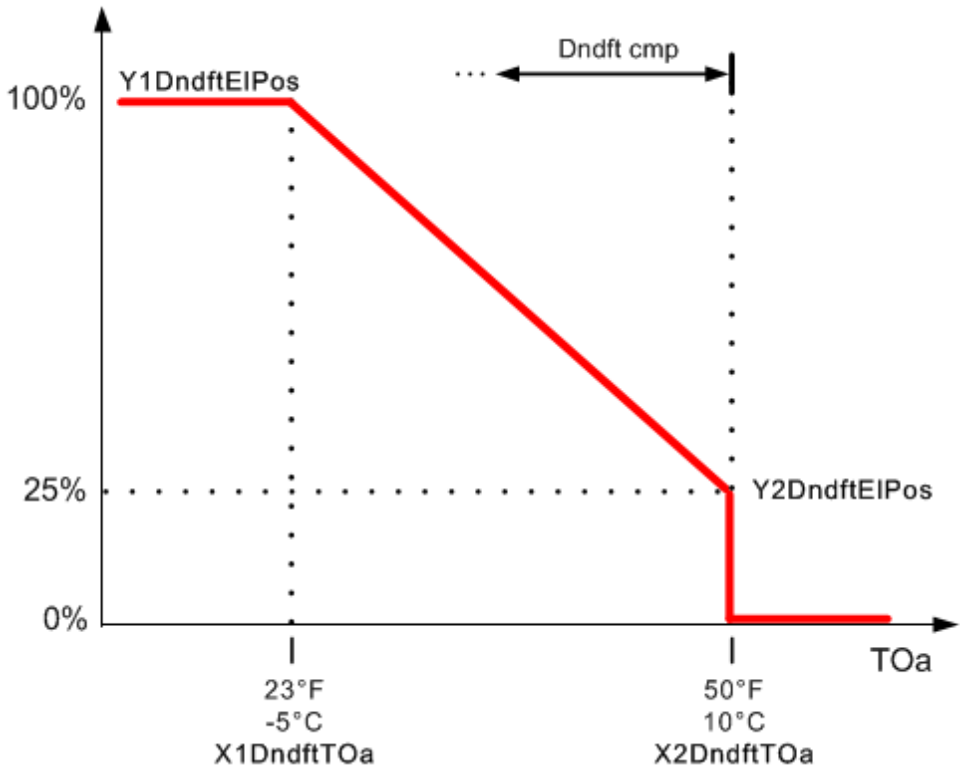
Radiator valve position objects (RadVlvPos) are referenced by the radiator valve position collection object (RadVlvPosCol); this collection object is a common node for any / all RadVlvPos object(s). The value for RadVlvPos comes from RadVlvPosVal.

Downdraft compensation: The downdraft compensation feature slows the sinking cold air flow at large window surfaces and combats cold wall effect at cold perimeter surfaces. This feature activates the radiator when the outside air temperature drops below a configured value, raising the minimum temperature of the radiator to a value higher than it would be otherwise.

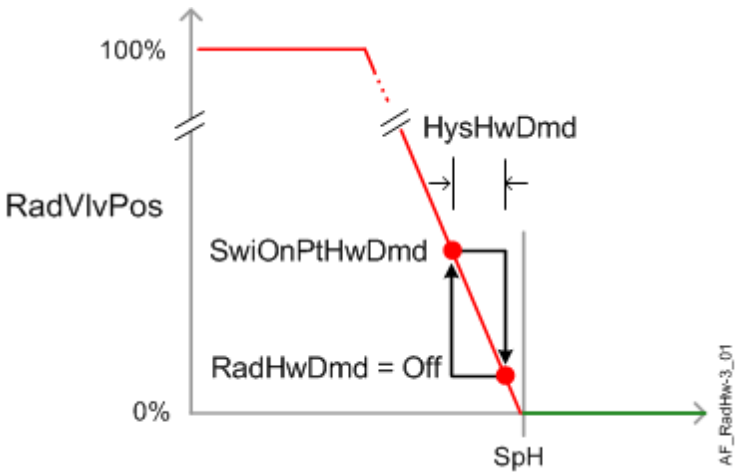
Valve Position	Outside Air Temperature
Y1DndftElPos: 100%	X1DndftTOa: 23° F
Y2DndftElPos: 25%	X2DndftTOa: 50° F

Downdraft compensation is implemented using a linear reset function. The following graphic shows factory default values for X,Y downdraft compensation parameters.

Parameter EnDndft must be set to 1:Yes for downdraft compensation to function (see Configuration).



The following figure(s) illustrates control modulation and related functions.



Configuration

Description	Parameter	Default value
Switch-on point for hot water demand ▶ When the radiant ceiling heating valve position is greater than the switch-on point, the radiant ceiling heating valve enables request hot water for heating.	SwiOnPtHwDmd	4 [%]
Hysteresis for hot water demand ▶ When the radiant ceiling heating valve position is less than the hysteresis value, the radiant ceiling heating valve disables request hot water for heating.	HysHwDmd	2 [%]
Enable downdraft compensation 0:No 1:Yes	EnDndft	0:No
Downdraft characteristics for outside air temperature X1 ▶ Outside air temperature where radiator hot water valve provides full (100%) downdraft control.	X1DndftTOa	-5 [° C], 23.0 [° F]
Downdraft characteristics for valve position Y1 ▶ The radiator valve position that provides 100% downdraft control.	Y1DndftVlvPos	100 [%]
Downdraft characteristics for outside air temperature X2 ▶ Outside air temperature where the radiator hot water valve begins to provide downdraft control.	X2DndftTOa	10 [° C], 50.0 [° F]
Downdraft characteristics for valve position Y2 ▶ The radiator valve position that initializes downdraft control.	Y2DndftVlvPos	25 [%]

Chilled Ceiling with Chilled Water (CcgChw11)

Main features:

- Chilled water cooling valve modulation
- Radiant ceiling available status
- Interlocks
- Supply chain interface
- Condensation monitoring
- Room dewpoint temperature monitoring

Basic function: Accept the request signal from its associated room controller and pass it through a device mode logic switch in the room segment; output the result as a command to the BACnet object that controls the output device. Specifically, the **Radiant ceiling cooling request (RcgCReq)** is received from the room and processed in the room segment into an analog output signal for the radiant ceiling (chilled beam) cooling valve position (RcgVlvPosC).

Radiant ceiling (Chilled beam) cooling valve modulation: In response to a radiant ceiling cooling request from the room, the chilled beam valve is modulated to control the room temperature at setpoint. The valve can also be 2-positioned in response to external trigger(s) for special modes such as cool down or safety conditions.

Multiple panel control: The radiant ceiling valve position collection object (RcgVlvPosCol) can reference and control multiple ceiling/passive chilled beam valve actuators. Radiant ceiling valve position objects (RcgVlvPos) are referenced by the radiant ceiling valve position collection object (RcgVlvPosCol); this collection object is a common node for any / all RcgVlvPos object(s). The value for RcgVlvPos comes from RcgVlvPosVal.

Condensation monitoring: To reduce the risk of condensation on the chilled beam, the modulating water valve can be forced closed at equipment protection priority by a condensation monitor sensor and/or logic that compares the room's dew point temperature to the chilled water temperature. See details in the **Safeties** section.

Safeties

This AF has two methods to reduce the probability of condensation forming on the chilled beam: a binary input for a physical condensation monitor switch and a room dewpoint monitoring cut-off function.

The **Condensation monitor detection input** (CdnMon) is for a physical condensation cut-out switch mounted within proximity to the chilled beam. When the switch activates due to sensing condensation, the chilled beam valve is commanded off at equipment protection priority (priority 4). (This also drives the "Available" signal.)

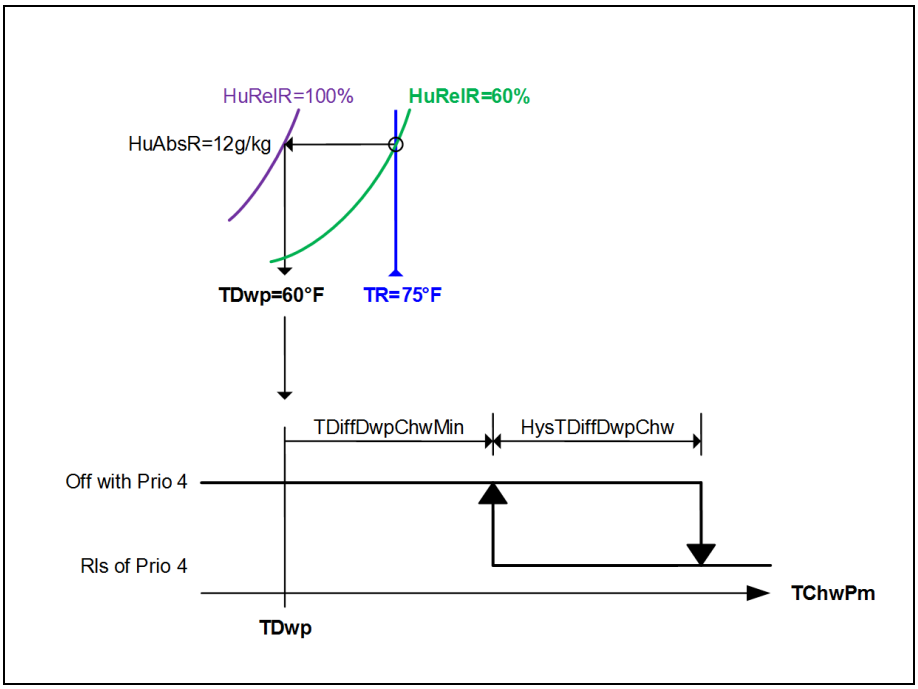
Parameter EnCdnMonIn must be set to 1 (Yes) for the Condensation monitoring to function (see Configuration below).

Room dewpoint monitoring cut-off: The primary chilled water temperature **(TChwPm)** is compared to the room dewpoint temperature **(TDwp).** The room dewpoint is calculated from the room unit temperature sensor and relative humidity sensor values. (See upper drawing in box below ; it is a section of a psychrometric chart.)

When the primary chilled water temperature is less than the dew point temperature of the room plus the minimum temperature difference between the room dew point and the chilled water temperature, then the Device mode (RcgDevMod) is set to Off at equipment protection priority (priority 4). (This also drives the "Available" signal.) When the primary chilled water temperature becomes greater than the above-described equipment cut-off temperature by a configured dead band (HysTDiffDwpChw), the Off command to the device mode is disabled.

Parameter EnTDwp must be set to 1:Yes for the cut-off to function (see **Configuration**).

The primary chilled water temperature is measured at the chiller and communicated to the room controller dewpoint logic using the supply chain function.



IF	THEN
TChwPm < TDwp + TDiffDwpChwMin	Valve = closed @prioity 4
TChwPm + TDiffDwpChwMin < TChwPm < TDwp + TDiffDwpChwMin + HysTDiffDwpChw	No action
TChwPm > TDwp + TDiffDwpChwMin + HysTDiffDwpChw	Valve = released from priority 4

Condensation Message (CdnMsg) is a binary output object for the supply chain logic and supports the following states:

- Normal (both the condensation monitor and the dew point monitoring cut-off logic output are False)
- Warning (either the condensation monitor or the dew point monitoring cut-off logic output is True)

The Enable parameters for these two functions do not need to be True for the condensation message to function.

Available Status

When the chilled beam/radiant ceiling is available for cooling, the binary output signal for "Radiant ceiling available for cooling" (RcgAvlC) will be "Yes" (available). RcgAvlC is used by the system to regulate cooling resources. For example, if there is a call for cooling but the chilled beam/radiant ceiling is not available because it is already at maximum capacity (e.g.: device mode is “Fully open”), then RcgAvlC

will signal "No" and the next available cooling resource in the temperature control sequence will be activated.

For cooling available status to be "Yes", device mode must equal "Control mode" (modulation).

Configuration

Parameters

Description	Name	Default value
Enable condensation monitor input	EnCdnMonIn	Yes
Enable dew point temperature This should only be enabled if the primary chilled water temperature is provided to the controller.	EnTDwp	Yes
Min.diff.dew point/chilled water temp.	TDiffDwpChwMin	2 [° F] 1 [° C]
Hys.f.min.diff.dew point/chilled w.temp.	HysTDiffDwpChw	1.5 [° F] 0.9 [° C]
Switch-on point for chilled water demand	SwiOnPtChwDmd	4%
Hysteresis for chilled water demand	HysChwDmd	2%

Supply Chains for Primary Plants / Room

This function exists to execute group data exchanged between room applications and primary system applications. It communicates with the primary system using standard BACnet objects. There are two ways data can be shared between the primary system and the rooms. These are:

- Read / write to standard BACnet Objects in individual automation stations.
- Each Central function AF includes **Group master** objects that link to the **Group member** objects in the room applications. Central function AF's are available from the library for download to an automation station.

See ABT Site Help, under **Building** > **Central functions** for more information on grouping.

Common uses for Group master / Group member functionality are Scheduling and Duct pressure reset. See the following sections for additional information.

Start/Stop on Demand from Zones

Scheduled Use

When the schedules apply to rooms, rather than equipment, a single schedule may apply to one or more rooms. The rooms served by one HVAC supply system can be driven by any number of schedules. Interactions between the scheduler and the room control application affect room operating mode demands for HVAC.

Unscheduled Use

Rooms scheduled to run in the Economy or Standby mode, switch to Comfort on input from occupancy sensors or a room unit. The room may call on primary plants to run and stop in response to this unscheduled use

Maintain Economy Conditions

Rooms operating in the Economy mode may need primary heating or cooling equipment to run intermittently in order to maintain the economy setpoints. The rooms send signals to indicate the demand for heating and cooling.

Duct pressure reset

Energy codes (for example, ASHRAE 90.1) in the US require controls that result in at least one damper nearly fully open' but do not require a specific algorithm. The air handler adjusts fan speed and duct pressure to the lowest level that satisfies air demands from the zones.

The VAV and FPB application templates support a variety of approaches to duct pressure reset. For example the saturation level parameter (StrtnLvl) can be adjusted to increase/decrease the terminal box's sensitivity to a saturation condition. The group master object for supply air coordination collects data from several supply air group members to support duct pressure reset.

Supply Chain Coordination - Supply Air: Group Member

Airflow deviation signal

When the deviation calculation is enabled, a determination is made if the setpoint is greater than the air flow for a period of time an analog deviation value is mode available to the central function for additional control logic or reporting.

The supply airflow deviation signal **(VavSuAirFlDvn)** is used for fan speed (static pressure) reset strategies at the air handling unit. It is obtained by measuring the airflow from the supply duct and comparing it to the airflow setpoint.

VavSuAirFlDvn (in percent) = VavSuSpAflRel minus VavSuAirFlRel

VavSuAirFlDvn will equal 0 in case of invalid condition

Dual Duct Saturation signal

When the saturation level calculation is enabled, a determination is made if the VAV box is starved (damper open greater than the saturation level value, i.e. not sufficient air) or satisfied. After saturation conditions are met (time delay DlyOnStrtn), the saturation signal, VavSuAflStrtn1, VavSuAflStrtn2 is set to True (starved) and can be shared via grouping with the central function to provide additional control such as AHU static pressure reset.

Each saturation signal **(VavSuAflStrtn1 and VavSuAflStrtn2)** is a binary object that is True ("Starved") when the air flow control loop cannot get enough air to reach setpoint for a time exceeding a built-in time delay. After the delay expires, open loop operation begins.

NOTE:
VavSuAflStrtn1/2 is always off if parameter EnStrtnCal = 0 (No). This allows the user to exclude a particular terminal from the saturation pressure reset system.

Relief input signal

A VAV box's binary **air flow relief object (VavSuAirFlRlf)** can be set to True by the air handling unit. This is done to relieve flow resistance in the duct system in order to maintain proper static pressure. The VAV controller responds by increasing its air flow setpoint (VavSuSpAirFl).

When device mode = control mode and both EnRlf (Enable relief) and VavSuAirFlRlf equal On, VavSuSpAirFl will be set to the maximum of either its current value or the parameter AirFlRlf.

NOTE:
Relief has no effect on the supply chain VAV air demand signal VavSuAirDmd.

Dual Duct AHU changeover condition signal

Each multistate **VAV supply changeover condition input signal (VavSuChovrCnd1, VavSuChovrCnd2**) comes from the room coordinating function (RCoo). It indicates the current heating / cooling available status for central AHU. Four states are supported:

1. Neither
2. Heating
3. Cooling
4. Neutral

Default configuration for VAV Dual Duct is Duct 1 is set to 'cooling' and Duct 2 is set to 'heating'. These can be changed, in defaults, or commanded by central equipment for each duct

"Neutral" means that heating and cooling PID controllers are both enabled and that the system is providing air that is not hot or cold.

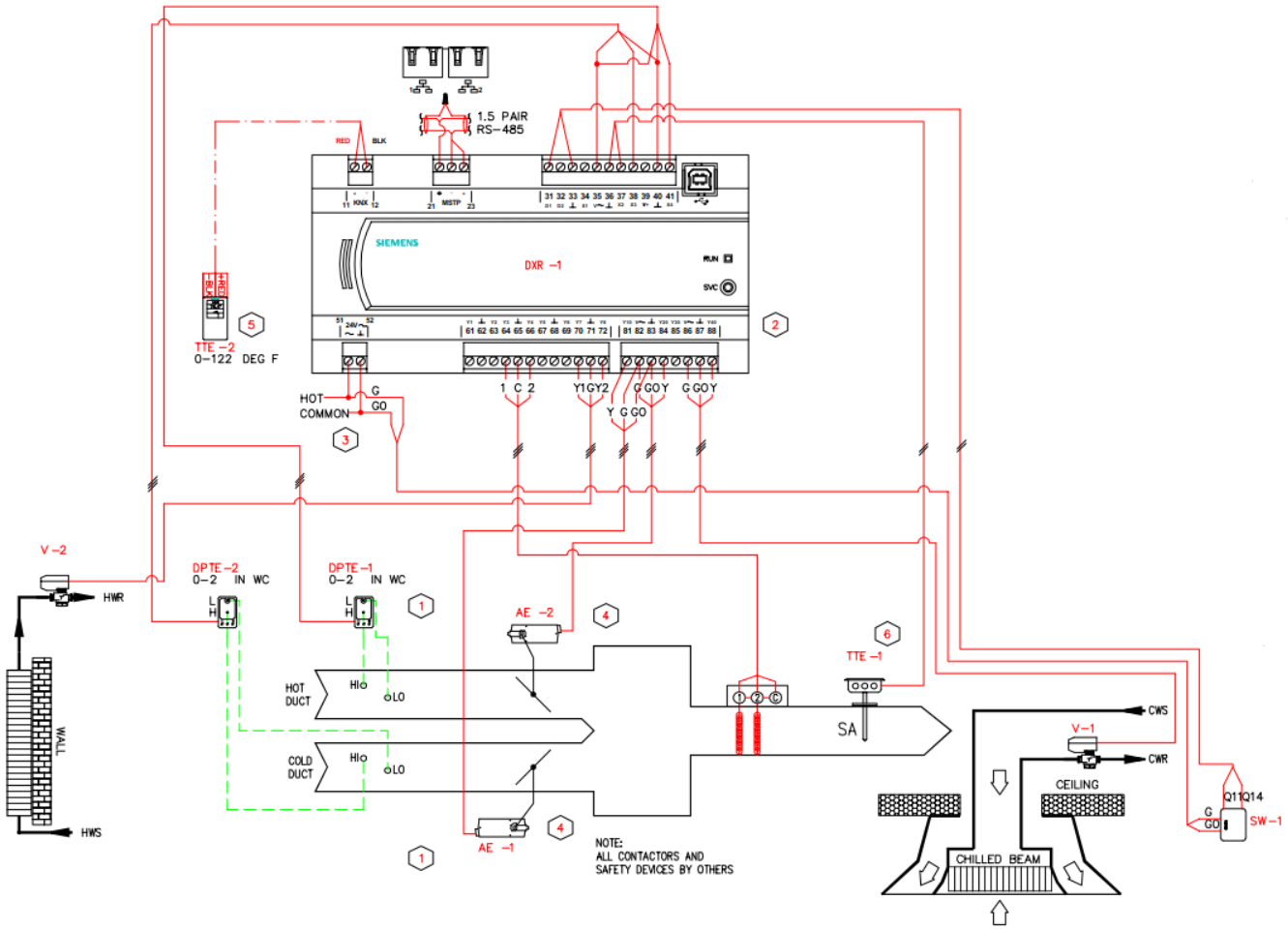
Configuration

Parameters

Description	Parameter	Pre-loaded Value
Enable deviation calculation 0:No 1:Yes	EnDvnCal	Yes
Enable saturation calculation 0:No 1:Yes	EnStrtnCal	Yes
Saturation level → If the percent open value for damper position (VavSuPos) is above the Saturation level (StrtnLvl) and the airflow error value (relative setpoint VavSuSpAflRel minus relative airflow VavSuSpAirFl) is greater than the Air volume flow error limit (AirFlErLm), the saturation signal VavSuAflStrtn will be True after DlyOnStrtn time. (If AirFlErLm is left at default 0%, then the airflow error value has no effect on the saturation signal.)	StrtnLvl	90%
Air volume flow error limit → In % of Nominal airflow value (AirFlNom); If the airflow error value (relative setpoint VavSuSpAflRel minus relative airflow VavSuSpAirFl) is greater than the Air volume flow error limit (AirFlErLm) and the percent open value for damper position (VavSuPos) is greater than StrtnLvl, the saturation signal (VavSuAflStrtn) will be True after DlyOnStrtn time. (If AirFlErLm is left at default 0%, then the airflow error value has no effect on the saturation signal.)	AirFlErLm	0.0%
Switch-on delay saturation → The minimum length of time a saturation condition must remain in effect before the saturation signal VavSuAflStrtn changes to True.	DlyOnStrtn	60.0 secs
Switch-on point for air flow demand → The minimum initial airflow setpoint value above which the supply chain airflow demand object (VavSuAirDmd) switches from Off to the current plant operating mode.	SwiOnAirFlDmd	4% (of AirFlNom)
Hysteresis for air flow demand → The percent value below SwiOnAirFlDmd at which the airflow demand object (VavSuAirDmd) switches from the current plant operating mode to Off.	HysAirFlDmd	2% (of AirFlNom)
Enable relief 0:No (disables the relief function) 1:Yes (enables the relief function)	EnRlf	No

Description	Parameter	Pre-loaded Value
Air volume flow relief → The minimum airflow setpoint for VAV box when its air flow relief object (VavSuAirFlRlf) is set to True.	AirFlRlf	0.0 ft3/min

Inputs and Outputs



14269 Input/Output Diagram

14269 Point Database

The table shows US engineering units and values, and also CA engineering units and values. CA values are shown in parentheses ( ).

#	Descriptor	Object Type	Instance #	Desigo Name	Description	Default Value	Units	Enumeration	On Text	Off Text
1	ROOM TEMP 4	AI	57	TR	Room temperature	--	DEG F (DEG C)	--	--	--
2	SPLY TEMP 4	AI	128	TSu	Supply air temperature	--	DEG F (DEG C)	--	--	--
3	SU DIFF 1P 3	AI	186	VavSuDiffP1	Supply air VAV differential pressure 1	--	in H2O (Pa)	--	--	--
4	SU DIFF 2P 4	AI	191	VavSuDiffP2	Supply air VAV differential pressure 2	--	in H2O (Pa)	--	--	--
5	COND STA 1	BI	20	CdnMon	Condensation monitor	Off	--	--	On	Off
6	RAD V POS 2	AO	120	RadVlvPos1	Radiator valve position 1	--	PCT	--	--	--
7	PANL C POS10	AO	164	RcgVlvPosC1	Radiant ceiling valve pos.for cooling 1	--	PCT	--	--	--
8	1DMPR POS 5	AO	247	VavSuPos1	Supply air VAV position 1	--	PCT	--	--	--
9	2DMPR POS 5	AO	251	VavSuPos2	Supply air VAV position 2	--	PCT	--	--	--
10	HTG EL 1ST 2	BO	100	HclEl1StPos	Heating coil electric pos.first stage	Off	--	--	On	Off
11	HTG EL 2ST 2	BO	102	HclEl2StPos	Heating coil electric pos.second stage	Off	--	--	On	Off
12	APPLICATION	ACnfVal	4	AppNr	Application number	14269	--	--	--	--
13	CMF CLG STPT	APrcVal	14	SpCCmf	Cooling setpoint for comfort	75 (24)	DEG F (DEG C)	--	--	--
14	STBY C DELTA	ACnfVal	15	DSpCPcf	Delta cooling setpoint for pre-comfort	2 (1)	DEG F (DEG K)	--	--	--
15	CLG STPT EFF	APrcVal	16	PrSpC	Present cooling setpoint	--	DEG F (DEG C)	--	--	--
16	PROT CLGSTPT	ACnfVal	17	SpCPrt	Cooling setpoint for protection	104 (40)	DEG F (DEG C)	--	--	--
17	ECO CLG STPT	ACnfVal	18	SpCEco	Cooling setpoint for economy	85 (30)	DEG F (DEG C)	--	--	--
18	STBY C SPEFF	ACalcVal	19	PrSpCPcf	Present cooling setpoint for pre-comfort	--	DEG F (DEG C)	--	--	--
19	CMF C SP EFF	ACalcVal	20	PrSpCCmf	Present cooling setpoint for comfort	--	DEG F (DEG C)	--	--	--
20	ECO C SP EFF	ACalcVal	21	PrSpCEco	Present cooling setpoint for economy	--	DEG F (DEG C)	--	--	--
21	PROT C SPEFF	ACalcVal	22	PrSpCPrt	Present cooling setpoint for protection	--	DEG F (DEG C)	--	--	--
22	CMF HTG STPT	APrcVal	32	SpHCmf	Heating setpoint for comfort	70 (21)	DEG F (DEG C)	--	--	--
23	PROT HTG SP	ACnfVal	33	SpHPrt	Heating setpoint for protection	45 (7)	DEG F (DEG C)	--	--	--

#	Descriptor	Object Type	Instance #	Desigo Name	Description	Default Value	Units	Enumeration	On Text	Off Text
24	ECO HTG STPT	ACnfVal	34	SpHEco	Heating setpoint for economy	55 (12)	DEG F (DEG C)	--	--	--
25	STBY H DELTA	ACnfVal	35	DSpHPcf	Delta heating setpoint for pre-comfort	2 (1)	DEG F (DEG K)	--	--	--
26	CMF H SP EFF	ACalcVal	36	PrSpHCmf	Present heating setpoint for comfort	--	DEG F (DEG C)	--	--	--
27	STBY H SPEFF	ACalcVal	37	PrSpHPcf	Present heating setpoint for pre-comfort	--	DEG F (DEG C)	--	--	--
28	HTG STPT EFF	APrcVal	38	PrSpH	Present heating setpoint	--	DEG F (DEG C)	--	--	--
29	ECO H SP EFF	ACalcVal	39	PrSpHEco	Present heating setpoint for economy	--	DEG F (DEG C)	--	--	--
30	PROT H SPEFF	ACalcVal	40	PrSpHPrt	Present heating setpoint for protection	--	DEG F (DEG C)	--	--	--
31	RM TEMP STPT	APrcVal	41	SpTR	Room temperature setpoint	--	DEG F (DEG C)	--	--	--
32	RM TEMP SHFT	APrcVal	42	SpTRShft	Room temperature setpoint shift	0	DEG F (DEG K)	--	--	--
33	ECO DCV STPT	ACnfVal	45	SpAQualREco	Setpoint room air quality for economy	1500	ppm	--	--	--
34	PROT DCV SP	ACnfVal	46	SpAQualRPrt	Setpoint room air quality for protection	2000	ppm	--	--	--
35	STBY DCV SP	ACnfVal	47	SpAQualRPcf	Setp.room air quality for pre-comfort	1200	ppm	--	--	--
36	VENT SP EFF	APrcVal	48	PrSpVnt	Present ventilation setpoint	--	ppm	--	--	--
37	CMF IAQ STPT	ACnfVal	49	SpAQualRCmf	Setpoint room air quality for comfort	1000	ppm	--	--	--
38	RM DCV EVAL	ACalcVal	50	RAQual	Room air quality	--	ppm	--	--	--
39	RM TEMP EVAL	ACalcVal	51	RTemp	Room temperature	--	DEG F (DEG C)	--	--	--
40	OA TEMP 1	APrcVal	52	TOa	Outside air temperature	--	DEG F (DEG C)	--	--	--
41	OA HUM	APrcVal	53	HuRelOa	Relative outside humidity	--	rh	--	--	--
42	RM HUM EVAL	ACalcVal	54	RHuRel	Relative humidity for room	--	rh	--	--	--
43	REHTG POS	ACalcVal	57	ReHclPos	Reheating coil position	--	PCT	--	--	--
44	RAD VLV VAL	APrcVal	66	RadVlvPosVal	Radiator valve position value	--	PCT	--	--	--
45	RAD HTG REQ	ACalcVal	67	RadHReq	Radiator heating request	--	PCT	--	--	--
46	PANEL CW REQ	ACalcVal	258	RcgCReq	Radiant ceiling cooling request	--	PCT	--	--	--
47	HTG ELEC PWR	ACalcVal	270	HclElPwr	Heating coil electric power	--	kW	--	--	--
48	HTG COIL REQ	ACalcVal	271	HclHReq	Heating coil heating request	--	PCT	--	--	--
49	PANL CLG VAL	APrcVal	548	RcgVlvPosCVal	Radiant ceiling valve pos.val.for cool.	--	PCT	--	--	--

#	Descriptor	Object Type	Instance #	Desigo Name	Description	Default Value	Units	Enumeration	On Text	Off Text
50	AIR VEL1EF	ACalcVal	691	VavSuAirVEff1	Supply air VAV effective air velocity 1	--	ft/m (m/s)	--	--	--
51	AIR VOL1SP 1	APrcVal	692	VavSuSpAirFl1	Supply air VAV setpoint f.air vol.flow 1	--	ft3/m (lps)	--	--	--
52	FLO REL1SP	ACalcVal	693	VavSuSpAflRel1	Supply air VAV setp.f.rel.air vol.flow 1	--	PCT	--	--	--
53	SU AIR1VOL 1	ACalcVal	694	VavSuAirFl1	Supply air VAV air volume flow 1	--	ft3/m (lps)	--	--	--
54	SU AIR1FLO	ACalcVal	695	VavSuAirFlRel1	Supply air VAV rel.air volume flow 1	--	PCT	--	--	--
55	AIR FL 1DV	ACalcVal	696	VavSuAirFlDvn1	Supply air VAV air volume flow deviat.1	--	PCT	--	--	--
56	AIR VEL2EF	ACalcVal	697	VavSuAirVEff2	Supply air VAV effective air velocity 2	--	ft/m (m/s)	--	--	--
57	AIR VOL2SP 1	APrcVal	698	VavSuSpAirFl2	Supply air VAV setpoint f.air vol.flow 2	--	ft3/m (lps)	--	--	--
58	FLO REL2SP	ACalcVal	699	VavSuSpAflRel2	Supply air VAV setp.f.rel.air vol.flow 2	--	PCT	--	--	--
59	SU AIR2VOL 1	ACalcVal	700	VavSuAirFl2	Supply air VAV air volume flow 2	--	ft3/m (lps)	--	--	--
60	SU AIR2FLO	ACalcVal	701	VavSuAirFlRel2	Supply air VAV rel.air volume flow 2	--	PCT	--	--	--
61	AIR FL 2DV	ACalcVal	702	VavSuAirFlDvn2	Supply air VAV air volume flow deviat.2	--	PCT	--	--	--
62	AIRVOL TOT	ACalcVal	703	VavSuAirFlTot	Supply air VAV total air volume flow	--	ft3/m (lps)	--	--	--
63	VAV CLG REQ	ACalcVal	704	VavSuCReq	Supply air VAV cooling request	--	PCT	--	--	--
64	VAV HTG REQ	ACalcVal	705	VavSuHReq	Supply air VAV heating request	--	PCT	--	--	--
65	VAV VENT REQ	ACalcVal	706	VavSuVntReq	Supply air VAV ventilation request	--	PCT	--	--	--
66	VAV VNT FLOW	ACalcVal	707	VavSuAflPvdVnt	Supply air VAV provided air flow f.vent.	--	ft3/m (lps)	--	--	--
67	CLG FLOW MAX	ACnfVal	732	VavSuAirFlMaxC	Supply air VAV max.air vol.flow f.cool.	1000 (500)	ft3/m (lps)	--	--	--
68	CLG FLOW MIN	ACnfVal	733	VavSuAirFlMinC	Supply air VAV min.air vol.flow f.cool.	0	ft3/m (lps)	--	--	--
69	HTG FLOW MAX	ACnfVal	734	VavSuAirFlMaxH	Supply air VAV max.air vol.flow f.heat.	800 (400)	ft3/m (lps)	--	--	--
70	HTG FLOW MIN	ACnfVal	735	VavSuAirFlMinH	Supply air VAV min.air vol.flow f.heat.	100 (50)	ft3/m (lps)	--	--	--
71	VENT FLO MAX	ACnfVal	736	VavSuAflMaxVnt	Supply air VAV max.air vol.flow f.vent.	500 (250)	ft3/m (lps)	--	--	--
72	VENT FLO MIN	ACnfVal	737	VavSuAflMinVnt	Supply air VAV min.air vol.flow f.vent.	0	ft3/m (lps)	--	--	--
73	VAV CLG DMD	ACalcVal	738	VavSuCDmd	Supply air VAV cooling demand	--	PCT	--	--	--

#	Descriptor	Object Type	Instance #	Desigo Name	Description	Default Value	Units	Enumeration	On Text	Off Text
74	VAV HTG DMD	ACalcVal	739	VavSuHDmd	Supply air VAV heating demand	--	PCT	--	--	--
75	VAV VENT DMD	ACalcVal	740	VavSuVntDmd	Supply air VAV ventilation demand	--	PCT	--	--	--
76	CMF BTN	BPrcVal	0	CmfBtn	Comfort button	Inactive	--	--	Active	Inactive
77	RAPID VENT	BPrcVal	2	RpdVnt	Rapid ventilation	Off	--	--	On	Off
78	NGT CLG REQ	BCalcVal	3	NgtCReq	Night cooling request	Inactive	--	--	Active	Inactive
79	COOL DN REQ	BCalcVal	4	CoolDwnReq	Cool down request	Inactive	--	--	Active	Inactive
80	WARM UP REQ	BCalcVal	5	WarmUpReq	Warm-up request	Inactive	--	--	Active	Inactive
81	OCC SEN EVAL	BCalcVal	6	RPscDet	Room presence detection	Absent	--	--	Present	Absent
82	WINDOW EVAL	BCalcVal	7	RWndSta	Room window state	Closed	--	--	Opened	Closed
83	CONDMON RSLT	BCalcVal	67	CdnMonRs	Result of condensation monitor	Off	--	--	On	Off
84	FRE CLGREQ 1	BCalcVal	275	FreeCReq	Free cooling request	Inactive	--	--	Active	Inactive
85	CNDMON MSG	BCalcVal	278	CdnMsg	Condensation message	Normal	--	--	Alert	Normal
86	SU FLO1SAT	BCalcVal	358	VavSuAflStrtn1	Supply air VAV air vol.flow saturation 1	Satisfd	--	--	Starved	Satisfd
87	SU FLO2SAT	BCalcVal	359	VavSuAflStrtn2	Supply air VAV air vol.flow saturation 2	Satisfd	--	--	Starved	Satisfd
88	SU FAN1CST	BCalcVal	363	FanSuCstVal1	Coasting value of supply air fan 1	Off	--	--	On	Off
89	SU FAN2CST	BCalcVal	364	FanSuCstVal2	Coasting value of supply air fan 2	Off	--	--	On	Off
90	AIR VOL1RF	BPrcVal	365	VavSuAirFlRlf1	Supply air VAV air volume flow relief 1	Off	--	--	On	Off
91	AIR VOL2RF	BPrcVal	366	VavSuAirFlRlf2	Supply air VAV air volume flow relief 2	Off	--	--	On	Off
92	CND MSG RS	BCalcVal	367	CdnMsgRs	Result of condensation message	Inactive	--	--	Active	Inactive
93	DEV STATUS	CmnEvt	0	AsSta	Automation station state	Normal	--	1:Normal 2:IntervAc 3:Fault 4:Alarm 5:FltAlrm	--	--
94	IO STATUS	CmnEvt	2	IOBusSta	I/O bus state	Normal	--	1:Normal 2:IntervAc 3:Fault 4:Alarm 5:FltAlrm	--	--

#	Descriptor	Object Type	Instance #	Desigo Name	Description	Default Value	Units	Enumeration	On Text	Off Text
95	PLNK STATUS	CmnEvt	4	PlnkBusSta	KNX PL-Link bus state	Normal	--	1:Normal 2:IntervAc 3:Fault 4:Alarm 5:FltAlrm	--	--
96	RM STATUS	CmnEvt	8	RSta	Room state	Normal	--	1:Normal 2:IntervAc 3:Fault 4:Alarm 5:FltAlrm	--	--
97	SEGM STATUS	CmnEvt	9	RSegmSta	Room segment state	Normal	--	1:Normal 2:IntervAc 3:Fault 4:Alarm 5:FltAlrm	--	--
98	RM OP MODE	MPrcVal	13	ROpMod	Room operating mode	Protect	--	1:Protect 2:Economy 3:PrComfrt 4:Comfort	--	--
99	GREEN LEAF	MPrcVal	15	REei	Energy efficiency indication room	Undef	--	1:Undef 2:Poor 3:Satisf 4:Good 5:Excel	--	--
100	RM LGT GRNLF	MCalcVal	16	RLgtEei	Room energy efficiency ind.lighting	Undef	--	1:Undef 2:Poor 3:Satisf 4:Good 5:Excel	--	--
101	RM SHD GRNLF	MCalcVal	17	RShdEei	Room energy efficiency ind.shading	Undef	--	1:Undef 2:Poor 3:Satisf 4:Good 5:Excel	--	--
102	RMHVAC GRNLF	MCalcVal	20	RHvacEei	Room energy efficiency indication HVAC	Undef	--	1:Undef 2:Poor 3:Satisf 4:Good 5:Excel	--	--
103	H.C STATE	MCalcVal	21	HCSta	Heating/cooling state	Neither	--	1:Neither 2:Heating 3:Cooling	--	--
104	NEXT OP MODE	MPrcVal	22	NxROpMod	Next room operating mode	Protect	--	1:Protect 2:Economy 3:PrComfrt 4:Comfort	--	--

#	Descriptor	Object Type	Instance #	Desigo Name	Description	Default Value	Units	Enumeration	On Text	Off Text
105	PLANT OPMODE	MPrcVal	23	PltOpMod	Plant operating mode	Off	--	1:Off 2:Protect 3:Economy 4:PrComfrt 5:Comfort 6:Warm-up 7:CoolDown 8:RmLTProt 9:NUsed1 10:FreeCool 11:NghtCool 12:Vent 13:NUsed2 14:AVlFlOf 15:SmCtPoPr 16:SmCtNgPr 17:Purge	--	--
106	DCV IND EVAL	MCalcVal	24	RAQualInd	Room air quality indication	Undef	--	1:Undef 2:Poor 3:Okay 4:Good	--	--
107	HC DEMAND	MCalcVal	31	HCDmd	Heating/cooling demand	Neither	--	1:Neither 2:Heating 3:Cooling	--	--
108	RAD HW DMD	MCalcVal	34	RadHwDmd	Radiator hot water demand	Off	--	1:Off 2:HeatDmd 3:Warm-up	--	--
109	RAD DEV MODE	MPrcVal	35	RadDevMod	Radiator device mode	Off	--	1:Off 2:CtrlMode 3:FullOpen 4:CMdDwDrf 5:DwnDrft	--	--
110	PANEL CW DMD	MCalcVal	86	RcgChwDmd	Radiant ceiling chilled water demand	Off	--	1:Off 2:CoolDmnd 3:FreeCool	--	--
111	PANEL MODE	MPrcVal	87	RcgDevMod	Radiant ceiling device mode	Off	--	1:Off 2:CtrlMod 3:FullOpen	--	--
112	HTG DEV MODE	MPrcVal	94	HclDevMod	Heating coil device mode	Off	--	1:Off 2:CtrlMod 3:FullOpen	--	--
113	RM UNIT STA4	BAPeripheralDevice	393	ROpUn 1	Room operator unit 1	Operat.	--	1:Operat. 2:DevStopd 3:DevNAsgn 4:DevMisng 5:CnfngDev 6:Unused 7:CnfError 8:Searchng	--	--
114	OP MODE EFF	MCalcVal	516	PrOpMod	Present operating mode	Protect	--	1:Protect 2:Economy 3:PrComfrt 4:Comfort	--	--

#	Descriptor	Object Type	Instance #	Desigo Name	Description	Default Value	Units	Enumeration	On Text	Off Text
115	VAV MODE	MPrcVal	740	VavSuDevMod	Supply air VAV device mode	Off	--	1:Off 2:CtrlMod 3:MxAiVlFl 4:MnAiVlFl 5:SmCtAFlS	--	--
116	1VAV CHGVR	MPrcVal	741	VavSuChovrCnd1	Supply air VAV changeover condition 1	Neither	--	1:Neither 2:Heating 3:Cooling 4:Neutral	--	--
117	2VAV CHGVR	MPrcVal	742	VavSuChovrCnd2	Supply air VAV changeover condition 2	Neither	--	1:Neither 2:Heating 3:Cooling 4:Neutral	--	--
118	SU AIR1DMD	MCalcVal	743	VavSuAirDmd1	Supply air VAV air demand 1 f.plant mode	Off	--	1:Off 2:Protect 3:Economy 4:PrComfrt 5:Comfort 6:Warm-up 7:Cooldown 8:RmLTProt 9:CdOvrFPr 10:FreeCool 11:NghtCool 12:Vent 13:EqTmpPro 14:ArVlFlwO 15:SmkCPoPr 16:SmkCNgPr 17:Purge	--	--
119	SU AIR2DMD	MCalcVal	744	VavSuAirDmd2	Supply air VAV air demand 2 f.plant mode	Off	--	1:Off 2:Protect 3:Economy 4:PrComfrt 5:Comfort 6:Warm-up 7:Cooldown 8:RmLTProt 9:CdOvrFPr 10:FreeCool 11:NghtCool 12:Vent 13:EqTmpPro 14:ArVlFlwO 15:SmkCPoPr 16:SmkCNgPr 17:Purge	--	--

BACnet Object Types:

- AI, AO, BI, BO, MI, MO – Standard BACnet physical inputs and outputs.
- APrcVal, BPrcVal, MPrcVal – Analog, Binary or Multi-state Process Values are virtual outputs (not connected to hardware) with priority arrays. They can be commanded by the application or by external sources.

- ACalcVal, BCalcVal, MCalcVal – Analog, Binary or Multi-state Calculated Values are virtual inputs (not connected to hardware) that are only written to by the application as result of states or calculations.
- ACnfVal, BCnfVal, MCnfVal – Analog, Binary or Multi-state Configuration Values are set per job requirements (for example, cooling setpoint for Economy) and are retained after power cycling.
- Additional object types (for example, CmnEvt) are special objects that convey status information.

Issued by
Smart Infrastructure
Building Products
1000 Deerfield Pkwy
Buffalo Grove IL 60089
Tel. +1 847-215-1000

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