

SIEMENS



Configure Custom Heat Pump Single Stage with Condenser Water Temperature Logic

Water Source Heat Pump with Reversing Valve, 1-Speed Fan, Hot Water Heating Coil, OA Damper and Hot Water Radiator

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Before You Begin

Scope and Purpose

This document provides configuration steps for engineering a custom heat pump app using a **Desigo DXR2.E18 Automation Station** device. The custom application includes logic that involves the condenser water supply temperature.

Also included is a Sequence of Operations summary based on Heat Pump template 14270, modified to reflect the custom application configuration. (see appendix)



Knowledge and Training Prerequisites

The reader / user of this document must be trained, knowledgeable, and familiar with using ABT Site to configure DXR automation stations.

See ABT Site Help for additional information as needed.

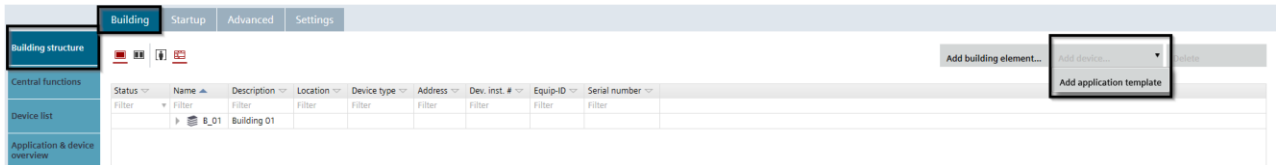
ABT Site & Hardware Requirements

The specific application configuration in this document was developed using:

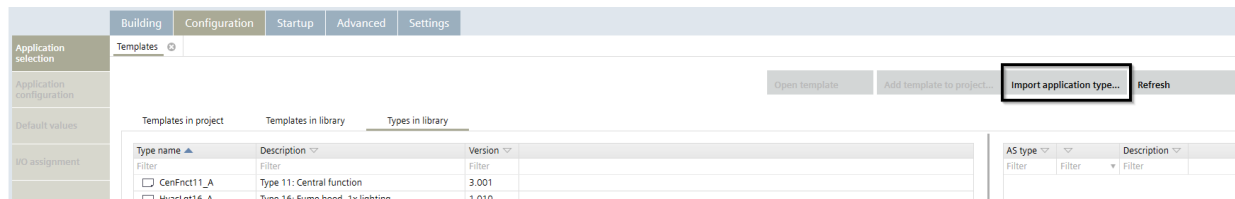
- ABT Site 3.1.1 (with patch 3); Metaset 1153
- Custom developed .s1ca file provided by Siemens Chicago SWH
- DXR2.E18 must be used – no other DXR versions are supported

Configure Custom Heat Pump – Single Stage with Condenser Water Temperature Logic

Step 1 – Import Application Type Into ABT Site



- ▷ In ABT Site, the desired project is open and the **Add application template** workflow is started
- ▷ **Configuration component** and **Application selection task** are active



1. Click **Import application type** and browse to location of the **s1ca** file and click Open.
2. With the **Types in library** tab active, select the newly imported application type (left side); also select associated DXR2.E18 hardware (right side).

Templates in project			Templates in library			Types in library		
Type name	Description	Version	Type name	Description	Version	Type name	Description	Version
Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter
<input type="checkbox"/> CenFnct11_A	Type 11: Central function	3.001						
<input type="checkbox"/> HvacLgt16_A	Type 16: Fume hood, 1x lighting	1.010						
<input type="checkbox"/> HvacLgt16_A_FDD	Type 16: Fume hood, FDD, 1x lighting	1.000						
<input type="checkbox"/> HvacLgtShd11_3Stg	Type 11: FCU, RCG, RAD, 4x Lgt, 2x Shd	1.002						
<input type="checkbox"/> HvacLgtShd11_A	Type 11: FCU, RCG, RAD, 4x Lgt, 2x Shd	3.001						
<input type="checkbox"/> HvacLgtShd12_A	Type 12: VAV, RCG, RAD, 4x Lgt, 2x Shd	3.001						
<input type="checkbox"/> HvacLgtShd12_A_FDD	Type 12: VAVFDD, RCG, RAD, 4x Lgt, 2x Shd	1.000						
<input type="checkbox"/> HvacLgtShd13_A	Type 13: FPB, RCG, RAD, 4x Lgt, 2x Shd	3.001						
<input type="checkbox"/> HvacLgtShd13_A_FDD	Type 13: FPB FDD, RCG, RAD, 4x Lgt, 2x Shd	1.000						
<input type="checkbox"/> HvacLgtShd13_MM	Type 13: FPB, RCG, RAD, 4x Lgt, 2x Shd	1.022						
<input type="checkbox"/> HvacLgtShd14_A	Type 14: CET, VAV, RCG, RAD, 4xLgt,2xShd	1.010						
<input type="checkbox"/> HvacLgtShd14_A_FDD	Type 14: CET, VAVFDD, RCG, RAD, 4xLgt,2xShd	1.000						
<input type="checkbox"/> HvacLgtShd15_A	Type 15: CET,VAV,PWR,RCG,RAD,4xLgt,2xShd	1.010						
<input type="checkbox"/> HvacLgtShd15_A_FDD	Type 15: CET,VAVFDD,PWR,RCG,RAD,4xLgt,2xShd	1.000						
<input type="checkbox"/> HvacLgtShd17_A	Type 17: FCU, HP, RCG, RAD,4x Lgt,2x Shd	1.001						
<input type="checkbox"/> SZVAVRTU	Single zone Vav RTU	1.028						

3. Click **Add template to project..** (provide template name, etc) and click OK.
(Once the type template loads, the **Application configuration** task displays.)
4. Click **Template properties** and click the Unlock button to unlock the template; provide number and description as needed and click OK.

Step 2 – Select On-Board Outputs

▷ **Configuration component** and **Application configuration task** are active

Fan Speed

Select the Fan Speed output.

Fan speed

Enable fan speed

Heat pump control

Enable heat pump variable speed

Enable heat pump source

None
None
1-stage; Y1; Normally open
2-stage; Y1, Y2; Normally open
Variable speed; Y10; 0...10 V

To add 'Additional parameters' to the Default values, left click on **Show/hide parameter...** button in the upper right of the Configuration Tab screen. Select %RSegm%, FAN SPD

Heat pump control

NOTE: Currently only HCclHpu12 (single stage compressor with reversing valve control) is supported with this custom configuration. This must be selected else there will be no custom logic involved in this application. (The custom addition to the Heat Pump adds logic that reads the Condenser Water temperature and will activate the heating/cooling coil only when the temperature is **above** a certain point (configurable, default: 60 °F)).

Select the **Heat pump control** output using the on-board output selector.

Heat pump control

Enable heat pump variable speed

Enable heat pump source

Enable heat pump hot gas reheating coil

Heating coil valve position

Enable heating coil electric position

Radiant ceiling valve position 1

Radiant ceiling valve position 2

Radiator valve position 1

None
None
1-stage; Y3; Reversing valve; Y2
1-stage; Y3; Reversing valve; Y8
2-stage; Y3, Y4; Reversing valve; Y2
2-stage; Y3, Y4; Reversing valve; Y8
2-stage, cooling; Y3, Y4; 2-stage, heating; Y7, Y8
Variable speed; Y20; Reversing valve; Y2
Variable speed; Y20; Reversing valve; Y8

To add 'Additional parameters' to the Default values, left click on **Show/hide parameter...** button in the upper right of the Configuration Tab screen. Select %RSegm%, HP CMD

Heating coil valve position

NOTE: Currently only HclHw11 is supported to be used with this custom. If not selected, there will be no custom logic involved in this application.

The custom addition to the Heating Coil adds logic that reads the Condenser Water temperature and will activate the heating coil only when the temperature is **below** a certain point (configurable, default: 60 ℉).

As a rule, 0-10Vdc actuators do not require any further configuration. If you select a 3-position actuator you will need to check the run-time to ensure the defined time matches, the actual actuator connected, the default time is 150 secs. The rise and fall times may need to both be defined/checked.

Heating coil valve position	None
Enable heating coil electric position	None
Radiant ceiling valve position 1	Water; Y5, Y6; 3-position
Radiant ceiling valve position 2	Water; Y5; Pulse width modulation thermal
Radiator valve position 1	Water; Y5; Pulse width modulation spring return
Enable radiator electric position 1	Water; Y30; 0...10 V
Radiator valve position 2	Electric 1-stage; Y5; Normally open
Enable radiator electric position 2	Electric 2-stage; Y5, Y6; Normally open
Binary output 1	Electric modulating; Y5; Pulse width mod.constant period
Binary output 2	Electric modulating; Y30; 0...10 V

To add 'Additional parameters' to the Default values, left click on [Show/hide parameter...](#) button in the upper right of the Configuration Tab screen. Select %RSegm%, HTG V POS

Step 3 – Select On-Board Inputs

Supply air temperature

If unsure of what sensor has been used, then review the wiring diagrams to identify the type of sensor being used. The configurations are made in “Application configuration” part of ABT Site, and the parameters defined in the “Defined values” section of the template.

Supply air temperature	None
Trend for supply air temperature	None
Room air quality	X2; LG-Ni1000
Relative humidity for room	X2; 0...10 V
Extract air temperature	X2; NTC 100k
Mixed air temperature	X2; NTC 10k
Outside air temperature local	X2; T1 (PTC)
Setpoint shift input value	X2; Pt1000 (EU)
Power	X2; Pt1000 (NA)

To add 'Additional parameters' to the Default values, Left click on [Show/hide parameter...](#) button in the upper right of the Configuration Tab screen. Select %RSegm%, SLPY TEMP

Fan State

Select the Fan State input using the on-board input selector.

Fan state	None
Heat pump fault 1	None
Heat pump fault 2	D1; Normally open
Heat pump fault 3	D2; Normally open
Heat pump fault 4	X1; Normally open
Heat pump fault 5	X2; Normally open
Heat pump source state	X3; Normally open
Heat pump source input available	X4; Normally open

To add 'Additional parameters' to the Default values, Left click on Show/hide parameter... button in the upper right of the Configuration Tab screen. Select %RSegm%, FAN STATUS

Step 4 – Select KNX PL-Link Device

The QMX3.P74 will display the selected information based on the figure below.

Function of the display elements and keys	Key	Key
	1	5
	2	6
	3	7
	4	8
	• An arrow indicates that an element can be operated	
	<ul style="list-style-type: none"> • Temperature display in °C or °F / humidity in % r.H. / air quality in text, symbol, or ppm of CO₂ 	
	<ul style="list-style-type: none"> • Toggling (key 1) between indoor and outdoor measurement (temperature, humidity, CO₂) 	
	<ul style="list-style-type: none"> • Indication that a window is open (connected window switch is active) 	
	<ul style="list-style-type: none"> • Display of the plant state (Heating or Cooling / inactive) Note: No manual switchover! Key 5 is used for Green Leaf 	
	<ul style="list-style-type: none"> • Green Leaf function: Pressing key 5 activates the RoomOptiControl function. 	
	<ul style="list-style-type: none"> • Display of the relative or absolute setpoint for temperature 	
	<ul style="list-style-type: none"> • Adjusting the setpoint using keys 2 and 6 	
	<ul style="list-style-type: none"> • Display of the present fan speed (when automatic) 	
	<ul style="list-style-type: none"> • Adjusting the fan speed using key 3 (or keys 3 and 7 if operation of room operating mode is disabled) 	
	<ul style="list-style-type: none"> • Display of the room operating mode (when automatic) 	
	<ul style="list-style-type: none"> • Adjusting the room operating mode using key 7 	
	<ul style="list-style-type: none"> • Navigation: toggle the display / setpoint setting between temperature / humidity / CO₂, using key 4. The black bar points to the displayed information. 	
	<ul style="list-style-type: none"> • Operation of the occupancy state (presence switch, Comfort prolongation) 	
	<ul style="list-style-type: none"> • Activate the Comfort prolongation using key 8 (only available if enabled) 	
	<ul style="list-style-type: none"> • Indicates that the room operator unit is locked by the system. – Operation is disabled – The display in line 1 shows the temperature from bus 	

Step 5 – Select Room Segment HVAC

HVAC	Active
Outside air damper	None
Fan	Single-speed fan 11
Heating/cooling coil	Heat/cool.coil HP 12, 1 BO, revers.valve
Heating coil	Hot water heating coil 11
Radiant ceiling	None
Radiator	None

Step 6 – Select Room HVAC Coordination

Room HVAC coordination	Active
Trend for room temperature	None
Trend for room air quality	None
Trend for relative humidity room	None
Plant operating mode determination	Active
Presence mode determination	None
Fan operation	Active
Room temperature setpoint determination	Active
Temperature control for cooling	Heat pump room temp.control cooling 11
Trend for present cooling setpoint	None
Temperature control for heating	Heat pump room temp.control heating 11
Trend for present heating setpoint	None
Heating/cooling state determination	Active
Ventilation control	None
Dehumidification control	None
Green leaf	Active

Configuration Default Values – ABT Site

Step 7 – Configure Default Values

Default values for KNX PL-Link Devices (QMX3.P74)

▼ KNX PL-Link device				
<input checked="" type="checkbox"/>	Room operator unit 1	Room unit, display temperature	Display room temperature	RM UNIT ST17
<input checked="" type="checkbox"/>	Room operator unit 1	Room unit, display humidity	Display room humidity	RM UNIT ST17
<input type="checkbox"/>	Room operator unit 1	Room unit, display windows status	No	RM UNIT ST17
<input checked="" type="checkbox"/>	Room operator unit 1	Room unit, display air quality	Display room air quality	RM UNIT ST17
<input checked="" type="checkbox"/>	Room operator unit 1	Room unit, air quality display	Symbolic	RM UNIT ST17
<input checked="" type="checkbox"/>	Room operator unit 1	Room unit, display heat/cool. status	Yes	RM UNIT ST17
<input type="checkbox"/>	Room operator unit 1	Enable operation: room temp. setpoint	No	RM UNIT ST17
<input type="checkbox"/>	Room operator unit 1	Room unit, room temp. setpoint display	Absolute temperature setpoint	RM UNIT ST17
<input type="checkbox"/>	Room operator unit 1	Enable operation: fan speed setpoint	No	RM UNIT ST17
<input type="checkbox"/>	Room operator unit 1	Enable operation: presence button	No	RM UNIT ST17
<input checked="" type="checkbox"/>	Room operator unit 1	Enable operation: temporary comfort	Yes	RM UNIT ST17
<input checked="" type="checkbox"/>	Room operator unit 1	Enable operation: room op.mode	Yes	RM UNIT ST17
<input checked="" type="checkbox"/>	Room operator unit 1	Enable operation: green leaf	Yes	RM UNIT ST17
<input checked="" type="checkbox"/>	Setpoint shift input value	Present maximum value	5.4	°F %RSegm%ROpUnDev(1)'SpShftIn
<input checked="" type="checkbox"/>	Setpoint shift input value	Present minimum value	-5.4	°F %RSegm%ROpUnDev(1)'SpShftIn

Room Operating Mode Determination

▼ Room operating mode determination				
<input checked="" type="checkbox"/>	Room operating mode determination	Time for comfort button	120:00:000	mm:ss:ms %R%ROpModDtr
<input checked="" type="checkbox"/>	Room operating mode determination	Comfort button inactive configuration	Auto	%R%ROpModDtr
<input type="checkbox"/>	Room operating mode determination	Op.command for energy effic.at automatic	Automatic	%R%ROpModDtr
<input checked="" type="checkbox"/>	Room operating mode determination	Manual operation lock configuration	Protection & Economy	%R%ROpModDtr
<input type="checkbox"/>	Room operating mode determination	Comfort/Pre-Conf./Economy to Protection	Energy efficiency condition	%R%ROpModDtr
<input type="checkbox"/>	Room operating mode determination	Comfort/Pre-Comfort to Economy	Energy efficiency condition	%R%ROpModDtr
<input type="checkbox"/>	Room operating mode determination	Comfort to Pre-Comfort	Energy efficiency condition	%R%ROpModDtr
<input type="checkbox"/>	Room operating mode determination	Protection/Economy/Pre-Conf.to Comfort	Comfort condition	%R%ROpModDtr
<input type="checkbox"/>	Room operating mode determination	Protection/Economy to Pre-Comfort	None	%R%ROpModDtr
<input type="checkbox"/>	Room operating mode determination	Protection to Economy	None	%R%ROpModDtr
<input type="checkbox"/>	Room operating mode determination	Repetition time energy efficiency trig.	60:00:000	mm:ss:ms %R%ROpModDtr
<input type="checkbox"/>	Room operating mode determination	Repetition number energy effic.trigger	0	--- %R%ROpModDtr
<input checked="" type="checkbox"/>	Room operating mode determination	Source for present operating mode	Plant op.mode	%R%ROpModDtr

- **Source of the present operating mode** [default= ROpMod]: Considers the impact of window contact, presence detector, manual fan operation inputs have on the room operating mode. Should be set to PltOpMod for proper sequencing.
- **Manual operation lock configuration** [default = ProtEcon]: Locks the manual operation of the room unit, during centrally scheduled room operating modes, so comfort cannot be increased/energy efficiency is maintained. Configure to support the appropriate room operating modes; 1: None, 2: Protection, 3: Protection/Economy, 4: Protection/Economy/Pre-Comfort.
- **Time for comfort button**, time period for the presence button and temporary Comfort, as triggered by the Comfort button [default time=2 hours].

Room Green Leaf

Typically, no changes are required to this section

	▼ Room green leaf				
<input type="checkbox"/>	Room green leaf	Switch-on delay EEI indication	15:000	ss.ms	%R%'RGrnLf
<input type="checkbox"/>	Room green leaf	Switch-on delay EEI indic.with shading	02:00:000	mm:ss:ms	%R%'RGrnLf

Room HVAC coordination

	▼ Room HVAC coordination				
<input type="checkbox"/>	Room HVAC coordination	Room air quality indication high limit	1600	ppm	%R%'RHvacCoo
<input type="checkbox"/>	Room HVAC coordination	Room air quality indication low limit	1000	ppm	%R%'RHvacCoo

Plant Operating Mode Determination

The room operating mode, presence detection, HVAC presence mode and window contact as well as the warm-up, cool down and free cooling signals received from the central workstation commands are read and used to determine the AHU plant operating modes. The plant operating mode (PltOpMod) is multi-state BACnet object and supports 17 different multiple states (1: Off, 2: Protection, 3: Economy, 4: Pre-Comfort, 5: Comfort, 6: Warm-up, 7: Cooldown, ...) Note: See Help file for more information. There is a 5 minute [Default] switch delay between switching plant operating mode states when a person is present/absent from the room.

<input checked="" type="checkbox"/>	Plant operating mode determination	Switch delay when present	05:00:000	mm:ss:ms	%R%'RHvacCoo'PltModDtr
<input checked="" type="checkbox"/>	Plant operating mode determination	Switch delay when absent	05:00:000	mm:ss:ms	%R%'RHvacCoo'PltModDtr

Fan Operation

Typically, no changes are required to this section

	▼ Fan operation				
<input type="checkbox"/>	Fan operation	Fan command for energy effic.at auto.	Automatic		%R%'RHvacCoo'FanOp
<input type="checkbox"/>	Fan operation	Fan command for energy effic.at manual	None		%R%'RHvacCoo'FanOp

Room Temperature Setpoint Determination

	▼ Room temperature setpoint determination				
<input type="checkbox"/>	Room temperature setpoint determination	Op.command for energy effic.at automatic	Automatic		%R%'RHvacCoo'SpTRDtr
<input type="checkbox"/>	Room temperature setpoint determination	Op.command for energy effic.at manual	None		%R%'RHvacCoo'SpTRDtr
<input checked="" type="checkbox"/>	Room temperature setpoint determination	Display absolute room temp.setpoint	Present value		%R%'RHvacCoo'SpTRDtr

Temperature Control for Cooling

NOTE: Setting the Fan Operation to “Series” allows the fan or coil to modulate to 100% before the next device in the sequence comes on.

	▼ Temperature control for cooling				
<input type="checkbox"/>	Temperature control for cooling	Fan operation	Parallel		%R%'RHvacCoo'TCtlC
<input type="checkbox"/>	Temperature control for cooling	Offset for fan start	0	°F	%R%'RHvacCoo'TCtlC
<input type="checkbox"/>	Temperature control for cooling	Coil valve start pos.by parall.operation	10	%	%R%'RHvacCoo'TCtlC
<input type="checkbox"/>	Temperature control for cooling	Coil valve end pos.by parallel operation	100	%	%R%'RHvacCoo'TCtlC
<input type="checkbox"/>	Temperature control for cooling	Fan end speed by parallel operation	50	%	%R%'RHvacCoo'TCtlC

Room operating mode configuration for cooling devices

Each room operating mode can be configured to support one of the following heating device configurations: None, Radiant & air treatment devices (RadATrDv), Radiant devices (RadDev), Air treatment devices (ATreaDev).

Typically, no changes are required to this section.

<input type="checkbox"/>	Temperature control for cooling	Comfort configuration	RadATrDv	%R%RHvacCooTctlC
<input type="checkbox"/>	Temperature control for cooling	Pre-Comfort configuration	RadATrDv	%R%RHvacCooTctlC
<input type="checkbox"/>	Temperature control for cooling	Economy configuration	RadATrDv	%R%RHvacCooTctlC
<input type="checkbox"/>	Temperature control for cooling	Protection configuration	RadATrDv	%R%RHvacCooTctlC
<input type="checkbox"/>	Temperature control for cooling	Cool down configuration	RadATrDv	%R%RHvacCooTctlC
<input type="checkbox"/>	Temperature control for cooling	Free cooling configuration	RadATrDv	%R%RHvacCooTctlC

Controller mode by room operating mode

The operation of the cooling coil or radiant devices can be configured to operate either in: Continuous (modulating) or 2-Position for each room operating mode. This allows radiant devices to easily be configure for cool-down mode.

Typically, no changes are required to this section.

<input type="checkbox"/>	Temperature control for cooling	Coil: controller mode by comfort	Cont	%R%RHvacCooTctlC
<input type="checkbox"/>	Temperature control for cooling	Coil: controller mode by pre-comfort	Cont	%R%RHvacCooTctlC
<input type="checkbox"/>	Temperature control for cooling	Coil: controller mode by economy	Cont	%R%RHvacCooTctlC
<input type="checkbox"/>	Temperature control for cooling	Coil: controller mode by protection	Cont	%R%RHvacCooTctlC
<input type="checkbox"/>	Temperature control for cooling	Coil: controller mode by cool down	Cont	%R%RHvacCooTctlC

Order Sequencing for Cooling Devices

The order sequencing for the cooling devices have default settings.

If a cooling device is not selected as an output device, it will not be used during the cooling sequence.

<input type="checkbox"/>	Temperature control for cooling	Outside air damper cooling sequence	1	---	%R%RHvacCooTctlC
<input type="checkbox"/>	Temperature control for cooling	Radiant ceiling cooling sequence	2	---	%R%RHvacCooTctlC
<input type="checkbox"/>	Temperature control for cooling	Heating/cooling coil cooling sequence	3	---	%R%RHvacCooTctlC
<input type="checkbox"/>	Temperature control for cooling	Fan cooling sequence	4	---	%R%RHvacCooTctlC

Room temperature controller cooling for heating/cooling coil

<input checked="" type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Gain	27.8	%/F	%R%RHvacCooTctlCHCclTRCtrC
<input type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Hysteresis switch-off	0.9	°F	%R%RHvacCooTctlCHCclTRCtrC
<input type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Hysteresis switch-on	0.9	°F	%R%RHvacCooTctlCHCclTRCtrC
<input type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Neutral zone	0	°F	%R%RHvacCooTctlCHCclTRCtrC
<input checked="" type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Integral action time Tn	1800	s	%R%RHvacCooTctlCHCclTRCtrC
<input checked="" type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Controller type	PID controller		%R%RHvacCooTctlCHCclTRCtrC
<input type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Controller output maximum	100	%	%R%RHvacCooTctlCHCclTRCtrC
<input type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Controller output minimum	0	%	%R%RHvacCooTctlCHCclTRCtrC
<input type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Controller output for offset	0	%	%R%RHvacCooTctlCHCclTRCtrC
<input checked="" type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Rise time from 0 to 100%	600	1/10s	%R%RHvacCooTctlCHCclTRCtrC
<input checked="" type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Fall time from 100 to 0%	600	1/10s	%R%RHvacCooTctlCHCclTRCtrC
<input type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Number of stages	1	---	%R%RHvacCooTctlCHCclTRCtrC
<input type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Switch delay	05:00	mm:ss	%R%RHvacCooTctlCHCclTRCtrC
<input type="checkbox"/>	Room temp.ctr.cool.for heating/cool.coil	Derivative action-time Tv	0	s	%R%RHvacCooTctlCHCclTRCtrC

Room temperature controller cooling for fan

<input checked="" type="checkbox"/>	Room temp.controller cooling for fan	Gain	27.8	%/°F	%R%'RHvacCoo'TCtlC'FanTRCtrC
<input type="checkbox"/>	Room temp.controller cooling for fan	Hysteresis switch-off	0.9	°F	%R%'RHvacCoo'TCtlC'FanTRCtrC
<input type="checkbox"/>	Room temp.controller cooling for fan	Hysteresis switch-on	0.9	°F	%R%'RHvacCoo'TCtlC'FanTRCtrC
<input type="checkbox"/>	Room temp.controller cooling for fan	Neutral zone	0	°F	%R%'RHvacCoo'TCtlC'FanTRCtrC
<input checked="" type="checkbox"/>	Room temp.controller cooling for fan	Integral action time Tn	1800	s	%R%'RHvacCoo'TCtlC'FanTRCtrC
<input checked="" type="checkbox"/>	Room temp.controller cooling for fan	Controller type	PID controller		%R%'RHvacCoo'TCtlC'FanTRCtrC
<input type="checkbox"/>	Room temp.controller cooling for fan	Controller output maximum	100	%	%R%'RHvacCoo'TCtlC'FanTRCtrC
<input type="checkbox"/>	Room temp.controller cooling for fan	Controller output minimum	0	%	%R%'RHvacCoo'TCtlC'FanTRCtrC
<input type="checkbox"/>	Room temp.controller cooling for fan	Controller output for offset	0	%	%R%'RHvacCoo'TCtlC'FanTRCtrC
<input checked="" type="checkbox"/>	Room temp.controller cooling for fan	Rise time from 0 to 100%	600	1/10s	%R%'RHvacCoo'TCtlC'FanTRCtrC
<input checked="" type="checkbox"/>	Room temp.controller cooling for fan	Fall time from 100 to 0%	600	1/10s	%R%'RHvacCoo'TCtlC'FanTRCtrC
<input type="checkbox"/>	Room temp.controller cooling for fan	Number of stages	1	---	%R%'RHvacCoo'TCtlC'FanTRCtrC
<input type="checkbox"/>	Room temp.controller cooling for fan	Switch delay	05:00	mm:ss	%R%'RHvacCoo'TCtlC'FanTRCtrC
<input type="checkbox"/>	Room temp.controller cooling for fan	Derivative action-time Tv	0	s	%R%'RHvacCoo'TCtlC'FanTRCtrC

Room temperature controller cooling for cooling coil

<input checked="" type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Gain	27.8	%/°F	%R%'RHvacCoo'TCtlC'CdTRCtrC
<input type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Hysteresis switch-off	0.9	°F	%R%'RHvacCoo'TCtlC'CdTRCtrC
<input type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Hysteresis switch-on	0.9	°F	%R%'RHvacCoo'TCtlC'CdTRCtrC
<input type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Neutral zone	0	°F	%R%'RHvacCoo'TCtlC'CdTRCtrC
<input checked="" type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Integral action time Tn	1800	s	%R%'RHvacCoo'TCtlC'CdTRCtrC
<input checked="" type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Controller type	PID controller		%R%'RHvacCoo'TCtlC'CdTRCtrC
<input type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Controller output maximum	100	%	%R%'RHvacCoo'TCtlC'CdTRCtrC
<input type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Controller output minimum	0	%	%R%'RHvacCoo'TCtlC'CdTRCtrC
<input type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Controller output for offset	0	%	%R%'RHvacCoo'TCtlC'CdTRCtrC
<input checked="" type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Rise time from 0 to 100%	600	1/10s	%R%'RHvacCoo'TCtlC'CdTRCtrC
<input checked="" type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Fall time from 100 to 0%	600	1/10s	%R%'RHvacCoo'TCtlC'CdTRCtrC
<input type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Number of stages	1	---	%R%'RHvacCoo'TCtlC'CdTRCtrC
<input type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Switch delay	05:00	mm:ss	%R%'RHvacCoo'TCtlC'CdTRCtrC
<input type="checkbox"/>	Room temp.ctr.cooling for cooling coil	Derivative action-time Tv	0	s	%R%'RHvacCoo'TCtlC'CdTRCtrC

Cooling Setpoints for Room Operating Mode

The cooling setpoints for each operating mode can be configured to meet job site specifications. Default values shown are based on ASHRAE 90.1-2016 recommendations.

<input checked="" type="checkbox"/>	Cooling setpoint for comfort	Default command	75	°F	CMF CLG STPT
<input checked="" type="checkbox"/>	Delta cooling setpoint for pre-comfort	Present value	2	°F	STBY C DELTA
<input checked="" type="checkbox"/>	Cooling setpoint for economy	Present value	85	°F	ECO CLG STPT
<input checked="" type="checkbox"/>	Cooling setpoint for protection	Present value	95	°F	PROT CLGSTPT

Temperature Control for Heating

<input type="checkbox"/>	Temperature control for heating	Fan operation	Parallel		%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Offset for fan start	0	°F	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Coil valve start pos.by parall.operation	10	%	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Coil valve end pos.by parallel operation	100	%	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Fan end speed by parallel operation	50	%	%R%'RHvacCoo'TCtlH

Room operating mode configuration for heating devices

Each room operating mode can be configured to support one of the following heating device configurations: None, Radiant & air treatment devices (RadATrDv), Radiant devices (RadDev), Air treatment devices (ATreaDev).

Typically, no changes are required to this section.

<input type="checkbox"/>	Temperature control for heating	Comfort configuration	RadATrDv	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Pre-Comfort configuration	RadATrDv	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Economy configuration	RadATrDv	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Protection configuration	RadATrDv	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Warm-up configuration	RadATrDv	%R%'RHvacCoo'TCtlH

Controller mode by room operating mode

The operation of the heating coil or radiant devices can be configured to operate either in: Continuous (modulating) or 2-Position for each room operating mode. This allows radiant devices to easily be configured for warm-up mode.

Typically, no changes are required to this section

<input type="checkbox"/>	Temperature control for heating	Coil: controller mode by comfort	Cont	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Coil: controller mode by pre-comfort	Cont	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Coil: controller mode by economy	Cont	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Coil: controller mode by protection	Cont	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Coil: controller mode by warm-up	Cont	%R%'RHvacCoo'TCtlH

Order Sequencing for Heating Devices

<input type="checkbox"/>	Temperature control for heating	Radiator heating sequence	1	---	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Radiant ceiling heating sequence	2	---	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Heating/cooling coil heating sequence	4	---	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Heating coil heating sequence	3	---	%R%'RHvacCoo'TCtlH
<input type="checkbox"/>	Temperature control for heating	Fan heating sequence	5	---	%R%'RHvacCoo'TCtlH

Room temperature controller heating for heating/cooling coil

<input checked="" type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Gain	27.8	%/F	%R%'RHvacCoo'TCtlH'HCCITRctrH
<input type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Hysteresis switch-off	0.9	°F	%R%'RHvacCoo'TCtlH'HCCITRctrH
<input type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Hysteresis switch-on	0.9	°F	%R%'RHvacCoo'TCtlH'HCCITRctrH
<input type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Neutral zone	0	°F	%R%'RHvacCoo'TCtlH'HCCITRctrH
<input checked="" type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Integral action time Tn	1800	s	%R%'RHvacCoo'TCtlH'HCCITRctrH
<input checked="" type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Controller type	PID controller		%R%'RHvacCoo'TCtlH'HCCITRctrH
<input type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Controller output maximum	100	%	%R%'RHvacCoo'TCtlH'HCCITRctrH
<input type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Controller output minimum	0	%	%R%'RHvacCoo'TCtlH'HCCITRctrH
<input type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Controller output for offset	0	%	%R%'RHvacCoo'TCtlH'HCCITRctrH
<input checked="" type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Rise time from 0 to 100%	600	1/10s	%R%'RHvacCoo'TCtlH'HCCITRctrH
<input checked="" type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Fall time from 100 to 0%	600	1/10s	%R%'RHvacCoo'TCtlH'HCCITRctrH
<input type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Number of stages	1	---	%R%'RHvacCoo'TCtlH'HCCITRctrH
<input type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Switch delay	05:00	mm:ss	%R%'RHvacCoo'TCtlH'HCCITRctrH
<input type="checkbox"/>	Room temp.ctr.heat.for heating/cool.coil	Derivative action-time Tv	0	s	%R%'RHvacCoo'TCtlH'HCCITRctrH

Room temperature controller heating for fan

<input checked="" type="checkbox"/>	Room temp.controller heating for fan	Gain	27.8	%/°F	%R%'RHvacCoo'TCtlH'FanTRCtrH
<input type="checkbox"/>	Room temp.controller heating for fan	Hysteresis switch-off	0.9	°F	%R%'RHvacCoo'TCtlH'FanTRCtrH
<input type="checkbox"/>	Room temp.controller heating for fan	Hysteresis switch-on	0.9	°F	%R%'RHvacCoo'TCtlH'FanTRCtrH
<input type="checkbox"/>	Room temp.controller heating for fan	Neutral zone	0	°F	%R%'RHvacCoo'TCtlH'FanTRCtrH
<input checked="" type="checkbox"/>	Room temp.controller heating for fan	Integral action time Tn	1800	s	%R%'RHvacCoo'TCtlH'FanTRCtrH
<input checked="" type="checkbox"/>	Room temp.controller heating for fan	Controller type	PID controller		%R%'RHvacCoo'TCtlH'FanTRCtrH
<input type="checkbox"/>	Room temp.controller heating for fan	Controller output maximum	100	%	%R%'RHvacCoo'TCtlH'FanTRCtrH
<input type="checkbox"/>	Room temp.controller heating for fan	Controller output minimum	0	%	%R%'RHvacCoo'TCtlH'FanTRCtrH
<input type="checkbox"/>	Room temp.controller heating for fan	Controller output for offset	0	%	%R%'RHvacCoo'TCtlH'FanTRCtrH
<input checked="" type="checkbox"/>	Room temp.controller heating for fan	Rise time from 0 to 100%	600	1/10s	%R%'RHvacCoo'TCtlH'FanTRCtrH
<input checked="" type="checkbox"/>	Room temp.controller heating for fan	Fall time from 100 to 0%	600	1/10s	%R%'RHvacCoo'TCtlH'FanTRCtrH
<input type="checkbox"/>	Room temp.controller heating for fan	Number of stages	1	---	%R%'RHvacCoo'TCtlH'FanTRCtrH
<input type="checkbox"/>	Room temp.controller heating for fan	Switch delay	05:00	mm:ss	%R%'RHvacCoo'TCtlH'FanTRCtrH
<input type="checkbox"/>	Room temp.controller heating for fan	Derivative action-time Tv	0	s	%R%'RHvacCoo'TCtlH'FanTRCtrH

Room temperature controller heating for heating coil

<input checked="" type="checkbox"/>	Room temp.ctr.heating for heating coil	Gain	27.8	%/°F	%R%'RHvacCoo'TCtlH'HcITRctrH
<input type="checkbox"/>	Room temp.ctr.heating for heating coil	Hysteresis switch-off	0.9	°F	%R%'RHvacCoo'TCtlH'HcITRctrH
<input type="checkbox"/>	Room temp.ctr.heating for heating coil	Hysteresis switch-on	0.9	°F	%R%'RHvacCoo'TCtlH'HcITRctrH
<input type="checkbox"/>	Room temp.ctr.heating for heating coil	Neutral zone	0	°F	%R%'RHvacCoo'TCtlH'HcITRctrH
<input checked="" type="checkbox"/>	Room temp.ctr.heating for heating coil	Integral action time Tn	1800	s	%R%'RHvacCoo'TCtlH'HcITRctrH
<input checked="" type="checkbox"/>	Room temp.ctr.heating for heating coil	Controller type	PID controller		%R%'RHvacCoo'TCtlH'HcITRctrH
<input type="checkbox"/>	Room temp.ctr.heating for heating coil	Controller output maximum	100	%	%R%'RHvacCoo'TCtlH'HcITRctrH
<input type="checkbox"/>	Room temp.ctr.heating for heating coil	Controller output minimum	0	%	%R%'RHvacCoo'TCtlH'HcITRctrH
<input type="checkbox"/>	Room temp.ctr.heating for heating coil	Controller output for offset	0	%	%R%'RHvacCoo'TCtlH'HcITRctrH
<input checked="" type="checkbox"/>	Room temp.ctr.heating for heating coil	Rise time from 0 to 100%	600	1/10s	%R%'RHvacCoo'TCtlH'HcITRctrH
<input checked="" type="checkbox"/>	Room temp.ctr.heating for heating coil	Fall time from 100 to 0%	600	1/10s	%R%'RHvacCoo'TCtlH'HcITRctrH
<input type="checkbox"/>	Room temp.ctr.heating for heating coil	Number of stages	1	---	%R%'RHvacCoo'TCtlH'HcITRctrH
<input type="checkbox"/>	Room temp.ctr.heating for heating coil	Switch delay	05:00	mm:ss	%R%'RHvacCoo'TCtlH'HcITRctrH
<input type="checkbox"/>	Room temp.ctr.heating for heating coil	Derivative action-time Tv	0	s	%R%'RHvacCoo'TCtlH'HcITRctrH

Heating Setpoints for Room Operating Mode

The heating setpoints for each operating mode can be configured to meet job site specifications. Default values shown are set based on ASHRAE 90.1-2016 recommendations.

<input checked="" type="checkbox"/>	Heating setpoint for comfort	Default command	70	°F	CMF HTG STPT
<input checked="" type="checkbox"/>	Delta heating setpoint for pre-comfort	Present value	2	°F	STBY H DELTA
<input checked="" type="checkbox"/>	Heating setpoint for economy	Present value	65	°F	ECO HTG STPT
<input checked="" type="checkbox"/>	Heating setpoint for protection	Present value	55	°F	PROT HTG SP

Heating/cooling state determination

<input type="checkbox"/>	Heating/cooling state determination	Shift of switch-on point for cool.state	0	°F	%R%'RHvacCoo'HCStaDtr
<input type="checkbox"/>	Heating/cooling state determination	Shift of switch-on point for heat.state	0	°F	%R%'RHvacCoo'HCStaDtr
<input checked="" type="checkbox"/>	Heating/cooling state determination	Switch-on delay for heat/cool.changeover	02:00:000	mm:ss.ms	%R%'RHvacCoo'HCStaDtr

Heating/Cooling coil

	▼ Heating/cooling coil				
<input checked="" type="checkbox"/>	Heating/cooling coil	Lockout heat pump at low outs.air temp.	39.2	°F	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Outs.air temp.hys.for lockout heat pump	1.8	°F	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Lockout heating at low outside air temp.	39.2	°F	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Outs.air temp.hys.for lock out heating	1.8	°F	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Manual control mode	Automatic		%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Enable fault input	Yes		%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Nominal electric power	0.4	kW	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Heat pump power	Calculated		%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Switch-on point for air flow hold cool.	66	%	%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Hysteresis for air vol.flow hold cooling	33	%	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Switch-off delay f.hold f.air flow cool.	00:000	ss.ms	%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Switch-on point for air flow hold heat.	66	%	%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Hysteresis for air vol.flow hold heating	33	%	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Switch-off delay f.hold f.air flow heat.	00:000	ss.ms	%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Switch-on point for air flow cool.req	66	%	%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Hysteresis for air vol.flow cool.req.	33	%	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Switch-on delay for air flow cool.req.	00:000	ss.ms	%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Switch-on point for air flow heat.req	66	%	%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Hysteresis for air vol.flow heat.req.	33	%	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Switch-on delay for air flow heat.req.	00:000	ss.ms	%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Switch-on point for air flow dehumid.req.	66	%	%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Hysteresis for air vol.flow dehumid.req.	33	%	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Switch-on delay for air flow dehumid.req.	00:000	ss.ms	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Switch-off delay for air flow dehumid.req.	00:000	ss.ms	%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Switch-on point for enable source	66	%	%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Hysteresis for enable source	33	%	%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Switch-off delay for enable source	00:000	ss.ms	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Source state monitoring	None		%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Switch-on delay for source state	00:000	ss.ms	%RSegm%'HVACHCcl
<input type="checkbox"/>	Heating/cooling coil	Enable monitoring source state available	No		%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Reversing valve activated by	Cooling		%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Compr.state by switchover revers.valve	Off		%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Changeover delay for heating/cooling	05:00:000	mm:ss.ms	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Minimum switch-on time for compressor	03:00:000	mm:ss.ms	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Minimum switch-off time for compressor	03:00:000	mm:ss.ms	%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Enable lockout HP at low outs.air temp.	No		%RSegm%'HVACHCcl
<input checked="" type="checkbox"/>	Heating/cooling coil	Enable lockout heat.at low outs.air temp	No		%RSegm%'HVACHCcl

Heating coil

	▼ Heating coil				
<input type="checkbox"/>	Heating coil	Switch-on point for hot water demand	4	%	%RSegm%'HVACHcl
<input type="checkbox"/>	Heating coil	Hysteresis for hot water demand	2	%	%RSegm%'HVACHcl
<input type="checkbox"/>	Heating coil	Switch-on point for air flow heat.req	4	%	%RSegm%'HVACHcl
<input type="checkbox"/>	Heating coil	Hysteresis for air vol.flow heat.req.	2	%	%RSegm%'HVACHcl
<input type="checkbox"/>	Heating coil	Switch-on delay for air flow heat.req.	30:000	ss.ms	%RSegm%'HVACHcl
<input type="checkbox"/>	Heating coil	Enable monitoring for air vol.flow state	No		%RSegm%'HVACHcl

Additional Parameters

	▼ Additional parameters				
<input type="checkbox"/>	Condenser water supply temperature	Default command	55	°F	CW ST
<input type="checkbox"/>	Condenser water supply temperature	Present value	0	°F	CW ST
<input type="checkbox"/>	Condenser water supply temperature switch on point	Default command	60	°F	CW ST SWI
<input type="checkbox"/>	Condenser water supply temperature switch on point	Present value	0	°F	CW ST SWI

Appendix

Sequence of Operation – Summary

Water Source Heat Pump Single Stage with Reversing Valve, 1-Speed Fan, Hot Water Heating Coil, OA Damper and Hot Water Radiator

Note

This summary is taken from the preloaded heat pump template 14270, which has many of the same features but is not a water source heat pump; also template 14270 has an electric heating coil instead of a hot water heating coil. This summary has been adjusted to reflect the differences between the custom app and template 14270.

Overview

This application controls a heat pump unit and a hot water radiator to maintain the room temperature at the heating and cooling setpoints. Ventilation and dehumidification are also controlled.

The heat pump unit comprises the following:

- Single stage heat pump compressor
- External reversing valve
- 1-Speed fan
- Hot water heating coil
- OA damper

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

- Heat pump, room heating demand
- Heat pump, room cooling demand
- Hot water coil, room heating demand
- Hot water radiator, room heating demand
- Room dehumidification demand (PID/Staged control)
- OA damper, economizer cooling demand (PID mixed air temperature control)
- Room ventilation demand (basic ventilation and/or demand control)

When the reversing valve is in the heating position, the heat pump unit and the hot water radiator control the room temperature in sequence at the heating setpoint.

When the reversing valve is in the cooling position, the heat pump compressor and fan control the room temperature in parallel at the cooling setpoint. If the outside air economizer is enabled, the OA damper modulates to either the mixed air temperature setpoint for cooling or the outside air damper minimum ventilation position, whichever is larger. (see **Ventilation control** and **Mixed air temperature control**).

In dehumidification mode, humidity is reduced by heat pump cooling while the space temperature is maintained by controlling the hot water heating coil for reheat as needed.

Inputs

- Room temperature sensor
- Room relative humidity sensor
- Room air quality sensor
- Room temperature setpoint shift
- Temporary Comfort button
- GreenLeaf button
- Fan control button
- Fan status
- Heat pump fault
- Condensate level monitor
- Mixed air temperature sensor
- Supply air temperature sensor (for monitoring only)

Outputs

- Heat pump single stage compressor
- Heat pump reversing valve position
- Single speed fan
- Hot water heating coil actuator
- Outside air damper actuator
- Hot water radiator actuator
- Binary output 1 (spare)

Water source monitoring

Several objects and parameters exist for monitoring water source availability and/or flow status. Various configurations are possible. When configured, if a monitored object indicates a problem with media availability or flow state, the heat pump compressor is shut off at equipment protection priority.

Related objects:

HP SRC EN – Enable heat pump source (EnHpuSrc)

HP SRC STT – Heat pump source state (HpuSrcSta)

HP SRC INP – Heat pump source input available (HpuSrcInAvl)

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 - optional)
- Economy (unoccupied)
- Protection (e.g. extended holiday - optional)

Comfort mode is applied per schedule via central command. 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 outside air damper minimum ventilation position (e.g. 20%, 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. Adjustments at the room unit [RM TEMP SHFT] will raise or lower both the heating and cooling setpoints together to maintain a constant deadband. The maximum manual setpoint shift is +/- 5.4°F, configurable.
- 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)

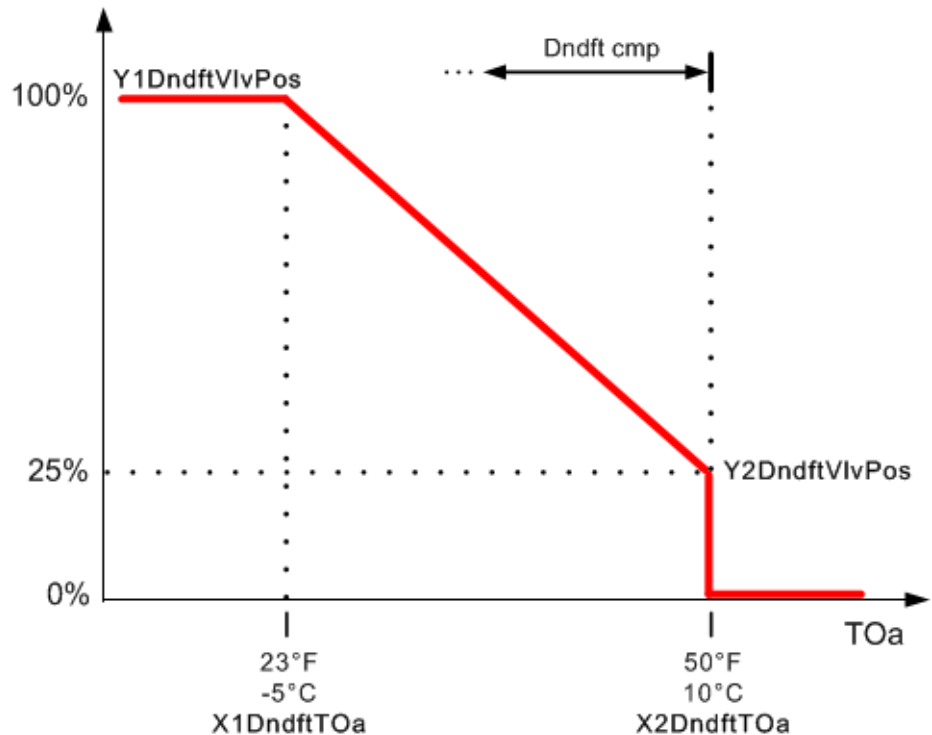
Heat pump control sequence – Room temperature

This sequence includes external reversing valve control.

- a) The heat pump unit single speed fan can be configured to provide continuous minimum ventilation to the room (ventilation mode: Min vent), or it can be configured to cycle the fan for heating or cooling and keep ventilation off (ventilation mode: Off). (Demand control ventilation mode is optionally available.)
- b) The heat pump unit can be configured to support the following control modes: Auto, Heating, or Cooling (default = Automatic).
- c) The heat pump unit is activated by a demand for cooling, heating, dehumidification or ventilation.
- d) Compressor commanding of the heat pump reversing valve switchover operation is configurable ("Reversing valve activated by" default = Cooling) and must match the operational type of the heat pump being used.
- e) Heat pump changeover delay for heating/cooling is configurable (default 5 minutes).
- f) When the room temperature [RM TEMP EVAL] is in the deadband between the effective heating and cooling setpoints:
 - i. The single speed fan will run to circulate air in the room for ventilation. The fan stays Off during Economy or Protection unless a configured ventilation flow is required.
 - ii. The single stage compressor, external reversing valve and hot water heating coil will be Off.
- g) When the room temperature rises above the effective cooling setpoint, the single speed fan, single stage compressor and external reversing valve are modulated in parallel to maintain the cooling setpoint as follows:
 - i. On a request for cooling, the single speed fan is commanded On, the external reversing valve is activated and the single stage compressor is commanded On.
 - ii. Minimum on and minimum off times (3 min, configurable) protect the heat pump compressor against short cycling. When a minimum timer is activated, the compressor and single speed fan are commanded at equipment protection priority. Normal priority returns after expiration of the timer.
- h) When the room temperature falls below the effective heating setpoint, the single speed fan, single stage compressor, external reversing valve, hot water heating coil and hot water radiator are controlled in sequence to maintain the heating setpoint as follows:
 - i. On a request for heating, the single speed fan is commanded On, the external reversing valve is deactivated and the single stage compressor is commanded On.
 - ii. Minimum-on and minimum-off timers (3 min, configurable) protect the heat pump compressor against short cycling. When a minimum timer is activated, the compressor and single speed fan are commanded at equipment protection priority. Normal priority returns after expiration of the timer.
 - iii. If the effective heating setpoint cannot be satisfied, the hot water heating coil is activated.
 - iv. If the effective heating setpoint still cannot be satisfied, the hot water radiator is activated to assist in maintaining the room at the effective heating setpoint.
 - v. Once the effective heating setpoint is reached, the sequence is reversed.

Radiator downdraft compensation – optional

Parameter EnDndft must be set to Yes for downdraft compensation to function. This feature activates the radiator when the outside air temperature drops below a configured value, raising the minimum temperature of the radiator. The graphic shows the "X", "Y" downdraft compensation parameters (default value).



- i) Warm-up cycle (via central command) – The heat pump unit single speed fan sequences with the single stage compressor, external reversing valve, and the hot water heating coil to satisfy the effective heating setpoint.
- j) Cool down cycle (via central command) – The heat pump unit single speed fan sequences with the single stage compressor and external reversing valve to satisfy the effective cooling setpoint.

Related objects:

- HP REV VLV – Heat pump reversing valve (HpuRvrVlv)
- HP CMD – Heat pump command (HpuCmd)
- FAN 1 SPD – Single-speed fan (Fan1Spd)
- FAN STATUS – Fan state (FanSta)
- RM TEMP EVAL – Room temperature (RTemp)
- HTG STPT EFF – Present heating setpoint (PrSpH)
- CLG STPT EFF – Present cooling setpoint (PrSpC)
- HC HW REQ – Heating/cooling coil heating request (HCclHReq)
- HC CW REQ – Heating/cooling coil cooling request (HCclCReq)
- HTG COIL REQ – Heating coil heating request (HclHReq)
- HTG V POS – Heating coil valve position (HclVlvPos)
- RAD HTG REQ – Radiator heating request (RadHReq)
- RAD VLV VAL – Radiator valve position value (RadVlvPosVal)

Heat pump control sequence – Dehumidification

The heat pump dehumidification sequence lowers room relative humidity by overriding the heat pump temperature control to cooling and commanding the fan to the speed setting for dehumidification.

- a) Each room operating mode (e.g., Comfort, Pre-Comfort, Economy and Protection) is configurable for dehumidification: Off / Dehumidify
 - Off - Dehumidification control is not available
 - Dehumidify - Dehumidification control is available
- b) Each room operating mode has its own humidity control setpoint, configurable.
 - Comfort = 60% RH
 - Pre-Comfort = 60% RH
 - Economy = 70% RH
 - Protection = 70% RH
- c) During dehumidification, the outside air damper will modulate to the smaller of the following two positions:
 - Minimum ventilation position (configured per room operating mode)
 - OA damper reset position based on mixed air temperature controller output for cooling

In addition, **DmpOaPosDhu** (Outside air damper position for dehumidification) represents the smallest damper position allowable during dehumidification (default 0%, configurable).
- d) When the room humidity is above the present room dehumidification setpoint, the single speed fan, single stage heat pump compressor and external reversing valve are controlled by the PID/Staged dehumidification controller to satisfy the dehumidification setpoint as follows:
 - i. On a request for dehumidification, the single speed fan is commanded On, the single stage compressor is commanded On and the external reversing valve is activated for cooling.
 - ii. Minimum on and minimum off times (3 min, configurable) protect the heat pump compressor against short cycling. When a minimum timer is activated, the compressor and the single speed fan are commanded at equipment protection priority. Normal priority returns after expiration of the timer.
 - iii. When the room humidity goes below the dehumidification setpoint (plus hysteresis, configurable), the dehumidification sequence stops and the heat pump unit responds to current control needs.
- e) During the dehumidification sequence, if the room temperature falls below the effective heating setpoint, the hot water heating coil will be controlled to satisfy and maintain the setpoint as needed. Additional heating element(s) (hot water radiator) will sequence after the hot water heating coil if needed.

Related objects:

- OA DMP POS – Outside air damper position (DmpOaPos)
- RM HUM EVAL – Relative humidity for room (RHuRel)
- OA TEMP – Outside air temperature (TOa)
- DEHUM STPT – Present dehumidification setpoint (PrSpDhu)
- CMF DEH SP – Relative room dehumidify setpoint for comfort (SpDhuRelRCmf)
- ECO DEH SP – Relative room dehumidify setpoint for economy (SpDhuRelREco)
- PCF DEH SP – Relative room dehumidify setpoint for pre-comfort (SpDhuRelRPcf)
- PRT DEH SP – Relative room dehumidify setpoint for protection (SpDhuRelRPrt)
- HP REV VLV – Heat pump reversing valve (HpuRvrVlv)
- HP CMD – Heat pump command (HpuCmd)
- FAN 1 SPD – Single-speed fan (Fan1Spd)
- FN SPD DEHUM – Fan speed for dehumidification (FanSpdDhu)

- FAN STATUS – Fan state (FanSta)*
- ECON STATUS – Outside air damper economizer state (DmpOaEcmSta)
- MIXED TEMPSP – Mixed air temperature setpoint for cooling (SpTMxC)
- DEHUM RQ – Heating/cooling coil dehumidification request (HCClDhuReq)
- OADMPR C REQ – Outside air damper cooling request (DmpOaCReq)
- OA VENT REQ – Outside air damper ventilation request (DmpOaVntReq)
- HTG STPT EFF – Present heating setpoint (PrSpH)
- HTG COIL REQ – Heating coil heating request (HclHReq)
- HTG V POS – Heating coil valve position (HclVlvPos)

*present on DXR2.x18 but not on DXR2.M11 default configuration

Mixed air temperature control

- a) For cooling, the outside air damper modulates in response to output from a mixed air temperature PID controller, to maintain the MA temperature setpoint for cooling (default 50°F, configurable).
- b) The outside air economizer will be enabled and active when the OA temperature is less than room temperature minus a configurable differential (default 0°F).
- c) When the economizer is enabled, the OA damper will modulate to the larger of either the position corresponding to the MA temperature setpoint for cooling, or the OA damper minimum ventilation position [OA VENT REQ] per room operating mode.
- d) When the economizer is disabled, the OA damper is commanded to minimum ventilation position [OA VENT REQ] per room operating mode.
- e) Cold weather ramp-up: During cold weather, the outside air damper will ramp open slowly. The ramp-up function (2 min., configurable) is enabled when the outside air temperature is less than the switch-on point (41°F configurable). An invalid outside air temperature sensor will also enable the ramp-up feature.
- f) Outside air damper output limits: To prevent excessive cold air / low temperature conditions, the maximum OA damper position is limited based on OA temp. This is done by using a reset function with configurable parameters:
 - X1TOa (default 43°F, 6°C) and Y1DmpPos (default 20%)
 - X2TOa (default 64°F, 18°C) and Y2DmpPos (default 100%)

When the outside air temperature \leq X1TOa, the maximum damper position is Y1DmpPos.
 When the outside air temperature \geq X2TOa, the maximum damper position is Y2DmpPos.

Related objects:

- OA DMP POS – Outside air damper position (DmpOaPos)
- RM TEMP EVAL – Room temperature (RTemp)
- OA TEMP – Outside air temperature (TOa)
- MIXED TEMPSP – Mixed air temperature setpoint for cooling (SpTMxC)
- ECON STATUS – Outside air damper economizer state (DmpOaEcmSta)
- OA VENT REQ – Outside air damper ventilation request (DmpOaVntReq)

Ventilation control

Basic ventilation

If demand control ventilation (DCV) is not used, then the outside air damper minimum ventilation position will equal the configured setting per room operating mode. Default values, configurable:

- Comfort = 20%
- Pre-Comfort = 10%
- Economy = 0%
- Protection = 0%

Demand control ventilation

When DCV has been configured and enabled, the outside air damper modulates to support the outside air ventilation request, which is expressed as the larger of either the OA damper minimum ventilation setting (configurable per room operating mode) or the OA damper position corresponding to the present demand signal for DCV. The demand signal for DCV will vary based on the DCV setpoint (configurable per room operating mode, e.g. 1000 ppm = Comfort mode default) and the current room air quality sensor reading.

Equipment protection

Condensate level monitoring – A binary input for monitoring the level of condensate can be wired to the automation station and the "Enable condensate level monitor" parameter can be set to Yes. When the condensate level monitor indicates the pan is full of water, the heat pump unit will be turned Off at equipment protection priority and all components (fan, compressor, heating coil and OA damper) will go to the Off state.

Heat pump fault – A binary heat pump fault input can be wired to the automation station and the "Enable fault input" parameter can be set to Yes. If a fault is detected the heat pump compressor will be turned Off at equipment protection priority.

Water source monitoring – Several objects and parameters exist for monitoring water source availability and/or flow status. When configured, if a monitored object indicates a problem with media availability or flow state, the heat pump compressor is shut off at equipment protection priority.

Low outside air temperature lockout (heat pump unit) – If the enable parameter for heat pump lock out (default = No) is set to Yes, then when the outside air temperature falls below the heat pump lock out limit (39°F, configurable) the heat pump compressor will be turned Off at equipment protection priority. (Requires valid outside air temperature from a local sensor or the field panel.)

Low outside air temperature lockout (heat pump heating only) – If the enable parameter for heating lock out (default = No) is set to Yes, then when the outside air temperature falls below the heating lock out limit (39°F, configurable) the heat pump compressor will be turned Off in heating mode at equipment protection priority. (Requires valid outside air temperature from a local sensor or the field panel.)

Fan airflow state – The heat pump single speed fan runs to provide airflow support for the heat pump compressor, the hot water heating coil, and the outside air damper. An internal interlock signal (AirFISta) keeps these components shut off at equipment protection priority if the fan is not running. (Note: the OA damper is configurable; it has an enable parameter that must be set to Yes for the interlock to function.)

Fan state binary input

(DXR2.x18 configuration only; not present in DXR2.M11 configuration)

A binary heat pump fan state input (Fan state) can be wired to the automation station and the "Enable state input" parameter can be set to Yes. If the fan is commanded On

but **Fan state** fails to provide the fan proof, the heat pump unit (compressor, heating coil and OA damper) will remain Off at equipment protection priority.

Related objects:

- COND LEVEL - Condensate level monitor (CdnLvIMon)
- HP FAULT - Heat pump fault (HpuFlt)
- HP SRC EN – Enable heat pump source (EnHpuSrc)
- HP SRC STT – Heat pump source state (HpuSrcSta)
- HP SRC INP – Heat pump source input available (HpuSrcInAvl)
- FAN STATUS - Fan state (FanSta)

Manual fan control (optional)

When configured, the fan speed button at the room operator unit allows the occupant to command the fan (auto, run, or off) when the room operating mode is Comfort. The current fan speed is displayed on the room operating unit. Fan speed shall be reset to normal (non manual) control to ensure energy efficiency when the GreenLeaf button is pushed.

- FAN 1 SPD SP – Setpoint for single-speed fan (SpFan1Spd)

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 3.6°F, configurable.
- GreenLeaf status can be externally reset to green (e.g. schedule change). The behavior is configurable.

Central plant coordination

Collect demand from room hot water valves (e.g., hot water radiators and heating coils) **(present in hot water configurations - not present otherwise)**

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.

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