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Version 0.1  
November, 2009  
Embedded AHU Controller: xxxx

This Profile is a DRAFT version.



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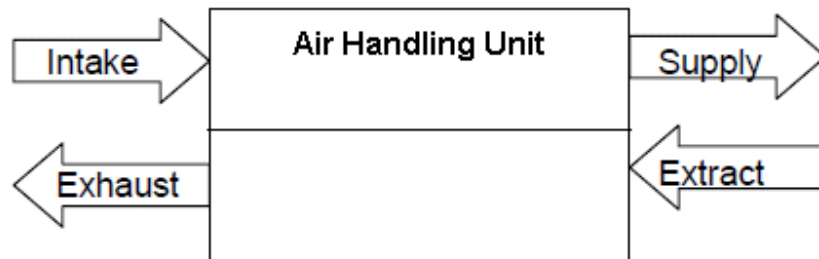
# LONMARK<sup>®</sup> Functional Profile: Embedded AHU Controller

## UFPTembeddedAHUCntroller

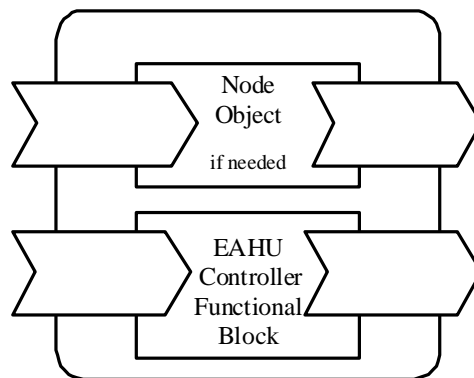
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## Overview

This document describes the profile for an Embedded Air Handling Unit Controller. (EAHU Controller). The EAHU Controller Functional Block enables LON control and supervision of a complete AHU, which have embedded controller with built-in ventilation functionality.



**Figure 1** Air Handling Unit (AHU)



**Figure 2** Node Concept

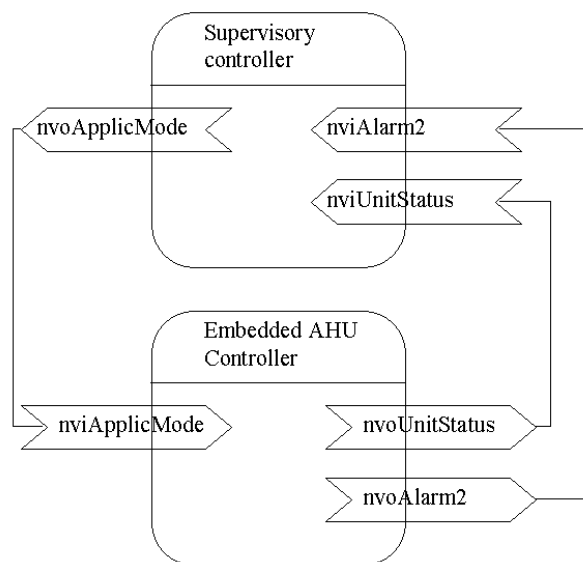
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## Example Usage

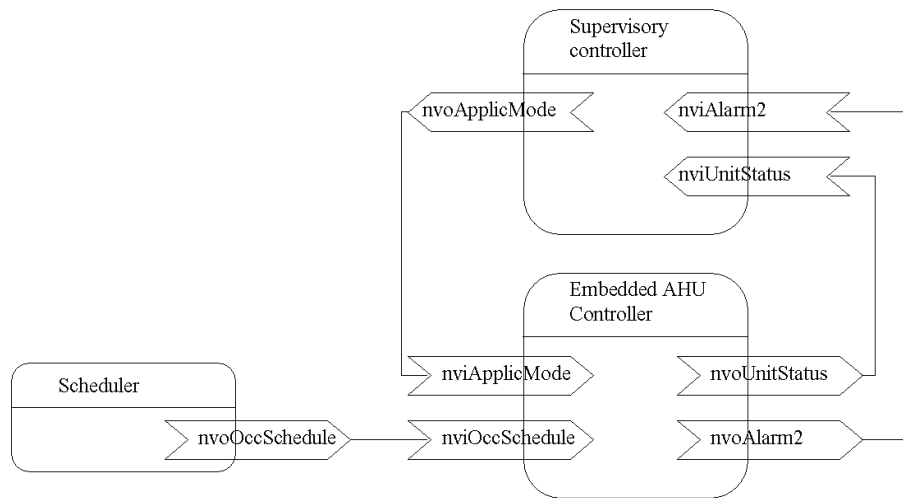
The EAHU Controller Functional Block may interact with one or more of the following LonMark Functional Block:

- Switch Functional Block #3200
- Scheduler Functional Block #3301
- BMS and monitoring node
- Embedded AHU Controller #8500
- Various sensor Functional Block.

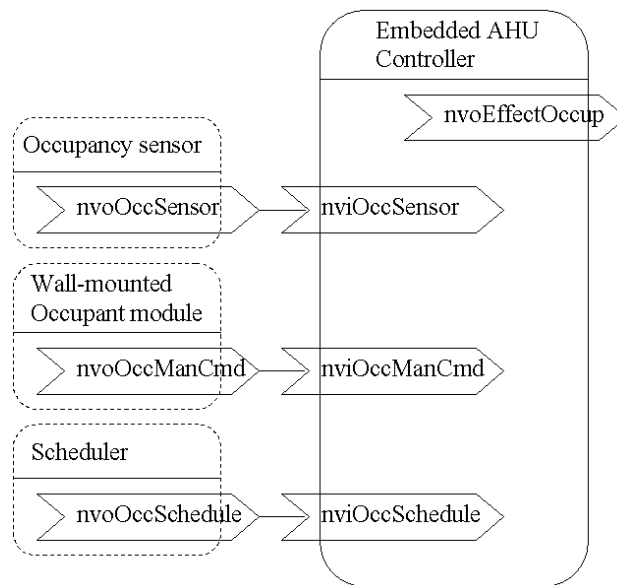
Typically the EAHU Controller output is connected to the input of a BMS (Building Management System) for surveillance and monitoring. The BMS may influence the EAHU controller, and decisions is directly transmitted to the EAHU Controller inputs.



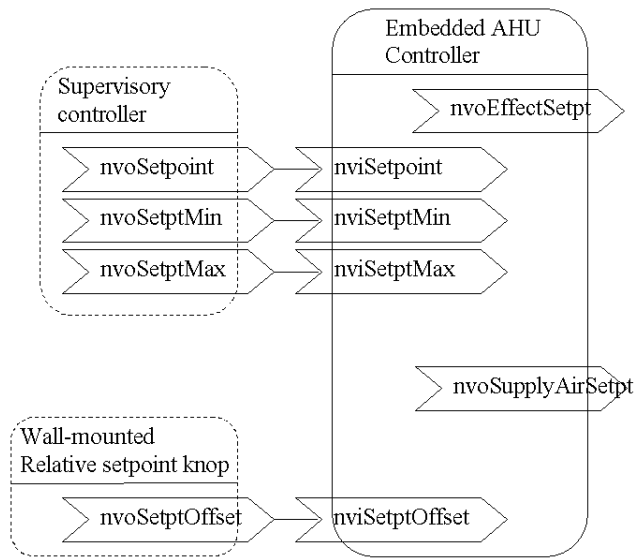
**Figure 3:** Basic system using Embedded AHU controller



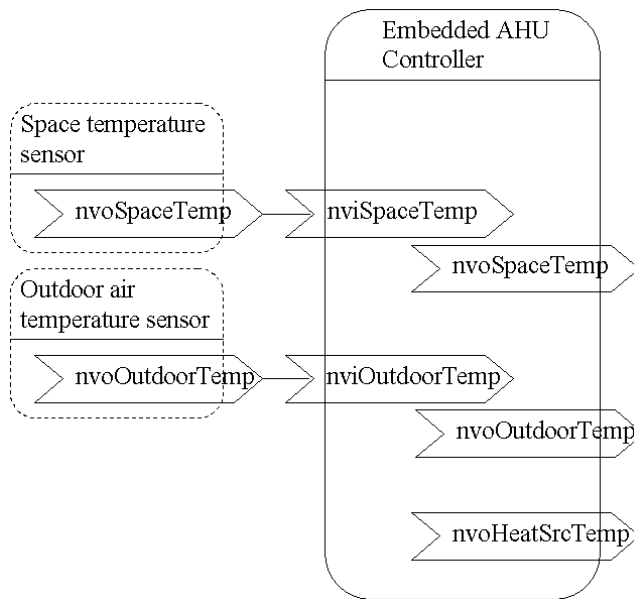
**Figure 4:** Small system using Embedded AHU controller



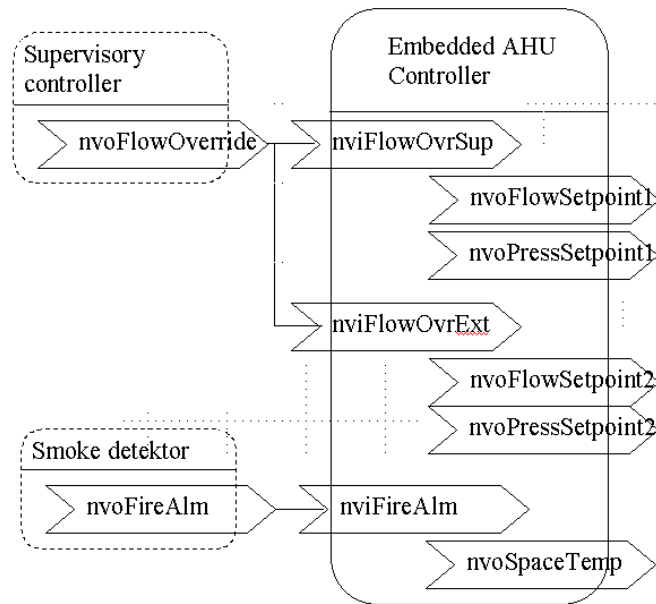
**Figure 5:** Occupancy and Embedded AHU controller



**Figure 6:** Temperature setpoints and Embedded AHU controller



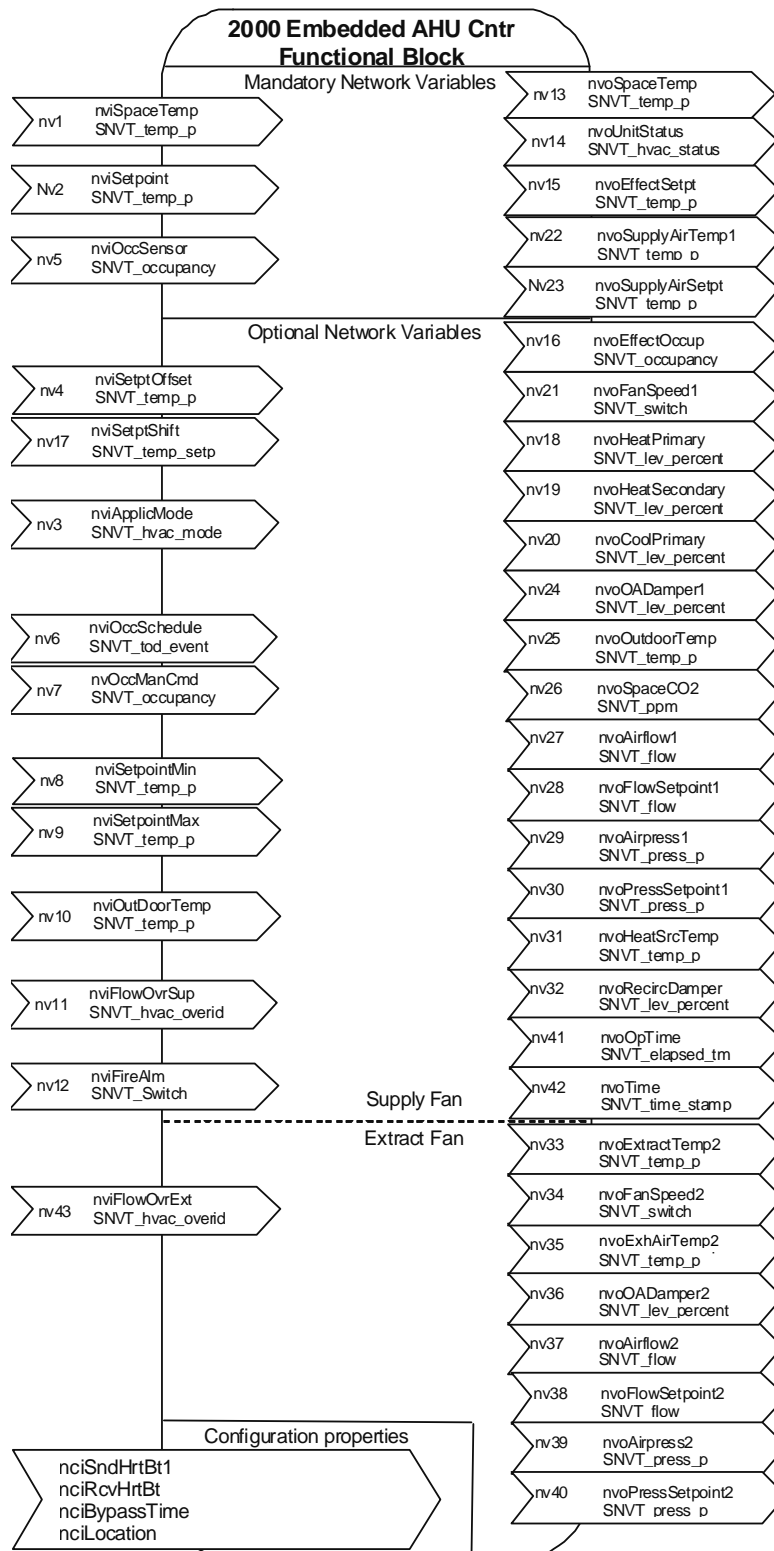
**Figure 7:** Temperature sensors and Embedded AHU controller



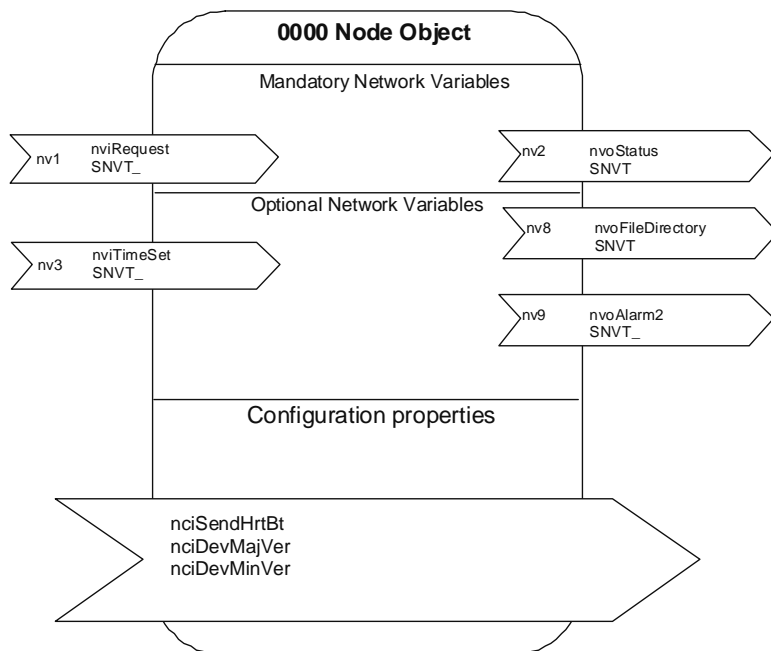
**Figure 8:** Fan speed, Fire alarm and Embedded AHU controller

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## Functional-Block Details



**Figure 9 : Functional-Block Details**



**Figure 10 : Node-Block Details**

**Table 2.1 : Network Variables, Node Object**

NV # (M/O) *	Variable Name	SNVT Name	SNVT Index	Description
1 (M)	nviRequest	SNVT_obj_request	92	Requests a particular mode for a particular functional block in the device
2 (M)	nvoStatus	SNVT_obj_status	93	Reports the status of the requested functional block in the device
3 (O)	nviTimeSet	SNVT_time_stamp	84	Synchronize the device's internal real time clock with an external time source
8 (O)	nvoFileDirectory	SNVT_address	114	Address for the file directory containing descriptors for configuration files
9 (O)	nvoAlarm2	SNVT_alarm_2	164	Transmits alarm data for each functional block on a device whenever an alarm occurs or is cleared, and upon request. Replaces <b>nvoAlarm</b>

\* M = mandatory, O = optional

**Table 2.2 : Network Variable Inputs, Embedded AHU Cntr**

NV # (M/O) *	Variable Name	Recv HrtBt	SNVT Name	SNVT Index	Class	Description
1 (M)	nviSpaceTemp	Yes	SNVT_temp_p	105	RAM	Space Temperature Input
2 (M)	nviSetpoint	No	SNVT_temp_p	105	RAM	Temperature Setpoint Input (absolute)
3 (O)	nviApplicMode	Yes	SNVT_hvac_mode	108	RAM	Application Mode Input
4 (O)	nviSetptOffset	Yes	SNVT_temp_p	105	RAM	Setpoint Offset Input
5 (M)	nviOccSensor	Yes	SNVT_occupancy	109	RAM	Occupancy Sensor Input
6 (O)	nviOccSchedule	Yes	SNVT_tod_event	128	RAM	Occupancy Scheduler Input
7 (O)	nviOccManCmd	No	SNVT_occupancy	109	RAM	Occupancy Override Input
8 (O)	nviSetpointMin	Yes	SNVT_temp_p	105	RAM	Setpoint supply air min. temperature
9 (O)	nviSetpointMax	Yes	SNVT_temp_p	105	RAM	Setpoint supply air max. temperature
10 (O)	nviOutdoorTemp	Yes	SNVT_temp_p	105	RAM	Outdoor Air Temperature Input
11 (O)	nviFlowOvrSup	No	SNVT_hvac_overid	111	RAM	Supply Air Flow Override Input
12 (O)	nviFireAlm	Yes	SNVT_switch	95	RAM	Fire Alarm Input
17 (O)	nviSetptShift	Yes	SNVT_temp_setpt	106	RAM	Setpoint Shift Input
43 (O)	nviFlowOvrExt	No	SNVT_hvac_overid	111	RAM	Extract Air Flow Override Input

\* M = mandatory, O = optional

**Table 2.3: Network Variable Outputs, Embedded AHU Cntr**

NV # (M/O) *	Variable Name	Snd HrtBt	SNVT Name	SNVT Index	Class	Description
13 (M)	nvoSpaceTemp	Yes	SNVT_temp_p	105	RAM	Effective Space Temperature Output
14 (M)	nvoUnitStatus	Yes	SNVT_hvac_status	112	RAM	Unit Status Output
15 (M)	nvoEffectSetpt	Yes	SNVT_temp_p	105	RAM	Effective Setpoint Output
16 (O)	nvoEffectOccup	No	SNVT_occupancy	109	RAM	Effective Occupancy Output
18 (O)	nvoHeatPrimary	Yes	SNVT_lev_percent	81	RAM	Primary Heat Output
19 (O)	nvoHeatSecondary	Yes	SNVT_lev_percent	81	RAM	Secondary Heat Output
20 (O)	nvoCoolPrimary	Yes	SNVT_lev_percent	81	RAM	Primary Cool Output
21 (O)	nvoFanSpeed1	Yes	SNVT_switch	95	RAM	Fan1 Speed Output
22 (M)	nvoSupplyAirTemp1	No	SNVT_temp_p	105	RAM	Supply Air Temperature Output
23 (M)	nvoSupplyAirSetpt	Yes	SNVT_temp_p	105	RAM	Supply Air Temperature Setpoint Output
24 (O)	nvoOADamper1	Yes	SNVT_lev_percent	81	RAM	Outdoor Air Damper1 Output
25 (O)	nvoOutdoorTemp	Yes	SNVT_temp_p	105	RAM	Outdoor Air Temperature Output
26 (O)	nvoSpaceCO2	Yes	SNVT_ppm	29	RAM	Space CO2 Sensor Output
27 (O)	nvoAirflow1	Yes	SNVT_flow	15	RAM	Air Flow1 Output
28 (O)	nvoFlowSetpoint1	Yes	SNVT_flow	15	RAM	Air Flow1 Setpoint Output
29 (O)	nvoAirPress1	Yes	SNVT_press_p	113	RAM	Air Pressure1 Output
30 (O)	nvoPressSetpoint1	Yes	SNVT_press_p	113	RAM	Air Pressure1 Setpoint Output
31 (O)	nvoHeatSrcTemp	Yes	SNVT_temp_p	105	RAM	Heat Source Temperature Output
32 (O)	nvoRecircDamper	Yes	SNVT_lev_percent	81	RAM	Recirculation Air Damper Output
33 (O)	nvoExtractTemp2	Yes	SNVT_temp_p	105	RAM	Extract Air Temperature Output
34 (O)	nvoFanSpeed2	Yes	SNVT_switch	95	RAM	Fan2 Speed Output
35 (O)	nvoExhAirTemp2	No	SNVT_temp_p	105	RAM	Exhaust Air Temperature Output
36 (O)	nvoOADamper2	Yes	SNVT_lev_percent	81	RAM	Outdoor Air Damper2 Output
37 (O)	nvoAirflow2	Yes	SNVT_flow	15	RAM	Air Flow2 Output
38 (O)	nvoFlowsetpoint2	Yes	SNVT_flow	15	RAM	Air Flow2 Setpoint Output
39 (O)	nvoAirpress2	Yes	SNVT_press_p	113	RAM	Air Pressure2 Output
40 (O)	nvoPressSetpoint2	Yes	SNVT_flow	15	RAM	Air Pressure2 Setpoint Output
41 (O)	nvoOpTime	No	SNVT_elapsed_tm	87	RAM	Accumulated Operation Time Output
42 (O)	nvoTime	No	SNVT_time_stamp	84	RAM	Device Real Time Clock Output

**Table 2.4: SCPT Details, Node object**

(M/O)*	SCPT Name NV Name Type or SNVT	SCPT Index	Associated NVs **	Description
(O)	SCPTmaxSendTime nciSndHrtBt SNVT_time_sec (107)	49	Entire Functional Block	The maximum period of time between consecutive transmissions of the current value
(O)	SCPTdevMajVer nciDevMajVer unsigned short	165	Entire Functional Block	The major version number for the device.
(O)	SCPTobjMinVer nciDevMinVer unsigned short	166	Entire Functional Block	The minor version number for the device.

\* M = mandatory, O = optional.

It should be Mandatory for CPs that are Mandatory for an NV that is also Mandatory. This is also valuable for CPs that apply to the Entire Functional Block.

\*\* List of NVs to which this configuration property applies.

An “(M)” means that the CP is Mandatory if the NV (to which it applies) is implemented. An “(O)” means that the CP is Optional if the NV (to which it applies) is implemented.

**Table 2.5: SCPT Details, Embedded AHU Cntr**

(M/O)*	SCPT Name	SCPT Index	SNVT Type (SNVT Index)	Class	Description
(M)	SCPTmaxSendTime nciSndHrtBt1	49	SNVT_time_sec (107)	NVM	The maximum period of time between consecutive transmissions of the current value
(O)	SCPTmaxRcvTime nciRcvHrtBt	48	SNVT_time_sec (107)	NVM	The maximum period of time that may expire with no updates on the associated input network variables before the object goes into heartbeat failure mode. A zero value disables
(O)	SCPTlocation nciLocation	17	SNVT_str_asc (36)	NVM	Location Label
(O)	SCPTbypassTime nciBypassTime	34	SNVT_time_min (123)	NVM	Defines the maximum amount of time that the controller can be in the bypass (occupancy) mode following the last bypass request. Zero disables the timer.

\* M = mandatory, O = optional.

It should be Mandatory for CPs that are Mandatory for an NV that is also

Mandatory. This is also valuable for CPs that apply to the Entire Functional Block.

- \*\* List of NVs to which this configuration property applies.  
An “(M)” means that the CP is Mandatory if the NV (to which it applies) is implemented. An “(O)” means that the CP is Optional if the NV (to which it applies) is implemented.

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## Mandatory Network Variables

### Space Temperature Input

network input sd\_string("@p1") SNVT\_temp\_p nviSpaceTemp;

This input network variable is used to connect an external space temperature sensor to the node. It is mandatory to the profile, but it does not have to be bound to a sensor node if the Embedded AHU Controller node itself provides a locally wired space temperature sensor. In any case, the nviSpaceTemp has priority if a valid value is present.

#### *Valid Range*

The valid range is -10°C to 50°C. The value 0x7FFF(=+327.67°C) will be handled as an invalid value.

#### *Default Value*

Default Value is 0x7FFF(=+327.67°C). This value will be adopted at power-up and in case of not receiving an update within the specified receive heartbeat time.

#### *Configuration Considerations*

This network variable is subject to the receive heartbeat time, nciRcvHrtBt.

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### Temperature Setpoint Input (absolute)

network input sd\_string("@p2") SNVT\_temp\_p nviSetpoint;

This input network variable is used to allow the temperature setpoints for the occupied and standby modes to be changed via the network. (Note: The unoccupied setpoints are not changed.) If a valid value is not present, either a locally wired setpoint knob or the appropriate setpoint as configured in nciSetpoints will be used.

There are two methods that can be used by the controller to derive the actual setpoints from nviSetpoint and nciSetpoints. Method 1 is referred to as the “symmetrical method”, since the effective heat/cool setpoints are always symmetrical relative to nviSetpoint, regardless of the values defined in nciSetpoints. Method 2 is referred to as the “asymmetrical method”, since the effective heat/cool setpoints are not always symmetrical relative to nviSetpoint, based on the values defined in nciSetpoints. Either method can be used in the

controller, as defined by the manufacturer.

Method #1: (also known as the symmetrical method)

The effective heat/cool setpoints for the occupied and standby modes are derived from nviSetpoint plus/minus half the occupied and standby deadbands calculated from nciSetpoints:

$$\begin{aligned} \text{deadband\_occupied} &= \text{occupied\_cool} - \text{occupied\_heat} \\ \text{deadband\_standby} &= \text{standby\_cool} - \text{standby\_heat} \\ \text{effective\_occupied\_cool} &= \text{nviSetpoint} + 0.5 (\text{deadband\_occupied}) \\ \text{effective\_occupied\_heat} &= \text{nviSetpoint} - 0.5 (\text{deadband\_occupied}) \\ \text{effective\_standby\_cool} &= \text{nviSetpoint} + 0.5 (\text{deadband\_standby}) \\ \text{effective\_standby\_heat} &= \text{nviSetpoint} - 0.5 (\text{deadband\_standby}) \end{aligned}$$

Method #2: (also known as the asymmetrical method)

The effective heat/cool setpoints for the occupied and standby modes are derived from nciSetpoints plus the absolute setpoint offset, calculated as the difference between nviSetpoint and the mean of the occupied\_heat and occupied\_cool setpoints defined in nciSetpoints:

$$\begin{aligned} \text{abs\_setpoint\_offset} &= \text{nviSetpoint} - (\text{occupied\_cool} + \text{occupied\_heat})/2 \\ \text{effective\_occupied\_cool} &= \text{occupied\_cool} + \text{abs\_setpoint\_offset} \\ \text{effective\_occupied\_heat} &= \text{occupied\_heat} + \text{abs\_setpoint\_offset} \\ \text{effective\_standby\_cool} &= \text{standby\_cool} + \text{abs\_setpoint\_offset} \\ \text{effective\_standby\_heat} &= \text{standby\_heat} + \text{abs\_setpoint\_offset} \end{aligned}$$

If nviSetpoint, nviSetptOffset and/or nviSetptShift are used together, the result on the effective setpoints is additive.

### ***Valid Range***

The valid range is 10°C to 35°C. The value 0x7FFF(=+327.67°C) will be handled as an invalid value.

### ***Default Value***

Default Value is 0x7FFF (= +327.67°C). This value will be adopted at powerup. This network variable input does not use the Receive Heartbeat function. When the default value is in effect, the Embedded AHU Controller will use the configuration property nciSetpoints.

### ***Configuration Considerations***

None specified

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## Occupancy Sensor Input

network input sd\_string("@p|5") SNVT\_occupancy nviOccSensor;

This input network variable is used to indicate the presence of occupants in the controlled space. It is typically sent by an occupancy sensor. In cases where an occupancy sensor is hardwired to the Embedded AHU Controller, a valid value for nviOccSensor will take precedence over the hardwired input.

This input is used in conjunction with nviOccSchedule and nviOccManCmd (if installed) to determine the effective occupancy mode. Refer to Effective Occupancy Output (nvoEffectOccup) for more information.

### *Valid Range*

0 = OC\_OCCUPIED: The occupancy sensor is indicating that there ARE occupants in the space.

1 = OC\_UNOCCUPIED: The occupancy sensor is indicating that there are NO occupants in the space.

0xFF = OC\_NUL: This is the initial value after power-up and it remains until another value is received. It is used to indicate that this network variable input is invalid or unused. OC\_NUL is equivalent to OC\_OCCUPIED.

All other enumerations are handled as equivalent to OC\_NUL.

### *Default Value*

The default value is OC\_NUL. This value will be adopted at power-up and in case of not receiving an update within the specified receive heartbeat time.

### *Configuration Considerations*

This network variable is subject to the receive heartbeat time, nciRcvHrtBt.

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## Effective Space Temperature Output

network output sd\_string("@p|13") SNVT\_temp\_p nvoSpaceTemp;

This output network variable is used to monitor the effective space temperature that the Embedded AHU Controller is using for control. If the input nviSpaceTemp has a valid value, this output will echo the value of the input. If a valid value for nviSpaceTemp does not exist, the locally wired sensor value is used. If neither value is available, the output will send the invalid value.

### *Typical Range*

The typical range is -10°C to 50°C.

### *Default Value*

The value 0x7FFF=+327.67°C will be used as an invalid value in case of a sensor failure.

### *Configuration Considerations*

This network variable will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

The variable is transmitted immediately when its value has changed significantly (manufacturer defined). Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is acknowledged.

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## **Unit Status Output**

network output sd\_string("@p14") SNVT\_hvac\_status nvoUnitStatus;

This output network variable is available to report the Embedded AHU Controller status. It combines the operating mode, the capacity of heating and cooling used and an indication if any alarms are present in the object. SNVT\_hvac\_status allows this information to be provided in one network variable.

Refer to Effective Heat/Cool Output (nvoHeatCool) for additional information regarding the value reported in the mode field. The value in the mode field will typically be the same value as the Effective Heat/Cool Output, except when the mode value is HVAC\_TEST.

### *Valid Range*

mode:	HVAC_HEAT, HVAC_MRNG_WRMUP, HVAC_COOL, HVAC_NIGHT_PURGE, HVAC_PRE_COOL, HVAC_OFF, HVAC_TEST, HVAC_EMERG_HEAT, HVAC_FAN_ONLY, HVAC_MAX_HEAT.
heat_output_primary:	0-100%, 0x7FFF (INVALID)
heat_output_secondary:	0-100%, 0x7FFF (INVALID)
cool_output:	0-100%, 0x7FFF (INVALID)

econ_output:	0-100%, 0x7FFF (INVALID)
fan_output:	0-100%, 0x7FFF (INVALID)
in_alarm:	0 Means there is no alarm. Not 0 Means there is an alarm. 0xFF Means that alarming is disabled.

### *Default Value*

mode:	manufacturer defined.
heat_output_primary:	0x7FFF (INVALID)
heat_output_secondary:	0x7FFF (INVALID)
cool_output:	0x7FFF (INVALID)
econ_output:	0x7FFF (INVALID)
fan_output:	0x7FFF (INVALID)
in_alarm:	0 Means there is no alarm.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged.

## **Effective Setpoint Output**

network output sd\_string("@p15") SNVT\_temp\_p nvoEffectSetpt;

This output network variable is used to monitor the effective temperature setpoint which may depend on nciSetpoints, nvoEffectOccup, nviSetpoint, nviSetpointOffset, nviHeatCool, and any local setpoint adjustment. For example, if the occupancy state is unoccupied and the heat/cool state is heat, then the effective setpoint would be equal to the unoccupied heating setpoint defined in nciSetpoints.

### *Typical Range*

The typical range is 10°C to 35°C.

### *Default Value*

The default value of SNVT\_temp\_p.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

The variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged.

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## **Supply Air Temperature Output**

network output sd\_string("@p22") SNVT\_temp\_p nvoSupplyAirTemp1;

This output network variable is used to monitor the temperature of the supply air that leaves the Air Handling Unit, if the unit controller provides a hardwired temperature sensor for this purpose.

### *Typical Range*

The typical range is 0°C to 100°C. The value 0x7FFF=+327.67°C will be sent as an invalid value in case of a sensor failure.

### *Default Value*

The default value of SNVT\_temp\_p.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

The variable is transmitted immediately when its value has changed significantly (manufacturer defined). Additionally, this network variable may also (as defined by the manufacturer) be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged.

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### **Supply Air temperature Setpoint Output**

network output sd\_string("@p|23") SNVT\_temp\_p nvoSupplyAirSetpt;

This output network variable is used to monitor the supply air temperature setpoint.

### *Typical Range*

The typical range is 10°C to 35°C. The value 0x7FFF=+327.67°C will be sent as an invalid value in case of a setpoint device failure.

### *Default Value*

The default value of SNVT\_temp\_p.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

The variable is transmitted immediately when its value has changed significantly (manufacturer defined). Additionally, this network variable may also (as defined by the manufacturer) be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged.

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## **Optional Network Variables**

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### **Application Mode Input**

network input sd\_string("@p|3") SNVT\_hvac\_mode nviApplicMode;

This network variable input is used to coordinate the Embedded AHU Controller with any supervisory controller. If a mode is requested that is not supported by the unit

controller, the unit controller will use a manufacturer-defined default mode.

nviApplicMode overrides nviHeatCool, unless nviApplicMode is HVAC\_AUTO, HVAC\_TEST, or HVAC\_NUL. If nviApplicMode is HVAC\_AUTO or HVAC\_NUL, then nviHeatCool determines the effective mode of the unit. If nviApplicMode is HVAC\_TEST, then the effective mode is manufacturer-defined. Refer to Effective Heat/Cool Output (nvoHeatCool) for more information.

### *Valid Range*

- 0 = HVAC\_AUTO (Mode determined by unit)
  - 1 = HVAC\_HEAT (Use heat setpoints)
  - 2 = HVAC\_MRNG\_WRMUP (Morning warmup)
  - 3 = HVAC\_COOL (Use cool setpoints)
  - 4 = HVAC\_NIGHT\_PURGE (Free cooling)
  - 5 = HVAC\_PRE\_COOL (Morning cooldown)
  - 6 = HVAC\_OFF (No unit operation allowed)
  - 7 = HVAC\_TEST (Special test mode, manufacturer-defined)
  - 8 = HVAC\_EMERG\_HEAT (Emergency heat)
  - 9 = HVAC\_FAN\_ONLY (No heating or cooling allowed)
  - 12 = HVAC\_MAX\_HEAT (Maximum heating - VAV)
  - 13 = HVAC\_ECONOMY
  - 14 = HVAC\_DEHUMID (Dehumidification)
  - 15 = HVAC\_CALIBRATE (Calibration mode - manufacturer defined)
  - 0xFF = HVAC\_NUL (same as HVAC\_AUTO)
- All other enumerations will be interpreted as manufacturer-defined.

### *Default Value*

The default value is HVAC\_AUTO. This value will be adopted at power-up and in case of not receiving an update within the specified receive heartbeat time.

### *Configuration Considerations*

This network variable is subject to the receive heartbeat time, nciRcvHrtBt.

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## **Setpoint Offset Input**

network input sd\_string("@p|4") SNVT\_temp\_p nviSetptOffset;

This input network variable is used to shift the effective occupied and standby temperature setpoints by adding nviSetptOffset to the current setpoints. (Note: The unoccupied setpoints are not changed.) It is typically bound to a supervisory node or to an external wall module having a relative setpoint knob. All occupied and standby setpoints will be shifted upward (+) or downward (-) by the value of nviSetptOffset.

If nviSetpoint, nviSetptOffset and/or nviSetptShift are used together, the result on the effective setpoints is additive.

## *Valid Range*

The valid range is -10°C to +10°C. The value 0x7FFF=+327.67°C will be handled as an invalid value.

## *Default Value*

Default Value is 0°C to disable the setpoint offset. This value will be adopted at power-up and in case of not receiving an update within the specified receive heartbeat time.

## *Configuration Considerations*

This network variable is subject to the receive heartbeat time, nciRcvHrtBt.

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## **Occupancy Scheduler Input**

network input sd\_string("@p|6") SNVT\_tod\_event nviOccSchedule;

This input network variable is used to command the Embedded AHU Controller into different occupancy modes. It is typically sent by a scheduler or a supervisory node.

SNVT\_tod\_event is a structure containing three parts. The first part, current\_state, is required for this network variable input. The additional parts, next\_state and time\_to\_next\_state, are optional. They can be used for control strategies that provide improved transitions between states. A scheduler node should send OC\_NUL and 0, respectively, if it does not use these functions. The controller node will ignore these values if the functions are not supported by the controller.

This input is used in conjunction with nviOccManCmd and nviOccSensor (if installed) to determine the effective occupancy mode. Refer to Effective Occupancy Output (nvoEffectOccup) for more information.

## *Valid Range*

for current\_state:

0 = OC\_OCCUPIED: The Embedded AHU Controller should operate in the occupied mode as defined by the manufacturer (e.g. occupied setpoint).

1 = OC\_UNOCCUPIED: The Embedded AHU Controller should operate in the unoccupied mode as defined by the manufacturer (e.g. unoccupied setpoint).

3 = OC\_STANDBY: The Embedded AHU Controller should operate in the standby mode as defined by the manufacturer (e.g. standby setpoint).

0xFF = OC\_NUL: This is the initial value after power-up and it remains until another value is received. It is used to indicate that this network variable input is invalid or unused.

The interpretation of all other enumerations will be manufacturer-specific.

for next\_state: (optional)

0 = OC\_OCCUPIED: The Embedded AHU Controller will operate in the occupied

mode as defined by the manufacturer (e.g. occupied setpoint).  
1 = OC\_UNOCCUPIED: The Embedded AHU Controller will operate in the unoccupied mode as defined by the manufacturer (e.g. unoccupied setpoint).  
3 = OC\_STANDBY: The Embedded AHU Controller will operate in the standby mode as defined by the manufacturer (e.g. standby setpoint).  
0xFF = OC\_NUL: This is the initial value after power-up and it remains until another value is received. It is used to indicate that this network variable input is invalid or unused.  
The interpretation of all other enumerations will be manufacturer-specific.  
for time\_to\_next\_state: (optional) 0 to 65,534 minutes, 0 = not used, 65,535 (0xFFFF) = Invalid

### ***Default Value***

current\_state = 0xFF = OC\_NUL  
next\_state = 0xFF = OC\_NUL  
time\_to\_next\_state = 0 minutes

These values will be adopted at power-up and in case of not receiving an update within the specified receive heartbeat time.

### ***Configuration Considerations***

This network variable is subject to the receive heartbeat time, nciRcvHrtBt.

---

### **Occupancy Override Input**

network input sd\_string("@p7") SNVT\_occupancy nviOccManCmd;

This input network variable is used to command the Embedded AHU Controller into different occupancy modes. It is typically sent by a wall-mounted occupant interface module or a supervisory node, to manually control occupancy modes, or to override the scheduled occupancy.

If a local Bypass Input is present, it can be used in conjunction with this network variable input. The local input, when active, forces a Bypass request (equivalent to OC\_BYPASS), overriding nviOccManCmd for the duration of the Local Bypass Time (determined by the configuration property nciBypassTime). When nviOccManCmd indicates OC\_BYPASS, the Local Bypass Time is also used. Whenever an update of nviOccManCmd is received indicating OC\_BYPASS, the bypass timer is restarted. This network variable input should never be bound to a network variable that uses a Send Heartbeat function.

This input is used in conjunction with nviOccSchedule and nviOccSensor (if installed) to determine the effective occupancy mode. Refer to Effective Occupancy Output (nvoEffectOccup) for more information.

### ***Valid Range***

0 = OC\_OCCUPIED: The Embedded AHU Controller should operate in the occupied mode as defined by the manufacturer (e.g. occupied setpoint).

- 1 = OC\_UNOCCUPIED: The Embedded AHU Controller should operate in the unoccupied mode as defined by the manufacturer (e.g. unoccupied setpoint).
- 2 = OC\_BYPASS: The Embedded AHU Controller should operate in the occupied mode for a period of time defined by nciBypassTime.
- 3 = OC\_STANDBY: The Embedded AHU Controller should operate in the standby mode as defined by the manufacturer (e.g. standby setpoint).
- 0xFF = OC\_NUL: This is the initial value after power-up and it remains until another value is received. It is used to indicate that this network variable input is invalid, unused or to cancel a previous command.

### *Default Value*

The default value OC\_NUL = 0xFF. This value will be adopted at power-up. This network variable input does not use the Receive Heartbeat function.

### *Configuration Considerations*

None specified

---

## **Setpoint SupplyAir min Temperature Input (absolute)**

network input sd\_string("@p8") SNVT\_temp\_p      nviSetpointMin;

This input network variable is used to allow the min. temperature setpoint for the supply air to be changed via the network.

### *Valid Range*

The valid range is 10°C to 35°C. The value 0x7FFF=+327.67°C will be handled as an invalid value.

### *Default Value*

Default Value is 0x7FFF (= +327.67°C). This value will be adopted at powerup. This network variable input does not use the Receive Heartbeat function. When the default value is in effect, the Embedded AHU Controller will use the configuration property nciSetpoints.

### *Configuration Considerations*

None specified

---

## Setpoint SupplyAir max Temperature Input (absolute)

network input sd\_string("@p9") SNVT\_temp\_p nviSetpointMax;

This input network variable is used to allow the max. temperature setpoint for the supply air to be changed via the network.

### *Valid Range*

The valid range is 10°C to 50°C. The value 0x7FFF=+327.67°C will be handled as an invalid value.

### *Default Value*

Default Value is 0x7FFF (= +327.67°C). This value will be adopted at powerup. This network variable input does not use the Receive Heartbeat function. When the default value is in effect, the Embedded AHU Controller will use the configuration property nciSetpoints.

### *Configuration Considerations*

None specified

---

## Outdoor Air Temperature Input

network input sd\_string("@p10") SNVT\_temp\_p nviOutdoorTemp;

This input network variable represents information from an outdoor air temperature sensor. This value is typically generated from either a communicating sensor or a supervisory controller. The unit may also have a locally wired outdoor air temperature sensor. Valid values of nviOutdoorTemp have priority over local sensor values.

### *Valid Range*

The valid range is -40°C to 50°C. The value 0x7FFF = +327.67°C will be handled as an invalid value in case of a sensor failure.

### *Default Value*

Default Value is 0x7FFF (= +327.67°C). This value will be adopted at power-up and in case of not receiving an update within the specified receive heartbeat time.

## Configuration Considerations

This network variable is subject to the receive heartbeat time, nciRcvHrtBt.

---

### Supply Air Flow Override Input

network input sd\_string("@p11") SNVT\_hvac\_overid          nviFlowOvrSup;

This input network variable is used for commanding the controller into a manual mode for overriding supply air flow control (most commonly when air balancing the system). This input would typically be initiated from a supervisory controller or service tool. It can be used to override heating and/or cooling flow devices. A product manufacturer can implement an optional time limit for this input, as defined by the Manual Time Limit (nciManualTime) configuration property. The response to unused or invalid values is manufacturer-defined.

When used on dual duct units, enumerations 17-48 should be used. The operation of the damper not being overridden is manufacturer defined.

### Valid Range

for state:

0 = HVO\_OFF: Normal control.

1 = HVO\_POSITION: Set damper position to the value in the percent field.

2 = HVO\_FLOW\_VALUE: Control flow to the value in the flow field.

3 = HVO\_FLOW\_PERCENT: Control flow to the value in the percent field. This is a percent of the maximum flow setting.

4 = HVO\_OPEN: Fully open the damper.

5 = HVO\_CLOSE: Fully close the damper.

6 = HVO\_MINIMUM: Control flow to the minimum flow setting.

7 = HVO\_MAXIMUM: Control flow to the maximum flow setting.

8 – 16 = Unused

17 = HVO\_POSITION\_1: Set heating or ventilation damper position to the value in the percent field.

18 = HVO\_FLOW\_VALUE\_1: Control heating or ventilation flow to the value in the flow field.

19 = HVO\_FLOW\_PERCENT\_1: Control heating or ventilation flow to the value in the percent field. This is a percent of the maximum flow setting.

20 = HVO\_OPEN\_1: Fully open the heating or ventilation damper.

21 = HVO\_CLOSE\_1: Fully close the heating or ventilation damper.

22 = HVO\_MINIMUM\_1: Control heating or ventilation flow to the minimum flow setting.

23 = HVO\_MAXIMUM\_1: Control heating or ventilation flow to the maximum flow setting.

24 – 32 = Unused

33 = HVO\_POSITION\_2: Set cooling damper position to the value in the percent field.

34 = HVO\_FLOW\_VALUE\_2: Control cooling flow to the value in the flow field.

35 = HVO\_FLOW\_PERCENT\_2: Control cooling flow to the value in the percent field. This is a percent of the maximum flow setting.  
 36 = HVO\_OPEN\_2: Fully open the cooling damper.  
 37 = HVO\_CLOSE\_2: Fully close the cooling damper.  
 38 = HVO\_MINIMUM\_2: Control cooling flow to the minimum flow setting.  
 39 = HVO\_MAXIMUM\_2: Control cooling flow to the maximum flow setting.  
 40 – 48 = Unused  
 0xFF = NUL: INVALID (same as 0 = HVO\_OFF).  
 for percent: 0 to 100%  
 for flow: 0 to 65,534 liters/sec

### *Default Value*

The default value is 0 = HVO\_OFF. This value will be adopted at power-up. This network variable input does not use the Receive Heartbeat function. Optionally, a manufacturer can choose to use the default value if an update is not received within the Manual Time Limit (nciManualTime).

### *Configuration Considerations*

None specified

## **Fire Alarm input**

```
network input sd_string("@p12") SNVT_switch          nviFireAlm;
```

This input network variable is used for commanding the controller into a manufacturer specific operation mode when a fire alarm condition occurs .

### **Valid Range**

The valid range for the value field is any value within the defined limits of the SNVT\_switch input. The following table describes the encoding of SNVT\_switch for various fire alarm conditions:

<b>state val</b>	<b>%</b>	<b>general purpose</b>
0	0	No alarm
1	1-100	Alarm

### *Default Value*

The default value is 0 = No alarm. This value will be adopted at power-up. This value will be adopted at power-up and in case of not receiving an update within the specified receive heartbeat time.

### *Configuration Considerations*

None specified

---

## Extract Air Flow Override Input

network input sd\_string("@p|43") SNVT\_hvac\_overrid          nviFlowOvrExt;

This input network variable is used for commanding the controller into a manual mode for overriding Extract air flow control (most commonly when air balancing the system). This input would typically be initiated from a supervisory controller or service tool. It can be used to override heating and/or cooling flow devices. A product manufacturer can implement an optional time limit for this input, as defined by the Manual Time Limit (nciManualTime) configuration property. The response to unused or invalid values is manufacturer-defined.

When used on dual duct units, enumerations 17-48 should be used. The operation of the damper not being overridden is manufacturer defined.

### *Valid Range*

for state:

0 = HVO\_OFF: Normal control.

1 = HVO\_POSITION: Set damper position to the value in the percent field.

2 = HVO\_FLOW\_VALUE: Control flow to the value in the flow field.

3 = HVO\_FLOW\_PERCENT: Control flow to the value in the percent field. This is a percent of the maximum flow setting.

4 = HVO\_OPEN: Fully open the damper.

5 = HVO\_CLOSE: Fully close the damper.

6 = HVO\_MINIMUM: Control flow to the minimum flow setting.

7 = HVO\_MAXIMUM: Control flow to the maximum flow setting.

8 – 16 = Unused

17 = HVO\_POSITION\_1: Set heating or ventilation damper position to the value in the percent field.

18 = HVO\_FLOW\_VALUE\_1: Control heating or ventilation flow to the value in the flow field.

19 = HVO\_FLOW\_PERCENT\_1: Control heating or ventilation flow to the value in the percent field. This is a percent of the maximum flow setting.

20 = HVO\_OPEN\_1: Fully open the heating or ventilation damper.

21 = HVO\_CLOSE\_1: Fully close the heating or ventilation damper.

22 = HVO\_MINIMUM\_1: Control heating or ventilation flow to the minimum flow setting.

23 = HVO\_MAXIMUM\_1: Control heating or ventilation flow to the maximum flow setting.

24 – 32 = Unused

33 = HVO\_POSITION\_2: Set cooling damper position to the value in the percent field.

34 = HVO\_FLOW\_VALUE\_2: Control cooling flow to the value in the flow field.

35 = HVO\_FLOW\_PERCENT\_2: Control cooling flow to the value in the percent field. This is a percent of the maximum flow setting.

36 = HVO\_OPEN\_2: Fully open the cooling damper.

37 = HVO\_CLOSE\_2: Fully close the cooling damper.

38 = HVO\_MINIMUM\_2: Control cooling flow to the minimum flow setting.  
 39 = HVO\_MAXIMUM\_2: Control cooling flow to the maximum flow setting.  
 40 – 48 = Unused  
 0xFF = NUL: INVALID (same as 0 = HVO\_OFF).  
 for percent: 0 to 100%  
 for flow: 0 to 65,534 liters/sec

## Default Value

The default value is 0 = HVO\_OFF. This value will be adopted at power-up. This network variable input does not use the Receive Heartbeat function. Optionally, a manufacturer can choose to use the default value if an update is not received within the Manual Time Limit (nciManualTime).

## Configuration Considerations

None specified

## Effective Occupancy Output

network output sd\_string("@p16") SNVT\_occupancy nvoEffectOccup;

This output network variable is used to indicate the actual occupancy mode of the unit. This information is typically reported to a supervisory controller, or provided to another Embedded AHU Controller to coordinate the operation of multiple units. The occupancy mode is determined by a combination of optional input network variables and logic in the controller, as defined by the controller manufacturer. An example of how the Effective Occupancy Output could be determined from various inputs is shown in the table below.

### Effective Occupancy Output (example application)

nviOccManCmd	nviOccSchedule4	nviOccSensor2	nvoEffectOccup
OC_OCCUPIED	Don't Care	Don't Care	OC_OCCUPIED
OC_UNOCCUPIED	Don't Care	Don't Care	OC_UNOCCUPIED
OC_BYPASS <sub>1</sub>	OC_OCCUPIED	Don't Care	OC_OCCUPIED
	OC_UNOCCUPIED	Don't Care	OC_BYPASS <sub>1</sub>
	OC_STANDBY	Don't Care	OC_BYPASS <sub>1</sub>
	OC_NUL	OC_OCCUPIED <sub>3</sub>	OC_OCCUPIED
		OC_UNOCCUPIED	OC_BYPASS <sub>1</sub>
OC_STANDBY	Don't Care	Don't Care	OC_STANDBY
OC_NUL	OC_OCCUPIED	OC_OCCUPIED <sub>3</sub>	OC_OCCUPIED
		OC_UNOCCUPIED	OC_STANDBY

OC_UNOCCUPIED	Don't Care	OC_UNOCCUPIED
OC_STANDBY	Don't Care	OC_STANDBY
OC_NUL	OC_OCCUPIED <sub>3</sub>	OC_OCCUPIED
	OC_UNOCCUPIED	OC_UNOCCUPIED

Notes:

- 1 OC\_BYPASS can be initiated by either nviOccManCmd or a local input. nvoEffectOccup will only be OC\_BYPASS for the duration of the Local Bypass Time (nciBypassTime), until reinitiated by either a transition of the local input or an update to nviOccManCmd.
- 2 The occupancy sensor can be either a local input or a network input. If a valid value for the network input is present, it has precedence over a local input.
- 3 For the occupancy sensor, OC\_NUL (and no local input) is interpreted as OC\_OCCUPIED.
- 4 For nviOccSchedule, this refers to the "current state" field.
- 5 "Don't Care" = Any State

### *Valid Range*

- 0 = OC\_OCCUPIED: The Embedded AHU Controller should operate in the occupied mode as defined by the manufacturer (e.g. occupied setpoint).
- 1 = OC\_UNOCCUPIED: The Embedded AHU Controller should operate in the unoccupied mode as defined by the manufacturer (e.g. unoccupied setpoint).
- 2 = OC\_BYPASS: The Embedded AHU Controller should operate in the occupied mode for a period of time defined by nciBypassTime.
- 3 = OC\_STANDBY: The Embedded AHU Controller should operate in the standby mode as defined by the manufacturer (e.g. standby setpoint).

### *Default Value*

0xFF = OC\_NUL.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

The variable is transmitted immediately when its value has changed. Additionally, this network variable may also (as defined by the manufacturer) be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged.

## **Fan1 Speed Output**

network output sd\_string("@p21") SNVT\_switch nvoFanSpeed1;

This output network variable reflects the actual supplyfan speed of a local multi-speed fan as well as the requested speed of a remote fan. It can be used as part of a control loop and for monitoring purposes.

When used to control a remote fan, this output indicates a requested fan speed.

When used to report the status of a hardwired fan output(s), this output indicates the actual fan speed.

### *Valid Range*

State	Value	Equivalent Percent	Actual or Requested Fan State	Actual or Requested Fan Speed
0	n/a	n/a	OFF	n/a
1	1 to 199	0.5 to 99.5%	ON	Mfgr. Defined
1	200	100.0%	ON	High or 100%
0xFF	n/a	n/a	Invalid	Invalid

### *Default Value*

The default value of SNVT\_switch.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged.

## **Primary Heat Output**

network output sd\_string("@p|18") SNVT\_lev\_percent nvoHeatPrimary;

This output network variable reflects the current level of the primary heat output (if hardwired) or can be used to control a remote primary heat source (valve, compressor, etc.).

### *Valid Range*

The valid range is 0% to 100% of primary heat capacity. The value 0x7FFF =

+163.835 % will be sent as an invalid value to indicate that no primary heat is used.

### ***Default Value***

The default value of SNVT\_lev\_percent.

### ***Configuration Considerations***

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### ***When Transmitted***

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### ***Default Service Type***

The default service type is unacknowledged.

Examples of Primary and Secondary Heat

<u>HVAC UnitType</u>	<u>Primary Heat</u>	<u>Secondary Heat</u>
AHU	Heat recovery	Electric/Hydronic
Fan Coil	Hydronic	Electric
Heat Pump	Compressor	Electric
VAV	Source Air	Electric/Hydronic
Rooftop	Electric/Gas	n/a

---

## **Secondary Heat Output**

network output sd\_string("@p19") SNVT\_lev\_percent      nvoHeatSecondary;

This output network variable reflects the current level of the secondary heat output (when present) or can be used to control a remote secondary heat source (valve, electric heat, etc.).

### ***Valid Range***

The valid range is 0% to 100% of secondary heat capacity. The value 0x7FFF = +163.835 % will be sent as an invalid value to indicate that no secondary heat is used.

### ***Default Value***

The default value of SNVT\_lev\_percent.

## *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

## *When Transmitted*

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

## *Default Service Type*

The default service type is unacknowledged.

---

## **Primary Cool Output**

network output sd\_string("@p20") SNVT\_lev\_percent      nvoCoolPrimary;

This output network variable reflects the current level of the primary mechanical cooling output (if hardwired) or can be used to control a remote mechanical cooling source.

## *Valid Range*

The valid range is 0% to 100% of primary cooling capacity. The value 0x7FFF = +163.835 % will be sent as an invalid value to indicate that no cooling is used.

## *Default Value*

The default value of SNVT\_lev\_percent.

## *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

## *When Transmitted*

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

## *Default Service Type*

The default service type is unacknowledged.

---

## **Outdoor Air Damper1 Output**

network output sd\_string("@p|24") SNVT\_lev\_percent          nvoOADamper1;

This output network variable reflects the current position of the outdoor supply air damper (if hardwired) or as a request to a remote outdoor air damper.

## *Valid Range*

The valid range is 0% to 100% outdoor air damper position. The value 0x7FFF = +163.835 % will be sent as an invalid value to indicate that no outdoor air damper is used.

## *Default Value*

The default value of SNVT\_lev\_percent.

## *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

## *When Transmitted*

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

## *Default Service Type*

The default service type is unacknowledged.

---

## **Outdoor Air Temperature Output**

network output sd\_string("@p|25") SNVT\_temp\_p          nvoOutdoorTemp;

This output network variable is used to monitor the outdoor air temperature if the unit controller provides a hardwired temperature sensor for this purpose.

## *Typical Range*

The typical range is -40°C to 70°C. The value 0x7FFF = +327.67°C will be handled as an invalid value in case of a sensor failure.

### *Default Value*

The default value of SNVT\_temp\_p.  
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### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged.

---

## **Space CO<sub>2</sub> Sensor Output**

network output sd\_string("@p|26") SNVT\_ppm nvoSpaceCO2;

This output network variable indicates the space CO<sub>2</sub> concentration in ppm, if the Embedded AHU Controller Device has a locally wired CO<sub>2</sub> sensor.

### *Typical Range*

The typical range is 0 to 5000 ppm. The value 0xFFFF = 65,535 is reserved to indicate an invalid value, such as a failed sensor.

### *Default Value*

The value 0xFFFF = 65,535 is reserved to indicate an invalid value, such as a failed sensor.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

This variable is transmitted immediately when its value has changed significantly.

Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### ***Default Service Type***

The default service type is unacknowledged.

---

### **Air Flow1 Output**

network output sd\_string("@p27") SNVT\_flow      nvoAirflow1

The output network variable is used to indicate the measured supply air flow.

### ***Valid Range***

The valid Range is 0 to 65,534 liters/sec. The value 0xFFFF=65,535 will be handled as an invalid value.

### ***Default Value***

The default value of SNVT\_flow.

### ***Configuration Considerations***

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### ***When Transmitted***

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### ***Default Service Type***

The default service type is unacknowledged.

---

### **Flow1 Setpoint Output**

network output sd\_string("@p28") SNVT\_flow      nvoFlowSetpoint1

This output network variable is used to indicate the active supply air flow setpoint used by the flow control. It can be used for monitoring

purposes or used with a compatible remote flow control device.

### *Valid Range*

The valid Range is 0 to 65,534 liters/sec. The value 0xFFFF=65,535 will be handled as an invalid value.

### *Default Value*

The default value of SNVT\_flow.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

The variable is transmitted immediately when its value has changed significantly (manufacturer defined). Additionally, this network variable may also (as defined by the manufacturer) be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged.

---

## **Air Pressure1 Output**

network output sd\_string("@p|29") SNVT\_press\_p nvoAirPress1

The output network variable is used to indicate the measured supply air pressure.

### *Valid Range*

The valid Range is 0 to 65,534 Pa The value 0xFFFF=65,535 will be handled as an invalid value.

### *Default Value*

The default value of SNVT\_press\_p.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

## *Default Service Type*

The default service type is unacknowledged.

---

## **Air Pressure1 Setpoint Output**

network output sd\_string("@p30") SNVT\_press\_p nvoPressSetpoint1

This output network variable is used to indicate the active supply air pressure setpoint used by the pressure control. It can be used for monitoring purposes or used with a compatible remote pressure control device.

## *Valid Range*

The valid Range is 0 to 65,534 Pa. The value 0xFFFF=65,535 will be handled as an invalid value.

## *Default Value*

The default value of SNVT\_flow.

## *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

## *When Transmitted*

The variable is transmitted immediately when its value has changed significantly (manufacturer defined). Additionally, this network variable may also (as defined by the manufacturer) be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

## *Default Service Type*

The default service type is unacknowledged.

---

## **Heat Source Temperature Output**

network output sd\_string("@p31") SNVT\_temp\_p nvoHeatSrcTemp;

This output network variable is used to monitor the Heat source temperature from a locally wired sensor value.

## *Typical Range*

The typical range is -10°C to 50°C.

### ***Default Value***

The value 0x7FFF=+327.67°C will be used as an invalid value in case of a sensor failure.

### ***Configuration Considerations***

This network variable will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### ***When Transmitted***

The variable is transmitted immediately when its value has changed significantly (manufacturer defined). Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### ***Default Service Type***

The default service type is acknowledged.

---

## **Recirculation Air Damper Output**

network output sd\_string("@p|32") SNVT\_lev\_percent      nvoRecircDamper;

This output network variable reflects the current position of the recirculation air damper.

### ***Valid Range***

The valid range is 0% to 100% recirculation air damper position. The value 0x7FFF = +163.835 % will be sent as an invalid value to indicate that no outdoor air damper is used.

### ***Default Value***

The default value of SNVT\_lev\_percent.

### ***Configuration Considerations***

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### ***When Transmitted***

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt)

configuration value.

### *Default Service Type*

The default service type is unacknowledged.

---

## **Accumulated Operation Time Output**

network output sd\_string("@p41") SNVT\_elapsed\_tm nvoOpTime;

This output network variable reflects the devices total accumulated operating time.

### *Valid Range*

Days (days) . The value 65535 represents NULL or unknown elapsed time.  
Minimum:0, Maximum: 65535

### *Default Value*

The default value of SNVT\_elapsed\_tm.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged.

---

## **Device Realtime Clock Output**

network output sd\_string("@p42") SNVT\_time\_stamp nvoTime;

This output network variable reflects the devices internal real time clock

### *Valid Range*

Year (years) . Zero (0) means year not specified. Minus one (-1) represents NULL date

Minimum:-1, Maximum: 3000

### ***Default Value***

The default value of SNVT\_elapsed\_tm.

### ***Configuration Considerations***

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### ***When Transmitted***

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### ***Default Service Type***

The default service type is unacknowledged.

---

## **Extract Air Temperature Output**

network output sd\_string("@p|33") SNVT\_temp\_p nvoExtractTemp2;

This output network variable is used to monitor the temperature of the Extract air that leaves the room, if the unit controller provides a hardwired temperature sensor for this purpose.

### ***Typical Range***

The typical range is 0°C to 100°C. The value 0x7FFF=+327.67°C will be sent as an invalid value in case of a sensor failure.

### ***Default Value***

The default value of SNVT\_temp\_p.

### ***Configuration Considerations***

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### ***When Transmitted***

The variable is transmitted immediately when its value has changed significantly (manufacturer defined). Additionally, this network variable may also (as defined by the manufacturer) be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### ***Default Service Type***

The default service type is unacknowledged.

---

## Fan2 Speed Output

network output sd\_string("@p|34") SNVT\_switch nvoFanSpeed2;

This output network variable reflects the actual extract fan speed of a local multi-speed fan as well as the requested speed of a remote fan. It can be used as part of a control loop and for monitoring purposes.

When used to control a remote fan, this output indicates a requested fan speed.

When used to report the status of a hardwired fan output(s), this output indicates the actual fan speed.

### *Valid Range*

State	Value	Equivalent Percent	Actual or Requested Fan State	Actual or Requested Fan Speed
0	n/a	n/a	OFF	n/a
1	1 to 199	0.5 to 99.5%	ON	Mfgr. Defined
1	200	100.0%	ON	High or 100%
0xFF	n/a	n/a	Invalid	Invalid

### *Default Value*

The default value of SNVT\_switch.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged.

---

## Exhaust Air Temperature Output

network output sd\_string("@p|35") SNVT\_temp\_p nvoExhAirTemp2;

This output network variable is used to monitor the temperature of the Exhaust air that leaves the AHU, if the unit controller provides a hardwired temperature sensor for this purpose.

### *Typical Range*

The typical range is 0°C to 100°C. The value 0x7FFF=+327.67°C will be sent as an invalid value in case of a sensor failure.

### *Default Value*

The default value of SNVT\_temp\_p.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

The variable is transmitted immediately when its value has changed significantly (manufacturer defined). Additionally, this network variable may also (as defined by the manufacturer) be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged

---

## Outdoor Air Damper2 Output

network output sd\_string("@p|36") SNVT\_lev\_percent nvoOADamper2;

This output network variable reflects the current position of the Outdoor air damper2.

### *Valid Range*

The valid range is 0% to 100% outdoor air damper position. The value 0x7FFF = +163.835 % will be sent as an invalid value to indicate that no outdoor air damper is used.

### *Default Value*

The default value of SNVT\_lev\_percent.

## *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

## *When Transmitted*

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

## *Default Service Type*

The default service type is unacknowledged.

---

## **Air Flow2 Output**

network output sd\_string("@p37") SNVT\_flow      nvoAirflow2

The output network variable is used to indicate the measured extract air flow.

## *Valid Range*

The valid Range is 0 to 65,534 liters/sec. The value 0xFFFF=65,535 will be handled as an invalid value.

## *Default Value*

The default value of SNVT\_flow.

## *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

## *When Transmitted*

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

## *Default Service Type*

The default service type is unacknowledged.

---

## Flow2 Setpoint Output

network output sd\_string("@p|38") SNVT\_flow nvoFlowSetpoint2

This output network variable is used to indicate the active extract air flow setpoint used by the flow control. It can be used for monitoring purposes or used with a compatible remote flow control device.

### *Valid Range*

The valid Range is 0 to 65,534 liters/sec. The value 0xFFFF=65,535 will be handled as an invalid value.

### *Default Value*

The default value of SNVT\_flow.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

The variable is transmitted immediately when its value has changed significantly (manufacturer defined). Additionally, this network variable may also (as defined by the manufacturer) be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged.

---

## Air Pressure2 Output

network output sd\_string("@p|39") SNVT\_press\_p nvoAirPress2

The output network variable is used to indicate the measured extract air pressure.

### *Valid Range*

The valid Range is 0 to 65,534 Pa The value 0xFFFF=65,535 will be handled as an invalid value.

### *Default Value*

The default value of SNVT\_press\_p.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

This variable is transmitted immediately when its value has changed significantly. Additionally, this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged.

---

## **Air Pressure2 Setpoint Output**

network output sd\_string("@p|40") SNVT\_press\_p nvoPressSetpoint2

This output network variable is used to indicate the active extract air pressure setpoint used by the pressure control. It can be used for monitoring purposes or used with a compatible remote pressure control device.

### *Valid Range*

The valid Range is 0 to 65,534 Pa. The value 0xFFFF=65,535 will be handled as an invalid value.

### *Default Value*

The default value of SNVT\_flow.

### *Configuration Considerations*

This value will be updated no faster than the Minimum Send Time (nciMinOutTm) configuration value, if used (manufacturer-defined).

### *When Transmitted*

The variable is transmitted immediately when its value has changed significantly (manufacturer defined). Additionally, this network variable may also (as defined by the manufacturer) be transmitted as a heartbeat output on a regular basis as dictated by the Maximum Send Time (nciSndHrtBt) configuration value.

### *Default Service Type*

The default service type is unacknowledged.

---

## Configuration Properties

### Send Heartbeat (Mandatory)

network input config sd\_string("&2,i,j,k,0\x80,49") SNVT\_time\_sec nciSndHrtBt1;

This configuration property defines the maximum period of time that expires before the specified network variable outputs will automatically be updated. The specific method for sending heartbeat updates is manufacturer-defined.

Network variable outputs can be defined in 2 categories for the use of send heartbeat, based upon whether they are specified for send heartbeat in the Network Variable Outputs Table, as shown below:

Network Variable Output	Specified for Send Heartbeat in table?	Result: Use Send Heartbeat?
Category 1	Yes	Yes
Category 2	No	Manufacturer-defined

### *Valid Range*

The valid range is any value between 0.0 sec and 6,553.4 sec. Setting nciSndHrtBt = 0.0 disables the Send Heartbeat mechanism.

### *Typical Default Value*

0 (no automatic update)

### *Configuration Requirements/Restrictions*

None.

### *SCPT Reference*

SCPTmaxSendTime (49)

---

### Receive Heartbeat (Optional)

network input config sd\_string("&2,i,j,k,0\x80,48") SNVT\_time\_sec nciRcvHrtBt;

This configuration property is used to control the maximum time that elapses after the last update to a specified network variable input before the Space Comfort Controller starts to use its default values. Network variable inputs can be defined in 3 categories for use of receive heartbeat, based upon whether they are specified for receive heartbeat in the Network Variable Inputs Table and whether they are bound, as shown below:

Network Variable Input	Specified for Receive Heartbeat in Table?	Bound?	Result: Use Receive Heartbeat?
------------------------	---	--------	--------------------------------

Category 1	Yes	Yes	Yes
Category 2	Yes	No	Manufacturer-defined
Category 3	No	Don't Care	No

### *Valid Range*

The valid range is any value between 0.0 sec and 6,553.4 sec. Setting nciRcvHrtBt = 0.0 disables the Receive Heartbeat mechanism.

### *Typical Default Value*

0 (no failure detect)

### *Configuration Requirements/Restrictions*

None.

### *SCPT Reference*

SCPTmaxRcvTime (48)

## **Local Bypass Time (Optional)**

```
network input config sd_string("&1,p,0\x80,34") SNVT_time_min    nciBypassTime;
```

This configuration property defines the maximum amount of time that the controller can be in the Bypass (occupancy) mode following a single Bypass request from either a local (hardwired) bypass switch or nviOccManCmd. Additional Bypass requests can restart the timer.

### *Typical Range*

The typical range is 0 to 240 minutes (4 hours). Setting nciBypassTime = 0 disables the Bypass function.

### *Typical Default Value*

0 (no bypass allowed)

### *Configuration Requirements/Restrictions*

None.

### *SCPT Reference*

SCPTbypassTime (34)

---

## Location Label (Optional)

```
network input config sd_string("&1,p,0\x80,17") SNVT_str_asc  
nciLocation;
```

This configuration property can be used to provide the location of the functional block (or device), where *p* is the functional-block index. The above code declaration is for providing the location of the functional block. If it is preferred, the location of the device can be represented with the following code declaration— if a Node Object functional block is present on the device:

```
network input config sd_string("&1,0,0\x80,17")  
SNVT_str_asc nciLocation;
```

### *Valid Range*

Any NULL-terminated ASCII string up to 31 bytes of total length (including NULL). The string must be truncated if the length does not allow the 31<sup>st</sup> character to be the NULL (0x00).

### *Default Value*

The default value is an ASCII string containing 31 NULLs (0x00).

### *Configuration Requirements/Restrictions*

This CP has no modification restrictions (no\_restrictions). It can be modified at any time.

### *SCPT Reference*

SCPTlocation (17)

---

## Object Major Version (Optional)

```
network input config sd_string("&1,P,0\x84,167")
unsigned short nciObjMajVer;
```

This configuration property can be used to provide the major version number of the functional block when implemented on a device.

### *Valid Range*

Any integer number from 0 to 255. Only 1-byte of information is accepted.

### *Default Value*

The default value is one (1).

### *Configuration Requirements/Restrictions*

This CP is a Constant (const\_flg).

The Constant flag means that all devices with the same Standard Program Identifier (SPID) will have the same value, while the Device-Specific flag attribute means that devices with an identical SPID may have different values for this configuration property.

The presence of these configuration properties within the functional block defines the major version and minor version of the functional block. The major version number must be incremented when the network interface for the functional block changes, while the minor version number must be incremented when the network interface remains the same, but the functional block has a different behavior.

### *SCPT Reference*

SCPTobjMajVer (167)

---

## Object Minor Version (Optional)

```
network input config sd_string("&1,P,0\ A4,168")
unsigned short nciObjMinVer;
```

This configuration property can be used to provide the minor version number of the functional block when implemented on a device.

### *Valid Range*

Any integer number from 0 to 255. Only 1-byte of information is accepted.

### *Default Value*

The default value is zero (0).

### *Configuration Requirements/Restrictions*

This CP has modification restrictions of Constant (`const_flg`) and Device-Specific (`device_specific_flg`): \xA4. It is not to be modified except that it *is* allowable to modify the value in a download of new code to the device.

The Constant flag means that all devices with the same Standard Program Identifier (SPID) will have the same value, while the Device-Specific flag attribute means that devices with an identical SPID may have different values for this configuration property.

The presence of these configuration properties within the functional block defines the major version and minor version of the functional block. The major version number must be incremented when the network interface for the functional block changes, while the minor version number must be incremented when the network interface remains the same, but the functional block has a different behavior.

### *SCPT Reference*

SCPTobjMinVer (168)

---

## **Key for Unresolved References**

*i . j . k* are the indices of the CP-associated NVs in relation to their declaration order within the node, when implemented.

*p* is this Object's index relative to the node `sd_string` declaration, when implemented.

---

## **Power-up State**

There is no immediate network action on Power-up State.

---

## **Boundary and Error Conditions**

None specified.

---

## **Additional Considerations**

None specified.

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