



LONMARK[®] Functional Profile: Thermostat

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Overview

This document describes the profile of a Thermostat object. This object is used in devices such as a wall mounted thermostat that is used to control the room temperature by controlling bounded heat and a bounded cool actuators. It is assumed that the space temperature is a mandatory output from the thermostat object and is derived from a temperature sensor mounted inside (or hard wired to) the device or optionally residing on the network.

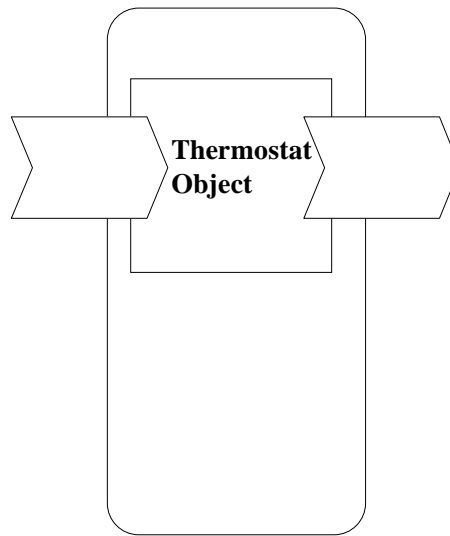


Figure 1.1 Functional Profile

Example Usage

The Thermostat object resides in a LONMARK device and interacts with one or more of the following LONMARK devices:

- room temperature sensor node
- remote wall module (including temperature sensor, setpoint)
- supervisory node (occupancy mode, heat/cool changeover)
- monitoring node
- heat actuator node (0..100%)
- cool actuator node (0..100%)

Object Details

The Thermostat object controls one heat output and one cool output. The Thermostat object may optionally control a terminal fan.

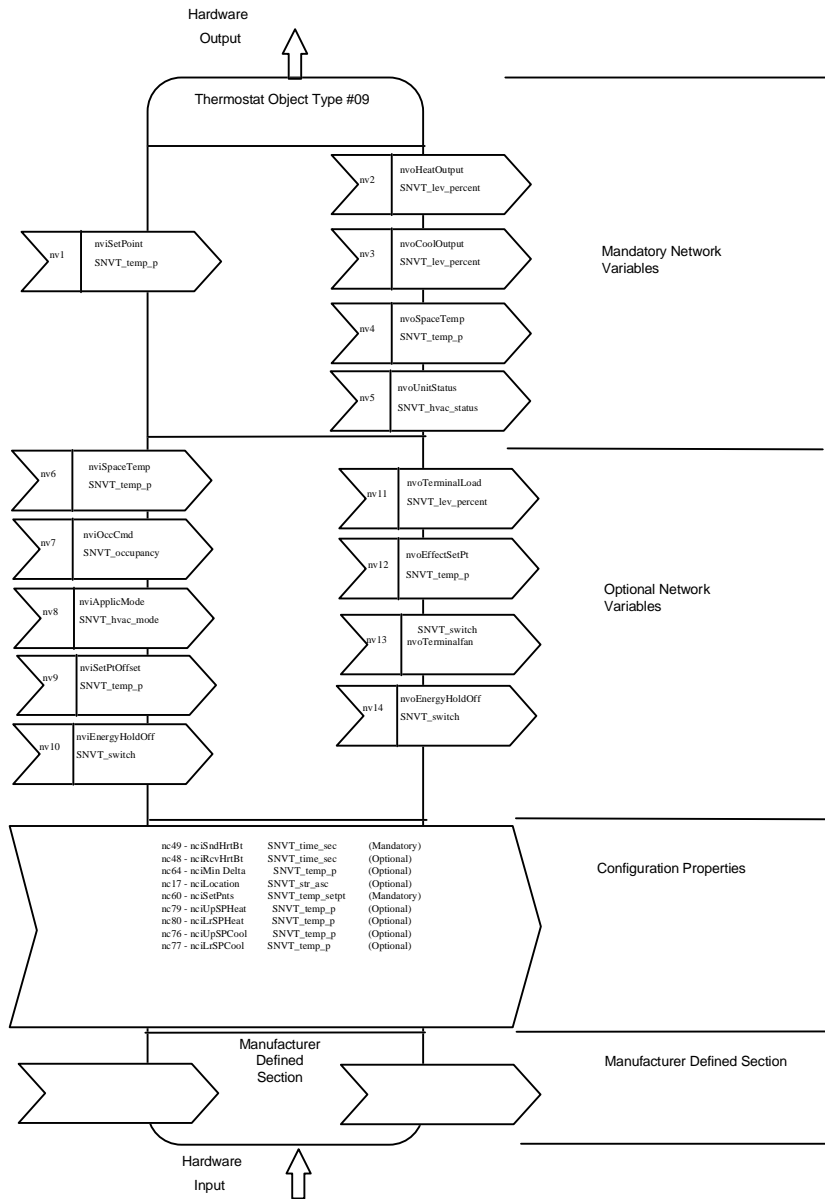


Figure 1.2 Thermostat Object Details

Mandatory Network Variables

Temperature Setpoint Input

```
network input SNVT_temp_p nviSetPoint;
```

This input network variable is used to allow the temperature setpoint for the occupied and standby mode being changed via the network. The individual heat/cool setpoints for occupied and standby mode then derive from `nviSetPoint` minus/plus half the occupancy zero-energy-bands calculated from `nciSetPnts` (`zeb_occ = occupied_cool - occupied_heat`; `zeb_standby = standby_cool - standby_heat`) where the zero-energy-band is defined as the range where neither heating nor cooling is active.

Although this NV input is mandatory to the profile, it does not have to be bound to any setpoint node. If a valid setpoint value is written to `nviSetPoint`, it will be used as the center setpoint. If an invalid setpoint is in `nviSetPoint`, either a locally wired setpoint knob or the appropriate setpoint as configured in `nciSetPnts` will be used.

Valid Range

The valid Range is 10°C to 35°C.

Default Value

Default Value is 0x7FFF (= +327.67°C). This value will be adopted at power-up and remains until an update receives. In this case, the thermostat object will work according the configuration of `nciSetPnts`.

Space Temperature Output

```
network output SNVT_temp_p nvoSpaceTemp;
```

This output network variable is used to send the value of a locally connected space temperature sensor to other nodes. It is mandatory to the profile.

Valid Range

The valid Range is -10°C to 50°C. The value 0x7FFF=+327.67°C will be handled as an invalid value in case of a sensor failure.

When Transmitted

The variable is transmitted immediately when its value has changed by a pre-determined amount. Additionally this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the optional Maximum Send Time configuration `nciSndHrtBt`.

Update Rate

There is no maximum update rate.

Default Service Type

The default service type is unacknowledged.

Heat Control Output

network output SNVT_lev_percent nvoHeatOutput;

This output network variable reflects the current position of the heat actuator and can be used as part of a control loop and for monitoring purposes.

Valid Range

The valid range is 0% to 100%.

When Transmitted

The variable is transmitted immediately when its value has changed by a pre-determined amount. Additionally this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the optional Maximum Send Time configuration `nciSndHrtBt`.

Update Rate

There is no maximum update rate.

Default Service Type

The default service type is unacknowledged.

Cool Control Output

network output SNVT_lev_percent nvoCoolOutput;

This output network variable reflects the current position of the cool actuator and can be used as part of a control loop and for monitoring purposes.

Valid Range

The valid range is 0% to 100%.

When Transmitted

The variable is transmitted immediately when its value has changed by a pre-determined amount. Additionally this network variable will also be transmitted as a heartbeat output on a regular basis as dictated by the optional Maximum Send Time configuration `nciSndHrtBt`.

Update Rate

There is no maximum update rate.

Default Service Type

The default service type is unacknowledged.

Unit Status Output

network output SNVT_hvac_status nvoUnitStatus;

This output network variable is available to report the object status. It combines the operating mode, the capacity of heating and cooling used and an indication if any alarms are present in the object.

Valid Range

Mode: HVAC_HEAT, HVAC_COOL, HVAC_OFF - HVAC_AUTO is not used, other enumerations are optional

heat_output_primary: 0-100%, 0xFFFF (INVALID)

heat_output_secondary: 0xFFFF (INVALID)

cool_output: 0-100%, 0xFFFF (INVALID)

econ_output: 0xFFFF (INVALID)

fan_output: 0-100%, 0xFFFF (INVALID)

in_alarm: 0 Means there is no alarm

Not 0 Means there is an alarm.

A filter alarm will also be indicated using this field.

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 optional Maximum Send Time configuration nciSndHrtBt.

Update Rate

There is no maximum update rate.

Default Service Type

The default service type is unacknowledged.

Optional Network Variables

Space Temperature Input

network input SNVT_temp_p nviSpaceTemp;

This input network variable is used to connect an external space temperature sensor to the node. It is optional to the profile, and it is used when the thermostat device does not have a locally wired space temperature sensor. In any case, the nviSpaceTemp has priority if bound to a sensor node (using the Neuron C function is_bound()).

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 to allow default behavior.

Occupancy Input

```
network input SNVT_occupancy nviOccCmd;
```

This input network variable is used to command the thermostat object into different occupancy modes. It is typically bound to a supervisory node's time program and/or an externally wired wall module with bypass button.

Valid Range

The valid range is described in the table below:

OC_OCCUPIED: The thermostat object should operate in occupied mode as defined by the manufacturer (e.g. occupied setpoint).

OC_UNOCCUPIED: The thermostat object should operate in unoccupied mode as defined by the manufacturer (e.g. unoccupied setpoint).

OC_BYPASS: The thermostat object should operate in temporary occupied mode. This input can be commanded from the supervisory node or from a local button. When the configured bypass time elapses, the Thermostat Device returns to the original occupancy mode (e.g. time program).

OC_STANDBY: The thermostat object should operate in standby mode as defined by the manufacturer (e.g. standby setpoint).

OC_NUL: This is the initial value after power-up and it remains until another value is received. It is used to operate according manufacturer-specific defaults.

Default Value

The default value is OC_NUL = 0xFF.

Application Mode Input

```
network input SNVT_hvac_mode nviApplicMode;
```

This network variable input is used to coordinate the thermostat object with any supervisory controller providing the supply energy, e.g. hot or cold water. It's used as heat/cool changeover.

Valid Range

The valid range is described in the table below:

HVAC_AUTO: The control loop automatically changes between application modes (e.g. HVAC_HEAT and HVAC_COOL) to provide the control objectives. In this case both, heat and cool supply is presumed to be available.

HVAC_HEAT: The control loop is in HVAC_HEAT mode and the thermostat object presumes, heat supply is available.

HVAC_COOL: The control loop is in HVAC_COOL mode and the thermostat object presumes, cool supply is available.

HVAC_OFF: Heating and cooling sources are at closed position.

The other enumeration provided by SNVT_hvac_mode are optional.

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 to allow failure reaction.

Setpoint Offset Input

```
network input SNVT_temp_p nviSetPtOffset;
```

This input network variable is used to shift the temperature setpoint via network by adding `nviSetPtOffset` to the current setpoint. It is typically bound to a supervisory node providing outside air temperature compensation or to an external wall module having a relative setpoint knob. This setpoint shifting operates only on occupied and standby setpoints and does not affect the unoccupied setpoint.

Valid Range

The valid Range is -10°C to +10°C.

Default Value

Default Value is 0°C to disable the setpoint offset. This value will be adopted at power-up and remains until an update receives.

Energy Hold Off Input

```
network input SNVT_switch nviEnergyHoldOff;
```

This input is from a device such as a door/window contact sensor. Moreover it is used if two or more controllers share one physical door/window contact or another device (EnergyHoldOff device) that forces all of them to go to a lower energy consuming operation. If a physical sensor is connected *and* the NV is bound, the NV overrides the physical value, i.e. the network value has precedence over the physical value. See `nvoEnergyHoldOff` for corresponding output NV.

Valid Range

The valid range is the range provided by SNVT_switch:

EnergyHoldOff (stop heating/cooling) is activated for 'state=1 and value ≠ 0%'. 'State=0' or 'state=1 and value=0%' leads to the normal heat/cool control.

Default Value

Default Value is state = FALSE (no Energy Hold Off requested). This value will be adopted at power-up and in case of not receiving an update afterwards.

Effective Setpoint Output

network output SNVT_temp_p nvoEffectSetPt

The output network variable is used to report the effective setpoint temperature when the setpoint is changed through `nciSetPnts`, `nviSetPoint`, `nviSetPtOffset` or by local means.

Valid Range

The valid Range is 10°C to 35°C.

When Transmitted

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

Update Rate

There is no maximum update rate.

Default Service Type

The default service type is unacknowledged.

Terminal Load Output

network output SNVT_lev_percent nvoTerminalLoad;

This output network variable reflects the current heat/cool energy demand of the Thermostat Device which is typically bound to an energy providing node. It is the output of the control algorithm where negative numbers indicate heating load and positive numbers indicate cooling load.

Valid Range

The valid range is -163.84% to +163.84%.

When Transmitted

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

Update Rate

There is no maximum update rate.

Default Service Type

The default service type is unacknowledged.

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Terminal Fan

network output SNVT_switch nvoTerminalFan;

This output network variable reflects the current fan speed of a multi-speed (n-speed) fan. It can be used as part of a control loop and for monitoring purposes.

Valid Range

The valid range is described below:

state = 0 or 1 (OFF or ON)

value = as defined below [n>= m]:

state	value	fan speed
0 (OFF)	0 %	OFF
1 (ON)	(1/n) * 100%	fan speed #1
1 (ON)	(2/n) * 100%	fan speed #2
1 (ON)	(m/n) * 100%	fan speed #m
1 (ON)	100%	fan speed #n

NOTE: Truncation should be used when computing the above values.

When Transmitted

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

Update Rate

There is no maximum update rate.

Default Service Type

The default service type is unacknowledged

Energy Hold Off Output

```
network output SNVT_switch nvoEnergyHoldOff;
```

This output is used to convey to other devices the state of an EnergyHoldOff device that is hardwired to the controller. Refer to EnergyHoldOff Input.

Valid Range

The valid range is the range provided by SNVT_switch as described below:

state	value	Energy Hold Off
0 (OFF)	0 %	no Energy Hold Off
1 (ON)	100 %	Energy Hold Off

Default Value

Default Value is 'state=FALSE and value=0% (no Energy Hold Off requested). This value will be adopted at power-up and in case of not receiving an update afterwards.

When Transmitted

The variable is transmitted immediately when its value has changed significantly or after the send heartbeat time if nonzero and a significant change has not occurred in that time.

Update Rate

There is no maximum update rate.

Default Service Type

The default service type is unacknowledged.

Configuration Properties

Send Heartbeat (Mandatory)

```
network input config SNVT_time_sec nciSndHrtBt;
```

This configuration network variable defines the maximum period of time that expires before the following network variable outputs will automatically being updated:

- nvoHeatOutput,
- nvoCoolOutput,
- nvoEnergyHoldOff
- nvoSpaceTemp
- nvoEffectSetPt
- nvoUnitStatus

Valid Range

The valid range is any value between 0.0 sec and 6,553.4 sec. Setting nciSndHrtBt = 0 disables the automatic update mechanism.

Default Value

0 (no automatic update)

SCPT Reference

SCPTmaxSendTime (#49)

Occupancy Temperature Setpoints (Mandatory)

```
network input config SNVT_temp_setpt nciSetPnts;
```

This configuration property defines the occupancy temperature setpoints for heat and cool mode. The setpoint will have an assigned upper and lower limit for each state defined below within the min. and max. range.

Valid Range and Default Value

	Minimum	Maximum	Default
occupied_cool	10 °C	35 °C	23 °C
standby_cool	10 °C	35 °C	25 °C
unoccupied_cool	10 °C	35 °C	28 °C
occupied_heat	10 °C	35 °C	21 °C
standby_heat	10 °C	35 °C	19 °C
unoccupied_heat	10 °C	35 °C	16 °C

SCPT Reference

SCPTsetPnts (#60)

Receive Heartbeat (Optional)

```
network input config SNVT_time_sec nciRcvHrtBt;
```

This configuration property is used to control the maximum time that elapses after the last update to `nviSpaceTemp` before the Thermostat Device adopts a default value. It is used for:

- `nviSpaceTemp`
- `nviApplicMode`
- `nviSetPtOffset`
- `nviEnergyHoldOff`

Valid Range

The valid range is any value between 0.0 sec and 6,553.4 sec. Setting `nciRcvHrtBt = 0` disables this network variable receive failure detect mechanism.

Default Value

0 (no failure detect)

SCPT Reference

SCPTmaxRcvTime (#48)

Minimum Temperature Delta (Optional)

```
network input config SNVT_temp_p nciMinDelta;
```

This configuration property defines the minimum delta temperature for reporting change of value between output network variable transitions.

Valid Range

The valid range is any value between 0.0°C and 10°C.

Default Value

0

SCPT Reference

SCPTminDeltaTemp(64)

Location Label (Optional)

```
network input config SNVT_str_asc nciLocation;
```

This configuration property can optionally be used to provide more descriptive physical location information than can be provided by the Neuron Chip's 6 byte location string. The location relates to the object and not to the node.

Valid Range

Any NULL terminated ASCII string of 31 bytes total length.

Default Value

The default value is an ASCII string containing all zeros (“\0”).

SCPT Reference

SCPT_location (#17)

Heating Setpoint Upper Limit (Optional)

```
network input config SNVT_temp_p nciUpSPHeat;
```

This configuration property can optionally be used to limit the extent to which the Heating Setpoint can be changed through `nviSetPoint` or `nviSetPointOffset`.

Valid Range

The valid range is any value between 10.0°C and 35.0°C.

Default Value

The default value is 35.0°C.

SCPT Reference

SCPTUprHeatSetpoint(80)

Heating Setpoint Lower Limit (Optional)

```
network input config SNVT_temp_p nciLrSPHeat;
```

This configuration property can optionally be used to limit the extent to which the Heating Setpoint can be changed through `nviSetPoint` or `nviSetPointOffset`.

Valid Range

The valid range is any value between 10.0°C and 35.0°C.

Default Value

The default value is 35.0°C.

SCPT Reference

SCPTLwrHeatSetpoint(79)

Cooling Setpoint Upper Limit (Optional)

```
network input config SNVT_temp_p nciUpSPCool;
```

This configuration property can optionally be used to limit the extent to which the Cooling Setpoint can be changed through `nviSetPoint` or `nviSetPointOffset`.

Valid Range

The valid range is any value between 10.0°C and 35.0°C.

Default Value

The default value is 10.0°C.

SCPT Reference

SCPTUprCoolSetpoint(77)

Cooling Setpoint Lower Limit (Optional)

```
network input config SNVT_temp_p nciLrSPCool;
```

This configuration property can optionally be used to limit the extent to which the Cooling Setpoint can be changed through `nviSetPoint` or `nviSetPointOffset`.

Valid Range

The valid range is any value between 10.0°C and 35.0°C.

Default Value

The default value is 10.0°C.

SCPT Reference

SCPTLwrCoolSetpoint(76)

Data Transfer

None specified.

Power-up State

The Input variables are set to their default values. The output network variables will be set to their initial value, which is 0% for `nvoHeatOutput`, `nvoCoolOutput`, and `nvoTerminalLoad`, OFF for `nvoTerminalFan` and `nvoEnergyHoldOff`, and +327.67°C for `nvoSpaceTemp` to indicate an invalid

value. The fields in nvoUnitStatus will be set to the initial values : mode HVAC_OFF, heat_output_primary 0, heat_output_secondary 0xFFFF, econ_output 0xFFFF, fan_output 0, in_alarm 0

Boundary and Error Conditions

None specified

Additional Considerations

None specified