LONMARK®

Functional Profile:
Refrigerated Display Case Controller Thermostat Object
Overview

This document describes the profile required for a refrigerated display case controller thermostat object, used on a central or local plant system. In general this object will be used along side other refrigerated display case objects, either on the same node or on external nodes in order to provide a complete control solution. The thermostat object makes use of the node object for alarm reporting and for day of week information. When using the thermostat object it is mandatory to use the nvoAlarm and nviTimeSet network variables of the node object.

Example Usage

The thermostat resides in a LONMARK device and communicates across a LONWORKS network interacting with one or more of the following LONMARK objects:

- Evaporator control object.
- Defrost control object.
- Rail heat control object.
- Fan control object.
- Schedule control object.
- Temperature sensor object.

These objects may all reside in the same node or may be distributed. In slave case applications there may be many instances of the objects listed above.
Thermostat Controller Object

The Thermostat object can be used in controllers where thermostat operation is required. All temperatures are of type SNVT_temp_p this gives good resolution over an appropriate temperature range without the need to use floating point or 32 bit arithmetic.

The configuration variables are shown as network variables in the examples. These could be implemented in any form & access made via file transfer or direct memory read / write.

Figure 2 Thermostat Object Functional Profile
Table 1 SNVT and SCPT details

<table>
<thead>
<tr>
<th>NV # (M/O)</th>
<th>Name</th>
<th>In/Out</th>
<th>SNVT Type (SNVT Index)</th>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (M)</td>
<td>nvoTemperature</td>
<td>Out</td>
<td>SNVT_temp_p (105)</td>
<td>I/O</td>
<td>Processed control temperature</td>
</tr>
<tr>
<td>2 (M)</td>
<td>nviThermostatState</td>
<td>In</td>
<td>SNVT_state (83)</td>
<td>I/O</td>
<td>Operating state of the thermostat</td>
</tr>
<tr>
<td>3 (O)</td>
<td>nviAirTemp1</td>
<td>In</td>
<td>SNVT_temp_p (105)</td>
<td>I/O</td>
<td>Monitored temperature</td>
</tr>
<tr>
<td>4 (O)</td>
<td>nviDayNight</td>
<td>In</td>
<td>SNVT_temp_p (105)</td>
<td>I/O</td>
<td>External day / night indicator</td>
</tr>
<tr>
<td>5 (O)</td>
<td>nvoCutoutTemp</td>
<td>Out</td>
<td>SNVT_temp_p (105)</td>
<td>I/O</td>
<td>Current cut out value</td>
</tr>
<tr>
<td>6 (O)</td>
<td>nviAirTemperature2</td>
<td>Out</td>
<td>SNVT_temp_p (105)</td>
<td>I/O</td>
<td>Monitored temperature</td>
</tr>
<tr>
<td>7 (O)</td>
<td>nvoDifference</td>
<td>Out</td>
<td>SNVT_temp_p (105)</td>
<td>I/O</td>
<td>Current difference value</td>
</tr>
<tr>
<td>8 (O)</td>
<td>nviDefrostState</td>
<td>In</td>
<td>SNVT_defr_state (122)</td>
<td>I/O</td>
<td>Defrost object state</td>
</tr>
<tr>
<td>9 (O)</td>
<td>nvoAlarmAirTemp</td>
<td>Out</td>
<td>SNVT_temp_p (105)</td>
<td>I/O</td>
<td>Current alarm air value</td>
</tr>
<tr>
<td>10 (O)</td>
<td>nvoDischargeTemp</td>
<td>Out</td>
<td>SNVT_temp_p (105)</td>
<td>I/O</td>
<td>Air discharge (air off coil)</td>
</tr>
<tr>
<td>11 (O)</td>
<td>nvoReturnTemp</td>
<td>Out</td>
<td>SNVT_temp_p (105)</td>
<td>I/O</td>
<td>Air return (air on coil)</td>
</tr>
<tr>
<td>12 (O)</td>
<td>nvoActuatorValve</td>
<td>Out</td>
<td>SNVT_lev_disc (22)</td>
<td>I/O</td>
<td>Refrigerant valve output</td>
</tr>
<tr>
<td>17 (O)</td>
<td>Location label</td>
<td>-</td>
<td>SNVT_str_asc (36)</td>
<td>config</td>
<td>Location text</td>
</tr>
<tr>
<td>49 (M)</td>
<td>Max send time</td>
<td>-</td>
<td>SNVT_time_sec (107)</td>
<td>config</td>
<td>Max time before updating outputs</td>
</tr>
<tr>
<td>120 (O)</td>
<td>Thermostat mode</td>
<td>-</td>
<td>SNVT_therm_mode (119)</td>
<td>config</td>
<td>Mode of operation</td>
</tr>
<tr>
<td>125 (O)</td>
<td>Cut out value</td>
<td>-</td>
<td>SNVT_temp_p (105)</td>
<td>config</td>
<td>Cut out threshold</td>
</tr>
<tr>
<td>130 (O)</td>
<td>Difference value</td>
<td>-</td>
<td>SNVT_temp_p (105)</td>
<td>config</td>
<td>Difference between cut in &amp; cut out</td>
</tr>
<tr>
<td>122 (O)</td>
<td>Difference night</td>
<td>-</td>
<td>SNVT_temp_p (105)</td>
<td>config</td>
<td>Diff between cut in &amp; out for night</td>
</tr>
<tr>
<td>121 (O)</td>
<td>Day night control</td>
<td>-</td>
<td>SNVT_lev_disc (22)</td>
<td>config</td>
<td>Use night &amp; day control</td>
</tr>
<tr>
<td>126 (O)</td>
<td>Air temp1 % day</td>
<td>-</td>
<td>SNVT_lev_percent (81)</td>
<td>config</td>
<td>Percent of air 1 &amp; 2 for day control</td>
</tr>
<tr>
<td>131 (O)</td>
<td>Air temp1 % night</td>
<td>-</td>
<td>SNVT_lev_percent (81)</td>
<td>config</td>
<td>Percent of air 1 &amp; 2 for night control</td>
</tr>
<tr>
<td>132 (O)</td>
<td>Air temp1 % alarm</td>
<td>-</td>
<td>SNVT_lev_percent (81)</td>
<td>config</td>
<td>Percent of air 1 &amp; 2 for alarm</td>
</tr>
<tr>
<td>134 (O)</td>
<td>Delta night</td>
<td>-</td>
<td>SNVT_temp_p (105)</td>
<td>config</td>
<td>Offset for night control</td>
</tr>
<tr>
<td>123 (O)</td>
<td>High limit temperature</td>
<td>-</td>
<td>SNVT_temp_p (105)</td>
<td>config</td>
<td>High temperature limit</td>
</tr>
<tr>
<td>128 (O)</td>
<td>Low limit temperature</td>
<td>-</td>
<td>SNVT_temp_p (105)</td>
<td>config</td>
<td>Low temperature limit</td>
</tr>
<tr>
<td>124 (O)</td>
<td>High limit delay</td>
<td>-</td>
<td>SNVT_time_sec (107)</td>
<td>config</td>
<td>High temperature limit delay</td>
</tr>
<tr>
<td>133 (O)</td>
<td>High limit defrost delay</td>
<td>-</td>
<td>SNVT_time_sec (107)</td>
<td>config</td>
<td>High temperature limit delay defrost</td>
</tr>
<tr>
<td>129 (O)</td>
<td>Low limit delay</td>
<td>-</td>
<td>SNVT_time_sec (107)</td>
<td>config</td>
<td>Low temperature limit delay</td>
</tr>
</tbody>
</table>

1 M - Mandatory, O - Optional
Mandatory Network Variables

Calculated Air Temperature

network output SNVT_temp_p nvoAirTemp;

The nvoAirTemp is the calculated case air temperature. An error on the sensor is indicated with the error value for SNVT_temp_p (0x7fff).

Valid Range
The valid range is -100°C to +150°C

Default Value
The default value is manufacturer specific.

Thermostat State

network output SNVT_state nvoThermostatState;

The nvoThermostatState indicates the current state of the Thermostat Object. There are currently three different control methods supported by the Thermostat Object:

<table>
<thead>
<tr>
<th>Control Method</th>
<th>Bit No. 0</th>
<th>Bit No. 1</th>
<th>Bit No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Thermostat</td>
<td>Off</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cut In/Out control</td>
<td>On</td>
<td>Cooling</td>
<td>Disabled</td>
</tr>
<tr>
<td>Modulating control</td>
<td>On</td>
<td>Cooling</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

Valid Range

<table>
<thead>
<tr>
<th>Bit No.</th>
<th>Min</th>
<th>Max</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Off</td>
<td>On</td>
<td>Thermostat control on/off</td>
</tr>
<tr>
<td>1</td>
<td>False</td>
<td>True</td>
<td>Cooling required</td>
</tr>
<tr>
<td>2</td>
<td>Disabled</td>
<td>Enabled</td>
<td>Modulating Thermostat</td>
</tr>
<tr>
<td>3</td>
<td>False</td>
<td>True</td>
<td>Night Setback mode</td>
</tr>
<tr>
<td>8 – 15</td>
<td></td>
<td></td>
<td>Manufacturer specific items</td>
</tr>
</tbody>
</table>

Default Value
Bit 0 = Off.

Optional Network Variables

Measured Air Temperature 1

network input SNVT_temp_p nviAirTemp1;
The nviAirTemp1 is to be assigned to discharge or return air as required. An error on the sensor is indicated with the error value for SNVT_temp_p (0x7fff).

**Valid Range**
The valid range is -100°C to +150°C

**Default Value**
The default value is 0

---

**Day Night Indication**

```plaintext
network input SNVT_lev_disc nviDayNight;
```

The thermostat object can be configured to use this network variable as a day/night indicator. ST_OFF indicates day and ST_ON indicates night.

**Valid Range**
The valid range is ST_OFF (0) or ST_ON (4). A value other than ST_OFF is interpreted as ST_ON.

**Default Value**
The default value is ST_OFF.

---

**Measured Air Temperature 2**

```plaintext
network input SNVT_temp_p nviAirTemp2;
```

The nviAirTemp2 is to be assigned to discharge or return air as required. An error on the sensor is indicated with a value outside the valid range.

**Valid Range**
The valid range is -100°C to +150°C

**Default Value**
The default value is 0

---

**Cut out Temperature**

```plaintext
network output SNVT_temp_p nvoCutoutTemp;
```

The nvoCutoutTemp indicates the current cut out limit used by the thermostat object in its algorithms.
**Valid Range**
The valid range is manufacturer specific.

**Default Value**
The default value is manufacturer specific.

---

**Difference Temperature**

```c
network output SNVT_temp_p nvoDifference;
```

The `nvoDifference` indicates the value to be added to the `nviCutoutTemp` to get the thermostat cut in limit if cut in / out control is selected. If modulating thermostat control is selected, the target temperature is the cut out limit + `nvoDifference` / 2.

**Valid Range**
The valid range is manufacturer specific.

**Default Value**
The default value is manufacturer specific.

---

**Defrost State**

```c
network output SNVT_defr_state nvoDefrostState;
```

The `nvoDefrostState` indicates the current state of the defrost object.

**Valid Range**

0  DF_STANDBY  
1  DF_PUMPDOWN  
2  DF_DEFROST  
3  DF_DRAINDOWN  
4  DF_INJECT_DLY  

**Default Value**

0  DF_STANDBY  

---

**Alarm Air Temperature**

```c
network output SNVT_temp_p nvoAlarmAirTemp;
```

The `nvoAlarmAirTemp` indicates the current air temperature used by the alarm section of the thermostat object.

**Valid Range**
The valid range is -100°C to +150°C.
Default Value
The default value is 0

Discharge Air Temperature

network output SNVT_temp_p nvoDischargeTemp;
The nvoDischargeTemp indicates the current evaporator discharge air temperature used by the thermostat object.

Valid Range
The valid range is -100°C to +150°C

Default Value
The default value is 0

Return Air Temperature

network output SNVT_temp_p nvoReturnTemp;
The nvoReturnTemp indicates the current evaporator return air temperature used by the thermostat object.

Valid Range
The valid range is -100°C to +150°C

Default Value
The default value is 0

Actuator Valve

network output SNVT_lev_disc nvoActuatorValve;
This output can be used to drive a refrigeration valve or compressor.

Valid Range
The valid range is ST_ON - ST_OFF. Any value other than ST_ON should be regarded as ST_OFF.

Default Value
The default value is ST_OFF.
Configuration Properties

**Location Label**

```
network input config SNVT_str_asc nciLocationLabel;
```

The Location Label can be used as a descriptive physical location description.

**Valid Range**

Any NULL terminated ASCII string.

**Default Value**

The default value is an ASCII string containing all zeroes.

**SCPT Reference**

SCPT_location #17

---

**Max Send Time**

```
network input config SNVT_time_sec nciMaxSendTime;
```

Indicates the maximum period of time that expires before the Thermostat object automatically updates its output network variables. A setting of 0 (zero) will force the thermostat object to only update its output variables when a change occurs.

**Valid Range**

That of SNVT.

**Default Value**

10 seconds.

**SCPT Reference**

SCPT_maxSendTime #49

---

**Thermostat Mode**

```
network input config SNVT_therm_mode nciThermostatMode;
```

The `nciThermostatMode` indicates the control strategy.

**Valid Range**

0  THERM_NO_CONTROL  Thermostat disabled.
1  THERM_IN_OUT      Cut in / out control.
2  THERM_MODULATING  Modulating control.
**Default Value**
0  THERM_NO_CONTROL.

**SCPT Reference**
SCPTthermMode #120

---

**Cut out Value**

```c
network input config SNVT_temp_p nciCutoutValue;
```

The `nciCutoutValue` indicates the cut out limit to be used for control purposes. If day night control is selected this value is used during day control.

**Valid Range**
The valid range is manufacturer specific.

**Default Value**
The default value is manufacturer specific.

**SCPT Reference**
SCPTcutOutValue #125

---

**Difference Value**

```c
network input config SNVT_temp_p nciDifferenceValue;
```

The `nciDifferenceValue` indicates the value to be added to the `nciCutoutTemp` to get the cut in limit if cut in/out control is selected. If modulating thermostat control is selected, the target temperature is the `nciCutoutLimit` + `nciDifferenceValue` / 2.

**Valid Range**
The valid range is manufacturer specific.

**Default Value**
The default value is manufacturer specific.

**SCPT Reference**
SCPTdiffValue #130

---

**Day Night Control**

```c
network input config SNVT_state nciDayNightControl;
```

The `nciDayNightControl` configures the day/night function.
Valid Range

<table>
<thead>
<tr>
<th>Bit 3</th>
<th>Bit 2</th>
<th>Bit 1</th>
<th>Bit 0</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Night setback is not required</td>
</tr>
<tr>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>On</td>
<td>Change between day &amp; night operation according to nviDayNight.</td>
</tr>
<tr>
<td>Off</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
<td>Change between day &amp; night operation according to interval time clock.</td>
</tr>
</tbody>
</table>

Bits 8 - 15 can be used for manufacture specific items.

Default Value

Bit 0 - Bit 2 = Off, Night setback not required - always day control.

SCPT Reference

SCPTdayNightCntrl #121

Air Temperature 1 - Percent Day

network input config SNVT_lev_percent nciAirTemp1PercentDay;

The nciAirTemp1PercentDay indicates the air temperature weighting to be used during Day control. The nviAirTemp2 portion is automatically calculated.

For example:

nviAirTemp1 measures - 25°C and nviAirTemp2 measures - 20°C. Required as a regulation parameter is a weighted average consisting of 60% nviAirTemp1 and the rest from nviAirTemp2 (only the nviAirTemp1 share is programmed). This gives a regulating value of

\[(0.6 \times -25°C) + (0.4 \times -20°C) = -23°C\]

Valid Range

The valid range is 0 - 100%.

Default Value

The default value is 100%, i.e. no nviAirTemp2 input required for day operation.

SCPT Reference

SCPTairTemp1Day #126

Air Temperature 1 - Percent Night

network input config SNVT_lev_percent nciAirTemp1PercentNight;

The nciAirTemp1PercentNight indicates the air temperature weighting to be used during Day control. The nviAirTemp2 portion is automatically calculated.

For example:

nviAirTemp1 measures - 25°C and nviAirTemp2 measures - 20°C. Required as a
The regulation parameter is a weighted average consisting of 60% nviAirTemp1 and the rest from nviAirTemp2 (only the nviAirTemp1 share is programmed). This gives a regulating value of

\[(0.6 \times -25^\circ C) + (0.4 \times -20^\circ C) = -23^\circ C\]

**Valid Range**
The valid range is 0 - 100%.

**Default Value**
The default value is 100%, i.e. no nviAirTemp2 input required for night operation.

**SCPT Reference**
SCPTairTemp1Night #131

---

**Delta Night**

network input config SNVT_temp_p nciDeltaNight;

The nciDeltaNight indicates the value to be added to the nciCutoutValue to get the cut out limit to be used during night control.

**Valid Range**
The valid range is manufacturer specific.

**Default Value**
The default value is manufacturer specific.

**SCPT Reference**
SCPTdeltaNight #134

---

**Difference Night**

network input config SNVT_temp_p nciDifferenceNight;

The nciDifferenceNight indicates the value to be added to the nciCutoutValue to get the cut in limit if cut in/out control is selected. If modulating thermostat control is selected, the target temperature is the nciCutout limit + nciDifferenceNight \(\div 2\).

**Valid Range**
The valid range is manufacturer specific.

**Default Value**
The default value is manufacturer specific.
**SCPT Reference**

SCPTdiffNight #122

---

**Air Temperature 1 Percent Alarm**

```
network input config SNVT_lev_percent nciAirTemp1PercentAlarm;
```

The `nciAirTemp1PercentAlarm` indicates the weighting of the `nviAirTemp1` sensor when calculating the `nviAlarmAirTemp`. The `nviAirTemp2` portion is automatically calculated.

**Valid Range**
The valid range is 0 - 100%.

**Default Value**
The default value is 100%, i.e. the `nviAirTemp2` sensor is not used in calculating the `nviAlarmAirTemp`.

**SCPT Reference**

SCPTairTemp1Alrm #132

---

**High Limit Temperature**

```
network input config SNVT_temp_p nciHighLimitTemp;
```

The `nciHighLimitTemp` is the high alarm set point for the `nvoAlarmAirTemp`. When there is night setback operation, the alarm limit is raised by the `nciDeltaNight` value.

**Valid Range**
The valid range is manufacturer specific.

**Default Value**
The default value is manufacturer specific.

**SCPT Reference**

SCPThighLimTemp #123

---

**Low Limit Temperature**

```
network input config SNVT_temp_p nciLowLimitTemp;
```

The `nciLowLimitTemp` is the low alarm set point for the `nvoAlarmAirTemp`.

**Valid Range**
The valid range is manufacturer specific.
**Default Value**
The default value is manufacturer specific.

**SCPT Reference**
SCPTlowLimTemp #128

---

**High Limit Defrost Delay**

```
network input config SNVT_time_sec nciHighLimitPdDly;
```

The `nciHighLimitPdDly` is the time limit before high `nvoAlarmAirTemp` alarm during pull-down. This value will apply until the actual `nvoAlarmAirTemp` has dropped below the `nciHighLimitTemp`. Thereafter shift to `nciHighLimitDelay2`.

**Valid Range**
The valid range for all fields is any value within the defined limits of `SNVT_time_sec`.

**Default Value**
The default value is manufacturer specific.

**SCPT Reference**
SCPTHighLimDefrDly #133

---

**High Limit Delay**

```
network input config SNVT_time_sec nciHighLimitDelay;
```

The `nciHighLimitDelay` is the time limit before high `nvoAlarmAirTemp` alarm during normal operation.

**Valid Range**
The valid range for all fields is any value within the defined limits of `SNVT_time_sec`.

**Default Value**
The default value is manufacturer specific.

**SCPT Reference**
SCPTHighLimDly #124

---

**Low Limit Delay**

```
network input config SNVT_time_sec nciLowLimitDelay;
```

The `nciLowLimitDelay` is the time delay before low `nvoAlarmAirTemp` alarm.
Valid Range
The valid range for all fields is any value within the defined limits of SNVT_time_sec.

Default Value
The default value is manufacturer specific.

SCPT Reference
SCPTLowLimDly #129

Data Transfer
The configuration variables are shown as network variables in the examples. These could be implemented in any form & access made via file transfer or direct memory read / write.

The type of data transfer supported can be found by looking at the node object network variables. If nvoFileDirectory is present then direct memory read / write is supported. If nviFileReq & nviFileStat are present then file transfer is supported. Otherwise look for configuration network variables.

Power-up State
The defrost object should power up in a benign state with network inputs set to default values. Network outputs should be updated to their default values & transmitted onto the network.

Boundary and Error Conditions
None specified.

Additional Considerations
None specified.