LONMARK®
Functional Profile:
Heat Pump with Temperature Control

LonMark Functional Profile   2

Overview

Heat Pump with Temperature Control

This the heat pump with temperature control object provides the control of a heat pump unit. This object compares room temperature with heating and cooling setpoints. The results of the comparison will energize the unit fan, compressor(s) and reversing valve(s) as needed.
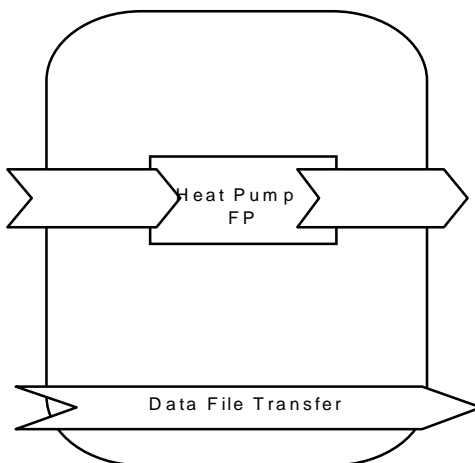

Figure 1.1 Functional Profile

Example Usage

The Heat Pump object 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)
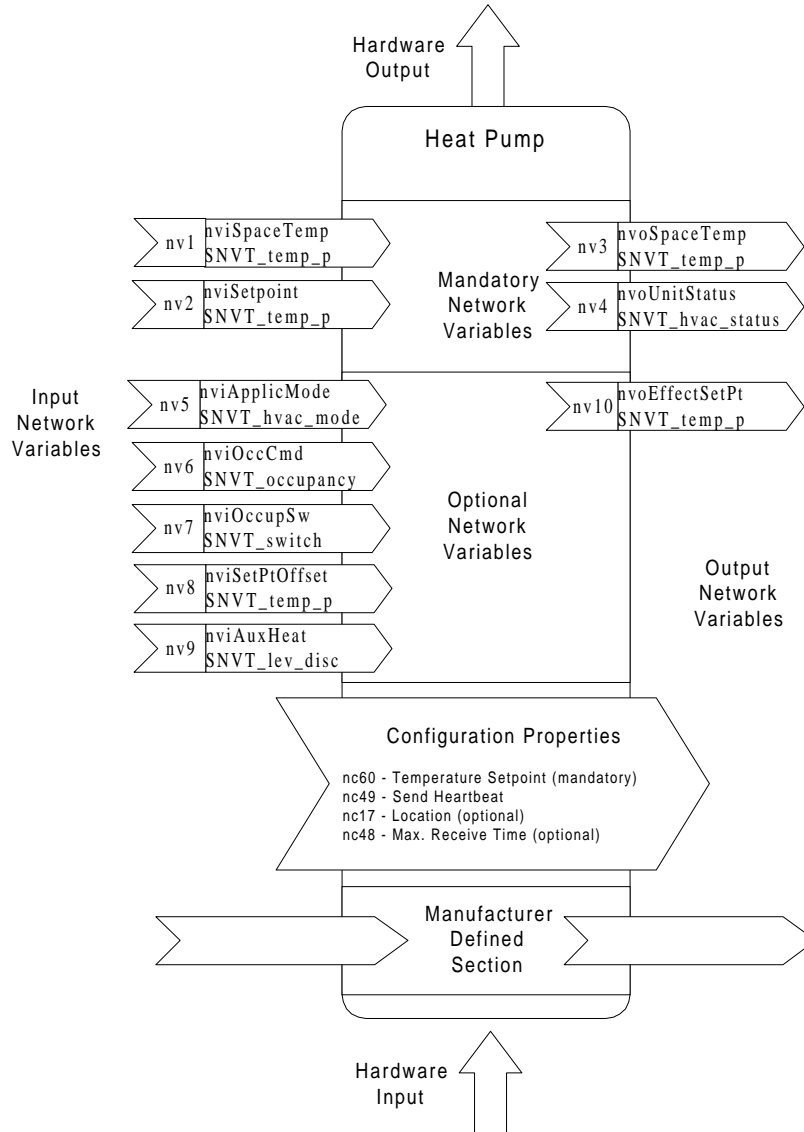· occupancy switch
· monitoring node

Object Details

Hardware
Output

Heat Pump

| nv1 | nviSpaceTemp SNVT_temp_p |
| nv2 | nviSetpoint SNVT_temp_p |

Mandatory
Network
Variables

| nv3 | nvoSpaceTemp SNVT_temp_p |
| nv4 | nvoUnitStatus SNVT_hvac_status |

Input
Network
Variables

nv5	nviApplicMode SNVT_hvac_mode
nv6	nviOccCmd SNVT_occupancy
nv7	nviOccupSw SNVT_switch
nv8	nviSetPtOffset SNVT_temp_p
nv9	nviAuxHeat SNVT_lev_disc

Optional
Network
Variables

| nv10 | nvoEffectSetPt SNVT_temp_p |

Output
Network
Variables

Configuration Properties

nc60 - Temperature Setpoint (mandatory)
nc49 - Send Heartbeat
nc17 - Location (optional)
nc48 - Max. Receive Time (optional)

Manufacturer
Defined
Section

Hardware
Input

Figure 1.2 Heat Pump with Temperature Control Object Details

Table 1.1 Heat Pump with Temperature Control Object Details

SNVT #	Name	In/Out	Class	Type	Description
1	nviSpaceTemp	In	ram	SNVT_temp_p	Remote Space Temperature
2	nviSetpoint	In	ram	SNVT_temp_p	Setpoint from Network
3	nvoSpaceTemp	Out	ram	SNVT_temp_p	Space Temp Value Used
4	nvoUnitStatus	Out	ram	SNVT_hvac_status	Current Status of Unit
5	nviApplicMode	In	ram	SNVT_hvac_mode	Command from System
6	nviOccCmd	In	ram	SNVT_occupancy	HVAC Occupancy Status
7	nviOccupSw	In	ram	SNVT_switch	Simple Occupancy Status
8	nviSetPtOffset	In	ram	SNVT_temp_p	Setpoint Offset
9	nviAuxHeat	In	ram	SNVT_switch	Auxilliary Heat Enable
10	nvoEffectSetPt	Out	ram	SNVT_temp_p	Setpoint Value Used

Mandatory 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 mandatory to the profile, but it does not have to be bound to a sensor node. The Heat Pump device can have a locally wired space temperature sensor. In either case, valid values of nviSpaceTemp have priority over local sensor values.

Valid Range

-327.68 to 327.66°C (0.01°C)

A value of 32767 (0x7fff) indicates an invalid value.

Default Value

The Default Value is the invalid value of 0x7FFF which equates to+327.67°C. This value will be adopted at power-up and remains in effect until an update is received. This value will also be adopted if a bound input does not receive an update within the optional Receive Heartbeat, nciRcvHrtBt. This value may also be sent by a sensor to indicate the sensor is present but it is not working correctly.

Temperature Setpoint Input

```
network input SNVT_temp_p nviSetPoint;
```

This input network variable is used to allow the temperature setpoint for the occupied mode to be changed via the network. The individual internal heat/cool setpoints for occupied are then calculated using this network input and the setpoint configuration properties using the following formulas:

```
occupied heat = nviSetPoint - (occupied cool config - occupied heat config) / 2
```

```
occupied cool = nviSetPoint+(occupied cool config - occupied heat config) / 2
```

Although this network variable 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 written to `nviSetPoint`, either a locally wired setpoint knob or the appropriate setpoint as configured in `nciSetPnts` will be used.

The internal setpoints are also affected by the Setpoint Offset Input, `nviSetPtOffset`, if present and valid.

The unoccupied setpoints are not affected by this input.

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

The Default Value is the invalid value of 0x7FFF which equates to+327.67°C. This value will be adopted at power-up and remains in effect until an update is received. This value will also be adopted if a bound input does not receive an update within the optional Receive Heartbeat, `nciRcvHrtBt`.

Space Temperature Output

```
network input SNVT_temp_p nvoSpaceTemp;
```

This output network variable is used to send the value of the controlled space temperature (either from a locally connected space temperature sensor or from the `nviSpaceTemp` input) to other nodes. It is mandatory to the profile.

Valid Range

-327.68 to 327.66°C (0.01°C)

A value of 32767 (0x7fff) indicates an invalid value.

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`.

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_FANONLY.
	HVAC_AUTO is not used, other enumerations are optional
heat_output_primary:	0-100%, 0xFFFF (INVALID).
heat_output_secondary:	0-100%, 0xFFFF (INVALID)
cool_output:	0-100%, 0xFFFF (INVALID).
econ_output:	0-100%, 0xFFFF (INVALID). The economizer output field will be zero if it doesn't apply to a particular unit.
fan_output:	0-100%, 0xFFFF (INVALID). For fans that have only an on/off state, the capacity values will be either 0.0 or 100.0% respectively.

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`.

Default Service Type

The default service type is unacknowledged.

Optional Network Variables

Application Mode Input

`network input SNVT_hvac_mode nviApplicMode;`

This network variable input is used to coordinate the Heat Pump with any supervisory controller or intelligent human interface device.

This network variable is required for Water Source Heat Pumps that do not have another way of detecting waterflow to the unit. This network variable is used to lock out compressor operation when a supervisory controller determines that water is not being provided to the unit. In this case, the HVAC_FANONLY state is necessary to provide ventilation to the space and disable compressor operation at the same time.

Valid Range

HVAC_AUTO:	The control loop automatically changes between application modes (e.g. HEAT and COOL) to provide the control objectives. Both Heating and Cooling are enabled .
HVAC_HEAT:	Heating is enabled and Cooling is disabled.
HVAC_COOL:	Cooling is enabled and Heating is disabled.
HVAC_FANONLY	Both Heating and Cooling are disabled. This disables compressor operation. Fan Operation is enabled.
HVAC_OFF:	The control loop is off and all outputs are off position.

The other enumerations provided by SNVT_hvac_mode are optional.

Default Value

The default value is HVAC_AUTO. This value will be adopted at power-up and remains in effect until an update is received. This value will also be adopted if a bound input does not receive an update within the optional Receive Heartbeat, `nciRcvHrtBt`.

HVAC Occupancy Input

`network input SNVT_occupancy nviOccCmd;`

This input network variable is used to place the heat pump into different occupancy modes. It is typically set by a supervisory node

Valid Range

The valid range is described in the table below:

OC_OCCUPIED:	The Heat Pump object should operate in occupied mode as defined by the manufacturer and use the occupied setpoint.
OC_UNOCCUPIED:	The Heat Pump object should operate in unoccupied mode as defined by the manufacturer and use the unoccupied setpoint.

OC_BYPASS:	The Heat Pump object should operate in temporary occupied mode. This input can be commanded from the supervisory node. When the configured bypass time elapses, the Heat Pump returns to the original occupancy mode.
OC_STANDBY:	The Heat Pump object should operate in standby mode as defined by the manufacturer and use the standby setpoint.
OC_NUL:	If this network variable is not present or it is set to this value or to an invalid value, the simple occupancy status (`nviOccupSw`) value will be used to determine if the unit should be in the occupied or unoccupied state.
	If the simple occupancy status variable is also invalid or not present, the unit will operate according manufacturer-specific defaults.

Default Value

The default value is `OC_NUL = 0xFF`. This value will be adopted at power-up and remains in effect until an update is received. This value will also be adopted if a bound input does not receive an update within the optional Receive Heartbeat, `nciRcvHrtBt`.

Simple Occupancy Input

```
network input SNVT_switch nviOccupSw;
```

This input network variable provides an indication of the simple two-state occupancy status of the unit, which is either unoccupied or occupied. A state field value of zero (0) means unoccupied, and a state field value of one (1) means occupied. This input will be used to indicate occupancy whenever the HVAC Occupancy Input (`nviOccCmd`) is not present, invalid, or set to OC_NUL

The HVAC Occupancy Input (`nviOccCmd`) takes precedence over this input if the values of both inputs are valid and there is a conflict between the two inputs.

The unit will operate according manufacturer-specific defaults if this input is invalid, and the HVAC Occupancy Input (`nviOccCmd`) is not present, invalid, or set to OC_NUL.

Valid Range

State field: 0 = unoccupied, 1 = occupied, 0xff = invalid

Value field: Not used

Default Value

The default value is `0xFF`. This value will be adopted at power-up and remains in effect until an update is received. This value will also be adopted if a bound input does not receive an update within the optional Receive Heartbeat, `nciRcvHrtBt`.

Setpoint Offset Input

```
network input SNVT_temp_p nviSetPtOffset;
```

This input network variable specifies the direction and magnitude of the shift of the current occupied setpoints.

If the setpoint adjust amount is negative, the current occupied heating and cooling setpoints will be shifted down by the adjustment amount. If the setpoint adjust amount is positive, the current occupied heating and cooling setpoints will be shifted up by the adjustment amount. The unoccupied setpoints are not affected.

Valid Range

-10.00 .. 10.00°C (0.01°C)

Default Value

The default value is `0.00°C`. This value will be adopted at power-up and remains in effect until an update is received. This value will also be adopted if a bound input does not receive an update within the optional Receive Heartbeat, `nciRcvHrtBt`.

Auxilliary Heat

```
network input SNVT_switch nviAuxHeat;
```

This input network variable indicates whether auxilliary heat has been enabled or disabled. If auxilliary heat is enabled, it is allowed in the heating mode. . This command does not force the unit into heating.

Valid Range

Level Value	Command Meaning
0 (OFF)	Disabled
1 (ON)	Enabled

Value field: Not used

Default Value

The default value is ON. This value will be adopted at power-up and remains in effect until an update is received. This value will also be adopted if a bound input does not receive an update within the optional Receive Heartbeat, `nciRcvHrtBt`. Setting this value to ON ensures that if an auxilliary heat enable command is not provided, the unit will be will be able use an auxilliary source of heat if it exists.

Effective Setpoint

```
network output SNVT_temp_p nvoEffectSetPt;
```

This input network variable provides an indication of the setpoint being used
for control.

Valid Range
The valid Range is 10°C to 35°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 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`.

Default Service Type

The default service type is unacknowledged.

Configuration Properties

Temperature Setpoints (Mandatory)

```
network input config SNVT_temp_setpt nciTempSetpts;
```

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)

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:

· nvoSpaceTemp,
· nvoUnitStatus,
· nvoEffectSetPt

Valid Range

The valid range is any value between 0.0 sec and 600 sec. Setting nciSndHrtBt = 0 disables the automatic update mechanism.

Default Value

0 (no automatic update)

SCPT Reference

SCPTMaxSendTime(49)

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)

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 a bound network input before the Heat Pump object adopts a default value for the following:

· nviSpaceTemp,
· nviSetpoint,
· nviApplicMode,
· nviOccCmd,
· nviOccupSw,
· nviSetPtOffset,
· nviAuxHeat.

Valid Range
The valid range is any value between 0.0 sec and 600 sec. Setting `nciRcvHrtBt = 0` disables this network variable receive failure detect mechanism.

Default Value
0 (no failure detect)

SCPT Reference
SCPTMaxRcvTime(48)

Data Transfer
None specified.

Power-up State

Upon power-up the input variables are set to their default values. The output network variables will be set to their initial value as follows:

nvoSpaceTemp:	INVALID
nvoEffectSetPt:	0

The fields in `nvoUnitStatus` will be set to the initial values :

mode:	HVAC_OFF
heat_output_primary:	0
heat_output_secondary:	0
econ_output:	0
fan_output:	0
in_alarm:	0

Boundary and Error Conditions
None specified.

Additional Considerations
None specified.