Version 1.0
Refrgerated Display Case Controller
Evaporator Object: 10011

LONMARK®
Functional Profile:
Refrigerated Display Case Controller
Evaporator Control Object

Overview

This document describes the profile required for a refrigerated display case controller evaporator control object, used on a central or local plant system. This profile supports the standard node object and data file transfer capability. In general this object will be used with other refrigerated display case controller objects either on the same node, or on external nodes in order to provide a complete control solution.

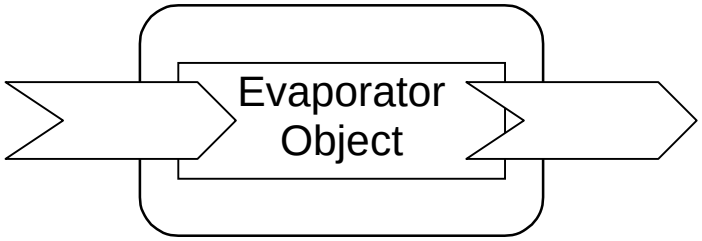

Figure 1 Evaporator Object Functional Profile

Example Usage

The evaporator object is used in a LONMARK device interacting with one or more of the following refrigerated display case controller objects residing on other LONMARK devices:

- Defrost control object.
- Thermostat 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 applications there may be many instances of the objects listed above.

Evaporator Controller Object

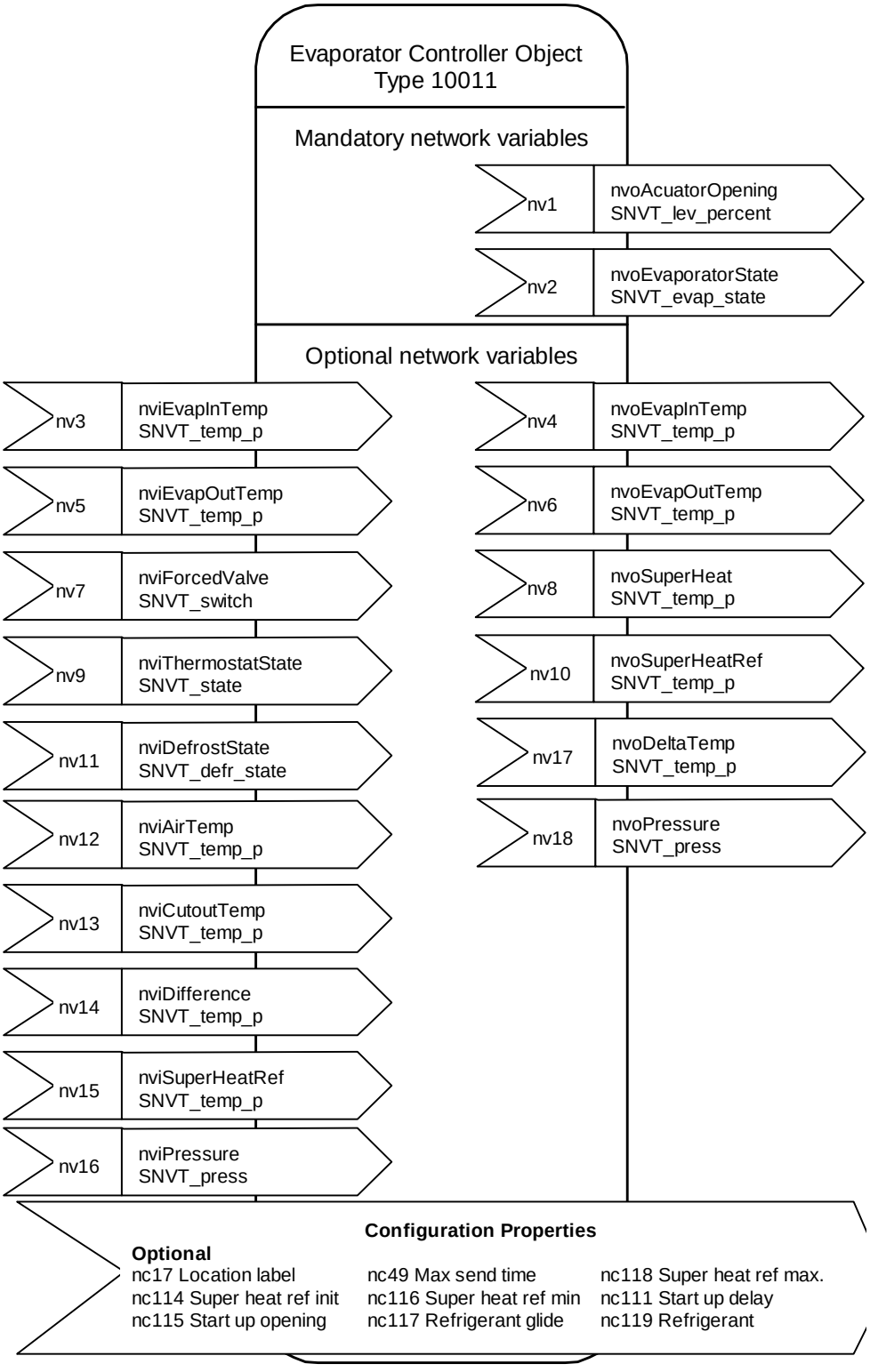

Figure 1 Evaporator Control Object Details

Table 1 SNVT details

NV # (M/O)[1]	Name	In Out	SNVT Type (SNVT Index)		Class	Description
1 (M)	nvoValveOpening	Out	SNVT_lev_percent	(81)	I/O	Percentage of valve opening
2 (M)	nvoEvaporatorState	Out	SNVT_evap_state	(118)	I/O	Evaporator object control state
3 (O)	nviEvapInTemp	In	SNVT_temp_p	(105)	I/O	Monitored temperature
4 (O)	nvoEvapInTemp	Out	SNVT_temp_p	(105)	I/O	Processed temperature
5 (O)	nviEvapOutTemp	In	SNVT_temp_p	(105)	I/O	Monitored temperature
6 (O)	nvoEvapOutTemp	Out	SNVT_temp_p	(105)	I/O	Processed temperature
7 (O)	nviForcedValve	In	SNVT_switch	(95)	I/O	Force valve opening
8 (O)	nvoSuperHeatTemp	Out	SNVT_temp_p	(105)	I/O	Current calculated super heat
9 (O)	nviThermostatState	In	SNVT_state	(83)	I/O	Thermostat object input
10 (O)	nvoSuperHeatRef	Out	SNVT_temp_p	(105)	I/O	Superheat reference
11 (O)	nviDefrostState	In	SNVT_defr_state	(122)	I/O	Defrost object input
12 (O)	nviAirTemp	In	SNVT_temp_p	(105)	I/O	Current air temperature
13 (O)	nviCutOutTemp	In	SNVT_temp_p	(105)	I/O	Thermostat cut out temperature
14 (O)	nviDifference	In	SNVT_temp_p	(105)	I/O	Thermostat difference temperature
15 (O)	nviSuperHeatRef	In	SNVT_temp_p	(105)	I/O	Super heat reference temperature
16 (O)	nviPressure	In	SNVT_press	(30)	I/O	External liquid pressure
17 (O)	nvoDeltaTemp	Out	SNVT_temp_p	(105)	I/O	Difference between evap in & out
18 (O)	nvoPressure	Out	SNVT_press	(30)	I/O	Internal liquid pressure
17 (O)	Location label	-	SNVT_str_int	(37)	config	Location text
49 (O)	Max send time	-	SNVT_time_sec	(107)	config	Max time before updating outputs
118 (O)	Super heat reference max	-	SNVT_temp_p	(105)	config	Maximum reference temperature
114 (O)	Super heat reference init	-	SNVT_temp_p	(105)	config	Initial reference temperature
116 (O)	Super heat reference min	-	SNVT_temp_p	(105)	config	Minimum reference temperature
111 (O)	Start up delay	-	SNVT_time_sec	(107)	config	Time for reduced opening
115 (O)	Start up opening	-	SNVT_lev_percent	(81)	config	Start up maximum opening
117 (O)	Refrigerant glide	-	SNVT_temp	(39)	config	Amount of glide in Kelvin
119 (O)	Refrigerant	-	SNVT_refrig_type	(xxx)	config	Refrigerant type structure

[1] M = mandatory, O = optional

Mandatory Network Variables

Valve opening

```
network output SNVT_lev_percent nvoValveOpening;
```

The current opening degree of the valve, in percent of fully open.

Valid Range

The valid range is 0 - 100%.

Default Value

The default value is 0%.

Evaporator state

```
network output SNVT_evap_state nvoEvaporatorState;
```

The current state of the evaporator object.

Valid Range

0	EVAP_NO_COOLING	Object not performing cooling (off cycle or disabled).
1	EVAP_COOLING	Object currently cooling.
2	EVAP_EMERG_COOLING	Object performing emergency cooling.

Default Value

0 EVAP_NO_COOLING.

Optional Network Variables

Evaporator Inlet Temperature

```
network input SNVT_temp_p nviEvapInTemp;
```

```
network output SNVT_temp_p nvoEvapInTemp;
```

These values indicate the current evaporator inlet (liquid line) temperature. The input can be used if the sensor is external to the evaporator object. The output can be used if the sensor is internal to the evaporator object.

Valid Range

The valid range is -100ºC to +150ºC

Default Value

The default value is 0

Evaporator Outlet Temperature

```
network input SNVT_temp_p nviEvapOutTemp;
```

```
network output SNVT_temp_p nvoEvapOutTemp;
```

These values indicate the current evaporator outlet (suction line) temperature. The input can be used if the sensor is external to the evaporator object. The output can be used if the sensor is internal to the evaporator object.

Valid Range

The valid range is -100ºC to +150ºC

Default Value

The default value is 0

Forced Valve

```
network input SNVT_switch nviForcedValve;
```

The nviForcedValve is used to force the valve to a given opening degree. The evaporator object will stay in this forced mode as long as SNVT_switch.state equals TRUE.

Valid Range

The valid range for SNVT_switch.value is 0 -100 and TRUE or FALSE for SNVT_switch.state.

Default Value

The default value for SNVT_switch.state is FALSE.

Super Heat Temperature

```
network output SNVT_temp_p nvoSuperHeatTemp;
```

The nvoSuperHeatTemp indicates the true evaporator super heat temperature. This variable should be used only when both pressure & temperature are used for calculation. If only temperatures are used then the delta temperature output should be used.

Valid Range

The valid range is -100ºC to +150ºC

Default Value

The default value is 0

Thermostat State

```
network input SNVT_state nviThermostatState;
```

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

```
No Thermostat          Bit 0 = Off ;Constant cooling required
Cut In/Out control     Bit 0 = On,
                       Bit 2 = Disabled.
                       Bit 1 = Cooling/no cooling
Modulating control     Bit 0 = On,
                       Bit 1 = Cooling/no cooling
                       Bit 2 = Enabled.
```

Valid Range

Bit No.	Min	Max	Description
0	Off	On	Thermostat control on/off
1	False	True	Cooling required
2	Disabled	Enabled	Modulating Thermostat
3	False	True	Night Setback mode
8..15			Manufacturer specific items

Default Value

Bit 0 = Off.

Super Heat Reference Temperature

```
network output SNVT_temp_p nvoSuperHeatRef;

network input SNVT_temp_p nviSuperHeatRef;
```

The nvoSuperHeatRef indicates the current target evaporator super heat temperature. The nviSuperHeatRef is an override input for the target super heat reference. This input should be used when the object is in override.

Valid Range

The valid range is -100ºC to +150ºC

Default Value

The default value is manufacturer specific.

Defrost State

```
network input SNVT_defr_state nviDefrostState;
```

The nviDefrostState 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.

Calculated Air Temperature

```
network input SNVT_temp_p nviAirTemp;
```

The nviAirTemp 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 -100ºC to +150ºC

Default Value

The default value is manufacturer specific.

Cut out Temperature

```
network input SNVT_temp_p nviCutoutTemp;
```

The nviCutoutTemp 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

```
network input SNVT_temp_p nviDifference;
```

The nviDifference indicates the value to be added to the nviCutoutTemp to get the thermostat cut in limit if cut in / out control is selected.

Valid Range

The valid range is manufacturer specific.

Default Value

The default value is manufacturer specific.

Delta Temperature

```
network output SNVT_temp_p nvoDeltaTemp;
```

The nvoDeltaTemp indicates the inferred evaporator super heat temperature. This variable should be used when pressure is not taken into account in the calculation.

Valid Range

The valid range is -100ºC to +150ºC

Default Value

The default value is 0

Liquid Line Pressure

```
network input SNVT_press nviPressure;
network output SNVT_press nvoPressure;
```

The pressure of the refrigerant in the liquid (evaporator feed) line.

The input variable would be included on nodes without the hardware interface to read a pressure sensor, whereas the output variable would be included on nodes with pressure sensor hardware.

Valid Range

-3276.8… 3276.7 kPa

Default Value

The default value is manufacturer specific.

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 value of 0 (zero) will force the evaporator object to only update its output variables when a change occurs.

Valid Range

The valid range of the SNVT.

Default Value

10 seconds.

SCPT Reference

SCPTmaxSendTime #49

Super heat reference min & max

```
network input config SNVT_temp_p nciSuperHtRefMax;
```

```
network input config SNVT_temp_p nciSuperHtRefMin;
```

The maximum & minimum values of the target super heat `nvoSuperHeatRef`.

Valid Range

The valid range is manufacturer specific.

Default Value

The default value is manufacturer specific.

SCPT Reference

SCPTsuperHtRefMax #118

Super heat reference initialisation

```
network input config SNVT_temp_p nciSuperHtRefInit;
```

The default value of the target super heat `nvoSuperHeatRef`.

Valid Range

The valid range is manufacturer specific.

Default Value

The default value is manufacturer specific.

SCPT Reference

SCPTsuperHtRefInit #114

Start up delay

```
network input config SNVT_time_sec nciStartUpDly;
```

The time delay before unrestricted control begins after power up, defrost or pack fail.

Valid Range

The valid range of the SNVT.

Default Value

The default value is manufacturer specific.

SCPT Reference

SCPTstrtupDelay #111

Start up opening

`network input config SNVT_lev_percent nciStartUpOpen;`

The maximum valve opening to use after power up, pack fail or defrost.

Valid Range

The valid range is manufacturer specific.

Default Value

The default value is manufacturer specific.

SCPT Reference

SCPTstrtupOpen #115

Refrigerant glide

`network input config SNVT_temp  nciRefGlide;`

A value in Kelvin for the 'glide' of the refrigerant in the system.

Valid Range

The valid range is manufacturer specific.

Default Value

The default value is manufacturer specific.

SCPT Reference

SCPTrefrigGlide #117

Refrigerant type

`network input config refrig_type nciRefType;`

The structure definition used by `refrig_type` is :

```
typedef struct
    {
    char        refrigerant[6];
    float_type  A;
    float_type  B;
```

```
float_type  C;
} refrig_type;
```

This structure indicates the refrigerant type used in the system. Its primary use is for temperature / pressure conversion.

The formula used is:-

$$t = \left(\frac{B}{\ln(p) - A} \right) - C$$

Where :-

t is temperature in °C.

p is the pressure in Bar absolute.

A, *B*, *C* are constants defined for a particular type of refrigerant.

Table 2 Refrigerant definitions.

Refrigerant	A	B	C
"R12"	9.16371	-1964.26	244.445
"R13"	9.51870	-1712.13	261.862
"R13b1"	9.16788	-1761.32	250.260
"R22"	9.54024	-1938.42	244.296
"R23"	10.17745	-1812.74	260.556
"R32"	10.82000	-2373.03	271.848
"R114"	9.25087	-2235.31	238.180
"R134a"	9.85263	-2127.77	242.389
"R142B"	10.36700	-2727.31	273.142
"R227"	8.85720	-1796.19	220.371
"R401"	9.87892	-2163.80	246.079
"R401A"	9.68669	-2065.49	242.441
"R401B"	9.90256	-2159.11	247.010
"R402"	10.13620	-2167.38	261.416
"R402A"	10.13620	-2167.38	261.416
"R402B"	10.0644	-2149.94	259.074
"R404A"	10.13710	-2186.78	262.077
"R407A"	10.42830	-2254.83	255.692
"R407B"	10.31000	-2193.57	256.255
"R407C"	10.39780	-2254.81	254.164
"R500"	9.67274	-2128.85	253.891
"R502"	9.71691	-2044.59	255.957
"R503"	9.96526	-1780.01	267.258
"R507"	9.50128	-1862.85	242.576
"R717"	10.58284	-2226.36	243.968

Valid Range

Refrigerant details & numbers are published by ASHRAE.

Default Value

The default value is manufacturer specific.

SCPT Reference

SCPTrefrigType #119

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 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.