L Gateway for VRV (PCC-10 Version)

Functional Specifications

Ver. 1.1

Draft Only

CC:

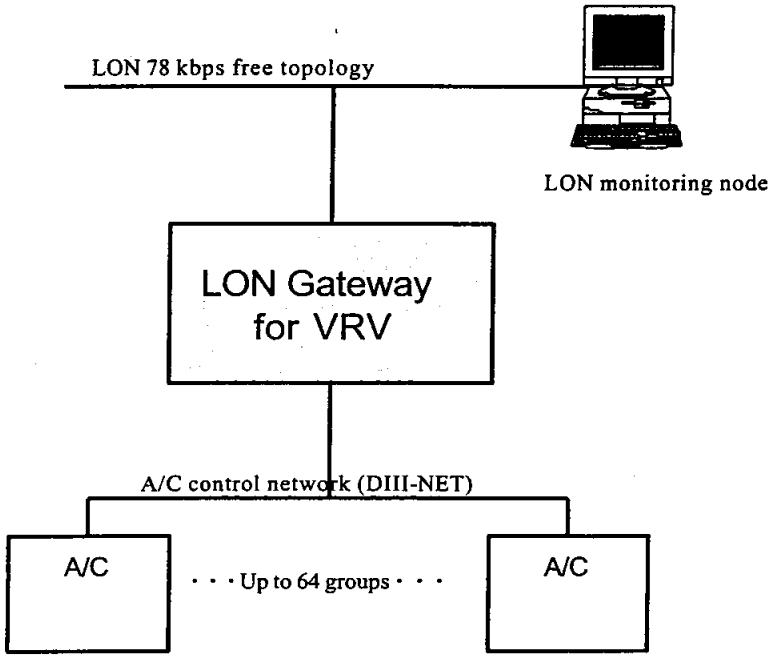
Contents

1. Introduction

These functional specifications for the L Gateway have been prepared for connecting Daikin's VRV to LonWorks.

2. System Configuration

One L Gateway can accommodate up to 64 groups of VRV for monitoring and controlling through LON.



3. Outline of Functions

3.1. Applicable A/C Type for Controlling and Monitoring

Daikin's DIII-NET-supporting VRV

3.2. Number of Connectable A/Cs

Up to 64 groups

3.3. Outline of LON Functions

L Gateway features the following LON functions:

1) Controlling

The L Gateway receives commands for each individual A/C from the LON monitoring node, then issues the command to the relevant A/C.

When it receives a central equipment operational command for an A/C system under the relevant DIII-NET from the LON monitoring node, the L Gateway executes the function.

2) Monitoring A/C status

A/C status values are communicated to the LON monitoring node through the LON network variables.

3) Notifying A/C status changes

Changes in the status values of an A/C, if any, are reported to the LON monitoring node through the LON network variables.

4. LON Interface Specifications

Protocol:	LonTalk protocol
Transmission rate:	78 kbps
Topology:	Free topology
Transmission media:	Twisted pair wire
Cable:	Echelon cable for PCC-10 (Model #2 Conductor Cable)

5. LON Communication Specifications

5.1. LonMark Template Profiles

Since VRV has not been specified by the LonMark Template Profiles provided by the LonMark Interoperability Association, Daikin established original specifications not utilizing LonMark Template Profiles. The original specifications conform to the standard types of network variables provided by the Interface Committee of JRAIA (see Reference No.01-6-01 of the Interface Committee).

5.2. LonMark Authorization

The types of network variables are originally established, therefore the specifications are not authorized by LonMark.

5.3. Commission

A service pin message should be sent for the commission. The equipment does not have aservice pin hardware button. Instead, the service pin message is sent by using a button on the screen. The following outlines the sending procedure for the service pin message.

1) If the screen does not appear on the display (i.e., the backlight is off), touch the display to show the screen (to turn the backlight on).

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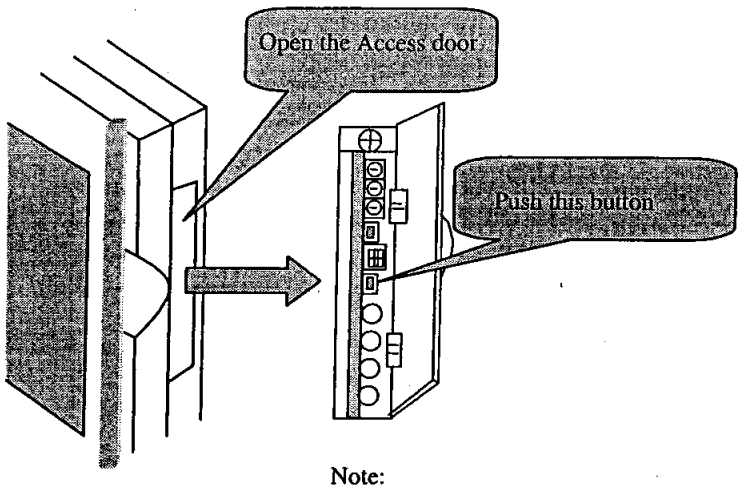
DAIKIN LON Gateway DCS601A1R

The Service Switch is the switch as on the figure below.



LON Gateway

Note:
Do not touch other buttons
Close the door when the operation is completed

5.4. Controlling and Monitoring Items

The following table shows controlling and monitoring items.

Table 5.1. Controlling and Monitoring Items

	Function	Description
Controlling items *11	ON/OFF command	ON/OFF of A/C
	Operation mode setting	Heating/Cooling/Ventilation/Auto*1
	Temperature setting	Temperature setting value*2
	Fan airflow setting	Airflow setting value*3
	Filter reset	Filter sign reset*4
	Forced thermostat OFF setting	Forced thermostat OFF
	Remote ON/OFF control rejection	Accepting/rejecting ON/OFF control*10
	Remote operation mode control rejection	Accepting/rejecting change of operation mode*10
	Remote temperature setting control rejection	Accepting/rejecting change of temperature setting value*10
	System forced OFF setting	System forced OFF command
Monitoring items	ON/OFF status report	ON/OFF status
	Operation mode status report	Heating/Cooling/Ventilation*5
	Temperature setting report	Temperature setting value*2
	Room temperature report	Current room temperature*2, *12
	Fan airflow setting report	Airflow setting value*3
	Filter sign report	Filter sign*6
	Error report	Error indication*7
	Error code report	Error code*7
	Thermostat status report	Thermostat status
	Forced thermostat OFF setting report	Forced thermostat OFF status
	Remote ON/OFF control rejection report	Unlocked status of ON/OFF control*10
	Remote operation mode control rejection report	Unlocked status of operation mode control*10
	Remote temperature setting control rejection report	Unlocked status of temperature setting control*10
	System forced OFF setting report	Canceling/setting of system forced OFF
	A/C communication status	Non-existence/Normal/Error*13

Notes: (numbers 8 and 9 are not assigned)

- *1 The Auto mode setting of an A/C without the heating/cooling selection option is translated as a temperature control command. Therefore the operation mode of such an A/C, when Auto mode is selected, is the same as an A/C with the option.
- *2 In the case of an outdoor air-treating A/C, the value is the setting value/measured value of the air discharge temperature.
- *3 On LON, all A/Cs are treated as two-speed A/Cs. <=4:low, >=5:high for monitoring and 1:low, 7:high for command on DIII-NET.
- *4 The Reset command for an A/C should only be issued for the items that are reported (i.e., filter and element signs).
- *5 The Auto mode status cannot be monitored. The Dry operation is reported as the Cooling operation.
- *6 OR status value of filter sign and element sign.
- *7 Communicated to LON when an error occurs. Error codes are indicated in the ASCHII2 character set.
- *10 The Control rejection setting appears to be set even for A/Cs without remote controls.
- *11 Any control commands to sub A/Cs in a remote control group are ignored.
- *12 For an A/C without a temperature sensor, the temperature to be reported is 0 ℃ or INVALID (0x7fff).
- *13 When a communication error occurs in an A/C, a report is issued with nvoHvacExist_nn, novErrStatus_nn, and nvoFailure_nn. The nearest value is maintained for other nvo**_nn.

5.5. LON Restrictions on Setting and Monitoring by Type and Status of A/C

- LON commands do not differentiate between A/Cs with the heating/cooling selection option and those without. Therefore, a command to change the operation mode received by an A/C without the heating/cooling selection option will be ignored. However, a command to change the operation mode issued to an A/C with the heating/cooling selection option can indirectly change the operation mode of A/Cs under it.
- LON commands do not differentiate between A/Cs with the auto mode supporting function and those without. Therefore, using the auto mode setting for an A/C without the supporting function may cause a change to an undesired mode.
- LON commands do not differentiate between A/Cs with BS equipment those without.
- Each sub remote controller is monitored as an A/C. However, all commands to a sub remote controller will be ignored.

5.6. Object

There are 65 objects in total including one GENERAL object and objects numbered from AC_01 through AC_64. General network variables such as a system forced OFF and network variables relating to each A/C are provided in GENERAL and AC_01 – AC_64 respectively.

Object Name									
AC_01	AC_02	AC_03	AC_04	AC_05	AC_06	AC_07	AC_08	AC_09	AC_10
AC_11	AC_12	AC_13	AC_14	AC_15	AC_16	AC_17	AC_18	AC_19	AC_20
AC_21	AC_22	AC_23	AC_24	AC_25	AC_26	AC_27	AC_28	AC_29	AC_30
AC_31	AC_32	AC_33	AC_34	AC_35	AC_36	AC_37	AC_38	AC_39	AC_40
AC_41	AC_42	AC_43	AC_44	AC_45	AC_46	AC_47	AC_48	AC_49	AC_50
AC_51	AC_52	AC_53	AC_54	AC_55	AC_56	AC_57	AC_58	AC_59	AC_60
AC_61	AC_62	AC_63	AC_64	GENERAL					

5.7. Configuration Properties (CP)

Configuration Properties are not supported.

Sending heartbeat signals will be supported as an optional function. This is because the Gateway accommodates up to 64 A/Cs, and therefore the number of network variables is extremely large.

5.8. Network Variables

5.8.1. Input Network Variables

The next list shows input network variables.

nn in a variable name indicates any of the A/C numbers from 01 through 64. A total of 64 network variables with _nn are provided respectively.

Table 5.1 List of Input Network Variables

Controlling items	Variables	Type	Value and meaning
ON/OFF command	nviOnOff_nn	SNVT_switch	(0,1)(*,0): OFF, (>0,1): ON
Operation mode setting	nviHeatCool_nn	SNVT_hvac_mode	0: Auto, 1: Heating, 3: Cooling, 9: Ventilation
Temperature setting	nviSetpoint_nn	SNVT_temp_p	15.00 35.00 ℃ *2
Fan airflow setting	nviFanSpeed_nn	SNVT_switch	(0<value<=100, 1) : low (>100, 1) : high
Filter reset	nviFSReset_nn	SNVT_switch	value=0 or 1: reset
Forced thermostat OFF setting	nviThermoOff_nn	SNVT_switch	(0,1)(*,0): cancel, (>0,1):set
Remote ON/OFF control rejection	nviRejOnOff_nn	SNVT_switch	(0,1)(*,0): accepting, (>0,1): rejecting
Remote operation mode control rejection	nviRejMode_nn	SNVT_switch	(0,1)(*,0): accepting, (>0,1): rejecting
Remote temperature setting control rejection setting	nviRejSetpoint_nn	SNVT_switch	(0,1)(*,0): accepting, (>0,1): rejecting
System forced OFF setting	nviSystemOff	SNVT_switch	(0,1)(*,0): normal, (>0,1): OFF
Clock setting			
(Variable for saving bind information)	nviSaveNetDB	SNVT_switch	see Article 5.9.

5.8.2. Output Network Variables

The list bellow shows output network variables.

nn in a variable name indicates any of the A/C numbers from 01 through 64. A total of 64 NVs with _nn are provided respectively.

Table 5.2 List of Output Network Variables

Monitoring items	Variables	Type	Value and meaning
ON/OFF status report	nvoOnOff_nn	SNVT_switch	(0,0):OFF, (200,1):ON
Operation mode status report	nvoHeatCool_nn	SNVT_hvac_mode	1: Heating, 3: Cooling, 9: Ventilation
Temperature setting report	nvoSetpoint_nn	SNVT_temp_p	15.00–35.00℃, 327.67: invalid *2
Room temperature report	nvoSpaceTemp_nn	SNVT_temp_p	0.00–50.00℃, 327.67: invalid *2
Fan airflow setting report	nvoFanSpeed_nn	SNVT_switch	(100, 1) : low (200, 1) : high
Filter sign report	nvoFiltersign_nn	SNVT_switch	(0,0):normal, (200,1): alarm
Error code report	nvoFailure_nn	SNVT_switch	(0,0):normal, (200,1): error
Error code report	nvoErrStatus_nn	SNVT_switch	(0,0):normal, ASCHII2-byte error code *1
Thermostat status report	nvoThermo_nn	SNVT_switch	(0, 0) : OFF (200, 1) : ON
Power integrated value report			
Thermostat forced OFF setting report	nvoThermoOff_nn	SNVT_switch	(0,0): cancel, (200,1):set
Remote ON/OFF control rejection report	nvoRejOnOff_nn	SNVT_switch	(0,0): accepting, (200,1): rejecting
Remote operation mode control rejection report	nvoRejMode_nn	SNVT_switch	(0,0): accepting, (200,1): rejecting
Remote temperature setting control rejection report	nvoRejSetpoint_nn	SNVT_switch	(0,0): accepting, (200,1): rejecting
System forced OFF setting report	nvoSystemOff	SNVT_switch	(0,0): normal, (200,1): OFF
A/C communication status	nvoHvacExist_nn	SNVT_switch	value=0: non-existence, 1: normal, 2: error, state=1
(Variable for saving bind information)	nvoSaveNetDB	SNVT_switch	see Section 5.9.

*1: value = upper code, state = lower code

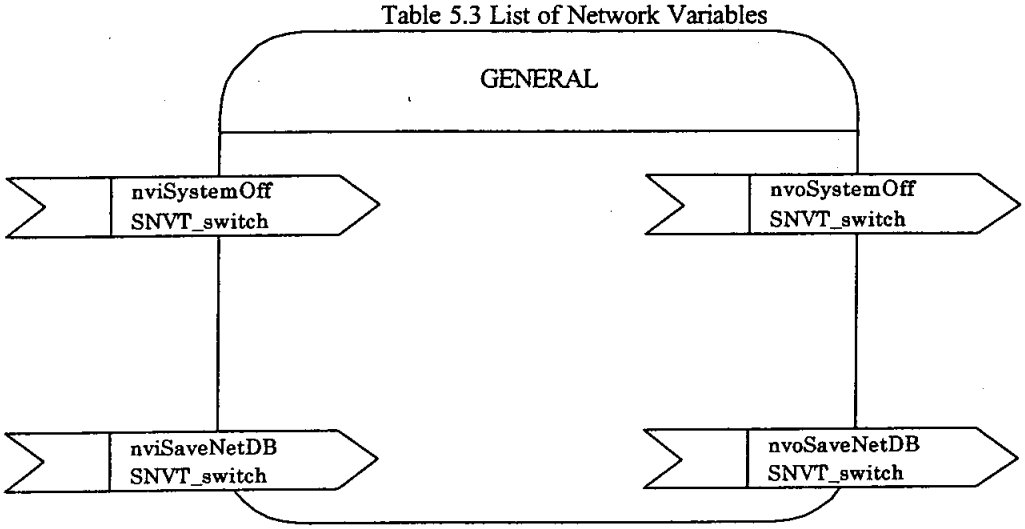
*2: The temperature range may vary according to the type of A/C

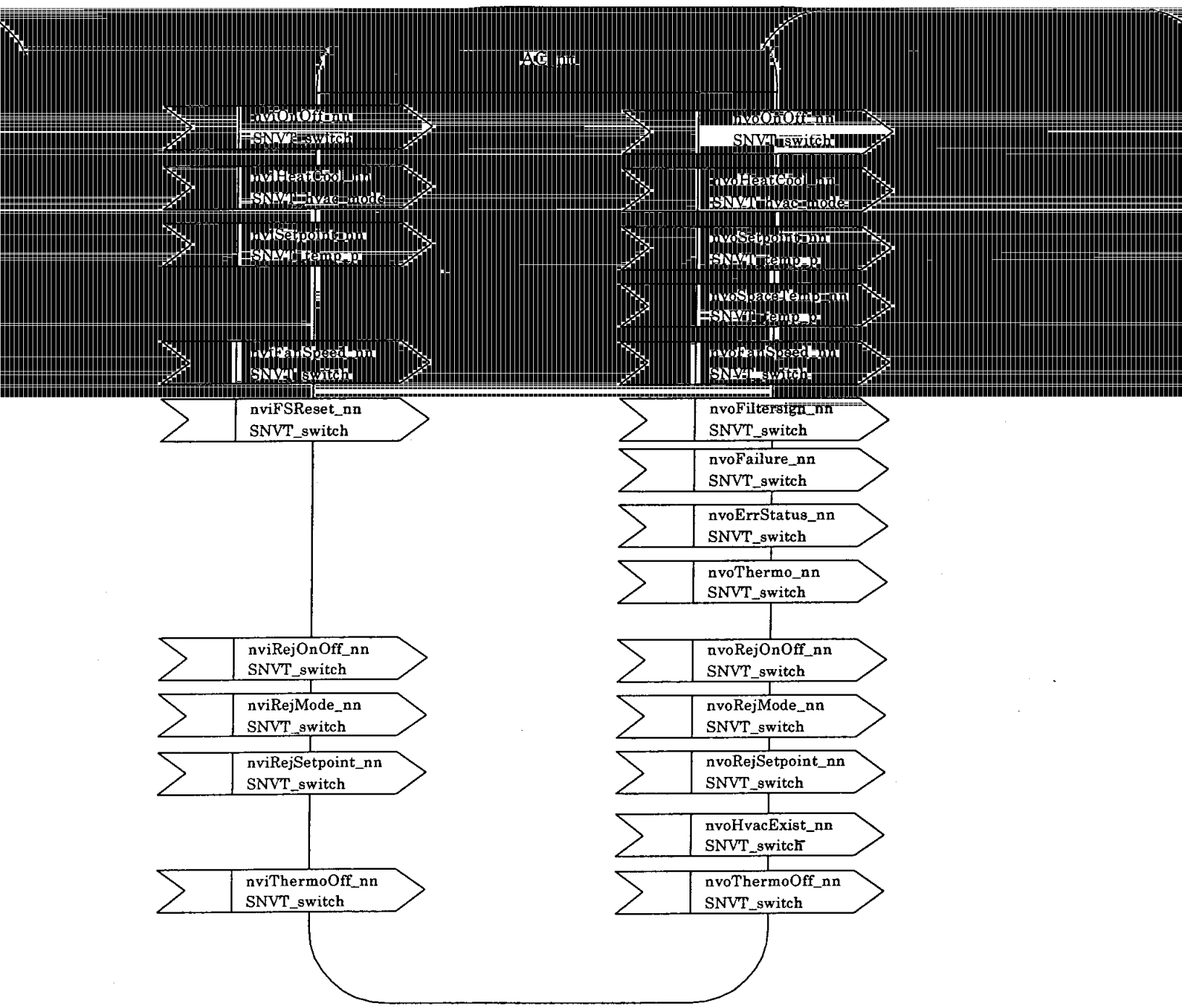
5.8.3. List of Network Variables

This list shows network variables of each object.

nn in a variable name indicates any of the A/C numbers from 01 through 64. A total of 64 NVs with _nn are provided for each object.

Table 5.3 List of Network Variables

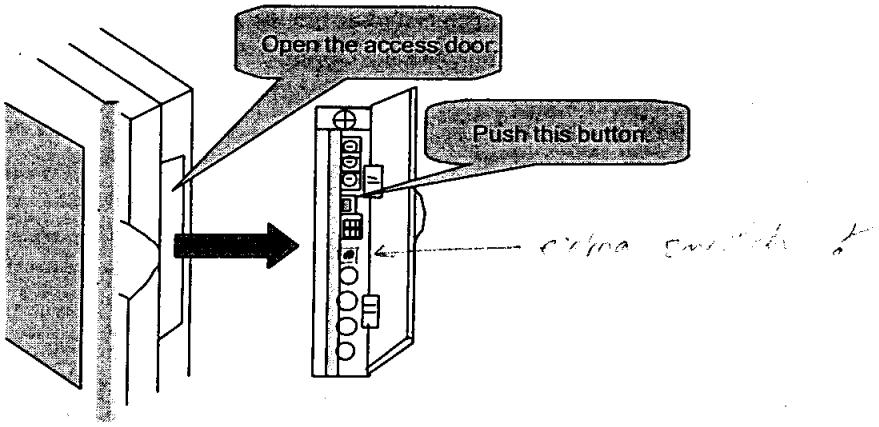



AG_nn
nviOnOff_nn
SNVT_switch
nviHeatCool_nn
SNVT_hvac_mode
nviSetpoint_nn
SNVT_temp_p
nviFanSpeed_nn
SNVT_switch
nvoOnOff_nn
SNVT_switch
nvoHeatCool_nn
SNVT_hvac_mode
nvoSetpoint_nn
SNVT_temp_p
nvoSpaceTemp_nn
SNVT_temp_p
nvoFanSpeed_nn
SNVT_switch
nviFSReset_nn
SNVT_switch
nvoFiltersign_nn
SNVT_switch
nvoFailure_nn
SNVT_switch
nvoErrStatus_nn
SNVT_switch
nvoThermo_nn
SNVT_switch
nviRejOnOff_nn
SNVT_switch
nviRejMode_nn
SNVT_switch
nviRejSetpoint_nn
SNVT_switch
nviThermoOff_nn
SNVT_switch
nvoRejOnOff_nn
SNVT_switch
nvoRejMode_nn
SNVT_switch
nvoRejSetpoint_nn
SNVT_switch
nvoHvacExist_nn
SNVT_switch
nvoThermoOff_nn
SNVT_switch

5.9. Saving Data After the Binding Operation (Important)

The network database, which includes configuration information, should be archived in a file according to the following procedure when configuration of network variables (binding operation) is done. Never turn off power of the L Gateway before completing the procedure.

1) Execute all the necessary binding operations.
2) Assign (0,0) to nviSaveNetDB.
3) Make sure that nvoSaveNetDB is (100,1).
4) Assign (200,1) to nviSaveNetDB.
5) Refer to nvoSaveNetDB and
   - go to step 6 if it is (200,1)
   - return to step 2 if it is (255,255).
6) Waite about one minute.
7) Turn on the power of the L Gateway again. If it is difficult to turn on the power again, open the access door on the right side of the display and push the reset button (see below) to restart the L Gateway.



L Gateway

Note: Do not touch other buttons. Closed the door when the operation is completed.

6. Other Important Matters

6.1. Restrictions

6.1.1. Restriction on the System Forced OFF Function

・System forced OFF

When a system forced OFF command is issued to the L Gateway by the LON monitoring node, all A/Cs connected to the A/C control network (DIII-NET) under the L Gateway stop. Not only LON but also remote controllers and other central equipment cannot issue a command to start A/Cs before the LON monitoring node issues a command to cancel a system forced OFF. Thus until the LON monitoring node issues a cancel command, A/Cs will remain in the forced OFF status. Once the LON monitoring node issues a command to cancel a system forced OFF to the L Gateway, LON, remote controllers and other central equipment can issue the ON command to A/Cs.

A/Cs maintain the forced OFF status even when a cancel command is issued. In other words, A/Cs do not automatically restart operations. To start A/Cs again, a ON command should be issued through the L Gateway, remote controllers or other central control equipment.

- Although remote controllers of A/Cs are put in an "inoperable condition for A/C ON" when the system forced OFF command is issued, the output network variable "remote ON/OFF control rejection report" is not reported to the LON monitoring node.

- The ON command may not be given correctly to A/Cs when the LON monitoring node issues the command to cancel a system forced OFF and then the A/C ON command within a short interval. Before the entire A/C control network (DIII-NET) under the L Gateway becomes free from a system forced OFF, the ON command to A/Cs may or may not be rejected. Furthermore, LON communication does not guarantee the starting sequence of processing based on multiple notifications of network variable changes.
  It is recommended to make sure that the forced OFF status has been cancelled when issuing the A/C ON command after the cancellation of the forced OFF.

6.1.2. Restriction on Operation Mode Changes

- The temperature setting command may not be given correctly to A/Cs when the LON monitoring node issues the change command for the operation mode and then the temperature setting command within a short interval. For example, if a command to set temperature is issued within a short interval after a command to change the operation mode from cooling to heating, the temperature setting command may be processed first to change the cooling temperature setting, followed by the operation mode change to heating, and then the default heating temperature setting may be set. LON communication does not guarantee the starting sequence of processing based on multiple notifications of network variable changes.
  Once the operation mode change command has been given, it is recommended to make sure that the operation mode has changed before issuing the temperature setting command.

6.1.3. Restriction on the LON Address Table

- The number of address table entries used for binding of network variables is limited to 15.

6.1.4. Other

- In each A/C control network (DIII-NET) system, one input node is available for the system forced OFF command (recommendation). The central equipment should be designated to the host equipment as an input node for the command of system forced OFF.

- The L Gateway is connected to the A/C control network (DII-NET) as the main central equipment. Therefore, other central control equipment, if any, should be connected to the network as the sub central equipment. Sub central control equipment is subject to restrictions in such areas as remote ON/OFF control rejection, for which commands cannot be issued.

- The L Gateway and other central monitoring connection equipment such as D-Bips / master station II should not be installed jointly.

- When power is applied to the L Gateway or the L Gateway is restarted without connecting to A/Cs, the screen will only display the message: "initializing, please wait".

6.2. Operation on the Screen

On the L Gateway, the following tasks should be done through the screen:

- Sending service pin messages; and
- Data saving when binding operation is done.

For detailed information on each task, see:

5.3. Commission

5.9. Data saving after the binding operation (Important)

Never perform unnecessary operations/settings. The L Gateway may not run properly with other operations not explained in each section.