

LRC-LG Room Controller for Toshiba air-conditioning units

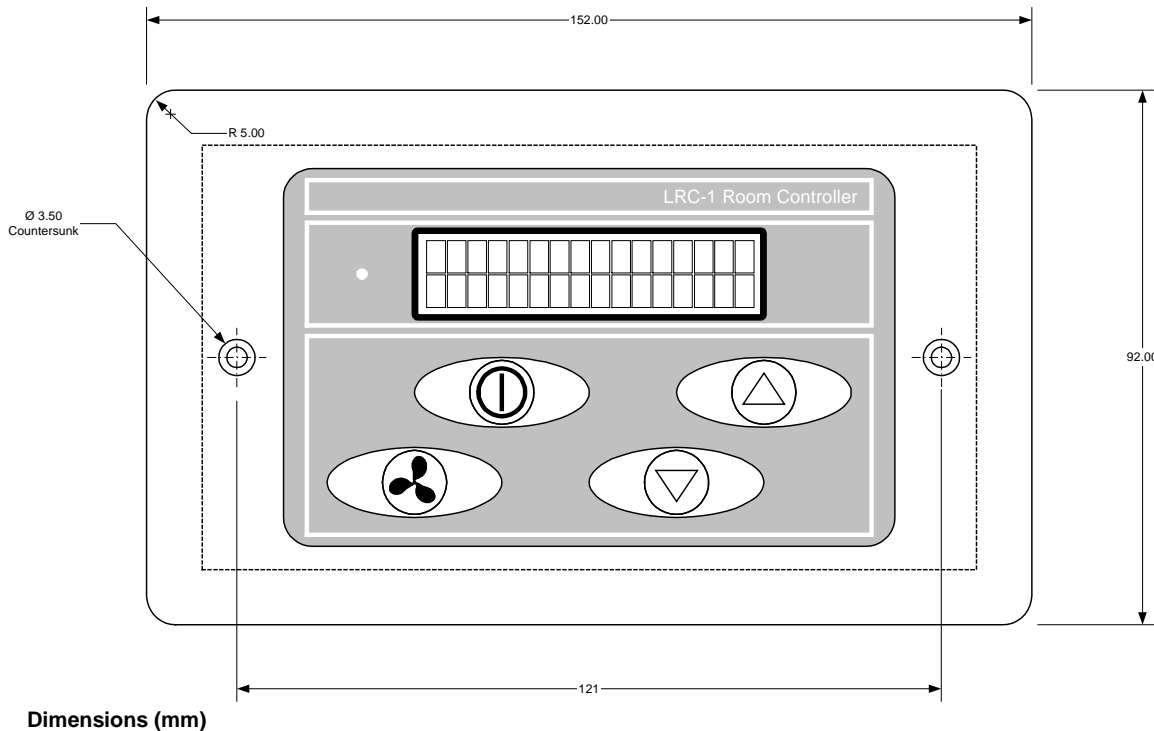


Description

The LRC-LG is a variant of the RealTime LRC-1 compatible with the LTX range of BMS interfaces. The LRC-LG is a LonWorks® product that directly interfaces with Toshiba split units and VRF units and can be controlled by BMS commands and also provide the occupant with a local user-interface to set the unit operating conditions such as the temperature setpoint and the fan speed. The LRC-LG utilises Toshiba communications protocols to communicate directly with both new RAV R407C units as well as existing RAV R22 units. As well as controlling the units this allows the LRC-1 to access fault codes within the units and display them at the user interface if required. The unit derives its power from the connection to the indoor unit and so no additional power sources are required.

The user interface consists of a 4-button membrane keypad with a two-line backlit LCD display and stainless steel bezel surround. The controller mounts in a standard double-gang backbox allowing the device to be flush mounted in both solid and partition walls.

BMS control allows the unit to be switched on and off remotely, the operating conditions to be varied and local user control to be locked out if desired. Individual unit fault code feedback is provided for feedback to the BMS interface. In addition remote reset functionality allows A/C units in fault conditions to be reset and the fault cleared..



LRC-LG

LRC-LG Features

- Compatible with Toshiba R22 (Series 0-3) and R407C (Series 4 – AI-Network) RAV units
- Replaces standard remote controllers
- Connects directly to indoor unit A-B-C connection
- Powered from indoor unit
- Local keypad control of On/off status, setpoint and fan speed
- Back-lit two-line LCD display showing unit status
- LonWorks network connection
- Feedback of fault codes for up to 16 units on LonWorks network
- Compatible with RealTime LTX BMS interface
- Multiple LRC-LG devices and one LG can interface to a single LTX interface

Description

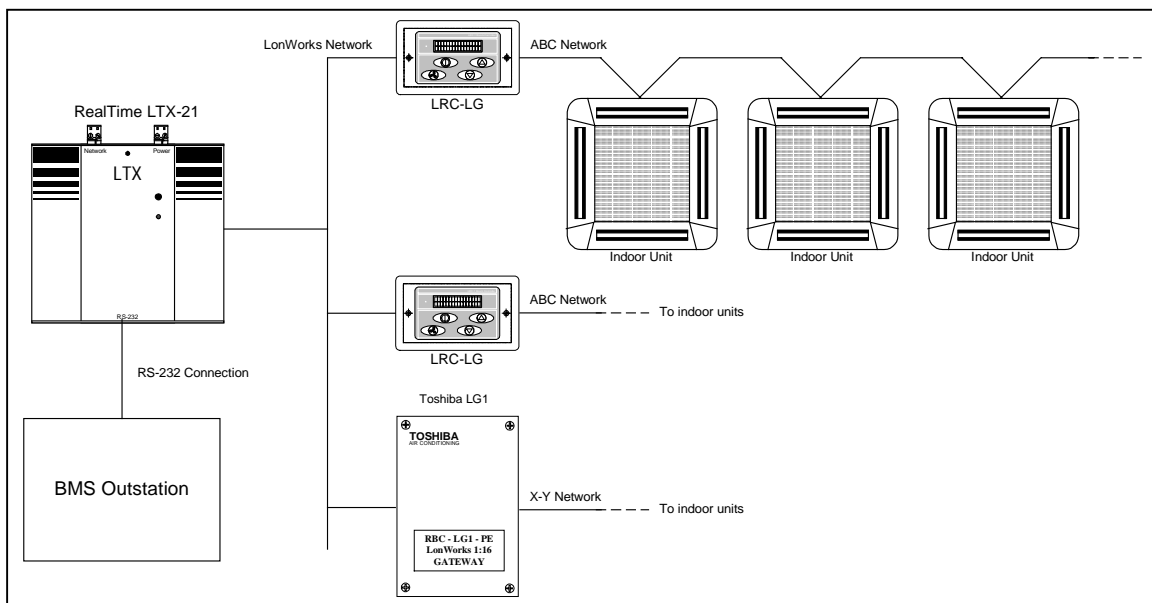
The LRC-LG connects to both Toshiba R22 and R407C RAV indoor units and replaces the standard remote controller. The LRC-LG is powered from the indoor unit and communicates with it via the ABC connection on the indoor unit PCB. The LRC can be installed as a stand-alone device or incorporated in a LonWorks network.

A LonWorks network port on the LRC-LG allows remote control and monitoring of the indoor unit and allows the local control to be locked out and overridden by the building management system. The LRC-LG is a variant of the RealTime LRC-1 interface, the LRC-LG is designed for interfacing to the RealTime LTX BMS interface. Up to 16 indoor units can be controlled as a group from the LRC and the fault codes for each of these units is available for remote monitoring purposes. In addition the fault-codes can be accessed via the local keypad using a combination of keys A full functional profile is provided at the end of this datasheet.

The LRC can be wall mounted to allow local control or can be mounted behind a blanking plate so the controller is purely used as an interface for BMS control.

BMS Interfacing

The interface is designed to operate in a similar fashion to a Toshiba LG1 so that it is compatible with standard RealTime LTX BMS interfaces. LRC interfaces can control up to 16 units as a single group, and feedback the individual fault codes for each of units. A standard LTX interface can handle up to 16 units, these units can be attached to one Toshiba LG1 and one or more LRC-LG interfaces as shown in the following diagram.



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An LTX interface assigns each attached A/C unit to a unit number between 1 and 16. If a Toshiba LG1 interface is attached to the LTX interface then these numbers correspond to the indoor unit XY LAN addresses. If fewer than 16 units are attached to the Toshiba LG1 then the spare slots can be filled with units attached to 1 or more LRC-LG interfaces. To achieve this it is necessary to *remap* the LRC-LG unit addresses to the spare address slots.

It is standard practice to address units beginning at address number 1. If for example if the Toshiba LG1 has units with addresses 1 to 12 connected, then there are four spare address slots 13 to 16 on the LTX. Given an LRC-LG with 4 units attached the addresses of these units will be set as 1 to 4 on the indoor unit rotary switches. The LRC-LG must be programmed to remap these addresses to the range 13 to 16. This is achieved using the configuration parameters *nciMinUnitAddr* and *nciMaxUnitAddr*. Setting *nciMinUnitAddr*=13 will map Unit 1 to Unit 13, Unit 2 to Unit 14 etc. Hence when the LTX sends out a query for Unit 13 data, the LRC-LG will respond with the data for Unit 1. The maximum address value is set by *nciMaxUnitAddr*, which defines the maximum address that the LRC-LG will respond to.

Example 1. The following example shows how the addressing of the units is arranged.

	A/C Unit Address		LTX Unit Number		<i>nciMinUnitAddr</i>	<i>nciMaxUnitAddr</i>
	From	To	From	To		
LG1	1	12	1	12	N/A	N/A
LRC	1	4	13	16	13	16

The configuration parameters *nciMinUnitAddr* and *nciMaxUnitAddr* are simply set to the desired address range within the LTX.

Example 2. The following example shows a more complex example where 3 LRC-LG groups are added to an interface together with an LG1 attached to 10 units.

	A/C Unit Address		LTX Unit Number		<i>nciMinUnitAddr</i>	<i>nciMaxUnitAddr</i>
	From	To	From	To		
LG1	1	10	1	10	N/A	N/A
LRC	1	1	11	11	11	11
LRC	1	3	12	14	12	14
LRC	1	2	15	16	15	16

LRC-LG Master/Slave Control

The LRC-LG controls all units attached to it as a single group. Therefore only one set of operating conditions are required. The first unit on the LRC-LG A-B-C network is always addressed as Unit #1 and this is treated as the Master. This corresponds to the LTX unit number equal to *nciMinUnitAddr*. In example 2 above the LTX Unit Numbers 11, 12 and 15 correspond to the master units for each of the LRC interfaces. Within the LTX these units should be setup as Zone Masters. The remaining unit numbers must be setup as Zone Slaves, primarily so that those zones are active and hence the fault codes visible within the LTX.

LRC-LG Feedback Data

Unlike the Toshiba LG1 the LRC does not have access to the return air and heat-exchanger temperatures as these are not accessible over the ABC network. This means that the temperature fields within an LTX interface will not contain valid data and should remain at zero. The fault codes are fed back in the same manner as faults from the Toshiba LG1 and should be interpreted using the appropriate service manual.

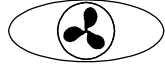
LRC-LG

Keypad Functionality

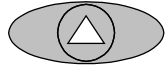
The LRC keypad has four keys that allow control over the on/off state, fanspeed and setpoint. These keys are as follows



On/Off This key toggles the state of the unit between on and off.



Fan speed The default operation of this key cycles the fan speed through AUTO, LOW, MEDIUM, HIGH on each press.

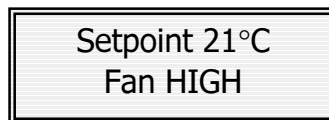


Increase setpoint Pressing this key will increase the setpoint by 1°C steps until it reaches the maximum value.

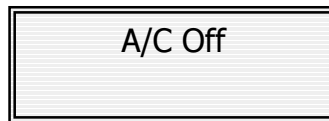


Decrease setpoint Pressing this key will decrease the setpoint by 1°C steps until it reaches the minimum value.

The two-line LCD displays the current status of the unit. When a key is pressed the backlight is switched on for 5 seconds to improve display visibility. When the indoor unit is switched on the display is of the form:



When the unit is switched off the LRC-1 displays:

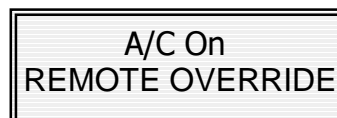
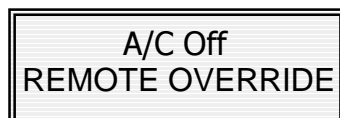


The keypad does not allow control over the indoor unit louvers (if available) and the run mode of the unit. On powering up the LRC assigns these to the default values of Louver=OFF and run mode=AUTO. These settings can be changed at any time via the LonWorks network by updating the *nviUnitSettings* network variables

Remote Override Mode

If the LRC is incorporated in a LonWorks control system then it is possible to switch the unit operation between local user control and remote BMS override. The network variable *nviUnitSettings.priority_c_o=0* is used to lockout BMS control and enable local keypad control. Setting *nviUnitSettings.priority_c_o=1* sets the LRC-LG to BMS control and locks out the keypad.


During BMS control the LRC keypad is locked out and the default display on the LCD screen is one of the following depending on the on/off state.





When the unit is on the display alternates between 'A/C On Remote Override' and the current unit settings.

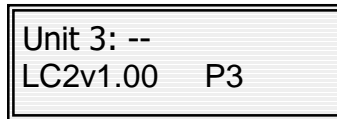
Engineering Commands

Unit Reset

Pressing and holding down  for at least 5 seconds will cause the LRC to send a reset signal to the indoor unit. This can be used to clear certain non-clearing fault codes.

Fault Code and Firmware Display

Pressing  +  will cause the display of the fault status for every active unit connected to the LRC. This display is of the following form







The first line of the display will continuously cycle through active units and display '—' for any unit with no fault, if a fault exists then the unit will display the fault code in hexadecimal. This mode is useful in commissioning as it shows all units that are detected on the ABC network. If unit address 1 is not detected then a '99' fault code will be generated for Unit 1. Consult the appropriate service manual for a description of these codes.

The second line displays the firmware version in a string of the form "LC2v...". This string is identical to the device program ID. To the right of the firmware version is the character 'P' followed by a digit. The digit can either be '3' or '4', this indicates the current protocol that the LRC is using, with 'P3' corresponding to Series 0 to 3 R22 protocol and 'P4' corresponding to Series 4 R407C protocols.

The display will remain until one or both of the buttons is released. If the setpoint has been modified by momentarily pressing one button before the other the setpoint will be restored to the value prior to depressing the keys.

Protocol Change

Pressing  +  followed by  causes the protocol the LRC is using to toggle between Series 3 and Series 4, as indicated by the 'Px' text described in the previous section. Each time  is pressed and released the protocol will be toggled. The LRC-1/S is initially factory configured to Series 3 protocols. Note that Series 3 covers all previous series using R22. The protocol can also be set using the config network variable *nciProtocol*. The following table provides guidance on which protocols should be used for which units. If in doubt consult Toshiba or RealTime. Note that units requiring different protocols should not be placed on the same LRC interface.

Unit Type	Protocol
R22 Heatpump R22 Cooling Only R407C Cooling Only (Split)	3
R407C Heatpump (Split or VRF) R407C Cooling Only (VRF)	4

NOTE: protocol change using the keypad is only available for the first 2 minutes after the LRC is powered-up or hard reset. This is to prevent accidental changes being made by users.

LRC Installation

A one page pull-out summary of these instructions is provided at the rear of this datasheet

Mechanical Installation

The LRC is designed for mounting in both flush and surface mounted standard double gang boxes. The boxes should be at least 35mm deep. Specific shapes and dimensions of boxes vary, therefore when selecting a particular make of box it is recommended that LRC is mounted in a sample prior to site installation to ensure the fit is acceptable. With flush mounted boxes the LRC will fit most dry-lining boxes, however with metal boxes it is important to test a sample as the internal dimensions of these boxes are very close to the external dimensions of the LRC rear casing.

The LRC can be installed with the keypad and display visible, or can be installed with the keypad and display covered over to prevent local access. For local access the LRC is mounted in the double gang box, then fastened in place with the supplied bezel and two slotted M3.5 raised countersunk screws. Alternatively tamperproof screws of suitable dimensions can be used.

For applications such as panel mounting where no access to the keypad is allowed then a standard double gang blanking plate can be mounted in place of the bezel.

Electrical Installation

For ease of installation the LRC has two-part electrical connectors so that wiring can be done separately from the LRC.

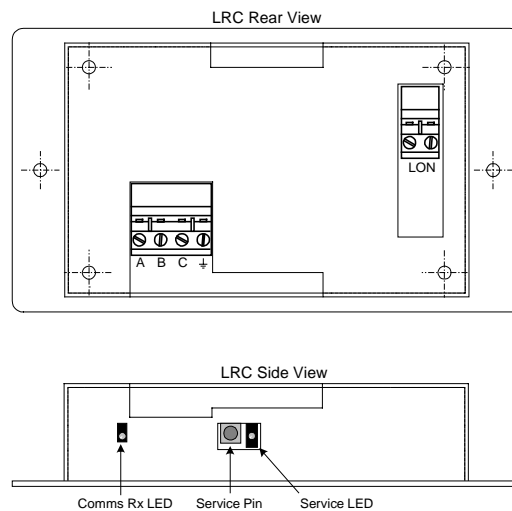


Figure 1. LRC rear and side views

Figure 1. shows the rear and side of the LRC. The LRC has two connectors at the rear, the ABC connection and the LonWorks connection labelled 'LON'.

The ABC connection is connected to the Toshiba indoor unit in the same fashion as a standard remote controller. Consult the appropriate Toshiba service manual for the correct installation procedure. Guidelines to installation are given below, however the Toshiba installation guide should be considered as the authoritative version.

The LRC ABC terminals should be connected to the ABC terminals of unit 1 using a 3-core cable suitable for carrying 12V AC with cross section of 0.75mm². Ensure that the diameter of the cable used can fit in the clearance between the rear of the LRC casing and the rear of the mounting box.

Further units can be daisy-chained onto the unit 1 connections by connecting terminals B and C only between the units. For all units other than unit 1 connector CN12 should be removed. The maximum length of the cable between the LRC and the furthest connected unit is 500 metres.

Note: The LRC-1 cannot be used in conjunction with another LRC-1 or other remote controller on the same ABC network

The LonWorks connection labelled 'LON' is polarity independent and should be wired with unshielded twisted pair. Consult the FTT-10A installation guide for suitable wiring specifications.

LonWorks Engineering

One or more LRC-LG interfaces can be bound to a RealTime LTX interface together with at the most one Toshiba LG1. Each interface requires 4 network variables to be bound between the LTX and the interface. The LTX-21 has a common set of network variables inputs and outputs that are bound to all of the devices in use. This means that all of the network outputs are bound as *group* bindings.

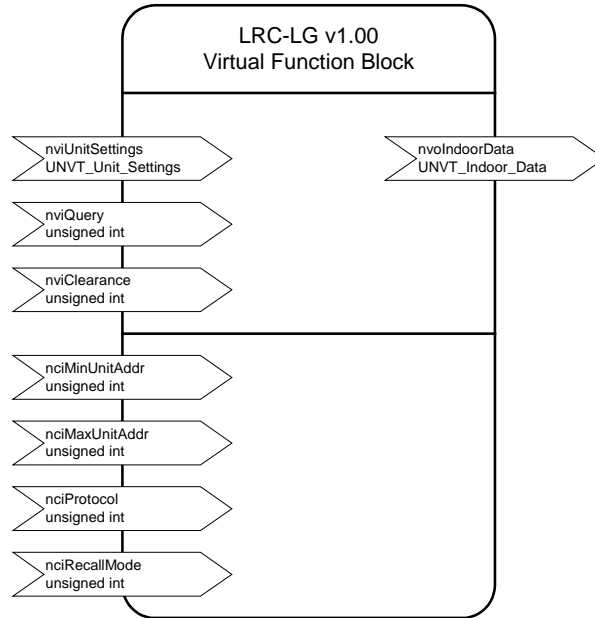
The following network variables should be bound

LTX-21	Direction	LRC-LG
nvoUnitSettings	⇒	nviUnitSettings
nvoQuery	⇒	nviQuery
nvoClearance	⇒	nviClearance
nviIndoorData	⇐	nvoIndoorData

The LTX-21 network variable *nviIndoorData* receives data from all of the attached interfaces and filters it according to the unit number field. This means that it is vitally important that there are no duplicated addresses across the interfaces as this will lead to inconsistent data.

For other LTX interfaces consult the appropriate datasheets for details of any alternative binding methods.

LRC-LG Functional Profile



The LRC-LG functional profile is shown above. The following table gives a summary for each network variable.

NV#	Name	In/Out	Type	Description
0	nviUnitSettings	input	UNVT_Unit_Settings	Unit settings
1	nviQuery	input	unsigned int	Unit query
2	nviClearance	input	unsigned int	Fault Clear
3	nvoIndoorData	output	UNVT_Indoor_Data	Unit feedback data
4	nciMinUnitAddr	config	unsigned int	First Unit Address
5	nciMaxUnitAddr	config	unsigned int	Last Unit Address
6	nciProtocol	config	unsigned int	Comms protocol
7	nciRecallMode	config	unsigned int	Central ->Local restore options

The LRC-LG is a room controller that combines a local user-interface with a remote control capability and the reporting of unit fault codes. The LRC-LG interfaces with Toshiba R22 and R407C (see list of compatible units) via the ABC connection. Up to 16 units can be operated as a single group. The LRC-LG is a variant of the LRC-1 interface with a functional profile similar to the Toshiba LG1 interface, this makes the LRC-LG compatible with the RealTime LTX BMS interface. Multiple LRC-LG interfaces can be operated from a single LTX interface as well as being operated in parallel with a Toshiba LG1 interface.

The unit can be operated either via the keypad or from remote commands it is necessary to define operating modes that lock-out either local or remote control in order to prevent conflicting demands being made on the unit. The value of *nviUnitSettings.priority_c_o* determines whether the LRC operates in central (BMS) or local (keypad) mode.

The louver status and run mode are not accessible from the local keypad and so these values are only configured under central control and are not locked out under any condition.

LRC-LG

LRC-LG Network Variables

network input UNVT_Unit_Settings **nviUnitSettings**

User defined data structure with the following fields

```
typedef struct {
    unsigned int    unit_number;
    SNVT_hvac_mode hvac_mode;
    SNVT_temp_p    setpoint;
    unsigned int    on_off;
    unsigned int    fan_speed;
    unsigned int    louver;
    unsigned int    filter_reset;
    unsigned int    priority_c_o;
    unsigned int    operation_ban;
} UNVT_Unit_Settings;
```

Valid values for these fields are as follows

Field	Valid Values
unit_number	1..16
hvac_mode	{AUTO=0, HEAT=1, COOL=3, FAN ONLY=9}
setpoint	18.00-29.00 Degrees Centigrade
on_off	{OFF=0, ON=1}
fan_speed	{AUTO=0, LOW=1, MEDIUM=2, HIGH=3}
louver	{OFF=0, ON=1}
filter_reset	{NORMAL=0, RESET=1}
priority_c_o	{LOCAL=0, CENTRE=1}
operation_ban	{NONE=0, PRESENT=1}

This data structure contains the complete operation commands for a single air-conditioning unit, addressed by the field `.unit_number`. Unlike the Toshiba LG1 the LRC-LG controls all attached units as a single group. The unit number 1 in the group is treated as the master. Due to the LRC-LG address remapping the master unit number corresponds to `nciMinUnitAddr`. So the master unit settings will be set when `nviUnitSettings.unit_number = nciMinUnitAddr`. This NV is compatible with the LTX `nvoUnitSettings` and is equivalent to the LG1 input `nviUnitSettings2`.

Central control is selected with `nviUnitSettings.priority_c_o=1`.

The value of `nviUnitSettings.operation_ban` is currently ignored.

network input unsigned int **nviQuery**

Input range is between 1 and 16 and corresponds to the current unit address being queried. The LRC-LG only responds to queries in the address range `nviQuery = nciMinUnitAddr` to `nviQuery = nciMaxUnitAddr`. The address remapping causes Unit #1 to appear as unit number `nciMinUnitAddr`. This allows multiple LRC-LG groups to be managed by a single LTX interface by mapping the groups into different address ranges within the LTX.

network input unsigned int **nviClearance**

Updating this input with the value 1 causes the LRC-LG to be reset, which in turn sends a reset signal to all attached units. This causes all faults to be cleared and any stopped units to be restarted.

network output UNVT_Indoor_Data nvoIndoorData

User defined data structure with the following fields

```
typedef struct {
    unsigned int    unit_number;
    SNVT_hvac_mode hvac_mode;
    SNVT_temp_p    setpoint;
    unsigned int   on_off;
    unsigned int   fan_speed;
    unsigned int   louver;
    unsigned int   filter_state;
    SNVT_temp_p    indoor_temp;
    SNVT_temp_p    heat_exch_temp;
    unsigned int   unit_fault;
} UNVT_Indoor_Data;
```

Valid values for these fields are as follows

Field	Valid Values
unit_number	1..16
hvac_mode	{AUTO=0, HEAT=1, COOL=3, FAN ONLY=9}
setpoint	18.00-29.00 Degrees Centigrade
on_off	{OFF=0, ON=1}
fan_speed	{AUTO=0, LOW=1, MEDIUM=2, HIGH=3}
louver	{OFF=0, ON=1}
filter_state	NOT IN USE
indoor_temp	NOT IN USE
heat_exch_temp	NOT IN USE
unit_fault	1..255, 0 indicates no unit

Given an nviQuery within the valid defined address range *nvoIndoorData* returns the operating conditions for the corresponding address mapped unit and the current fault code for the unit. As the units are operating in master-slave all unit queries will return the same operating conditions. Under central control these values will be the current values as set by the BMS, under local control the values will reflect the current settings set from the keypad by the user. This feedback allows software grouping to be performed over multiple interfaces, so e.g. units connected to an LG1 interface can be slaved to an LRC-LG group.

Note that the filter state and the indoor and heat-exchanger temperatures are *not* available from the LRC. These values are included to make the NV structure compatible with the LTX interface and the Toshiba LG1.

network input config unsigned int nciMinUnitAddr

The config network variable *nciMinUnitAddr* defines the lowest valid address value for nviQuery and maps the unit addresses so that Unit #1 attached to the LRC-LG corresponds to *nviQuery=nciMinUnitAddr*. Default value is 1.

network input config unsigned int nciMaxUnitAddr

The config network variable *nciMaxUnitAddr* defines the highest valid address value for nviQuery and maps the unit addresses so that Unit #1 attached to the LRC-LG corresponds to *nviQuery=nciMinUnitAddr*, and the highest address value that the LRC-LG will respond to is *nviQuery=nciMaxUnitAddr*. Default value is 16.

network input config unsigned int nciProtocol

The value of *nciProtocol* sets the Toshiba communications protocol that the LRC-LG uses. Setting *nciProtocol=3* configures the LRC to operate in 'Series 0 to 3' protocol compatible with

old R22 systems and new R407C cooling only split units. Setting *nciProtocol=4* (or any value other than 3) causes the LRC to operate in 'Series 4' protocol compatible with R407C heatpumps and all R407C VRF systems. Default value is 3.

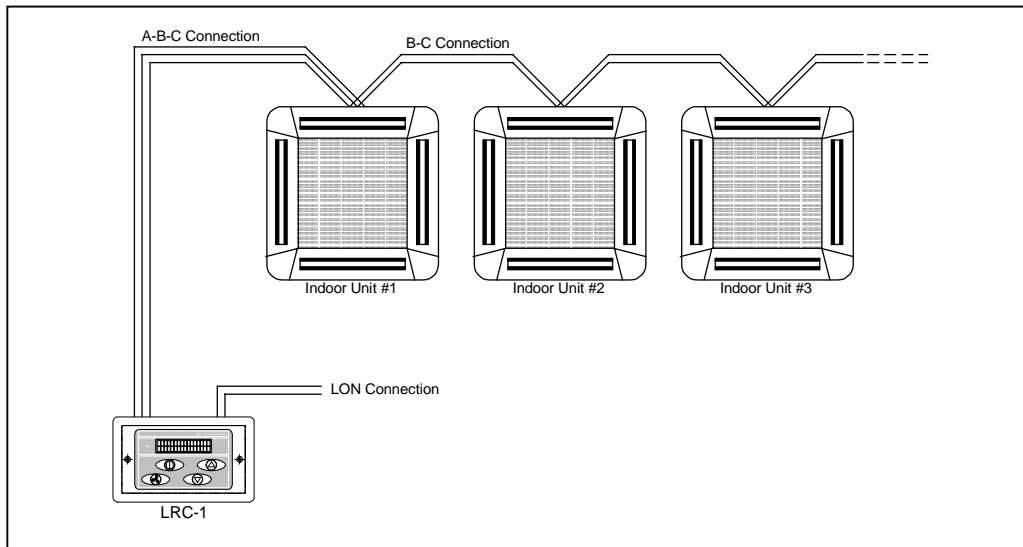
network input config unsigned int nciRecallMode

The value of *nciRecallMode* determines how the LRC transitions from central to local control. This allows previous user selected operating conditions to be restored, or for local control to be initialised with the current BMS operating conditions.

nciRecallMode	Restore options on central-local transition
0 (default)	On/Off state, setpoint, fanspeed
1	setpoint, fanspeed
2	None (use BMS settings)

The default value is 0.

Installation Instructions



Flush Mounting

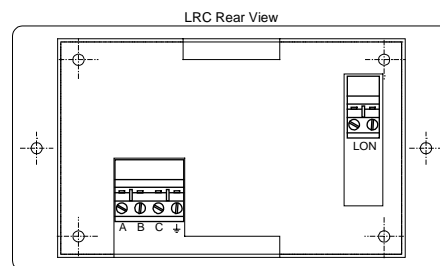
- 1) The LRC-1 should be mounted in a standard double-gang dry-lining box with at least 35mm internal depth. It is possible to mount the LRC-1 in a metal back-box but the box must be selected to ensure that the internal height of the box is at least 68mm and the depth is at least 35mm. Place the supplied stainless steel bezel over the front of the unit and fix in place using two countersunk M3.5 screws through the two mounting holes.

Surface Mounting

- 2) The LRC-1 can be mounted in a surface mounted double-gang box providing the internal depth of the box is at least 35mm. If the LRC-1 is to be blanked off then fix a standard double gang blanking plate over the front using two countersunk M3.5 screws. Otherwise fix the supplied stainless steel bezel over the front and fasten using two countersunk M3.5 screws.

Electrical Connections

- 3) The LRC-1 is powered via the ABC connection to the Toshiba indoor unit. If panel mounting then wire the ABC terminals on the LRC-1 (shown to the right) to suitably labelled field wiring terminals. If field mounted then wire the ABC connection from the associated indoor unit to the ABC terminals on the LRC-1. With multiple indoor units wire in the same way as for the Toshiba Remote Controller. The connection should be wired using a 3-core cable suitable for carrying 12V AC with cross section of 0.75mm².
- 4) Connect the LonWorks network to the two way orange connector labelled 'LON' at the rear of the LRC-1. The connection is polarity independent. The wiring should be unshielded twisted pair.



LRC-LG

Technical Specification

Electrical

Supply	12V AC on AB connection from indoor unit
Power	1VA
Processor	Echelon 3120
Clock Speed	10 MHz
LON Network	FTT-10A Transceiver, Free topology network

Environmental

Temperature Storage	-10oC to 50oC
Operation	0oC to 50oC
Humidity	0-90% RH non-condensing
Protection	IP30
EMC Emissions	EN50081-1
EMC Immunity	EN50082-1

Mechanical

Dimensions	(all dimensions in mm)
Bezel	H97 x W152 x D5 5mm proud of flush mount Mounting holes 3.5 dia, countersunk 121mm apart
Front Plate	H76 x W136 Mounting holes 3.5 dia, 121mm apart
Rear box	H68 x W108 x D26 H68 x W108 x D30 with connectors
Mounting	Flush or surface mounted double gang box, min depth 35mm
Bezel Material	16 gauge Bright annealed stainless steel (standard option)
Casing Material	Zinc coated mild steel
Weight	200g
ABC and LON Connectors	Two part rising clamp 0.5mm" to 2.5mm" cross sectional area cable

Future updates of this datasheet available from <http://www.realtime-controls.co.uk>