

LRC-1 Room Controller for Toshiba air-conditioning units

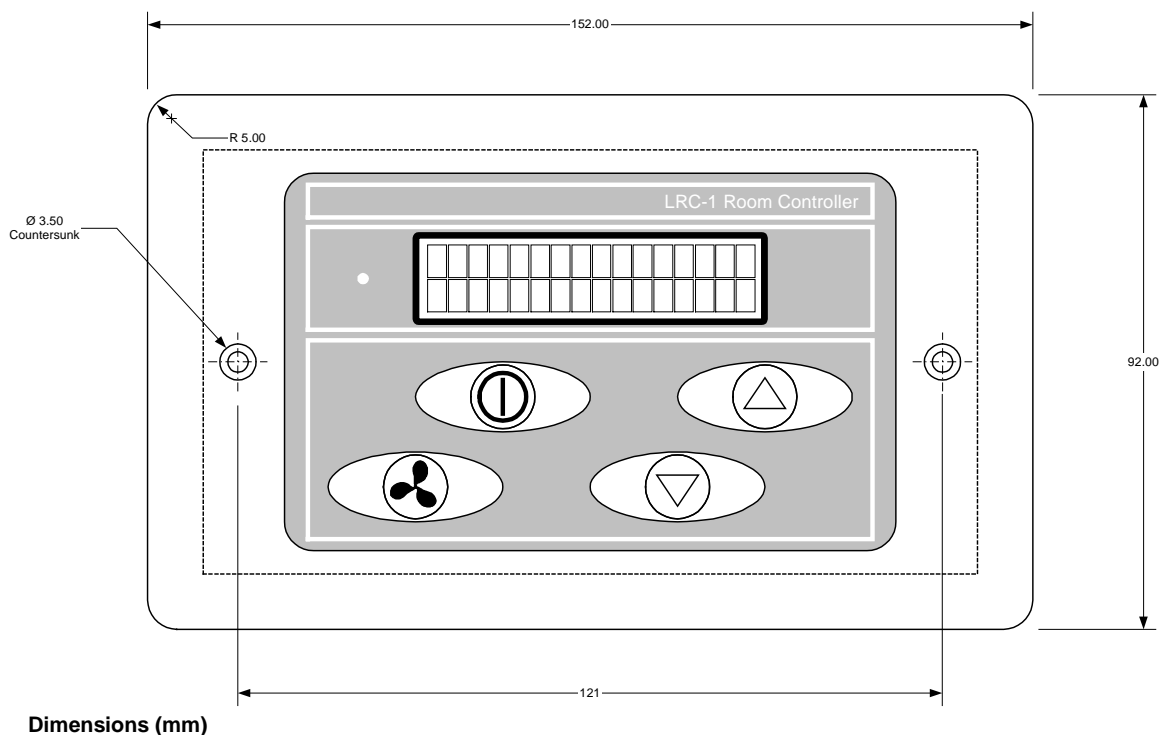


Description

The LRC-1 is an open-systems LonWorks® product that directly interfaces with Toshiba split units and VRF units and provides the occupant with a local user-interface to set the unit operating conditions such as the temperature setpoint and the fan speed. The LRC-1 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 LRC-1 derives its power from the connection to the indoor unit and so no additional power sources are required.

The LRC-1 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.

The LRC-1 is powered by a microprocessor which adds a LonWorks networking capability to the controller. Standard 'Network Variables' within the controller allow remote monitoring and control of the LRC-1 and the attached indoor unit. This 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. In addition fault codes occurring within the indoor unit are reported over the network, facilitating rapid and appropriate response to any faults that occur.



LRC-1/S

LRC-1/S 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
- Standard network variable allow complete remote control of indoor unit
- Feedback of fault codes for up to 16 units on LonWorks network
- Local and remote lockout with optional override timers.

Description

The LRC-1 connects to both Toshiba R22 and R407C RAV indoor units and replaces the standard remote controller. The LRC-1 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.

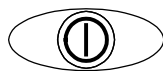
A LonWorks network port on the LRC-1 allows remote control and monitoring of the indoor unit and allows the local control to be locked out and overridden by the building management system. Standard network variables allow the LRC-1 to bound to other LonWorks devices to achieve remote control of the unit. Up to 16 indoor units can be controlled as a group from the LRC-1 and the fault codes for each of these units is available as a network variable 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-1 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.

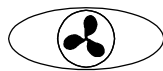
The LRC-1 is compatible with the RealTime LTX-22 BMS interface, allowing the LRC-1 to be controlled and monitored from a standard BMS.

Keypad Functionality

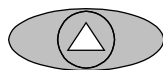
The LRC keypad has four keys that allow control over the on/off state, fanspeed and setpoint. These keys are as follows



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.

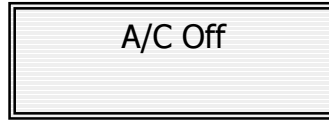


Decrease setpoint Pressing this key will decrease the setpoint by 1°C steps until it reaches the minimum value.

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 using the network variables *nviLouver* and *nviRunMode*

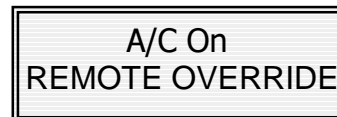
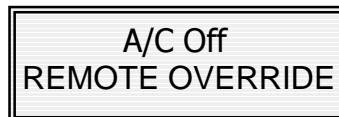
Remote Override Mode

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 *nviOccState* is used to lockout remote BMS control and local keypad control as shown in the following table.

nviOccState	Control Mode
OC_UNOCCUPIED	Remote control, local keypad lockout
OC_OCCUPIED	Remote lockout, local keypad control
OC_BYPASS	'Last touched' control
OC_STANDBY	'Last touched' control

The OC_BYPASS and OC_STANDBY modes allow updates from either the BMS via network variables or from the user via the keypad. These modes can cause conflict between the user and the BMS unless carefully used, however they are useful for commissioning purposes.


During OC_UNOCCUPIED mode the LRC keypad is locked out and the default display on the LCD screen is one of the following depending on the state of *nviOnOff*:





Engineering commands

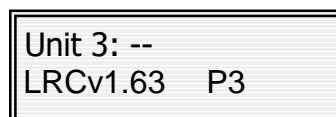
Several additional commands are available from the LRC keypad for engineering purposes.

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 "LRCv...". 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 4 protocols. Note that Series 3 covers all previous series using R22.

NOTE: This feature 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. 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

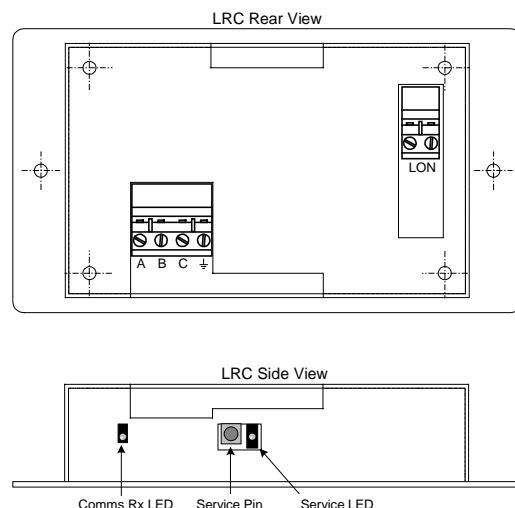


Figure 1. LRC rear and side views

LRC-1/S

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.

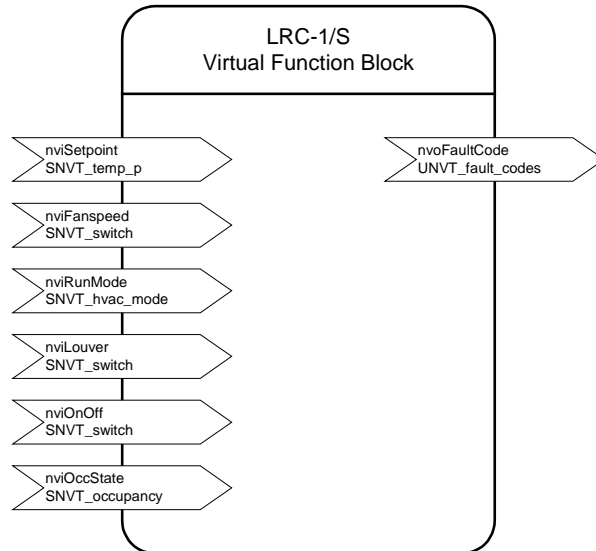
The LRC ABC terminals should be connected to the ABC terminals of unit 1 using a 3-core cable suitable for carrying 12V AC with cross section of 0.75mm². Ensure that the diameter of the cable used can fit in the clearance between the rear of the LRC casing and the rear of the mounting box.

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.

LRC-1/S Functional Profile



The LRC-1 functional profile is shown above. The following table gives a summary for each network variable.

NV#	Name	In/Out	Type	Description
0	nviSetpoint	In	SNVT_temp_p	Remote setpoint
1	nviFanspeed	In	SNVT_switch	Remote fanspeed
2	nviRunMode	In	SNVT_hvac_mode	Remote operating mode
3	nviLouver	In	SNVT_switch	Remote louvre status
4	nviOnOff	In	SNVT_switch	Remote on/off status
5	nviOccState	In	SNVT_occupancy	occupancy state
6	nvoFaultCode	Out	UNVT_fault_codes	Unit fault codes

The LRC-1/S is a room controller that combines a local user-interface with a remote control capability and the reporting of unit fault codes. The LRC-1/S 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 and the fault code status for each unit is reported back and available in the *nvoFaultCode* network variable.

Because 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 *nviOccState* provides modes in which either local or remote control of certain parameters are locked-out, as well as a 'last-touched' mode which allows operation from local and remote sources simultaneously.

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

The *nvoFaultCode* reports the fault codes for each of up to 16 units connected to the LRC-1 via the ABC connection. This network variable contains an array of 16 values with the first value corresponding to the unit with address 1, and the sixteenth value corresponding to the unit with address 16. A value of 255 (decimal) corresponds to a normally operating unit, a value of 0 indicates no unit exists at that address. Other values indicate particular faults. If no unit with address 1 exists then a '99' (hex) fault code will be generated.

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LRC-1/S Network Variables

network input SNVT_temp_p nviSetpoint

Active when *nviOccState* is not OC_OCCUPIED. Sets the operating setpoint of the units. Valid range is 18 to 28 Degrees C. Fractional values are rounded to the nearest whole degree The default value on power-up is 21 Degrees C.

network input SNVT_switch nviFanspeed

Active when *nviOccState* is not OC_OCCUPIED. Sets the fanspeed according to the following formula

nviFanspeed.state	nviFanspeed.value	Fan speed
0	n/a	AUTO
1	0.5 to 33.0	LOW
1	33.5 to 66.0	MEDIUM
1	66.5 to 100.0	HIGH
1	>100.0	HIGH
2 to 0xFF	n/a	AUTO

The default value on power-up is .state=0, .value=0 giving AUTO fan speed.

network input SNVT_hvac_mode nviRunMode

Active under all *nviOccState* conditions. Sets the run mode of the units according to the following table

nviRunMode	Unit Mode
HVAC_AUTO	AUTO
HVAC_HEAT	HEAT
HVAC_COOL	COOL
HVAC_FAN_ONLY	FAN ONLY
any other valid state	AUTO

Note that cooling only units should be set to HVAC_COOL in order for them to operate.

The default value on power-up is HVAC_AUTO.

network input SNVT_switch nviLouver

Active under all *nviOccState* conditions. Switches the louvers on the units between on and off. The condition for the louvers to be ON is *nviLouver.state=1* and *nviLouver.value>0*. All other combinations set the louvers OFF. The default value is .state=0, .value=0 giving louver OFF.

network input SNVT_switch nviOnOff

Active when *nviOccState* is not OC_OCCUPIED. Switches the units on and off. The condition for the units to be ON is *nviOnOff.state=1* and *nviOnOff.value>0*. All other combinations set the units OFF. The default value is .state=0, .value=0 giving units OFF.

*network input SNVT_occupancy **nviOccState***

Switches control between the local user interface and remote control via network variables. The source of the on/off status, setpoint and fan speed is controlled by this input. The valid values are given in the following table

nviOccState	Control Mode
OC_UNOCCUPIED	Remote control, local keypad lockout
OC_OCCUPIED	Remote lockout, local keypad control
OC_BYPASS	'Last touched' control
OC_STANDBY	'Last touched' control

When the variable is set to OC_UNOCCUPIED the local keypad control is completely locked out. The LRC display shows AC/On or AC/Off together with REMOTE OVERRIDE. When the variable is set to OC_OCCUPIED the on/off state, setpoint and fanspeed are controlled from the local user interface which displays the state of these three variables, the network variables corresponding to these are locked out. If the variable is set to OC_BYPASS or OC_STANDBY the local interface is the same as in the OC_OCCUPIED state but the network variables are not locked out. This produces a 'last-touched' behaviour where setting a network variable will override the local setting, and setting the value through the local keypad overrides previous network settings. These states are particularly useful during commissioning the settings from the network are displayed on the keypad.

The default values is OC_OCCUPIED, network variables locked out and keypad enabled.

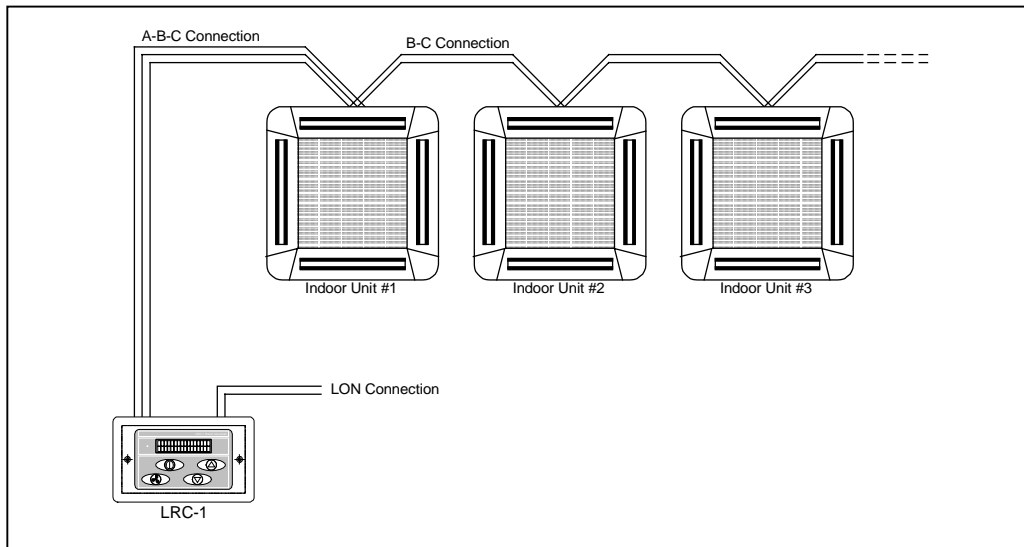
*network output UNVT_fault_codes **nvoFaultCode***

The *nvoFaultCode* returns the fault status of up to 16 units connected to the LRC. This is a user defined network variable of the following form

```
typedef struct {
    unsigned int    unit_fault[16];
} UNVT_fault_codes;
```

Each member of the array of values represents the fault status of one unit with unit addresses relating to the corresponding member of the array. For any unused address the corresponding array value will be zero, except for unit 1, which if absent will cause the first array value to be set to 153 decimal ('99' hex). Each allocated address index will return a value of 255 decimal ('FF' hex). Any other value corresponds to a unit fault.

Installation Instructions



Flush Mounting

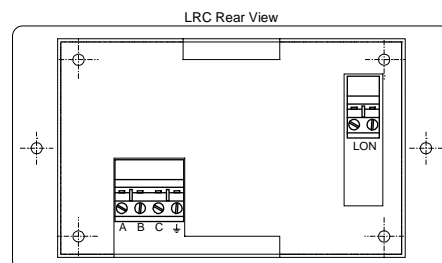
- 1) The LRC-1 should be mounted in a standard double-gang dry-lining box with at least 35mm internal depth. It is possible to mount the LRC-1 in a metal back-box but the box must be selected to ensure that the internal height of the box is at least 68mm and the depth is at least 35mm. Place the supplied 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-1/S

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 ² to 2.5mm ² cross sectional area cable

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