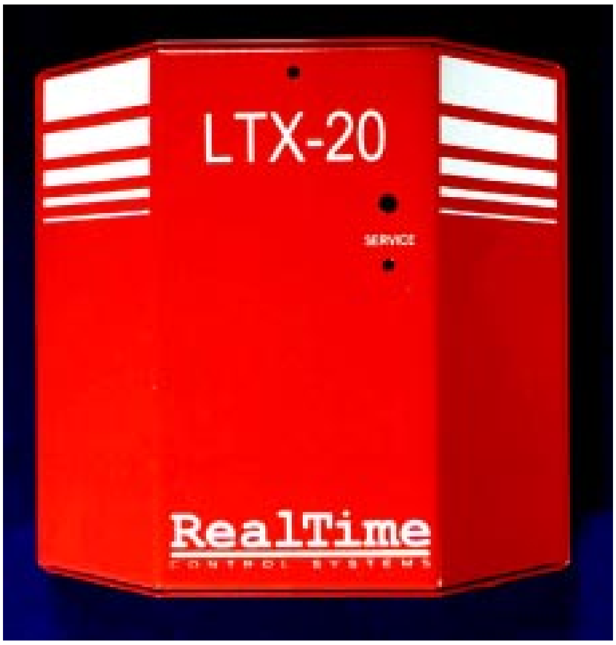
RealTime
CONTROL SYSTEMS

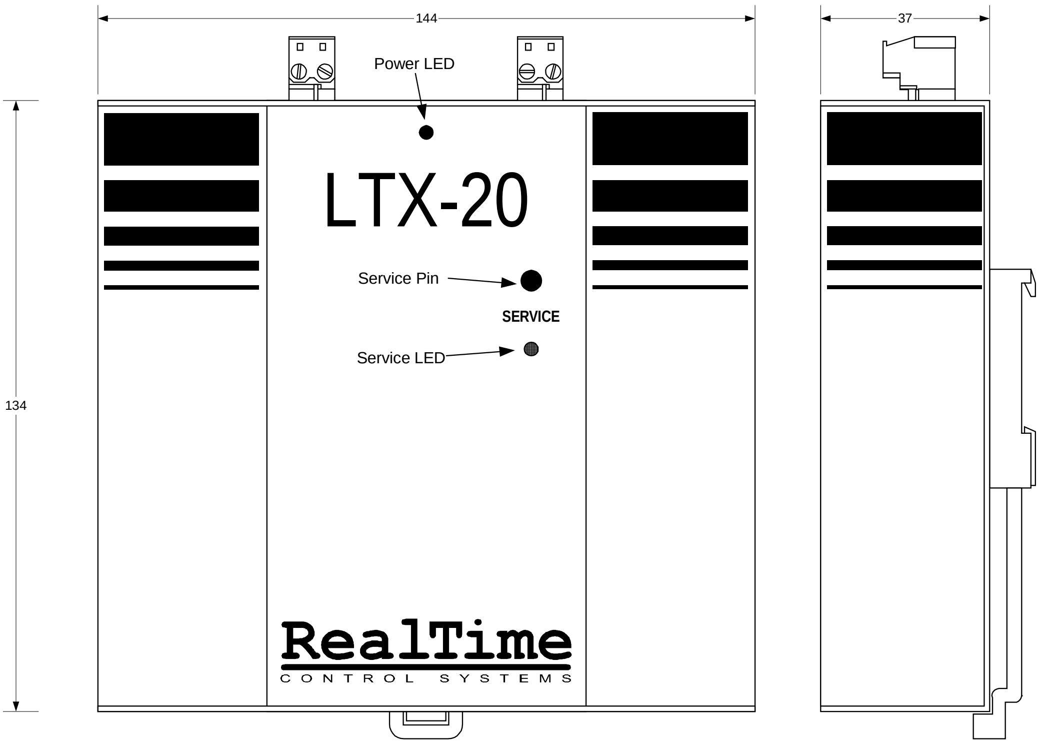
LTX-22 Datasheet

LTX-22 BMS Gateway for Toshiba air-conditioning units



Description

The LTX-22 provides the necessary functionality for integrating both R22 (Series 0 to 3) and R407C (Series 4) Toshiba RAV range air-conditioning units with the UK's leading BMS manufacturers products. The LTX-22 is used in conjunction with up to 4 RealTime LRC-1 interfaces that communicate directly with Toshiba indoor units as well as providing local user interfaces. The gateway removes the need for hardwired connections to BMS input and outputs and replaces them with a networked connection. All functionality available using hardwired inputs is available, in addition specific fault-codes from the Toshiba system are reported as BMS alarms and can be received by any connected BMS supervisor either on site or remotely. The gateway can handle up to 16 units controlled in up to 4 independent groups, removing the need for up to 20 hardwired i/o points on the BMS, and can report fault codes from each of the indoor units connected. Furthermore the LTX-22 can provide feedback for up to 16 LonWorks temperature sensors to allow for monitoring of space and return air temperatures.



Dimensions (mm)

LTX-22

Features

- Direct integration with existing control strategy
- Integrates up to four RealTime LRC-1 Toshiba controllers into BMS strategy
- Allows integrated control of both R22 and R407C indoor units
- Control of up to 16 indoor units in up to 4 separate groups
- No hardwiring required
- BMS alarm reporting of fault codes for each of the 16 indoor units and attached outdoor units.
- Programmable default operating conditions
- Feedback of up to 16 LonWorks temperature sensors
- Co-ordinated BMS and local user control with local lockout facilities
- Compatible with UK leading BMS control system

System Requirements

The LTX-22 connects to the host BMS via the RJ-11 Supervisor port found on most controllers. For correct functionality the controller must have a ‘network aware’ supervisor port – consult the manufacturers literature to ensure that the selected controller has this capability.

The control of the air-conditioning equipment is achieved via RealTime LRC-1 Toshiba to LonWorks interfaces. Each LRC-1 connects to the Toshiba indoor units using the Toshiba ABC wiring. Up to 16 indoor units can be controlled as a group from a single LRC-1. The LonWorks port on the LRC-1 allows common operating conditions for the group to be set as well as reporting fault codes for each of the units connected. The LRC-1 has a local user interface which allows the user to have control over the setpoint, fanspeed and on/off status of the unit. The LRC-1 can be operated under local user control or can be configured to lock-out local user control and only respond to BMS commands. The local/remote lockout is controlled by BMS commands and allows user control to be enabled for specific periods during occupancy.

The LTX-22 can be bound to up to four LRC-1 controllers, giving four independently controlled groups of units. The LTX-22 is limited to handling a total of 16 indoor units across the four LRC-1 interfaces, the design rules for group sizes are outlined in the next section. Figure 1 shows the connectivity between the BMS, the LTX-22, LRC-1s and the air-conditioning units.

Both the LTX-22 and LRC-1 are based on LonWorks® technology which allows the devices to be directly connected via a single free-topology network. In order to enable communications between the LTX-22 and the LRC-1 interfaces it is necessary to ‘bind’ the devices together

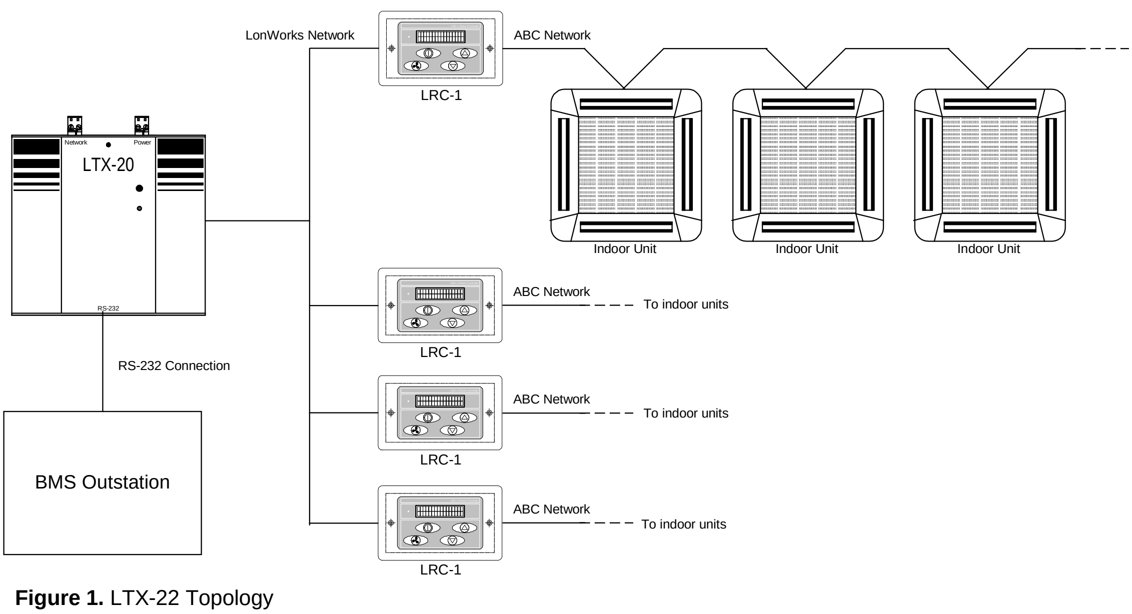


Figure 1. LTX-22 Topology

using a suitable LonWorks Network Management tool. The LonWorks design and commissioning should be performed by a competent LonWorks engineer.

Once the initial network engineering has been performed the system can be configured and tested from either the LonWorks or the BMS side of the gateway.

Design Rules for Unit Grouping

The LTX-22 has four Groups that are linked by LonWorks binding to a particular LRC-1. Each of the indoor units linked to the LRC-1 are mapped into an array of Zone objects numbered 1 to 16 within the LTX-22.

The unit addresses that are 'visible' for each group are dependent on what other groups are allocated. Figure 2 illustrates graphically how the unit visibility relates to the groups that are bound. In the figure each of the columns in the two rows shows the active units for a particular combination of groups. The active groups are indicated to the right of the columns. At the left of the rows the corresponding LTX zone is indicated. Within the columns the units are indicated by the group number and the unit address, so unit with address 12 in the LRC bound to the LTX-22 Group 3 is written 'G3U12'.

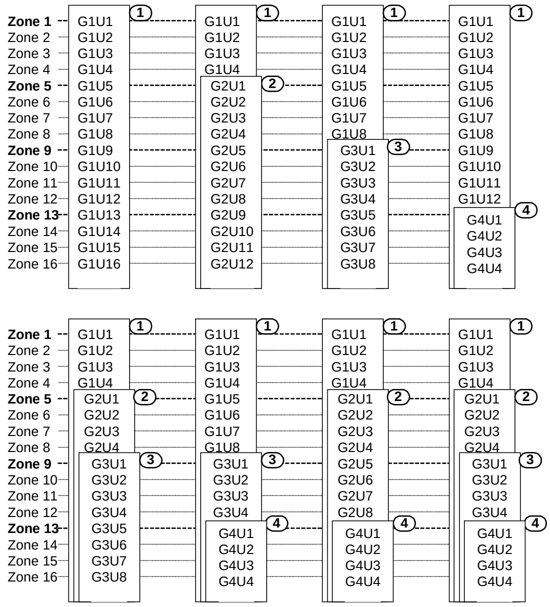


Figure 2 Unit grouping combinations

The simplest configuration is with only Group 1 bound. This makes all 16 addresses in group 1 visible, with the LTX Zone 1 corresponding to G1U1, up to Zone 16 corresponding to G1U16. This configuration is shown in the left most column of the top row in figure 2.

If a second group is added, the units that are visible in both groups are dependent on which second group is used. If Group 2 is added, then this will mask all of the Group 1 units beyond G1U4, as shown in the second column in the first row of the figure. Hence with this combination Group 1 has units G1U1-G1U4 visible, and Group 2 has units G2U1-G2U12 visible. Group 2 units are mapped so that LTX Zone 5 corresponds to G2U1 and Zone 16 corresponds to G2U12.

If Group 3 was added instead of Group 2, then the first 8 units of group 1 remain visible, and the first 8 units of Group 3 are also visible and mapped so that Zone 9 corresponds to G3U1 and Zone 16 corresponds to G3U8. Hence in this case two groups of 8 units are handled.

If three out of the four available groups are used, then two of the groups will have 4 units visible and one of the groups will have 8 units visible. If all four of the groups are allocated then each group will have 4 units visible. In every case the visible unit addresses begin at address1.

The number of units visible for a group can be 4, 8, 12 or 16 depending on group allocation. The combinations available are [16], [12,4], [8,8], [8,4,4], [4,4,4,4]. No matter what combination of groups are used, it is only possible to see a maximum of 16 units. When allocating groups whose size is not a multiple of 4 it is necessary to select the next largest group size that is a multiple of 4, so if 5 units are allocated to a group it is necessary to use a group of size 8 to ensure all 5 units are visible. Therefore it may not be possible to use all 16 allocated units within a single LTX-22.

Example 1: *Two independently controlled groups are required, one with three units and one with nine units. This can be achieved by allocating the three units to Group 1, and the nine units to Group 2 so that Group 1 has a capacity of four units and Group 2 has a capacity of 12 units.*

Example 2: *Three independently controlled groups are required, of sizes eight, six and two. The total number of units is 16, but it is not possible to fit these three groups into one LTX-22. In this case one LTX-22 can handle two of the groups, but an additional LTX-22 must be added to handle the third group.*

LTX-22 Functionality

Each LRC-1 group requires the following information to be set to determine its operation.

- Setpoint
- Fan speed
- Run Mode
- Louver Control
- On/Off state

Values for these states are usually determined in the BMS control strategy according to time-of-day, external conditions etc.

The LTX-22 works by extracting these values from the analogue array of an outstation and converting them into *network variables* compatible with the LonWorks interface to the LRC-1. The LRC-1 feeds back the fault codes from each unit. Each Group can be independently mapped into a different part of the analogue array, allowing multiple ‘soft’ zones and the ability to rezone through software. The control can be split over two outstations if more complex control strategy is required.

The LTX-22 monitors the faults codes of each of the indoor units and if a unit enters a particular fault state a standard BMS alarm is generated which reports which unit is in alarm and the particular fault code. These codes are briefly summarised at the end of this datasheet. The fault-codes can be written into fields in the BMS outstation to allow the hexadecimal fault codes to be displayed on BMS supervisors. Decimal equivalents of the fault codes can also be written to the BMS to allow the control system to account for faulty units.

The LTX-22 also provides a ‘fail-safe’ mode of operation that places all of the air-conditioners in a user defined default mode should communications with the BMS fail for any reason.

Toshiba Configuration

The LRC-1 communicates with the indoor units via the Toshiba ABC network. Every unit should be connected to the ABC network as described in the Toshiba installation manual and allocated a unique address from 1 to 16 using the rotary switch on the indoor unit. Addressing should begin at address 1 for each LRC-1 group. If unit 1 is not included in the addressing the LRC-1 will generate a ‘99’ fault code.

Both R22 and R407C systems can be used, although R22 and R407C units should not be connected to the same LRC-1, so each group can be either R22 or R407C. Due to the use of the ABC connection it is not possible to extract temperature measurements from the indoor units.

LonWorks Configuration

The first step in configuring a systems is to perform the necessary LonWorks engineering to bind the LTX-22 and the LRC-1s together. Any suitable LonWorks network management tool can be used. Details of the LTX-22 functional profile are provided at the back of this datasheet.

Firstly, install the LTX-22 in the engineering tool using the service pin method. If no copy of the external interface file is available then upload this from the device. Add the LTX-22 function block to the project.

For each LRC-1, firstly install the device and then bind LRC-1 to the selected LTX-22 Group object. There are 4 LonMark group objects numbered accordingly.

Once the binding for each zone is complete the LonWorks engineering of the system is complete, however it is recommended the engineering tool is left attached to the network, or is reattached after commissioning is complete as this will allow LTX-22 configuration parameters to be saved in the project database for backup purposes.

BMS Configuration

The next step is to configure the LTX-22 gateway to transfer data to and from the the BMS and to report alarms to the correct destination. The strategy running in the BMS will determine the required operating conditions for each zone. The following summarises the required outputs for a single zone and the values that should be set for different operating requirements.

Output	Values
1. Setpoint	between 18 and 29 Degrees C
2. Fanspeed	0 AUTO 1 LOW 2 MEDIUM 3 HIGH
3. Run Mode	0 AUTO 1 HEAT 3 COOL 9 FAN ONLY
4. Louver Control	0 OFF 1 ON
5. On/Off	0 BMS control - OFF 1 BMS control – ON 10 Local Control – OFF 11 Local Control – ON 20 Either Control – OFF 21 Either Control – ON

For each zone five adjacent nodes in the analogue array of the controlling outstation must be reserved. So for example if analogue nodes A161 to A165 are reserved for Zone 1, then A161 will contain the Setpoint, A162 will contain the Fan speed and so on up to A165 which contains the On/Off status.

For zone ‘x’ the command Zx(R) is used to define the remote offset into the outstation analog array where the five values are located. In the above example the command Z1(R=161) is used to set Zone 1 to point to analog nodes 161 to 165. The default Remote Offset value for each zone is zero, this means that the zone is inactive. Setting the Remote Offset value for particular zone to a non-zero value sets the zone as *active*, meaning that the corresponding indoor unit is polled, temperature measurements and any fault are fedback and the indoor unit is controlled from the remote outstation analog array.

Master and Slave Zones

In the LTX-22 each Zone 1 to 16 can be mapped into the BMS as a separate control zone. In the LTX-22 each Group is controlled in a master-slave fashion so that only a single set of control commands can be sent to all of the units within a group. To follow convention, unit 1 of a group is considered the master, therefore only the Zones associated with unit 1 addresses can be mapped back into the BMS. As shown in figure 2, the master zones for each group are as follows:

Group	Master Zone
Group 1	Zone 1
Group 2	Zone 5
Group 3	Zone 9
Group 4	Zone 13

Therefore for each Group object that is bound to an LRC-1, the corresponding Zone remote offset Zx(R) must be set to map the group into the BMS. For example if Group 3 is active then Z9(R) must be configured to point to the array of control variables within the BMS associated with this group.

Indoor Unit Temperature Feedback

The LTX-22 can be used to feedback temperature measurements from up to 16 LonWorks temperature sensors. These can be positioned to provide return air-temperature for each indoor unit or space temperatures local to the units. The LTX-22 contains an Open-Loop sensor objects containing an array of 16 network variables nviSpaceTemp[16] of type SNVT_temp_p. Each of these 16 variables is mapped back to 1 of the 16 zones within the LTX-22. However, due to the vagaries of LonWorks the network variables are numbered from 0 to 15, with the network variable names nviSpaceTemp[0] to nviSpaceTemp[15]. Hence the Zone 1 temperature measurement is actually nviSpaceTemp[0].

Every Zone that has a bound temperature input can feedback this temperature to the BMS. This is achieved by allocating an array of up to 16 adjacent analog nodes within the remote outstation for each set of temperatures. The command F(R) defines an offset into the analog array for the return air temperatures. Temperatures are fedback for zones that have bound inputs, hence if only Zones 1 and 2 have bound temperature inputs then only two consecutive analog nodes need to be reserved for the temperature measurements. For example if there are 10 bound zones 1 to 10, if F(R=201) then the return air temperatures from zones 1 to 10 will be written to analog nodes 201 to 210. Note that the offset is based on the zone number, so if Zones 1 and 16 are bound and F(R=201). the analog nodes 201 and 216 will be written to.

Temperature feedback from zones is independent of whether any indoor unit exists at that Zone so all Zones can be used for temperature feedback even if only a single indoor unit is being controlled.

Fault Code Feedback

The fault codes for each zone are reported as alarms to the alarm supervisor. Additionally it is possible to write the fault codes into the remote outstation in a similar fashion to the temperature feedback. The standard method for reporting and displaying faults from air-conditioners is based on *hexadecimal* numbers, with codes such as ‘0C’ and ‘B7’.To retain consistency with service manuals this method is used in the LTX-22 to report fault codes. However the standard method for displaying values within the remote outstation uses decimal values. In order to allow fault codes to be displayed in hexadecimal the codes are treated as text and written into an internal sensor ‘Units’ fields, for example S17(%=”0C”) and S18(%=”—“). By allocating a set of internal sensors for this purpose and leaving their values as zero, it is possible to display the sensor label and units to give a summary of all units codes on a single page. With some supervisors it is necessary to reload the page to refresh the values as they are only read from the outstation once. The command F(H) defines an offset into the sensor array as with the temperature offsets. So for example with zones 1 to 10 active, setting F(S=17) will write the fault codes for each zone into sensors S17(%) to S28(%). At present no alarm bits are set within the sensor.

It is possible that there is a need to use the fault status of each indoor unit to generate additional alarms or to operate some form of change-over. In this case there is a need to send a decimal value to the outstation so that the value can be used within strategy calculations. The command F(D) defines an offset into the analog array that allows each active zones fault code to be written as a *decimal* value, using the same offset method used for temperature feedback. The fault code is written as its decimal equivalent e.g. '0C' is written as 12 and 'B7' is written as 183. The standard method for displaying the 'no fault' condition is to display to dashes in the form '—', this actually corresponds to a hexadecimal value of 'FF', equating to 255 in decimal. Therefore the value 255 indicates a normally operating unit, and a strategy that tests if value NOT EQUAL to 255 can be used to perform changeover if a fault occurs. Similarly specific strategy can be written to respond to particular fault conditions.

It is strongly recommended that the decimal values are not displayed to the user as the use of hexadecimal values is well established and displaying the decimal values is likely to lead to confusion.

Co-ordinated BMS and Local Control

The LTX-22 allows BMS control of the air-conditioning system and in the most basic configuration no local user control of the units is available. This is generally the most energy efficient mode of operation as the BMS control is used to minimise the energy used to condition the spaces. In this case the LRC units bound to the LTX-22 would be panel mounted or placed behind blanking plates so that the user has no access to the controllers, however they can still be used for commissioning purposes.

The LTX-22 can also be used to operate the system in conjunction with wall-mounted LRC controllers. This type of control is more complex as it requires co-ordination to ensure that the BMS does not override user demands.

Combined BMS/local control generally involves allocating times during which the user has control of the system, and times during which the BMS has control of the system. This is achieved by using several different On/Off modes. The fifth control parameter written in the BMS is the On/Off value, this has a number of different modes

OnOff Value	**On/Off Mode**
0	BMS control - OFF
1	BMS control – ON
10	Local Control – OFF
11	Local Control – ON
20	Either Control – OFF
21	Either Control – ON

The basic control mode is BMS control, in which case the local user control is locked out. The LRC will indicate that it is under remote control and will not accept keypad commands. Changing to local control locks out further commands from the BMS and enables control from the LRC keypad. For example the transition OnOff=0 to OnOff=10 causes the unit to remain off, but enables the local controller and locks out the BMS control. If a user switches the unit on, and alters the operating mode, the unit will remain under user control until the OnOff state enables BMS commands. An LRC controller allows control over unit On/Off state, setpoint and fan speed, however louver state and run mode cannot be controlled. Therefore these commands are only set from the BMS and are therefore not locked out during local control. Therefore the louver status and run mode can always be changed from the BMS even during local control.

Example: *a meeting room is held off during unoccupied hours (OnOff=0) and during occupied hours local control is enabled but the system is kept off (OnOff=10). If the meeting room becomes occupied during defined occupancy hours the occupants can turn the system on until the occupancy time defined in the BMS is ended, at which time OnOff changes to 0, the system is turned off and local control is locked out.*

The mode OnOff=11 allows the unit to be turned on, so that the indoor unit controls to whatever the current BMS operating conditions are. After the unit has been turned on the BMS control is locked out and the user is free to make any desired alterations to the units operation.

A further refinement to the strategy can be achieved using the LRC override timer, in local mode OnOff=10 or OnOff=11 any user overrides will remain for x minutes after the first user command, after which the LRC will revert to the current BMS settings.

The OnOff modes 0 and 1 override any timer operation so even if the system is running in timed override, a transition to 0 will switch the unit off and lockout user control. A transition to 10 will not turn the unit off until the timer runs out.

Example: *a meeting room is turned off during unoccupied hours (OnOff=10) with local control available should the room be occupied outside of occupied hours. The LRC override timer is set to 120 minutes; should any user switch the system on, the system will run for 120 minutes under user command before switching back to BMS control. During occupancy hours the OnOff status can remain as 10 to keep the unit off, or the OnOff status can be set to 11 to turn the unit on in some default setback mode. Should a user override occur, at the end of the timed period the unit will revert to the setback state.*

The modes OnOff=10 and OnOff=11 lockout BMS control after a transition to these OnOff states so that any further changes of fanspeed, setpoint etc. are not sent to the unit. An alternative local operating mode is available using OnOff=20,21. In this mode *either* BMS or local control can occur. E.g setting OnOff=21 will turn the unit on, and further BMS changes in operating modes and setpoint will be sent to the indoor unit. However if the local user controller is operated, timed lockout of the BMS will occur. This method can be used to apply e.g default setpoint scheduling during occupancy hours until local timed user override occurs. If this mode is used with R(T=0), the system will operate in a 'Last Touched' mode. Either changes in the BMS settings or the local interface settings are accepted. Provided no changes in the BMS settings occur, local control is enabled, should any change in the BMS settings occur then these will override the BMS control. This mode can be used to provide infrequent scheduling of the system during occupied hours but may prove annoying to users. However this mode is useful in commissioning as the LRC will display the current BMS settings and so can be used to prove the transfer of information from the BMS to the LRC.

Multiple Outstation Addressing

With heavy strategy usage it is possible that not all zones can be controlled from a single outstation. In this case the use of a secondary outstation is possible. By defining secondary remote outstation R(S) and the switchover zone F(S), the control becomes split between the primary remote R(M) and the secondary remote R(S). The switchover zone defines the zone at which the switch between the two outstation occurs. For example if F(S=10), then zones 1 to 9 are controlled from the primary remote, and zones 10 to 16 are controlled from the secondary.

If switchover is used then the indoor unit temperature and fault code feedback is also switched between primary and secondary. The remote offsets F(H), F(D), and F(R) define the base offsets into analog and sensor arrays for both outstations; for example, if F(R=201) and F(S=10) then A201 to A209 in the primary outstation contain the return air temperatures from zones 1 to 9, and A210 to A216 in the secondary outstation contain data from the zones 10 to 16.

LTX-22 Configuration

The LTX-22 is configured using text communications. There are two possible ways of ways of communicating with the gateway using text communications, either using standard BMS engineering software or using a LonWorks SNVT to enter commands. Engineering from the

LonWorks side is achieved by setting up a network variable browser with monitoring enabled and browsing the LTX-22 Node Object. Within the node object are two SNVTs called nviCommandLine and nvoCommandLine. The nviCommandLine can hold text commands of up to 30 characters, and the nvoCommandLine will report any responses to these commands, although responses of greater than 30 characters will be truncated. The LonWorks side engineering feature is useful in situations where only a single supervisor port is available and so both the BMS engineering software and the LTX-22 cannot be plugged into the system at the same time. Using the LonWorks nviCommandLine method allows most engineering and commissioning steps can be performed without disconnecting the LTX-22 from the BMS.

If the LTX-22 is engineered in VDU mode it will not return the usual menu commands, but can still be engineered using text commands. When entering VDU mode the LTX-22 will return the header of the form

```
LTX-22 Iss1.00 Config Mode
OS1:OK  OS2:OK
```

The first line gives the device type and the firmware issue mode. The second line shows the current communications status. If communications with the primary remote outstation is ok then OS1:OK will be displayed, if a communications failure has occurred then OS1:FAIL will be displayed. If a secondary outstation is allocated and there are active zones allocated to the secondary then OS2 will be displayed along with OK/FAIL according to the communications status. If there is at least one active zone then LG1 communications status will display FAIL if all of the actives zones are not returning data from the LG1.

Alarm Modes

The LTX-22 has several alarm modes relating to different problems and mode changes.

An alarm is generated when ever the LTX-22 resets or powers-up. The time and date in the alarm is established from the remote outstation so the alarm is not generated until the time is established, however if communications can not be established with the remote outstation then a comms alarm will be generated with the time and data fields containing zero values.

If communications fails with either the primary or secondary remote outstations then a remote comms alarm is generated for either the primary (OS1) or the secondary (OS2). A comms failure causes the active zones mapped to that particular outstation to placed into default override mode using the defaults defined in A(D). The default conditions will be retained until communications is re-established. In addition communications polling for affected outstation backs off to prevent network congestion from undelivered messages. A communications cleared alarm will be reported when communication is re-established.

The indoor unit fault code recorded in each active zone is also reported as a hexadecimal fault code, an “ERROR CLEARED” alarm is reported when the fault clears. The fault reports the Zone number and the group code as shown in the example below

Example: Alarm Format

```
LTX-22      Zone #5 G2U1      FAULT CODE : 09         08:14 17/03/00
O039Z005 OUTL
```

Engineering Commands

Addressing

Remote Outstation Address

Command :	R(M)	addRess(reMote address)

Defines the outstation address of the remote BMS outstation where the control values for each of the control zones are located. This outstation must be on the same LAN as the LTX-22. This address is also used to set the time in the LTX-22. The default value for R(M) is zero, which prevents the LTX-22 from updating any of the zones control values or time values.

Secondary Outstation Address

Command :	R(S)	addRess(Secondary address)

Defines the outstation address of the optional secondary remote BMS outstation where the control values for each of the control zones can be located by defining a switchover zone F(S). This outstation must be on the same LAN as the LTX-22. The default value for R(S) is zero, which prevents the LTX-22 from updating any zones that are allocated to the secondary outstation.

Alarm Address and LAN

Command :	R(A,R)	addRess(Alarm address, alaRm lan)

Defines the address and remote Lan of the target for BMS alarms. The default value for R(R) is zero, the local lan. The default value for R(A) is also zero, this value defines no alarm target so no alarms are transmitted.

Local Address and Lan

Command :	R(L,N)	addRess(Local address, local laN)

The local address is defined by the controller that to which the LTX-22 is attached and is automatically detected.

Device Identifier

Command :	R(D)	addRess(iDentifier)

The identifier is a 15 character text identifier that can consist of upper and lower case characters, numbers, spaces and punctuation excluding inverted commas. The identifier is used in alarm transmissions should be set to identify the device and its function. The identifier is written by placing inverted commas around the string e.g. R(D=”abcd”).

Alarm Filter Time

Command :	R(F)	addRess(Filter time)

The alarm filter is used only for Toshiba alarms and can be used to prevent short 'glitch' alarms from being reported. Filter time defines the minimum time in minutes that an alarm must exist before it is reported. Similarly an alarm must be cleared for the same amount of time before the alarm is reported. If F=0 then all alarms are reported no matter how short the duration before the alarm clears or changes. The default value is zero, no alarm filtering.

Feedback Offset Indexes

Switchover Zone

Command :	F(S)	oFfset(Switchover zone)

Defines the zone at which control switches from primary to secondary outstation. Valid when a secondary address R(S) is set. The default value is zero, meaning all zones are located on the primary remote outstation. If F(S=1) then all zones are located on the secondary outstation.

Hexadecimal Fault Code Offset

Command :	F(H)	oFfset(Hexadecimal fault code offset)

Defines the offset into the Sensor array in the remote outstation (and the secondary if used) where fault codes can be reported. The codes are reported in hexadecimal and written into the Units field S(%). The default value is zero, no feedback of hex fault codes. Values are only reported for active zones, if H=1 then S1(%) contains the hex fault code for Zone 1, and S16(%) contains the fault code for Zone 16.

Decimal Fault Code Offset

Command :	F(D)	oFfset(Decimal fault code offset)

Defines the offset into the analog array in the remote outstation (and the secondary if used) where fault codes can be reported. The codes are reported in decimal and written into the analog node value The default value is zero, no feedback of decimal fault codes. Values are only reported for active zones, if D=101 then A101(V) contains the decimal fault code for Zone 1, and A116(V) contains the fault code for Zone 16.

Return Air Temperature Offset

Command :	F(R)	oFfset(Return air temperature offset)

Defines the offset into the analog array in the remote outstation (and the secondary if used) where return air temperatures can be reported. The default value is zero, no feedback of return air temperatures. Values are only reported for active zones, if D=101 then A101(V) contains the return air temperature for Zone 1, and A116(V) contains the return air temperature for Zone 16. The temperatures are reported to a resolution of 0.5^{o}C, the resolution available from the indoor units.

Zone Control

Zone Remote Analogue Array Offset

Command :	Zx(R)	Zone x(Remote offset) where x=1, 5, 9, 13

The remote offset defines the location of the control values for Zone x in the remote outstation analogue array. Each zone corresponds to five consecutive values in the analog array beginning at the location defined by Zx(R).

For example Z5(R=161) specifies that zone 5 corresponds to analogue nodes 161 to 165 in the remote outstation. In this case the values are is follows

A161(V) is the setpoint temperature
A162(V) is the fanspeed
A163(V) is the run mode
A164(V) is the louver control
A165(V) is the on/off state

The default value for Zx(R) is zero, this indicates that the remote link feature for zone x is not activated and the network outputs for this zone are only controlled by the local analog array values.

The LonMark group objects that are bound to LRCs are related to the Zones as follows

Group	Master Zone
Group 1	Zone 1
Group 2	Zone 5
Group 3	Zone 9
Group 4	Zone 13

All other zones are slave zones and setting the Remote offset has no effect.

Zone Alarm Summary

Command :	Zx(A)	Zone x(Alarms) where x=1 to 16

The alarm summary is a read-only command that returns the hexadecimal alarm code for the corresponding indoor unit. In addition, if the corresponding network variable is bound the command also returns the return-air temperature zone. The identifier GxUy is displayed with the zone number to indicate which Group and Unit are associated with the zone.

For example the command Z1(A)Z2(A)Z3(A)Z4(A) will produce the response of the form:

```
Z1   G1U1 CODE:09
Z2   G1U2 CODE:--  RA:19.5
Z3   RA:22.34
Z4   NOT ACTIVE
```

In this example two indoor units with addresses 1 and 2 are active in group 1. Unit 1 has fault code 09 and unit 2 has no fault. In addition nviSpaceTemp[1] and nviSpaceTemp[2] are bound which are mapped to zones 2 and 3. No active unit exists for Zone 4 and nviSpaceTemp[3] is not bound so Zone 4 displays “NOT ACTIVE”.

The command Z(A) returns the data for all 16 LTX-22 zones

Analog Array

Analogue Value

Command :	Ax(V)	Analogue(Value) where x=1 to 82

The LTX-22 contains a simple analogue array containing the various control values for each of the sixteen zones. The zones relate to the local analogue array as follows

	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9	Z10	Z11	Z12	Z13	Z14	Z15	Z16
Setpoint	**1**	6	11	16	**21**	26	31	36	**41**	46	51	56	**61**	66	71	76
Fan Speed	**2**	7	12	17	**22**	27	32	37	**42**	47	52	57	**62**	67	72	77
Mode	**3**	8	13	18	**23**	28	33	38	**43**	48	53	58	**63**	68	73	78
Louvre	**4**	9	14	19	**24**	29	34	39	**44**	49	54	59	**64**	69	74	79
On/Off	**5**	10	15	20	**25**	30	35	40	**45**	50	55	60	**65**	70	75	80

The local analogue array is particularly useful as a commissioning tool. Before the remote link is established with the outstation, even with the LTX-22 disconnected from the BMS, the local analog values can be written to (via nviCommandLine) in order to locally set the operating conditions of each indoor unit. This can only be achieved if the remote zone offset for that zone is set to zero or the remote address R(M=0), otherwise it will appear that a communcations fault has occurred and the zone will be set to its default values. The analog array values will also be set to default when the device is reset or repowered.

Only zones 1, 5, 9 and 13 are actively mapped to the four groups in the LTX-22 so only the analog values associated with these zones are relevant to the control of the LRC controllers bound to the four LTX-22 Group objects.

Two additional analog nodes A81(V) and A82(V) are available for commissioning purposes. Writing a valid Zone number to A81(V) and a value of between 1 and 255 to A82(V) will cause a fault to be generated in the zone defined by A81(V), where the value A82(V) is the decimal code that will be converted into a hexadecimal value. Writing A82(V=255) will clear the fault. If the zone is inactive i.e. Zx(R=0), then the zone will be made temporarily active but its fault values will not be written into the remote outstation. If the zone is active and there is a corresponding indoor unit then test fault will be set and reported, and will then be overwritten by the actual fault status of the unit. If the zone is set active but no indoor unit exists with the same zone number then the test fault will be retained and written to the remote outstation, but when the LTX-22 polling of the zone times out it will set a '99' 'no comms with indoor unit' fault code.

Analogue Default Conditions

Command :	Ax(D)	Analogue(Default) where x=1 to 80

The default operating conditions for the plant. These default conditions will be set should communications fail to be established with the remote outstation, or if a particular zone has a remote offset of zero. At present the same default conditions are established for all zones. For example setting the default Fan speed to Medium for zone 1 (i.e. A2(D=2)), will set the default fan speed for all zones. Similarly setting A32(D=2) sets the default fan speed for Zone 7 but also sets the defaults for all other zones.

The initial factory default settings for the LTX-22 are

Setpoint =21oC, Fan speed =0 (AUTO), HvacMode = 0 (AUTO), Louver = 0 (closed),.On/Off=1(ON)

Time

Current Time

Command :	T(H,N,D,M,Y)	Time(Hour, miNute, Day, Month, Year)

Returns the current time as set by the remote outstation defined by R(M). Default values are all zero before communications are established.

Last Reset Time

Command :	T(L)	Time(Last reset)

Returns the time of the last LTX power-up or reset providing communication was established with the primary remote outstation. Default values are all zero before communications are established.

Alarm Review

Alarm Review

Command :	Vx	reView x (x=1..20)

Allows the last 20 alarms to be reviewed. The command Vx displays the 10 alarms from x to x+9 in the alarm buffer. If x>11 then returns alarms x to 20. The alarm at index 1 is the earliest alarm and index 20 contains the latest alarm (if at least 20 alarms have been generated). So V1 displays alarms 1 to 10 and V11 displays alarms 11 to 20 in the buffer.

If an alarm has not been acknowledged by the alarm supervisor then an asterisk '*' will be displayed after the index number and the alarm is still queued for transmission.

The alarm review buffer retains alarm information across node resets but does not retain alarms across power-ups.

LTX Commands

A number of commands are available for performing various diagnostic operations via text commands. The basic format of the commands is "#(command)".

Reset Command

Command :	#(R=1)	#(Reset)

Causes the LTX-22 to perform a software reset as if the device were re-powered. The command requires that #(R=1) is entered rather than simply #(R) to reduce the chance of a reset occurring due to mistyping.

Wink Command

Command :	#(W)	#(Wink)

Causes the yellow service LED on the front of the LTX-22 to blink several times. Useful for identifying a specific device if several are in use.

Test Alarm Command

Command :	#(A)	#(test Alarm)

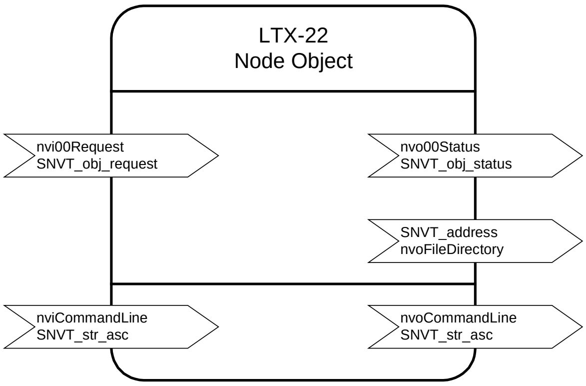
If a valid alarm address is set, #(A) causes the LTX-22 to send a test alarm to the alarm supervisor, and causes another alarm to be sent when it receives an acknowledgement from the supervisor. A useful commissioning tool for proving the alarm reporting route in both directions. The LTX-22 locally responds to the #(A) command by responding with “>TEST ALARM OCCURRED”, and when the supervisor acknowledgement is received with “>TEST ALARM CLEARED”.

LTX-22 Functional Profile

The LTX-22 contains the following LonMark objects

ID#	Name	Type
0	Node	Node object
1	Group 1	Controller object
2	Group 2	Controller object
3	Group 3	Controller object
4	Group 4	Controller object
5	Temperature	Open loop sensor object

LTX-22 Node Object



The LTX-22 node object is shown above. The following table gives a summary for each network variable.

NV#	Name	In/Out	Type	Description
0	nvi00Request	In	SNVT_obj_request	Standard request NV
1	nvo00Status	Out	SNVT_obj_status	Standard response NV
2	nvoFileDirectory	Out	SNVT_address	File pointer to configuration data
3	nviCommandLine	In	SNVT_str_asc	Command Line input string
4	nvoCommandLine	Out	SNVT_str_asc	Command Line response string

LTX-22 Node Object Network Variables

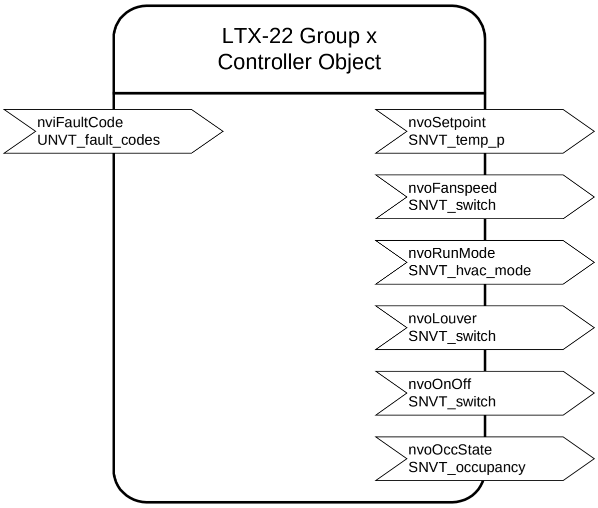
network input SNVT_str_asc ***nviCommandLine***

This NV is primarily used for commissioning and engineering purposes. A string of up to 30 ASCII characters plus a terminator can be entered. All of the standard LTX-22 text based engineering commands can be entered. Any responses to the commands are returned in nvoCommandLine. The commands can entered from any engineering tool that allows the SNVT value to be manually entered.

network output SNVT_str_asc ***nvoCommandLine***

Returns responses to commands entered in nviCommandLine. The response is limited to 30 characters so responses of length greater than 30 characters are truncated. For commands that produce multi-line responses each response is sent to the NV, but it is likely that only the last line of the response will be observed.

LTX-22 Group Objects



The LTX-22 has 4 Controller objects labelled *Group 1* to *Group 4*. Each of these objects is bound to an independently controlled group of terminal units mapped from the BMS.

LTX-22 Node Object Network Variables

network input UNVT_fault_codes ***nviFaultCode***

The nviFaultCode returns the fault status of up to 16 units and maps them into the LTX Zones according to the group allocations. 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 should be zero. Each allocated address index should return a value of 255 decimal (‘FF’ hex). Any other value corresponds to a unit fault.

network output SNVT_temp_p ***nvoSetpoint***

Sets the operating setpoint of the units for the current group. Valid range is 18 to 28 Degrees C. The default value on power-up is 21 Degrees C.

network output SNVT_switch ***nvoFanspeed***

Sets the fanspeed according to the following formula

nvoFanspeed.state	nvoFanspeed.value	Fan speed
0	0	AUTO
1	0.5 to 33.0	LOW
1	33.5 to 66.0	MEDIUM
1	66.5 to 100.0	HIGH

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

---

network output SNVT_hvac_mode ***nvoRunMode***

Sets the run mode of the units. 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 output SNVT_switch ***nvoLouver***

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 output SNVT_switch ***nvoOnOff***

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.

---

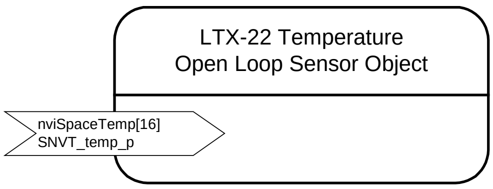
network output SNVT_occupancy ***nvoOccState***

Switches control between the local user interface and remote control via network variables. The on/off status determines the occupancy state. The valid values are given in the following table

On/Off Value	nviOccState	Control Mode
0,1	OC_UNOCCUPIED	Remote control, local keypad lockout
10,11	OC_OCCUPIED	Remote lockout, local keypad control
20,21	OC_BYPASS	'Last touched' control

The default values is OC_UNOCCUPIED, BMS control enable and remote control locked out.

LTX-22 Temperature Object



The LTX-22 has one Open-Loop sensor object containing and array of 16 network variable inputs for feedback of temperature measurements to the BMS

network input SNVT_temp_p ***nviSpaceTemp[16]***

The network variable array is indexed starting from zero so the 16 network variables are numbered nviSpaceTemp[0] to nviSpaceTemp[15]. Each network variable is fedback to the

LTX Zone array. The LTX Zone array is numbered from 1 to 16 so nviSpaceTemp[0] maps to Zone 1 and nviSpaceTemp[15] maps to Zone 16.

Any nviSpaceTemp[] that is bound becomes active and the temperature is visible within the LTX engineering mode and can be written back to the BMS is F(R) is non-zero.

Configuration Parameters

The LTX-22 has a series of internal configuration parameters stored in EEPROM that retain all of the addressing settings of the device. These are not designed to be directly edited via LonWorks. Instead they are accessed through commands such as “R(M=38,A=91)”. This is a safe access method that ensures that only valid values are set. The values can be set on the LonWorks side using nviCommandLine.

The LonWorks engineering tool used should have the capability for uploading and downloading configuration parameters. After the device has been engineered the configuration parameters should be uploaded from the device (e.g using the command “Resync CPs” in LonMaker and selecting *Upload from device*). If the device needs to be replaced in the future or the database is duplicated for another site, these values will be installed in the new device.

Summary of Toshiba Alarm Codes

Below is a brief summary of the Alarm codes that can be generate by the Toshiba units. Refer to the Toshiba Service manual for more detailed explanations of the codes.

Hex Code	Fault	Decimal Code
00	No indoor unit connected	0
04	No communication on 1-2-3 terminals	4
08	Reverse temperature change	8
09	Frost or no-temp change	9
0B	Indoor unit float switch	11
0C	Indoor temperature sensor TA	12
0D	Indoor heat-exchanger sensor TC	13
12	Indoor microprocessor fault	18
14	Refer to outdoor unit (Super Multi)	20
15	Refer to Multi Con	21
18	Refer to outdoor unit (TE Sensor Fault)	24
19	Refer to outdoor unit (TL/TD Sensor Fault)	25
1C	Refer to outdoor unit (Super Multi)	28
1D	Refer to outdoor unit (Super Multi)	29
1E	Refer to outdoor unit (High discharge temp)	30
1F	Refer to outdoor unit (Super Multi)	31
21	Refer to outdoor unit (High pressure switch)	33
99	No communications with indoor unit	153
B7	Group Fault Code	183
FF	No Fault	255

NOTE: There only difference between decimal and hexadecimal is the way the number is displayed. When viewing fault codes from the LRC the data may be formatted in either hexadecimal or decimal format, depending on what viewing method is used. To maintain compatibility with established fault code methods these codes are reported by the LTX-22 in *hexadecimal*.

Engineering Quick Reference

LTX-22 Command Summary

Analog(Value, Default)

oFfset(Switchover zone, Hex fault code offset, Decimal fault code offset, Return air temp offset)

addRess(iDentifier, Local address, local laN, Alarm address, alaRm lan, reMote address, Secondary remote, alarm Filter mins)

Time(miN,Hour,Day,Month,Year, Last restart time)

Zone(Remote, Alarms)

alarm reView {1..20}

#(Reset=1, Wink, Alarm test)

LTX-22 Functionality Summary

Analog Array Value to Zone Mapping, master zones shown in bold

	Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8	Z9	Z10	Z11	Z12	Z13	Z14	Z15	Z16
Setpoint	**1**	6	11	16	**21**	26	31	36	**41**	46	51	56	**61**	66	71	76
Fan Speed	**2**	7	12	17	**22**	27	32	37	**42**	47	52	57	**62**	67	72	77
Mode	**3**	8	13	18	**23**	28	33	38	**43**	48	53	58	**63**	68	73	78
Louvre	**4**	9	14	19	**24**	29	34	39	**44**	49	54	59	**64**	69	74	79
On/Off	**5**	10	15	20	**25**	30	35	40	**45**	50	55	60	**65**	70	75	80

Analog Value Mapping to Unit Operating Conditions

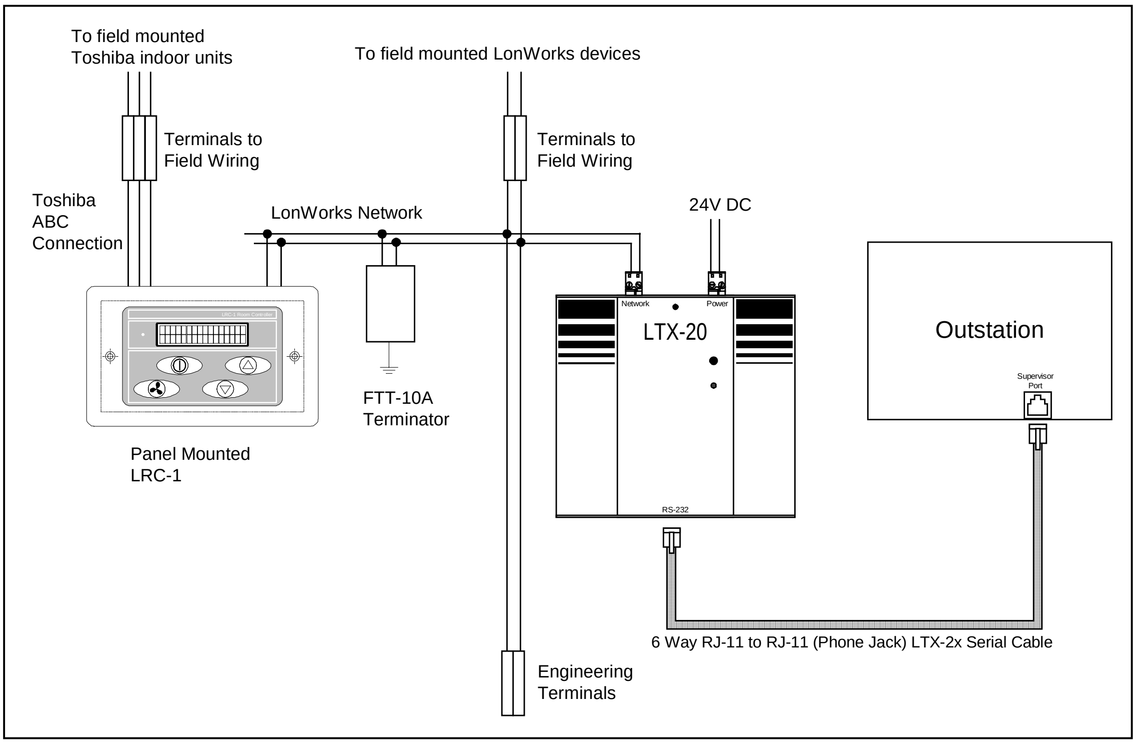
	Valid Values
Setpoint	18C to 29C (to nearest whole degree)
Fan Speed	0=AUTO, 1=LOW, 2=MEDIUM, 3=HIGH
Mode	0=AUTO, 1=HEAT, 3=COOL, 9=FAN ONLY
Louvre	0=OFF, 1=ON
On/Off	0=BMS OFF, 1=BMS ON ,10=LOCAL OFF, 11=LOCAL ON, 20=LAST OFF, 21=LAST ON

LTX-22 Engineering Summary

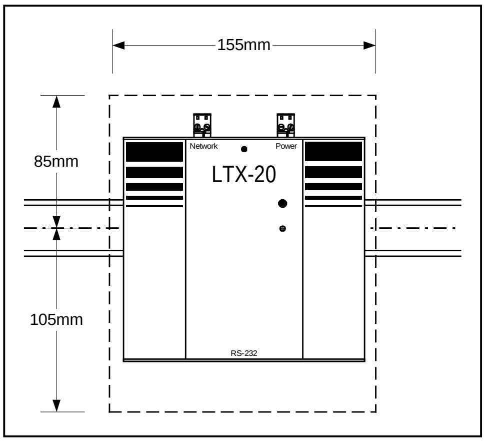
For LTX-22 Firmware 1.00

1. Assign each indoor unit to an LRC Group with a an address unique to that group
2. Register the LRCs and LTX-22 in a LonWorks engineering tool
3. Bind each LRC to the chosen LTX-22 Group object, ensure that nviFaultCodes is bound to activate the group, in addition bind any temperature network variables required for temperature feedback
4. Assign each active Zone(Remote) to the first analog address in the Remote Outstation of the control group
5. Set the remote outstation address R(M)
6. Assign global defaults to each of the unit settings A(D) (use A1(D) to A5(D))
7. Set the LTX-22 identifier R(D)
8. Set the alarm address and lan R(A,R)
9. (optional) set the secondary remote R(C) and the switchover zone R(S)
10. (optional) set the alarm filter hysteresis value in minutes R(F)
11. (optional) Set the analog addresses of the indoor unit temperatures in the remote outstation F(R)
12. (optional) Set the address offsets of the fault codes in the remote outstation F(H,D)

Installation Instructions



The LTX-22 is connected as shown in the above diagram.



1) Mount the LTX-22 on a standard symmetric DIN rail. A clearance of 85mm above and 105mm below the DIN rail centreline should be allowed and 155mm horizontal clearance. See the figure to the right.

2) Connect the LTX-22 Power connector (Black) to a 1.5VA 24Vdc supply. The connection is polarity independent. **Note that the power supply should not be isolated, 0V should be connected to ground**. Do not power the device up.

3) Connect the LonWorks network to the LTX-22 connector labelled 'Network' (Orange); the connection is polarity independent. Multiple devices can be connected in parallel. Field terminals should be made available if there are devices to be connected outside of the panel.

4) Connect the LonWorks connection from the LTX-22 to a pair of screw-terminals mounted on the DIN rail adjacent to the LTX-22. This is for engineering purposes and allows easy access to the network.

5) Connect a network terminator in parallel to the LonWorks network if specified.

6) Connect the supplied grey RJ-11 to RJ-11 cable between the LTX-22 port labelled 'RS-232' and the outstation supervisor port.

Technical Specification

Electrical

Supply	24V DC unisolated
Power	1.5VA
Processor	Echelon 3150
Clock Speed	10 MHz
External Memory	32kb PROM, 24kb SRAM
LON Network	FTT-10A Transceiver, Free topology network
RS-232	9k6 baud, max cable length 3 metres Use cable LT-CC-1 supplied

Mechanical

Dimensions	H138 x W146 x D38 without DIN clip H144 x W146 x D48 with DIN clip
Mounting	Quick release standard DIN rail
Clearance around DIN rail	Minimum 85mm above and 105mm below DIN rail centreline
Casing Material	Casing – Powder coated 18 gauge steel to RAL 3020
Weight	250g
Power and LON **Connectors**	Two part rising clamp 0.5mm" to 2.5mm" cross sectional area cable
RS-232 Connector	RJ-11 Socket

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

Note on Serial Communications

Serial communications with the BMS involves RS-232 communications using the Tx and Rx channels but no hardware handshaking. This makes the operation of the LTX and the connected outstation completely asynchronous and independent and avoids any possibility that hardware handshaking could influence the operation of the outstation communications port.