

Wireless Nexus Option Area Controller & Router OWNERS'S MANUAL

NOTE TO INSTALLER

This manual must be turned over to owner on completion of installation.

1. Installer

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1.1 Placing the Area Controller in the controller holder

- Install the controller holder to a wall with the attached screw.
- Placing the Area Controller on the controller holder

1.2 Antenna installation

- Install the antenna on the AC (Area Controller) See Install
- Turn the AC power OFF. All electrical installations should be performed by qualified personnel. The antenna supplied with this equipment must be installed as shown below in Figure 1.

Important : the mating torque of the antenna must be 8 inch-pounds minimum and must not exceed a maximum of 10 inch-pounds.

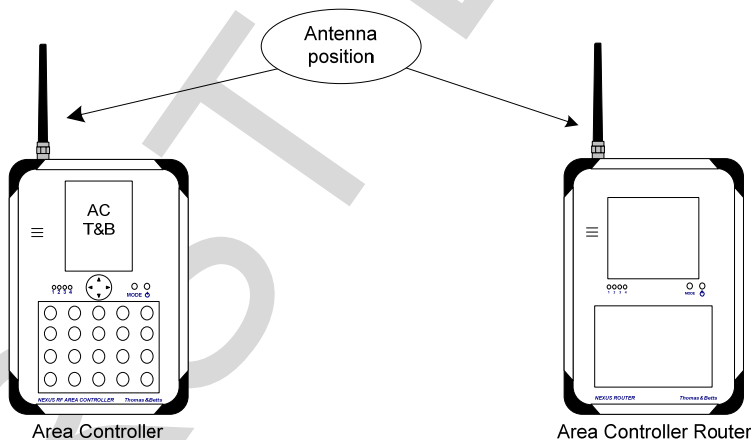


Figure 1

WARNING

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

- (1) this device may not cause harmful interference.
- (2) this device must accept any interference received, including interference that may cause undesired operation.
- (3) the user must install the ferrites supplied by the manufacturer. See example in Figure 2 (Ferrite installation details for the AC and ACR)
- (4) only the supplied antenna must be installed in this equipment. See section "Unauthorized Antenna Modifications" at next page.

1.3 Cabling installation

- Install all cables, Ethernet for LAN, Power adaptor, ...
- Install the two Ferrites include with this package on the Power supply cable and on the Ethernet cable. See Figure 2 (Ferrite installation details for the AC and ACR)

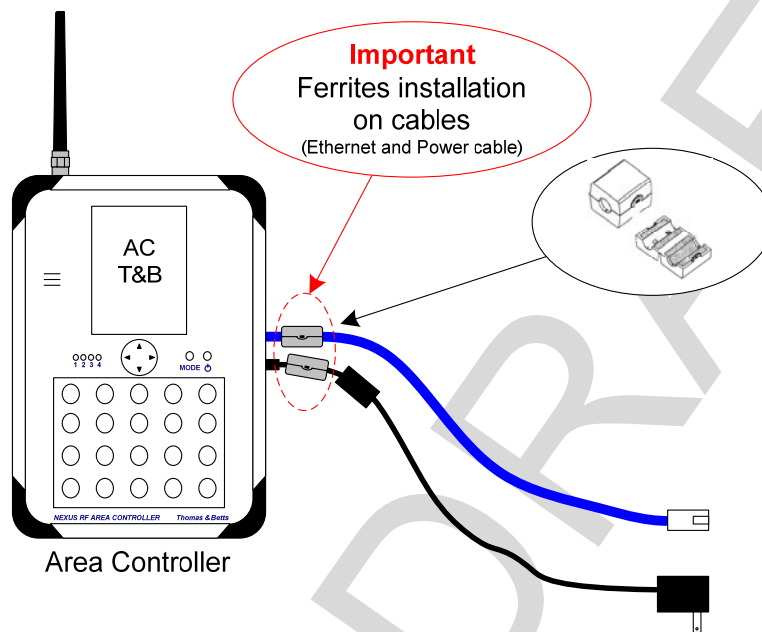


Figure 2 (Ferrite installation details for the AC and ACR)

2. INSTRUCTION TO THE USER

2.1 FCC Statement

This device complies with part 15 of the FCC rules.

FCC ID: W3BNEXUSAC

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.



IMPORTANT! Changes or modifications not covered in this addendum must be approved in writing by the manufacturer's Regulatory Engineering Department. Changes or modifications made without written approval may void the user's authority to operate this equipment.

2.2 Industry Canada

The term "IC:" before the certification/registration number only signifies that the Industry Canada technical specifications were met.

IC: 8100A- NEXUSAC

Canadian Wireless Regulatory

This Class B digital apparatus meets all the requirements of the Canadian Interference Causing Equipment Regulations. Operation is subject to the following two conditions: a) this device may not cause any interference, and b) this device must accept any interference, including interference that may cause undesired operation of the device. To prevent radio interference to the licensed service, this device is intended to be operated indoors, and away from windows to prevent maximum shielding. Equipment (or its transmit antenna) that is installed outdoors is subject to licensing.

Unauthorized Antenna Modifications

Use only the supplied integral antenna. Unauthorized antenna modifications or attachments could damage the unit and may violate FCC regulations. Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.



Precautions against electrostatic discharge (ESD)

Make sure to discharge any built-up static electricity from yourself and your electronic measurement devices before touching this equipment. The recommendation from the dealer is that you take this precaution before installation and connecting this equipment.

3. Nexus Wireless system User Guide

3.1 Radio operations modes basic characteristics.

3.1.1 Mesh Network Mode (this is the normal mode of operation of the Wireless Nexus System)

- Lowest channel frequency: 918.6 MHz
- Highest channel frequency: 925.8 MHz
- Modulation Mode: GFSK
- Modulation frequency deviation: 19KHz
- Data Rate: 38 Kbits/s
- Maximum Output Power: -6.7 dBm

3.1.2 Backdoor Mode (used for close range communication for service purposes, using a mobile Area Controller)

- Channel frequency: 918.0 MHz
- Modulation Mode: MSK
- Data Rate: 125 Kbits/s
- Maximum Output Power: -14.4 dBm

3.2 Introduction to Nexus RF

Nexus RF is a system that enables remote monitoring and testing of emergency lights using an RF mesh network. There are 5 main components to the system:

- RF enabled emergency light units
- Area Controllers
- Area Controller Routers
- Area Controller IP backbone
- RF repeaters

The RF mesh network replaces the data cable that is connected to each of the emergency light units in a conventional monitored system.

3.3 RF Mesh Network Operation

A “network” is the group of units controlled by an AC or ACR (referred to generically as Routers). The Nexus RF protocol uses mesh networking to transfer messages between the Router and all units in the network. This means that a particular RF unit does not need to be able to communicate directly with the Router – the message is relayed automatically from one unit to the next to get to its final destination. The number of hops a message must make is minimised automatically by the protocol.

When a Router is turned on it will attempt to form a network. Any units nearby that do not yet belong to a network will discover the new network and attempt to join it. Other units that may not be in direct range of the new Router will now be able to join this network through units that have joined it already. If a unit loses contact with its current network, it will search all the available channel frequencies for a new network and will attempt to join the first available network it finds.

Theoretically there can be up to 100 units in a network, but the practical maximum is determined by site specific conditions. Generally speaking the larger the number of units in a network, the more restricted is the data rate over the network.

3.4 Nexus RF System Design Sequence

3.4.1 Plan the SPU Locations

The emergency lighting units in the Nexus RF system are positioned according to the requirements of AS/NZ 2293 and are connected to the mains in the same way as conventional Single Point Units except that there is no need to provide for a separate mains emergency lighting test switch. Each Emergency unit is assigned a unique integer number called the SPU_ID. This number identifies the location on the floor plan of the emergency unit. If the unit has to be replaced for some reason, the SPU_ID should remain the same. In order to make the units easier to locate the SPU_ID is usually assigned sequentially. If need be the SPU_ID is easily changed.

3.4.2 Plan the AC and ACR Locations

There should be at least one Area Controller and a number of Area Controller Routers for each domain. The total number of Routers will depend on the number of units in the domain and the layout of the building. A rule of thumb is a maximum of about 80 to 100 units for each Router. The smaller the number of units in each RF channel, the faster the system response. The Routers should be placed approximately in the centre of the group of units to be monitored so that the hop count to each unit is minimised. The Area Controller would normally be placed in an area where it can easily be accessed by maintenance staff as it is the primary user interface for the system. It is possible to have multiple ACs in a domain if it is necessary to have multiple points of user interface.

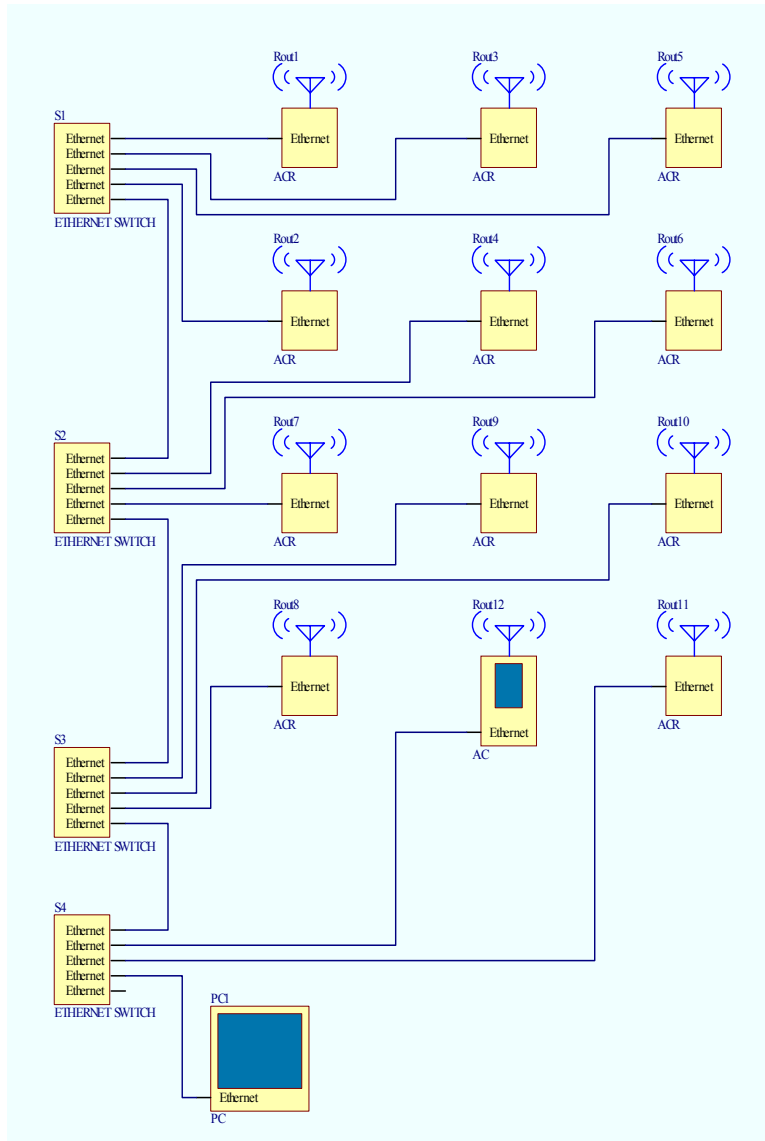
3.4.3 Plan the Trunk Route

The Routers must all be connected to an IP backbone network. The preferred network type is an Ethernet LAN using standard Cat-5 data cable. If there is an existing LAN available, then with the permission of the network administrator, each of the Routers can be connected to spare ports on the LAN. If there is no existing LAN, or the administrator will not allow the connection of the system, then it will be necessary to install a dedicated LAN. If there are only 2 AC/ACR devices, then they can be directly connected using a Cat-5 crossover cable. Alternatively, 2 or more devices can be connected using an Ethernet hub or switch. In this case straight-through cables are used. Note that there is a limit of about 100m for a run of Cat-5 cable. A longer distance will require the use of additional Ethernet hubs or switches. The supply and installation of the Ethernet backbone is generally the responsibility of the installing contractor. It is essential to ensure that the Cat-5 trunk cabling is installed in accordance with the data cabling regulations. Refer to the installation section for the restrictions.

3.4.4 Mark up Drawings with Details

The as-built floor plan drawings should be updated with the SPU_ID, AC and ACR locations. In the case of a dedicated LAN, the locations of the switches and the CAT-5 data cable runs should also be marked.

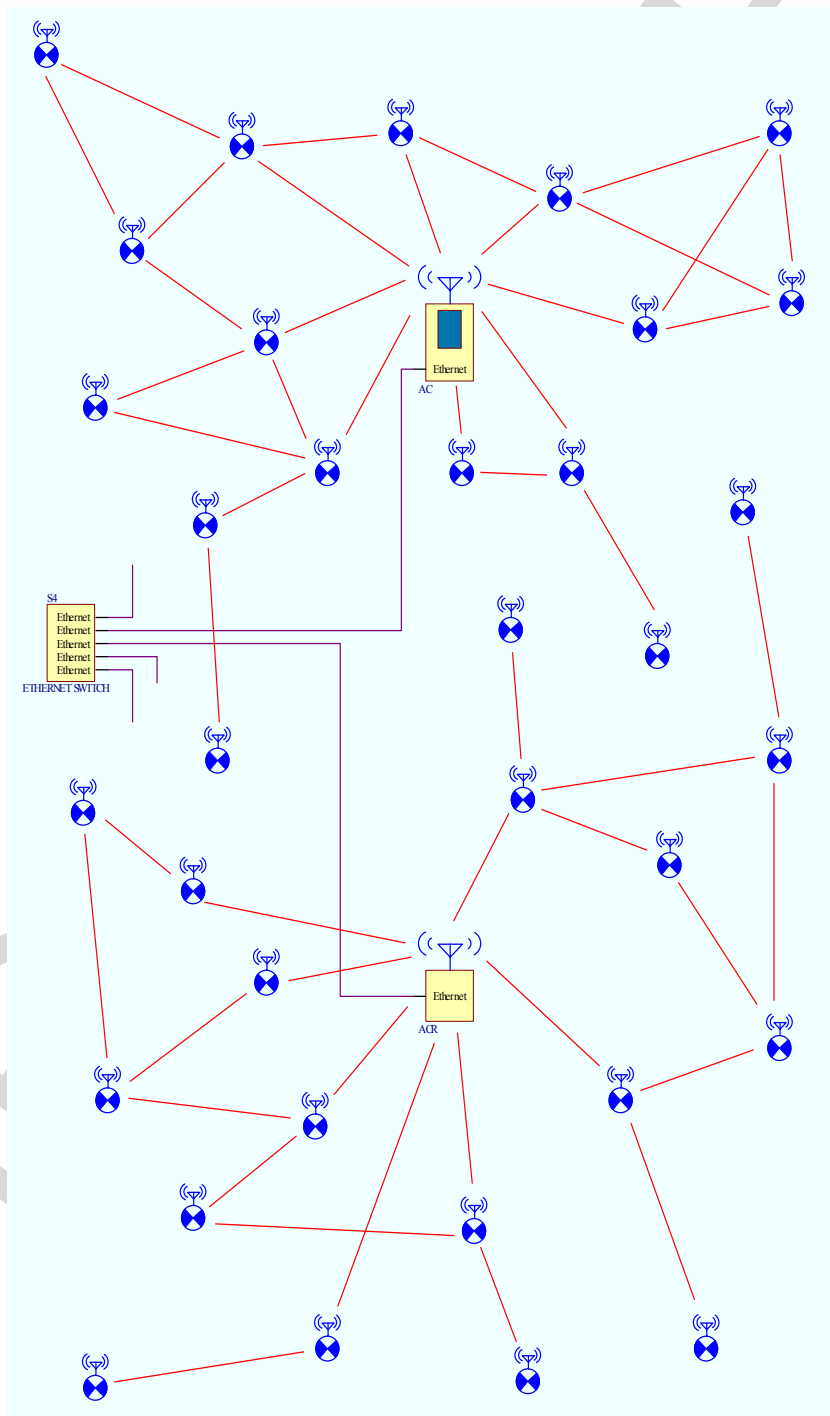
3.4.5 Example of an Ethernet backbone network



This diagram shows an example of a large Nexus RF system with an Ethernet LAN backbone. Each AC or ACR is connected back to an Ethernet switch port by a length of Cat-5 data cable. In this case a PC is shown connected to the LAN. This is optional and provides the user an alternative view of the system via the web browser (Microsoft Internet Explorer) running on the PC. Each Router (AC or ACR) controls its own network of RF units.

3.4.6 Example of an RF mesh network

This diagram shows an example of a part of a Nexus RF system. The AC and ACR each control one RF network. The connections shown between the various SPUs represents the mesh network. Some units have multiple connections to other units. Some units have direct connections to the Router.



3.5 Area Controller Operation

3.5.1 AC Keypad Interface

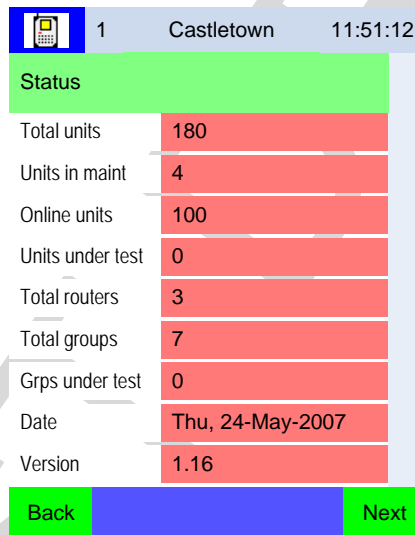
The AC user interface can be operated using the keymat or using a USB keyboard or mouse. The keymat is OK for occasional use but for extensive amounts of data entry – for instance during system commissioning – a normal keyboard is more efficient.

There are basically 4 different types of screens: Menu (yellow), List (white), Data Display (red), Data Edit (blue). They behave in characteristic ways.

Items in a screen are selected with the cursor buttons ▲ ▼ and accepted or rejected with ► or ◀.

[Enter](#) and [Back](#) on the keymat have similar functions to ► or ◀. If a USB keyboard is used, the cursor buttons behave in the same way as cursor buttons on the keymat. If a USB mouse is connected, the black cross pointer on the display becomes active and can be used to select items. [Back](#) and [Next](#) on the bottom row of the display have the same function as [Back](#) and [Enter](#) on the keymat.

3.5.2 Status screen



1 Castletown 11:51:12	
Status	
Total units	180
Units in maint	4
Online units	100
Units under test	0
Total routers	3
Total groups	7
Grps under test	0
Date	Thu, 24-May-2007
Version	1.16
Back	Next

When the AC is switched on and boots up, the Status screen is displayed. This is a summary of the current system status.

The top row of the display shows the domain number (1), domain name (Castletown) and the time. The second row shows the name of the screen (Status).

Total units is the number of units that have been connected to all of the networks in the domain. If you select [Total units](#) then press ► or [Enter](#), the display will jump to the Units in Domain screen.

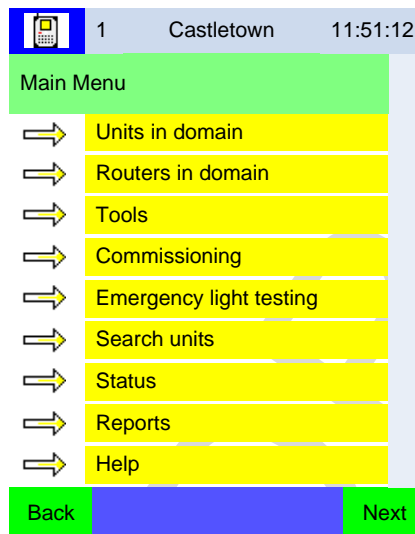
[Units in maint](#) is the total number of units in the Maintenance group. Select and Enter this to jump to the Maintenance Group Menu.

Not all lines in a Data display screen will behave in this manner. The other items in this display will lead to the Main Menu. Generally speaking, items in a Data Display window will lead to a Data edit screen which enables the Data item to be edited.

[Online units](#) is the number of units currently in communication with their respective channels in the domain.

To go to the main menu press [Back](#) or ◀.

3.5.3 Main Menu screen



The Main Menu: is a list of menu options:

[Units in Domain](#) – shows a List of units in the domain. The domain refers to the entire system.

[Routers in Domain](#) – shows a List of routers in the domain. Use this menu item to access channels.

[Tools](#) – shows a Menu of tools relevant to the whole system

[Commissioning](#) - shows a Menu of options for commissioning units and routers

[Emergency Light Testing](#) – shows a Menu of options relevant to grouping and testing the emergency lights

[Search Units](#) - shows a Menu of options for locating or identifying specific units

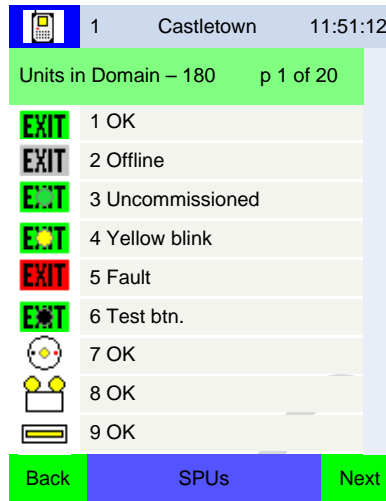
[Status](#) – shows a Data Display of information relevant to the entire system

[Reports](#) – shows a menu of different report options for the system

[Help](#) – provides access to information about the software

To go to the Units in Domain screen select [Units in Domain](#) and press ▶, [Enter](#) or [Next](#).

3.5.4 Units in Domain screen



The Units in Domain screen shows a list of all units in the domain across multiple pages. The pages can be accessed using the PAGE UP and PAGE DOWN buttons on the keypad. Each unit is represented by an icon.

The units can be displayed in a variety of ways controlled by the [Mode](#) button:



















- Icon, SPU_ID and status SPU_s
- Icon, MAC address and status MACs
- Icon, SPU_ID, MAC address and status SPU_m
- Icon, SPU_ID and location SPU_l
- Icon, SPU_ID and Group SPU_g
- Icon, Network address and status NETs

The Mode enunciator on the bottom line of the display shows which mode is selected – SPU_s etc.

3.5.5 Unit Icon

The unit icon indicates the state of the unit. The table lists the alternative icons for one type of fitting – the Quickfit and the plain icons for other fittings.

- The unit will indicate a fault if it detects a problem with its current state or it has failed its last discharge test or diagnostic test.
- If the AC can no longer communicate with the unit the icon indicates the unit is offline. This may be because of a comms problem or because of a more fundamental problem such as the unit being disconnected from the mains.
- If the unit is under test the normal icon will have a red dot superimposed over it.
- If the unit is uncommissioned – ie does not yet have an SPU ID – it gets a green dot.
- It is useful sometimes to be able to identify one or more fittings by flashing the LED – when a unit has been put in yellow blink mode it has a yellow dot over the icon.
- If a unit is part of the network but has not been identified as a particular type of fitting – it is represented as an unknown.

Icon	Appearance	Description
	Plain icon	Quickfit/Legend OK
	Red icon	Quickfit/Legend fault
	Grey icon	Quickfit/Legend no communications
	Red dot	Quickfit/Legend under test
	Green dot	Quickfit/Legend not commissioned
	Yellow dot	Quickfit/Legend yellow flashing LED
	Plain icon	Flood
	Plain icon	Batten
	Plain icon	Spitfire
	Plain icon	Repeater
	? green background	Unit unconfigured – type unknown
	? grey background	Unit unconfigured – type unknown and no communications
	Plain icon	Area Controller
	Plain icon	Area Controller (remote)
	Grey icon	Area Controller no communications
	Plain icon	Area Controller Router
	Grey icon	Area Controller Router no communications
		Group

3.6 Unit Address

Each node has several different types of address:

3.6.1 MAC address

The MAC address is a unique 48-bit number that is programmed permanently into the unit in the factory. The MAC address is displayed in hex format with leading zeroes eg: 00.00.10.b6. The full stops act as place markers to make the number easier to read.

3.6.2 Network Address

The network address consists of 4 numbers in sequence: the Domain ID-Router ID-Slot ID-Node ID. When a unit joins a network it is supplied a network address by the Router controlling that network. This address is not fixed for an RF network as a unit may move automatically from one network to another as RF conditions on the site change.

3.6.3 SPU_ID

When a unit is commissioned it is given an SPU_ID by the installer which is unique in that domain. Prior to being commissioned the SPU_ID of a unit is zero. The list of units is always sorted first by SPU_ID then by MAC so that a list of uncommissioned units is sorted by MAC address.

3.6.4 Group Address

The group address is the means of collecting units together for scheduled emergency lighting testing. It consists of a group number and group name. Once nodes are commissioned they can be grouped arbitrarily across the domain by the user.

3.7 Network Setup

3.7.1 Set Up the Router Addresses

Each Router comes from the factory preset with a unique set of addresses. These are printed on a label on the front of the ACR and on the right hand side of the AC.

Name – this is usually the serial number of the Router but it can be changed to another string.

Router ID – this is a unique number applied to the AC or ACR in production. It can be changed to another number as long as it is unique in the domain. Make sure that the main AC has the lowest Router ID since the Router with the lowest ID is the master time clock.

IP Address and Net mask – each Router is supplied with a fixed IP address which will work without change on a dedicated IP backbone. If the general purpose LAN in the building is to be used it will be necessary for the IT system administrator to supply the appropriate fixed IP addresses.

For the Routers to be able to communicate over the backbone, they must each have a list of the address details of the others.

First view the current setup of the AC: Power up all the Routers and connect them to the Ethernet network using the RJ-45 ports. The AC boots up then displays the Status screen. Press [Back](#) or [◀](#) to move to the Main Menu. From the Main Menu select [Commissioning-Routers-Set my Router ID](#). This screen shows all the address details of the AC. The Domain ID should be 1 (default), System ID 1000 (default) and the remaining items should match the label on the unit. There is no need to change any of the items on this screen unless the unit is being set up with specific IP address for an existing LAN. To back out without making changes, press [Back](#). To accept changes press [Next](#) or [Enter](#).

Now populate the Router table: From the Main Menu select [Routers in Domain](#). This will display a list of Routers in the Router table – there may only be one listed at this stage – the AC itself. From the Main Menu select [Commissioning-Routers-Add Router to Domain](#). Enter the address details (listed on the label on the front) of the first Router – to accept changes press [Next](#) or [Enter](#) or press [Back](#) to exit without changes. Go to the Routers in Domain screen - the display will show the Routers in Domain screen and the Router just entered should appear on that screen. If the Router is actually connected to the

Ethernet LAN it will show a lit up icon (perhaps after a minute or so in some cases), otherwise it will show as greyed out. Enter the address details of all the other Routers in the same way.

At the end of this process the AC will have a list of all the other Routers in its Router table. Check the Routers in Domain page again to confirm this. Once the LAN is connected to all these Routers they will each build their own version of the table and each Router will be able to communicate with all other Routers connected to the backbone.

3.7.2 Assign channels to the Routers

Each Router has 3 slots for interface cards – each of which can be assigned to a separate channel. Slot 1 (on the top of the unit) is usually used for the RF controller. (Future versions of the system will have the ability to have other types of channel such as data cable). For instance, a system with 1 AC and 3 ACRs, each with one RF interface card in slot 1, should have 4 channels registered. The channel address is made up of the Router number and the slot number. So this system with say Routers 27, 38, 52 and 20 will have channels 27-1, 38-1, 52-1 and 20-1. For the sake of neatness it is possible to re-number the Routers to say 1, 2, 3 and 4 so that the channels would be 1-1, 2-1, 3-1, 4-1.

To see if the channels have been registered go to [Routers in Domain](#), check within each Router listed for its channel(s). To add a channel to a Router select [Commissioning-Routers-Add Channel to Router](#) from the main menu. Enter the Router ID and Slot ID for each required channel in turn then check in [Channels](#) to see if they are all listed correctly. If the Ethernet trunk is working correctly and the Routers are powered up, connected to the backbone and correctly addressed, then each channel should be shown as a lit up router icon. Any channels listed but not communicating will show as greyed out. Note that when you back out of the Channel Menu the Channels in Domain screen is displayed which shows all the channels in all the routers in the domain.

3.7.3 Set the Date and Time

Each Router has its own battery backed real time clock. These clocks automatically synchronise across the backbone network to the time and date set in the Router with the lowest Router ID. The data and time for an AC can be set from the local screen. If this AC has the lowest Router ID, that time will be propagated across the network to all the other Routers. The data and time for a Router can also be set via the internal web server from a remote PC.

3.7.4 RF Network Formation – System ID

If the Routers are connected and set up correctly, they will each attempt to start a network and then any RF emergency units installed and powered up in the vicinity will attempt to join a network. Note that each channel in the system corresponds to a network. There is one more condition for network formation – the emergency units must be pre-programmed with a System ID which matches the system ID of the channel. By default all RF units are shipped with the same system ID – 1000. They will only join a network started by a Router channel with a matching System ID. The System ID provides a mechanism for two systems to sit side by side and yet stay separate. This may be required when for instance a tenant in a shopping centre wants a separate system to the one run by the centre management.

Emergency units are shipped from the factory with SPU_ID = 0. A unit with SPU_ID = 0 is uncommissioned. Commissioning is the process of assigning a non-zero SPU_ID to a unit. When the Routers are operational and the emergency units powered up the RF networks will form automatically. No further intervention is required from the operator until the time comes to enter the final SPU_IDs and location data. To view all the units that have joined networks in the domain select [Units in Domain](#) from the Main Menu. Note that if the Routers are switched off then on again the RF networks will completely reform. This may take some time but it does not affect the system in any way other than delaying activity.

3.8 Commissioning

When a unit has SPU_ID = 0 it is uncommissioned. Once the unit joins a network it can be assigned an SPU_ID. The SPU_ID is the link between the physical location of a unit and its hardware MAC address. The SPU_ID must be marked by the installing contractor on the floor plan or on the ceiling or wall adjacent to the unit.

The key to commissioning is to ensure that each unit in the Nexus database is assigned the correct SPU_ID.

There are 2 distinct methods of commissioning:

3.8.1 Network commissioning

Each unit shipped from the factory has a label attached showing the MAC address of the unit. When the unit is installed, the contractor records this number either on the floor plan that has the SPU_IDs marked or on a sheet of paper that has the location and SPU_ID of each fitting listed.

From the Main Menu select [Commissioning-Units over network](#). All of the units in the domain will be listed. Using the Mode button select the display with MAC addresses. The node list is always sorted first by SPU_ID then by MAC address so that a list of uncommissioned units (with SPU_ID zero) will be displayed in order of MAC address. Either select the first MAC address in the list or move down the list and select the node with the MAC address you want. The AC will suggest the next unused integer for SPU_ID. The AC will also send a command to this unit to commence yellow blinking – the LED on the fitting will flash yellow. The unit icon in the top left hand corner of the display will change to the yellow blink state when the unit confirms that it has received the yellow blink message. Either accept the suggested SPU_ID with [Enter](#) or change the number to the correct SPU_ID then [Enter](#). Confirm the selection by pressing [Enter](#) again. The AC will send out the commissioning message and display a message to that effect. If the unit responds correctly the AC will indicate that the unit has been commissioned. The icon in the top corner should change to the commissioned state to confirm that the unit has received the new SPU_ID.

Alternatively, from the Main Menu select [Commissioning-Units over network](#). Again all of the units in the domain will be listed. Press the test switch on the unit to be commissioned – the AC will hide all other units in the list and display only the unit selected by pressing the test switch. Press [Enter](#) and the AC will suggest the next unused integer for SPU_ID. Either accept this or enter another number. This method can really only be used for units near the AC or when there are two operators – one to operate the AC and the other to operate the test switch on the units. In this situation the AC is not truly mobile because the traffic is flowing through the mesh network. If the AC is moved under these circumstances the network will have to re-build itself around the AC continuously. This will actually work but it may be a little slow.

3.8.2 Mobile commissioning

The mobile commissioning method does not use the network – instead it uses a low power direct RF link between a mobile AC and the unit to be commissioned. From the Main Menu select [Commissioning-Units mobile](#). The AC will display a list of all units within direct (low power) radio range. This list is sorted by SPU_ID in the normal manner so that any uncommissioned units in the list will appear at the top. Press the test switch on the unit to be commissioned – if it is one of the units listed, the AC will hide the others. Press [Enter](#) and the AC will suggest the next unused integer for SPU_ID and put that unit into yellow blink mode. Enter the correct SPU_ID and the unit is now commissioned. The AC display will return to the list of all units within radio range. If you cannot reach the test switch then choose one of the units in the list – one that has a description that matches the unit in question – and select it. The AC will suggest the next unused integer for SPU_ID and put that unit into yellow blink mode. If the unit in question is also the one that starts yellow blinking then set the SPU_ID in the usual manner. If the LED can't be sighted then use the shortcut [FUNC-1](#) (press [FUNC](#) then [1](#) in sequence) to put the unit into emergency mode for a short period to aid in identifying the unit. If the unit identified is not the correct one, press [Back](#) and choose another from the list.

3.9 Emergency Lighting Testing

3.9.1 Emergency Lighting Test

According to CSA / UL regulations, an emergency unit installed in a building must be tested every 1 month, 6 months and year. See

Table 1 below

	Canadian CSA (minutes)	American UL (minutes)
Monthly test	1	1
6 th month test	10	30
12 th month test	30	90

Table 1

3.9.2 Group Names

The group is the addressing mechanism to enable scheduled testing of emergency units. Groups are created as required by the user. Groups have a group number and a group name. When a unit first joins the network, it is automatically added to a group with group number 0 and group name Group 0. To see a list of all the groups created select [Emergency Lighting Testing – List Groups](#) from the Main Menu. To add a group select [Add Group](#) from the Emergency Lighting Testing menu. The AC will suggest a group number and name – edit these as required and press [Enter](#) or [Next](#) to accept. To rename a group, select from the list of groups, then select [Rename Group](#) from the Group Menu. Edit the details as required.

3.9.3 Using Groups

Groups are listed in the Groups in Domain screen with their number and name. If the group is currently in test then that status is also shown.

To put units into a group select [Emergency Lighting Testing – List Groups](#) from the Main Menu, select the desired group from the list and press [Add online units to this group](#). A list of all the nodes in the domain will appear.

To change the group for a particular fitting from the Unit Menu select [Unit Tools – Group tools – Change Group](#) and enter the group number of the new group.

3.9.4 Scheduling Emergency Lighting Tests

Select the group to be tested from the Groups in Domain Menu then select [Schedule Group Discharge Test](#). The current settings are displayed – press ► to edit the details and [Next](#) or [Enter](#) to accept the changes. The schedule consists of a start date and time together with and a test start window. The test start window is the time allowed for the test to get underway. If communications are poor there may be a delay between the test start command being sent to the fittings and the test commands being received by the fittings. In order to prevent a test being commenced too long after the intended start time (and thereby perhaps inconveniencing the building occupants), the test start window can limit the start time delay. If the test command couldn't be sent in time then the units affected will be placed automatically in the Retest group.

The default initial values for the test schedule are:

Date: current date

Time: current time

Test start window: 60 mins

When the test start commands are sent out to the units in the group two additional parameters are added: Set limit and Pass limit. The set limit is the maximum time the test for a particular unit can run before it times out. The pass limit is the statutory time limit that the test must run for: 120mins for a node with a battery in its first 6 months of life and 60 / 90 mins thereafter (CSA / UL). These values are determined individually for each unit by the AC.

3.9.5 Retest Group

The Retest group is a virtual group used to collect all units that require re-testing for some reason or because they failed to carry out their last scheduled test. The Retest group is scheduled in the same way as a normal test group. Units are automatically placed in the group if a scheduled test is not carried out. They are automatically removed from the Retest group if the test is completed (whether test passed or failed). Units can also be manually placed in the Retest group and manually removed.

3.9.6 Maintenance Group

The Maintenance group is a virtual group used to collect all units that either have a static fault or have failed their last diagnostic test or discharge test. Faulty fittings are placed automatically in this group – and are removed automatically when the faults are cleared. If a fitting has failed a previous discharge test, and the problem that caused the failure has been addressed, then the unit should be retested. It would be wasteful to retest the whole group because a few units failed so the unit is placed manually in the Retest group. To do this select [Emergency – Light – Testing – Maintenance Group – Place in Retest Group](#) to display the list of units in the group. Select in turn any units that you want to place in the Retest group using ▼ and ► or [Enter](#). Note that the Maintenance Group list can be accessed directly from the Status screen. Select [Units in Maint](#) then press ► or [Enter](#).

3.10 Reports

There are a number of reports that can be generated relating to the status, testing and maintenance of the emergency lighting system. Each of the reports is generated in simple text format and downloaded onto a USB flash stick. Note that the flash memory should be formatted for the FAT32 file system. File names for the reports are suggested by the AC eg: /reports/070521TR0UD.txt – this file was created on 7th May 2007, a Test Result report for all Units in Domain. If another report was generated straight afterwards it would have an updated numerical index ie: /reports/070521TR1UD.txt The file names suggested by the AC for the reports can be edited by the user. To view or print the reports plug the USB flash stick into a PC and open the files with any text editor. The results can be put into a tabular format by opening in a spreadsheet application (eg Excel) and parsing using “comma” as the text delimiter.

3.10.1 Test Result report

From The Main Menu select [Reports – Test result](#) then select between:

- latest test result for all units in domain
- latest test result for all units in a specified group
- all test results for an individual unit

Insert a USB flash memory stick in the USB port and follow the prompts. The AC will create a file in a folder called “reports”.

The test result report includes a site summary showing:

number of emergency units in the domain
number of units with a current discharge test pass
number of units with 6 monthly discharge test due
number of units with discharge test fail

The test result for each SPU selected is in the format:

test date
test time
test result – pass, fail, invalid.
discharge duration – time in minutes that unit was able to run in emergency test mode
set limit – time in units that unit would be allowed to test for until interrupted by timeout –
test stop cause – battery voltage under threshold, lamp current under threshold, relay did not operate, aborted by user or timeout.

3.10.2 Work Instruction Report

The work instruction report includes all units in the maintenance group. For each unit the report includes:

the date of entry into the maintenance group and the fault status on entry

the last 3 discharge or diagnostic test results

the current status – either OK or faulty. If the status is faulty then a list of each individual fault detected is displayed – including the bit number of the fault.

unit, lamp and battery ages – the age in years of each of the items. The “unit” refers to the Printed Circuit Assembly. The age is calculated from the date of manufacture or from the date of replacement in the maintenance log for that unit. Note that it is the responsibility of the maintenance contractor to correctly enter the maintenance history data.

suggested maintenance actions:

check emergency lamp - this is suggested if the unit terminates a test due to lamp current limit before the required time limit. Note that a unit without a functioning emergency lamp will terminate a test immediately and register a discharge time of zero.

check mains lamp – this is suggested if the LDR indicates low light from the mains powered lamp when the SA line is active.

check SA wiring to unit – this is suggested if the unit indicates the mains lamp powered from the SA line is lit while the SA sense indicates the SA line is off.

check battery – this is suggested if the battery is not charging or the unit terminates a test due to battery voltage limit before the required time limit

check test switch – this is suggested if the test switch on the emergency unit has been operated continuously for more than 10 minutes.

check LDR – this is suggested if the LDR indicates low light from the mains powered lamp when the SA line is active or if the LDR indicates light from the mains powered lamp when the SA line is not. In the first instance the LDR could possibly be fitted to the wrong lamp or could itself be faulty. In the second instance the LDR could be fitted to the wrong lamp or be responding to excessive amounts of stray light.

check unit – this is suggested if the fault is unknown.

check comms – this is suggested if there is no communications with the unit. It is possible that communications to an RF node can come and go as the units attempts to join the strongest network. Persistent lack of communications suggests that the unit is either un-powered or in need of a better RF signal path. The antenna may not be connected correctly, or it may be pointed in the wrong direction. Alternatively the unit may be too far from the nearest network and requires an RF repeater to boost the RF signal.

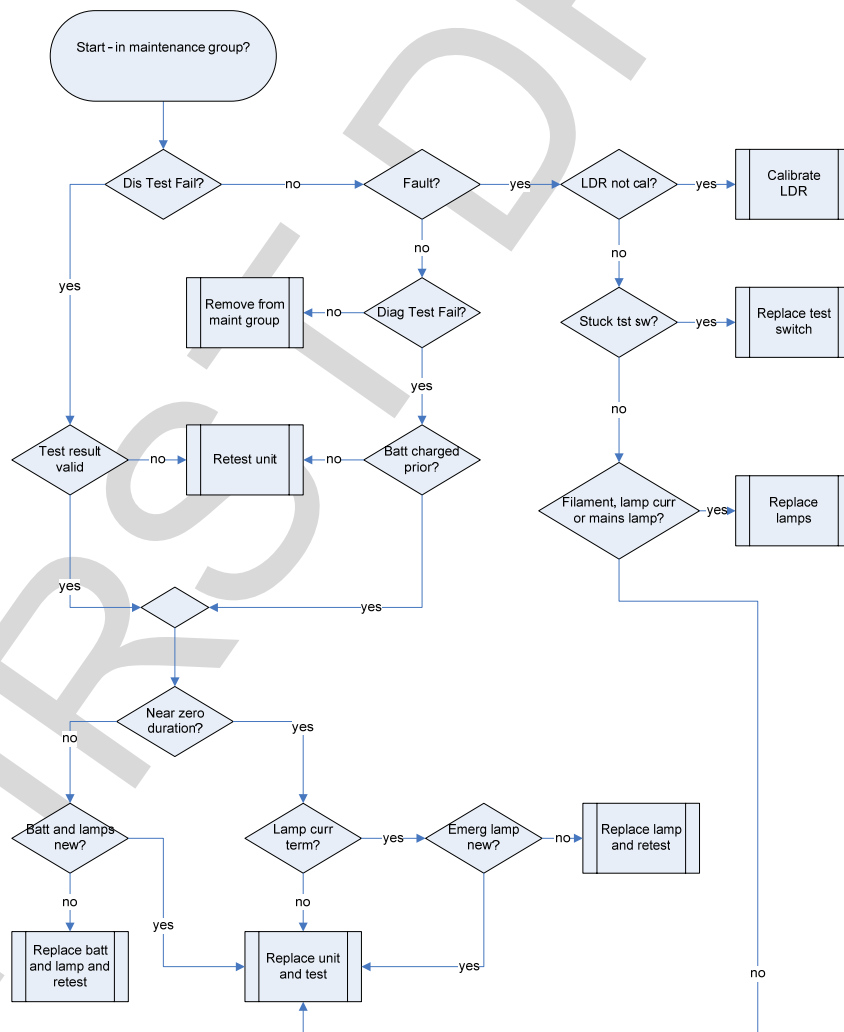
re-test unit – this is suggested if the unit has failed a test without the battery having been fully charged prior to the test.

3.10.3 Basic Work Instruction report

The basic work instruction report includes all units in the maintenance group. The report is intended as a guide to estimating the amount of replacement product required to bring a site up to standard. For each unit there will be one or more suggested actions:

- Calibrate LDR
- Replace test switch
- Replace lamps
- Retest
- Replace lamp and retest
- Replace battery and lamp and retest
- Replace unit and test

The flow chart below describes the process the AC uses to determine the results:



3.10.4 Offline report

Units which are offline are not included in the maintenance group. A unit is shown as offline if it is unpowered or not communicating. The offline report list all offline units and includes the unit type and data and time each unit was last online. If a unit is powered it may be offline due to a hardware fault or because the RF communications are poor due to site conditions or poor antenna placement. A healthy unit sends out a packet to the AC every minute. The AC records the date and time of this packet. An offline unit may require replacement or antenna adjustment.

3.10.5 Maintenance History report

Select report for:

- all maintenance actions within the last 12 months for all units in domain
- all maintenance actions within the last 12 months for all units in a specified group
- all maintenance actions for an individual unit

The Maintenance History report includes a site summary showing:

number of emergency units in the domain
number of units with a current discharge test pass
number of units with 6 monthly discharge test due
number of units with discharge test fail
number of units with annual cleaning requirement fail

Each maintenance action is listed together with date and time of entry into the system.

Note that it is the responsibility of the maintenance contractor to enter maintenance actions as they are carried out.

Possible maintenance actions are:

Replaced emergency lamp
Replaced mains lamp
Replaced battery
Replaced test switch
Replaced LDR
Replaced unit
Checked comms
Re-tested unit
Cleaned Unit
Other

3.10.6 Status report

The Status report is used to select units that exhibit a particular combination of faults or other characteristics.

The possible selection criteria are:

Unit type: M,S,B,F,R

Unit part number:

Fault bit_1 or Fault bit_2 ... or Fault bit_32

Unit age between A,B

Lamp age between A,B

Battery age between A,B

All units which satisfy all criteria specified are selected for the report.

For each unit selected the following information is printed:

Unit identification
Reason for being in and time spent in maintenance group
Last test result
Fault status
Age of unit, lamp and battery

3.10.7 Location report

The location report includes all the units in the database. For each unit the report lists all the available location information as well as lamp, battery and unit age. This report is used to help in locating units and also to check if all relevant location data has been entered into the database.

3.10.8 Connection report

The connection report includes all devices in the database. The report is used to analyse the communication connection topology of the network. For each unit the report lists:

SPU_ID:<SPU_ID>

Unit Type:
Group:
Unit Description:
Unit Part Number:
Location:

MAC address:
Firmware id: <sys-net-app>
Hop count to ACR:
Leaf node:
RF channel:
Rx packets:
Tx packets:
Unit load:
Up time:
On line time:
System ID:
Neighbour list:<neighbour SPU, neighbour MAC, neighbour RSSI>

3.11 Nexus RF Network Management

The mesh network consists of RF links between individual units. Only links with relatively strong signal strengths are considered to be viable by the protocol. These links are referred to as Direct links. To determine the RF performance of a single unit select [Unit RF status](#) from the Unit Menu. The AC displays the System ID of the unit and the time since the unit last communicated with the AC. Every

minute, a unit sends out a status packet to the AC so the Last seen value is usually less than 60 seconds. If the unit is offline, the Last seen value will indicate how long the unit has been offline.

The [Direct links](#) screen lists all the units that this unit has a direct connection to. For each unit it lists the RF signal strength received from the remote unit. This value is expressed in dBm. -45dBm is a very strong signal while -100dBm is a very weak signal. This screen may take some time to return useful values as the data is slow to extract. The AC requests that the unit report back on all the messages it sees in a 5 second period – the request is repeated every 20 seconds.

The [RSSI](#) screen lists all the units that the unit in question can see – this is usually a longer list with lower signal strengths.

Often the signal strength is not a good indicator of the quality of a link because it does not take account of signal distortion due to reflections. The protocol handles this by looking at the reliability of a link rather than just its signal strength – which in any case is a widely varying quantity.

The [Info](#) screen shows the packet related data. [Hop cnt](#) is the number of hops a message must take to reach the Router from the unit in question. A hop count of 1 shows the unit has a direct link to the Router.

[Load](#) is the amount of network traffic going through the unit – 20% is considered to be maximum capacity.

[Up time](#) is the amount of time the unit has been running since last powered up.

The RF units have ample RF transmit power and receive sensitivity for the distances which separate emergency lights in a building. However, a building is a complex RF environment with reflecting surfaces, attenuating materials and external noise sources. The RF environment can be very dynamic and can be strongly dependant on the time of day.

Once a site is fully installed it will be apparent which units communicate well and which do not. Areas with poor links back to the Router may require the addition of RF repeaters. These are RF units identical the RF emergency fittings but without any lighting functionality. The best method is to mark out the RF performance of the network on a floor plan and determine if any RF repeaters are required. Sometime it may be useful to change the location of Routers or add additional Routers to keep the average hop count of units in each network low. Hop counts should be kept below 5 or 6 if possible. A network with large hop counts and large numbers of units will be slow.

Channels which are side by side will slowly transfer units backwards and forwards between them in an attempt to keep the network loads balanced.

3.12 Maintenance History

Maintenance actions carried out on each unit should be recorded in the database. This is a requirement of the emergency Lighting Standard ???? which is called up by the Building code.

The date and time of entry of the maintenance actions are recorded. Specific actions can be checked off as appropriate from the list.

Maintenance actions:

Replaced sustained lamp

Replaced maintained lamp

Replaced emergency lamp

Replaced battery

Replaced diffuser

Replaced unit

Cleaned unit
Repaired wiring
Reconnected unit

If maintenance actions other than those listed are carried out they can be entered in the maintenance notes field.

The lighting standard requires that emergency units be cleaned at least once a year. This should be in general the only maintenance item for the bulk of units during their lifetime. To avoid having to enter this maintenance item for each unit individually it is possible to enter it globally for all units.

3.13 Area Controller Firmware Update

To check the version of the AC firmware select [Help-About](#) or [Status](#) from the Main Menu. From time to time it will be necessary to update the AC firmware. From Main Menu select [Tools-Firmware upgrade – Upgrade AC firmware](#). The unit will prompt you to insert a USB Flash Memory stick containing the latest revision. Press [Enter](#) and the unit will reboot itself and propagate the new software to all the other routers on the backbone network.

3.14 Emergency Light Units - SPUs

3.14.1 Configuration

A unit that is not configured has no information about its own identity. For instance an unconfigured Quickfit does not know it is a Quickfit. This information is normally stored in a unit during production testing. If for some reason a fitting has either no unit type or the wrong unit type then re-enter it. Select [Unit details](#) from the Unit menu for the unit in question, highlight [Unit Type](#) and press [Enter](#). Choose from the Unit Type list:

- Batten
- Flood
- Quickfit/Legend
- Repeater
- Spitfire

If necessary change the unit sub-type as well in the same way. Choose from the Unit Sub-type list:

- Any
- Maintained
- Non maintained
- Sustained
- Twin maintained

Fittings with LDRs have their LDRs calibrated in the factory. If a unit has an LDR and is reconfigured in the field then it will require re-calibration of the LDR. Note that a fitting in this state is placed in the maintenance group.

3.14.2 SPU Status

If there are no detectable faults with a unit it will return a status of OK in the Units list. If it is testing, has the test switch operated, is in yellow blink mode or is uncommissioned but is otherwise OK it will return one of those states as its status. If the unit has a fault or has failed its last test it will return a status of Fault.

To see in greater detail the type of fault, select [Unit status](#). This page lists all the known faults as well as the date and time when the unit was placed in the maintenance group as a result of being faulty.

List of possible status bits:

Bit number	State
0	Button is stuck
1	Relay is stuck
2	Filament failure
3	Unspecified HW fault
4	No lamp current
5	Battery is discharged
6	Battery is not charging
7	Mains lamp is not working
8	Emergency tube is too dim
9	Inverter is erroneously off
10	Inverter is erroneously on
11	Lamp current when there shouldn't be
12	Mains lamp is too dim
13	SA off and mains lamp on
14	LDR not calibrated
15	Repeater's buzzer is on
21	Mains lamp is off
22	Mains lamp is on
23	Last test failed
24	Fault status
25	Fitting is OK
26	Not charged for 16 hours
27	Button is pressed
28	Test is running
29	Yellow LED is on (or blinking)
30	Unit is not commissioned
31	Unit is not configured

3.14.3 Data stored in Node:

The following data is stored in each unit:
 Address data (SPU_ID, System_ID, MAC address, network_ID, node_ID);
 Group_ID (current and default);
 Configuration data (T&B part number, unit type);
 Location data;
 Test result data (7 sets);
 Last fault date (1);
 Unit mfg/change date for unit, lamp and battery;
 Discharge test set time.

This is a subset of the information about each fitting stored in the main AC database and is enough information to usefully re-construct the database in the event of its loss.

3.14.4 SPU LED Colour Meanings

The LED on a fitting will flash according to its status. The table below describes the various states. The states are prioritised – a state with high priority will take precedence over a state with low priority. For instance if a unit is under test – and therefore showing a red slow flash – is put into yellow blink at the same time, the LED will show the yellow link pattern since it has a higher priority.

Priority	Index	LED pattern description	State
1	13,14,15	yellow flash - one long six short	Configured and in flash yellow mode for identification
2	0	green very slow flash	Unconfigured
3	11	red slow flash	Configured, not in yellow flash and emergency test running
4	12	green on steady	OK and button pressed
4	1,2,3,4,5,6	green flash with one red blink	Configured but emergency hardware fault
5	7	green flash with two red blinks	Configured and hardware OK but unit uncommissioned and no RF network connection
5	8	green flash with three red blinks	Configured and hardware OK and RF network connection OK but unit uncommissioned
5	9	alternating green/red flash	Configured, commissioned and hardware OK but no RF network connection
5	10	red on steady	OK

3.14.5 Menu Tree

- Units in domain
 - <unit list>
 - Unit status
 - Unit RF status
 - Direct links
 - RSSI
 - Info
 - Unit location
 - Unit details
 - Unit test
 - Diagnostic test
 - Scheduled test
 - Previous test
 - Unit maintenance
 - List unit maintenance
 - Add unit maintenance record
 - Unit tools
 - Commission unit
 - Group tools
 - Change group
 - Return to Default group
 - Set current group as default group
 - Yellow blink on
 - Yellow blink off
 - Set SPUID
 - Reset unit
 - Calibrate LDR
 - Upload firmware
- Routers in domain
 - <router list>
 - Units in router
 - <unit list>
 - (Unit Menu)
 - Channels in Router
 - <channel list>
 - Units in channel
 - Channel status
 - Channel tools
 - Set RF channel number
 - Stop channel operation
 - Start channel operation
 - Channel yellow blink on
 - Channel yellow blink off
 - Channel RF status
 - Direct links
 - RSSI
 - Info
- Tools
 - Delete tools
 - Delete unit
 - Delete by List
 - Delete by SPUID
 - Delete by MAC
 - Delete channel

<channel list>
Delete Router
<router list>
Delete Domain
Domain yellow blink off
Change Domain name
Backup database
Load database
Set clock
Firmware upgrade
 Upgrade AC firmware
 Download ELN firmware to AC
 Download EIM firmware to AC
 Upload ELN firmware across network
 Upload by List
 Upload by SPUID
 Upload by MAC
 Upload ELN firmware directly
 Upload EIM firmware to EIM
Production Testing
Commissioning
 Units over network
 <unit list>
 Units mobile
 Routers
 Add router to domain
 Add channel to router
 Set my router ID
Emergency light testing
 List groups
 <group list>
 Units in group
 Group status
 Group details
 Schedule group discharge test
 Perform group diagnostic test
 Group yellow blink on
 Group yellow blink off
 Delete this group
 Add units to group
 <unit list>
 Add group
 Maintenance group
 Units in group
 Group status
 Yellow blink on
 Yellow blink off
 Retest group
 Units in group
 Group status
 Schedule group discharge test
 Perform group diagnostic test
 Yellow blink on
 Yellow blink off
 Add maintenance units to this group
Search units
 By SPUID

- By MAC address
- By pressing service button
- Status
- Reports
 - Test result
 - For units in domain
 - For units in group
 - For individual unit
 - Work instruction
 - Basic work instruction
 - Maintenance history
 - For units in domain – 12 mths
 - For units in group – 12 mths
 - For individual unit – all
 - Status
 - Unit type
 - Unit part number
 - Fault bit list
 - Unit age band
 - Lamp age band
 - Battery age band
 - Location
 - For units in domain
 - For units in group
 - For individual unit
 - Connection
 - Offline units
- Help
 - About

3.15 Nexus RF Database

The Nexus database stores all the information pertaining to the system and the units. A copy of this database is stored in each router in the domain. As the contents of the database changes, the system ensures that each copy of the database is kept up to date. If a Router is disconnected from the backbone for a period, when it is reconnected the system ensures that the most up-to-date information is copied to all the other routers. The database can be backed up using a USB flash drive – the database files are compressed into a single .tar file. To backup the database select [Tools – Backup database](#) from the Main Menu. The AC will prompt to insert a USB flash. The AC will create a folder on the flash drive and load the backup. To load a copy of the database select [Tools – Load database](#) and insert the USB flash drive. The AC will display a list of files – each with a date code. Select the appropriate file.

3.16 Glossary

AC	Area Controller – has LCD and keyppad
AC mobile	AC with internal rechargeable battery pack for mobile use
ACR	Area Controller Router – same as AC but with no LCD or keypad and without option of battery pack
Channel	Corresponds to a slot in the AC or ACR. Each AC or ACR
Channel number	
Commissioned	
Configured	
Default Group	
Diagnostic Test	
Domain	
Domain ID	
Firmware	
Group	
HW ID	
MAC address	
Maintenance Group	A collection of all nodes in the domain with either a status fault, discharge test failure, diagnostic test failure or communications fault
Node ID	
Part Desc	
Part No	
Retest Group	
RFCH	
Router ID	
Scheduled Test	
Slot ID	
SPUID	
Status	
Status Code	
Unit	
Unit type	
Yellow blink	
Single Point Unit	
RF_SPU	
SA	Switched Active
USA	Un-switched Active
LDR	Light Dependant Resistor used to sense the mains powered lamp light output

3.16.1 Menu Shortcuts

Func 1	Status
Func 2	
Func 3	
Func 4	Search Units
Func 5	
Func 6	
Func 7	
Func 8	
Func 9	

FIRST DRAFT