SS9002 ESBox LT

User Manual – Version 1.2

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1 Safety Notices

This manual does not comprehensively cover all safety measures for installation and operation of the device, since local code requirements and special operating conditions may necessitate further measures.

Qualified Personnel

This device should be installed by technically qualified personnel. Failure to install in compliance with national and local electrical codes and according to Saturn South recommendations may result in electrical shock or fire hazard, unsatisfactory performance, or equipment failure.

This product is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience or knowledge, unless they have been given supervision or instruction concerning use of the product by a person responsible for their safety.

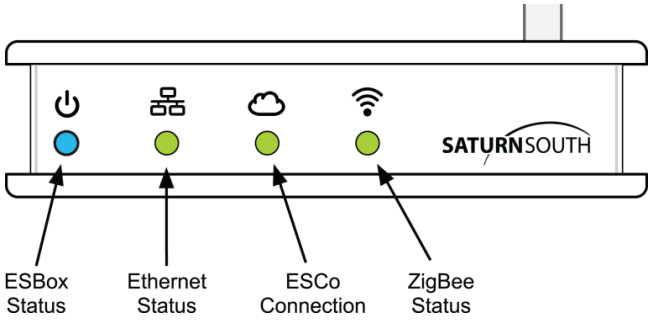
Children should be supervised to ensure that they do not play with the product.

Maintenance

Servicing of this device in the field is not possible and should not be attempted. If servicing is required, please return this device to Saturn South or an authorised distributor. Opening the product enclosure, for any reason, will render the Product Warranty void.

2 LED Quick Reference

SS9002 ESBox LT



LED Status indications are shown in the same order as in the above diagram, for example:

The above status would indicate that the ESBox was operating normally, that an Ethernet connection is detected, that it has recently communicated with the ESCo successfully, and that the ZigBee network is functioning correctly.
If a the current status of an individual LED does not affect the meaning of the remainder of the LED pattern, it will appear as a  . Blinking LEDs are shown as an outline in the colour of the blink, such as  , which indicates blinking green. For example:

Means that the 'ESBox Status' LED will be solid blue, the 'ZigBee Status' LED will be blinking green, and that the 'Ethernet Status' and 'ESCo Connection' LEDs are not relevant to the meaning of the status.

ESBox LT LED Indications in normal operation

LED Status	Comments
	ESBox is functioning correctly.
	ESBox is in 'Permit Joining' mode.
	ZigBee network is starting up or restarting. This state should not persist for more than a few seconds.
	ZigBee network failure.
	No connection to ESCo.
	Succesfully connected to ESCo, but failed authentication.
	No Ethernet connection detected.
	Ethernet connection detected, but ESBox has not been issued an address via DHCP.
	ESBox application is starting up. This state should not persist for more than a few seconds.
	ESBox application error. Report the colour of the next three LEDs to Saturn South for debug purposes.
	ESBox is in 'Update' mode.
	ESBox is downloading files from the update server.
	ESBox application update in progress.
	ESBox coorinator update in progress.

3 Button Quick Reference

SS9002 ESBox LT

Feature Name	Button Sequence	Intention of Sequence	Notes
Factory Reset	LLLSS	Performs factory reset.	The ESBox will lose all knowledge of any currently paired devices, and will clear any existing OTA update registrations.
Permit Join Mode	LSSS	Places device into 'Permit Joining' mode to allow the device to connect to ESBox's network.	
Reset Static	LSSLS	When entered, the ESBox will use a default static IP the next time it starts.	ESBox can be reached at 10.55.55.1 in this mode.
Reset DHCP	LSSLSS	When entered, the ESBox will use DHCP the next time it starts, irrespective of the current network settings.	
Reboot	LSLS	Reboot device	
De-register Updates	LLSSS	De-register and ZigBee updates that have been registered on the ESBox.	This will cancel any active OTA process. The ESBox's device list will be unaffected.
Reset Network	LLSLS	Clear the ESBox's device list and restart the ZigBee network.	Registered OTA updates will be preserved.
Reset UI Password	LSLLS	Reset the ESBox Web UI login to username 'esbox' and password 'esbox'	
Force Re-Enable Web UI	LSLSS	Enable the Web UI even if it has been explicitly disabled in the .usrconf settings file	WAPP_en=0 will be ignored until the next restart.

Button press sequences are composed of only two types of button press:

- Short press ("S") – less than one second
- Long press ("L") – greater than 2 seconds (the ESBox LEDs will turn green when the button has been held for long enough to register a 'Long' press)

Button press sequences are expressed as combinations of these two types, for example: **LSSS** = A long press, followed by three short presses.
Button press sequences are acknowledged immediately when they are entered. If a mistake is made when entering a button press sequence, the user should wait for at least 5 seconds for the sequence monitor to reset, and then try again. The device LED will blink amber for a few seconds to indicate a reset of the button sequence monitor. Note that much of the functionality described here can also be accessed through the 'Devices' page on the ESBox web interface.

4 Product Overview

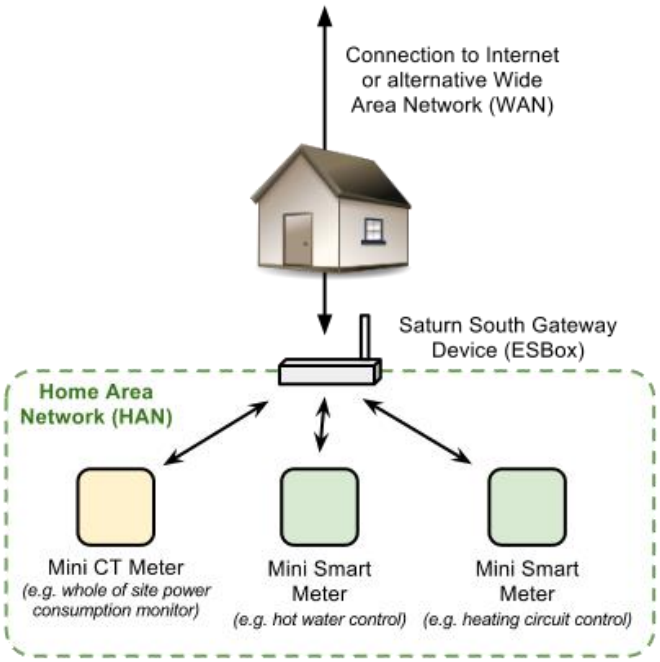
The SS9002 ESBox LT ZigBee-Ethernet gateway provides a bidirectional link between installed ZigBee devices – such as Saturn South load control products – and a remote server. Up to 20 ZigBee devices can be managed simultaneously by the ESBox LT, with support for a growing number of third-party ZigBee Home Automation compatible devices.

The SS9002 ESBox LT is capable of storing up to 28 days of measurement data for 8 load control devices in internal memory. Logged data can be retrieved on demand by a remote server or sent automatically at a configurable interval.

A flexible update system enables remote firmware upgrades for the ESBox LT and Over The Air (OTA) updating of devices connected to the ZigBee network. Standards-based network security ensures the privacy of consumer information at all times.

A straightforward deployment and commissioning process helps to minimise the cost of large scale roll-outs, and powerful Zigbee network diagnostics tools are available to troubleshoot Home Area Network (HAN) setup in difficult sites.

The ESBox LT connects via wired Ethernet to any network with internet access, and logged data is retrieved from the ESBox LT using a freely available protocol. Communications can be dynamically throttled to limit the use of the consumer's Internet bandwidth as required.



The ESBox LT is suitable for a wide range of applications, from basic data logging and energy consumption reporting, to high-speed Demand Management and Network Support applications in isolated power networks.

5 Technical Specifications

Type: ESBox LT ZigBee-Ethernet Gateway

Model: SS9002.1

Power Supply: 5VDC 0.6A

Operating Temperature Range: -20°C to +65°C

Storage Temperature Range: -25°C to +80°C

Relative Humidity: 10-95% non-condensing

Average Power Consumption: <4W

Mass: 0.080kg

Dimensions: 80 x 56 x 23.5 mm

Standards and Approvals:

- AS/NZS 61000.6.3
- AS/NZS 4268
- Radiocommunications Class Licence (2000)
- RCM

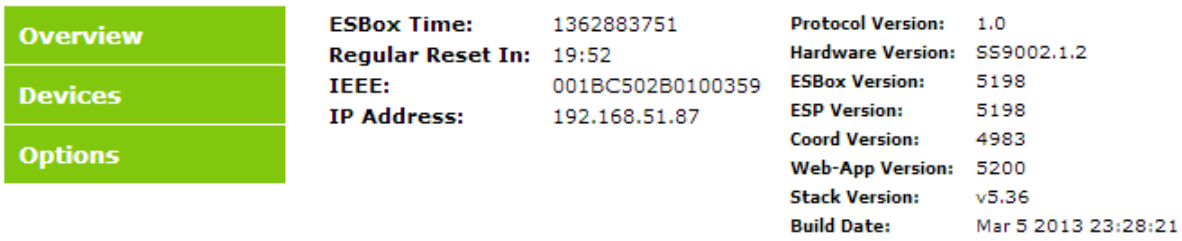
6 Web Interface Overview

The ESBox LT includes a web interface for configuring the device's network options, ESCo/backhaul connection settings, and for managing the ZigBee network.

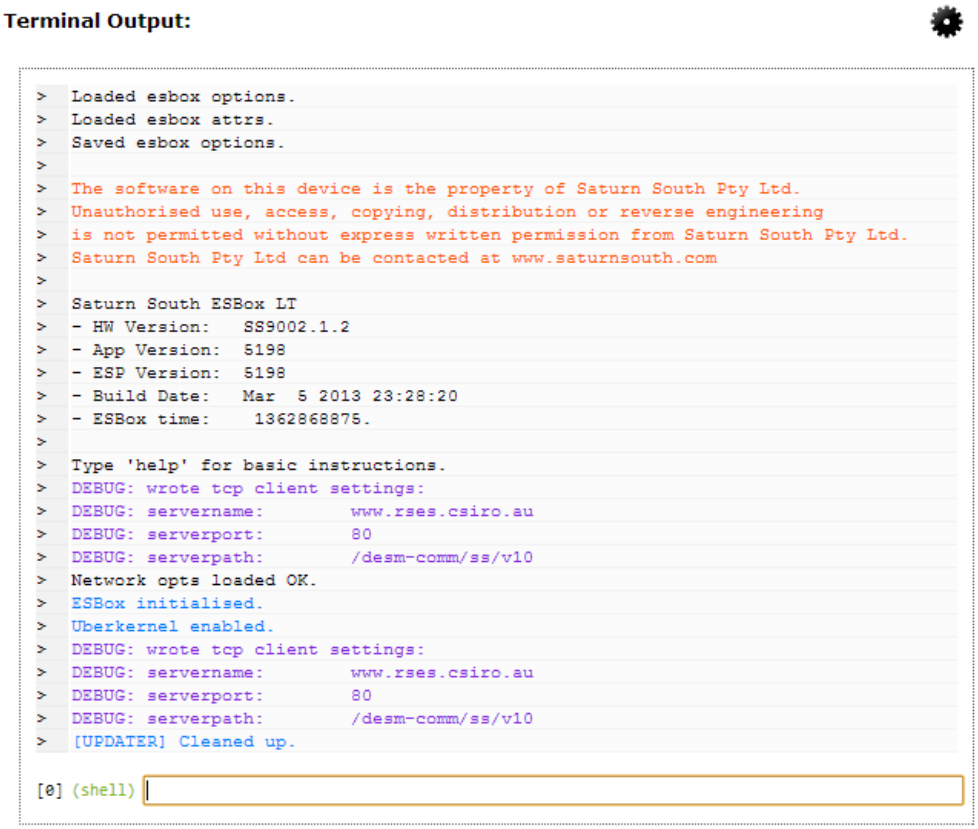
6.1 Overview Page

The ESBox Overview page is the default page, and can be accessed from other pages using the 'Overview' button on the navigation panel on the left hand side.

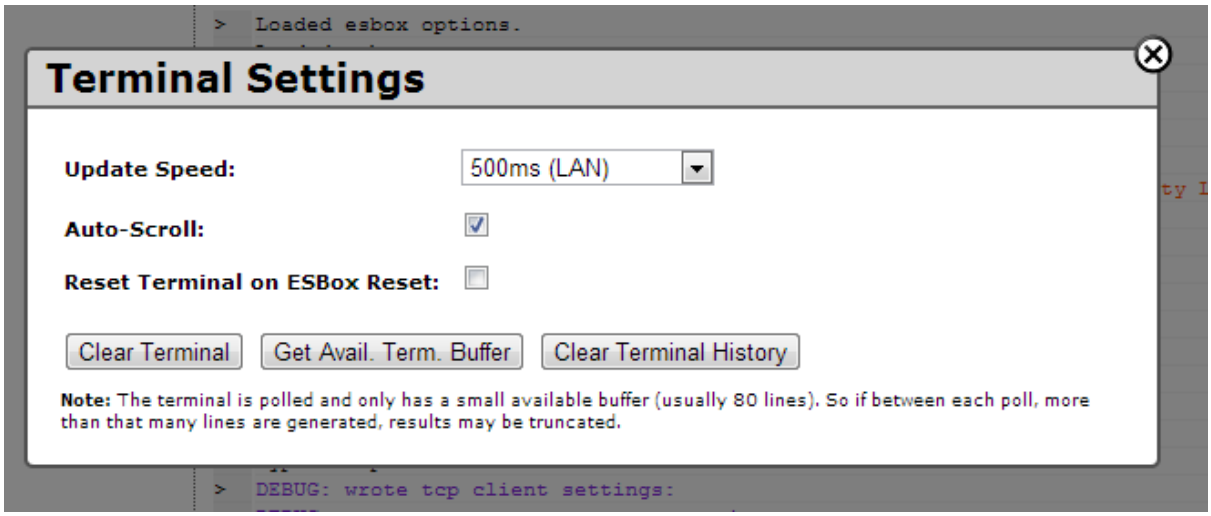
This page presents a summary of the status of the ESBox, including version information for each component of the device firmware, the local machine time, and the device's unique ZigBee IEEE address.



The Overview page also features a live terminal that can be used to manually send commands to the ESBox, edit device setting files, inspect core software modules, and access debugging information.



The AJAX update period for the terminal and other display options are available in the terminal settings menu, which can be accessed by clicking on the cog icon above the terminal.



This document does not provide a comprehensive set of documentation for the functionality exposed through the ESBox's terminal. A significant amount of terminal functionality is self-documented, and an overview of the most common commands can be retrieved by typing 'help' into the terminal, and detailed help for each command can be retrieved using the '<command> --help' command.

The green text to the left of the command line entry box at the bottom of the terminal describes the application that is currently in focus. The default application is 'shell', which provides a set of Unix-style commands for navigating and modifying the file system, such as 'cd', 'rm', 'mv', etc. Other applications can be brought to the foreground using the 'show' command.

6.2 Wedit – Inbuilt AJAX text editor

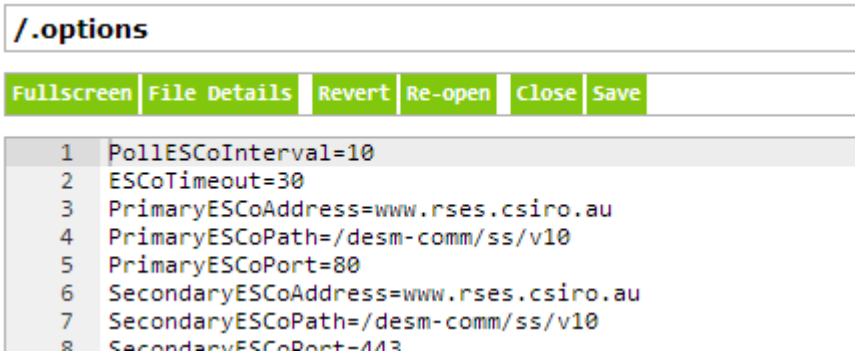
One of the key features built in to the ESBox web application is the in-browser AJAX based text wed editor (wedit). Wedit can be used to modify ESBox configuration files manually, or to manually save new update hex images to the ESBox's non-volatile flash.

To edit a text file using wedit, enter the name of an existing or new file after the wedit command. For example, the ESBox options file can be edited manually by typing 'wedit .options' while the 'shell' application is in focus.

```
$
$  ls
>  r/o|hid|sys|    size     |    date    |  time   |name
>  ---+---+---+-----------+----------+--------+--------------------------------
>  -  |-  |-  |         0 B|2013/03/05|13:11:52|<log>
>  -  |-  |-  |         0 B|2013/03/05|13:11:52|<dl>
>  -  |-  |-  |         0 B|2013/03/05|13:11:52|<zbupdate>
>  -  |-  |-  |       902 B|2013/03/10|03:51:44|.options.old
>  -  |-  |-  |       902 B|2013/03/10|03:53:14|.options
>  -  |-  |-  |       142 B|2013/03/06|03:47:26|SS.otareg
>  -  |-  |-  |   9.486 kB|2013/03/10|03:53:20|ss.nodes
>  -  |-  |-  |         0 B|2013/03/05|13:13:22|<srv>
>  -  |-  |-  |   1.339 MB|2013/03/05|13:15:02|supdate.hex
>  -  |-  |-  |       142 B|2000/01/17|17:43:08|.nwkopts
>  ---+---+---+-----------+----------+--------+--------------------------------
$
$
$  wedit .options
>  [WEDIT] File '/.options' opened (existing file).
>  File opened. You can edit, download or close it.

[0] (shell)
```

When a file is opened using the wedit tool, an 'edit' hyperlink will be printed in the terminal that can be used to access the wedit text editor interface.

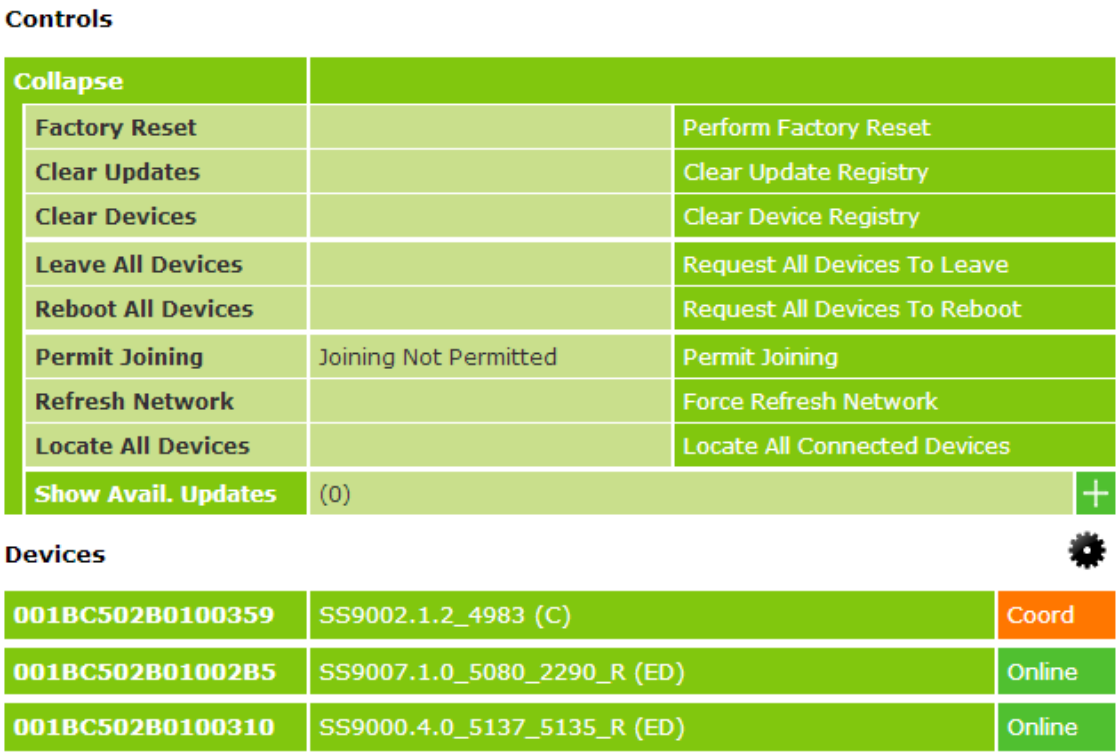


Please the ESBox-ESCo Protocol Specification document for a complete description of the ESBox Options listed in the .options file.

Formatting and syntax highlighting for the open file can be customised using the wedit settings menu accessed by clicking the cog icon on the right hand side of the wedit page.

6.3 Devices Page

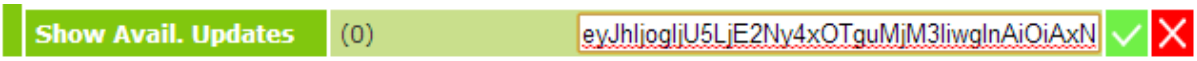
The Devices page gives an overview of devices that are connected to the ESBox, provides tools for managing and tracking OTA updates, and provides some basic metering and control functionality.



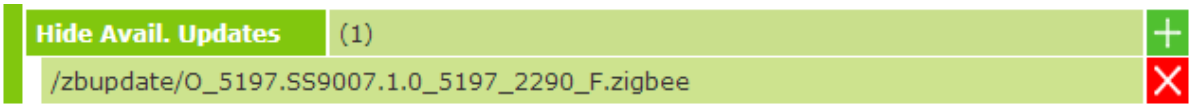
The controls at the top of the page provide the following functionality:

- **Factory Reset** – Resets the ESBox ZigBee coordinator, clears the ESBox's node list (i.e. the ESBox 'forgets' about any currently joined children), clears the update table (i.e. deregisters any registered OTA update files), and reboots the ESBox.
- **Clear Updates** – Deregisters any registered OTA updates, leaving the node list unaffected.
- **Clear Devices** – Clears the node list in the ESBox (i.e. the ESBox 'forgets' about any currently joined children). Any OTA updates that are currently registered will remain registered and be applied, if appropriate, to new devices that join the network.
- **Leave All Devices** – Instructs all devices connected to the ZigBee network to leave the network. For Saturn South devices, this will result in the leaving devices performing a standard Factory Reset.
- **Reboot All Devices** – Instructs all devices connected to the ZigBee network to reboot.
- **Permit Joining** – Enables permit joining mode on the ESBox, and also causes the ESBox to transmit a 'Permit Joining' request to any connected routers.
- **Refresh Network** – When a new device connects to the ESBox's ZigBee network, the ESBox will automatically query basic information for the new node to display in the expanded 'Devices' list items. Pressing the 'Refresh Network' button will force the ESBox to refresh this basic information for each device in the node list.
- **Locate All Devices** – Instruct all connected Saturn South devices to blink the 'Locate' pattern. Used to easily identify all of the devices that are connected to this ZigBee network.

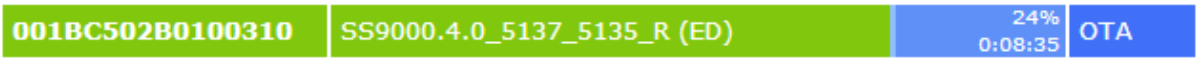
- **Show Available Updates** - If there are Over The Air (OTA) updates registered on the ESBox, clicking to expand this item will show a list of all files currently registered. New OTA files can be registered on the ESBox using the '+' button to the right of the 'Show Available Updates' button, and then entering a valid update token into the text field that appears inline and clicking on the tick button.



The ESBox web interface will unresponsive for a few seconds while the update is downloaded, after which the new OTA file will be visible in the Available Updates list:



When a device in the ZigBee network detects that an appropriate update image is available, it will automatically begin to download the new image, in which case the OTA update progress will be displayed in the device's summary bar:



The network coordinator (ESBox) is always the first node shown in the device list.

001BC502B0100359	SS9002.1.2_4983 (C)	Coord
Manufacturer	Saturn South	
Model	SS9002.1.2_4983	
Location	-	
Node Type	Coordinator (This ESBox)	
001BC502B01002B5	SS9007.1.0_5080_2290_R (ED)	Online
Leave		Request Device To Leave
Reboot		Reboot This Device
Locate		Locate This Device
Refresh Network		Refresh This Device
Manufacturer	Saturn South	
Model	SS9007.1.0_5080_2290_R	
Location	-	
Join Time	1362538531 (4 days ago)	
Last Contact Time	1362891491 (6 seconds ago)	
Time Since Rejoin	1362871292 (5 hours ago)	
Switch State	Off	Toggle Relay
Link Quality	LQI Test Not Running	Start Test
Node Type	End Device	

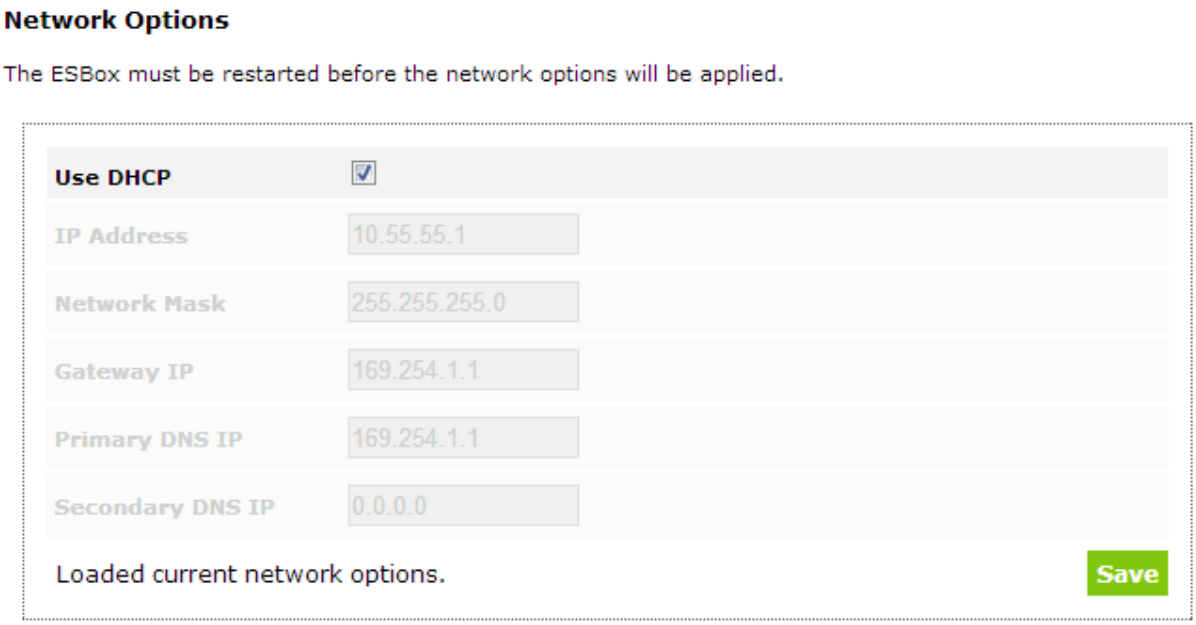
Each item in the device list can be expanded to reveal more detailed information and controls for that device. For non-coordinator devices in the device list, the following controls are provided:

- **Request Device to Leave** - Send a signal to this device to ask it to leave the network. For Saturn South devices, this will result in the remote device performing a standard Factory Reset.
- **Reboot This Device** – Command this device to reboot. Only supported by Saturn South devices.
- **Locate This Device –** Instructs the device to blink the 'Locate' pattern. Used to easily identify the device in practical deployments (e.g. when installed in a switchboard). Only supported by Saturn South devices.
- **Refresh This Device** – Instruct the ESBox to query this device's basic information (model number, manufacturer, etc).
- **Toggle Relay (or 'Switch On/Off')** – Basic relay control functionality for switching devices.
- **Start Test** – Instructs the ESBox to begin a link quality indication (LQI) test with this device. Results of the LQI test are displayed in line with this button as well as on the device's summary bar in collapsed view:

001BC502B01002B5	SS9007.1.0_5080_2290_R (ED)	62% 74%	Online

6.4 Network Options

The Network Options page is accessible via the 'Options' button in the navigation panel on the left hand side of the web interface. The default username and password for this page are both '*esbox*'.



This page can be used to configure a static IP address for the ESBox – DHCP is enabled by default on the ESBox.

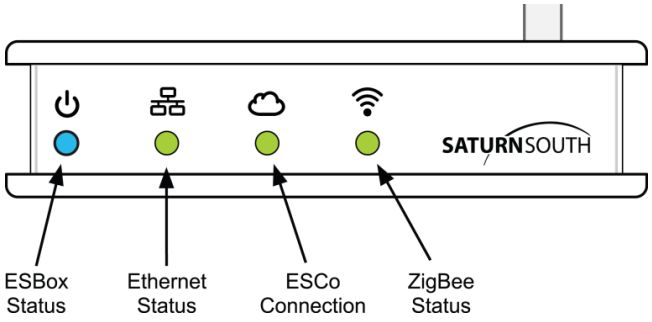
7 ESBox-ESCo Protocol

A RESTful HTTP/HTTPS based protocol is used to exchange commands and responses between the ESBox (Energy Services Box) and server (Energy Services Company - 'ESCo') as required to interact with the ESBox and ZigBee network. The protocol uses human readable commands encoded in JSON, with communications between the ESBox and ESCo initiated by the client at a configurable frequency.A full specification for the ESBox-ESCo Protocol is available on request from Saturn South.

8 Installation

The ESBox requires only a connection to a power supply and a wired Ethernet connection to function correctly. Each ESBox is supplied with an external screw-on antenna that should be attached during installation. When power is applied to the ESBox and Ethernet is connected, the device should start up and connect to the ESCo within 6 seconds.

During installation, the status of the ESBox can be quickly determined by observing the state of the front panel LEDs. The diagram below shows the LED pattern that will be visible when the device is operating normally.



The ‘Ethernet Status’ LED will turn red if there is no Ethernet connection detected; this state typically reflects a physical connectivity issue, such as an unconnected Ethernet cable. When the Ethernet cable is correctly connected, the ‘Ethernet Status’ LED will blink green while the device negotiates an IP address using DHCP.

If the ‘ESCo Connection’ LED is red, this ESBox is not able to communicate with a compliant ESCo. Check the ESBox’s settings for Primary and Secondary ESCo (address, port and path). If the ‘ESCo Connection’ LED is blinking red, the ESBox is able to communicate with a compliant ESCo but is not properly authenticated. Contact the ESCo operator if this condition occurs and ensure that the ESBox is correctly registered with the ESCo.

Refer to the LED Quick Reference guide at the start of this document for more information on the ESBox LED status indications.

9 Errors and Troubleshooting

The following table gives an exhaustive list of possible error indications that can be displayed on the ESBox LT. Please refer to this table when reporting issues to Saturn South.

LED Status	Comments
	No Error or Unknown Error.
	RTC Init Error.
	B1==2 and U==1.
	File System Error.
	FATFS Init Error.
	Too many update retries. Requires manual override.
	Userspace load failed with no update.
	Flash erase failed.
	FATFS failed during flash.
	Unexpected EOF during flash operation.
	Update read too much hex.
	Update read not enough hex.
	NVM write failure.
	Update checksum mismatch.
	Terminal flash failure.
	B1 missing magic number.
	Userspace missing magic number.
	Tried to revert but no ‘supdate’ available for revert.
	U flag set and revert – too many attempts.
	U1 – no magic number and revert – too many attempts.
	U flag set and revert, no ‘supdate’ file available.
	U1 – no magic number and revert, no ‘supdate’ file available.