



Exegin ZigBee / 802.15.4 Transceiver
Installation and Configuration Guide

Version 3.0

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Made in Canada.

Exegin Technologies Limited
204 - 2071 Kingsway Avenue
Port Coquitlam, B.C. V3C 6N2
<http://www.exegin.com/>
P/N 79-051-100

Table of Contents

i	List of Tables	5
ii	List of Figures	6
1	Overview Of The Manual	8
	Contents of the Manual.....	8
	Documentation Conventions	8
2	Introduction to the Q51 ZigBee / 802.15.4 Transceiver	10
	What is the Q51?	10
	Physical Features	10
	How Does the Q51 Work?.....	11
	Product Features	11
3	Installing the Q51	12
	Site Requirements.....	12
	Unpacking the Q51	13
	Connecting the Q51 to a Network	13
4	Configuring the Q51 on Your Network	15
	Required TCP/IP Settings.....	15
	Troubleshooting Tips.....	17
5	Q51 ZigBee Sniffer and Scans Configuration	18
	Required Sniffer Settings.....	18
	Optional Sniffer and Scans Settings	19
6	Using a Browser to Configure the Q51	22
	Accessing the Q51 HTML Pages	22
	Q51 Home / Sniffer Page.....	23
	Sniffer Form	24
	Scans Forms.....	25
	Network Forms.....	28
	Administration Forms.....	29
	Performing Firmware Upgrades	30
7	Q51 Regulatory information	33
	Radio Frequency Notifications	33
8	Q51 Specifications	37
	Physical Features	37
	Electrical Details.....	38
	Antenna Radiation Pattern.....	38
	Q51 LEDs	39
	Network Interfaces	40
	Software Specifications	41
	Dipswitch Specifications	42

9	Getting Help	44
	Help Methods Available	44
	Repair Procedure	45
10	Glossary	48

LIST OF TABLES

Table 1:	Q51 Packing List.....	13
Table 2:	STAT LED Patterns	39
Table 3:	NET LED Patterns	40
Table 4:	RF LED Patterns	40
Table 5:	UTP (RJ45) Connector Pinout	40
Table 6:	Q51 Dipswitch Settings	43

LIST OF FIGURES

Figure 1:	Q51 Side View	13
Figure 2:	Q51 Top View: LED Status Indicators	14
Figure 3:	Interface Settings Form.....	16
Figure 4:	Sniffer Settings Form.....	19
Figure 5:	Energy Scan Settings Form.....	20
Figure 6:	Password Dialog for Access to Administration Forms.....	23
Figure 7:	Q51 HTML Menu	24
Figure 8:	Sniffer Settings Form	24
Figure 9:	Energy Scans settings Form.....	26
Figure 10:	Beacon Scans Settings Form.....	27
Figure 11:	InterfacesSettings Form	28
Figure 12:	Password Form.....	29
Figure 13:	Firmware Upgrade Form.....	30
Figure 14:	Firmware File Selection Dialog	31
Figure 15:	Reboot Form	32
Figure 16:	Q51 Declaration of Conformity	36
Figure 17:	Micro USB B socket	38
Figure 18:	Antenna Radiation Pattern	39
Figure 19:	Q51 Bottom View	42
Figure 20:	Sample Commercial Invoice.....	47

1 OVERVIEW OF THE MANUAL

This manual describes the installation and configuration of the Q51 ZigBee / 802.15.4 Transceiver on your network. For the latest information on the Q51, please see the Technical Support section of Exegin's Web site:

<http://www.exegin.com/>

Contents of the Manual

This manual contains the following chapters:

- 2: Introduction to the Q51 ZigBee / 802.15.4 Transceiver.** A description of how the Q51 works, and its main features.
- 3: Installing the Q51.** Installing and connecting the Q51 ZigBee / 802.15.4 Transceiver to a TCP/IP network.
- 4: Configuring the Q51 on Your Network.** Describes how to set up the TCP/IP network parameters on the Q51.
- 5: Q51 ZigBee Sniffer and Scans Configuration.** Describes how to set up the ZigBee and host parameters on the Q51.
- 6: Using a Browser to Configure the Q51.** Descriptions of the Q51 web pages for configuring the ZigBee Transceiver and viewing its status.
- 8: Q51 Specifications.** Providing hardware and software specifications for the Q51, connector pinouts, LED status indicators and variable definitions.
- 9: Getting Help.** Where to find help and how to return the Q51 for repair.
- 10: Glossary.**

Documentation Conventions

The document conventions used in this manual and the appendices are as follows:

- The Courier font in **boldface** indicates commands that you type.

```
$ping www.exegin.com
```
- Regular Courier font indicates displayed results.

```
www.exegin.com is alive
```
- Example names, numbers, and commands are presented in **bold**.

1. Overview Of The Manual

Documentation Conventions

To create an IP address for the Q51 using the TCP/IP **arp** command, do the following...

- Variable values are shown in *italics*. *Italics* may also be used to add emphasis.

```
ping ipname
```

```
ipname is alive
```

Please enter the *ipname* at the prompt.

Make sure you *first* contact...

2 INTRODUCTION TO THE Q51 ZIGBEE / 802.15.4 TRANSCEIVER

This chapter describes the Q51's architecture and special features. The topics included are:

- *What is the Q51?* on page 10
- *Physical Features* on page 10
- *How Does the Q51 Work?* on page 11
- *Product Features* on page 11

What is the Q51?

The Q51 ZigBee Transceiver allows the real time capture, dissection and display of ZigBee / IEEE 802.15.4 packets with a compatible software application (example: WireShark). Active and passive RF channels scans.

Typical applications for the Q51 include: analysis of IEEE 802.15.4 devices; interconnection of the devices in their PANs.

Physical Features

The key physical components of the Q51 are:

- a 10/100 network interface connector to connect to the network
- 2.4 GHz, IEEE 802.15.4 radio to listen and scan for information
- Flash memory to store firmware and user-configurable settings
- High-performance internal 32-bit microprocessor subsystem for speed, efficiency and reliability

For more detailed specifications of the Q51, please see chapter 8, *Q51 Specifications*.

How Does the Q51 Work?

The Q51 Protocol Analyzer enables comprehensive analysis of a 2.4 GHz, IEEE 802.15.4 traffic by forwarding the captured information via TCP/IP to a workstation running a compatible software application (example: WireShark).

Product Features

The Q51 offers an extensive list of features including:

- internal radio circuitry supporting 2.4 GHz, IEEE 802.15.4 PANs
- simple and fast configuration of TCP/IP and IEEE 802.15.4 operating parameters
- built-in HTML forms for easy cross-platform configuration and status monitoring with any web browser
- TCP/IP configuration via DHCP
- configuration security through passwords
- extensive built-in troubleshooting tools
- simple flash memory upgrades over TCP/IP using a web browser

3 INSTALLING THE Q51

This chapter describes the following:

- [Site Requirements](#) on page 12
- [Unpacking the Q51](#) on page 13
- [Connecting the Q51 to a Network](#) on page 13

Site Requirements

Prepare to install the Q51 in a clean, well-ventilated environment protected from extremes of temperature, humidity, mechanical shock, or vibration. Provide enough space at the front and back of the unit for cable connections.

Depending upon the specific options selected at time of ordering, the Q51 may be powered from a 115 or 230 VAC outlet using the supplied external transformer through a output cord to a micro-USB power connector, or over the Ethernet cable (Power Over Ethernet - POE) from an Ethernet switch providing power as defined in the IEEE standard 802.11 af. If using the external AC transformer, prepare to install the Q51 within four meters (13 feet) of a grounded 115 or 230 VAC outlet.

The Q51 must be installed within RF range of the local IEEE 802.15.4 wireless PAN, in order to connect to the PAN and therefore bridge it over the TCP/IP network. The maximum distance from the Q51 to the nearest IEEE 802.15.4 PAN node will vary depending upon the installation environment and capabilities of the other IEEE 802.15.4 node(s).

The Q51 is an intentional radiator of Radio Frequency (RF) energy. In order to limit RF exposure to personnel in the immediate area, the Q51 should be located and installed such that a separation of at least 20 centimeters is maintained between the Q51's antenna and personnel in the vicinity of the device.

Note: ESD precautions should be used when attaching or removing the antenna.

Unpacking the Q51

Upon receiving the Q51, check the packaging for any damage or missing pieces. Immediately report problems to the shipping company or vendor.

Table 1—Q51 Packing List

ZigBee / 802.15.4 Transceiver	<ul style="list-style-type: none">• Q51• 2.4 GHz Antenna• Power Supply• micro USB cable• Install Guide
-------------------------------	--

Connecting the Q51 to a Network

Attach the 2.4 GHz Antenna to **ANT-0**, located on the side panel of the Q51 (see [Figure 1](#)). Plug a network cable into the connector, **UTP** and the other end of the cable to the network.

If installing a Q51 without the Power Over Ethernet (POE) option, insert the two or three-prong power cable of the AC adapter into an AC outlet, and insert the micro-USB power connectors into the **POWER** connector on the side panel of the Q51; this will power on the device.

Figure 1—Q51 Side View



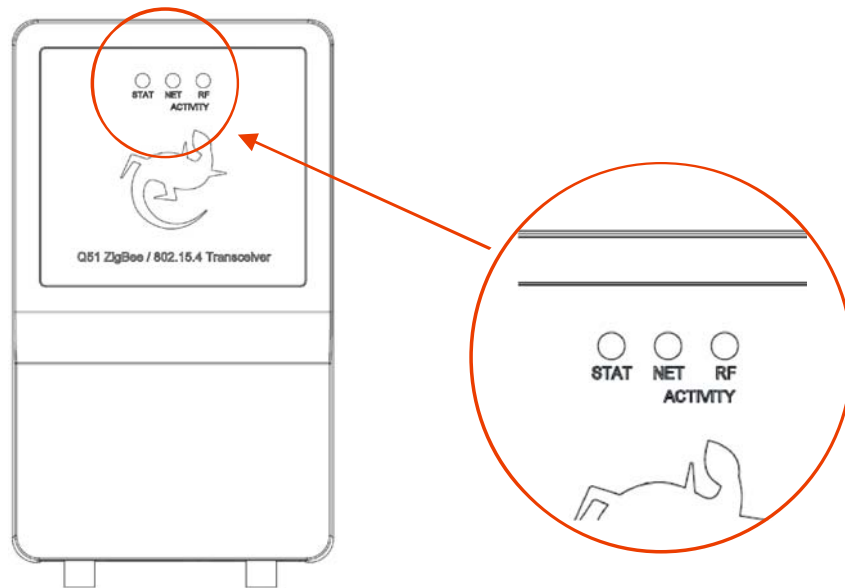
Two LED indicators are used to indicate Ethernet link integrity (see [Figure 1](#)). The green LED at the bottom left of the UTP network connector will be illuminated when a 100 MB/S link is established over the network connection, or extinguished otherwise. The

3. Installing the Q51

Connecting the Q51 to a Network

red/orange LED at the bottom right of the UTP network connector will be illuminated when a 10 MB/S link is established over the network connection, or extinguished otherwise.

Figure 2—Q51 Top View: LED Status Indicators



Watch the LED indicators on the top panel as they cycle through the power-on self-test. When the test is complete, the STAT LED will flash once per second or, if there is no IP address configured, twice per second.

4 CONFIGURING THE Q51 ON YOUR NETWORK

This chapter describes how to configure the required and optional TCP/IP settings for the Q51 on your network. The following steps are covered:

- [Required TCP/IP Settings](#):
- [Troubleshooting Tips](#) on page 17.

Once the TCP/IP network port is configured on the Q51, additional configuration is required to connect the Q51 to the local ZigBee Personal Area Network (PAN), and also to bridge that local PAN to another remote PAN over TCP/IP. Please refer to [Q51 ZigBee Sniffer and Scans Configuration](#) on page 18 for details on ZigBee and bridge configuration.

Required TCP/IP Settings

Initial IP address for the Q51

Since the has no physical user interface such as a display or keyboard, all operating parameters must be configured by means of a TCP/IP network connection from a separate computer. However, the Q51 must first be assigned an IP address in order to function on a TCP/IP network. This raises the question of how to configure a Q51 when it is first installed on the network fresh from the factory.

As delivered from the factory, the Q51 is configured to request an IP address from a DHCP server when attached to a TCP/IP network. The IP address assigned to the Q51 may be determined by querying the DHCP server using its administration interface and locating the IP address of the desired Q51 by matching its Ethernet MAC address. Please refer to the documentation for the particular DHCP server used to determine how this may be done.

Optional Static IP address and subnet mask for Q51

Using the IP address provided by the DHCP server, you add a Static IP address and subnet mask for the Q51 ZigBee / 802.15.4 Transceiver using the:

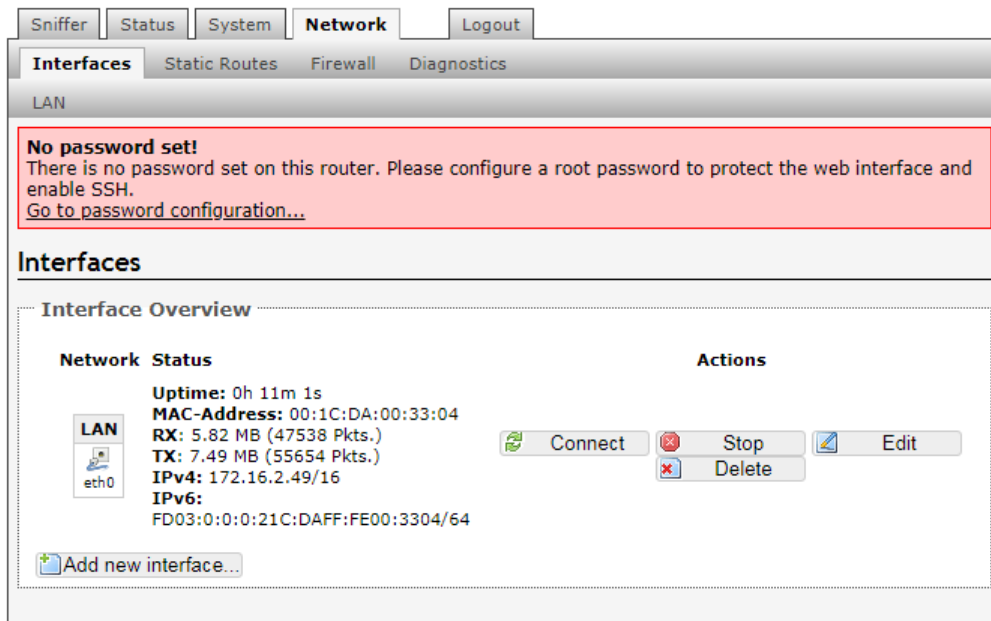
- Q51 HTML forms, [page 15](#)

Using HTML forms

1. Load the Q51 HTML forms as described in [Using HTML forms](#) on page 15, then click on "Network" - "Interface" tab .

The Interface Settings form is displayed ([Figure 3](#)).

Figure 3—Interface Settings Form



2. If static addressing is desired, then click on the "Add new interface..." at the bottom of the window.
3. Enter a name for this new interface, example "Q51_Static".
4. Leave "Static address" as Protocol of the new interface and click on "Ethernet Adapter: "etho" (lan)".
5. Click on "Submit".
6. Enter the IP address in the **IPv4 address** field.
7. Select the Q51's subnet mask in the **Subnet Mask** field.
8. [Optional setting] In order to communicate across subnets with the Q51, enter the address of the default gateway in the **Default Gateway** field.
9. [Optional setting] In order to use host and domain names in addition to dotted quad IP addresses, enter the address of the domain name server in the **DNS Server Address** field.
10. [Optional setting] Enter the suffix of the domain name for the Q51 in the **DNS Domain Suffix** field.
11. Click on "Save & Apply" when done.
12. [Optional setting] Click on the Interface tab and click on "Stop" to stop the interface that is no longer required.

After successfully assigning the settings you will be connect to the Q51 using the new IP address.

4. Configuring the Q51 on Your Network

Troubleshooting Tips

An Important Note Once you have configured the unit using any of the above methods, the STAT LED will flash once per second. This means the Q51 is configured and recognizable on the network.

The STAT LED will flash when the IP Address is configured; it does not mean that the unit is properly configured, only that an IP address has been saved.

Troubleshooting Tips

Q51 will not talk on the network

- Have you tried to **ping** with the IP address instead of the IP name? This will eliminate any name-lookup issues and focus more on the communications between the Q51 and your host.
- Is it possible that a duplicate IP address has been assigned?
- Did you use the correct netmask for your particular environment?
- Are you sure you are trying to talk to the Q51 from a host on the *same subnet*? The ZigBee Transceiver can only be seen locally unless you configured a routing entry earlier on.
- Is the STAT LED on the front of the Q51 flashing once per second or is it flashing faster? A slower, once-a-second rate indicates that the ZigBee Transceiver is in fact configured with an IP address. A faster rate indicates that the Q51 is unaware of the IP address and you may need to try the configuration process again.
- Have you confirmed the network connection to the Q51 is working correctly? Trying different network cables and locations will help narrow down the problem.
- Has the Q51 been moved from another network? If so, it will likely need to be reconfigured to integrate with its new location. This includes at minimum a new IP address and netmask. Please see [Using HTML forms](#) on page 15 for possible configuration methods.
- Do you have a DHCP server running on your network? By default, the Q51 comes with the DHCP request turned *on* so although you may have stored a particular network configuration in the unit's EEPROM, a DHCP server may supply new *network* parameters upon bootup. To turn off DHCP on the unit, please see [Optional Static IP address and subnet mask for Q51](#) on page 15.

5 Q51 ZIGBEE SNIFFER AND SCANS CONFIGURATION

This chapter describes how to configure the required and optional ZigBee Personal Area Network (PAN) and bridge settings for the Q51. The following steps are covered:

- *Required Sniffer Settings*
 - [Selecting the RF Channels](#) on page 18
- *Optional Sniffer and Scans Settings*
 - [Energy Scans settings](#) on page 20
 - [Beacon Scans settings](#) on page 21

Required Sniffer Settings

Selecting the RF Channels

As shipped from the factory, the Q51 is configured to Off.

The Q51 must be configured to use the same radio channel(s) as the other nodes in the local ZigBee PAN. This configuration may be performed using HTML forms.

Using HTML forms

1. Load the Q51 HTML forms as described in [Sniffer Settings Form](#) on page 19, then select "Sniffer"- "Configurations".

The Sniffer Settings configuration form is displayed ([Figure 4](#)).

Figure 4—Sniffer Settings Form

The screenshot shows a web interface for configuring a sniffer. At the top, there are tabs for 'Sniffer', 'Status', 'System', 'Network', and 'Logout'. Below these is a sub-menu with 'Configuration', 'Status', 'Energy Scan', and 'Beacon Scan'. A red warning box at the top states: 'No password set! There is no password set on this router. Please configure a root password to protect the web interface and enable SSH. Go to password configuration...'. The main section is titled 'Sniffer Configuration' and is divided into two parts: 'Common Sniffer Configuration' and 'Settings'. Under 'Common Sniffer Configuration', there is a 'Radio' section with a '2.4 GHz Channel' dropdown menu set to '20'. Under 'Settings', there is a 'Device ID (0x0000 to 0xffff)' text input set to '0x0000', and two checked checkboxes: 'Send to Multicast IP (239.255.255.251)' and 'Filter Bad FCS'. At the bottom right, there are three buttons: 'Reset', 'Save', and 'Save & Apply'.

2. Select the desired 2.4 GHz Channel by clicking on the down-arrow indicator of the drop down box.
3. Optional, type in a number to identify the device. Each packet sent to the WireShark host will have this device ID number. This allows WireShark to distinguish between packets from two Q51 transceivers.
4. Optional, unselect "Send to Multicast IP (239.255.255.251)" and type in the hostname or IP address of the WireShark host to which packets are forwarded (UDP port 17754) for display and dissection.
5. Click on "Save & Apply" when done.
6. Click on "Status" tab for real-time status information from the radio.

Optional Sniffer and Scans Settings

Enabling Capture Settings for FCS

By default, the Q51 forwards drop packets that have failed the FCS check and uses the FCS field to forward additional information.

1. Load the Q51 HTML forms as described in [Q51 HTML Menu](#) on page 24, then select "Sniffer" from the Main Menu.

The Sniffer Settings configuration form is displayed ([Figure 4](#)).

5. Q51 ZigBee Sniffer and Scans Configuration

Optional Sniffer and Scans Settings

2. To disable Filter Bad FCS, the Q51 will forward received packets that fail the FCS check for display and dissection, check the box labelled 'Filter Bad FCS'; otherwise leave this box un-checked.
3. To disable the FCS field within a received IEEE 802.15.4 frame is included, check the box labelled 'Filter Bad FCS'; otherwise, leave this box un-checked.
4. Click on "Save & Apply" when done.

Energy Scans settings

The Q51 will perform an energy scan on the selected RF Channels. The maximum RSSI reading (post code gain) across all iterations and for each channel is displayed. When multiple iterations of the scan are performed, the average of all the maximum RSSI readings is displayed.

Using HTML forms

1. Load the Q51 HTML forms as described in [Q51 HTML Menu](#) on page 24, then select "Energy Scan" under the Sniffer tab.

The Scans Settings configuration form is displayed ([Figure 5](#)).

Figure 5—Energy Scan Settings Form

The screenshot displays the Q51 web interface for the Energy Scan configuration. At the top, there are navigation tabs: Sniffer, Status, System, Network, and Logout. Below these are sub-tabs: Configuration, Status, Energy Scan, and Beacon Scan. A prominent red warning box at the top reads: "No password set! There is no password set on this router. Please configure a root password to protect the web interface and enable SSH. Go to password configuration...". The main content area is titled "Energy Scan" and is enclosed in a dotted border. It is divided into two sections: "Control" and "Results". The "Control" section contains the following fields and controls: "Channel ('all' or blank for all channels):" with a text input containing "all"; "Duration:" with a dropdown menu set to "3"; "Iterations:" with a text input containing "3"; "Control:" with a green "Start" button and a grey "Stop" button; and "Current Scanning State" with the value "Idle". The "Results" section shows a table header with columns: "Channel", "MHz", "Energy (dBm)", and "Energy".

2. You can use "all" for all channels (11-25) in the "Channel" box or enter a number from 11 to 25 as a channel to scan, example: "20"..
3. With the "Durations" dropdown box, you can select the length of time the radio listens on a channel to obtain a maximum energy level reading for that channel or channels. Default is 3 seconds.

5. Q51 ZigBee Sniffer and Scans Configuration

Optional Sniffer and Scans Settings

4. Enter the number of times the selected channels are to be scanned in the "Iterations" box. An average energy level is determined for each channel from the values from each scan. Minimum is 1.
5. Click on "Save & Apply" when done.

Beacon Scans settings

The Q51 will perform an energy scan on the selected RF Channels. The maximum RSSI reading (post code gain) across all iterations and for each channel is displayed. When multiple iterations of the scan are performed, the average of all the maximum RSSI readings is displayed.

Using HTML forms

1. Load the Q51 HTML forms as described in [Q51 HTML Menu](#) on page 24, then select "Beacon Scans" from the Main Menu.
2. You can use "all" for all channels (11-25) in the "Channel" box or enter a number from 11 to 25 as a channel to scan, example: "20".
3. With the "Durations" dropdown box, you can select the length of time the radio listens on a channel to obtain a maximum energy level reading for that channel or channels. Default is 3 seconds.
4. Enter the number of times the selected channels are to be scanned in the "Iterations" box. An average energy level is determined for each channel from the values from each scan. Minimum is 1.
5. Click on "Save & Apply" when done.

6 USING A BROWSER TO CONFIGURE THE Q51

This chapter describes the HTML pages provided with the Q51. The ZigBee Transceiver settings can be configured and its status observed at any time, by calling up these pages.

The following HTML pages are described here:

- [Accessing the Q51 HTML Pages](#) on page 22
 - [Password Protection](#) on page 23
- [Q51 Home / Sniffer Page](#) on page 23
- *Sniffer Form*
 - [Sniffer Settings Form](#) on page 24
- *Scans Forms*
 - [Energy Scans Settings Form](#) on page 25
 - [Beacon Scans Settings Form](#) on page 26
 - [Network Forms](#) on page 28
 - [Network Forms](#) on page 28
- *Network Forms*
 - [Network Settings Form](#) on page 28
 - [Administration Forms](#) on page 29
- *Administration Forms*
 - [Password Form](#) on page 29
 - [Firmware Upgrade Form](#) on page 30
 - [Reboot](#) on page 31

Accessing the Q51 HTML Pages

To access the Q51's HTML pages, do the following:

1. Ensure that the ZigBee Transceiver has an IP address and subnet mask so that it is identifiable on your TCP/IP network.
2. Ensure that your network station can successfully "**ping**" the Q51 over the network.

3. Direct your Web browser to the Uniform Resource Locator (URL):

http://Q51IPaddress

For example: **http://192.168.11.9**

4. When prompted for a User ID and Password, type in "root" for the ID and press ENTER at the password prompt.

By default, no password is set. However, if a password has been configured, then type it in and then press ENTER.

Password Protection

Some of the Q51 configuration forms are password-protected. When first accessing these forms, a password dialog will be displayed as shown in [Figure 6](#).

Figure 6—Password Dialog for Access to Administration Forms

No password set!
There is no password set on this router. Please configure a root password to protect the web interface and enable SSH.
[Go to password configuration...](#)

Authorization Required

Please enter your username and password.

Username

Password

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By default, the Q51 the user name: 'root'. Passwords may be set. As shipped from the factory, the password is blank. Passwords may be set for each user ID; please refer to [Password Form](#) on page 29 for details on how this is done.

To access a password-protected form, enter 'root' as the user name and the associated password, then click the 'Login' button at the right corner.

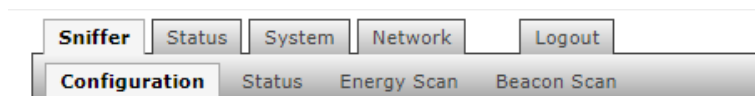
Q51 Home / Sniffer Page

The Home / Sniffer page for the Q51 ZigBee / 802.15.4 Transceiver provides a menu of pages (see [Figure 7](#)) that facilitate viewing and changing the status and operating parameters of the Q51. It also required settings page for the Q51, and a link to the Exegin web site.

6. Using a Browser to Configure the Q51

Sniffer Form

Figure 7—Q51 HTML Menu



Sniffer Configuration

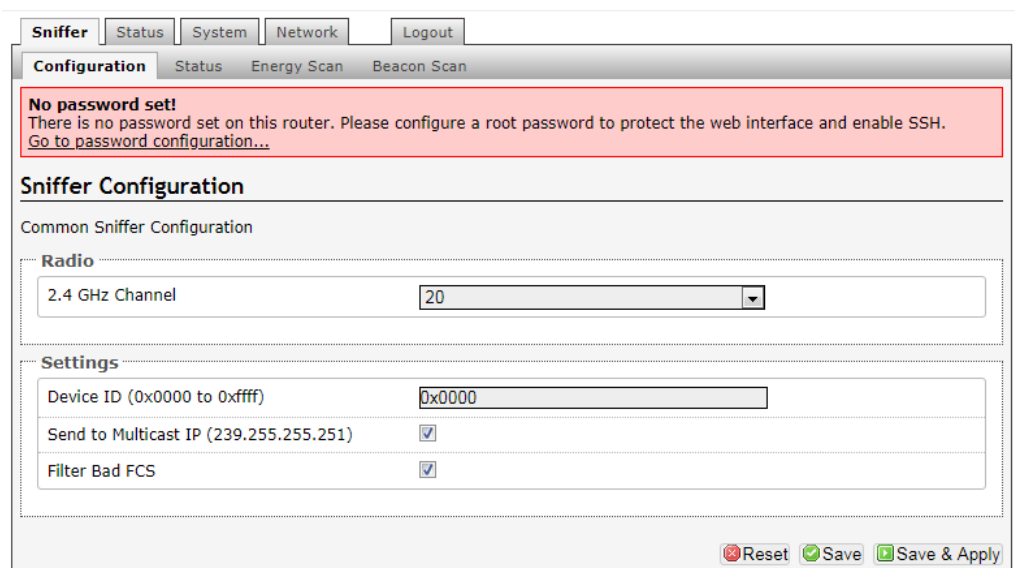
The first field on this page, Radio - 2.4 GHz Channel is required to start the process to receive IEEE 802.15.4 packets.

Sniffer Form

Sniffer Settings Form

the Sniffer Settings form appears as shown in [Figure 8](#).

Figure 8—Sniffer Settings Form



Radio Channels

The Q51 has a drop down box to select the desired channel for the 2.4 GHz radio.

Default: Set to Off.

Device ID

Device ID field allows the user to defined device identification in each packet sent to the WireShark host. This helps WireShark to distinguish between packets from two Q51 Transceivers.

6. Using a Browser to Configure the Q51

Scans Forms

Send to Multicast IP Un-select "Multicast IP (239.255.255.251)." to forward the packets to a destination or computer. Device ID field allows the user to defined device identification in each packet sent to the WireShark host. This helps WireShark to distinguish between packets from two Q51 Transceivers.

Destination Hostname

Hostname field is for the IP address of the WireShark host to which packets are forwarded (UDP port 17754) for display and dissection.

Default: The captured packets will be broadcast onto the LAN via Multicast IP (239.255.255.251).

Filter Bad FCS Modify the packets being sent to the destination or computer. Select the Filter Bad FCS to drop received packets that fail the FCS check.

Default: Filter Bad FCS.

Select the Include FCS field within a received IEEE 802.15.4 frame is included. Otherwise, the FCS field is used to forward additional information about the received packet, such as the packet's LQI value.

Default: Include FCS Field disabled.

Saving Configuration Changes Any changes on this page will be saved only when the 'Save & Apply' button is clicked. To erase all changes, click the 'Reset' button.

Scans Forms

Energy Scans Settings Form

The Energy Scans and Settings form is shown in [Figure 9](#).

Figure 9—Energy Scans settings Form

OpenWrt Attitude Adjustment 2
Load: 0.32 0.32 0.39
Hostname: OpenWrt
Unsaved Changes: 0
Auto Refresh: on

Sniffer Status System Network Logout

Configuration Status **Energy Scan** Beacon Scan

No password set!
There is no password set on this router. Please configure a root password to protect the web interface and enable SSH.
[Go to password configuration...](#)

Energy Scan

Control

Channel ('all' or blank for all channels):

Duration:

Iterations:

Control: Start Stop

Current Scanning State: Idle

Results

Channel	MHz	Energy (dBm)	Energy
11	2405	-59	
12	2410	-60	
13	2415	-66	
14	2420	-77	

This page to perform an energy scan on the selected RF Channels. The maximum RSSI reading (post code gain) across all iterations and for each channel is displayed. When multiple iterations of the scan are performed, the average of all the maximum RSSI readings is displayed.

RF Channels The channels to be scanned as either a single channel or all the of channels.

Default: 11-26.

Duration The length of time per second the radio listens on a channel to obtain a maximum energy level reading for that channel

Default: 3

Iterations The number of times the selected channels are scanned. An average energy level is determined for each channel from the values from each scan. Minimum is 1.

Default: 3.

Beacon Scans Settings Form

The Beacon Scans and Settings form is shown in [Figure 10](#).

Figure 10—Beacon Scans Settings Form

OpenWrt Attitude Adjustment 2
Load: 0.29 0.29 0.36
Hostname: OpenWrt
Unsaved Changes: 0
Auto Refresh: on

Sniffer | Status | System | Network | Logout

Configuration | Status | Energy Scan | **Beacon Scan**

No password set!
There is no password set on this router. Please configure a root password to protect the web interface and enable SSH.
[Go to password configuration...](#)

Beacon Scan

Control

Channel ('all' or blank for all channels):

Duration:

Iterations:

Control:

Current Scanning State: Idle

Results

Channel	MHz	PAN ID	Network Address	Permit Join	LQI	Extended Info
11	2405	0xb38c	0x7cb0	no	255	ZigBee: StackProfile=PRO, EPID=12-34-56-78-12-34-56-78
11	2405	0xb38c	0x73ff	no	212	ZigBee: StackProfile=PRO, EPID=12-34-56-78-12-34-56-78
11	2405	0xb38c	0x09ca	no	255	ZigBee: StackProfile=PRO, EPID=12-34-56-78-12-34-56-78
11	2405	0xb38c	0xcf6b	no	255	ZigBee: StackProfile=PRO, EPID=12-34-56-78-12-34-56-78

This page to perform an energy scan on the selected RF Channels. The maximum RSSI reading (post code gain) across all iterations and for each channel is displayed. When multiple iterations of the scan are performed, the average of all the maximum RSSI readings is displayed.

RF Channels The channels to be scanned as either a single channel, a range of channels with a dash or a set of channels using commas.

Default: 11-26.

Duration The length of time per second the radio listens on a channel to obtain a maximum energy level reading for that channel

Default: 3.

Iterations The number of times the selected channels are scanned. An average energy level is determined for each channel from the values from each scan. If iterations is set to zero, then the scan will run indefinitely or until the user cancels the scan. he length of time the radio listens on a channel to obtain a maximum energy level reading for that channel.

Default: 3.

Network Forms

Network Settings Form

The Interfaces Settings form appears as is shown in Figure 11.

Figure 11—InterfacesSettings Form

OpenWrt Attitude Adjustment 2
Load: 0.57 0.65 0.49
Hostname: OpenWrt
Unsaved Changes: 0
Auto Refresh: on

Sniffer | Status | System | **Network** | Logout

Interfaces | Static Routes | Firewall | Diagnostics

No password set!
There is no password set on this router. Please configure a root password to protect the web interface and enable SSH.
[Go to password configuration...](#)

Interfaces

Interface Overview

Network	Status	Actions
Q51_STATIC eth0	Uptime: 2h 42m 27s MAC-Address: 00:1C:DA:00:33:04 RX: 5.79 MB (43053 Pkts.) TX: 24.03 MB (79672 Pkts.) IPv4: 172.16.1.128/16, 172.16.2.49/16 IPv6: FD03:0:0:0:21C:DAFF:FE00:3304/64	<input type="button" value="Connect"/> <input type="button" value="Stop"/> <input type="button" value="Delete"/> <input type="button" value="Edit"/>
LAN eth0	Uptime: 2h 38m 41s MAC-Address: 00:1C:DA:00:33:04 RX: 5.79 MB (43053 Pkts.) TX: 24.03 MB (79672 Pkts.) IPv4: 172.16.1.128/16, 172.16.2.49/16 IPv6: FD03:0:0:0:21C:DAFF:FE00:3304/64	<input type="button" value="Connect"/> <input type="button" value="Stop"/> <input type="button" value="Delete"/> <input type="button" value="Edit"/>

Static vs Dynamic Addressing

The Q51 may be set up to automatically request its TCP/IP parameters over the network from a DHCP (Dynamic Host Configuration Protocol) server. To enable this feature, click on the radio button labelled 'Obtain an IP address automatically'. When this feature is enabled, the DHCP server will provide all TCP/IP configuration data; in this case, none of the other fields on the TCP/IP Settings form need to be filled in.

If static addressing is desired, then click on the button labelled 'Add new interface...'. For static addressing, the IP address and Subnet mask are required to be entered. All other parameters are optional, depending upon your installation requirements.

Default: Unconfigured (blank) IP address and subnet mask; dynamic addressing enabled.

Administration Forms

Several forms are available for administering basic system settings, such as passwords and firmware upgrades.

Password Form

The Password administration form is shown in [Figure 12](#).

Figure 12—Password Form



The screenshot shows the Exegin Technologies Limited web interface. At the top right, system information is displayed: OpenWrt Attitude Adjustment 2, Load: 0.28 0.28 0.31, Hostname: OpenWrt, and Unsaved Changes: 0. The main navigation bar includes tabs for Sniffer, Status, System (selected), Network, and Logout. Under the System tab, there are sub-tabs for System, Administration (selected), Software, Startup, Scheduled Tasks, LED Configuration, and Backup / Flash Firmware. A red-bordered warning box states: "No password set! There is no password set on this router. Please configure a root password to protect the web interface and enable SSH. Go to password configuration...". Below this is the "Router Password" section, which includes the instruction "Changes the administrator password for accessing the device" and two password input fields labeled "Password" and "Confirmation".

All settings are protected by a password so that only authorized users can make changes. When you try to open any configuration page, you will be asked for a user name and password. At the prompt, you will need to enter **root** (unless you have another user configured with root privileges) followed by the associated password. If there is no password, leave the field blank and press ENTER.

Settings can only be altered by a user with root privileges; guest users can only view settings. Both types of users can be assigned passwords. To change a password, type the old password in the "Old" field. Then type the new password twice: once in the "New" field and once in the "Confirm" field.

Default: Blank passwords for root user.

Firmware Upgrade Form

Firmware Upgrade

Performing Firmware Upgrades

Since the Q51's firmware is stored in Flash ROM, upgrading is easy. Using a computer with a web browser on a TCP/IP network, the ZigBee Transceiver can be upgraded to a newer firmware version without needing new hardware. Please refer to [Firmware Upgrade Form](#) on page 30 for step-by-step instructions on how to load new firmware into the Q51.

Firmware File

The latest firmware file is always available at Exegin's web site ("<http://www.exegin.com/>"), or it can be ordered through Exegin Technical Support. Please see [Help Methods Available](#) on page 44 for further information.

The Firmware Upgrade Form ([Figure 13](#)) facilitates uploading of new firmware to the Q51.

Figure 13—Firmware Upgrade Form

The screenshot shows a web browser interface for the Q51. At the top, there are tabs for Sniffer, Status, System, Network, and Logout. Below these, a navigation bar includes System, Administration, Software, Startup, Scheduled Tasks, LED Configuration, and Backup / Flash Firmware. A red warning box states: "No password set! There is no password set on this router. Please configure a root password to protect the web interface and enable SSH. Go to password configuration...". The main content area is titled "Flash operations" and has two sub-sections: "Backup / Restore" and "Flash new firmware image". The "Backup / Restore" section includes a "Download backup:" field with a "Generate archive" button and a "Restore backup:" field with "Choose File" and "Upload archive..." buttons. The "Flash new firmware image" section includes a "Keep settings:" checkbox and an "Image:" field with "Choose File" and "Flash image..." buttons.

6. Using a Browser to Configure the Q51

Performing Firmware Upgrades

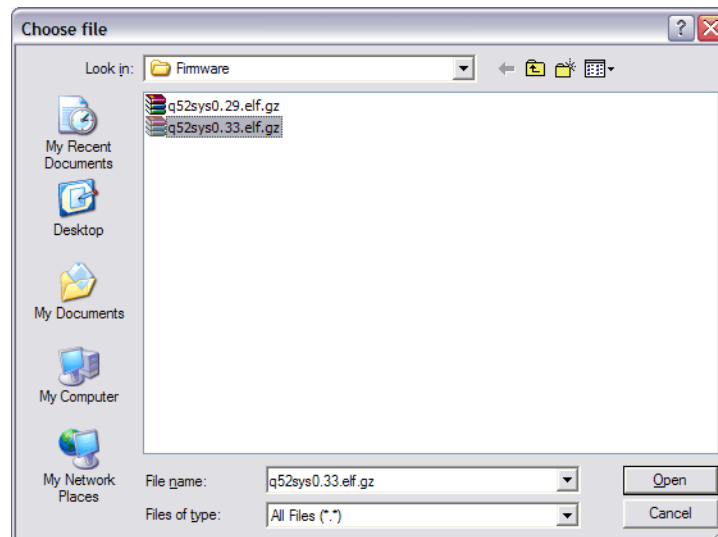
The firmware upgrade procedure uploads a new firmware image from your workstation into the flash memory of the Q51. This firmware image file must have been previously obtained from Exegin technical support personnel or downloaded directly from Exegin's web site:

<http://www.exegin.com/>

Please refer to [Contacting Exegin](#) on page 44 for more details on how to contact Exegin technical support.

File to Upload Enter the location of the new firmware file on your computer's hard drive. The full path to the file must be entered. Alternatively, clicking the the 'Browse...' button will open a file selection dialog ([Figure 14](#)) which will allow you to navigate your computer's hard drive and select the firmware file interactively.

Figure 14—Firmware File Selection Dialog



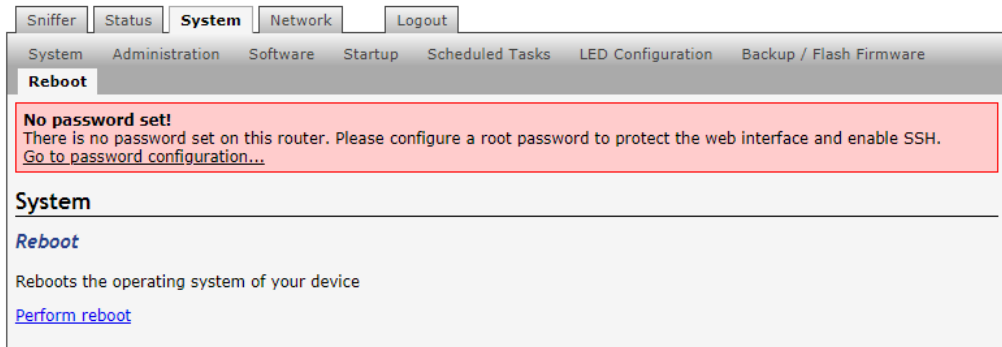
Upgrade Once the file location has been specified, clicking the 'Flash image' button will cause the selected firmware file to be uploaded to the Q51.

On the Flash Firmware - Verify page, click on "Proceed" to continue the upgrading of the firmware. The Q51 will restart when the firmware has been installed.

Reboot The Reboot page ([Figure 15](#)) allows you to do a soft power of cycle the Q51, click on "Perform reboot".

6. Using a Browser to Configure the Q51
Performing Firmware Upgrades

Figure 15—Reboot Form



7 Q51 REGULATORY INFORMATION

FCC Part 15

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 into 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.

CE Mark conformity declaration

The Q51 fulfills the requirements for radiated emissions according to limit B of EN55022/1987 and the requirements for immunity according to EN50082-1/1992 residential, commercial, and light industry.

Radio Frequency Notifications

FCC Notifications

RF Radiation

The Q51 is an intentional radiator of Radio Frequency (RF) energy. In order to limit RF exposure to personnel in the immediate area, the Q51 should be located and installed such that a separation of at least 20 centimeters is maintained between the Q51's antenna and personnel in the vicinity of the device.

Modification warning

Caution: changes or modifications to this equipment, not expressly approved by Exegin Technologies Limited could void the user's authority to operate the equipment.

Industry Canada Notifications

This Class B digital apparatus complies with Canadian ICES-003. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

Approved Antenna

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

This device has been designed to operate with the antennas listed below, and having a maximum gain of 3 dB. Antennas not included in this list or having a gain greater than 3 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

- Antenna Factor Corp: Part no ANT-2.4-CW-RCL

EU Notifications

Exegin Technologies Limited declares that this product conforms to the specifications listed in this manual, following the provisions of the European R&TTE directive 1999/5/EC:

Exegin Technologies Limited vakuuttaa täten että dieses produkt tyypinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien näiden direktiivien muiden ehtojen mukainen.

Exegin Technologies Limited déclare que le produit est conforme aux conditions essentielles et aux dispositions relatives à la directive 1999/5/EC.

- EN 301 489-1, 301 489-17 General EMC requirements for Radio equipment.
- EN 609 50 Safety
- EN 300-328-1, EN 300-328-2 Technical requirements for Radio equipment.

CAUTION—This equipment is intended to be used in all EU and EFTA countries. Outdoor use may be restricted to certain frequencies and/or may require a license for operation. Contact local Authority for procedure to follow.

Note: ESD precautions should be used when attaching or removing the antenna.

Note: Combinations of power levels and antennas resulting in a radiated power level of above 100 mW equivalent isotropic radiated power (EIRP) are considered as not compliant with the above mentioned directive and are not allowed for use within the European community and countries that have adopted the European R&TTE directive 1999/5/EC. For more details on legal combinations of power levels and antennas, contact Exegin Technologies Limited

7. Q51 Regulatory information

Radio Frequency Notifications

Do not use this product near water, for example, in a wet basement or near a swimming pool.

Avoid using this product during an electrical storm. There may be a remote risk of electric shock from lightning.

Belgique

Dans le cas d'une utilisation privée, à l'extérieur d'un bâtiment, au-dessus d'un espace public, aucun enregistrement n'est nécessaire pour une distance de moins de 300m. Pour une distance supérieure à 300m un enregistrement auprès de l'IBPT est requise. Pour une utilisation publique à l'extérieur de bâtiments, une licence de l'IBPT est requise. Pour les enregistrements et licences, veuillez contacter l'IBPT.

France

2.4 GHz Bande : les canaux 10, 11, 12, 13 (2457, 2462, 2467, et 2472 MHz respectivement) sont complètement libres d'utilisation en France (en utilisation intérieur). Pour ce qui est des autres canaux, ils peuvent être soumis à autorisation selon le département. L'utilisation en extérieur est soumise à autorisation préalable et très restreinte. Vous pouvez contacter l'Autorité de Régulation des Télécommunications (<http://www.art-telecom.fr>) pour de plus amples renseignements.

Figure 16—Q51 Declaration of Conformity

Declaration of Conformity

We, Exegin Technologies Limited, Manufacturer /
Importer, 204 – 2071 Kingsway Avenue, Port
Coquitlam, BC, V3C 6N2, Canada



hereby declare that under sole responsibility the following equipment:

- Q51 ZigBee 802.15.4 Transceiver
- Q52 ZigBee Bridge Device

are in conformity with the provisions of the following EC Directives, including all amendments, and with national legislation implementing these directives:

European Council Directive 1999/5/EC

and that the following harmonized standards have been applied:


RF: EN 300 328 v1.6.1

EMC: EN 301 489-01 v1.6.1, EN 301 489-17 v1.2.1

Electrical Safety: EN 60950-1:2001 +A11:2004

Full name and identification of the person empowered to sign on behalf of the manufacturer:

Name	Title
Fred Fierling	President

Signature	Date	Place
	2007/08/31	Port Coquitlam

8 Q51 SPECIFICATIONS

Hardware and software specifications are described in this chapter.

Hardware specifications are covered in the following sections:

- [Physical Features](#) on page 37
- [Electrical Details](#) on page 38
- [Q51 LEDs](#) on page 39
- [Network Interfaces](#) on page 40

Software Specifications are covered in the following sections:

- [Standards supported](#) on page 41
- [TCP port numbers used on the Q51](#) on page 41
- [UDP port numbers used on the Q51](#) on page 41
- [Error conditions](#) on page 41
- [Internal errors such as bus errors, address errors or illegal instructions force the Q51 into this non-operational mode.](#) on page 41.

Physical Features

Dimensions

Metric Width:65 mm
 Height: 23.5 mm
 Length: 111 mm

Imperial Width: 2.55"
 Height: 1.925"
 Length: 4.4"

Weight: 80g or 3 oz (Device); 175g or 6 oz (external transformer)

Environmental details

Operating: 0° C to 50° C
Storage: -40° C to 85° C

95% maximum humidity, non-condensing.

Electrical Details

Micro USB B socket

Figure 17 shows the Micro USB B socket on the Q51 side panel.

Figure 17—Micro USB B socket

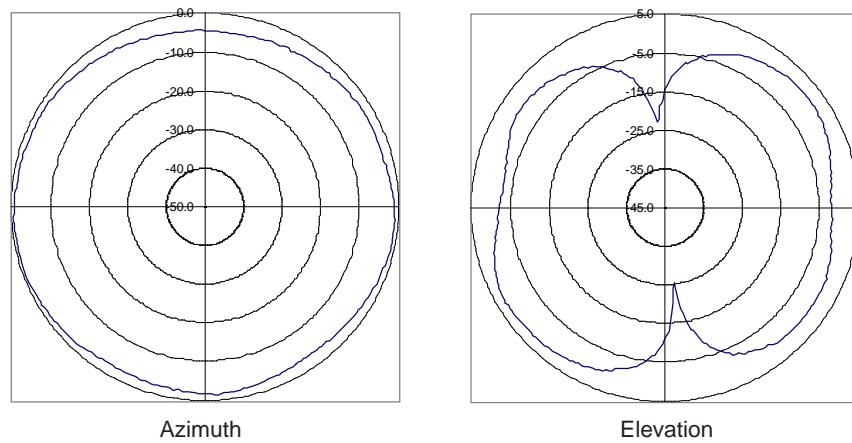


Power supply options	External transformer available in 120V/60Hz or 220-240V/50Hz.	
Power supply requirements	Typical	120VAC +/- 10% 35mA, 60Hz 240VAC +/- 10% 18mA, 50/60Hz
	Maximum	120VAC +/- 10% 40mA, 60Hz 240VAC +/- 10% 20mA, 50/60Hz
DC power requirements	Voltage	4.5-6.0 VDC regulated
	Current, Typical	300 mA
	Current, Maximum	330 mA
DC Power consumption	Typical	1.8 W
	Maximum	2.0 W
IEEE 802.3.af Power over Ethernet	Class 1 device, 1.2W typical	

Antenna Radiation Pattern

Figure 18 shows the radiation pattern of the standard antenna supplied with the Q51.

Figure 18—Antenna Radiation Pattern



Q51 LEDs

STAT	System Status
NET	Data to Ethernet
RF	Data to ZigBee PAN

Run and auto-reset mode

Run Mode is the normal operating state of the Q51. Auto-reset mode is entered when the watchdog timer is triggered and the ZigBee Transceiver has reset itself. The STAT LED flashes differently depending on whether the device's IP address is configured.

Table 2—STAT LED Patterns

FLASH RATE	INDICATES
Green, on once per second (i.e., more off than on)	Normal Mode, IP address configured
Green, on twice per second	IP address not configured
Red, off twice per second	System error

Table 3—NET LED Patterns

FLASH RATE	INDICATES
On	Network link present
Off	Network link not present
Blinking, off 1/3 second	Network link present and transmitting; flashes off 1/3 second each time a packet is transmitted

Table 4—RF LED Patterns

FLASH RATE	INDICATES
On	Network link present
Off	Network link not present
Blinking, off 1/3 second	Network link present and transmitting; flashes off 1/3 second each time a packet is transmitted

Network Interfaces

The Q51 network interfaces provide compatibility with TCP/ICMP/IP and 802.3 Ethernet protocols with an IEEE 802.3 10/100Base-T UTP Ethernet female RJ45 connector.

Network Connector Pinouts

[Table 5](#) shows the pinout for the UTP (RJ45) connector.

Table 5—UTP (RJ45) Connector Pinout

Pin	Signal	Source	Pin	Signal	Source
1	TX_D1+	Q51	5	BI-D3-	Q51
2	TX_D1-	Q51	6	RX_D2-	Network
3	RX_D2+	Network	7	BI_D4+	Network
4	BI-D3+	Q51	8	BI_D4-	Network

Software Specifications

Standards supported

ARC	Ethernet Address Control Protocol
ARP	Address Resolution Protocol
DHCP	Dynamic Host Configuration Protocol
ICMP	Internet Control Message Protocol
IP	Internet Protocol
TCP	Transmission Control Protocol
UDP	User Datagram Protocol

TCP port numbers used on the Q51

22	TCP Protocol for SSH port
----	---------------------------

UDP port numbers used on the Q51

68	DHCP client port
17754	Encap. ZigBee Packets

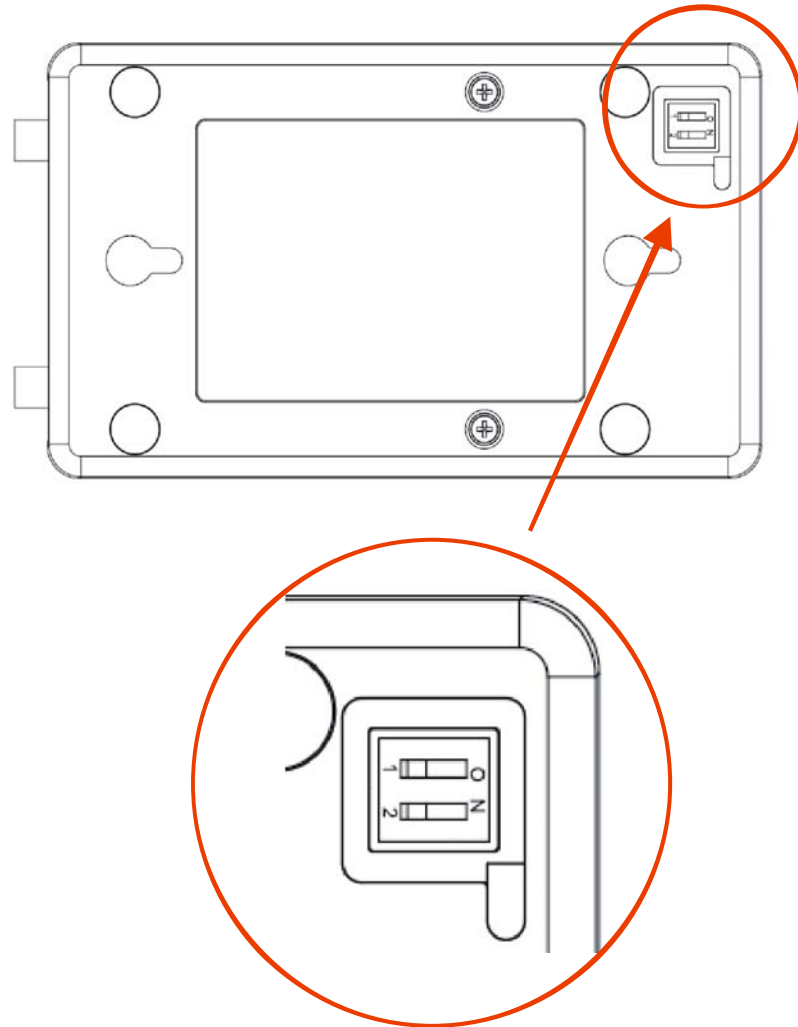
Error conditions

Firmware panic	Unrecoverable errors detected by the Q51 firmware force it into panic mode. Manually reset the Q51 to resume normal operation.
Watchdog halt	The watchdog timer is a hardware device that resets the system if not serviced regularly by the CPU. It's purpose is to prevent the CPU from entering an infinite loop because of a hardware or firmware problem. After a watchdog interrupt, some diagnostic information is saved for debugging and the device resumes operation in Auto-reset Mode. The Q51 will auto-reset up to 16 times before entering non-operational Watchdog Halt.
Spurious halt	Unsupported interrupts force the Q51 into this non-operational mode and typically indicate a hardware problem.
Hardware exception	Internal errors such as bus errors, address errors or illegal instructions force the Q51 into this non-operational mode.

Dipswitch Specifications

There are two dipswitches on the rear surface (Figure 19) of the Q51. Table 6 on page 43 lists the different modes controlled by dipswitch 1 and 2. Ensure that **dipswitch 1** and **dipswitch 2** are set to the "off" position for normal operations. They are in the "off" position when shipped from the factory.

Figure 19—Q51 Bottom View



8. Q51 Specifications
Dipswitch Specifications

Table 6—Q51 Dipswitch Settings

Dipswitch		Comments
1	2	
OFF	OFF	Normal operation. With both dipswitches in the "OFF" position, the unit will boot up using the settings in Flash rather than the default settings. Dipswitch 2 is in the "OFF" position from the factory so that the new settings that you store will be used.
OFF	ON	Factory default settings. With the dipswitches in this configuration, the unit will boot up and all settings stored in Flash will be erased except the Ethernet address and key value.
ON	ON	Factory bootloader mode. Do not use this mode except as directed by Exegin technical support.

9 GETTING HELP

This chapter identifies other sources of Help for installing and configuring your Q51 ZigBee / 802.15.4 Transceiver and defines the repair procedure.

Help Methods Available

"Troubleshooting Tips" sections

Troubleshooting tips are listed at the end of each network configuration chapter. These are the most commonly asked relevant questions. There are additional troubleshooting tips in the appendices as well.

Web site

Exegin's Web site, <http://www.exegin.com/>, contains information about the company and its products. You will find a link to the Technical Support page that contains the "Support Shack", a central location for technical bulletins and firmware and software histories and files.

Contacting Exegin

If you need technical assistance from Exegin, please have this information on hand:

- Q51 MAC Address found on the bottom of the ZigBee Transceiver.
- Description of your network environment and peripherals attached.
- Description of the problem.

Contact options

Email "support@exegin.com"

Call +1 604 468-2552 and select Technical Support from the list of options (#3)

Note: Email queries will have the fastest response time.

Repair Procedure

Warranty description

Exegin Systems Ltd. warrants this product to be free from defects in workmanship and material for **one (1) year** from the time of the original purchase date.

During this period, Exegin will repair or replace a defective product with a new or rebuilt product at no extra charge except as stipulated below.

At no time shall Exegin's liability exceed the replacement cost of the subject item.

All expressed and implied warranties for this product including all warranties of Merchantability, Suitability, and Fitness for a particular application are limited to **one (1) year** from the time of the original purchase date. In no event shall Exegin be liable for Loss of Use, Loss of Profits or Revenues, or other Indirect, Incidental, or Consequential Damages. This warranty *does not imply the right to loaner or replacement units during the time required to perform repairs.*

This warranty *does not* cover any losses or damage caused by:

- shipping,
- improper installation, use, or maintenance,
- unauthorized repair, modification, alteration, or replacement of components,
- excessive environmental conditions including electrical power surges, temperature, humidity, or any other irregularities,
- negligence or abuse.

Returning for repair

To obtain service under this warranty, you must *first* contact Exegin's Technical Support department to rule out configuration errors. A Support Technician will ensure the problem is related to the hardware. If so, a Return Merchandise Authorization (RMA) number will be given to you by the technician. The defective product should then be returned to Exegin for repair.

Please use the following guidelines when shipping goods back for warranty claim:

- Package the product securely, in original packaging if possible, to prevent damage during shipping.
- Indicate the RMA number clearly on the address label of the shipping carton.
- Include a copy of the invoice/receipt.
- You may use any courier company. However, we recommend using Federal Express due to its lower charges for customs.

9. Getting Help

Repair Procedure

Note: Under a normal warranty repair, Exegin will only pay for the shipping charges to return the Q51 to you.

If you ship from a country other than Canada, type (on any paper) a commercial invoice containing the following information:

- your address
- Exegin's address (as "consignee")
- country of origin of the product (i.e. Canada)
- number of packages in the shipment
- description of the product
- quantity
- total value of shipment (i.e. your total purchase price)
- reason for return (e.g. warranty repair)
- a declaration.

Canada Customs requires that this invoice accompany the returned product. For an example, refer to [Figure 20](#).

Download a copy from the website:

<http://www.exegin.com/support/docs/ComInvoice.html>

Figure 20—Sample Commercial Invoice

COMMERCIAL INVOICE from		
Leslie Smith ABC Corporation 1234 Western Parkway Anycity, NC USA, 27511		
DATE OF EXPORT: 22/02/96		
AIR WAYBILL NO: 123-12341234		
CONSIGNEE: Exegin Systems Ltd. 204 - 2071 Kingsway Avenue Port Coquitlam, B.C. V3C 6N2, Canada		
IMPORTER (if other than consignee) same as consignee		
COUNTRY OF ORIGIN: Canada		
# OF		TOTAL
PKGS	DESCRIPTION	QTY VALUE
1	Ethernet ZigBee Transceiver	1 100.00
REASON FOR RETURN: warranty repair		
I declare all information contained in this invoice to be true and correct.		
_____	Leslie Smith	24/03/2002
SIGNATURE	NAME	DATE

10 GLOSSARY

ARP	<i>Address Resolution Protocol.</i> Associates a selected IP address with a network device's Ethernet address.
BPS	Bits per second.
Daemon	A continuously running process that handles system-wide functions such as print spooling.
Default router	A network device that allows communication to and from external subnets by forwarding any IP packets accordingly.
DHCP	<i>Dynamic Host Configuration Protocol.</i> Allows a network device to discover its IP address dynamically upon bootup.
DNS	Domain Name Server. Host providing responses to queries for a given host name's IP address.
EEPROM	<i>Electrically-Erasable, Programmable Read-Only Memory.</i> Preserves data after power is removed. Also known as Flash memory.
Factory defaults	ZigBee Transceiver settings shipped with the Q51.
FCS	Frame Check Sequence.
Flash	Permanent memory in the EEPROM. Stores firmware code and configurable settings. Allows for upgrades without replacing hardware inside the Q51.
HTML	<i>HyperText Markup Language.</i> Format used for documents viewable on the World Wide Web.
HTTP	<i>HyperText Transport Protocol.</i> Protocol used for the delivery of web pages.
IEEE	<i>Institute of Electrical and Electronics Engineers.</i>
Ifnum	<i>Interface Number.</i> Represents the network interface. This will be "1" for an Ethernet network.
LQI	<i>Link Quality Indicator,</i> IEEE 802.15.4 standard which enables the measurement of link quality between neighboring nodes in the network
Netmask	see <i>subnet mask.</i>
PAN	<i>Personal Area Network.</i> A wireless network made up of ZigBee wireless devices communicating under control of a ZigBee Coordinator device.
PDF	<i>Portable Document Format.</i> Encodes different types of documents enabling them to be read across multiple platforms.

10. Glossary

Ping	A program used to test reachability of destinations by sending them an ICMP echo request and waiting for a reply. It is a standard command to test a TCP/IP connection. (e.g. " ping 192.168.11.9 ")
RAM	<i>Random Access Memory.</i> Volatile memory within the Q51 that contains current/working settings. Settings are lost once the power is removed.
RARP	<i>Reverse Address Resolution Protocol.</i> Allows a network device to discover its IP address dynamically upon bootup. The IP address does not need to be stored within the device permanently.
RF	<i>Radio Frequency.</i> A radio signal that propagates through the environment via electromagnetic radiation.
Router	A device that forwards IP packets to their destination. Also called a gateway. See <i>Default Router</i> .
MAC Address	Number found on the bottom of the Q51. Each Q51 is assigned a unique MAC Address
Socket	TCP connection between two hosts consisting of a source and destination TCP port number at each end.
Subnet mask	A binary value used to divide IP networks into smaller subnetworks or subnets. This mask is used to help determine whether IP packets need to be forwarded on to other subnets.
Tar	UNIX command for archiving data onto a permanent storage medium.
TCP/IP	<i>Transmission Control Protocol/Internet Protocol.</i> Suite of protocols that act as the base protocol for the Internet.
TCP port	A logical connection point in the software of a TCP host or device. When two IP devices talk, they establish a socket which consists of a source and destination TCP port number on both ends.
ZigBee	A set of electrical and protocol standards defining a means by which low-cost control devices may communicate over low-power wireless links within a building. Defined and maintained by the ZigBee Alliance. More information may be obtained from the Alliance's web site: http://www.zigbee.org/