Exegin Q58 802.15.4 SPI Module

OEM Manual

Version 0.9

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Made in Canada.

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1 CONTENTS

This manual is written for hardware and software engineers designing a Q58 into a microprocessor-based system. For the latest information on the Q58, please see the Technical Support section of Exegin's Web site:

`http://www.exegin.com/`

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 exegin.com`**

- Regular Courier font indicates displayed results.

  `exegin.com is alive`

- Example names, numbers, and commands are presented in **bold**.

  To create an IP address for the Q58 using the TCP/IP **arp** command, do the following...

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

  `ping `*`ipname`*

  `ipname` `is alive`

  Please enter the ***`ipname`*** at the prompt.

  Make sure you *first* contact...

2 OVERVIEW

This chapter describes the Q58's architecture and special features. The topics included are:

Introduction

The Q58 802.15.4 SPI Module allows a microprocessor-based host with a SPI interface to connect to two separate IEEE 802.15.4 networks. It is typically used in conjunction with up to two instances of mesh networking processes that run on the host.

Figure 1 — Top View

Hardware Features

The Q58 hardware features include:

- Through-hole or socket mounted PCB
- Two Atmel ATmega128RFRR2 SoC radios on one SPI bus
- Two U.FL connectors for external antennas
- Flash memory to store firmware and user-configurable settings

Firmware Features

The Q58 firmware features include:

- Full Implementation of IEEE 802.15.4-2006 Media Access Control (MAC) and Physical (PHY)
- Includes license for one instance of Exegin's ZigBee PRO mesh networking stack

Block Diagram

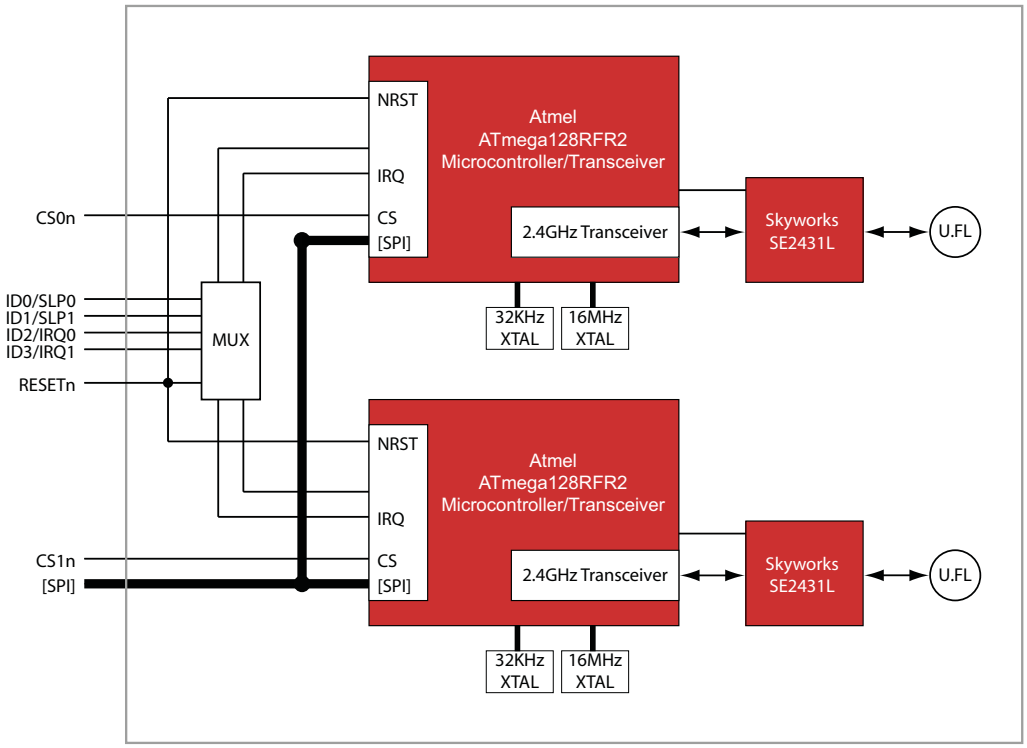

Figure 2 — Block Diagram

Pinout

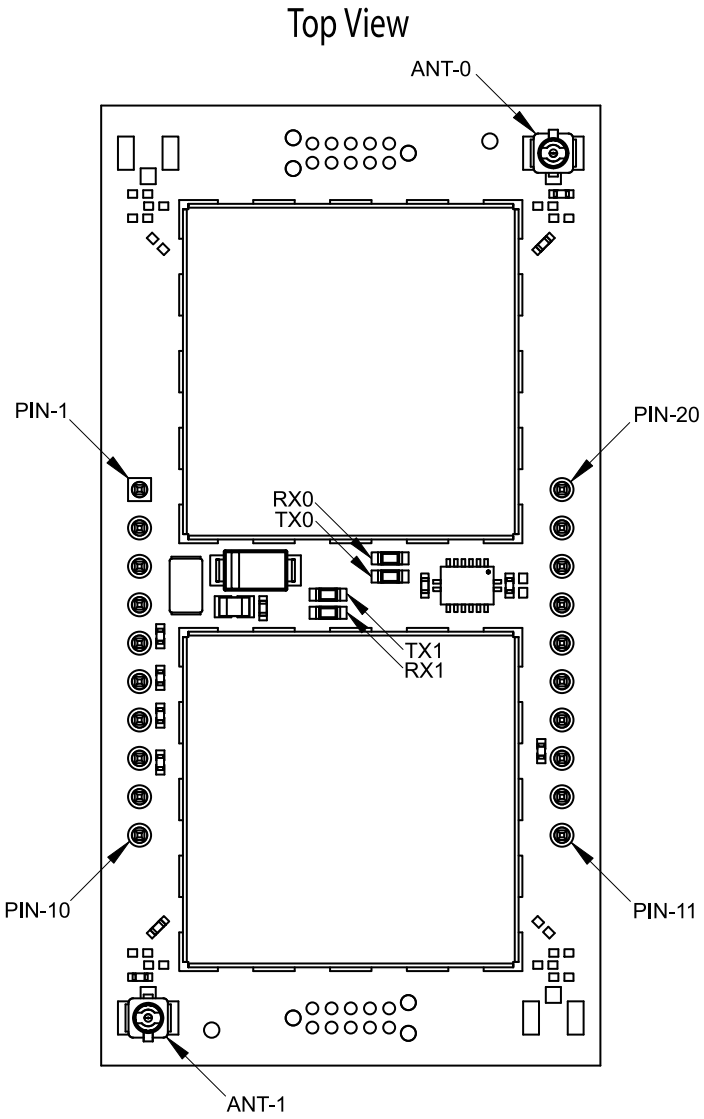

Figure 3 — Pinout

Pin Assignments

Table 1 —

Pin	Name	Direction	Description
1	CHG	-	Frame (Chassis) Ground
2	RSVD1	-	Reserved, no connect
3	RSVD2	-	Reserved, no connect
4	RSVD3	-	Reserved, no connect
5	SPI_CS0n	Input	Chip Select, Radio 0, active low
6	SPI_SPCK	Input	SPI Clock
7	SPI_MOSI	Input	SPI Master Out Slave In
8	SPI_MISO	Output	SPI Master In Slave Out
9	VCC	-	Power Supply
10	GND	-	Ground
11	GND	-	Ground
12	VCC	-	Power Supply
13	$\overline{\text{SPI\_CS1}}$	Input	Chip Select, Radio 1, active low
14	$\overline{\text{RESET}}$	Input	Module reset, active low
15	ID0/$\overline{\text{SLP0}}$	In/Out	ID Bit 0 when $\overline{\text{RESET}}$ active. Sleep 0, active low output when $\overline{\text{RESET}}$ inactive
16	ID1/$\overline{\text{SLP1}}$	In/Out	ID Bit 1 when $\overline{\text{RESET}}$ active. Sleep 1, active low output when $\overline{\text{RESET}}$ inactive
17	ID2/$\overline{\text{IRQ0}}$	In/Out	ID Bit 2 when $\overline{\text{RESET}}$ active. IRQ0, active low interrupt when $\overline{\text{RESET}}$ inactive
18	ID3/$\overline{\text{IRQ1}}$	In/Out	ID Bit 3when $\overline{\text{RESET}}$ active. IRQ1, active low interrupt when $\overline{\text{RESET}}$ inactive
19	RSVD0	In/Out	Reserved, no connect
20	CHG	-	Frame (Chassis) Ground

Table 2 — Pin Assignments

Mechanical

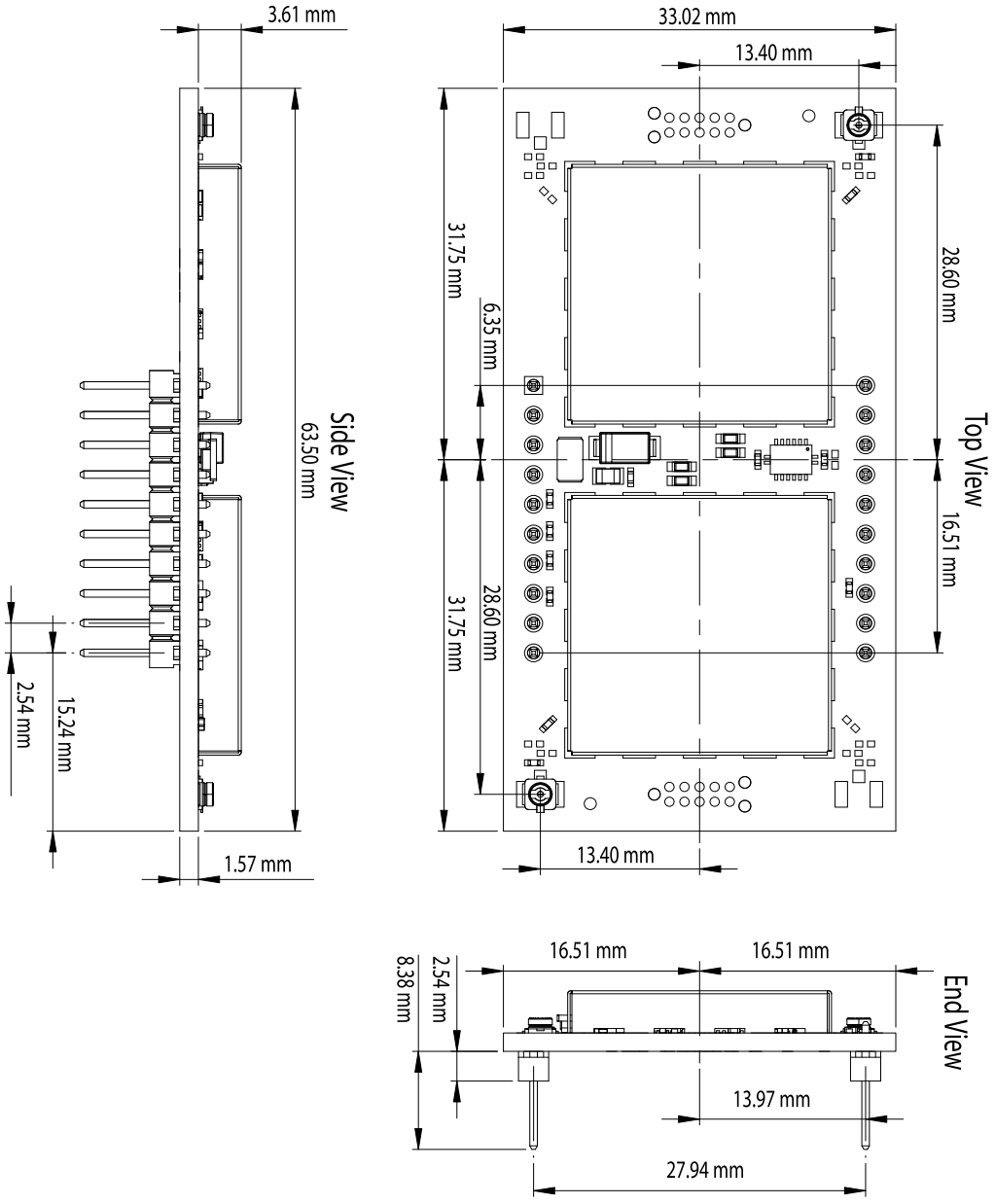

Figure 4 — Mechanical Drawings

Dimensions

Metric
Width: 33.02 mm
Height: 7.72 mm (above mounting surface)
Length: 63.5 mm

Imperial	Width: 2.55" Height: 1.925" Length: 4.4"
Weight:	14g / 0.5 oz. (Device); 175 g or 6 oz.

Environmental

Operating:	-40° C to 85° C
Storage:	-40° C to 125° C

95% maximum humidity, non-condensing.

Electrical

Power

Voltage:	3.0 - 3.6 VDC
Current, Typical:	100 mA
Current, Maximum:	150 mA

JTAG Interface

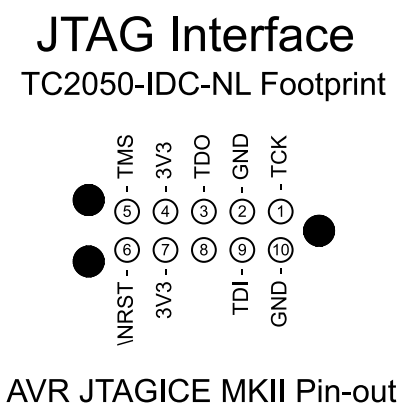

Figure 5 — JTAG Interface

A JTAG interface allows customers to write and debug their own firmware. Contact Exegin's support department for more details.

Design Notes

Host

The Q58 requires only a power supply and SPI bus connection to operate. Conditioning circuitry prevents host power supply noise from adversely affecting radio performance. Nevertheless, good design and layout practices will insure optimum performance. Keep power and signal traces connected to the Q58 separated from noisy clocks and fast-transition signals. Switching power supplies with switching frequencies above 500kHz are optimal. Power supply ripple should be 100mV or less. Connections to power pins should be wider than signal pins and appropriate for the maximum current.

Antenna Location

Position approved antennas away from any ground planes or metal components.

3 Q58 REGULATORY INFORMATION

Introduction

RF modules like the Q58 are intended for original equipment manufacturers who wish to add a wireless interface to their products without incurring the cost of regulatory testing as an intentional radiator. To market products in different parts of the world, OEMs must comply with rules established by different regulatory agencies as follows.

Radio Frequency Notifications

FCC

Notifications

Q58 802.15.4 SPI Modules comply with Part 15 of the FCC rules and regulations. To fulfill FCC Certification requirements, the OEM must comply with the following regulations:

1. The Q58 must be labelled with its own FCC ID number and, if the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module.
2. Only the tested and approved antennas listed in Table ?? may be used with the module.

OEM Labeling Requirements

WARNING: The OEM must ensure that FCC labeling requirements are met. This includes a clearly visible label on the outside of the final product enclosure that displays the contents shown in Figure 1.

> Contains FCC ID: VQ458Q3
> Contains IC ID: 7162A-58Q3
>
> The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (i) this device may not cause harmful interference and (ii) this device must accept any interference received, including interference that may cause undesired operation.

Figure 1— FCC Labeling Requirement

Notices

IMPORTANT: The Q58 is limited to OEM installation ONLY. The OEM integrator is responsible for ensuring that the end-user has no manual instructions to remove or install the Q58.

IMPORTANT: The Q58 has been certified by the FCC for use with other products without any further certification (as per FCC section 2.1091). Modifications not expressly approved by Exegin could void the user's authority to operate the equipment.

IMPORTANT: OEMs must test final product to comply with unintentional radiators (FCC section 15.107 & 15.109) before declaring compliance of their final product to Part 15 of the FCC Rules.

IMPORTANT: The Q58 has been certified for remote and base radio applications. If the Q58 is used in a portable device, where the antenna can be less than 20 cm from the human body when the device is operational, the system integrator is responsible for passing additional SAR (Specific Absorption Rate) testing based on FCC rules 2.1091 and FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields, OET Bulletin and Supplement C. Testing results must be submitted to the FCC for approval prior to selling the integrated unit.

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: Re-orient or relocate the receiving antenna, increase the separation between the equipment and receiver, Connect equipment and receiver to outlets on different circuits, or consult the dealer or an experienced radio/TV technician for help.

Antennas

The antennas in Table 1 have been tested and approved for use:

Table 1 — Tested and Approved Antennas

Manufacturer	Part Number	Type	Gain
Tyco	2118059-1	PCB Trace, Adhesive Mount	4 dBi

RF Exposure

The following must be included as a warning statement in OEM product manuals to alert users to FCC RF exposure compliance.

WARNING: To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 20 cm or more must be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.

Industry Canada

Labeling Requirements

WARNING: The Original Equipment Manufacturer (OEM) must ensure that Industry Canada labeling requirements are met. This includes a clearly visible label on the outside of the final product enclosure that displays the contents shown in Figure ??. System integrators must also ensure its product complies with Industry Canada's ICES-003 & FCC Part 15, Sub. B - Unintentional Radiators.

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 (EIRP) is not more than that permitted for successful communication.

This device has been designed to operate with the antennas listed below in Table 1, and having a maximum gain of 4 dBi. Antennas not included in this list or having a gain greater than 4 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

ETSI

If the Q58 is incorporated into a product, the OEM must ensure compliance of the final product to the European harmonized EMC and low-voltage/safety standards. A Declaration of Conformity must be issued for each of these standards and kept on file as described in Annex II of the R&TTE Directive.

Furthermore, the manufacturer must maintain a copy of the Q58 user manual documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. If any of these specifications are exceeded in the final product, a submission must be made to a notified body for compliance testing to all required standards.

Labeling Requirements

The 'CE' marking must be affixed to a visible location on the OEM product.

The CE mark shall consist of the initials "CE" as follows:

- If the CE marking is reduced or enlarged, the proportions given in the above graduated drawing must be respected.
- The CE marking must have a height of at least 5 mm except where this is not possible on account of the nature of the device
- The CE marking must be affixed visibly, legibly, and indelibly.

Restrictions

Power Output: In Europe the Q58 must operate at or below a transmit power output of 10 dBm. To meet this requirement, customers can either adjust the transmit power of the standard Q58 (P/N 98-058-012) or order the European version of the Q58 (P/N 98-058-014). European regulations also require an EIRP power maximum of ??.? dBm (?? mW) for the Q58.

France: Outdoor use is limited to 10mW EIRP within the 2454-2483.5MHz band.

Declarations of Conformity

Exegin does not list the entire set of standards that must be met for each country. Exegin customers assume full responsibility for learning and meeting the required guidelines for each country in their distribution market.

International

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.

Canada

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

France

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

4 GETTING HELP

This chapter identifies other sources of Help for installing and configuring your Q58 802.15.4 SPI Module 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 Support page that contains the technical bulletins and firmware and software histories and files.

Contacting Exegin

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

- Q58 serial number found on the bottom of the 802.15.4 SPI Module.
- Description of your network environment and peripherals attached.
- Description of the problem.

Contact options

Email "**support@exegin.com**"

Call **+1 604 468-2552 x637**.

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.

Note: Under a normal warranty repair, Exegin will only pay for the shipping charges to return the Q58 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 1:

Figure 1—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.
401- 2071 Kingsway Avenue
Port Coquitlam, B.C.
V3C 6N2, Canada

IMPORTER (if other than consignee)
same as consignee

COUNTRY OF ORIGIN: Canada

# OF PKGS	**DESCRIPTION**	**QTY**	**TOTAL VALUE**
1	Ethernet 802.15.4 SPI Module 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**

5 GLOSSARY

ARP	*Address Resolution Protocol.* 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	*Dynamic Host Configuration Protocol.* 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	*Electronically-Erasable, Programmable Read-Only Memory.* Preserves data after power is removed. Also known as Flash memory.
Factory defaults	802.15.4 SPI Module settings shipped with the Q58.
Flash	Permanent memory in a device. Stores firmware code and configurable settings. Allows for upgrades without replacing hardware inside the Q58.
FTP	*File Transfer Protocol.* Used for transferring files from one TCP/IP host to another and used in the upgrade process.
HTML	*HyperText Markup Language.* Format used for documents viewable on the World Wide Web.
HTTP	*HyperText Transport Protocol.* Protocol used for the delivery of web pages.
IEEE	*Institute of Electrical and Electronics Engineers.*
Ifnum	*Interface Number.* Represents the network interface. This will be "1" for an Ethernet network.
Netmask	see *subnet mask.*
OEM	*Original Equipment Manufacturer.*
PAN	*Personal Area Network.* A wireless network made up of ZigBee wireless devices communicating under control of a ZigBee Coordinator device.
PDF	*Portable Document Format.* Encodes different types of documents enabling them to be read across multiple platforms.
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	*Random Access Memory.* Volatile memory within the Q58 that contains current/working settings. Settings are lost once the power is removed.
RARP	*Reverse Address Resolution Protocol.* 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	*Radio Frequency.* 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 *Default Router.*
Serial number	Number found on the bottom of the Q58. Each Q58 is assigned a unique serial number.
SoC	*System on a Chip.* A microprocessor with integrated flash and RAM memory.
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	*Transmission Control Protocol/Internet Protocol.* 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.
Telnet	Command and protocol to establish a terminal connection between two hosts on an IP network.
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/*

