RADIO MODULE
MXR-EM50D-W

ZIGBEE TRANSCEIVER MODULE

Supports the following parts:
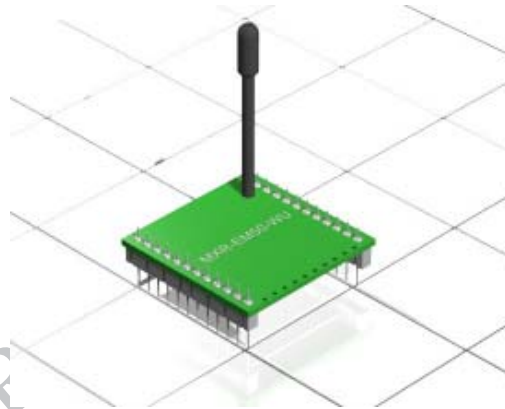
MXR-EM50D-W

PRELIMINARY

DATA SHEET

Radios, Inc.

February 25, 2009 Preliminary Data Sheet

MXR-EM50D-W

ZIGBEE TRANSCEIVER MODULE

The MXR-EM50D-W provides a true ZigBee embedded module that combines a 2.4GHz IEEE 802.15.4 compliant radio t ransceiver with a powerful, efficient industry proven 16-bit microprocessor with comprehensive hardware supported network-level debugging features to simplify development.Designed specifically for use with EmberZNet PRO 3.1. The MXR-EM50D-W integrated microprocessor includes plenty of FLASH and RAM to accommodate user applications built around the EmberZNet Pro 3.1 networking library, and eases integration and debugging by providing hardware-supported guaranteed timing, protected application memory space, and a unique, non-intrusive, network level debugging capability. It provides exceptional immunity to other 2.4GHz interferers such as Wi-Fi, and excellent receiver

It provides exceptional immunity to other 2.4GHz interferers such as Wi-Fi, and excellent receiver sensitivity for long range.PowerApplications requiring years of battery life take advantage of the MXR-EM50D-W's low operating and sleep currents.The MXR-EM50D-W's integrated voltage regulator supports a wide range of operating voltages that allows hardware to be optimized for use with lithium-ion oralkaline batteries, without additional circuitry.

Key Features

- IEEE 802.15.4 standard compliant on-chip transceiver/modem
- 2.4GHz
- 16 selectable channels
- Programmable output power
- Multiple power saving modes
- -40°C to +85°C temperature range
- Support for SMAC, IEEE 802.15.4, and ZigBee software
- Low voltage MCU built in

Typical Applications

- 2.4 GHz IEEE 802.15.4 systems
- ZigBee systems
- Residential and commercial automation
- Industrial Control
- Health Care

PRODUCT ORDER INFORMATION	
Part Number	Description
MXR-EM50D-W	2.4 GHZ Zigbee Transceiver

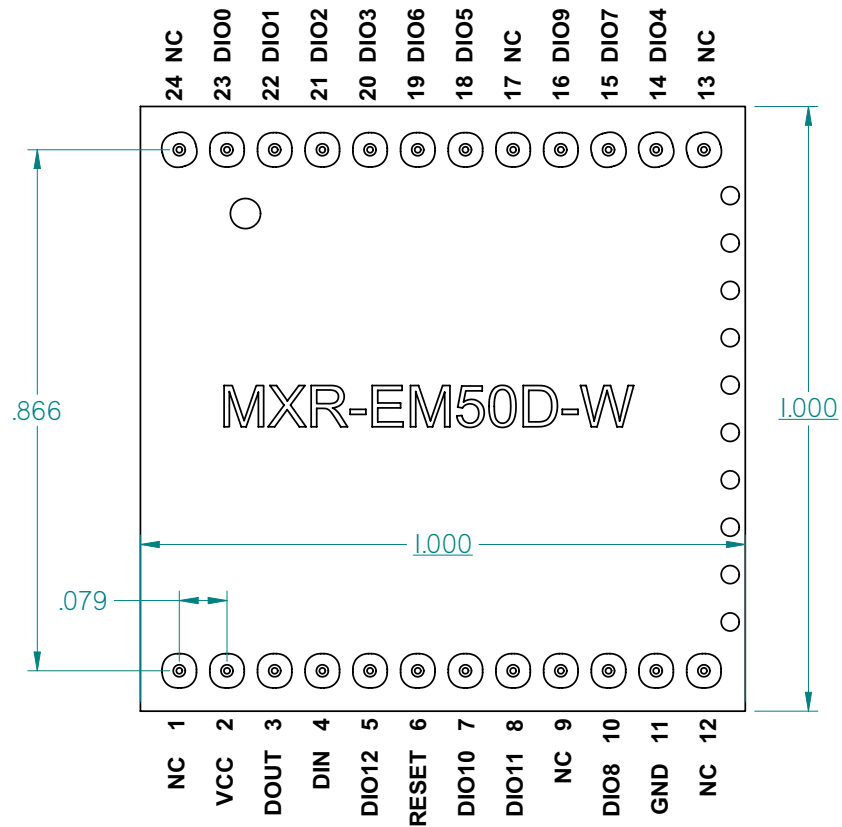| Contact Information	
Radios, Inc. 1408 Center Avenue Oostburg, WI 53070	Phone: 920-564-6622 Fax: 920-564-6630 Email: sales@radiosinc.com

MXR-EM50D-W

ZIGBEE TRANSCEIVER MODULE

Mechanical and Pin Diagram

PRELIMINARY

1 Document Purpose

This document provides the details of the firmware commands to be used during the Compliance testing of the MXR-EM50D-W Radio Communication Module (RCM). These firmware commands are integrated into a more complex software stack developed by Ember Corporation. In order to test and characterize the board, a RANGEST application was developed which abstracts the Hardware from the higher layers. The RANGETEST application is currently loaded onto the boards for compliance testing.

In order for a user to utilize these commands, a computer with a serial port running a windows terminal application (i.e. HyperTerminal) is required.

1) One MXR-EM50D-W
2) One MXR-EM50D-W Test Fixture

2 Overview

The MXR-EM50D-W RCM provides a complete wireless system solution for Zigbee-based Applications. It is designed around the MXR-EM50D-W, Ember's SOC. The RCM will be used by SW Developers to develop Applications on top of Ember's EmberZNet Zigbee-compliant Stack. The MXR-EM50D-W contains radio circuitry operating in the 2.4 GHz Industrial, Scientific and Medical (ISM) Frequency Band at a maximum of +4 dBm (normal mode) or +5 dBm (boost mode). An integrated XAP2b Microcontroller, Flash, RAM and peripherals make the MXR-EM50D-W one of the most complete Zigbee platforms on the market.

Each RCM has been loaded with test software which will configure the transceiver for the different compliance tests. The RCM is compliant with the IEEE 802.15.4 PHY and MAC standard. The raw data rate is 250 kbps. Each byte of data is split into two four-bit symbols. Each symbol is digitally spread into a 32-chip sequence according to the IEEE 802.15.4 standard The transceiver modulates this stream with an Offset Q-PSK modulation algorithm.

Ember supports 16 –5MHz wide channels within this frequency band. These are listed in table 1, and can be configured using the procedure outlined below. The transceiver transmits at a maximum +4dBm (normal mode) or +5dBm (boost mode), and it can be configured to transmit at a minimum -32 dBm. The power settings are listed in Table 2.

Table 1: List of Support Frequency Channels

Channel Number (hexadecimal)	Channel Frequency (GHz)
0x0B	2.405
0x0C	2.410
0x0D	2.415
0x0E	2.420
0x0F	2.425
0x10	2.430
0x11	2.435
0x12	2.440
0x13	2.445
0x14	2.450
0x15	2.455
0x16	2.460
0x17	2.465
0x18	2.470
0x19	2.475
0x1A	2.480

1 Firmware Commands

1.1 Software Configuration Details

In order to configure the transceiver for the different test modes the test engineer must have a PC with a Serial COMM port as well as a Serial Cable (DB-9).

Then, they should follow this procedure:

- o Connect one end of the Serial cable into the MXR-EM50D-W Test Board
- o Connect the other end to a serial port on a computer.

With either fixture power switch turned on , run HyperTerminal and configure the Serial Port with the following settings:

- o Baud Rate: 115,200

- o   Data Bits: 8

- o   Parity: N

- o   Stop Bits: 1

- o   No Xon/Xoff

- o   No Hardware Handshake

Once the COMM port has been configured, the operator can type a "?" at the prompt and a menu of software supported options scrolls across the hyperterminal.

1.1 To change channel:

Within the Hyperterminal application, the operator should use the "channel n" command, where n is the channel (in hexadecimal) from Table 1.

Example:

> channel b (sets the channel to 11 or 2.405 GHz)

1.2 To change TX Power:

Within the Hyperterminal application, the operator should use the "txpow" command. The TX power levels can be between -32 dBm and +4 dBm

Example:

> txpow (enter)

> Please input Power setting: -1 (enter)

> Power is set to -1 dBm

1.3 To transmit unmodulated:

Within the Hyperterminal application, the operator should use the "txtone" command to transmit a constant tone at the center frequency. Note, the channel should be set before issuing the txtome command.

Example:

> txtone

1.4 To transmit modulated data:

Within the Hyperterminal application, the operator should use the "txstream" command to transmit a constant spread and modulated data no breaks.

Example:

> txstream

1.1 To put the transceiver in RX Mode

Within the Hyperterminal application, the operator should use the "receive."

Example:

> receive

1.2 To put the transceiver in Boost Mode

Within the Hyperterminal application, the operator can put the device into Boost Mode with the following command:

Example:

> ➢ txpowermode 1 0

In order to go back to Normal mode, the operator can use the following command:

> ➢ txpowermode 0 0

Or simply power cycle the board.

Please note, after the above commands are used, the commands described in sections 3.1 to 3.6 still apply. The device stays in Boost Mode until it is forced to Normal Mode or power cycled.

Pin Assignments for the MXR-EM50D-W Modules
(Low-asserted signals are distinguished with a horizontal line above signal name.)

Pin #	Name	Direction	Description
1	VCC	-	Power supply
2	DOUT	Output	UART Data Out
3	DIN / **CONFIG**	Input	UART Data In
4	DIO12	Either	Digital I/O 12
5	$\overline{\text{RESET}}$	Input	Module Reset (reset pulse must be at least 200 ns)
6	PWM0 / RSSI / DIO10	Either	PWM Output 0 / RX Signal Strength Indicator / Digital IO
7	PWM / DIO11	Either	Digital I/O 11
8	[reserved]	-	Do not connect
9	$\overline{\text{DTR}}$ / SLEEP_RQ/ DIO8	Either	Pin Sleep Control Line or Digital IO 8
10	GND	-	Ground
11	DIO4	Either	Digital I/O 4
12	$\overline{\text{CTS}}$ / DIO7	Either	Clear-to-Send Flow Control or Digital I/O 7
13	ON / $\overline{\text{SLEEP}}$ / DIO9	Output	Module Status Indicator or Digital I/O 9
14	[reserved]	-	Do not connect
15	Associate / DIO5	Either	Associated Indicator, Digital I/O 5
16	$\overline{\text{RTS}}$ / DIO6	Either	Request-to-Send Flow Control, Digital I/O 6
17	AD3 / DIO3	Either	Analog Input 3 or Digital I/O 3
18	AD2 / DIO2	Either	Analog Input 2 or Digital I/O 2
19	AD1 / DIO1	Either	Analog Input 1 or Digital I/O 1
20	AD0 / DIO0 / Commissioning Button	Either	Analog Input 0, Digital IO 0, or Commissioning Button

Specification	XBee ZNet 2.5
Performance	
Indoor/Urban Range	up to 133 ft. (40 m)
Outdoor RF line-of-sight Range	up to 400 ft. (120 m)
Transmit Power Output	2mW (+3dBm), boost mode enabled 1.25mW (+1dBm), boost mode disabled
RF Data Rate	250,000 bps
Serial Interface Data Rate (software selectable)	1200 - 230400 bps (non-standard baud rates also supported)
Receiver Sensitivity	-96 dBm, boost mode enabled -95 dBm, boost mode disabled

United States FCC

The MXR-EM50D-W RF Module complies with Part 15 of the FCC rules and regulations. Compliance with the labeling requirements, FCC notices and antenna usage guidelines is required.

To fufill FCC Certification, the OEM must comply with the following regulations:

1.The system integrator must ensure that the text on the external label provided with this device is placed on the outside of the final product. [Figure A-01]

2.MXR-EM50D-W RF Module may only be used with antennas that have been tested and approved for use with this module [refer to the antenna tables in this section].

OEM Labeling Requirements

⚠ WARNING: The Original Equipment Manufacturer (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 the figure below.

Required FCC Label for OEM products containing the MXR-EM50D-W RF Module

Contains FCC ID: W4C-EM50D-W*

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.

R

FCC Notices

IMPORTANT: The MXR-EM50D-W RF Module have 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 Radios, Inc. 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 RF module has been certified for remote and base radio applications. If the module will be used for portable applications, the device must undergo SAR testing.

This equipment has been tested and found to comply with the limits 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.

Furthermore, the manufacturer must maintain a copy of the MXR-EM50D-W 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.

Important Note

Radios, Inc. does not list the entire set of standards that must be met for each country. Radios, Inc. customers assume full responsibility for learning and meeting the required guidelines for each country in their distribution market. For more information relating to European compliance of an OEM product incorporating the MXR-EM50D-W RF Module, contact Radio's Inc..

MXR-EM50D-W RF Module

The following antennas have been tested and approved for use with the embedded MXR-EM50D-W RF Module:

- Attached Monopole Whip (1.5 dBi)

Canada (IC)

Labeling Requirements

Labeling requirements for Industry Canada are similar to those of the FCC. A clearly visible label on the outside of the final product enclosure must display the following text:

Contains Model , IC:

The integrator is responsible for its product to comply with IC ICES-003 & FCC Part 15, Sub. B - Unintentional Radiators. ICES-003 is the same as FCC Part 15 Sub. B and Industry Canada accepts FCC test report or CISPR 22 test report for compliance with ICES-003.

MXR-EM50D-W

ZIGBEE TRANSCEIVER MODULE

Product Warranty and Disclaimer Information:

Radios, Inc. is dedicated to providing its customers with the best possible products, and is continually working on improving the quality and function of its entire product line. Therefore, Radios, Inc. reserves the right to make changes to the design, specifications, or manufacturing of its products without notice. The information contained in this data sheet is believed to be complete, accurate, and reliable as of the time of publication. Because product specifications are based on representative lot samples, however, values can vary from lot to lot and are not guaranteed. Radios, Inc. does not assume any liability or responsibility arising from the application or use of any product described herein, and makes no guarantee, warranty, or representation regarding the suitability or legality of any product for use in a specific application. Radios, Inc. does not assume any liability for any infringement of patents or other rights of third parties which may result from the use of its products. No product sold by Radios, Inc. is intended for use in a life critical application, or an application where the safety of property is at risk. The user assumes full and complete responsibility for any use of Radios, Inc.'s products in an application where the safety of life or property is at stake.

A product can be returned directly to Radios, Inc. for evaluation. All returns must have a valid RMA number attached. RMA numbers can be obtained by calling customer service at Radios, Inc. If a product is found to be defective and is returned within 90 days of purchase, Radios, Inc. may repair or replace, at its option, said defective product. This warranty does not apply to products which have been disassembled, modified, or subjected to conditions exceeding the application specifications. Under no conditions will Radios, Inc. be responsible for losses arising from the use or failure of a device in any application or for losses arising from failure to meet delivery requirements, other than the repair, replacement, or refund limited to the original product purchase price. No other warranties, express, implied, or statutory, including warranty of fitness for a particular purpose, apply.

MXR-EM50D-W

ZIGBEE TRANSCEIVER MODULE

Technical Support:

Radios Inc. is committed to providing its customers with excellent technical support and the resources necessary to assist its customers with their product development. Customers have several options to obtain assistance. First, any questions or concerns can be e-mailed to Radios Inc. at incoming@radiosinc.com. We monitor our e-mail daily, and will respond to all questions promptly. Additionally, to speak directly to a technical support representative, customers may call Radios Inc. at 920-564-6622.

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Editorial Information:

<div style="text-align:center">(Date)</div>

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