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ZigRay User Manual

The purpose of this kit is to provide an easy to use, out-of-the-box demonstration of the IEEE 802.15.4 and ZigBee compatible ZigRay transceiver. A sample software application which uses the Freescale MAC is pre-installed on each of the two ZigRay transceivers. The sample application allows switch closures on one Demo board to illuminate LEDs on the other, and a wireless UART implementation allowing RS-232 or USB wireless communications.

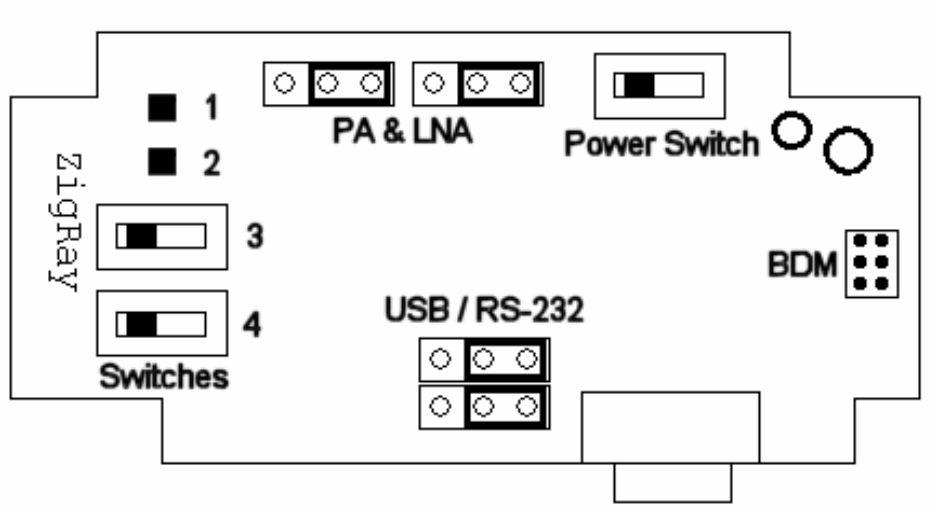
ZigRay™ is a trademark of Tecnova.

ZigBee™ is a registered trademark of the ZigBee Alliance.

This demo uses the IEEE 802.15.4 standard to send packets of data between two wireless units. One unit is called a PAN coordinator and is responsible for starting, and maintaining, the wireless network. The other network nodes are called devices. They search for a PAN coordinator and ask to join the network. The PAN coordinator then assigns a network address to the device. This address association is stored in the PAN coordinator, and if the same device re-joins the network at some later time, the same network address is assigned.

Contents of Kit

Quantity	Description
2	**ZigRay** Radios
2	Demo 1 carriers
6	AAA batteries
1	CD with documentation and demo software

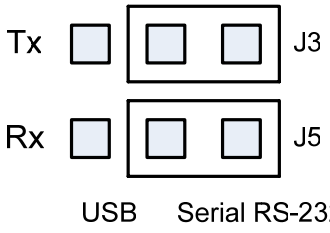


General Layout of Switches and Jumpers

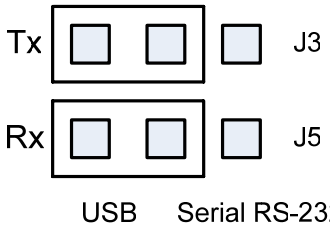
Serial RS-232 or USB Jumper Selection

The Demo board provides both RS-232 serial and USB ports. Two shorting jumpers are used for selection as shown below.

Place the jumpers as shown below for **serial RS-232.** (Default)



Place the jumpers as shown below for **USB**.



Transmission Distances

The transmission distance of wireless devices is affected by many factors, including:

1. Antenna radiation pattern
2. Antenna losses
3. Polarization losses
4. Multipath fading
5. Reflections
6. Additional path losses: walls, vegetation, etc.
7. Interference and noise
8. Humidity

Therefore, the outdoor, unobstructed line of sight distance obtained under ideal conditions will be substantially longer than that obtained under actual, real-life conditions. The useful range needs to allow for various losses to insure the signal can still be received under varying conditions.

Within buildings, the useful range is very difficult to specify due to widely varying building materials. The attenuation of a wall is highly dependent on the structure. For example, if the walls are wooden frame and sheetrock, steel studs or roofs, or made of reinforced concrete, the attenuation will be different. In general, the useful range will be shorter if the signal must pass through several walls.

The ZigRay transceiver, with the PA and LNA turned on, has achieved an outdoor transmission distance of over 750 meters (2,460 feet). Indoor "useful range" distance will be significantly shorter, and will need to be tested in the target environment. "Useful range" includes a Link Margin which is defined as how many dB's the signal is above the receiver sensitivity level, given optimum conditions. The Link Margin then shows how many dB's can be lost before the radio link is lost. For most applications, it should be possible to achieve a "useful range" of 50m to 100m or more in an indoor environment.

Getting Started

Unpack the contents of the Demo Kit. Plug the two ZigRay transceiver boards into the Demo boards. Position the ZigRay with the antenna (slot) toward the outside edge of the Demo board. The pins on the Demo board should go through the bottom of the ZigRay transceiver as shown below.

Install 3 AAA batteries into the battery holders on each of the Demo boards observing the correct polarity.

Power Switch

The Power Switch is a two-position slide switch located on the outside edge of the Demo board. The Demo board can be powered from the 3 AAA batteries, or from a USB (master or hub) device. (The batteries can be removed when using an external USB device.) When the Power Switch is in the right (**BATT**) position, the batteries supply power. When the Power Switch is in the left (**USB**) position, the external USB device will supply power.

Basic Operation

After installing the batteries, turn on both units by moving the Power Switch to the **BATT** position. The **PAN coordinator** will turn on its 4 LED's on the Demo board, and then turn them off after 2 seconds. The **device** will turn on its 4 LED's on the Demo board, and then once communication is established with the **PAN coordinator**, the LEDs will turn off. This indicates successful association between the **PAN coordinator** and the **device**.

Push the buttons and change the switches on either the PAN coordinator or the device. The corresponding LED on the other unit should change. Turn on one, or both, switches and leave them on. Rotate the potentiometer. The LED brightness on the other unit should increase for clockwise rotation, and decrease for counter-clockwise rotation.

There are two LED's on the ZigRay radio itself, the one closest to the antenna (near the slot in the PC board) will light when a packet is transmitted, and will be turned off when the acknowledge for that packet is received. The second LED, nearest the connector, will toggle for every received packet.

The PAN coordinator does not send any packets until asked for by a device. The device periodically sends a data request message to the PAN coordinator. If the PAN coordinator has anything to transmit, it will send a data packet. If not, a "no data" message is sent. The rate at which the device sends the data request varies. If there is nothing going on, the rate is slowed down to conserve battery power. As soon as any activity is detected, like pressing a button, changing a switch, or turning the potentiometer, the rate is increased. Note that the time it takes to recognize the first activity may be up to ½ second.

Wireless UART

Connect the Demo 1 boards to two separate computers using either the RS-232 connectors, or change the jumpers (J3 & J5, see page 2) and use the USB. Open HyperTerminal on each PC. Configure it to use the proper Com port at 19200 BAUD, 8 bits, no Parity, 1 Stop bit, and Flow Control set to None. Messages typed on one computer should appear on the other, and vise-versa.

Switch Demo

Each time a button is pressed, or a switch is changed, a packet of data is sent. The device sends the packet immediately, while the PAN coordinator waits to send the packet until the device asks for it (via a poll). The packet format is as follows:

Byte 1	Byte 2	Byte 3	Byte 4
Command	Switch States	Potentiometer	Unused

Commands are as follows:

Command	Description
A	Push button 1 pressed
a	Push button 1 released
B	Push button 2 pressed
b	Push button 2 released
C	Switch 1 changed to on
c	Switch 1 changed to off
D	Switch 2 changed to on
d	Switch 2 changed to off
S	No change (update)
P	Potentiometer change

Switch State values:

Switch State	Value
Switch 1	0x01 = on
Switch 2	0x02 = on
Switch 3	0x04 = on
Switch 4	0x08 = on

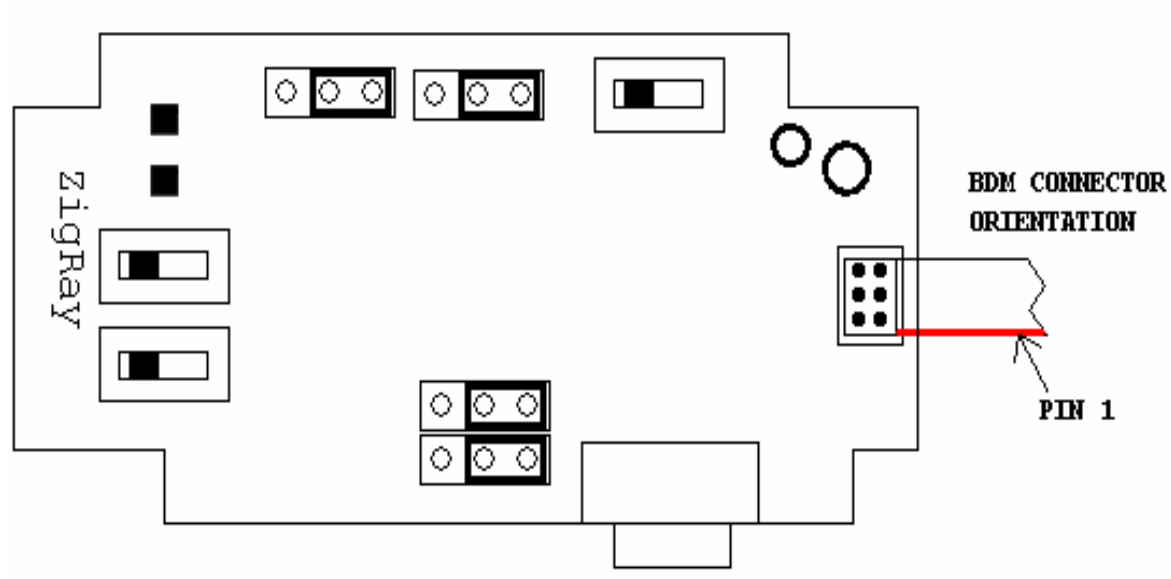
Wireless UART

The wireless UART uses the same packet format as the switches. The command byte is 'U' for an ASCII data packet.

Byte 1	Byte 2…Byte n
Command	ASCII data (up to 100 bytes)

BDM Connector J2

Connector J2 provides a connection for a standard Freescale BDM cable. When using the BDM, be sure it is connected properly with the cable directed toward the outside of the board. Improper connection may permanently damage the BDM device, the Demo board, and the ZigRay transceiver.



BDM orientation and default switch location

The MAC (long) address

The MAC address is a 64 bit unique number, represented as 8 hexadecimal numbers. The number used in a particular radio board is a combination of the number on the label of that radio and a fixed prefix. The following is the format for the MAC address:

8	7	6	5	4	3	2	1
00	0C	04	00	01	------	------	------

The lower 3 hexadecimal numbers (for 3, 2, and 1) come from the label affixed to the radio.

Source Code and Build Versions

The CD contains the source code, documentation, and other useful information (see README file).

Other resources

http://www.zigbee.org

http://www.freescale.com

Where Do I Go From Here

The purpose of this kit is to provide an easy to use, out-of-the-box demonstration of the IEEE 802.15.4 and ZigBee compatible ZigRay transceiver. Now that you have learned about the capabilities of ZigRay, you may be ready to use it in a product or application. Depending on your needs:

1. You can make software modifications yourself by using the provided source code and obtaining a license for the Metrowerks tools and BDM debugger cable. http://www.metrowerks.com/MW/Develop/Embedded/HC08/Default.htm

2. Contact Tecnova to develop the ZigRay software needed for your application.

3. Contact Tecnova to design your entire product and integrate the ZigRay technology. Tecnova offers product design and development, including electronic design, mechanical design, embedded software, Windows software, and LabVIEW software. For more information, see http://www.tecnova.com/ or email info@tecnova.com

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Appendix A – Agency Certifications

FCC Statements

The ZigRay module has been certified by the FCC under Part 15 of the rules and regulations and can be used with any other product without further certification or testing. Operation by an OEM is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that my cause undesired operation.

If this equipment does cause harmful interference, which can be detected by turning on and off the ZigRay unit, the end user is encouraged to resolve the interference by following these short guidelines:

1. Re-orient or relocate the receiving antenna
2. Increase the separation between the equipment and receiver
3. Connect equipment and receiver to outlets on different circuits

The OEM user of the ZigRay must test their final product configuration to comply with Unintentional Radiator Limits before declaring compliance per Part 15 of the FCC Rules.

WARNING: Changes or modifications not expressly approved by Tecnova could void the user's authority to operate the equipment.

RF Exposure

This equipment complies with FCC and IC radiation exposure limits set forth for an uncontrolled environment. This equipment is in direct contact with the body of the user under normal operating conditions. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Approved Antennas

The OEM user of the ZigRay module must only use the approved antenna, (PCB Trace Antenna) that has been certified with this module.

Label Responsibility

To fulfill the FCC certification requirements, the OEM user of the ZigRay module must ensure that the information provided on the ZigRay label be clearly visible. If the final product does not clearly show the ZigRay label, then a separate label must be place on the outside of the final product. This label *must* refer to the enclosed module.

The exterior label can be worded in one of two ways.

“Contains Transmitter Module FCC ID: UBX-ZIGRAY”

Or

“Contains FCC ID: UBX-ZIGRAY”

The OEM must also include the RF exposure statement as a CAUTION in manuals for OEM products to caution users on FCC RF Exposure compliance.

Canadian Statements

Industry Canada Statement

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

Section 14 of RSS-210

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population.

Consult Safety Code 6, obtainable from Health Canada’s website: www.hc-sc.gc.ca/rpb