ZigBee Board

User Manual

1.0, Oct 2013

ZILOGIC
SYSTEMS

Table of Contents

Chapter 1. ZigBee Board

ZigBee is a low power, wireless mesh network standard, largely used in the areas of home automation, medical data collection and industrial control. The ZigBee Board allows a micro-controller to connect to ZigBee network, through a UART interface. The ZigBee Board connects to Zilogic's development kits through a UART-I²C header. In addition, the ZigBee Board can also be used with other deveolpment kits that have an RS-232 UART interface, using the ZKit RS232 transceiver and a null modem cable.

At the core of the ZigBee Board is the XBee module from Digi, which implements the ZigBee stack. The program running on the development kit can interact with the ZigBee stack, by sending commands through the UART interface.

1. Features

- Powered from motherboard
- Built in +3.3V regulator for XBee module
- XBee ZB and XBee-PRO ZB compatible
- LEDs for TX/RX and ZigBee state
- Connects through UART
- Standard TTL compatible inputs used in most microcontrollers and control systems
- 0.1" 10 pin FRC header for connection to motherboard
- Ready to go with Zilogic's motherboards

2. Wireless Parameters

Parameter	XBee ZB	XBee-PRO ZB
Data rate	250Kbps	250Kbps
Indoor range	40m	90m
Line of sight	120m	1500m
Tx. Power	1.25mW / 2mW	63mW

3. Block Diagram

The devices available on the board, is shown in the following block diagram. Each device is described in detail in the following sections.
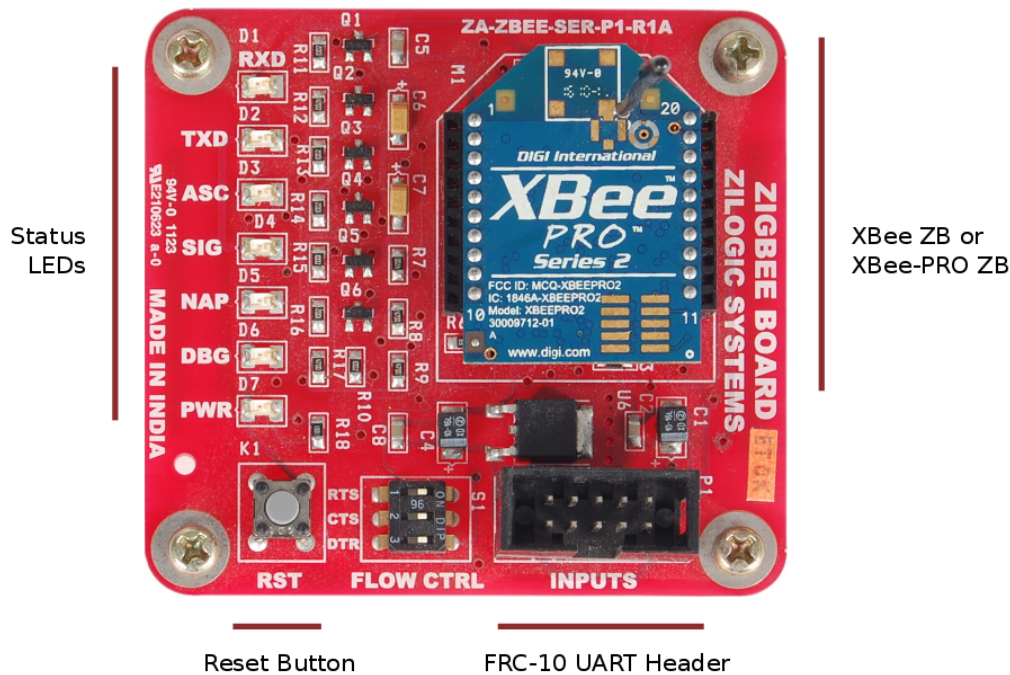
Figure 1.1. Block Diagram
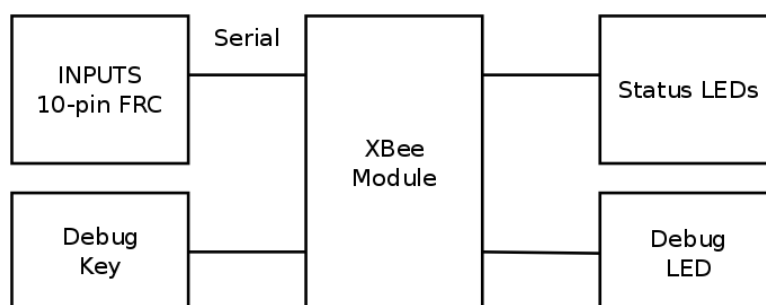
4. Locating Components

The location of the components on the board is indicated in the following diagrams.

Figure 1.2. Front View

5. Power Supply

The Zigbee Board is powered from the motherboard through the FRC header. Detailed power supply specifications are available in section Specifications.

6. XBee Module

The XBee ZB Module or XBee-PRO ZB Module can be mounted in the ZigBee board. The module provides a UART interface through which the motherboard can send and receive data. The module can also be configured through the serial interface.

7. Status LEDs

The status LEDs indicate the following information.

RXD LED   Blink indicates data has been received by the module from the host.

TXD LED   Blink indicates data has been transmitted by the module to the host.

ASC LED   Continuos blinking indicates associated with a network, in case of a router or end device. And PAN ID and radio channel has been selected in the case of coordinator.

SIG LED   Brighter LED indicates a more stable link. In other words, shows the received signal strength of the last received packet.

NAP LED   ON indicates device has woken up from sleep state.

8. Debug LED

A Debug LED is provided for testing IOs. The Debug LED is connected to the pin `DIO4` of the XBee module.

9. Flow Control DIP Switch

The RTS, CTS and DTR signals can be connected or disconnected from the FRC header using the `FLOW CTRL` DIP switch.

It is a good idea to use flow control, to prevent data loss. If flow control is required, then flow control should be enabled in the module using the `D6` and `D7` AT commands. And the `RTS` and `CTS` DIP switches should be in ON position.

Figure 1.3. Flow Control DIP Switch
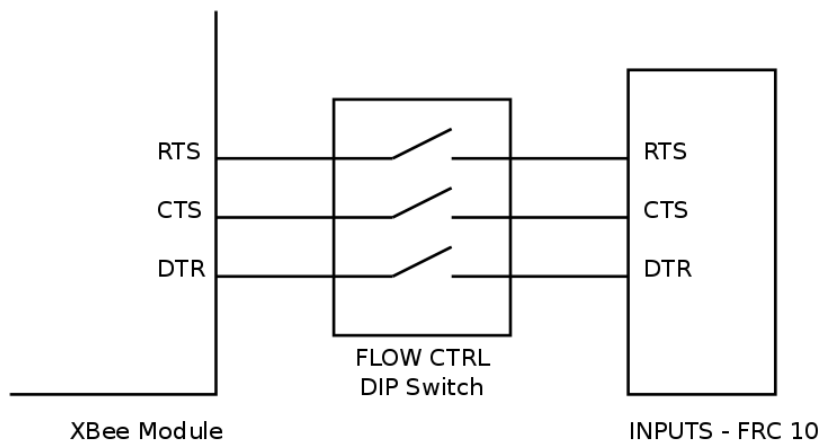
10. Connectors and Headers

10.1. `INPUTS` Header

The Zigbee Board can interface with the `UART` connector on the motherboard using its 10 pin `INPUTS` FRC connector. The signal details are given below.

Table 1.1. FRC-10 Connector

Pin #	Signal	Signal Type
1	5V	Supply from motherboard
2	TXD	TTL Out
3	RXD	TTL In
4	Not Connected	-
5	Not Connected	-
6	RTS	TTL In
7	CTS	TTL Out
8	DTR	TTL In
9	Not Connected	-
10	GND	Ground

11. Specifications

Parameter	Value	Condition
VCC		
Voltage	5V	
Max. Current	100mA	With XBee ZB Module
Digital Inputs		
Input Low Voltage	0.0 - 0.8V	
Input High Voltage	2.0 - 5.0V	

Chapter 2. Board Usage

1. Programming XBee Firmware

The XBee module should be programmed with the appropriate firmware using the X-CTU tool provided by Digi. Firmware programming can be done using the `USB ZigBee Adapter` board from Zilogic Systems.

2. AT Mode and API Mode

The XBee modules can communicate using two protocols with the host.

1. AT Mode
2. API Mode

In AT mode, the module provides an AT command interface, similar to AT modem commands, for configuration. The AT mode also supports transparent mode of operation in which serial data sent to the module, is transmitted over the air to a remote ZigBee node.

In API mode, the module uses a binary packet interface for communicating with the host. The available packets and their formats is described in the XBee module's user manual.

3. Communicating in AT mode

The module is first updated with an AT mode firmware. AT commands can then be sent to the device through the UART interface.

The serial parameters are specified in the following table.

No.	Parameter	Value
1	Baudrate	9600
2	Data Bits	8
3	Stop Bits	1
4	Parity	None
5	Flow Control	None

The rest of the discussion will assume the availablility of the following functions:

`write(s)`   Writes the string `s` to the serial port.

`readln()`   Reads and returns a line from the serial port. A line is terminated by a `\r` character.

`mdelay(t)`   Generates a delay for `t` msecs.

By default the module will be in transparent mode of operation, to enter AT command mode use the following sequence.

```
mdelay(1000)
write("+++")
readln() # returns "OK\r"
```

The module on entry into AT command mode, responds with `OK\r`. After which AT commands can be sent to the device. The character `+` used for entering the AT command mode, is called

the Command Character. The time to wait between a character transmission and a Command Character is called the guard time. The guard time and command character is configurable using AT commands. The default is 1 second and `+` , respectively.

As an example of execution of AT commands, after entering into AT command mode, the firmware version can obtained using the `VR` AT command, as shown below.

```
write("ATVR\r")
readln() # Returns "2070\r"
```

The module can be put back to transparent mode of operation manually using the `CN` AT command. The module also switches back to transparent mode of operation after a timeout, 10 seconds by default. The command mode timeout is also configurable using the `CT` AT command.

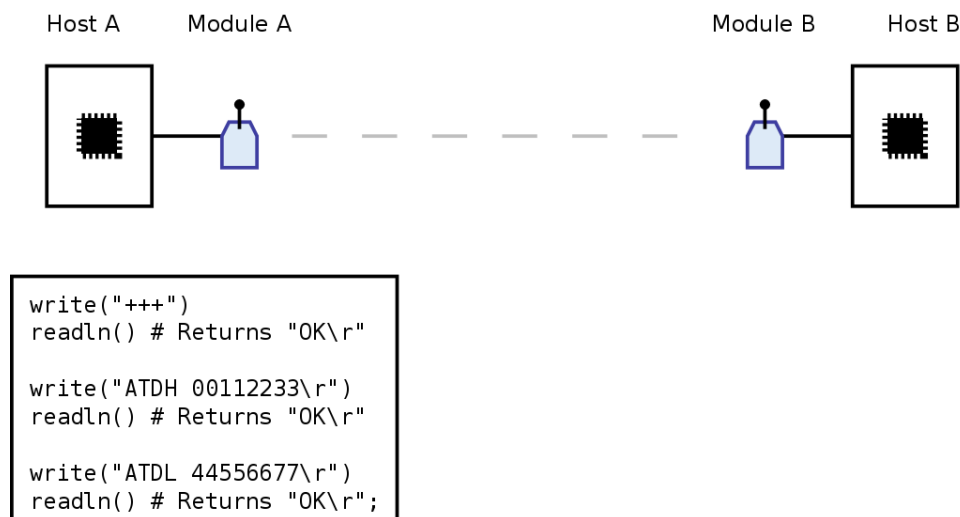# 4. Sending and Receiving Data in Transparent Mode

Transparent mode of operation is demonstrated using a two node network, consisting of a coordinator and router. The following sequence shows how to send a message from the coordinator to the router.

1. Update the coordinator AT firmware in module A, and router AT firmware in module B.

2. Connect the ZigBee Boards to the motherboard. Ensure the ASC LED is blinking in both the modules.

Figure 2.1. Two Node Network

3. Note down the 64-bit MAC address specified in the module B. The 64-bit MAC of the module can be obtained from the label on the back of the module. The 64-bit MAC can also be obtained using the `SH` and `SL` AT commands. Lets assume the routers MAC address is `0011223344556677`

4. In module A, set the destination addressing using the `DH` and `DL` AT commands. `DH` is used to specify the higher order 32 bits and `DL` is used to specify the lower order 32 bits.

Figure 2.2. Setting the Destination

Host A   Module A   Module B   Host B

```
write("+++")
readln() # Returns "OK\r"

write("ATDH 00112233\r")
readln() # Returns "OK\r"

write("ATDL 44556677\r")
readln() # Returns "OK\r";
```

5. Switch both the module into transparent mode of operation, using the `CN` AT command. Type a message to be sent to module B, the message should appear on module B's serial output.

Figure 2.3. Sending and Receiving Message

Host A sending
message to Host B

Host B gets the
message "Hello ZigBee!"

Host A   Module A   Module B   Host B

```
write("ATCN\r")
readln() # Returns "OK\r";

write("Hello ZigBee!\r");
```

```
write("ATCN\r")
readln() # Returns "OK\r"

readln() # Returns
         # "Hello ZigBee!\r"
```
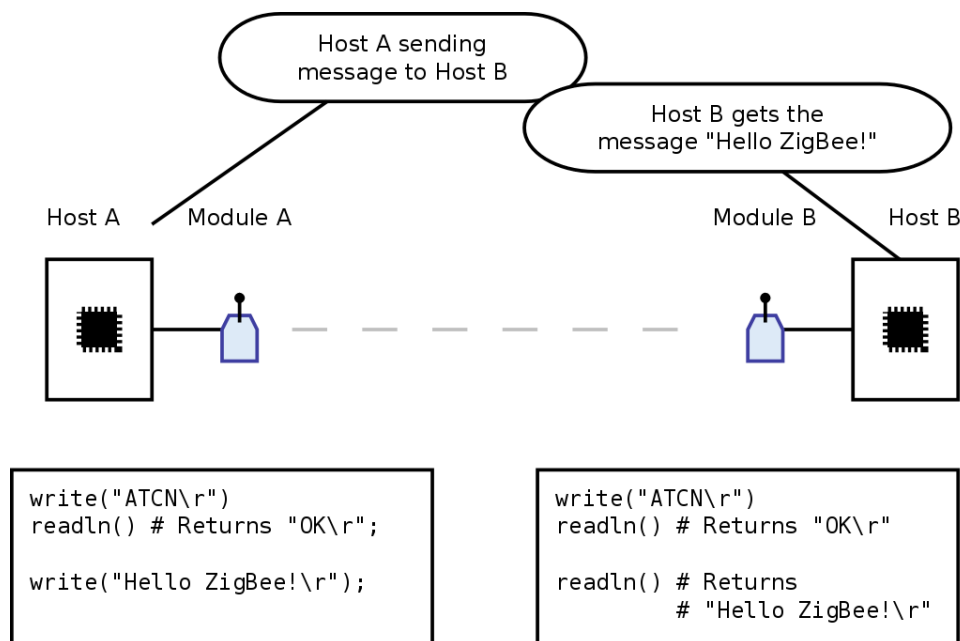
Appendix A. Legal Information

1. Copying

This work is licensed under the Creative Commons Attribution-Share Alike 2.5 India License. To view a copy of this license, visit http://creativecommons.org/licenses/by-sa/2.5/in/ or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.

2. Limited Hardware Warranty

The warranties provided by Zilogic Systems in this Limited Hardware Warranty apply only to Hardware Products you purchase for your use, and not for resale. The term "Hardware Product" means a computing device with a specific function and limited configuration ability.

2.1. LIMITED HARDWARE WARRANTY

Zilogic Systems warrants that the hardware components of its Hardware Product shall be free from material defects in design, materials, and workmanship and will function, under normal use and circumstances, in accordance with the documentation provided, for a period of one (1) year from the date of purchase of the Hardware Product.

Your sole and exclusive remedy, and Zilogic Systems' sole and exclusive liability for defective hardware components, shall be that Zilogic Systems, subject to the terms and conditions of this Section, and solely upon confirmation of a defect or failure of a hardware component to perform as warranted, shall at its sole option, either repair or replace the nonconforming hardware component. All replacement parts furnished to you under this warranty shall be refurbished and equivalent to new, and shall be warranted as new for the remainder of the original warranty period. All defective parts, which have been replaced, shall become the property of Zilogic Systems. All defective parts that have been repaired shall remain your property.

2.2. EXCLUSIONS

The foregoing warranties and remedies shall be void as to any Hardware Products damaged or rendered unserviceable by one or more of the following: (1) improper or inadequate maintenance by anyone other than Zilogic Systems or Zilogic Systems' authorized engineers, (2) interfacing supplied by anyone other than Zilogic Systems, (3) modifications, alterations or additions to the Hardware Products by personnel not certified by Zilogic Systems or Zilogic Systems' authorized engineers to perform such acts, or other unauthorized repair, installation or other causes beyond Zilogic Systems' control, (4) unreasonable refusal to agree with engineering change notice programs, (5) negligence by any person other than Zilogic Systems or Zilogic Systems' authorized engineers, (6) misuse, abuse, accident, electrical irregularity, theft, vandalism, fire, water or other peril, (7) damage caused by containment and/or operation outside the environmental specifications for the Hardware Products, (8) alteration or connection of the Hardware Products to other systems, equipment or devices (other than those specifically approved by Zilogic Systems) not in accordance to the board and on-board device specifications (9) any use that is inconsistent with the user manual supplied with the Hardware Product. The warranty period is not extended if Zilogic Systems repairs or replaces a warranted product or any parts. Zilogic Systems may change the availability of limited hardware warranties, at its discretion, but any changes will not be retroactive.

2.3. HARDWARE RETURN PROCEDURES

If a Hardware Product or one of its component parts does not function as warranted during the warranty period, and such nonconformance can be verified by Zilogic Systems, Zilogic Systems, at

its election, will provide either return and replacement service or replacement with a refurbished part/unit for the Hardware Product under the type of warranty service Zilogic Systems designates for that Hardware Product. A defective Hardware Product or one of its component parts may only be returned to Zilogic Systems upon Zilogic Systems' prior written approval. Any such approval shall reference an RMA number issued by an authorized Zilogic Systems service representative. If you do not register the Hardware Product with Zilogic Systems, you may be required to present proof of purchase as evidence of your entitlement to warranty service. The Hardware Product's serial number will be required for all RMA cases.

Transportation costs, if any, incurred in connection with the return of a defective item to Zilogic Systems shall be borne by You. Any transportation costs incurred in connection with the redelivery of a repaired or replacement item to You by Zilogic Systems shall be borne by Zilogic Systems; provided, however, that if Zilogic Systems determines, in its sole discretion, that the allegedly defective item is not covered by the terms and conditions of the warranty or that a warranty claim is made after the warranty period, the cost of the repair by Zilogic Systems, including all shipping expenses, shall be reimbursed by You.

2.4. HARDWARE REPLACEMENT PROCEDURES

Zilogic Systems will attempt to diagnose and resolve your problem over the phone or e-mail. Upon determination of the hardware issue is related to a malfunction of one of the Hardware Product components, an RMA process will be initiated by Zilogic Systems.

For Warranty Replacement service, it is required that you deliver the faulty unit to a location Zilogic Systems designates, and provide courier name and tracking number to Zilogic Systems. After the Faulty unit is returned to Zilogic Systems, Zilogic Systems will use commercially reasonable efforts to ship the replacement hardware within fourteen (14) business days. Actual delivery times may vary depending on availability of the spares and customer's location.

2.5. ADDITIONAL RESPONSIBILITIES

You agree:

- To provide Zilogic Systems or its partner with sufficient and safe access to your facilities to permit Zilogic Systems to fulfill its obligations.
- To ship back the faulty Hardware Product (or replaceable unit) suitably packaged, quoting the RMA number, to the Zilogic Systems designated location.
- You shall ship the faulty Hardware Product once Zilogic Systems approves the RMA and provide the courier name and tracking number.
- To securely erase from any Hardware Product you return to Zilogic Systems for any reason all programs and data not provided by Zilogic Systems with the Hardware Product. You acknowledge that in order to perform its responsibilities under this Limited Hardware Warranty, Zilogic Systems may ship all or part of the Hardware Product or its software to third party locations around the world, and you authorize Zilogic Systems to do so.

2.6. LIMITATION OF LIABILITY

Zilogic Systems' development kits are not designed, authorized or warranted to be suitable for use in medical, military, aircraft, space or life support equipment, not in applications where failure or malfunction of a Zilogic Systems product can resonably be expected to result in personal injury, death or severe property or environmental damage.

NOTWITHSTANDING ANYTHING ELSE IN THIS AGREEMENT OR OTHERWISE, NEITHER ZILOGIC SYSTEMS NOR ITS SUPPLIERS WILL BE LIABLE WITH RESPECT TO ANY SUBJECT MATTER OF THIS AGREEMENT UNDER ANY CONTRACT, NEGLIGENCE, STRICT LIABILITY, OR OTHER LEGAL

OR EQUITABLE THEORY, REGARDLESS OF WHETHER ZILOGIC SYSTEMS OR ITS SUPPLIERS WERE ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, FOR: (i) ANY PUNITIVE, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOST DATA OR LOST PROFITS; OR (ii) FOR COSTS OF PROCUREMENT OF SUBSTITUTE GOODS, TECHNOLOGY OR SERVICES; OR (iii) FOR ANY CLAIMS BASED ON ANY ERROR, DEFECT OR NONCONFORMITY IN THE PRODUCTS OR SERVICE, FOR ANY AMOUNT IN EXCESS OF THE PRICE PAID TO ZILOGIC SYSTEMS FOR SUCH DEFECTIVE PRODUCT(S) OR SERVICE; OR (IV) FOR ALL OTHER CLAIMS NOT RELATED TO AN ERROR, DEFECT OR NONCONFORMITY IN THE PRODUCTS, ANY AMOUNTS IN EXCESS IN THE AGGREGATE OF THE AMOUNT PAID TO ZILOGIC SYSTEMS HEREUNDER DURING THE THREE (3) MONTHS PRECEDING THE DATE THE CAUSE OF ACTION AROSE.

WARRANTY DISCLAIMER. EXCEPT AS STATED HEREIN, ZILOGIC SYSTEMS MAKES NO WARRANTIES WITH RESPECT TO any PRODUCT, license or SERVICE AND DISCLAIMS ALL Statutory or IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, or arising from a course of dealing or usage of trade and any WARRANTIES OF NONINFRINGEMENT. ZILOGIC SYSTEMS DOES NOT WARRANT THAT THE ZILOGIC SYSTEMS PRODUCT(s) WILL MEET any REQUIREMENTS or THAT THE OPERATION OF ZILOGIC SYSTEMS PRODUCTS WILL BE UNINTERRUPTED OR ERROR FREE.