![OLIMEX logo]

MOD-ZIGBEE-PIR sensor development board
USER'S MANUAL

All boards produced by Olimex LTD are ROHS compliant

Revision B, Januray 2013
Designed by OLIMEX Ltd, 2011

Disclaimer:

Thank you for purchasing the MOD-ZIGBEE-PIR board manufactured by Olimex!

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SECTION 1
OVERVIEW

Thank you for choosing the MOD-ZIGBEE-PIR development board from Olimex! This document provides a User's Guide for the Olimex MOD-ZIGBEE-PIR sensor module. As an overview, this chapter gives the scope of this document and lists the board's features. The document's organization is then detailed.

1.1   Scope

The MOD-ZIGBEE-PIR is a motion detector unit equipped with passive infrared (PIR) sensor which utilizes open source ZigBee stack, and has the option to be configured to use MiWi stack. This guide focuses on MOD-ZIGBEE-PIR board.

1.2   Features

- MRF24J40 + PIC18F26K20 with open source MiWi and Zigbee stack
- PIR sensor motion detector, sends wireless alarm to Zigbee nodes when motion is detected
- RF Transceiver – MRF24J40 IEEE 802.15.4™ Standard compliant 2.4 GHz RF transceiver
- [UEXT connector](#) to all boards with UEXT
- mini ICSP connector
- On-board antenna
- On-board temperature sensor – TCN75A
- Option for external power supply through EXT_PWR
- EXT/BAT switch
- Reset circuit
- two user buttons
- two status LEDs
- RST button
- 2x1,5V AA battery holders
- PCB: FR-4, 1.00 mm (0,039"), solder mask, silkscreen component print
- Dimensions: 93 mm x 32 mm (3.66''x 1.2'')

1.3   Board highlights

Perfect board for sensor networks with its PIR sensor and built-in temperature sensor.

The bundle PIC18F26K20 + mini ICSP + 2 buttons + 2 LEDs (green and red) + reset button means that the board can be reprogrammed and used as a development board and allows modifications.

Two supported free stacks – Microchip's MiWi or ZigBee.

Three ways of powering the board via batteries, via external power supply, via ICSP programmer.

The board has UEXT connector for easier communication.

FR-4 is the most used glass-reinforced epoxy laminate for PCBs.

1.4   Similar boards

MOD-ZIGBEE-UEXT is a version of MOD-ZIGBEE-PIR without the motion detection sensor. It is supplied by a single battery and has a female UEXT connector. MOD-ZIGBEE-UEXT is thinner than MOD-ZIGBEE-PIR because of the different battery types used for battery powering of the board.

1.5   Organization

Each section in this document covers a separate topic, organized as follow:
-         Section 1 is an overview of the board usage and features
-         Section 2 provides a guide for quickly setting up the board, software features and introduces its strong points
-         Section 3 contains the general board diagram and layout
-         Section 4 describes the component that is the heart of the board: the PIC18F26K20 microcontroller
-         Section 5 is an explanation of the control circuitry associated with the microcontroller to reset, power and clock the board
-         Section 6 covers the connector pinout, peripherals and jumper description
-         Section 7 shows the memory map
-         Section 8 provides the schematics
-         Section 9 contains the revision history

SECTION 2
SETTING UP THE MOD-ZIGBEE-PIR DEVELOPMENT BOARD

This section helps you set up the MOD-ZIG-BEE-PIR development board for the first time.

Please consider first the electrostatic warning to avoid damaging the board, then discover the hardware and software required to operate the board.

The procedure to power up the board is given, and a description of the default board behavior is detailed.

2.1   Electrostatic Warning

The MOD-ZIG-BEE development board is shipped in a protective anti-static package. The board must not be exposed to high electrostatic potentials. A grounding strap or similar protective device should be worn when handling the board. Avoid touching the component pins or any other metallic element.

2.2   Requirements

In order to set up the MOD-ZIGBEE-PIR evaluation board, the following items are required:

-        The MOD-ZIG-BEE development board itself
-        2 x 1,5V batteries AA type OR 3,3 V external supply OR ICSP programmer

Note: The board is not delivered with an ICSP debugger/programmer, which is needed if you want to use software different than the one the board is preprogrammed with. The board comes preprogrammed as a RFD end device (you will need a coordinator device to accomplish communication). Remember that the connector on the board is mini ICSP (6 pin, step 0.5''). You may use one of the following device combinations for this purpose:

-        Olimex's PIC-ICD2-POCKET + Olimex's PIC-ICSP
-        Olimex's PIC-KIT3 + Olimex's PIC-ICSP

Or any compatible device you already have.

For the wireless communication you can download the stack software for free from the MiWi web page or ZigBee's web page. Also, a host-based software toolchain might be required in order to program/debug the MOD-ZIGBEE-PIR board.

2.3   Powering up the board

On applying power via one of the three options available (2 x 1.5V AA batteries, 3.3V from mini ICSP or 3.3V external supply) the red LED (LED1) should light.

2.4   Prebuilt software

The board comes preprogrammed as a ZigBee communication device. This means if you want to accomplish ZigBee connectivity you have to program your other device as a host.

The ZigBee and Microchip's MiWi can be downloaded for free. Note that you can use MiWi if you don't use Microchip's transceiver + Microchip's processor.

For general programming we recommend you use Microchip's MPLAB IDE and compiler C18.

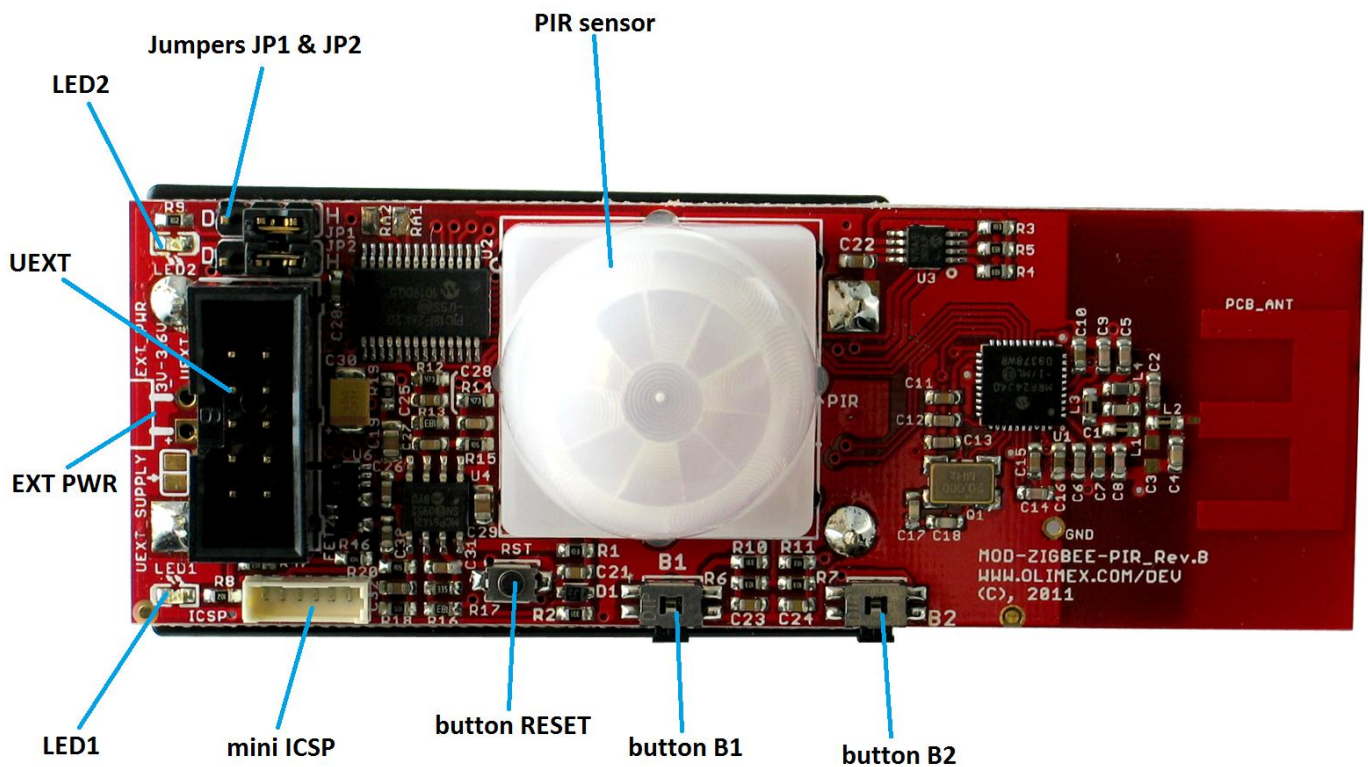# SECTION 3
MOD-ZIGBEE-PIR BOARD DESCRIPTION

Here you get acquainted with the main parts of the board. Note the names used on the board differ from the names used here to describe them. For the actual names check the MOD-ZIGBEE-PIR board itself.

For example: BUTTON (seen on the op view below) is named BUT; RESET is named RST; etc

3.1   Layout (Top view):

3.2   Layout (Bottom view):

SECTION 4
THE PIC18F26K20 MICROCONTROLLER

4.1   Features

High-Performance RISC CPU:
- C Compiler Optimized Architecture:
  - Optional extended instruction set designed to optimize re-entrant code
- 1024 bytes Data EEPROM
- 64 Kbytes Linear Program Memory Addressing
- 3936 bytes Linear Data Memory Addressing
- 16 MIPS Operation
- 16-bit Wide Instructions, 8-bit Wide Data Path
- Priority Levels for Interrupts
- 31-Level, Software Accessible Hardware Stack
- 8 x 8 Single-Cycle Hardware Multiplier

Flexible Oscillator Structure:
- Precision 16 MHz Internal Oscillator Block:
  - Factory calibrated to ± 1%
  - Software selectable frequencies range of 31 kHz to 16 MHz
  - 64 MHz performance available using PLL – no external components required
- Four Crystal modes up to 64 MHz
- Two External Clock modes up to 64 MHz
- 4X Phase Lock Loop (PLL)
- Secondary Oscillator using Timer1 @ 32 kHz
- Fail-Safe Clock Monitor:
  - Allows for safe shutdown if peripheral clock stops
  - Two-Speed Oscillator Start-up

Special Microcontroller Features:
- Operating Voltage Range: 1.8V to 3.6V
- Self-Programmable under Software Control
- Programmable 16-Level High/Low-Voltage
Detection (HLVD) module:
  - Interrupt on High/Low-Voltage Detection
- Programmable Brown-out Reset (BOR):
  - With software enable option
- Extended Watchdog Timer (WDT):
  - Programmable period from 4 ms to 131s
- Single-Supply 3V In-Circuit Serial
    Programming™ (ICSP™) via Two Pins
- In-Circuit Debug (ICD) via Two Pins

Extreme Low-Power Management with nanoWatt XLP:
- Sleep mode: < 100 nA @ 1.8V
- Watchdog Timer: < 800 nA @ 1.8V
- Timer1 Oscillator: < 800 nA @ 32 kHz and 1.8V

Analog Features:
- Analog-to-Digital Converter (ADC) module:
  - 10-bit resolution, 13 External Channels
  - Auto-acquisition capability
  - Conversion available during Sleep

- 1.2V Fixed Voltage Reference (FVR) channel
- Independent input multiplexing
- Analog Comparator module:
  - Two rail-to-rail analog comparators
  - Independent input multiplexing
- Voltage Reference (CVREF) module
  - Programmable (% VDD), 16 steps
  - Two 16-level voltage ranges using VREF pins

Peripheral Highlights:
- 25 I/O Pins plus 1 Input-only Pin:
  - High-Current Sink/Source 25 mA/25 mA
  - Three programmable external interrupts
  - Four programmable interrupt-on-change
  - Eight programmable weak pull-ups
  - Programmable slew rate
- Capture/Compare/PWM (CCP) module
- Enhanced CCP (ECCP) module:
  - One, two or four PWM outputs
  - Selectable polarity
  - Programmable dead time
  - Auto-Shutdown and Auto-Restart
- Master Synchronous Serial Port (MSSP) module
  - 3-wire SPI (supports all 4 modes)
  - I2C™ Master and Slave modes with address mask
- Enhanced Universal Synchronous Asynchronous
Receiver Transmitter (EUSART) module:
  - Supports RS-485, RS-232 and LIN
  - RS-232 operation using internal oscillator
  - Auto-Wake-up on Break
  - Auto-Baud Detect

For comprehensive information on the microcontroller visit the Microchip's web page for a datasheet.

At the moment of writing the microcontroller datasheet can be found at the following link:

http://ww1.microchip.com/downloads/en/DeviceDoc/41303G.pdf

5.1 Power supply

MOD-ZIGBEE-PIR can be powered from 4 sources:

- 2 x 1,5V AA batteries placed in the BAT1 and BAT2 slots

- Providing 3 to 3.6V to EXT_PWR pin holes (near UEXT connector)

- Providing 3.3V via the mini ICSP

- Providing 3.3V via the UEXT

When powered and functional the current consumption is ~30 mA.

5.2 Reset

MOD-ZIGBEE-PIR reset circuit includes D1 (0.2W, SMD), R1 (10kΩ), R2 (330Ω), C21 (100nF), PIC18F26K20 pin 1 (MCLR#) and a RESET button.

5.3 Clock

Quartz crystal Q1 20.000 MHz is connected to PIC18F26K20 pin 33 (OSC2) and pin 34 (OSC1).

SECTION 6
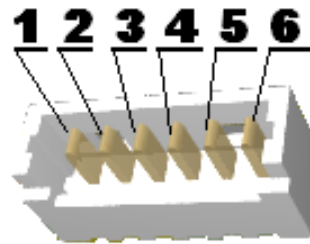## HARDWARE

6.1   miniICSP

The miniICSP connector provides option to reprogram the board.

Pin #	Signal Name
1	RESET
2	+3.3V
3	GND
4	PGD
5	PGC
6	Not connected

6.2   UEXT

MOD-ZIGBEE-PIR board has UEXT connector and can interface Olimex's UEXT modules. Note that the UEXT connector on MOD-ZIGBEE-PIR is a female one.
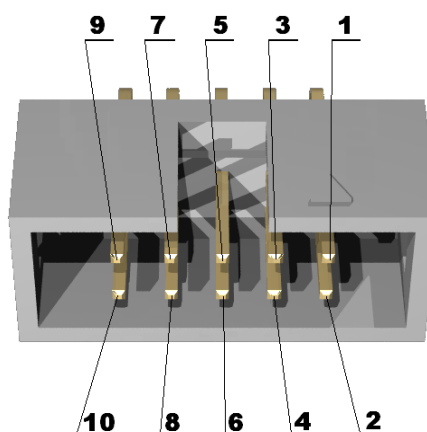
The Tx and Rx by default are in DEVICE mode. To switch to HOST mode set the jumpers to position 1-3 (D).

For more information on UEXT please visit:

http://www.olimex.com/dev/OTHER/UEXT.pdf

For the UEXT Pin-signal table check the next page

Pin #	Signal Name
1	+3.3V
2	GND
3	TXD
4	RXD
5	SCL
6	SDA
7	Not connected
8	Not connected
9	Not connected
10	Not connected

6.3   Jumper description

JP1 & JP2

These jumpers, when both in position 2-3, enable DEVICE UEXT.
These jumpers, when both in position 1-2, enable HOST UEXT.

Default state is 2-3.

UEXT_SUPPLY

When closed the board is powered by the UEXT.

Default state is open.

6.4 Test pads

There are two test pads RA1 and RA2 near the PIC MCU. They are connected to pins 9 and 10 of the MCU, resepctively.
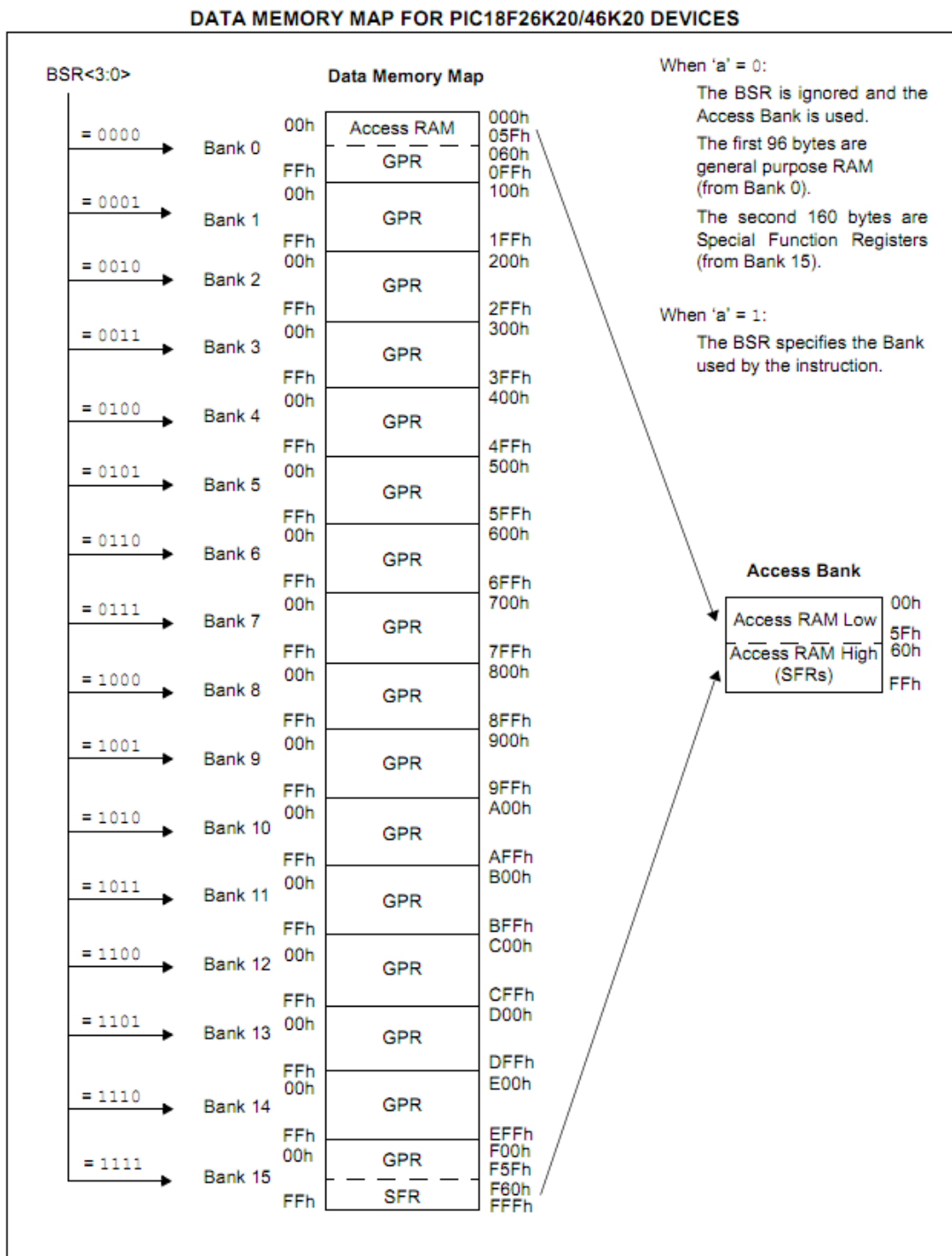
6.5 LEDs & Buttons

The board has 2 LEDS: LED1 is RED; LED2 is GREEN.

The board has 2 user buttons: B1 and B2.

SECTION 7
MEMORY

7.1 Memory map

DATA MEMORY MAP FOR PIC18F26K20/46K20 DEVICES

SECTION 8
SCHEMATICS

8.1   Eagle schematic

MOD-ZIGBEE-PIR schematic can also be downloaded at our web page for MOD-ZIGBEE-PIR:
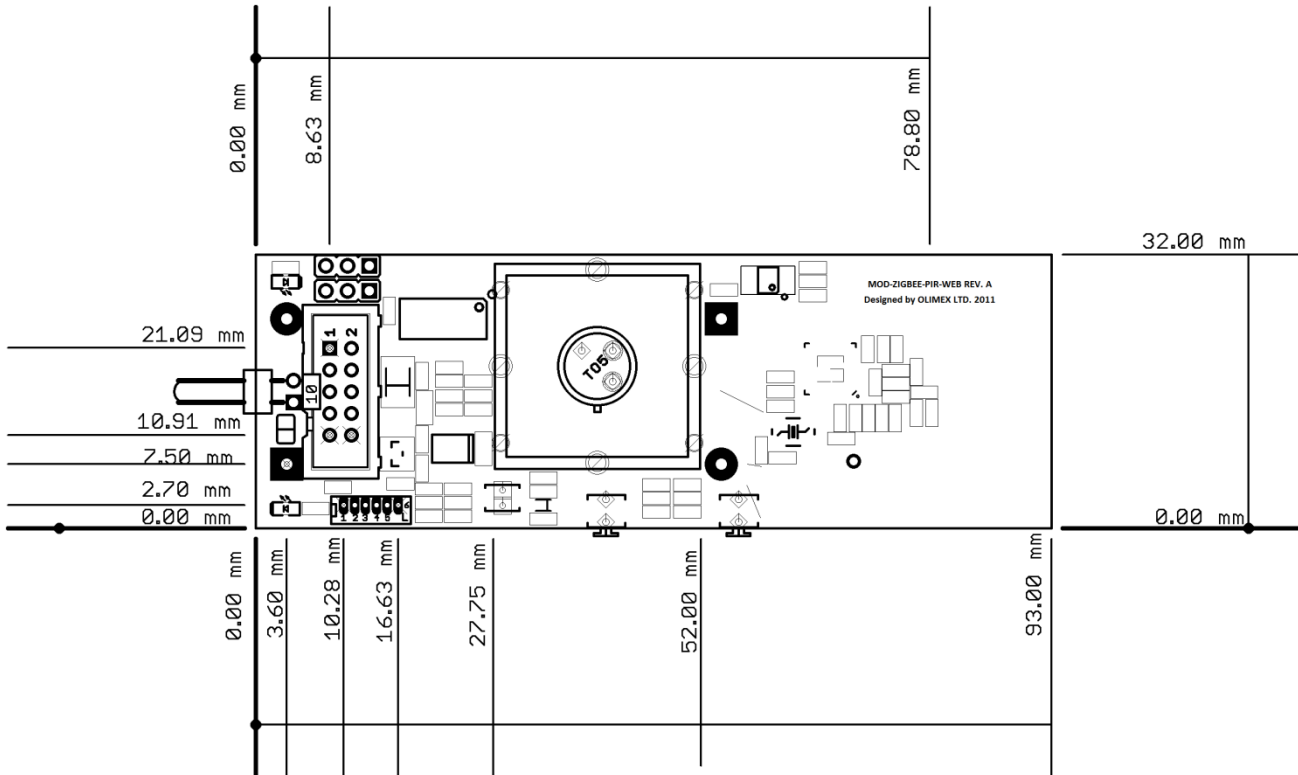http://olimex.com/dev/mod-zigbee-pir.html. They are located in HARDWARE section.

The EAGLE schematic is situated on the next page for quicker reference.
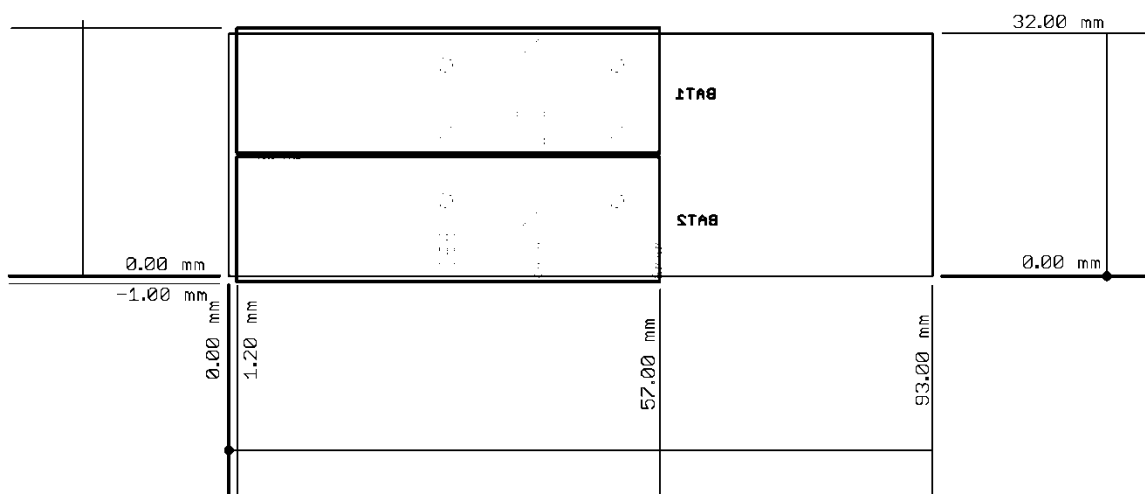
8.2   Physical dimensions

Here you can find the physical dimensions of the board in millimeters.

8.2.1 Top view

8.2.2 Bottom view

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SECTION 9
REVISION HISTORY

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9.1   Document revision and order codes

Revision	Changes	Modified Pages
A	Initial Creation	All
B	Fixed several mistakes and added newer schematic	All

ORDER CODES:

MOD-ZIGBEE-PIR - assembled, programmed, tested, calibrated development boards
PIC-ICD2-POCKET + PIC-ICSP - for custom programming/debugging (if you do not wish to use PINGUINO IDE)
PIC-KIT3 + PIC-ICSP - for custom programming/debugging (if you do not wish to use PINGUINO IDE)

How to order?

You can order from our online shop directly or from any of our distributors. The full list of distributors might be found here: https://www.olimex.com/Distributors/.
Check our webpage https://www.olimex.com/ for more info.