

# **Billion ZigBee Module**

## **User Manual**

### **(MD1000)**

# DESCRIPTION

The MD1000 module is a ZigBee™ network solution that integrates a 2.4Ghz, IEEE 802.15.4-compliant transceiver with a 32 bit ARM® Cortex M3 microprocessor. It contains integrated Flash and RAM memory and peripherals of use to designers of ZigBee-based applications.

The transceiver utilized an efficient architecture in which the integrated receiver channel filtering allows for co-existence with other communication standards in the 2.4Ghz spectrum such as Wi-Fi and Bluetooth. An optional high performance radio mode (boost mode) is software selectable to boost dynamic range by a further 8dB. The highly integrated antenna, power regulator, and Xtal keep the external component count low. The internal PCB traced antenna and an external U.FL connector port is user selectable. This is maximum the flexibility for the designer to minimize the cost or maximize the system performance.

The EM357 has 192kB of embedded Flash memory and 12kB of integrated RAM for data and program storage. The EM357 software stack employs an effective wear-leveling algorithm in order to optimize the lifetime of the embedded Flash.

To support user-defined application, a number of peripherals such as GPIO, UART, SPI, I<sup>2</sup>C, ADC, and general purpose timers are integrated. Also, an integrated voltage regulator, power-on-reset circuitry, sleep timer, and low-power sleep modes are available. The deep sleep mode draws less than 2uA, allowing products to achieve long battery life. The equipped internal watch-dog timer allows the system to be reactivated once the system go into a dead-lock state. This mechanism makes the system more reliable and available.

Target application for the MD1000 includes:

- Home automation and control
- Building automation and control
- Smart energy monitoring and control
- Tele-healthcare
- Asset tracking



# GENERAL FEATURES

- Ember™ EM357 platform
- 192KB Flash memory, with option read protection
- 12KB SRAM
- 32-bit ARM® Cortex M3 microprocessor
- 24 general purpose I/O ports
- DMA-SPI, I2C and UART interfaces
- Integrated 12-bit resolution ADC
- Designed for EmberZNet ZigBee Pro compliant networks
- Miniature footprint: 2cm x 3cm
- Integrated PCB trace antenna and U.FL external antenna connector
- 16 RF channels
- Over indoor 30m and outdoor visual contact 100m of range
- JTAG interface
- AES 128-bit encryption
- Low power consumption
- Constant RF out power over 2.1~3.6 V voltage range
- FCC and NCC certified
- RoHS compliant

## Product Specification

Chip Set	Ember EM357 SoC
Operation Voltage	2.1~3.6V
Network Standard	IEEE 802.15.4
Modulation	DSSS PHY employing Offset-QPSK
Network Architectures	Star or Mesh
Data Rate	250Kbps
Integrated Memory	192KB of Flash, 12KB of SRAM
Power Consumption	TX: under 40mA, RX: under 40mA Deep sleep: under 2uA
Watchdog	Internal watchdog timer and power-on-reset circuitry
Encryption	Integrated 128-bit AES encryption accelerator
Operating Frequency Band	2.405Ghz ~ 2.480Ghz (16 Channels with 5Mhz wide)
Antenna Type	1. Internal PCB Traced Planar Inverted-F Antenna 2. U.FL Connector for External Antenna
TX Output Power	Max. +3dBm (+8dBm in Boost mode) , Min. -43dbm

RX Sensitivity	Typical -100dBm(-101dBm in Boost mode) at 1% packet error rate
Operating Temperature (Ambient)	-40 °C ~ +85 °C
Humidity (Non-condensing)	0~95% RH

## I/O PIN ASSIGNMENT

Pin #	Name	Direction	Description
1	GND	Ground	Ground
2	NC	NC	No connection
3	GND	Ground	Ground
4	GND	Ground	Ground
5	GND	Ground	Ground
6	NC	NC	No connection
7	VCC	Power	3.3V power supply input (2.1V~3.6V)
8	VCC	Power	3.3V power supply input (2.1V~3.6V)
9	nReset	I	Reset input (>26usec, active low)
10	PC5	I/O	GPIO
11	PC6	I/O	GPIO
12	PC7	O	ZigBee status LED output (current: 4mA)
13	PA7	I/O	GPIO
14	PB3	I	UART CTS input
15	GND	Ground	Ground
16	GND	Ground	Ground
17	PB4	O	UART RTS output
18	PA0	O	SC2MOSI (OTA)
19	PA1	I	SC2MISO (OTA)
20	PA2	O	SC2SCLK (OTA)
21	PA3	O	SC2nSSEL (OTA)
22	PA4	I/O	GPIO
23	PA5	I/O	GPIO
24	PA6	I/O	GPIO
25	PB1	O	UART TXD output
26	PB2	I	UART RXD input
27	JTCK	I	JTAG JTCK
28	JTDO-PC2	O	JTAG JTDO
29	JTDI-PC3	I	JTAG JTDI
30	GND	Ground	Ground
31	GND	Ground	Ground
32	JTMS-PC4	I	JTAG JTMS
33	PB0	I/O	GPIO
34	PC1	I/O	GPIO
35	JRST-PC0	I	JTAG JRST
36	NC	NC	No connection

37	PB6	I	ZigBee WPS input
38	VCC	Power	3.3V power supply input
39	ANT_0	I	Internal Antenna: ANT_0 = High, ANT_1 = Low input (default) External Antenna: ANT_0 = Low, ANT_1 = High input
Pin #	Name	Direction	Description
40	ANT_1	I	Internal Antenna: ANT_0 = High, ANT_1 = Low input (default) External Antenna: ANT_0 = Low, ANT_1 = High input
41	GND	Ground	Ground
42	GND	Ground	Ground
43	GND	Ground	Ground
44	NC	NC	No connection
45	GND	Ground	Ground

# ELECTRICAL CHARACTERISTICS

## Absolute Maximum Ratings

Parameter	Min.	Typ.	Max.	Unit
Power supply voltage	-0.3		3.6	V
Voltage on any digital pin	-0.3		VCC + 0.3 Max 3.6	V
Operation temperature range	-40		85	°C
Storage temperature range	-40		125	°C

**Note:** Exceeding the maximum ratings may cause permanent damage to the module or devices.

## Operating Conditions

Parameter	Min.	Typ.	Max.	Unit
Power supply voltage	2.1		3.6	V
Input current for logic 0			-0.5	μA
Input current for logic 1			0.5	μA
Input voltage for logic 0	0		20% VCC	V
Input voltage for logic 1	80% VCC		VCC	V
Output voltage for logic 0	0		18% VCC	V
Output voltage for logic 1	82% VCC		VCC	V
Input pull-up resistor value	24	29	34	KΩ
Input pull-down resistor value	24	29	34	KΩ
Output source current (standard current pad)			4	mA
Output sink current (standard current pad)			4	mA
Output source current high current pad: PA6,PA7,PB6,PB7,PC0			8	mA
Output sink current high current pad: PA6,PA7,PB6,PB7,PC0			8	mA
Ambient temperature range	-40	25	+85	°C

## DC Characteristics

Parameter	Min.	Typ.	Max.	Unit
Active Current (TX)				
TX, Normal Mode, +3 dBm		31		mA
TX, Boost Mode, +8 dBm		39		mA
TX, Normal Mode, 0 dBm		28.5		mA
Active Current (RX)				
RX, Normal Mode, +3 dBm		26		mA
RX, Boost Mode, +8 dBm		27		mA

summarizes the DC characteristics at 25°C and VDD of 3V of the EM35x Module.

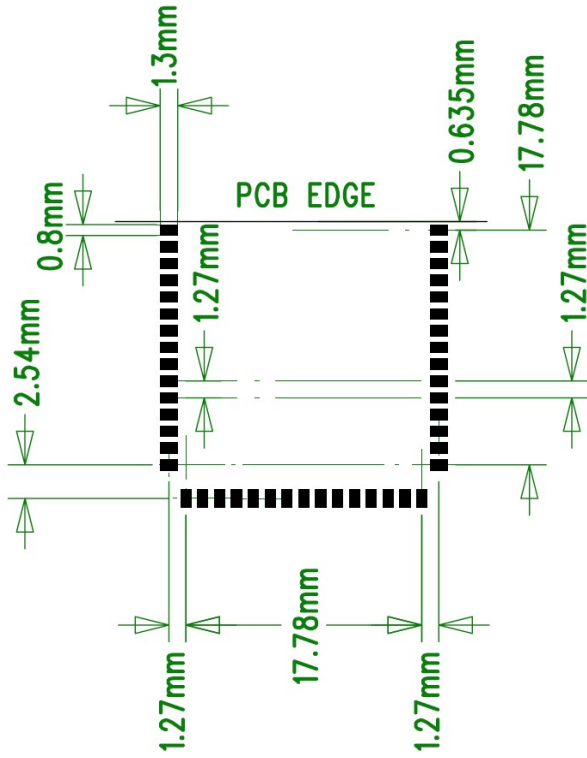
## RF Characteristics (@25°C, VCC=3.3V)

Parameter	Min.	Typ.	Max.	Unit
Frequency Range	2405		2480	MHz
Channel Spacing		5		MHz
RX Sensitivity (1% PER, 20-byte packet)				
Normal Mode		-100	-94	dBm
Boost Mode		-101	-95	dBm
Adjacent Channel Rejection				
High Side		35		dB
Low Side		35		dB
2nd High Side		43		dB
2nd Low Side		43		dB
All other channels		40		dB
TX Power (Maximum)				dB
Boost Mode		8		dBm
Normal Mode		3		dBm
Error Vector Magnitude (Offset EVM) (per IEEE 802.15.4-2003)		5	15	%

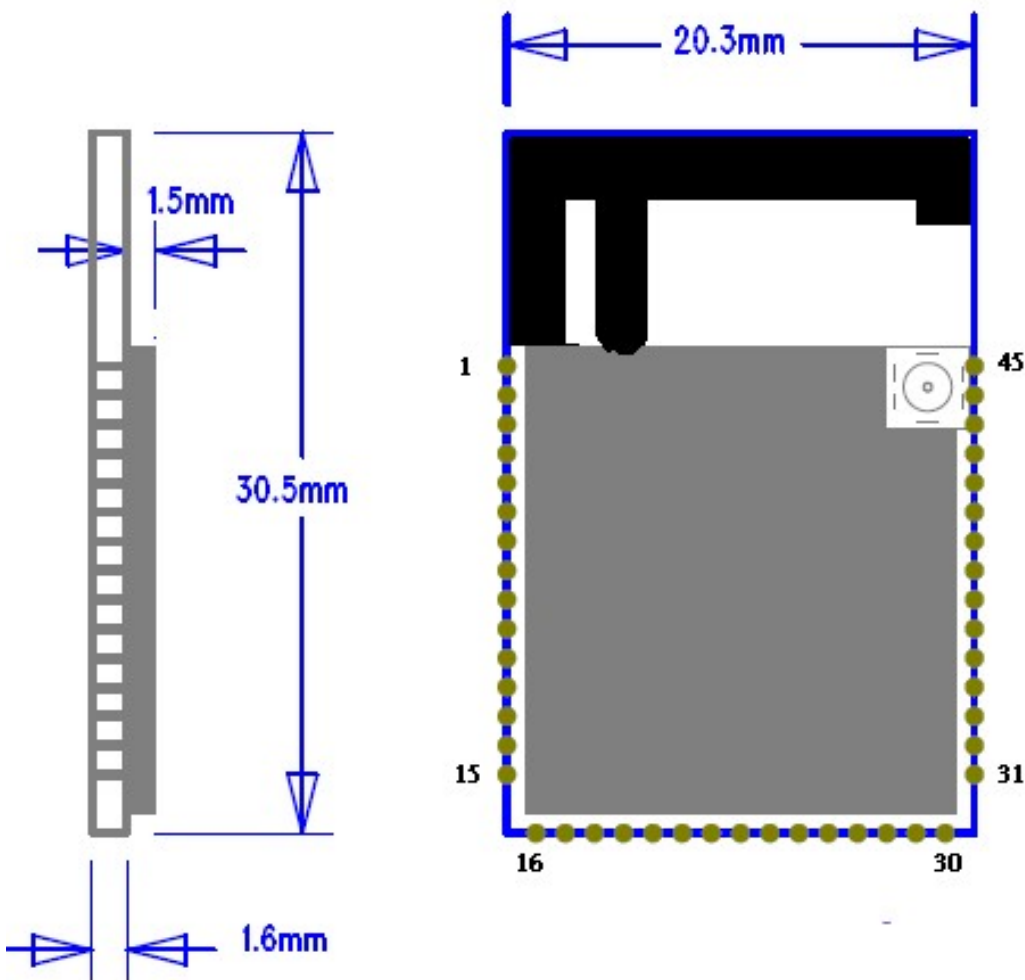




# PCB COPPER PATTERN LAYOUT

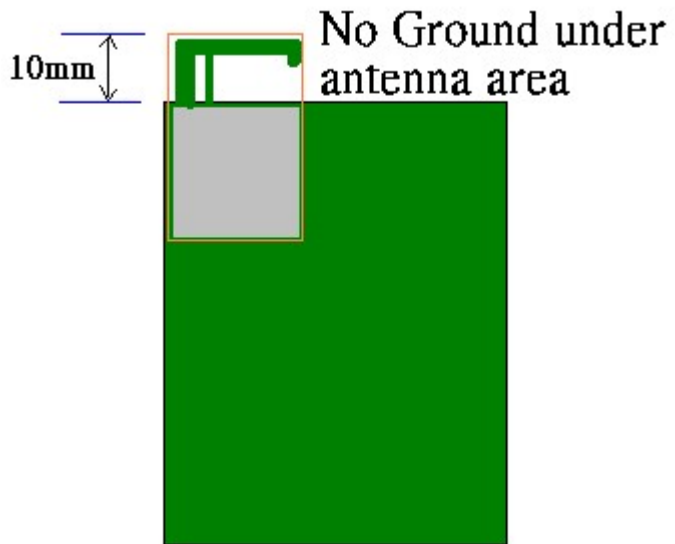


# DIMENSIONS



# Placement Guideline

It is recommended that MD1000 be placed on the corner of the main board and near the edge as shown below.



## **Federal Communication Commission Interference Statement**

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:

- ♦ Reorient or relocate the receiving antenna.
- ♦ Increase the separation between the equipment and receiver.
- ♦ Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- ♦ Consult the dealer or an experienced radio/TV technician for help.

## **FCC Caution:**

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference

(2) This device must accept any interference received, including interference that may cause undesired operation.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. . This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

## **Co-location statement**

This device and its antenna(s) must not be co-located or operating in conjunction with any other antenna or transmitter.

## **FCC Radiation Exposure Statement**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This module is intended for OEM integrator. The OEM integrator is responsible for the compliance to all the rules that apply to the product into which this certified RF module is integrated. Additional testing and certification may be necessary when multiple modules are used.