

**Appendix 6.**

**User manual**

# ZBM(Zigbee Module) Hardware Description



2012-05-26

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Caution : Any changes or modifications in construction of this device which are not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

# 1. Hardware Description

ZigBee Module (ZBM) is a RF module supporting 2.4 GHz Industrial, scientific and medical(ISM) radio bands that are radio bands reserved internationally for the use of radio frequency(RF) energy for industrial, scientific and medical purposes other than communications. This module consists of the RF Transceiver, RF Circuit, 8051-compatible MCU and some external devices satisfying I E E E 802.15.4 ZigBee-compliant PHY, MAC and can transfer up to up to 1Mbps in data rate.

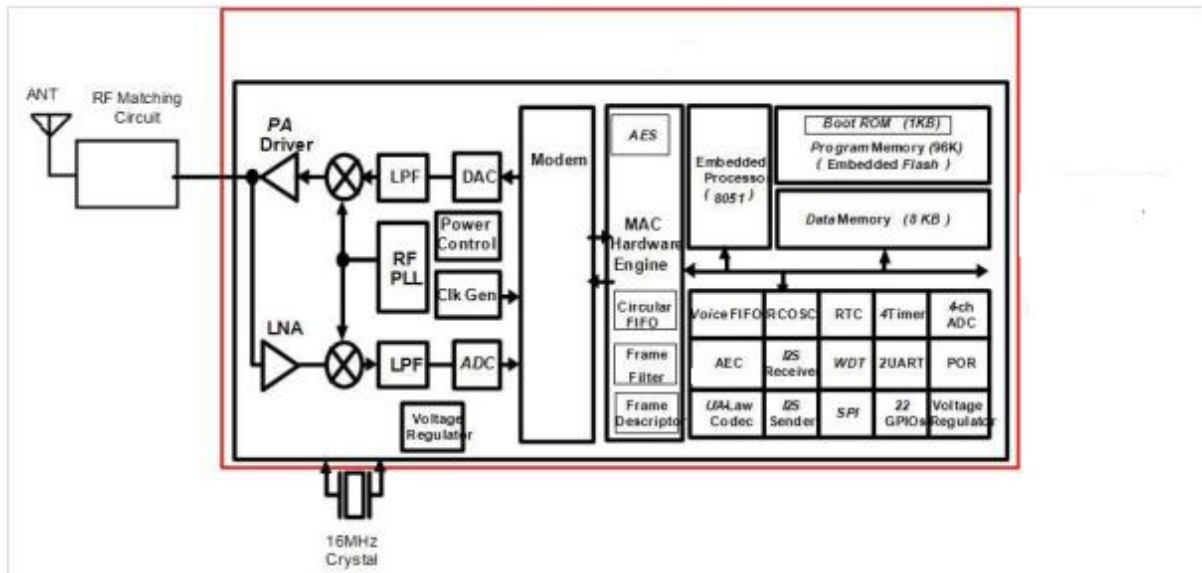
## 1.1 Fields of Applications

- Factory Automation and Motor Control
- Replacement for legacy wired UART
- Energy Management
- Low Power Telemetry
- Health-care equipments

## 1.2 Image



### 1.3 Block Description



- Uses Zigbee single chip integrated With 2.4GHz RF Transceiver, base-band modem, hardwired MAC, Internal Flash Memory, and 8051MCU.
- Various peripheral devices such as 22 General Purpose I/Os, 4-channel 8-bit ADC, and Two High-Speed UARTs.
- Firmware downloads using UART1 in ISP(In-System-Programming) Mode.

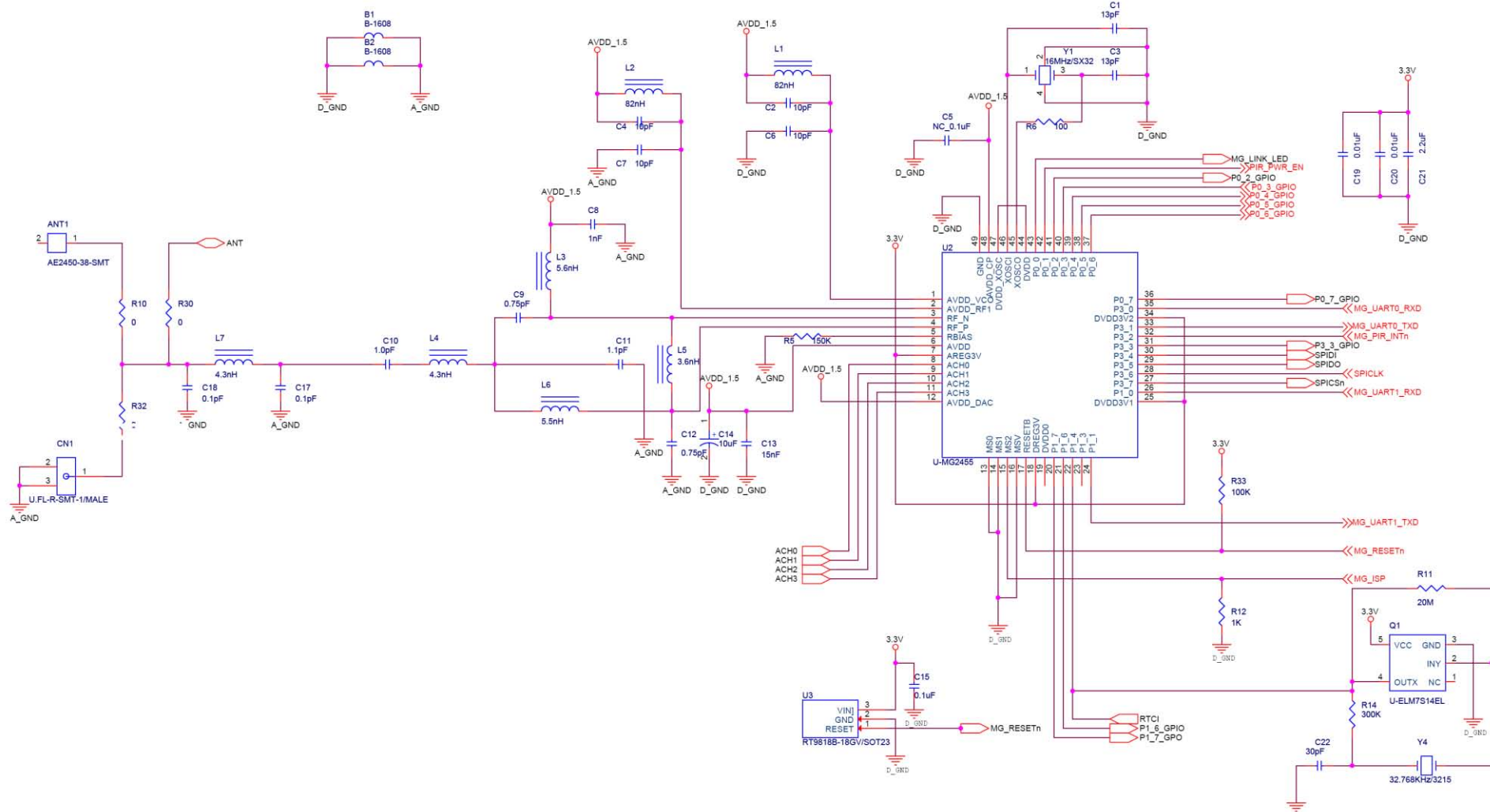
### 1.3 Parts List

### 1.3.1 ZBM(ZigBee)

NO	PartNo	Description	Geom	Vendor	Q'ty	Reference
1	GRM1555C1HR50CA01D	CAP 0.5pF 1005	C1005	MURATA	2	R10 C17
2	CL05B103K05NNNC	CAP 0.01UF, 1005	c1005	SAMSUNG	1	C19
3	CL05B103K05NNNC	CAP 0.01UF, 1005	c1005	SAMSUNG	1	C20
4	CL05B104K05NNNC	CAP 0.1UF, 1005	c1005	SAMSUNG	1	C15
5	GRM1555C1HR75CZ01D	CAP 0.75PF, 1005	c1005	MURATA	1	C9
6	GRM1555C1HR75CZ01D	CAP 0.75PF, 1005	c1005	MURATA	1	C12
7	GRM1555C1H1R0CA01D	CAP 1.0PF, 1005	c1005	MURATA	2	C10 L7
8	GJM1555C1H1R1CB01D	CAP 1.1PF, 1005	c1005	MURATA	1	C11
9	RC1005J101CS	RES 100, 1005	r1005	SAMSUNG	1	R6
10	WR04X1003FTL	RES 100K, 1005	r1005	WALSIN	1	R33
11	CL05C100DB5NNNC	CAP 10PF, 1005	c1005	SAMSUNG	1	C4
12	CL05C100DB5NNNC	CAP 10PF, 1005	c1005	SAMSUNG	1	C6
13	CL05C100DB5NNNC	CAP 10PF, 1005	c1005	SAMSUNG	1	C2
14	CL05C100DB5NNNC	CAP 10PF, 1005	c1005	SAMSUNG	1	C7
15	TMCMA1C106MTRF	T/T 10UF, 16V 3216	tc3216	HITACHI	1	C14
16	0402N130J500	CAP 13PF, 1005	c1005	WALSIN	2	C1 C3
17	WR04X154JTL	CAP 150K_1005	r1005	WALSIN	1	R5
18	CL05B153K05NNNC	CAP 15NF, 1005	c1005	SAMSUNG	1	C13
19	SM325-16M-9D	XTAL SX-32 16MHz 9pF	smd sx-32	SNK	1	Y1
20	RC1005J103CS	RES 1K, 1005	r1005	SAMSUNG	1	R12
21	GRM155R71H102KA01D	CAP 1NF, 1005	c1005	MURATA	1	C8
22	CL05A225M05NSNC	CAP 2.2UF 1005	c1005	SAMSUNG	1	C21
23	WF04G206JTL	RES 20M 1005	r1005	WALSIN	1	R11
24	LQG15HN3N6S02D	INDUCTOR 3.6NH, 1005	bead1005	MURATA	1	L5
25	RC1005J304CS	RES 300K 1005	r1005	SAMSUNG	1	R14
26	0402N300J500	CAP 30PF 1005	c1005	SAMSUNG	1	C22
27	CM315A 32.768KHz	SMD 32.768KHZ/3215	xtal_nx3215sa-32	SNK	1	Y4
28	LQW15AN4N3C00D	IND 4.3nH 1005	bead1005	MURATA	1	L4
29	LQG15HS5N6S02D	IND 5.6NH, 1005	bead1005	MURATA	1	L6
30	LQG15HS5N6S02D	IND 5.6NH, 1005	bead1005	MURATA	1	L3
31	LQG15HS82NJ02D	IND 82nH_1005	bead1005	MURATA	2	L1 L2
32	AE-2450-SMT	AE2450-38-SMT	Chip Ant 3*8*1.6t	안테나엔진	1	ANT1
33	BLM18PG300SN1D	BEAD -1608	bead1608	MURATA	2	B1 B2
34	RT9818B-18GV	Volt detector 1.8v	sot23	RICHTEK	1	U3
35	ELM7S14BEL	CMOS LOGIC	sot23_5	ELM	1	Q1
36	MG2455-F48	SoC(System-on-Chip)	qfp48_w675_1040_050	RadioPulse	1	U2
37	U.FL-R-SMT-1(10)	UMCC U.FL CONNECTOR	U.FL-R-SMT-1	HIROSE	1	CN1
38	PCB GT-ZBM V1.0	27 x 21.5 x 1.2T X 4L	1.2T X 4L	세종전자	1	
39	ZBM	ZBM	zbm_th		1	J1
40	NC RC1005J000CS NC	NC R1005	NC r1005	SAMSUNG	2	R30 R32
41	NC C1005	NC C1005	NC c1005	SAMSUNG	2	C5 C18

### 1.4 Circuit Description

## 1.4.1 ZigBee



Zigbee Communication is designed to use Zigbee's exclusive chip MG2455 of RadioPulse. While the power of 3.3V is supplied, 1.5V of the high-frequency 2.4GHz is produced within the MG2422 then used. MG2455 functions by 16MHz's clock, 32.768KHz clock is being used to obtain real time information, and

2.4GHz high frequency signal is outputted as pin3 and pn4 and transmitted through the output circuit, 2.4 GHz frequency band circuit, and as well as antenna circuit. On the other hand, high-frequency signal of 2.4GHz is received through antenna, and through antenna circuit 2.4GHz frequency band circuit output circuit, it is inputted to MG2455 to be transferred to controller.

### 1.4.2 MCU

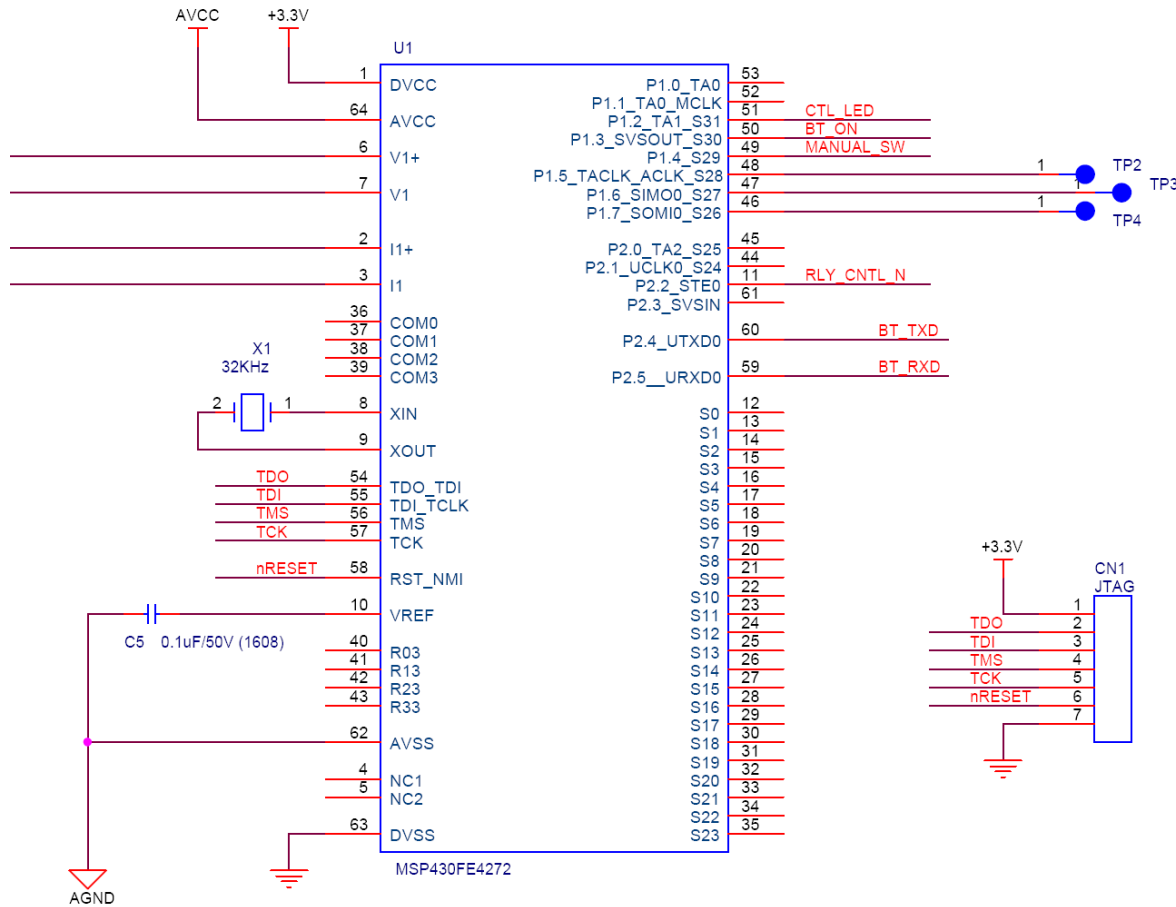


IMAGE 16 MCU



Power supplied by Main Control Unit : MSP430 + 3.3V to reset with "Pin 58" functioning with 32.768KHz that detected AC voltage is inputted as "Pin 6 and Pin 7" while inputting detected AC voltage current as "Pin 2 and Pin 3". Zigbee Communication Module is interfaced with asynchronous serial communication of Pin 59 and Pin 60 to transmit Zigbee(2.4GHz) through the collection device PCAP(Power Control Access Point).

제품의 성능 개선을 위하여 커넥터(CN1)으로 펌웨어를 다운로드 할 수 있도록 설계되었다.

## 1.5 RF MODEM SPEC

### 1.5.1 ZigBee

Item	Spec	Remark
Frequency Range	2400~2483.5MHz	
Frequency Tolerance	<±20ppm	
Occupied B.W	2MHz	
Output Power (Normal)	7dBm (±1dB)	
VSWR	<2.0 : 1	
Flatness	<1dB	
Spurious Emissions		
1GHz Under	<-30dBm	
1GHz ~ 2.4GHz	<-30dBm	
~ 12GHz	<-30dBm	
2nd Harmonic	<-45dBm	
3rd Harmonic	<-70dBm	
Inband Spurious	<-45dBm	
Adjacent Channel Rejection	±3.5MHz >40dBc	
Secondary Radiated Emission	<-58dBm	Limit of secondary radiated emissions.
Phase Noise	1MHz -110dBc / Hz	
	2MHz -112dBc / Hz	

#### RF Transceiver

- Single-chip 2.4GHz RF Transceiver
- Low Power Consumption
- Low Operating Voltage of 1.5V
- High Sensitivity of -98dBm@1.5V
- No External T/R Switch and Filter needed
- On-chip VCO, LNA, and PA
- Programmable Output Power up to +8dBm@1.5V
- Direct Sequence Spread Spectrum
- O-QPSK Modulation
- Scalable Data Rate: 250Kbps for ZigBee
- RSSI Measurement
- Compliant to IEEE802.15.4

#### 128-byte CPU dedicated Memory

- 1KB Boot ROM
- Dual DPTR Support
- I2S/PCM Interface with two 128-byte FIFOs
- Two High-Speed UARTs with Two 16-byte FIFOs (up to 1Mbps)
- Quadrature Signal Decoder
- On-chip Power-on-Reset

- SPI Master/Slave Interface

Clock Inputs

- 16MHz Crystal for System Clock
- 32.768kHz Oscillator for Sleep Timer

Power

- Separate On-chip Regulators for Analog and Digital Circuitry.
- Power Supply Range for Internal Regulator(1.9V(Min) ~ 3.6V(Max))

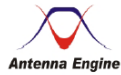
This device complies with part 15 of the FCC Rules,  
Operation is subject to following two conditions :

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

*(Add the following information in the user  
manual of FCC ID: OSGZBM)*

**If the FCC ID is not visible when the module is  
installed inside another device, then the  
outside of the device into which the module is  
installed must also display a label referring to  
the enclosed module. This exterior label shall  
be: "Contains FCC ID: XXXYYYYYYY"**

## 1.5.2 ZigBee Antenna Specification and Characteristic



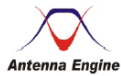
# ***ANTENNA ENGINE***

2.4GHz 칩안테나 규격서  
[AE-2450-38-SMT]

2011. 03. 28.

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***ANTENNA ENGINE***



- 목 차 -

1. SPECIFICATIONS
2. Radiation Pattern
3. 3D-Measurement
4. Input Impedance
5. 도면

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***ANTENNA ENGINE***

## 1. SPECIFICATIONS

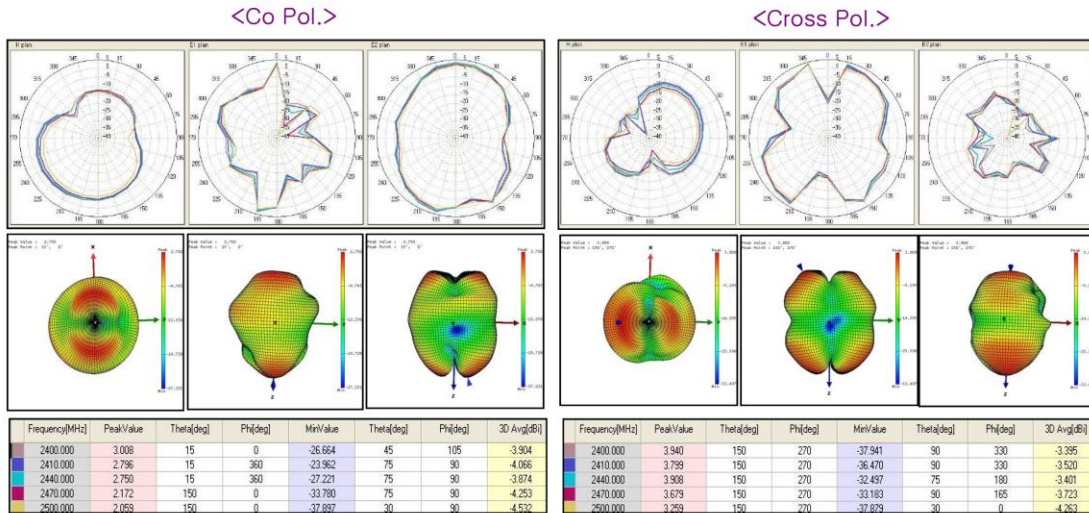
ELECTRICAL Char.	SPECIFICATIONS	REMARK
Model	AE-2450-38-SMT	
Frequency Range	2400~2500[MHz]	
V.S.W.R	2.0 :1	
Gain	1 ±0.5[dBi]	
Polarizations	Isotropic	
Input Impedance	50[Ω]	
Input Power	1[W]	
MECHANICAL Char.	SPECIFICATIONS	
Feed Type	SMT	
Size[W x H x D]	8 x 3 x 1.6[mm]	



안테나 장착 위치

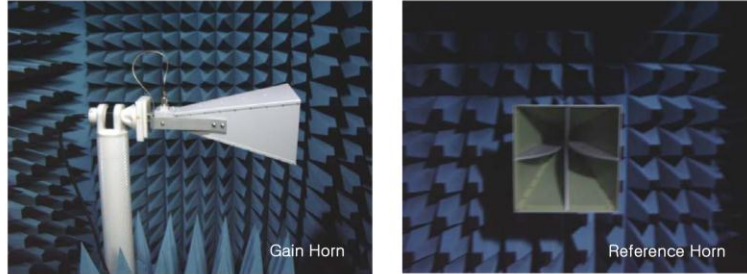
### ANTENNA ENGINE

## 2. Radiation Pattern



### ANTENNA ENGINE

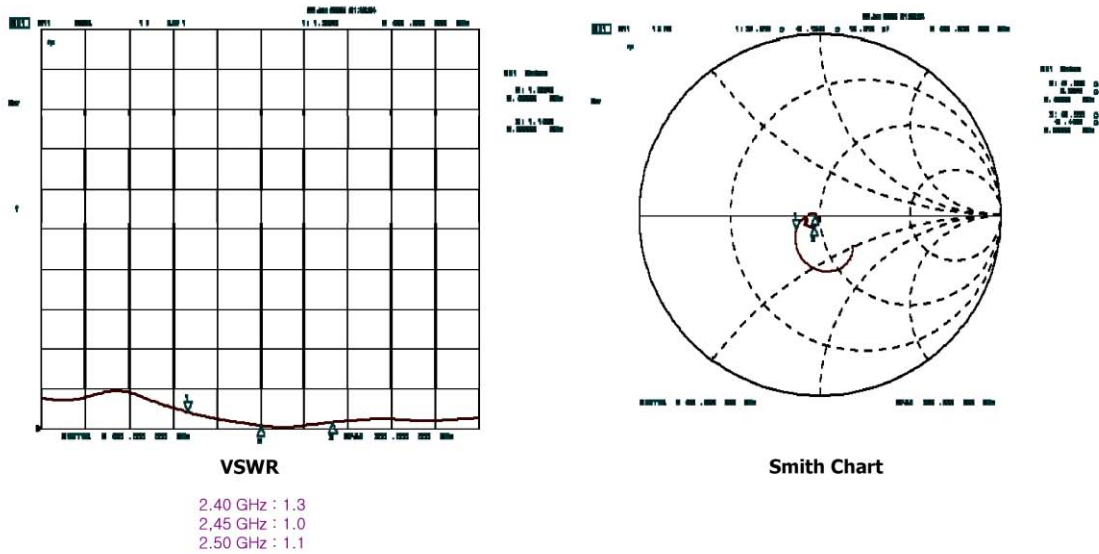
### 3. 3D-Measurement



- Calibration 주파수 대역 : 2.4 ~ 2.5[GHz]
- 2D 복사패턴 Angle step : 05°
- 3D 복사패턴 Angle step : 15°
- 안테나의 이득과 복사 패턴을 정확히 측정하기 위해 챔버내에 설치된 혼안테나를 Calibration 하는 장면.
- 3D 복사패턴을 측정하기 위한 안테나의 설치.

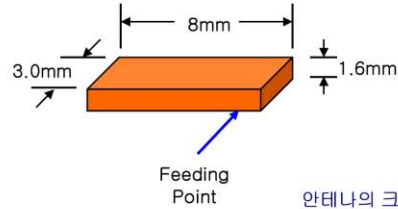
## ANTENNA ENGINE

### 4. Input Impedance

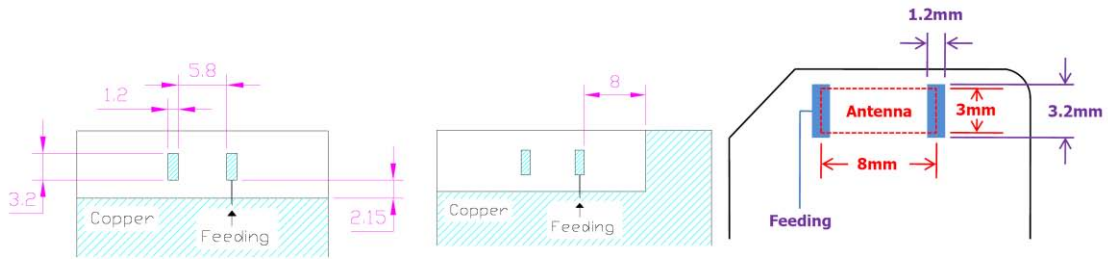


## ANTENNA ENGINE

5. 도면



안테나의 크기는 세트 메인보드의 크기에 따라  
변경 될 수 있습니다.



측면 그라운드 면과의 간격은 **8mm**이상

## 2. How to setup the equipment

### 2.1 ZigBee

#### 2.1.1. Channel setup Method

##### 2.1.1.1. UART connect

- 1) Connect the "Serial Connection Cable" to the PC USB port and PCAP **J6** headerpin.
  - A) Connect the "Serial Connection Cable" to the PC USB port and PCAP **J6** headerpin.

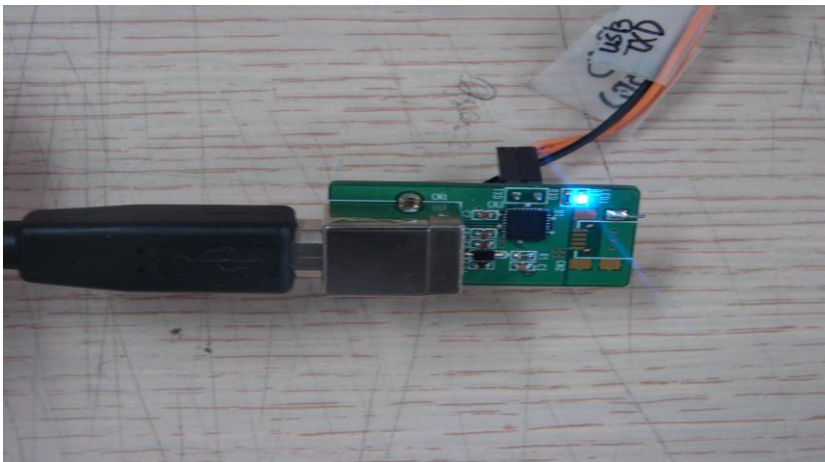


IMAGE Serial Connection Cable

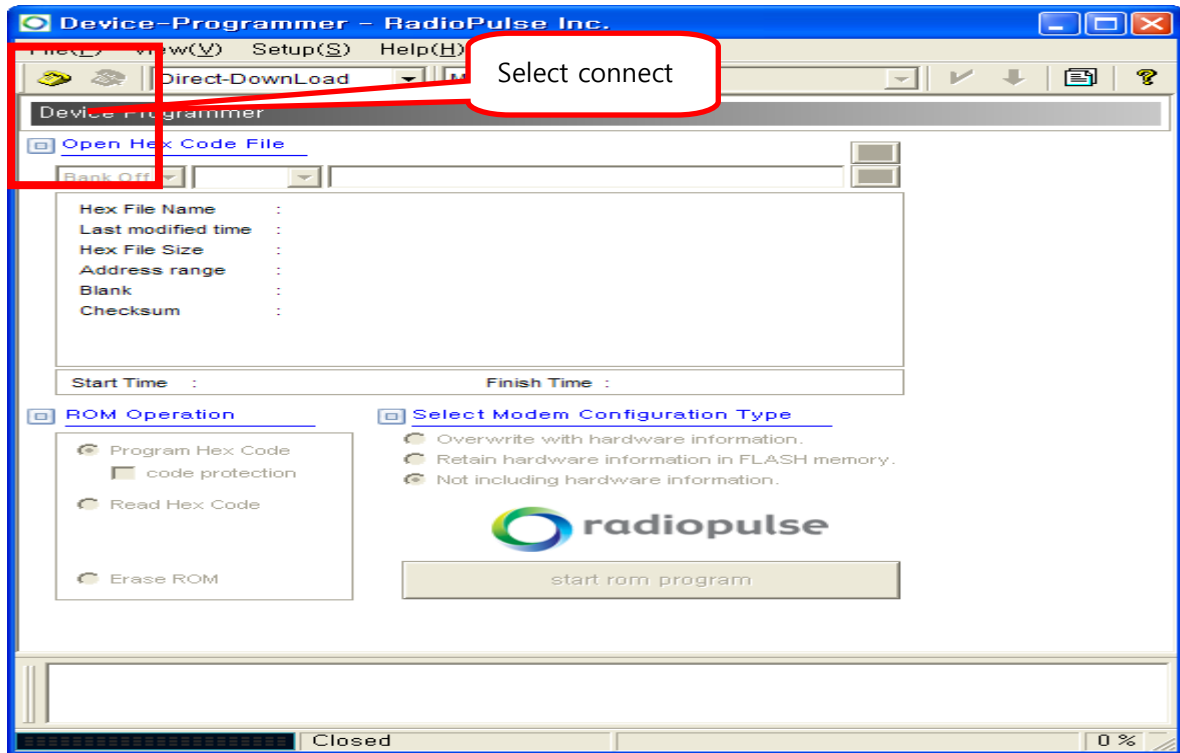
- B) Photo of CN4 헤더 connection

classification	contents	reference
1	+3.3 V	Connect to #5 Pin when ISP fusing occurs.
2	GND	
3	TXD( PCAP STANDARD UART2)	
4	RXD( PCAP STANDARD UART2)	
5	ISP Enable	Connect to #1 Pin when SP fusing occurs.
6	Reset*	

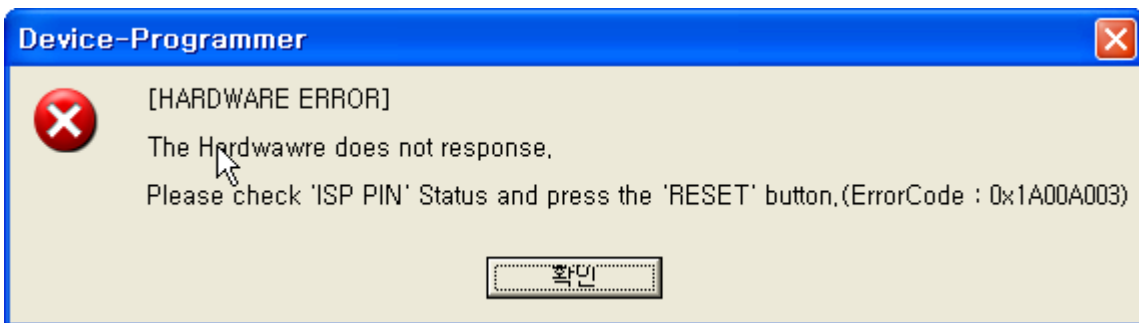


2) Run applications for windows

-Start the "Device-Programmer 3.50" from PC.

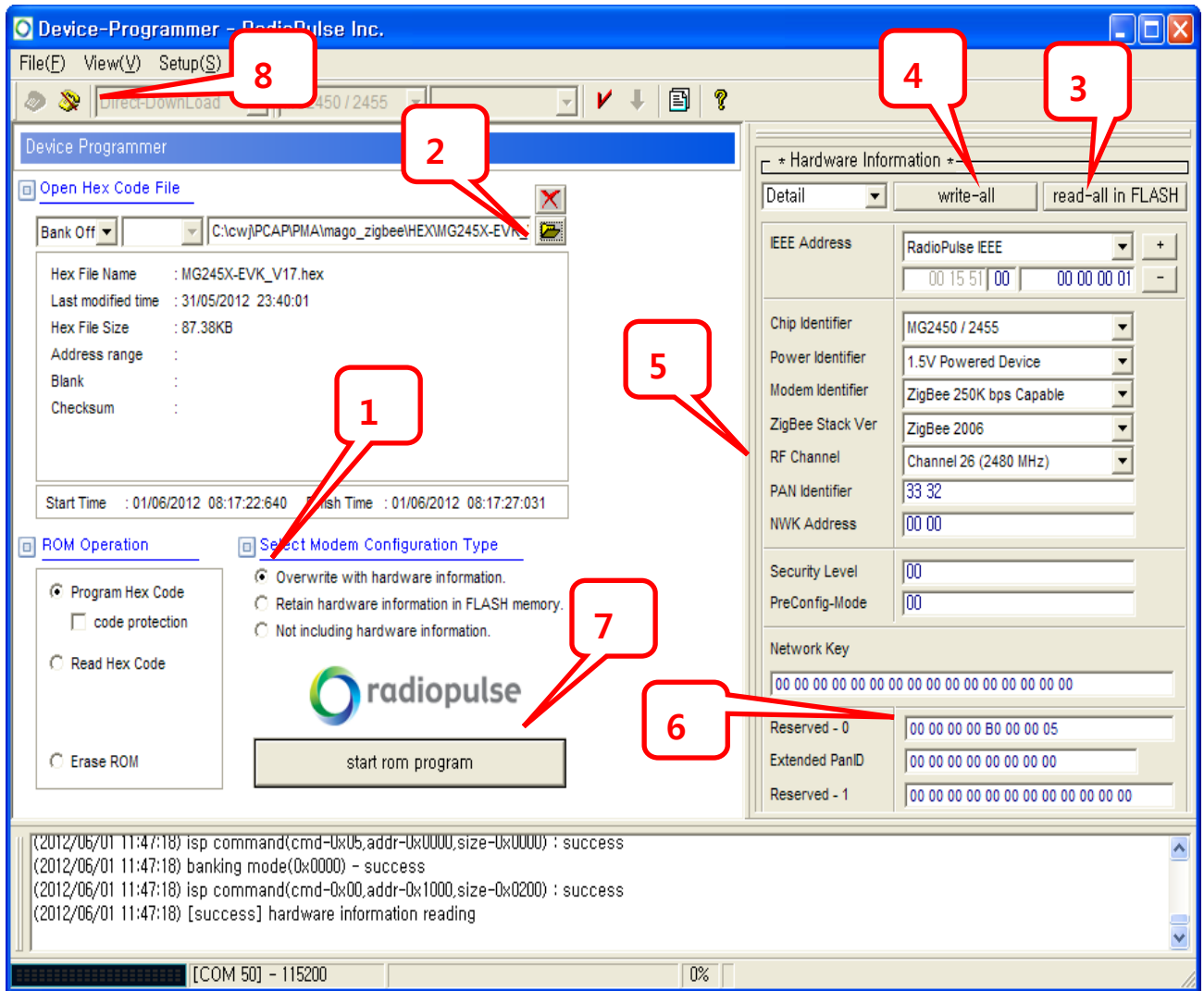


- If the error message Pops up, force reset by connecting #6 Reset Pin with GND pin twice.



- Select the serial Port that is registered on the PC device management.

The image shows a 'Communication' dialog box with a blue title bar and a close button. The main area is titled 'Select Communication Mode'. There are two radio buttons: 'RS232 (Serial)' is selected, and 'Ethernet (TCP/IP)' is unselected. Under 'RS232 (Serial)', there are five dropdown menus: 'Port' (COM2), 'Rates' (115200), 'Data' (8), 'Parity' (None), and 'stop' (1). Under 'Ethernet (TCP/IP)', there are two text input fields: 'IP Address' (192 . 168 . 0 . 191) and 'Port' (10001). At the bottom, there are two buttons: 'Connect' and 'Cancel'.



classification	contents
1	Overwrite with hardware information select
2	Select image circuit
3	Read the current issues of Hardware setting alert.
4	Select for Hardware setup change.
5	Comparison between the setting value and the image.
6	Current Board's Address information. -Check if ZB MAC written on the label attached the Board matches.
7	Select when new image fusing occurs.
8	And program

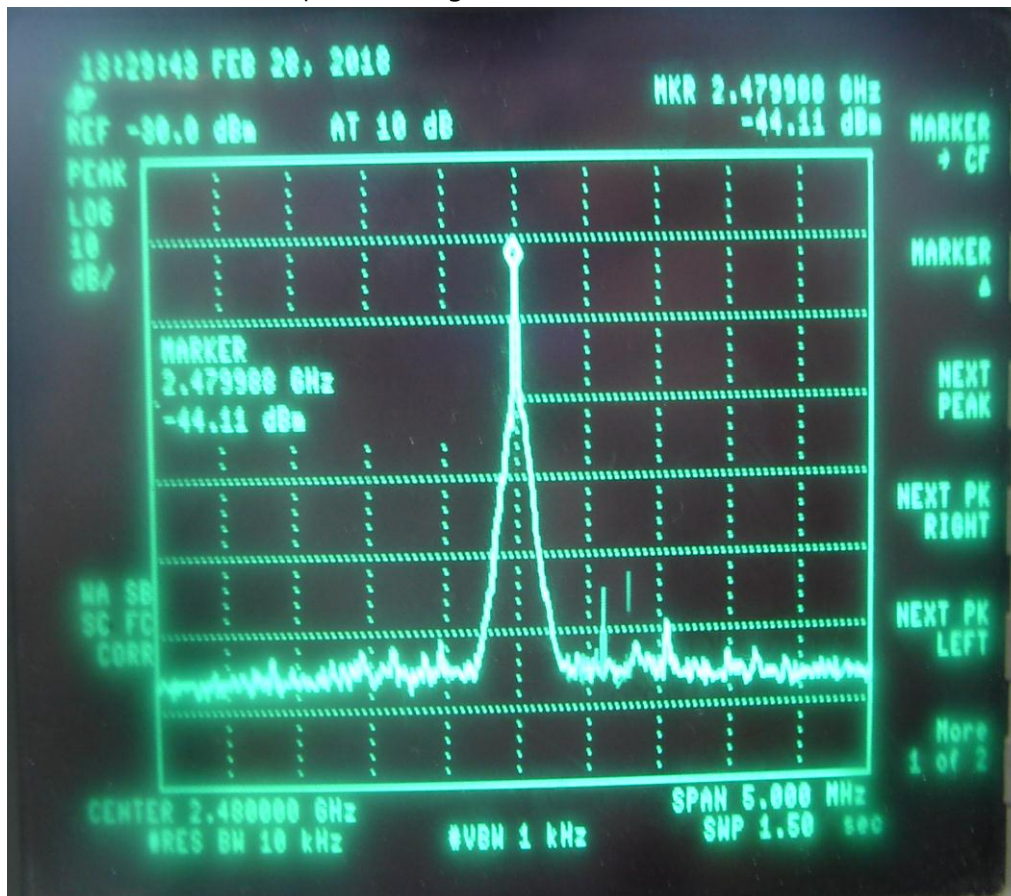
## 2.1.2. Non-modulated signal output

- 1) And the program "Device-Programmer 3.50".
- 2) Start the Serial Program "Tonken2" and check the Port set for the PC's Part to set the preferences( 11520 bps, 8bit ).
- 3) "Menu" window appears if "H" is inputted on the debugging screen.

```
=====PMA HELP =====
[CH] : HELP Menu

      [7] : WDT RESET
[CC] : Channel Change      [CD] : DataRate Change
[CE] : Energy Detection   [CP] : PowerDown
[CV] : VERSION
[CM] : TEST_TXOUT : Modulation with IFS
[CN] : TEST_TXOUT : Modulation without IFS
[CU] : TEST_TXOUT : Unmodulated Carrier
[CB] : TEST_TXOUT : Back To Normal Mode
[CI] : Select Item
```

- 4) Select **U** "[U] : TEST\_TXOUT : Unmodulated Carrier" on the debugging Screen, and check wave pattern using SPECTRUM ANALYZER.



### 2.1.3. Continuous signal output.

- 1) When Serial Program "Tonken2" wstarts, check the PC's Port to change the preferences. (11520 bps, 8bit )
- 2) Menu window appears if **H** is inputted on the debugging screen.

```
=====PMA HELP =====
[CH] : HELP Menu

      [7] : WDT RESET
[CC] : Channel Change      [CD] : DataRate Change
[CE] : Energy Detection   [CP] : PowerDown
[CV] : VERSION
[CM] : TEST_TXOUT : Modulation with IFS
[CN] : TEST_TXOUT : Modulation without IFS
[CU] : TEST_TXOUT : Unmodulated Carrier
[CB] : TEST_TXOUT : Back To Normal Mode
[CI] : Select Item
```

- 3) "[M] : TEST\_TXOUT : Modulation with IFS" select M on the debugging screen, and check ware Pattern with SPECTRUM ANALYZER.

