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Version No.：E
Issued Date: 2014/2/14

Approval Sheet

(產品承認書)

產品名稱 ： **BT4.0 module (Nordic nRF51822)**

產品型號 ： **MDBT40**

Approved	Checked	Designed

客戶名稱 ：_____

產品名稱 ：_____

產品型號 ：_____

Checked	Received

Index

1. Overall Introduction

Raytac's MDBT40 is a BT4.0 (Bluetooth low energy or BLE) module designed based on Nordic nRF581822 solution. The feature of the module:

1. Dual Transmission Mode of BLE & RF 2.4G upon customer preference.

2. Compact size with (L)18x(W)10x(H)3.2mm

3. Low power requirements, ultra-low peak, average and idle mode power consumption.

4. Compatible with a large installed based of mobiles phones, tablets and computers.

5. Fully coverage of wireless applications.

6. BLE & RF transmission switching may help products to fit all operation system

7. BLE & RF transmission switching may help products fit all kinds of hardware.

1.1 Applications

. Computer peripherals and I/O devices

- **. Mouse**
- **. Keyboard**
- **. Multi-touch trackpad**

. Interactive entertainment devices

- **. Remote control**
- **. 3D Glasses**
- **. Gaming controller**

. Personal Area Networks

- **. Health/fitness sensor and monitor devices**
- **. Medical devices**
- **. Key-fobs + wrist watch**
- **. Remote control toys**

1.2 Features

. 2.4GHZ transceiver

. -93dbm sensitivity in Bluetooth low energy mode

. TX Power -20 to +4dbm

. RSSI (1db resolution)

. ARM Cortex – M0 32 bit processor

.Serial Wire Debug (SWD)

. S100 series SoftDevice ready

. Memory

. 256kb or 128kb embedded flash program, memory

. 16kb RAM

. Support for non-concurrent multiprotocol operation

. On-air compatibility with nRF24L series

. Flexible Power Management

. Supply voltage range 1.8V to 3.6V (Typical 3.0V)

. 2.5us wake-up using 16MHz RCOSC

. 0.6uA @ 3V mode

. 1.2uA @ 3V in OFF mode + 1 region RAM retention

. 2.6uA @ 3V ON mode, all blocks IDLE

. 8/9/10 bit ADC- 8 configurable channels

. 31 General Purpose I/O Pins

. One 32 bit and two 16 bit timers with counter mode

. SPI Master

. Two-wire Master (I2C compatible)

. UART (CTS/RTS)

. CPU independent Programmable Peripheral Interconnect (PPI)

. Quadrature Decoder (QDEC)

. AES HW encryption

. Real Timer Counter (RTC)

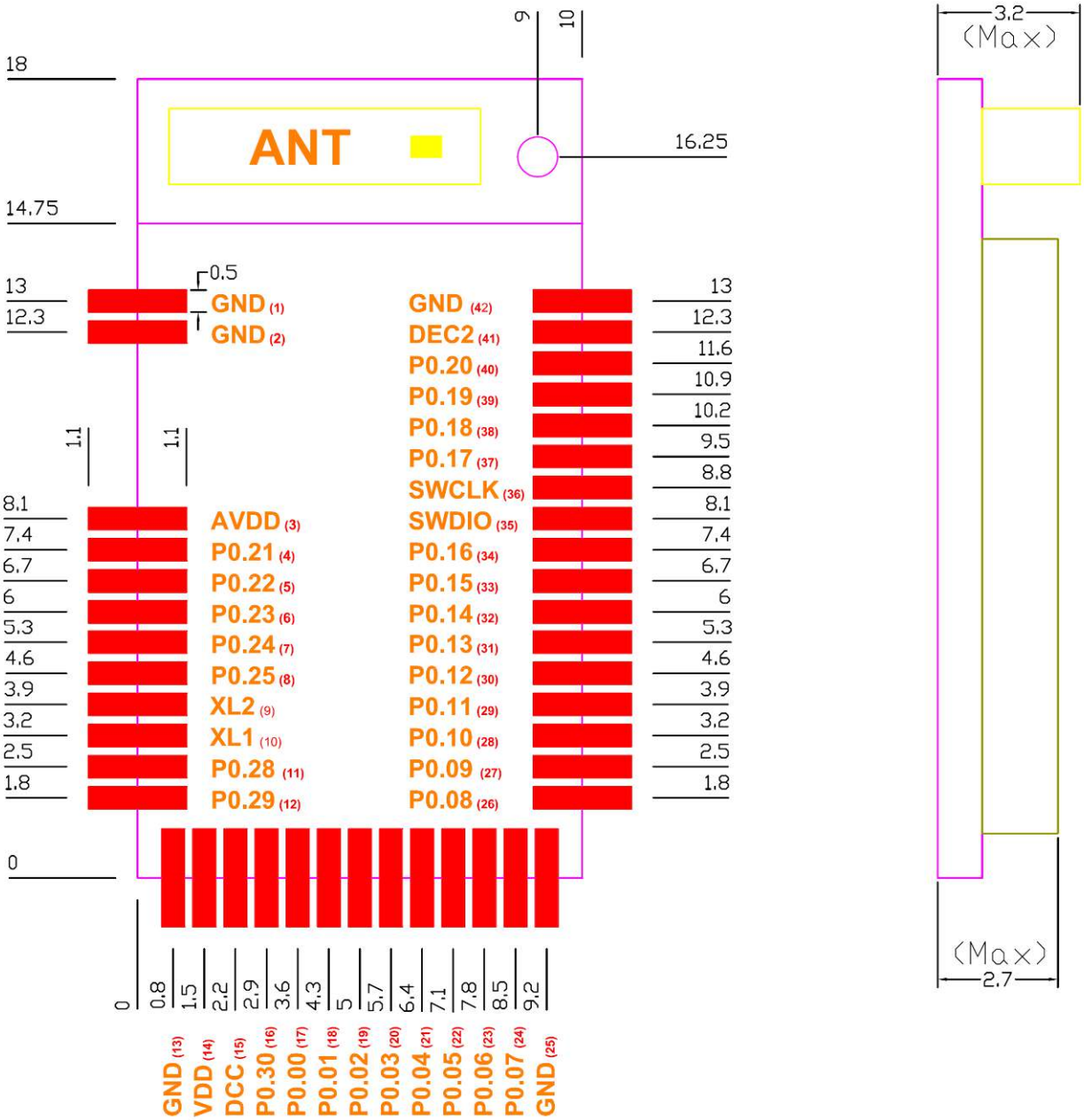
1.3 Profile and Service Information

Adopted Profile	Adopted Services	Supported
HID over GATT	HID Battery Device Information	YES
Heart Rate Monitor	Heart Rate Device Information	YES
Proximity	Link Loss Immediate Alert TX Power	YES
Blood Pressure	Blood pressure	YES
Health Thermometer	Health Thermometer	YES
Glucose	Glucose	YES
Phone Alert Status	Phone Alert Status	YES
Alert Notification	Alert Notification	YES
Time	Current Time Next DST Change Reference Time Update	YES
Find Me	Immediate Alert	YES
Cycling speed and cadence	Cycling speed and cadence Device information	YES
Running speed and cadence	Running speed and cadence Device information	YES

2. Product Dimension

2.1 PCB Dimensions, & Pin Indication & layout Guide

PCB SIZE：10 x18 (mm)



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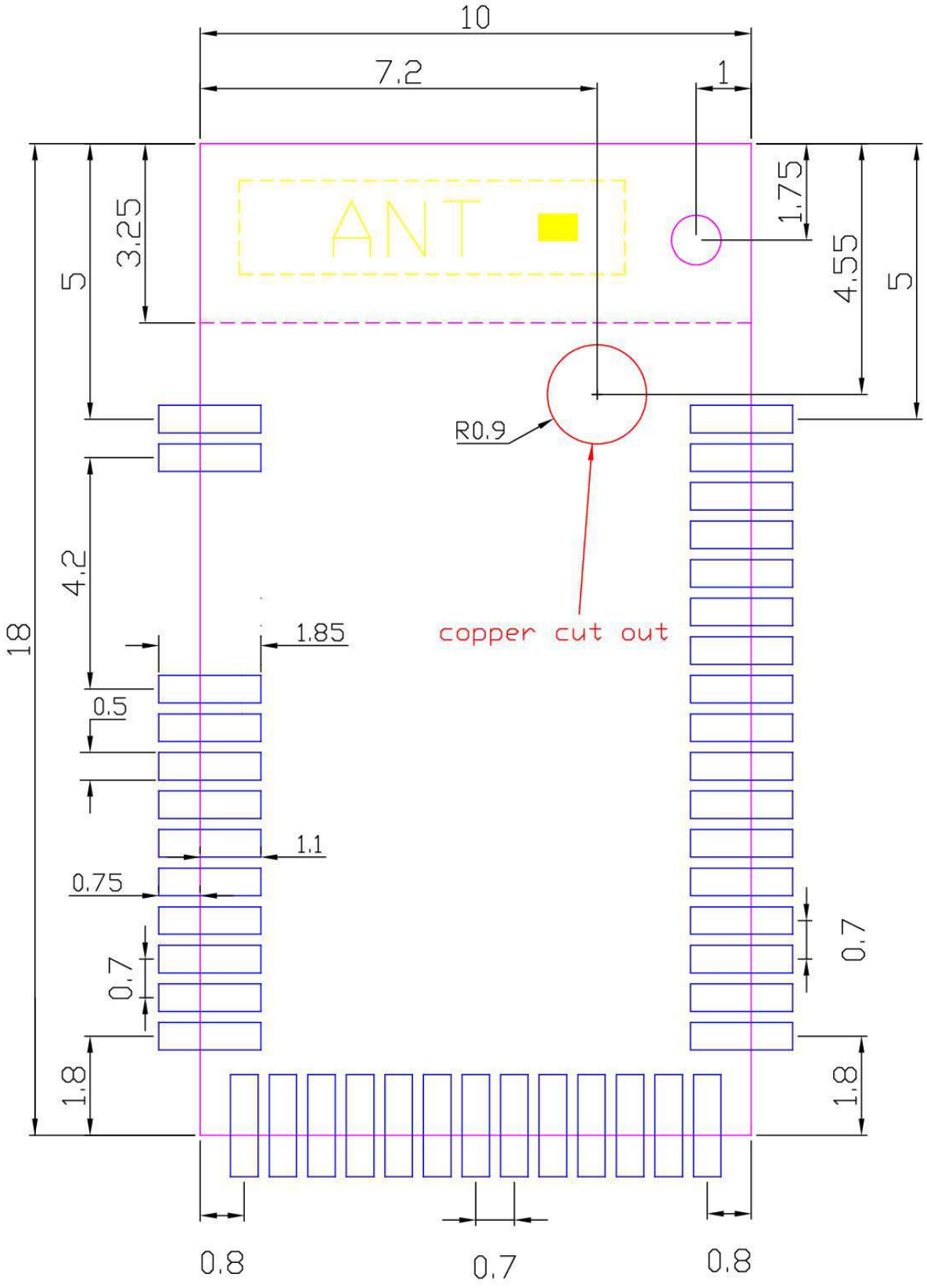


Top View（單位：mm）

recommended solder pad layout

2.2 Pin Assignment

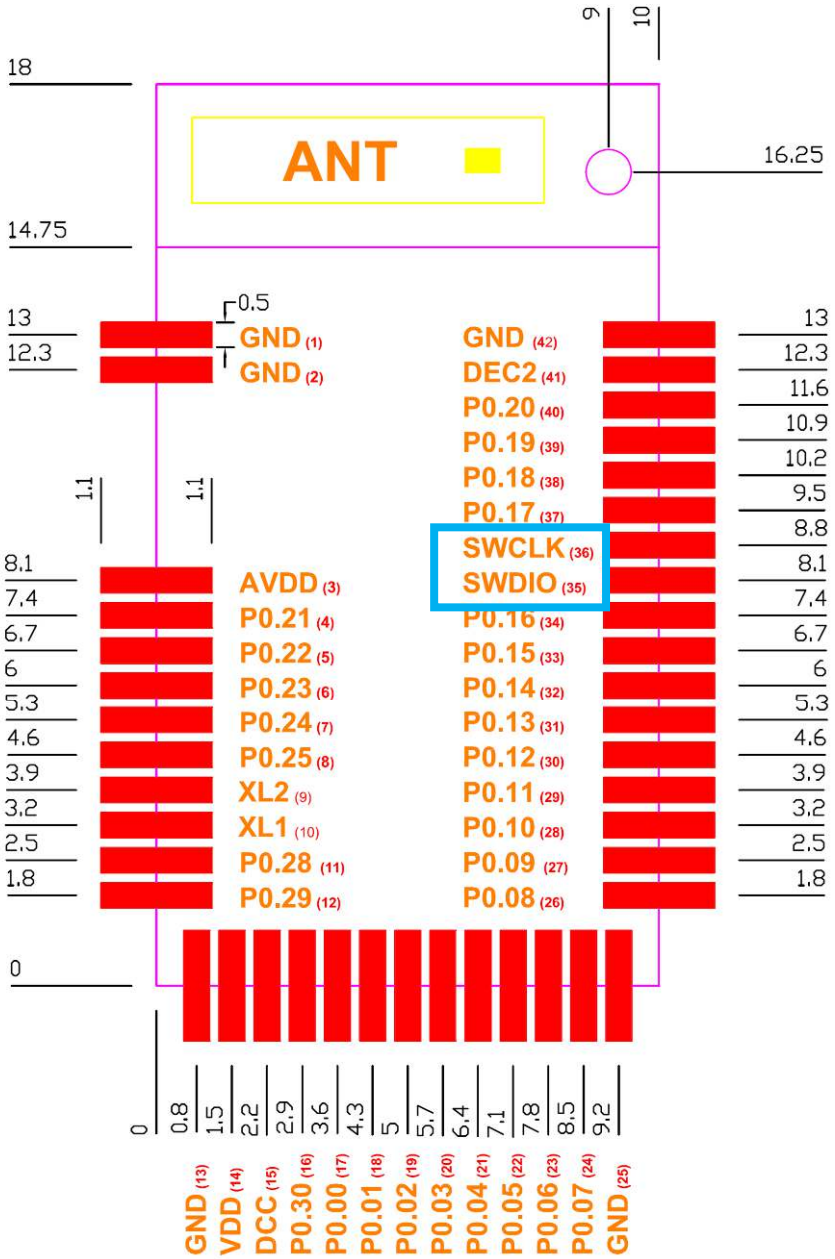
Pin No.	Name	Pin function	Description
(1)(2)	GND	Ground	The pad must be connected to a solid ground plane
(3)	AVDD	Power	Analog power supply
(4)	P0.21	Digital I/O	General-purpose digital I/O
(5)	P0.22	Digital I/O	General-purpose digital I/O
(6)	P0.23	Digital I/O	General-purpose digital I/O
(7)	P0.24	Digital I/O	General-purpose digital I/O
(8)	P0.25	Digital I/O	General-purpose digital I/O
(9)	P0.26	Digital I/O	General-purpose digital I/O
	AIN0	Analog input	ADC input 0
	XL2	Analog output	Connector for 32.768KHz crystal
(10)	P0.27	Digital I/O	General-purpose digital I/O
	AIN1	Analog input	ADC input 1
	XL1	Analog input	Connector for 32.768KHz crystal or external 32.768KHz clock reference
(11)	P0.28	Digital I/O	General-purpose digital I/O
(12)	P0.29	Digital I/O	General-purpose digital I/O
(13)	GND	Ground	The pad must be connected to a solid ground plane
(14)	VDD	Power	Power supply
(15)	DCC	Power	DC/DC output voltage to external LC filter
(16)	P0.30	Digital I/O	General-purpose digital I/O
(17)	P0.00	Digital I/O	General-purpose digital I/O
	AREF0	Analog input	ADC Reference voltage
(18)	P0.01	Digital I/O	General-purpose digital I/O
	AIN2	Analog input	ADC input 2
(19)	P0.02	Digital I/O	General-purpose digital I/O
	AIN3	Analog input	ADC input 3
(20)	P0.03	Digital I/O	General-purpose digital I/O
	AIN4	Analog input	ADC input 4
(21)	P0.04	Digital Input	General-purpose digital I/O
	AIN5	Analog input	ADC input 5
(22)	P0.05	Digital I/O	General-purpose digital I/O
	AIN6	Analog input	ADC input 6

Pin No.	Name	Pin function	Description
(23)	**P0.06**	Digital I/O	General-purpose digital I/O
	AIN7	Analog input	ADC input 7
	AREF1	Analog input	ADC Reference voltage
(24)	**P0.07**	Digital I/O	General-purpose digital I/O
(25)	**GND**	Ground	The pad must be connected to a solid ground plane
(26)	**P0.08**	Digital I/O	General-purpose digital I/O
(27)	**P0.09**	Digital I/O	General-purpose digital I/O
(28)	**P0.10**	Digital I/O	General-purpose digital I/O
(29)	**P0.11**	Digital I/O	General-purpose digital I/O
(30)	**P0.12**	Digital I/O	General-purpose digital I/O
(31)	**P0.13**	Digital I/O	General-purpose digital I/O
(32)	**P0.14**	Digital I/O	General-purpose digital I/O
(33)	**P0.15**	Digital I/O	General-purpose digital I/O
(34)	**P0.16**	Digital I/O	General-purpose digital I/O
(35)	**SWDIO/RESET**	Digital I/O	System reset(active low).Also HW debug and flash Programming
(36)	**SWDCLK**	Digital input	HW debug and flash programming. Connect a 12K ohm resister to GND for flash programming .
(37)	**P0.17**	Digital I/O	General-purpose digital I/O
(38)	**P0.18**	Digital I/O	General-purpose digital I/O
(39)	**P0.19**	Digital I/O	General-purpose digital I/O
(40)	**P0.20**	Digital I/O	General-purpose digital I/O
(41)	**DEC2**	Power	Power supply decoupling. Low voltage mode VCC
(42)	**GND**	Ground	The pad must be connected to a solid ground plane

[1] Digital I/O pad with 5mA source/sink capability.

2.3 Software & Hardware Installation

Software installation: via SWCLK and SWDIO.



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Hardware installation : SMT

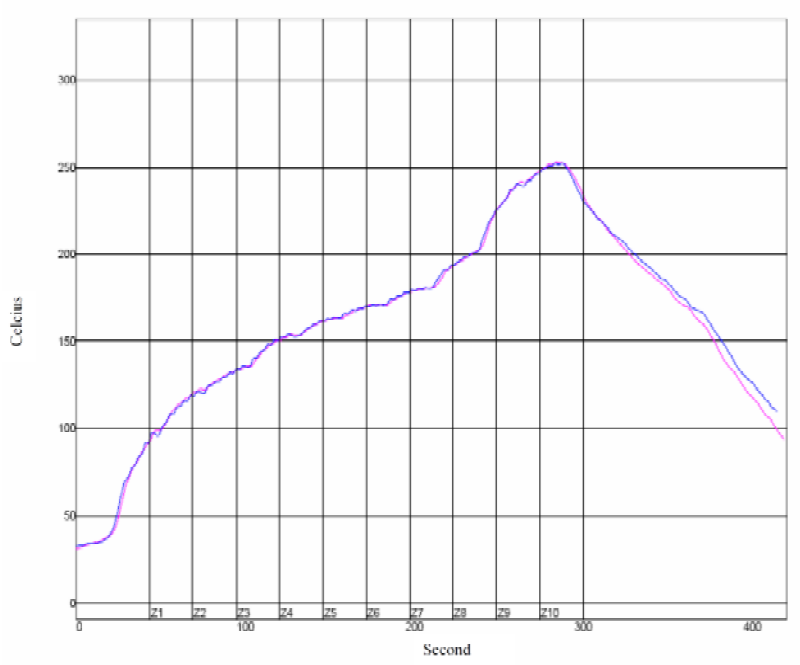
DZ131

Name of Oven: De-Bang Oven

Location: B

Process Limit: SMIC ECO Solder Paste-New

Temperature Settings (Celsius)										
Temperature Zone	1	2	3	4	5	6	7	8	9	10
Upper Temperature Zone	130	140	150	170	175	180	190	220	265	265
Lower Temperature Zone	130	140	150	170	175	180	190	220	265	265
Speed of Conveyor Belt(cm/m	85.0									



PWI=88%	Max. Rising Slope		Constant Temperature (150℃ ~ 200℃)		Time above Reflow /220℃		Max. Temperature	
PCB	2.53	53%	115.86	86%	63.94	13%	252.96	73%
PCB	2.56	56%	116.47	88%	63.94	13%	252.34	64%
Difference between Temperature	0.03		0.61		0.00		0.62	

Process Limit:

Solder Paste: SMIC ECO Solder Paste-New			
	Lowest Limit	Highest Limit	in
Max. Rising Slope (Target=2.0): (Divided by 20 seconds)	0	3	℃/second
Time Constant Temperature (150℃ ~ 200℃):	60	120	second
Time Above Reflow-220℃:	30	90	second
Max. Temperature:	240	255	℃

Temperature Profile is from Kicthermal.

KIC
San Diego, CA USA

Tel: +1-858-673-6050
Fax:+1-858-673-0085

www.kicthermal.com
tech@kicmail.com

3. Main Chip Solution

RF IC	Crystal Frequency
Nordic NRF51822/QFN48	16MHZ

4. Shipment Packing Information

88 pcs/ Tray

10 Trays / Export Carton (880pcs per carton)

N.W: 2.1Kg (may subject to be changed upon contents)

5. Specification

5.1 Absolute maximum ratings

Symbol	Parameter	Min.	Max.	Unit
Supply voltages				
VDD		-0.3	+3.6	V
DEC2[1]			2	V
VSS			0	V
I/O pin voltage				
VIO		-0.3	VDD + 0.3	V
Environmental QFN48 package				
Storage temperature		-40	+125	°C
MSL	Moisture Sensitivity Level		2	
ESD HBM	Human Body Model		4	kV
ESD CDM	Charged Device Model		750	V

Flash memory			
Endurance	20 000		write/erase cycles
Retention	10 years at 40 °C		
Number of times an address can be written between erase cycles		2	times

5.2 Operation conditions

Symbol	Parameter	Notes	Min.	Typ.	Max.	Units
VDD	Supply voltage, normal mode		1.8	3.0	3.6	V
VDD	Supply voltage, normal mode, DC/DC converter output voltage 1.9 V		2.1	3.0	3.6	V
VDD	Supply voltage, low voltage mode	1	1.75	1.8	1.95	V
t_{R_VDD}	Supply rise time (0 V to 1.8 V)	2			60	ms
T_A	Operating temperature		-25	25	75	°C

5.3 Electrical Specifications

5.3.1 Radio transceiver

. General radio characteristics

Symbol	Description	Note	Min.	Typ.	Max.	Units	Test level
f_{OP}	Operating frequencies	1 MHz channel spacing	2400		2483	MHz	N/A
PLL_{res}	PLL programming resolution			1		MHz	N/A
$\Delta f250$	Frequency deviation @ 250 kbps			±170		kHz	2
Δf_{1M}	Frequency deviation @ 1 Mbps			±170		kHz	2
Δf_{2M}	Frequency deviation @ 2 Mbps			±320		kHz	2
Δf_{BLE}	Frequency deviation @ BLE		±225	±250	±275	kHz	4
bps_{FSK}	On-air data rate		250		2000	kbps	N/A

. Radio current consumption

Symbol	Description	Note	Min.	Typ.	Max.	Units	Test level
$I_{TX,+4dBm}$	TX only run current @ P_{OUT} = +4 dBm	1		16		mA	4
$I_{TX,0dBm}$	TX only run current @ P_{OUT} = 0 dBm	1		10.5		mA	4
$I_{TX,-4dBm}$	TX only run current @ P_{OUT} = -4 dBm	1		8		mA	2
$I_{TX,-8dBm}$	TX only run current @ P_{OUT} = -8 dBm	1		7		mA	2
$I_{TX,-12dBm}$	TX only run current @ P_{OUT} = -12 dBm	1		6.5		mA	2
$I_{TX,-16dBm}$	TX only run current @ P_{OUT} = -16 dBm	1		6		mA	2
$I_{TX,-20dBm}$	TX only run current @ P_{OUT} = -20 dBm	1		5.5		mA	2
$I_{TX,-30dBm}$	TX only run current @ P_{OUT} = -30 dBm	1		5.5		mA	2
$I_{START,TX}$	TX startup current	2		7		mA	1
$I_{RX,250}$	RX only run current @ 250 kbps			12.6		mA	1
$I_{RX,1M}$	RX only run current @ 1 Mbps			13		mA	4
$I_{RX,2M}$	RX only run current @ 2 Mbps			13.4		mA	1
$I_{START,RX}$	RX startup current	3		8.7		mA	1

1. Valid for data rates 250 kbps, 1 Mbps, and 2 Mbps
2. Average current consumption (at 0 dBm TX output power) for TX startup (130 µs), and when changing mode from RX to TX (130 µs).
3. Average current consumption for RX startup (130 µs), and when changing mode from TX to RX (130 µs).

5.3.2 Transmitter specifications

Symbol	Description	Min.	Typ.	Max.	Units	Test level
P_{RF}	Maximum output power		4		dBm	4
P_{RFC}	RF power control range	20	24		dB	2
PRFCR	RF power accuracy			±4	dB	1
P_{WHISP}	RF power whisper mode		-30		dBm	2
P_{BW2}	20 dB bandwidth for modulated carrier (2 Mbps)		1800	2000	kHz	2
P_{BW1}	20 dB bandwidth for modulated carrier (1 Mbps)		950	1100	kHz	2
P_{BW250}	20 dB bandwidth for modulated carrier (250 kbps)		700	800	kHz	2
$P_{RF1.2}$	1^{st} Adjacent Channel Transmit Power 2 MHz (2 Mbps)			-20	dBc	2
$P_{RF2.2}$	2^{nd} Adjacent Channel Transmit Power 4 MHz (2 Mbps)			-45	dBc	2
$P_{RF1.1}$	1^{st} Adjacent Channel Transmit Power 1 MHz (1 Mbps)			-20	dBc	2
$P_{RF2.1}$	2^{nd} Adjacent Channel Transmit Power 2 MHz (1 Mbps)			-40	dBc	2
$P_{RF1.250}$	1^{st} Adjacent Channel Transmit Power 1 MHz (250 kbps)			-25	dBc	2
$P_{RF2.250}$	2^{nd} Adjacent Channel Transmit Power 2 MHz (250 kbps)			-40	dBc	2
$t_{TX,30}$	Maximum consecutive transmission time, $f_{TOL} < \pm 30$ ppm			16	ms	1
$t_{TX,60}$	Maximum consecutive transmission time, $f_{TOL} < \pm 60$ ppm			4	ms	1

5.3.3 Receiver specifications

Symbol	Description	Min.	Typ.	Max.	Units	Test level
Receiver operation						
PRX_{MAX}	Maximum received signal strength at < 0.1% PER		0		dBm	1
$PRX_{SENS,2M}$	Sensitivity (0.1% BER) @ 2 Mbps		-85		dBm	2
$PRX_{SENS,1M}$	Sensitivity (0.1% BER) @ 1 Mbps		-90		dBm	2
$PRX_{SENS,250k}$	Sensitivity (0.1% BER) @ 250 kbps		-96		dBm	2
P_{SENS} IT 1 Mbps BLE	Receiver sensitivity: Ideal transmitter		-93		dBm	2
P_{SENS} DT 1 Mbps BLE	Receiver sensitivity: Dirty transmitter		-91		dBm	2
RX selectivity - modulated interfering signal[1]						
	2 Mbps					
C/I_{CO}	C/I co-channel		12		dB	2
C/I_{1ST}	1^{st} ACS, C/I 2 MHz		-4		dB	2
C/I_{2ND}	2^{nd} ACS, C/I 4 MHz		-24		dB	2
C/I_{3RD}	3^{rd} ACS, C/I 6 MHz		-28		dB	2
C/I_{6th}	6^{th} ACS, C/I 12 MHz		-44		dB	2
C/I_{Nth}	N^{th} ACS, C/I f_i > 25 MHz		-50		dB	2
	1 Mbps					
C/I_{CO}	C/I co-channel (1 Mbps)		12		dB	2
C/I_{1ST}	1^{st} ACS, C/I 1 MHz		4		dB	2
C/I_{2ND}	2^{nd} ACS, C/I 2 MHz		-24		dB	2
C/I_{3RD}	3^{rd} ACS, C/I 3 MHz		-30		dB	2
C/I_{6th}	6^{th} ACS, C/I 6 MHz		-40		dB	2
C/I_{12th}	12^{th} ACS, C/I 12 MHz		-50		dB	2
C/I_{Nth}	N^{th} ACS, C/I f_i > 25 MHz		-53		dB	2

Symbol	Description	Min.	Typ.	Max.	Units	Test level
	250 kbps					
C/I_{CO}	C/I co-channel		4		dB	2
C/I_{1ST}	1st ACS, C/I 1 MHz		-10		dB	2
C/I_{2ND}	2nd ACS, C/I 2 MHz		-34		dB	2
C/I_{3RD}	3rd ACS, C/I 3 MHz		-39		dB	2
C/I_{6th}	6th ACS, C/I f_i > 6 MHz		-50		dB	2
C/I_{12th}	12th ACS, C/I 12 MHz		-55		dB	2
C/I_{Nth}	Nth ACS, C/I f_i > 25 MHz		-60		dB	2
	***Bluetooth* Low Energy RX selectivity**					
C/I_{CO}	C/I co-channel		10		dB	2
C/I_{1ST}	1st ACS, C/I 1 MHz		1		dB	2
C/I_{2ND}	2nd ACS, C/I 2 MHz		-25		dB	2
C/I_{3+N}	ACS, C/I (3+n) MHz offset [n = 0, 1, 2, . . .]		-51		dB	2
C/I_{Image}	Image blocking level		-30		dB	2
$C/I_{Image\pm1MHz}$	Adjacent channel to image blocking level (±1 MHz)		-31		dB	2
RX intermodulation[2]						
P_IMD_{2Mbps}	IMD performance, 2 Mbps, 3rd, 4th and 5th offset channel		-41		dBm	2
P_IMD_{1Mbps}	IMD performance, 1 Mbps, 3rd, 4th and 5th offset channel		-40		dBm	2
$P\_IMD_{250kbps}$	IMD performance, 250 kbps, 3rd, 4th and 5th offset channel		-36		dBm	2
P_IMD_{BLE}	IMD performance, 1 Mbps BLE, 3rd, 4th and 5th offset channel		-39		dBm	2

1. Wanted signal level at P_{IN} = -67 dBm. One interferer is used, having equal modulation as the wanted signal. The input power of the interferer where the sensitivity equals BER = 0.1% is presented.
2. Wanted signal level at P_{IN} = -64 dBm. Two interferers with equal input power are used. The interferer closest in frequency is unmodulated, the other interferer is modulated equal with the wanted signal. The input power of interferers where the sensitivity equals BER = 0.1% is presented.

5.3.4 Radio timing Parameters

Symbol	Description	250 k	1 M	2 M	BLE	Jitter	Units
t_{TXEN}	Time between TXEN task and READY event	132	132	132	140	0	µs
$t_{TXDISABLE}$	Time between DISABLE task and DISABLED event when the radio was in TX	10	4	3	4	1	µs
t_{RXEN}	Time between the RXEN task and READY event	130	130	130	138	0	µs
$t_{RXDISABLE}$	Time between DISABLE task and DISABLED event when the radio was in RX	0	0	0	0	1	µs
$t_{TXCHAIN}$	TX chain delay	5	1	0.5	1	0	µs
$t_{RXCHAIN}$	RX chain delay	12	2	2.5	3	0	µs

5.3.5 RSSI Specifications

Symbol	Description	Note	Min.	Typ.	Max.	Units	Test level
$RSSI_{ACC}$	RSSI accuracy	Valid between: -50 dBm and -80 dBm			±6	dB	2
$RSSI_{RESOLUTION}$	RSSI resolution			1		dB	1
$RSSI_{PERIOD}$	Sample period		8.8			µs	1
$RSSI_{CURRENT}$	Current consumption in addition to I_{RX}			250		µA	1

5.3.6 CPU

Symbol	Description	Min.	Typ.	Max.	Units	Test level
$I_{CPU, Flash}$	Run current at 16 MHz, Executing code from flash memory		4.4[1]		mA	2
$I_{CPU, RAM}$	Run current at 16 MHz, Executing code from RAM		2.4[2]		mA	1
$I_{START, CPU}$	CPU startup current		600		µA	1
$t_{START, CPU}$	IDLE to CPU execute	0	[3]		µs	1

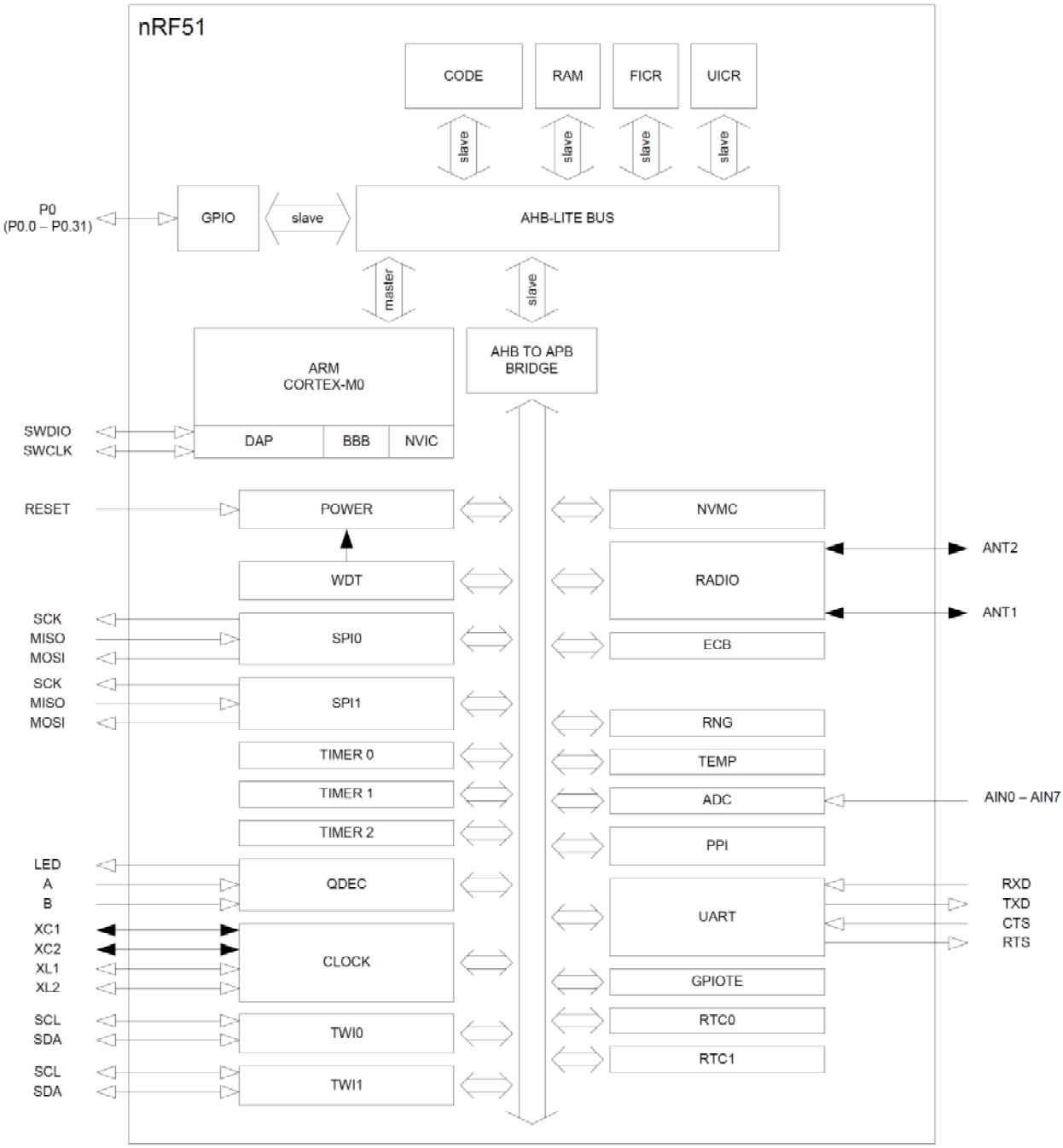
5.3.7 Power management

Symbol	Description	Note	Min.	Typ.	Max.	Units	Test level
$t_{POR, 1\mu s}$	Time Reset is active from VDD reaches 1.7 V with 1 µs rise time		0.2	2.7		ms	1
$t_{POR, 50\ ms}$	Time Reset is active from VDD reaches 1.7 V with 50 ms rise time		6.5	29		ms	1
I_{OFF}	Current in SYSTEM-OFF, no RAM retention			0.4		µA	1
$I_{OFF, 8\ k}$	Current in SYSTEM-OFF mode 8 kB SRAM retention			0.6		µA	1
$I_{OFF, 16\ k}$	Current in SYSTEM-OFF mode 16 kB SRAM retention			0.8		µA	1
I_{OFF2ON}	OFF to CPU execute transition current			400		µA	1
t_{OFF2ON}	OFF to CPU execute			9.6	10.6	µs	1
I_{ON}	SYSTEM-ON base current			2.3		µA	2
I_{1V2}	Current drawn by 1V2 regulator			290		µA	2
t_{1V2}	Startup time for 1V2 regulator			2.3		µs	1
I_{1V7}	Current drawn by 1V7 regulator			90		µA	2
t_{1V7}	Startup time for 1V7 regulator			2	3.6	µs	1
$I_{1V2RC16}$	Current drawn by 1V2 regulator and 16 MHz RCOSC when both are on at the	See ***Table 24***		830[1]		µA	1

Symbol	Description	Note	Min.	Typ.	Max.	Units	Test level
$I_{1V2XO16}$	Current drawn by 1V2 regulator and 16 MHz XOSC when both are on at the same time	See ***Table 24***		740[1]		µA	1
I_{DCDC}	Current drawn by DC/DC converter			300		µA	1
F_{DCDC}	DC/DC converter current conversion factor		0.65[2]		1.2[2]		1
$t_{START,DCDC}$	DC/DC converter startup time		10[2]		425[2]	µs	1

1. This number includes the current used by the automated power and clock management system.
2. F_{DCDC} and $t_{START,DCDC}$ will vary depending on VDD and device internal current consumption (I_{DD}). The range of values stated in this specification is for VDD between 2.1 V and 3.6 V, and I_{DD} between 4 mA and 20 mA. Please refer to the *nRF51 Series Reference Manual*, v1.1 or later, for a method to calculate these numbers based on VDD and I_{DD}.

6. Block Diagram



nRF51822 block diagram

7. Antenna

ACX
Advanced Ceramic X

AT7020 Series

Multilayer Chip Antenna

Features

- ❖ Monolithic SMD with small, low-profile and light-weight type.
- ❖ Wide bandwidth

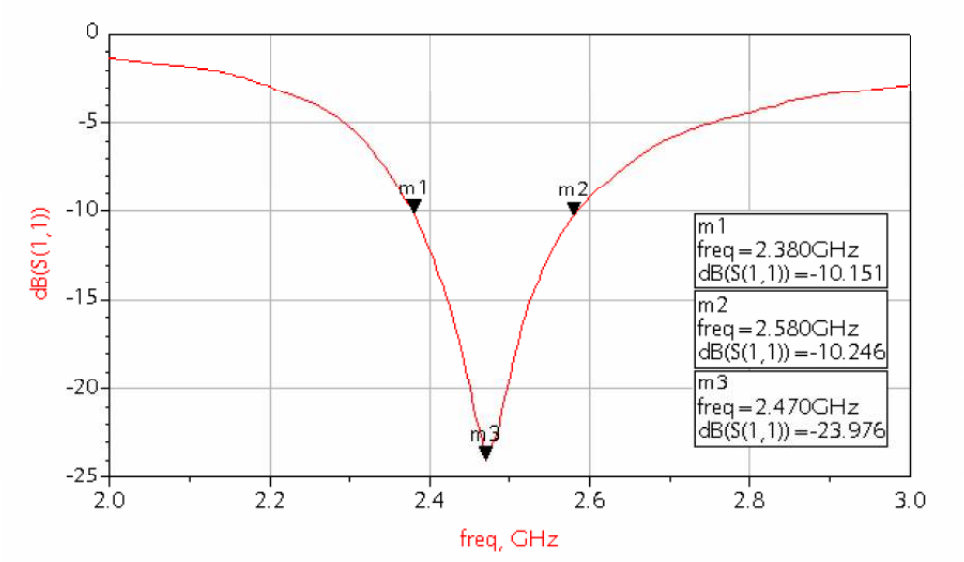
Applications

- ❖2.4GHz WLAN, Home RF, Bluetooth Modules, etc.

Specifications

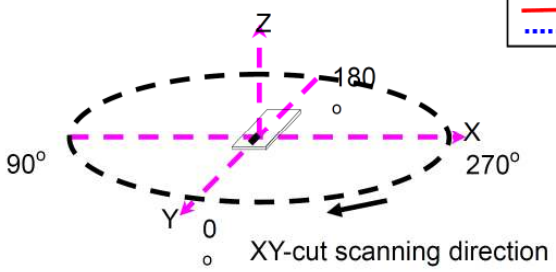
Part Number	Frequency Range (MHz)	Peak Gain (dBi typ.)	Average Gain (dBi typ.)	VSWR	Impedance
AT7020 -E3R0HBA_	2400~2500	1.3dBi (XZ-V)	-0.5dBi (XZ-V)	2 max.	50 Ω

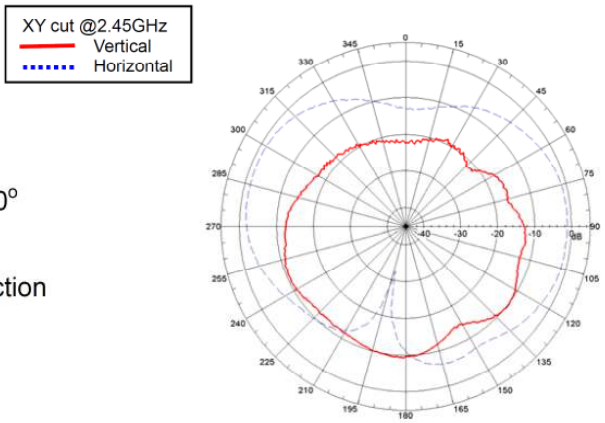
❖ Return Loss/With Matching Circuits



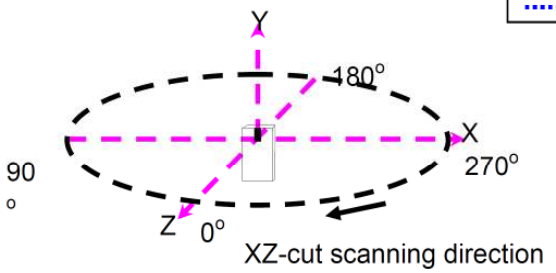
❖ Radiation Patterns

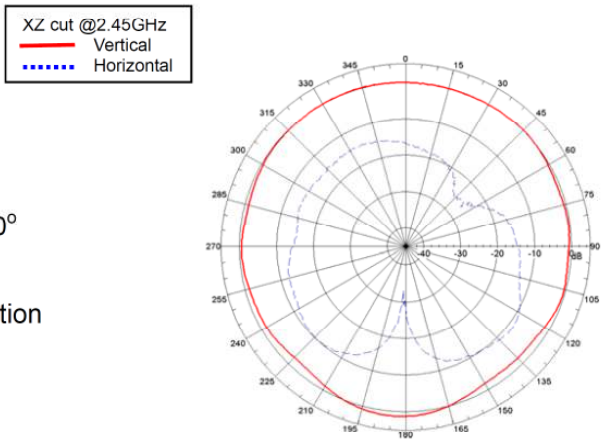
XY-V/XY-H



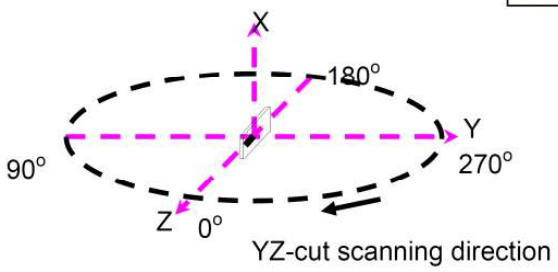


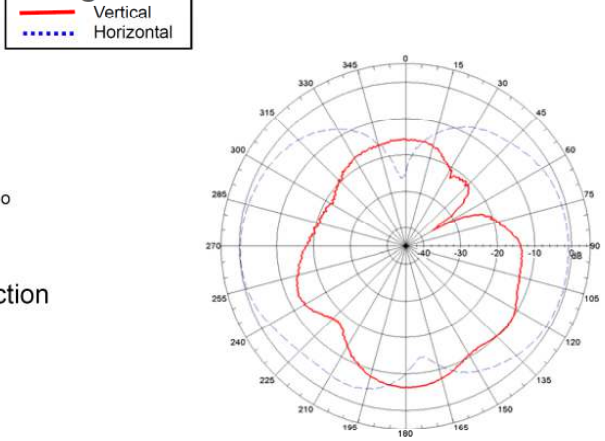
XZ-V/XZ-H





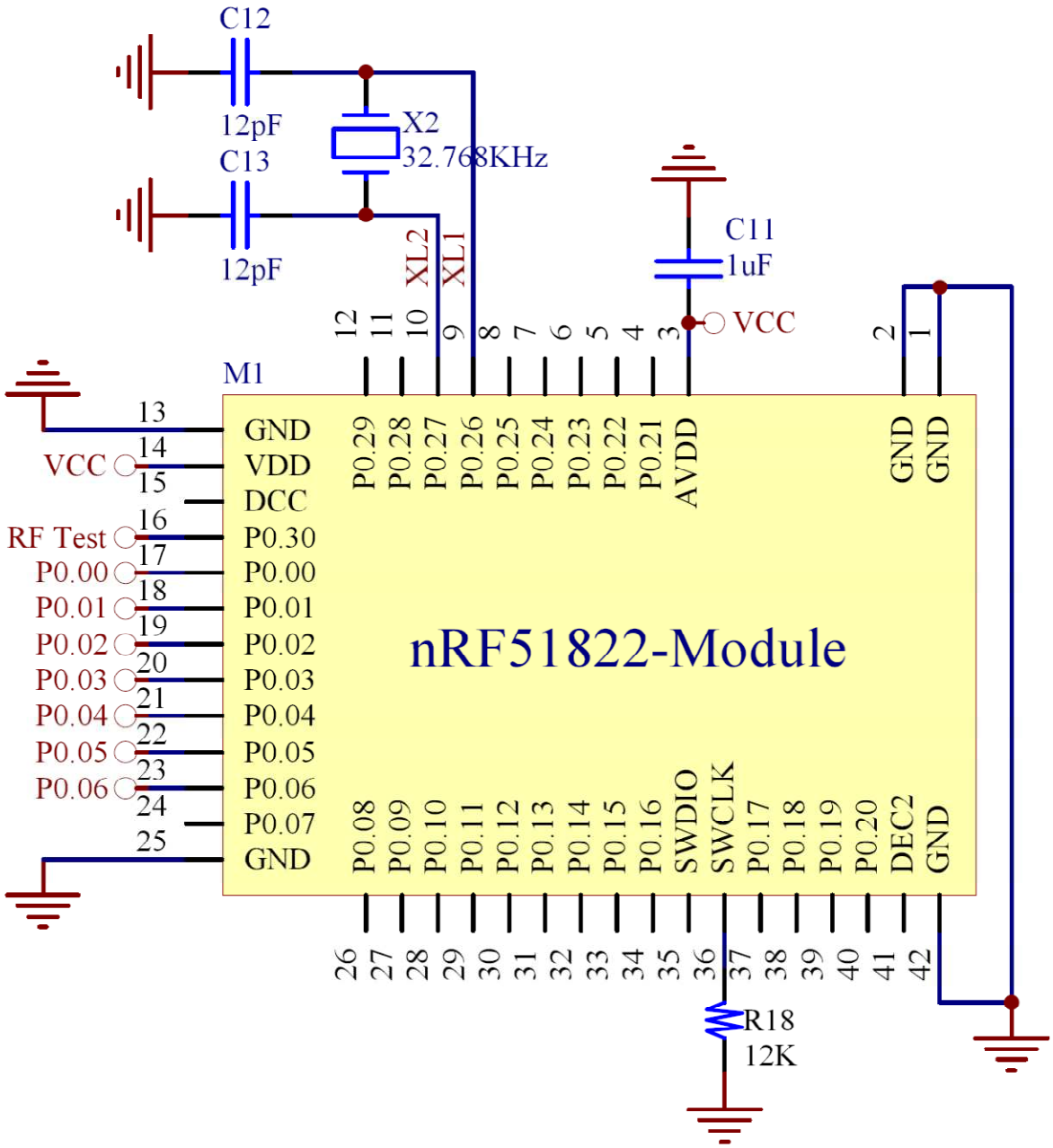
YZ-V/YZ-H



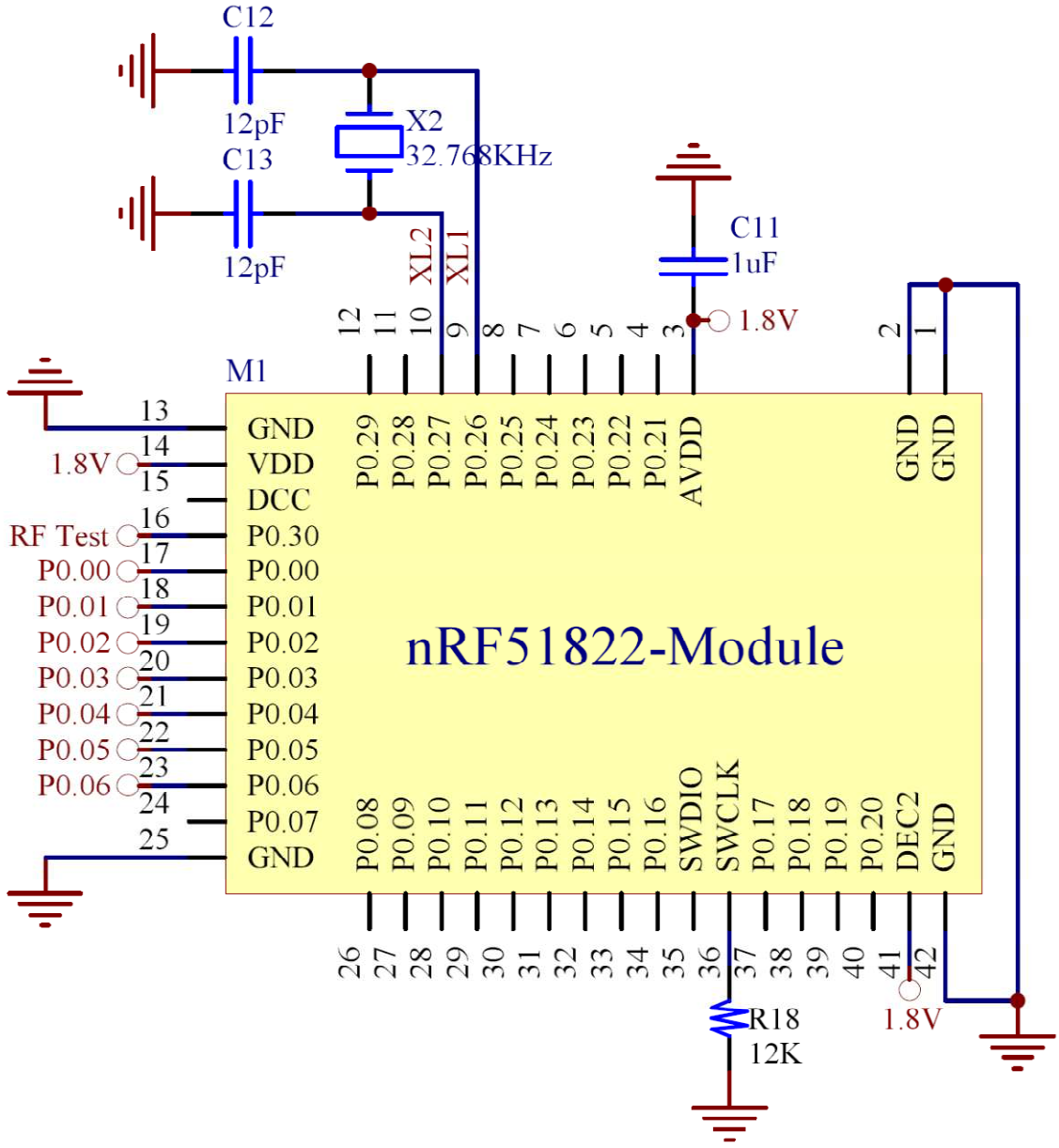


8. Reference Circuit

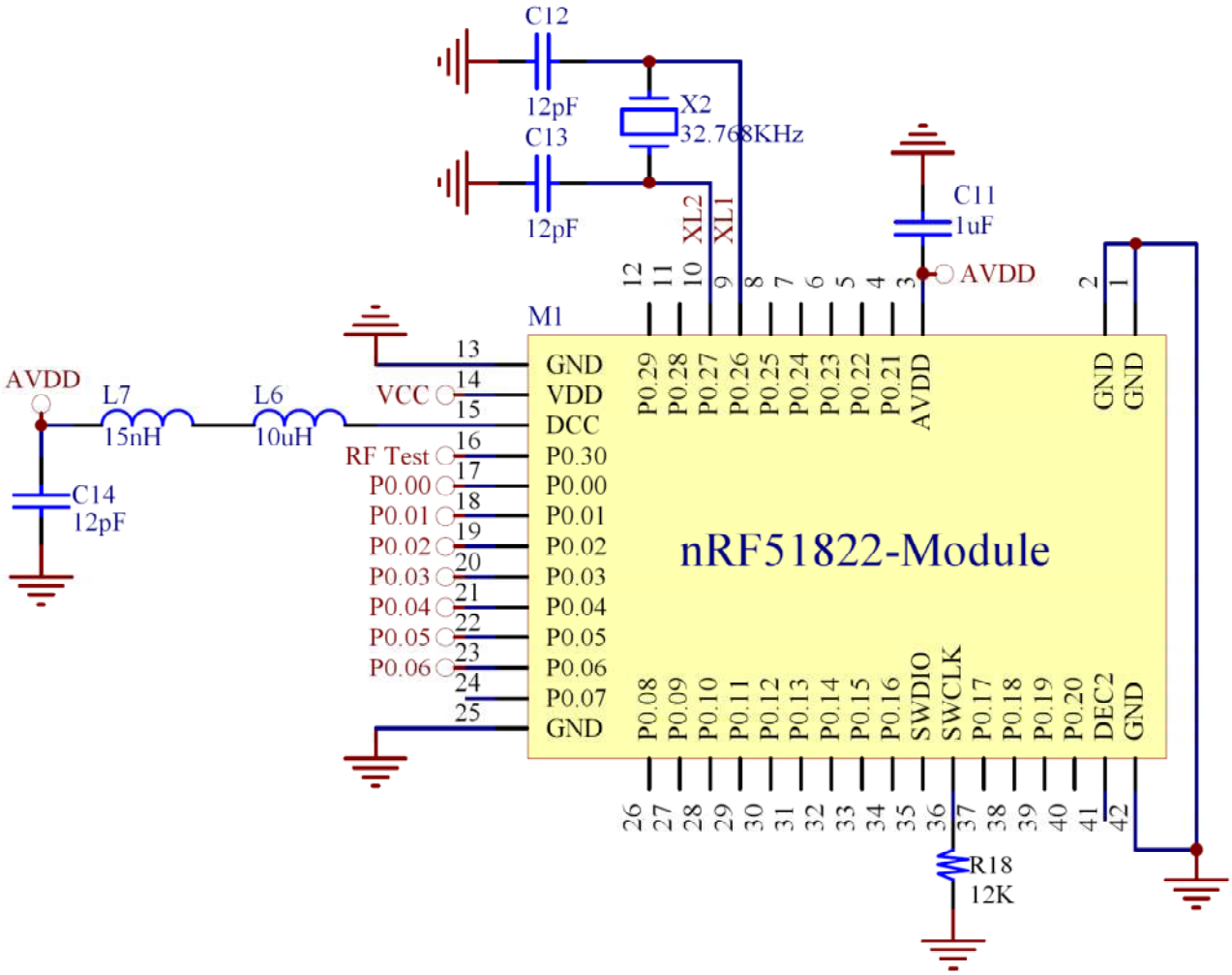
8.1 nRF51822 schematic with internal LDO



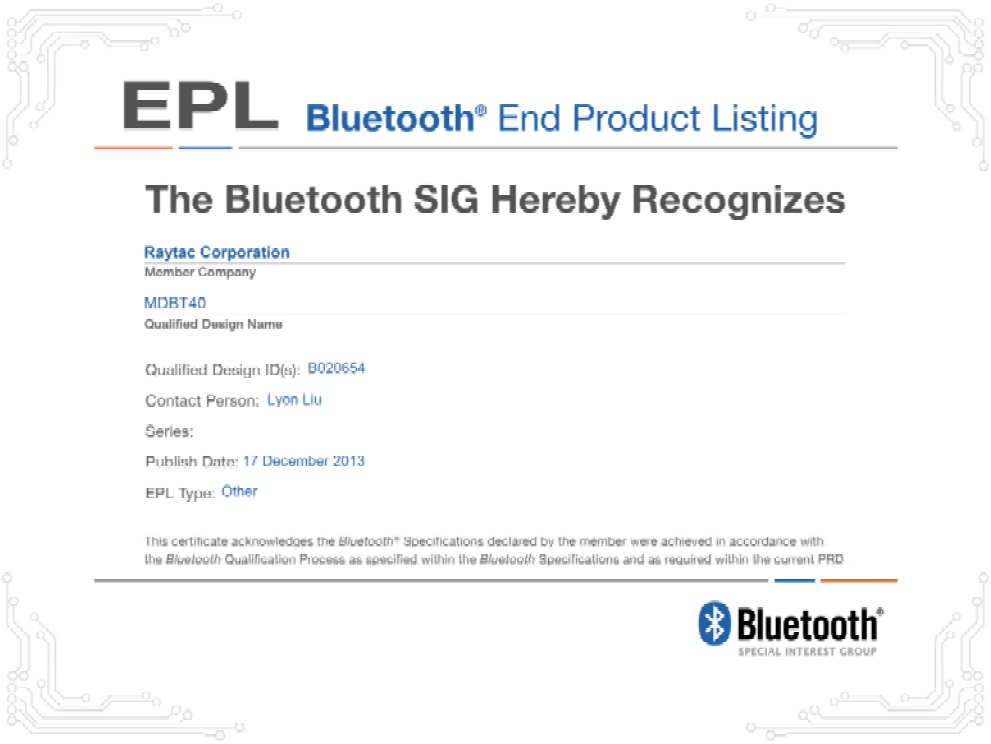
8.2 nRF51822 schematic with 1.8V low voltage mode



8.3 nRF51822 schematic with internal DC/DC converter



9. BQB Certification



EPL Bluetooth® End Product Listing

The Bluetooth SIG Hereby Recognizes

Raytac Corporation
Member Company

MDBT40
Qualified Design Name

Qualified Design ID(s): B020654

Contact Person: Lyon Liu

Series:

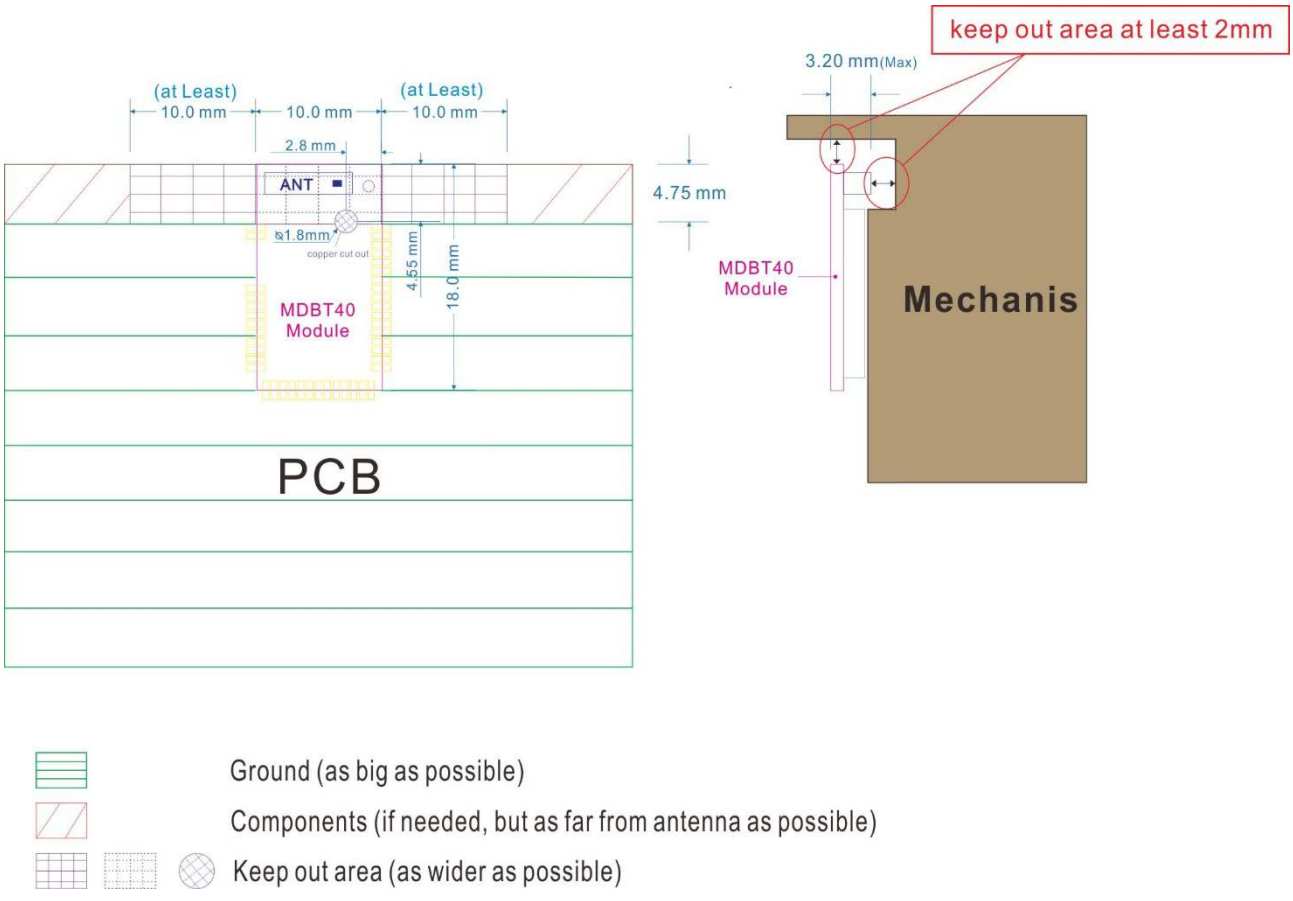
Publish Date: 17 December 2013

EPL Type: Other

This certificate acknowledges the *Bluetooth*® Specifications declared by the member were achieved in accordance with the *Bluetooth* Qualification Process as specified within the *Bluetooth* Specifications and as required within the current PRD

Bluetooth SPECIAL INTEREST GROUP

10. Carrier Keep Out Area



11. Current Consumption Reference Data (BT3.0 VS BT4.0)

Mouse Power Consumption			
	BT4.0 (Based on nRF51822)		**BT3.0**
	BT4.0 Mode	RF2.4GHz	
2 x AAA	9.5 Months	10 Months	2.9 Months
2 x AA	21 Months	22 Months	6.2 Months
Including Sensor	**BT4.0 (Based on nRF51822)**		**BT3.0 @3V**
	BT4.0 Mode @ 1.5V	RF2.4GHz @1.5V	
Active-Mouse moving (4.3%) (7.5ms report rate)	5.4 mA 8.1 mW	5.8 mA 8.7 mW	8.7 mA 26.1 mW
Rest 1>1s (4.1%) Link maintained Sensor latency: 20ms	900 uA 1.35 mW	350 uA No link 1.05 mW	1.24 mA 3.72 mW
Rest 2>10 sec (4.9%) Link maintained Sensor latency: 100ms	680 uA 1.02 mW	120 uA 198 uW	900 uA 2.7 mW
Rest 2d>60 sec Link maintained Sensor latency: 100ms	120 uA 180 uW	120 uA 198 uW	900 uA 2.7 mW
Rest 3>600s (86.3) Link disconnected Sensor latency: 500ms	90 uA 135 uW	90 uA 135 uW	797 uA 2.3 mW

Keyboard Power Consumption			
	BT4.0 (Based on nRF51822)		**BT3.0 @3V**
	BT4.0 Mode @3V	RF2.4GHz @3V	
Active 6 letters/s	200 uA	5.8 mA 8.7 mW	8.7 mA 26.1 mW
Rest 1 Maintain link	20 - 40 uA	NA	20 - 40 uA
Rest 2 after>1min, disconnected	0.8 uA	0.8 uA	2 uA Only when PC is off

12. BT 4.0 Product Certification Cost Comparison Chart

(Example: Based on Nordic nRF51 series BT4.0 + 2.4GHz RF Mode)

(First Certification Application)		
	Chip On Board To Build Up Finished Product	Apply Raytac Module MDBT40 To Build Up Finished Product
Declaration ID	US$8,000	US$8,000
BQB Test	US$7,000	US$0
USA FCC Test for BT4.0	US$3,600	US$0
USA FCC Test for RF	US$600	
Japan Telec Test for BT4.0	US$5,500	US$1,000
Japan Telec Test for RF	US$5,500	
Total	US$30,200	US$9,000
Note:	1. BQB lab handling charge is not included 2. Declaration ID cost based on normal application 3. Above cost list provided for reference, it may be varied according to different testing lab	1. BQB lab handling charge is not included 2. Declaration ID cost based on normal application 3. FCC applicant is Raytac (For the case of copy report to change the applicant, the cost is about US$1800) 4. Telec US$1000 is based applicant as Raytac to add the finished product 5.Telec: For the case of copy report to change the applicant, the cost is about US$2800 6. Above cost list provided for reference, it may be varied according to different testing lab

(Later Series Product Certification Application)		
	Chip On Board To Build Up Finished Product	Apply Raytac Module MDBT40 To Build Up Finished Product
Declaration ID or Product List	US$8,000	US$0
BQB Test	US$7,000	US$0
USA FCC Test for BT4.0	US$3,600	US$0
USA FCC Test for RF	US$600	
Japan Telec Test for BT4.0	US$5,500	US$1,000
Japan Telec Test for RF	US$5,500	
Total	US$30,200	US$1,000
Note:	1. BQB lab handling charge is not included 2. Declaration ID cost based on normal application 3. Above cost list provided for reference, it may be varied according to different testing lab	1. BQB lab handling charge is not included 2. Declaration ID cost based on normal application 3. FCC applicant is Raytac (For the case of copy report to change the applicant, the cost is about US$1800) 4. Telec US$1000 is based applicant as Raytac to add the finished product 5.Telec: For the case of copy report to change the applicant, the cost is about US$2800 6. Above cost list provided for reference, it may be varied according to different testing lab

13. FCC Statement

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 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: 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 complies with Part 15 of the FCC Rules. Operation 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 may cause undesired operation.

IMPORTANT NOTE:

FCC Radiation Exposure Statement:

The product comply with the US portable RF exposure limit set forth for an uncontrolled environment and are safe for intended operation as described in this manual. The further RF exposure reduction can be achieved if the product can be kept as far as possible from the user body or set the device to lower output power if such function is available.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This device is intended only for OEM integrators under the following conditions:

1) The transmitter module may not be co-located with any other transmitter or antenna,

As long as 1 condition above is met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed

IMPORTANT NOTE

In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

The final end product must be labeled in a visible area with the following: “Contains FCC ID: SH6MDBT40”.

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user’s manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.