GrassWonder

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Approval Sheet

(產品承認書)

產品名稱 (Product):　　　BT 4.0 Module (Nordic nRF51822)

產品型號 (Model No.):　　　nRF51822 (GWBT40-P001-SIP)

客戶　(Customer):

Advantages of GWBT40-P Series

1. Long Working Distance
   GWBT40-P Series: Up to 10 meters in open space

Index

List of GrassWonder's Model No.

Series	Nordic Solution	GrassWonder No.	IC Version	Antenna	RAM	Flash Memory
GWBT40	nRF51822	GWBT40 - P001	1	Chip Antenna	32 kb	256 K

.

1. Overall Introduction

GrassWonder's GWBT 40 is BT 4.0 stack (Bluetooth low energy or BLE) module designed based on **Nordic nRF51822 SoC solution**, which incorporates: **GPIO**, **UART**, **I2C** and **ADC interfaces** for connecting peripherals and sensors.

The feature of the module:

1. Transmission Mode of BLE 2.4G upon customer preference.

2. Compact size with **(L) 18 x (W) 10 x (H) 2.5 mm**

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

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

1.1 Applications

. Support for Bluetooth peripherals

. Remote control

. Audio-visual entertainment products

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

    . 256 kb embedded flash programmed memory

    . 32kb RAM

. Support for non-concurrent multiprotocol operation

    . On-air compatibility with nRF24L series

. Flexible Power Management

    . Supply voltage range 1.8V to 3.6V

    . 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)

2. Product Dimension

2.1 GWBT40-P Series

PCB Dimensions, & Pin Indication & Layout Guide

PCB SIZE：(L) 18 x (W) 10 mm

GND (1)	GND (42)
GND (2)	DEC2 (41)
	P0.20 (40)
	P0.19 (39)
	P0.18 (38)
	P0.17 (37)
	SWCLK (36)
AVDD (3)	SWDIO (35)
P0.21 (4)	P0.16 (34)
P0.22 (5)	P0.15 (33)
P0.23 (6)	P0.14 (32)
P0.24 (7)	P0.13 (31)
P0.25 (8)	P0.12 (30)
XL2 (9)	P0.11 (29)
XL1 (10)	P0.10 (28)
P0.28 (11)	P0.09 (27)
P0.29 (12)	P0.08 (26)

GND (13) VDD (14) DCC (15) P0.30 (16) P0.00 (17) P0.01 (18) P0.02 (19) P0.03 (20) P0.04 (21) P0.05 (22) P0.06 (23) P0.07 (24) GND (25)

〈Max〉 2.5

TOP

ANT
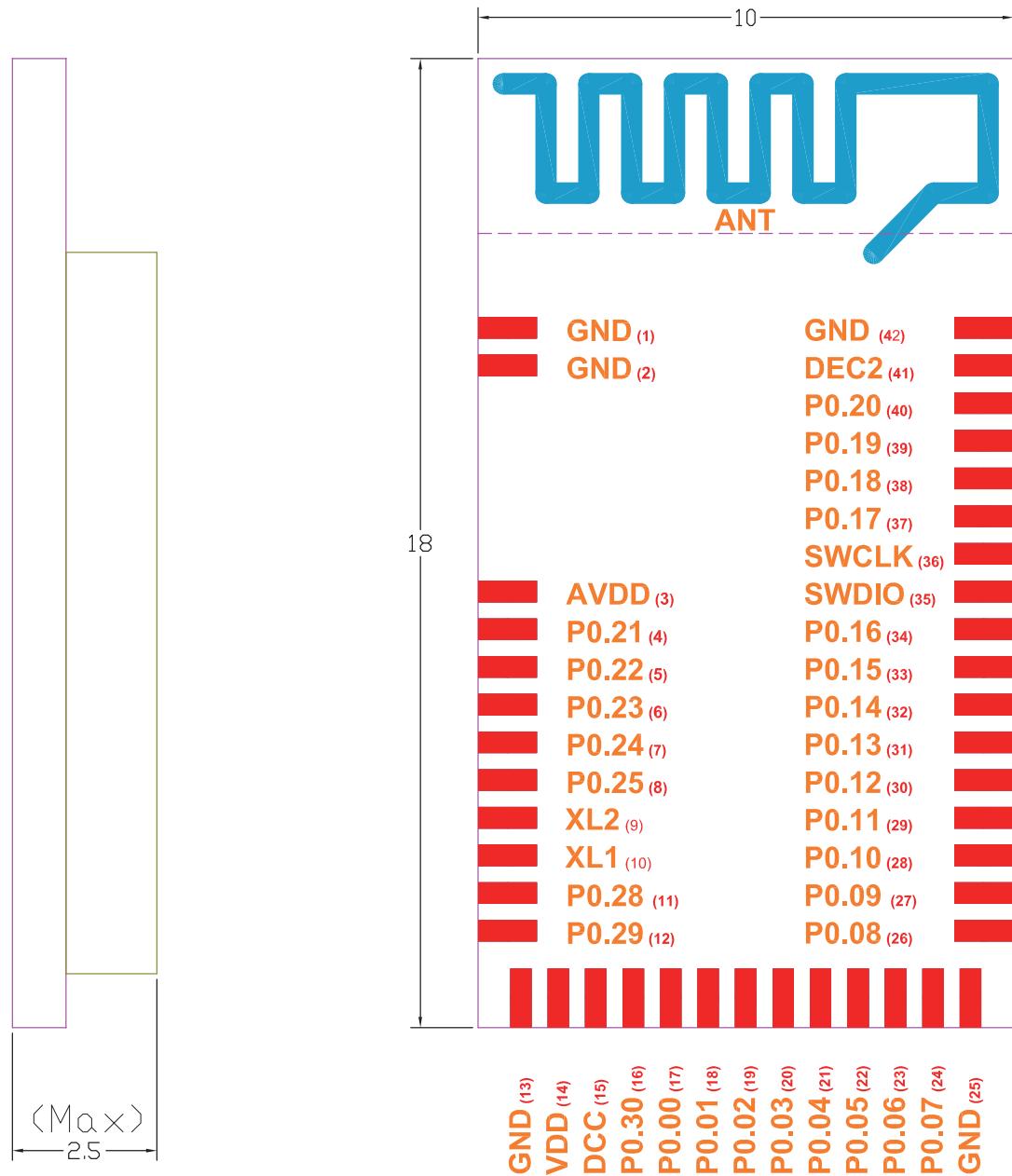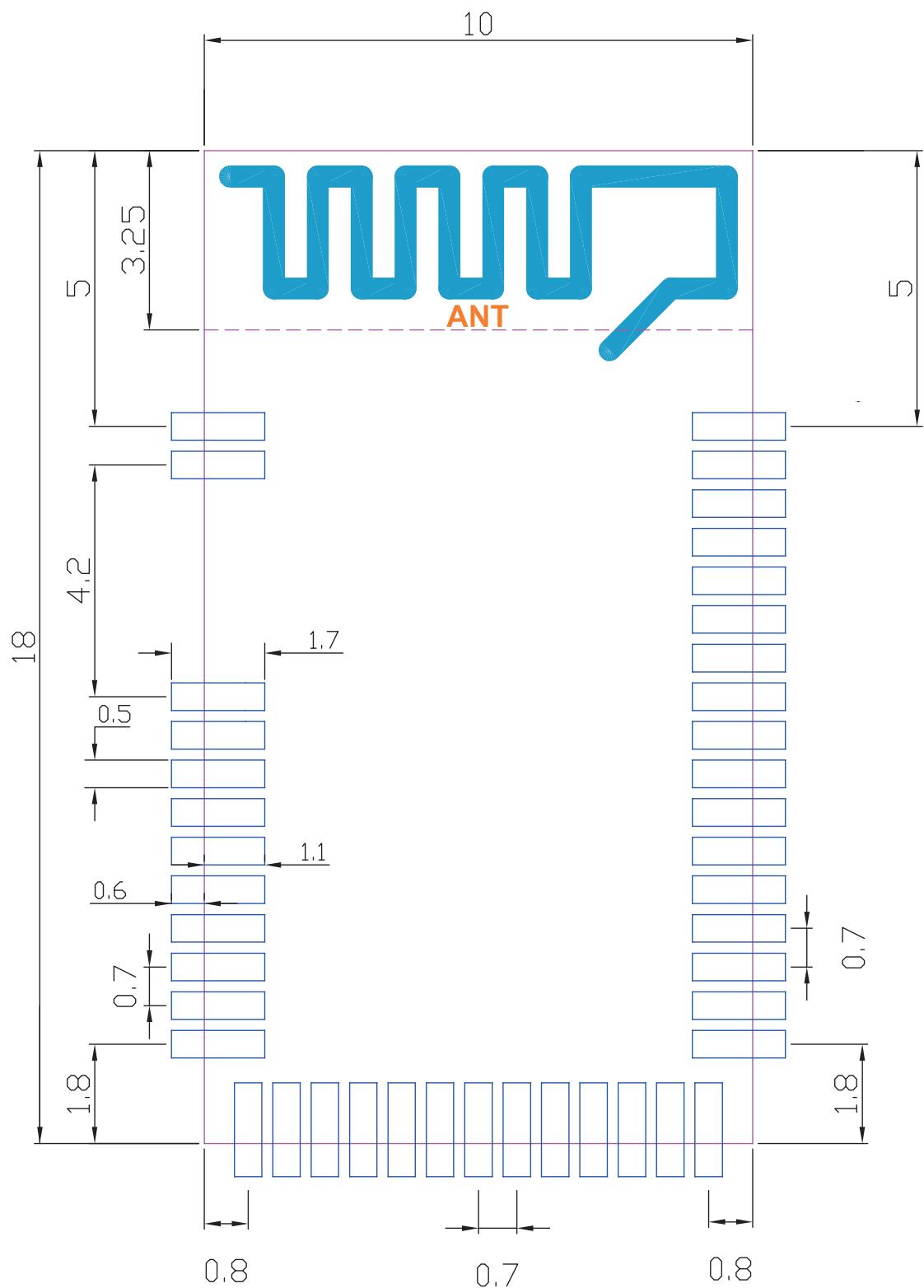
Top View

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.
(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.**

3. Main Chip Solution

RF IC	Crystal Frequency
Nordic NRF51822/QFN48	16MHZ

4. Shipment Packaging Information

Model	Cus. No.	FW Version	Marking	Photo
GWBT40-P001		GWBT40-P001	Black	

5. Specification

nRF51822

Multiprotocol *Bluetooth*® low energy/2.4 GHz RF System on Chip

Product Specification v3.1

Key Features

- 2.4 GHz transceiver
    - -93 dBm sensitivity in *Bluetooth*® low energy mode
    - 250 kbps, 1 Mbps, 2 Mbps supported data rates
    - TX Power -20 to +4 dBm in 4 dB steps
    - TX Power -30 dBm Whisper mode
    - 13 mA peak RX, 10.5 mA peak TX (0 dBm)
    - 9.7 mA peak RX, 8 mA peak TX (0 dBm) with DC/DC
    - RSSI (1 dB resolution)
- ARM® Cortex™-M0 32 bit processor
    - 275 µA/MHz running from flash memory
    - 150 µA/MHz running from RAM
    - Serial Wire Debug (SWD)
- S100 series SoftDevice ready
- Memory
    - 256 kB or 128 kB embedded flash program memory
    - 16 kB or 32 kB RAM
- On-air compatibility with nRF24L series
- Flexible Power Management
    - Supply voltage range 1.8 V to 3.6 V
    - 4.2 µs wake-up using 16 MHz RCOSC
    - 0.6 µA at 3 V OFF mode
    - 1.2 µA at 3 V in OFF mode + 1 region RAM retention
    - 2.6 µA at 3 V 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/Slave
- Low power comparator
- Temperature sensor
- Two-wire Master (I2C compatible)
- UART (CTS/RTS)
- CPU independent Programmable Peripheral Interconnect (PPI)
- Quadrature Decoder (QDEC)
- AES HW encryption
- Real Timer Counter (RTC)
- Package variants
    - QFN48 package, 6 x 6 mm
    - WLCSP package, 3.50 x 3.83 mm
    - WLCSP package, 3.83 x 3.83 mm
    - WLCSP package, 3.50 x 3.33 mm

Applications

- Computer peripherals and I/O devices
    - Mouse
    - Keyboard
    - Multi-touch trackpad
- Interactive entertainment devices
    - Remote control
    - Gaming controller
- Beacons
- Personal Area Networks
    - Health/fitness sensor and monitor devices
    - Medical devices
    - Key-fobs + wrist watches
- Remote control toys

5.1 Absolute Maximum Ratings

Symbol	Parameter	Min.	Max.	Unit
Supply voltages				
VDD		-0.3	+3.9	V
DEC2			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
Environmental WLCSP package				
Storage temperature		-40	+125	°C
MSL	Moisture Sensitivity Level		1	
ESD HBM	Human Body Model		4	kV
ESD CDM	Charged Device Model		500	V
Flash memory				
Endurance		20 000[1]		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		-40	25	85	°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 at 250 kbps.			±170		kHz	2
Δf_{1M}	Frequency deviation at 1 Mbps.			±170		kHz	2
Δf_{2M}	Frequency deviation at 2 Mbps.			±320		kHz	2
Δf_{BLE}	Frequency deviation at 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 at P_{OUT} = +4 dBm.	1		16		mA	4
$I_{TX,0dBm}$	TX only run current at P_{OUT} = 0 dBm.	1		10.5		mA	4
$I_{TX,-4dBm}$	TX only run current at P_{OUT} = -4 dBm.	1		8		mA	2
$I_{TX,-8dBm}$	TX only run current at P_{OUT} = -8 dBm.	1		7		mA	2
$I_{TX,-12dBm}$	TX only run current at P_{OUT} = -12 dBm.	1		6.5		mA	2
$I_{TX,-16dBm}$	TX only run current at P_{OUT} = -16 dBm.	1		6		mA	2
$I_{TX,-20dBm}$	TX only run current at P_{OUT} = -20 dBm.	1		5.5		mA	2
$I_{TX,-30dBm}$	TX only run current at 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 at 250 kbps.			12.6		mA	1
$I_{RX,1M}$	RX only run current at 1 Mbps.			13		mA	4
$I_{RX,2M}$	RX only run current at 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
$P_{RF1.2}$	1st Adjacent Channel Transmit Power. ±2 MHz (2 Mbps).			-20	dBc	2
$P_{RF2.2}$	2nd Adjacent Channel Transmit Power. ±4 MHz (2 Mbps).			-45	dBc	2
$P_{RF1.1}$	1st Adjacent Channel Transmit Power. ±1 MHz (1 Mbps).			-20	dBc	2
$P_{RF2.1}$	2nd Adjacent Channel Transmit Power. ±2 MHz (1 Mbps).			-40	dBc	2
$P_{RF1.250}$	1st Adjacent Channel Transmit Power. ±1 MHz (250 kbps).			-25	dBc	2
$P_{RF2.250}$	2nd Adjacent Channel Transmit Power. ±2 MHz (250 kbps).			-40	dBc	2
$t_{TX,30}$	Maximum consecutive transmission time, $f_{TOL} < \pm30$ ppm.			16	ms	1
$t_{TX,60}$	Maximum consecutive transmission time, $f_{TOL} < \pm60$ 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) at 2 Mbps.		-85		dBm	2
$PRX_{SENS,1M}$	Sensitivity (0.1% BER) at 1 Mbps.		-90		dBm	2
$PRX_{SENS,250k}$	Sensitivity (0.1% BER) at 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.[1]		-91		dBm	2

Symbol	Description	Min.	Typ.	Max.	Units	Test level
RX selectivity - modulated interfering signal[2]						
	2 Mbps					
C/I_{CO}	C/I co-channel.		12		dB	2
C/I_{1ST}	1st ACS, C/I 2 MHz.		-4		dB	2
C/I_{2ND}	2nd ACS, C/I 4 MHz.		-24		dB	2
C/I_{3RD}	3rd ACS, C/I 6 MHz.		-28		dB	2
C/I_{6th}	6th ACS, C/I 12 MHz.		-44		dB	2
C/I_{Nth}	Nth 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}	1st ACS, C/I 1 MHz.		4		dB	2
C/I_{2ND}	2nd ACS, C/I 2 MHz.		-24		dB	2
C/I_{3RD}	3rd ACS, C/I 3 MHz.		-30		dB	2
C/I_{6th}	6th ACS, C/I 6 MHz.		-40		dB	2
C/I_{12th}	12th ACS, C/I 12 MHz.		-50		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[3]

Symbol	Description	Min.	Typ.	Max.	Units	Test level
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. As defined in the *Bluetooth Core Specification* v4.0 Volume 6: Core System Package (Low Energy Controller Volume).
2. 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.
3. Wanted signal level at P_{IN} = -64 dBm. Two interferers with equal input power are used. The interferer closest in frequency is not modulated, 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 range -50 dBm to -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

1. Includes CPU, flash, 1V2, 1V7, RC16M.
2. Includes CPU, RAM, 1V2, RC16M.
3. t_{1V2} if 1V2 regulator is not running already.

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.			0.6[1]		µA	2
$I_{OFF, 8\,k}$	Current in SYSTEM OFF mode 8 kB SRAM retention.			1.2[1]		µA	2
$I_{OFF, 16\,k}$	Current in SYSTEM OFF mode 16 kB SRAM retention.			1.8[1]		µA	2
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 with 16 kB RAM enabled.			2.6[1]		µA	2
t_{1V2}	Startup time for 1V2 regulator.			2.3		µs	1
$I_{1V2RC16}$	Current drawn by 1V2 regulator and 16 MHz RCOSC when both are on at the same time.	See *Table 28* on page 39		880[2]		µA	1
$I_{1V2XO16}$	Current drawn by 1V2 regulator and 16 MHz XOSC when both are on at the same time.	See *Table 28* on page 39		810[2]		µA	1
$I_{1V2XO32}$	Current drawn by 1V2 regulator and 32 MHz XOSC when both are on at the same time.	See *Table 28* on page 39		840[2]		µA	1
t_{1V7}	Startup time for 1V7 regulator			2	3.6	µs	1
I_{1V7}	Current drawn by 1V7 regulator			105		µA	2
I_{DCDC}	Current drawn by DC/DC converter.			300		µA	1
F_{DCDC}	DC/DC converter current conversion factor.		0.65[3]		1.2[3]		1
$t_{START,DCDC}$	DC/DC converter startup time.		10[3]		425[3]	µs	1

6. Block Diagram

nRF51822 block diagram
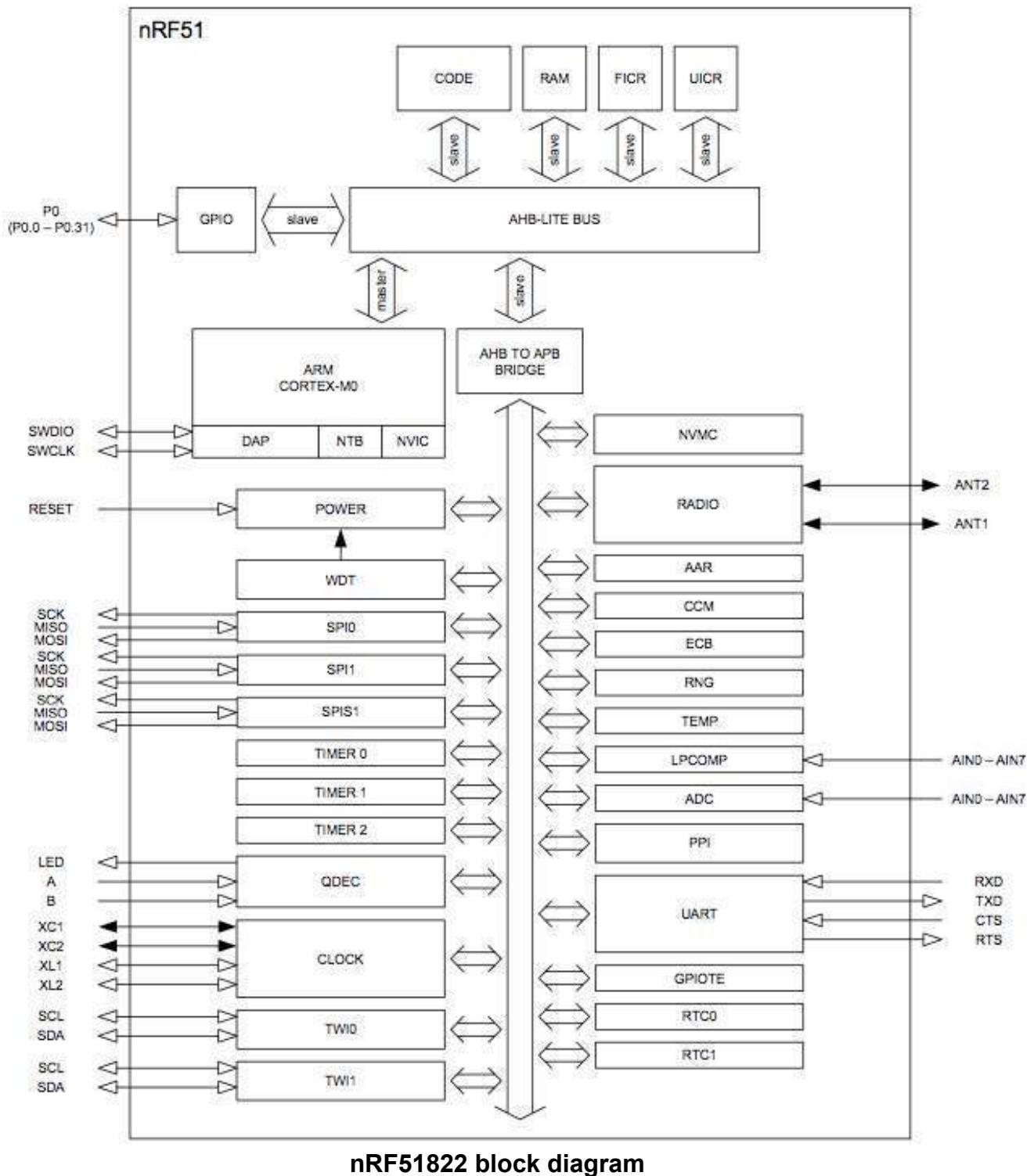
7. Antenna

Antenna Manufacturer : Raytac Corporation.
MODEL:Printed Trace Antenna

C. X-Z polarization scan

	Model No.	Ant. Polarization	Freq(MHz)	Peak angle	Value	Average
🟨	XZ 2400 H	Horizontal	2400.0	330.3	-0.9	-6.1
🟦	XZ 2450 H	Horizontal	2450.0	332.8	-2.5	-7.6
🟩	XZ 2500 H	Horizontal	2500.0	346.0	-5.5	-9.8

|	Model No.	Ant. Polarization	Freq(MHz)	Peak angle	Value	Average
🟨	XZ 2400 V	Vertical	2400.0	232.1	-2.0	-5.7
🟦	XZ 2450 V	Vertical	2450.0	221.8	-4.1	-6.6
🟩	XZ 2500 V	Vertical	2500.0	312.7	-4.8	-8.5
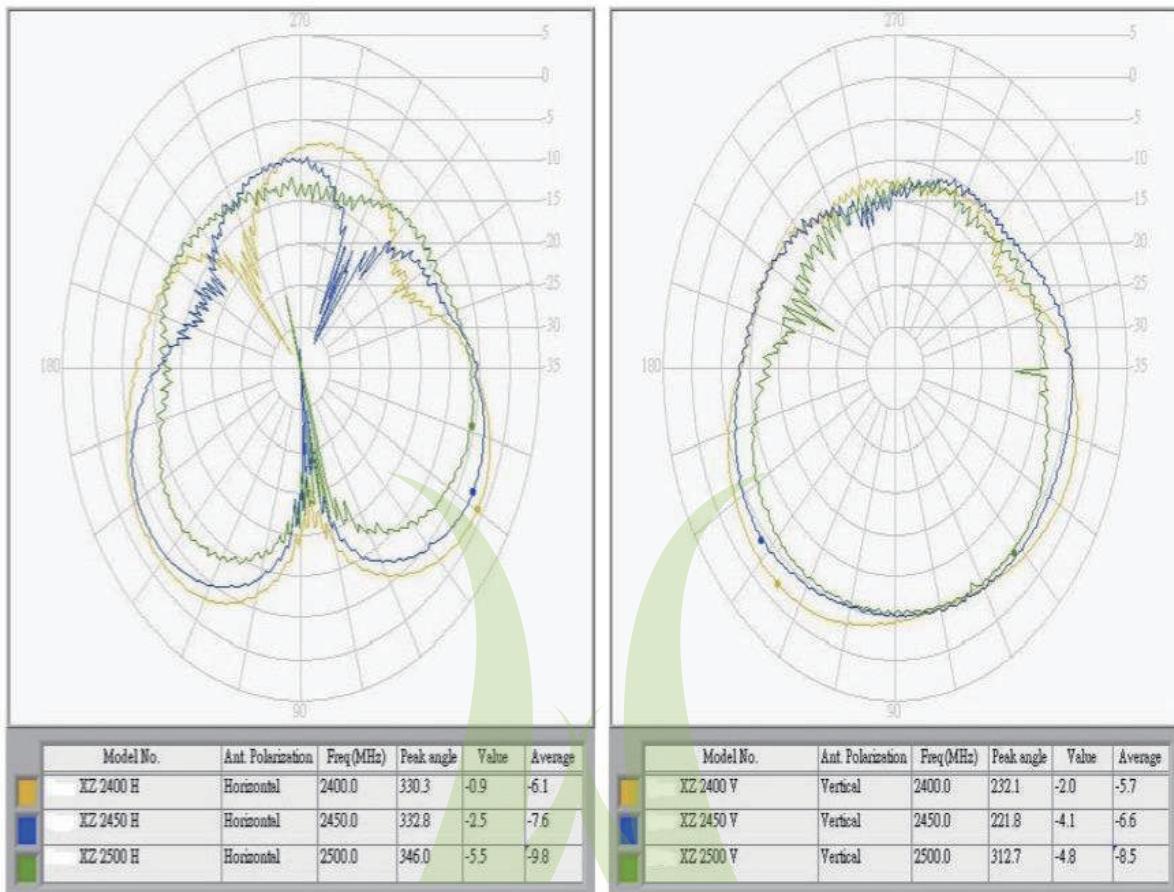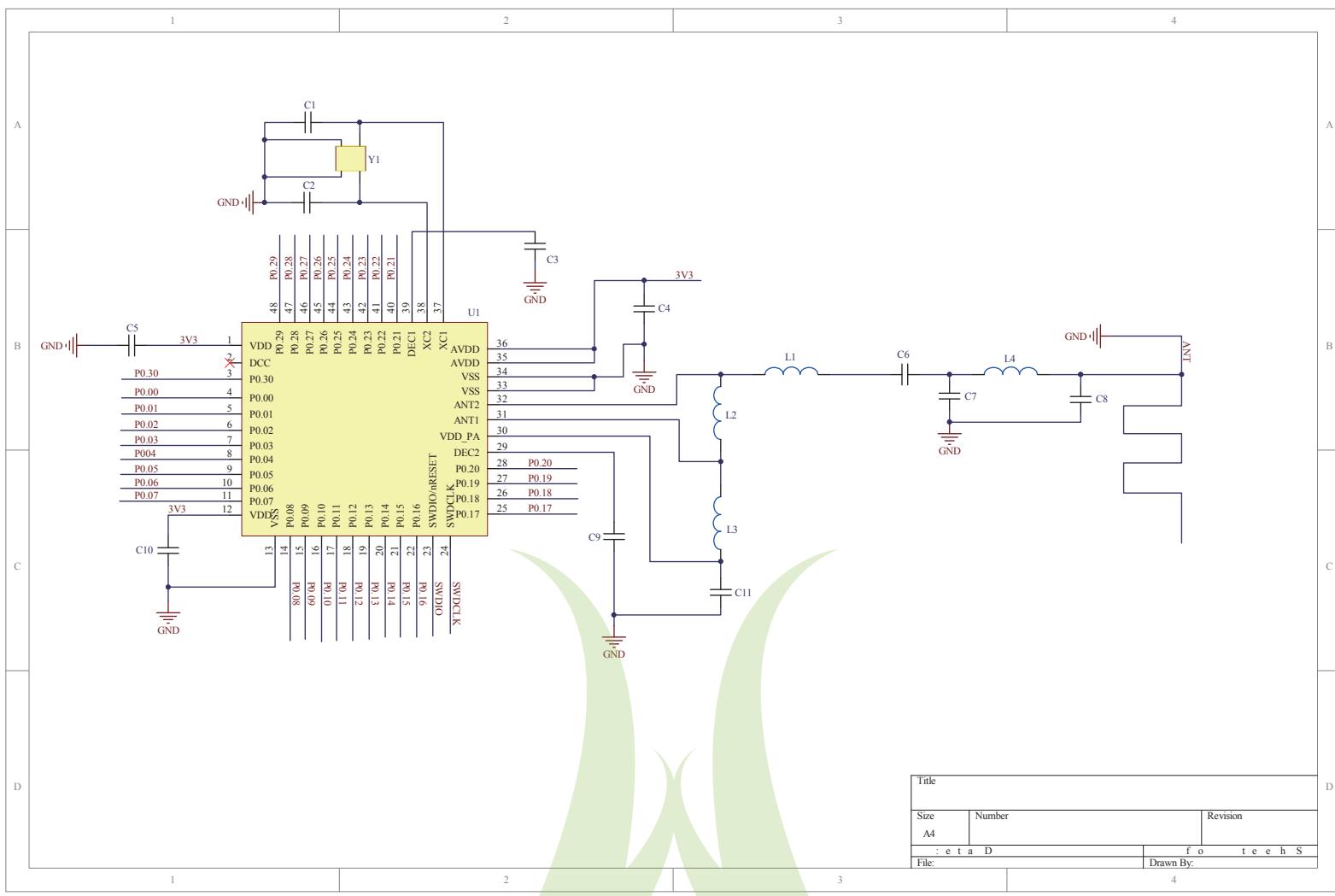
8. Reference Circuit

9. Carrier Keep-Out Area

Reference Item: GWBT40-P
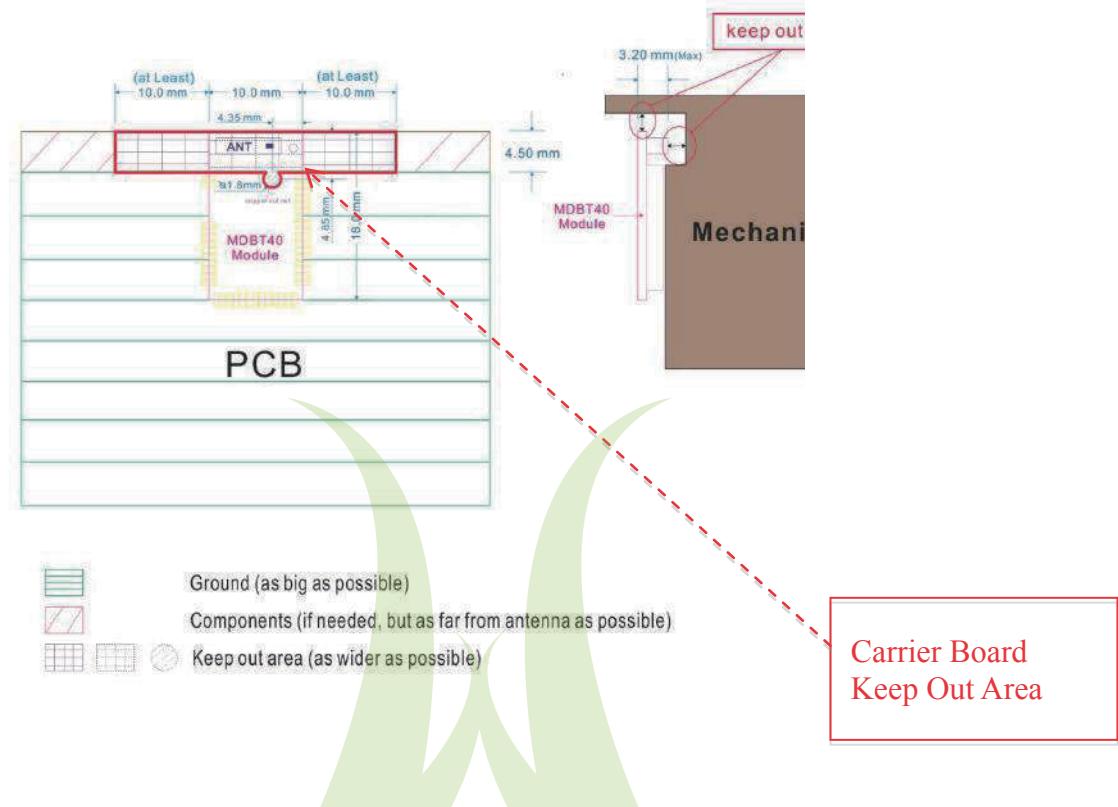
1. Carrier Board under the BLUE PART
   (antenna and test pin pad)
   Carrier Board is not allowed to have ground or circuit or
   components in any layer.

2. Carrier Board under the GREEN PART
   a. Suggest to equip ground full green area in first layer
   b. If first layer equipped ground, 2nd and 3rd layer can
      have circuit in this area.
   c. If first layer equipped ground, 4th layer can have
      components in this area.

10. nRF51 IC Compatibility with SDK & SoftDevice

nRF51 IC rev.	nRF51 SDK	SoftDevices									
		nRF51422/nRF51822						nRF51422			
		S110		S120		S130		S210		S310	
		SD	SDS	SD	SDS	SD	SDS	SD	SDS	SD	SDS
1	4.4.2	5.2.1[a]	1.1	-	-	-	-	2.0.0[b]	1.0	-	-
2	4.4.2	5.2.1	1.1	-	-	-	-	3.0.0	1.2	-	-
	5.2.0	6.0.0 6.2.1	1.2	-	-	-	-	3.0.0	1.2	1.0.0	1.0
	6.1.0	7.0.0 7.1.0	1.3	1.0.1	1.1	-	-	3.0.0	1.2	1.0.0	1.0
	-	8.0.0	2.0	2.0.0	2.1	-	-	4.0.1	2.0	2.0.1	2.0
3	6.1.0	7.1.0	1.3	1.0.1	1.1	-	-	3.0.0	1.2	1.0.0	1.0
	7.0.1					0.5.0-1 alpha	0.5	4.0.1	2.0	-	-
	7.1.0							4.0.1	2.0	2.0.1	2.0
	7.2.0										
	8.0.0	8.0.0	2.0	2.0.0	2.1	0.9.0-1 alpha	0.5	4.0.1	2.0	-	-
	-	-	-	-	-	1.0.0-3 alpha	0.5	-	-	-	-

a. Valid for nRF51822 only.
b. Preprogrammed in factory.

The SDK version must match with its corresponding softdevice version to make BLE work.

Warning

This device complies with part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
NOTE: 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:
n Reorient or relocate the receiving antenna.
n Increase the separation between the equipment and receiver.
n Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
n Consult the dealer or an experienced radio/TV technician for help.
To maintain compliance with FCC's RF Exposure guidelines, This equipment should be installed and operated with minimum distance between 20cm the radiator your body: Use only the supplied antenna.

FCC ID: 2AMHK-NRF51822

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

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and

2) This device and its antenna(s) must not be co-located with any other transmitters except in accordance with FCC multi-transmitter product procedures. Referring to the multi-transmitter policy, multiple-transmitter(s) and module(s) can be operated simultaneously without C2P.

3) For all products market in US, OEM has to limit the operation channels in CH1 to CH11 for 2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end-user regarding to Regulatory Domain change.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of 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.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains   FCC ID:2AMHK-NRF51822 ". If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of 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.