



Data Sheet

BT40 Module Spec

Nordic nRF51822/51422 module

Version 1.2
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1. Overall Introduction

BT40 Bluetooth module is a BT4.1 (Bluetooth low energy or BLE) module designed based on Nordic nRF51822 and nRF51422 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 & (L)18.5x(W)11.4x(H)2.0 mm
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 track pad
- . 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
 - . 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)

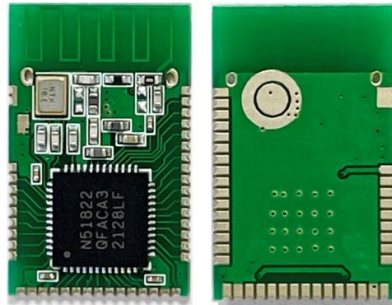
. AES HW encryption

. Real Timer Counter (RTC)

1.3 Profile and Service Information

Adopted Profile	Adopted Service	Supported
HID over GATT	HID	Yes
	Battery	
	Device Information	
Heart Rate Monitor	Heart Rate	Yes
	Device Information	
Proximity	Link Loss	Yes
	Immediate Alert	
	Tx power	
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	Yes
	Next DST change	
Find Me	Immediate alert	Yes
Cycling Speed and Cadence	Cycling speed and cadence device	Yes
	information	
Running Speed and Cadence	Running speed and Cadence device	Yes
	information	

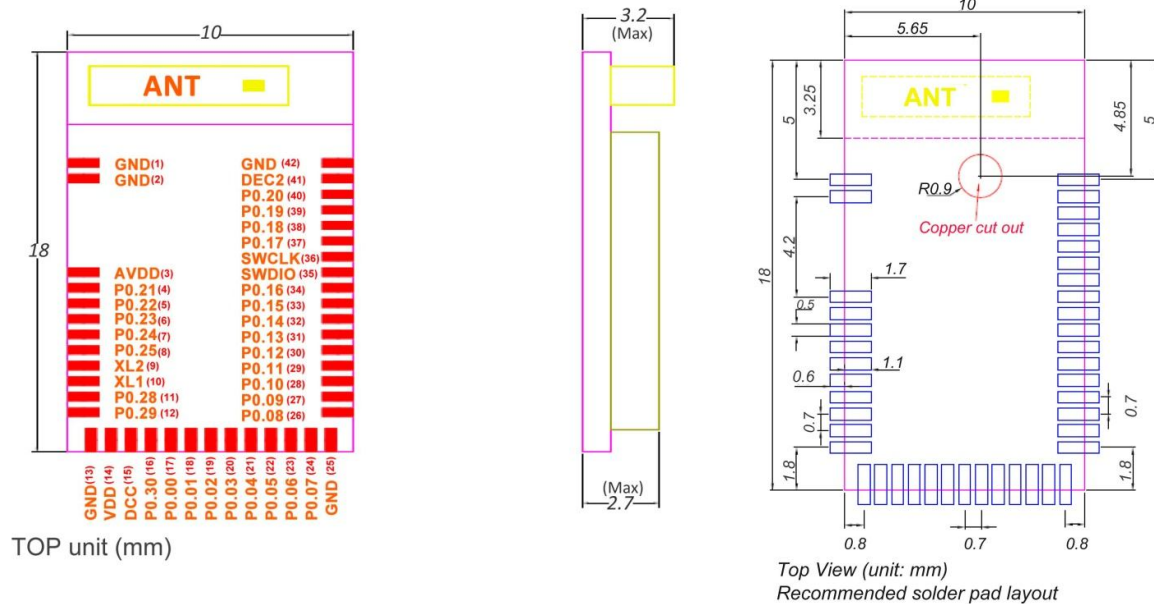
2. Product Dimension



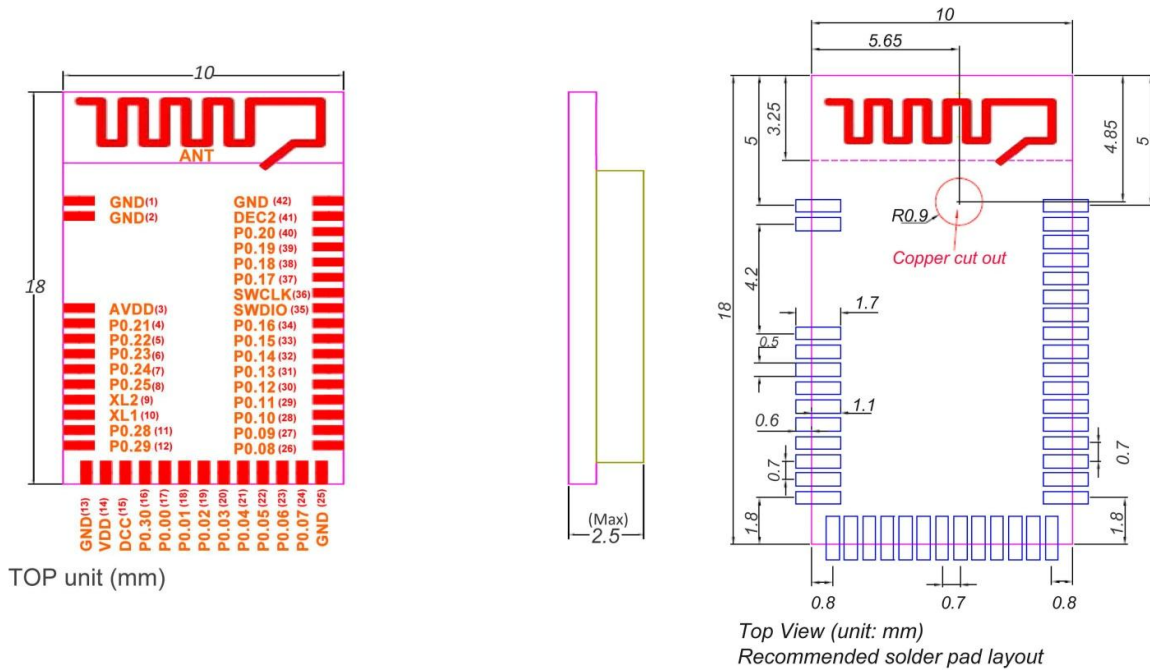
(PCB ANT Type)

2.1 PCB Dimensions & Pin Indication & Layout Guide

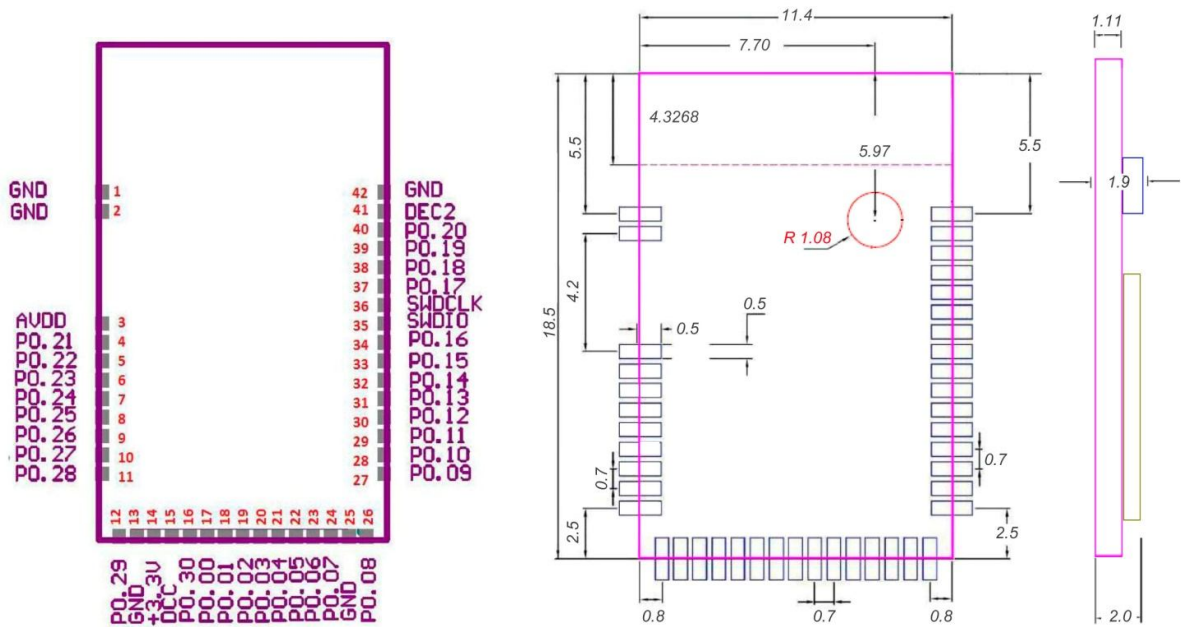
2.1.1 Chip ANT Type: PCB Size: 10 x 18 (mm) – MDBT Series



2.1.2 PCB ANT Type: PCB Size: 10 x 18 (mm) – MDBT Series



2.1.3 Loop ANT Type: PCB Size: 11.4 x 18.5 (mm) – STBT Series



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
	AREFO	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.

3. Main Chip Solution

RF IC	Crystal Frequency
Nordic nRF51822/QFN48	16Mhz
Nordic nRF51422/QFN48	16Mhz

4. Shipment Packing Information

Series : MDBT 88 pcs/ Tray

10 Trays / Export Carton (880pcs per carton)

Series : STBT 60 pcs/ Tray

10 Trays / Export Carton (600pcs per carton)

5. Specification

5.1 Absolute Maximum Rating

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
Δf_{250}	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 μ s), and when changing mode from RX to TX (130 μ s).
3. Average current consumption for RX startup (130 μ s), and when changing mode from TX to RX (130 μ s).

5.3.2 Transmitter Specification

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 Specification

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 signal¹						
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}	1 st ACS, C/I 1 MHz		-10		dB	2
C/I _{2ND}	2 nd ACS, C/I 2 MHz		-34		dB	2
C/I _{3RD}	3 rd ACS, C/I 3 MHz		-39		dB	2
C/I _{6th}	6 th ACS, C/I f _i > 6 MHz		-50		dB	2
C/I _{12th}	12 th ACS, C/I 12 MHz		-55		dB	2
C/I _{Nth}	N th 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}	1 st ACS, C/I 1 MHz		1		dB	2
C/I _{2ND}	2 nd 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±1MHz}	Adjacent channel to image blocking level (±1 MHz)		-31		dB	2
RX intermodulation²						
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

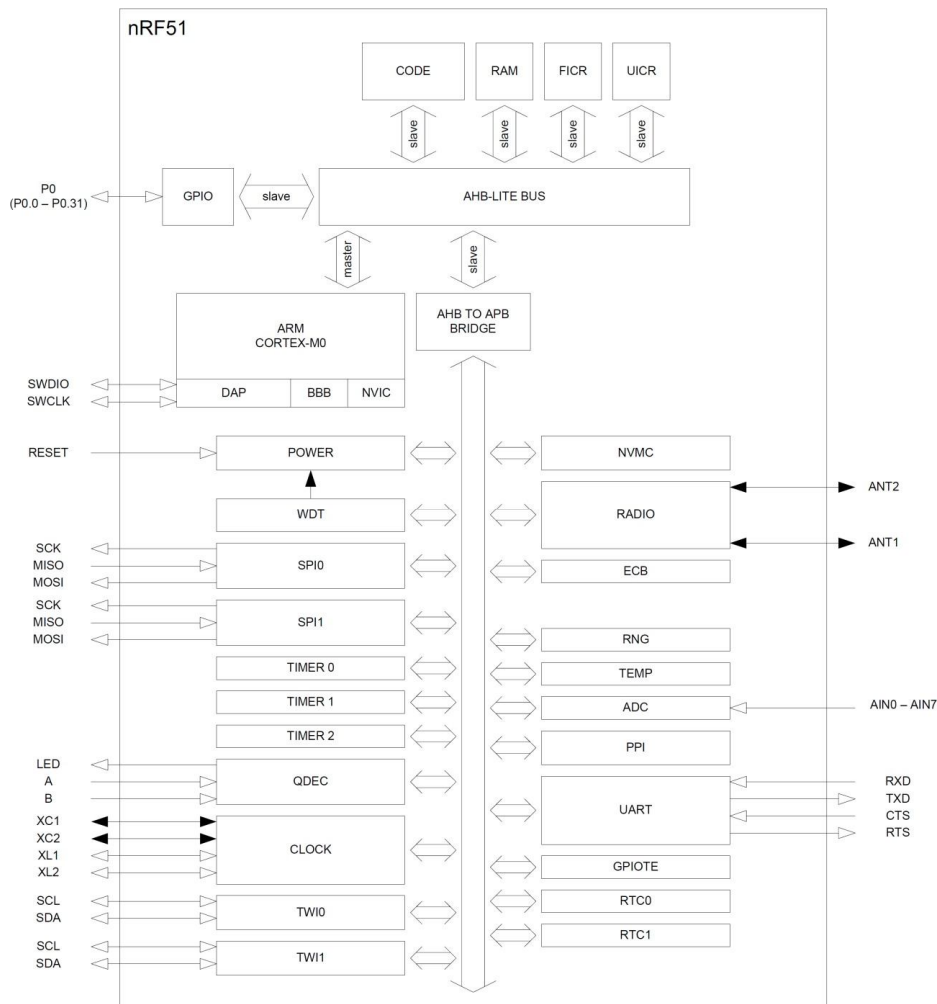
5.3.7 Power Management

Symbol	Description	Note	Min.	Typ.	Max.	Units	Test level
t _{POR, 1μs}	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 <i>Table 24</i>		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
$t_{\text{START,DCDC}}$	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 $t_{\text{START,DCDC}}$ 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



AT7020 Series Multilayer Chip Antenna

Features

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

Applications

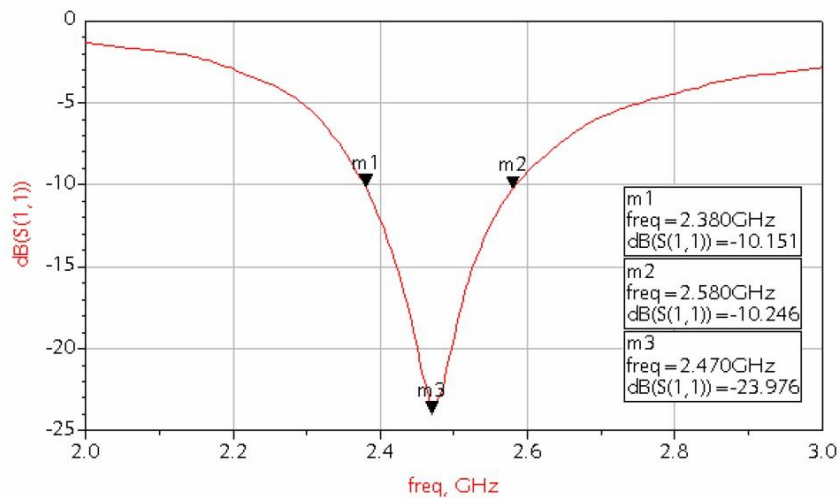
- ❖ 2.4GHz WLAN, Home RF, Bluetooth Modules, etc.



Specifications

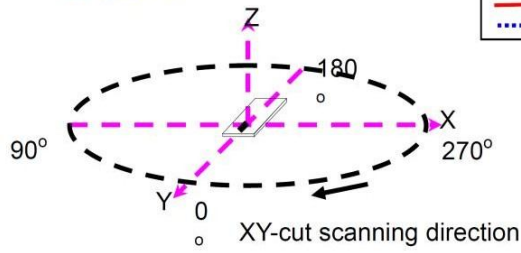
Part Number	Frequency Range (MHz)	Peak Gain (dBi typ.)	Average Gain (dBi typ.)	VSWR	Impedance
AT7020 -E3R0HBA_	2400~2500	1.3dBi (XZ-V)	-0.5dBi (XZ-V)	2 max.	50 Ω

- ❖ Return Loss/With Matching Circuits

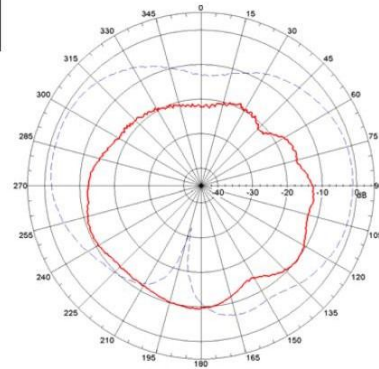


❖ Radiation Patterns

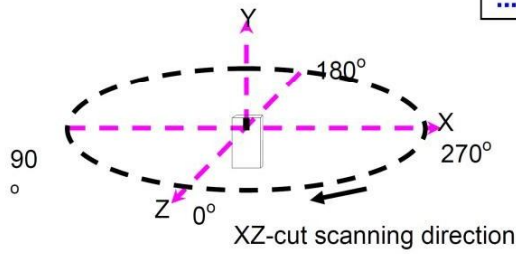
XY-V/XY-H



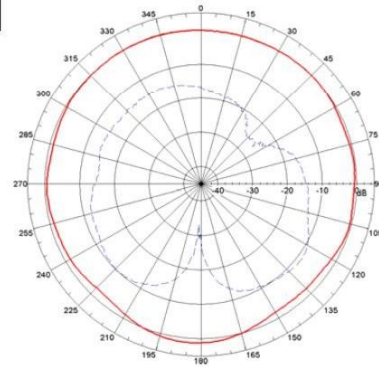
XY cut @2.45GHz
 — Vertical
 Horizontal



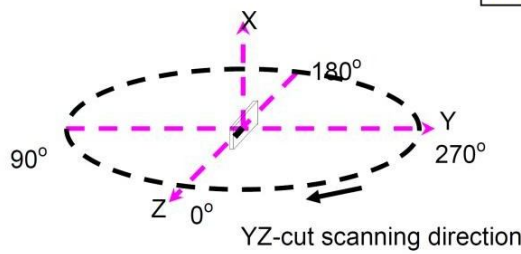
XZ-V/XZ-H



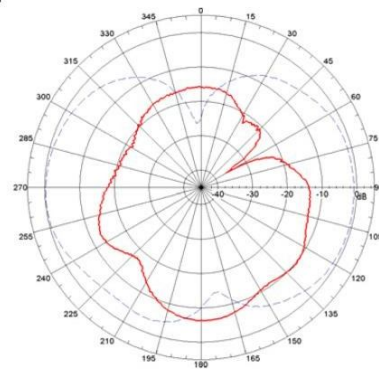
XZ cut @2.45GHz
 — Vertical
 Horizontal



YZ-V/YZ-H

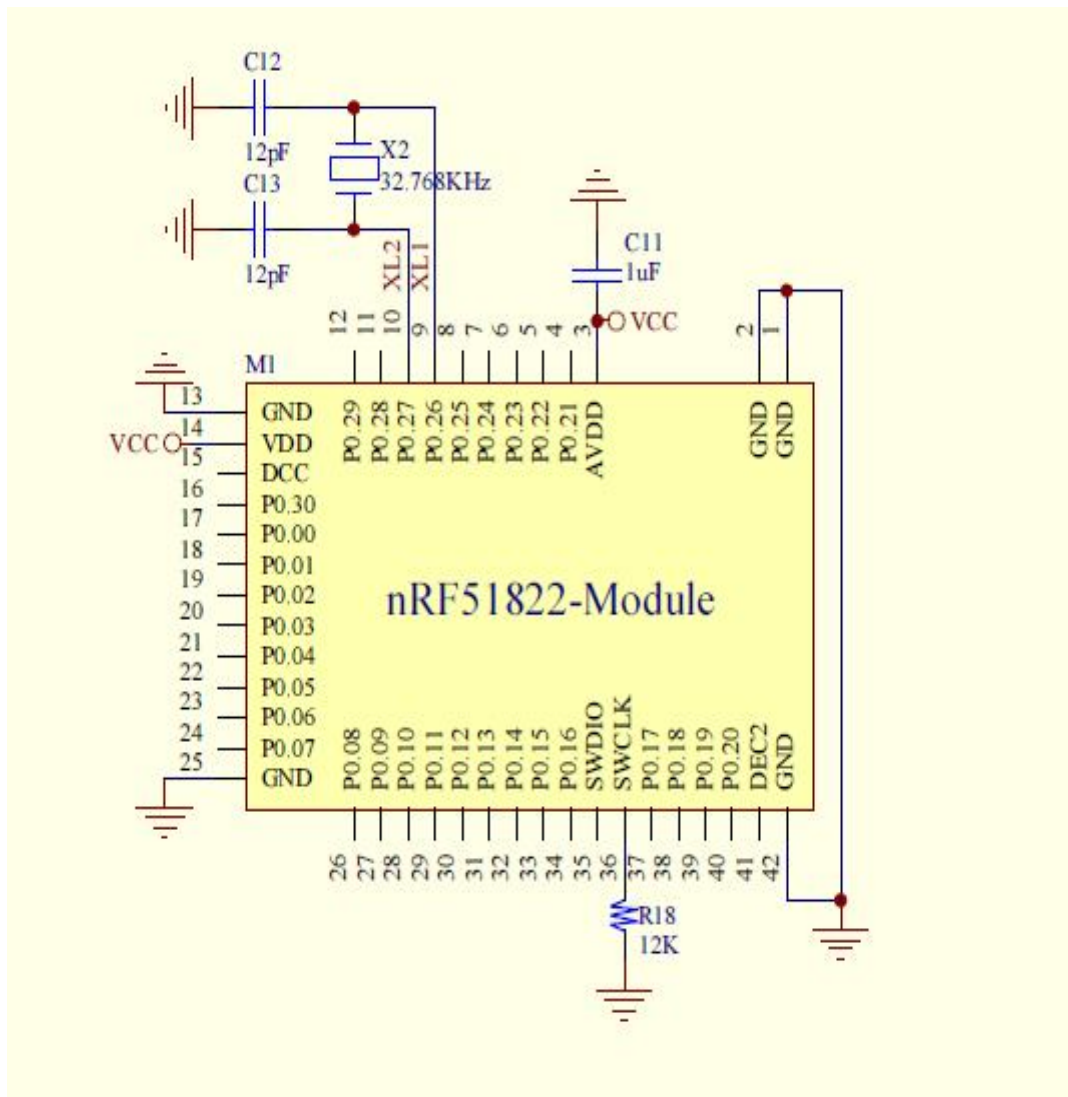


YZ cut @2.45GHz
 — Vertical
 Horizontal

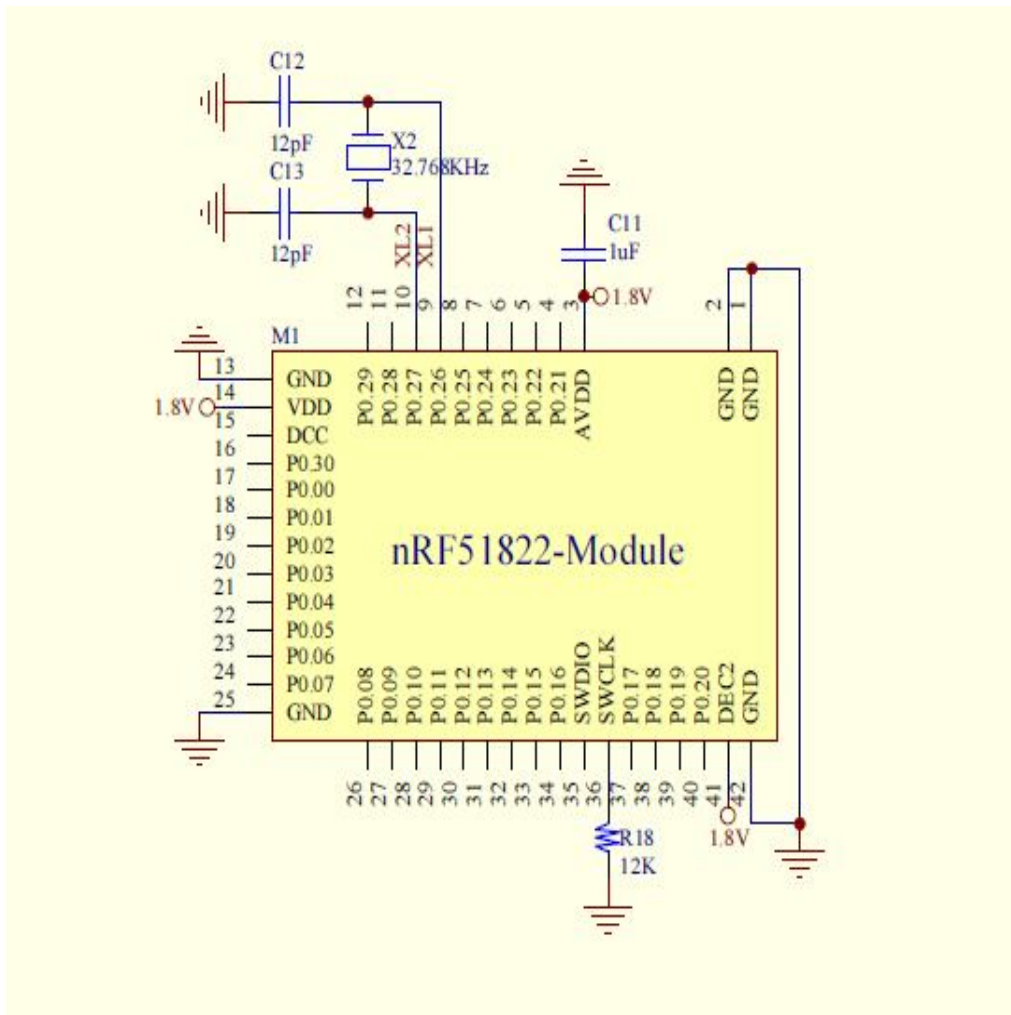


8. Reference Circuit

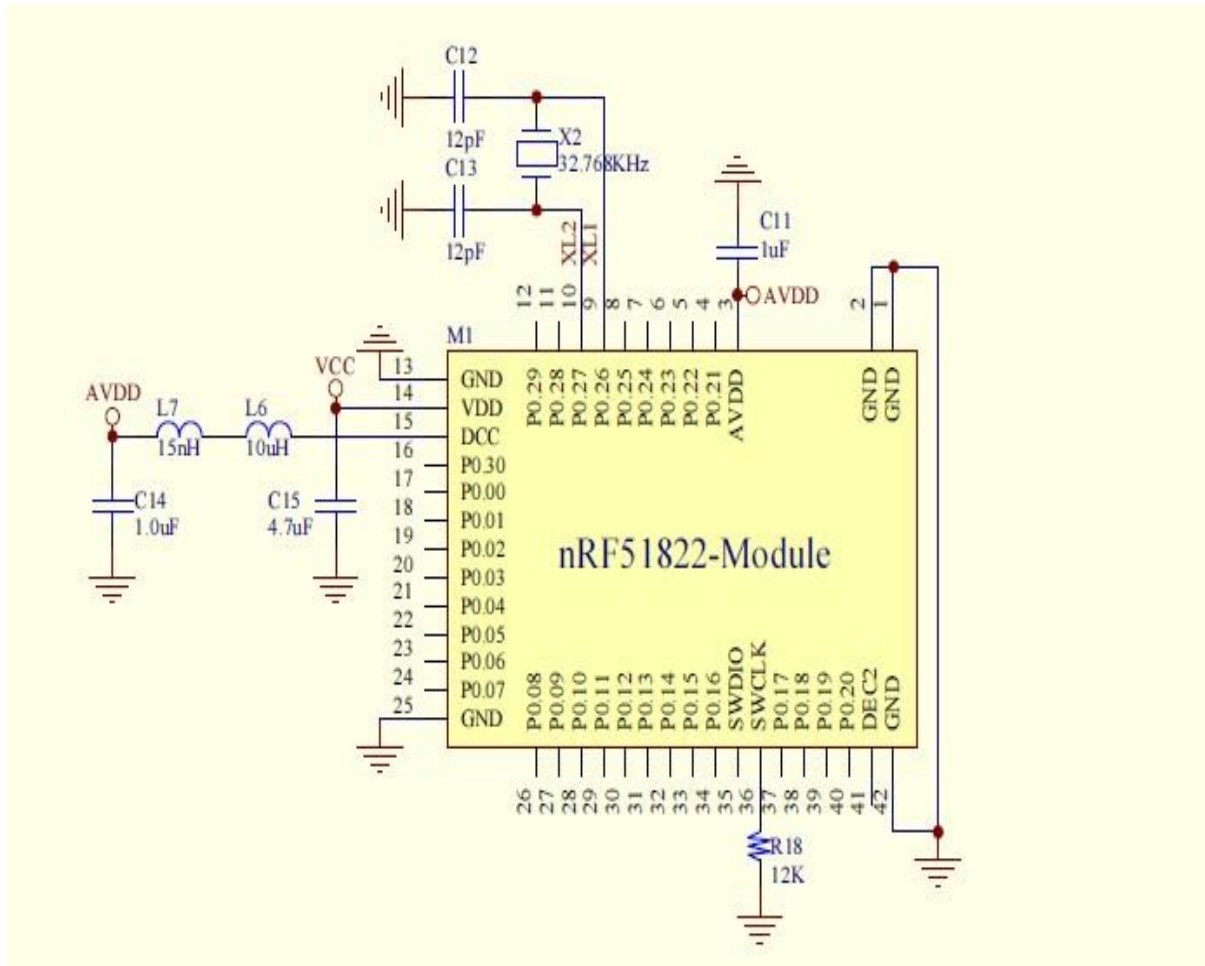
8.1 nRF51822 Schematic with Internal LDO



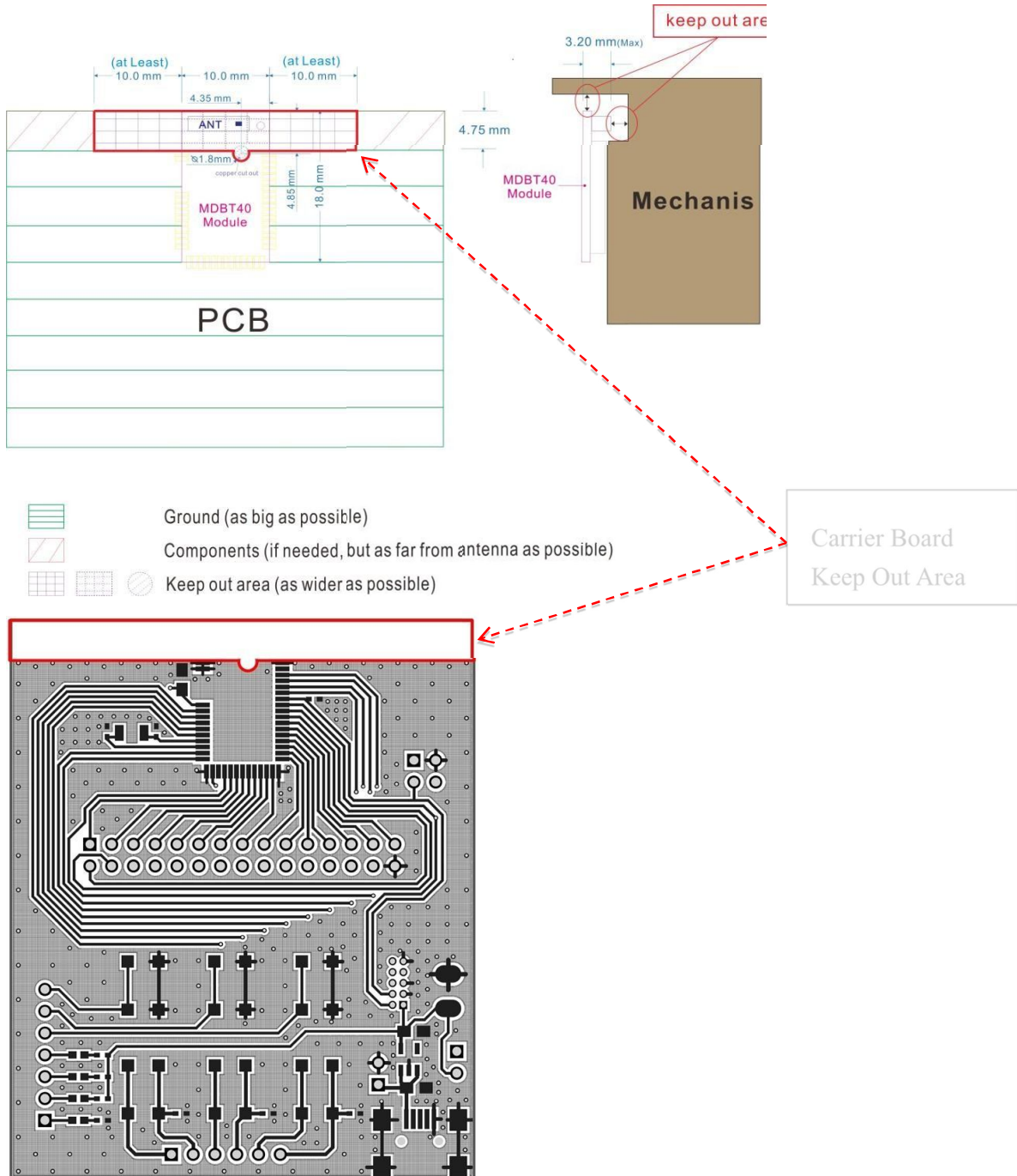
8.2 nRF51822 Schematic with 1.8V Low Voltage Mode



8.3 nRF51822 Schematic with Internal DC/DC Converter



9. Carrier Keep-out Area



10. nRF51 SDK Support

nRF51 SDK v5.2.0 supports the following:

- **System-on-chips**

nRF51822 QFAA FA	nRF51822 QFAA GC
nRF51822 QFAA G0	nRF51822 CEAA CA
nRF51822 CEAA DA	nRF51822 CEAA D0
nRF51822 QFAB B0	nRF51422 QFAA E0
nRF51422 CEAA B0	

- **SoftDevices**

S110 v6.0.0	S120 v0.8.0-3.alpha
S210 3.0.0-3.beta	S310 1.0.0-2.alpha

- **Hardware Boards**

PCA10000 v1.0 (Only for use with Master Emulator)

PCA10000 v2.1.0 and 2.2.0

PCA10001 v2.1.0 and 2.2.0

PCA10003 v3.0.0

PCA10004 v2.1.0 and v2.2.0

PCA10005 v2.1.0 and v2.2.0

PCA10006 v3.0.0

PCA10007 v3.0.0

Customers that are using older versions of the hardware or SoftDevices should use nRF51 SDK v4.4.x.