Gwell

Approval Sheet

(產品承認書)

產品名稱　：**Nordic nRF51822/51422 module spec**

產品型號　：**GW-STBT40- xxxxxx**

Approved	Checked	Designed

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1. Overall Introduction

Gwell's BT40 series 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)

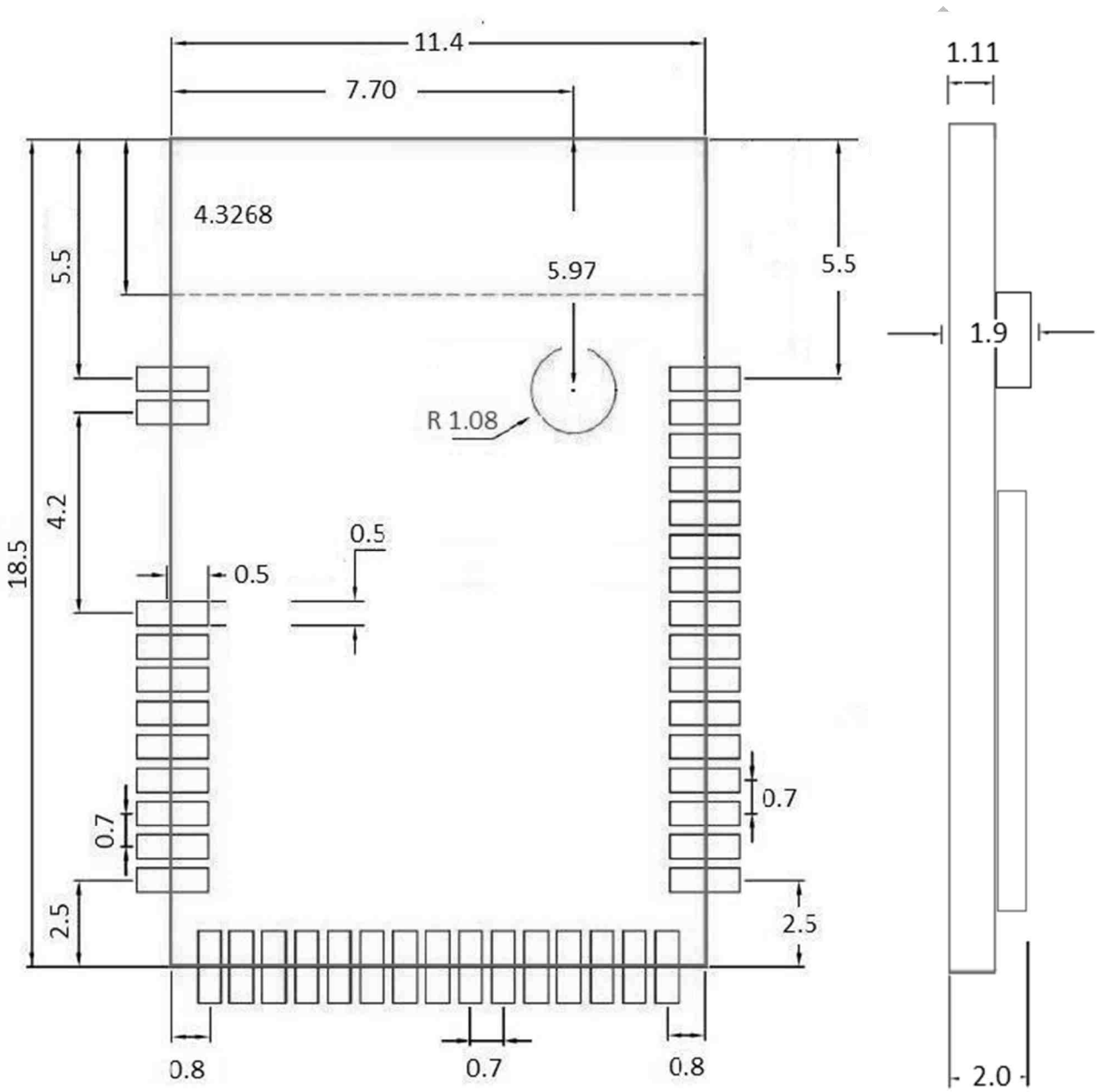
1.3 Profile and Service Information

Adopted Profile	Adopted 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

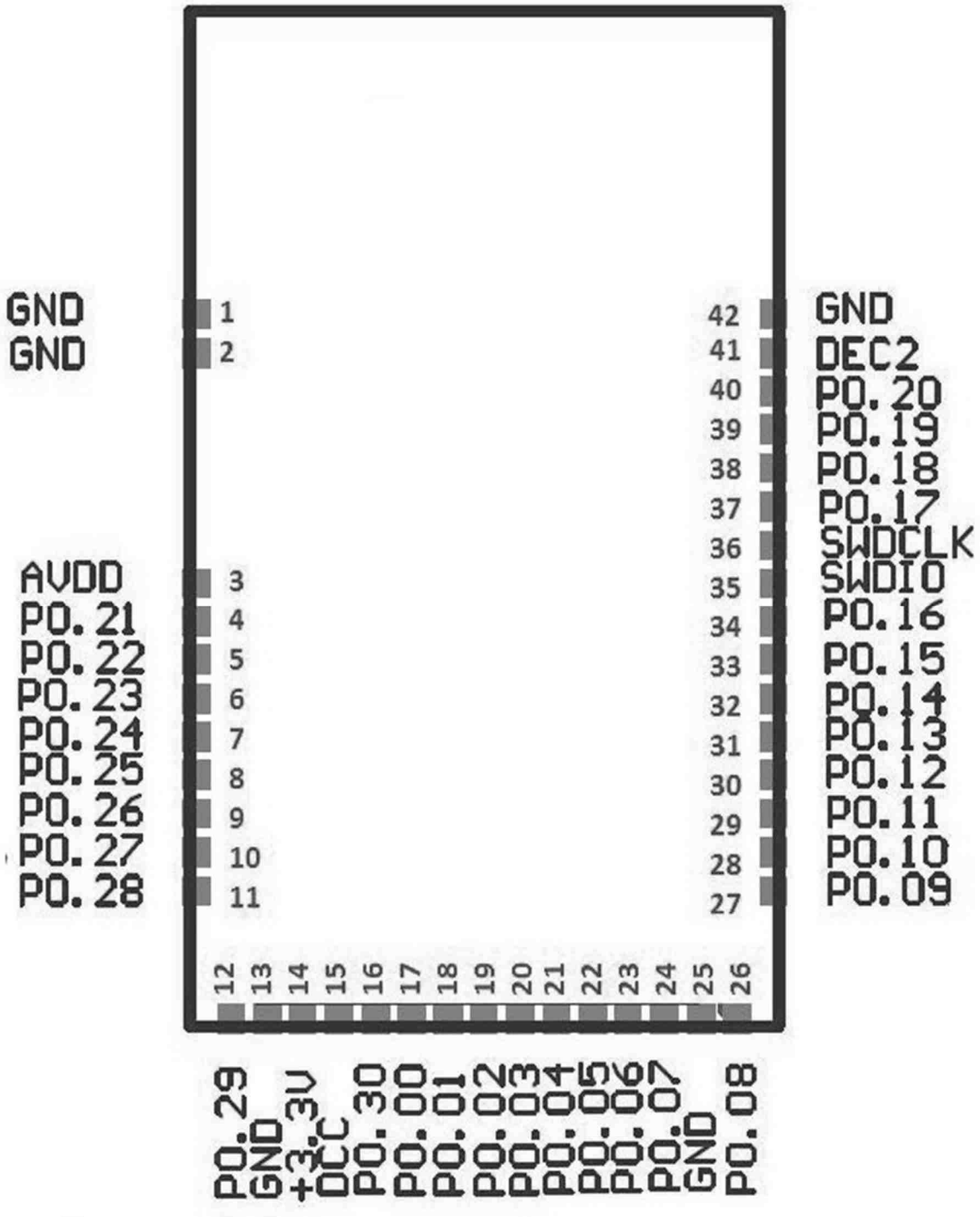
2. Product Dimension

2.1 PCB Dimensions, & Pin Indication & Layout Guide

Loop ANT type: PCB SIZE：11.4 x 18.5 (mm) – STBT Series



TOP View (單位:mm)


GND 1
GND 2
AVDD 3
P0.21 4
P0.22 5
P0.23 6
P0.24 7
P0.25 8
P0.26 9
P0.27 10
P0.28 11
42 GND
41 DEC2
40 P0.20
39 P0.19
38 P0.18
37 P0.17
36 SWDCLK
35 SWDIO
34 P0.16
33 P0.15
32 P0.14
31 P0.13
30 P0.12
29 P0.11
28 P0.10
27 P0.09
12 P0.29
13 GND
14 +3.3V
15 VCC
16 P0.30
17 P0.00
18 P0.01
19 P0.02
20 P0.03
21 P0.04
22 P0.05
23 P0.06
24 P0.07
25 GND
26 P0.08

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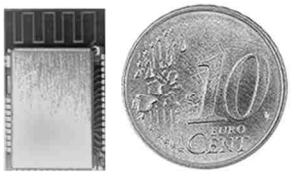
Picture: RF module vs coin



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.

3. Main Chip Solution

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

4. Shipment Packing Information

Series : STBT

60 pcs/ Tray

10 Trays / Export Carton (600pcs per carton)

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
Δf250	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
$P_{RF1.2}$	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} < ±30 ppm			16	ms	1
$t_{TX,60}$	Maximum consecutive transmission time, f_{TOL} < ±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
$C/I_{Image±1MHz}$	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

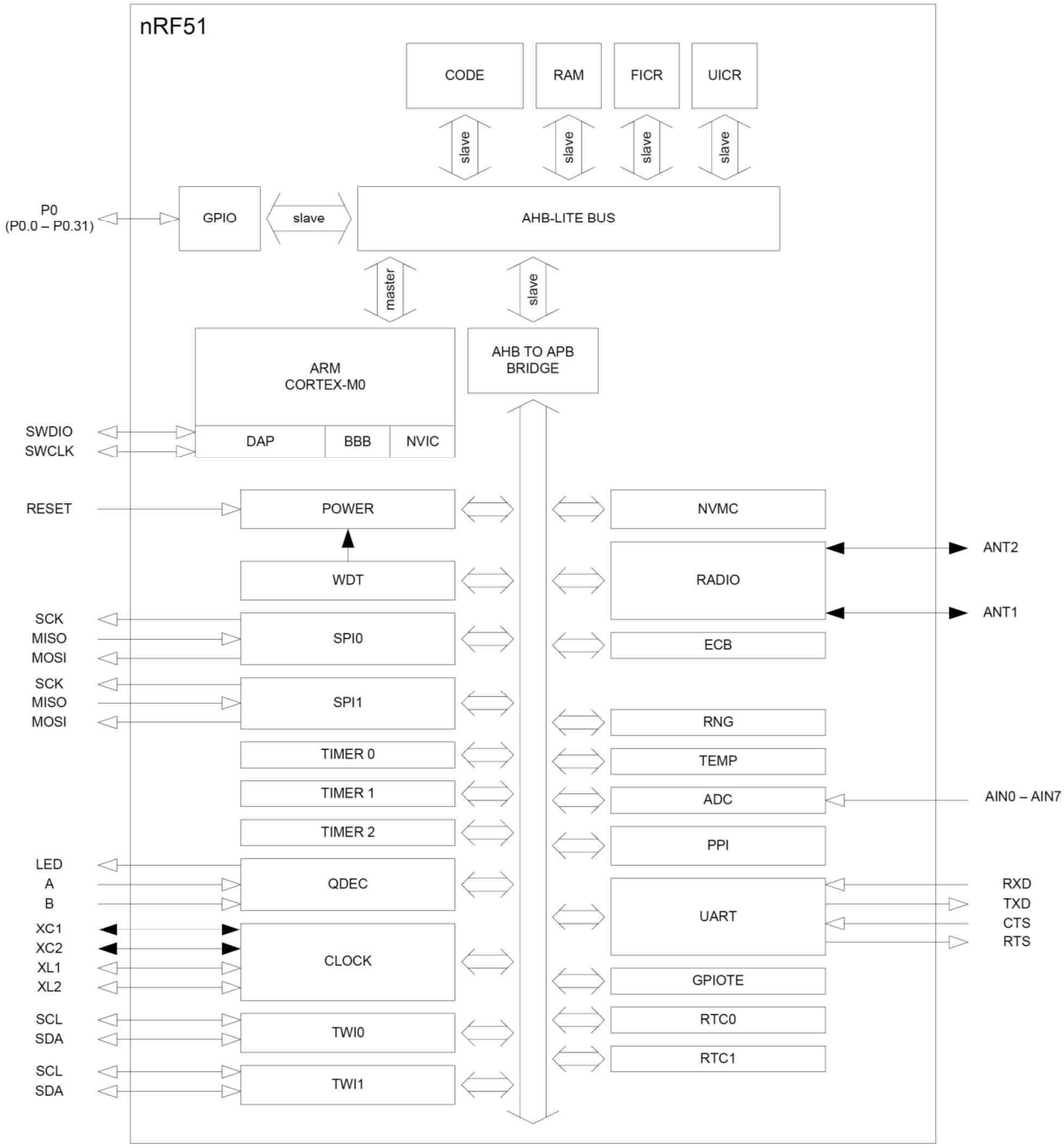
5.3.7 Power Management

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}.

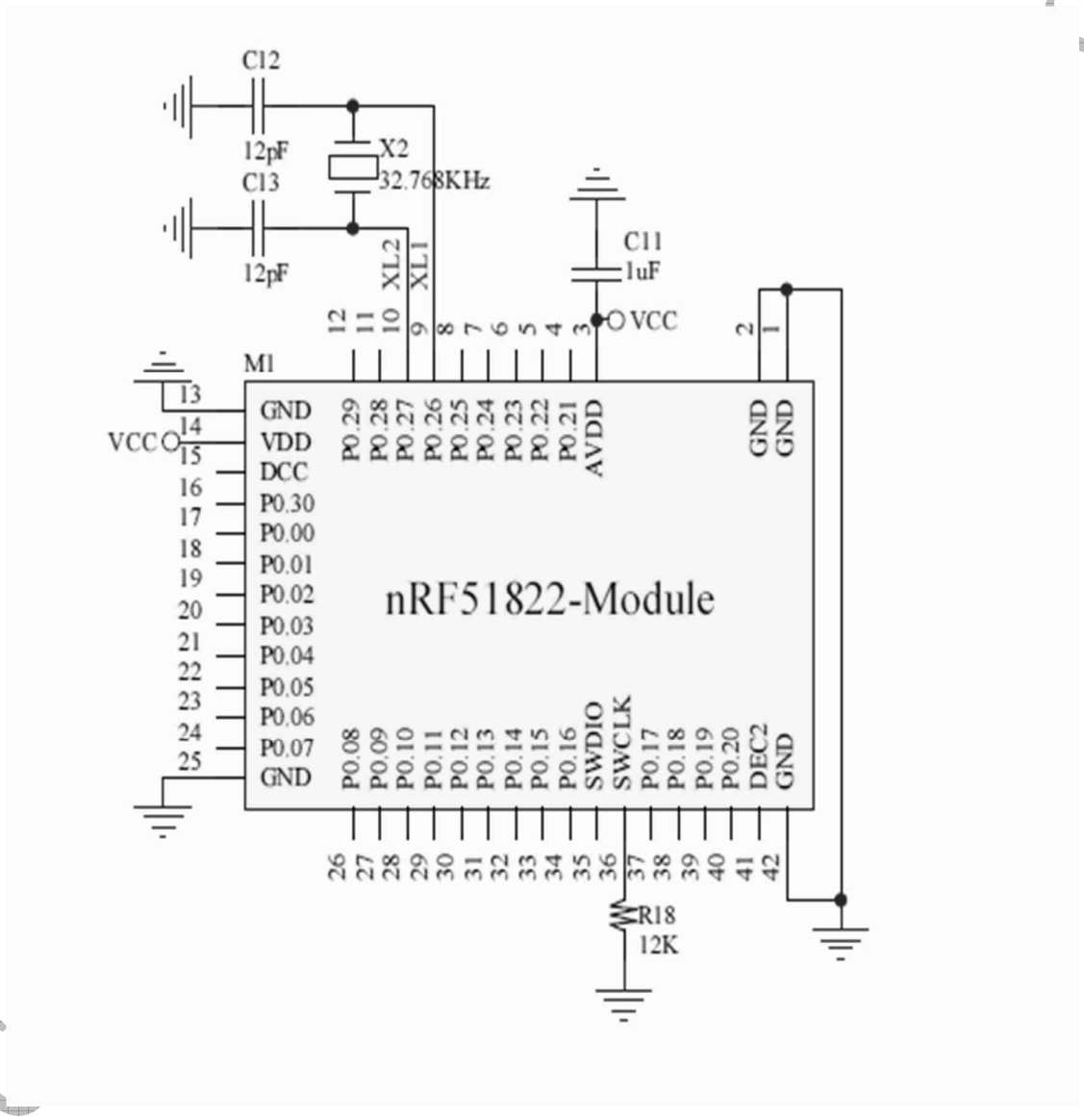
6. Block Diagram



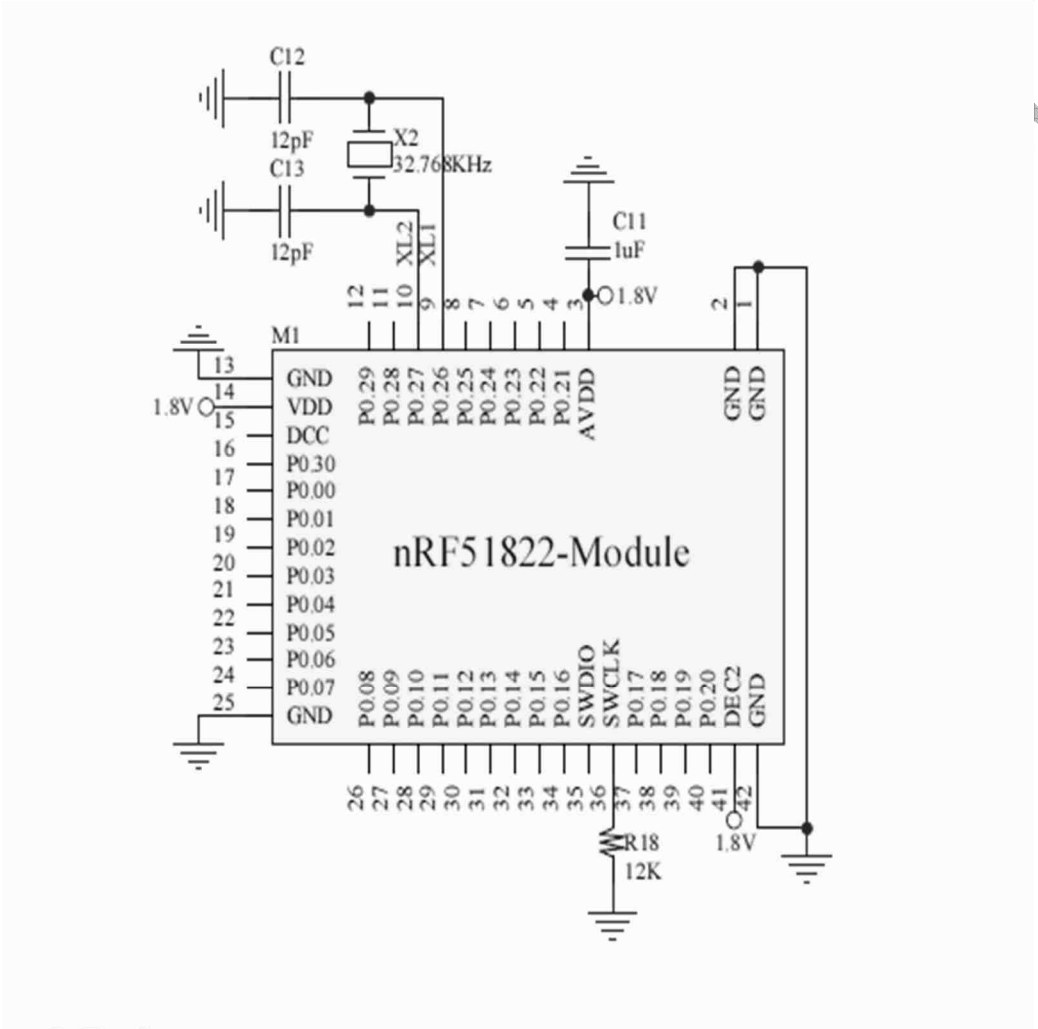
nRF51822 block diagram

7. Reference Circuit

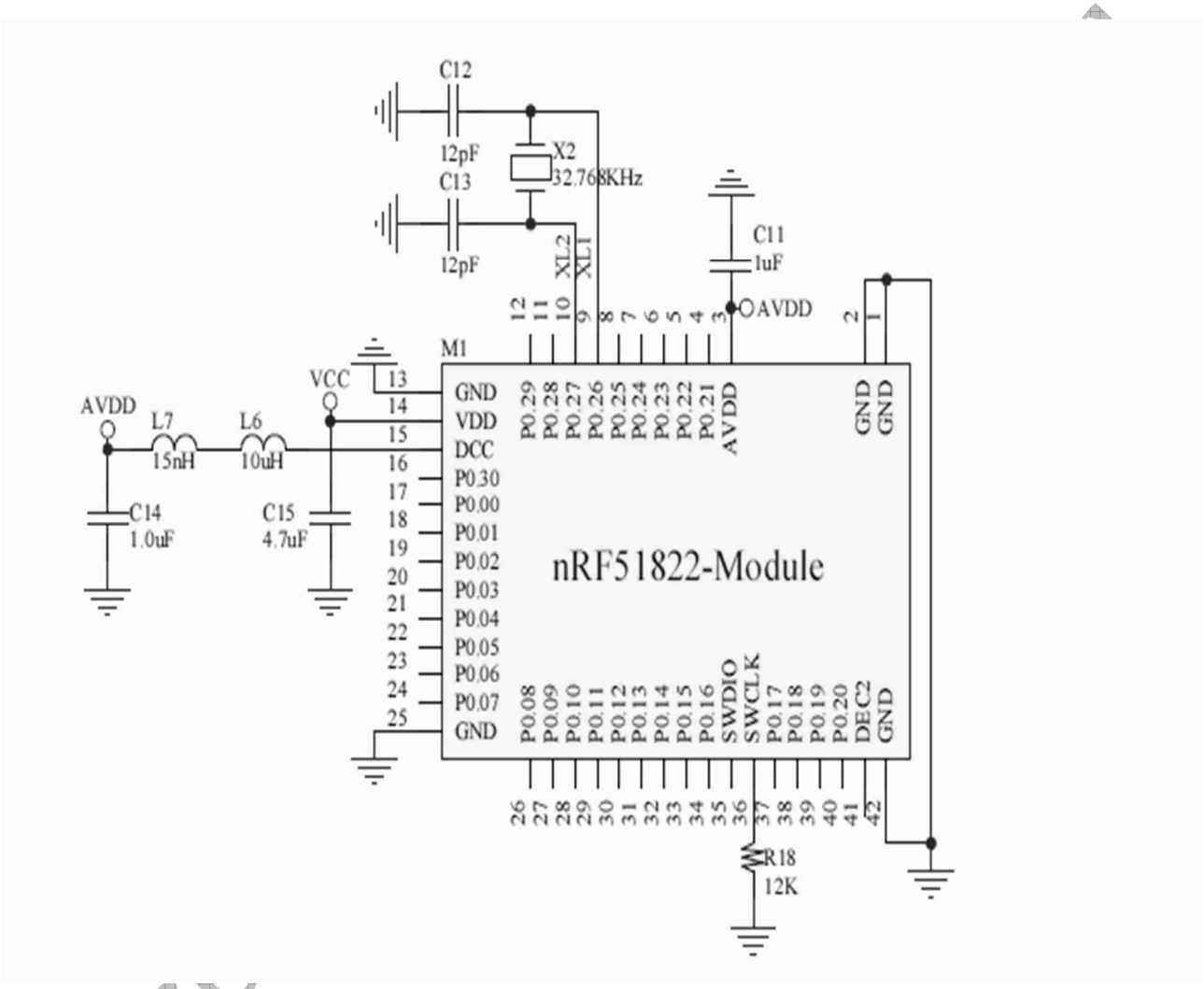
7.1 nRF51822 Schematic with Internal LDO



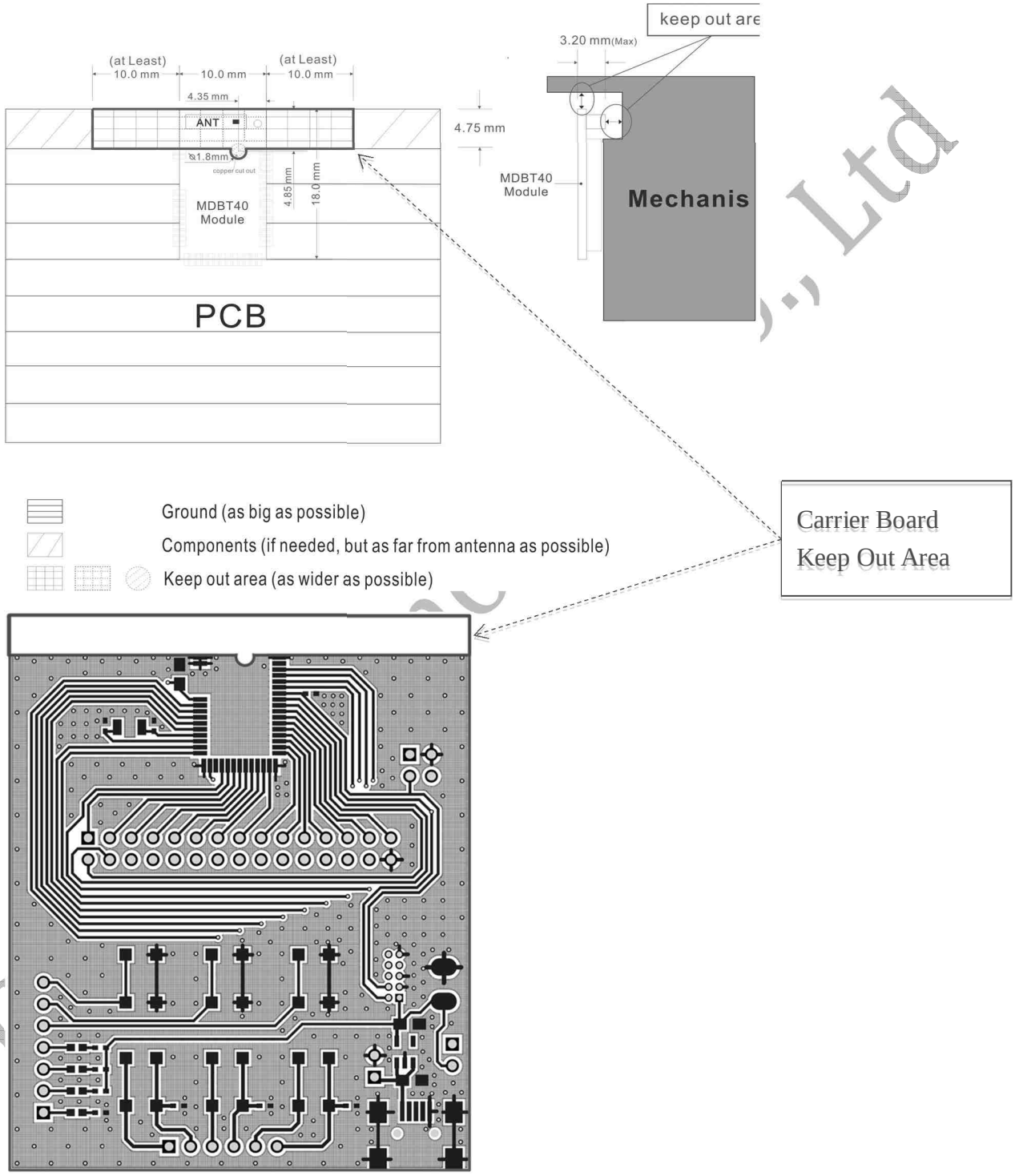
7.2 nRF51822 Schematic with 1.8V Low Voltage Mode



7.3 nRF51822 Schematic with Internal DC/DC Converter



8. Carrier Keep-Out Area



9. nRF51 SDK Support

nRF51 SDK v5.2.0 supports the following:

- **System-on-chips**

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

- **SoftDevices**

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

- **Hardware Boards**

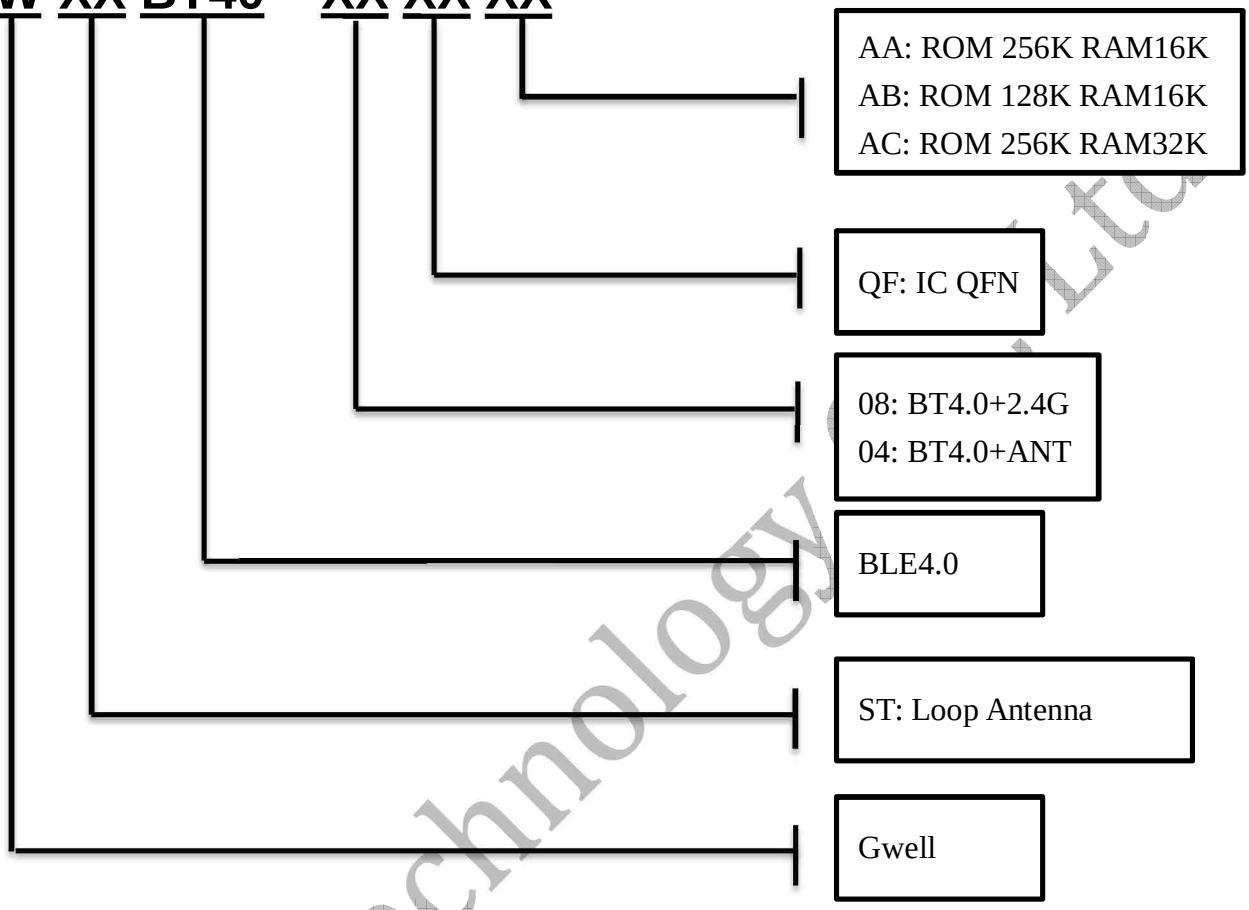
  PCA10000 v1.0 (Only for use with Master Emulator)
  PCA10000 v2.1.0 and 2.2.0
  PCA10001 v2.1.0 and 2.2.0
  PCA10003 v3.0.0
  PCA10004 v2.1.0 and v2.2.0
  PCA10005 v2.1.0 and v2.2.0
  PCA10006 v3.0.0
  PCA10007 v3.0.0

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

Gwell

10. Ordering Information

GW-XX BT40 – XX XX XX



Part Number

GW-STBT40-08QFAB
GW-STBT40-08QFAA
GW-STB40-08QFAC
GW-STBT40-04QFAB
GW-STB40-04QFAA
GW-STB40-04QFAC

Manual and Product Labeling Information To the End User

The end user manual shall include all required regulatory information /warning as shown in this manual. And when this module is installed in the host product, You must include a " Contains FCC ID:2AEMSGWBTM0-A0" in the label of the host product.

FCC Caution:

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the 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.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

珺崴科技股份有限公司

241 新北市三重區重新路五段 609 巷 14 號 2F-4

2F-4, No.14, Lane 609, Sec 5,Chung Hsin Rd.,

San Chung Dist, New Taipei City, Taiwan, R.O.C.

Tel: 886-2-2999-9152 Fax: 886-2-2999-9153

統一編號: 28896730