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# Approval Sheet

NAME : **BT4.x module**  
P/N : **nano51822-AA (RAM 16K)**

| Approved | Checked | Designed |
|----------|---------|----------|
|          |         |          |

## The Merit of nano51822 Module

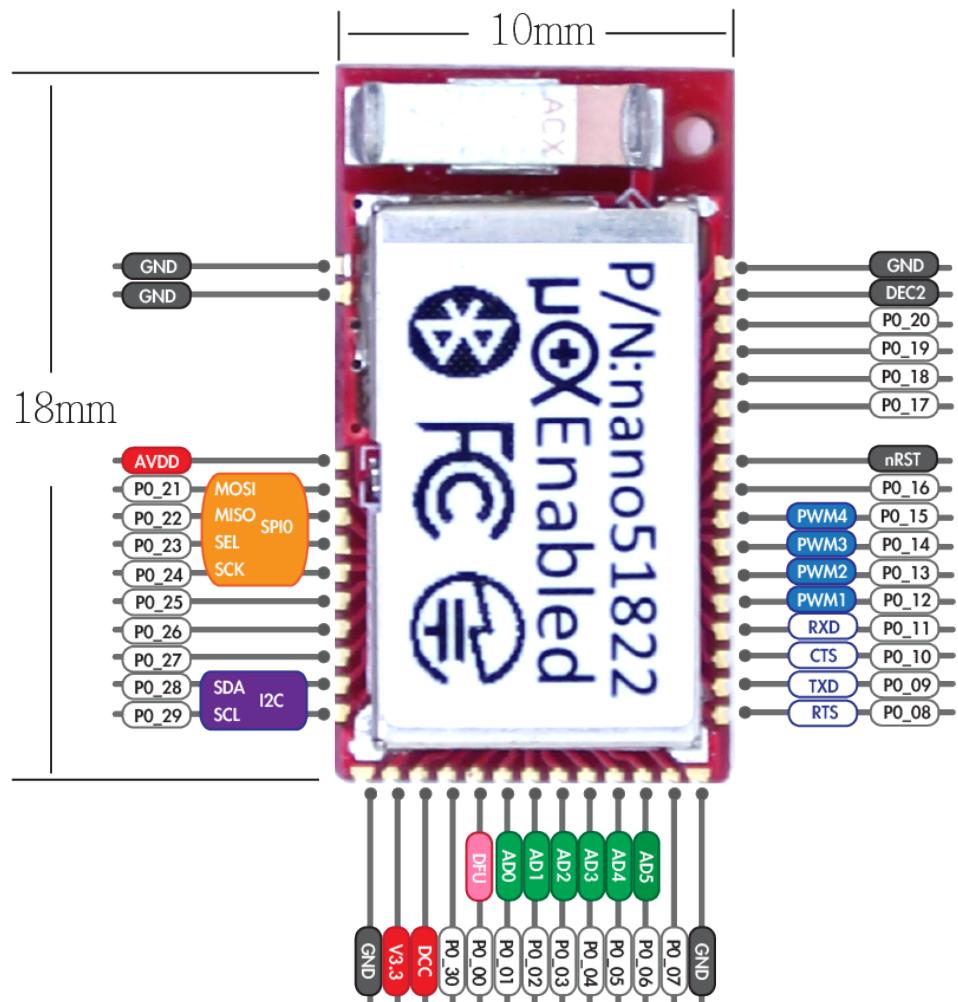
1. Long Working Distance (Over 80M in open space)
2. Declaration ID already included all Nordic applied profiles.
3. Real-Time Operating System Supported.
4. Friendly developer environment.
5. FCC (USA) and Telec (Japan) certificate & CE(EU) granted.

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# 1. Overall Introduction



**uCXpresso.NRF nano51822 is a BT4.1 (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 base of mobile 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

SoT (Smart of Things) : Everything link to smart.

## 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)
- . RTOS 8.1.x ready
- . S110 SoftDevice 7.x ready
- . uCXpresso.NRF RTOS C/C++ Framework enabled.
- . Friendly and Free LPCXpresso IDE supported. (for Windows, Linux and OS/X)
- . Memory
  - . 152kb embedded flash memory for User's App.
  - . 6kb RAM memory for User's App.
- . 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- 6 configurable channels
- . 30 General Purpose I/O Pins
- . One 16 bit timers with timer mode
- . SPI Master
- . Two-wire Master (I2C compatible)
- . UART (CTS/RTS)
- . AES HW encryption
- . Real Timer Counter (RTC)

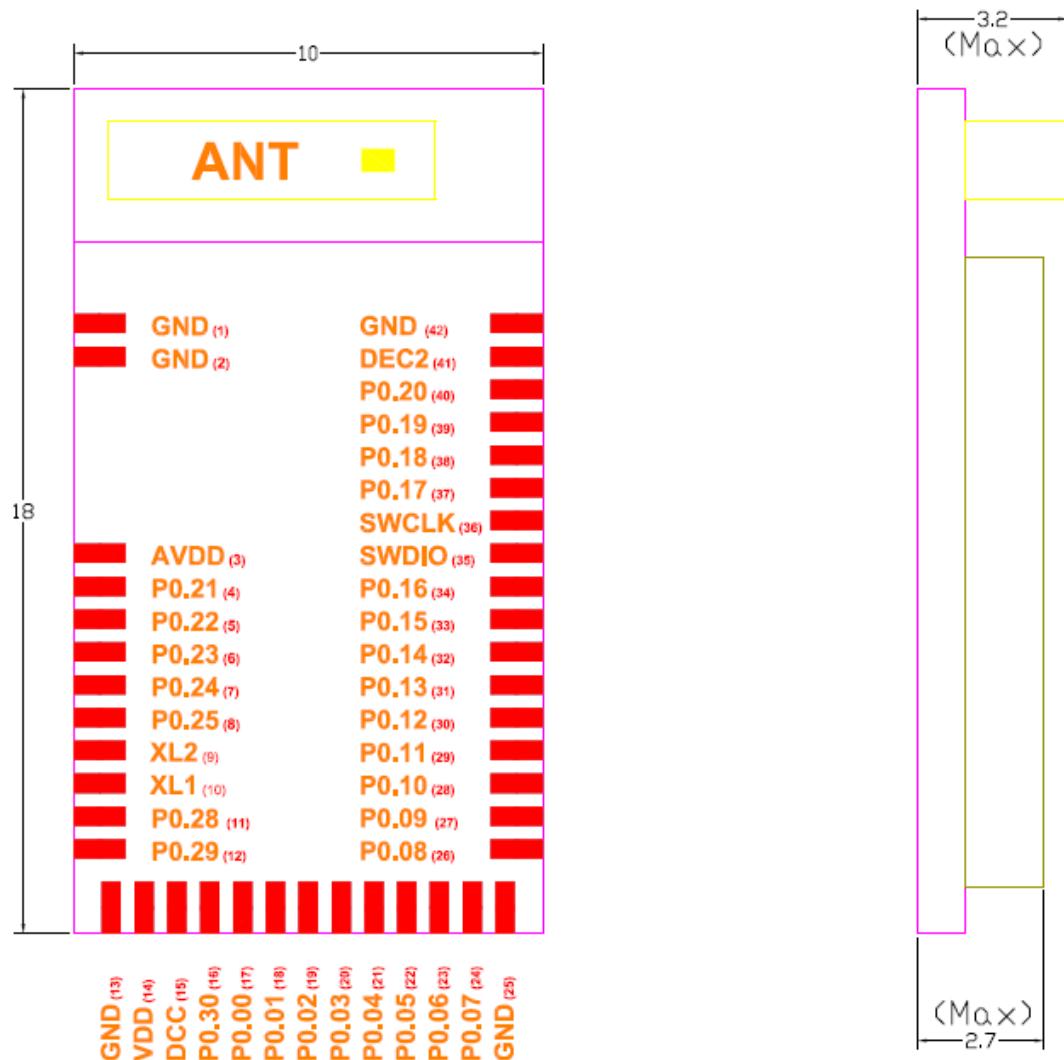
## 1.3 Profile and Service Information

| Adopted Profile           | Adopted Services   | Supported |
|---------------------------|--|-----------|
| HID over GATT             | HID<br>Battery<br>Device Information                     | YES       |
| Heart Rate Monitor        | Heart Rate<br>Device Information                         | YES       |
| Proximity                 | Link Loss<br>Immediate Alert<br>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<br>Next DST Change<br>Reference Time Update | YES       |
| Find Me                   | Immediate Alert  | YES       |
| Cycling speed and cadence | Cycling speed and cadence<br>Device information          | YES       |
| Running speed and cadence | Running speed and cadence<br>Device information          | YES       |

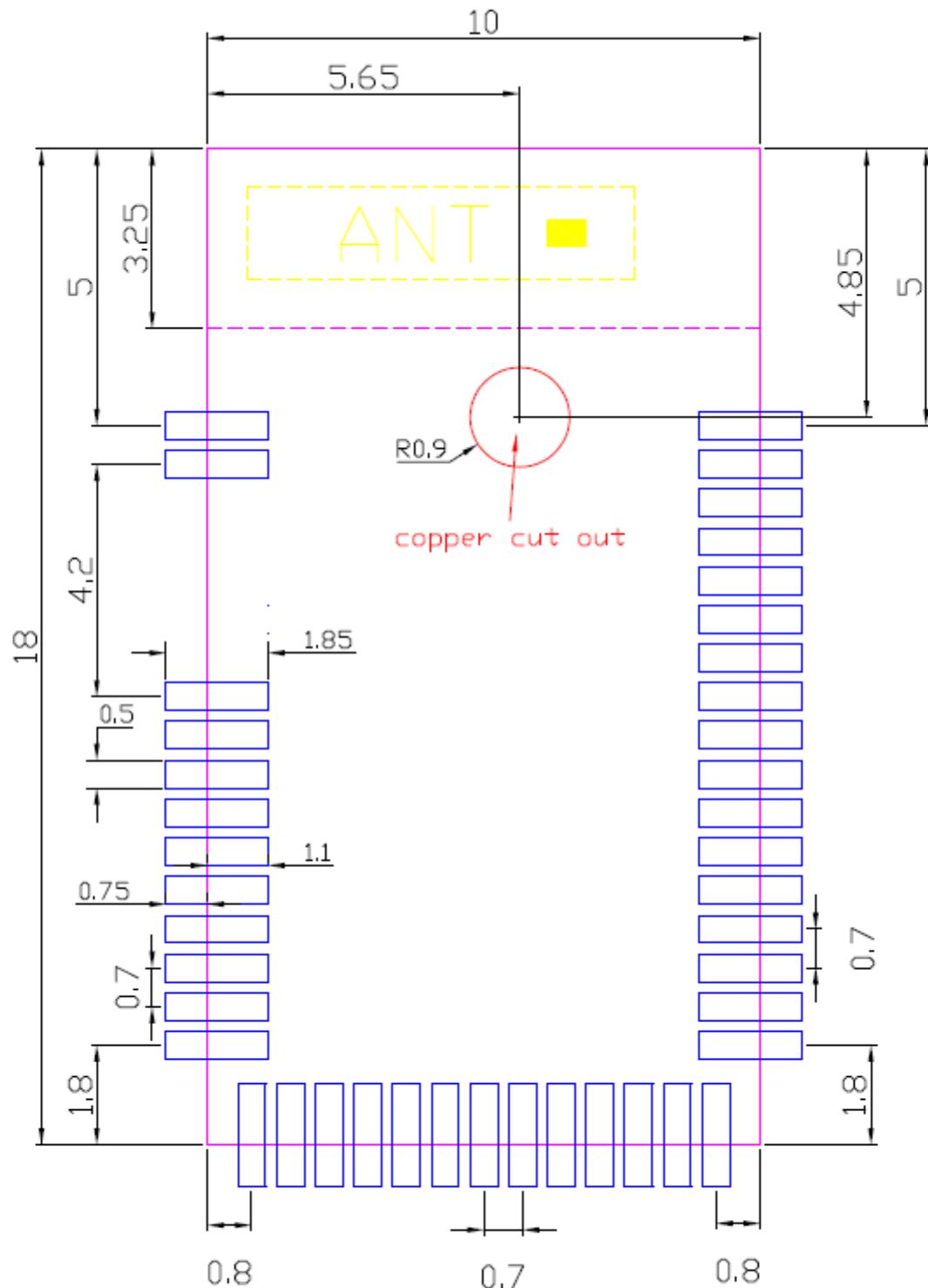
## 2. Product Dimension

### 2.1 PCB Dimensions, & Pin Indication & Layout Guide

PCB SIZE : 10 x18 (mm)



T □ P 單位(mm)



Top View (單位:mm)  
recommended solder pad layout

## 2.2 Pin Assignment

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

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

<sup>1</sup> Digital I/O pad with 5mA source/sink capability.

### 3. SoB (System on Board) Solution

| RF Module            | Crystal Frequency |
|----------------------|-------------------|
| nano51822 SoB Module | 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               |
|--|----------------------------|-------------------|-----------|--------------------|
| <b>Supply voltages</b>   |                            |                   |           |                    |
| VDD  |                            | -0.3              | +3.6      | V                  |
| DEC2 <sup>1</sup>  |                            | 2                 |           | V                  |
| VSS  |                            | 0                 |           | V                  |
| <b>I/O pin voltage</b>   |                            |                   |           |                    |
| VIO  |                            | -0.3              | VDD + 0.3 | V                  |
| <b>Environmental QFN48 package</b>                             |                            |                   |           |                    |
| Storage temperature  |                            | -40               | +125      | °C                 |
| MSL  | Moisture Sensitivity Level |                   | 2         |                    |
| ESD HBM  | Human Body Model           |                   | 4         | kV                 |
| ESD CDM  | Charged Device Model       |                   | 750       | V                  |
| <b>Flash memory</b>  |                            |                   |           |                    |
| 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                                  | <sup>1</sup> | 1.75 | 1.8  | 1.95 | V     |
| t <sub>R_VDD</sub> | Supply rise time (0 V to 1.8 V)                                   | <sup>2</sup> |      |      | 60   | ms    |
| T <sub>A</sub>     | 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        |
| $\Delta f_{250}$ | Frequency deviation @ 250 kbps |                       |           | $\pm 170$ |           | kHz   | 2          |
| $\Delta f_{1M}$  | Frequency deviation @ 1 Mbps   |                       |           | $\pm 170$ |           | kHz   | 2          |
| $\Delta f_{2M}$  | Frequency deviation @ 2 Mbps   |                       |           | $\pm 320$ |           | kHz   | 2          |
| $\Delta f_{BLE}$ | Frequency deviation @ BLE      |                       | $\pm 225$ | $\pm 250$ | $\pm 275$ | 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  $\mu$ s), and when changing mode from RX to TX (130  $\mu$ s).
3. Average current consumption for RX startup (130  $\mu$ s), and when changing mode from TX to RX (130  $\mu$ s).

## 5.3.2 Transmitter Specifications

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

### 5.3.3 Receiver Specifications

| Symbol   | Description                                      | Min. | Typ. | Max. | Units | Test level |
|--|--|------|------|------|-------|------------|
| <b>Receiver operation</b>  |  |      |      |      |       |            |
| PRX <sub>MAX</sub>   | Maximum received signal strength at < 0.1% PER   | 0    |      |      | dBm   | 1          |
| PRX <sub>SENS,2M</sub>   | Sensitivity (0.1% BER) @ 2 Mbps                  | -85  |      |      | dBm   | 2          |
| PRX <sub>SENS,1M</sub>   | Sensitivity (0.1% BER) @ 1 Mbps                  | -90  |      |      | dBm   | 2          |
| PRX <sub>SENS,250k</sub>   | Sensitivity (0.1% BER) @ 250 kbps                | -96  |      |      | dBm   | 2          |
| P <sub>SENS IT</sub><br>1 Mbps BLE                               | Receiver sensitivity: Ideal transmitter          | -93  |      |      | dBm   | 2          |
| P <sub>SENS DT</sub><br>1 Mbps BLE                               | Receiver sensitivity: Dirty transmitter          | -91  |      |      | dBm   | 2          |
| <b>RX selectivity - modulated interfering signal<sup>1</sup></b> |  |      |      |      |       |            |
| <b>2 Mbps</b>  |  |      |      |      |       |            |
| C/I <sub>CO</sub>  | C/I co-channel                                   | 12   |      |      | dB    | 2          |
| C/I <sub>1ST</sub>   | 1 <sup>st</sup> ACS, C/I 2 MHz                   | -4   |      |      | dB    | 2          |
| C/I <sub>2ND</sub>   | 2 <sup>nd</sup> ACS, C/I 4 MHz                   | -24  |      |      | dB    | 2          |
| C/I <sub>3RD</sub>   | 3 <sup>rd</sup> ACS, C/I 6 MHz                   | -28  |      |      | dB    | 2          |
| C/I <sub>6TH</sub>   | 6 <sup>th</sup> ACS, C/I 12 MHz                  | -44  |      |      | dB    | 2          |
| C/I <sub>NTH</sub>   | N <sup>th</sup> ACS, C/I f <sub>i</sub> > 25 MHz | -50  |      |      | dB    | 2          |
| <b>1 Mbps</b>  |  |      |      |      |       |            |
| C/I <sub>CO</sub>  | C/I co-channel (1 Mbps)                          | 12   |      |      | dB    | 2          |
| C/I <sub>1ST</sub>   | 1 <sup>st</sup> ACS, C/I 1 MHz                   | 4    |      |      | dB    | 2          |
| C/I <sub>2ND</sub>   | 2 <sup>nd</sup> ACS, C/I 2 MHz                   | -24  |      |      | dB    | 2          |
| C/I <sub>3RD</sub>   | 3 <sup>rd</sup> ACS, C/I 3 MHz                   | -30  |      |      | dB    | 2          |
| C/I <sub>6TH</sub>   | 6 <sup>th</sup> ACS, C/I 6 MHz                   | -40  |      |      | dB    | 2          |
| C/I <sub>12TH</sub>  | 12 <sup>th</sup> ACS, C/I 12 MHz                 | -50  |      |      | dB    | 2          |
| C/I <sub>NTH</sub>   | N <sup>th</sup> ACS, C/I f <sub>i</sub> > 25 MHz | -53  |      |      | dB    | 2          |

| Symbol                                     | Description  | Min. | Typ. | Max. | Units | Test level |
|--|--|------|------|------|-------|------------|
| <b>250 kbps</b>                            |  |      |      |      |       |            |
| C/I <sub>co</sub>                          | C/I co-channel   | 4    |      |      | dB    | 2          |
| C/I <sub>1ST</sub>                         | 1 <sup>st</sup> ACS, C/I 1 MHz                               | -10  |      |      | dB    | 2          |
| C/I <sub>2ND</sub>                         | 2 <sup>nd</sup> ACS, C/I 2 MHz                               | -34  |      |      | dB    | 2          |
| C/I <sub>3RD</sub>                         | 3 <sup>rd</sup> ACS, C/I 3 MHz                               | -39  |      |      | dB    | 2          |
| C/I <sub>6th</sub>                         | 6 <sup>th</sup> ACS, C/I $f_i > 6$ MHz                       | -50  |      |      | dB    | 2          |
| C/I <sub>12th</sub>                        | 12 <sup>th</sup> ACS, C/I 12 MHz                             | -55  |      |      | dB    | 2          |
| C/I <sub>Nth</sub>                         | N <sup>th</sup> ACS, C/I $f_i > 25$ MHz                      | -60  |      |      | dB    | 2          |
| <b>Bluetooth Low Energy RX selectivity</b> |  |      |      |      |       |            |
| C/I <sub>co</sub>                          | C/I co-channel   | 10   |      |      | dB    | 2          |
| C/I <sub>1ST</sub>                         | 1 <sup>st</sup> ACS, C/I 1 MHz                               | 1    |      |      | dB    | 2          |
| C/I <sub>2ND</sub>                         | 2 <sup>nd</sup> ACS, C/I 2 MHz                               | -25  |      |      | dB    | 2          |
| C/I <sub>3+N</sub>                         | ACS, C/I (3+n) MHz offset [n = 0, 1, 2, ...]                 | -51  |      |      | dB    | 2          |
| C/I <sub>Image</sub>                       | Image blocking level   | -30  |      |      | dB    | 2          |
| C/I <sub>Image±1MHz</sub>                  | Adjacent channel to image blocking level ( $\pm 1$ MHz)      | -31  |      |      | dB    | 2          |
| <b>RX intermodulation<sup>2</sup></b>      |  |      |      |      |       |            |
| P_IMD <sub>2Mbps</sub>                     | IMD performance, 2 Mbps, 3rd, 4th and 5th offset channel     | -41  |      |      | dBm   | 2          |
| P_IMD <sub>1Mbps</sub>                     | IMD performance, 1 Mbps, 3rd, 4th and 5th offset channel     | -40  |      |      | dBm   | 2          |
| P_IMD <sub>250kbps</sub>                   | IMD performance, 250 kbps, 3rd, 4th and 5th offset channel   | -36  |      |      | dBm   | 2          |
| P_IMD <sub>BLE</sub>                       | 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:<br>-50 dBm and<br>-80 dBm |      |      | ±6   | dB    | 2          |
| $RSSI_{RESOLUTION}$ | RSSI resolution                                |  |      | 1    |      | dB    | 1          |
| $RSSI_{PERIOD}$     | Sample period                                  |  | 8.8  |      |      | μs    | 1          |
| $RSSI_{CURRENT}$    | Current consumption<br>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,<br>Executing code from flash memory |      | 4.4 <sup>1</sup> |      | mA    | 2          |
| $I_{CPU, RAM}$   | Run current at 16 MHz,<br>Executing code from RAM          |      | 2.4 <sup>2</sup> |      | mA    | 1          |
| $I_{START, CPU}$ | CPU startup current  |      | 600              |      | μA    | 1          |
| $t_{START, CPU}$ | IDLE to CPU execute  | 0    | 3                |      | μs    | 1          |

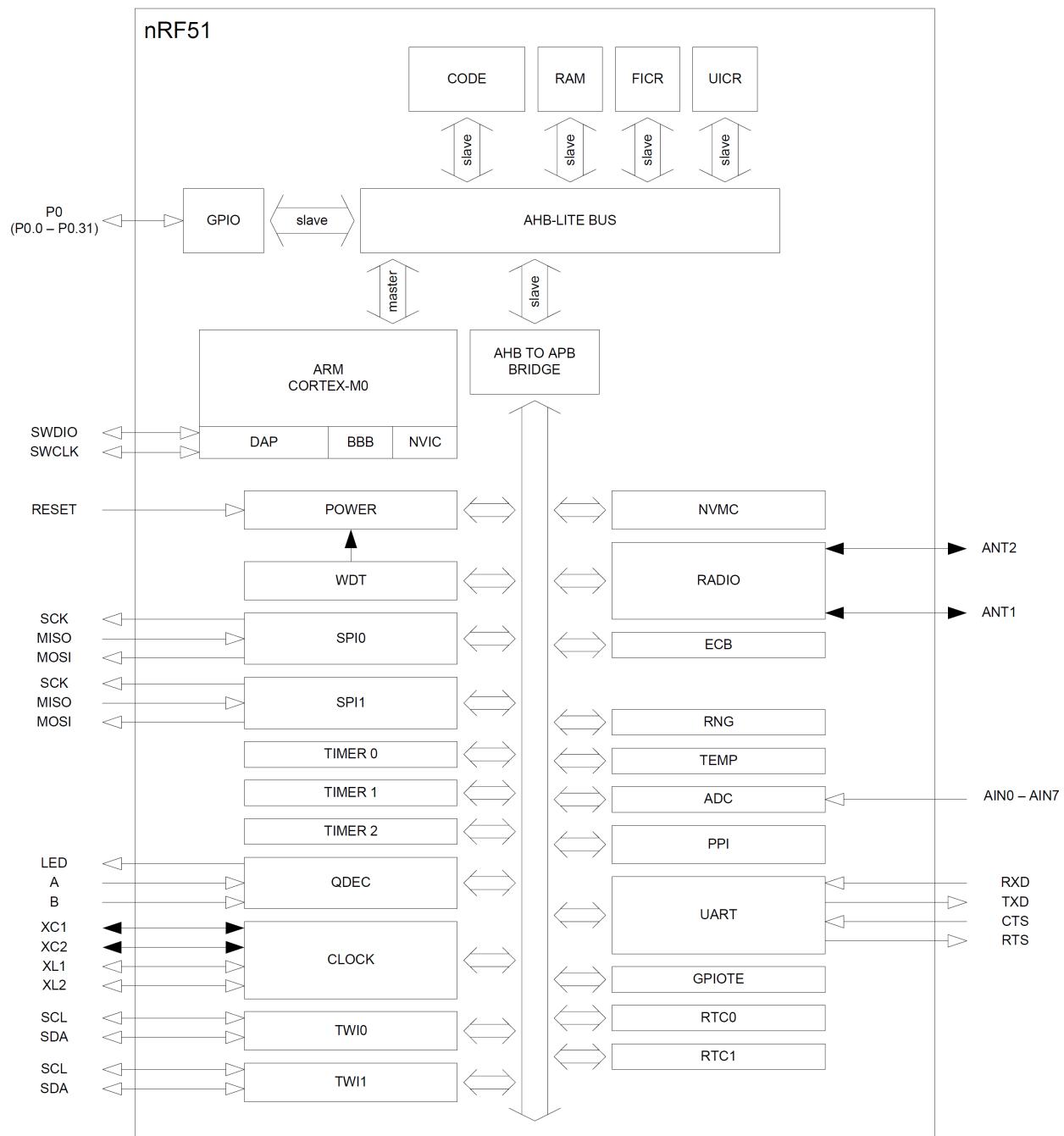
## 5.3.7 Power Management

| 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 $\mu s$ 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              |      | $\mu A$ | 1          |
| $I_{OFF, 8 k}$    | Current in SYSTEM-OFF mode 8 kB SRAM retention                                    |              |      | 0.6              |      | $\mu A$ | 1          |
| $I_{OFF, 16 k}$   | Current in SYSTEM-OFF mode 16 kB SRAM retention                                   |              |      | 0.8              |      | $\mu A$ | 1          |
| $I_{OFF2ON}$      | OFF to CPU execute transition current   |              |      | 400              |      | $\mu A$ | 1          |
| $t_{OFF2ON}$      | OFF to CPU execute  |              | 9.6  | 10.6             |      | $\mu s$ | 1          |
| $I_{ON}$          | SYSTEM-ON base current  |              |      | 2.3              |      | $\mu A$ | 2          |
| $I_{1V2}$         | Current drawn by 1V2 regulator  |              |      | 290              |      | $\mu A$ | 2          |
| $t_{1V2}$         | Startup time for 1V2 regulator  |              |      | 2.3              |      | $\mu s$ | 1          |
| $I_{1V7}$         | Current drawn by 1V7 regulator  |              |      | 90               |      | $\mu A$ | 2          |
| $t_{1V7}$         | Startup time for 1V7 regulator  |              |      | 2                | 3.6  | $\mu s$ | 1          |
| $I_{1V2RC16}$     | Current drawn by 1V2 regulator and 16 MHz RCOSC when both are on at the same time | See Table 24 |      | 830 <sup>1</sup> |      | $\mu A$ | 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 <sup>1</sup> |                  | $\mu A$ | 1          |
| $I_{DCDC}$       | Current drawn by DC/DC converter   |              |                   | 300              |                  | $\mu A$ | 1          |
| $F_{DCDC}$       | DC/DC converter current conversion factor  |              | 0.65 <sup>2</sup> |                  | 1.2 <sup>2</sup> |         | 1          |
| $t_{START,DCDC}$ | DC/DC converter startup time   |              | 10 <sup>2</sup>   |                  | 425 <sup>2</sup> | $\mu s$ | 1          |

1. This number includes the current used by the automated power and clock management system.
2.  $I_{DCDC}$  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



**nano51822 block diagram**

## 7. Antenna

### **AT7020 Series** **Multilayer Chip Antenna**



#### Features

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

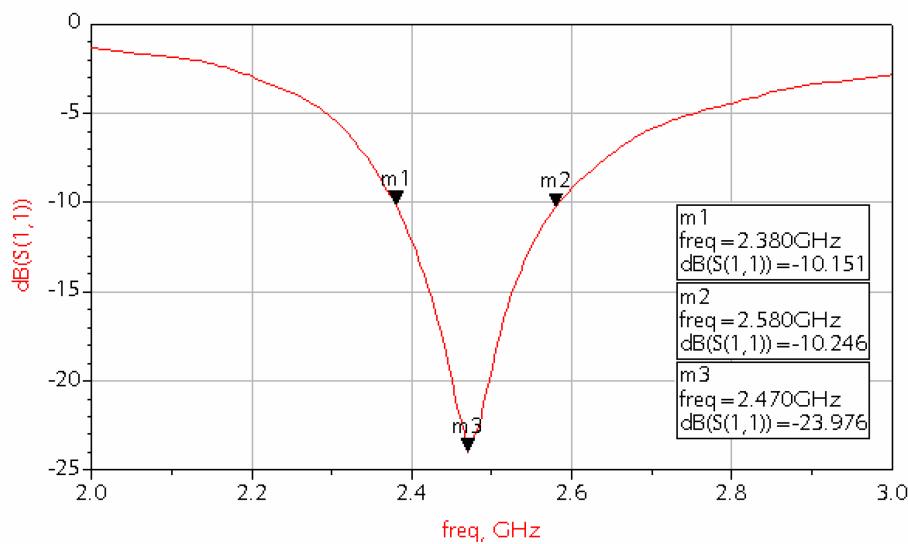
#### Applications

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

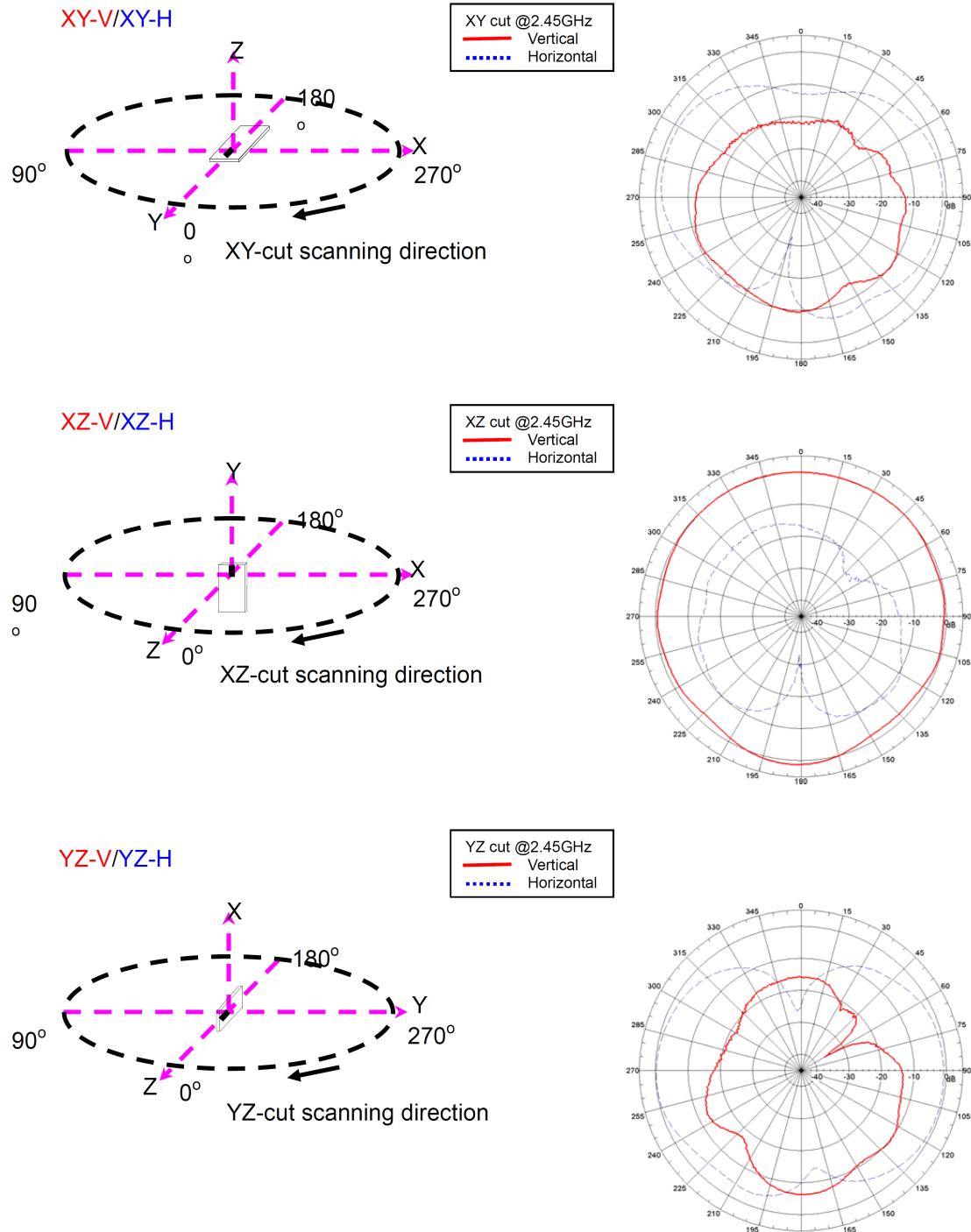
#### Specifications

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

- ❖ Return Loss/With Matching Circuits

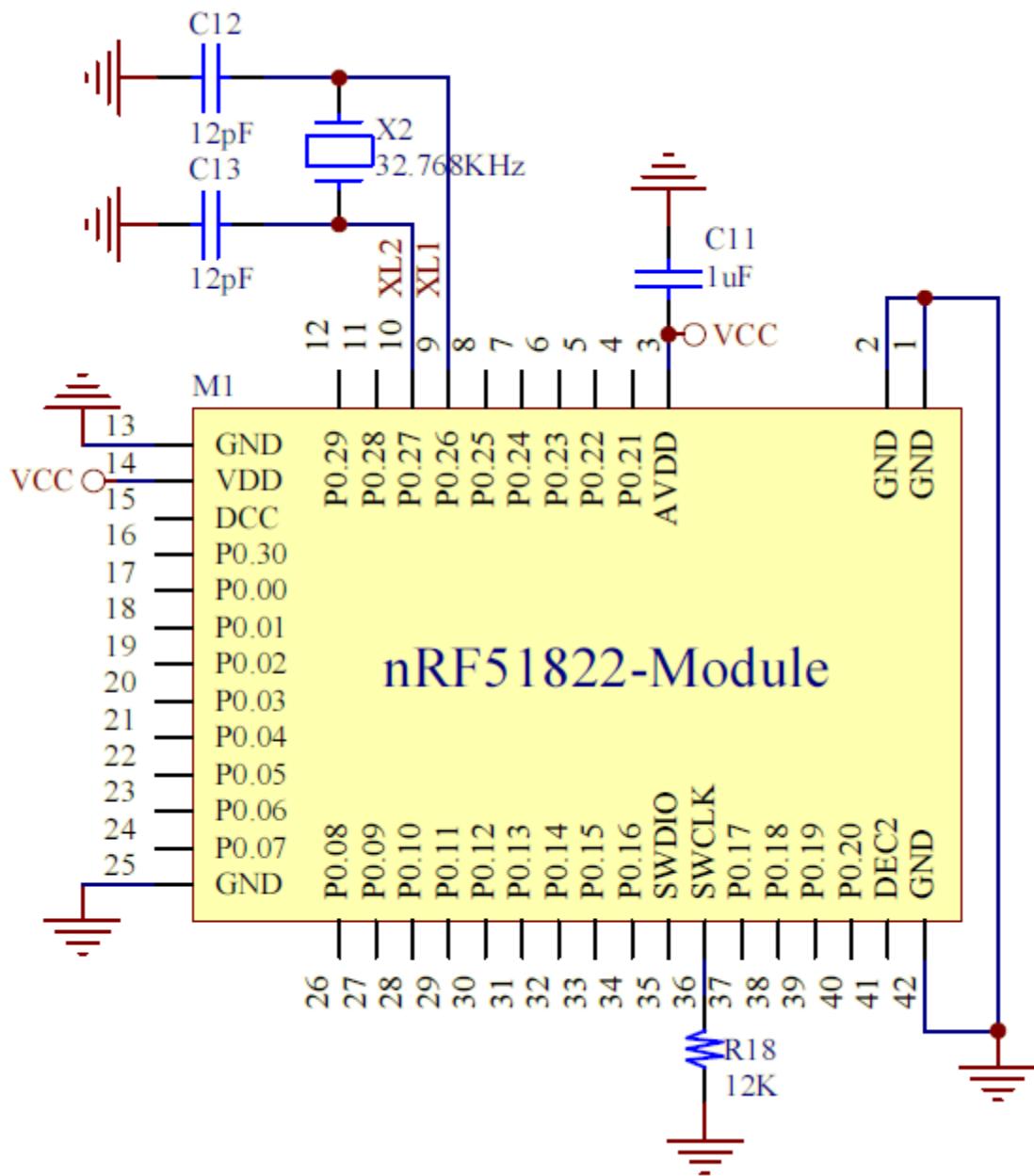


### ❖ Radiation Patterns

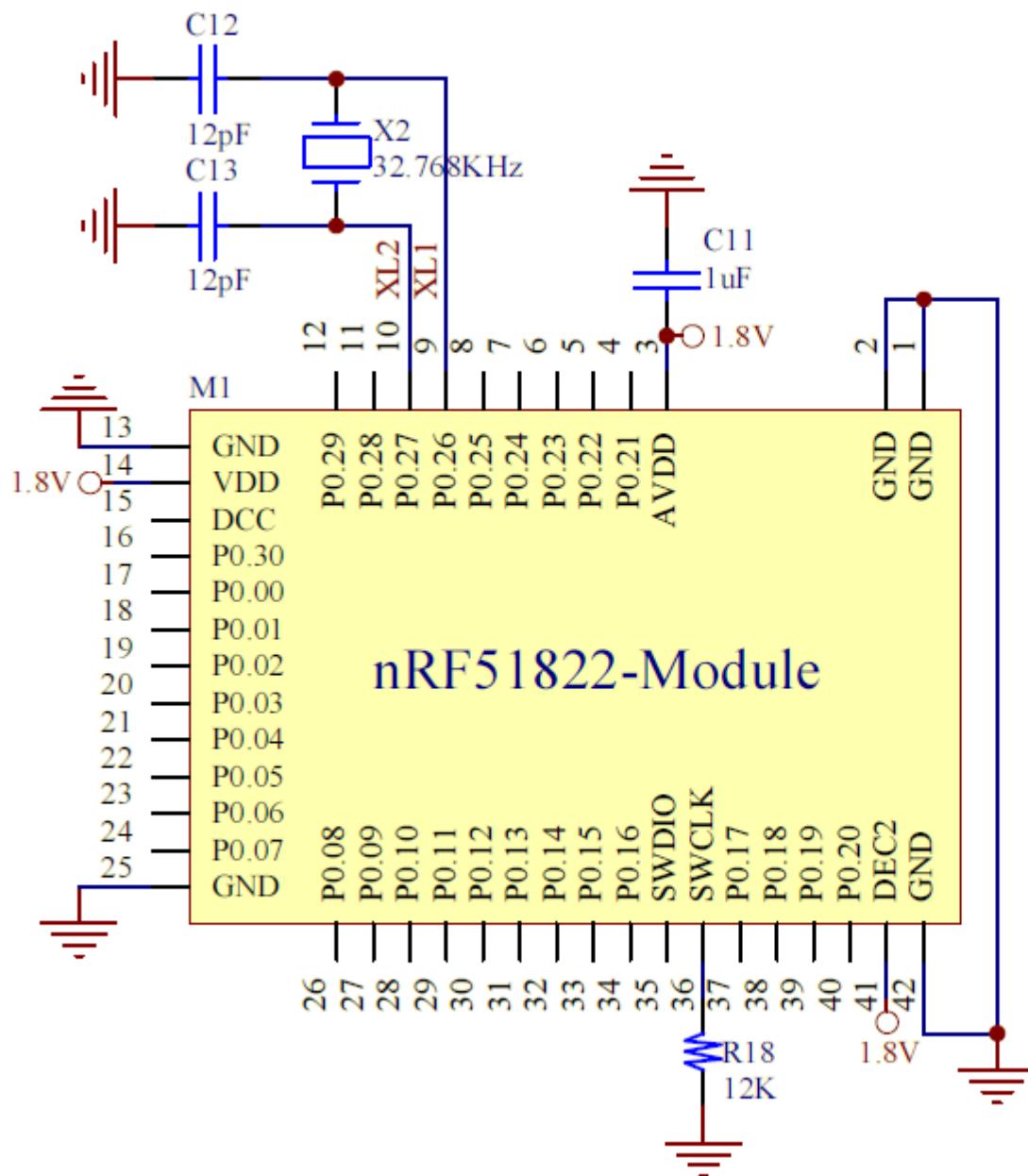


## 8. Reference Circuit

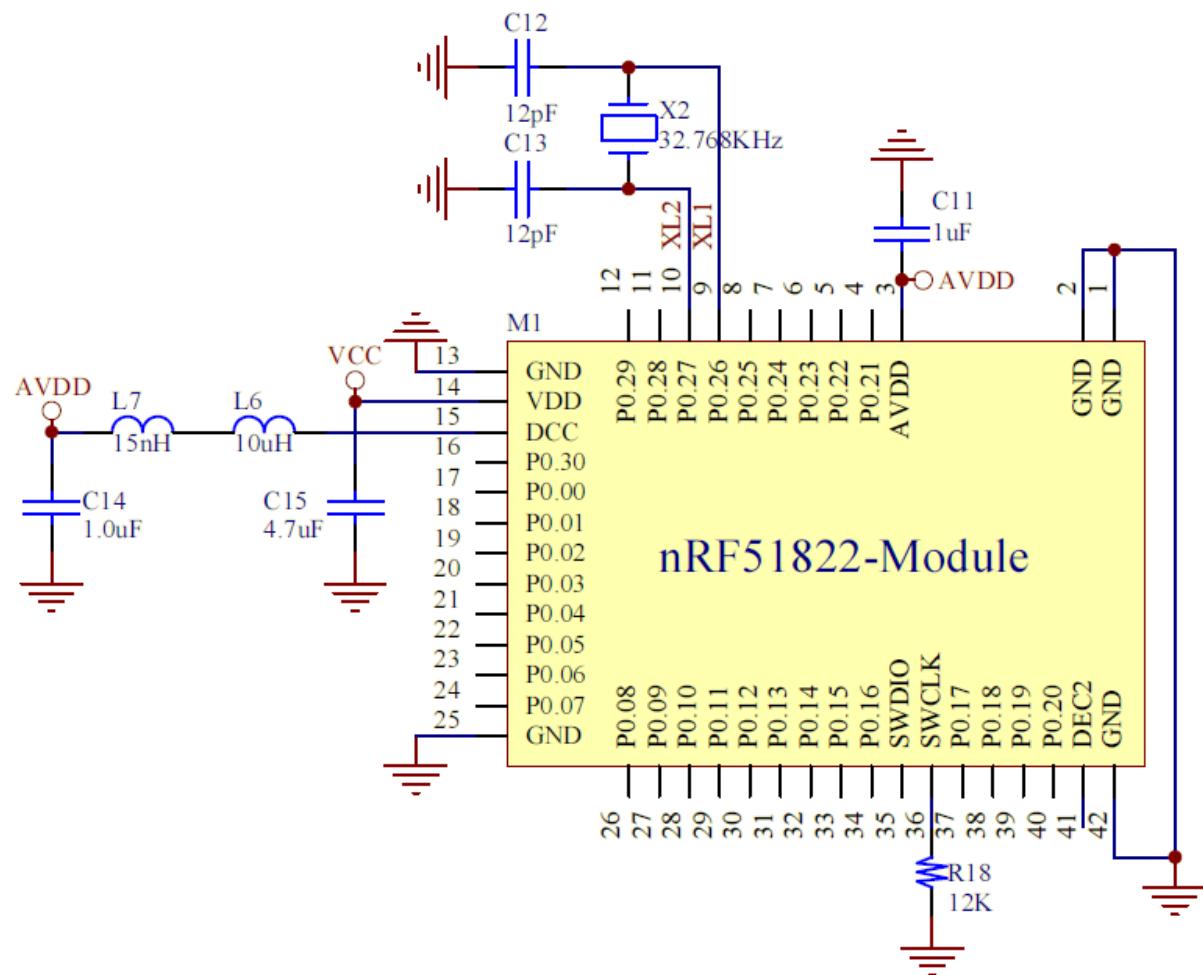
### 8.1 nano51822 Schematic with external LDO



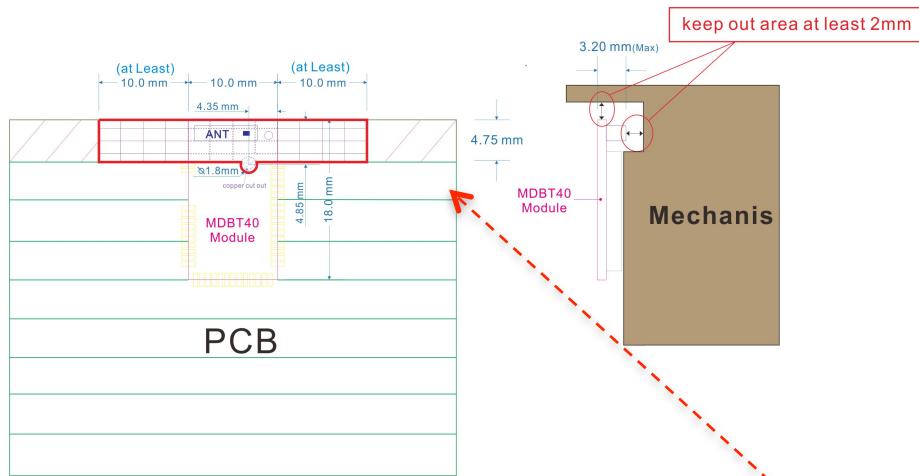
## 8.2 nano51822 Schematic with 1.8V Low Voltage Mode



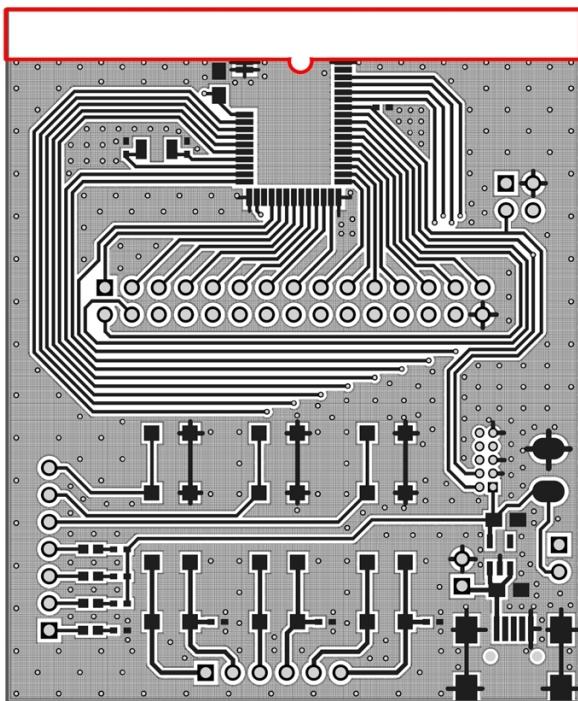
## 8.3 nano51822 Schematic with Internal DC/DC Converter



## 9. Carrier Keep-Out Area



- [Ground Plane] Ground (as big as possible)
- [Component Silhouette] Components (if needed, but as far from antenna as possible)
- [Red Border] Keep out area (as wider as possible)



Carrier Board  
Keep Out Area

## 10. Current Consumption Reference Data (BT3.0 VS BT4.0)

| Mouse Power Consumption  |                            |                              |                    |
|--|----------------------------|------------------------------|--------------------|
|  | BT4.0 (Based on nano51822) |                              | 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 nano51822) |                              | BT3.0 @3V          |
|  | BT4.0 Mode @ 1.5V          | RF2.4GHz @1.5V               |                    |
| Active-Mouse moving<br>(4.3%)<br>(7.5ms report rate)             | 5.4 mA<br>8.1 mW           | 5.8 mA<br>8.7 mW             | 8.7 mA<br>26.1 mW  |
| Rest 1>1s (4.1%)<br>Link maintained<br>Sensor latency: 20ms      | 900 uA<br>1.35 mW          | 350 uA<br>No link<br>1.05 mW | 1.24 mA<br>3.72 mW |
| Rest 2>10 sec (4.9%)<br>Link maintained<br>Sensor latency: 100ms | 680 uA<br>1.02 mW          | 120 uA<br>198 uW             | 900 uA<br>2.7 mW   |
| Rest 2d>60 sec<br>Link maintained<br>Sensor latency: 100ms       | 120 uA<br>180 uW           | 120 uA<br>198 uW             | 900 uA<br>2.7 mW   |
| Rest 3>600s (86.3)<br>Link disconnected<br>Sensor latency: 500ms | 90 uA<br>135 uW            | 90 uA<br>135 uW              | 797 uA<br>2.3 mW   |

| Keyboard Power Consumption            |                            |                  |                             |
|---------------------------------------|----------------------------|------------------|-----------------------------|
|                                       | BT4.0 (Based on nano51822) |                  | BT3.0 @3V                   |
|                                       | BT4.0 Mode @3V             | RF2.4GHz @3V     |                             |
| Active<br>6 letters/s                 | 200 uA                     | 5.8 mA<br>8.7 mW | 8.7 mA<br>26.1 mW           |
| Rest 1<br>Maintain link               | 20 - 40 uA                 | NA               | 20 - 40 uA                  |
| Rest 2<br>after>1min,<br>disconnected | 0.8 uA                     | 0.8 uA           | 2 uA<br>Only when PC is off |

# 11. BT 4.0 Product Certification Cost Comparison Chart

## BT 4.0 Product Safety & Certification Cost Comparison List

| (First Certification Application) |  |  |
|-----------------------------------|--|--|
|                                   | Chip On Board To Build Up Finished Product   | Apply Raytac Module MDBT40 To Build Up Finished Product  |
| <b>Declaration ID</b>             | US\$8,000  | US\$8,000  |
| <b>BQB Test</b>                   | US\$7,000  | US\$0  |
| <b>USA FCC Test for BT4.0</b>     | US\$3,600  |  |
| <b>*USA FCC Test for RF</b>       | US\$600  | US\$0  |
| <b>Japan Telec Test for BT4.0</b> | US\$5,500  |  |
| <b>*Japan Telec Test for RF</b>   | US\$5,500  | US\$0  |
| <b>CE Certification</b>           | US\$4,500  | US\$0  |
| <b>Total</b>                      | <b>US\$34,700</b>  | <b>US\$8,000</b>   |
| <b>Note:</b>                      | 1. BQB lab handling charge is not included<br>2. Declaration ID cost based on normal application<br>3. * Test for RF refer to 2.4GHz RF(nRF51822) or ANT(nRF51422), can be waived if no need such application.<br>4. Above cost list provided for reference, it may be varied according to different testing lab | 1. BQB lab handling charge is not included<br>2. Declaration ID cost based on normal application<br>3. Above cost list provided for reference, it may be varied according to different testing lab |

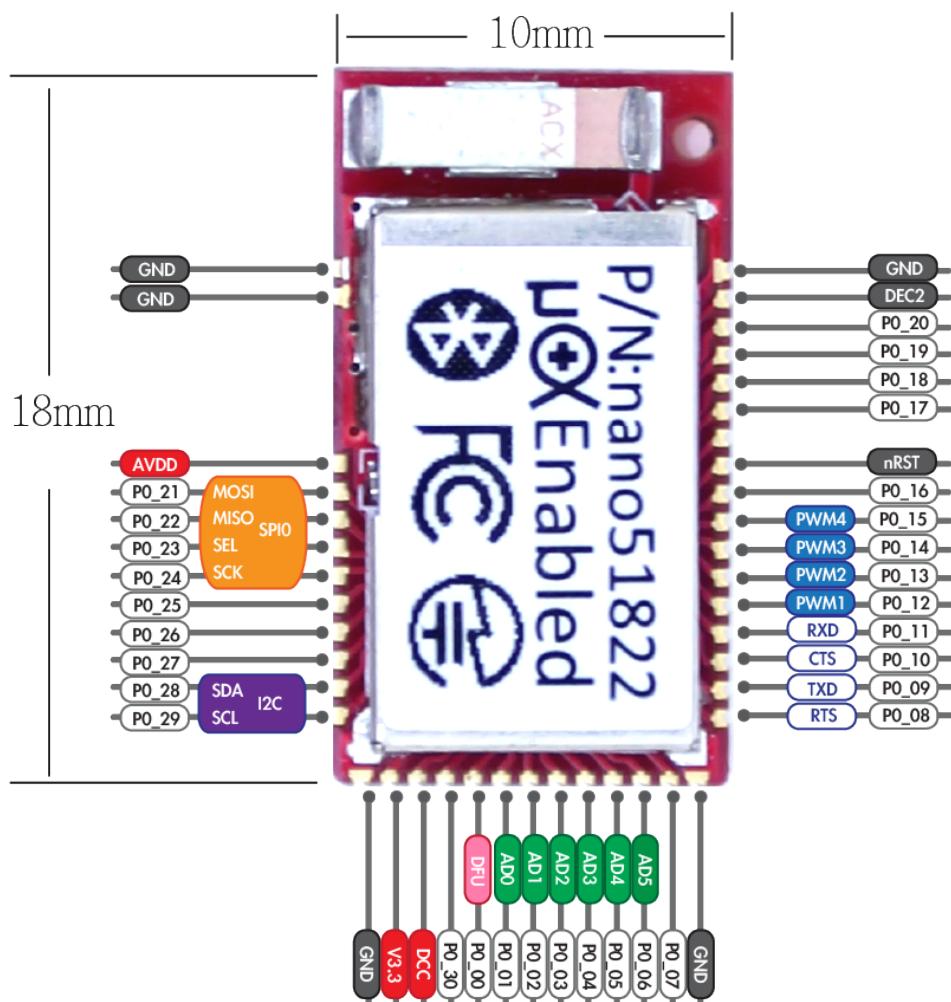
| (Later Series Product Certification Application) |  |  |
|--|--|--|
|  | Chip On Board To Build Up Finished Product   | Apply Raytac Module MDBT40 To Build Up Finished Product  |
| <b>Declaration ID or Product List</b>            | US\$8,000  | US\$0  |
| <b>BQB Test</b>                                  | US\$7,000  | US\$0  |
| <b>USA FCC Test for BT4.0</b>                    | US\$3,600  |  |
| <b>USA FCC Test for RF</b>                       | US\$600  | US\$0  |
| <b>Japan Telec Test for BT4.0</b>                | US\$5,500  |  |
| <b>Japan Telec Test for RF</b>                   | US\$5,500  | US\$0  |
| <b>CE Certification</b>                          | US\$4,500  | US\$0  |
| <b>Total</b>                                     | <b>US\$34,700</b>  | <b>US\$0</b>   |
| <b>Note:</b>                                     | 1. BQB lab handling charge is not included<br>2. Declaration ID cost based on normal application<br>3. * Test for RF refer to 2.4GHz RF(nRF51822) or ANT(nRF51422), can be waived if no need such application.<br>4. Above cost list provided for reference, it may be varied according to different testing lab | 1. BQB lab handling charge is not included<br>2. Declaration ID cost based on normal application<br>3. Above cost list provided for reference, it may be varied according to different testing lab |

## 12. uCXpresso.NRF RTOS C/C++ Framework

### 13.1 Specifications

- Kernel: FreeRTOS v8.1.2 and later
- Driver: S110 SoftDevice 7.0
- OTA DFU support Dropbox and Google Driver
- Rich BLE Class Library
- Rich Peripherals Class Library
- RTOS Class Library

### 13.2 uCXpresso.NRF defined pin assignment



#### GPIO Example Code:

```
CPin led(17); // Set a LED pin on P0.17  
led.output(); // Set led as an output pin
```

## 13.2 Flash Memory Block



nano51822 Memory Block

## 13.3 GitHub Location

<https://github.com/ucxpresso/nano51822>