Rayson

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Approval Sheet

Date : 24-May-2025

Customer	
Part Number	
Description	Bluetooth BLE Module
Customer's Project	
Manufacturer	Rayson Technology Co., Ltd
Model Name	BTM-NL15X

Supplier Level：■New Source □Second Source

Contact Person：_____ Tel：+886-3-5633666

Approval status :

E.E. engineer：_____ □Approval □Reject

M.E. engineer：_____ □Approval □Reject

P.E. engineer：_____ □Approval □Reject

Approval：_____

Accessories：

■ Specification ■ Sample □ Drawing □ Test Report

□ AT Command sets □ Packing Diagram

Revision History

Revision No.	Date	Description
V.0.0	2025/03/03	Draft version.
V.0.1	2025/04/28	Initial version.
V.0.2	2025/05/24	1. Updated module photo 2. Updated 6.Debug & Programming photo

Rayson *Bluetooth® Module*

Nordic nRF54L15 BLE Module BTM-NL15X

Features

Radio

- Bluetooth® 6.0, IEEE 802.15.4 (Thread & Zigbee), 2.4GHz Transceiver.
- -94dBm sensitivity in 1Mbps Bluetooth® low energy (BLE) mode
- -102dBm sensitivity in 125kbps BLE mode (long range)
- +8dBm TX power (down to -8dBm in 1dB steps)
- Supported data rates:
  - Bluetooth 6.0 : 2Mbps, 1Mbps, 500kbps, 125kpcs
  - IEEE 802.15.4-2020 : 250kbps
  - Proprietary 2.4GHz : 4Mbps, 2Mbps, 1Mbps
- RSSI (1dB resolution)
- AoA and AoD direction finding using BLE
- Mesh

MCU

- ARM Cortex–M33, 128MHz
- 1524KB non-volatile memory (RRAM) / 256 kB RAM
- Serial Wire Debug (SWD)

Security

- 128 bit AES/ECB/CCM/AAR co-processor (on-the-fly packet encryption)

Peripherals

- Type 2 NFC-A tag with wake-on field
- 31 general purpose I/O pins
- ADC with up to eight programmable gain channels. 14bit at 31.25ksps, 12bit at 250ksps, and up to 10bit at 2Msps.
- comparator and low-power comparator with wake-up from System OFF mode
- Temperature sensor
- Up to five fully featured serial interfaces with EasyDMA, Supporting I2C, SPI controller/peripheral, and UART
  - One high-speed SPIM up to 32MHz , Four up to 8 MHz
  - I2C up to 400kHz
- Three pulse width modulator (PWM) units with EasyDMA
- I2S two channel Inter-IC sound interface
- Pluse density Modulation (PDM) interface
- Up to two quadrature decoder (QDEC)
- Seven 32-bit timers with counter mode
- Two realtime counters (RTC), and one global RTC(GRTC) That can run in System OFF mode and implement a shared system timer
- Supply voltage range 1.7V to 3.5V
- Small outline.
  BTM-NL15C (with Antenna) : 14.5 x 10.5 x 2.15 mm
  BTM-NL15 (without Antenna) : 11.25 x 10.5 x 2.15 mm

Outline

Applications

- Health / fitness sensor and monitor devices
- Wireless payment enabled devices
- Smart home sensors and controllers
- Industrial IoT sensors and controllers
- Remote controls
- Gaming controllers
- Access Control
- Home Appliances
- Mesh Network
- Asset tracking
- Gateways and hubs
- Digital Key

Specification Summary

Radio		
Protocol	Bluetooth 6.0 IEEE 802.15.4-2020 (THREAD ,Matter and Zigbee) 2.4G proprietary	
Frequency	2.402 GHz to 2.480 GHz for BLE (CH0 to CH39) 2.405 GHz to 2.480 GHz for IEEE 802.15.4-2006 PHY (CH11 to CH26)	
Modulations	1. GFSK at LE-1M 2. GFSK at LE-2M 3. GFSK at LE-Coded(LongRange): 500Kbps,125Kbps	
Nordic proprietary 1Mbps, 2Mbps, 4Mbps modes radio	1. 1Mbps nRF proprietary mode 2. 2Mbps nRF proprietary mode 3. 4Mbps nRF proprietary mode	
Transmit power	+8dBm to –8dBm (in 1 dB steps)	
Receiver sensitivity	-91dBm (2Mbps), -94 dBm (1Mbps), -102dBm (125kbps BLE), -97dBm (500kbps BLE)	
Antenna	BTM-NL15C : Integrated (Chip Antenna) BTM-NL15 : RF IO	
Bluetooth		
Version	BT 6.0 – Single mode	
Security	128bit AES / ECB / CCM / AAR	
Bluetooth LE Features		
Central / Peripheral roles Mesh Networking GATT client & GATT server		LE 2M PHY Channel Sounding LE Codec PHY
NFC		
Frequency	13.56 MHz	
Date rate	106kbps	
Peripherals		
Interfaces	SPI Master / SPI Slave Quad SPI x1 (32MHz) UART Two –Wire Master / Slave (I2C) Global RTC WDT x2 COMP LPCOMP	I2S PWM x3 PDM Analog input 8CH (SAR,8/10/12/14bit) QDEC x2 Timer x7 TEMP GPIO x 31

Hardware	
Power supply	**VDD: 1.7V to 3.5V**
Temperature Range	**-40 to +85°C**
BTM-NL15C Dimensions	
Length	**14.5 mm ± 0.1mm**
Width	**10.5 mm ± 0.1mm**
Height	**2.15 mm ±0.15mm**
BTM-NL15 Dimensions	
Length	**11.25 mm ± 0.1mm**
Width	**10.5 mm ± 0.1mm**
Height	**2.15 mm ±0.15mm**

Ordering Information

The following table provides the BTM-NL15X module ordering information.

Table 11-1. BMT-NL15X Module Ordering Information

Module Part number	Nordic IC	Description	Antenna	Shield
BTM-NL15	nRF54L15	Bluetooth 6.0 BLE module	No (External)	YES
BTM-NL15C	nRF54L15	Bluetooth 6.0 BLE module	Yes (On Board)	YES

General Electrical Specification

Absolute Maximum Ratings:		
Symbol	**Min.**	**Max.**
Supply voltage		
Supply Voltage (VDD)	-0.3V	3.6V
I/O pin voltage ($V_{I/O}$)		
$V_{I/O}$, VDD ≦ 3.5V	-0.3V	VDD + 0.3V
$V_{I/O}$, VDD > 3.5V		3.6V
Environmental		
Storage Temperature	-40 ℃	+105 ℃
Moisture Sensitivity Level (MSL)		2
ESD Human Body Model (HBM)		1KV
ESD Charged Device Model (CDM)		500V
Flash memory		
Endurance	10,000 Write/erase cycles	
Retention at 85℃	10 years	
Retention at 85℃	2 years	

Recommended Operating Condition:			
Symbol	**Min.**	**Nom.**	**Max.**
VDD, Supply voltage	1.7 V	3V	3.5V
VDD, Supply voltage needed during power-on reset	1.75 V		
Operating Temperature range	-40 ℃	+25 ℃	+85 ℃

General Radio Characteristics:					
Symbol	**Description**	**Min.**	**Nom.**	**Max.**	**Units.**
f_{op}	Operating frequencies	2402		2480	MHz
$f_{PLL,CH,SP}$	PLL channel spacing		1.0		MHz
$f_{DELTA,1M}$	Frequency deviation @ 1Mbps		±170		kHz
$f_{DELTA,BLE,1M}$	Frequency deviation @ LE 1Mbps		±250		kHz
$f_{DELTA,2M}$	Frequency deviation @ 2Mbps		±320		kHz
$f_{DELTA,BLE,2M}$	Frequency deviation @ LE 2Mbps		±500		kHz
f_{SKBPS}	On-the-air data rate	125		2000	Kbps
$f_{CHIP,IEEE\ 802.15.4}$	Chip rate in IEEE 802.15.4 mode		2000		Kchip/s

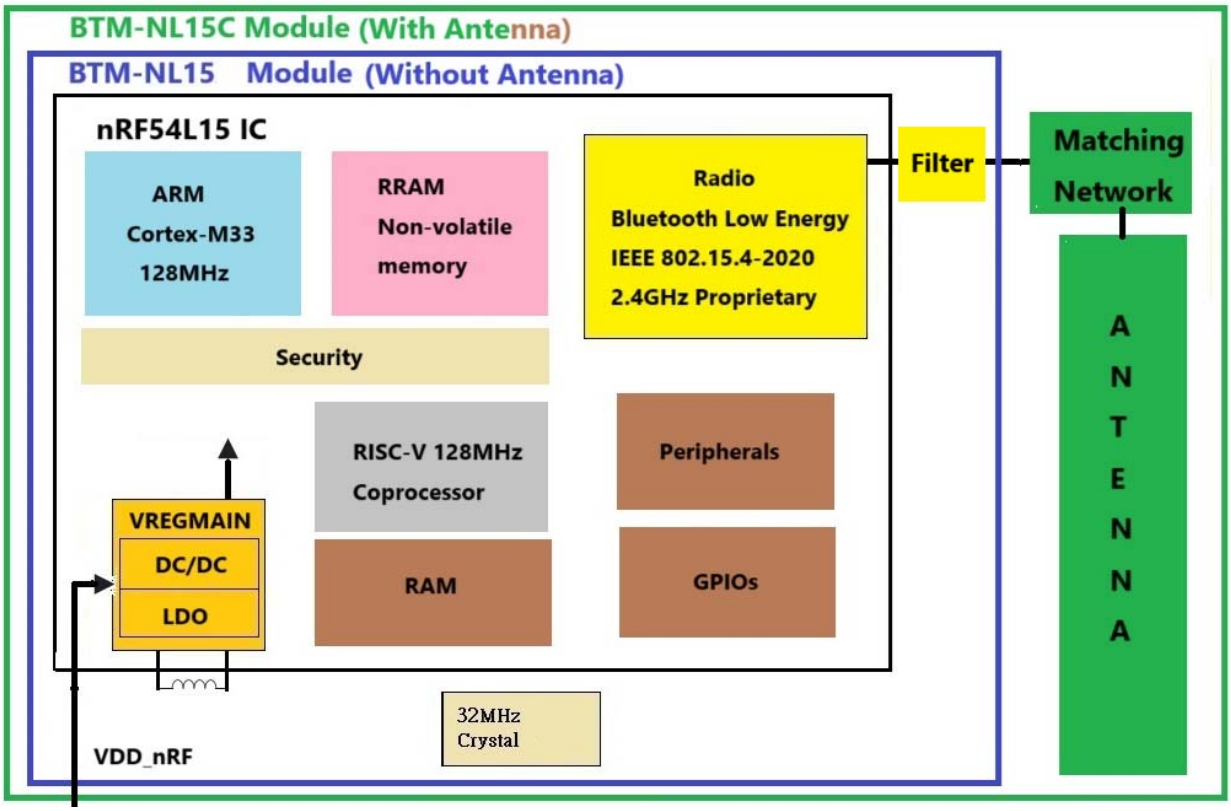
Transmitter Specification:					
Symbol	**Description**	**Min.**	**Nom.**	**Max.**	**Units.**
P_{RF}	Maximum output power	-8	7	+8	dBm
P_{RFCR}	RF power accuracy	-2		+2	dB
$P_{RF1,1}$	1st Adjacent Channel Transmit Power 1MHz (1Mbps)		-25		dBc
$P_{RF2,1}$	2nd Adjacent Channel Transmit Power 2MHz (1Mbps)		-48		dBc
$P_{RF1,2}$	1st Adjacent Channel Transmit Power 2MHz (2Mbps)		-25		dBc
$P_{RF2,2}$	2nd Adjacent Channel Transmit Power 4MHz (2Mbps)		-52		dBc
E_{vm}	Error vector magnitude IEEE 802.15.4		2		%rms
$P_{harm2nd,IEEE\ 802.15.4}$	2nd harmonics in IEEE 802.15.4 mode		-63		dBm
$P_{harm3rd,IEEE\ 802.15.4}$	3rd harmonics in IEEE 802.15.4		-68		dBm

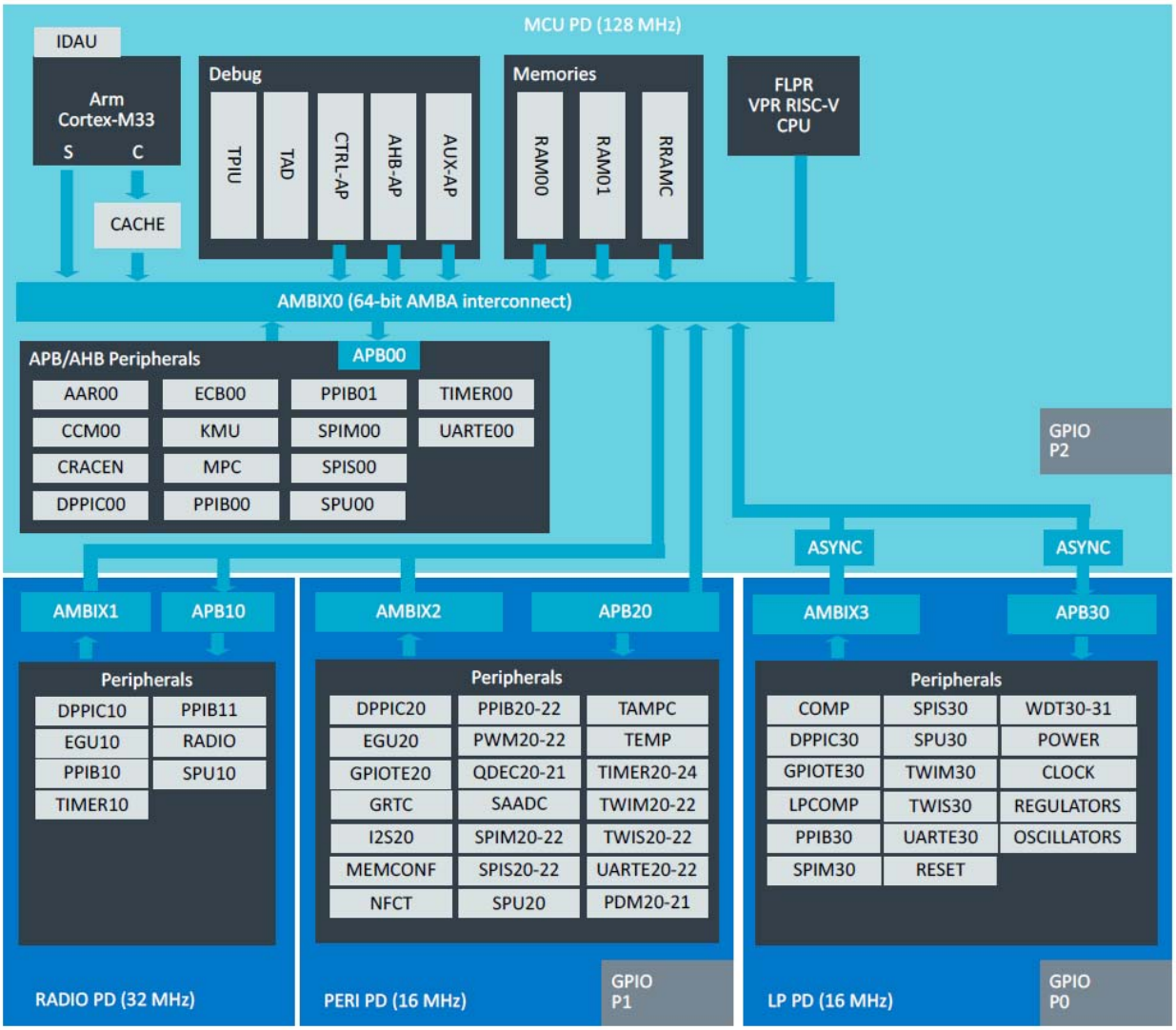
RSSI Specification:					
Symbol	**Description**	**Min.**	**Nom.**	**Max.**	**Units.**
$RSSI_{ACC}$	RSSI accuracy		±2.0		dB
$RSSI_{RESOLUTION}$	RSSI resolution		1.0		dB
$RSSI_{PERIOD}$	RSSI sampling time from RSSI_START task		0.25		us
$RSSI_{SETTLE}$	RSSI settling time after signal level change		15	20	us

Receiver operation:					
Symbol	**Description**	**Min.**	**Nom.**	**Max.**	**Units.**
$P_{RX,MAX}$	Maximum received signal strength at < 0.1% PER		0		dBm
$P_{SENS,IT,1M}$	Sensitivity, 1Mbps nRF mode ideal transmitter		-94		dBm
$P_{SENS,IT,2M}$	Sensitivity, 2Mbps nRF mode ideal transmitter		-91		dBm
$P_{SENS,IT,BLELE125k}$	Sensitivity,125kbps Bluetooth LE mode		-102		dBm
$P_{SENS,IT,BLELE500k}$	Sensitivity,500kbps Bluetooth LE mode		-97		dBm
$P_{SENS,IEEE\ 802.15.4}$	Sensitivity in IEEE 802.15.4 mode		-102		dBm

Radio current consumption :		
Symbol	**TYP**	**Units.**
Active with radio		
Bluetooth LE TX 1Mbps at 0dB ,CW (VDD_nRF =3.0V, DC/DC)	5.4	mA
Bluetooth LE TX 1Mbps at +4dBm ,CW (VDD_nRF =3.0V, DC/DC)	7.9	mA
Bluetooth LE TX 1Mbps at +8dBm ,CW (VDD_nRF =3.0V, DC/DC mode)	12.8	mA
Bluetooth LE RX 1Mbps (VDD_nRF =3.0V, DC/DC mode)	3.6	mA
Bluetooth LE TX 1Mbps at 0dB ,CW (VDD_nRF =3.0V, LDO mode)	13.1	mA
Bluetooth LE TX 1Mbps at +4dBm ,CW (VDD_nRF =3.0V, LDO mode)	20.3	mA
Bluetooth LE TX 1Mbps at +8dBm ,CW (VDD_nRF =3.0V, LDO mode)	33.1	mA
Bluetooth LE RX 1Mbps (VDD_nRF =3.0V, LDO mode)	7.6	mA
Bluetooth LE TX 1Mbps at 0dB ,CW (VDD_nRF =1.8V, DC/DC mode)	7.6	mA
Bluetooth LE TX 1Mbps at +4dBm ,CW (VDD_nRF =1.8V, DC/DC mode)	11.9	mA
Bluetooth LE TX 1Mbps at +8dBm ,CW (VDD_nRF =1.8V, DC/DC mode)	20.4	mA
Bluetooth LE RX 1Mbps (VDD_nRF =1.8V, DC/DC mode)	4.5	mA
Bluetooth LE TX 1Mbps at 0dB ,CW (VDD_nRF =1.8V, LDO mode)	12.9	mA
Bluetooth LE TX 1Mbps at +4dBm ,CW (VDD_nRF =1.8V, LDO mode)	20.1	mA
Bluetooth LE TX 1Mbps at +8dBm ,CW (VDD_nRF =1.8V, LDO mode)	33.1	mA
Bluetooth LE RX 1Mbps (VDD_nRF =1.8V, LDO mode)	7.4	mA
Active with processing		
CPU CoreMark from RRAM with cache	2.4	mA
Sleep		
System ON IDLE with GRTC (XOSC) and 256KB RAM	3.0	uA
System ON IDLE with GRTC (XOSC) and 192KB RAM	2.6	uA
System ON IDLE with GRTC (XOSC) and 96KB RAM	2.0	uA
System OFF with GRTC wakeup	0.8	uA
System OFF	0.6	uA

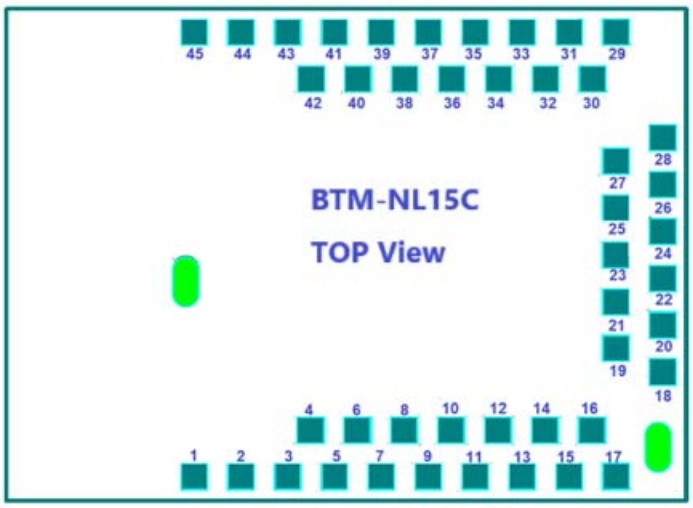
Block Diagram

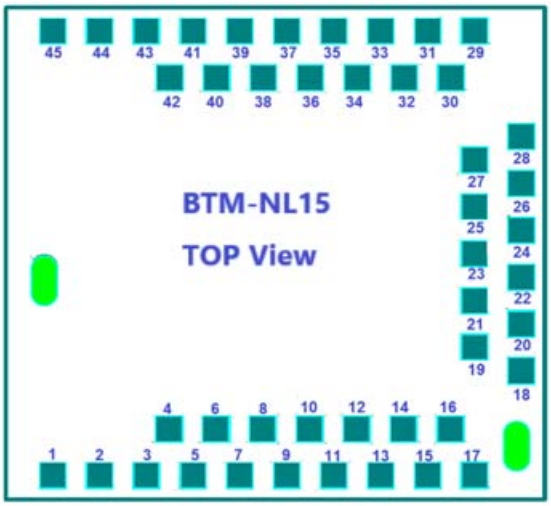




Module Pin Assignments

The functions of the BTM-NL15 and BTM-NL15C modules are the same except for the difference in pin 44; all other pin configurations are identical.





Pin	Pin Name	Pin Function.	Pin Description	Dedicated Function.
1.	GND	Power	Ground	
2.	GND	Power	Ground	
3.	GND	Power	Ground	
4.	P1.09	Digital I/O Digital I/O Digital I/O	General purpose I/O TAMPC active shield 2 output RADIO DEFGPIO	 TAMPC RADIO
5.	DECA	Power	Do not connect to other devices	
6.	P1.10	Digital I/O Digital I/O Digital I/O	General purpose I/O TAMPC active shield 2 input RADIO DEFGPIO	 TAMPC RADIO
7.	P1.12/AIN5/CK #CK(Clock pin)	Digital I/O Digital I/O Digital I/O Analog input	General purpose I/O TAMPC active shield 3 input RADIO DEFGPIO Analog input	 TAMPC RADIO
8.	P1.11/AIN4/CK #CK(Clock pin)	Digital I/O Digital I/O Digital I/O Analog input	General purpose I/O TAMPC active shield 3 output RADIO DEFGPIO Analog input	 TAMPC RADIO
9.	P1.13/AIN6	Digital I/O Digital I/O Analog input	General purpose I/O RADIO DEFGPIO Analog input	 RADIO
10.	P1.14/AIN7	Digital I/O	General purpose I/O	

		Digital I/O Analog input	RADIO DEFGPIO Analog input	RADIO
11.	P1.02/NFC1	Digital I/O NFC input	General purpose I/O NFC antenna connection	
12.	P1.01/XL2	Digital I/O Analog input	General purpose I/O Connection for 32.768kHz crystal	
13.	GND	Power	Ground	
14.	P1.00/XL1	Digital I/O Analog input	General purpose I/O Connection for 32.768kHz crystal	
15.	GND	Power	Ground	
16.	P1.03/NFC2/CK #CK(Clock pin)	Digital I/O NFC input	General purpose I/O NFC antenna connection	
17.	GND	Power	Ground	
18.	VDD_NRF	Power	Power supply	
19.	P1.06/AIN2	Digital I/O Digital I/O Analog input	General purpose I/O TAMPC active shield 1 output Analog input	TAMPC
20.	P1.07/AIN3	Digital I/O Digital I/O Analog input	General purpose I/O TAMPC active shield 1 input Analog input	TAMPC
21.	P1.05/AIN1	Digital I/O Digital I/O Digital I/O Analog input	General purpose I/O TAMPC active shield 0 input RADIO DEFGPIO Analog input	 TAMPC RADIO
22.	P1.08/CLK16M/CK #CK(Clock pin)	Digital I/O Digital I/O Analog input	General purpose I/O GRTC HF clock output External reference for SAADC	
23.	P1.04/AIN0/CK #CK(Clock pin)	Digital I/O Digital I/O Analog input	General purpose I/O TAMPC active shield 0 output Analog input	TAMPC
24.	P0.00	Digital I/O	General purpose I/O	
25.	P2.01/CK #CK(Clock pin)	Digital I/O Digital I/O Digital I/O Digital I/O	General purpose I/O SPIM SCK SPIS SCK QSPI SCK	SPIM00/20 SPIS0/S20 FLPR
26.	P2.03	Digital I/O Digital I/O	General purpose I/O QSPI D2	 FLPR
27.	P2.00	Digital I/O Digital I/O Digital I/O	General purpose I/O SPIM DCX UARTE RXD	 SPIM00/20 UARTE00/20

		Digital I/O	QSPI D3	FLPR (QSPI)
28.	P2.04	Digital I/O	General purpose I/O	
		Digital I/O	SPIM SDI	SPIM00/20
		Digital I/O	SPIS SDI	SPIS0/20
		Digital I/O	UARTE CTS	UARTE00/20
		Digital I/O	QSPI D1	FLPR
29.	P2.05	Digital I/O	General purpose I/O	
		Digital I/O	SPIM CS	SPIM00/20
		Digital I/O	UARTE RTS	UARTE00/20
		Digital I/O	QSPI CS	FLPR
30.	P2.02	Digital I/O	General purpose I/O	
		Digital I/O	SPIM SDO	SPIM00/20
		Digital I/O	SPIS SDO	SPIS0/20
		Digital I/O	UARTE TXD	UARTE00/20
		Digital I/O	QSPI DO	FLPR
		Digital I/O	Serial wire output (SWO)	Trace
31.	P2.06/CK	Digital I/O	General purpose I/O	
	#CK(Clock pin)	Digital I/O	SPIM SCK	SPIM00/21
		Digital I/O	SPIS SCK	SPIS20/21
		Digital I/O	Trace clock	Trace
32.	P2.10	Digital I/O	General purpose I/O	
		Digital I/O	Trace data	Trace
		Digital I/O	SPIM CS	SPIM00/21
		Digital I/O	UARTE RTS	UARTE00/21
33.	P2.07/SWO	Digital I/O	General purpose I/O	
		Digital I/O	Trace data	Trace
		Digital I/O	Serial wire output (SWO)	Trace
		Digital I/O	SPIM DCX	SPIM00/21
		Digital I/O	UARTE RXD	UARTE00/21
34.	P2.09	Digital I/O	General purpose I/O	
		Digital I/O	Trace data	Trace
		Digital I/O	SPIM SDI	SPIM00/21
		Digital I/O	SPIS SDI	SPIS00/21
		Digital I/O	UARTE CTS	UARTE00/21
35.	P0.03/CK	Digital I/O	General purpose I/O	
	#CK(Clock pin)	Digital I/O	GRTC PWM output	GRTC
36.	P2.08	Digital I/O	General purpose I/O	
		Digital I/O	Trace data	Trace
		Digital I/O	SPIM SDO	SPIM00/21
		Digital I/O	SPIS SDO	SPIS00/21
		Digital I/O	UARTE TXD	UARTE00/21

37.		**P0.04/CK** **#CK(Clock pin)**	**Digital I/O** **Digital I/O**	**General purpose I/O** **GRTC LF clock output**	**GRTC**
38.		**P0.02**	**Digital I/O**	**General purpose I/O**	
39.		**P0.01**	**Digital I/O**	**General purpose I/O**	
40.		**SWDCLK**	**Debug**	**Serial wire clock. Input with on-chip pull-up**	
41.		**NRESET**	**Reset**	**Pin reset with on-chip pull-up**	
42.		**SWDIO**	**Debug**	**Serial wire data. Bidirectional with standard-drive and on-chip pull-dwon.**	
43.		**GND**	**Power**	**Ground**	
44.	**BTM-NL15C**	**GND**	**Power**	**Ground**	
	BTM-NL15	**RF_IO**	**RF**	**Bluetooth RF IO**	
45.		**GND**	**Power**	**Ground**	

Clock pins

The device has dedicated clock pins.

Some peripherals have clock signals. Dedicated clock pins have been optimized to ensure correct timing relationship between clock and data signals for these peripherals. See the following table for which peripheral signals must use clock pins. The pin assignment table identifies clock pins.

Clock pins can also be used as regular I/O data pins.

The peripheral data signal must be configured to use pins close to the clock pin. This ensures that the internal paths from the peripheral to the pin have the same delay, so that the data and clock signals reach the pins at the same time.

For high-speed signals, the printed circuit board (PCB) layout must use short PCB traces of identical length. This makes sure any delays are kept to a minimum, with close to identical delay on the clock and data path.

The following table shows which peripheral signals must use clock pins.

Peripheral	Signal	Clock pin required
SPIM/SPIS	SDO	
	SDI	
	SCK	X
	CSN	
	DCX	
TWIM/TWIS	SDA	X
	SCL	X
PDM	DIN	
	CLK	X
I2S	MCK	X

	LRCK	
	SCK	X
	SDIN	
	SDOUT	
TRACE	TRACEDATA[]	
	TRACECLK	X (dedicated pin)
GRTC	CLKOUT32K	X (dedicated pin)
	PWMOUT	X (dedicated pin)
	CLK16M	X (dedicated pin)

1. CPU

The ARM® Cortex®-M33 processor has a 32-bit instruction set (Thumb-2 technology) that implements a super set of 16-bit and 32-bit instructions to maximize code density and performance.

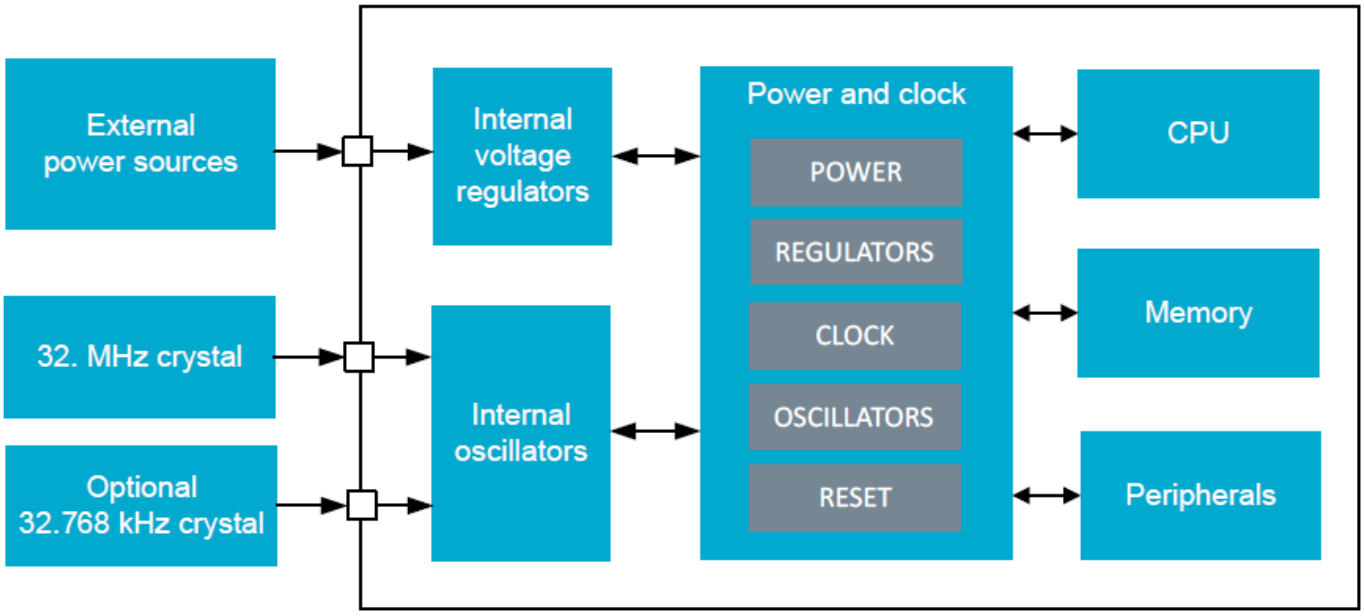
This processor implements several features that enable energy-efficient arithmetic and high-performance signal processing, including:

- Digital signal processing (DSP) instructions
    - Single-cycle multiply and accumulate (MAC) instructions
    - 8-bit and 16-bit single instruction multiple data (SIMD) instructions
- Hardware divide
- Single-precision floating-point unit (FPU)
- Memory Protenction Unit (MPU)
- Atm TrustZone for Armv8-M
- Stack limit checking

2. POWER – Power supply

1) The power and clock management system is optimized for ultra-low power applications to provide maximum power efficiency.

The power and clock management system is shown in the following figure.



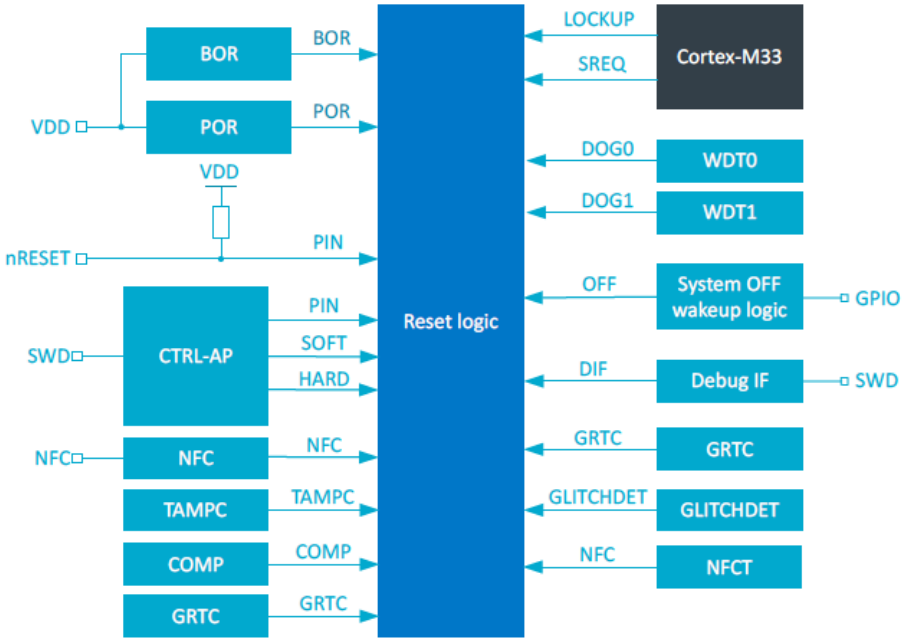
The power and clock management system automatically tracks the power and clock resources requested by components in the system at any given time. To achieve the lowest power consumption possible, the system evaluates the requests, starts and stops clock sources, and chooses the most optimal regulator operation modes.

3. Reset

A system-level reset is triggered by the following resets :

- Brownout
- Power – on
- CTRL – AP
- Watchdog
- Wakeup from System OFF
- Tamper detection
- Voltage glitch detection
- CPU Lockup
- Pin

The system reset sources are shown in the following figure.



After a reset , the device automatically start up. The register RESETREAS can be read to determine which source generated the reset.

4. Clocks

The BTM-NL15X requires two clocks, a high frequency clock and a low frequency clock.

The high frequency clock is provided on-module by a high-accuracy 32-MHz crystal as required by the nRF54L15 for radio operation.

The low frequency clock can be provided internally by an RC oscillator or synthesized from the fast clock; or externally by a 32.768 kHz crystal. An external crystal provides the lowest power consumption and greatest accuracy. Using the internal RC oscillator with calibration provides acceptable performance for BLE applications at a reduced cost and slight increase in power consumption.

6.1 LFCLK controller

The system supports the following low frequency clock sources.

- 32.768 kHz RC oscillator (LFRC)
- 32.768 kHz crystal oscillator (LFXO)
- 32.768kHz synthesized from HFCLK (LFSYNT)

LFXO can run in System OFF mode. The other clock sources only run in System ON mode.

The following LF clocks are available in the system.

Clock	Description
PCLK32KI	Maximum output power
GRTC.LFLPRC	Direct path from 32.768 kHz internal oscillator (LFRC) to GRTC peripheral. Available in System ON modes.

GRTC.LFXO	Direct path from 32.768 kHz crystal oscillator (LFXO) to GRTC peripheral. Available in System ON or OFF modes.

Low frequency crystal oscillator (LFXO)

Symbol	Description	Min	Typ	Max	Unit
F_{NOM_LFXO}	Crystal frequency	-	32.768	-	kHz
$F_{TOL\_LFXO\_BLE}$	Frequency tolerance requirement for BLE stack	-	-	±250	ppm
Cpin	Input capacitance on XL1 and XL2 pads	4.0	-	17.0	pF
t_{START_LFXO}	Startup time for 32.768 kHz crystal oscillator	-	-	-	s

5. GPIO – General purpose input / output

The general purpose input/output pins (GPIOs) are grouped as one or more ports with each port having up to 31 GPIO pins.

GPIO has the following user-configurable features:

- Configurable output drive strength
- Internal pull-up and pull-down resistors
- Wake-up from high or low level triggers on all pins
- Trigger interrupt on state changes on any pin
- All pins can be used by the PPI task/event system
- One or more GPIO outputs can be controlled through PPI and GPIOTE channels
- All pins can be individually mapped to interface blocks for layout flexibility
- GPIO state changes captured on SENSE signal can be stored by LATCH register
- Support for secure and non-secure attributes for pins in conjunction with the system protection unit

GPIO Electrical Specification

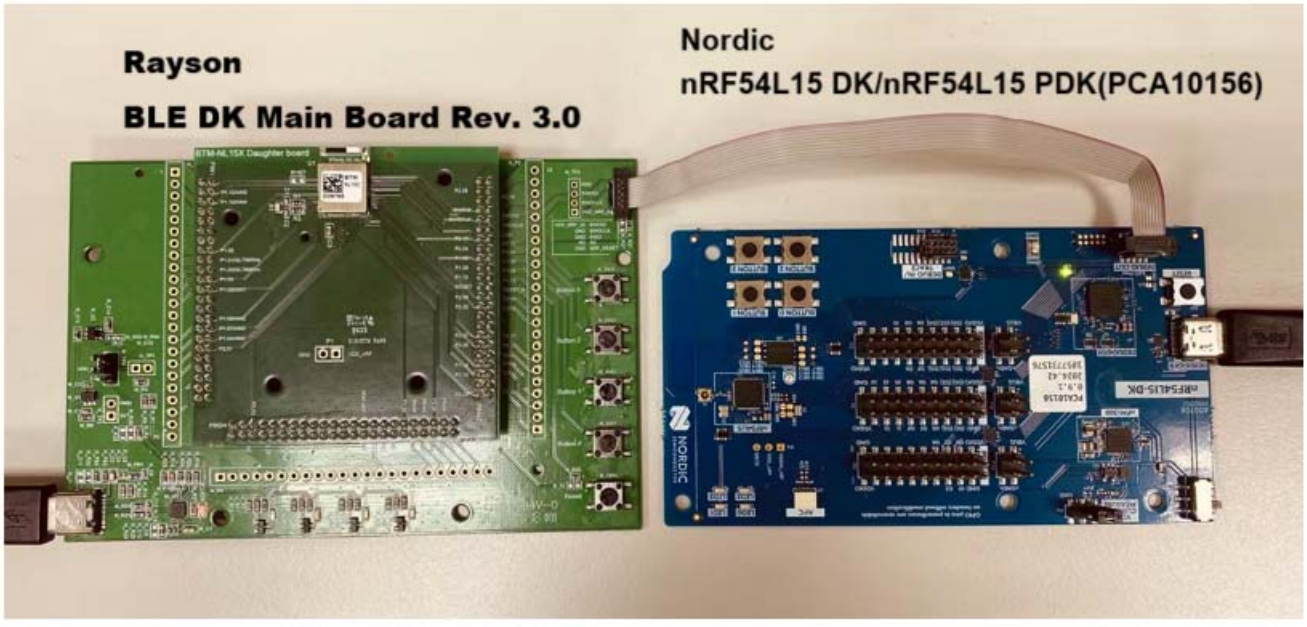
Symbol	Description	Min	Typ	Max	Unit
V_{IH}	Input high voltage	0.7 x VDD	-	VDD	V
V_{IL}	Input low voltage	VSS	-	0.3 x VDD	V
$V_{OH,SD}$	Output high voltage, standard drive, 0.5 mA, VDD ≥1.7	VDD–0.4	-	VDD	V
$V_{OH,HDH}$	Output high voltage, high drive, 5 mA, VDD >= 2.7 V	VDD–0.4	-	VDD	V
$V_{OH,HDL}$	Output high voltage, high drive, 3 mA, VDD >= 1.7 V	VDD–0.4	-	VDD	V
$V_{OL,SD}$	Output low voltage, standard drive, 0.5 mA, VDD ≥1.7	VSS	-	VSS+0.4	V
$I_{OL,SD}$	Current at VSS+0.4 V, output set low, standard drive, VDD ≥1.7	1	3	4	mA
$I_{OL,HDL}$	Current at VSS+0.4 V, output set low, high drive, VDD >= 1.7 V	3			mA

$I_{OL,ED}$	Current at VSS+0.4 V, output set low, extra drive, VDD >= 1.7 V	16			mA
$I_{OH,SD}$	Current at VDD -0.4 V, output set high, standard drive, VDD ≥1.7	1	3	4	mA
$I_{OH,HDL}$	Current at VDD -0.4 V, output set high, high drive, VDD >= 1.7 V	4			mA
$I_{OH,ED}$	Current at VDD -0.4 V, output set high, extra drive, VDD >= 1.7 V	14			mA
$I_{GPIO,TOTAL}$	Recommended maximum sustained current drawn by all GPIOs			15	mA
$t_{HRF,12pF}$	Rise/fall time, high drive mode, 20-80%, 12 pF load		4		ns
$t_{HRF,12pF}$	Rise/fall time, extra drive mode, 20-80%, 12 pF load		0.9		ns
R_{PU}	Pull-up resistance	12	14	16	kΩ
R_{PD}	Pull-down resistance	12	14	18	kΩ
C_{PAD}	Pad capacitance		1		pF
C_{PAD_NFC}	Pad capacitance on NFC pads		5		pF

6. Debug & Programming

Please use the Nordic nRF54L15DK/nRF54L15PDK as the programmer, along with the Rayson BTM-NL15X-DK development board as the development tool, to perform code compilation and development for the nRF54L15.

- Step 1: Power the NRF54L15 DK and BTM-NL15X-DK via a USB-C cable.
- Step 2: Connect the Nordic nRF54L15 DK and Rayson BTM-NL15X-DK using an IDC (SWD) cable.



7. NFC

NFC-A Listen mode compliant:

Based on NFC forum specification

– 13.56 MHz

– Date rate 106 kbps

– NFC-A tag (can only be a target/tag; cannot be an initiator)

Modes of Operation:

– Disable

– Sense

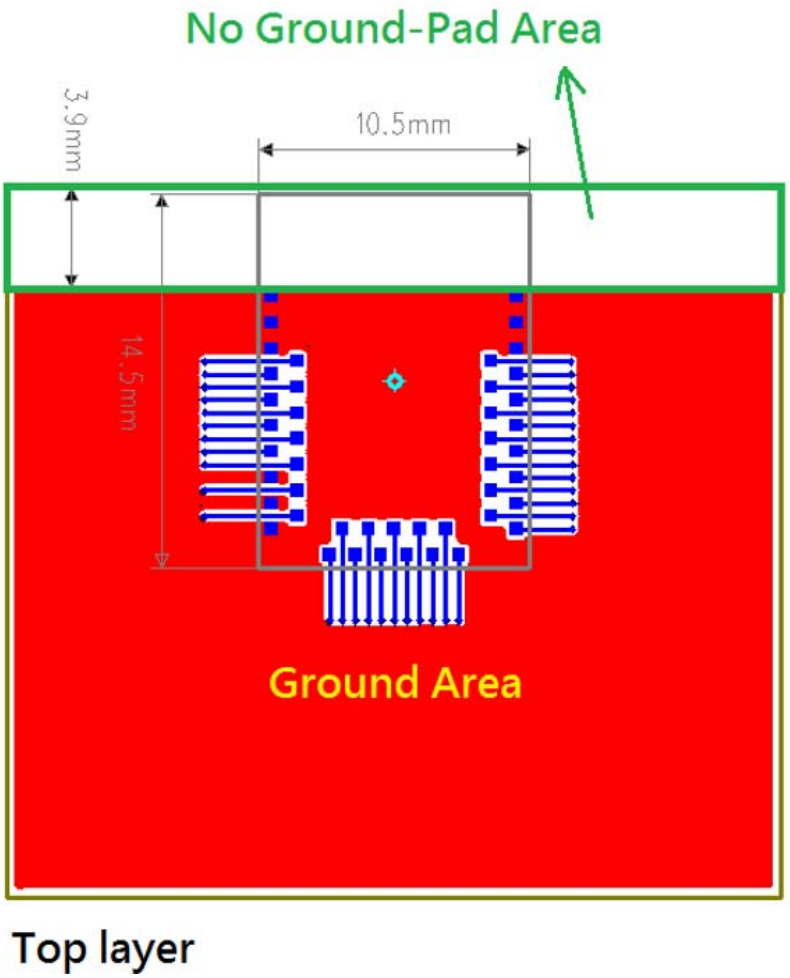
– Activated

8. RF Layout Suggestion

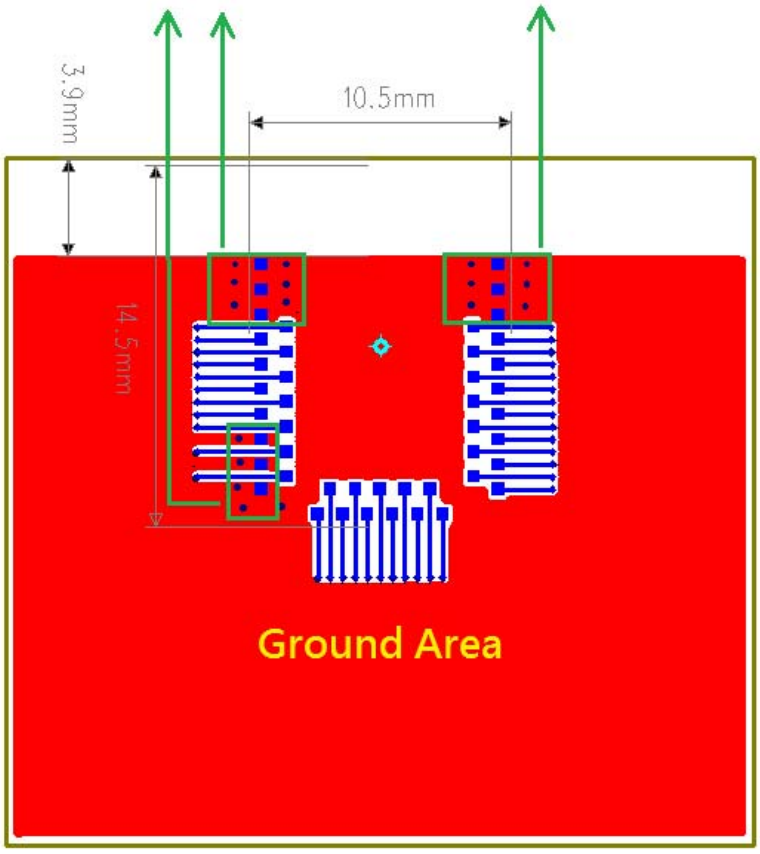
Make sure to keep the No Ground Pad as wider as you can regardless of the size of your PCB.

No Ground Pad should be included in the corresponding position of the antenna in EACH LAYER

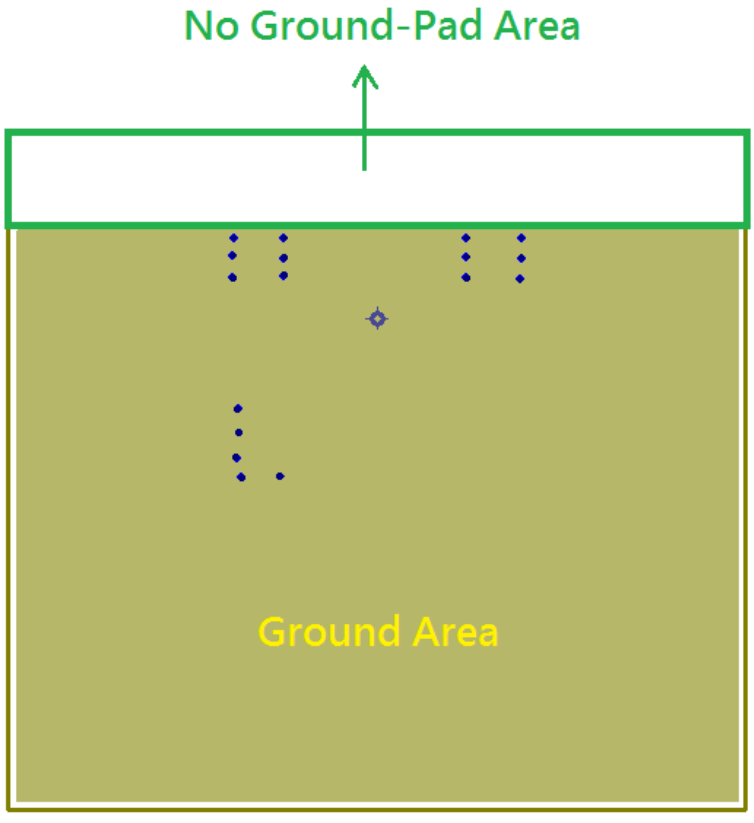
Place the module towards the edge of PCB to have better performance than placing it on the center.



Place add via holes in GROUND area as many as possible, especially around the three conrners.



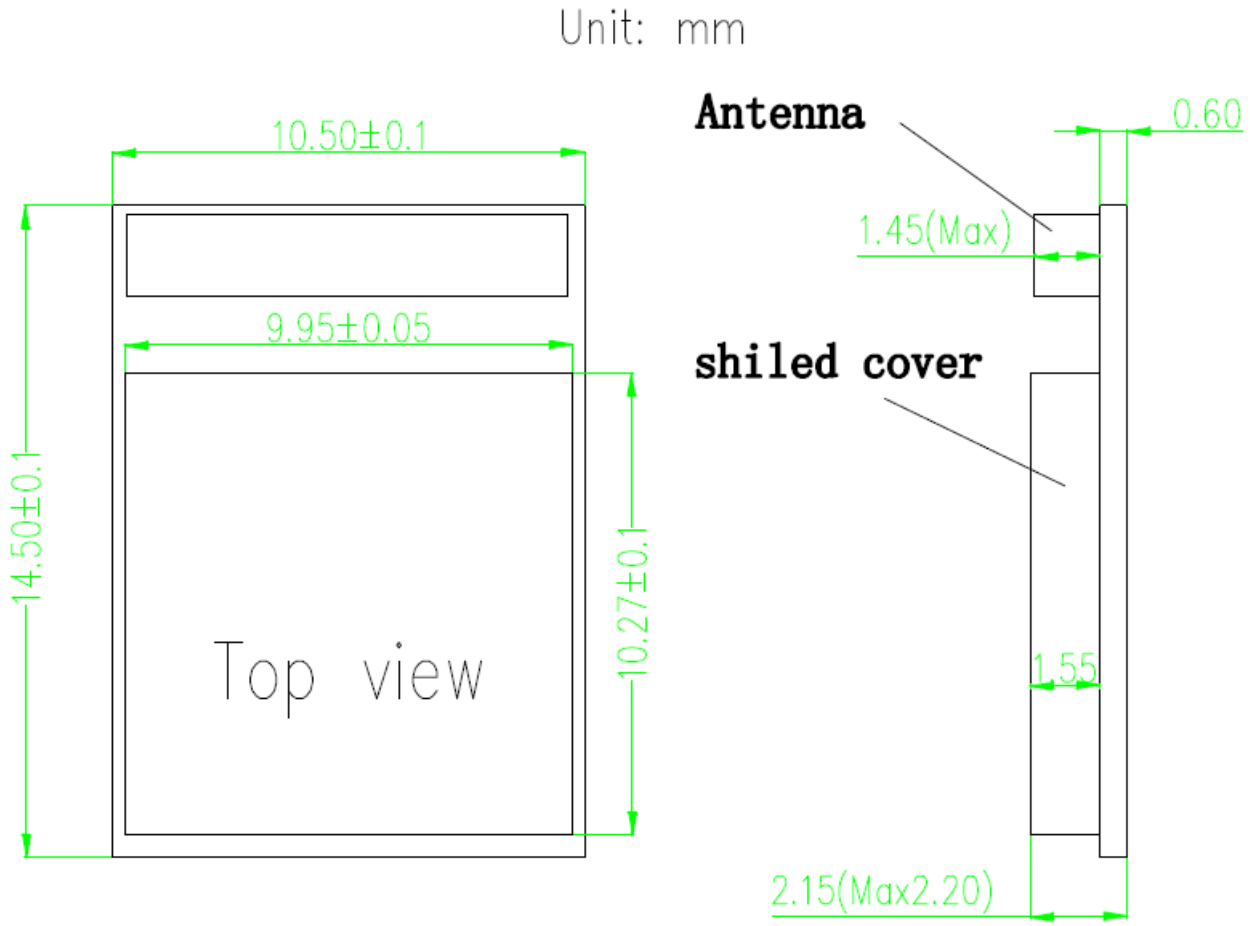
Top layer



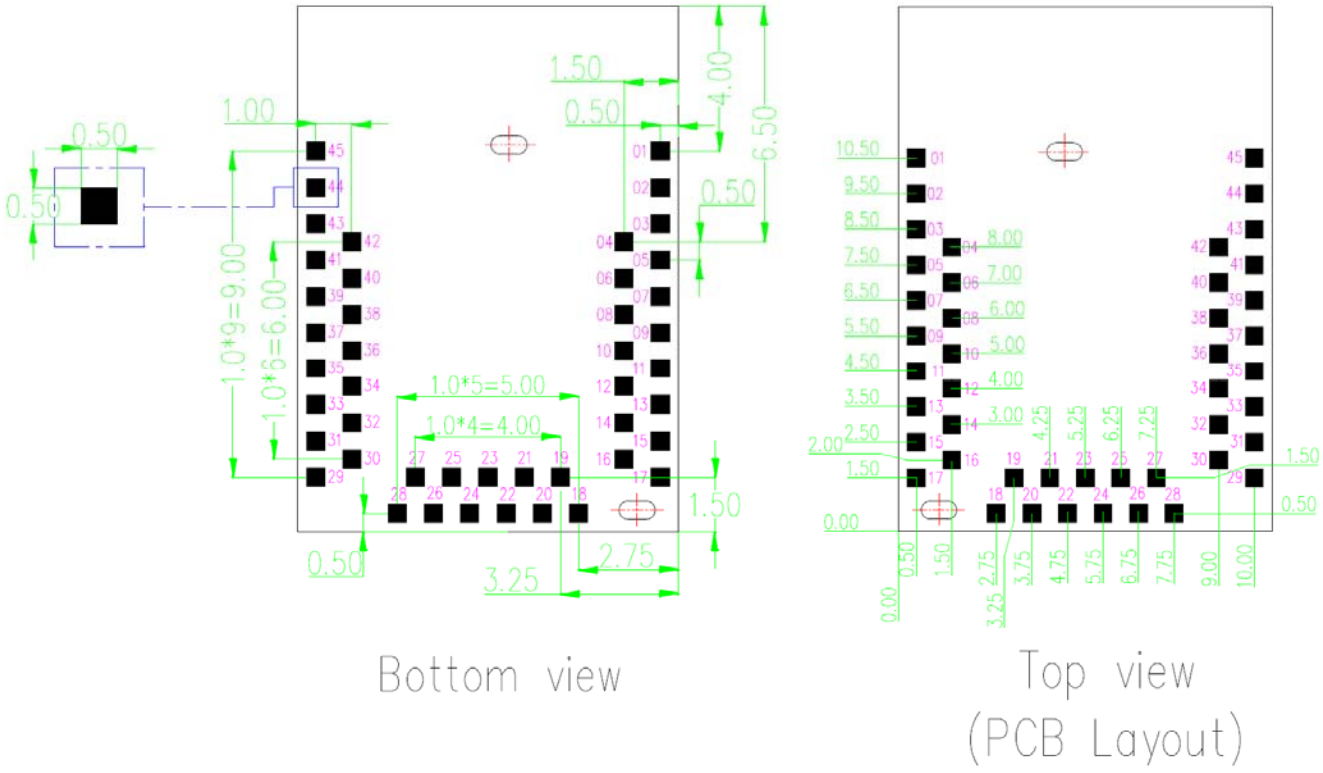
Bottom layer

9. Mechanical Data

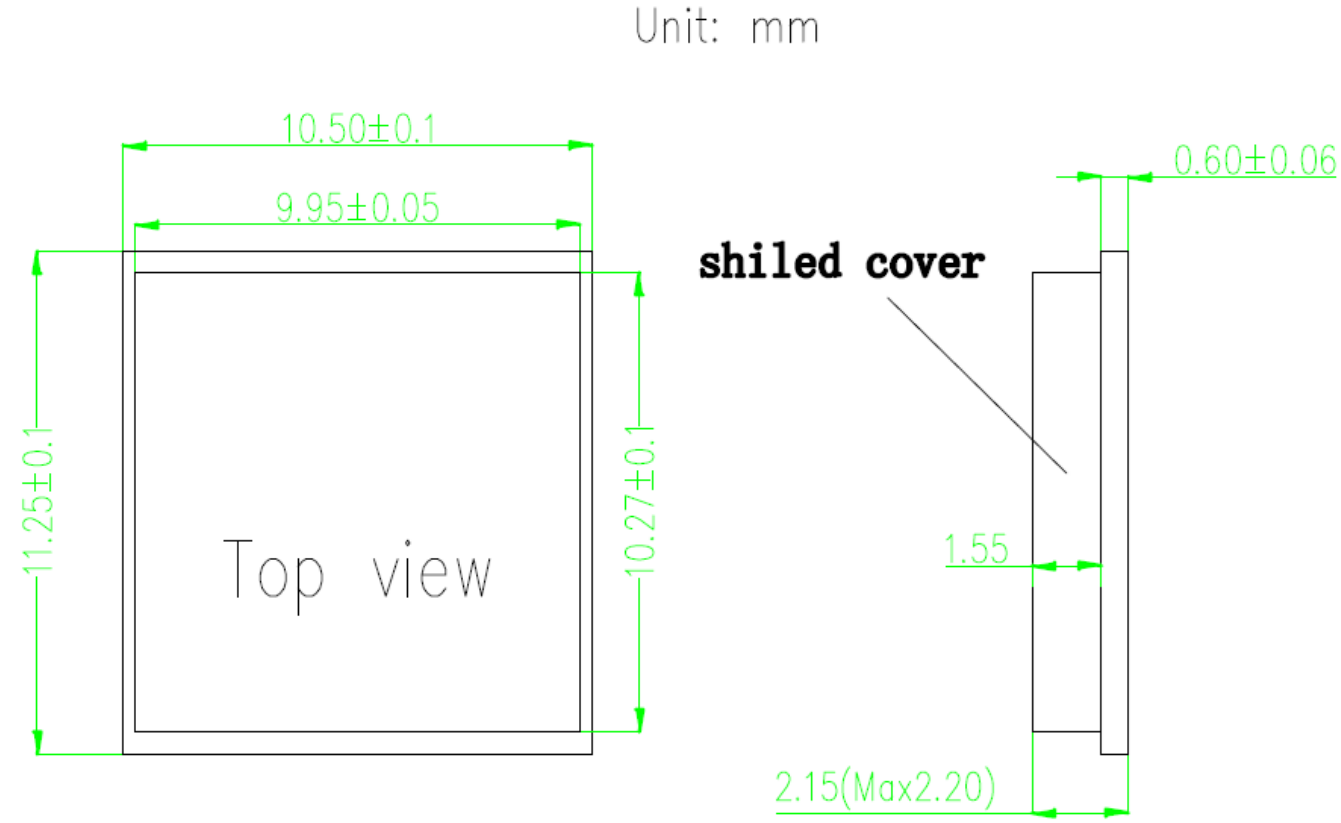
9.1 BTM-NL15C Mechanical Dimensions



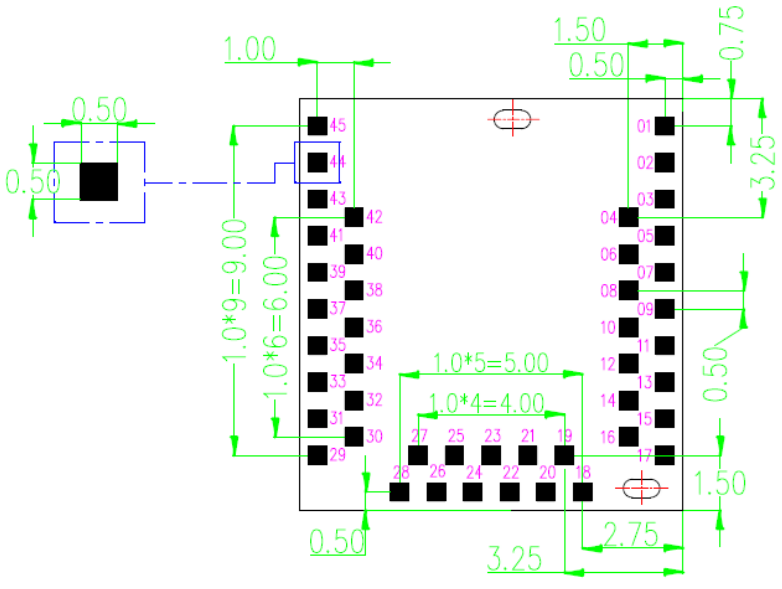
9.2 BTM-NL15C Recommended PCB Land Pads

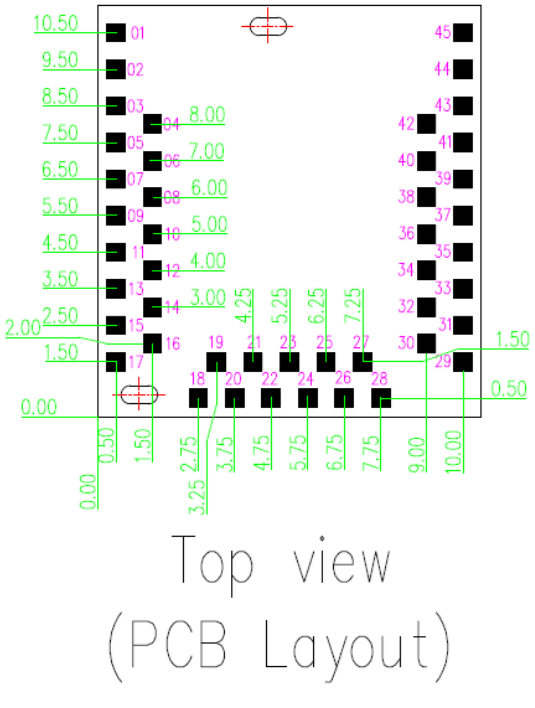


9.3 BTM-NL15 Mechanical Dimensions



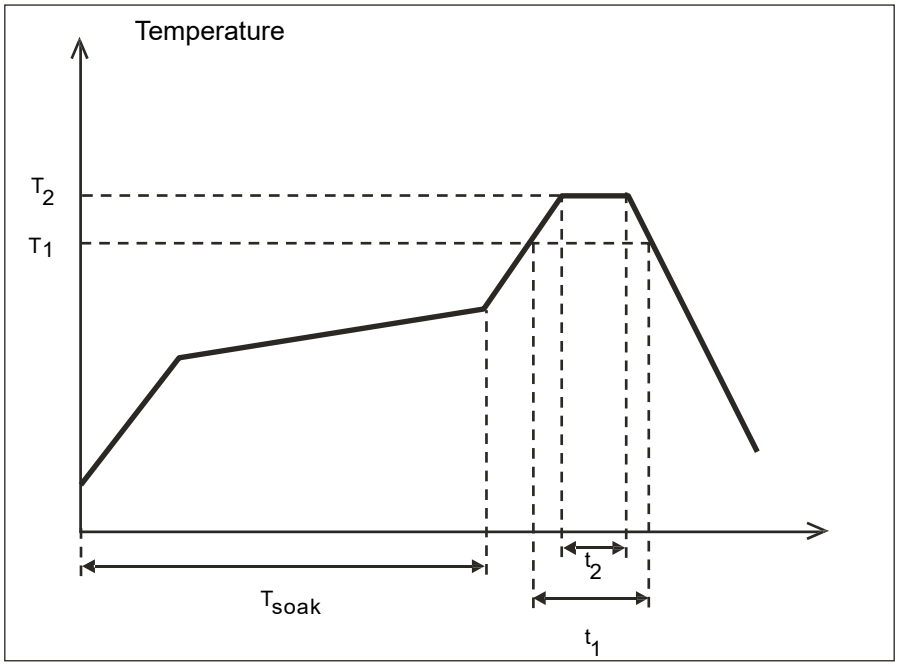
9.4 BTM-NL15 Recommended PCB Land Pads

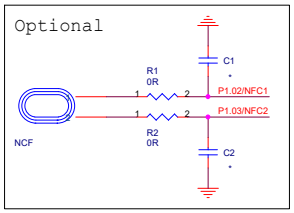


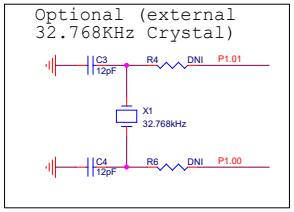


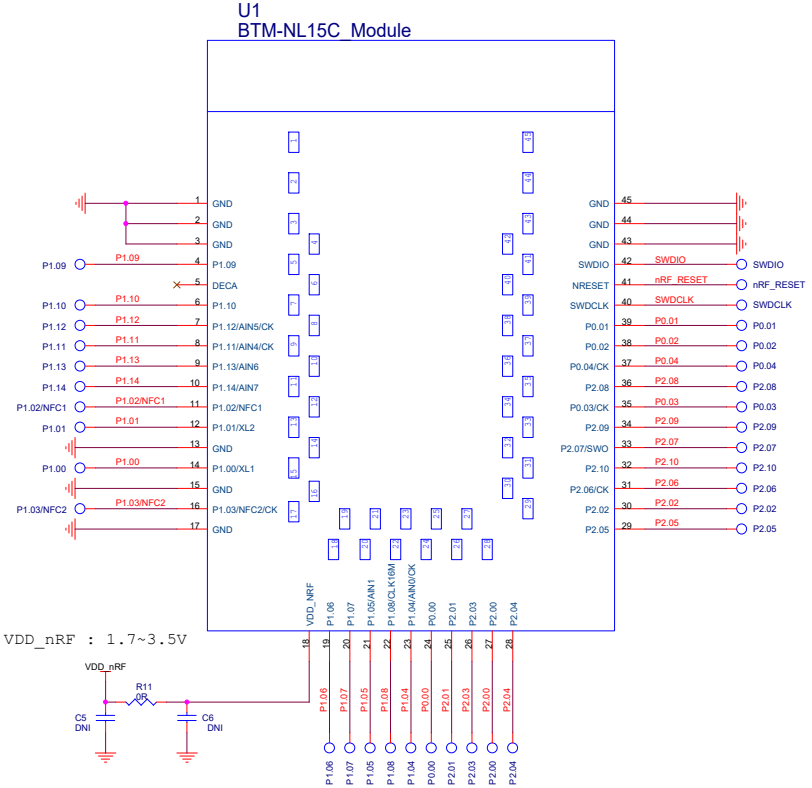
10. Solder Reflow Temperature Profile

Reflow profile requirements		
Parameter Specification	**Reference**	**Specification**
Average temperature gradient in preheating		1~2.5°C/s to 175°C equilibrium.
Soak time	T_{soak}	120~180 seconds
Time above 217°C (T_1)	t_1	45~90 seconds
Peak temperature in reflow	T_2	250°C (–0/+5°C)
Time at peak temperature	t_2	6 seconds
Temperature gradient in cooling		6°C/second max.





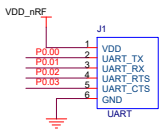




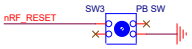
VDD_nRF : 1.7~3.5V

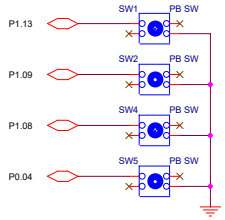
REMARK:
* The RAYSON standard software defaults to using DC/DC mode, with a 4.7μH inductor already included inside the module.
*The RAYSON standard software defaults to using the internal RC oscillator of the IC.
* HFXO 32MHz (INTCAP value: 0x25)
* default radio tx power initial +8 dbm

Uart pin define:
P0.00: UART_TX
P0.01: UART_RX
P0.02: UART_RTS
P0.03: UART_CTS
UART parameter:
Buad rate: 115200
Flow ctrl: RTS/CTS

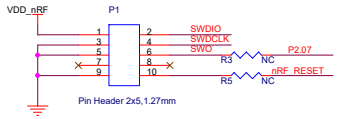


Boot/Reset button





Debug connector

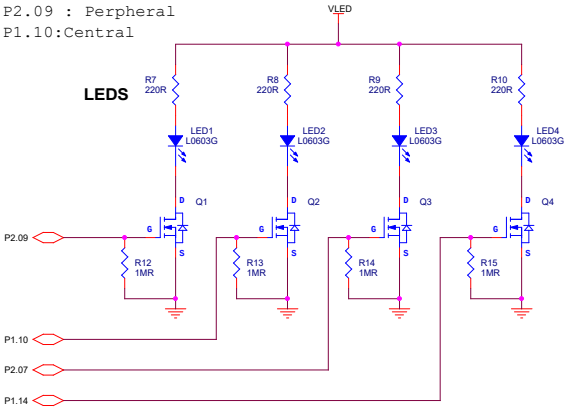


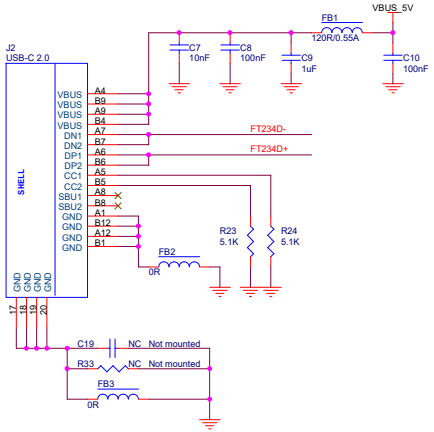
Scanner/Advertising: 1sec on, 1sec off

Connected : always on

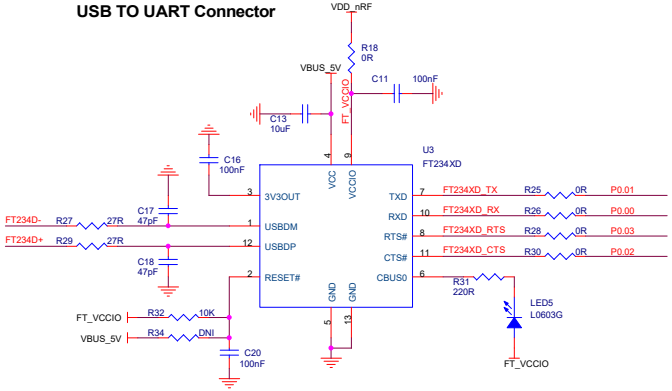
P2.09 : Perpheral
P1.10:Central

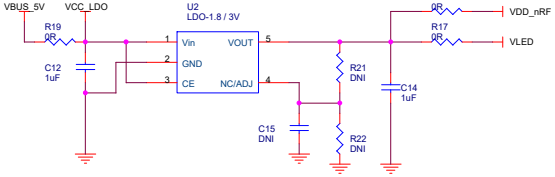
LEDS





USB TO UART Connector





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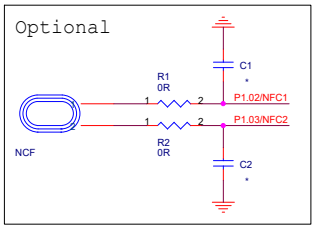
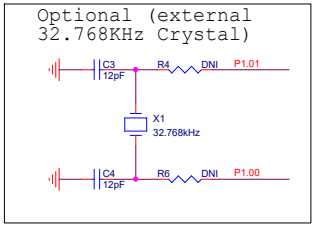
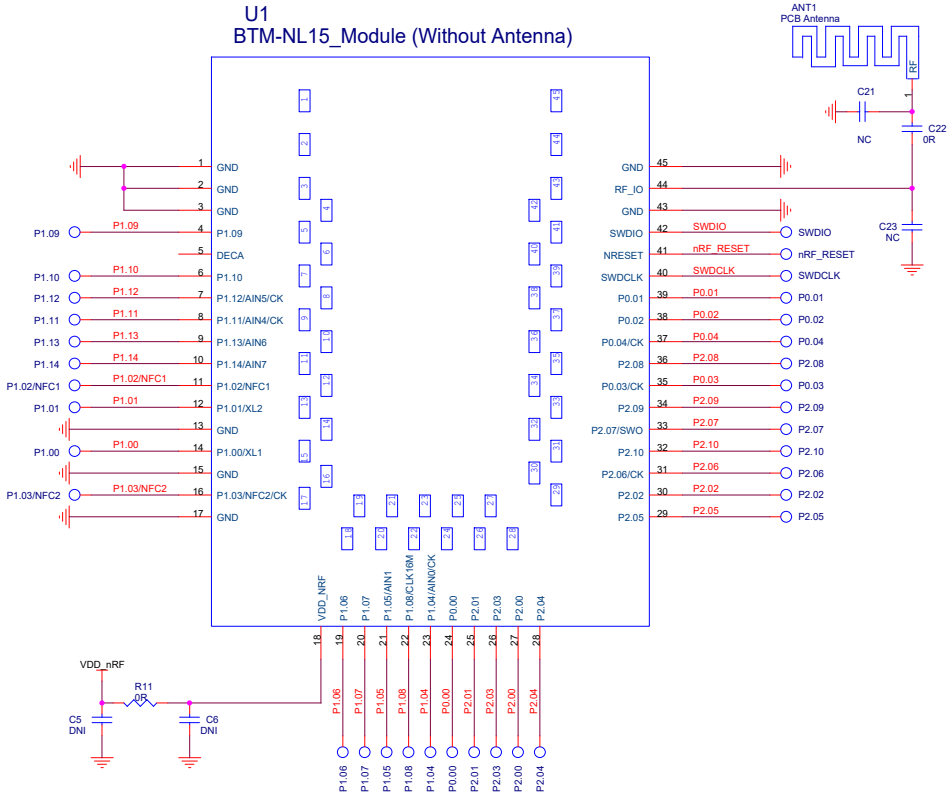
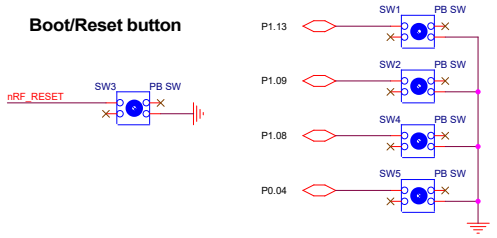


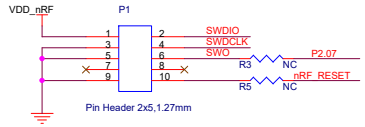




Boot/Reset button



Debug connector



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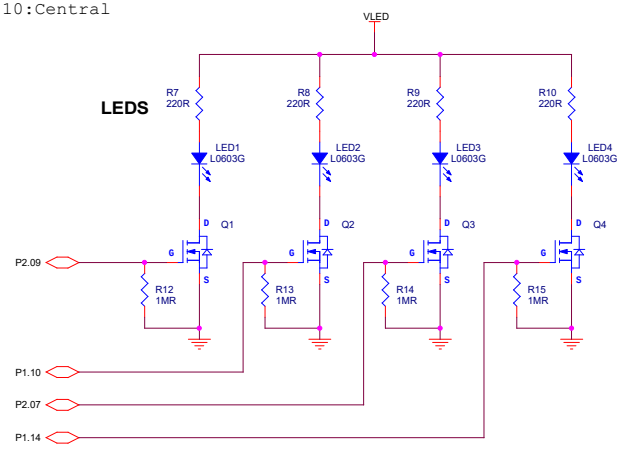

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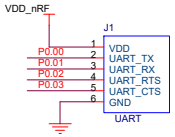
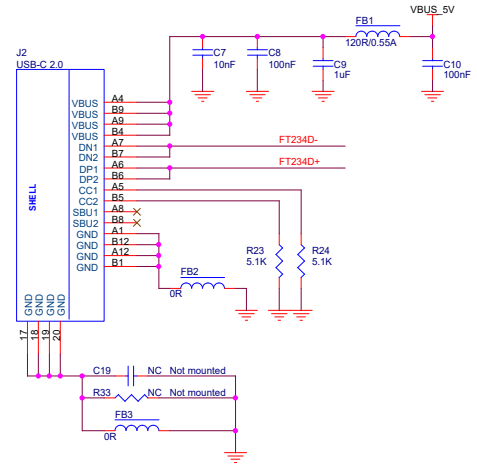
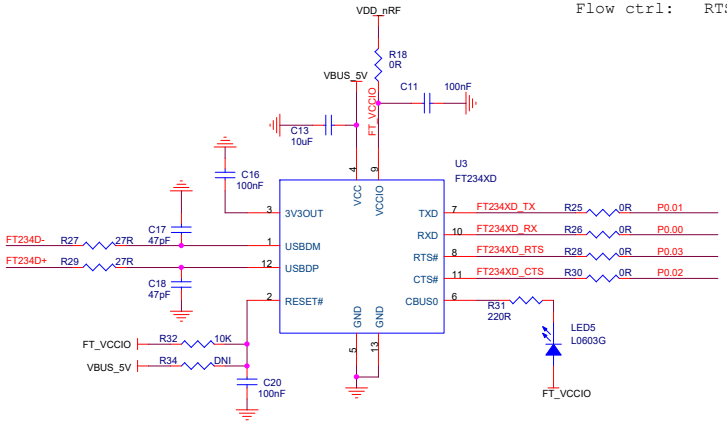
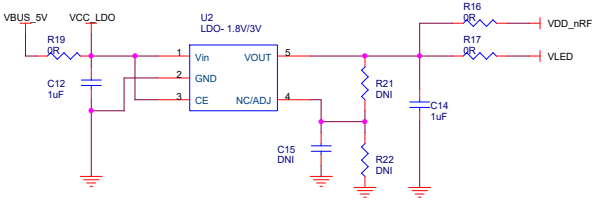




USB TO UART Connector





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