ABLUE TECHNOLOGY

PTR9818PA

Full Bluetooth 5 ready multi-protocol SoC Module with PA, Embedded Cortex™ M4F 32 bit processor Support Bluetooth 5, Zigbee, Thread, MESH, ANT Ideal choice of IoT and Smart product

The PTR9818PA ultra-low power Bluetooth 5 ready multiprotocol System on Module based on the nRF52840 from Nordic Semiconductor,, designed for longer distance communication, built-in maximum +20dBm RF output. The module can support Bluetooth 5.2 by upgrading the protocol stack. The module with an ARM® Cortex™ M4F 32 bit processor, 1MB Flash/256KB RAM, embedded 2.4GHz transceiver, and integrated antenna, provide a complete solution with no additional RF design, Bluetooth 5, ANT/ANT+, 802.15.4 and 2.4GHz proprietary multiprotocol support, allowing faster time to market, while simplifying designs, reducing BOM costs, also reduce the burden of Regulatory approvals to enter the world market. Making you more quickly into the Bluetooth smart application and remove the worries.
It has an ARM® TrustZone® CryptoCell-310 co-processor for implementation of IoT security.

Features

- Nordic nRF52840 with ARM Cortex M4F
- Multiprotocol support : Bluetooth 5, ANT/ANT+, and 2.4GHz proprietary, 802.15.4 Thread and Zigbee
- Bluetooth 5: 2 Mbps, 1 Mbps, 500 kbps, 125 kbps
- IEEE 802.15.4-2006: 250 kbps
- Proprietary 2.4 GHz: 2 Mbps, 1 Mbps
- Integrated DC-DC converter
- Serial Wire Debug (SWD)
- Nordic SoftDevice Ready
- Over-the-Air (OTA) firmware update
- Flash/RAM: 1MB/256KB.
- 46 General purpose I/O pins(reserve 2 I/O for RF front-end control)
- 15 level low-power comparator with wake-up from System OFF mode
- Two 2-wire Master/Slave (I2C compatible)
- 12 bit/200KSPS ADC
- 1 QSPI (32Mbps)
- 4 SPI Master/ 3 SPI Slave (8Mbps)
- 2 UART (with CTS/RTS and DMA)
- 4x 4-channel PWM unit with EasyDMA
- USB 2.0 full speed (12 Mbps) controller
- 20 channel CPU independent Programmable Peripheral Interconnect (PPI).
- Quadrature Demodulator (QDEC)
- 128-bit AES HW encryption
- 5 x 32 bits, 3 x 24 bits Real Time Counters (RTC)
- NFC-A tag interface for OOB pairing
- Sizes: 24.3x17.5 x1.8mm
- Ext. IPX Antenna
- DC/DC on board
- No external components required
- Operation voltage: 2.7V to 3.6V

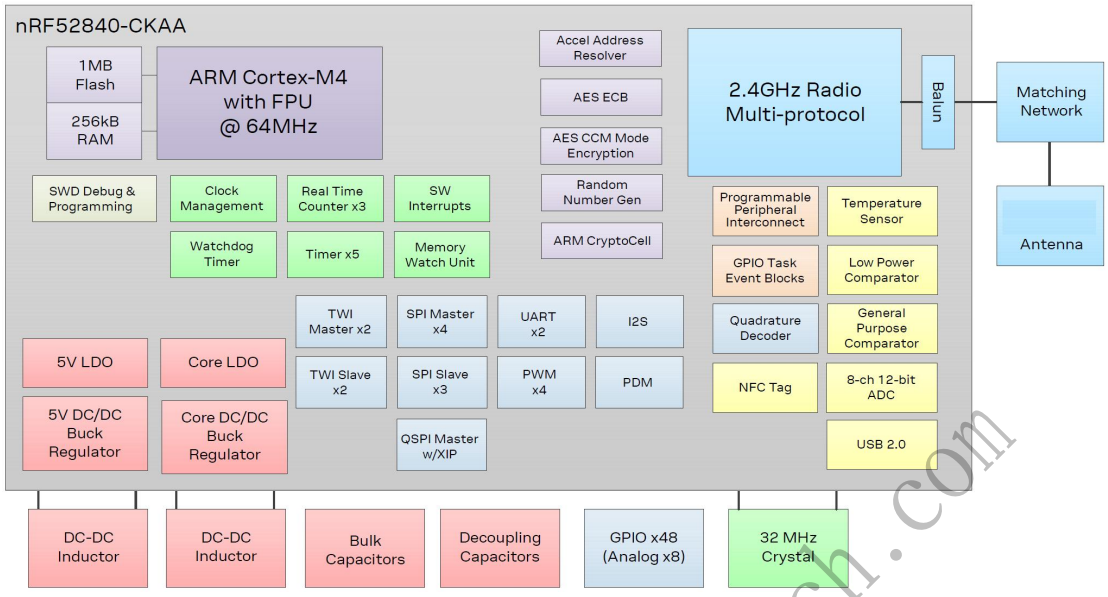
Typical Applications:

- 2.4 GHz Bluetooth low energy systems
- 2.4 GHz Proprietary systems
- Sports and leisure equipment
- Mobile phone accessories, Connected Appliances
- Health Care and Medical
- Consumer Electronics, Game pads
- Human Interface Devices, Remote control
- Building environment control / monitoring
- RFID, Security Applications，Low-Power Sensors
- Bluetooth Low Energy GateWay
- iBeacons™,Indoor navigation
- Lighting Products
- Fitness devices, Wearables

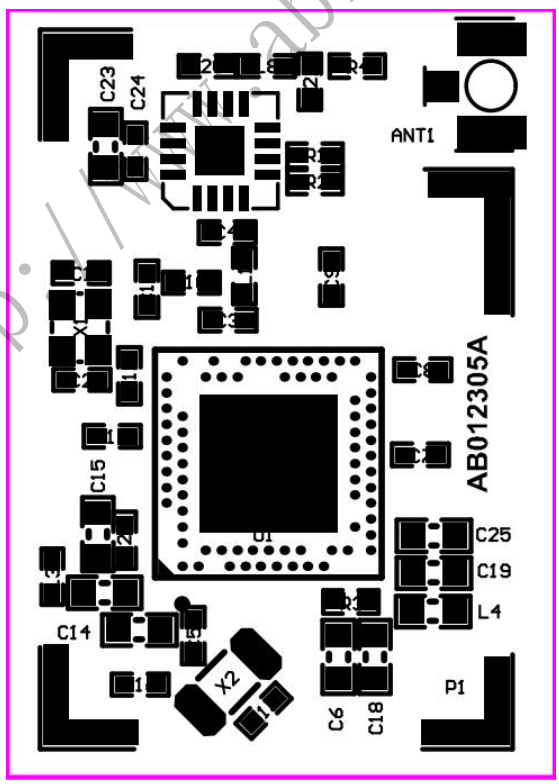
Quick Specifications:

Multi-protocol	
Version	Bluetooth 5.0 and Higher/ANT/2.4GHz Proprietary/802.15.4/Zigbee
Security	AES-128
Radio	
Frequency	2.360GHz to 2.500GHz
Modulations	GFSK at 2/1 Mbps, Long range 125/500kbps, 802.15.4- 250 kbps
Transmit power	Max +20dBm
Receiver sensitivity	-103dBm@BLE 125kbps(long range), -96dBm@BLE 1M
Antenna	Ext. IPX Antenna
Current Consumption	
TX only @ 20 dBm	~100 mA
RX only @ 1 Mbps @ 3V, DC/DC enabled	4.6 mA
CPU @ 64MHz from flash @ 3V, DC/DC	3.3 mA
System On	1.5 μA
System Off	0.4μA
Operating conditions	
Power supply	2.7~3.6V
Operating temperature	-25~+85 °C

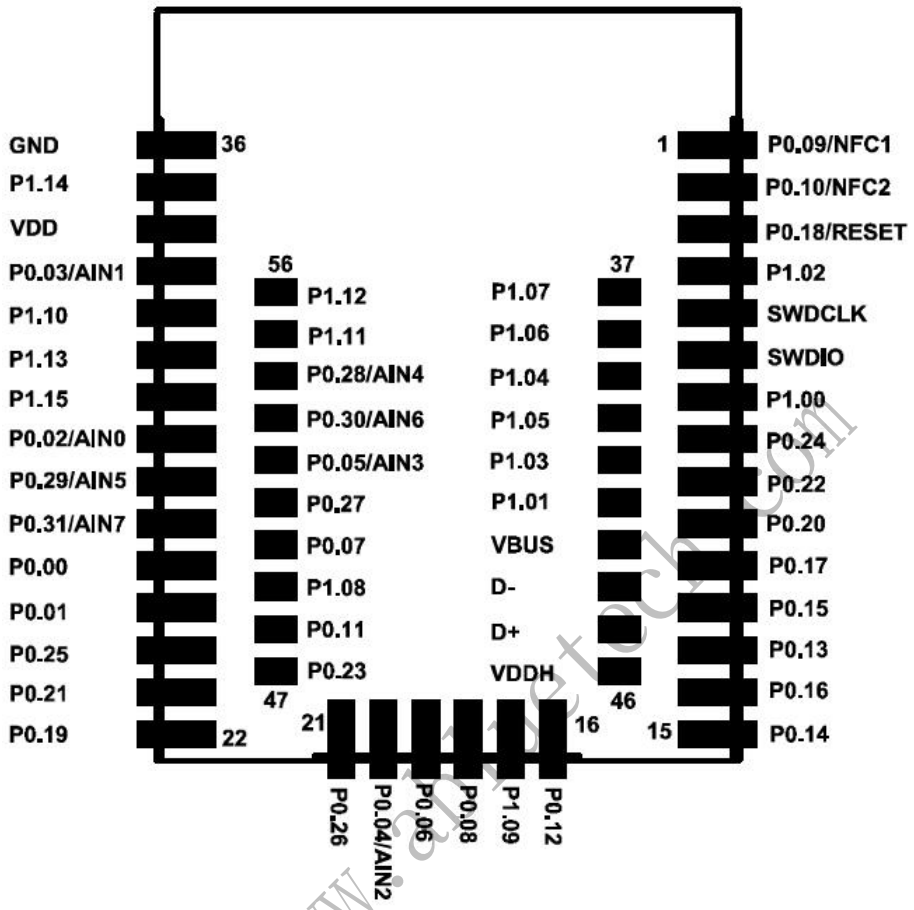
Block diagram:



Module Top View:



Pin Description of Module（Top View）:



Pin	Name	Description	Recommend usage
Pin1	P0.09/NFC1	Digital I/O/ NFC input	Standard drive, low frequency I/O
Pin2	P0.10/NFC2	Digital I/O/ NFC input	Standard drive, low frequency I/O
Pin3	P0.18/RESET	Digital I/O/RESET	QSPI/CSN/RESET
Pin4	P1.02	Digital I/O	
Pin5	SWDCLK	HW debug and programming	
Pin6	SWDIO	HW debug and programming	
Pin7	P1.00	Digital I/O	
Pin8	P0.24	Digital I/O	QSPI
Pin9	P0.22	Digital I/O	QSPI
Pin10	P0.20	Digital I/O	
Pin11	P0.17	Digital I/O	
Pin12	P0.15	Digital I/O	
Pin13	P0.13	Digital I/O	
Pin14	P0.16	Digital I/O	
Pin15	P0.14	Digital I/O	
Pin16	P0.12	Digital I/O	
Pin17	P1.09	Digital I/O	
Pin18	P0.08	Digital I/O	

Pin19	P0.06	Digital I/O	
Pin20	P0.04/AIN2	Digital I/O/Analog input 2	
Pin21	P0.26	Digital I/O	
Pin22	P0.19	Digital I/O	QSPI/SCK
Pin23	P0.21	Digital I/O	QSPI
Pin24	P0.25	Digital I/O	
Pin25	P0.01/XL2	Reserve for 32.768KHz use	
Pin26	P0.00/XL1	Reserve for 32.768KHz use	
Pin27	P0.31/AIN7	Digital I/O/Analog input 7	Standard drive, low frequency I/O
Pin28	P0.29/AIN5	Digital I/O/Analog input 5	Standard drive, low frequency I/O
Pin29	P0.02/AIN0	Digital I/O/Analog input 0	Standard drive, low frequency I/O
Pin30	P1.15	Digital I/O	Standard drive, low frequency I/O
Pin31	P1.13	Digital I/O	Standard drive, low frequency I/O
Pin32	P1.10	Digital I/O	Standard drive, low frequency I/O
Pin33	P0.03/AIN1	Digital I/O/Analog input 1	Standard drive, low frequency I/O
Pin34	VDD	Power Supply	
Pin35	P1.14	Digital I/O	
Pin36	GND	Ground	
Pin37	P1.07	Digital I/O	Reserved for control PA/LNA internal
Pin38	P1.06	Digital I/O	Reserved for control PA/LNA internal
Pin39	P1.04	Digital I/O	Standard drive, low frequency I/O
Pin40	P1.05	Digital I/O	Standard drive, low frequency I/O
Pin41	P1.03	Digital I/O	Standard drive, low frequency I/O
Pin42	P1.01	Digital I/O	Standard drive, low frequency I/O
Pin43	VBUS	Power	5 V input for USB 3.3 V regulator
Pin44	D-	USB D-	USB
Pin45	D+	USB D+	USB
Pin46	VDDH	High voltage power supply	
Pin47	P0.23	Digital I/O	QSPI
Pin48	P0.11	Digital I/O	
Pin49	P1.08	Digital I/O	
Pin50	P0.07	Digital I/O	
Pin51	P0.27	Digital I/O	
Pin52	P0.05/AIN3	Digital I/O/Analog input 3	
Pin53	P0.30/AIN6	Digital I/O/Analog input 6	Standard drive, low frequency I/O
Pin54	P0.28/AIN4	Digital I/O/Analog input 4	Standard drive, low frequency I/O
Pin55	P1.11	Digital I/O	
Pin56	P1.12	Digital I/O	Standard drive, low frequency I/O

*Low frequency I/O is signals with a frequency up to 10 kHz

*The module needs to reserve 2 I/O for RF front-end control， already internally connected on module.

Note: An internal 4.7μF bulk capacitor has been included on the module. For those application that with heavy GPIO usage and/or current draw, it is good design practice to add additional bulk capacitance as required for your application.

General Purpose I/O:

Each GPIO can be accessed individually with the following user configurable features:

- Input/output direction
- Output drive strength
- Internal pull-up and pull-down resistors
- Wake-up from high or low level triggers on all pins
- Trigger interrupt on all pins
- All pins can be used by the PPI task/event system; the maximum number of pins that can be interfaced through the PPI at the same time is limited by the number of GPIOTE channels
- All pins can be individually configured to carry serial interface or quadrature demodulator signals

Hardware RESET:

There is on-chip power-on reset circuitry, But can still be used in external reset mode, in this case, GPIO pin P0.18 as an external hardware reset pin. In order to utilize P0.18 as a hardware reset, the UICR registers PSELRESET[0] and PSELRESET[1] must be set alike, to the value of 0x7FFFFF12. When P0.18 is programmed as RESET, the internal pull-up is automatically enabled.

HW debug and flash programming of Module :

The Module support the two pin Serial Wire Debug (SWD) interface and offers flexible and powerful mechanism for non-intrusive debugging of program code. Breakpoints, single stepping, and instruction trace capture of code execution flow are part of this support.

Pin	Flash Program interface
SWDIO	Debug and flash programming I/O
SWDCLK	Debug and flash programming I/O

This is the hardware debug and flash programming of module, J-Link Lite support, please refer www.segger.com.

PA control:

1. Hardware connection

nRF52840	PA/LNA
P1.07	RXEN
P1.06	TXEN

2. Device control

The SoftDevice for the nRF52 has support for enable/disable switching of external Power Amplifiers (PA) using GPIO pins.

In the module, P1.06 and P1.07 is reserved to control PA. The following function can be used to enable PA signal . Add this function to your project and call it after ble_stack_init():

P1.06	P1.07	PA status
1	0	TXEN
0	1	RXEN
0	0	IDLE
1	1	INVALID

```
static void pa_assist(uint32_t gpio_pa_pin)

{

    ret_code_t err_code;

    static const uint32_t gpio_toggle_ch = 0;

    static const uint32_t ppi_set_ch = 0;

    static const uint32_t ppi_clr_ch = 1;

    // Configure SoftDevice PA assist

    ble_opt_t opt;

    memset(&opt, 0, sizeof(ble_opt_t));

    // Common PA config

    opt.common_opt.pa_lna.gpiote_ch_id    = gpio_toggle_ch;     // GPIOTE channel

    opt.common_opt.pa_lna.ppi_ch_id_clr = ppi_set_ch;       // PPI channel for pin setting
```

```
    opt.common_opt.pa_lna.ppi_ch_id_set = ppi_clr_ch;     // PPI channel for pin clearing

    // PA config

    opt.common_opt.pa_lna.pa_cfg.active_high = 1;       // Set the pin to be active high

    opt.common_opt.pa_lna.pa_cfg.enable         = 1;     // Enable toggling

    opt.common_opt.pa_lna.pa_cfg.gpio_pin      = gpio_pa_pin;    // The GPIO pin to toggle

    opt.common_opt.pa_lna.lna_cfg.active_high    = NULL;

    opt.common_opt.pa_lna.lna_cfg.enable          = NULL;

    opt.common_opt.pa_lna.lna_cfg.gpio_pin        = NULL;

    err_code = sd_ble_opt_set(BLE_COMMON_OPT_PA_LNA, &opt);

    APP_ERROR_CHECK(err_code);

}
```

The following main function is an example that to show you how to enable PA signal in your project:

```
int main(void)

{

    uint32_t err_code;

    bool erase_bonds;

    // Initialize.

    APP_TIMER_INIT(APP_TIMER_PRESCALER, APP_TIMER_OP_QUEUE_SIZE, false);

    uart_init();

    buttons_leds_init(&erase_bonds);

    ble_stack_init();

    pa_assist(24); //after initializing ble stack, call this function will enable PA signal

    gap_params_init();
```

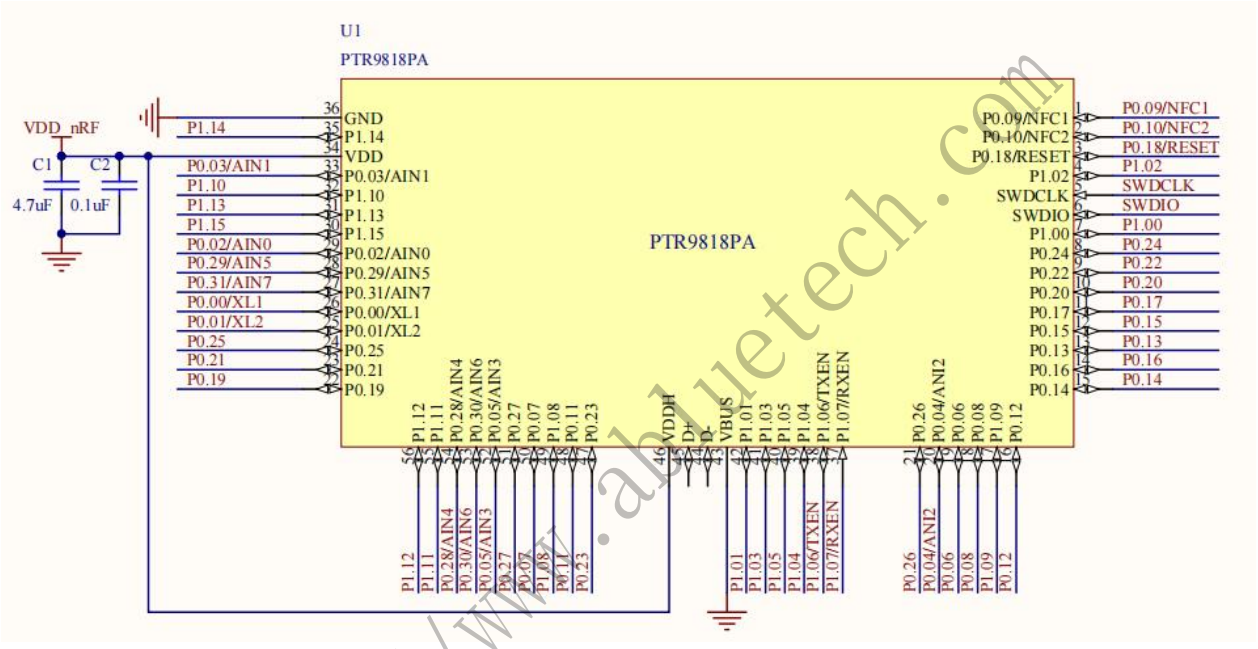
```
    services_init();

    advertising_init();

    conn_params_init();

    err_code = ble_advertising_start(BLE_ADV_MODE_FAST);

    APP_ERROR_CHECK(err_code);

    // Enter main loop.

    for (;;)

    {power_manage();}

}
```

Reference circuitry:

In this section there are 2 reference circuits to show how to design an application circuit with this module.

Reference Circuit configuration 1

- Typical Applications
- Use Normal voltage mode
- Normal voltage mode is entered when the supply voltage is connected to both the VDD and VDDH pins (so that VDD equals VDDH).



Configurations summary for reference circuit 1

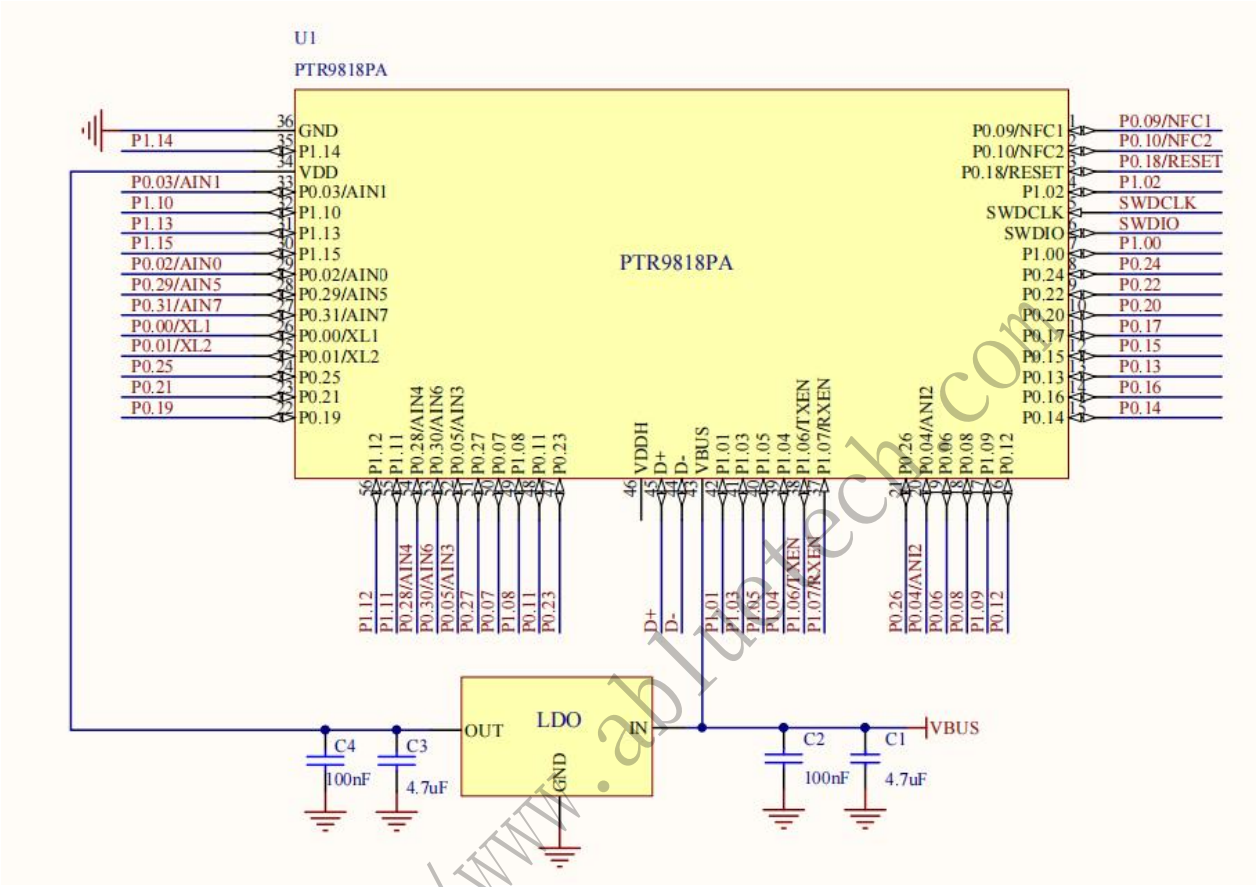
Config no.	Main Supply		EXT Supply Output	USB
	VDDH	VDD		
Config.1	N/A	Battery/Ext.regulator	No	No

Explanation of symbols in reference circuit 1 schematic

Symbol	Parameter	Min.	Typ.	Max.	Units
V_{DD}	Main supply voltage in normal voltage mode	2.7	3	3.6	V

Reference Circuit configuration 2

- USB Applications
- When using the USB peripheral, 5V USB supply needs to be provided on the VBUS pin.



Configurations summary for reference circuit 2

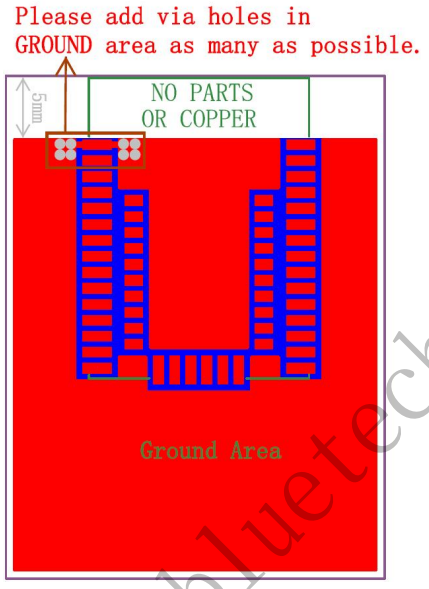
Config no.	Main Supply		EXT Supply Output	USB
	VDDH	VDD		
Config.2	N/A	Battery/Ext.regulator	No	Yes

Explanation of symbols in reference circuit 2 schematic

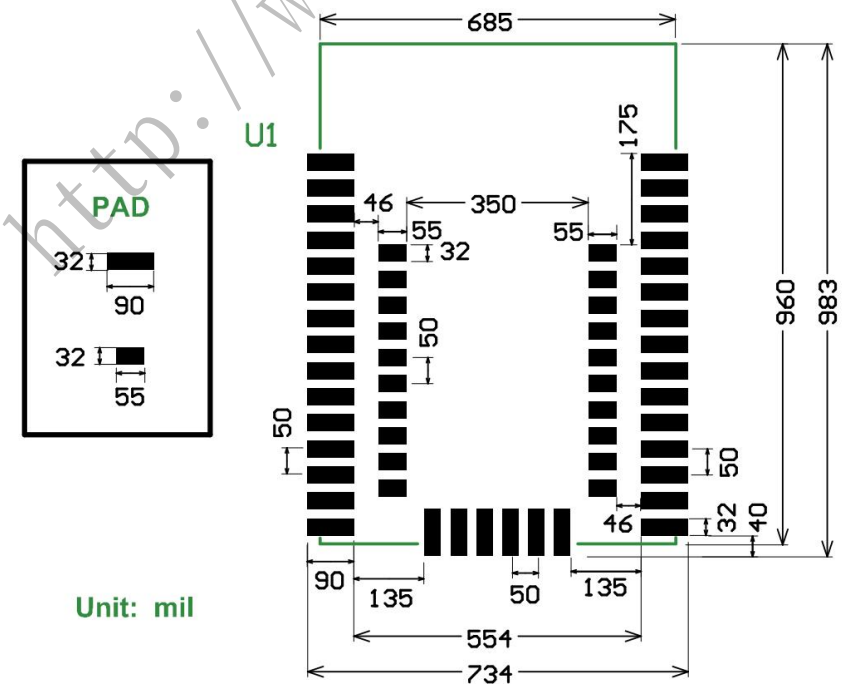
Symbol	Parameter	Min.	Typ.	Max.	Units
V_{DD}	Main supply voltage in normal voltage mode	2.7	3	3.6	V
V_{BUS}	Supply voltage on VBUS pin	4.35	5	5.5	V

Recommended RF Layout & Ground Plane:

The module integrated antenna requires a suitable ground plane to radiate effectively. The area under and extending out from the antenna portion of the module should be kept clear of copper and other metal. The module should be placed at the edge of the PCB with the antenna edge facing out. Reducing the ground plane will reduce the effective radiated power. Please add as more as possible via holes on the mother board near the GND pin of module, this will be good for the RF performance of system board.



PCB Footprint （Top View）:



Operating Conditions:

Parameter	Min.	Typ.	Max.	Unit
Supply voltages				
VDD	1.7	3.0	+3.6	V
VDDH	2.5	3.7	+5.5	V
VBUS	4.35	5	+5.5	V
Operating Temperature Range	-40	25	85	℃

Absolute Maximum Ratings:

Parameter	Min.	Max.	Unit
Supply voltages			
VDD	-0.3	+3.9	V
VDDH	-0.3	+5.8	V
VBUS	-0.3	+5.8	V
VSS	0	0	V
I/O pin voltage			
Voltage on GPIO pins ($V_{CC} \leq 3.6V$)	-0.3	VDD + 0.3	
Voltage on GPIO pins ($V_{CC} > 3.6V$)	-0.3	+3.9	
NFC antenna pin current		80	mA
RF input level		20	dBm
Environmental			
ESD Human Body Model		2	KV
ESD Human Body Model Class		3A	
ESD Charged Device Model		500	V
Storage temperature	-40	125	℃
Flash memory Endurance		10000	Write/erase cycles

Note: Exceeding one or more of the limiting values may cause permanent damage to the module.

Notes and Cautions:

Design Notes

(1) It is critical to following the recommendations of this document to ensure the module meets the specifications.

(2) Power supply must be free of AC ripple voltage. If such noise is present, it is critical to provide proper filtering and decoupling.

(3) The module should not be stressed mechanically after installation.

(4) Exposing the module to significant temperatures will result in degradation and decreased lifetime.

(5) Keep module away from other high frequency devices which may interfere with operation such as

other transmitters and devices generating high frequencies.

(6) Avoid static electricity, ESD and high voltage as these may damage the module.

Handling and Storage

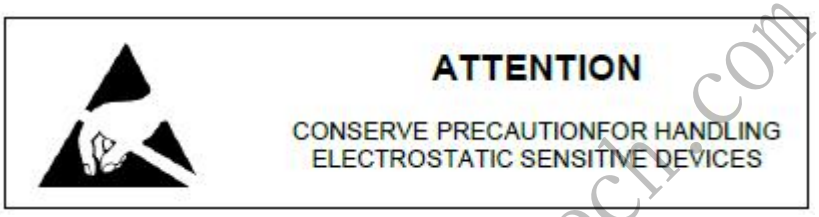
(1) Keep module away from other high frequency devices which may interfere with operation such as other transmitters and devices generating high frequencies.

(2) Do not expose the module to the following conditions: Corrosive gasses such as Cl2, H2S, NH3, SO2, or NOX Extreme humidity or salty air Prolonged exposure to direct Sunlight Temperatures beyond those specified for storage.

(3) Do not apply mechanical stress.

(4) Do not drop or shock the module.

(5) Avoid static electricity, ESD and high voltage as these may damage the module.

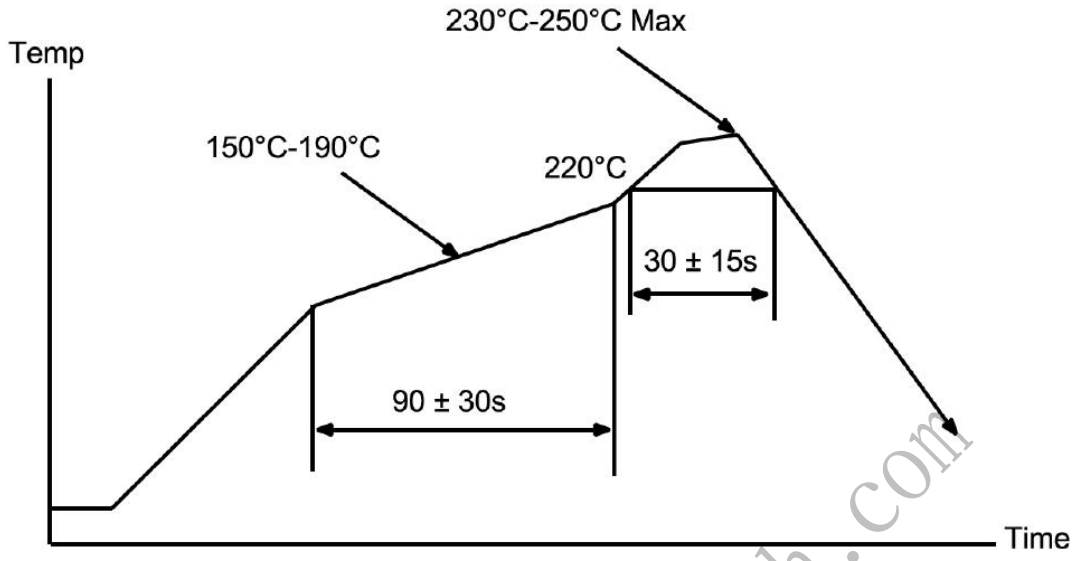


Moisture Sensitivity

All plastic packages absorb moisture. During typical solder reflow operations when SMDs are mounted onto a PCB, the entire PCB and device population are exposed to a rapid change in ambient temperature. Any absorbed moisture is quickly turned into superheated steam. This sudden change in vapor pressure can cause the package to swell. If the pressure exerted exceeds the flexural strength of the plastic mold compound, then it is possible to crack the package. Even if the package does not crack, interfacial delamination can occur.

Since the device package is sensitive to moisture absorption, it is recommended to bake the product before assembly.

Solder Reflow Temperature-Time Profile



Life Support Applications

Products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Customers using or selling these products for use in such applications do so at their own risk.

Additional Customization

We provide extensive customization, design and manufacturing services to ensure the perfect fit for your product. Our wide selection of modules allows developers to create any number of products. Should you need more information and assistance in integrating this module or developing your product, please contact us.

- Custom Hardware design including Modules, RF and Antenna Design
- Bluetooth Low Energy and Firmware Development
- Mobile Apps for iOS and Android
- Cloud Platform

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Right and Statements

- Reserves the right to make corrections, modifications, and/or improvements to the product and/or its specifications at any time without notice.
- Assumes no liability for the user’s product and/or applications.
- We have a strict and careful check and collation, but can not guarantee this manual without any errors and omissions.

Ordering Information:

Part Number	Description
PTR9818PA	Bluetooth Low Energy System on Module,EXT. IPX antenna
XANT-IPX-10	2.4GHz FPC Antenna with IPX connector, 2dB gain
XANT-SMA-10	2.4GHz Omni Antenna with SMA connector, 3dB gain
XIPX-SMA-10	IPX to SMA Converter RF cable，use for IPX type connector of RF module to SMA type Antenna.
PTR9818PA-EVB	Evaluation boards for module，with key, LED, I/O extend，sock for coin cell battery.