

# PAR2801-Q32P

## Low-power Bluetooth Module



### DISCLAIMER AND COPYRIGHT NOTICE

Information in this document, including URL references, is subject to change without notice.

This document is provided "As if" with no whatsoever, including any warranty of merchantability, noninfringement, fitness for any purpose, or any warranty otherwise arising out of any proposal, specification or samples.

All liability, including liability for infringement of any proprietary rights, relating to use of information in this document is disclaimed. No licenses express or implied, by estoppel or otherwise, to any intellectual property rights are granted herein.

The Bluetooth logo and symbol belong to the Bluetooth SIG Inc.

The Wi-Fi Alliance Member Logo is a trademark of the Wi-Fi Alliance.

All trade names, trademarks and registered trademarks mentioned in this document are property of their respective owners, and are hereby acknowledged.

Copyright by ITON Technology Corp. All rights reserved.

## Table of Contents

|                                                          |           |
|----------------------------------------------------------|-----------|
| <b>Table of Contents</b> .....                           | <b>2</b>  |
| <b>1 Device Overview</b> .....                           | <b>3</b>  |
| <b>1.1 Features</b> .....                                | <b>3</b>  |
| <b>1.2 Applications</b> .....                            | <b>3</b>  |
| <b>1.3 Description</b> .....                             | <b>3</b>  |
| <b>1.4 Functional Block Diagram</b> .....                | <b>3</b>  |
| <b>2 Pin Configuration and Functions</b> .....           | <b>5</b>  |
| <b>2.1 Module Pin Diagram with Parts Placement</b> ..... | <b>5</b>  |
| <b>2.2 Pinout Description</b> .....                      | <b>5</b>  |
| 2.2.1 Pinout Description .....                           | <b>5</b>  |
| 2.2.2 IO Multiplexing Modes .....                        | <b>7</b>  |
| <b>3 Specification</b> .....                             | <b>8</b>  |
| <b>3.1 Absolute Maximum Rating</b> .....                 | <b>8</b>  |
| <b>3.2 Recommended Operating Conditions</b> .....        | <b>8</b>  |
| <b>3.3 RF Characteristics</b> .....                      | <b>8</b>  |
| 3.3.1 Transmitter Specification .....                    | <b>8</b>  |
| 3.3.2 Receiver Specification .....                       | <b>9</b>  |
| <b>3.4 Power Consumption Summary</b> .....               | <b>9</b>  |
| <b>4 Application, Implementation, and Layout</b> .....   | <b>10</b> |
| <b>4.1 Application Diagram</b> .....                     | <b>10</b> |
| <b>4.2 Typical Application Circuit</b> .....             | <b>10</b> |
| <b>4.3 Layout Guideline</b> .....                        | <b>11</b> |
| <b>5 Mechanical and Package</b> .....                    | <b>11</b> |
| <b>5.1 Recommended PCB Footprint</b> .....               | <b>11</b> |
| <b>5.2 Package Information</b> .....                     | <b>12</b> |
| <b>6 Thermal Reflow</b> .....                            | <b>12</b> |
| <b>7 Revision History</b> .....                          | <b>13</b> |

## 1 Device Overview

### 1.1 Features

- Qualified Bluetooth Low Energy v5.0 slave device
- Cortex-M0 32-bit MCU with max. 32 MHz clock rate
- Low power and excellent performance 2.4 GHz transceiver
- 2 channel 10-bit SAR ADC
- 128 KB flash, 80 KB SRAM, and 24 KB ROM
- 16 MHz and 32.768 kHz crystal oscillator circuit
- Communication interfaces supported
  - Two I2C master
  - Two 2/4-wire SPI master
  - Two UART
- Digital peripherals
  - Three LED drive IO
  - Three PWM channels
- On-module PCB antenna with 50 ohm impedance and an optional RF pin to connect to an external antenna
- 4 dBm maximum transmitting power
- -93 dBm receiving sensitivity
- No welded shield

### 1.2 Applications

- HID peripherals
- Health and fitness wearable device
- Interactive entertainment device
- Home and industrial automation
- Security / Proximity applications

### 1.3 Description

PAR2801-Q32P is a BLE module built on PixArt Cortex-M0 core BLE4.0 SoC PAR2801. It integrates 128 KB on-chip flash and 80 KB SRAM. The peripherals include 18 GPIOs multiplexed with PWM, I2C, UART, ADC and SPI interfaces.

### 1.4 Functional Block Diagram

The PAR2801QN-GHVC chip has integrated an ARM® Cortex®-M0 processor, a BLE v5.0 baseband control core ROM, Flash, Bluetooth Modem, Radio Transceiver, on-chip Balun for the BLE application.

Figure 1 shows the architecture block diagram of the chip. The subsequent chapters illustrate the detailed information of different interface blocks.

Figure 2 shows the architecture block diagram of the module.

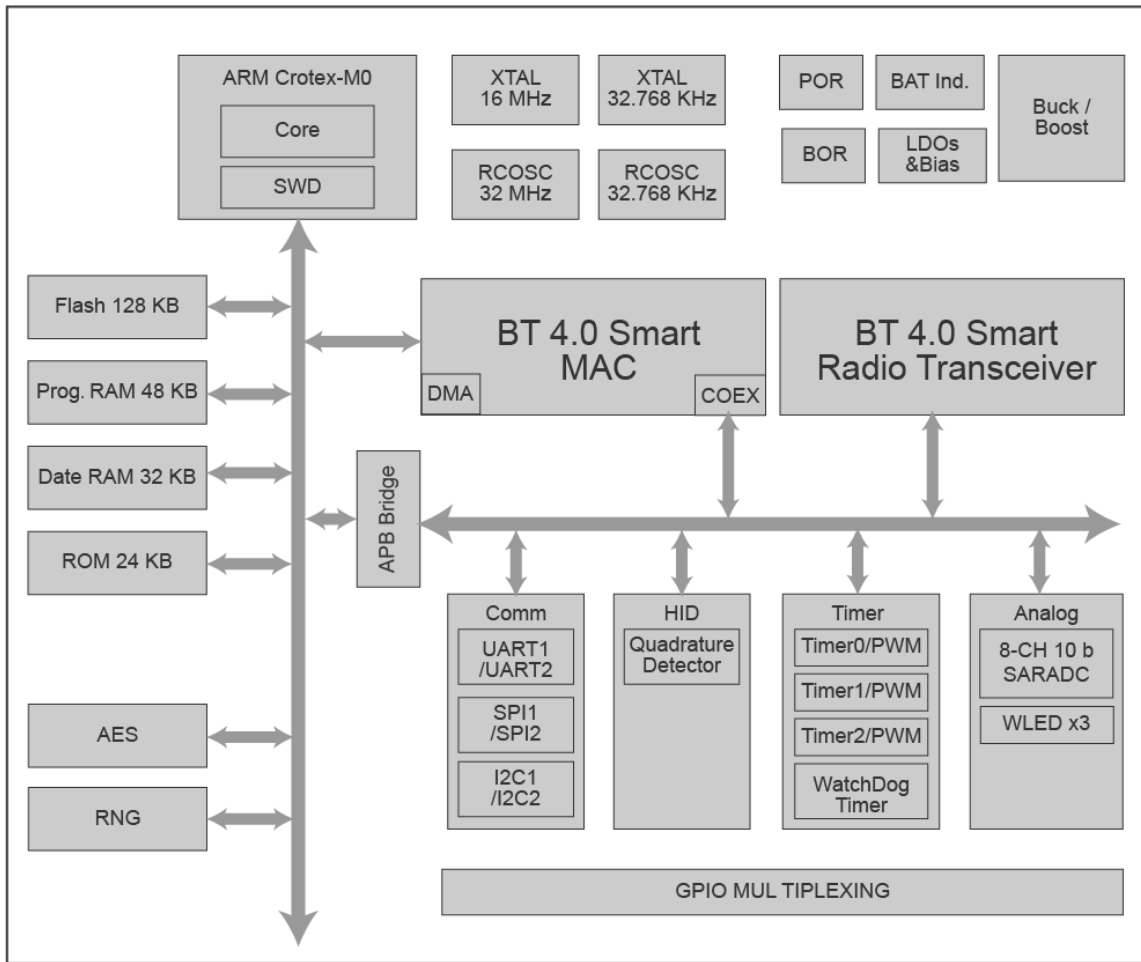


Figure 1. Functional Block Diagram of the Chip

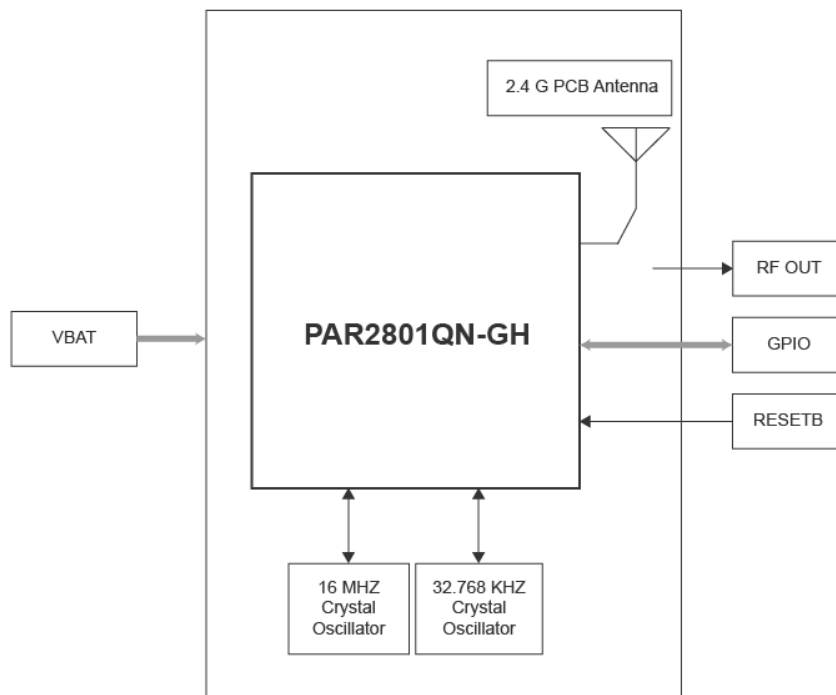


Figure 2. Module Functional Block Diagram

## 2 Pin Configuration and Functions

### 2.1 Module Pin Diagram with Parts Placement

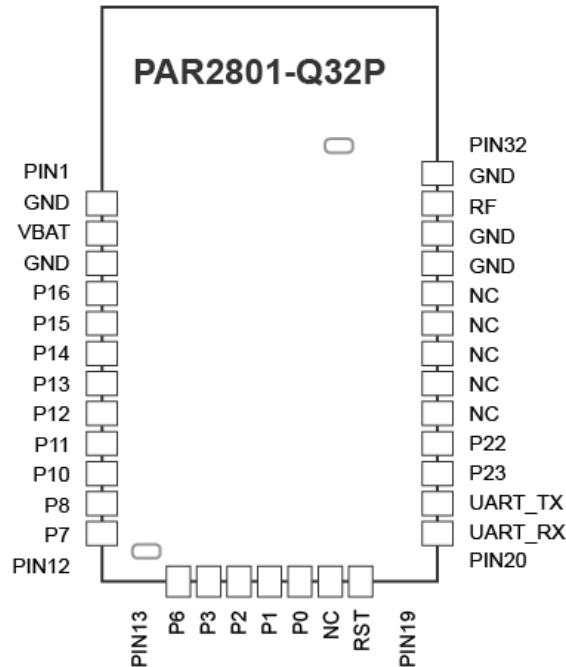


Figure 3. Pin Diagram of PAR2801-Q32P

## 2.2 Pinout Description

### 2.2.1 Pinout Description

Table 1. Pin Attributes of PAR2801-Q32P

| Pin | Name   | Pin Type | Description                                                                                                                                                              |
|-----|--------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | GND    | Power    | Ground                                                                                                                                                                   |
| 2   | VBAT   | Power    | Input power pin, connecting to a battery or an external power source. Recommended to add decoupling capacitor, 10 $\mu$ F. Keep PCB trace as short and wide as possible. |
| 3   | GND    | Power    | Ground                                                                                                                                                                   |
| 4   | GPIO16 | BiDir    | GPIO, MouseKey_B5, PWM0, or LED0<br>I2C: Data IO, I2C_SDA1                                                                                                               |
| 5   | GPIO15 | BiDir    | GPIO, MouseKey_B4, PWM1, or LED1<br>I2C: Clock output, I2C_SCL1                                                                                                          |
| 6   | GPIO14 | BiDir    | GPIO, MouseKey_CPI, PWM2, or LED2                                                                                                                                        |
| 7   | GPIO13 | BiDir    | GPIO, MouseKey_Middle                                                                                                                                                    |
| 8   | GPIO12 | BiDir    | GPIO, MouseKey_Right                                                                                                                                                     |

|    |        |       |                                                                                                                                         |
|----|--------|-------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 9  | GPIO11 | BiDir | GPIO, MouseKey_Left                                                                                                                     |
| 10 | GPIO10 | BiDir | GPIO, Motion_Wake_Up as motion detect for external sensor, Active_Low                                                                   |
| 11 | GPIO8  | BiDir | GPIO<br>SPI4W: Master, Chip Select, SPI_CSN<br>SPI3W: Master, Chip Select, SPI_CSN                                                      |
| 12 | GPIO7  | BiDir | GPIO<br>SPI4W: Master, Data_input, SP_DI<br>SPI3W: Master, Data_IO, SPI_DIO<br>I2C: Data_IO, I2C_SDA0                                   |
| 13 | GPIO6  | BiDir | GPIO<br>SPI4W: Master, Clock output, SPI_CLK<br>SPI3W: Master, Clock output, SPI_CLK<br>I2C: Clock output, I2C_SCL0                     |
| 14 | GPIO3  | BiDir | GPIO<br>SPI4W: Master, Data input, SPI_DI_1<br>UART: UART_RTS0                                                                          |
| 15 | GPIO2  | BiDir | GPIO, PWM0, or LED0<br>SPI4W: Master, Clock output, SPI_CLK_1<br>UART: UART_CTS0                                                        |
| 16 | GPIO1  | BiDir | GPIO, PWM1, or LED1<br>Analog Input_1<br>I2C: Data IO, I2C_SDA1<br>UART: UART_TXD1                                                      |
| 17 | GPIO0  | BiDir | GPIO, PWM2, or LED2<br>Analog Input_0<br>I2C: Clock output, I2C_SCL0<br>UART: UART_RXD0                                                 |
| 18 | NC     |       |                                                                                                                                         |
| 19 | RST    | In    | Active low signal at least 10 ms for HW reset. The module has add a RC POR circuit (R=100 k, C=100 nF) connected to VDDIO power domain. |
| 20 | GPIO26 | BiDir | GPIO, PWM0, or LED0<br>I2C: Clockoutput, as I2C_SCL0,<br>UART: UART_RXD0                                                                |
| 21 | GPIO27 | BiDir | GPIO, PWM2, or LED2<br>I2C: Data IO, as I2C_SDA0<br>UART: UART_TXD0                                                                     |
| 22 | GPIO23 | BiDir | GPIO, or Key_Z2<br>I2C: Data IO, as I2C_SDA1<br>UART: UART_TXD1                                                                         |
| 23 | GPIO22 | BiDir | GPIO, or Key_Z1<br>I2C: Clock output, I2C_SCL1<br>UART: UART_RXD1                                                                       |

|    |     |       |                                                                              |
|----|-----|-------|------------------------------------------------------------------------------|
| 24 | NC  |       |                                                                              |
| 25 | NC  |       |                                                                              |
| 26 | NC  |       |                                                                              |
| 27 | NC  |       |                                                                              |
| 28 | NC  |       |                                                                              |
| 29 | GND | Power | Ground                                                                       |
| 30 | GND | Power | Ground                                                                       |
| 31 | RF  | BiDir | 2.4 GHz transceiver RF port. Default connected to PCB antenna in the module. |
| 32 | GND | Power | Ground                                                                       |

### 2.2.2 IO Multiplexing Modes

| GPIO#  | 0      | 1              | 2          | 3        | 4         | 5         |
|--------|--------|----------------|------------|----------|-----------|-----------|
| GPIO0  | GPIO0  | Analog Input0  |            | I2C_SCL1 | UART_RXD1 | PWM2/LED2 |
| GPIO1  | GPIO1  | Analog Input1  |            | I2C_SDA1 | UART_TXD1 | PW12/LED1 |
| GPIO2  | GPIO2  | M_SPICK_1      |            |          | UART_CST0 | PWM0/LED0 |
| GPIO3  | GPIO3  | M_SPIDI_1      |            |          | UART_RTS0 |           |
| GPIO6  | GPIO6  | M_SPICK_0      | M_SPICK_0  | I2C_SCL0 |           |           |
| GPIO7  | GPIO7  | M_SPIDI_0      | M_SPI_IO_0 | I2C_SDA0 |           |           |
| GPIO8  | GPIO8  | M_SPICSN_0     | M_SPICSN_0 |          |           |           |
| GPIO10 | GPIO10 | MOTION_Wake_UP |            |          |           |           |
| GPIO11 | GPIO11 | MouseKey(BL)   |            |          |           |           |
| GPIO12 | GPIO12 | MouseKey(BR)   |            |          |           |           |
| GPIO13 | GPIO13 | MouseKey(BM)   |            |          |           |           |
| GPIO14 | GPIO14 | MouseKey(CPI)  |            |          |           | PWM2/LED2 |
| GPIO15 | GPIO15 | MouseKey(B4)   |            | I2C_SCL1 |           | PWM1/LED1 |
| GPIO16 | GPIO16 | MouseKey(B5)   |            | I2C_SDA1 |           | PWM0/LED0 |
| GPIO22 | GPIO22 | MouseKey(Z1)   |            | I2C_SCL1 | UART_RXD1 |           |
| GPIO23 | GPIO23 | MouseKey(Z2)   |            | I2C_SDA1 | UART_TXD1 |           |
| GPIO26 | GPIO26 |                |            | I2C_SCL0 | UART_RXD0 | PWM0/LED0 |
| GPIO27 | GPIO27 |                |            | I2C_SDA0 | UART_TXD0 | PWM2/LED2 |

### 3 Specification

#### 3.1 Absolute Maximum Rating

| Parameter                | Symbol             | Min. | Max.                   | Unit | Note                                                                             |
|--------------------------|--------------------|------|------------------------|------|----------------------------------------------------------------------------------|
| V <sub>BAT</sub> Voltage | V <sub>BAT3V</sub> | -0.4 | V <sub>BAT</sub> + 0.3 | V    |                                                                                  |
| ESD                      | ESD <sub>HBM</sub> |      | 2                      | kV   | Class 2 on all pins, as per human body model. JESD22-A114E with 15 sec internal. |

#### 3.2 Recommended Operating Conditions

| Parameter                      | Symbol             | Min. | Typ. | Max. | V  | Note               |
|--------------------------------|--------------------|------|------|------|----|--------------------|
| Supply Voltage                 | V <sub>BAT3V</sub> | 1.9  | 3.0  | 3.6  | V  | Including ripples. |
| Storage Temperature            | T <sub>S</sub>     | -20  | -    | 70   | °C |                    |
| Operating Junction Temperature | T <sub>J</sub>     | -20  | -    | 70   | °C |                    |

#### 3.3 RF Characteristics

##### 3.3.1 Transmitter Specification

| Parameters                             | Symbol                   | Condition                              | Min. | Typ. | Max. | Unit         |
|----------------------------------------|--------------------------|----------------------------------------|------|------|------|--------------|
| Frequency Range                        | FR <sub>TX</sub>         |                                        | 2402 | -    | 2480 | MHz          |
| Max. Output Power                      | P <sub>O, MAX</sub>      |                                        | -    |      | 4    | dBm          |
| Default Output Power                   | P <sub>O, DEF</sub>      |                                        |      | 0    |      | dBm          |
| Output Power Adjust Range              | P <sub>O, ADJ</sub>      |                                        | -3   |      | 4    | dBm          |
| Output Power Variation                 | PO, VAR                  | All channels TX power variation        |      | 2    |      | dBm          |
| TX 20 dB Bandwidth                     | BW <sub>20dB</sub>       |                                        |      |      | 1150 | kHz          |
| 1 <sup>st</sup> Adjacent Channel Power | P <sub>AJC1</sub>        |                                        |      |      | -20  | dBc          |
| 2 <sup>nd</sup> Adjacent Channel Power | P <sub>AJC2</sub>        |                                        |      |      | -40  | dBc          |
| Delta F1 Frequency Deviation           | f <sub>1AVG</sub>        |                                        | 225  |      | 275  | kHz          |
| Delta F2 Frequency Deviation           | f <sub>2AVG</sub>        |                                        | 185  |      |      | kHz          |
| AVG Delta F2/Delta F1                  | f <sub>AVG</sub>         | Δf <sub>2AVG</sub> /Δf <sub>1AVG</sub> | 0    |      |      |              |
| Frequency Offset                       | F <sub>OFFSET</sub>      |                                        | -150 |      | 150  | kHz          |
| Carrier Frequency Drift                | CF <sub>DRIFT</sub>      |                                        |      |      | 50   | kHz          |
| Carrier Frequency Drift rate           | CF <sub>DRIFT_Rate</sub> |                                        |      |      | 20   | kHz/50<br>μs |
| 2 <sup>nd</sup> Harmonics Power Level  | Har <sub>2nd</sub>       | @P <sub>out</sub> = 0 dBm              |      |      | -40  | dBm          |



|                                       |                    |               |  |  |     |     |
|---------------------------------------|--------------------|---------------|--|--|-----|-----|
| 3 <sup>rd</sup> Harmonics Power Level | Har <sub>3rd</sub> | @Pout = 0 dBm |  |  | -45 | dBm |
|---------------------------------------|--------------------|---------------|--|--|-----|-----|

Notes:

Electrical Characteristics are measured under BLE specification and recommended operating conditions.

### 3.3.2 Receiver Specification

| Parameters                          | Symbol                        | Condition                                                            | Min. | Typ. | Max. | Unit |
|-------------------------------------|-------------------------------|----------------------------------------------------------------------|------|------|------|------|
| Frequency Range                     | FR <sub>TX</sub>              |                                                                      | 2402 | -    | 2480 | MHz  |
| Maximum Input Power                 | RX <sub>MAX</sub>             | With PER < 30.8%                                                     |      | 0    |      | dBm  |
| Ideal Signal Sensitivity            | SEN <sub>IDEAL</sub>          |                                                                      |      | -93  |      | dBm  |
| Dirty Signal Sensitivity            | SEN <sub>DIRTY</sub>          |                                                                      |      | -90  |      | dBm  |
| <b>C/I and Selectivity</b>          |                               |                                                                      |      |      |      |      |
| C/I Co-Channel                      | C/I <sub>CO</sub>             |                                                                      |      | 9    |      | dB   |
| C/I Adjacent +1 MHz                 | C/I <sub>1M</sub>             |                                                                      |      | -1   |      | dB   |
| C/I Adjacent +2 MHz                 | C/I <sub>2M</sub>             |                                                                      |      | -35  |      | dB   |
| C/I Adjacent ≥ +3 MHz               | C/I <sub>3M</sub>             |                                                                      | -40  | -48  |      | dB   |
| C/I Image Channel                   | C/I <sub>IMG</sub>            |                                                                      |      | -25  |      | dB   |
| C/I Image + 1 M Channel             | C/I <sub>IMG+1M</sub>         |                                                                      |      | -35  |      | dB   |
| <b>Inter-Modulation Performance</b> |                               |                                                                      |      |      |      |      |
| IMD Performance                     | IMD                           | 3 <sup>rd</sup> , 4 <sup>th</sup> and 5 <sup>th</sup> offset channel | -24  |      |      | dBm  |
| <b>Blocking Performance</b>         |                               |                                                                      |      |      |      |      |
| Blocking 30 MHz ~ 2000 MHz          | P <sub>BLK_30~2000MHz</sub>   |                                                                      | -10  |      |      | dBm  |
| Blocking 2003 MHz ~ 2399 MHz        | P <sub>BLK_2003~2399MHz</sub> |                                                                      | -30  |      |      | dBm  |
| Blocking 2484 MHz ~ 2497 MHz        | P <sub>BLK_2484~2497MHz</sub> |                                                                      | -30  |      |      | dBm  |
| Blocking 3000 MHz ~ 12.75 GHz       | P <sub>BLK_3~12.75GHz</sub>   |                                                                      | -10  |      |      | dBm  |

Notes:

Electrical Characteristics are measured under BLE specification and recommended operating conditions.

### 3.4 Power Consumption Summary

| Parameters                | Condition                 | Min. | Typ. | Max. | Unit |
|---------------------------|---------------------------|------|------|------|------|
| Supply Current @DTM-TX RF | @V <sub>BAT3V</sub> = 3 V |      | 10.0 |      | mA   |

|                         |                           |      |    |
|-------------------------|---------------------------|------|----|
| Supply Current @ DTM-RX | @V <sub>BAT3V</sub> = 3 V | 13.5 | mA |
|-------------------------|---------------------------|------|----|

## 4 Application, Implementation, and Layout

### 4.1 Application Diagram

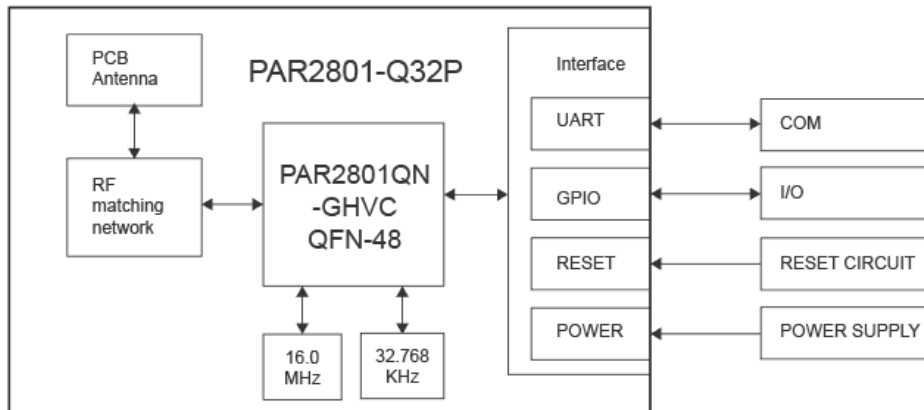


Figure 4. PAR2801-Q32P Application Diagram

### 4.2 Typical Application Circuit

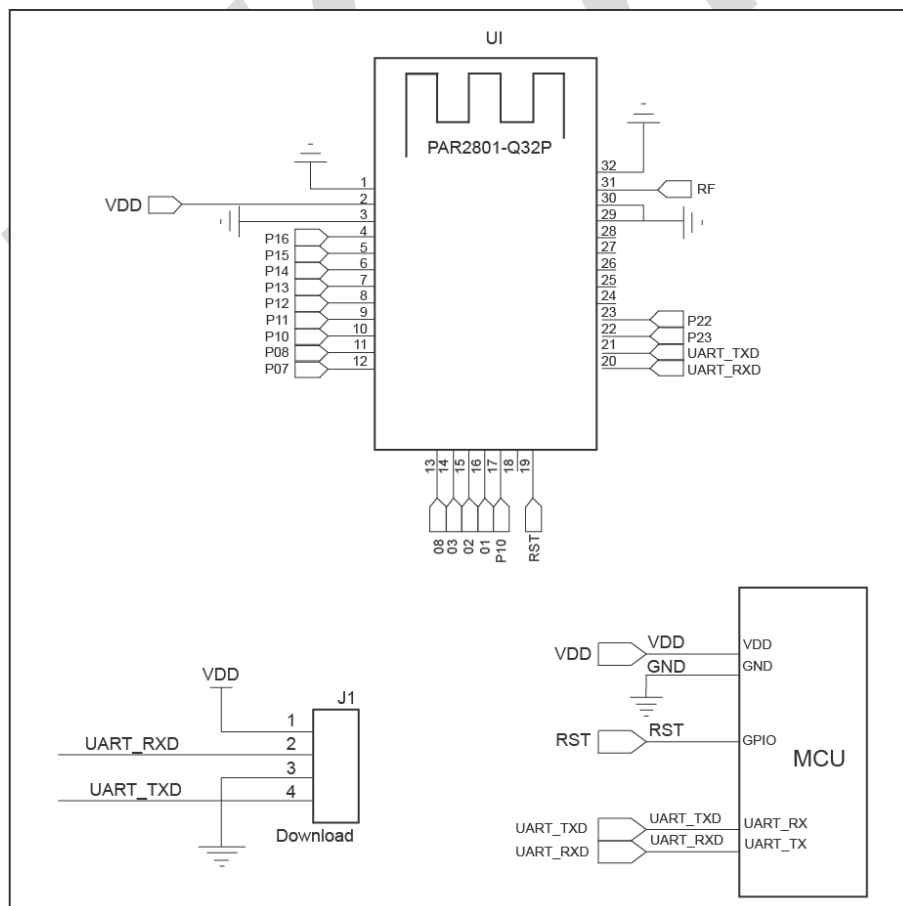


Figure 5. Typical Application Circuit

Note:

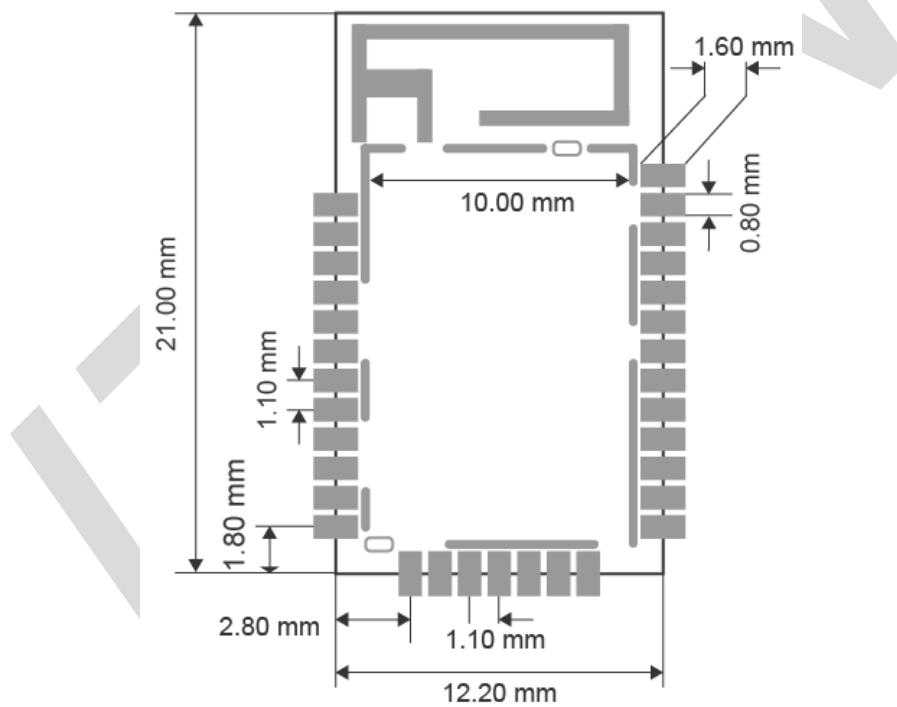
1. VDD:1.9 V ~ 3.6 V; recommend: 3.0 V
2. The MCU communicate with the module should attention level matched.

### 4.3 Layout Guideline

1. It is recommended to place this module at the edge of the main board. The module PCB antenna is oriented towards the outside of the board. Away from some sources of interference such as DCDC.
2. The copper of the PCB antenna area in the main board should be hollowed all layers. Forbid routing under the module

## 5 Mechanical and Package

### 5.1 Recommended PCB Footprint



L: 12.20 mm ± 0.13 mm; W: 21.00 mm ± 0.13 mm; H: 1.8 mm ± 0.2 mm

Figure 6. Recommended PCB Footprint of PAR28011-Q32P

## 5.2 Package Information

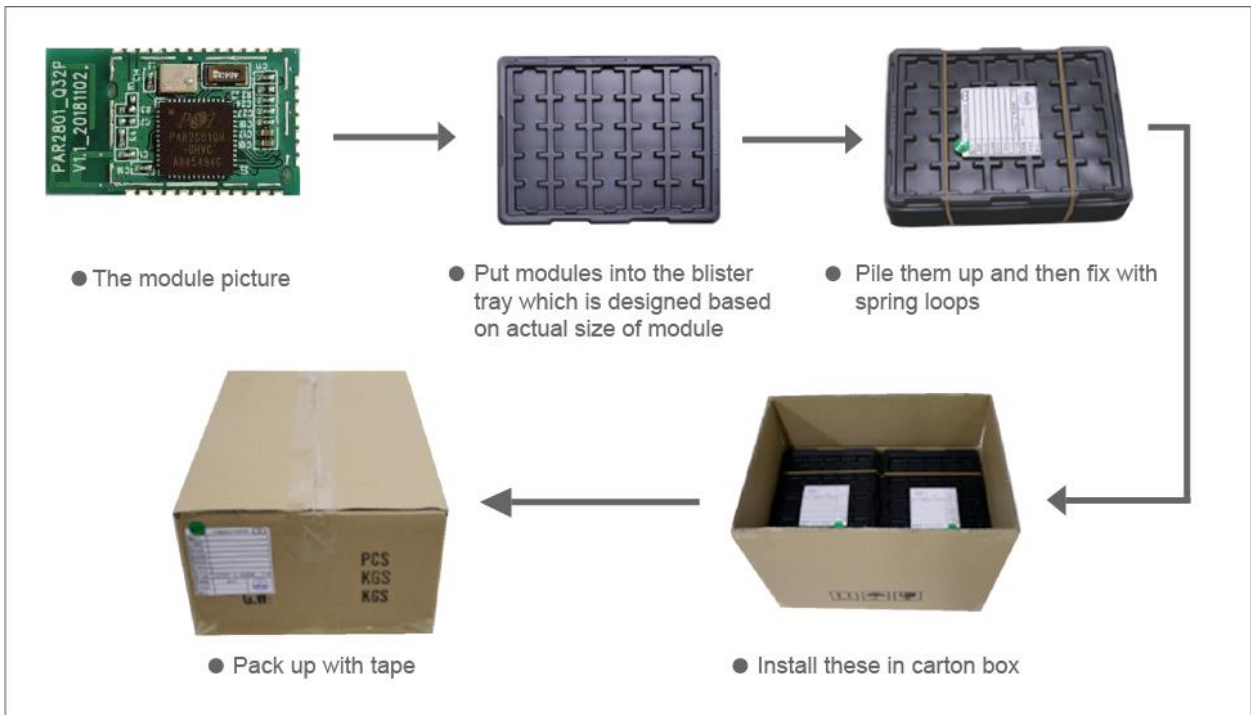


Figure 7. Packaging Information of PAR28011-Q32P

## 6 Thermal Reflow

Referred to IPC/JEDEC standard.

Peak temperature: <250 °C

Number of times: ≤2

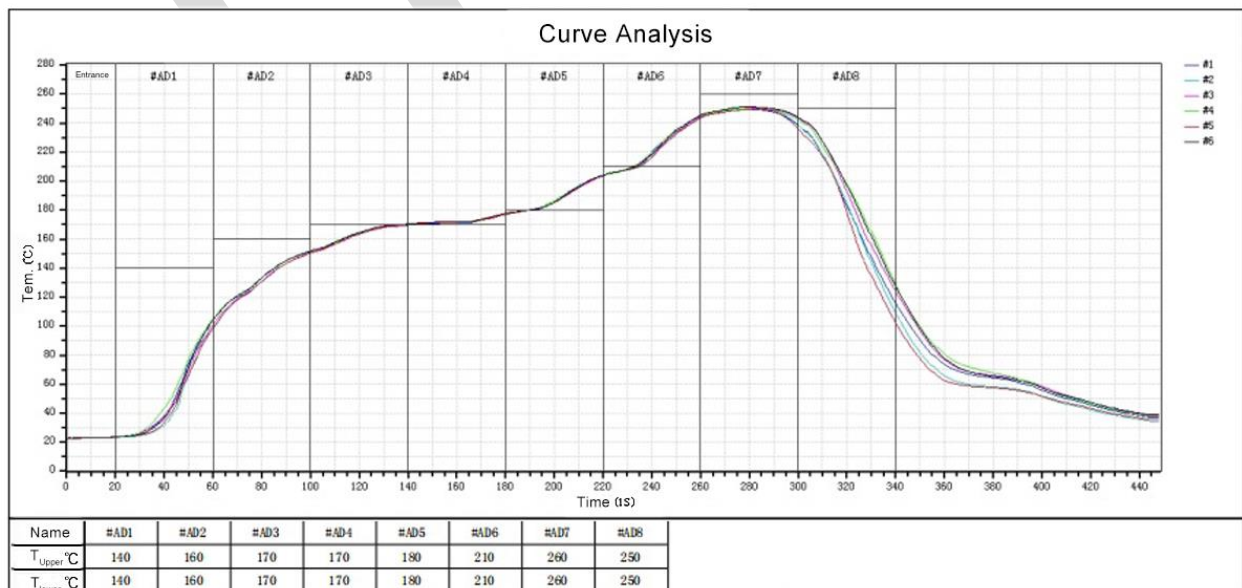


Figure 8. Recommended Reflow for Lead Free Solder

## 7 Revision History

| Date       | Version No. | Description               | Author |
|------------|-------------|---------------------------|--------|
| 2018.11.02 | V1.0        | The draft version         | WL     |
| 2019.04.26 | V1.1        | Update Bluetooth version. | WL     |
| 2019.08.08 | V1.2        | English Version rewritten |        |