# 产品规格书

型号：TL8821CSSC

规格：12*12*0.8mm 44PIN

版本：V1.0

页数：24页

# Contents

**Change History of Revision..... 3**

1. **General Description.....4**
2. **Features..... 5**
3. **Block Diagram.....10**
4. **General Specification.....10**
5. **Power Supply DC Characteristics.....11**
6. **Electrical Specifications.....11**
7. **Bluetooth Specification.....13**
8. **Pin Definition..... 14**
9. **Size reference..... 16**
10. **SDIO interface Circuit reference pictures..... 17**
11. **Recommended Reflow Profile.....17**
12. **Packaging Information .....18**

13. purchase information .....18

# Change History of Revision

| Revisio | Date | Contents of Revision Change | Remark |
|---|---|---|---|
| 1.0 | 2017-06-23 | 首次发布产品规格书 | 2017-06-23 |
| 1.0 | 2019-02-25 | 1. 新增加模块图片<br>2. 修改模块尺寸 | 2019-02-25 |
| 1.1 | 2023-01-11 | Update the specification format | 2023-01-11 |
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# 1. General Description

The Realtek RTL8821CS is a highly integrated single-chip that support 1-stream 802.1 lac solutions with Multi-user MIMO (Multiple-Input, Multiple-Output) STA mode with integrated Bluetooth 2.1/4.2 controller, SDIO (SDIO 1.1/2.0/3.0) interface, and HS-UART mixed interface. It combines a WLAN MAC, a 1T1R capable WLAN baseband, and RF in s single chip. The RTL8821CS provides a complete solution for a high-performance integrated wireless and Bluetooth device.

The RTL8821CS baseband implements Multi-user Multiple Input, Multiple Output (MU MIMO) Orthogonal Frequency Division Multiplexing (OFDM) STA mode with one transmit and one receive path (1T1R). Features include one spatial stream transmission, short Guard Interval (GI) of 400ns， spatial spreading, and support for variant channel bandwidth. Moreover, RTL8821CS provides one spatial stream space-time block code (STBC), Transmit Beamforming (TxBF) and Low Density Parity Check (LDPC) to extend the range of transmission. As the recipient, the RTL8821CS also supports explicit sounding packet feedback that helps senders with beamforming capability.

For legacy compatibility, Direct Sequence Spread Spectrum (DSSS), Complementary Code Keying (CCK) and OFDM baseband processing are included to support all IEEE 802.1 lb, 802.1 lg and 802.1 la data rates. Differential phase shift keying modulation schemes, DBPSK and DQPSK with data scrambling capability are available, and CCK provides support for legacy data rates, with long or short preamble. The high speed FFT/IFFT paths, combined with BPSK, QPSK, 16QAM, 64QAM and 256QAM modulation of the individual subcarriers, and rate compatible coding rate of 1/2, 2/3, 3/4, and 5/6, provide up to 433.3Mbps for IEEE 802.1 lac MIMO OFDM.

The RTL8821CS builds in an enhanced signal detector, an adaptive frequency domain equalizer, and a soft-decision Viterbi decoder to alleviate severe multi-path effects and mutual interference in the reception of multiple streams. Robust interference detection and suppression are provided to protect against Bluetooth, cordless phone, and microwave oven interference.

Receive vector diversity for multi-stream application is implemented for efficient utilization of the MIMO channel. Efficient IQ-imbalance, DC offset, phase noise, frequency offset, and timing offset compensations are provided for the radio frequency front-end.

The RTL8821CS supports fast receiver Automatic Gain Control (AGC) with synchronous and asynchronous control loops among antennas, antenna diversity functions, and adaptive transmit power control functions to obtain better performance in the analog portions of the transceiver.

The RTL8821CS MAC supports 802.1 le for multimedia applications, 802.lli and WAPI (Wireless Authentication Privacy Infrastructure) for security, and 802.1 ln/802. llac for enhanced MAC protocol efficiency. Using packet aggregation techniques such as A-MPDU with BA and A-MSDU, protocol efficiency is significantly improved. Power saving mechanisms such as Legacy Power Save, U-APSD, and MIMO power saving reduce the power wasted during idle time, and compensate for the extra power required to transmit MIMO OFDM. The RTL8821CS provides simple legacy, 20MHz/40MHz/80MHz co-existence mechanisms to ensure backward and network compatibility.

The RTL8821CS Bluetooth controller complies with Bluetooth core specification v4.1 and supports dual mode (BR/EDR + Low Energy Controllers). It is compatible with previous versions, including v2.1 + EDR. For BR/EDR, it supports scatternet topology and allows active links in slave mode, and active links in master mode. For Low Energy, it supports multiple states and allows active links in master mode. The links in BR/EDR and LE can be active simultaneously.

## 2. Features

**General**

- CMOS MAC，Baseband PHY and RF in a single chip for IEEE 802.1 la/b/g/n/ac compatible WLAN
- Support 802.llac lxl,Wave-2 compliant with MU-MIMO STA mode
- Complete 802.1 In MIMO solution for 2.4GHz and 5Ghz band

Maximum PHY data rate up to 86.7Mbps using 20MHz bandwidth, 200Mbps using 40MHz bandwidth, and 433.3Mbps using 80MHz bandwidth.

Backward compatible with 802.1 la/b/g devices while operating at 802.1 In data rates

Backward compatible with 802.1 la/n devices while operating at 802.1 lac data rates.

**Host Interface**

- Complies with SDIO 1.1/2.0/3.0 for WLAN with clock rate up to 100MHz (SDR50 and DDR50)

G-SPI interface for configurable endian for WLAN

Complies with HS-UART with configurable baud rate for Bluetooth

**Standards Supported**

- IEEE 802.1 la/b/g/n/ac compatible WLAN
- IEEE 802.1 le QoS Enhancement (WMM)
- IEEE 802.lli (WPA, WPA2). Open, shared key, and pair-wise key authentication services
- IEEE 802.1 lh DFS，TPC，Spectrum Measurement

**MAC Features**

- Frame aggregation for increased MAC efficiency (A-MSDU, A-MPDU)
- Low latency immediate Block Acknowledgement (BA)
- Long NAV for media reservation with CF-End for NAV release
- Multiple BSSID feature allows the RTL8821CS to assume multiple MAC identities when used as a wireless bridge
- Transmit Opportunity (TXOP) Short Inter-Frame Space (SIFS) bursting for higher multimedia bandwidth
- WiFi Direct supports wireless peer to peer applications

**Other Features**

- Supports Wake-On-WLAN via Magic Packet and Wake-up frame
- Transmit Beamforming

**Peripheral Interfaces**

- Up to 15 General Purpose Input/Output pins
- Three configurable LED pins (mux with GPIO pins)

**PHY Features**

- IEEE 802.1 lac OFDM
- IEEE 802.1 In OFDM
- One Transmit and One Receive path ■ 5MHz /10MHz / 20MHz / 40MHz / 80MHz bandwidth transmission ■ Support 2.4Ghz and 5Ghz band

■ IEEE 802.1 lk Radio Resource Measurement
WAPI (Wireless Authentication
Privacy Infrastructure) certified.
Cisco Compatible Extensions (CCX)
for WLAN devices

- PHY-level spoofing to enhance legacy compatibility
- MIMO power saving mechanism ■ Channel management and co-existence
- WiFi NAN (Neighborhood Area Network) support
- WiFi FTM (Fine Time Measurement) supported
- WiFi TDLS (Tunneled Direct Link Setup) Supported

- CCA on secondary through RTS/CTS handshake.
- Support TCP/UDP/IP checksum offload

- Generates 40MHz clock for peripheral chip.
- Single external power source 3.3V only

- Maximum data rate 54Mbps in 802.11 g, 150Mbps in 802.1 In and 433Mbps in 802.1 lac.
- Switch diversity used for DSSS/CCK ■ Support STBC receiving
- Support LDPC transmitting

**6/17**

channels
- Short Guard Interval (400ns)
- Sounding packet.
- DSSS with DBPSK and DQPSK, CCK modulation with long and short preamble
- OFDM with BPSK, QPSK, 16QAM, 64QAM and 256QAM modulation. Convolutional Coding Rate: 1/2, 2/3, 3/4, and 5/6

**Bluetooth Controller**
- Compatible with Bluetooth V2.1+EDR
- Support Bluetooth 4.1 features
- HS-UART interface for Bluetooth data transmission compliant with H4 and H5 specification
- PCM interface for audio data transmission via Bluetooth controller
- Integrated MCU to execute Bluetooth protocol stack
- Supports all packet types in basic rate and enhanced data rate

**Bluetooth Transceiver**
- Fast AGC control to improve receiving dynamic range
- Supports AFH to dynamically detect channel quality to improve transmission quality
- Integrated internal Class 1, Class 2, and Class 3 PA

**Peripheral Interfaces**
- General Purpose Input/Output (8 pins)
- 4-wire EEPROM control interface (93C46)
- Three configurable LED pins

Hardware antenna diversity
Fast receiver Automatic Gain Control (AGC)
On-chip ADC and DAC
Build-in both 2.4GHz and 5GHz PA Build-in both 2.4GHz and 5GHz LNA

- Supports SCO/eSCO link (allows one link for PCM interface and three links for HS-UART)
- Supports piconets in a scatternet
- Supports Secure Simple Pairing
- Supports Low Power Mode (Sniffi^Sniff Sub-rating)
- Enhanced BT/WLAN Coexistence Control to improve transmission quality in different profiles
- Bluetooth 4.0 Dual Mode support: Simultaneous LE and BR/EDR
- Supports multiple Low Energy states

- Supports Enhanced Power Control
- Supports Bluetooth Low Energy
- Integrated 32K oscillator for power management

- Flexible CRYSTAL frequency selection(52, 48, 40, 38.4, 27, 26， 25,24,20, 19.2, 17.664, 16, 14.318, 13 and 12MHz)
- Support CRYSTAL or external clock input

# 3.Block Diagram

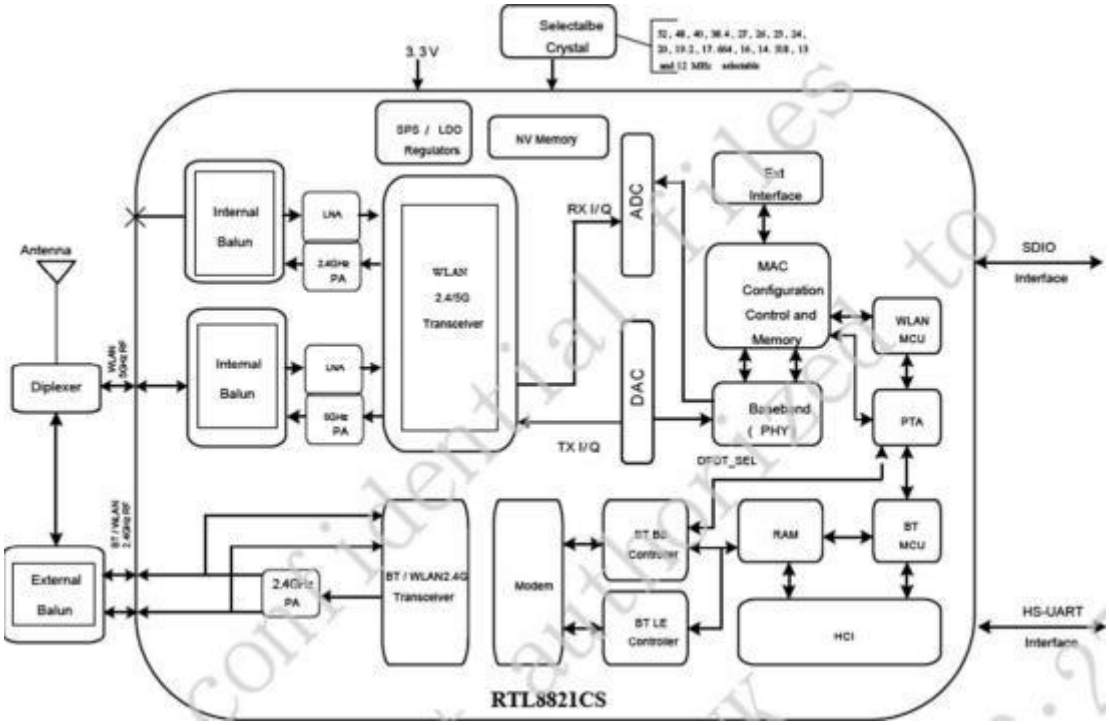



**Figure 1. Dual-Band MIMO lxl Solution(llac lxl MAC/BB/RF + PA) and Integrated Bluetooth Controller Solution with Single Antenna …RTL8821CS**

# 4.General Specification

| | |
|---|---|
| Model | TL8821CSSC |
| Product Name | WLAN 1 la/b/g/n/ac SDIO module |
| Major Chipset | RealtekRTL8821CS |
| Standard | WIFI: IEEE802.1 la/b/g/n/ac<br>BT:2.1/4.1 |
| Data Transfer Rate | 1，2,5.5,6，ll，12，18,22,24,30,36,48,54,60,90，120 and maximum of 433Mbps |
| Modulation Method | DSSS，DBPSK，DQPSK， CCK and OFDM (BPSK/QPSK/16QAM/64QAM/256QAM) |
| Frequency Band | 2.4GHz /5 GHz +BT 4.2 v2.1+EDR |
| OS Support | Linux, Android |
| Security | 64-bit WEP (WEP-40) and 128-bit WEP (WEP-104) encryption with hardware TKIP and CKIP processing |

| | |
|---|---|
| | AES-CCMP hardware processing<br>SMS4-WPI (WAPI) hardware processing |
| Bus Interface | WiFi: SDIO<br>BT: UART |
| Operating Channel | WiFi 2.4GHz:<br>United States : 11: (Ch. 1-11)；<br>Europe : 13: (Ch. 1-13)；<br>Japan : 14: (Ch. 1-14)<br>BT 2.4GHz: Ch. 0 ~78 |
| Power Consumption | 3.3 V ±0.2V I/O supply voltage |
| Operating Temperature | 0 ~+60° C ambient temperature |
| Storage Temperature | -20 ~70°C ambient temperature |
| Humidity | 5 to 90 % maximum (non-condensing) |
| Dimension | 12x12 xl.6mm (LxWxH) ±0.2MM |

# 5.Power Supply DC Characteristics

### 1) Power Supply Characteristics

| Symbol | Parameter | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|
| VD33 | 3.3V I/O Supply Voltage | 3.0 | 3.3 | 3.6 | V |
| VD10 | 1.05V Core Supply Voltage | 0.945 | 1.05 | 1.155 | V |

### 2) DC Characteristics

| **Module** | **Voltage** | **Current Consumption (linking)** |
|---|---|---|
| RL-SM02D-8821CS-V1.0 | 2.4G | （上网或者看电影时的功耗） |
| | 5G | （上网或者看电影时的功耗） |

# 6.Electrical Specifications

1) RF Characteristics for IEEE802.11b (11Mbps mode unless otherwise specified)

| Items | Contents | | | |
|---|---|---|---|---|
| Specification | IEEE802.11b | | | |
| Channel frequency | 2412 ~ 2484 MHz | | | |
| RX (per<85 dBm@8%) | -85 dBm | | | |
| Freq.Error(± 13ppm) | ±13 ppm | | | |
| TX Characteristics | Min. | Typ. | Max. | Unit |
| Power Level (±1.5dBm) | | 16 | | dBm |
| EVM (<-18) | | -9 | | dB |

2) RF Characteristics for IEEE802.11g ( 54Mbps mode unless otherwise specified)

| Items | Contents | | | |
|---|---|---|---|---|
| Specification | IEEE802.11g | | | |
| Channel frequency | 2412 ~ 2484 MHz | | | |
| RX (per<70 dBm@10%) | -70 dBm | | | |
| Freq.Error(± 13ppm) | ±13 ppm | | | |
| TX Characteristics | Min. | Typ. | Max. | Unit |
| Power Level (±1.5dBm) | | 15 | | dBm |
| EVM (<-25) | | -28 | | dB |

3) RF Characteristics for IEEE802.11n (BW20 MCS7)

| Items | Contents | | | |
|---|---|---|---|---|
| Specification | IEEE802.1 In (BW20 MCS7) | | | |
| Channel frequency | 2422 ~ 2462 MHz | | | |
| RX (per<65 dBm@10%) | -65 dBm | | | |
| Freq.Error(± 13ppm) | ±13 ppm | | | |
| TX Characteristics | Min. | Typ. | Max. | Unit |
| Power Level (±1 . 5 dBm) | | 14 | | dBm |
| EVM (<-28) | | -28 | | dB |

4) RF Characteristics for IEEE802.11n (BW40 MCS7)

| Items | Contents | | | |
|---|---|---|---|---|
| Specification | IEEE802.1 In (BW40 MCS7) | | | |
| Channel frequency | 2412 ~ 2484 MHz | | | |
| RX (per<65 dBm@10%) | -65 dBm | | | |
| Freq.Error(± 13ppm) | ±13 ppm | | | |
| TX Characteristics | Min. | Typ. | Max. | Unit |
| Power Level (±1.5dBm) | | 14 | | dBm |
| EVM (<-28) | | -28 | | dB |

5) RF Characteristics for IEEE802.11ac (BW20 MCS8)

| Items | Contents | | | |
|---|---|---|---|---|
| Specification | IEEE802.1 lac (BW20 MCS8) | | | |
| Channel frequency | 4.9GHz ~6.0GHz | | | |
| RX (per<61 dBm@10%) | -63 dBm | | | |
| Freq.Error(± lOppm) | ± lOppm | | | |
| TX Characteristics | Min. | Typ. | Max. | Unit |
| Power Level (±1.5dBm) | | 11 | | dBm |
| EVM (<-28) | | -30 | | dB |

6) RF Characteristics for IEEE802.11ac (BW40 MCS7)

| Items | Contents |
|---|---|

| Specification | IEEE802.1 lac (BW40 MCS7) | | | |
|---|---|---|---|---|
| Channel frequency | 4.9GHz ~6.0GHz | | | |
| RX (per<61 dBm@10%) | -5 8 dBm | | | |
| Freq.Error(± lOppm) | ± lOppm | | | |
| TX Characteristics | Min. | Typ. | Max. | Unit |
| Power Level (±2 dBm) | | 12 | | dBm |
| EVM (<-30) | | -30 | | dB |

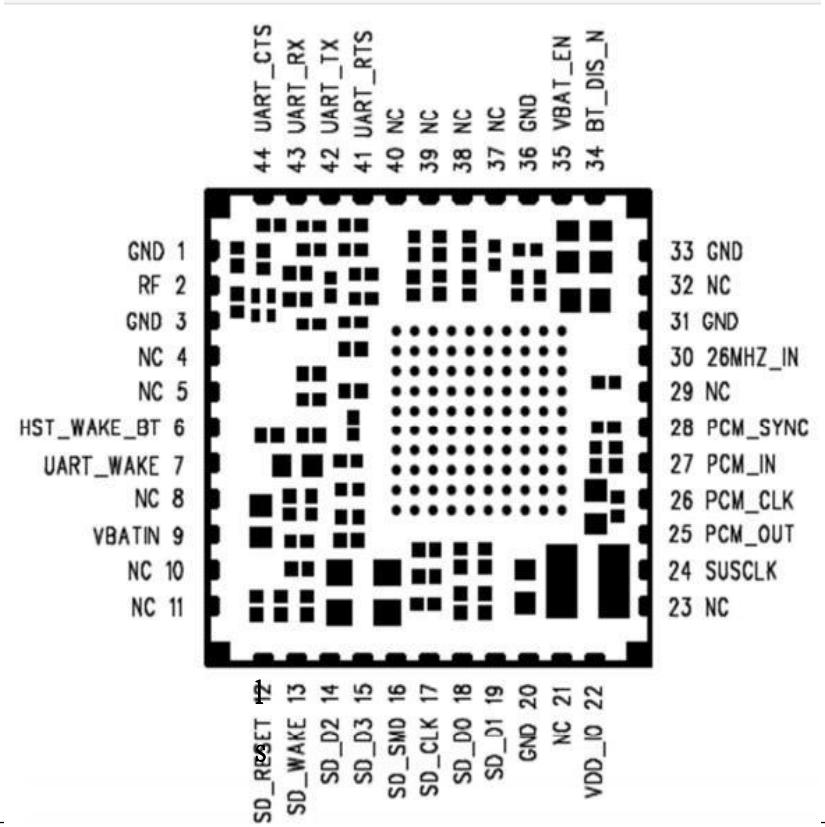
7) RF Characteristics for IEEE802.11ac (BW80 MCS9)

| Items | Contents | | | |
|---|---|---|---|---|
| Specification | IEEE802.1 lac (BW80 MCS9) | | | |
| Channel frequency | 4.9GHz ~6.0GHz | | | |
| RX (per<59 dBm@10%) | -51 dBm | | | |
| Freq.Error(± lOppm) | ± lOppm | | | |
| TX Characteristics | Min. | Typ. | Max. | Unit |
| Power Level (±2 dBm) | | 10 | | dBm |
| EVM (<-32) | | -32 | | dB |

# 7.Bluetooth Specification

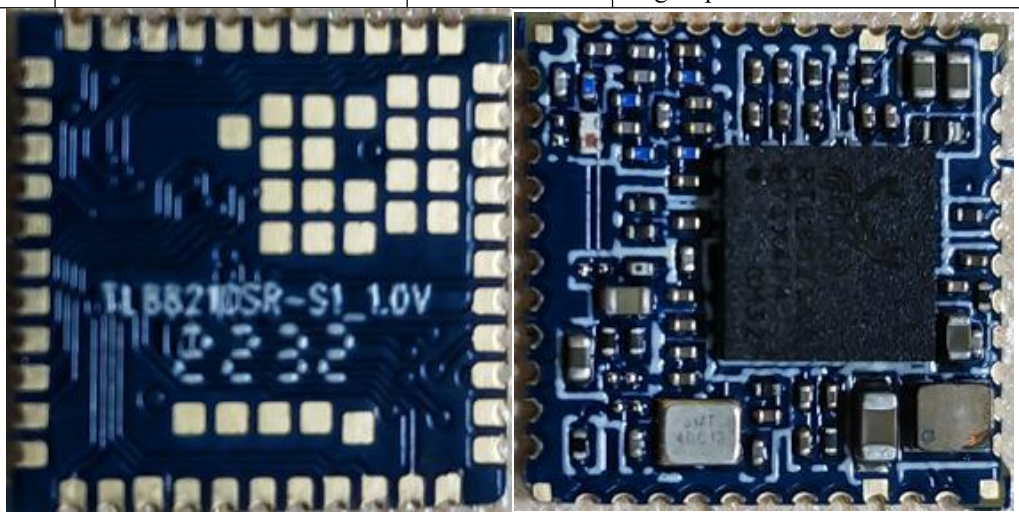
| Feature | Description | | |
|---|---|---|---|
| General Specification | | | |
| Bluetooth Standard | Bluetooth V4.1 of 1, 2 and 3 Mbps. | | |
| Host Interface | USB | | |
| Antenna Reference | Small antennas with 0~2 dBi peak gain | | |
| Frequency Band | 2.400 GHz ~2483.5 GHz | | |
| Number of Channels | 79 channels | | |
| Modulation | FHSS, GFSK, DPSK, DQPSK | | |
| RF Specification | | | |
| | Min | Typical | Max |
| Output Power (Class 1.5) | 2 | 5 | 8 |
| Output Power (Class 2) | | 2 | |
| Sensitivity @ BER=0.1% for GFSK (1Mbps) | | -89 | |
| Sensitivity @ BER=0.01% for n/4-DQPSK (2Mbps) | | -85 | |
| Sensitivity @ BER=0.01% for 8DPSK (3Mbps) | | -83 | |
| Maximum Input Level | GFSK(lMbps):-20dBm | | |
| | k /4-DQPSK (2Mbps) :-20dBm | | |
| | 8DPSK (3Mbps) :-20dBm | | |

# 8. Pin Definition



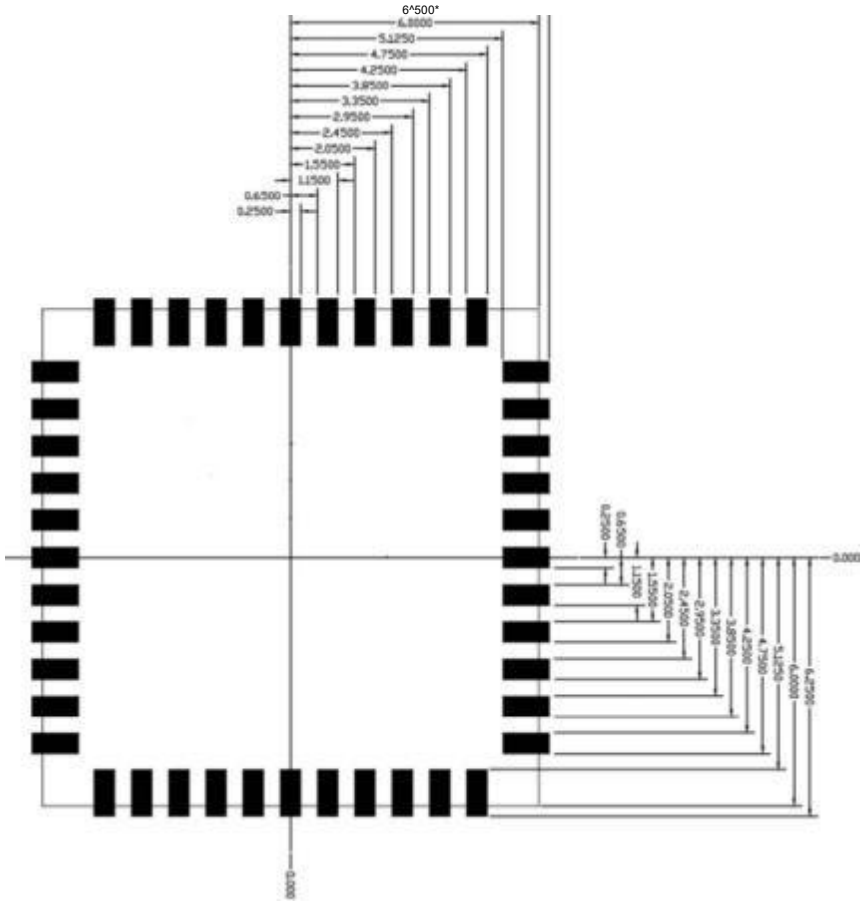

| Pin | Function cr | Type | Description |
|---|---|---|---|
| 1 | GND o | — | Ground connections |
| 2 | RF | I/O | BTAVLAN 2G RF Differential I/O P |
| 3 | GND | — | Ground connections |
| 4~5 | NC | — | NC |
| 6 | HSTWAKEBT | IO | GPIO13 |
| 7 | UARTWAKE | IO | GPIO14 |
| 8 | NC | - | NC |
| 9 | VBATIN | p | Battery LDO input, 5.5V-2.8V<br>The power source supplied for this LDO should keep working during system power off. e.g. a battery like power source. |
| 10~11 | NC | — | NC |
| 12 | SDRESET | IO | GPIO9 |
| 13 | SDWAKE | IO | GPIO4 |
| 14 | SDD2 | IO | SDIO Data Line2 |
| 15 | SD D3 | IO | SDIO DataLine3 |
| 16 | SD SMD | IO | SDIO Command Input |

| | | | |
|---|---|---|---|
| 17 | SDCLK | I | SDIO Clock Input |
| 18 | SD D0 | IO | SDIO Data LineO |
| 19 | SD D1 | IO | SDIO Data Line 1 |
| 20 | GND | — | Ground connections |
| 21 | NC | — | NC |
| 22 | VDDIO | P | supply voltage for SDIO IO |
| *23* | NC | — | NC |
| 24 | SUSCLK | I | Shared with EECS. External 32K or RTC clock input. |
| 25 | PCMOUT | IO | GPIO1 |
| 26 | PCMCLK | IO | GPIO3 |
| *27* | PCMIN | IO | GPIOO |
| *28* | PCMSYNC | IO | GPIO2 |
| *29* | NC | — | NC |
| 30 | 26MHZIN | I | 26M/40MHz OSC Input<br>Input of 26M/40MHz Crystal Clock Reference |
| 31 | GND | — | Ground connections |
| 32 | NC | — | NC |
| 33 | GND | — | Ground connections |
| 34 | BT DIS N | IO | GPIO11 |
| 35 | VBATEN | I | This pin can externally shutdown the RTL8821CS VBAT LDO (a LDO supports 2.8V ~ 5.5V input and 3.3V output) function when |
| 36 | GND | — | Ground connections |
| 37~40 | NC | — | NC |
| 41 | UARTRTS | 0 | High-Speed UART RTS |
| 42 | UARTTX | 0 | High-Speed UART Data Out |
| 43 | UARTRX | I | High-Speed UART Data In |
| 44 | UARTCTS | I | High-Speed UART CTS |



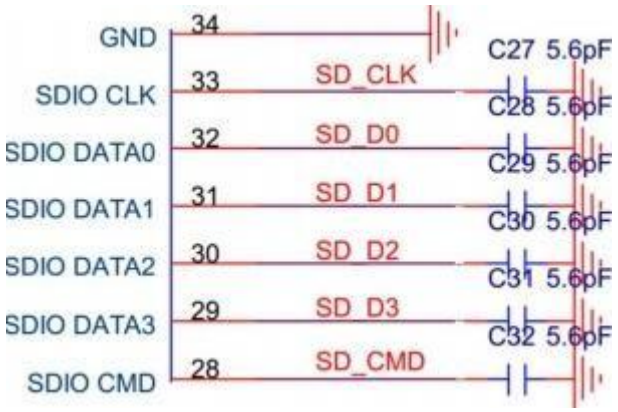
## 9. Size reference

| Dimensions (mm) | Length | Width | Height |
|---|---|---|---|
| | 12.0 (Tolerance:±0.2mm) | 12.0 (Tolerance:±0.2mm) | 1.8 (Tolerance:±0.1mm) |



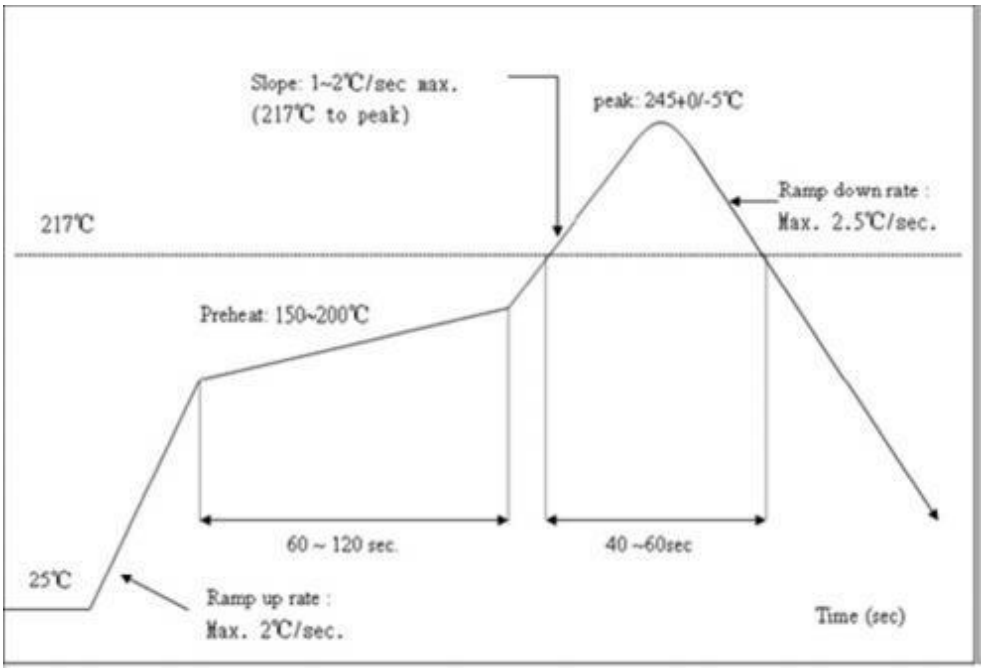

**The PCB tolerances within + / -0.2 or so**

## 10.SDIO interface Circuit reference pictures




## 11.Recommended Reflow Profile

Referred to IPC/JEDEC standard.
Peak Temperature : <250°C
Number of Times :≯2 times



## 12. Packaging information

- 使用真空卷带包装；
- 卷带颜色：蓝色；
- 真空包装内置干燥剂，6 色湿度卡；
- 其他未尽事宜按客户要求包装执行；




## 13. purchase information

TL8821CSSC-X

Z：屏蔽罩