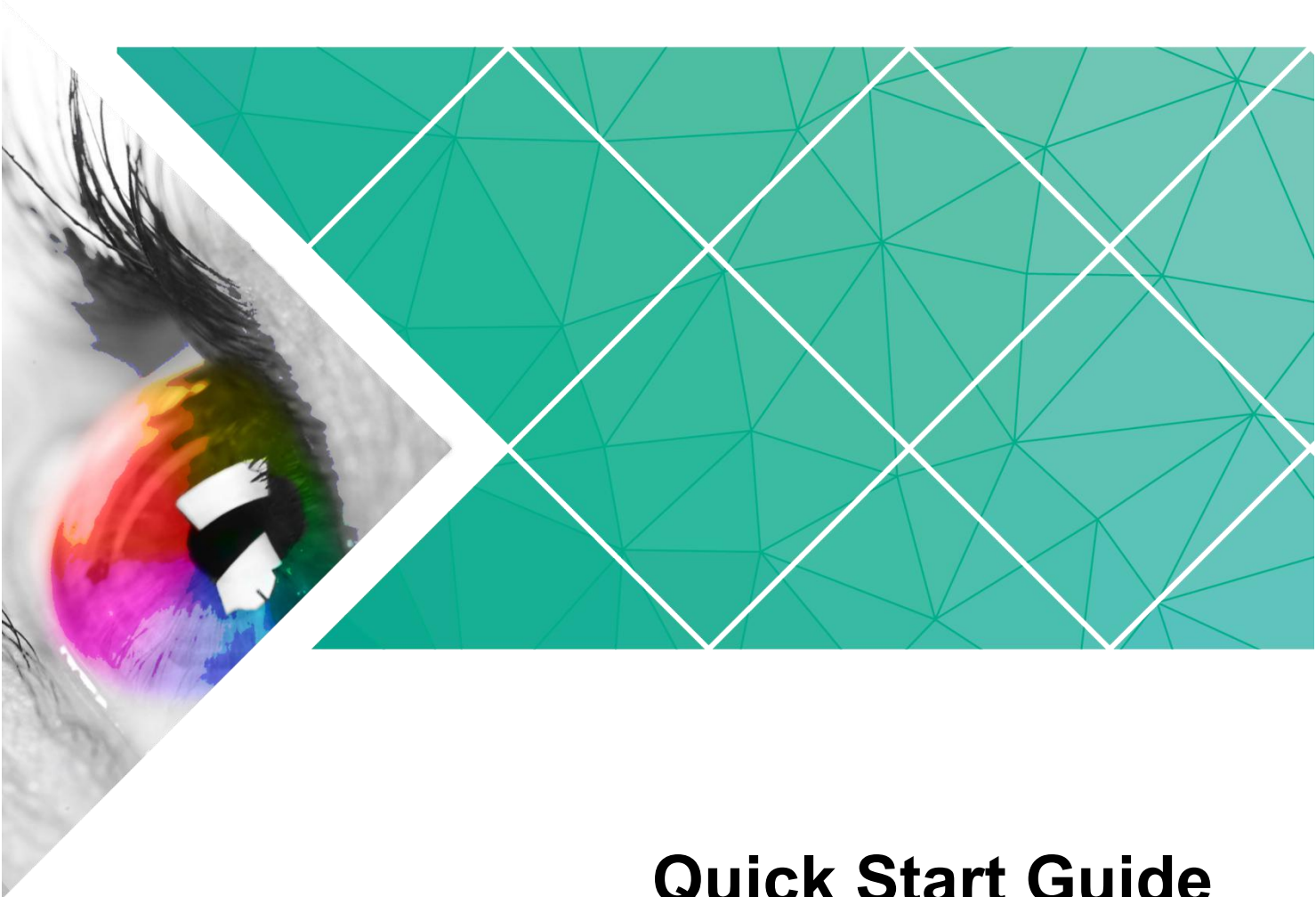# Taurus Series

## Multimedia Players

## Quick Start Guide

Version: V1.0.0

Doc. ID: NS120100144

# Change History

| Version | Release Date | Description |
|---------|-------------|-------------|
| V1.0.0 | 2017-07-20 | First release. |

# Table of Contents

# 1   Overview

## 1.1  Scenario

This document introduces a quick way to use Taurus series multimedia players and provides instructions for the first-timer.

## 1.2  Procedures
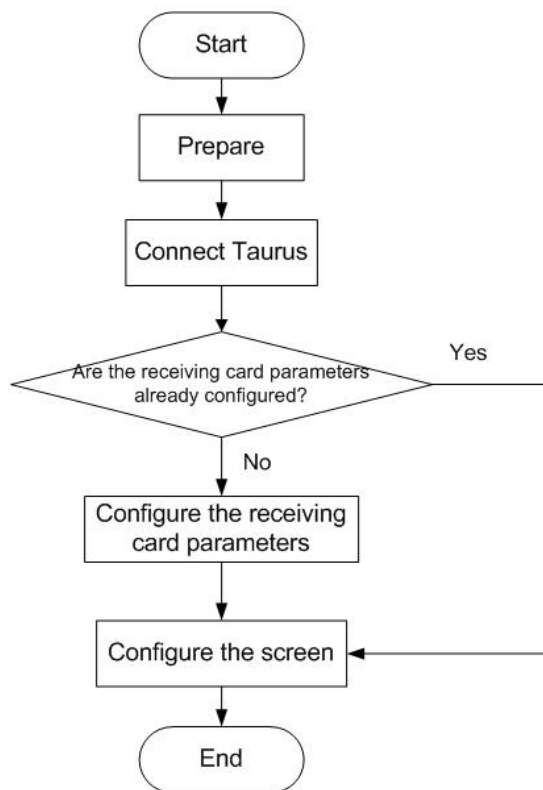
# 2   **Preparation**

## 2.1  Getting and Installing Software

| Item | Description | How to get | How to install |
|---|---|---|---|
| ViPlex Handy | It is a LAN-based display management software, including the one applicable to Android and iOS operating systems, is mainly used for display management as well as solution editing and publishing. | Scan the following OR code to download and install the APP.<br><br>Use the App Store on your iPhone to get ViPlex Handy for iOS. | Software installation is the same as other applications. |
| ViPlex Express | It is a LAN-based display management software applicable to the Windows operating system, and is mainly used for display management as well as solution editing and publishing. | Visit www.novastar.tech, download and install the required software. | |
| NovaLCT-Taurus | Screen configuration software, which only supports Windows and is mainly used for adjusting screens to the optimal display status. | Visit www.novastar.tech, download and install the required software. | |

## 2.2  Getting Documents

| Item | Description | How to get |
|------|-------------|------------|
| *Taurus Series Multimedia Players Product Description-V1.0.0* | Describing application scenarios, features, safety instructions, hardware structure, software structure and specifications of Taurus series products. | Visit www.novastar.tech to download the required documents. |

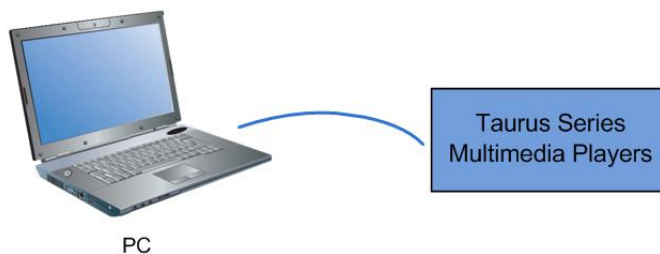## 2.3  Getting Required Account Information

| Item | Account Name | Default Password |
|------|--------------|------------------|
| Connect Taurus WiFi AP | AP+ *last 8 digits of the SN*, For example: AP10000033 | 12345678 |
| Log into the Taurus | admin | 123456 |

# 3     Taurus Connections

## 3.1   Connecting via Ethernet Cable

### Network Diagram

Users can access the Taurus directly when it is connected via the Ethernet cable.



PC

### Configuration

Step 1   Refer to "6 General Operations" to log in to the Taurus.
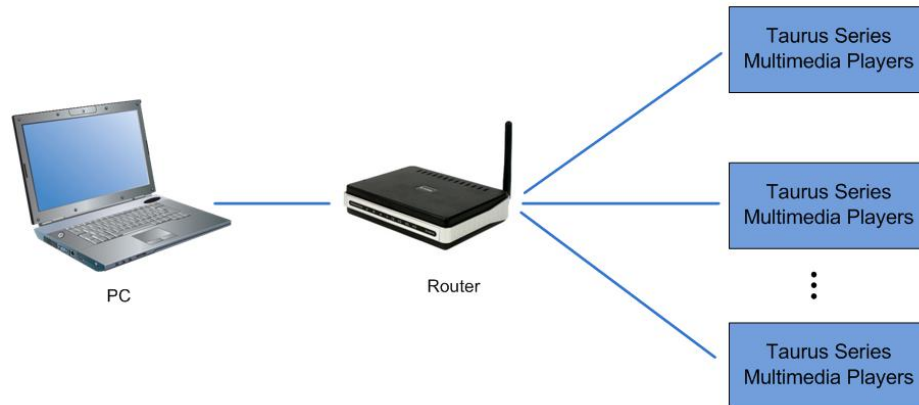
Step 2   Turn off DHCP and set static IP address for the Taurus.

- ViPlex Handy: Select **Network Setting**, **Wired Network Setting** in the **Screen management** page.
- ViPlex Express: Select **Screen Control**, **Network configuration**.

## 3.2   Connecting via Local Area Network (LAN)

### Network Diagram

Users can access the Taurus through LAN when it is connected via LAN.

## Configuration

No need for configuration.

# 3.3 Connecting via Wi-Fi

The Taurus series products have dual WiFi function which can provide Wi-Fi hotspot as well as serve as WiFi Station at the same time. The WiFi working frequency range is 2400~2483.5MHz.

## 3.3.1 Wi-Fi AP Mode

### Network Diagram

Users can access the Taurus directly when it is connected via WiFi AP.
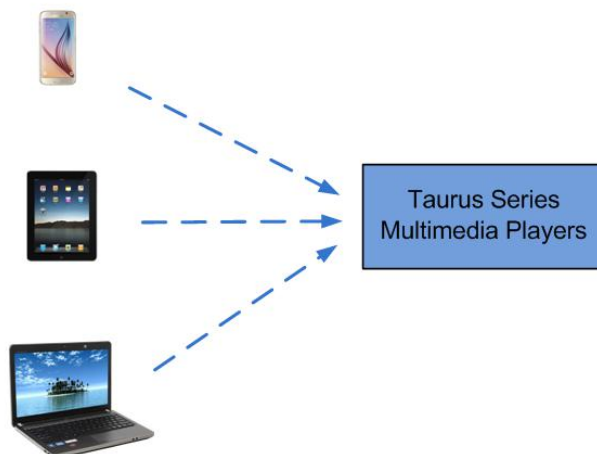


## Configuration

No need for configuration. Please connect the WiFi AP of the Taurus. SSID is "AP + last 8 digits of the SN", for example, "AP10000033".

## 3.3.2 WiFi Sta Mode

### Network Diagram

Users can access Taurus through external router when it is connected via WiFi Sta.
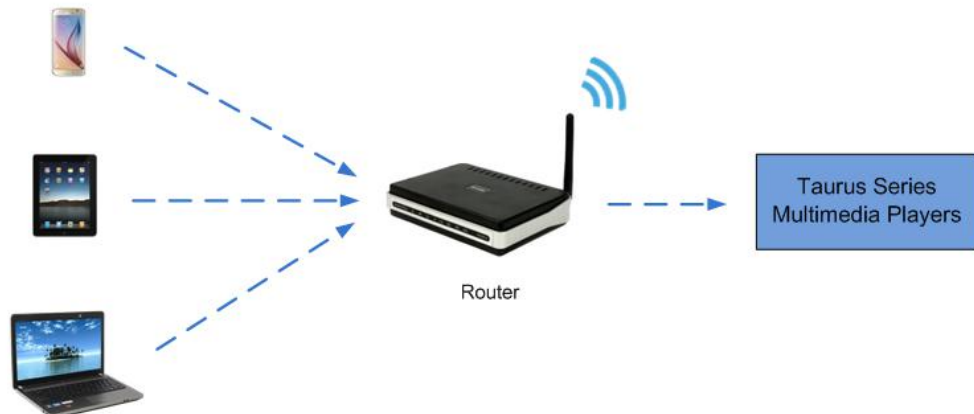


### Configuration

Step 1 Refer to "6 General Operations" to log in to the Taurus.

Step 2 Turn on Wi-Fi Sta mode. Click the Wi-Fi name of the external router and then enter the password of the Wi-Fi.

- ViPlex Handy: Select **Network Setting**, **WiFi Setting** in the **Screen management** page.
- ViPlex Express: Select **Screen Control**, **Network configuration**.

## 3.3.3 WiFi AP+Sta Mode

### Network Diagram

By using WiFi AP+Sta connection, users can directly access the Taurus or access the Internet through bridging connection.

## Configuration

Step 1   Refer to "6 General Operations" to log in to the Taurus.
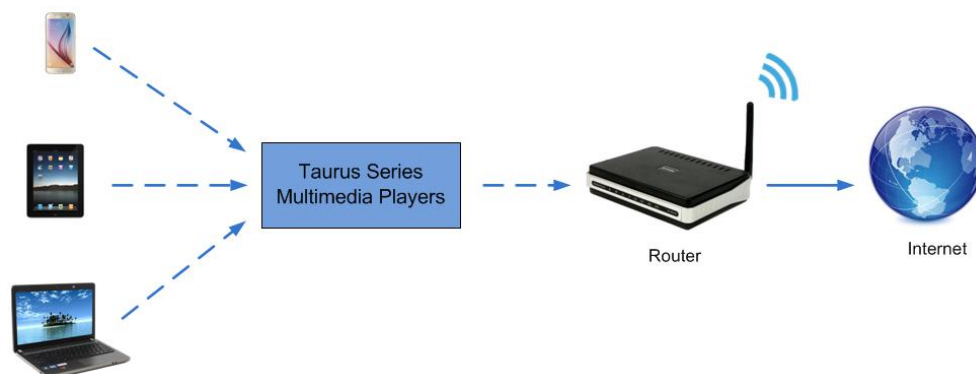
Step 2   Turn on Wi-Fi Sta mode. Click the Wi-Fi name of the external router and then enter the password of the Wi-Fi.

- ViPlex Handy: Select **Network Setting**, **WiFi Setting** in the **Screen management** page.
- ViPlex Express: Select **Screen Control**, **Network configuration**.

## Related Information

The Taurus can be connected to the Internet through following two ways. The priority order of the three ways is from high to low.

- Wired network
- WiFi Sta

# 4 Receiving Card Parameter Configuration

If receiving card parameters are already configured, please skip this chapter and perform the operations in "5 Screen Configuration".

## 4.1 Loading Configuration File or Configuring the Parameters Manually Through NovaLCT-Taurus

Step 1 Start NovaLCT-Taurus.

Step 2 Select **System**, **Search All Display**.

System will display the screen information list.

Step 3 Click screen information and click **Connect System**.

The gray button on the page will become normal.

Step 4 Select **User**, **Advanced login**.

Step 5 Enter password and click **Login**.

Default password is "admin".

Step 6 Click to enter the **Screen Config** page.

Step 7 Confirm whether the local PC has the required receiving card configuration file.

- Yes. Please perform **Load Configuration File**.

- No. Please perform **Manual Configuration**.

### Loading Configuration File

Step 1 Select **Cascading scan board** and **Load Configuration File**. Click **Browse** to choose a configuration file from the local PC.

Step 2 Click **Next** to load the configuration file.

### Manual Configuration

Step 1 Select **Cascading scan board** and click **Next**.

Step 2 Configure receiving card parameters based on actual conditions.

Step 3    Click **Send To HW**.

Step 4    Set parameters based on actual conditions and click **Send**.

Step 5    Adjust parameters until the screen displays normally and then click **Save to Screen**.

Step 6    (Optional) Click **Save Config File** to back up the receiving card configuration file to
            the local PC.

# 4.2  Loading the Configuration File Through ViPlex Handy

Step 1    Save the receiving card configuration file to mobile phone.

Step 2    Refer to "6 General Operations" to log in to the Taurus.

Step 3    Click screen name to enter the **Screen management** page.

Step 4    Select **Screen Setting**, **Receiving card configuration** to enter the **Receiving card
            configuration** page.

Step 5    Select the receiving card configuration file and click **Send**.

# 5    Screen  Configuration

## 5.1  Configuring a Screen Through ViPlex Handy

Step 1    Refer to "6 General Operations" to log in to the Taurus.

Step 2    Click screen name to enter the **Screen management** page.

Step 3    Select **Screen Setting**, **Screen configuration** to enter the **Screen configuration** page.

Step 4    Configure screen information based on actual conditions and click **OK**.

# 6    General  Operations

## 6.1  Taurus Login with ViPlex Handy (Android and iOS)

### Before You Begin

- Acquire the SSID and password of Wi-Fi AP of Taurus series products. SSID is default to be composed of AP and the last 8 numbers of SN, and the password is default as "**12345678**".
- Acquire the login password of user "admin" of which the default password is "**123456**".

### Operating Procedures

ViPlex Handy can connect numerous Taurus series products.

Step 1   Connect Wi-Fi AP of the Taurus series products.

Step 2   Start ViPlex Handy.

System can automatically detect the Taurus series products and refresh **Screen list**. Users can also slide down **Screen list** to manually refresh the list.

- : denotes that Taurus is online and you can log into it.
- : denotes that Taurus is offline and you cannot log into it.
- : denotes that Taurus login is successful.

Step 3   Click **Connect** next to the screen name.

Step 4   Enter the user name and password and click **Login**.

## 6.2  Taurus Login with ViPlex Express (Windows)

### Before You Begin

- Acquire the SSID and password of Wi-Fi AP of Taurus series products. SSID is default to be composed of AP and the last 8 numbers of SN, and the password is default as "**12345678**".
- Acquire the login password of user "admin" of which the default password is "**123456**".
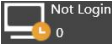
## Operating Procedures

ViPlex Express can connect numerous Taurus series products.

Step 1   Connect Wi-Fi AP of the Taurus series products.

Step 2   Start the ViPlex Express.

Step 3   Click **Refresh** and the screen list will be displayed on the page.

- : denotes that Taurus is online and you can log into it.

- : denotes that Taurus is offline and you cannot log into it.

- : denotes that Taurus login is successful.

After the Taurus is found by ViPlex Express, the ViPlex express will try to log into to the Taurus with the default account or the account used for last login.

Step 4   Taurus login is successful or not.

- Yes.  appears and no further operation is required.

- No.  appears and then perform Step 5.

Step 5   Click **Connect** on the right of the screen information.

Step 6   Enter the username and password, and click **OK**.

# 7 Caution

## FCC Caution:

Any changes or modifications not expressly approved by the party responsible for compliance could

void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment .This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

## CE Caution:

This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

## IC Warning:

RSS-Gen Issue 3 December 2010"&"CNR-Gen 3e éditionDécembre 2010:

- English:

This device complies with Industry Canada licence-exempt RSS standard(s).

Operation is subject to the following two conditions: (1) This device may not cause interference, and (2) This device must accept any interference, including interference that may cause undesired operation of the device.

- French:

Le présentappareilestconforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitationestautorisée aux deux conditions suivantes:

(1) l'appareil ne doit pas produire de brouillage, et

(2) l'utilisateur de l'appareildoit accepter tout brouillageradioélectriquesubi, mêmesi le brouillageest susceptible d'encompromettre le fonctionnement.

## Battery Caution:

CAUTION
RISK OF EXPLOSION IF BATTERY IS REPLACED
BY AN INCORRECT TYPE.
DISPOSE OF USED BATTERIES ACCORDING
TO THE INSTRUCTIONS

# 正基科技股份有限公司

# SPECIFICATION

**SPEC. NO.：** _____ REV： ___1.3___

**DATE：** 12. 26.2014

**PRODUCT NAME：** AP6212

| NAME | APPROVED | CHECKED | PREPARED | DCC ISSUE |
|------|----------|---------|----------|-----------|
|      |          |         |          |           |

# AMPAK

# AP6212

## WiFi+Bluetooth 4.1+FM RX
## SIP Module Spec Sheet

# Revision History

| Date | Revision Content | Revised By | Version |
|------|------------------|------------|---------|
| 2014/04/08 | - Preliminary | Brian | 1.0 |
| 2014/09/02 | - Pin Definition Modified | Brian | 1.1 |
| 2014/11/26 | - Bluetooth Spec Modified | Brian | 1.2 |
| 2014/12/26 | - Add Process | Brian | 1.3 |
| | | | |
| | | | |

# Contents

# 1. Introduction

AMPAK Technology would like to announce a low-cost and low-power consumption module which has all of the WiFi, Bluetooth and FM functionalities. The highly integrated module makes the possibilities of web browsing, VoIP, Bluetooth headsets, FM radio functional applications and other applications. With seamless roaming capabilities and advanced security, also could interact with different vendors' 802.11b/g/n Access Points in the wireless LAN.

The wireless module complies with IEEE 802.11 b/g/n standard and it can achieve up to a speed of 72.2Mbps with single stream in 802.11n draft, 54Mbps as specified in IEEE 802.11g, or 11Mbps for IEEE 802.11b to connect to the wireless LAN. The integrated module provides SDIO interface for WiFi, UART / I2S / PCM interface for Bluetooth and UART / I2S / PCM interface for FM.

This compact module is a total solution for a combination of WiFi + BT + FM technologies. The module is specifically developed for Smart phones and Portable devices.

# 2. Features

- 802.11b/g/n single-band radio
- Bluetooth V4.1(HS) with integrated Class 1.5 PA and Low Energy (BLE) support
- Concurrent Bluetooth, FM (RX) RDS/RBDS, and WLAN operation
- Simultaneous BT/WLAN receive with single antenna
- WLAN host interface options:
    - SDIO v2.0 — up to 50 MHz clock rate
- BT host digital interface:
    - UART (up to 4 Mbps)
- FM multiple audio routing options: I2S, PCM, eSCO, A2DP
- IEEE Co-existence technologies are integrated die solution
- ECI — enhanced coexistence support, ability to coordinate BT SCO transmissions around WLAN receives

A simplified block diagram of the module is depicted in the figure below.
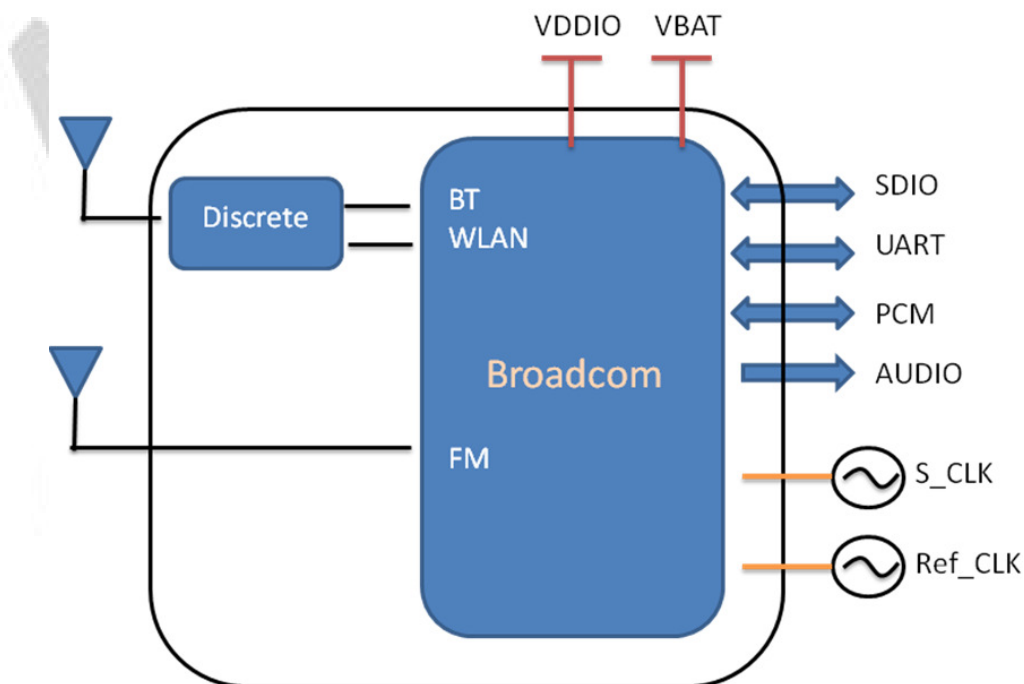
# 3. Deliverables

## 3.1 Deliverables

The following products and software will be part of the product.

- Module with packaging
- Evaluation Kits
- Software utility for integration, performance test.
- Product Datasheet.
- Agency certified pre-tested report with the adapter board.

## 3.2 Regulatory certifications

The product delivery is a pre-tested module, without the module level certification. For module approval, the platform's antennas are required for the certification.

# 4. General Specification

## 4.1 General Specification

| Model Name | AP6212 |
|---|---|
| Product Description | Support WiFi/Bluetooth/FM functionalities |
| Dimension | L x W x H: 12 x 12 x 1.5 (typical) mm |
| WiFi Interface | SDIOV2.0 |
| BT Interface | UART / PCM |
| FM Interface | UART / PCM / Audio |
| Operating temperature | -30℃ to 85℃ |
| Storage temperature | -40℃ to 85℃ |
| Humidity | Operating Humidity 10% to 95% Non-Condensing |

## 4.2 Voltages

### 4.2.1 Absolute Maximum Ratings

| Symbol | Description | Min. | Max. | Unit |
|---|---|---|---|---|
| VBAT | Input supply Voltage | -0.5 | 5.5 | V |
| WL_VIO_SD | Digital/Bluetooth/SDIO/ I/O Voltage | -0.5 | 3.6 | V |

### 4.2.2 Recommended Operating Rating

The module requires two power supplies: VBAT and VDDIO.

| | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|
| Operating Temperature | -30 | 25 | 85 | deg.C |
| VBAT | 3.0 | 3.6 | 4.8 | V |
| VDDIO | 1.7 | 3.3 | 3.6 | V |

# 5. WiFi RF Specification

## 5.1 2.4GHz RF Specification

Conditions : VBAT=3.6V ; VDDIO=3.3V ; Temp:25°C

| Feature | Description |
|---|---|
| WLAN Standard | IEEE 802.11b/g/n, WiFi compliant |
| Frequency Range | 2.400 GHz ~ 2.497 GHz (2.4 GHz ISM Band) |
| Number of Channels | 2.4GHz：Ch1 ~ Ch14 |
| Modulation | 802.11b : DQPSK, DBPSK, CCK<br>802.11 g/n : OFDM /64-QAM,16-QAM, QPSK, BPSK |
| Output Power | 802.11b /11Mbps : 16 dBm ± 1.5 dB @ EVM ≤ -9dB<br>802.11g /54Mbps : 15 dBm ± 1.5 dB @ EVM ≤ -25dB<br>802.11n /65Mbps : 14 dBm ± 1.5 dB @ EVM ≤ -28dB |
| Receive Sensitivity (11n,20MHz) @10% PER | -  MCS=0       PER @ -85 dBm, typical<br>-  MCS=1       PER @ -84 dBm, typical<br>-  MCS=2       PER @ -82 dBm, typical<br>-  MCS=3       PER @ -80 dBm, typical<br>-  MCS=4       PER @ -77 dBm, typical<br>-  MCS=5       PER @ -73 dBm, typical<br>-  MCS=6       PER @ -71 dBm, typical<br>-  MCS=7       PER @ -68 dBm, typical |
| Receive Sensitivity (11g) @10% PER | -   6Mbps      PER @ -86 dBm, typical<br>-   9Mbps      PER @ -85 dBm, typical<br>-  12Mbps      PER @ -85 dBm, typical<br>-  18Mbps      PER @ -83 dBm, typical<br>-  24Mbps      PER @ -81 dBm, typical<br>-  36Mbps      PER @ -78 dBm, typical<br>-  48Mbps      PER @ -73 dBm, typical<br>-  54Mbps      PER @ -71 dBm, typical |
| Receive Sensitivity (11b) @8% PER | -  1Mbps      PER @ -90 dBm, typical<br>-  2Mbps      PER @ -88 dBm, typical<br>-  5.5Mbps    PER @ -87 dBm, typical<br>-  11Mbps     PER @ -84 dBm, typical |
| Data Rate | 802.11b : 1, 2, 5.5, 11Mbps<br>802.11g : 6, 9, 12, 18, 24, 36, 48, 54Mbps |

| Data Rate (20MHz ,Long GI,800ns) | 802.11n: 6.5, 13, 19.5, 26, 39, 52, 58.5, 65Mbps |
|---|---|
| Data Rate (20MHz ,short GI,400ns) | 802.11n : 7.2, 14.4, 21.7, 28.9, 43.3, 57.8, 65,72.2Mbps |
| Maximum Input Level | 802.11b : -10 dBm |
| | 802.11g/n : -20 dBm |
| Antenna Reference | Small antennas with 0~2 dBi peak gain |

# 6. Bluetooth Specification

## 6.1 Bluetooth Specification

Conditions : VBAT=3.6V ; VDDIO=3.3V ; Temp:25°C

| Feature | Description | | |
|---|---|---|---|
| **General Specification** | | | |
| Bluetooth Standard | Bluetooth V4.1 of 1, 2 and 3 Mbps. | | |
| Host Interface | UART | | |
| Antenna Reference | Small antennas with 0~2 dBi peak gain | | |
| Frequency Band | 2402MHz ~ 2480MHz | | |
| Number of Channels | 79 channels | | |
| Modulation | FHSS, GFSK, DPSK, DQPSK | | |
| **RF Specification** | | | |
| | **Min.** | **Typical.** | **Max.** |
| Output Power (Class 1.5) | | 8 dBm | |
| Sensitivity @ BER=0.1% for GFSK (1Mbps) | | -86 dBm | |
| Sensitivity @ BER=0.01% for π/4-DQPSK (2Mbps) | | -86 dBm | |
| Sensitivity @ BER=0.01% for 8DPSK (3Mbps) | | -80 dBm | |
| Maximum Input Level | GFSK (1Mbps):-20dBm | | |
| | π/4-DQPSK (2Mbps) :-20dBm | | |
| | 8DPSK (3Mbps) :-20dBm | | |

# 7. FM Specification

## 7.1 FM Specification (TBD)

Conditions : VBAT=3.6V ; VDDIO=3.3V ; Temp:25°C

| Feature | Description | | | | |
|---|---|---|---|---|---|
| **General Specification** | | | | | |
| Frequency Band | 76MHz-108MHz | | | | |
| Host Interface | HCI UART, I2S/PCM | | | | |
| Channel step | 50 KHz | | | | |
| Analog Audio output load | $R_L$>30KΩ, $C_L$>20pF | | | | |
| **Characteristics** | **Condition** | **MIN** | **TYP** | **MAX** | **UNIT** |
| Transmitter (FM Tx load = 120nH, Q>30) | Output Power Level | | | | dBuV |
| | Audio harmonic distortion (fmod=1KHz, △f=75KHz, Pilot △f=6.75KHz) | | | | % |
| | Audio SNR ( △f=22.5KHz, I2S audio in SNR ≧ 57dB ) — MONO | | | | dB |
| | Audio SNR ( △f=22.5KHz, I2S audio in SNR ≧ 57dB ) — Stereo | | | | dB |
| Receiver (FM Tx Antenna = 120nH, Q>30) | RDS Sensitivity | | | | dBm |
| | Audio harmonic distortion (Vin=1mV, △f=75KHz) — fmod=1KHz | | | | % |
| | Audio harmonic distortion (Vin=1mV, △f=75KHz) — fmod=3KHz | | | | % |
| | Maximum SNR (fmod=1KHz,△f=22.5 KHz, BW=300Hz to 15KHz) — MONO | | | | dB |
| | Maximum SNR (fmod=1KHz,△f=22.5 KHz, BW=300Hz to 15KHz) — Stereo | | | | dB |
| | RF input power level | | | | dBuV |

# 8. Pin Assignments

## 8.1 Pin Outline

< TOP VIEW >
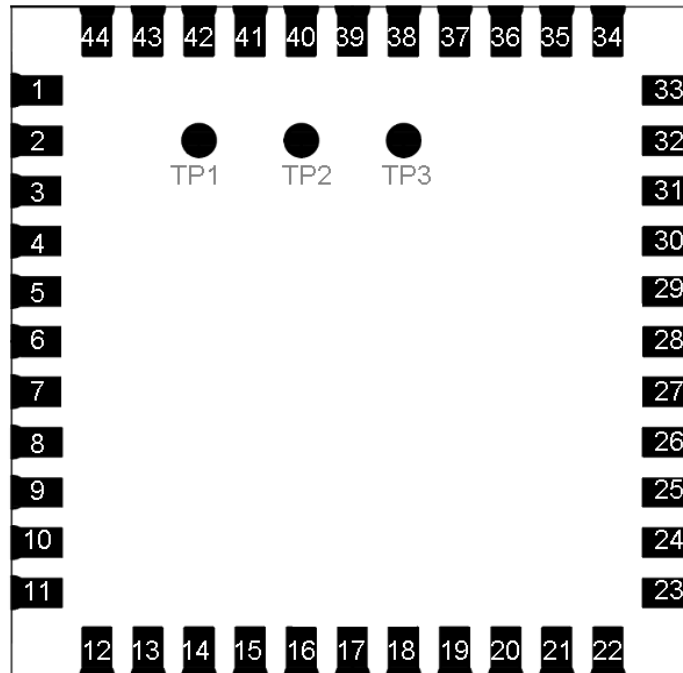


## 8.2 Pin Definition

| NO | Name | Type | Description |
|----|------|------|-------------|
| 1 | GND | — | Ground connections |
| 2 | WL_BT_ANT | I/O | RF I/O port |
| 3 | GND | — | Ground connections |
| 4 | FM_RX | I | FM radio RF input antenna port |
| 5 | NC | — | Floating (Don't connected to ground) |
| 6 | BT_WAKE | I | HOST wake-up Bluetooth device |
| 7 | BT_HOST_WAKE | O | Bluetooth device to wake-up HOST |
| 8 | NC | — | Floating (Don't connected to ground) |
| 9 | VBAT | P | Main power voltage source input |
| 10 | XTAL_IN | I | Crystal input |
| 11 | XTAL_OUT | O | Crystal output |
| 12 | WL_REG_ON | I | Internal regulators power enable/disable |
| 13 | WL_HOST_WAKE | O | WLAN to wake-up HOST |

| 14 | SDIO_DATA_2 | I/O | SDIO data line 2 |
|----|-------------|-----|------------------|
| 15 | SDIO_DATA_3 | I/O | SDIO data line 3 |
| 16 | SDIO_DATA_CMD | I/O | SDIO command line |
| 17 | SDIO_DATA_CLK | I/O | SDIO clock line |
| 18 | SDIO_DATA_0 | I/O | SDIO data line 0 |
| 19 | SDIO_DATA_1 | I/O | SDIO data line 1 |
| 20 | GND | — | Ground connections |
| 21 | VIN_LDO_OUT | P | Internal Buck voltage generation pin |
| 22 | VDDIO | P | I/O Voltage supply input |
| 23 | VIN_LDO | P | Internal Buck voltage generation pin |
| 24 | LPO | I | External Low Power Clock input (32.768KHz) |
| 25 | PCM_OUT | O | PCM Data output |
| 26 | PCM_CLK | I/O | PCM clock |
| 27 | PCM_IN | I | PCM data input |
| 28 | PCM_SYNC | I/O | PCM sync signal |
| 29 | NC | — | Floating (Don't connected to ground) |
| 30 | NC | — | Floating (Don't connected to ground) |
| 31 | GND | — | Ground connections |
| 32 | NC | — | Floating (Don't connected to ground) |
| 33 | GND | — | Ground connections |
| 34 | BT_RST_N | I | Low asserting reset for Bluetooth core |
| 35 | NC | — | Floating (Don't connected to ground) |
| 36 | GND | — | Ground connections |
| 37 | GPIO4 | I/O | WiFi Co-existence pin with LTE |
| 38 | GPIO3 | I/O | WiFi Co-existence pin with LTE |
| 39 | GPIO2 | I/O | WiFi Co-existence pin with LTE |
| 40 | GPIO1 | I/O | WiFi Co-existence pin with LTE |
| 41 | UART_RTS_N | O | Bluetooth/FM UART interface |
| 42 | UART_TXD | O | Bluetooth/FM UART interface |
| 43 | UART_RXD | I | Bluetooth/FM UART interface |
| 44 | UART_CTS_N | I | Bluetooth/FM UART interface |
| 45 | TP1 | O | FM Analog AUDIO left output |
| 46 | TP2 | O | FM Analog AUDIO right output |
| 47 | TP3 (NC) | — | Floating (Don't connected to ground) |

# 9. Dimensions

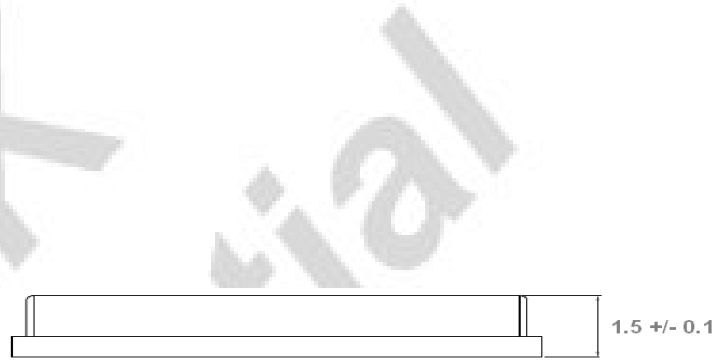## 9.1 Physical Dimensions

(Unit: mm)
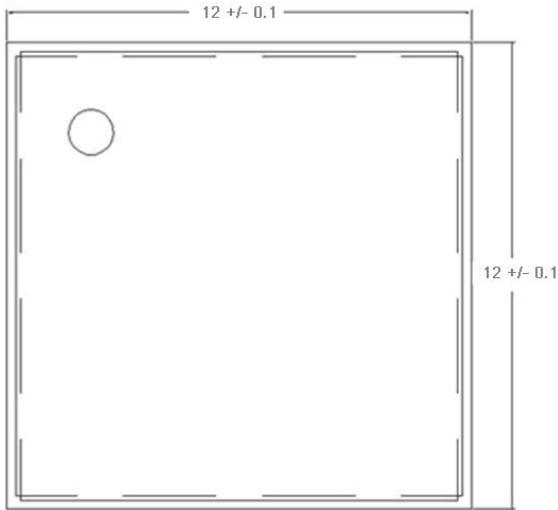
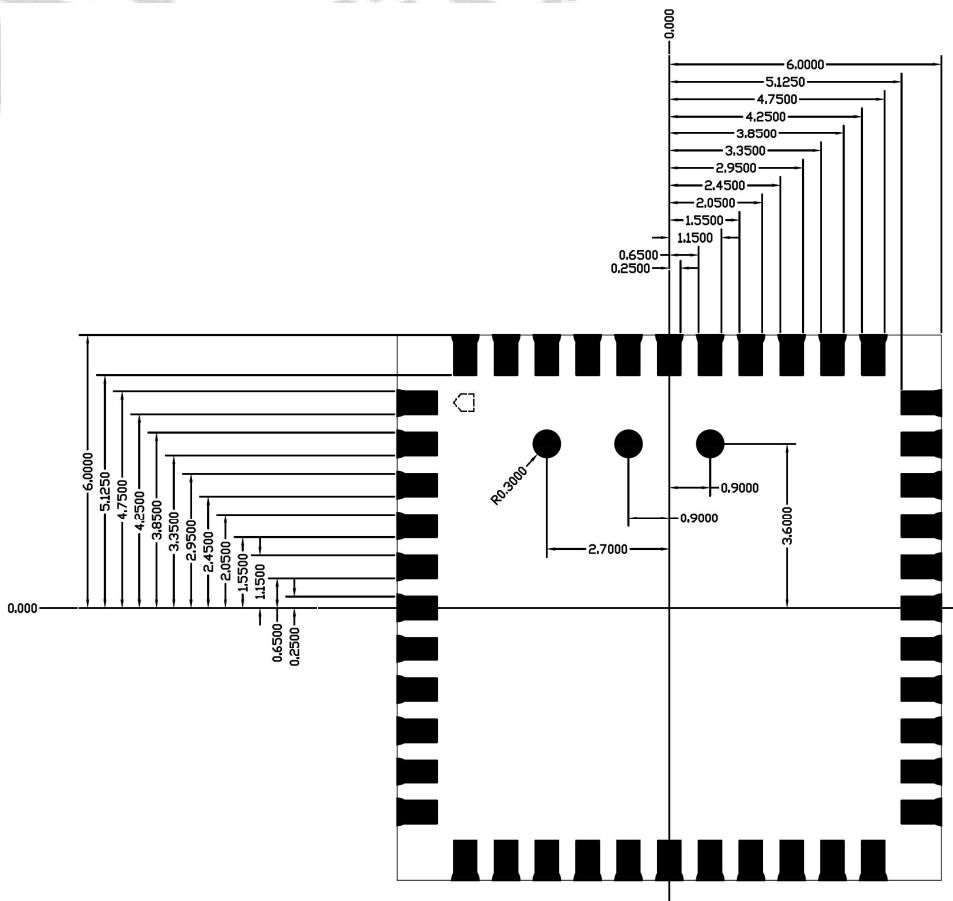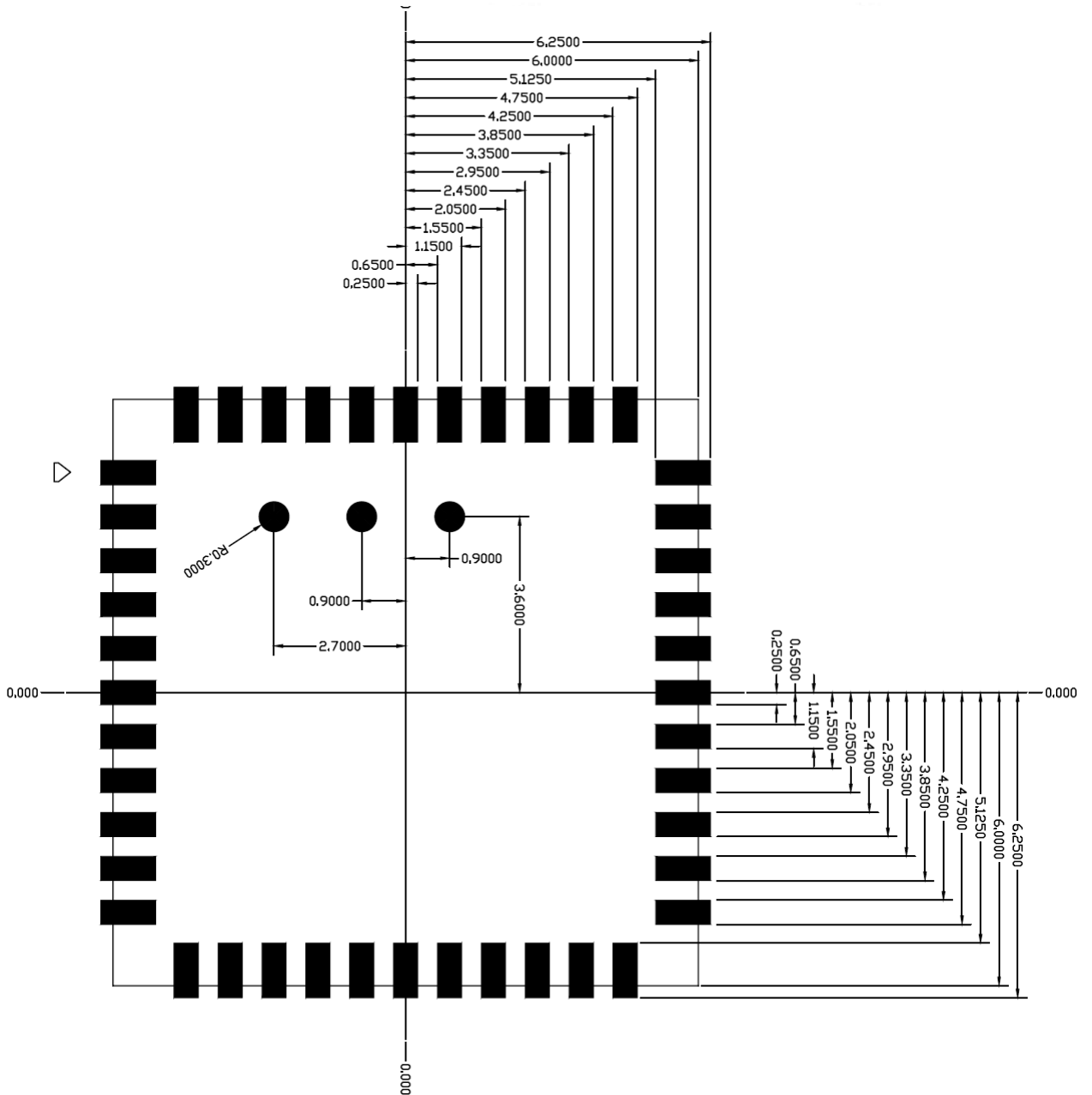< TOP VIEW >                                    < Side View >

< TOP VIEW >

## 9.2 Layout Recommendation

(Unit: mm)

< TOP VIEW >

# 10.   External clock reference

External LPO signal characteristics

| Parameter | Specification | Units |
|---|---|---|
| Nominal input frequency | 32.768 | kHz |
| Frequency accuracy | $\pm 30$ | ppm |
| Duty cycle | 30 - 70 | % |
| Input signal amplitude | 400 to 1800 | mV, p-p |
| Signal type | Square-wave | - |
| Input impedance | >100k | $\Omega$ |
| | <5 | pF |
| Clock jitter (integrated over 300Hz – 15KHz) | <1 | Hz |
| Output high voltage | 0.7Vio - Vio | V |

External Ref_CLK signal characteristics

| No. | Item | Symb. | Electrical Specification | | | | Remark |
|---|---|---|---|---|---|---|---|
| | | | Min. | Type | Max. | Units | |
| 1 | Nominal Frequency | F0 | | 26.00000 | | MHz | |
| 2 | Mode of Vibration | | | Fundamental | | | |
| 3 | Frequency Tolerance | $\Delta$F/F0 | -10 | - | 10 | ppm | at 25℃±3℃ |
| 4 | Operating Temperature Range | $T_{OPR}$ | -30 | - | 85 | ℃ | |
| 5 | Frequency Stability | TC | -10 | - | 10 | ppm | |
| 6 | Storage Temperature | $T_{STG}$ | -55 | - | 125 | ℃ | |
| 7 | Load capacitance | CL | - | 16 | | pF | |
| 8 | Equivalent Series Resistance | ESR | - | - | 50 | $\Omega$ | |
| 9 | Drive Level | DL | - | 100 | 200 | μW | |
| 10 | Insulation Resistance | IR | 500 | - | - | M$\Omega$ | At 100V$_{DC}$ |
| 11 | Shunt Capacitance | C0 | - | - | 3 | pF | |
| 12 | Aging Per Year | Fa | -2 | - | 2 | ppm | First Year |

## 10.1 SDIO Pin Description

The module supports SDIO version 2.0 for 4-bit modes (100 Mbps), and high speed 4-bit (50 MHz clocks – 200 Mbps). It has the ability to stop the SDIO clock and map the interrupt signal into a GPIO pin. This 'out-of-band' interrupt signal notifies the host when the WLAN device wants to turn on the SDIO interface. The ability to force the control of the gated clocks from within the WLAN chip is also provided.

❖ Function 0 Standard SDIO function (Max BlockSize / ByteCount = 32B)
❖ Function 1 Backplane Function to access the internal System On Chip (SOC) address space (Max BlockSize / ByteCount = 64B)
❖  Function 2 WLAN Function for efficient WLAN packet transfer through DMA (Max BlockSize/ByteCount=512B)

SDIO Pin Description

| SD 4-Bit Mode | |
|---|---|
| DATA0 | Data Line 0 |
| DATA1 | Data Line 1 or Interrupt |
| DATA2 | Data Line 2 or Read Wait |
| DATA3 | Data Line 3 |
| CLK | Clock |
| CMD | Command Line |

# 11.   Host Interface Timing Diagram

## 11.1 Power-up Sequence Timing Diagram

The module has signals that allow the host to control power consumption by enabling or disabling the Bluetooth, WLAN and internal regulator blocks. These signals are described below.

Additionally, diagrams are provided to indicate proper sequencing of the signals for carious operating states. The timing value indicated are minimum required values: longer delays are also acceptable.

※ WL_REG_ON: Used by the PMU to power up the WLAN section. When this pin is high, the regulators are enabled and the WLAN section is out of reset. When this pin is low the WLAN section is in reset.

※ BT_RST_N: Low asserting reset for Bluetooth and FM only. This pin has no effect on WLAN and does not control any PMU functions. This pin must be driven high or low (not left floating).
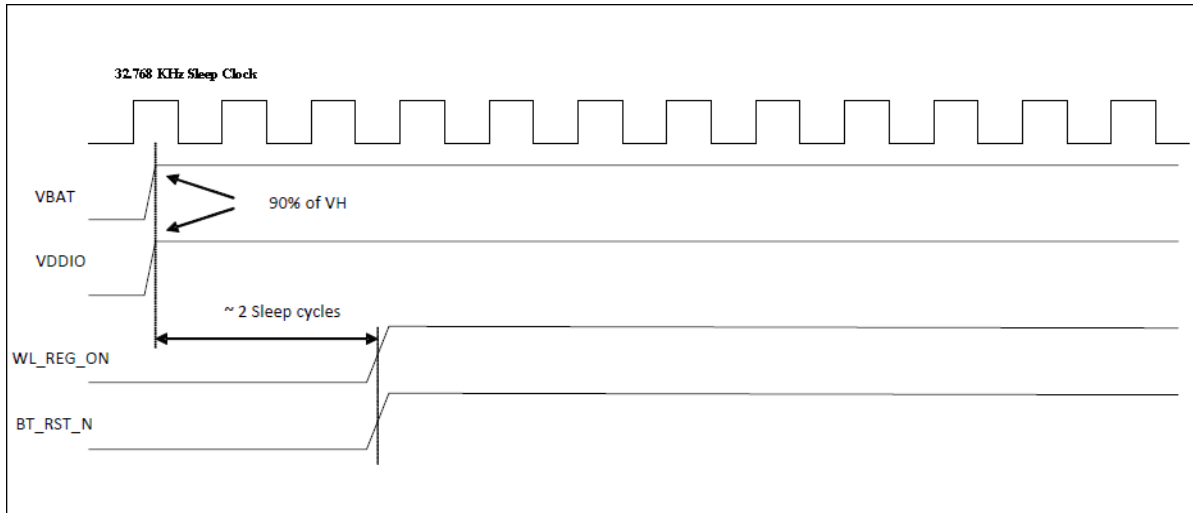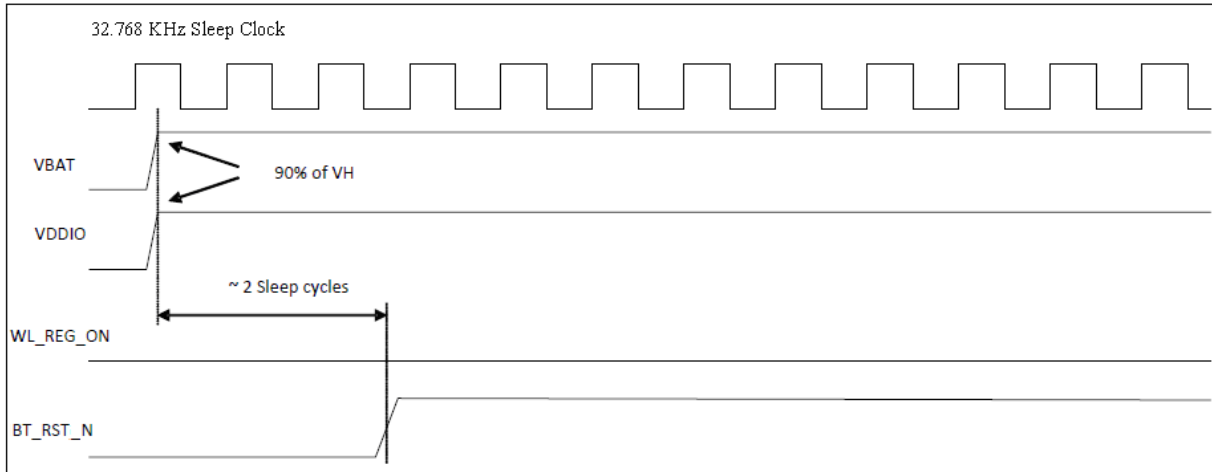
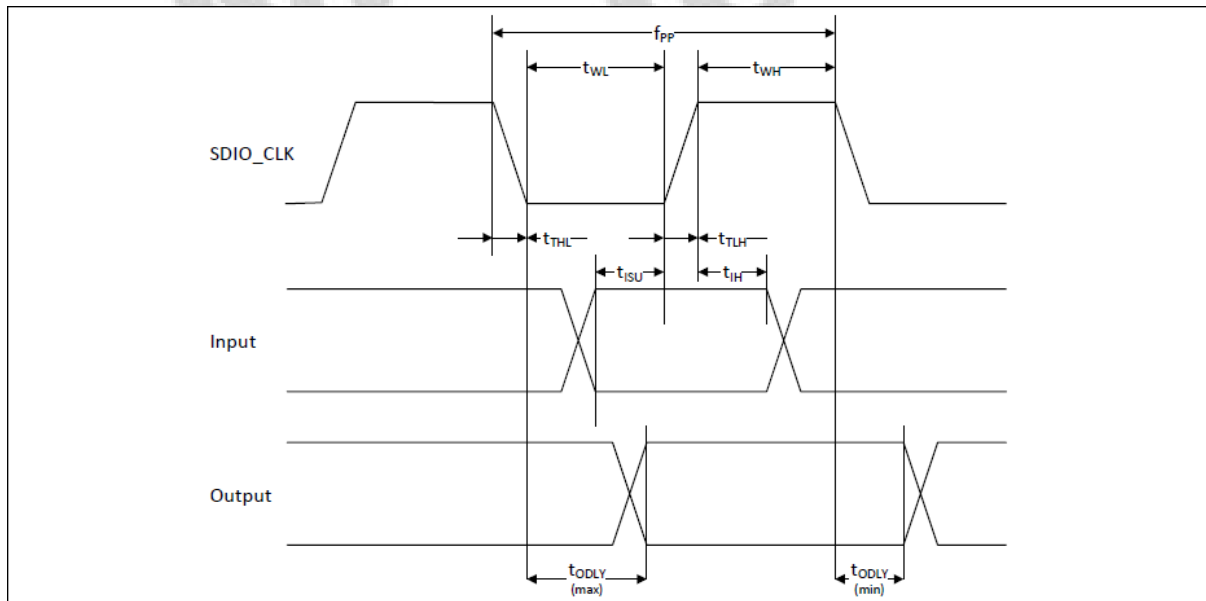WLAN=ON, Bluetooth=ON
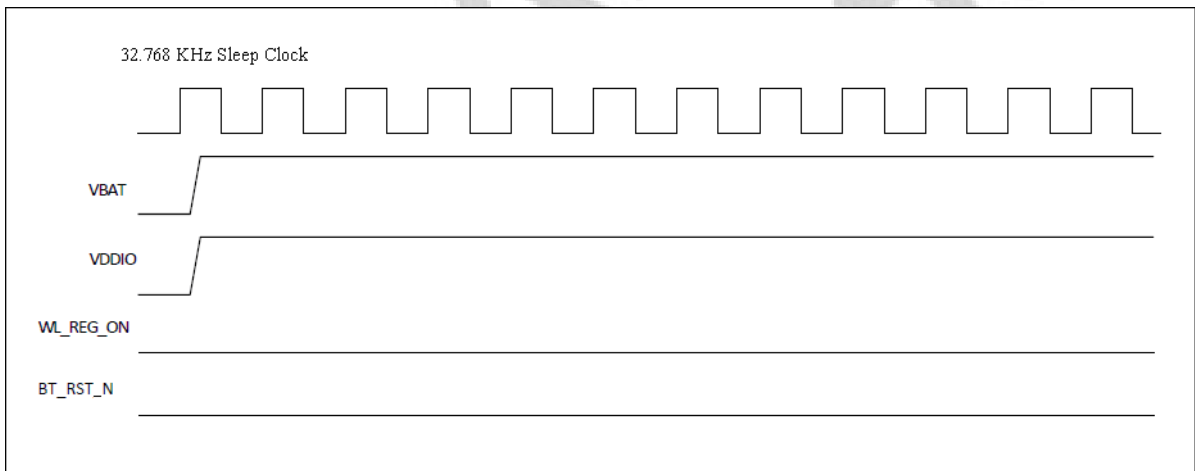


WLAN=OFF, Bluetooth=OFF
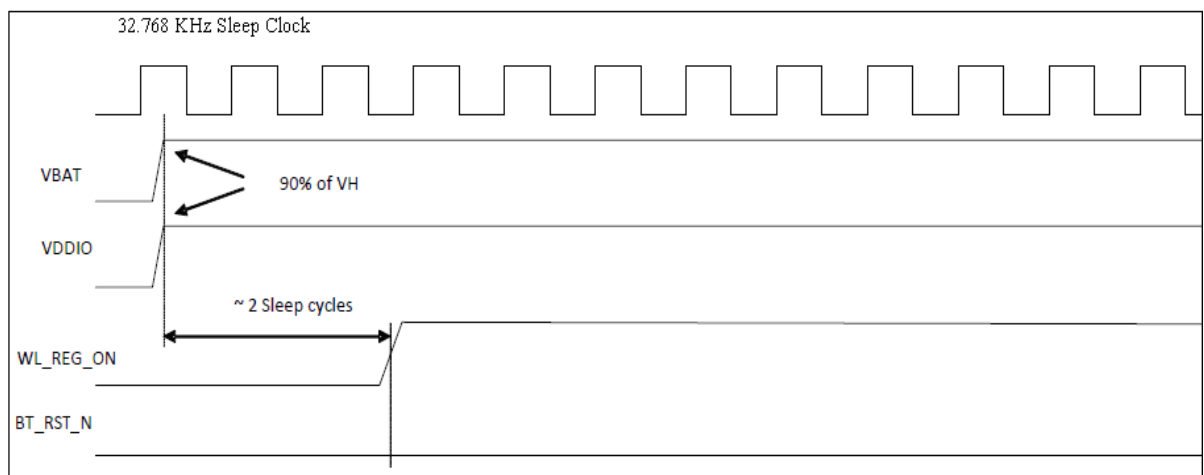


WLAN=ON, Bluetooth=OFF

WLAN=OFF, Bluetooth=ON

## 11.2 SDIO Default Mode Timing Diagram

| Parameter | Symbol | Minimum | Typical | Maximum | Unit |
|---|---|---|---|---|---|
| **SDIO CLK (All values are refferred to minimum VIH and maximum VIL[b] )** | | | | | |
| Frequency-Data Transfer mode | fPP | 0 | - | 25 | MHz |
| Frequency-Identification mode | fOD | 0 | - | 400 | kHz |
| Clock low time | tWL | 10 | - | - | ns |
| Clock high time | tWH | 10 | - | - | ns |
| Clock rise time | tTLH | - | - | 10 | ns |
| Clock low time | tTHL | - | - | 10 | ns |
| **Inputs: CMD, DAT (referenced to CLK)** | | | | | |
| Input setup time | tISU | 5 | - | - | ns |
| Input hold time | tIH | 5 | - | - | ns |
| **Outputs: CMD, DAT (referenced to CLK)** | | | | | |
| Output delay time – Data Transfer mode | tODLY | 0 | - | 14 | ns |
| Output delay time – Identification mode | tODLY | 0 | - | 50 | ns |

a. Timing is based on CL ≤ 40pF load on CMD and Data.
b. min(Vih) = 0.7 x VDDIO and max(Vil) = 0.2 x VDDIO.

## 11.3 SDIO High Speed Mode Timing Diagram
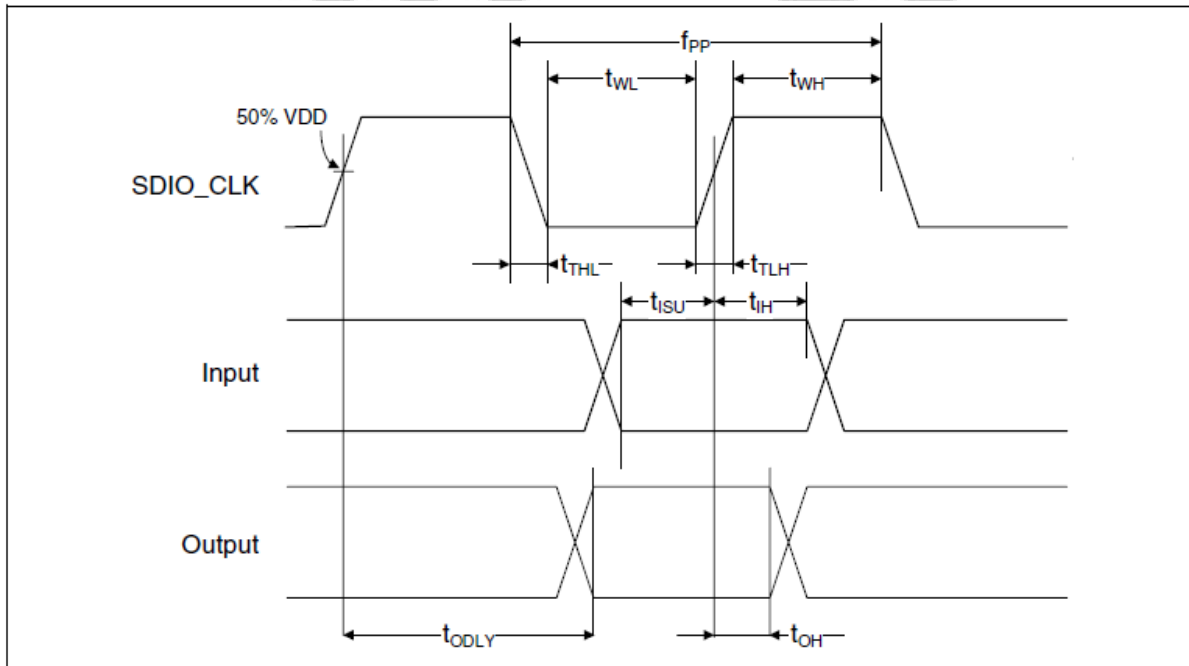


| Parameter | Symbol | Minimum | Typical | Maximum | Unit |
|---|---|---|---|---|---|
| **SDIO CLK (All values are refferred to minimum VIH and maximum VIL[b] )** | | | | | |
| Frequency-Data Transfer mode | fPP | 0 | - | 50 | MHz |
| Frequency-Identification mode | fOD | 0 | - | 400 | kHz |
| Clock low time | tWL | 7 | - | - | ns |
| Clock high time | tWH | 7 | - | - | ns |
| Clock rise time | tTLH | - | - | 3 | ns |
| Clock low time | tTHL | - | - | 3 | ns |
| **Inputs: CMD, DAT (referenced to CLK)** | | | | | |
| Input setup time | tISU | 6 | - | - | ns |
| Input hold time | tIH | 2 | - | - | ns |
| **Outputs: CMD, DAT (referenced to CLK)** | | | | | |
| Output delay time – Data Transfer mode | tODLY | - | - | 14 | ns |
| Output hold time | tOH | 2.5 | - | - | ns |
| Total system capacitance (each line) | CL | - | - | 40 | pF |

a. Timing is based on CL ≤ 40pF load on CMD and Data.
b. min(Vih) = 0.7 x VDDIO and max(Vil) = 0.2 x VDDIO.

# 12. Recommended Reflow Profile
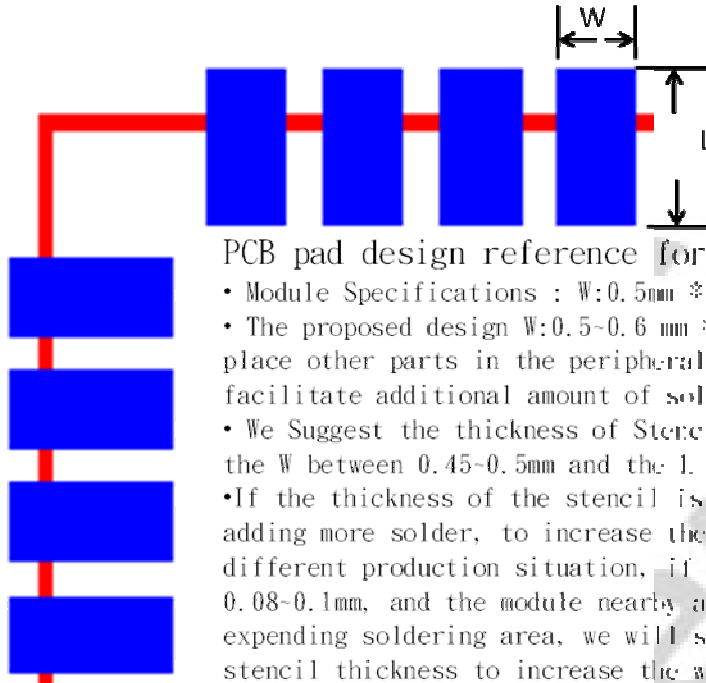
Referred to IPC/JEDEC standard.

Peak Temperature : <250℃

Number of Times : ≤2 times
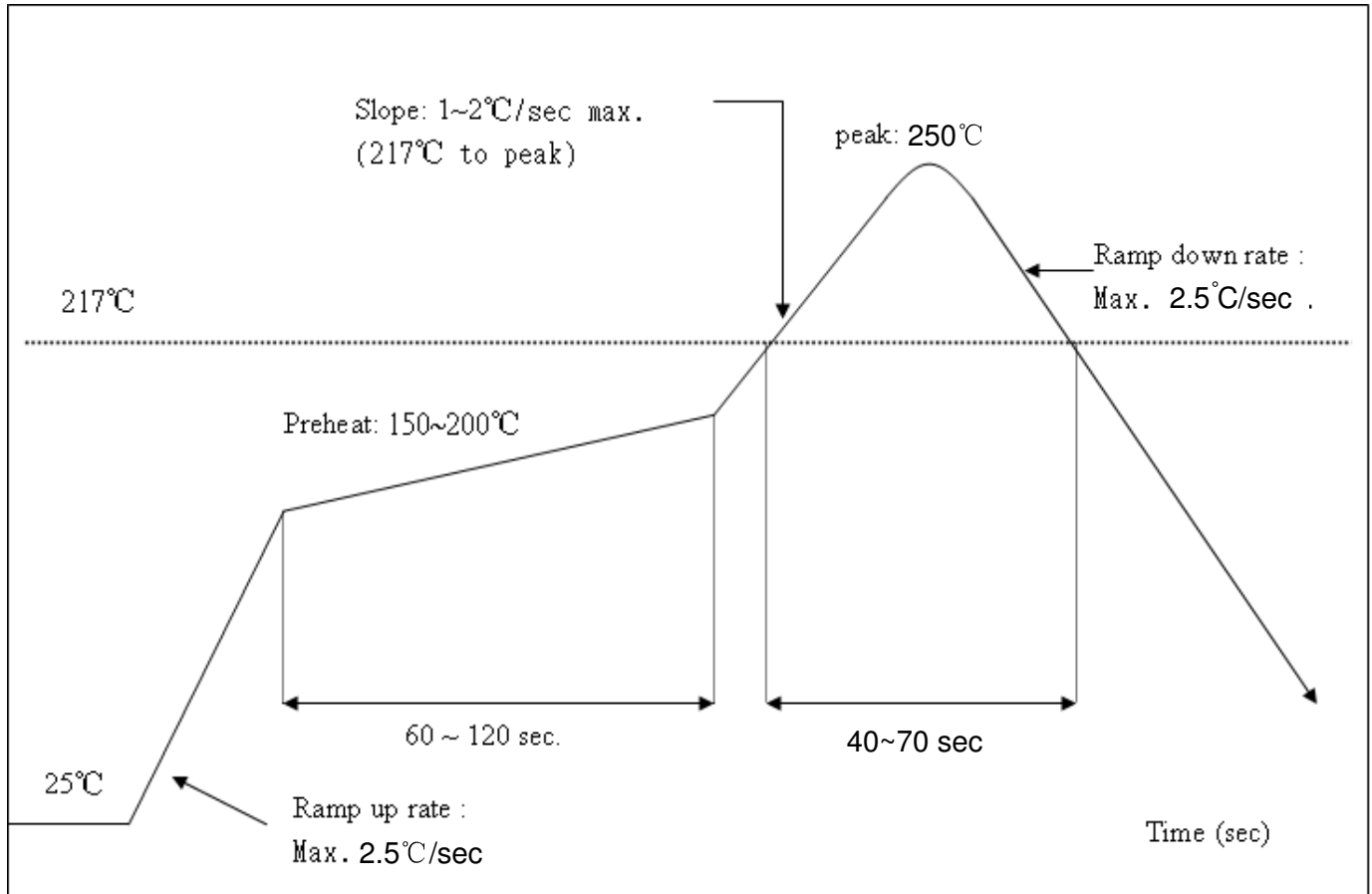


It must use N2 for reflow and suggest the concentration of oxygen less than 5000 ppm .

# Solder Paste definition

PCB pad design reference for AP Series models :
• Module Specifications : W:0.5mm * L:0.87mm pitch 0.9 mm
• The proposed design W:0.5~0.6 mm * L:1.25mm. Consider not place other parts in the peripheral area of 1 mm ~ 1.5 mm to facilitate additional amount of solder for PCB pad.
• We Suggest the thickness of Stencil between 0.12 mm~0.15mm, the W between 0.45~0.5mm and the L between 1.1.4~1.5mm.
•If the thickness of the stencil is thinner, we suggest to adding more solder, to increase the wetting ability. Depends on different production situation, if the stencil thickness is 0.08~0.1mm, and the module nearby area is no more space for expending soldering area, we will suggest to increase the stencil thickness to increase the wetting ability.
•The major consideration parts of stencil design is to increase the solder paste wetting ability.

• PCB pad design reference for AP Series models :
    • Module Specifications L:0.7mm
    • The design for PCB Pad : L:0.7mm
    • We recommen the apertures for stencil L:0.5mm~0.6mm
    • In order to avoid highness impact caused solder paste thickness, the stencil open size can be appropriately retracted
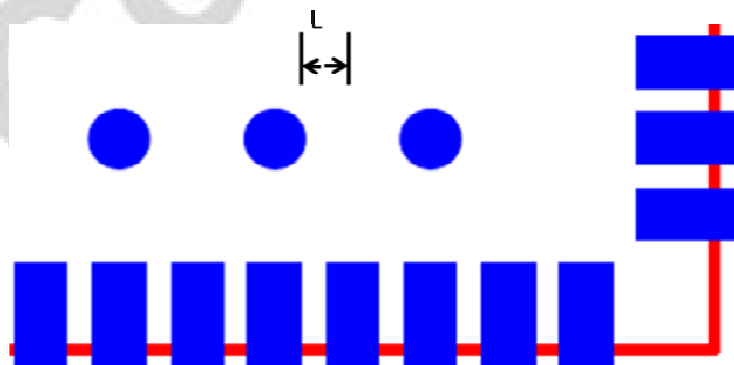
# 13. Package Information

## 13.1 Label

Label A→ Anti-static and humidity notice
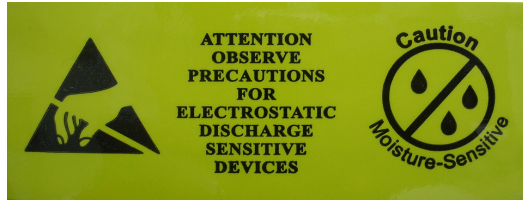


Label B→ MSL caution / Storage Condition



Label C→ Inner box label .



Label D→ Carton box label .

## 13.2 Dimension



| W | 24.00±0.30 |
|---|---|
| A0 | 12.30±0.10 |
| B0 | 12.30±0.10 |
| K0 | 1.80±0.10 |
| E | 1.75±0.10 |
| F | 11.50±0.10 |
| P0 | 4.00±0.10 |
| P1 | 16.00±0.10 |
| P2 | 2.00±0.10 |
| D0 | 1.50 $^{+0.10}_{-0.00}$ |
| D1 | ⌀1.50MIN |

1. 10 sprocket hole pitch cumulative tolerance ±0.20.
2. Carrier camber is within 1 mm in 250 mm.
3. Material : Black Conductive Polystyrene Alloy.
4. All dimensions meet EIA-481-D requirements.
5. Thickness : 0.30±0.05mm.
6. Packing length per 22" reel : 98.5 Meters.(1:3)
7. Component load per 13" reel : 1500 pcs.

Humidity indicator

Desiccant

B

A

C

C

50mm

338mm

355mm

D

360mm

285mm

375mm
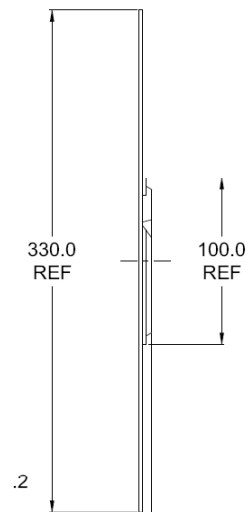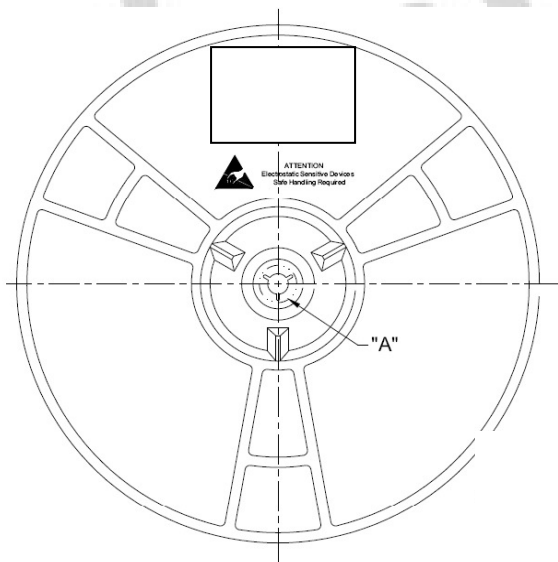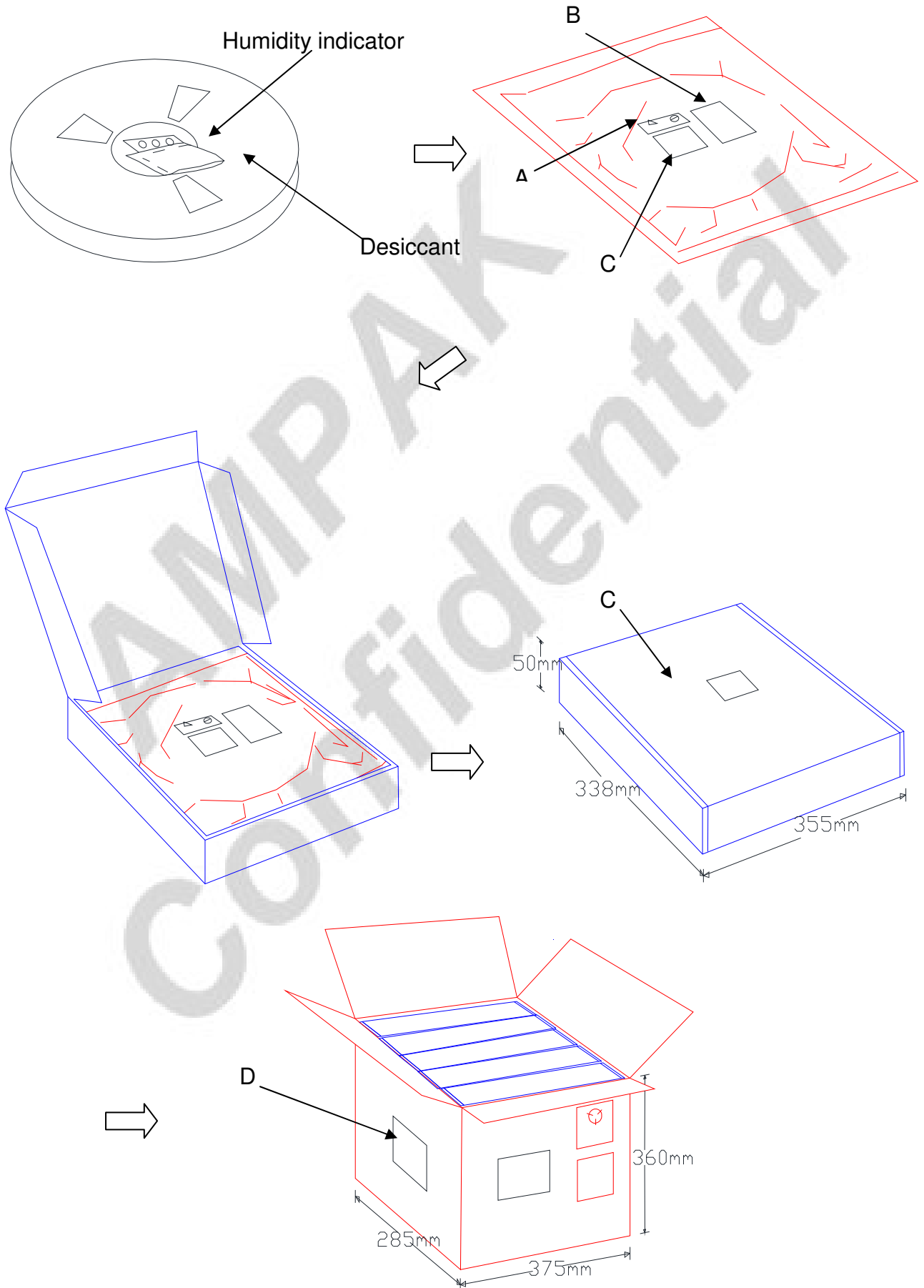
## 13.3 MSL Level / Storage Condition



LEVEL

**4**

⊘ (no moisture symbol)

# Caution
### This bag contains
## MOISTURE-SENSITIVE DEVICES
Do not open except under controlled conditions

1. Calculated shelf life in sealed bag: 12 months at< 40℃ and < 90% relative humidity(RH)

2. Peak package body temperature: 225℃ [ ]  240℃ [ ]  250℃ [V]  260℃ [ ]

3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must
   a) Mounted within: 48 hours of factory conditions <30℃/60% RH, OR
   b) Stored at <10% RH

4. Devices require bake, before mounting, if:
   a) Humidity Indicator Card is>10%when read at 23±5℃
   b) 3a or 3b not met

5. If baking is required, devices may be baked for 24 hours at 125±5℃

   Note : If device containers cannot be subjected to high temperature or shorter bake times are desired, reference IPC/JEDEC J-STD-033 for bake procedure

Bag Seal Date:          **See-SEAL DATELABEL**

Note:Level and body temperature defined by IPC/JEDED J-STD-020

**※NOTE : Accumulated baking time should not exceed 96hrs**
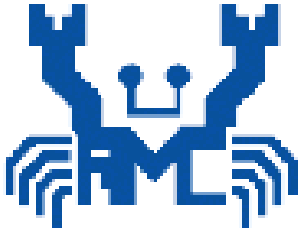
# RTL8188EUS

# SINGLE-CHIP IEEE 802.11b/g/n 1T1R WLAN

## DATASHEET
**(CONFIDENTIAL: Development Partners Only)**

**Rev. 0.2**
**27 Mar. 2012**
**Track ID:**

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## USING THIS DOCUMENT

This document is intended for the software engineer's reference and provides detailed programming information.

Though every effort has been made to ensure that this document is current and accurate, more information may have become available subsequent to the production of this guide.

## REVISION HISTORY

| Revision | Release Date | Summary |
|----------|--------------|---------|
| 0.2 | 2012/3/27 | Preliminary release |

# Table of Contents

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# List of Figures

# 1. General Description

The Realtek RTL8188EUS is a highly integrated single-chip 802.11n Wireless LAN (WLAN) network USB interface (USB 1.0/1.1/2.0 compliant) controller. It combines a WLAN MAC, a 1T1R capable WLAN baseband, and WLAN RF in a single chip. The RTL8188EUS provides a complete solution for a high throughput performance integrated wireless LAN device.

The RTL8188EUS WLAN baseband implements Orthogonal Frequency Division Multiplexing (OFDM) with 1 transmit and 1 receive path and is compatible with the IEEE 802.11n specification. Features include one spatial stream transmission, short guard interval (GI) of 400ns, spatial spreading, and transmission over 20MHz and 40MHz bandwidth.

For legacy compatibility, Direct Sequence Spread Spectrum (DSSS), Complementary Code Keying (CCK) and OFDM baseband processing are included to support all IEEE 802.11b and 802.11g 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, and 64QAM modulation of the individual subcarriers and rate compatible punctured convolutional coding with coding rate of 1/2, 2/3, 3/4, and 5/6, provide higher data rates of 54Mbps and 150Mbps for IEEE 802.11g and 802.11n OFDM respectively.

The RTL8188EUS WLAN Controller 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.

Efficient IQ-imbalance, DC offset, phase noise, frequency offset, and timing offset compensations are provided for the radio frequency front-end. Selectable digital transmit and receive FIR filters are provided to meet transmit spectrum mask requirements and to reject adjacent channel interference, respectively.

The RTL8188EUS WLAN Controller supports fast receiver Automatic Gain Control (AGC) with synchronous and asynchronous control loops among antennas, antenna diversity functions, and adaptive transmit power control function to obtain the better performance in the analog portions of the transceiver.

The RTL8188EUS WLAN MAC supports 802.11e for multimedia applications, 802.11i for security, and 802.11n 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, and U-APSD, reduce the power wasted during idle time, and compensates for the extra power required to transmit OFDM. The RTL8188EUS provides simple legacy and 20MHz/40MHz co-existence mechanisms to ensure backward and network compatibility.

# 2. Features

**General**

- 46-pin QFN

- CMOS MAC, Baseband PHY, and RF in a single chip for IEEE 802.11b/g/n compatible WLAN

- Complete 802.11n solution for 2.4GHz band

- 72.2Mbps receive PHY rate and 72.2Mbps transmit PHY rate using 20MHz bandwidth

- 150Mbps receive PHY rate and 150Mbps transmit PHY rate using 40MHz bandwidth

- Compatible with 802.11n specification

- Backward compatible with 802.11b/g devices while operating in 802.11n mode

**Interface**

- Complies with USB 1.0/1.1/2.0 for WLAN

**Standards Supported**

- IEEE 802.11b/g/n compatible WLAN

- IEEE 802.11e QoS Enhancement (WMM)

- 802.11i (WPA, WPA2). Open, shared key, and pair-wise key authentication services

**WLAN MAC Features**

- Frame aggregation for increased MAC efficiency (A-MSDU, A-MPDU)

- Low latency immediate High-Throughput Block Acknowledgement (HT-BA)

- PHY-level spoofing to enhance legacy compatibility

- Power saving mechanism

- Channel management and co-existence

- Transmit Opportunity (TXOP) Short Inter-Frame Space (SIFS) bursting for higher multimedia bandwidth

**WLAN PHY Features**

- IEEE 802.11n OFDM

- One Transmit and one Receive path (1T1R)

- 20MHz and 40MHz bandwidth transmission

- Short Guard Interval (400ns)

- DSSS with DBPSK and DQPSK, CCK modulation with long and short preamble

- OFDM with BPSK, QPSK, 16QAM, and 64QAM modulation.
  Convolutional Coding Rate: 1/2, 2/3, 3/4, and 5/6

- Maximum data rate 54Mbps in 802.11g and 150Mbps in 802.11n

- Hardware antenna diversity in per packet base

- Selectable receiver FIR filters

- Programmable scaling in transmitter and receiver to trade quantization noise against increased probability of clipping

- Fast receiver Automatic Gain Control (AGC)

- On-chip ADC and DAC

**Peripheral Interfaces**

■  General Purpose Input/Output (8 pins)

■  Three configurable LED pins

# 3. Application Diagram

## 3.1. Single-Band 11n (1x1) Solution with Single Antenna
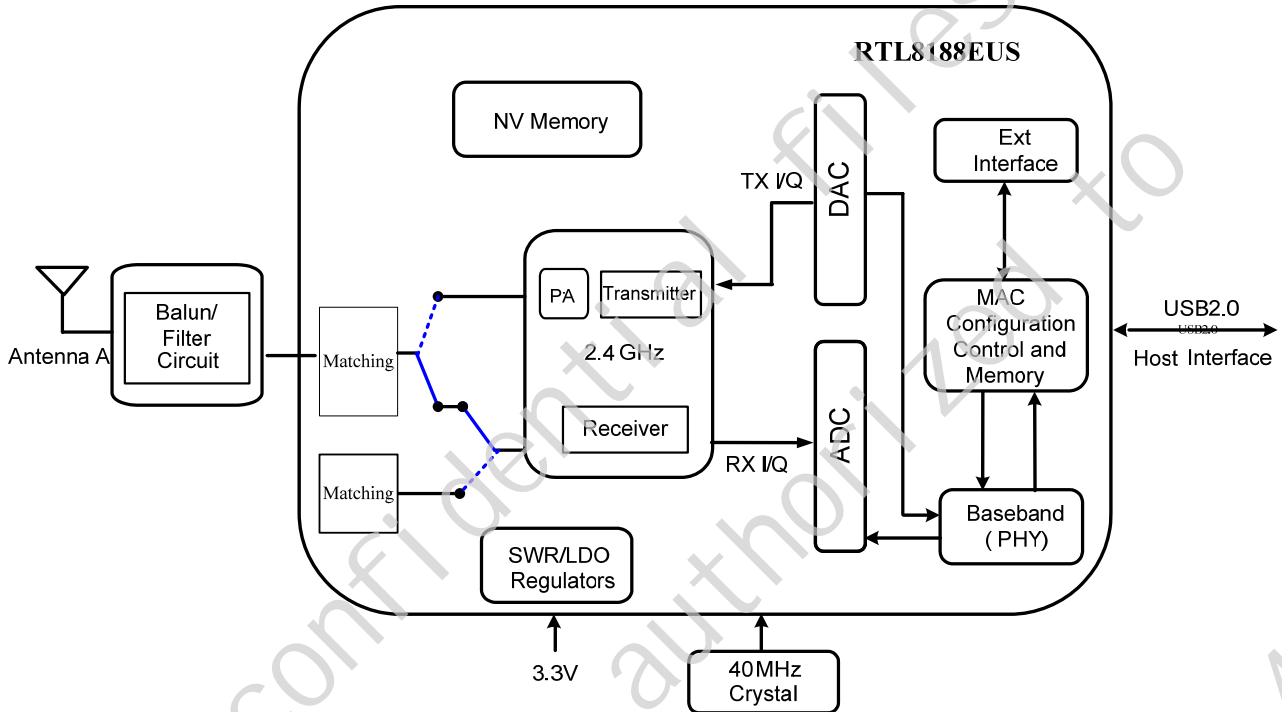


**Figure 1. Single-Band 11n (1x1) Solution**

## 3.2. Single-Band 11n (1x1) Solution with Transmit & Receive Diversity
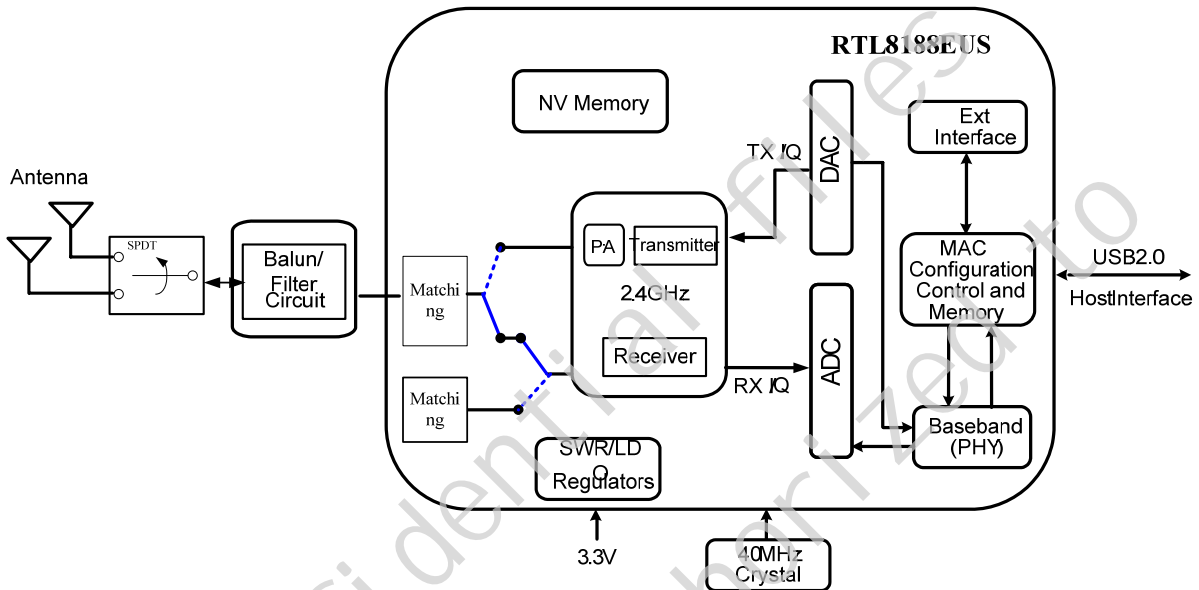


**Figure 2. Single-Band 11n (1x1) Transmit & Receive Diversity solution**

## 3.3. Single-Band 11n (1x1) Solution with Transmit & Receive Diversity
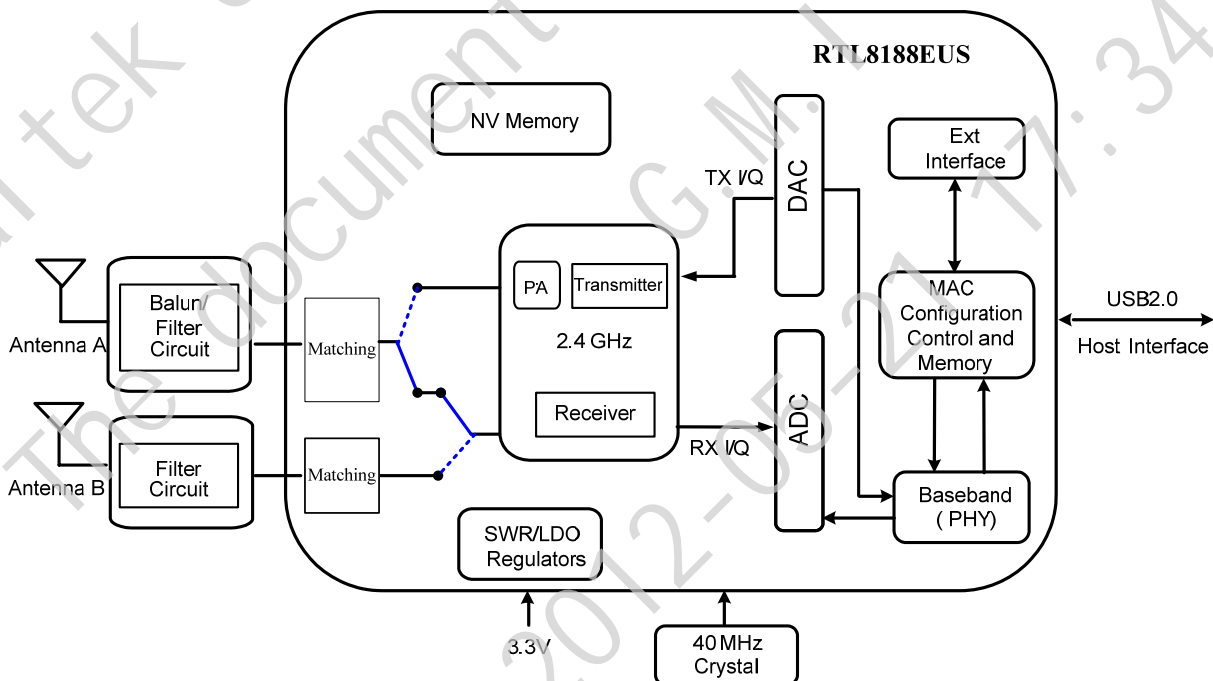


**Figure 3. Single-Band 11n (1x1) Transmit & Receive Diversity sSolution**

# 4. Pin Assignments
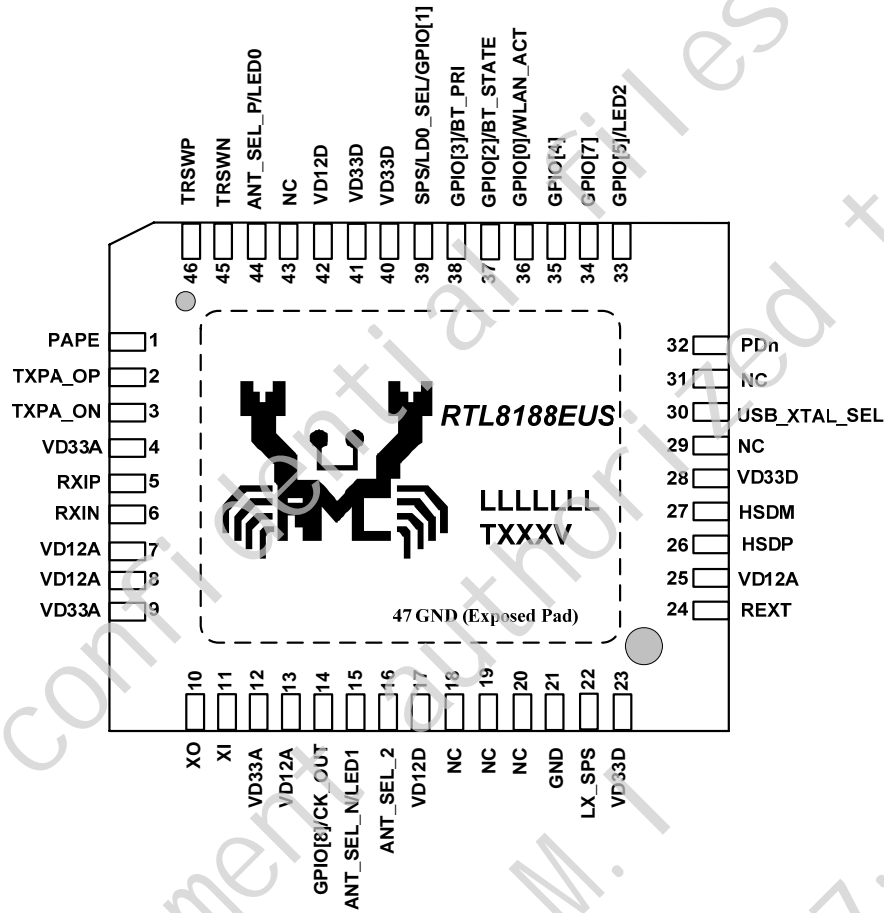


**Figure 4. Pin Assignments**

## 4.1. Package Identification

'Green' package is indicated by a 'G' in the location marked 'T' in Figure 4.

# 5. Pin Descriptions

The following signal type codes are used in the tables:

      I: Input                               O: Output

      T/S: Tri-State bi-directional input/output pin     S/T/S: Sustained Tri-State

O/D: Open Drain                                                      P: Power pin

# 5.1. USB Bus Transceiver Interface

**Table 1.   USB bus Transceiver Interface**

| Symbol | Type | Pin No | Description |
|--------|------|--------|-------------|
| HSDM/HSDP | I | 27/26 | USB Receive Differential Pair |

# 5.2. Power Pins

**Table 2.   Power Pins**

| Symbol | Type | Pin No | Description |
|--------|------|--------|-------------|
| LX_SPS | P | 22 | Switching Regulator Output |
| VD33A | P | 4,9,12, | VDD 3.3V for Analog |
| VD33D | P | 23,28,40,41 | VDD 3.3V for Digital |
| VD12A | P | 7,8,13,25 | Analog 1.2V Regulator Output |
| VD12D | P | 17,42 | Digital 1.2V Regulator Output |
| GND | P | 21,47 | Ground |

# 5.3. RF Interface

**Table 3.   RF Interface**

| Symbol | Type | Pin No | Description |
|--------|------|--------|-------------|
| TRSWN | O | 45 | Transmit/Receive<br>Shared with LED2, can be selected by control register |
| PAPE | O | 1 | 2.4GHz Transmit Power Amplifier Power Enable 0 |
| TRSWP | O | 46 | Transmit/Receive |
| TXPA_OP | O | 2 | RF TX Negative Signal |
| TXPA_ON | O | 3 | RF TX Positive Signal |
| RX_IP | I | 5 | RF RX Positive Signal |
| RX_IN | I | 6 | RF RX Negative Signal |
| ANT_SEL_P | O | 44 | Antenna Control Positive Signal<br>Shared with LED0, can be selected by control register |
| ANT_SEL_N | O | 15 | Antenna Control Negative Signal<br>Shared  with LED1, can be selected by control register |
| ANT_SEL_2 | O | 16 | Antenna Control Extend Signal |

## 5.4. LED Interface

**Table 4. LED Interface**

| Symbol | Type | Pin No | Description |
|--------|------|--------|-------------|
| LED0 | O | 44 | LED Pins (Active Low) |
| | | | Shared with ANT_SEL_P, can be selected by control register |
| LED1 | O | 15 | LED Pins (Active Low) |
| | | | Shared with ANT_SEL_N, can be selected by control register |
| LED2 | O | 33 | LED Pins (Active Low) |
| | | | Shared with GPIO5, can be selected by control register |

## 5.5.  Clock and Other Pins

**Table 5.  Clock and Other Pins**

| Symbol | Type | Pin No | Description |
|---|---|---|---|
| XI | I | 11 | 25/40MHz OSC Input<br>Input of 25/40MHz Crystal clock reference |
| XO | O | 10 | Output of 25/40MHz Crystal Clock Reference |
| PDn | I | 32 | This Pin can Externally Shutdown RTL8188CE without Extra Power Switch |
| REXT | O | 24 | Band gap. It needs to link 24k resister pull down. |
| USB_XTAL_SEL | I | 30 | Trap Function:  Decide to use the 25/40Mhz crystal  by this pin power on latch low or high.<br>USB_XTAL_SEL = 1, XTAL frequency is 40MHz<br>USB_XTAL_SEL = 0, XTAL frequency is 25MHz |
| GPIO0/WLAN_ACT | IO | 36 | General Purpose Input/Output Pin or Bluetooth Coexistence WLAN_ACT Pin<br>The WLAN_ACT signal indicates when WLAN is either transmitting or receiving in the 2.4GHz ISM band. |
| GPIO1/ (SPS/LDO_SEL mode) | IO | 39 | Trap Function:  Decide to use the SWR or LDO for 3.3V -> 1.2V by this pin power on latch low or high.<br>LDO_SPS_SEL = 0, use SWR<br>LDO_SPS_SEL = 1, use LDO<br>General Purpose Input/Output Pin or Bluetooth Coexistence WLAN_RX Pin. |
| GPIO2/BT_STATE | IO | 37 | General Purpose Input/Output Pin or Bluetooth Coexistence BT_STAT Pin<br>The BTSTAT signal indicates when normal Bluetooth packets are being transmitted or received. |
| GPIO3/BT_PRI | IO | 38 | General Purpose Input/Output Pin or Bluetooth Coexistence BT_PRI Pin<br>The BTPRI signal indicates when a high priority Bluetooth packet is being transmitted or received. |
| GPIO4 | IO | 35 | General Purpose Input/Output Pin |
| GPIO5/LED2 | IO | 33 | General Purpose Input/Output Pin<br>Shared with LED2, can be selected by control register |
| GPIO7 | IO | 34 | This pin can also support WLAN Radio off function with host interface remaining connected. |
| GPIO8/CK_OUT | IO | 14 | General Purpose Input/Output Pin<br>Buffered 25/40M clock outputs for other peripheral IC |
| NC | NA | 18,19,20,29,31,43 | No connect. Let it open. |

# 6. Electrical and Thermal Characteristics

## 6.1. Temperature Limit Ratings

Table 6.    Temperature Limit Ratings

| Parameter | Minimum | Maximum | Units |
|---|---|---|---|
| Storage Temperature | -55 | +125 | °C |
| Ambient Operating Temperature | 0 | 70 | °C |
| Junction Temperature | 0 | 125 | °C |

## 6.2. DC Characteristics

### 6.2.1. Power  Supply Characteristics

Table 7.    DC Characteristics

| Symbol | Parameter | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|
| VD33A, VD33D | 3.3V I/O Supply Voltage | 3.0 | 3.3 | 3.6 | V |
| VD12A, VD12D | 1.2V Core Supply Voltage | 1.10 | 1.2 | 1.32 | V |
| VD15A, VD15D | 1.5V Supply Voltage | 1.425 | 1.5 | 1.575 | V |
| IDD33 | 3.3V Rating Current | - | - | 600 | mA |

### 6.2.2. Digital IO Pin DC Characteristics

Table 8.    3.3V GPIO DC Characteristics

| Symbol | Parameter | Minimum | Normal | Maximum | Units |
|---|---|---|---|---|---|
| $V_{IH}$ | Input high voltage | 2.0 | 3.3 | 3.6 | V |
| $V_{IL}$ | Input low voltage | -- | 0 | 0.9 | V |
| $V_{OH}$ | Output high voltage | 2.97 | -- | 3.3 | V |
| $V_{OL}$ | Output low voltage | 0 | -- | 0.33 | V |

Table 9.    2.8V GPIO DC Characteristics

| Symbol | Parameter | Minimum | Normal | Maximum | Units |
|---|---|---|---|---|---|
| $V_{IH}$ | Input high voltage | 1.8 | 2.8 | 3.1 | V |
| $V_{IL}$ | Input low voltage | -- | 0 | 0.8 | V |
| $V_{OH}$ | Output high voltage | 2.5 | -- | 3.1 | V |
| $V_{OL}$ | Output low voltage | 0 | -- | 0.28 | V |

**Table 10.  1.8V GPIO DC Characteristics**

| Symbol | Parameter | Minimum | Normal | Maximum | Units |
|--------|-----------|---------|--------|---------|-------|
| $V_{IH}$ | Input high voltage | 1.7 | 1.8 | 2.0 | V |
| $V_{IL}$ | Input low voltage | -- | 0 | 0.8 | V |
| $V_{OH}$ | Output high voltage | 1.62 | -- | 1.8 | V |
| $V_{OL}$ | Output low voltage | 0 | -- | 0.18 | V |

# 7. Interface Timing Specification

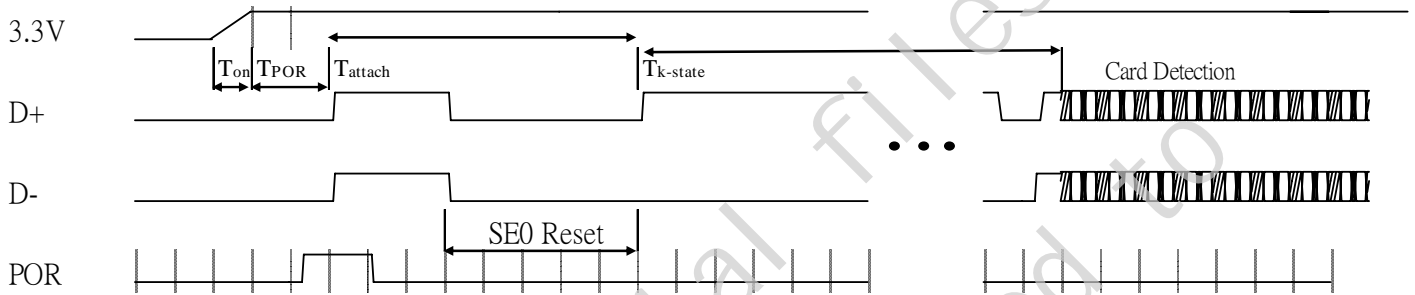## 7.1. USB Bus during Power On Sequence



Figure 5. RTL8188EUS USB Bus Power On Sequence

$T_{on}$: The main power ramp up duration

$T_{por}$: The power on reset releases and power management unit executes power on tasks

$T_{attach}$: USB attach state

$T_{k-state}$: the duration from resister attached to USB host starting card detection procedure

*The power on flow description:*

After main 3.3V ramp up, the internal power on reset is released by power ready detection circuit and the power management unit will be enabled. The power management unit enables the internal regulator and clock circuits.
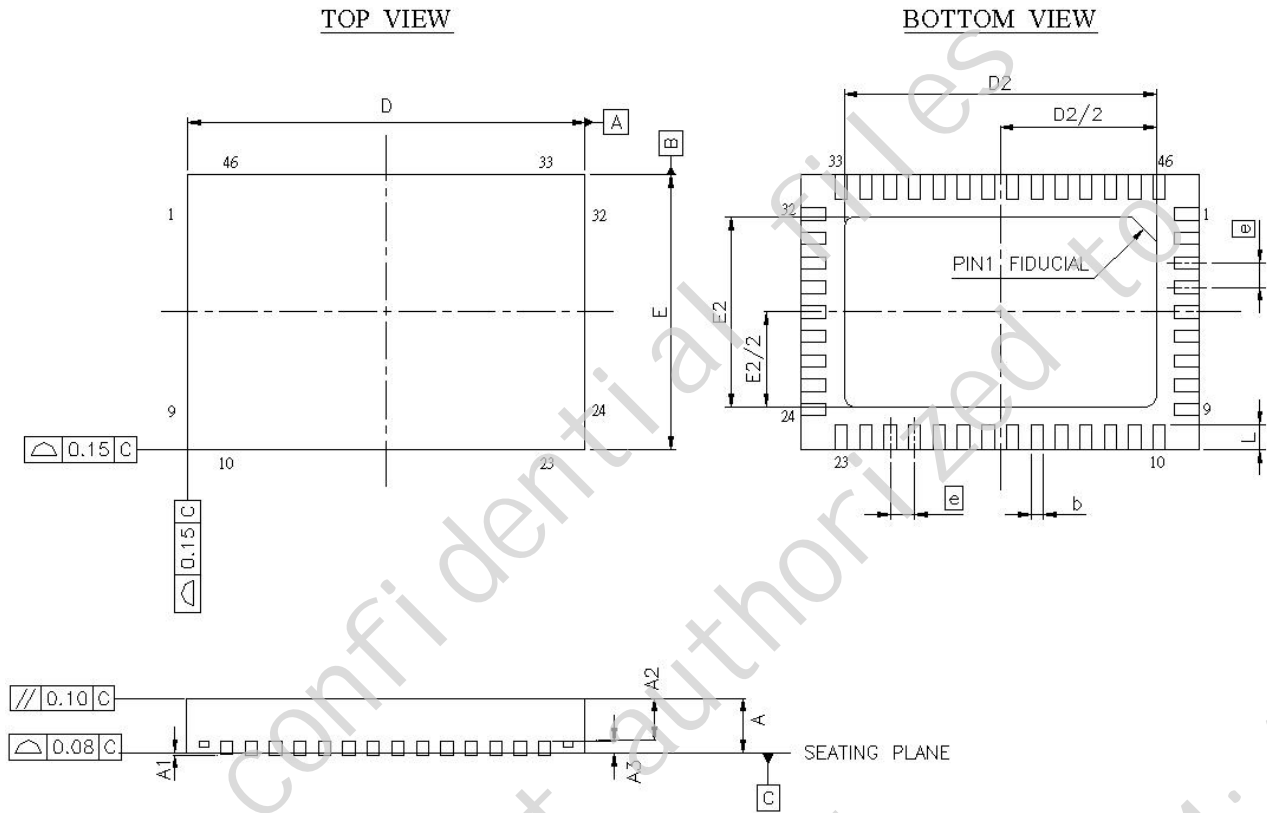
The power management unit also enables the USB circuits.

USB analog circuits attach resisters to indicate the insertion of the USB device

Table 11.    The typical timing range

|  | Unit | Min | Typical | Max |
|---|---|---|---|---|
| $T_{on}$ | ms | -- | 1.5 | 5 |
| $T_{por}$ | ms | -- | 2 | 10 |
| $T_{attach}$ | ms | 2 | 7 | 15 |
| $T_{k-state}$ | ms | 50 | 250 | -- |

# 8.    Mechanical Dimensions



## 8.1.    Mechanical Dimensions Notes

| Symbol | Dimension in mm | | | Dimension in inch | | |
|---|---|---|---|---|---|---|
| | Min | Nom | Max | Min | Nom | Max |
| A | 0.75 | 0.85 | 1.00 | 0.030 | 0.034 | 0.039 |
| $A_1$ | 0.00 | 0.035 | 0.05 | 0.000 | 0.001 | 0.002 |
| $A_2$ | 0.55 | 0.65 | 0.80 | 0.022 | 0.026 | 0.032 |
| $A_3$ | 0.20 REF | | | 0.008 REF | | |
| b | 0.15 | 0.20 | 0.25 | 0.006 | 0.008 | 0.010 |
| D | 6.50BSC | | | 0.256BSC | | |
| D2 | 4.85 | 5.1 | 5.35 | 0.191 | 0.201 | 0.211 |
| E | 4.5BSC | | | 0.177BSC | | |
| E2 | 2.25 | 2.5 | 2.75 | 0.088 | 0.098 | 0.108 |
| e | 0.40BSC | | | 0.016BSC | | |
| L | 0.30 | 0.40 | 0.50 | 0.012 | 0.016 | 0.020 |

Notes：
1.    CONTROLLING DIMENSION：MILLIMETER(mm).
2.    REFERENCE DOCUMENTL：JEDEC MO-220.

# 9. Ordering Information

**Table 12. Ordering Information**

| Part Number | Package | Status |
|---|---|---|
| RTL8188EUS-CG | QFN-46, 'Green' Package | Engineering Samples |

*Note: See page 7 for package identification.*

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