# AF61Y Hardware Design

**Automotive Wi-Fi&Bluetooth Module Series**

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# Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any terminal or mobile incorporating the module. Manufacturers of the terminal should notify users and operating personnel of the following safety information by incorporating these guidelines into all manuals of the product. Otherwise, Quectel assumes no liability for customers' failure to comply with these precautions.

| | |
|---|---|
|  | Full attention must be paid to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a handsfree kit) causes distraction and can lead to an accident. Please comply with laws and regulations restricting the use of wireless devices while driving. |
|  | Switch off the terminal or mobile before boarding an aircraft. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. If there is an Airplane Mode, it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on an aircraft. |
|  | Wireless devices may cause interference on sensitive medical equipment, so please be aware of the restrictions on the use of wireless devices when in hospitals, clinics or other healthcare facilities. |
|  | Terminals or mobiles operating over radio signal and cellular network cannot be guaranteed to connect in certain conditions, such as when the mobile bill is unpaid or the (U)SIM card is invalid. When emergency help is needed in such conditions, use emergency call if the device supports it. In order to make or receive a call, the terminal or mobile must be switched on in a service area with adequate cellular signal strength. In an emergency, the device with emergency call function cannot be used as the only contact method considering network connection cannot be guaranteed under all circumstances. |
|  | The terminal or mobile contains a transceiver. When it is ON, it receives and transmits radio frequency signals. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment. |
|  | In locations with explosive or potentially explosive atmospheres, obey all posted signs and turn off wireless devices such as mobile phone or other terminals. Areas with explosive or potentially explosive atmospheres include fueling areas, below decks on boats, fuel or chemical transfer or storage facilities, and areas where the air contains chemicals or particles such as grain, dust or metal powders. |

# About the Document

## Revision History

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# 1 Introduction

This document describes the AF61Y features, performance, and air interfaces and hardware interfaces connected to your applications. The document provides a quick insight into interface specifications, RF performance, electrical and mechanical specifications, and other module information as well.

## 1.1. Special Mark

**Table 1: Special Mark**

| Mark | Definition |
|---|---|
| * | Unless otherwise specified, when an asterisk (*) is used after a function, feature, interface, pin name, AT command, argument, and so on, it indicates that the function, feature, interface, pin, AT command, argument, and so on, is under development and currently not supported; and the asterisk (*) after a model indicates that the sample of the model is currently unavailable. |

# 2 Product Overview

The module is an automotive Wi-Fi and Bluetooth module with low power consumption and high performance. It is compliant with IEEE 802.11a/b/g/n/ac and Bluetooth 5.2 standard protocols. The module provides a PCIe interface for Wi-Fi applications and a UART interface and PCM interface for Bluetooth applications, as well as Wi-Fi & Bluetooth coexistence interfaces. It is an SMD module with compact packaging. Related information is listed in the table below:

**Table 2: Basic Information**

| AF61Y | |
|---|---|
| Packaging type | LGA |
| Pin counts | 112 |
| Dimensions | (23.0 ±0.2) mm x (23.0 ±0.2) mm x (3.0 ±0.2) mm |
| Weight | Approx. 3.58 g |

## 2.1. Key Features

**Table 3: Key Features**

| Category | Description |
|---|---|
| Supply Voltage | **VDD_CORE:**<br>● 1.71–1.89 V<br>● Typ.: 1.8 V<br>**VDD_IO:**<br>● 1.62–1.98 V<br>● Typ.: 1.8 V<br>**VDD_PA:**<br>● 2.09–2.31 V<br>● Typ.: 2.2 V |

| | |
|---|---|
| Operating Frequency | **Wi-Fi:**<br>● 2.4 GHz: 2.400–2.4835 GHz<br>● 5 GHz: 5.150–5.850 GHz<br>**Bluetooth:**<br>● 2.402–2.480 GHz |
| Wi-Fi Data Rates | **2.4 GHz**<br>● 802.11b: 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps<br>● 802.11g: 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, 54 Mbps<br>● 802.11n: HT20 (MCS 0–7), HT40 (MCS 0–7)<br>**5 GHz**<br>● 802.11a: 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, 54 Mbps<br>● 802.11n: HT20 (MCS 0–7), HT40 (MCS 0–7)<br>● 802.11ac: VHT20 (MCS 0–8), VHT40 (MCS 0–9), VHT80 (MCS 0–9) |
| Wi-Fi Transmitting Power | **2.4 GHz:**<br>● 802.11b @ 11 Mbps: 17.5 dBm<br>● 802.11g @ 54 Mbps: 15 dBm<br>● 802.11n @ HT20 MCS 7: 13.5 dBm<br>● 802.11n @ HT40 MCS 7: 12 dBm<br>**5 GHz:**<br>● 802.11a @ 54 Mbps: 13 dBm<br>● 802.11n @ HT20 MCS 7: 12.5 dBm<br>● 802.11n @ HT40 MCS 7: 12 dBm<br>● 802.11ac @ VHT20 MCS 8: 11.5 dBm<br>● 802.11ac @ VHT40 MCS 9: 10 dBm<br>● 802.11ac @ VHT80 MCS 9: 9.5 dBm |
| Wi-Fi Protocol Features | The module complies with IEEE 802.11a/b/g/n/ac protocol |
| Wi-Fi Modulations | CCK, BPSK, QPSK, 16QAM, 64QAM and 256QAM |
| Wi-Fi Operating Modes | AP and STA |
| Bluetooth Protocol Features | Bluetooth 5.2 |
| Bluetooth Modulations | GFSK, 8-DPSK and π/4-DQPSK |
| Bluetooth Operating Modes | ● Bluetooth Classic (BR + EDR)<br>● Bluetooth Low Energy (BLE) |
| Wi-Fi & Bluetooth Application Interfaces | ● PCIe interface: for Wi-Fi application<br>● UART & PCM interfaces: for Bluetooth application |
| Antenna Interfaces | ● Bluetooth & Wi-Fi antenna interface 0 (ANT_WIFI0)<br>● Wi-Fi antenna interface 1 (ANT_WIFI1)<br>● Reserved dedicated Bluetooth antenna interface (ANT_BT) |

| | |
|---|---|
| | ● 50 Ω characteristic impedance |
| Temperature Ranges | ● Normal operating temperature [1]: -40 °C to +85 °C<br>● Storage temperature: -40 °C to +90 °C |
| RoHS | All hardware components are fully compliant with EU RoHS directive. |

## 2.2. Functional Diagram

The functional diagram illustrates the following major functional parts:

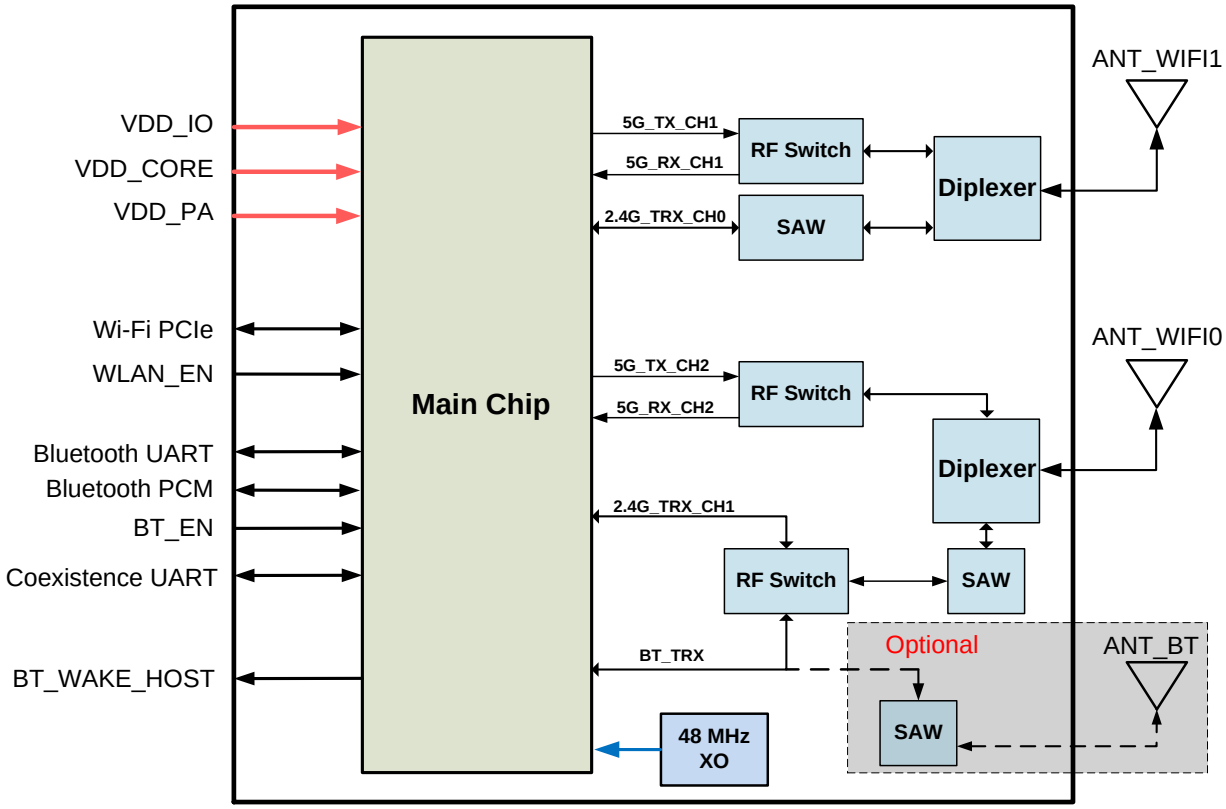



**Figure 1: Functional Diagram**

[1] Within this temperature range, the module's related performance meets IEEE and Bluetooth specifications.

## 2.3. Pin Assignment

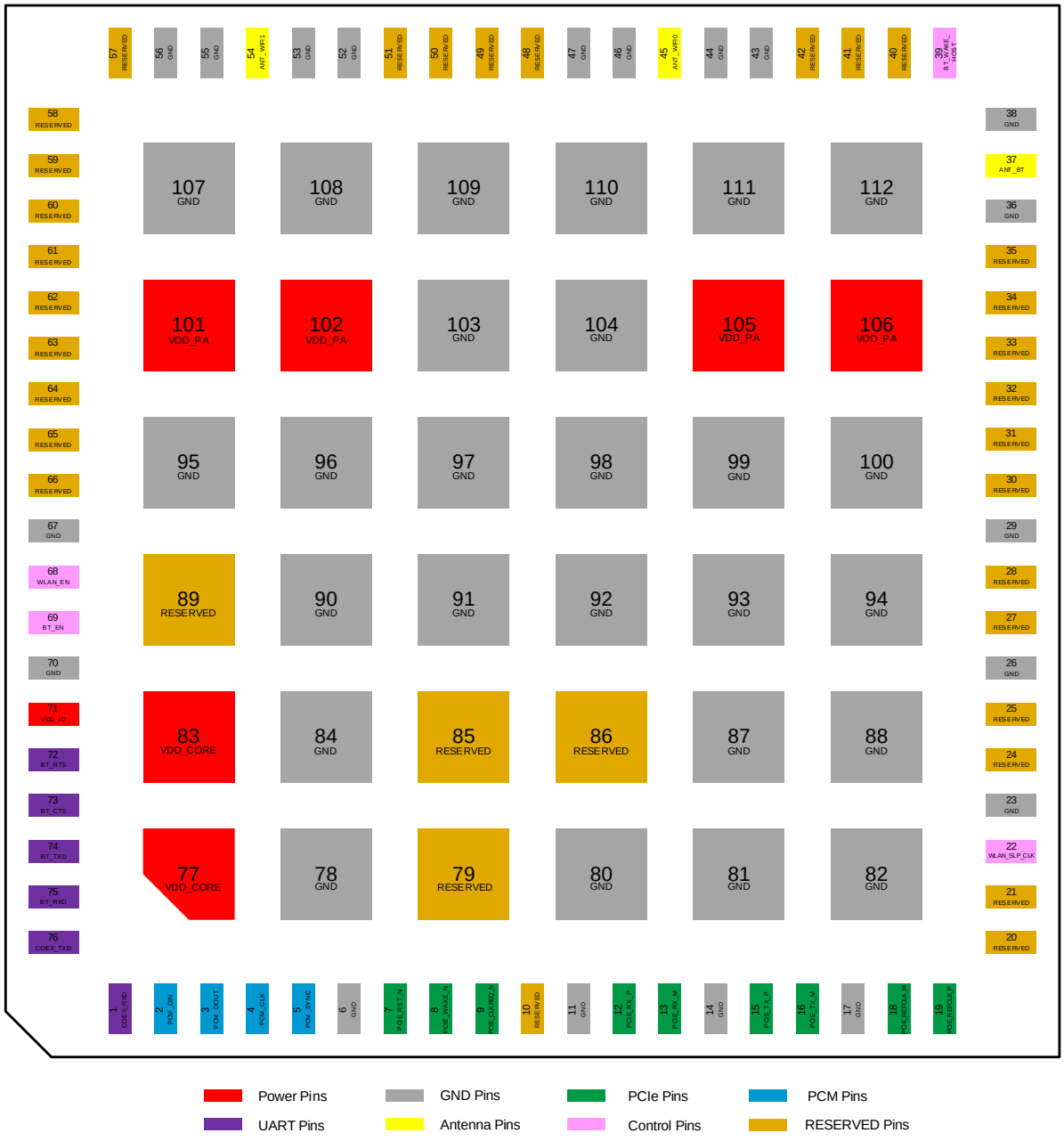



**Figure 2: Pin Assignment (Top View)**

**NOTE**

Keep all RESERVED and unused pins unconnected.

## 2.4. Pin Description

**Table 4: Parameter Definition**

| Parameter | Description |
|---|---|
| AI | Analog Input |
| AO | Analog Output |
| AIO | Analog Input/Output |
| DI | Digital Input |
| DO | Digital Output |
| PI | Power Input |

DC characteristics include power domain and rated current.

**Table 5: Pin Description**

| **Power Supply** | | | | | |
|---|---|---|---|---|---|
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| VDD_CORE | 77, 83 | PI | Main power supply for the module | Vmin = 1.71 V<br>Vnom = 1.8 V<br>Vmax = 1.89 V | It must be provided with sufficient current up to 1.3 A. |
| VDD_PA | 101, 102, 105, 106 | PI | Power supply for RF | Vmin = 2.09 V<br>Vnom = 2.2 V<br>Vmax = 2.31 V | It must be provided with sufficient current up to 1.5 A. |
| VDD_IO | 71 | PI | Power supply for the module's I/O pins | Vmin = 1.62 V<br>Vnom = 1.8 V<br>Vmax = 1.98 V | It must be provided with sufficient current up to 50 mA. |
| GND | 6, 11, 14, 17, 23, 26, 29, 36, 38, 43, 44, 46, 47, 52, 53, 55, 56, 67, 70, 78, 80–82, 84, 87, 88, 90–100, 103, 104, 107–112 | | | | |
| **Bluetooth Application Interfaces** | | | | | |

| Pin Name | Pin No. | I/O | Description | DC Characteristic | Comment |
|---|---|---|---|---|---|
| BT_EN | 69 | DI | Bluetooth enable control | VDD_IO | Active high. |
| PCM_SYNC | 5 | DIO | PCM data frame sync | | In master mode, it is an output signal. In slave mode, it is an input signal. It requires an external 10 kΩ pull-down resistor if you tend to boot the pin. |
| PCM_CLK | 4 | DIO | PCM clock | | In master mode, it is an output signal. In slave mode, it is an input signal. |
| PCM_DIN | 2 | DI | PCM data input | | If unused, keep it open. |
| PCM_DOUT | 3 | DO | PCM data output | | An external pull-down resistor should not be added. If unused, keep it open. |
| BT_TXD | 74 | DO | Bluetooth UART transmit | | An external pull-down resistor should not be added. |
| BT_RXD | 75 | DI | Bluetooth UART receive | | |
| BT_RTS | 72 | DO | Request to send signal from the module | | An external pull-down resistor should not be added. |
| BT_CTS | 73 | DI | Clear to send signal to the module | | |
| **Wi-Fi Application Interfaces** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |

| | | | | | |
|---|---|---|---|---|---|
| WLAN_EN | 68 | DI | WLAN function enable control | VDD_IO | Active high. |
| PCIE_REFCLK_P | 19 | AI | PCIe reference clock (+) | | Require differential impedance of 100 Ω. PCIe Gen 2 compliant. |
| PCIE_REFCLK_M | 18 | AI | PCIe reference clock (-) | | |
| PCIE_TX_M | 16 | AO | PCIe transmit (-) | | |
| PCIE_TX_P | 15 | AO | PCIe transmit (+) | | |
| PCIE_RX_M | 13 | AI | PCIe receive (-) | | |
| PCIE_RX_P | 12 | AI | PCIe receive (+) | | |
| PCIE_CLKREQ_N | 9 | DO | PCIe clock request | VDD_IO | |
| PCIE_RST_N | 7 | DI | PCIe reset | | |
| PCIE_WAKE_N | 8 | DO | PCIe wake up | | |
| **RF Antenna Interfaces** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| ANT_WIFI0 | 45 | AIO | Bluetooth & 2.4 GHz/5 GHz Wi-Fi antenna interface 0 | | 50 Ω characteristic impedance. |
| ANT_WIFI1 | 54 | AIO | 2.4 GHz/5 GHz Wi-Fi antenna interface 1 | | |
| ANT_BT | 37 | AIO | Reserved dedicated Bluetooth antenna interface | | |
| **Coexistence Interface** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| COEX_TXD | 76 | DO | LTE & WLAN/Bluetooth coexistence transmit | VDD_IO | External pull-down resistor should not be added. If unused, keep it open. |
| COEX_RXD | 1 | DI | LTE & WLAN/Bluetooth | | If unused, keep it open. |

| | | | | | |
|---|---|---|---|---|---|
| | | | coexistence receive | | |
| **WLAN_SLP_CLK Interface*** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| WLAN_SLP_CLK | 22 | DI | WLAN sleep clock | 1.8 V | Internal sleep clock by default. Keep this pin open. |
| **Control Signal Interface*** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| BT_WAKE_HOST | 39 | DO | Bluetooth wake up host | 1.8 V | It requires an external 10 kΩ pull-down resistor if you tend to boot the pin. |
| **Reserved Pins** | | | | | |
| **Pin Name** | **Pin No.** | | | | **Comment** |
| RESERVED | 10, 20, 21, 24, 25, 27, 28, 30–35, 40–42, 48–51, 57–66, 79, 85, 86, 89 | | | | Keep these pins open. |

## 2.5. EVB Kit

Quectel supplies an evaluation board (V2X&5G EVB) with accessories to develop and test the module. For more details, see ***document [1]***.

# 3 Operating Characteristics

## 3.1. Power Supply

### 3.1.1. Power Supply Interface

The following table shows the power supply pins and ground pins of AF61Y.

**Table 6: VDD and GND Pins**

| Pin Name | Pin No. | Description | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| VDD_CORE | 77, 83 | Main power supply for the module | 1.71 | 1.8 | 1.89 | V |
| VDD_PA | 101, 102, 105, 106 | Power supply for RF | 2.09 | 2.2 | 2.31 | V |
| VDD_IO | 71 | Power supply for the module's I/O pins | 1.62 | 1.8 | 1.98 | V |
| GND | 6, 11, 14, 17, 23, 26, 29, 36, 38, 43, 44, 46, 47, 52, 53, 55, 56, 67, 70, 78, 80–82, 84, 87, 88, 90–100, 103, 104, 107–112 | | | | | |

### 3.1.2. Reference Design for Power Supply

The module is powered by VDD_CORE and VDD_PA. It is recommended to use a power chip with a maximum output current of up to 1.3 A to supply for VDD_CORE, and a power chip with a maximum output current of up to 1.5 A to supply for VDD_PA. To ensure better power supply performance, it is recommended to parallel a 100 μF decoupling capacitor and 22 μF, 100 nF, 33 pF and 10 pF filter capacitors near the input terminal of the VDD_CORE and VDD_PA. Meanwhile, it is suggested to add a TVS component near the input terminal of the VDD_CORE and VDD_PA to improve the surge voltage bearing capacity of the module. As per design rules, the longer the traces of the VDD_CORE and VDD_PA are, the wider they should be.

Reference circuit of the input terminal of the VDD_CORE and VDD_PA is as shown in the figure below:

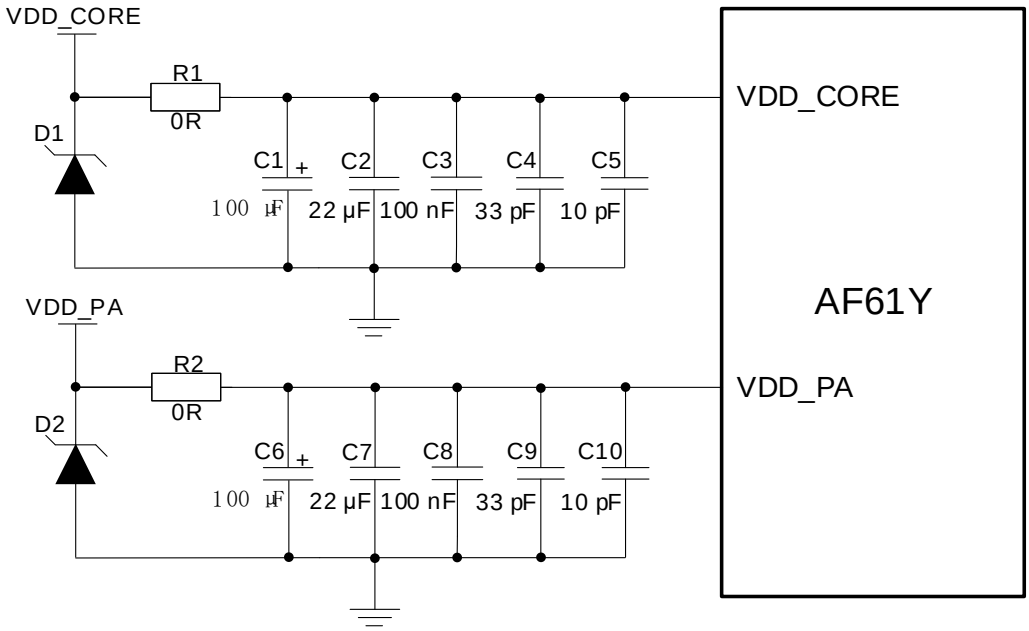



**Figure 3: Reference Design of Power Supply**

### 3.1.3. Turn-on Timing

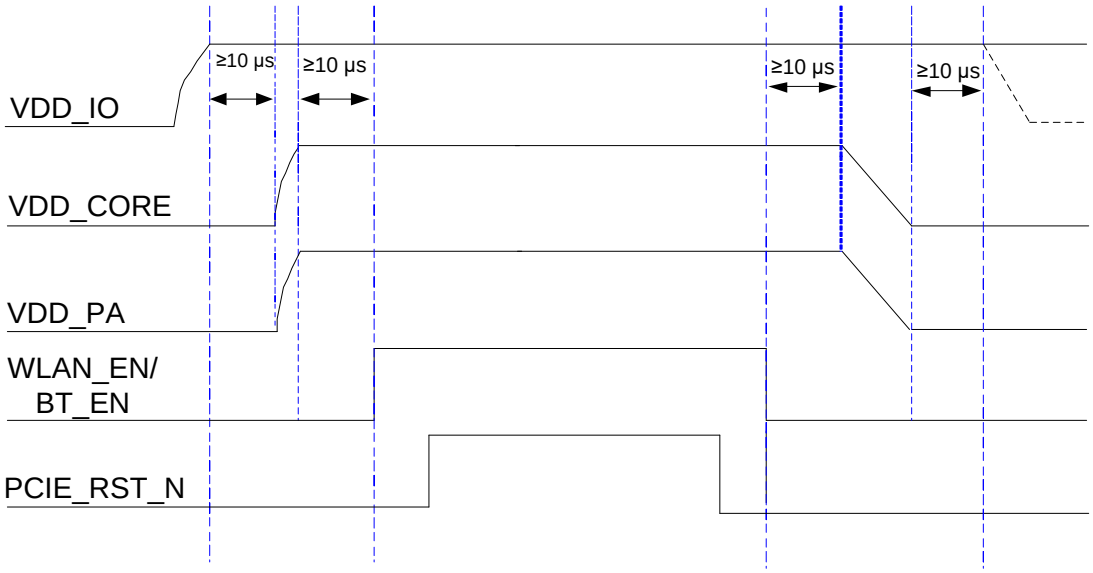



**Figure 4: Turn-on Timing**

## 3.2. Bootstrap Pins

Bootstrap pins are essential for operational boot-up. If it is designed incorrectly, AF61Y will go into a non-operational mode. Bootstrap pins are sampled within 100 ms of the first enable pin, either WLAN_EN or BT_EN. The bootstrap values will be latched until the next power cycle of the module.

**Table 7: Bootstrap Pins**

| Pin Name | Pin No. | A 10 kΩ Pull-up Resister Inside of the Module | Comment |
|---|---|---|---|
| PCM_DOUT | 3 | √ | Please ensure that the level logic is high during boot-up, so do not add a pull-down resistor or connect it to GND outside of the module. |
| PCM_SYNC | 5 | - | Please ensure that the level logic is low, during boot-up, so it is recommended to add a 10 kΩ pull-down resistor outside of the module. |
| BT_WAKE_HOST | 39 | - | Please ensure that the level logic is low, during boot-up, it is recommended to add a 10 kΩ pull-down resistor outside of the module. |
| BT_RTS | 72 | √ | Please ensure that the level logic is high during boot-up, so do not add a pull-down resistor or connect it to GND outside of the module. |
| BT_TXD | 74 | √ | Please ensure that the level logic is high during boot-up, so do not add a pull-down resistor or connect it to GND outside of the module. |
| COEX_TXD | 76 | √ | Please ensure that the level logic is high during boot-up, so do not add a pull-down resistor or connect it to GND outside of the module. |

**NOTE**

Please pay attention to the initial state of these pins on the host side.

# 4 Application Interfaces

## 4.1. Wi-Fi Application Interfaces

The following figure shows the Wi-Fi application interface connection between AF61Y and host:

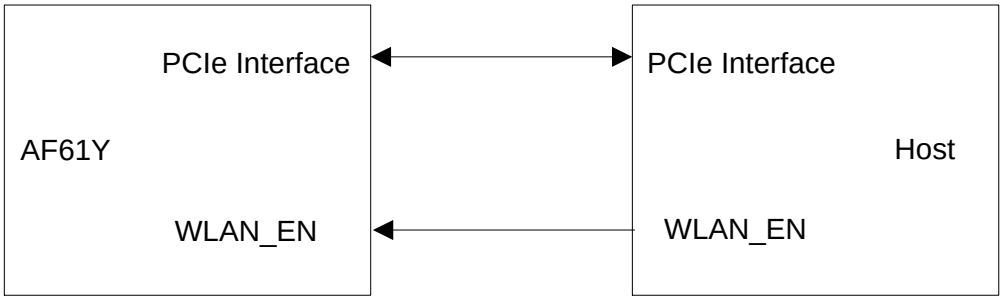



**Figure 5: Block Diagram of Wi-Fi Application Interface Connection**

### 4.1.1. WLAN_EN

WLAN enable function of AF61Y is controlled by WLAN_EN.

**Table 8: Pin Description of WLAN_EN**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| WLAN_EN | 68 | DI | WLAN function enable control | Active high. |

**NOTE**

WLAN_EN is the sensitive signal. When routing, keep it far away from power supply traces, crystal-oscillators, magnetic devices, sensitive signals and signals like RF signals, analog signals, and noise signals generated by clock, DC-DC, etc.

### 4.1.2. PCIe Interface

**Table 9: Pin Definition of PCIe Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| PCIE_REFCLK_P | 19 | AI | PCIe reference clock (+) | Require differential impedance of 100 Ω. PCIe Gen 2 compliant. |
| PCIE_REFCLK_M | 18 | AI | PCIe reference clock (-) | |
| PCIE_TX_P | 15 | AO | PCIe transmit (+) | |
| PCIE_TX_M | 16 | AO | PCIe transmit (-) | |
| PCIE_RX_P | 12 | AI | PCIe receive (+) | |
| PCIE_RX_M | 13 | AI | PCIe receive (-) | |
| PCIE_CLKREQ_N | 9 | DO | PCIe clock request | VDD_IO power domain. |
| PCIE_RST_N | 7 | DI | PCIe reset | |
| PCIE_WAKE_N | 8 | DO | PCIe wake up | |

The following figure shows the PCIe interface connection between AF61Y and host.

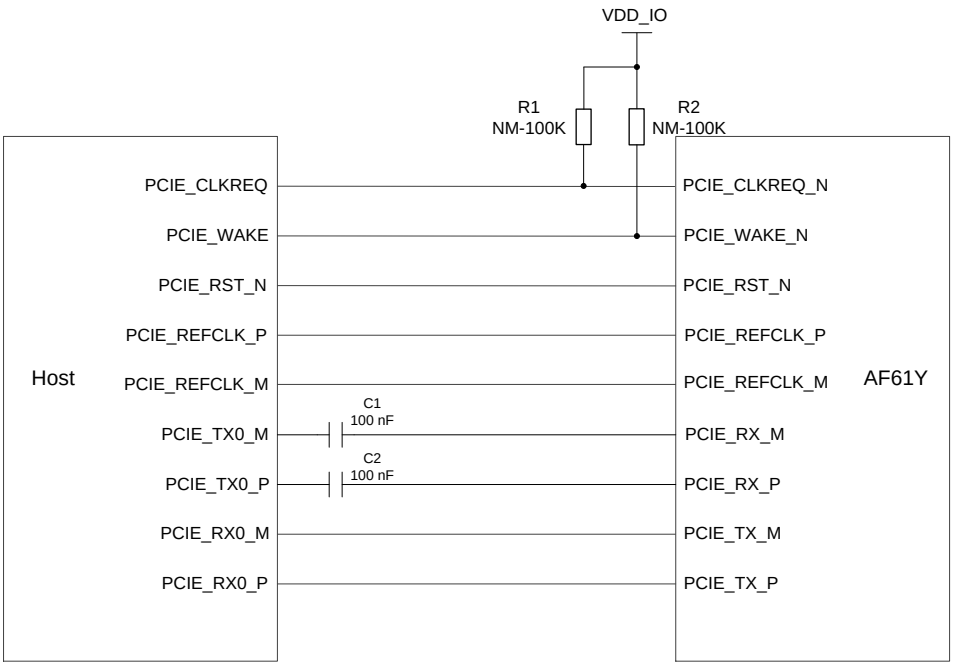



**Figure 6: PCIe Interface Connection**

In order to ensure the signal integrity of PCIe interface, C1 and C2 should be placed close to the host.

The following principles of PCIe interface design should be complied with to meet PCIe Gen 2 specifications.

- It is important to route the PCIe signal traces as differential pairs with total grounding. And the differential impedance is 100 Ω ±10 %.
- For PCIe signal traces, the maximum length of each differential data pair (PCIE_TX/PCIE_RX/PCIE_REFCLK) is recommended to be less than 300 mm, and each differential data pair matching should be less than 0.7 mm (5 ps).
- The spacing between the Tx/Rx signal trace and other signal traces must be greater than 4 times the trace width.
- It is important to route the PCIe differential traces in inner-layer of the PCB with ground planes above and below and keep away from the interference sources such as crystals, switching power and RF signal traces.

**NOTE**

1. For PCIE_TX_M and PCIE_TX_P, a 100 nF coupling capacitor has been respectively placed inside the module.
2. For PCIE_CLKREQ_N and PCIE_WAKE_N, a pull-up 10 kΩ resistor has been respectively placed inside the module.

## 4.2. Bluetooth Application Interfaces

The following figure shows the Bluetooth application interface connection between AF61Y and host:

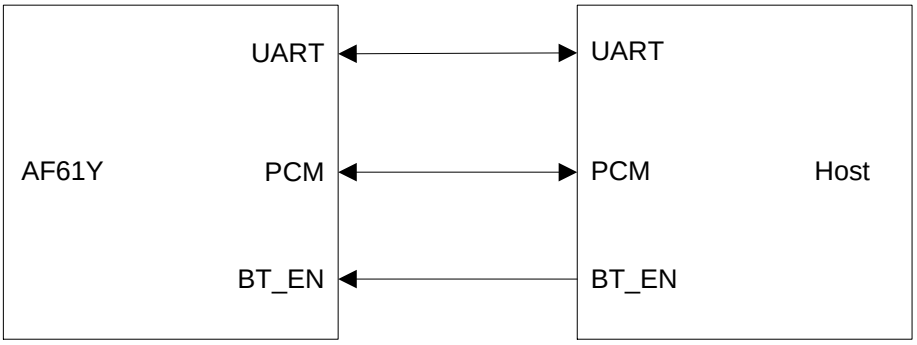



**Figure 7: Block Diagram of Bluetooth Application Interface Connection**

### 4.2.1. PCM Interface

The module provides PCM interface for audio over Bluetooth.

**Table 10: Pin Description of PCM Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| PCM_SYNC | 5 | DIO | PCM data frame sync | In master mode, it is an output signal. In slave mode, it is an input signal.<br>It requires an external 10 kΩ pull-down resistor if you tend to boot the pin. |
| PCM_CLK | 4 | DIO | PCM clock | In master mode, it is an output signal. In slave mode, it is an input signal. |
| PCM_DIN | 2 | DI | PCM data input | If unused, keep it open. |
| PCM_DOUT | 3 | DO | PCM data output | An external pull-down resistor should not be added.<br>If unused, keep it open. |

The following figure shows a reference design for PCM interface connection between AF61Y and host:

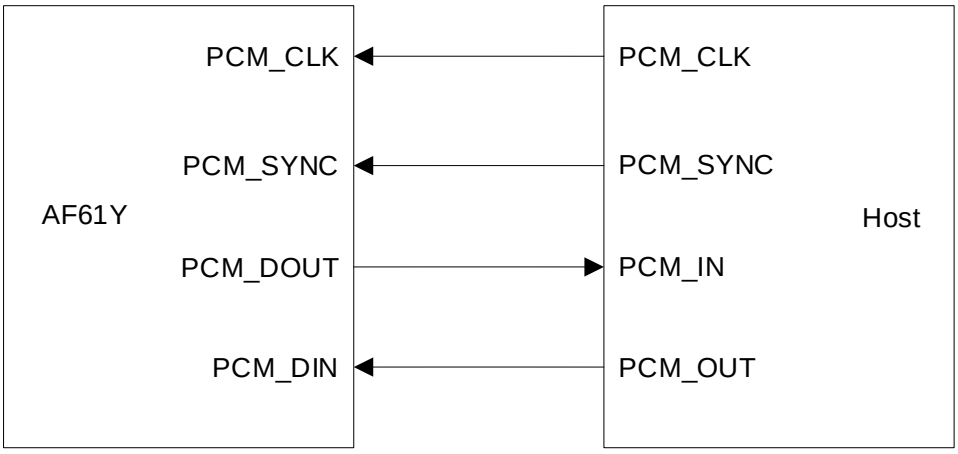



**Figure 8: Block Diagram of PCM Interface**

When the host PCM level does not match the AF61Y PCM, it necessary to add a voltage-level translator. For the PCM_DOUT and PCM_SYNC are bootstrap pins, it is recommended to keep the voltage-level translator disable during boot-up. Enable or disable the voltage-level translator OE pin.

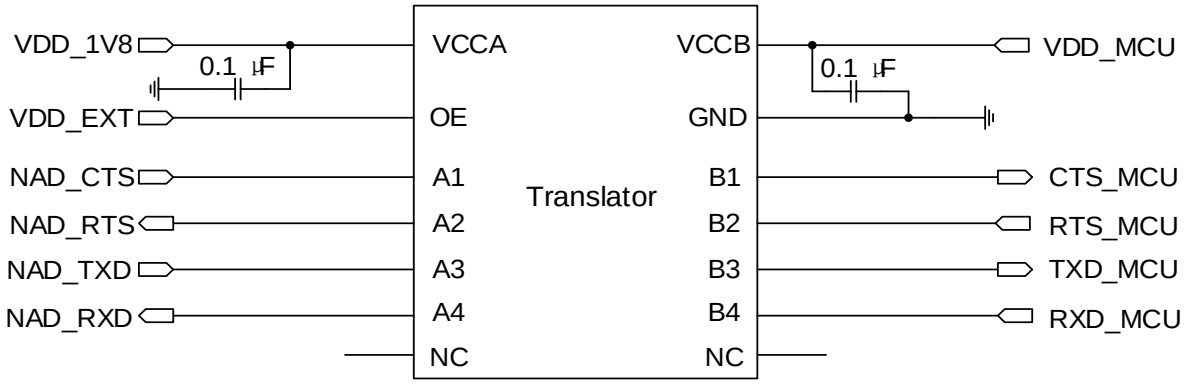



**Figure 9: Voltage-level Translator for PCM Interface**

### 4.2.2. BT_EN

Bluetooth function of AF61Y is controlled by BT_EN. When BT_EN is at a high level, Bluetooth function will be enabled.

**Table 11: Pin Description of BT_EN**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| BT_EN | 69 | DI | Bluetooth enable control | Active high. |

### 4.2.3. BT_WAKE_HOST*

BT_WAKE_HOST is used to wake up the host and it is active high.

**Table 12: Pin Description of BT_WAKE_HOST**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| BT_WAKE_HOST | 39 | DO | Bluetooth wake up host | 1.8 V power domain.<br>It requires an external 10 kΩ pull-down resistor if you tend to boot the pin. |

### 4.2.4. Bluetooth UART

AF61Y supports an HCI UART as defined in *Bluetooth Core Specification Version 5.2*. The UART supports hardware flow control, and it can be used for data transmission with up to 3.2 Mbps baud rates.

**Table 13: Pin Description of Bluetooth UART**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| BT_TXD | 74 | DO | Bluetooth UART transmit | An external pull-down resistor should not be added. |
| BT_RXD | 75 | DI | Bluetooth UART receive | |
| BT_RTS | 72 | DO | Request to send signal from the module | An external pull-down resistor should not be added. |
| BT_CTS | 73 | DI | Clear to send signal to the module | |

The following figure shows a reference design for Bluetooth UART connection between AF61Y and the peripheral:

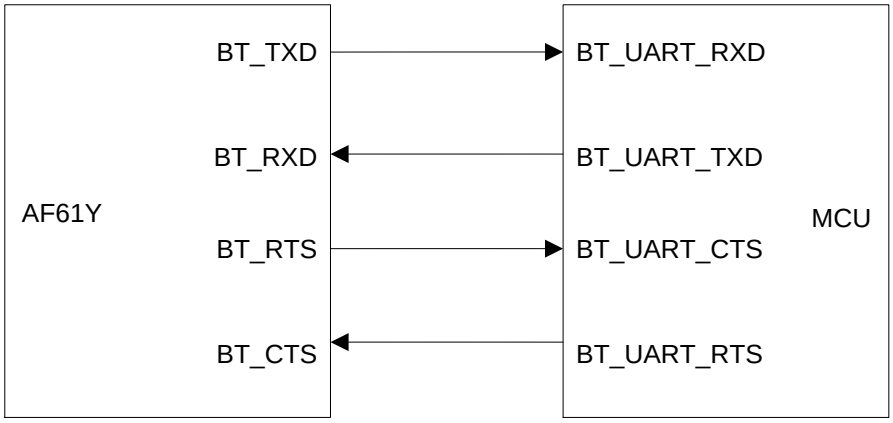



**Figure 10: Block Diagram of Bluetooth UART Connection**

When the HOST UART level does not match the AF61Y UART, it necessary to add a voltage-level translator, for the BT_RTS and BT_TXD are bootstrap pins, it is recommended to keep the voltage-level translator disable during boot-up. Enable or disable voltage-level translator OE pin.

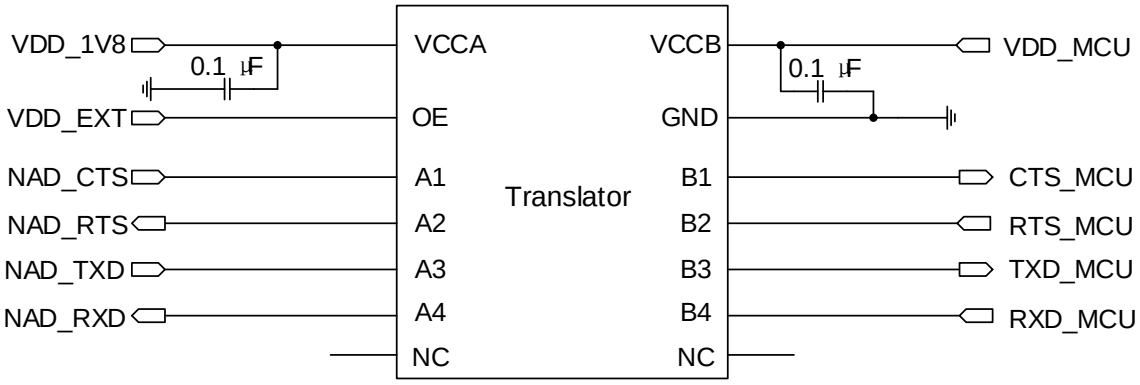



**Figure 11: Voltage-level Translator for UART**

## 4.3. Other Interfaces

### 4.3.1. Coexistence UART

**Table 14: Pin Description of Coexistence UART**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| COEX_TXD | 76 | DO | LTE & WLAN/Bluetooth coexistence transmit | External pull-down resistor should not be added.<br>If unused, keep it open. |
| COEX_RXD | 1 | DI | LTE & WLAN/Bluetooth coexistence receive | If unused, keep it open. |

The following figure shows the coexistence interface connection between AF61Y and host:

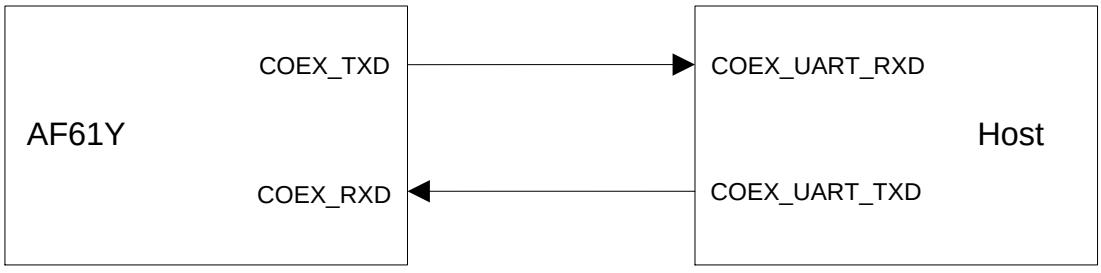



**Figure 12: Block Diagram of Coexistence Interface Connection**

### 4.3.2. WLAN_SLP_CLK*

The 32.768 kHz sleep clock is used in low power consumption modes, such as power saving mode and sleep mode. It can ensure basic logic operations when the module is in sleep mode.

**Table 15: Pin Description of WLAN_SLP_CLK**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| WLAN_SLP_CLK | 22 | DI | WLAN sleep clock | Internal sleep clock by default.<br>Keep this pin open. |

# 5 RF Specifications

Appropriate antenna type and design should be used with matched antenna parameters according to specific application. It is required to perform a comprehensive functional test for the RF design before mass production of terminal products. The entire content of this chapter is provided for illustration only. Analysis, evaluation and determination are still necessary when designing target products.

## 5.1. RF Antenna

### 5.1.1. Antenna Interfaces & Frequency Bands

**Table 16: Pin Description of RF Antenna Interfaces**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| ANT_WIFI0 | 45 | AIO | Bluetooth & 2.4 GHz/5 GHz Wi-Fi antenna interface 0 | 50 Ω characteristic impedance. |
| ANT_WIFI1 | 54 | AIO | 2.4 GHz/5 GHz Wi-Fi antenna interface 1 | |
| ANT_BT | 37 | AIO | Reserved dedicated Bluetooth antenna interface | |

**Table 17: Operating Frequency of AF61Y (Unit: GHz)**

| Parameter | Frequency |
|---|---|
| 2.4 GHz Wi-Fi | 2.400–2.4835 |
| 5 GHz Wi-Fi | 5.150–5.850 |
| Bluetooth | 2.402–2.480 |

### 5.1.2. Reference Design

The module provides three RF antenna pins for Wi-Fi & Bluetooth antenna connection. The RF trace in host PCB connected to the module's RF antenna pin should be microstrip line or other types of RF trace, with the characteristic impedance close to 50 Ω.

It is recommended to reserve a π-type matching circuit for better RF performance. For ANT_WIFI0, you can place the matching components C1, R1 and C2 to antennas as close as possible. Capacitors C1 and C2 are not mounted by default. R1 is mounted with a 0 Ω resistor. C3 is a 33 pF capacitor and D1 is a TVS by default. The reference design of ANT_WIFI1 and ANT_BT is the same.

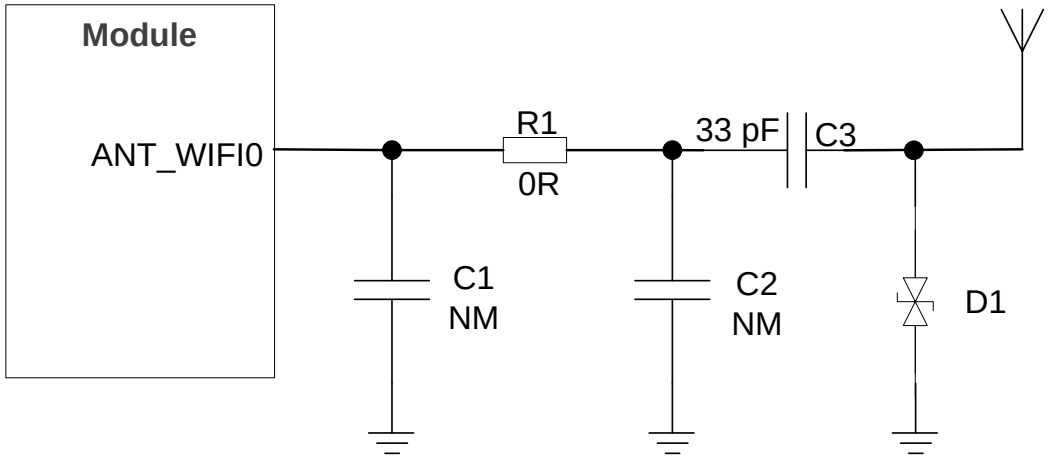



**Figure 13: Reference Design of RF Antenna Interface**

Another type of reference circuit for the RF antenna interface is shown below. It is designed for vehicle applications. It is recommended to reserve two notch filter circuits and a π-type matching circuit for better RF performance. For ANT_WIFI0, L1, C2, C3 and L3 comprise two notch filter circuits for filtering out interference caused by a particular frequency. When L1, C2, C3 and L3 are not mounted, C4, R1 and C1 comprise a π-type matching circuit. Capacitors (C1, C2, C3 and C4) and inductors (L1 and L3) are not mounted by default, and R1 is only mounted with a 0 Ω resistor by default. The reference design of ANT_WIFI1 and ANT_BT is the same.

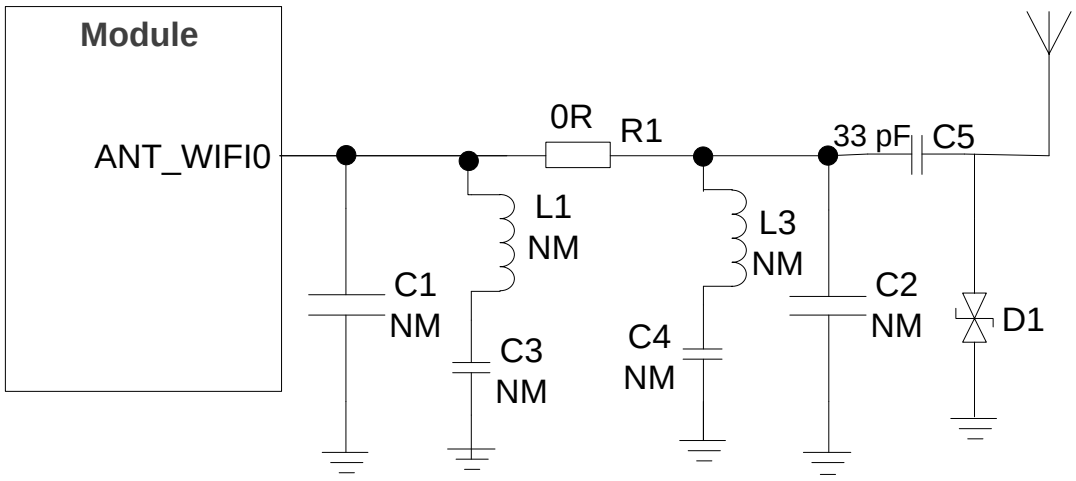



**Figure 14: Reference Design of RF Antenna Interface (Vehicle Applications)**

## 5.2. RF Performance

### 5.2.1. Wi-Fi Performance

#### 5.2.1.1. Transmitting Power

**Table 18: Conducted RF Transmitting Power at 2.4 GHz (Unit: dBm)**

| Standard | Data Rate | Typ. |
|---|---|---|
| 802.11b | 1 Mbps | 17.5±2.5db |
| 802.11b | 11 Mbps | 17.5±2.5db |
| 802.11g | 6 Mbps | 17±2.5db |
| 802.11g | 54 Mbps | 15±2.5db |
| 802.11n (HT20) | MCS 0 | 17±2.5db |
| 802.11n (HT20) | MCS 7 | 13.5±2.5db |
| 802.11n (HT40) | MCS 0 | 16.5±2.5db |
| 802.11n (HT40) | MCS 7 | 12±2.5db |

**Table 19: Conducted RF Transmitting Power at 5 GHz (Unit: dBm)**

| Standard | Data Rate | Typ. |
|---|---|---|
| 802.11a | 6 Mbps | 15.5±2.5db |
| 802.11a | 54 Mbps | 13±2.5db |
| 802.11n (HT20) | MCS 0 | 15.5±2.5db |
| 802.11n (HT20) | MCS 7 | 12.5±2.5db |
| 802.11n (HT40) | MCS 0 | 15±2.5db |
| 802.11n (HT40) | MCS 7 | 12±2.5db |
| 802.11ac (VHT20) | MCS 0 | 15.5±2.5db |
| 802.11ac (VHT20) | MCS 8 | 11.5±2.5db |
| 802.11ac (VHT40) | MCS 0 | 15±2.5db |
| 802.11ac (VHT40) | MCS 9 | 10±2.5db |
| 802.11ac (VHT80) | MCS 0 | 14.5±2.5db |
| 802.11ac (VHT80) | MCS 9 | 9.5±2.5db |

#### 5.2.1.2. Receiver Sensitivity

**Table 20: Conducted RF Receiver Sensitivity at 2.4 GHz (Unit: dBm)**

| Standard | Data Rate | Max. | Typ. |
|---|---|---|---|
| 802.11b | 1 Mbps | -82 | -97 |
| 802.11b | 11 Mbps | -76 | -89 |
| 802.11g | 6 Mbps | -82 | -92.5 |
| 802.11g | 54 Mbps | -65 | -74.5 |
| 802.11n (HT20) | MCS 0 | -82 | -91.5 |
| 802.11n (HT20) | MCS 7 | -64 | -72 |
| 802.11n (HT40) | MCS 0 | -79 | -89 |

| | | | |
|---|---|---|---|
| 802.11n (HT40) | MCS 7 | -61 | -69.5 |

**Table 21: Conducted RF Receiver Sensitivity at 5 GHz (Unit: dBm)**

| Standard | Data Rate | Max. | Typ. |
|---|---|---|---|
| 802.11a | 6 Mbps | -82 | -90 |
| 802.11a | 54 Mbps | -65 | -71.5 |
| 802.11n (HT20) | MCS 0 | -82 | -89 |
| 802.11n (HT20) | MCS 7 | -64 | -70.5 |
| 802.11n (HT40) | MCS 0 | -79 | -86 |
| 802.11n (HT40) | MCS 7 | -61 | -68 |
| 802.11ac (VHT20) | MCS 0 | -82 | -89 |
| 802.11ac (VHT20) | MCS 8 | -59 | -66 |
| 802.11ac (VHT40) | MCS 0 | -79 | -86 |
| 802.11ac (VHT40) | MCS 9 | -54 | -63 |
| 802.11ac (VHT80) | MCS 0 | -76 | -82 |
| 802.11ac (VHT80) | MCS 9 | -51 | -57 |

### 5.2.2. Bluetooth Performance

**Table 22: Bluetooth Transmitting and Receiving Performance**

| Mode | Transmitting Power | Receiver Sensitivity |
|---|---|---|
| BR | 9 ±2.5 dBm | -93 dBm |
| EDR | 4 ±2.5 dBm | -87 dBm |
| BLE | 6 ±2.5 dBm | -96 dBm |

**NOTE**

The data above are tested under Bluetooth power class 1.5.

## 5.3. RF Routing Guidelines

For user's PCB, the characteristic impedance of all RF traces should be controlled to 50 Ω. The impedance of the RF traces is usually determined by the trace width (W), the materials' dielectric constant, the height from the reference ground to the signal layer (H), and the spacing between RF traces and grounds (S). Microstrip or coplanar waveguide is typically used in RF layout to control characteristic impedance. The following are reference designs of microstrip or coplanar waveguide with different PCB structures.

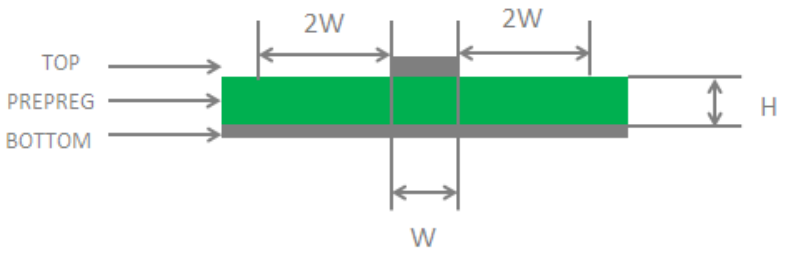



**Figure 15: Microstrip Design on a 2-layer PCB**

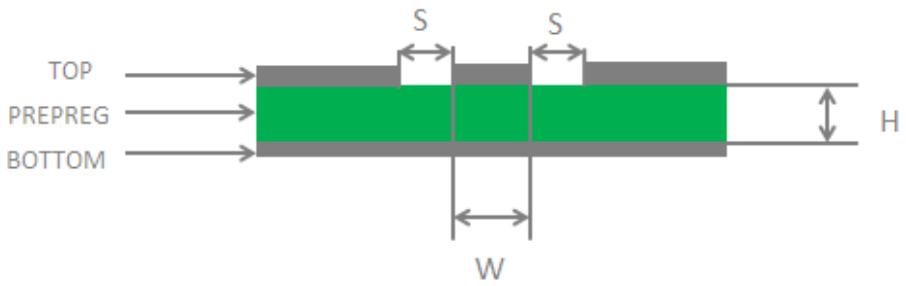



**Figure 16: Coplanar Waveguide Design on a 2-layer PCB**

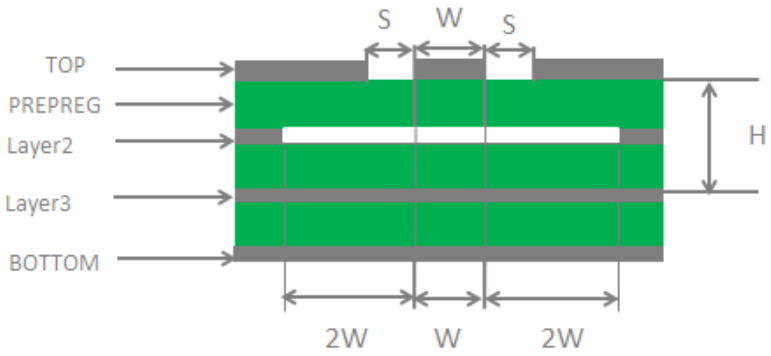



**Figure 17: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)**

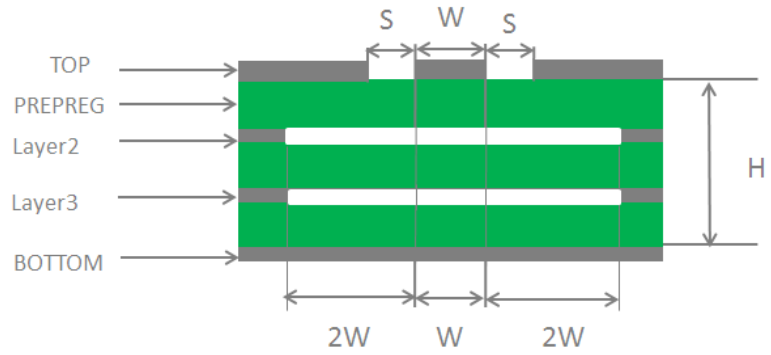



**Figure 18: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)**

To ensure RF performance and reliability, follow the principles below in RF layout design:

- Use an impedance simulation tool to accurately control the characteristic impedance of RF traces to 50 Ω.
- The GND pins adjacent to RF pins should not be designed as thermal relief pads, and should be fully connected to ground.
- The distance between the RF pins and the RF connector should be as short as possible and all the right-angle traces should be changed to curved ones. The recommended trace angle is 135°.
- There should be clearance under the signal pin of the antenna connector or solder joint.
- The reference ground of RF traces should be complete. Meanwhile, adding some ground vias around RF traces and the reference ground could help to improve RF performance. The distance between the ground vias and RF traces should be at least twice the width of RF signal traces (2 × W).
- Keep RF traces away from interference sources, and avoid intersection and paralleling between traces on adjacent layers.

For more details about RF layout, see ***document [2]***.

## 5.4. Requirements for Antenna Design

**Table 23: Antenna Requirements**

| Parameter | Requirements |
|---|---|
| Frequency Range (GHz) | ● GHz Wi-Fi: 2.400–2.4835<br>● GHz Wi-Fi: 5.150–5.850<br>● Bluetooth: 2.402–2.480 |
| Cable Insertion Loss (dB) | < 1 |
| VSWR | ≤ 2 (Typ.) |
| Gain (dBi) | 1 (Typ.) |
| Max. Input Power (W) | 50 |
| Input Impedance (Ω) | 50 |
| Polarization Type | Vertical |

## 5.5. RF Connector Recommendation

If RF connector is used for antenna connection, it is recommended to use the U.FL-R-SMT connector provided by Hirose.

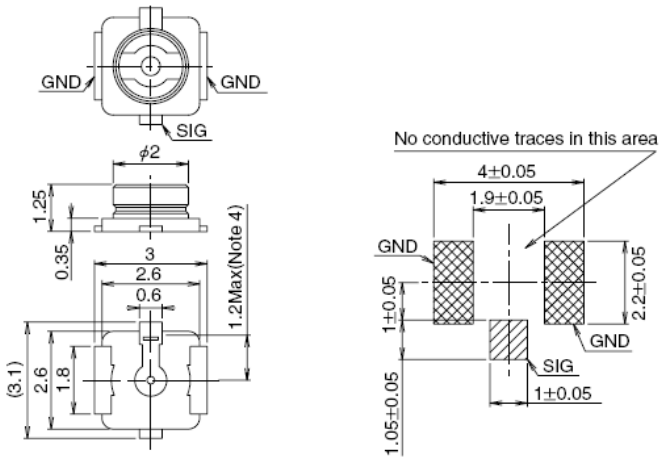



**Figure 19: Dimensions of the Receptacle (Unit: mm)**

U.FL-LP series mated plugs listed in the following figure can be used to match the U.FL-R-SMT connector.

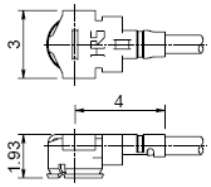
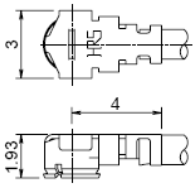
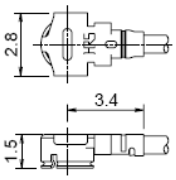
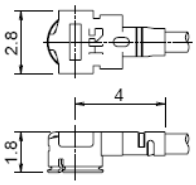
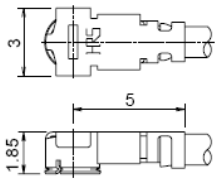
| Part No. | U.FL-LP-040 | U.FL-LP-066 | U.FL-LP(V)-040 | U.FL-LP-062 | U.FL-LP-088 |
|---|---|---|---|---|---|
| |  |  |  |  |  |
| Mated Height | 2.5mm Max.<br>(2.4mm Nom.) | 2.5mm Max.<br>(2.4mm Nom.) | 2.0mm Max.<br>(1.9mm Nom.) | 2.4mm Max.<br>(2.3mm Nom.) | 2.4mm Max.<br>(2.3mm Nom.) |
| Applicable cable | Dia. 0.81mm<br>Coaxial cable | Dia. 1.13mm and<br>Dia. 1.32mm<br>Coaxial cable | Dia. 0.81mm<br>Coaxial cable | Dia. 1mm<br>Coaxial cable | Dia. 1.37mm<br>Coaxial cable |
| Weight (mg) | 53.7 | 59.1 | 34.8 | 45.5 | 71.7 |
| RoHS | YES | | | | |

**Figure 20: Specifications of Mated Plugs**

The following figure describes the space factor of mated connectors.

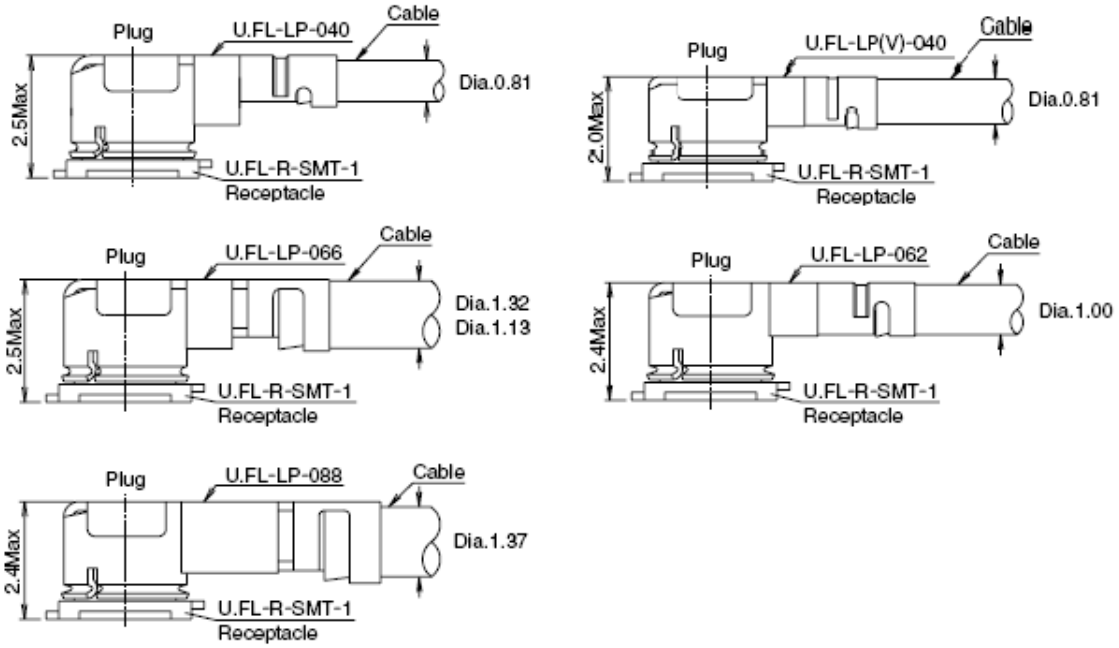



**Figure 21: Space Factor of Mated Connectors (Unit: mm)**

For more details, please visit http://www.hirose.com.

# 6 Electrical Characteristics and Reliability

## 6.1. Absolute Maximum Ratings & Recommended Operating Conditions

**Table 24: Absolute Maximum Ratings (Unit: V)**

| Parameter | Min. | Max. |
|---|---|---|
| VDD_CORE | -0.5 | 1.98 |
| VDD_PA | -0.5 | 2.42 |
| VDD_IO | -0.5 | 3.6 |
| Digital I/O Input Voltage | -0.3 | 2.0 |

**Table 25: Recommended Operating Conditions (Unit: V)**

| Parameter | Min. | Typ. | Max. |
|---|---|---|---|
| VDD_CORE | 1.71 | 1.8 | 1.89 |
| VDD_PA | 2.09 | 2.2 | 2.31 |
| VDD_IO | 1.62 | 1.8 | 1.98 |

## 6.2. Power Consumption

**Table 26: Wi-Fi Power Consumption of the Module (Normal Operation Mode; Unit: mA)**

| Standard | Condition | $I_{VDD\_CORE}$ | $I_{VDD\_IO}$ | $I_{VDD\_PA}$ |
|---|---|---|---|---|
| 802.11b | Tx 1 Mbps | 280 | 5.6 | 455 |
| | Tx 11 Mbps | 290 | 5.6 | 460 |
| 802.11g | Tx 6 Mbps | 303 | 5.7 | 455 |
| | Tx 54 Mbps | 327 | 5.8 | 420 |
| 802.11n (2.4 GHz) | Tx HT20 @ MCS 0 | 305 | 5.8 | 440 |
| | Tx HT20 @ MCS 7 | 320 | 5.8 | 390 |
| | Tx HT40 @ MCS 0 | 317 | 5.8 | 450 |
| | Tx HT40 @ MCS 7 | 317 | 5.6 | 375 |
| 802.11a | Tx 6 Mbps | 325 | 5.9 | 515 |
| | Tx 54 Mbps | 338 | 5.9 | 456 |
| 802.11n (5 GHz) | Tx HT20 @ MCS 0 | 327 | 5.9 | 516 |
| | Tx HT20 @ MCS 7 | 343 | 6.0 | 458 |
| | Tx HT40 @ MCS 0 | 358 | 6.0 | 498 |
| | Tx HT40 @ MCS 7 | 348 | 5.8 | 433 |
| 802.11ac | Tx VHT20 @ MCS 0 | 326 | 5.9 | 498 |
| | Tx VHT20 @ MCS 8 | 345 | 5.9 | 438 |
| | Tx VHT40 @ MCS 0 | 357 | 6.0 | 497 |
| | Tx VHT40 @ MCS 9 | 348 | 5.9 | 408 |
| | Tx VHT80 @ MCS 0 | 410 | 6.1 | 462 |
| | Tx VHT80 @ MCS 9 | 348 | 5.8 | 400 |

## 6.3. Digital I/O Characteristics

**Table 27: VDD_IO I/O Requirements**

| Parameter | Description | Min. | Max. | Unit |
|---|---|---|---|---|
| $V_{IH}$ | High-level input voltage | 0.65 × VDD_IO | VDD_IO + 0.3 | V |
| $V_{IL}$ | Low-level input voltage | -0.3 | 0.35 × VDD_IO | V |
| $V_{OH}$ | High-level output voltage | VDD_IO - 0.45 | VDD_IO | V |
| $V_{OL}$ | Low-level output voltage | 0 | 0.45 | V |

## 6.4. ESD Protection

Static electricity occurs naturally and it may damage the module. Therefore, applying proper ESD countermeasures and handling methods is imperative. For example, wear anti-static gloves during the development, production, assembly and testing of the module; add ESD protection components to the ESD sensitive interfaces and points in the product design.

**Table 28: ESD Characteristics (Temperature: 25–30 °C, Humidity: 40 % ±5 %; Unit: kV)**

| Test Interfaces | Contact Discharge | Air Discharge |
|---|---|---|
| VDD, GND | ±8 | ±12 |
| Antenna interfaces | ±6 | ±10 |
| Other Interfaces | ±6 | ±10 |

## 6.5. Operating and Storage Temperatures

**Table 29: Operating and Storage Temperatures (Unit: °C)**

| Parameter | Min. | Typ. | Max. |
|---|---|---|---|
| Normal Operating Temperature [2] | -40 | +25 | +85 |
| Storage Temperature | -40 | - | +90 |

[2] Within this temperature range, the module's related performance meets IEEE and Bluetooth specifications.

# 7 Mechanical Information

This chapter describes the mechanical dimensions of the module. All dimensions are measured in millimeter (mm), and the dimensional tolerances are ±0.2 mm unless otherwise specified.

## 7.1. Mechanical Dimensions

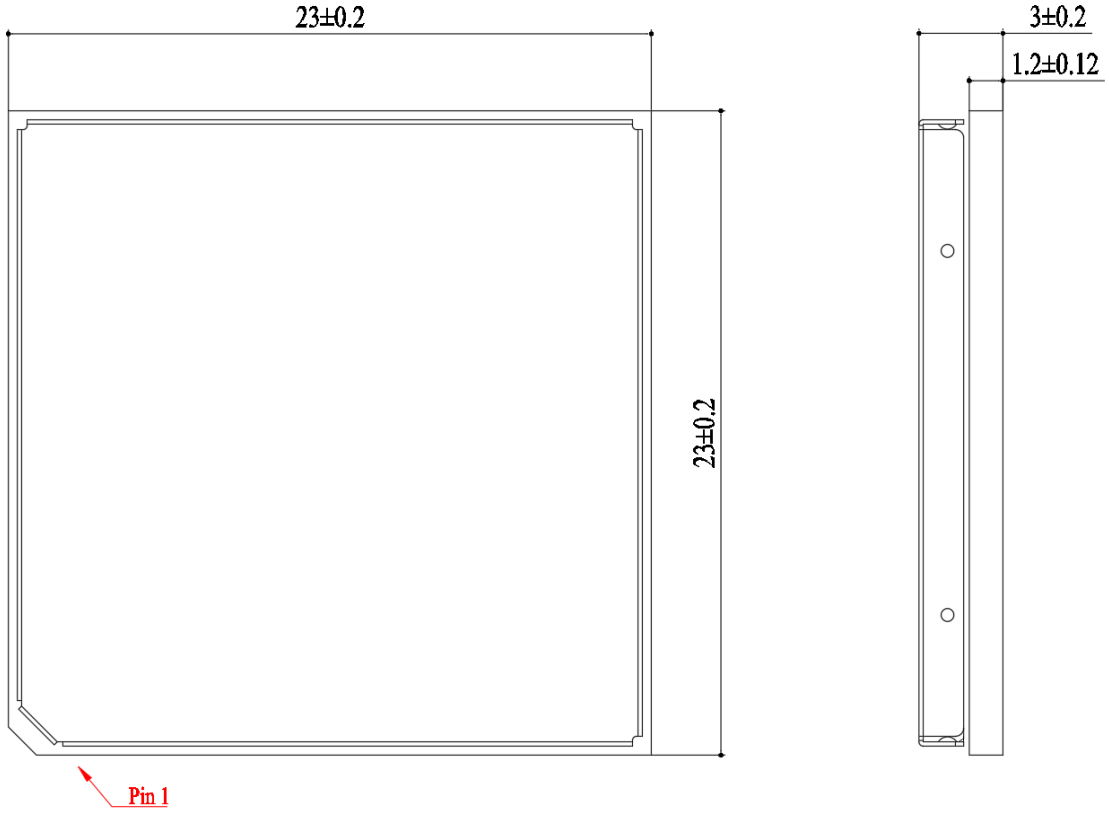



**Figure 22: Top and Side Dimensions**

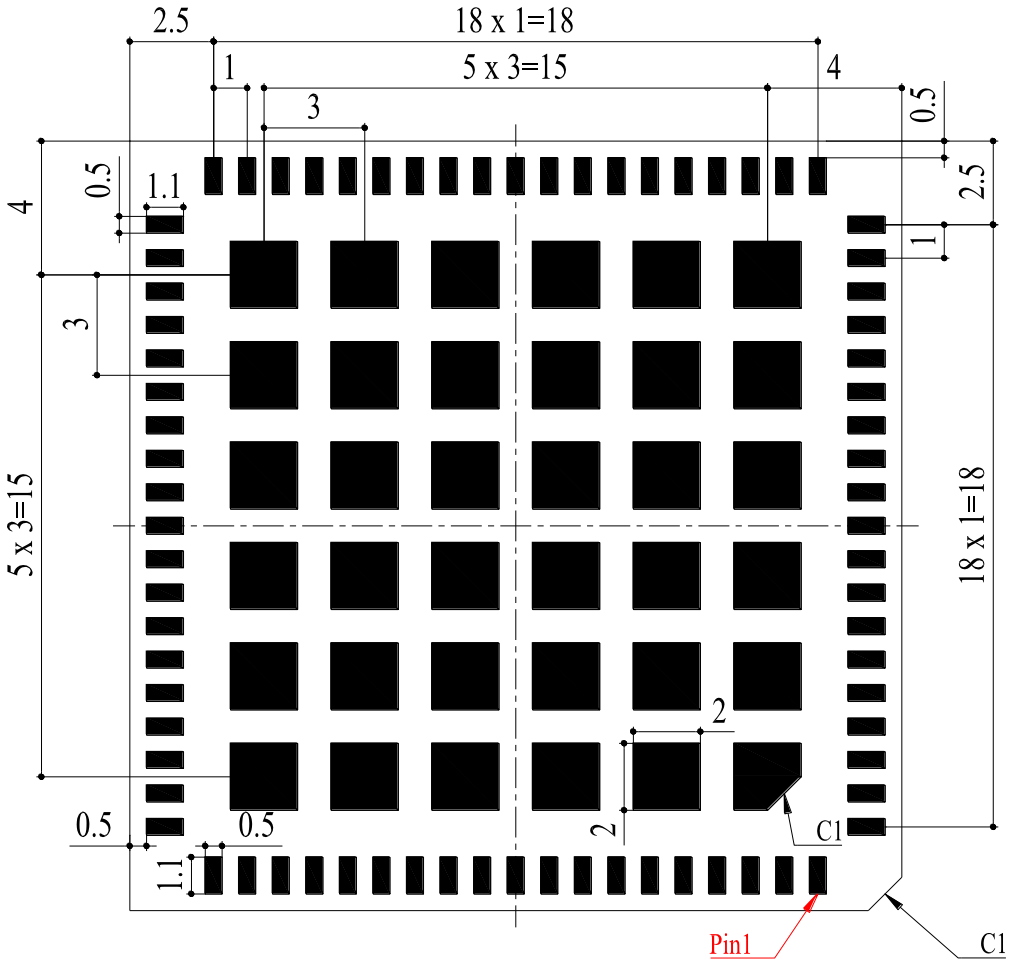



**Figure 23: Bottom Dimensions (Bottom View)**

**NOTE**

1. The package warpage level of the module conforms to the *JEITA ED-7306* standard.
2. Keep at least 3 mm between the module and other components on the motherboard to improve soldering quality and maintenance convenience.

## 7.2. Recommended Footprint

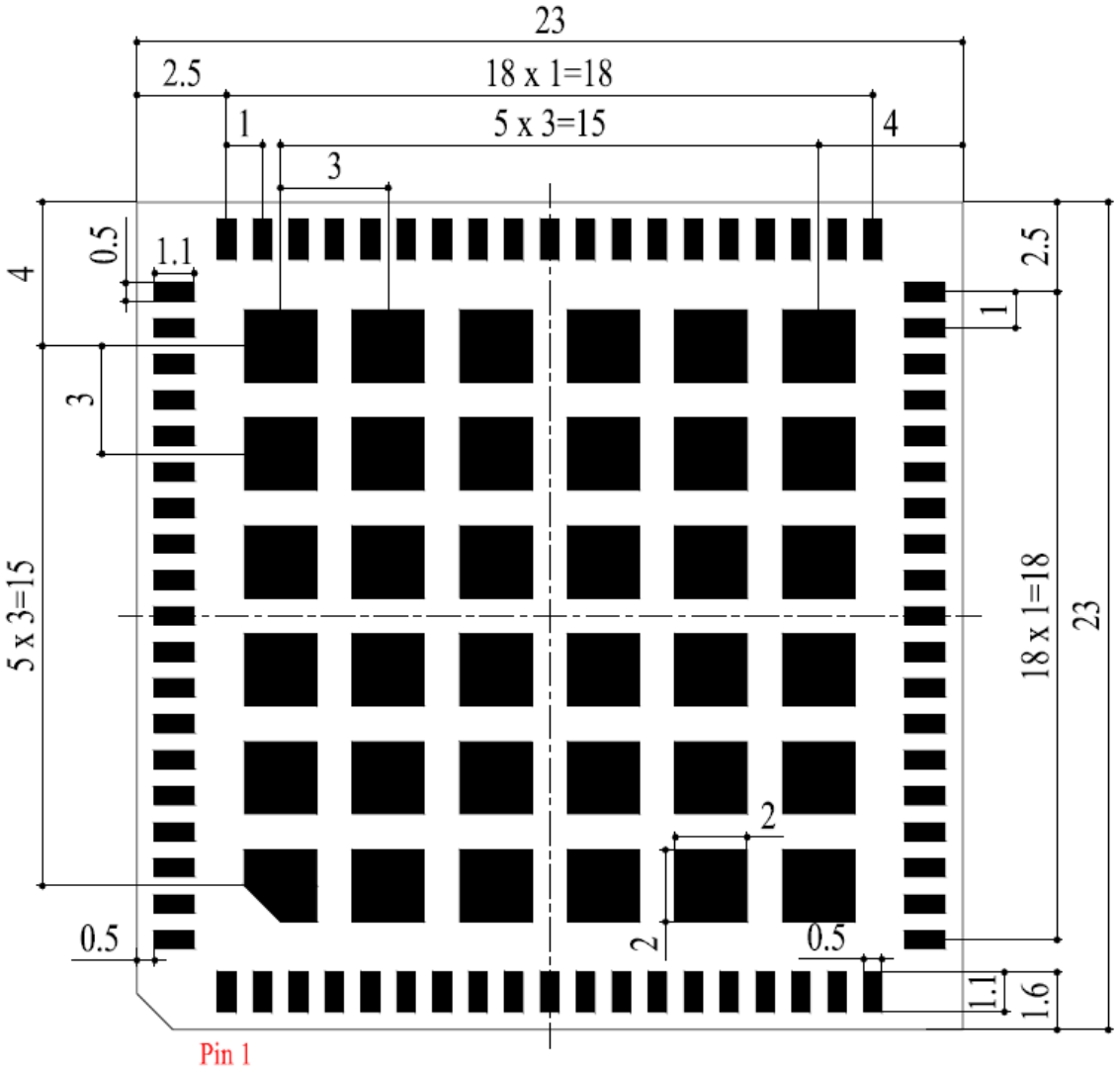



**Figure 24: Recommended Footprint**

**NOTE**

Keep at least 3 mm between the module and other components on the motherboard to improve soldering quality and maintenance convenience.

## 7.3. Top and Bottom Views

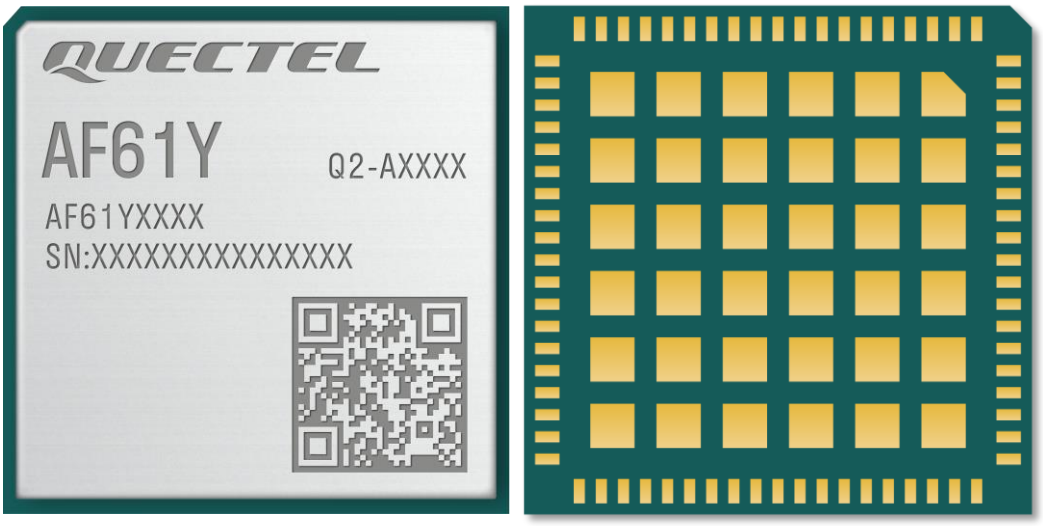



**Figure 25: Top and Bottom Views of the Module**

**NOTE**

Images above are for illustration purpose only and may differ from the actual module. For authentic appearance and label, please refer to the module received from Quectel.

# 8 Storage, Manufacturing & Packaging

## 8.1. Storage Conditions

The module is provided with vacuum-sealed packaging. MSL of the module is rated as 3. The storage requirements are shown below.

1. Recommended storage condition: the temperature should be 23 ±5 °C and the relative humidity should be 35–60 %.

2. Shelf life (in a vacuum-sealed packaging): 12 months in recommended storage condition.

3. Floor life: 168 hours [3] in a factory where the temperature is 23 ±5 °C and relative humidity is below 60 %. After the vacuum-sealed packaging is removed, the module must be processed in reflow soldering or other high-temperature operations within 168 hours. Otherwise, the module should be stored in an environment where the relative humidity is less than 10 % (e.g., a dry cabinet).

4. The module should be pre-baked to avoid blistering, cracks and inner-layer separation in PCB under the following circumstances:

   - The module is not stored in recommended storage condition;
   - Violation of the third requirement mentioned above;
   - Vacuum-sealed packaging is broken, or the packaging has been removed for over 24 hours.

5. If needed, the pre-baking should follow the requirements below:

   - The module should be baked for 8 hours at 120 ±5 °C;
   - The module must be soldered to PCB within 24 hours after the baking, otherwise it should be put in a dry environment such as in a dry cabinet.

[3] This floor life is only applicable when the environment conforms to *IPC/JEDEC J-STD-033*. It is recommended to start the solder reflow process within 24 hours after the package is removed if the temperature and moisture do not conform to, or are not sure to conform to *IPC/JEDEC J-STD-033*. And do not unpack the modules in large quantities until they are ready for soldering.

**NOTE**

1. To avoid blistering, layer separation and other soldering issues, extended exposure of the module to the air is forbidden.
2. Take out the module from the package and put it on high-temperature-resistant fixtures before baking. If shorter baking time is desired, see *IPC/JEDEC J-STD-033* for the baking procedure.
3. Pay attention to ESD protection, such as wearing anti-static gloves, when touching the modules.

## 8.2. Manufacturing and Soldering

Push the squeegee to apply the solder paste on the surface of stencil, thus making the paste fill the stencil openings and then penetrate to the PCB. Apply proper force on the squeegee to produce a clean stencil surface on a single pass. To guarantee module soldering quality, the thickness of stencil for the module is recommended to be 0.13–0.15 mm. For more details, see ***document [3]***.

The recommended peak reflow temperature should be 235–246 ºC, with 246 ºC as the absolute maximum reflow temperature. To avoid damage to the module caused by repeated heating, it is recommended that the module should be mounted only after reflow soldering for the other side of PCB has been completed. The recommended reflow soldering thermal profile (lead-free reflow soldering) and related parameters are shown below:

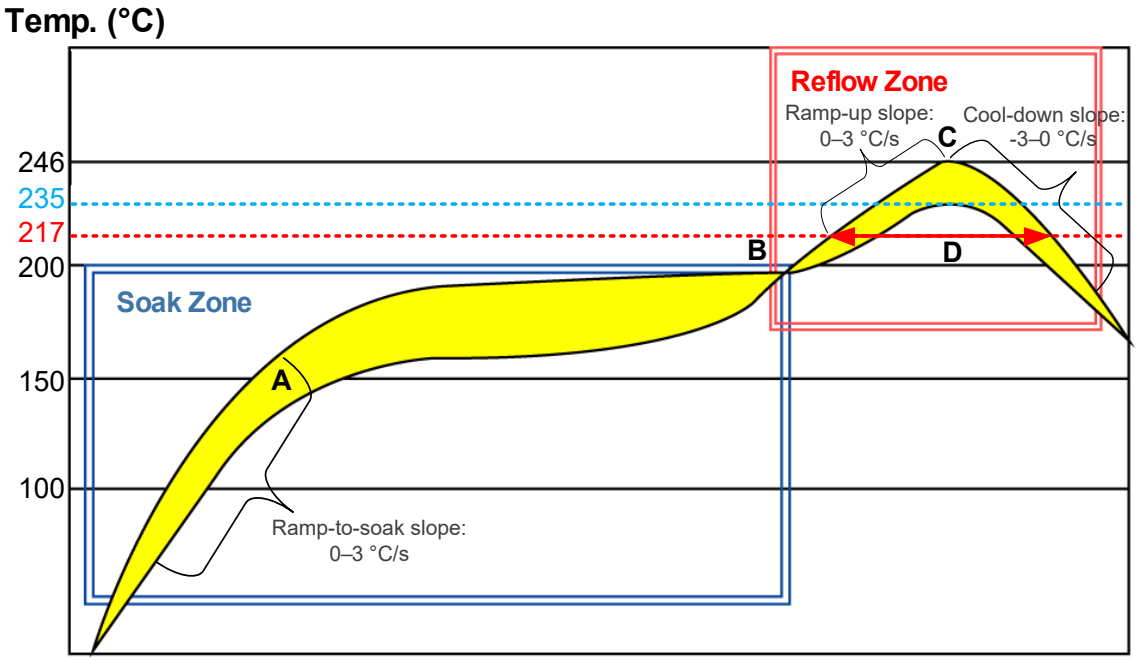



**Figure 26: Recommended Reflow Soldering Thermal Profile**

**Table 30: Recommended Thermal Profile Parameters**

| Factor | Recommended Value |
|---|---|
| **Soak Zone** | |
| Ramp-to-soak slope | 0–3 °C/s |
| Soak time (between A and B: 150 °C and 200 °C) | 70–120 s |
| **Reflow Zone** | |
| Ramp-up slope | 0–3 °C/s |
| Reflow time (D: over 217 °C) | 40–70 s |
| Max. temperature | 235–246 °C |
| Cool-down slope | -3–0 °C/s |
| **Reflow Cycle** | |
| Max. reflow cycle | 1 |

**NOTE**

1. The above profile parameter requirements are for the measured temperature of the solder joints. Both the hottest and coldest spots of solder joints on the PCB should meet the above requirements.
2. During manufacturing and soldering, or any other processes that may contact the module directly, NEVER wipe the module's shielding can with organic solvents, such as acetone, ethyl alcohol, isopropyl alcohol, trichloroethylene, etc. Otherwise, the shielding can may become rusted.
3. The shielding can for the module is made of Cupro-Nickel base material. It is tested that after 12 hours' Neutral Salt Spray test, the laser engraved label information on the shielding can is still clearly identifiable and the QR code is still readable, although white rust may be found.
4. If a conformal coating is necessary for the module, do not use any coating material that may chemically react with the PCB or shielding cover, and prevent the coating material from flowing into the module.
5. Avoid using ultrasonic technology for module cleaning since it can damage crystals inside the module.
6. Due to the complexity of the SMT process, contact Quectel Technical Support in advance for any situation that you are not sure about, or any process (e.g. selective wave soldering, ultrasonic soldering) that is not mentioned in ***document [3]***.

## 8.3. Packaging Specifications

This chapter outlines the key packaging parameters and processes. All figures below are for reference purposes only, as the actual appearance and structure of packaging materials may vary in delivery.

The modules are packed in a tape and reel packaging as specified in the sub-chapters below.

### 8.3.1. Carrier Tape

Carrier tape dimensions are illustrated in the following figure and table:

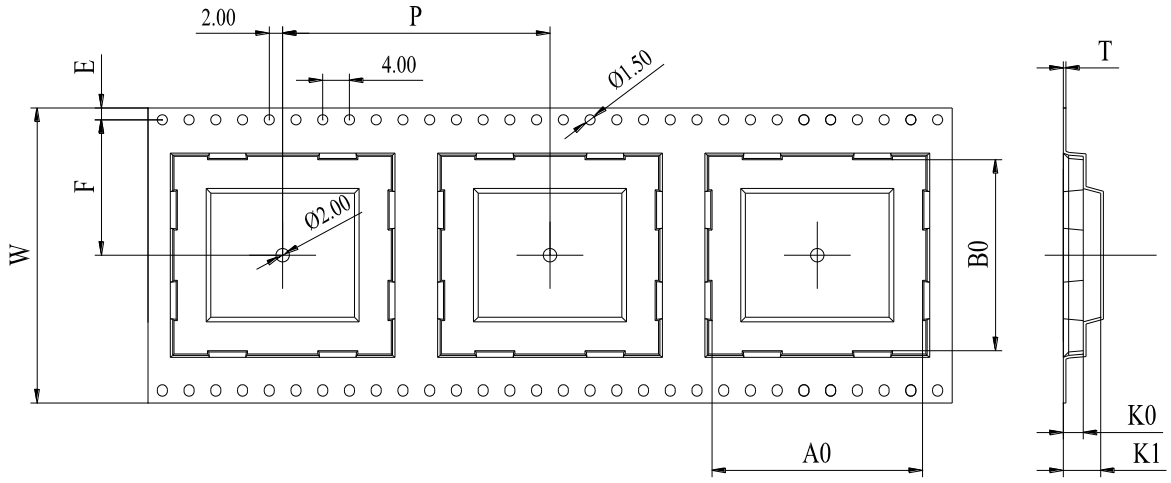



**Figure 27: Carrier Tape Dimension Drawing**

**Table 31: Carrier Tape Dimension Table (Unit: mm)**

| W | P | T | A0 | B0 | K0 | K1 | F | E |
|---|---|---|---|---|---|---|---|---|
| 44 | 32 | 0.4 | 23.5 | 23.5 | 3.5 | 6.8 | 20.2 | 1.75 |

### 8.3.2. Plastic Reel

Plastic reel dimensions are illustrated in the following figure and table:

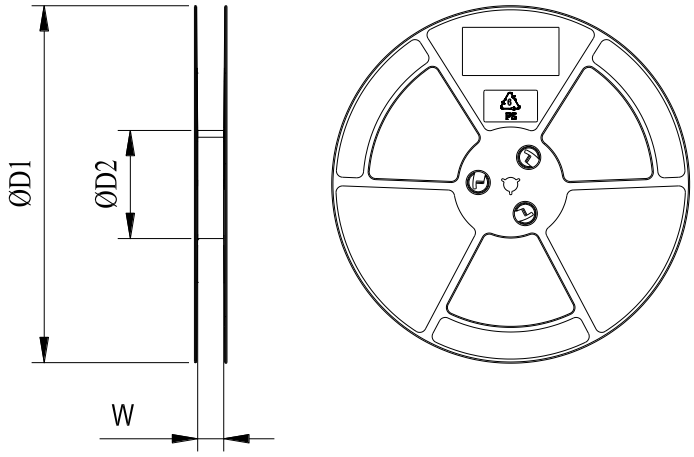



**Figure 28: Plastic Reel Dimension Drawing**

**Table 32: Plastic Reel Dimension Table (Unit: mm)**

| øD1 | øD2 | W |
|---|---|---|
| 330 | 100 | 44.5 |

### 8.3.3. Mounting Direction

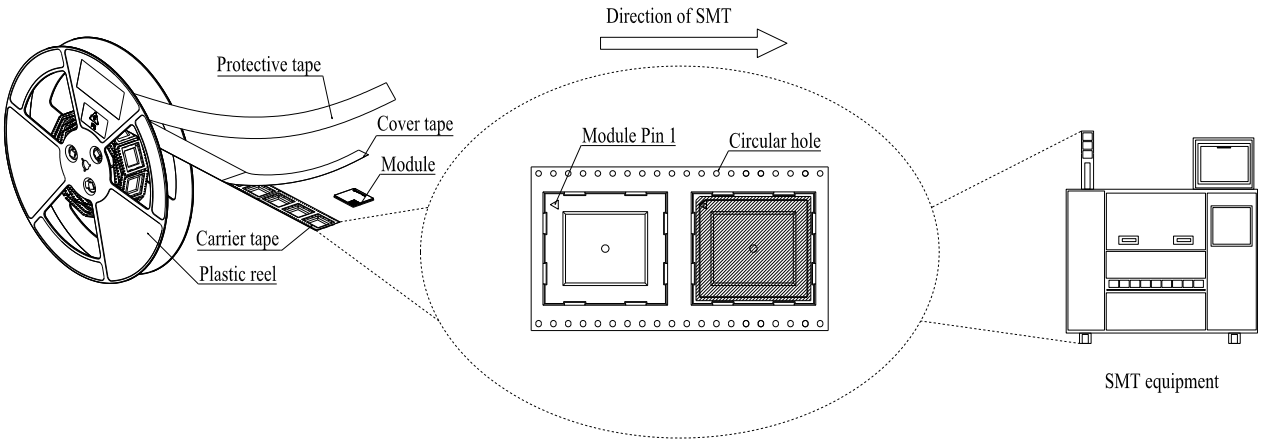
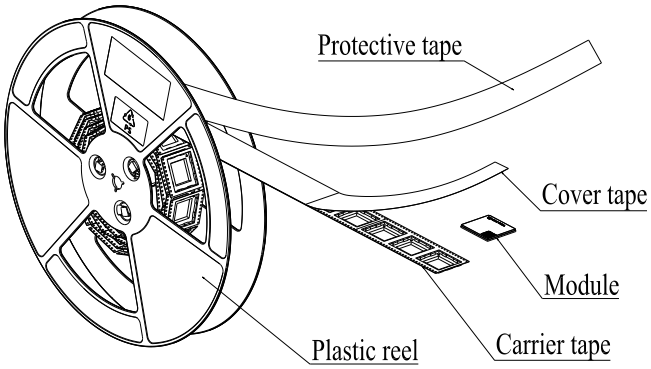


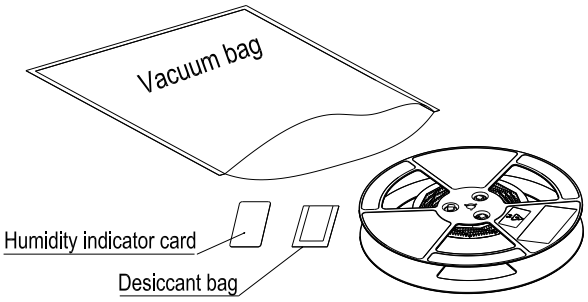

**Figure 29: Mounting Direction**

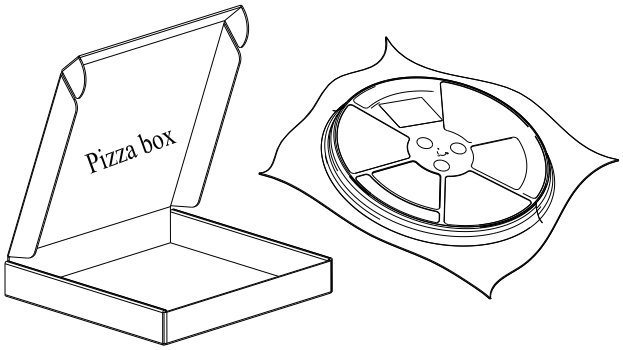
### 8.3.4. Packaging Process




Place the module onto the carrier tape and use the cover tape to cover them securely with cover tape. Wind the heat-sealed carrier tape onto a plastic reel and apply a protective tape for additional protection. 1 plastic reel can load 250 modules.

Place the packaged plastic reel, humidity indicator card and desiccant bag into a vacuum bag, and vacuumize it.




Place the vacuum-packed plastic reel into the pizza box.

Put 4 packaged pizza boxes into 1 carton box and seal it. 1 carton box can pack 1000 modules.

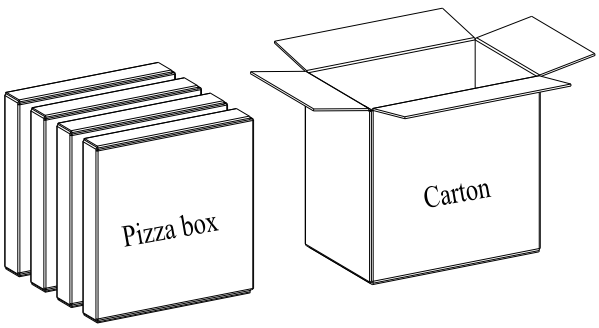



**Figure 30: Packaging Process**

# 9 Appendix References

**Table 33: Related Documents**

| Document Name |
|---|
| [1] Quectel_V2X&5G_EVB_User_Guide |
| [2] Quectel_RF_Layout_Application_Note |
| [3] Quectel_Module_SMT_User_Guide |

**Table 34: Terms and Abbreviations**

| Abbreviation | Description |
|---|---|
| AP | Access Point |
| BLE | Bluetooth Low Energy |
| BPSK | Binary Phase Shift Keying |
| BR | Basic Rate |
| CCK | Complementary Code Keying |
| CTS | Clear To Send |
| DCE | Data Communications Equipment |
| DPSK | Differential Phase Shift Keying |
| DQPSK | Differential Quadrature Reference Phase Shift Keying |
| DTE | Data Terminal Equipment |
| EDR | Enhanced Data Rate |
| ESD | Electrostatic Discharge |

| | |
|---|---|
| EVB | Evaluation Board |
| GATT | Generic Attribute Profile |
| GFSK | Gaussian Frequency Shift Keying |
| GND | Ground |
| HFP | Hands-free Profile |
| HT | High Throughput |
| IEEE | Institute of Electrical and Electronics Engineers |
| I/O | Input/Output |
| LGA | Land Grid Array |
| LTE | Long Term Evolution |
| Mbps | Megabits per second |
| MCS | Modulation and Coding Scheme |
| MSL | Moisture Sensitivity Levels |
| PA | Power Amplifier |
| PCB | Printed Circuit Board |
| PCIe | Peripheral Component Interconnect Express |
| PCM | Pulse Code Modulation |
| QAM | Quadrature Amplitude Modulation |
| QPSK | Quadrature Phase Shift Keying |
| RF | Radio Frequency |
| RoHS | Restriction of Hazardous Substances |
| RTS | Request To Send |
| Rx | Receive |
| RXD | Receive Data (Pin) |
| SMD | Surface Mount Device |

| | |
|---|---|
| SMT | Surface Mount Technology |
| STA | Station |
| TBD | To Be Determined |
| Tx | Transmit |
| TXD | Transmit Data (Pin) |
| UART | Universal Asynchronous Receiver/Transmitter |
| VHT | Very High Throughput |
| Vmax | Maximum Voltage |
| Vnom | Nominal Voltage |
| Vmin | Minimum Voltage |
| VSWR | Voltage Standing Wave Ratio |
| WLAN | Wireless Local Area Network |

**CE**

Hereby, [Quectel Wireless Solutions Co., Ltd.] declares that the radio equipment type [AF61Y] is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address: http://www.quectel.com/support/technical.htm

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

The device is restricted to indoor use only when operating in the 5250-5350 MHz frequency range.

| | | | | | | |
|---|---|---|---|---|---|---|
| AT | BE | BG | HR | CY | CZ | DK |
| EE | FI | FR | DE | EL | HU | IE |
| IT | LV | LT | LU | MT | NL | PL |
| PT | RO | SK | SI | ES | SE | UK(NI) |

**Disposal of old electrical appliances**

The European directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE), requires that old household electrical appliances must not be disposed of in the normal unsorted municipal waste stream. Old appliances must be collected separately in order to optimize the recovery and recycling of the materials they contain, and reduce the impact on human health and the environment.

The crossed out "wheeled bin" symbol on the product reminds you of your obligation, that when you dispose of the appliance, it must be separately collected.

Consumers should contact their local authority or retailer for information concerning the correct disposal of their old appliance.

**FCC ID: XMR2024AF61Y**

# OEM/Integrators Installation Manual

## Important Notice to OEM integrators

1. This module is limited to OEM installation ONLY.
2. This module is limited to installation in mobile or fixed applications, according to Part 2.1091(b).
3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations
4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part
15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s).
The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed.

## Important Note

notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify to XXXX that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the USI, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

## End Product Labeling

When the module is installed in the host device, the FCC/IC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: “Contains FCC ID: XMR2024AF61Y”
“Contains IC: 10224A-2024AF61Y “
The FCC ID/IC ID can be used only when all FCC/IC compliance requirements are met.

## Antenna Installation

(1) The antenna must be installed such that 20 cm is maintained between the antenna and users,
(2) The transmitter module may not be co-located with any other transmitter or antenna.
(3) Only antennas of the same type and with equal or less gains as shown below may be used with this module. Other types of antennas and/or higher gain antennas may require additional authorization for operation.

| Antenna type | 2.4GHz band<br>Peak Gain (dBi) | 5GHz band<br>Peak Gain (dBi) | 5.8GHz band<br>Peak Gain (dBi) |
|---|---|---|---|
| Dipole | -0.1 | -0.3 | 0.4 |

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC/IC authorization is no longer considered valid and the FCC ID/IC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC/IC authorization.

## Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

## Federal Communication Commission Interference Statement

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.
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

## List of applicable FCC rules

This module has been tested and found to comply with part 15.247 and 15.407 requirements for Modular Approval.
The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC

rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

## This device is intended only for OEM integrators under the following conditions: (For module device use)

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna.
As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

## Radiation Exposure Statement

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

**IC: 10224A-2024AF61Y**

## Industry Canada Statement

This device complies with Industry Canada's licence-exempt RSSs. 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.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
(1) l'appareil ne doit pas produire de brouillage, et
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

## Radiation Exposure Statement

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

## Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

## RSS-247 Section 6.4 (5) (6) (for local area network devices, 5GHz)

The device could automatically discontinue transmission in case of absence of information to transmit, or operational failure. Note that this is not intended to prohibit transmission of control or signaling information or the use of repetitive codes where required by the technology.

The device for operation in the band 5150–5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems;
The maximum antenna gain permitted for devices in the bands 5250–5350 MHz and 5470–5725 MHz shall comply with the e.i.r.p. limit; and
The maximum antenna gain permitted for devices in the band 5725–5825 MHz shall comply with the e.i.r.p. limits specified for point-to-point and non point-to-point operation as appropriate.

L'appareil peut interrompre automatiquement la transmission en cas d'absence d'informations à transmettre ou de panne opérationnelle. Notez que ceci n'est pas destiné à interdire la transmission d'informations de contrôle ou de signalisation ou l'utilisation de codes répétitifs lorsque cela est requis par

la technologie.

Le dispositif utilisé dans la bande 5150-5250 MHz est réservé à une utilisation en intérieur afin de réduire le risque de brouillage préjudiciable aux systèmes mobiles par satellite dans le même canal;
Le gain d'antenne maximal autorisé pour les dispositifs dans les bandes 5250-5350 MHz et 5470-5725 MHz doit être conforme à la norme e.r.p. limite; et
Le gain d'antenne maximal autorisé pour les appareils de la bande 5725-5825 MHz doit être conforme à la norme e.i.r.p. les limites spécifiées pour un fonctionnement point à point et non point à point, selon le cas.

## This device is intended only for OEM integrators under the following conditions: (For module device use)

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna.
As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

## Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

## IMPORTANT NOTE:

In the event that these conditions cannot be met (for example certain laptop configurations or colocation with another transmitter), then the Canada authorization is no longer considered valid and the IC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

## NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada

n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

## End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains IC: 10224A-2024AF61Y”.

## Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 10224A-2024AF61Y".

## Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user’s manual of the end product which integrates this module.
The end user manual shall include all required regulatory information/warning as show in this manual.

## Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.
Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.