

MAYA-W3 series

Host-based multiradio modules with Wi-Fi 6/6E and Bluetooth 5.4

System integration manual



Abstract

Targeted towards hardware and software application engineers, this document describes how to integrate MAYA-W3 modules in application products and explains the hardware design-in, software, component handling, regulatory compliance, and testing of the modules. It also lists the external antennas approved for use with the module. Designed for a wide range of industrial applications, this range of ultra-compact, cost-efficient, host-based, multiradio modules includes product variants that are supplied with or without internal antenna. Integrated with a MAC/Baseband processor and RF front end components, MAYA-W3 modules connect to a host processor through various interfaces, including SDIO / GSPI for Wi-Fi, High-Speed UART for Bluetooth.

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This document applies to the following products:

Product name	Type number	Chipset	PCN reference	Product status
MAYA-W380	MAYA-W380-00B-00	CYW55513	N/A	Functional sample
MAYA-W381	MAYA-W381-00B-00	CYW55513	N/A	Initial production
MAYA-W382	MAYA-W382-00B-00	CYW55513	N/A	Initial production
MAYA-W383	MAYA-W383-00B-00	CYW55513	N/A	Initial production
MAYA-W386	MAYA-W386-00B-00	CYW55513	N/A	Initial production
MAYA-W361	MAYA-W361-00B-00	CYW55512	N/A	Initial production
MAYA-W362	MAYA-W362-00B-00	CYW55512	N/A	Initial production
MAYA-W363	MAYA-W363-00B-00	CYW55512	N/A	Initial production
MAYA-W366	MAYA-W366-00B-00	CYW55512	N/A	Initial production
MAYA-W331	MAYA-W331-00B-00	CYW55511	N/A	Initial production
MAYA-W330	MAYA-W330-00B-00	CYW55511	N/A	Functional sample
MAYA-W332	MAYA-W332-00B-00	CYW55511	N/A	Initial production
MAYA-W333	MAYA-W333-00B-00	CYW55511	N/A	Initial production
MAYA-W336	MAYA-W336-00B-00	CYW55511	N/A	Initial production

 For information about the related hardware, software, and status of listed product types, see also the respective data sheets [\[1\]](#).

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1 System description

1.1 Overview

The MAYA-W3 series comprises ultra-compact multiradio modules with Wi-Fi 6/6E and Bluetooth 5.4, including variants with or without an on-board antenna. The MAYA-W3 series supports IEEE 802.11a/b/g/n/ac/ax Wi-Fi standards with tri-band 2.4/5/6 GHz and 20 MHz channel width, supporting PHY data rates up to 802.11ax MCS11 (1024-QAM 5/6). The modules can work as a station with different types of access-points, as a simple access-point, in P2P communication, or as a combination of these. MAYA-W3 supports both Bluetooth BR/EDR and Bluetooth Low Energy 5.4, including long-range PHY and isochronous channels for LE audio.

MAYA-W3 series supports an optional LTE filter and is available with different antenna options, including variants with U.FL connector, antenna pins, or an on-board antenna. The module comes with RF calibration and MAC addresses available in the integrated OTP memory.

The modules are developed for reliable, high-demanding, industrial devices and applications that demand high performance.

Radio type approvals for Europe (RED), the United States (FCC), Canada (ISED), and other country certifications (China, Japan, Taiwan, Brazil) are planned.

1.2 Module architecture

MAYA-W3 includes the Infineon CYW55513/2/1 System-On-Chip (SoC) with fully integrated power management circuitry that provides power to the internal voltage domains of the SoC, integrated MAC/baseband processor, transceivers for Wi-Fi 2.4 GHz, 5 GHz, and 6 GHz (depending on chipset variant) and Bluetooth long range 5.4. MAYA-W3 also includes discrete RF components for configuring the antenna interface enabling the antenna path connections as shown in the MAYA-W3 series data sheet [\[1\]](#).

For host CPU connectivity, the Secure Digital Input Output (SDIO) 3.0 interface is used for Wi-Fi communication and firmware downloads, and the Universal Asynchronous Receiver Transmitter (UART) interface is used for Bluetooth communication. The host interface configuration is selected through [Configuration pins](#).

A PCM/I2S interface provides connection to optional external audio codec and external audio system for Bluetooth voice applications.

The module includes internal coexistence interface that enable the coexistence of Wi-Fi and Bluetooth. An interface for coexistence with external radios is also available.

MAYA-W3 is available in module variants with different RF architecture and antenna connection type, including variants with two U.FL connectors or pins for connecting external antennas, variants with a single shared antenna pin for Wi-Fi and Bluetooth, and variants with a single RF antenna pin and antenna feed pin to an on-board antenna. See the MAYA-W3 series data sheet [\[1\]](#) for the list of available module variants.

2 Module integration

MAYA-W3 is designed for integration into the application product together with a Host CPU system. [Figure 1](#) shows a typical integration.

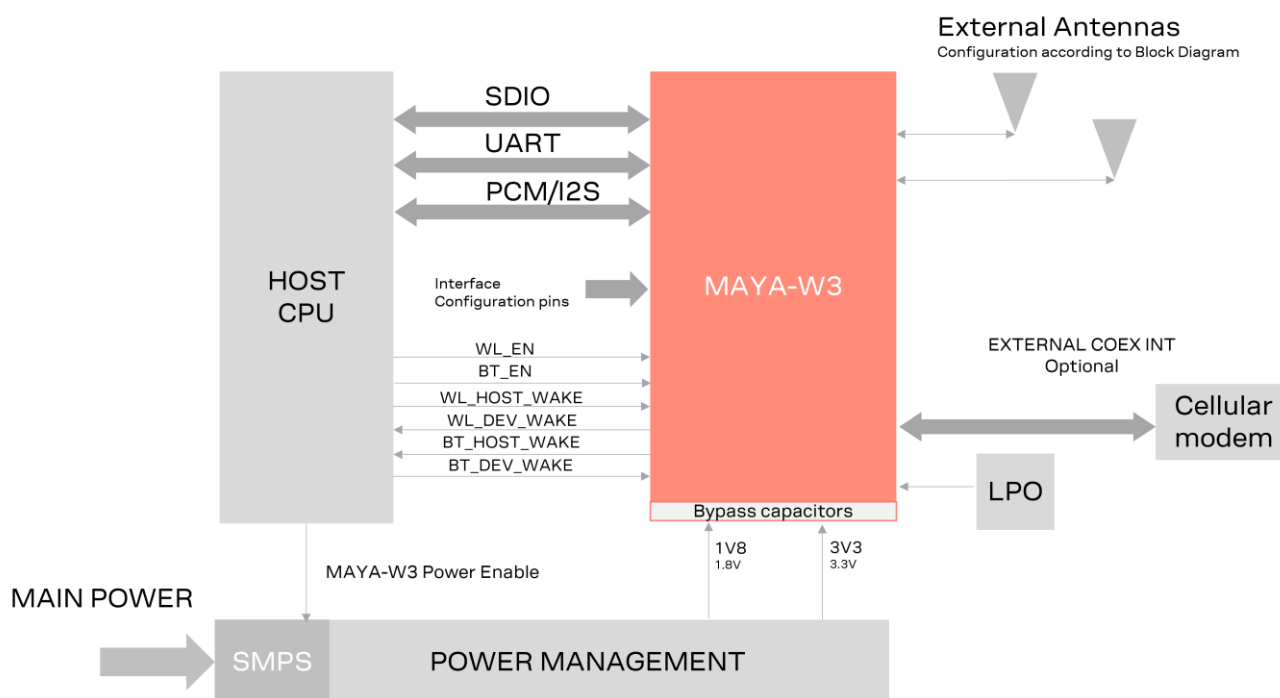


Figure 1. MAYA-W3 integration in host system

- The SDIO provides the main interface for Wi-Fi data and downloading firmware.
- The UART interface is used for Bluetooth data and firmware download.
- The preferred data and communication interface between Host CPU and MAYA-W3 is set according to the instructions for [Configuration pins](#).
- Control signals for power down, reset, and host and module wake-up are available to control MAYA-W3 from host CPU.
- The module is power supplied through the **3V3**, and **1V8** pins.
- MAYA-W3x0 have two U.FL connectors for simultaneous 2.4/5/6 GHz Wi-Fi and Bluetooth.
- MAYA-W3x1 have two RF pins for simultaneous 2.4/5/6 GHz Wi-Fi and Bluetooth.
- MAYA-W3x3 have a single antenna pin for shared 2.4/5/6 GHz Wi-Fi and Bluetooth.
- MAYA-W3x6 include a single antenna pin that shall be connected to the integrated antenna.
- An advanced antenna arbitration algorithm is used to support antenna sharing on the single antenna variants. In this configuration Bluetooth TX is time multiplexed with Wi-Fi 2.4 GHz TX and a shared LNA is used on the RX path. Wi-Fi 5/6 GHz and Bluetooth work simultaneously.
- The dual antenna MAYA-W3x0 or MAYA-W3x1 are recommended for applications with simultaneous Bluetooth and Wi-Fi 2.4 GHz operation using dedicated LNAs .
- For correct operation, it is important to correctly configure MAYA-W3 with the settings and start-up sequences described. This configuration puts requirements for enabling the timing of power sources and the assertion of **WL_EN** and **BT_EN**.
- MAYA-W3 includes a PCM/I2S interface that can be used to connect a codec for Bluetooth audio. If the interface is not used, it can be omitted.

2.1 Power supply interface

MAYA-W3 series power supply pins **3V3** and **1V8** pins must be sourced by a regulated DC power supply, such as an LDO or SMPS. The appropriate type for your design depends on the main power source of the application.

Pin	Name	I/O	Description	Remarks
A7, B7	3V3	PWR	3.3 V analog power supply	
A2	1V8	PWR	1.8 V analog power supply	

Table 1. Power supply pins

The DC power supply can be taken from any of the following sources:

- Switched Mode Power Supply (SMPS)
- Low Drop Out (LDO) regulator

When choosing between an SMPS or LDO to supply the modules, it is advisable to consider the acceptable power and thermal dissipation of the application product. See also [Module supply design](#).

Module power up must strictly follow the defined [power-up sequence](#). It is important to design the power management to comply with the recommended power-up sequence.

The current consumed through the supply pins by MAYA-W3 series modules can vary by several orders of magnitude depending on the operation mode and state. The current consumption can change from high consumption, experienced during Wi-Fi transmission at maximum RF power level in connected-mode, to low current consumption during the low power idle-mode when power saving is enabled. Regardless of the chosen DC power supply, it is crucial that it can satisfy the high peak current consumed by the module. When designing the supply circuitry for the module, a contingency of at least 20% over the stated peak current is recommended. See also [Module supply design](#).

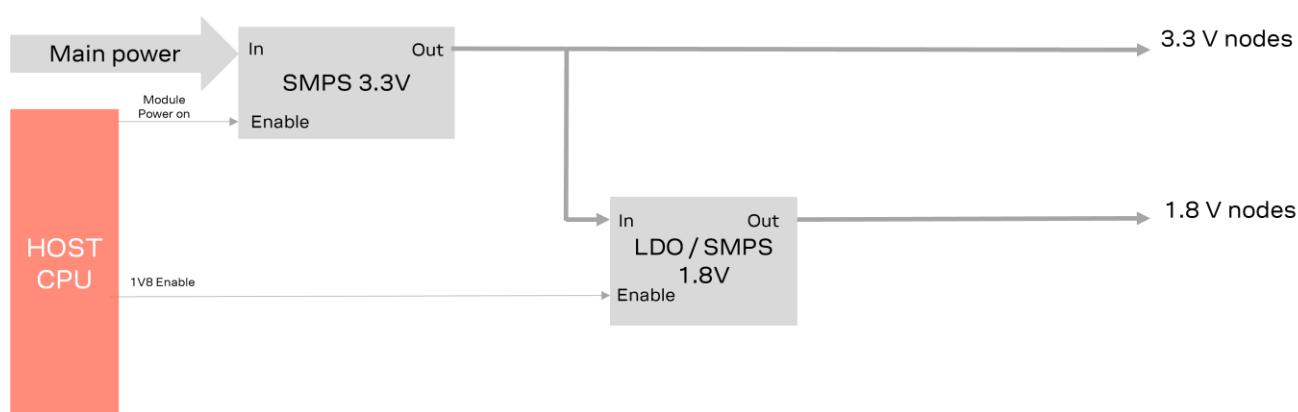


Figure 2: Proposed implementation of MAYA-W3 power supply circuitry

2.2 Antenna interfaces

Different antenna solutions can be used to integrate MAYA-W3 modules into application designs.

2.2.1 Antenna solutions

MAYA-W3 series modules antenna solutions are described in section [Module integration](#). Internal and single antenna pin is available in MAYA-W3x6. Other variants use internal U.FL connectors or antenna pins.

Figure 3 shows the available antenna options.

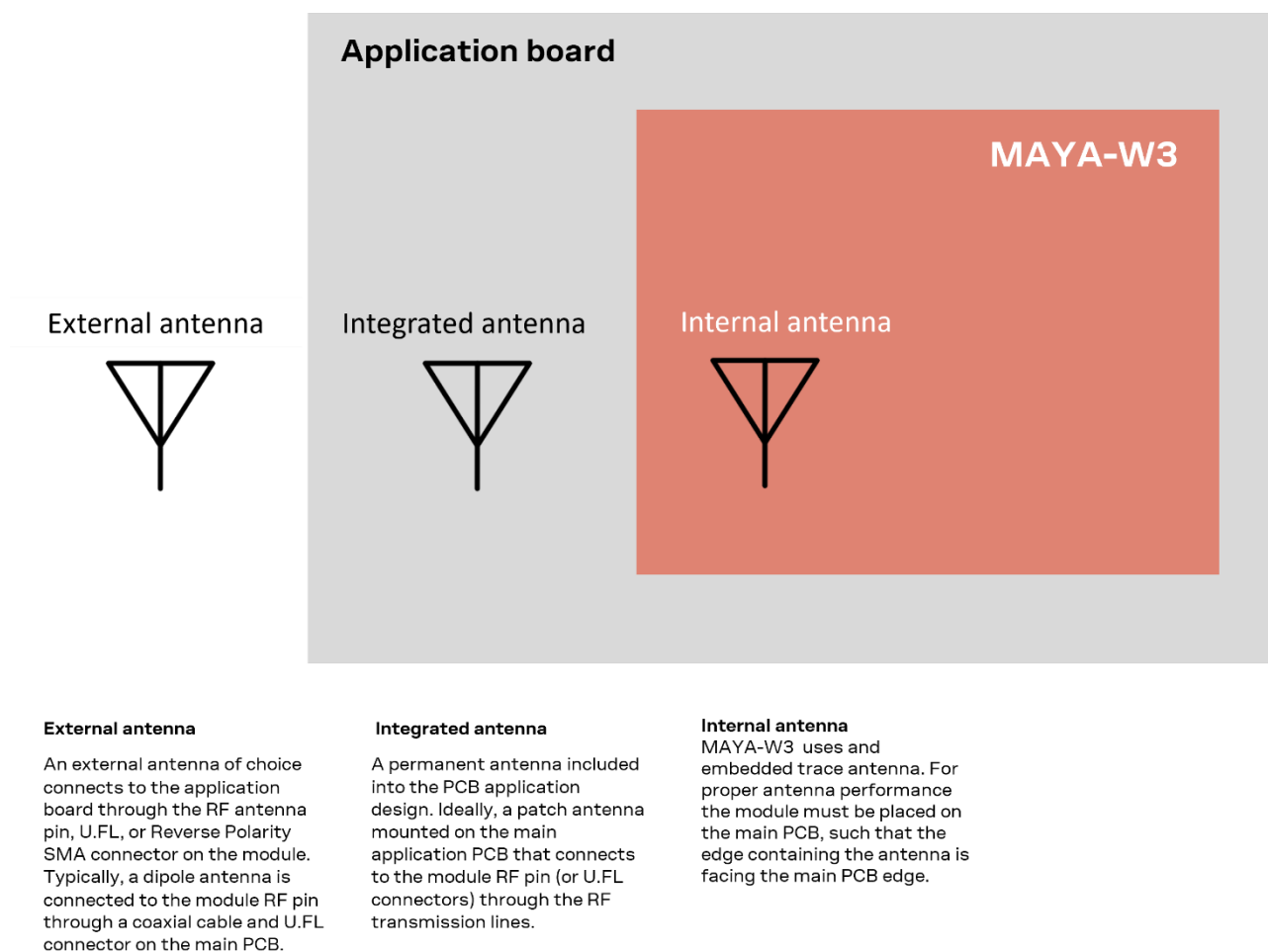


Figure 3: Antenna options

2.2.2 RF pins and connectors

MAYA-W3 supports RF pins or U.FL connectors to connect external or integrated Wi-Fi and Bluetooth antennas.

U.FL. Connector	Function
J1	U.FL connector for external 2.4/5/6 GHz Wi-Fi antenna
J2	U.FL connector for external Bluetooth antenna

Table 2: RF connectors for MAYA-W3x0

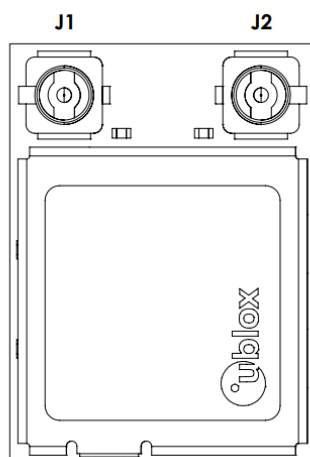


Figure 4: MAYA-W3x0 antenna connector placement (top view)

Pin	Name	Function
K9	RF_ANT1	Antenna pin for external 2.4/5/6 GHz Wi-Fi antenna
K1	RF_ANT0	Antenna pin for external Bluetooth antenna

Table 3: RF pin functions MAYA-W3x1

Pin	Name	Function
K9	RF_ANT1	Single antenna pin for external 2.4/5/6 GHz Wi-Fi and Bluetooth antenna

Table 4: RF pin functions MAYA-W3x3

Table 5 describes the function of the RF pin/connector function on MAYA-W3x6 modules with integrated antenna.

Pin	Pin	Function
K9	RF_ANT1	Single antenna pin to be connected to L9
L9	ANT_EXT_FEED	External antenna feed pin from RF_ANT1 for embedded PCB antenna

Table 5: RF pin functions MAYA-W3x6

 For proper implementation of antennas in the application product, follow the [RF interface options](#). See also the Antenna integration application note [\[11\]](#).

2.2.3 Approved antenna designs

MAYA-W3 modules come with a pre-certified antenna design that can save cost and time during the certification process. To leverage this benefit, customers are required to implement an antenna layout that is fully compliant with the u-blox reference design outlined in the MAYA-W3 antenna reference design application note [\[14\]](#). Reference design source files are available from u-blox on request.¹

¹ Reference designs are only available after certification.

For Bluetooth and Wi-Fi operation, MAYA-W3 modules have been tested and approved for use with the antennas featured in the list of [Pre-approved antennas](#).

-  To implement a design compliant with the u-blox FCC certification Grant follow the instructions in the MAYA-W3 antenna reference design application note [\[14\]](#).

2.2.4 Integrated antennas

MAYA-W3 module variants with RF pins allow an SMD antenna to be mounted on the application board, which is then connected with a transmission line. The module variants suitable for use with an integrated antenna are described in [Antenna solutions](#).

For proper implementation for antennas in the application product, follow the [RF interface options](#).

2.2.5 External antennas

External antennas are preferably used with MAYA-W3 module variants equipped with U.FL connectors. The antennas connect to the module through coaxial cables. The module variants suitable for use with an external antenna are described in [Antenna solutions](#).

External antennas are particularly suited for application products housed in metal casings that demand that the antennas are placed externally.

For proper implementation for antennas in the application product, follow the [RF interface options](#).

-  To avoid invalidating the compliance and pre-certification of u-blox modules with the various regulatory bodies, use only external antennas included the list of [Pre-approved antennas](#). u-blox modules may also be integrated with other antennas. In which case, OEM installers must certify their own designs with the respective regulatory agencies.

2.2.6 Internal antennas

MAYA-W3x6 modules include an internal Niche antenna that is printed on the PCB and connected to pin L9. [Table 5](#) describes the function of antenna pin and embedded antenna feed pin on MAYA-W3x6 modules. To use the internal antenna, pin L9 must be connected to the RF signal pin K9. The antenna utilizes antenna technology from Abracon. The variants equipped with an internal antenna are described in [Antenna solutions](#).

For proper antenna performance observe the following design considerations.

- To enable good antenna radiation performance, it is important to place the module on the edge of the main PCB with the antenna facing outwards.
- A ground plane extending at least 10 mm on both sides of the module is recommended.
- Include a non-disruptive GND plane underneath the module with a clearance, cut out, underneath the antenna, as shown in [Figure 5](#).
- Observe the antenna clearance shall be implemented on all layers.
- To avoid degradation of the antenna characteristics, do not place physically tall or large components closer than 10 mm to the module antenna.
- To avoid any adverse impact on antenna performance, include a 5 mm clearance between the antenna and the casing. Polycarbonate (PC) and Acrylonitrile butadiene styrene (ABS) materials have less impact on antenna performance than other types of thermoplastics.
- Include plenty of stitching vias from the module ground pins to the GND plane layer. Ensure that the impedance between the module pins and ground reference is minimal.
- Consider the end products use case and assembly to make sure that the antenna is not obstructed by any external item.

Figure 3 shows the PCB artwork on main PCB top layer for MAYA-W3x6 modules. It also shows the placement and GND clearance of the internal PCB trace antenna. The antenna clearance is only required for these module variants.

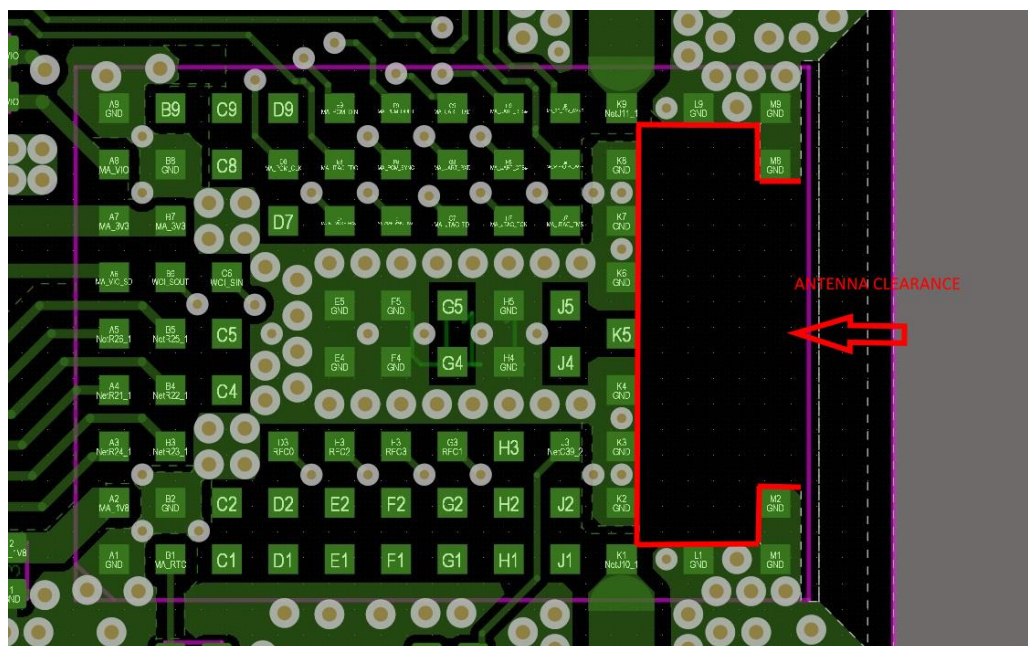


Figure 5: PCB artwork on main PCB top layer for MAYA-W3x6

2.3 System function interfaces

2.3.1 Power up sequence

Figure 6 shows the recommended power-up sequence of a MAYA-W3 series module. Start with applying **3V3** before or at the same time as **1V8**. Once these voltages have reached 90%, **WL_EN** and **BT_EN** can be set high after at least 50 us (or two 32 kHz LPO clock cycles) to enable internal power management circuitry.

Pin	Name	I/O	Description	Remarks
A7, B7	3V3	PWR	3.3 V analog power supply	
A2	1V8	PWR	1.8 V analog power supply	
J3	WL_EN	I	Wi-Fi enable	This pin has an internal 50 kΩ pull-down resistor that is enabled by default. It can be disabled through programming
J7	BT_EN	I	Bluetooth enable	This pin has an internal 50 kΩ pull-down resistor that is enabled by default. It can be disabled through programming

Table 6. Signals involved in power-up sequence

- **3V3** and **1V8** should not rise 10%-90% faster than 40 microseconds.
- **3V3** should be up before or at the same time as **1V8**. **1V8** should NOT be present first or be held high before **3V3** is high.

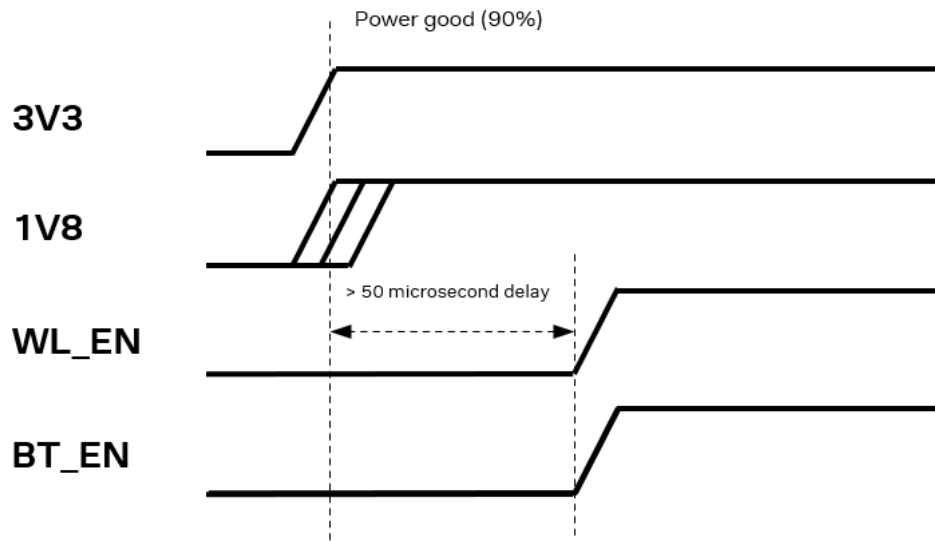


Figure 6: Power sequence of MAYA-W3 module

2.3.2 Power down

MAYA-W3 modules WLAN and Bluetooth section enter **Power Down** mode when respectively **WL_EN** and **BT_EN** is deasserted. When both **WL_EN** and **BT_EN** are deasserted the power on **3V3** and **1V8** supplies can be removed and the module then enters the **Power Off** mode.

2.3.3 Reset

Although external reset is not a prerequisite for correct operation, it can be asserted by the host controller through **WL_EN** and **BT_EN** in the event of any abnormal module behavior.

MAYA-W3 series modules uses two control signals to enable or disable Wi-Fi and Bluetooth:

- **WL_EN:** This controls the CYW5551x power management regulators and when this pin is low, the Wi-Fi section is in reset. Wi-Fi is out of reset when this pin is set high.
- **BT_EN:** This controls the CYW5551x power management regulators and when this pin is low, the Bluetooth section is in reset. Bluetooth is out of reset when this pin is set high.

 A firmware download to the module is required after each reset.

2.3.4 Power states

MAYA-W3 series modules have several operation states. The power states and general guidelines for Wi-Fi and Bluetooth operations are defined in [Table 7](#).

General status	Power state	Description
Power-down	Not Powered	3V3 and 1V8 supplies not present or below the operating range. The module is switched off.
	Power Down	Deasserting WL_EN and BT_EN while 3V3 and 1V8 supplies are present powers down the module. This represents the lowest leakage mode of operation with active voltage rails. Register and memory states are not maintained in power-down mode. The module is automatically reset after exiting power-down mode, which means that the firmware must be downloaded again. If firmware is not downloaded, the device must be kept in its power-down state to reduce the leakage.
Normal operation	Active	Enables TX/RX data connection with the system running at the specified power consumption.
	Deep sleep	Low-power state used in the sleep state of many power-save modes. Memory is placed in low-power retention mode.

Table 7: Description of module power states

2.4 Configuration pins

MAYA-W3 series provides one configuration pin, **SD_DAT[2]**, for selecting the host interface configuration. To set a configuration bit to 0, attach a 10 kΩ resistor to GND. No external pull-up resistor is required to set a configuration bit to 1.

The state of the hardware is determined by the pin state at power-on after the boot code finishes and before the firmware download begins. The configuration pins revert to normal function after boot-up.

Pin	Name	I/O type	Description	Strap value
B5	SD_DAT[2]	I/O	Strap mode: Configuration pin Normal function: SDIO interface data bit 2	0: GSPI 1: SDIO (default pull during strapping)

Table 8: Configuration pin

 When using the SDIO interface, ensure that the host CPU does not drive the **SD_DAT[2]** line low during module start-up. Doing so may interfere with proper initialization and lead to unexpected behavior. In this case use 10 kohm pull-up resistor on the SDIO interface including the **SD_DAT[2]** line.

2.5 Wake-up signals

A deep sleep mode in MAYA-W3 is used to reduce power consumption. [Table 9](#) shows optional out-of-band wake-up pins to wake up the radios from sleep mode. Radio to host wake-up output signals can be used to wake up the host from sleep mode.

Pin	Name	I/O Type	Description
F7	WL_HOST_WAKE	O	Wi-Fi radio to host wake-up output signal
J8	WL_DEV_WAKE	I	Wi-Fi radio wake-up input signal
E7	BT_HOST_WAKE	O	Bluetooth radio to host wake-up output signal
J9	BT_DEV_WAKE	I	Bluetooth radio wake-up input signal

Table 9: Wake-up pins

2.6 Host interfaces

MAYA-W3 series modules support SDIO 3.0, high-speed UART, and GSPI host interfaces. All Wi-Fi traffic is communicated through the SDIO or GSPI interface. The high-speed UART interface between the host and the MAYA-W3 module is used for the Bluetooth traffic. For information about the configuration options for the host interface, see also [Configuration pins](#).

2.6.1 SDIO 3.0 interface

MAYA-W3 series modules include a SDIO device interface that is compatible with the industry-standard SDIO 3.0 specification with a clock range of up to 100 MHz. The host controller uses the SDIO bus protocol to access the Wi-Fi function. The interface supports 4-bit SDIO transfer mode with data rates up to 50 MB/s in SDR/DDR50 mode.

 The SDIO interface voltage is set to 1.8 V by the **1V8** supply pin.

MAYA-W3 modules act as devices on the SDIO bus.

[Table 10](#) summarizes the supported bus speed modes.

Bus speed mode	Max. bus speed [MB/s]	Max. clock frequency [MHz]	Signal voltage [V]
SDR50	50	100	1.8
DDR50	50	50	1.8

Bus speed mode	Max. bus speed [MB/s]	Max. clock frequency [MHz]	Signal voltage [V]
SDR25	25	50	1.8
SDR12	12.5	25	1.8
HS: High-speed	25	50	1.8
DS: Default speed	12.5	25	1.8

Table 10: SDIO bus speeds

MAYA-W3 includes internal on-chip 100 kΩ (nominal value) pull-up resistors on the SDIO signals. Even though, it is recommended to connect pull-up resistors to these lines. See also [Data communication interfaces](#). Small value in-series termination resistors might also be applied to mitigate signal integrity and EMI issue.

[Table 11](#) describes the function of each of the SDIO signals.

Pin	Name	I/O	Description	Remarks
A4	SD_CLK	I	SDIO Clock input	
B4	SD_CMD	I/O	SDIO Command line	External PU required
B3	SD_DAT[0]	I/O	SDIO Data line bit 0	External PU required
A3	SD_DAT[1]	I/O	SDIO Data line bit 1	External PU required
B5	SD_DAT[2]	I/O	SDIO Data line bit 2	External PU required
A5	SD_DAT[3]	I/O	SDIO Data line bit 3	External PU required

Table 11: SDIO signal definitions

SDIO interface pins are powered by the **1V8** voltage domain.

2.6.2 High-speed UART interface

MAYA-W3 supports a high-speed host interface for Bluetooth operation. The baud rate is adjustable from 9600 bps to 4.0 Mbps. The default baud rate is 115.2 Kbaud. The UART supports RX/TX pins and mandatory RTS/CTS flow control signals. [\[1\]](#) describes the module pins for the UART interface.

[Table 12](#) describes the function of each of the UART signals.

Pin	Name	I/O type	Description
G9	UART_TX	O	UART serial output signal, Connect to Host RX
G8	UART_RX	I	UART serial input signal, Connect to Host TX
H9	UART_RTS	O	UART request-to-send output signal (active low), Connect to Host CTS
H8	UART_CTS	I	UART clear-to-send input signal (active low), Connect to Host RTS

Table 12: UART signal description

High-Speed UART signals are powered by the **1V8** voltage domain.

2.6.3 GSPI interface

MAYA-W3 supports a GSPI host interface for Wi-Fi operation with a maximum throughput up to 20 Mbps. The pins are shared with the SDIO interface. [\[1\]](#) describes the module pins for the GSPI interface. Configuration for GSPI is described in [Configuration pins](#).

Pin	Pin name	I/O type	Description	SDIO pin multiplexing
A5	GSPI_CS	I	GSPI chip select input signal	SDIO_DAT[3]
A3	GSPI_IRQ	O	GSPI interrupt request signal	SDIO_DAT[1]
A4	GSPI_SCLK	I	GSPI clock input signal	SDIO_CLK
B3	GSPI_MISO	O	GSPI master in slave out signal	SDIO_DAT[0]
B4	GSPI_MOSI	I	GSPI master out slave in signal	SDIO_CMD

Table 13: GSPI interface description

2.6.4 PCM/I2S - Audio interface

MAYA-W3 series modules support a Pulse Code Modulation (PCM) interface that supports:

- Central or peripheral mode
- Sample rate 8 kHz for NBS and 16 kHz for WBS
- PCM sample width of 16 bits
- Bit clocks of 128 kHz, 256 kHz , 512 kHz , 102 kHz , and 2048 kHz with a different number of 16-bit slots

In PCM central mode, the interface generates the **PCM_CLK** and **PCM_SYNC** signals. In peripheral mode, **PCM_CLK** and **PCM_SYNC** are generated by another central device on the bus and MAYA-W3 configures these pins as inputs.

The PCM interface shares the pins with the I2S interface.

Pin	Name	I/O type	Description	I2S pin multiplexing
F9	PCM_DOUT	O	PCM data out	I2S_DOUT
E9	PCM_DIN	I	PCM data in	I2S_DIN
D8	PCM_CLK	I/O	PCM clock, can be output (if central) or input (if peripheral)	I2S_BCLK
F8	PCM_SYNC	I/O	PCM sync, can be output (if central) or input (if peripheral)	I2S_LRCLK
E8	PCM_MCLK	O	Optional clock pin	I2S_CCLK

Table 14: PCM interface description

2.7 General purpose I/O

MAYA-W3 supports up to 14 GPIO pins. On power-up and reset, the GPIO pins assume a high-impedance tristate. The JTAG and coexistence interfaces can be assigned to the GPIO pins. After initialization, firmware is downloaded, and the pads are programmed in line with the functionality of the GPIOs. For pin assignment information, see also the MAYA-W3 data sheet [1].

2.8 External coexistence interface

External coexistence interfaces enable signaling between the internal radios and external co-located wireless devices for optimal performance when sharing the wireless medium. External radios can be connected to the 4-wire LTE coexistence interface (4Wire), to the 2-wire wireless coexistence interface 2 (WCI-2), to the 3-wire Zigbee coexistence interface or to the 3-wire Ultra-wide band coexistence interface. WCI-2 message format and message type comply with Bluetooth special interest group (SIG) core specification volume 7, part C.

Pin	Name	I/O type	Description	GPIO pin multiplexing
C5	LTE_FRAME_SYNC	I		GPIO[2]

Pin	Name	I/O type	Description	GPIO pin multiplexing
C4	LTE_TX_IN	I		GPIO[3]
C6	LTE_RX_IN	I		GPIO[4]
B6	WL_PRIORITY_OUT	O		GPIO[5]

Table 15: 4Wire LTE external coexistence interface description

Pin	Name	I/O type	Description	GPIO pin multiplexing
B6	WCI-2_SIN	I	WCI-2 serial interface input	GPIO[4]
C6	WCI-2_SOUT	O	WCI-2 serial interface output	GPIO[5]

Table 16: WCI-2 external coexistence interface description

Pin	Pin name	I/O type	Description	GPIO pin multiplexing
C5	ZB_RF_ACTV	I		GPIO[2]
C4	ZB_PRIORITY	I		GPIO[3]
B6	ZB_TXCONF	O		GPIO[5]

Table 17: 3-wire Zigbee external coexistence interface description

Pin name	I/O type	Description	GPIO pin multiplexing
UWB_RF_ACTV	I		GPIO[2]
UWB_PRIORITY	I		GPIO[3]
UWB_TXCONF	O		GPIO[5]

Table 18: 3-wire UWB external coexistence interface description

2.9 Other remarks

2.9.1 Unused pins

MAYA-W3 series modules have unconnected (NC) pins that are reserved for future use. These pins must be left unconnected on the application board.

3 Design-in

Follow the design guidelines in this chapter to optimize the integration of MAYA-W3 series modules in the final application board.

3.1 Overview

Although all application circuits must be properly designed, and the following aspects of the application design require special attention:

- Module antenna integration. **RF_ANT**.
 - Antennas and RF circuits affect the RF performance and certification compliance. It is important to follow the design instructions given here to reach specified performance. Further, to maintain compliance and subsequent certification of the application design, it is important to observe the applicable parts of antenna schematic and layout described in [Antenna design](#).
- Module power supply. **Power** and **GND**.
 - Power supply circuits might affect the products operating stability and RF performance. It is important to select a suitable device capable to source the adequate voltage and current. It is also important to implement adequate power and ground planes in PCB stack-up and to implement bypass capacitors for these supplies. See also [Supply interfaces](#).
- High-speed interfaces, such as **SDIO**, high-speed **UART**, **GSPI**, and **PCM**.
 - High-speed interfaces are a potential source of noise that can affect the regulatory compliance of standards for radiated emissions. It is important to follow the schematic and layout design recommendations described in [SDIO 3.0 interface](#) and the [General high-speed layout guidelines](#).
- System functions: **Power Down**, **Reset** and [Configuration](#).
 - Careful utilization of these pins in the application design is necessary to ensure correct operation of the product. Specifically, observe the state and voltage level is correctly defined during module boot and operation. It is important to follow the pin design described in the [General high-speed layout guidelines](#).
- Other pins: specific signals.
 - Careful utilization of these pins is necessary to ensure that the module operates correctly. It is important to follow the schematic and design layout recommendations.
- **NC** pins must not be connected.

3.2 RF interface options

Short range modules provide several RF-interface options for connecting external antennas. Module variants also provides internal antennas when using such module there are special considerations about GND clearance and keep out area to account when designing the host PCB:

- The **RF_ANT** pins have a nominal characteristic impedance of 50 Ω . For correct impedance matching, these pins must be connected to the respective antenna through a 50 Ω U.FL connector and coax or a transmission line – depending on the type of module connector. Poor termination of **RF_ANT** pins will result in degraded performance of the module.
- For multiple antenna products, such as MIMO, follow the requirements described in [Table 19](#) and [Table 20](#) to optimize the isolation between the antennas and ensure good application performance.

 According to FCC regulations, the transmission line from the module antenna pin to the physical antenna (or antenna connector on the host PCB) is considered part of the approved antenna design. Therefore, module integrators must use exactly the antenna reference design used in the module FCC type approval or certify their own design.

For instructions on how to design circuits that comply with these requirements, see also [Antenna interfaces](#).

3.2.1 Antenna design

To optimize the radiated performance of the final product, the selection and placement of both the module and antenna must be chosen with due regard to the mechanical structure and electrical design of the product. To avoid later redesigns, it is important to decide the positioning of these components at an early phase of the product design.

The compliance and subsequent certification of the RF design depends heavily on the radiating performance of the antennas.

To ensure that the RF certification of MAYA-W3 modules is extended through to the application design, carefully follow the guidelines outlined below.

- External antennas, including, linear monopole classes:
 - Place the module and antenna connector in any convenient area on the board. External antennas do not impose any restriction on where the module is placed on the PCB.
 - Select antennas with an optimal radiating performance in the operating bands. The radiation performance depends mainly on the antennas.
 - Choose RF cables that offer minimum insertion loss. Unnecessary insertion loss is introduced by low quality or long cables. Large insertion losses reduce radiation performance.
 - Use a high-quality 50 Ω coaxial connector for proper PCB-to-RF-cable transition.
- Integrated antennas, such as PCB trace Inverted-F, monopole, monopole slot or similar antennas impose physical restrictions on the PCB design:
 - These antennas excite RF currents on its counterpoise. Typical the PCB ground plane of the device becomes part of the antenna and its dimensions define the minimum frequency that can be radiated. Therefore, the ground plane shall never be reduced to a size smaller than a quarter of the wavelength of the minimum frequency that shall be radiated. The placement of the ground plane related to the antenna shall also be considered. Follow the instructions in the reference design section to implement it correctly if using a module including an antenna.
 - The wavelength on a PCB, is calculated according: $\lambda = \frac{c}{f\sqrt{\epsilon}}$
 For Bluetooth and Wi-Fi in 2.4 GHz band, $f = 2.4 \text{ GHz}$, the wavelength in free spaces is $\lambda = 12.5 \text{ cm}$, Quarter wavelength $\lambda/4 = 3.125 \text{ cm}$ or about 1.5 cm on a FR4 substrate PCB.
- Choose antennas with optimal radiating performance in the operating bands. Radiation performance depends on the complete product and antenna system design, including the mechanical design and usage of the product. [Table 19](#) summarizes the requirements for the antenna RF interface.
- Make the RF isolation between the system antennas as high as possible, and the correlation between the 3D radiation patterns of the two antennas as low as possible. In general, RF separation of at least a quarter wavelength between the two antennas is required to achieve a minimum isolation and low pattern correlation. If possible, increase the separation to maximize the performance and fulfill the requirements in [Table 20](#).

Item	Requirements	Remarks
Impedance	50 Ω nominal characteristic impedance	The impedance of the antenna RF connection must match the 50 Ω impedance of Antenna pins.
Frequency Range	2400 - 2500 MHz 5150 - 7125 MHz	For 802.11b/g/n/ax and Bluetooth For 802.11a/n/ac/ax.
Return Loss	S11 < -10 dB (VSWR < 2:1) recommended S11 < -6 dB (VSWR < 3:1) acceptable	The Return loss or the S11, as the VSWR, refers to the amount of reflected power, measuring how well the primary antenna RF connection matches the 50 Ω characteristic impedance of antenna pins.

Item	Requirements	Remarks
		The impedance of the antenna termination must match as much as possible the 50 Ω nominal impedance of antenna pins over the operating frequency range, to maximize the amount of power transferred to the antenna.
Efficiency	> -1.5 dB (> 70%) recommended > -3.0 dB (> 50%) acceptable	Radiation efficiency is the ratio of the radiated power to the power fed to the antenna input: the efficiency is a measure of how well an antenna receives or transmits.
Maximum Gain		To comply with regulatory agencies radiation exposure limits the maximum antenna gain must not exceed the value specified in type approval documentation.

Table 19: Summary of antenna interface requirements

[Table 20](#) specifies additional requirements for implementing a dual antenna design.

Item	Requirements	Remarks
Isolation (in-band)	S21 > 30 dB recommended	The antenna-to-antenna isolation is the S21 parameter between the two antennas in the band of operation. Lower isolation might be acceptable depending on use-case scenario and performance requirements.
Isolation (out-of-band)	S21 > 35 dB recommended S21 > 30 dB acceptable	Out-of-band isolation is evaluated in the band of the aggressor. This ensures that the transmitting signal from the other radio is sufficiently attenuated by the receiving antenna. It also avoids any saturation and intermodulation effect on the receiver port.
Envelope Correlation Coefficient (ECC)	ECC < 0.1 recommended ECC < 0.5 acceptable	The ECC parameter correlates the far field parameters between antennas in the same system. A low ECC parameter is fundamental in improving the performance of MIMO-based systems.

Table 20: Summary of Wi-Fi/Bluetooth coexistence requirements

 When operating dual antennas in the same 2.4 GHz band, sufficient isolation is critical for attaining an optimal throughput performance in Wi-Fi/Bluetooth coexistence mode.

Select antennas that provide:

- Optimal return loss (or VSWR) over all the operating frequencies.
- Optimal efficiency figure over all the operating frequencies.
- An appropriate gain that does not exceed the regulatory limits specified in some regulatory country authorities like the FCC in the United States.

A useful approach for the antenna microstrip design is to place an U.FL connector close to the embedded PCB or chip antenna. The U.FL connector only needs to be mounted on units used for verification.

3.2.1.1 Integrated antenna design

If integrated antennas are used, the transmission line is terminated by the antennas themselves or by the antenna together with the connected coaxial cable and U.FL plug.

Consider the following the guidelines when designing the antenna:

- The antenna design process should commence at the same time as the mechanical design of the product. PCB mock-ups are useful in estimating overall efficiency and radiation path of the intended design during early development stages.
- Use antennas designed by an antenna manufacturer that provide the best possible return loss (or VSWR).

- Provide a ground plane large enough according to the related integrated antenna requirements. The ground plane of the application PCB may be reduced to a minimum size that must be similar to one quarter of wavelength of the minimum frequency that has to be radiated. The overall antenna efficiency may benefit from larger ground planes.
- Proper placement of the antenna and its surroundings is also critical for antenna performance. Avoid placing the antenna close to conductive or RF-absorbing parts, such as metal objects or ferrite sheets, as these may absorb part of the radiated power, shift the resonant antenna frequency of the antenna, or otherwise affect the antenna radiation pattern.
- Ensure that installation and deployment of the antenna system, including PCB layout and matching circuitry, is done correctly. In this regard, it is recommended that you strictly follow the specific guidelines provided by the antenna manufacturer.
- Antennas may require tuning/matching to reach the target performance. It is recommended to plan measurement and validation activities with the antenna manufacturer before releasing the end-product to manufacturing.
- The receiver section may be affected by noise sources like hi-speed digital busses. Avoid placing the antenna close to busses as DDR. Otherwise, consider taking specific countermeasures, like metal shields or ferrite sheets, to reduce the interference.
- Be aware of interaction between co-located RF systems. Coexistence with cellular modem might require embedded SAW or BAW LTE coexistence filter this is especially critical if using LTE bands located close to the ISM 2.4 GHz band.

3.2.1.2 RF transmission line design

RF transmission lines, such as those that connect from **RF_ANT** pins to their related antenna connectors or antenna, must be designed with a characteristic impedance of 50 Ω .

Figure 7 shows the design options for implementing a transmission line, namely:

- Microstrip – track separated with dielectric material and coupled to a single ground plane.
- Coplanar microstrip – track separated with dielectric material and coupled to both the ground plane and side conductor. This is the most common transmission line implementation.
- Stripline – track separated by dielectric material and sandwiched between two parallel ground planes.

The parameters shown in the cross-sectional area of each trace design include:

- Width (W) – shows the width of the copper layer on the top layer
- Distance (S) – shows the distance between the top copper layer and the two adjacent GND planes.
- Dielectric substrate thickness (H) – shows the distance between the GND reference on the bottom plane and the copper layer on the top layer.
- Thickness of the copper layer (T) – can also be represented by “Base Copper Weight”, which is commonly used as the parameter for PCB stack-up.
- Dielectric constant (ϵ_r) defines the ratio between the electric permeability of the material against the electric permeability of free space.

- ✎ The width of a 50 Ω microstrip depends on mainly “ ϵ_r ” and “H”, which must be calculated for each PCB layer stack-up.

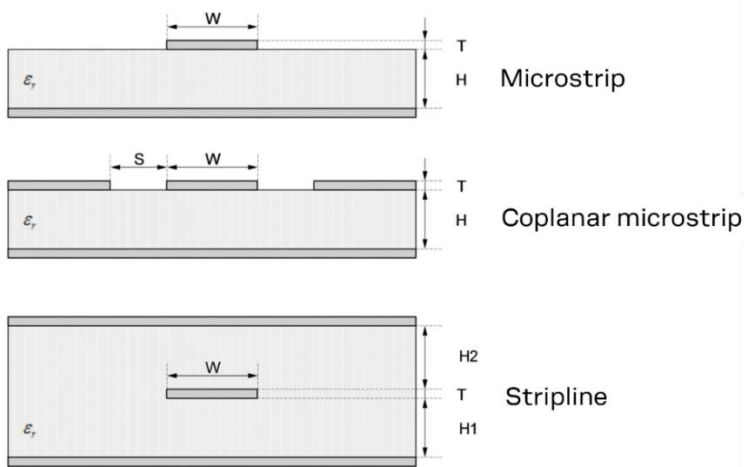


Figure 7: Transmission line trace design

Follow these recommendations to design a 50 Ω transmission line correctly:

- Designers must provide enough clearance from surrounding traces and ground in the same layer. In general, the trace to ground clearance should be at least twice that of the trace width. The transmission line should also be “guarded” by the ground plane area on each side.
- In the first iteration, calculate the characteristic impedance using tools provided by the layout software. Ask the PCB manufacturer to provide the final values usually calculated using dedicated software and production stack-ups. It is sometimes possible to request an impedance test coupon on side of the panel to measure the real impedance of the traces.
- Although FR-4 dielectric material can result in high losses at high frequencies, it can still be an appropriate choice for RF designs. In which case, aim to:
 - Minimize RF trace lengths to reduce dielectric losses.
 - If traces longer than few centimeters are needed, use a coaxial connector and cable to reduce losses.
 - For good impedance control over the PCB manufacturing process, design the stack-up with wide 50 Ω traces with width of at least 200 μm .
 - Contact the PCB manufacturer for specific tolerance of controlled impedance traces. As FR-4 material exhibits poor thickness stability it gives less control of impedance over the trace width.
- For PCBs with components larger than 0402 and dielectric thickness below 200 μm , add a keep-out, that is, some clearance (void area) on the ground reference layer below any pin on the RF transmission lines. This helps to reduce the parasitic capacitance to ground.
- Route RF lines in 45° angle and avoid acute angles. The transmission lines width and spacing to GND must be uniform and routed as smoothly as possible.
- Add GND stitching vias around transmission lines.
- Provide a sufficient number of vias on the adjacent metal layer. Include a solid metal connection between the adjacent metal layer on the PCB stack-up to the main ground layer.
- To avoid crosstalk between RF traces and Hi-impedance or analog signals, route RF transmission lines as far from noise sources (like switching supplies and digital lines) and any other sensitive circuit.
- Avoid stubs on the transmission lines. Any component on the transmission line should be placed with the connected pin located over the trace. Also avoid any unnecessary components on RF traces.

Figure 8 shows a trace and ground design example. The left image shows coplanar microstrips connecting the modules RF pins to SMA connectors. The image in the middle shows layer 2 and how to design the GND clearance under the coplanar microstrips. The image to the right shows the GND reference implemented on layer 3. The ground clearance on L2 allows for a wider microstrip, which is less lossy than a narrow one. The ground clearance is especially critical in the 5-7 GHz band. A wider trace also has less impedance variation over PCB production batches due to the absolute tolerances in the PCB etching process. The right-hand side GND clearance under the module is only needed when using the internal PCB trace Niche antenna.

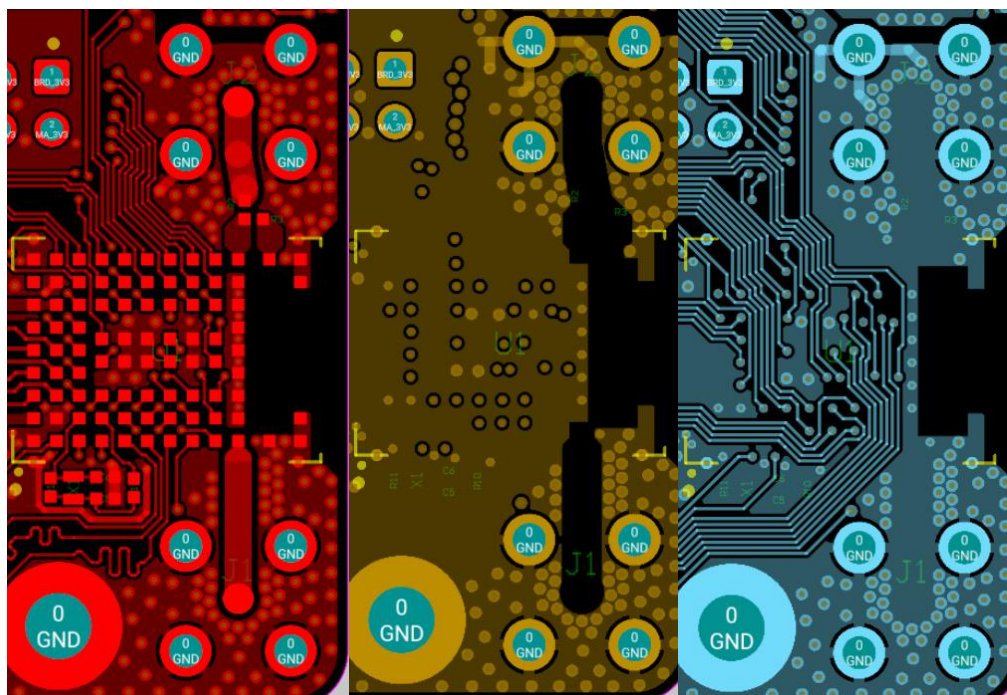


Figure 8: RF trace and ground design example

Figure 9 shows typical artwork implementing a coplanar microstrip on a PCB. The trace includes, from the module pad to the PCB edge, coplanar microstrip, impedance matching PI network, and U.FL RF connectors.

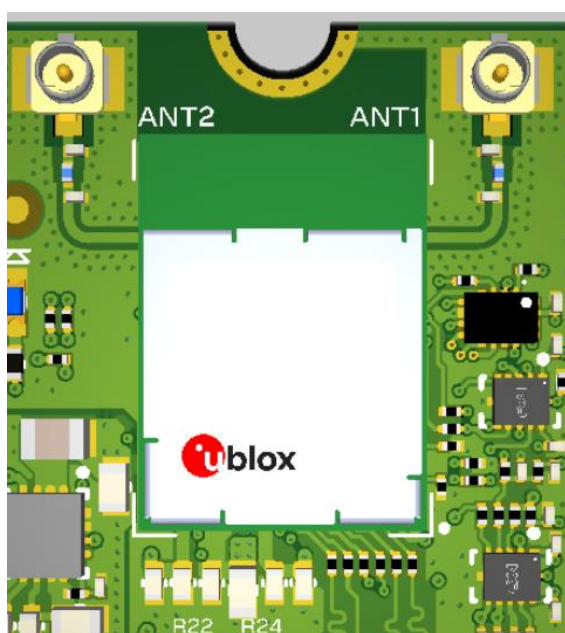


Figure 9: Layout example showing implementation

Figure 10 shows layout of pads for an U.FL connector. Especially consider the GND clearance under the signal pad.

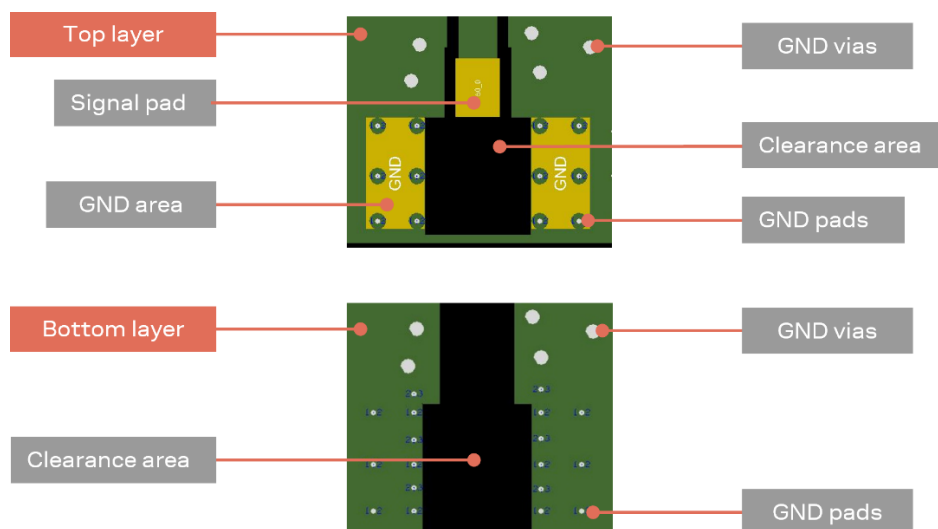


Figure 10: U.FL connector layout, top layer (top), and inner layer 1 (bottom)

3.3 Supply interfaces

3.3.1 Module supply design

Although the GND pins are internally connected in the module, it is advisable to connect all available ground pins on the application board to solid ground with a good (low impedance) connection to host PCB ground. This minimizes power loss, improves RF performance, and allows for more efficient thermal performance.

Low impedance connection of the module supply pins, supplied by a DC supply source, is required for accurate RF performance.

Consider the following guidelines when developing the schematic:

- All power supply pins must be connected to an appropriate DC source.
- Any series component with an Equivalent Series Resistance (ESR) greater than a few $m\Omega$ should be avoided. The only exception to this general rule is the use of ferrite beads for DC filtering. To avoid possible instability in the DC supply, only use ferrite beads if needed.
- For high-frequency filtering, additional bypass capacitors in the range of 100 nF to 1 μ F are required on all supply pins. Offering low ESR/ESL resistance, a class II ceramic capacitor with an X7R or X5R dielectric is well suited for this purpose. Bypass capacitors of a smaller size can be chosen to minimize ESL (Equivalent Series Inductance) in the manufacturing process. The capacitor should be placed as close as possible to the module supply pin.
- To help filter current spikes from the RF section and avoid ground bounce, a minimum bulk capacitance of 10 μ F should be applied to the **1V8** and **3V3** rails and placed close to the module supply pins. Offering low ESR/ESL resistance, a class II ceramic capacitor with an X7R or X5R dielectric is well suited for this purpose. Special care should be taken in the selection of X5R/X7R dielectrics due to capacitance derating versus DC bias voltage.

3.3.1.1 Guidelines for supply circuit design using an SMPS

A Switched Mode Power Supply (SMPS) is generally recommended for converting the main supply to the module supply when the voltage difference is relatively high. In these circumstances, the use of an SMPS dissipate less power and subsequently generates less power dissipation and heat than an LDO. By contrast, an LDO is generally simpler to use and does not generate the amount of noise an SMPS might.

The characteristics of the SMPS should consider the following prerequisites not to degrade the module's stability, RF performance or violate spurious emission standards.

- **Power capability:** The regulator, together with any additional filter in front of the module, must be capable of providing a voltage within the specified operating range. It must also be capable of delivering the specified peak current.
- **Low output ripple:** The peak-to-peak ripple voltage of the switching regulator must not exceed the specified limits. This requirement is applicable to both the voltage ripple generated by the SMPS at operating frequency and the high-frequency noise generated by power switching.
- **PWM/PFM mode operation:** It is advisable to select regulators that support a fixed Pulse Width Modulation (PWM) mode. Pulse Frequency Modulation (PFM) mode typically exhibits higher ripple and can affect RF performance. If power consumption is not a primary concern, PFM/PWM mode transitions should be avoided in favor of fixed PWM operation to reduce the peak-to-peak noise on voltage rails. Switching regulators with mixed PWM/PFM mode can be used provided that the PFM/PWM modes and transition between modes complies with the requirements.

3.3.1.2 Guidelines for supply circuit design using a LDO linear regulator

The use of a linear regulator is appropriate when the difference between the available supply rail and the module supply is relatively low. Linear regulators can also be considered for powering 1.8 V domains – particularly those having low current requirements and those cascaded from an SMPS-generated low voltage rail.

The characteristics of the Low Drop-Out (LDO) linear regulator used to power the voltage rails must consider the following prerequisites to enable stable module operation.

- **Power capabilities:** The LDO linear regulator must be able to provide a voltage within the specified operating range. It must also be capable of withstanding and delivering the maximum specified peak current while in “connected mode”.
- **Power dissipation:** The power handling capability of the LDO linear regulator must be checked to limit its junction temperature to the maximum rated operating range. The worst-case junction temperature can be estimated as shown below:

$$T_{j,est} = (V_{in} - V_{out}) * I_{avg} * \theta_{ja} + T_a$$

Where: θ_{ja} is the junction-to-ambient thermal resistance of the LDO package², I_{avg} is the current consumption of the given voltage rail in continuous TX/RX mode and T_a is the maximum operating temperature of the end product inside the housing.

² Thermal dissipation capability reported on datasheets is usually tested on a reference board with adequate copper area (see also JESD51 [10]). Junction temperature on a typical PCB can be higher than the estimated value due to the limited space to dissipate the heat. Thermal reliefs on pads also affect the capability of a device to dissipate heat.

3.4 Data communication interfaces

3.4.1 SDIO 3.0 interface

The SDIO interface support a clock frequency at up to 100 MHz. This requires that special care must be taken to guarantee signal integrity and minimize electromagnetic interference (EMI) issues.

It is advisable to route all signals in the bus so that they have the same length and the appropriate grounding in the surrounding layers. The total bus length shall be kept to a minimum. To minimize crosstalk with other parts of the circuit, the layout of the SDIO bus shall be designed with enough isolation between its signals and surrounding busses/traces. It is recommended to separate traces width at least three times the trace width. The traces shall be routed with a single-ended impedance of 50 Ω .

Implement an undisrupted return-current path in close vicinity to the signal traces. [Figure 11](#) shows an optional application schematic for the SDIO bus, while [Table 21](#) summarizes the electrical requirements of the bus. Even though on chip Pull-up resistors are included in many ASICs it is advisable to add external ones for optimum pull-up to match routing and host CPU impedance.

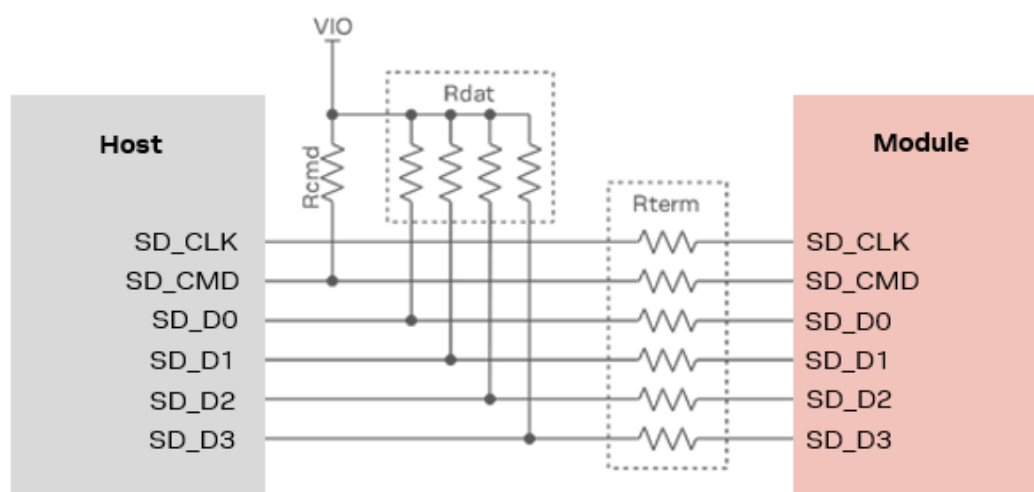


Figure 11: SDIO application schematic

 A small value capacitor in the range of a few pF to **GND** could be considered for **SD_CLK** as an EMI debug option and signal termination. This capacitor shall be placed as close as possible to the MAYA-W3 clock input pin and can be assembled only for EMI purpose. The capacitor value adds to total line capacitance and must not exceed total allowed capacitance to avoid violating clock rise and fall timing specifications.

Signal group	Parameter	Min.	Typ.	Max.	Unit
CLK, CMD, DAT[0:3]	Single ended impedance, Z_0		50		Ω
CLK, CMD, DAT[0:3]	Impedance control	$Z_0 - 10\%$	Z_0	$Z_0 + 10\%$	Ω
DAT[0:3]	Pull-Up range, Rdat	10	47	100	k Ω
CMD	Pull-Up range, Rcmd	10	10	50	k Ω
CLK, CMD, DAT[0:3]	Series termination (Host side), Rterm ³	0	0		Ω
CLK, CMD, DAT[0:3]	Bus length ⁴			100	mm
CMD, DAT[0:3]	Bus skew length mismatch to CLK	-3		+3	mm

³ Series termination values larger than typical recommended only for addressing EMI issues

⁴ Routing should minimize the total bus length.

Signal group	Parameter	Min.	Typ.	Max.	Unit
CLK	Center to center CLK to other SDIO signals ⁵	4*W			
CMD, DAT[0:3]	Center to center between signals ¹¹	3*W			

Table 21: SDIO bus requirements

3.4.2 High-speed UART interface

The high-speed UART interface for the MAYA-W3 complies with the Bluetooth HCI UART Transport layer. The module uses the settings shown in [Table 22](#).

UART Settings	
Baud rate default after reset	115 200 baud
Data bits	8
Parity bit	No parity
Stop bit	1 stop bit
Flow Control	RTS/CTS

Table 22: HCI UART transport layer settings

RTS/CTS flow control is used to prevent temporary UART buffer overrun.

- If RTS is 0 (output, active low), the module is ready to receive and the host is allowed to send.
- If CTS is 0 (input, active low), the host is ready to receive and the module is allowed to send.



The use of hardware flow control with RTS/CTS is mandatory.

Examples of common baud rates are listed in [Table 23](#). For proper operation, baud rate error must be kept within $\pm 2\%$.

Baud rate			
9600	57600	1444444	4000000
14400	115200	1500000	
19200	230400	2000000	
28800	460800	3000000	
38400	921600	3692000	

Table 23: Possible baud rates for the UART interface

3.5 Other interfaces and notes

All pins have internal keeper resistors; leave unused pins open.

3.6 General high-speed layout guidelines

These guidelines describe best practices for the layout of all high-speed busses. Designers should prioritize the layout of higher speed busses. Low frequency signals, other than those with high-impedance traces, are generally not critical to the layout.

-  Low frequency signals with high-impedance traces (such as signals driven by weak pull resistors) may be affected by crosstalk. For these high impedance traces, a supplementary isolation of 4*W from other busses is recommended.

⁵ To accommodate BGA escape, center-to-center spacing requirements can be ignored for up to 10 mm of routed length.

3.6.1 General considerations for schematic design and PCB floor planning

- Verify which signal bus requires termination and add appropriate series resistor terminations to the schematics.
- Carefully consider the placement of the module with respect to the antenna position and host processor; minimize RF trace length first and then the SDIO bus length.
- SDIO bus routing must aim to keep layer-to-layer transition to a minimum.
- Verify the allowable stack-ups, and the controlled impedance dimensioning for antenna traces and busses, with the PCB manufacturer.
- Verify that the power supply design and power sequence are compliant with the specifications described in [System function interfaces](#).

3.6.2 Component placement

- Accessory parts like bypass capacitors must be placed as close as possible to the module to improve filtering capability. Prioritize placing the smallest capacitors close to module pins.
- Do not place components close to the antenna area. Follow the recommendations of the antenna manufacturer to determine distance of the antenna in relation to other parts of the system. Designers should also maximize the distance of the antenna to High-frequency busses, like DDRs and related components. Alternatively, consider an optional metal shield to reduce interferences that might otherwise be picked up by the antenna and subsequently reduce module sensitivity.

3.6.3 Layout and manufacturing

- Avoid stubs on high-speed signals. Test points or component pads should be placed over the PCB trace.
- Verify the recommended maximum signal skew for differential pairs and length matching of buses.
- Minimize the routing length; longer traces degrade signal performance. Ensure that maximum allowable length for high-speed busses is not exceeded.
- Ensure to track any impedance matched traces. Consult early with the PCB manufacturer for proper stack-up definition.
- RF, analog, and digital sections should have dedicated and clearly separated areas on the board.
- No digital routing is allowed in the GND reference plane area of RF traces (ANT pins and Antenna).
- Designers are strongly recommended to avoid digital routing beneath all layers of RF traces.
- Ground cuts or separation are not allowed below the module.
- As a first priority, minimize the length of the RF traces. Then, minimize bus length to reduce potential EMI issues related to the radiation of digital busses.
- All traces (Including low speed or DC traces) must couple with a reference plane (GND or power).
- Hi-speed busses are not allowed to change reference plane. If a change to the reference plane is unavoidable, some capacitors and an adequate number of vias, connecting the reference planes, must be added in the area of transition to provide a low impedance return path through the various reference planes.
- Trace routing should maintain a distance that is greater than $3 \times W$ from the edge of the ground plane routing.
- Separate traces of high speed buses by at least three times the trace width to minimize cross talk.
- Power planes should maintain a safe distance from the edge of the PCB. The distance must be sufficient to route a ground ring around the PCB, and the ground ring must then be stitched to other layers through vias.
- Route the power supply in low impedance power planes. If you choose to route the power supply with traces, do not route loop structures.

 The heat dissipation during continuous transmission at maximum power can significantly raise the temperature of application baseboards under MAYA-W3 series modules. Avoid placing temperature sensitive devices close to the module and provide these devices with sufficient grounding to transfer generated heat to the PCB.

3.7 Module footprint and paste mask

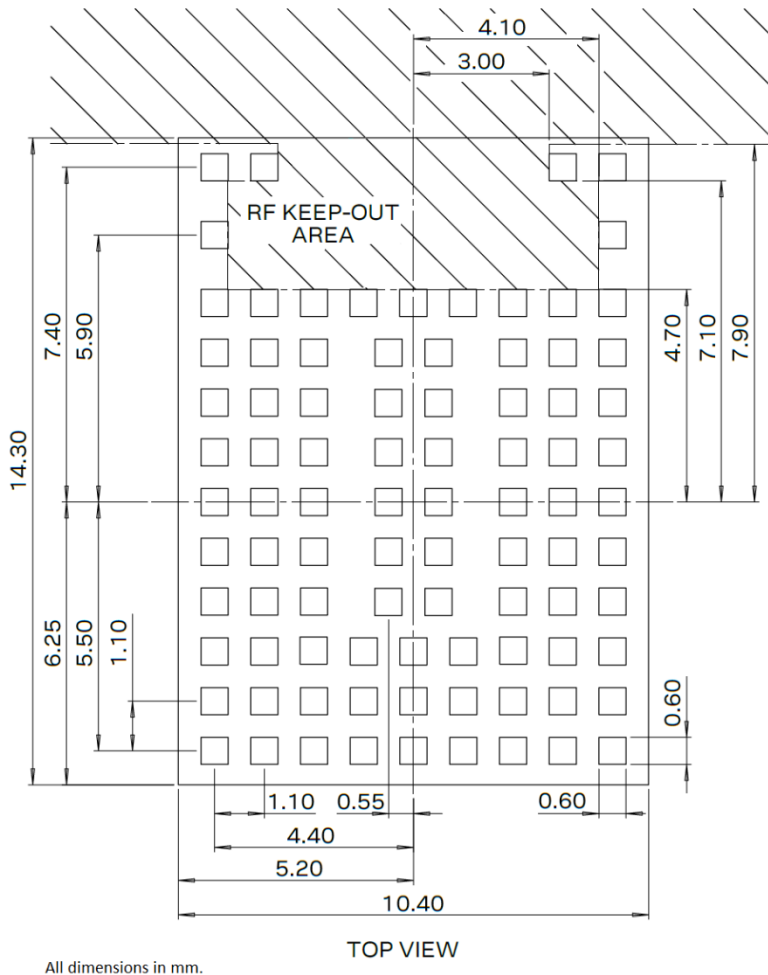


Figure 12: Recommended footprint for MAYA-W3, bottom view

Figure 12 shows the pin layout of MAYA-W3 series modules. The proposed land pattern layout complements the pin layout of the module. Both Solder Mask Defined (SMD) and Non Solder Mask Defined (NSMD) pins can be used with adherence to the following considerations:

- All pins should be Non-Solder Mask Defined (NSMD)
- To help with the dissipation of the heat generated by the module, GND pads must have good thermal bonding to PCB ground planes.

The suggested stencil layout should follow the module's copper pad layout, as shown in Figure 12. The "RF KEEP-OUT AREA" is only applicable for MAYA-W3x6 when using the internal PCB antenna. It can be omitted for the other module variants.

3.8 Thermal guidelines

The module is designed to operate at an ambient temperature [1] inside an enclosure box. The module generates heat during high loads that must be dissipated to sustain the lifetime of the module and other components.

The thermal dissipation measures described below aim to decrease the module's internal temperature and consequently increases the long-term reliability of the device.

For best performance, application PCB layouts should adhere to the following guidelines:

- Vias specification for ground filling: 300/600 μ m, with no thermal reliefs allowed on vias.
- Ground via densities under the module: 50 *vias/cm*²; thermal vias can be placed in gaps between the thermal pads of the module.
- Minimum layer count and copper thickness: 4 *layers*, 35 μ m.
- Minimum board size: 55x70 mm.
- To optimize the heat flow from the module, power planes and signal traces should not cross the layers beneath the module.

These recommendations facilitate a design that is capable of achieving a thermal characterization parameter of $\psi_{JB} = TBD$ °C/W , where *JB* refers to the junction between the module and the bottom side of the main PCB characterization parameter.

Use the following hardware techniques to further improve thermal dissipation in the module and optimize its performance in customer applications:

- Maximize the return loss of the antenna to reduce reflected RF power to the module.
- Improve the efficiency of any component that generates heat, including power supplies and processor, by dissipating it evenly throughout the application device.
- Provide sufficient ventilation in the mechanical enclosure of the application.
- For continuous operation at high temperatures, particularly in high-power density applications or smaller PCB sizes, include a heat sink on the bottom side of the main PCB. The heat sink is best connected using electrically insulated / high thermal conductivity adhesive⁶.

3.9 ESD guidelines

The modules are manufactured using a highly automated process, which complies with IEC61340-5-1 [6] (STM5.2-1999 Class M1 devices) standard. Customer on-site manufacturing processes that satisfy the basic ESD control program are sufficient to comply with the necessary precautions⁷ for handling the modules.

In compliance with the following European regulations, designers must implement proper protection measures against ESD events on any pin exposed to end users:

- ESD testing standard CENELEC EN 61000-4-2 [4]
- Radio equipment standard ETSI EN 301 489-1 [5]

The minimum requirements as per these European regulations are summarized in [Table 24](#).

Application	Category	Immunity level
All exposed surfaces of the radio equipment and any ancillary equipment in the end product.	Contact discharge	4 kV
	Air discharge	8 kV

Table 24: Minimum ESD immunity requirements based on EN 61000-4-2

Compliance with the protection levels specified in EN 61000-4-2 [4] are fulfilled by including proper ESD protection in parallel to any susceptible trace that is close to areas accessible to end users.

⁶ Typically not required.

⁷ Minimum ESD protection level for safe handling is specified in JEDEC JEP155 (HBM) and JEP157 (CDM) for ± 500 V and ± 250 V respectively.

-  Special care should be taken with the **RF_ANT** pins that, if exposed, might be needed to be protected with an ESD absorber with adequate parasitic capacitance. For 5/6 GHz operation, a protection with maximum internal capacitance of 0.1 pF is advised.

3.10 Design-in checklists

3.10.1 Schematic checklist

- ☐ Check that the module pins have been properly numbered and designated in the schematic (including thermal pins). See [Pin list](#).
- ☐ Power supply design complies with the voltage supply requirements in [Module supply design](#) and the power supply requirements described in the module data sheet [1].
- ☐ The [Power-up sequence](#) has been properly implemented.
- ☐ Adequate bypassing has been included in front of each power pin. See [Power-up sequence](#).
- ☐ Each signal group is consistent with its own power rail supply or proper signal translation has been provided. See [Pin list](#).
- ☐ Configuration pins are properly set at bootstrap. See [Configuration pins](#).
- ☐ SDIO bus includes series resistors and pull-ups, if needed. See also [Figure 10](#) and [SDIO 3.0 interface](#).
- ☐ Unused pins are properly terminated. See [Unused pins](#).
- ☐ A pi-filter is provided in front of each antenna for final matching. [High-speed UART interface](#).
- ☐ Additional RF co-location filters have been considered in the design. See block diagrams in the module data sheet [1].

3.10.2 Layout checklist

- ☐ PCB stack-up and controlled impedance traces follow the recommendations given by the PCB manufacturer. See [RF transmission line design](#).
- ☐ All pins are properly connected, and the footprint follows u-blox pin design recommendations. See [Module footprint and paste mask](#).
- ☐ Proper clearance has been provided between the RF and digital sections of the design. See [Layout and manufacturing](#).
- ☐ Proper isolation has been provided between antennas (RF co-location, diversity, or multi-antenna design). See [Layout and manufacturing](#).
- ☐ Bypass capacitors have been placed close to the module. See [Component placement](#).
- ☐ Low impedance power path has been provided to the module. See [Component placement](#).
- ☐ Controlled impedance traces have been properly implemented in the layout (both RF and digital) and the recommendations provided by the PCB manufacturer have been followed. See [RF transmission line design](#) and [Component placement](#).
- ☐ 50 Ω RF traces and connectors follow the rules described in [Antenna design](#).
- ☐ RF keep-out area has been implemented for MAYA-W3 variants using the internal antenna.
- ☐ Antenna integration has been reviewed by the antenna manufacturer.
- ☐ Proper grounding has been provided to the module for the low impedance return path and heat sink. See [Layout and manufacturing](#).
- ☐ Reference plane skipping has been minimized for high frequency busses. See [Layout and manufacturing](#).
- ☐ All traces and planes are routed inside the area defined by the main ground plane. See [Layout and manufacturing](#).
- ☐ u-blox has reviewed and approved the PCB⁸.

⁸ This is applicable only for end-products based on u-blox reference designs.

4 Module migration

MAYA-W3 is possible to migrate from MAYA-W1 and MAYA-W2. These modules have identical mechanical dimensions and footprint. The pin out is with minor exemptions generic. This allows for making a common design compatible with different modules by using assembly options of external components.

For detailed information, carefully study the [Module integration](#) and [Design-in](#).

4.1 Host interface compatibility

The supported interface versions, along with their electrical parameters are defined in the data sheet [1]. Observe the following when implementing the host interfaces into the application product.

- SDIO. Implement the correct voltage for the migrating design whether it is 1.8 V or 3.3 V. Use a level shifter if needed to change interface voltage.
- PCIe. Implement the correct interface impedance and voltage. This is defined by the version of the interface and shown in the module data sheet [1]. Commonly, u-blox modules implement the same or compatible version. PCIe is backwards compatible unless otherwise stated.
- UART, has a single implementation which is compatible with all u-blox modules.
- PCM / I2S, has a single implementation which is compatible with all u-blox modules.
- SPI, has a single implementation which is compatible with all u-blox modules.

4.1.1 Interface configuration

All modules use configuration pins to select the chosen interfaces. These pins are probed during boot-up. Implement pull-down resistors on all configuration pins that shall be set low for any of the used modules. Populate the resistors according with used module. With no component connected, the default logic state of each pin is high on all modules. See also [Configuration pins](#).

4.2 Power Supply and start-up sequence

Make sure that the power nodes can supply the specified peak current with some margin. If the required voltage level is different between modules it is suggested to select an LDO or SMPS from a standard series that has drop-in compatible variants with different output voltage.



Current consumption figures are described in the Data sheet's Electrical specification section.

Implement the power supplies and power management circuitry to comply with the start-up sequences described in the System integration manuals. It is recommended to implement this either with separate LDOs or voltage switches enabled by host CPU GPIO's. A hardware sequenced designed power management can also be implemented. See also [Power up sequence](#).

4.3 Control signals

Control signals are used to set the module in Power Down state or in Wi-Fi or Bluetooth sleep mode. Control signals to wake up the host CPU are also available.

It is suggested to implement the design with the complete set of signals intended to use and add series 0 Ω resistors to select or not select the wanted control signals according with used module. See also [Wake-up signals](#).

4.4 RF interface

All module's RF interfaces have a nominal impedance of 50 Ω and are interchangeable. Follow the instructions in [RF interface options](#).

4.4.1 Internal antenna

Place a module with internal antenna on the application PCB according with instructions in the system integration manual.

For Niche antenna the module shall be placed on the edge of the application PCB with the antenna facing outwards. Any copper, traces or GND, shall be cleared on all layers beneath the module's antenna area.

For PIFA metal antenna or meander PCB trace antenna the module shall be placed on the edge of the application PCB with the antenna facing outwards. Underneath the antenna the application PCB shall have a full ground plane.

4.4.2 External antenna

Connect external antennas with 50 Ω microstrips and 50 Ω RF connectors. If needed tune the antenna matching PI network components to reach full antenna performance.

If migrating to a module operating in an extended frequency band make sure that the selected antenna covers the intended frequency bands.

4.5 Mechanical design

All modules are mechanically compatible and comply with the same land pattern design. Any deviations are found in each module's Mechanical specification section in the Data sheets.



Slight deviations of mechanical outline might occur.

4.6 Production and handling

The same soldering process and profile applies to all modules.

Consider the defined reflow cycle numbers for the used module if intended for several reflow soldering cycles.

5 Software

The chapter describes the available software options for MAYA-W3 series modules, which are based on the Infineon CYW5551x chipsets. The drivers and firmware required to operate MAYA-W3 series modules are developed by Infineon.



For the latest MAYA-W3 series software deliverables, [contact](#) your local support team.

6 Handling and soldering

⚠ MAYA-W3 series modules are Electrostatic Sensitive Devices that demand the observance of special handling precautions against static damage. Failure to observe these precautions can result in severe damage to the product.

6.1 ESD handling precautions

As the risk of electrostatic discharge in the RF transceivers and patch antennas of the module is of particular concern, standard ESD safety practices are prerequisite. See also [Figure 13](#).

Consider also:

- When connecting test equipment or any other electronics to the module (as a standalone or PCB-mounted device), the first point of contact must always be to local GND.
- Before mounting a patch antenna, connect the device to ground.
- When handling the RF pin, do not touch any charged capacitors. Be especially careful when handling materials like patch antennas (~10 pF), coaxial cables (~50-80 pF/m), soldering irons, or any other materials that can develop charges.
- To prevent electrostatic discharge through the RF input, do not touch any exposed antenna area. If there is any risk of the exposed antenna being touched in an unprotected ESD work area, be sure to implement proper ESD protection measures in the design.
- When soldering RF connectors and patch antennas to the RF pin on the receiver, be sure to use an ESD-safe soldering iron (tip).

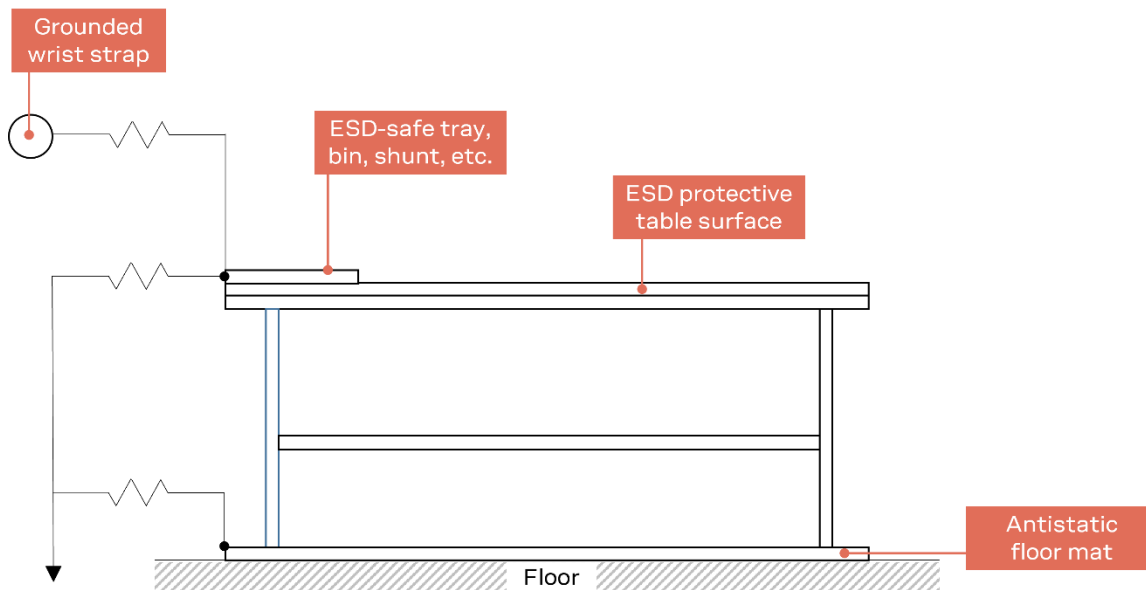


Figure 13: Standard workstation setup for safe handling of ESD-sensitive devices

6.2 Packaging, shipping, storage, and moisture preconditioning

For information pertaining to reels, tapes, or trays, moisture sensitivity levels (MSL), storage, shipment, and drying preconditioning, see the MAYA-W3 series data sheet [\[1\]](#) and the Product packaging guide [\[2\]](#).

6.3 Reflow soldering process



The U.FL connector variants MAYA-W3x0 are suitable for one-time reflow.



Other MAYA-W3 variants are suitable for two time reflow.

MAYA-W3 modules are surface mounted devices supplied on a multi-layer FR4-type PCB with gold-plated connection pads. The modules are produced in a lead-free process using lead-free soldering paste. The thickness of solder resist between the host PCB top side and the bottom side of the MAYA-W3 module must be considered for the soldering process.

MAYA-W3 modules are compatible with industrial reflow profile for RoHS solders, and “no-clean” soldering paste is strongly recommended.

The reflow profile used is dependent on the thermal mass of the entire populated PCB, the heat transfer efficiency of the oven, and the type of solder paste that is used. The optimal soldering profile must be trimmed for the specific process and PCB layout.

A vacuum reflow process is not recommended to use for MAYA-W3 modules.

The target values shown in [Table 25](#) and [Figure 14](#) are given as general guidelines for a Pb-free process only. For further information, see also the JEDEC J-STD-020E [\[7\]](#) standard.

Process parameter		Unit	Target
Pre-heat	Ramp up rate to T_{SMIN}	K/s	3
	T_{SMIN}	°C	150
	T_{SMAX}	°C	200
	t_S (from 25°C)	s	150
	t_S (Pre-heat)	s	110
Peak	T_L	°C	217
	t_L (time above T_L)	s	90
	T_P	°C	245-250
	t_P (time above $T_P - 5^\circ\text{C}$)	s	30
Cooling	Ramp-down from T_L (max)	K/s	6
General	$T_{to\ peak}$	s	300
	Allowed reflow soldering cycles	-	1 (MAYA-W3x0) 2 (MAYA-W3x1, MAYA-W3x3, MAYA-W3x6)

Table 25: Recommended reflow profile

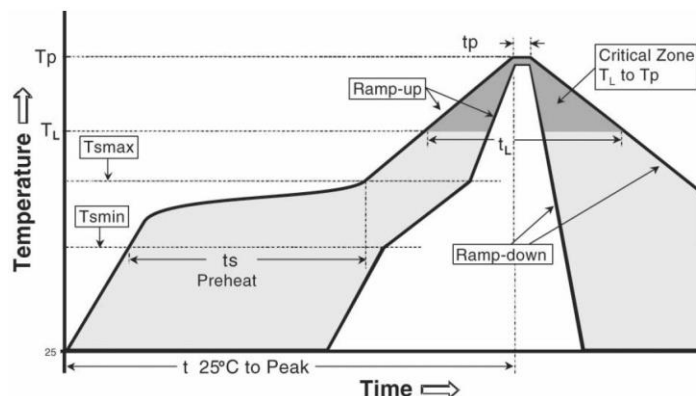


Figure 14: Reflow profile



The lower value of T_P and slower ramp down rate is preferred.

6.3.1 Cleaning

Cleaning the modules is not recommended. Residues underneath the modules cannot be easily removed with a washing process.

- Cleaning with water will lead to capillary effects where water is absorbed in the gap between the baseboard and the module. The combination of residues of soldering flux and encapsulated water leads to short circuits or resistor-like interconnections between neighboring pins. Water will also damage the sticker and the ink-jet printed text.
- Cleaning with alcohol or other organic solvents can result in soldering flux residues flooding into areas that are not accessible for post-wash inspections. The solvent will also damage the label and the ink-jet printed text.
- Ultrasonic cleaning will permanently damage the module and the crystal oscillators in particular. For best results use a “no clean” soldering paste and circumvent the need for a cleaning stage after the soldering process.

6.3.2 Other notes

- Boards with combined through-hole technology (THT) components and surface-mount technology (SMT) devices may require wave soldering to solder the THT components. Only a single wave-soldering process is allowed for boards populated with the modules. Miniature Wave Selective Solder processes are preferred over traditional wave soldering processes.
- Hand-soldering is not recommended.
- Rework is not recommended.
- Conformal coating can affect the performance of the module, which means that it is important to prevent the liquid from flowing into the module. The RF shields do not provide protection for the module from coating liquids with low viscosity; therefore, care is required while applying the coating. Conformal coating of the module will void the warranty.
- Grounding metal covers: Attempts to improve grounding by soldering ground cables, wick, or other forms of metal strips directly onto the EMI covers is done so at the customer’s own risk and will void the module warranty. The numerous ground pins on the module are adequate to provide optimal immunity to interferences.
- The modules contain components which are sensitive to Ultrasonic Waves. Use of any Ultrasonic Processes (cleaning, welding, etc.) may damage the module. The use of ultrasonic processes together with the module will void the warranty.

7 Regulatory compliance

7.1 General requirements

MAYA-W3 series modules are designed to comply with the regulatory demands of Federal Communications Commission (FCC), Innovation, Science and Economic Development Canada (ISED)⁹ and the CE mark. This chapter contains instructions on the process needed for an integrator when including the MAYA-W3 module into an end-product.

- Any deviation from the process described may cause the MAYA-W3 series module not to comply with the regulatory authorizations of the module and thus void the user's authority to operate the equipment.
- Any changes to hardware, hosts or co-location configuration may require new radiated emission and SAR evaluation and/or testing.
- The regulatory compliance of MAYA-W3 does not exempt the end-product from being evaluated against applicable regulatory demands; for example, FCC Part 15B criteria for unintentional radiators [9].
- The end-product manufacturer must follow all the engineering and operating guidelines as specified by the grantee (u-blox).
- The MAYA-W3 is for OEM integrators only.
- Only authorized antenna(s) may be used. Refer to [Pre-approved antennas](#) for the list of authorized antennas. In the end-product, the MAYA-W3 module must be installed in such a way that only authorized antennas can be used.
- The end-product must use the specified antenna trace reference design, as described in the MAYA-W3 antenna reference design application note [14].
- Any notification to the end user about how to install or remove the integrated radio module is NOT allowed.

 If these conditions cannot be met or any of the operating instructions are violated, the u-blox regulatory authorization will be considered invalid. Under these circumstances, the integrator is responsible to re-evaluate the end-product including the MAYA-W3 series module and obtain their own regulatory authorization, or u-blox may be able to support updates of the u-blox regulatory authorization. See also [Antenna requirements](#).

7.1 European Union regulatory compliance

MAYA-W3 series modules comply with the essential requirements and other relevant provisions of Radio Equipment Directive (RED) 2014/53/EU.

For information about the regulatory compliance of MAYA-W3 series modules against requirements and provisions in the European Union, see the MAYA-W3 Declaration of Conformity [16].

Frequency Band Restriction:

Operation in the 5150–5250 MHz band is restricted to indoor use only in the following countries:

AT, BE, BG, CH, CY, CZ, DE, DK, EE, EL, ES, FI, FR, HR, HU, IE, IS, IT, LI, LT, LU, LV, MT, NL, NO, PL, PT, RO, SE, SI, SK, UK(NI), TR

Frequency bands of operation 2400 to 2483.5 MHz and 5470 to 5725 MHz. Maximum transmit power less than 20 dBm EIRP.

Frequency band of operation 5725 to 5850 MHz. Maximum transmit power less than 14 dBm (25mW) EIRP.

⁹ Formerly known as IC (Industry Canada).

Frequency bands of operation 5150 to 5250 MHz and 5945 to 6425 MHz. Maximum transmit power less than 23 dBm EIRP.

7.1.1 CE End-product regulatory compliance

7.1.1.1 Safety standard

In order to fulfill the safety standard EN 60950-1 [8], the MAYA-W3 module must be supplied with a Class-2 Limited Power Source.

7.1.2 CE Equipment classes

In accordance with Article 1 of Commission Decision 2000/299/EC¹⁰, MAYA-W3 is defined as either Class-1 or Class-2 radio equipment, the end-product integrating MAYA-W3 inherits the equipment class of the module.



For guidance on end product marking in according with RED, see <http://ec.europa.eu/>

 The EIRP of the MAYA-W3 module must not exceed the limits of the regulatory domain that the module operates in. Depending on the host platform implementation and antenna gain, integrators have to limit the maximum output power of the module through the host software. For information about the corresponding maximum transmit power levels of [Pre-approved antennas](#).

7.2 Great Britain regulatory compliance

For information about the regulatory compliance of MAYA-W3 series modules against requirements and provisions in Great Britain, see also the MAYA-W3 UKCA Declaration of Conformity [15].

7.2.1 UK Conformity Assessed (UKCA)

 The United Kingdom is made up of the Great Britain (including England, Scotland, and Wales) and the Northern Ireland. Northern Ireland continues to accept the CE marking. The following notice is applicable to Great Britain only.

MAYA-W3 series modules have been evaluated against the essential requirements of the Radio Equipment Regulations 2017 (SI 2017 No. 1206, as amended by SI 2019 No. 696).

For guidance on end product marking in accordance with UKCA, see <https://www.gov.uk/guidance/using-the-ukca-marking>.

7.3 United states/Canada End-product regulatory compliance

u-blox represents that the modular transmitter fulfills the FCC/ISED regulations when operating in authorized modes on any host product given that the integrator follows the instructions as described in this document. Accordingly, the host product manufacturer acknowledges that all host products referring to the FCC ID or ISED certification number of the modular transmitter and placed on the market by the host product manufacturer need to fulfil all of the requirements mentioned below. Non-compliance with these requirements may result in revocation of the FCC approval and removal of the host products from the market. These requirements correspond to questions featured in the FCC guidance for software security requirements for U-NII devices, FCC OET KDB 594280 D02 [13].

 The modular transmitter approval of MAYA-W3, or any other radio module, does not exempt the end product from being evaluated against applicable regulatory demands.

¹⁰ 2000/299/EC: Commission Decision of 6 April 2000 establishing the initial classification of radio equipment and telecommunications terminal equipment and associated identifiers.

The evaluation of the end product shall be performed with the MAYA-W3 module installed and operating in a way that reflects the intended end product use case. The upper frequency measurement range of the end product evaluation is the 10th harmonic of 5.8 GHz as described in KDB 996369 D04.

The following requirements apply to all products that integrate a radio module:

- Subpart B – UNINTENTIONAL RADIATORS
To verify that the composite device of host and module comply with the requirements of FCC part 15B, the integrator shall perform sufficient measurements using ANSI 63.4-2014.
- Subpart C – INTENTIONAL RADIATORS
It is required that the integrator carries out sufficient verification measurements using ANSI 63.10-2013 to validate that the fundamental and out of band emissions of the transmitter part of the composite device complies with the requirements of FCC part 15C.

When the items listed above are fulfilled, the end product manufacturer can use the authorization procedures as mentioned in Table 1 of 47 CFR Part 15.101, before marketing the end product. This means the customer has to either market the end product under a Suppliers Declaration of Conformity (SdoC) or to certify the product using an accredited test lab.

The description is a subset of the information found in applicable publications of FCC Office of Engineering and Technology (OET) Knowledge Database (KDB). We recommend the integrator to read the complete document of the referenced OET KDB's.

- KDB 178919 D01 Permissive Change Policy
- KDB 447498 D01 General RF Exposure Guidance
- KDB 594280 D01 Configuration Control
- KDB 594280 D02 U-NII Device Security
- KDB 784748 D01 Labelling Part 15 18 Guidelines
- KDB 996369 D01 Module certification Guide
- KDB 996369 D02 Module Q&A
- KDB 996369 D04 Module Integration Guide

7.3.1 United States compliance statement (FCC)

Table 26 shows the FCC IDs allocated to MAYA-W3 series modules.

Model	FCC ID
MAYA-W381-00B	XPYMAYAW3A
MAYA-W382-00B	XPYMAYAW3A
MAYA-W383-00B	XPYMAYAW3A
MAYA-W386-00B	XPYMAYAW3A
MAYA-W361-00B	XPYMAYAW3A
MAYA-W362-00B	XPYMAYAW3A
MAYA-W363-00B	XPYMAYAW3A
MAYA-W366-00B	XPYMAYAW3A
MAYA-W331-00B	XPYMAYAW3A
MAYA-W332-00B	XPYMAYAW3A
MAYA-W333-00B	XPYMAYAW3A
MAYA-W336-00B	XPYMAYAW3A

Table27: FCC IDs for different variants of MAYA-W3 series modules

MAYA-W3 series modules have modular approval and comply 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.

 Any changes or modifications NOT explicitly APPROVED by u-blox could cause the MAYA-W3 series module to cease to comply with FCC rules part 15 thus void the user's authority to operate the equipment.

The internal / external antenna(s) used for this module must provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

For FCC end product labeling requirements, see End product labeling requirements.

7.3.2 Canada compliance statement (ISED)

MAYA-W3 series modules are certified for use in accordance with the Canada Innovation, Science and Economic Development Canada (ISED) Radio Standards Specification (RSS) RSS-247 Issue 2 and RSS-Gen. 7 shows the ISED certification IDs allocated to MAYA-W3 series modules.

Model	ISED ID
MAYA-W381-00B	8595A-MAYAW3A
MAYA-W382-00B	8595A-MAYAW3A
MAYA-W383-00B	8595A-MAYAW3A
MAYA-W386-00B	8595A-MAYAW3A
MAYA-W361-00B	8595A-MAYAW3A
MAYA-W362-00B	8595A-MAYAW3A
MAYA-W363-00B	8595A-MAYAW3A
MAYA-W366-00B	8595A-MAYAW3A
MAYA-W331-00B	8595A-MAYAW3A
MAYA-W332-00B	8595A-MAYAW3A
MAYA-W333-00B	8595A-MAYAW3A
MAYA-W336-00B	8595A-MAYAW3A

Table 27: ISED IDs for different variants of MAYA-W3 series modules

MAYA-W3 series complies with ISED (Innovation, Science and Economic Development Canada)¹¹ license-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.

¹¹ Formerly known as IC (Industry Canada).

-  Any notification to the end user of installation or removal instructions about the integrated radio module is NOT allowed. Unauthorized modification could void authority to use this equipment.

This equipment complies with ISED RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator and your body.

This radio transmitter IC: **8595A-MAYAW3A** has been approved by ISED to operate with the antenna types listed in [Approved antennas](#) with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

-  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.
-  Operation in the 5600–5650 MHz band is not allowed in Canada. High-power radars are allocated as primary users (i.e., priority users) of the bands 5250–5350 MHz and 5650–5850 MHz and that these radars could cause interference and/or damage to LE-LAN devices.

Le présent appareil est conforme aux CNR d'ISED 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.

Cet équipement est conforme aux limites d'exposition de rayonnement d'ISED RSS-102 déterminées pour un environnement non contrôlé. Cet équipement devrait être installé et actionné avec la distance minimum 20 cm entre le radiateur et votre corps.

Cet émetteur radio, IC: **8595A-MAYAW3A** été approuvé par ISED pour fonctionner avec les types d'antenne énumérés dans la section [Approved antennas](#) avec le gain maximum autorisé et l'impédance nécessaire pour chaque type d'antenne indiqué. Les types d'antenne ne figurant pas dans cette liste et ayant un gain supérieur au gain maximum indiqué pour ce type-là sont strictement interdits d'utilisation avec cet appareil.

-  Le dispositif de fonctionnement dans la bande 5150–5250 MHz est réservé à une utilisation en intérieur pour réduire le risque d'interférences nuisibles à la co-canal systèmes mobiles par satellite
-  Opération dans la bande 5600–5650 MHz n'est pas autorisée au Canada. Haute puissance radars sont désignés comme utilisateurs principaux (c.-à-d. utilisateurs prioritaires) des bandes 5250–5350 MHz et 5650–5850 MHz et que ces radars pourraient causer des interférences et / ou des dommages à dispositifs LAN-EL.

The internal / external antenna(s) used for this module must provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

For ISED end product labeling requirements, see [End product labeling requirements](#).

The approval type for all MAYA-W3 series variants is a single modular approval. Due to ISED Modular Approval Requirements (Source: RSP-100 Issue 10), any application which includes the module must be approved by the module manufacturer (u-blox). The application manufacturer must provide design data for the review procedure. prohibited for use with this device.

-  Devices shall not be used for control of or communications with unmanned aircraft systems.
-  Devices shall not be used on oil platforms.

-  Devices shall not be used on aircraft, except for the low-power indoor access points, indoor subordinate devices, low-power client devices, and very low-power devices operating in the 5925-6425 MHz band, that may be used on large aircraft as defined in the [Canadian Aviation Regulations](#), while flying above 3,048 metres (10,000 feet).
-  Devices shall not be used on automobiles.
-  Devices shall not be used on trains.
-  Devices shall not be used on maritime vessels.
-  Client devices shall not be capable of initiating a network
-  Devices shall not connect directly to another standard client device or low-power client device.
-  Devices may transmit brief messages to an access point after detecting a signal confirming that the access point is operating on a particular frequency in order to join the access point's network.

7.3.3 Referring to the u-blox FCC/ISED certification ID

If the [General requirements](#), [United states/Canada End-product regulatory compliance](#) and all [Antenna requirements](#) are met, the u-blox modular FCC/ISED regulatory authorization is valid and the end-product may refer to the u-blox FCC ID and ISED certification number. u-blox may be able to support updates to the u-blox regulatory authorization by adding new antennas to the u-blox authorization for example. See also [Antenna requirements](#).

-  To use the u-blox FCC / ISED grant and refer to the u-blox FCC ID / ISED certification ID, the integrator must confirm with u-blox that all requirements associated with the [Configuration control and software security of end-products](#) are fulfilled.

7.3.4 Obtaining own FCC/ISED certification ID

Integrators who do not want to refer to the u-blox FCC/ISED certification ID, or who do not fulfil all requirements to do so may instead obtain their own certification. With their own certification, the integrator has full control of the grant to make changes.

Integrators who want to base their own certification on the u-blox certification can do so via a process called “Change in ID” (FCC) / “Multiple listing” (ISED). With this, the integrator becomes the grantee of a copy of the u-blox FCC/ISED certification. U-blox will support with an approval letter that shall be filed as a Cover Letter exhibit with the application.

-  For modules where the FCC ID / ISED certification ID is printed on the label, the integrator must replace the module label with a new label containing the new FCC/ISED ID. For a description of the labeling requirements, see also [End product labeling requirements](#).

-  It is the responsibility of the integrator to comply with any upcoming regulatory requirements.

7.3.5 Antenna requirements

In addition to the general requirement to use only authorized antennas, the u-blox grant also requires a separation distance of at least 20 cm from the antenna(s) to all persons. The antenna(s) must not be co-located with any other antenna or transmitter (simultaneous transmission) as well. If this cannot be met, a Permissive Change as described below must be made to the grant.



To support verification activities that may be required by certification laboratories, customers applying for Class-II Permissive changes must implement the setup described in the radio test guide application note.

7.3.5.1 Separation distance

If the required separation distance of 20 cm cannot be fulfilled, a SAR evaluation must be performed. This consists of additional calculations and/or measurements. The result must be added to the grant file as a Class II Permissive Change.

7.3.5.2 Co-location (simultaneous transmission)

If the module is to be co-located with another transmitter, additional measurements for simultaneous transmission are required. The results must be added to the grant file as a Class II Permissive Change.

7.3.5.3 Adding a new antenna for authorization

If the authorized antennas and/or antenna trace design cannot be used, the new antenna and/or antenna trace designs must be added to the grant file. This is done by a Class I Permissive Change or a Class II Permissive Change, depending on the specific antenna and antenna trace design.

- Antennas of the same type and with less or same gain as those included in the list of [Pre-approved antennas](#) can be added under a Class I Permissive Change.
- Antenna trace designs deviating from the u-blox reference design and new antenna types are added under a Class II Permissive Change.
- For 5 GHz modules, the combined minimum gain of antenna trace and antenna must be greater than 0 dBi to comply with DFS testing requirements.

 Integrators intending to refer to the u-blox FCC ID / ISED certification ID must [contact](#) their local support team to discuss the Permissive Change Process. Class II Permissive Changes are subject to NRE costs.

7.3.6 Configuration control and software security of end-products



“Modular transmitter” hereafter refers to MAYA-W3xx (FCC ID : XPYMAYAW3A.).

As the end-product must comply with the requirements addressed by the OET KDB 594280 [12], the host product integrating the MAYA-W3 must comply with the following requirements:

- Upon request from u-blox, the host product manufacturer will provide all of the necessary information and documentation to demonstrate how the requirements listed below are met.
- The host product manufacturer will not modify the modular transmitter hardware.
- The configuration of the modular transmitter when installed into the host product must be within the authorization of the modular transmitter at all times and cannot be changed to include unauthorized modes of operation through accessible interfaces of the host product. The [Wi-Fi Tx output power limits](#) must be followed. In particular, the modular transmitter installed in the host product will not have the capability to operate on the operating channels/frequencies referred to in the section(s) below, namely one or several of the following channels: 12 (2467 MHz), 13 (2472 MHz), 120 (5600 MHz), 124 (5620 MHz), and 128 (5640 MHz). The channels 12 (2467 MHz), 13 (2472 MHz), 120 (5600 MHz), 124 (5620 MHz), and 128 (5640 MHz) are allowed to be used only for modules that are certified for the usage (“modular transmitter”). Customers must verify that the module in use is certified as supporting DFS client/master functionality.
- The host product uses only authorized firmware images provided by u-blox and/or by the manufacturer of the RF chipset used inside the modular transmitter.
- The configuration of the modular transmitter must always follow the requirements specified in [Operating frequencies](#) and cannot be changed to include unauthorized modes of operation through accessible interfaces of the host product.

- The modular transmitter must when installed into the host product have a regional setting that is compliant with authorized US modes and the host product is protected from being modified by third parties to configure unauthorized modes of operation for the modular transmitter, including the country code.
- The host product into which the modular transmitter is installed does not provide any interface for the installer to enter configuration parameters into the end product that exceeds those authorized.
- The host product into which the modular transmitter is installed does not provide any interface to third parties to upload any unauthorized firmware images into the modular transmitter and prevents third parties from making unauthorized changes to all or parts of the modular transmitter device driver software and configuration.

 OET KDB 594280 D01 [12] lists the topics that must be addressed to ensure that the end-product specific host meets the Configuration Control requirements.

 OET KDB 594280 D02 [13] lists the topics that must be addressed to ensure that the end-product specific host meets the Software Security Requirements for U-NII Devices.

7.3.7 Operating frequencies

MAYA-W3 802.11b/g/n/ax operation outside the 2412–2462 MHz band is prohibited in the US and Canada and 802.11a/n/ac/ax operation in the 5600–5650 MHz band is prohibited in Canada. Configuration of the module to operate on channels 12–13 and 120–128 must be prevented accordingly.

Transmitters in the 5.925–7.125 GHz band are prohibited from operating to control or communicate with unmanned aircraft systems, including drones.

The channels allowed while operating under the definition of a master or client device¹² are described in Table 26.

The transmit power tolerance in all frequency bands and in the temperature range from –40°C to +85°C is +2 dB/-3 dB.

Channel number	Channel center frequency [MHz]	Master device	Client device	Remarks
1 – 11	2412 – 2462	Yes	Yes	
12 – 13	2467 – 2472	No	No	
36 – 48	5180 – 5240	Yes	Yes	Canada (ISED): Devices are restricted to indoor operation only and the end product must be labelled accordingly.
52 – 64	5260 – 5320	No	Yes	
100 – 116	5500 – 5580	No	Yes	
120 – 128	5600 – 5640	No	No	USA (FCC): Client device operation allowed under KDB 905462
132 – 144	5660 – 5720	No	Yes	
149 – 165	5745 – 5825	Yes	Yes	
U-NII-5	5925 – 6425	Yes	Yes	Low-power access point (indoor only) and standard-power access point (AFC controlled)
U-NII-6	6425 – 6525	Yes	Yes	Low-power access point (indoor only)
U-NII-7	6525 – 6875	Yes	Yes	Low-power access point (indoor only) and standard-power access point (AFC controlled)
U-NII-8	6875 – 7125	Yes	Yes	Low-power access point (indoor only)

Table 26: Allowed channel usage under FCC/ISED regulation

¹² 47 CFR §15.202



15.407 (j) Operator Filing Requirement:

Before deploying an aggregate total of more than one thousand outdoor access points within the 5.15–5.25 GHz band, parties must submit a letter to the Commission acknowledging that, should harmful interference to licensed services in this band occur, they will be required to take corrective action. Corrective actions may include reducing power, turning off devices, changing frequency bands, and/or further reducing power radiated in the vertical direction. This material shall be submitted to Laboratory Division, Office of Engineering and Technology, Federal Communications Commission, 7435 Oakland Mills Road, Columbia, MD 21046. Attn: U-NII Coordination, or via Web site at <https://www.fcc.gov/labhelp> with the subject line: “U-NII-1 Filing”.

7.3.8 End product labeling requirements

For an end-product using the MAYA-W3, there must be a label containing, at least, the following information:

This device contains FCC ID: (XYZ)(UPN) IC: (CN)-(UPN)
--

(XYZ) represents the FCC “Grantee Code”, this code may consist of Arabic numerals, capital letters, or other characters, the format for this code will be specified by the Commission’s Office of Engineering and Technology¹⁴. (CN) is the Company Number registered at ISED. (UPN) is the Unique Product Number decided by the grant owner.

The label must be affixed on an exterior surface of the end product such that it will be visible upon inspection in compliance with the modular labeling requirements of OET KDB 784748. The host user manual must also contain clear instructions on how end users can find and/or access the FCC ID of the end product.

The label on the MAYA-W3 module containing the original FCC ID acquired by u-blox can be replaced with a new label stating the end-product’s FCC/ISED ID in compliance with the modular labeling requirements of OET KDB 784748.

FCC end product labeling

The outside of final products containing the MAYA-W3 module must display in a user accessible area a label referring to the enclosed module. This exterior label can use wording such as the following: “Contains Transmitter Module FCC ID: XPYMAYAW3A” or “Contains FCC ID: XPYMAYAW3A”.

In accordance with 47 CFR § 15.19, the end product shall bear the following statement in a conspicuous location on the device:

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

ISED end product labeling

The ISED certification label of a module shall be clearly visible at all times when installed in the host device; otherwise, the host device must be labeled to display the ISED certification number for the module, preceded by the words “Contains transmitter module”, or the word “Contains”, or similar wording expressing the same meaning, as follows: “Contains transmitter module IC: 8595A-MAYAW3A”.

¹⁴ 47 CFR 2.926

L'étiquette d'homologation d'ISED d'un module donné doit être posée sur l'appareil hôte à un endroit bien en vue en tout temps. En l'absence d'étiquette, l'appareil hôte doit porter une étiquette sur laquelle figure le numéro d'homologation du module d'ISED, précédé des mots « Contient un module d'émission », ou du mot « Contient », ou d'une formulation similaire allant dans le même sens et qui va comme suit : « Contient le module d'émission IC: 8595A-MAYAW3A.

The end product shall bear the following statement in both English and French in a conspicuous location on the device:

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

Son utilisation est soumise aux deux conditions suivantes :
Cet appareil ne doit pas causer d'interférences et
il doit accepter toutes interférences reçues, y compris celles susceptibles d'avoir des effets indésirables sur son fonctionnement.

Labels of end products capable to operate within the band 5150–5250 MHz shall also include:

For indoor use only

Pour usage intérieur seulement

When the device is so small or for such use that it is not practicable to place the statements above on it, the information shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC/ISED ID label must be displayed on the device as described above.

In case, where the final product will be installed in locations where the end-consumer is unable to see the FCC/ISED ID and/or this statement, the FCC/ISED ID and the statement shall also be included in the end-product manual.

7.4 Japan radio equipment compliance

7.4.1 Compliance statement

MAYA-W3 series modules comply with the Japanese Technical Regulation Conformity Certification of Specified Radio Equipment (ordinance of MPT N°. 37, 1981), Article 2, Paragraph 1:

- Item (19) “Low power data communications system in the 2.4GHz band (2400-2483.5MHz)”
- Item (19)-3 “Low power data communications system in the 5GHz band”
- Item (19)-3 “Low power data communications system in the 6GHz band”

Japan Indoor Use Statement: The MAYA-W3 series module is restricted on the Japanese market to be used indoors only if the product is operating in the 5.2/5.3 GHz band (W52, W53).

[Table](#) shows the Giteki certification IDs allocated to MAYA-W3 series modules.

Model	Giteki ID
MAYA-W331, MAYA-W330	MIC ID: R 003-250218, MIC ID: T P250200003
MAYA-W366	MIC ID: R 003-250217, MIC ID: T P250199003
MAYA-W363, MAYA-W362	MIC ID: R 003-250216, MIC ID: T P250198003
MAYA-W361, MAYA-W360	MIC ID: R 003-250215, MIC ID: T P250197003
MAYA-W382, MAYA-W383	MIC ID: R 003-250214, MIC ID: T P250196003
MAYA-W386	MIC ID: R 003-250213, MIC ID: T P250195003
MAYA-W381, MAYA-W380	MIC ID: R 003-250212, MIC ID: T P250194003
MAYA-W336	MIC ID: R 003-250220, MIC ID: T P250202003

Table 27: Giteki IDs for different variants of MAYA-W3 series modules

7.4.2 End product labelling requirement

End products based on MAYA-W3 series modules and targeted for distribution in Japan must be affixed with a label with the “Giteki” marking, as shown in Figure 15. The “Indoor use only” information translated into Japanese below is mandatory if the product is operating in the 5.2/5.3 GHz band. The marking must be visible for inspection.

MAYA-W331 and MAYA-W330:  R T 003-250218 P250200003 この製品は屋内においてのみ使用可能です	MAYA-W366:  R T 003-250217 P250199003 この製品は屋内においてのみ使用可能です
MAYA-W363 and MAYA-W362:  R T 003-250216 P250198003 この製品は屋内においてのみ使用可能です	MAYA-W361 and MAYA-W360:  R T 003-250215 P250197003 この製品は屋内においてのみ使用可能です
MAYA-W382 and MAYA-W383:  R T 003-250214 P250196003 この製品は屋内においてのみ使用可能です	MAYA-W386:  R T 003-250213 P250195003 この製品は屋内においてのみ使用可能です
MAYA-W381 and MAYA-W380:  R T 003-250212 P250194003 この製品は屋内においてのみ使用可能です	MAYA-W336:  R T 003-250220 P250202003 この製品は屋内においてのみ使用可能です
MAYA-W333 and MAYA-W332  R T 003-250219 P250201003 この製品は屋内においてのみ使用可能です	

Figure 15: Giteki **R** and **T** marks with the MAYA-W2 MIC certification numbers

7.5 Pre-approved antennas

Refer to the MAYA-W3 antenna reference design application note for the specifications that must be fulfilled in the end product that uses radio type approval of the MAYA-W3 module. The MAYA-W3 antenna reference design application note provides PCB layout details and electrical specifications.

For Bluetooth and Wi-Fi operation in the 2.4 GHz band and Wi-Fi operation in the 5 GHz and 6 GHz bands, MAYA-W3 has been tested and approved for use with the external antennas listed below for the following variants: MAYA-W381-00B, MAYA-W382-00B, MAYA-W383-00B, MAYA-W361-00B, MAYA-W362-00B, MAYA-W363-00B, MAYA-W331-00B, MAYA-W332-00B, MAYA-W333-00B

Manufacturer	Part number	Antenna type	Peak gain [dBi] / band			Validated regulatory domain
			2.4 GHz	5 GHz	6 GHz	
Linx Technologies	ANT-DB1-RAF-RPS	Dipole antenna	4.1	5.1	4.8	US/Canada/ EU/Great Britain (FCC/ISED/RED/UKCA)
Chang Hong	DA-2458-02-SMR	Dipole antenna	2.85	2.17		US/Canada/ EU/Great Britain (FCC/ISED/RED/UKCA)
TE Connectivity	001-0012	Dipole antenna	2	2		US/Canada/ EU/Great Britain (FCC/ISED/RED/UKCA)
Taoglas	GW.59.3153	Dipole antenna	3.8	5.3	5.6	US/Canada/ EU/Great Britain (FCC/ISED/RED/UKCA)
Laird	MAF94051	Dipole antenna	2.1	3.4		US/Canada/ EU/Great Britain (FCC/ISED/RED/UKCA)
Molex	1461530050	PCB patch	3.2	4.25	5.8	US/Canada/ EU/Great Britain (FCC/ISED/RED/UKCA)
Molex	2042810100	PCB patch	2	3.3	4.5	US/Canada/ EU/Great Britain (FCC/ISED/RED/UKCA)
Unictron	H2B1PD1A1C385L	PCB patch	2.7	3.5		US/Canada/ EU/Great Britain (FCC/ISED/RED/UKCA)
Laird	EFB2471A3S	PCB patch	2.2	3.9	3.8	US/Canada/ EU/Great Britain (FCC/ISED/RED/UKCA)
Taoglas	PC17.07.0070A	PCB patch	0.9			US/Canada/ EU/Great Britain (FCC/ISED/RED/UKCA)
Taoglas	FXP75.07.0045B	PCB patch	2.5			US/Canada/ EU/Great Britain (FCC/ISED/RED/UKCA)

Table 28: List of approved external antennas

For Bluetooth and Wi-Fi operation in the 2.4 GHz band and Wi-Fi operation in the 5 GHz and 6 GHz bands, MAYA-W3 has been tested and approved for use with the internal antenna listed below for the following variants: MAYA-W386-00B, MAYA-W366-00B, MAYA-W336-00B

Manufacturer	Part number	Antenna type	Peak gain [dBi] / band			Validated regulatory domain
			2.4 GHz	5 GHz	6 GHz	
u-blox (Abracon licence)	u-blox PCB Trace Antenna	PCB antenna	-1.34	2.41	3.42	US/Canada/ EU/Great Britain (FCC/ISED/RED/UKCA)

Table 29: List of approved external antennas

8 Product testing

8.1 u-blox in-line production testing

As part of our focus on high quality products, u-blox maintain stringent quality controls throughout the production process. This means that all units in our manufacturing facilities are fully tested and that any identified defects are carefully analyzed to improve future production quality.

The Automatic test equipment (ATE) deployed in u-blox production lines logs all production and measurement data – from which a detailed test report for each unit can be generated. [Figure 16](#) shows the ATE typically used during u-blox production.

u-blox in-line production testing includes:

- Digital self-tests (firmware download, MAC address programming)
- Measurement of voltages and currents
- Functional tests (host interface communication)
- Digital I/O tests
- Measurement and calibration of RF characteristics in all supported bands, including RSSI calibration, frequency tuning of reference clock, calibration of transmitter power levels, etc.
- Verification of Wi-Fi and Bluetooth RF characteristics after calibration, like modulation accuracy, power levels, and spectrum, are checked to ensure that all characteristics are within tolerance when the calibration parameters are applied.



Figure 16: Automatic test equipment for module test

8.2 OEM manufacturer production test

As all u-blox products undergo thorough in-series production testing prior to delivery, OEM manufacturers do not need to repeat any firmware tests or measurements that might otherwise be necessary to confirm RF performance. Testing over analog and digital interfaces is also unnecessary during an OEM production test.

OEM manufacturer testing should ideally focus on:

- Module assembly on the device; it should be verified that:
 - Soldering and handling process did not damage the module components
 - All module pins are well soldered on the application board
 - There are no short circuits between pins
- Component assembly on the device; it should be verified that:
 - Communication with host controller can be established
 - The interfaces between module and device are working
 - Overall RF performance test of the device including antenna

In addition to this testing, OEMs can also perform other dedicated tests to check the device. For example, the measurement of module current consumption in a specified operating state can identify a short circuit if the test result deviates that from that taken against a “Golden Device”.

The standard operational module firmware and test software on the host can be used to perform functional tests (communication with the host controller, check interfaces) and perform basic RF performance testing. Special manufacturing firmware can also be used to perform more advanced RF performance tests.

Appendix

A Wi-Fi transmit output power limits

A.1 FCC/ISED regulatory domain

Table 27 to Table 29 list the maximum allowable conducted output power limits for operation in the FCC/ISED regulatory domains. The output power limits are applicable with the pre-approved antennas listed in section 6.4.

A.1.1 Wi-Fi output power for 2.4 GHz band

- MAYA-W381-00B and MAYA-W386-00B

Channel	802.11b	802.11g	802.11n 20 MHz	802.11ax 20 MHz
1	18	16	16	16
2	18	17	17	17
3	18	18	18	18
4	18	18	18	18
5	18	18	18	18
6	18	18	18	18
7	18	18	18	18
8	18	18	18	18
9	18	18	18	18
10	18	17	17	17
11	18	16	15	16

Table 27: FCC / ISED Wi-Fi power table for operation in the 2.4 GHz band

A.1.2 Wi-Fi output power for 5 GHz band

- MAYA-W381-00B and MAYA-W386-00B

Channel	802.11a	802.11n 20 MHz	802.11ac 20 MHz	802.11ax 20 MHz
36	14	14	14	14
40	14	14	14	14
44	14	14	14	14
48	14	14	14	14
52	15	15	15	15
56	15	15	15	15
60	15	15	15	15
64	14	14	14	14
100	14	12	13	13
104	15	15	15	14
108	15	15	15	15
112	15	15	15	15
116	15	15	15	15
120	15	15	15	15
124	15	15	15	15
128	15	15	15	15
132	15	15	15	15
136	15	15	15	15
140	14	11	13	12
144	15	15	15	15
149	15	15	15	15
153	15	15	15	15
157	15	15	15	15
161	15	15	15	15
165	15	15	15	15

Table 28: FCC / ISSED Wi-Fi power table for operation in the 5 GHz band

A.1.3 Wi-Fi output power for 6 GHz band

- MAYA-W381-00B and MAYA-W386-00B

Channel	802.11ax 20 MHz
1	3
5 - 89	3
93	3
97	3
101 - 109	3
113	3
117	3
121 - 177	3
181	3
185	3
189	3
193 - 229	3
233	-7

Table 29: FCC / ISSED Wi-Fi power table for operation in the 6 GHz band

A.2 RED regulatory domain

Table 30 and Table 31Error! Reference source not found. list the maximum allowable conducted output power limits for operation in the RED/UKCA regulatory domains. The output power limits are applicable with the pre-approved antennas listed in section 6.4 *for all MAYA-W3 variants*.

A.2.1 Wi-Fi output power for 2.4 GHz band EN 300 328

Channels	802.11b	802.11g	802.11n 20 MHz	802.11ac 20 MHz	802.11ax 20 MHz
SISO	11	15	15	-	15
MIMO	-	-	-	-	-

Table 30: RED Wi-Fi power table for operation in the 2.4 GHz band

A.2.2 Wi-Fi output power for 5 GHz band EN 301 893

Channels	802.11a	802.11n 20 MHz	802.11ac 20 MHz	802.11ax 20 MHz
SISO	10	10	10	10
MIMO	-	-	-	-

Table 31: RED Wi-Fi power table for operation in the 5 GHz band

A.2.3 Wi-Fi output power for 5 GHz band EN 300 440

Channels	802.11a	802.11n 20 MHz	802.11ac 20 MHz	802.11ax 20 MHz
SISO	7	7	7	7
MIMO	-	-	-	-

Table 32: RED Wi-Fi power table for operation in the 5 GHz band

A.2.4 Wi-Fi output power for 6 GHz band EN 303 687

Channels	802.11a	802.11n 20 MHz	802.11ac 20 MHz	802.11ax 20 MHz
SISO	-	-	-	13
MIMO	-	-	-	-

Table 33: RED Wi-Fi power table for operation in the 5 GHz band

B Glossary

Abbreviation	Definition
AEC	Automotive Electronics Council
AP	Access Point
API	Application Programming Interface
ATE	Automatic Test Equipment
BT	Bluetooth
CDM	Charged Device Model
CE	European Conformity
CTS	Clear to Send
DC	Direct Current
DDR	Double Data Rate
DFS	Dynamic Frequency Selection
DHCP	Dynamic Host Configuration Interface
EDR	Enhanced Data Rate
EEPROM	Electrically Erasable Programmable Read-Only Memory
EIRP	Equivalent Isotropic Radiated Power
EMI	Electromagnetic Interference
ESD	Electro Static Discharge
ESL	Equivalent Series Inductance
ESR	Equivalent Series Resistance
FCC	Federal Communications Commission
GND	Ground
GPIO	General Purpose Input/Output
HBM	Human Body Model
HS	High-Speed
HCI	Host Controller Interface
ISED	Innovation, Science and Economic Development Canada
I2C	Inter-Integrated Circuit
KDB	Knowledge Database
LAN	Local Area Network
LDO	Low Drop Out
LED	Light-Emitting Diode
LPO	Low Power Oscillator
LTE	Long Term Evolution
MAC	Medium Access Control
MMC	Multi Media Card
MWS	Mobile Wireless Standards
NRE	Non-recurring engineering
NSMD	Non Solder Mask Defined
OEM	Original equipment manufacturer
OET	Office of Engineering and Technology
OS	Operating System
PCB	Printed Circuit Board
PCI	Peripheral Component Interconnect

Abbreviation	Definition
PCIe	PCI Express
PCM	Pulse-code modulation
PHY	Physical layer (of the OSI model)
PMU	Power Management Unit
RF	Radio Frequency
RSDB	Real Simultaneous Dual Band
RST	Request to Send
SDIO	Secure Digital Input Output
SMD	Solder Mask Defined
SMPS	Switching Mode Power Supply
SMT	Surface-Mount Technology
SSID	Service Set Identifier
STA	Station
TBD	To be Decided
THT	Through-Hole Technology
UART	Universal Asynchronous Receiver-Transmitter
VCC	IC power-supply pin
VIO	Input offset voltage
VSDB	Virtual Simultaneous Dual Band
VSWR	Voltage Standing Wave Ratio
WFD	Wi-Fi Direct
WLAN	Wireless local area network
WPA	Wi-Fi Protected Access

Table 34: Explanation of the abbreviations and terms used

Related documents

- [1] MAYA-W3 series data sheet, [UBX-22007996](#)
- [2] Product packaging guide, [UBX-14001652](#)
- [3] u-blox Limited Use License Agreement, LULA-M
- [4] IEC EN 61000-4-2 – Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test
- [5] ETSI EN 301 489-1 – Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements
- [6] IEC61340-5-1 – Protection of electronic devices from electrostatic phenomena – General requirements
- [7] JEDEC J-STD-020E – Moisture/Reflow Sensitivity Classification for Nonhermetic Surface Mount Devices
- [8] ETSI EN 60950-1:2006 – Information technology equipment – Safety – Part 1: General requirements
- [9] FCC Regulatory Information, Title 47 – Telecommunication
- [10] JESD51 – Overview of methodology for thermal testing of single semiconductor devices
- [11] Antenna Integration application note, [UBX-18070466](#)
- [12] FCC guidance [594280 D01 Configuration Control v02 r01](#),
- [13] FCC guidance [594280 D02 U-NII Device Security v01r03](#)
- [14] MAYA-W3 antenna reference design application note, [UBX-TBD](#)
- [15] UKCA Declaration of Conformity, [UBX-23009118](#)
- [16] EU Declaration of Conformity, [UBX-23009117](#)



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Revision history

Revision	Date	Name	Comments
R01	16-Feb-2024	Iber, mzes	Initial release
		Iber	MAYA-W331-00B added in Document information. Added High-speed mode in Table 10 and corrected signaling voltage to 1.8 V. Added warning about host CPU pulling SD_DAT[2] low.

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