

M2-JODY-W3

M.2 card for JODY-W3 Wi-Fi 6 and Bluetooth 5.3

Product Manual



Abstract

This technical data sheet describes the M2-JODY-W3 card module which offers 802.11/ac/ax and dual-mode Bluetooth 5.3 in an M.2 Key E form factor. The M2-JODY-W3 card provides all the features and functionality supported in the JODY-W3 module, with the added benefits associated with easy installation and replacement. The card can be inserted in a standard M.2 Key E slot without the need to solder the module on a host or carrier PCB.

Document information

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Initial production	Early production information	Data from product verification. Revised and supplementary data may be published later.
Mass production / End of life	Production information	Document contains the final product specification.

This document applies to the following products:

Product name	Type number	Chipset	IN/PCN reference	Product status
M2-JODY-W377	M2-JODY-W377-00C-00	NXP 88W9098	N/A	Initial production

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1 Functional description

1.1 Overview

The M2-JODY-W3 card features the JODY-W3 multi-radio module, based on the NXP 88W9098 chipset. The type 2230 Key E M.2 card supports all features and functionality of the module on a convenient expansion card that plugs directly to the host platform.

Even though the M2-JODY-W3 card is of standard grade, the module variant used on the card is the JODY-W377-00B professional grade module.

1.2 Product features

As the M2-JODY-W3 card supports all the features that the integrated JODY-W3 module supports, this document aims to describe the extended features of the M2-JODY-W3 card specifically. For more information about the JODY-W3 module, see the JODY-W3 series datasheet [1]. Table 1 describes the features of card.

	M2-JODY-W377
Grade	
Automotive	
Professional	
Standard	•
Radio	
Bluetooth qualification	v5.3
Bluetooth profiles	HCI
Bluetooth BR/EDR	•
Bluetooth Low Energy	•
Wi-Fi IEEE 802.11 standards	Wi-Fi 6 (802.11ax)
Wi-Fi 2.4 / 5 [GHz]	2.4 and 5
LTE filter	•
Bluetooth output power conducted [dBm]	10
Wi-Fi output power conducted [dBm]	19
Antenna type	3 U.FL connectors
OS support	
Android / Linux drivers (from u-blox)	•
Interfaces	
UART ^B	1
PCIe ^W	1
SDIO [version]	v3*
PCM / I2S (Bluetooth audio)	1
Features	
Micro Access Point [max connects]	64
AES hardware support	•
Wi-Fi direct	•
RF parameters in OTP memory	•
MAC addresses in OTP memory	•
Concurrent dual band	•

B = For Bluetooth only
W = For Wi-Fi only

* = Requires minor hardware modification

Table 1: Key features of the M2-JODY-W3 card module

1.3 Product description

Product name	Description
M2-JODY-W3	Standard grade M.2 card module with three antenna connectors and concurrent dual-band 2x2 2.4 GHz and 5 GHz 802.11 ax, Bluetooth/Bluetooth Low Energy (LE) 5.3. NXP chipset 88W9098.

Table 2: Product description

1.4 Block diagram

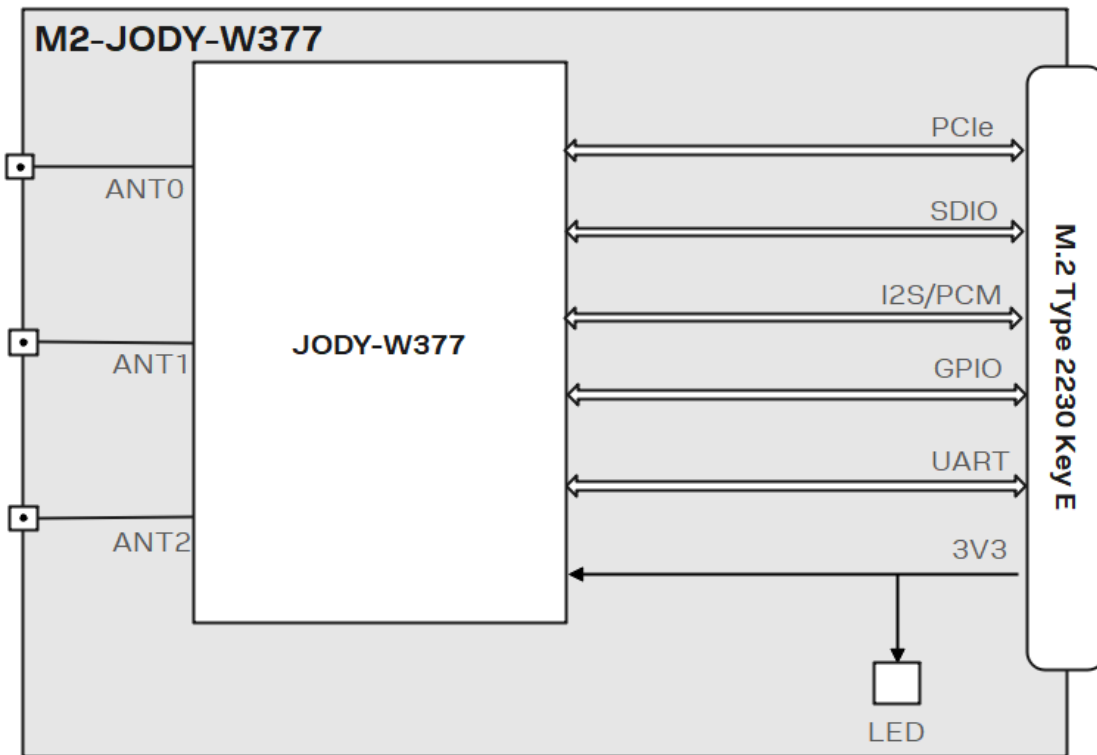


Figure 1: Block diagram of the M2-JODY-W3 card module

2 Interfaces

The M2-JODY-W3 card supports all JODY-W3 module interfaces. For more information about these interfaces, see the JODY-W3 series data sheet [\[1\]](#).

2.1 Boot configuration pins

By default, the M2-JODY-W3 card is configured for using the PCIe interface for Wi-Fi and the UART interface for Bluetooth.

Host interface selection and firmware boot options are selected using the JODY-W3 module configuration pins (CONFIG[2:0]). The configuration settings for the available boot options are shown in [Table 3](#).

Pin name	Pin numbers	Configuration settings		
		Strap value	Wi-Fi	Bluetooth
CONFIG[2:0]	6, 7, 8	000	SDIO	UART
		001	Reserved	reserved
		010*	Reserved	reserved
		011	PCIe	UART
		100	Reserved	reserved
		101	Reserved	reserved
		110	Reserved	reserved
		111	Reserved	reserved

Table 3: Firmware boot options of the JODY-W3 module

The M2-JODY-W3 card supports the same boot options as the JODY-W3 module. To set any CONFIG[2:0] configuration pin to logic-low level (“0”), it must be pulled down with a 51 kΩ resistor to GND. JODY-W3 has internal pull-up resistors and as a result, no external pull-up resistors is required to set a configuration pin to logic-high level (“1”).

Figure 2 shows the “011” default configuration used to select the PCIe interface for Wi-Fi and UART interface for Bluetooth.

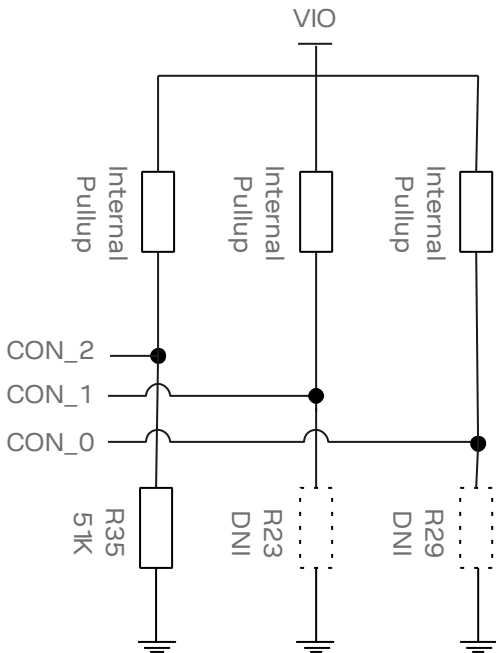


Figure 2: Default configuration of the M2-JODY-W3 boot pins

Figure 3 shows the physical locations of pulldown resistor positions, R23, R29 and R35. Mount resistors R23 and R29 to configure the host interface for Wi-Fi over SDIO and Bluetooth over UART operation.

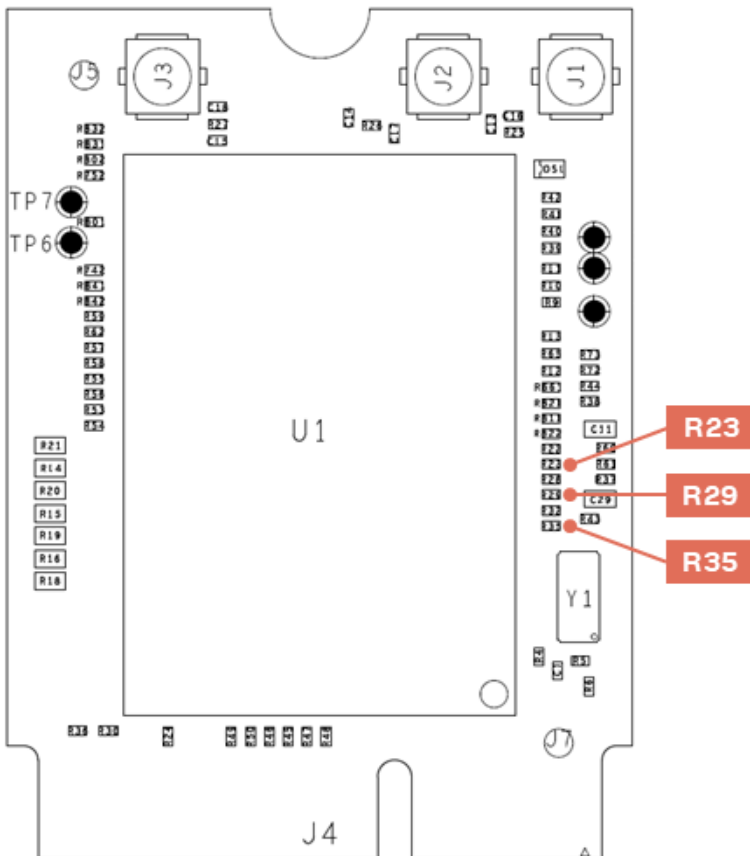


Figure 3: Position of R23, R29 and R35 on M2-JODY-W3 (top side)

2.2 PCIe

The PCI Express interface complies with the PCIe 2.0 standard with 2.5/5 Gbps speeds and allows a host controller to access JODY-W3 Wi-Fi functionality using the PCIe bus protocol. For information about the parameters supported by the PCI Express interface, see the JODY-W3 data sheet [\[1\]](#).

2.3 SDIO

The SDIO device interface is conformant with the industry standard SDIO 3.0 specification (UHS-I up to 104 MB/s) and allows a host controller to access JODY-W3 Wi-Fi functionality using the SDIO bus protocol. The interface supports 4-bit SDIO transfer mode over the full clock range up to 208 MHz.

2.4 UART

JODY-W3 series modules support a high-speed UART interface that is conformant with the industry-standard 16550 specification. For information about the features and baud rates supported in the JODY-W3 series high-speed UART, see the JODY-W3 data sheet [\[1\]](#).

2.5 PCM/I2S

M2-JODY-W3 supports the full functionality of the JODY-W3 series PCM and I2S interfaces for audio. The pins of the PCM and I2S interfaces are shared.

3 Pin definition

The M2-JODY-W3 card module implements the standard pinout of M.2 mechanical Type E sockets as defined by the PCI Express M.2 Specification [4]. In co-operation with NXP, the card fully supports the optional sideband and debug signals as defined by the NXP Wi-Fi/Bluetooth M.2 Key E Pinout Definition [5].

3.1 Pin assignment

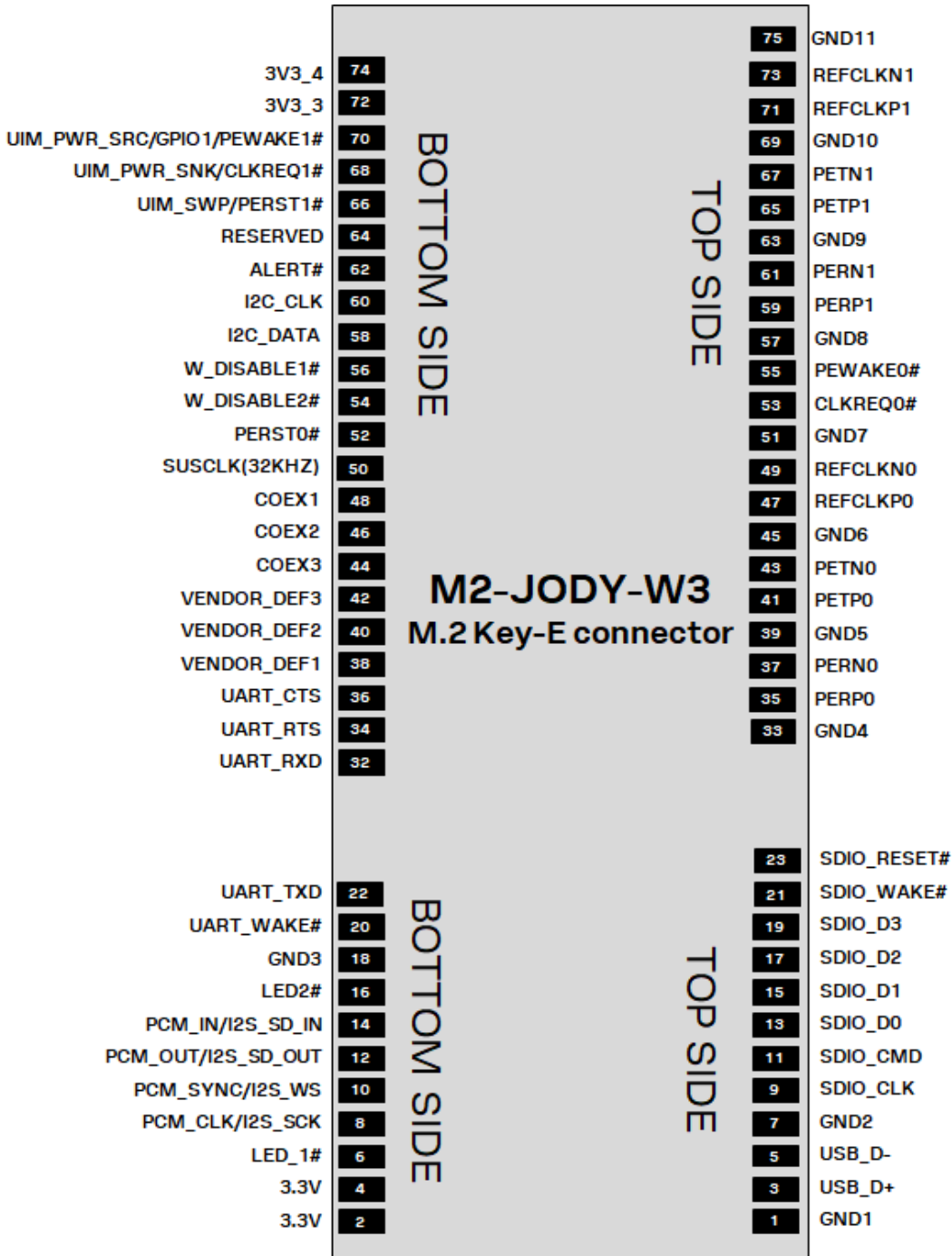


Figure 4: M2-JODY-W3 pin assignment

3.2 Pin description

Table 4 and Table 5 describe the M2-JODY-W3 pins located at the top and bottom side of the M.2 card, respectively. The signal direction of the pins (inputs or outputs) is shown from the perspective of the M2-JODY-W3 card.

Pin no.	Pin name	Pin type	Voltage	Description
1	GND1	GND		Ground
3	USB_D+	NC		USB data + serial data interface. Not connected
5	USB_D-	NC		USB data - serial data interface. Not connected
7	GND2	GND		Ground
9	SDIO_CLK	I	1.8V	SDIO Clock
11	SDIO_CMD	I/O	1.8V	SDIO Command
13	SDIO_D0	I/O	1.8V	SDIO Data 1
15	SDIO_D1	I/O	1.8V	SDIO Data 2
17	SDIO_D2	I/O	1.8V	SDIO Data 3
19	SDIO_D3	I/O	1.8V	SDIO Data 4
21	SDIO_WAKE#	O	VIO	NXP usage: WLAN_WAKE_HOST . Sideband signal used by the Wi-Fi radio to wake up the platform. Active Low by default. Connect to Host GPIO Open drain. Pullup required on platform
23	SDIO_RESET#	NC	VIO	NXP usage: WLAN_INDEPENDENT_RESET . Sideband signal to independently reset the Wi-Fi radio. Active Low by default. Connect to Host GPIO
M.2 Key E connector notch				
33	GND4	GND		Ground
35	PERP0	I	1.8V	PCIe RX
37	PERN0	I	1.8V	PCIe RX
39	GND5	GND		Ground
41	PETP0	O	1.8V	PCIe TX
43	PETN0	O	1.8V	PCIe TX
45	GND6	GND		Ground
47	REFCLKP0	O	1.8V	PCIe Reference Clock
49	REFCLKN0	O	1.8V	PCIe Reference Clock
51	GND7	GND		Ground
53	CLKREQ0#	I/O	3.3V	PCIe Clock Request
55	PEWAKE0#	I/O	3.3V	PCIe PME Wake
57	GND8	GND		Ground
59	PERP1	NC	1.8V	PCIe RX. Not connected
61	PERN1	NC	1.8V	PCIe RX. Not connected
63	GND9	GND		Ground
65	PETP1	NC	1.8V	PCIe TX. Not connected
67	PETN1	NC	1.8V	PCIe TX. Not connected
69	GND10	GND		Ground

Pin no.	Pin name	Pin type	Voltage	Description
71	REFCLKP1	NC	1.8V	PCIe Reference Clock. Not connected
73	REFCLKN1	NC	1.8V	PCIe Reference Clock. Not connected
75	GND11	GND		Ground

Table 4: M2-JODY-W3 pinout – top side

Pin no.	Pin name	Pin type	Voltage	Description
2	3.3V	P	3.3V	Supply voltage pin
4	3.3V	P	3.3V	Supply voltage pin
6	LED_1#	NC		Not connected
8	PCM_CLK/I2S_SCK	I/O	VIO	PCM data clock
10	PCM_SYNC/I2S_WS	I/O	VIO	PCM frame sync
12	PCM_OUT/I2S_SD_OUT	O	VIO	PCM data output
14	PCM_IN/I2S_SD_IN	I	VIO	PCM data input
16	LED2#	NC		Not connected
18	GND3	GND		Ground
20	UART_WAKE#	O	3.3V	NXP usage: BT_WAKE_HOST . Sideband signal used by the Bluetooth radio to wake up the platform. Active Low by default. Connect to Host GPIO Open drain. Pullup required on platform.
22	UART_TXD	O	VIO	UART transmit. Connected to host platform UART receive (UART_RXD)

M.2 Key E connector notch

32	UART_RXD	I	VIO	UART receive. Connected to host platform UART transmit (UART_TXD)
34	UART_RTS	O	VIO	UART Request-To-Send. Connected to host platform UART Clear-To-Send (UART_CTS)
36	UART_CTS	I	VIO	UART Clear-To-Send. Connected to host platform UART Request-To-Send (UART_RTS)
38	VENDOR_DEF1	I/O	VIO	NXP usage: JTAG_TDO . Used for debug. Connected to JTAG header on platform
40	VENDOR_DEF2	I	VIO	NXP usage: DEV_WLAN_WAKE . Sideband signal used by the platform to wake up the Wi-Fi radio. Active Low. Connect to Host GPIO
42	VENDOR_DEF3	I	VIO	NXP usage: DEV_BT_WAKE . Sideband signal used by the platform to wake up the Bluetooth radio. Active Low. Connect to Host GPIO
44	COEX3	I/O	VIO	NXP usage: JTAG_TDI Used for debug. Connected to header on platform
46	COEX2	I/O	VIO	NXP usage: JTAG_TCK . Used for debug. Connected to header on platform
48	COEX1	I/O	VIO	NXP usage: JTAG_TMS . Used for debug. Connected to header on platform
50	SUSCLK(32KHZ)	NC		Not connected
52	PERST0#	I	3.3V	PCIe host indication to reset the device
54	W_DISABLE2#	I	3.3V	NXP usage: BT_INDEPENDENT_RESET . Sideband signal to independently reset the Bluetooth radio. Active Low by default. Connected to Host GPIO

Pin no.	Pin name	Pin type	Voltage	Description
56	W_DISABLE1#	I	3.3V	NXP usage. PDn . Full Power-down for the Wi-Fi/BT radio: High = normal mode, Low = full power-down mode. Connect to Host GPIO
58	I2C_DATA	NC		I2C data. Not connected
60	I2C_CLK	NC		I2C clock. Not connected
62	ALERT#	NC		Not connected
64	RESERVED	NC		Not connected
66	UIM_SWP/PERST1#	NC		Not connected
68	UIM_PWR_SNK/CLKREQ1#	NC		Not connected
70	UIM_PWR_SRC/GPIO1/PEWAKE1#	NC		Not connected
72	3V3_3	P	3.3V	Supply voltage pin
74	3V3_4	P	3.3V	Supply voltage pin

Table 5: M2-JODY-W3 pinout (bottom side)

4 Electrical specifications

Stressing the device above one or more of the [Absolute maximum ratings](#) can cause permanent damage. These are stress ratings only. Operating the module at these or at any conditions other than those specified in the [Operating conditions](#) should be avoided. Exposure to absolute maximum rating conditions for extended periods can affect device reliability.

All given application information is only advisory and does not form part of the specification.

4.1 Absolute maximum ratings

Symbol	Description	Min.	Max.	Units
3V3	Power supply voltage	-0.3	4.0	V
VIO	I/O supply voltage 1.8 V / 3.3 V	-	4.0	V
T _{STORAGE}	Storage temperature	-40	+85	°C

Table 6: Absolute maximum ratings

4.2 Maximum ESD ratings

Applicability	Min.	Max.	Units
Human Body Model (HBM), according to ANSI/ESDA/JEDEC JS-001	-1500	+1500	V
Charged Device Model (CDM), according to ANSI/ESDA/JEDEC JS-002	-500	+500	V

Table 17: Maximum ESD ratings

4.3 Operating conditions

Symbol	Parameter	Min.	Typ.	Max.	Units
3V3	Power supply voltage	2.8	-	3.6	V
VIO	I/O supply voltage 1.8 V	1.7	-	1.9	V
	I/O supply voltage 3.3 V	2.8	-	3.6	V
T _A	Ambient operating temperature	-40	-	+85	°C
Ripple Noise	Peak-to-peak voltage ripple on all supply lines.	-	-	10	mV

Table 18: Operating conditions

4.1 Power consumption

Peak current condition	Temperature	Supply current	Units
Active transmission at max. rated output power (WiFi)	Room temperature	2	A
Active transmission at max. rated output power (Bluetooth)	Room temperature	0.2	A
Firmware initialization	Room temperature	1.5	A

Table 19: Peak current consumption

4.2 Digital pad ratings

Symbol	Parameter	VIO	Min.	Max.	Units
V _{IH}	Input high voltage	1.8 V - 3.3 V	0.7*VIO	VIO+0.4	V
V _{IL}	Input low voltage	1.8 V - 3.3 V	-0.4	0.3*VIO	V
V _{HYS}	Input hysteresis	1.8 V - 3.3 V	100	-	mV
V _{OH}	Output high voltage	1.8 V - 3.3V	VIO-0.4	-	V
V _{OL}	Output low voltage	1.8 V - 3.3 V	-	0.4	V

Table 22: DC characteristics VIO

4.3 Radio specifications

4.3.1 Bluetooth

Parameter	Specification
RF Frequency Range	2.4 – 2.5 GHz
Supported Modes	Bluetooth 5.3 Bluetooth Low Energy (LE) - LE long range - Shared RF with BR/EDR - 2 Mbps LE
Modulation	1 Mbit/s: GFSK (BR) 2 Mbit/s: $\pi/4$ DQPSK (EDR) 3 Mbit/s: 8DQPSK (EDR)
Transmit Power	BDR: +10 dBm \pm 2 dB EDR: +7 dBm \pm 2 dB Bluetooth LE: +8 dBm \pm 2 dB
Sensitivity	DH5: -94 dBm (De-sense of 5.5 dB at 2440 MHz, 2 dB at 2480 MHz) 3DH5: -87 dBm (De-sense of 6 dB at 2440 MHz, 2 dB at 2480 MHz) LR8: -106 dBm (De-sense of 11dB at 2440 MHz, 5 dB at 2480 MHz) LR2: -105 dBm (De-sense of 11dB at 2440 MHz, 5 dB at 2480 MHz) LE1M: -101 dBm (De-sense of 10 dB at 2440 MHz, 4 dB at 2480 MHz) LE2M: -98 dBm (De-sense of 5 dB at 2440 MHz, 1 dB at 2480 MHz)

Table 7: Bluetooth radio parameters

4.3.2 Wi-Fi

M2-JODY-W3 cards support dual-band Wi-Fi with 802.11a/b/g/n/ac/ax operation in the 2.4 GHz and 5 GHz radio bands.

Parameter	Operation Mode	Specification
RF Frequency range	802.11b/g/n/ax	2.400 – 2.500 GHz
	802.11a/n/ac/ax	5.150 – 5.850 GHz
Modulation	802.11b	CCK and DSSS
	802.11a/g/n/ac/ax	OFDM
Supported data rates	802.11b	1, 2, 5.5, 11 Mbit/s
	802.11a/g	6, 9, 12, 18, 24, 36, 48, 54 Mbit/s
	802.11n SISO and MIMO	MCS0 – MCS15 and MCS 32 (duplicate 6 Mbps)
	802.11ac SISO and MIMO	MCS0 – MCS9
	802.11ax SISO and MIMO	MCS0 – MCS11

Parameter	Operation Mode	Specification
Supported channel bandwidth	802.11ac/ax	20, 40, 80 MHz
Supported guard interval (GI)	802.11n/ac	400, 800 ns
	802.11ax	800, 1600 ns
	802.11ac	Short guard interval supported

Table 8: Wi-Fi radio parameters

Parameter	Band	Operating mode	Data rate	Bandwidth	Specification		
Sensitivity	2.4 GHz	802.11b	1 Mbps / 2 Mbps	20 MHz	-97 dBm / -94 dBm		
			5.5 Mbps / 11 Mbps		-92 dBm / -89 dBm		
		802.11g	6 Mbps / 9 Mbps	20 MHz	-91 dBm / -90 dBm		
			12 Mbps / 18 Mbps		-89 dBm / -87 dBm		
			24 Mbps / 36 Mbps		-84 dBm / -80 dBm		
			48 Mbps / 54 Mbps		-76 dBm / -75 dBm		
			802.11n		MCS0 / MCS1	20 MHz	-91 dBm / -88 dBm
		MCS2 / MCS3	-86 dBm / -84 dBm				
		MCS4 / MCS5	40 MHz	-80 dBm / -76 dBm			
		MCS6 / MCS7		-74 dBm / -73 dBm			
		802.11ac	MCS0 / MCS1	40 MHz	-89 dBm / -86 dBm		
			MCS2 / MCS3		-84 dBm / -81 dBm		
			MCS4 / MCS5	-77 dBm / -73 dBm			
			MCS6 / MCS7	-72 dBm / -70 dBm			
			802.11ax	MCS0 / MCS1	20 MHz	-91 dBm / -88 dBm	
				MCS2 / MCS3		-86 dBm / -83 dBm	
				MCS4 / MCS5		-80 dBm / -75 dBm	
				MCS6 / MCS7		-74 dBm / -73 dBm	
				MCS8		-68 dBm	
			802.11ax	MCS0 / MCS1	40 MHz	-88 dBm / -86 dBm	
		MCS2 / MCS3		-84 dBm / -81 dBm			
		MCS4 / MCS5		-77 dBm / -73 dBm			
		MCS6 / MCS7		-72 dBm / -70 dBm			
		MCS8 / MCS9		-66 dBm / -64 dBm			
		802.11ax		MCS0 / MCS1	40 MHz	-89 dBm / -86 dBm	
				MCS2 / MCS3		-85 dBm / -81 dBm	
				MCS4 / MCS5		-79 dBm / -75 dBm	
				MCS6 / MCS7		-73 dBm / -72 dBm	
				MCS8 / MCS9		-68 dBm / -66 dBm	
			MCS10 / MCS11	-63 dBm / -62 dBm			
			802.11a	6Mbps/9Mbps		20 MHz	-90 dBm / -89 dBm
				12 Mbps/18 Mbps			-88 dBm / -86 dBm

Parameter	Band	Operating mode	Data rate	Bandwidth	Specification					
			24 Mbps/36 Mbps		-83 dBm / -80 dBm					
			48 Mbps/54 Mbps		-75 dBm / -74 dBm					
	802.11n	MCS0 / MCS1	20 MHz		-90 dBm / -88 dBm					
					MCS2 / MCS3	-85 dBm / -82 dBm				
					MCS4 / MCS5	-79 dBm / -75 dBm				
					MCS6 / MCS7	-73 dBm / -72 dBm				
		MCS0 / MCS1	40 MHz	-88 dBm / -85 dBm						
		MCS2 / MCS3	-83 dBm / -80 dBm							
		MCS4 / MCS5	-77 dBm / -72 dBm							
		MCS6 / MCS7	-71 dBm / -70 dBm							
		802.11ac	MCS0/MCS1	20 MHz		-90 dBm / -88 dBm				
						MCS2/MCS3	-85 dBm / -83 dBm			
						MCS4/MCS5	-79 dBm / -75 dBm			
						MCS6/MCS7	-73 dBm / -72 dBm			
			MCS8	-68 dBm						
			MCS0/MCS1	40 MHz	-88 dBm / -85 dBm					
			MCS2/MCS3	-83 dBm / -80 dBm						
			MCS4/MCS5	-76 dBm / -72 dBm						
	MCS6/MCS7	-71 dBm / -70 dBm								
	MCS8/MCS9	-65 dBm / -64 dBm								
	802.11ax	MCS0/MCS1	80 MHz		-85 dBm / -82 dBm					
					MCS2/MCS3	-80 dBm / -77 dBm				
					MCS4/MCS5	-73 dBm / -69 dBm				
					MCS6/MCS7	-68 dBm / -66 dBm				
					MCS8/MCS9	-62 dBm / -61 dBm				
		MCS0 / MCS1	20 MHz			-90 dBm / -88 dBm				
						MCS2 / MCS3	-87 dBm / -83 dBm			
						MCS4 / MCS5	-81 dBm / -76 dBm			
						MCS6 / MCS7	-75 dBm / -74 dBm			
						MCS8 / MCS9	-69 dBm / -68 dBm			
	MCS10 / MCS11				-63 dBm / -62 dBm					
					MCS0 / MCS1	40 MHz			-88 dBm / -86 dBm	
									MCS2 / MCS3	-84 dBm / -81 dBm
									MCS4 / MCS5	-78 dBm / -74 dBm
									MCS6 / MCS7	-73 dBm / -72 dBm
	MCS8 / MCS9	-67 dBm / -66 dBm								
	MCS10 / MCS11				-62 dBm / -59 dBm					
					MCS0 / MCS1	80 MHz			-85 dBm / -83 dBm	
									MCS2 / MCS3	-81 dBm / -77 dBm
									MCS4 / MCS5	-76 dBm / -71 dBm
									MCS6 / MCS7	-70 dBm / -69 dBm
	MCS8 / MCS9	-65 dBm / -63 dBm								
	MCS10 / MCS11				-59 dBm / -57 dBm					

Table 9: Wi-Fi radio sensitivity

Please refer to Appendix A for the Tx output power limits

5 Antenna connectors

The M2-JODY-W3 card features three U.FL connectors, with one for each of the three antenna pins:

- Connectors J2 and J3 are connected to JODY-W3 pins 24 and 29 (**ANT0** and **ANT1** respectively) for Wi-Fi operation.
- Connector J1 is connected to JODY-W3 pin 21 (pin name **ANT2**) for Bluetooth.

The location of the U.FL connectors on the M.2 card is shown in [Figure 5](#).

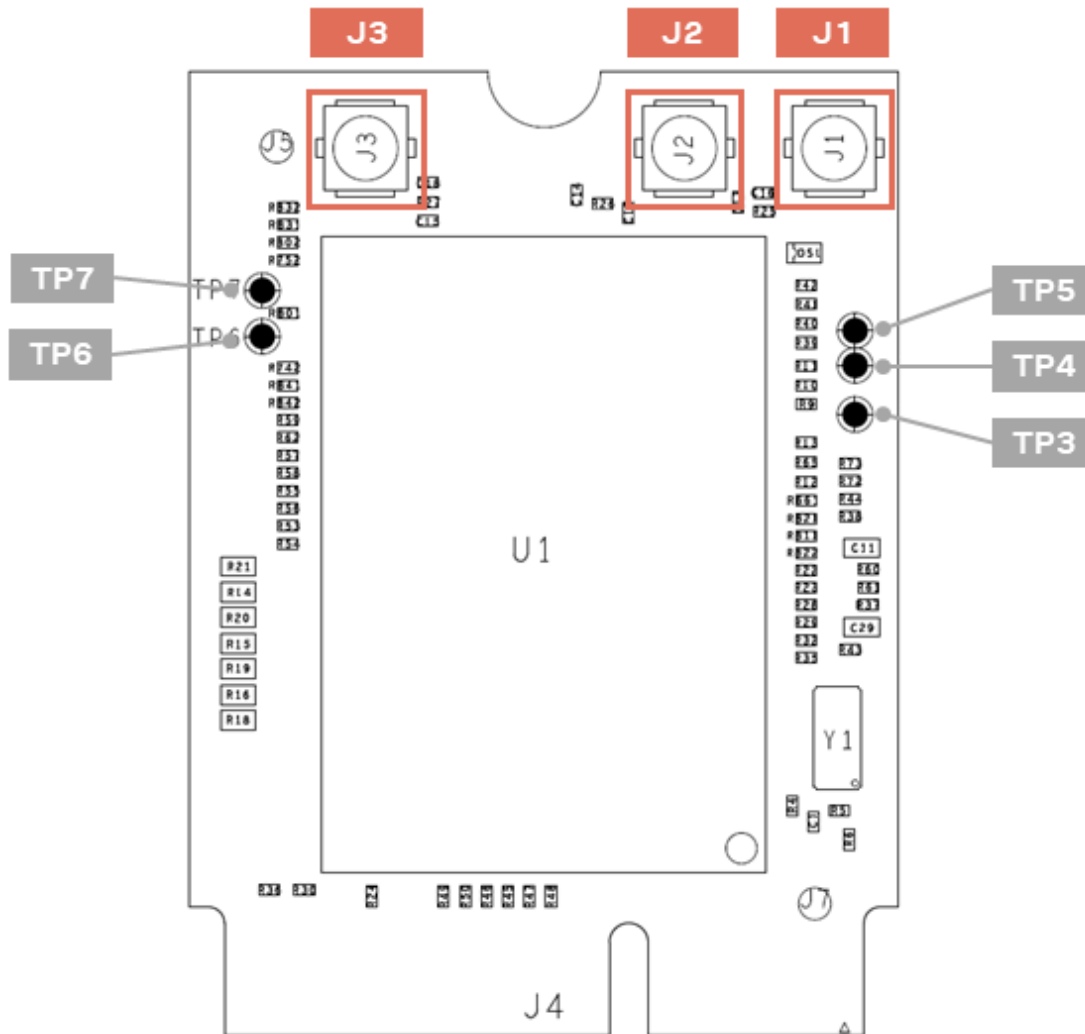


Figure 5: Location of M2-JODY-W3 antenna U.FL connectors

- Given the small size and low profile of the U.FL connector, be sure to follow the manufacturer's instructions to avoid any damage when mating and un-mating the connector. See also the U.FL series guideline [\[6\]](#) and U.FL series data sheet [\[7\]](#).

6 Voltages

The M2-JODY-W3 card requires a **3.3 V power supply**. The card takes the 3.3 V supply from the **3.3V** pins on the M.2 connector, while the 1.8 V supply is generated by the on-card DC-DC converter.

The default setting for **VIO** is 1.8 V but can be changed to 3.3 V by moving the 0 Ω resistor in position R1 to R7 (default = DNI), as shown in [Figure 6](#). Note that R1 and R7 share a common pad. Only one of the two resistors R1 and R7 should be present at any time.

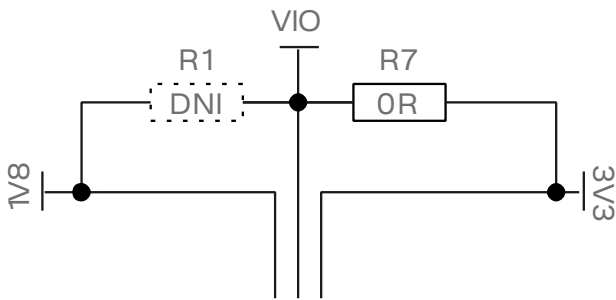


Figure 6: Placement of 0 Ω resistor to change VIO from 1.8 V to 3.3 V

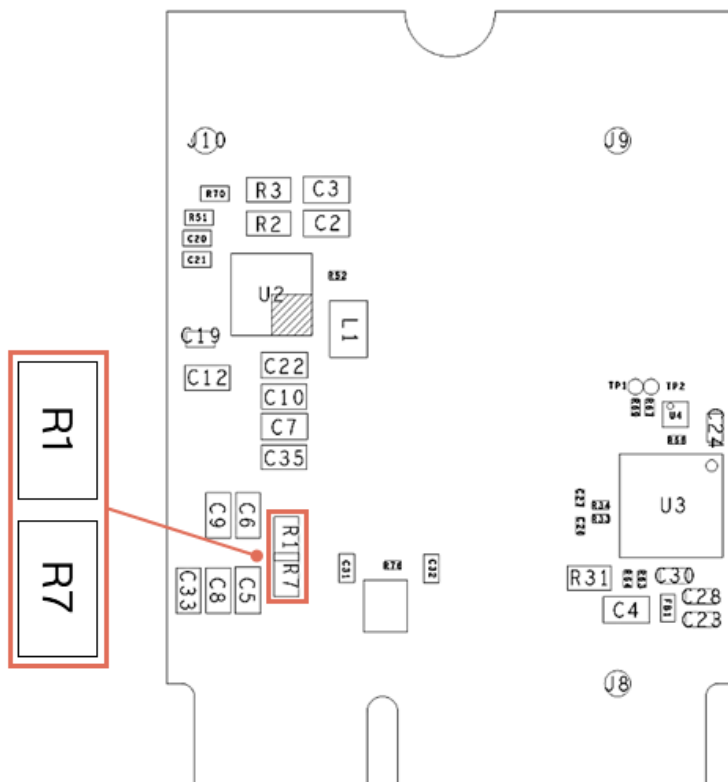


Figure 7: Position of R1 and R7 on M2-JODY-W3 (bottom side)

An on-card level-shifter (as shown in [Figure 8](#)) translates M.2 signals **W_DISABLE1#**, **W_DISABLE2#** and **UART_WAKE#** from 3.3 V to VIO.

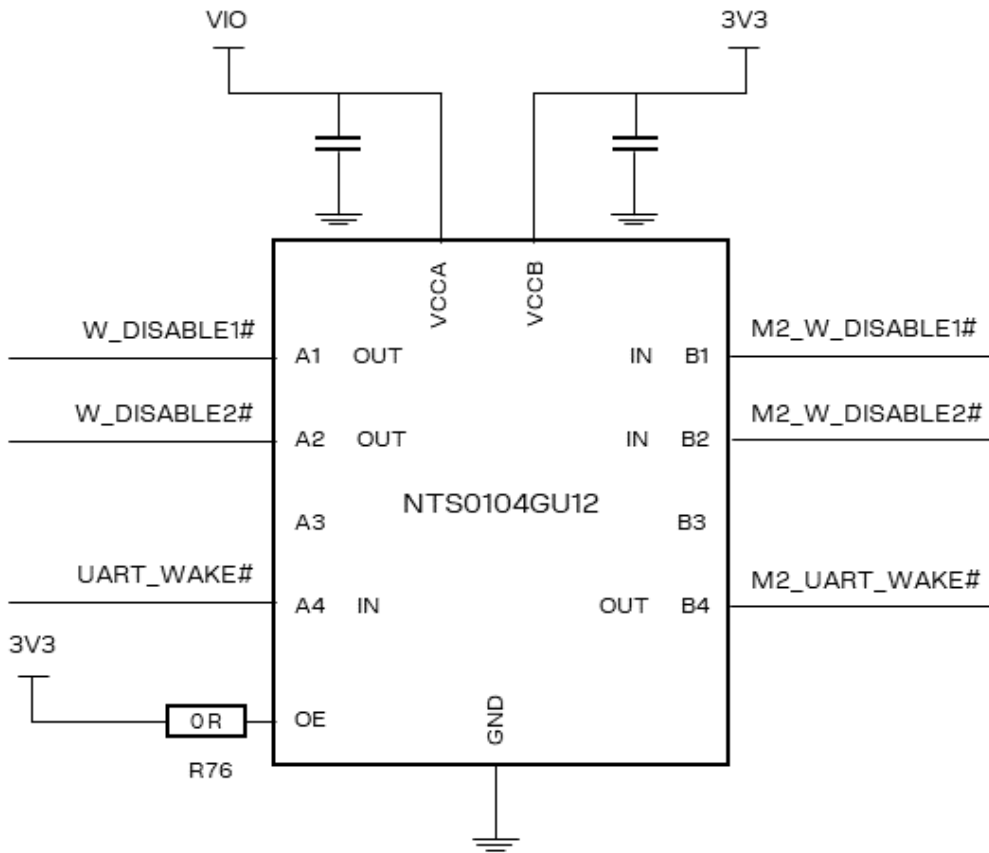


Figure 8: VIO-to-3.3 V level shifter showing VCCA and VCCB

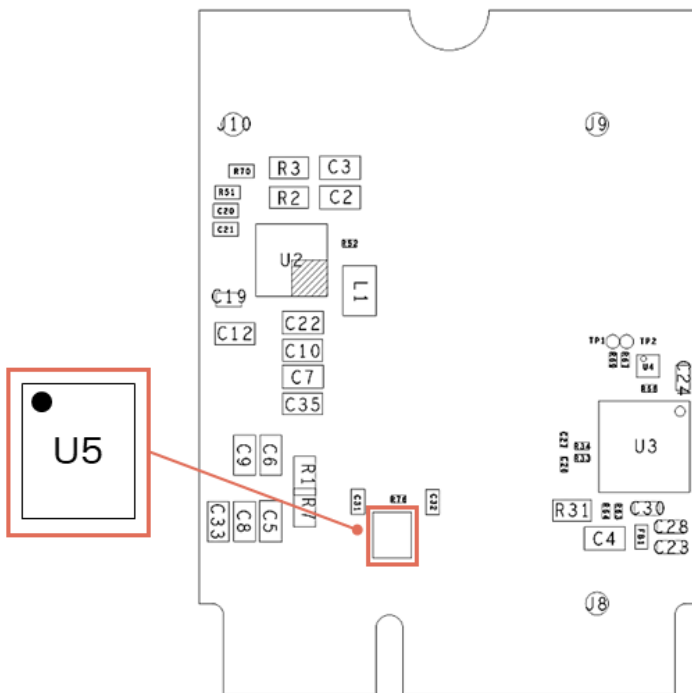


Figure 9: Position of VIO-to-3.3 V level shifter on M2-JODY-W3 (bottom side)

7 Test points

On-card test points TP1, TP2, and TP3, allow NXP sideband signals to be probed, as shown on [Table 10](#). For information that describes how these signals are used in NXP platforms, see the tables shown in the [pin description](#) and the NXP M.2 Key E Pinout Definition [\[5\]](#).

Test point #	M.2 pin#	NXP usage
TP1	21	WLAN_WAKE_HOST
TP2	20	BT_WAKE_HOST
TP3	23	WLAN_INDEPENDENT_RESET

Table 10: M.2 pin number and functionality of the M2-JODY-W3 cards test points

8 Mechanical specification

8.1 Physical dimensions

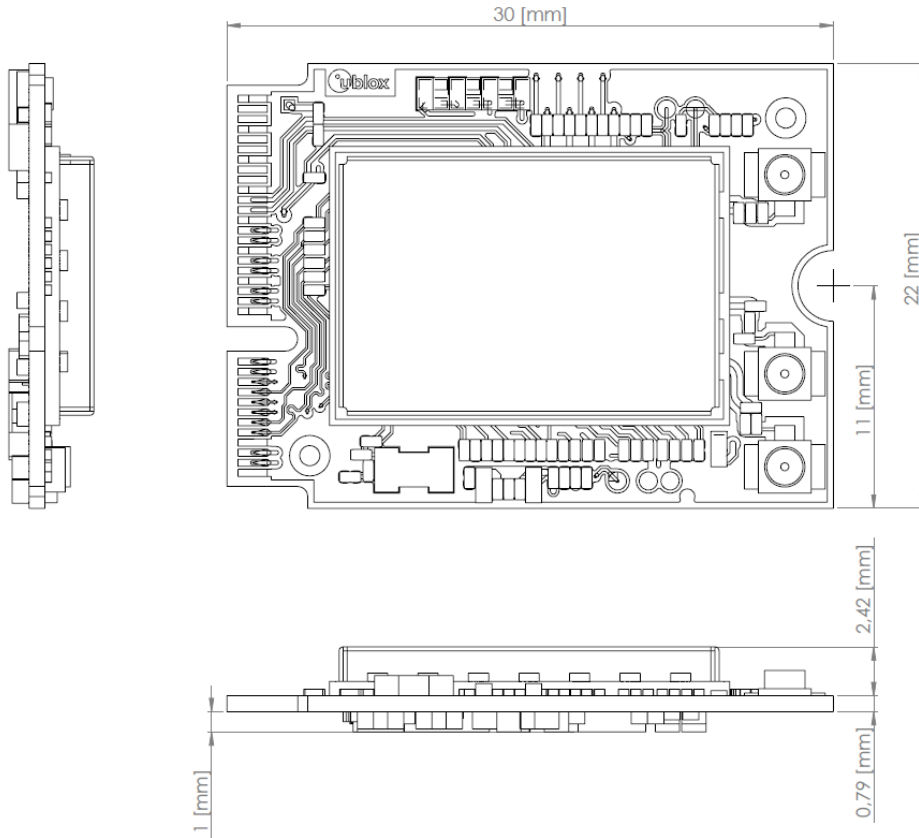


Figure 10: Physical dimensions of the M2-JODY-W3 card

9 Software

M2-JODY-W3 cards are based on the NXP 88W9098 chipset and the drivers and firmware required to operate JODY-W2 series modules are developed by NXP. A firmware binary is downloaded by the host operating system driver at start-up.

The following software options are available for the card:

- Open-source Linux/Android driver (`mxm_mwifiefx`) for mainstream use is available free of charge and already integrated into the Linux BSP for NXP i.MX application processors
- Proprietary Linux/Android drivers providing different feature packs. The drivers are distributed by u-blox to customers that have signed a limited use license agreement (LULA-M) [8] with u-blox. The driver package can be signed electronically and is also available directly from NXP. Contact your local support team for further information.

M2-JODY-W3 software packages typically include:

- Source code that includes dedicated Linux kernel drivers for Wi-Fi and Bluetooth
- Dedicated firmware images that are uploaded to the device during initialization
- Various configuration tools
- Laboratory and manufacturing tools for RF testing.


10 Regulatory compliance

10.1 General requirements

M2-JODY-W3 card is designed to comply with the regulatory demands of Federal Communications Commission (FCC), , UK Conformity Assessed (UKCA), and European standards for CE marking.²


This section contains instructions on the process needed for an integrator when including the M2-JODY-W3 card into an end-product.

- Any deviation from the process described may cause the M2-M2-JODY-W3 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 M2-JODY-W3 card 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).
- Only authorized antenna(s) may be used. Refer to section 10.3 for the list of authorized antennas. In the end-product, the M2-JODY-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 Antenna integration application note [11].
- 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 M2-M2-JODY-W3 card 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](#).

10.2 FCC/ISED 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 [16].

 The approval of the M2-JODY-W3 product, or any other radio module, does not exempt the end product from being evaluated against applicable regulatory demands.

The evaluation of the end product shall be performed with the M2-JODY-W3 card 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.

² All approvals pending

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

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


If the [General requirements](#), [FCC/ISED End-product regulatory compliance](#) regulations, 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; for example, adding new antennas to the u-blox authorization.

-  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.

10.2.2 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's label with a new label containing the new FCC/ISED ID. For more information about the labeling requirements, see in section 10.2.6.

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

10.2.3 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.

 In order 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 [12].

10.2.3.1 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.


10.2.3.2 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.


10.2.3.3 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 an already approved antenna 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 with the intention 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 will be subject to NRE costs.

10.2.4 Configuration control and software security of end-products

 “Modular transmitter” hereafter refers to M2-JODY-W377 (FCC ID XPYJODYW377)³.

As the end-product must comply with the requirements addressed by the OET KDB 594280 [15], the host product integrating the M2-JODY-W3 card 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.

 The OET KDB 594280 D01 [15] lists the topics that must be addressed to ensure that the end-product specific host meets the Configuration Control requirements.

 The OET KDB 594280 D02 [16] lists the topics that must be addressed to ensure that the end-product specific host meets the Software Security Requirements for U-NII Devices.

³ Approvals are pending

10.2.5 Operating frequencies

M2-JODY-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. The channels allowed are described in [Table 11](#).

Channel number	Channel center frequency [MHz]	Allowed channels	Remarks
1 – 11	2412 – 2462	Yes	
12 – 13	2467 – 2472	No	
36 – 48	5180 – 5240	Yes	Canada (ISED): Devices are restricted to indoor operation only and the end product must be labelled accordingly.
52 – 64	5260 – 5320	Yes ⁴	
100 – 116	5500 – 5580	Yes ⁴	
120 – 128	5600 – 5640	No	USA (FCC): Client device operation allowed under KDB 905462
132 – 144	5660 – 5720	Yes ⁴	
149 – 165	5745 – 5825	Yes	

Table 11: Allowed channel usage under FCC/ISED regulation



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”.

10.2.6 End product labeling requirements

For an end-product using the M2-JODY-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 Technology⁵. (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.

⁴ DFS certification is pending.

⁵ 47 CFR 2.926

The label on the M2-JODY-W3 card 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

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 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.

10.3 Pre-approved antennas

This section lists the different external antennas that are pre-approved for use with the M2-JODY-W3 card.

10.3.1 Wi-Fi / Bluetooth dual band antennas

For Bluetooth and Wi-Fi operation in the 2.4 GHz band and Wi-Fi operation in the 5 GHz band M2-JODY-W3 has been tested and approved for use with the dual-band antennas shown in

Manufacturer	Part Number	Antenna Type	Peak Gain (dB)	
			2.4 GHz band	5 GHz band
TE Connectivity	2195630-1	Dual-band dipole antenna	2.0	2.0
TE Connectivity	001-0009	Dual-band dipole antenna	2.0	2.0
TE Connectivity	001-0012	Dual-band dipole antenna	2.0	2.0

Table 1112.

Manufacturer	Part Number	Antenna Type	Peak Gain (dB)
--------------	-------------	--------------	----------------

			2.4 GHz band	5 GHz band
TE Connectivity	2195630-1	Dual-band dipole antenna	2.0	2.0
TE Connectivity	001-0009	Dual-band dipole antenna	2.0	2.0
TE Connectivity	001-0012	Dual-band dipole antenna	2.0	2.0

Table 11: List of approved dual-band antennas

- Important: For compliance with FCC §15.407(a), the EIRP is not allowed to exceed 125 mW (21 dBm) at any elevation angle above 30° (measured from the horizon) when operated as an outdoor access point in U-NII-1 band, 5.150-5.250 GHz.

10.4 Configuration of Wi-Fi transmit power limits

JODY-W3 modules contain calibration data for the output power limits in OTP. This calibration data enables the module to achieve maximum transmit power levels that still pass the required EVM and spectral mask limits. The maximum transmit-power levels that can be used in an end-product also depend on:

- Regulatory domain limits
- Restricted band of usage
- Gain of the antenna and antenna trace design

A configuration file on the host system and the utility `m1anut1` is used to reduce the transmit power levels as required.

Transmit power limit configuration files are provided by u-blox for the certified regulatory domains which addresses the reference designs and the approved antennas.

- The correct transmit power limits must be applied to the module after startup of the host system or change of the regulatory domain during runtime.

10.4.1 Wi-Fi power table

The Wi-Fi power table defines the transmit power levels for the Wi-Fi radio. The power levels are based on regulatory compliance, IEEE 802.11 requirements, and product design constraints. The TX power table can be adjusted to achieve the highest transmit power level for each Wi-Fi channel, bandwidth, and modulation within the constraints defined by the certification.

The Wi-Fi power table is defined in a transmit power configuration file, `txpwrlimit_cfg_XX.conf`, where “XX” stands for the alpha2 country code. It allows developers to fine tune specific transmit power levels for the Wi-Fi radio, including:

- Band (2G and 5G)
- Channel
- Modulation rate (CCK and OFDM)
- Bandwidth (20, 40, and 80 MHz)

Transmit power configuration files for each completed certification are included in the Yocto meta-layer. Transmit power config files are named as per the name of the certification region, for example `txpwrlimit_cfg_ETSI.conf`. The configuration files are used by the recipe in the meta-layer to derive binary files, which can be automatically loaded by the driver, for each country in the certification region, such as, Germany (DE), France (FR), and so on.


For the exact power limits used for the various certifications, see the [Appendix: Wi-Fi Tx output power limits](#). The JODY-W3 system integration manual [2] contains details about configuring Wi-Fi Tx output power limits along with examples.

11 Product handling


11.1 Packaging

Packaged and shipped in trays containing multiple M.2 cards.

11.2 Shipment, storage, and handling

 For more information regarding shipment, storage, and handling see the Packaging information reference guide [\[3\]](#).

11.2.1 ESD handling precautions

 M2-JODY-W3 cards are Electrostatic Sensitive Devices (ESD) that demand the observance of special handling precautions against electrostatic damage. Failure to observe the precautions can result in severe damage to the card.

M2-JODY-W3 cards are manufactured through a highly automated process, which complies with IEC61340-5-1 (STM5.2-1999 Class M1 devices) standard. In compliance with the following European regulations, proper measures must be taken to protect M2-JODY-W3 from ESD events on any pin that might be exposed to the end user:

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

The minimum requirements that must be met to satisfy European regulations are described in [Table 123](#).

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

Table 123: ESD immunity ratings based on EN 61000-4-2

Compliance with standard protection level specified in EN 61000-4-2 is achieved by including proper ESD protection in the production line and close to all areas that are accessible to the end user.

12 Labeling and ordering

The labels applied to M2-JODY-W3 cards include important product information.

Figure 11 shows the label applied to M2-JODY-W3 cards. Each of the given label references are described in Table 134.

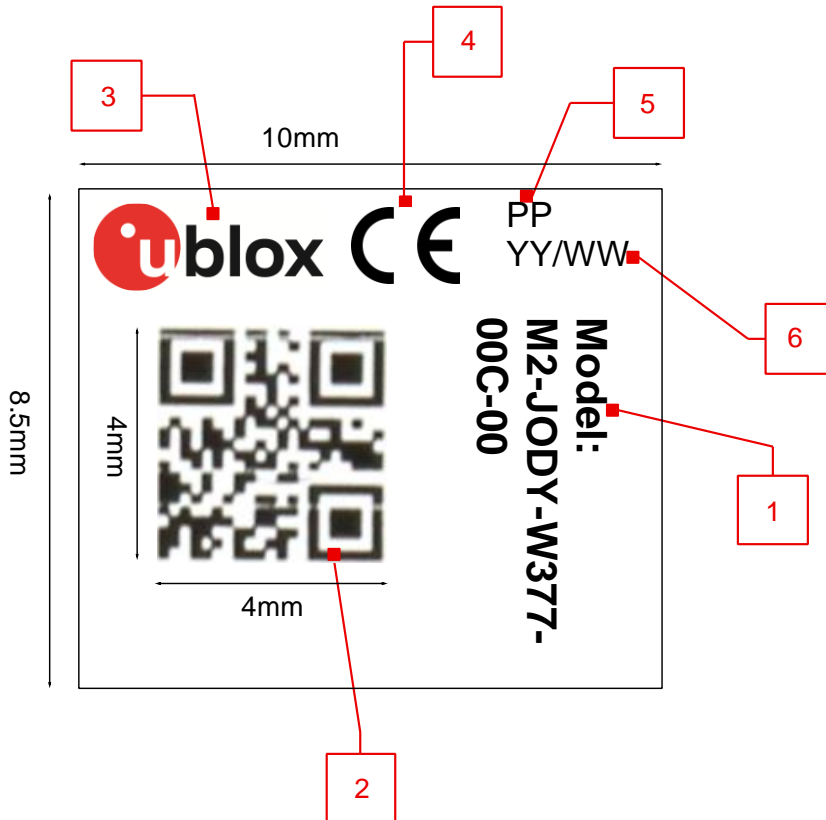


Figure 11. Product label format with dimensions


Reference	Description
1	Text in bold font: "Model:" type number with the product version
2	DataMatrix (product identifier, serial number, datacode) <ul style="list-style-type: none"> Product identifier: 3 digits defined by EMS Serial number Datacode: 4 digits
3	Company logo and trademark
4	Placeholder for CE marking (when certified)
5	Panel position number
6	Production date YY/WW (year/week)

Table 134. M2-JODY-W3 card label description

12.1 Ordering codes

Ordering code	Product name	Product
M2-JODY-W377-00C	M2-JODY-W377	M.2 key E card (2230) with three antenna U.FL connectors and concurrent dual-band 2x2 2.4 GHz and 5 GHz 802.11ax, Bluetooth/Bluetooth LE 5.3. Operational temperature -40 °C to +85 °C, standard grade module with NXP chipset 88W9098. Packaged in tray containing multiple M.2 cards.

Table 145: Product ordering codes

 Product changes affecting form, fit, or function are documented by u-blox. Visit our website for a list of Product Change Notifications (PCNs).

Appendix

A Wi-Fi Tx output power limits

A.1. FCC/ISED regulatory domain

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

Channel	Modulation	Channel bandwidth	Data rates	Maximum power setting
1	CCK and DSSS	20 MHz	1, 2, 5.5, 11 Mbps	19 dBm
2	CCK and DSSS	20 MHz	1, 2, 5.5, 11 Mbps	20 dBm
3 - 10	CCK and DSSS	20 MHz	1, 2, 5.5, 11 Mbps	21 dBm
11	CCK and DSSS	20 MHz	1, 2, 5.5, 11 Mbps	19 dBm
1	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	14 dBm
2	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	15 dBm
3	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	16 dBm
4 - 9	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	17 dBm
10	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	15 dBm
11	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	13 dBm
1	OFDM	20 MHz	HT20 MCS0-MCS7	14 dBm
2	OFDM	20 MHz	HT20 MCS0-MCS7	15 dBm
3	OFDM	20 MHz	HT20 MCS0-MCS7	16 dBm
4 - 8	OFDM	20 MHz	HT20 MCS0-MCS7	17 dBm
9	OFDM	20 MHz	HT20 MCS0-MCS7	16 dBm
10	OFDM	20 MHz	HT20 MCS0-MCS7	14 dBm
11	OFDM	20 MHz	HT20 MCS0-MCS7	13 dBm
3 - 8	OFDM	40 MHz	HT40 MCS0-MCS7	13 dBm
9	OFDM	40 MHz	HT40 MCS0-MCS7	12 dBm
1	OFDM	20 MHz	VHT20 MCS0-MCS8	13 dBm
2 - 3	OFDM	20 MHz	VHT20 MCS0-MCS8	15 dBm
4	OFDM	20 MHz	VHT20 MCS0-MCS8	16 dBm
5 - 8	OFDM	20 MHz	VHT20 MCS0-MCS8	17 dBm
9	OFDM	20 MHz	VHT20 MCS0-MCS8	16 dBm
10	OFDM	20 MHz	VHT20 MCS0-MCS8	14 dBm
11	OFDM	20 MHz	VHT20 MCS0-MCS8	12 dBm
3 - 6	OFDM	40 MHz	VHT40 MCS0-MCS9	13 dBm
7 - 9	OFDM	40 MHz	VHT40 MCS0-MCS9	12 dBm

Table 156: FCC Wi-Fi power table for operation in the 2.4 GHz band in SISO mode

Channel	Modulation	Channel bandwidth	Data rates	Maximum power setting
1	OFDM	20 MHz	HT20 MCS0-MCS7	13 dBm
2	OFDM	20 MHz	HT20 MCS0-MCS7	14 dBm
3 - 9	OFDM	20 MHz	HT20 MCS0-MCS7	15 dBm
10	OFDM	20 MHz	HT20 MCS0-MCS7	13 dBm
11	OFDM	20 MHz	HT20 MCS0-MCS7	12 dBm
3 - 8	OFDM	40 MHz	HT40 MCS0-MCS7	12 dBm
9	OFDM	40 MHz	HT40 MCS0-MCS7	11 dBm
1	OFDM	20 MHz	HE20 MCS0-MCS11	12 dBm
2	OFDM	20 MHz	HE20 MCS0-MCS11	13 dBm
3	OFDM	20 MHz	HE20 MCS0-MCS11	14 dBm
4	OFDM	20 MHz	HE20 MCS0-MCS11	15 dBm
5 - 8	OFDM	20 MHz	HE20 MCS0-MCS11	16 dBm
9	OFDM	20 MHz	HE20 MCS0-MCS11	14 dBm
10	OFDM	20 MHz	HE20 MCS0-MCS11	13 dBm
11	OFDM	20 MHz	HE20 MCS0-MCS11	11 dBm
3 - 6	OFDM	40 MHz	HE40 MCS0-MCS11	12 dBm
7 - 9	OFDM	40 MHz	HE40 MCS0-MCS11	11 dBm

Table 167: FCC Wi-Fi power table for operation in the 2.4 GHz band in MIMO mode

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

Channel	Modulation	Channel bandwidth	Data rates	Maximum power setting
36	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	16 dBm
40 - 48	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	17 dBm
52- 60	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	18 dBm
64	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	16 dBm
36	OFDM	20 MHz	HT20 MCS0-MCS7	14 dBm
40 - 60	OFDM	20 MHz	HT20 MCS0-MCS7	17 dBm
64	OFDM	20 MHz	HT20 MCS0-MCS7	14 dBm
36	OFDM	20 MHz	VHT20 MCS0-MCS8	14 dBm
40 - 60	OFDM	20 MHz	VHT20 MCS0-MCS8	17 dBm
64	OFDM	20 MHz	VHT20 MCS0-MCS8	14 dBm
36	OFDM	20 MHz	HE20 MCS0-MCS11	14 dBm
40 - 60	OFDM	20 MHz	HE20 MCS0-MCS11	15 dBm
64	OFDM	20 MHz	HE20 MCS0-MCS11	14 dBm
38	OFDM	40 MHz	HT40 MCS0-MCS7	13 dBm
46 - 54	OFDM	40 MHz	HT40 MCS0-MCS7	16 dBm
62	OFDM	40 MHz	HT40 MCS0-MCS7	13 dBm
38	OFDM	40 MHz	VHT40 MCS0-MCS9	13 dBm
46 - 54	OFDM	40 MHz	VHT40 MCS0-MCS9	16 dBm
62	OFDM	40 MHz	VHT40 MCS0-MCS9	13 dBm
38	OFDM	40 MHz	HE40 MCS0-MCS11	13 dBm
46 - 54	OFDM	40 MHz	HE40 MCS0-MCS11	15 dBm
62	OFDM	40 MHz	HE40 MCS0-MCS11	13 dBm
42, 58	OFDM	80 MHz	VHT80 MCS0-MCS9	12 dBm
42, 58	OFDM	80 MHz	HE80 MCS0-MCS11	12 dBm

Table 178: FCC Wi-Fi power table for operation in the 5 GHz U-NII-1 and U-NII-2A bands in SISO mode.

Channel	Modulation	Channel bandwidth	Data rates	Maximum power setting
36	OFDM	20 MHz	HT20 MCS0-MCS7	14 dBm
40 - 48	OFDM	20 MHz	HT20 MCS0-MCS7	15 dBm
52 - 60	OFDM	20 MHz	HT20 MCS0-MCS7	17 dBm
64	OFDM	20 MHz	HT20 MCS0-MCS7	14 dBm
36	OFDM	20 MHz	VHT20 MCS0-MCS8	14 dBm
40 - 48	OFDM	20 MHz	VHT20 MCS0-MCS8	15 dBm
52 - 60	OFDM	20 MHz	VHT20 MCS0-MCS8	17 dBm
64	OFDM	20 MHz	VHT20 MCS0-MCS8	14 dBm
36 - 48	OFDM	20 MHz	HE20 MCS0-MCS11	14 dBm
52 - 60	OFDM	20 MHz	HE20 MCS0-MCS11	15 dBm
64	OFDM	20 MHz	HE20 MCS0-MCS11	14 dBm
38	OFDM	40 MHz	HT40 MCS0-MCS7	12 dBm
46	OFDM	40 MHz	HT40 MCS0-MCS7	15 dBm
54	OFDM	40 MHz	HT40 MCS0-MCS7	16 dBm
62	OFDM	40 MHz	HT40 MCS0-MCS7	12 dBm
38	OFDM	40 MHz	VHT40 MCS0-MCS9	12 dBm
46	OFDM	40 MHz	VHT40 MCS0-MCS9	15 dBm
54	OFDM	40 MHz	VHT40 MCS0-MCS9	16 dBm
62	OFDM	40 MHz	VHT40 MCS0-MCS9	12 dBm
38	OFDM	40 MHz	HE40 MCS0-MCS11	12 dBm
46	OFDM	40 MHz	HE40 MCS0-MCS11	14 dBm
54	OFDM	40 MHz	HE40 MCS0-MCS11	15 dBm
62	OFDM	40 MHz	HE40 MCS0-MCS11	12 dBm
42, 58	OFDM	80 MHz	VHT80 MCS0-MCS9	11 dBm
42, 58	OFDM	80 MHz	HE80 MCS0-MCS11	11 dBm

Table 189: FCC Wi-Fi power table for operation in the 5 GHz U-NII-1 and U-NII-2A bands in MIMO mode.

Channel	Modulation	Channel bandwidth	Data rates	Maximum power setting
100	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	15 dBm
104 - 136	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	18 dBm
140	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	15 dBm
100	OFDM	20 MHz	HT20 MCS0-MCS7	15 dBm
104 - 136	OFDM	20 MHz	HT20 MCS0-MCS7	17 dBm
140	OFDM	20 MHz	HT20 MCS0-MCS7	14 dBm
100	OFDM	20 MHz	VHT20 MCS0-MCS8	15 dBm
104 - 136	OFDM	20 MHz	VHT20 MCS0-MCS8	17 dBm
140	OFDM	20 MHz	VHT20 MCS0-MCS8	14 dBm
100	OFDM	20 MHz	HE20 MCS0-MCS11	14 dBm
104 - 136	OFDM	20 MHz	HE20 MCS0-MCS11	15 dBm
140	OFDM	20 MHz	HE20 MCS0-MCS11	14 dBm
102	OFDM	40 MHz	HT40 MCS0-MCS7	12 dBm
110	OFDM	40 MHz	HT40 MCS0-MCS7	16 dBm
134	OFDM	40 MHz	HT40 MCS0-MCS7	15 dBm
142	OFDM	40 MHz	HT40 MCS0-MCS7	14 dBm
102	OFDM	40 MHz	VHT40 MCS0-MCS9	12 dBm
110	OFDM	40 MHz	VHT40 MCS0-MCS9	16 dBm
134	OFDM	40 MHz	VHT40 MCS0-MCS9	14 dBm
102	OFDM	40 MHz	HE40 MCS0-MCS11	12 dBm
110	OFDM	40 MHz	HE40 MCS0-MCS11	15 dBm
134	OFDM	40 MHz	HE40 MCS0-MCS11	15 dBm
142	OFDM	40 MHz	HE40 MCS0-MCS11	13 dBm
106	OFDM	80 MHz	VHT80 MCS0-MCS9	12 dBm
138	OFDM	80 MHz	VHT80 MCS0-MCS9	15 dBm
106	OFDM	80 MHz	HE80 MCS0-MCS11	12 dBm
138	OFDM	80 MHz	HE80 MCS0-MCS11	14 dBm

Table 20: FCC Wi-Fi power table for operation in the 5 GHz U-NII-2e band in SISO mode

Channel	Modulation	Channel bandwidth	Data rates	Maximum power setting
100	OFDM	20 MHz	HT20 MCS0-MCS7	14 dBm
104 - 136	OFDM	20 MHz	HT20 MCS0-MCS7	17 dBm
140	OFDM	20 MHz	HT20 MCS0-MCS7	14 dBm
100	OFDM	20 MHz	VHT20 MCS0-MCS8	14 dBm
104 - 136	OFDM	20 MHz	VHT20 MCS0-MCS8	17 dBm
140	OFDM	20 MHz	VHT20 MCS0-MCS8	14 dBm
100	OFDM	20 MHz	HE20 MCS0-MCS11	14 dBm
104 - 136	OFDM	20 MHz	HE20 MCS0-MCS11	15 dBm
140	OFDM	20 MHz	HE20 MCS0-MCS11	14 dBm
102	OFDM	40 MHz	HT40 MCS0-MCS7	11 dBm
110	OFDM	40 MHz	HT40 MCS0-MCS7	16 dBm
134, 142	OFDM	40 MHz	HT40 MCS0-MCS7	15 dBm
102	OFDM	40 MHz	VHT40 MCS0-MCS9	11 dBm
110	OFDM	40 MHz	VHT40 MCS0-MCS9	16 dBm
134	OFDM	40 MHz	VHT40 MCS0-MCS9	15 dBm
142	OFDM	40 MHz	VHT40 MCS0-MCS9	16 dBm
102	OFDM	40 MHz	HE40 MCS0-MCS11	11 dBm
110, 134, 142	OFDM	40 MHz	HE40 MCS0-MCS11	15 dBm
106	OFDM	80 MHz	VHT80 MCS0-MCS9	11 dBm
138	OFDM	80 MHz	VHT80 MCS0-MCS9	16 dBm
106	OFDM	80 MHz	HE80 MCS0-MCS11	11 dBm
138	OFDM	80 MHz	HE80 MCS0-MCS11	15 dBm

Table 219: FCC Wi-Fi power table for operation in the 5 GHz U-NII-2e band in MIMO mode

Channel	Modulation	Channel bandwidth	Data rates	Maximum power setting
144 - 165	OFDM	20 MHz	6, 9, 12, 18, 24, 36, 48, 54 Mbps	16 dBm
144, 149	OFDM	20 MHz	HT20 MCS0-MCS7	16 dBm
153 - 165	OFDM	20 MHz	HT20 MCS0-MCS7	15 dBm
140	OFDM	20 MHz	VHT20 MCS0-MCS8	14 dBm
144 - 165	OFDM	20 MHz	VHT20 MCS0-MCS8	15 dBm
144 - 165	OFDM	20 MHz	HE20 MCS0-MCS11	14 dBm
151, 159	OFDM	40 MHz	HT40 MCS0-MCS7	14 dBm
151, 159	OFDM	40 MHz	VHT40 MCS0-MCS9	14 dBm
151	OFDM	40 MHz	HE40 MCS0-MCS11	13 dBm
159	OFDM	40 MHz	HE40 MCS0-MCS11	12 dBm
155	OFDM	80 MHz	VHT80 MCS0-MCS9	15 dBm
155	OFDM	80 MHz	HE80 MCS0-MCS11	15 dBm

Table 202: FCC Wi-Fi power table for operation in the 5 GHz U-NII-3 band in SISO mode

Channel	Modulation	Channel bandwidth	Data rates	Maximum power setting
144 - 153	OFDM	20 MHz	HT20 MCS0-MCS7	17 dBm
157 - 165	OFDM	20 MHz	HT20 MCS0-MCS7	15 dBm
144 - 153	OFDM	20 MHz	VHT20 MCS0-MCS8	17 dBm
157 - 165	OFDM	20 MHz	VHT20 MCS0-MCS8	15 dBm
144 - 153	OFDM	20 MHz	HE20 MCS0-MCS11	15 dBm
157 - 165	OFDM	20 MHz	HE20 MCS0-MCS11	13 dBm
151	OFDM	40 MHz	HT40 MCS0-MCS7	15 dBm
159	OFDM	40 MHz	HT40 MCS0-MCS7	14 dBm
151, 159	OFDM	40 MHz	VHT40 MCS0-MCS9	16 dBm
151	OFDM	40 MHz	HE40 MCS0-MCS11	15 dBm
159	OFDM	40 MHz	HE40 MCS0-MCS11	13 dBm
155	OFDM	80 MHz	VHT80 MCS0-MCS9	15 dBm
155	OFDM	80 MHz	HE80 MCS0-MCS11	13 dBm

Table 213: FCC Wi-Fi power table for operation in the 5 GHz U-NII-3 band in MIMO mode


B Glossary

Abbreviation	Definition
BLE	Bluetooth Low Energy
BSP	Board Support Package
BT	Bluetooth
DNI	Do Not Insert
I2S	Inter-IC-Sound
IC	Integrated Circuit
MIMO	Multiple Input, Multiple Output
PCIe	Peripheral Component Interconnect Express
PCM	Pulse Code Modulation
SDIO	Secure Digital Input Output
SISO	Single Input, Single Output
TBD	To be defined / determined
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus
VIO	Input /Output Voltage
U.FL	Low-profile SMT coaxial connector

Table 224: Explanation of the abbreviations and terms used

Related documentation

- [1] JODY-W3 series data sheet, UBX-19010615
- [2] JODY-W3 system integration manual, UBX-19011209
- [3] Packaging information reference guide, [UBX-14001652](#)
- [4] PCI Express M.2 Specification Revision 4.0, Version 1.0, November 5, 2020
- [5] Wi-Fi/Bluetooth M.2 Key E Pinout Definition – NXP Application Note AN13049, Rev.1, November 12, 2020
- [6] Hirose Electric Co. LTD - U.FL Series Catalog, August, 2021
- [7] Hirose Electric Co. LTD - U.FL Series Specification Sheet, June 19, 2020
- [8] u-blox Limited Use License Agreement (LULA-M)
- [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-20053581
- [12] Radio test guide for NXP based modules, UBX-15014433
- [13] Embedded Linux for i.MX Applications Processors, <https://www.nxp.com/design/software/embedded-software/i-mx-software/embedded-linux-for-i-mx-applications-processors:IMXLINUX>
- [14] NXP UM11490, Feature Configuration Guide for NXP-based Wireless Modules on i.MX 8M Quad EVK, <https://www.nxp.com/webapp/Download?colCode=UM11490>
- [15] FCC guidance [594280 D01 Configuration Control v02 r01](#),
- [16] FCC guidance [594280 D02 U-NII Device Security v01r03](#)

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Revision history

Revision	Date	Name	Comments
R01	28-Feb-2023	frca	Initial release

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