S

JODY-W1 series

Host-based multiradio modules with Wi-Fi and Bluetooth

Data sheet

Abstract

This technical data sheet describes the JODY-W1 series modules with 2x2 MIMO 802.11n/ac and dual-mode Bluetooth® 5. JODY-W1 is ideal for in-vehicle-infotainment and telematics applications with simultaneous use cases requiring high data rates, such as in-car hotspots, Wi-Fi display applications such as Apple CarPlay, or video streaming across multiple clients. Connection to a host processor is through PCIe, SDIO, or High-Speed UART interfaces.

UBX-16013635 - R22
C1-Public

Document information

Title	**JODY-W1 series**
Subtitle	Host-based multiradio modules with Wi-Fi and Bluetooth
Document type	Data sheet
Document number	UBX-16013635
Revision and date	R22 27-Feb-2023
Disclosure restriction	C1-Public

Product status	Corresponding content status	
Functional Sample	Draft	For functional testing. Revised and supplementary data will be published later.
In Development / Prototype	Objective Specification	Target values. Revised and supplementary data will be published later.
Engineering Sample	Advance Information	Data based on early testing. Revised and supplementary data will be published later.
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	PCN reference	Product status
JODY-W163-A	JODY-W163-04A-11	CYW89359	N/A	Initial production
JODY-W163-A	JODY-W163-13A-11	CYW89359	N/A	Initial production
JODY-W164-A	JODY-W164-03A-11	CYW89359	N/A	Initial production
JODY-W164-A	JODY-W164-27A-11	CYW88359	N/A	Initial production
JODY-W164-A	JODY-W164-13A-11	CYW89359	N/A	Initial production
JODY-W164-A	JODY-W164-15A-11	CYW88359	N/A	Initial production
JODY-W167-A	JODY-W167-00A-11	CYW88359	N/A	Initial production
JODY-W167-A	JODY-W167-03A-11	CYW89359	N/A	Initial production
JODY-W174-A	JODY-W174-03A-11	CYW89459	N/A	Engineering sample
JODY-W174-A	JODY-W174-13A-11	CYW89459	N/A	Engineering sample
JODY-W174-A	JODY-W174-12A-11	CYW88459	N/A	Engineering sample
JODY-W174-A	JODY-W174-15A-11	CYW88459	N/A	Engineering sample

Contents

1 Functional description

1.1 Overview

The JODY-W1 series offers a range of compact modules based on the Infineon CYW88359/CYW89359 (JODY-W16x) and CYW88459/CYW89459 (JODY-W17x), AEC-Q100-compliant chipsets. The modules enable Wi-Fi, Bluetooth®, and Bluetooth low energy communication, and are ideal for in-vehicle-infotainment and telematics applications with simultaneous use cases requiring high data rates, such as in-car hotspots, Wi-Fi display applications like Apple CarPlay, or video streaming across multiple clients.

JODY-W1 modules can be operated in the following modes:

- Wi-Fi 2x2 MIMO 802.11n/ac in 2.4 GHz or 5 GHz
- Wi-Fi 1x1 SISO 802.11n/ac in 2.4 / 5 GHz real simultaneous dual band (RSDB)
- Dual-mode Bluetooth v5, including audio with simultaneous operation in both Wi-Fi modes

JODY-W1 modules undergo extended automotive qualification testing in accordance with ISO 16750-4 and are manufactured in line with ISO/TS 16949. The modules connect to a host processor through PCIe, SDIO, or High-Speed UART interfaces.

1.2 Applications

Automotive applications

- In-car Access Point for internet access
- In-car applications such as Apple CarPlay, Miracast, etc.
- Rear-seat display
- Rapid sync-n-go applications and fast content download to the vehicle
- Hands-free equipment (Bluetooth)

Industrial applications

- Manufacturing floor automation, wireless control terminals and point-to-point backhaul
- Machine control
- Medical in-hospital applications
- Security and surveillance
- Outdoor content distribution
- Robust wireless connectivity in a broad range of industrial applications

1.3 Product features

	JODY-W163	JODY-W164	JODY-W167	JODY-W174
Grade				
Automotive	•	•	•	•
Professional				
Standard				
Radio				
Bluetooth qualification	v5	v5	v5	v5.1
Bluetooth profiles		HCI		
Bluetooth BR/EDR	•	•	•	•
Bluetooth low energy	•	•	•	•
Wi-Fi IEEE 802.11 standards		a/b/g/n/ac		
Wi-Fi 2.4 / 5 [GHz]		2.4 and 5		
LTE filter	o	o	o	o
Bluetooth output power conducted [dBm]	10	10	10	10
Wi-Fi output power conducted [dBm]	18	18	18	18
Antenna type	2p	2p	3p	2p
OS support				
Android / Linux drivers (from Infineon)	•	•	•	•
QNX (via third party)	•	•	•	•
Interfaces				
High-speed UART [B]	1	1	1	1
PCIe [W]		1	1	1
SDIO [W] [version]	v3			
PCM (Bluetooth audio)	1	1	1	1
Features				
Micro Access Point [max connects]	10	10	10	12
AES hardware support	•	•	•	•
Wi-Fi direct	•	•	•	•
Factory-assigned MAC address	•	•	•	•
Factory calibrated RF	•	•	•	•
Simultaneous STA/AP on different channels	•	•	•	•
WPA, WAPI, WPA2, and WPS	•	•	•	•
WPA3				•
DFS Master + RSDB				•

B = For Bluetooth only
W = For Wi-Fi only
o = On request

2p = 2 antenna pins, one each for Bluetooth and Wi-Fi
3p = 3 pins, 2 for Wi-Fi and 1 for Bluetooth antenna

Table 1: Key features of JODY-W1 series

1.4 Block diagrams

Figure 1 shows the block diagram for JODY-W163-A, JODY-W164-A, and JODY-W174-A variants.

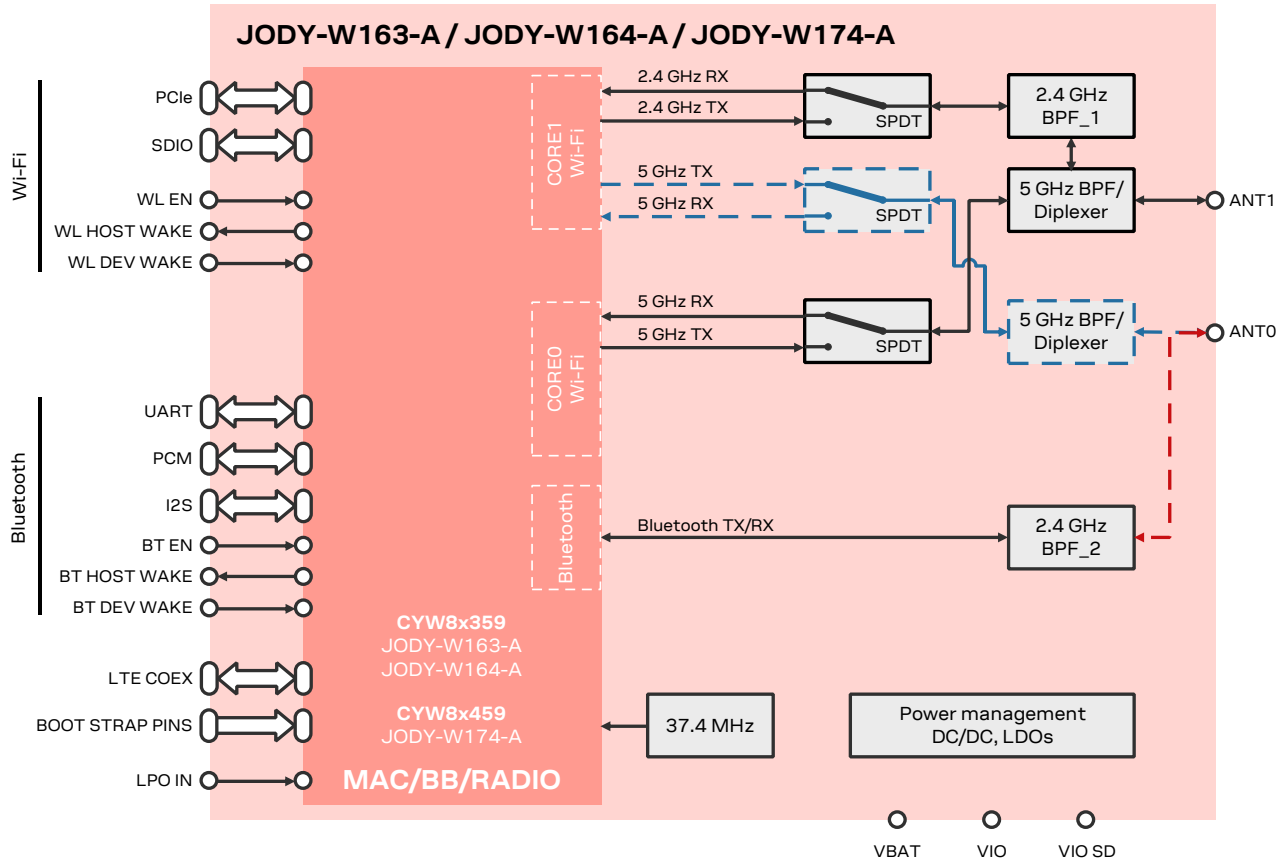

Figure 1: JODY-W163-A, JODY-W164-A, and JODY-W174-A block diagram

Table 2 shows the supported host interfaces, antenna, and band-pass filter configurations for JODY-W163-A, JODY-W164-A, and JODY-W174-A module variants. The modules have two antenna pins: one for 2.4/5 GHz Wi-Fi (enables RSDB mode on a single antenna pin), and one for Bluetooth and 5 GHz Wi-Fi on some variants.

Ordering code	Host i/f	Antenna pin configuration		Band-pass filters	
		ANT0	ANT1	BPF_1	BPF_2
JODY-W164-03A JODY-W174-03A	PCIe PCIe	5 GHz Wi-Fi and Bluetooth	2.4 and 5 GHz Wi-Fi (RSDB)	Non-LTE coexistence	Non-LTE coexistence
JODY-W163-04A	SDIO	Bluetooth	2.4 and 5 GHz Wi-Fi (RSDB)	Non-LTE coexistence	Non-LTE coexistence
JODY-W164-27A JODY-W164-15A JODY-W174-15A	SDIO PCIe PCIe	Bluetooth	2.4 and 5 GHz Wi-Fi (RSDB)	LTE coexistence	Non-LTE coexistence
JODY-W163-13A JODY-W164-13A JODY-W174-12A JODY-W174-13A	SDIO PCIe PCIe PCIe	5 GHz Wi-Fi and Bluetooth	2.4 and 5 GHz Wi-Fi (RSDB)	LTE coexistence	Non-LTE coexistence

Table 2: Supported antenna and filter configurations for JODY-W163-A, JODY-W164-A, and JODY-W174-A

☞ Module variants equipped with an LTE coexistence filter, as shown in Table 2, are recommended when co-located with LTE devices operating in LTE bands 7, 38, 40 or 41. See also LTE Coexistence performance.

Figure 2 shows the block diagram for the JODY-W167-A module variant.

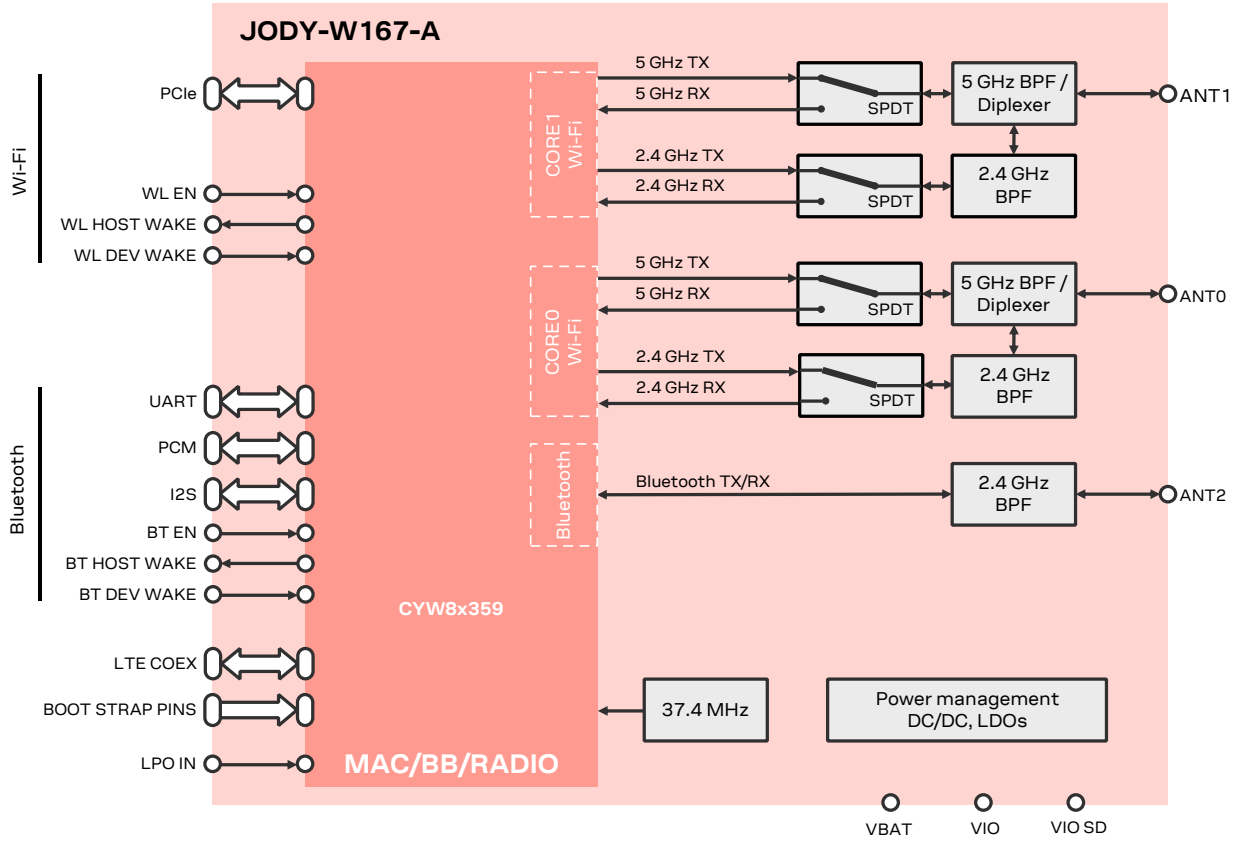

Figure 2: Block diagram of JODY-W167-A

Table 3 shows the supported host interfaces, antenna, and band-pass filter configurations for JODY-W167-A. The modules have three antenna pins: two for 2.4/5 GHz Wi-Fi (enables 2x2 MIMO operation), and one dedicated for Bluetooth.

Ordering code	Host i/f	Antenna configuration			Band-pass filters	
		ANT0	ANT1	ANT2	BPF_1	BPF_2
JODY-W167-00A JODY-W167-03A	PCIe	2.4 and 5 GHz Wi-Fi	2.4 and 5 GHz Wi-Fi	Bluetooth	Non-LTE coexistence	Non-LTE coexistence

Table 3: Supported antenna and filter configurations for JODY-W167-A

1.5 Product selection guidelines

Wi-Fi antenna configuration	Chipset	Host interface	LTE filter	Ordering code
RSDB operation on single antenna	89359	PCIe	✓	-
			-	-
		SDIO	✓	-
			-	JODY-W163-04A
	88359	PCIe	✓	JODY-W164-15A
			-	-
		SDIO	✓	JODY-W164-27A
			-	-
	88459	PCIe	✓	JODY-W174-15A
			-	-
RSDB operation on single antenna, or 2x2 MIMO 5 GHz	89359	PCIe	✓	JODY-W164-13A
			-	JODY-W164-03A
		SDIO	✓	JODY-W163-13A
			-	-
	89459	PCIe	✓	JODY-W174-13A
			-	JODY-W174-03A
	88459	PCIe	✓	JODY-W174-12A
			-	-
2x2 MIMO 2.4 GHz, or 2x2 MIMO 5 GHz	89359	PCIe	-	JODY-W167-03A
	88359		-	JODY-W167-00A

Table 4: Selection guidelines for JODY-W1 series module variants

1.6 Wi-Fi operation modes

The dual-MAC architecture of JODY-W1 series modules allow Wi-Fi operation on two fully concurrent 1x1 (SISO) channels in RSDB configuration, or Wi-Fi operation on a single channel in 2x2 (MIMO) configuration. Dual-mode Bluetooth is supported concurrently in the Wi-Fi operation mode.

1.6.1 RSDB single and multi-role operation modes

2.4 GHz band	5 GHz band	Notes
AP	AP	Any channel
P2P (GO)	P2P (GO)	Any channel[1]
AP	STA	Any channel
STA	AP	Any channel
P2P (GO)	STA	Any channel[1]
STA	P2P (GO)	Any channel[1]
AP+STA	AP	Any channel. AP+STA on the same 2.4 GHz channel.
AP	AP+STA	Any channel. AP+STA on the same 5 GHz channel.
P2P (GO)	P2P (GO) + STA	Any channel. P2P (GO) + STA on the same 5 GHz channel[1]
P2P (GO) + STA	P2P (GO)	Any channel. P2P (GO) + STA on the same 2.4 GHz channel[1]

Table 5: Supported RSDB configurations

[1] Autonomous GO supported for P2P (GO)

1.6.2 MIMO single and multi-role operation modes

2.4 GHz band	5 GHz band	Notes
AP		Any channel
STA		Any channel
P2P (GO)		Any channel[1]
P2P (GC)		Any channel
AP+STA		Any channel. AP+STA on the same 2.4 GHz channel.
P2P (GO)+STA		Any channel. P2P (GO)+STA on the same 2.4 GHz channel.
P2P (GC)+STA		Any channel. P2P (GC)+STA on the same 2.4 GHz channel.
	AP	Any channel
	STA	Any channel
	P2P (GO)	Any channel[1]
	P2P (GC)	Any channel
	AP+STA	Any channel. AP+STA on the same 5 GHz channel.
	P2P (GO)+STA	Any channel. P2P (GO)+STA on the same 5 GHz channel.
	P2P (GC)+STA	Any channel. P2P (GC)+STA on the same 5 GHz channel.

Table 6: Supported MIMO configurations

☞ 2.4 GHz 2x2 MIMO options are only supported on JODY-W167. The JODY-W163, JODY-W164, and JODY-W174 variants supporting 5 GHz 2x2 MIMO options are described in Table 2.

1.7 Supported features

1.7.1 Wi-Fi Features

- Wi-Fi standards:
  - IEEE 802.11a/b/g/n/ac/e/i/v/w/h[2] in station and access point modes
  - IEEE 802.11d/u in station mode only
- IEEE 802.11ac Wave-1 (JODY-W16x) and Wave-2 (JODY-W17x) compliant
- Simultaneous client and access point operation (up to 10 clients supported in total)
- Supports Wi-Fi direct/P2P mode
- IEEE 802.11ac 2x2 antenna configuration
- IEEE 802.11 PHY data rates up to 866 Mbps
- WPA/WPA2, WAPI STA, AES, TKIP security features
- WPA/WPA2 Enterprise 802.1X
- WPA3 support (JODY-W174)
- Wi-Fi channels: 2.4 GHz: 1–13, 5 GHz: 36–165
- RSDB mode
- SU-MIMO configurations, JODY-W174: MU-MIMO in STA mode
- SDIO 3.0 or PCIe 3.0 (Gen1 speed) host interface for Wi-Fi.

1.7.2 Bluetooth features

- Bluetooth Low Energy and Classic Bluetooth v2.1+EDR over high-speed UART interface
- JODY-W16x: Bluetooth v5.0 specification compliant with v4.2 feature level support
- JODY-W17x: Bluetooth v5.1, including LE-2Mbps, LE-Long Range, LE-Advertising Extensions
- PCM /I2S interface for voice applications

[2] JODY-W1 has not been certified to operate as DFS master. DFS master operation in RSDB mode is only supported on JODY-W174.

1.7.3 General product features

- Driver support for Linux 3.x/4.x/5.x
- Low-power and sleep modes for Bluetooth and Wi-Fi core
- Coexistence arbitration for Wi-Fi/Bluetooth/LE operation
- Variants with dedicated high-performance Wi-Fi/LTE coexistence filter available
- Small footprint (19.8 mm x 13.8 mm), LGA package
- Automotive qualification testing (climatic, mechanical, and operating life tests) in accordance with ISO 16750-4

1.7.4 Compliance

- RoHS compliant
- Radio type approvals for Europe, USA, and Canada

☞ Additional country certifications on inquiry

1.7.5 Reserved MAC addresses

The JODY-W1 series has four unique consecutive MAC addresses reserved for each module. The first two addresses are stored in the configuration during production. The first MAC address is used for Bluetooth communication and the second MAC address is used as the primary address for Wi-Fi communication. The Data matrix code displayed on the product label includes the Bluetooth MAC address. The remaining two MAC addresses are not used in the manufacturing configuration but are reserved for use with the module. See also Product labeling.

MAC address	Assignment	Last two bits of MAC address	Example
Module1, address 1	Bluetooth	0b00	*D4:CA:6E:44:00:04*
Module1, address 2	Wi-Fi	0b01	D4:CA:6E:44:00:05
Module1, address 3	(free for use)	0b10	D4:CA:6E:44:00:06
Module1, address 4	(free for use)	0b11	D4:CA:6E:44:00:07
Module2, address 1	Bluetooth	0b00	*D4:CA:6E:44:00:08*
Module2, address 2	Wi-Fi	0b01	D4:CA:6E:44:00:09
Module2, address 3	(free for use)	0b10	D4:CA:6E:44:00:0A
Module2, address 4	(free for use)	0b11	D4:CA:6E:44:00:0B

Table 7: MAC address assignment

2 Interfaces

2.1 Host interface configuration

JODY-W1 uses pins 6, 7, and 8 to accommodate the host interface configuration input that sets the desired operation after module reset. To configure these pins for a specific operational mode, the input must be connected to ground using pull-down 10 kΩ (or less) resistor. No external circuitry is required to set a configuration pin to high logical level.

Although external reset is not a prerequisite for correct operation, the host controller can reset the module through **WL_EN** / **BT_EN** (active high) to correct any abnormal module behavior.

Depending on the module variant, either SDIO or PCIe Wi-Fi host interface must be used:

PCIe enable Pin 6	SDIO disable Pin 7	SDIO VDD select Pin 8	VIO_SD supply Pin 4	Wi-Fi interface
1	1	1	3.3 V or 1.8 V	PCIe
0	0	1	1.8 V	SDIO 1.8 V
0	0	0	3.3 V	SDIO 3.3 V

Table 8: Module host interface configuration

⚠ Depending on the variant, JODY-W1 series modules support either SDIO or PCIe host interfaces. The host interface configuration must be selected accordingly, as shown in Table 8. See also Table 2 and Table 3.

2.2 SDIO interface

The SDIO device interface conforms to the industry standard SDIO 3.0 specification that supports UHS-I bus speed up to 104 MByte/s. It allows host controllers to access the Wi-Fi functions of JODY-W1 series modules, using the SDIO bus protocol. The interface supports 4-bit SDIO transfer mode at the full clock range of 0 to 208 MHz.

The interface supports the following modes:

- Default speed and High speed modes
- SDR12, SDR25, SDR50 modes (up to 100 MHz) (1.8 V)
- SDR104 mode (208 MHz) (1.8 V)
- DDR50 mode (50 MHz) (1.8 V)

2.2.1 Default speed and High speed modes

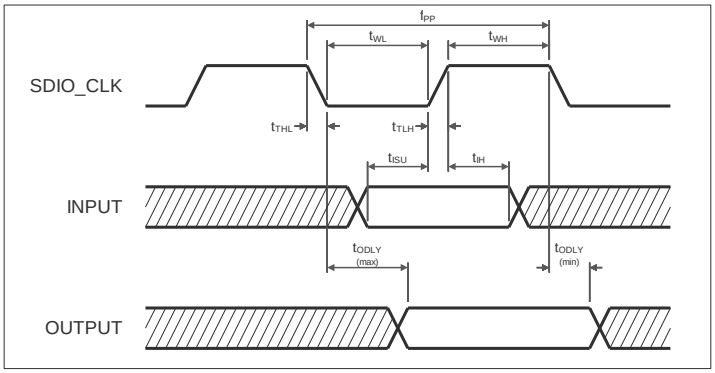

Figure 3: SDIO Protocol timing diagram - Default speed mode (3.3 V)

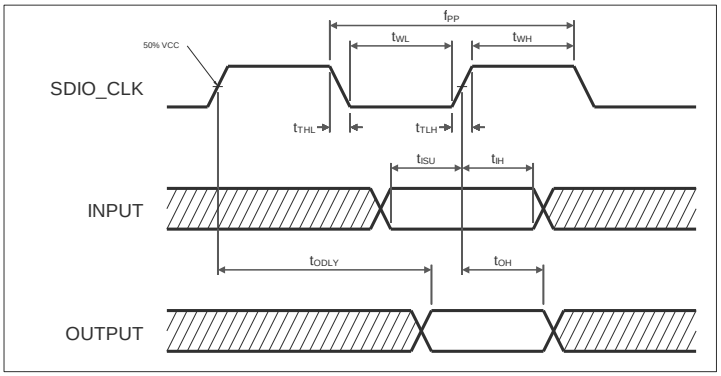

Figure 4: SDIO Protocol timing diagram – High speed mode (3.3 V)

Symbol	Parameter	Condition	Min.	Typ	Max.	Units
f_{PP}	Clock frequency – Data Transfer Mode	Normal	0	-	25	MHz
		High speed	0	-	50	MHz
f_{OD}	Clock frequency – Identification Mode	Normal	0		400	kHz
		High speed	0	-	400	kHz
t_{WL}	Clock low time	Normal	10	-	-	ns
		High speed	7	-	-	ns
t_{WH}	Clock high time	Normal	10	-	-	ns
		High speed	7	-	-	ns
t_{TLH}	Clock rise time	Normal	-	-	10	ns
		High speed	-	-	3	ns
t_{THL}	Clock low time	Normal	-	-	10	ns
		High speed	-	-	3	ns
t_{ISU}	Input setup time	Normal	5	-	-	ns
		High speed	6	-	-	ns
t_{IH}	Input hold time	Normal	5	-	-	ns
		High speed	2	-	-	ns
t_{ODLY}	Output delay time – Data Transfer Mode	Normal	0	-	14	ns
		High speed	-	-	14	ns
t_{ODLY}	Identification Mode	Normal	0	-	50	ns
t_{ODLY}	Output delay time CL ≤ 40 pF (1 card)	Normal	0	-	14	ns
t_{OH}	Output hold time	High speed	2.5	-	-	ns
CL	Total system capacitance (each line)	High speed	0	-	40	pF

Table 9: SDIO timing data – Default speed, High speed modes (3.3 V)

2.2.2 SDR12, SDR25, SDR50 Modes (up to 100 MHz) (1.8 V)

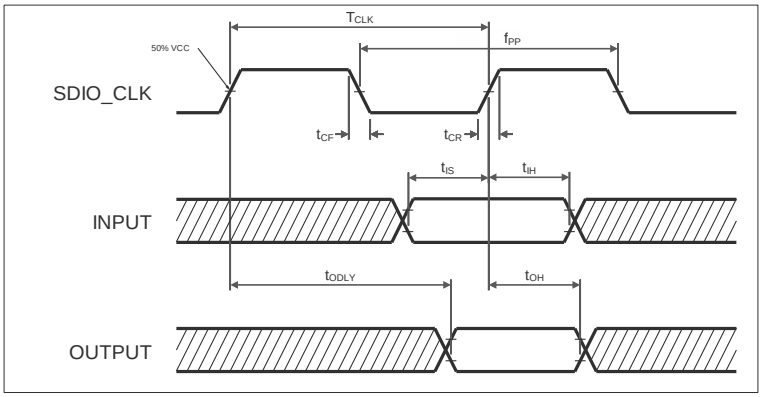

Figure 5: SDIO protocol timing diagram – SDR12, SDR25, SDR50 modes (up to 100 MHz) (1.8 V)

Symbol	Parameter	Condition	Min.	Typ	Max.	Units
f_{PP}	Clock frequency	SDR12	0	-	25	MHz
		SDR25	0	-	50	MHz
		SDR50	0	-	100	MHz
t_{IS}	Input setup time	SDR12/25/50	3	-	-	ns
t_{IH}	Input hold time	SDR12/25/50	0.8	-	-	ns
t_{CLK}	Clock time	SDR12/25/50	10	-	40	ns
-	Clock duty	SDR12/25/50	30		70	%
t_{CR}, t_{CF},	Rise time, fall time T_{CR}, T_{CF} < 2 ns (max) at 100 MHz C_{CARD} = 10 pF	SDR12/25/50		-	0.2*T_{CLK}	ns
t_{ODLY}	Output delay time $C_L \leq 30$ pF	SDR12/25	-	-	14	ns
		SDR50	-		7.5	
t_{OH}	Output hold time C_L = 15 pF	SDR12/25/50	1.5	-	-	ns

Table 10: SDIO Timing data – SDR12, SDR25, SDR50 modes (up to 100 MHz) (1.8 V)

2.2.3 SDR104 mode (208 MHz) (1.8 V)

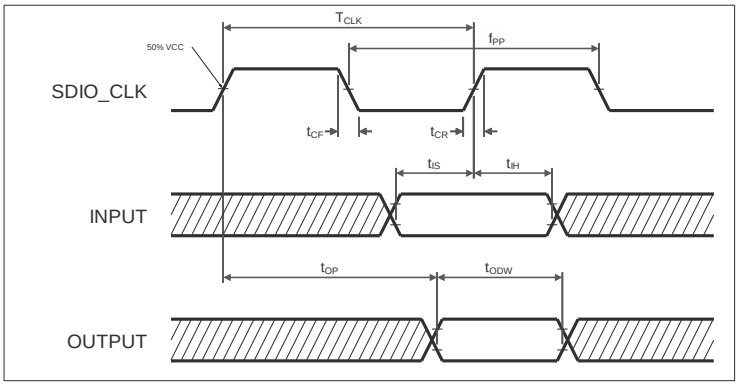

Figure 6: SDIO Protocol timing diagram – SDR104 mode (208 MHz)

Symbol	Parameter	Condition	Min.	Typ	Max.	Units
f_{PP}	Clock frequency	SDR104	0	-	208	MHz
T_{IS}	Input setup time	SDR104	1.4	-	-	ns
T_{IH}	Input hold time	SDR104	0.8	-	-	ns

Symbol	Parameter	Condition	Min.	Typ	Max.	Units
T_{CLK}	Clock time	SDR104	4.8	-	-	ns
t_{CR}, t_{CF},	Rise time, fall time T_{CR}, T_{CF} < 0.96 ns (max) at 208 MHz C_{CARD} = 10 pF	SDR104		-	0.2*T_{CLK}	ns
T_{OP}	Card output phase	SDR104	0	-	2	UI
dT_{OP}	Delay variation due to temperature change after tuning	SDR104	-350		+1550	ps
T_{ODW}	Output timing of variable data window	SDR104	0.6	-	-	UI

Table 11: SDIO Timing data – SDR104 mode (208 MHz)

2.2.4 DDR50 mode (50 MHz) (1.8 V)

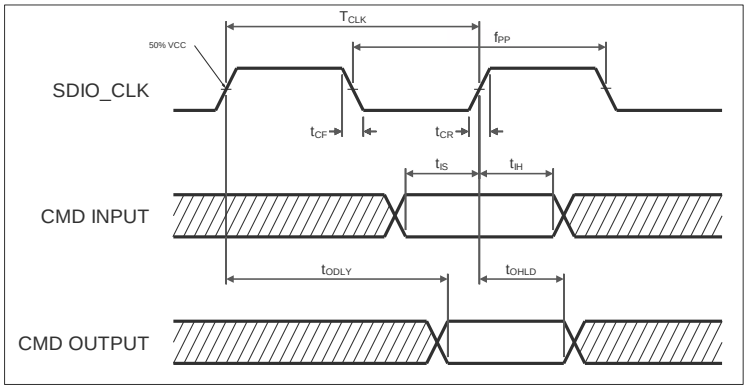

Figure 7: SDIO CMD Timing diagram – DDR50 mode (50 MHz)

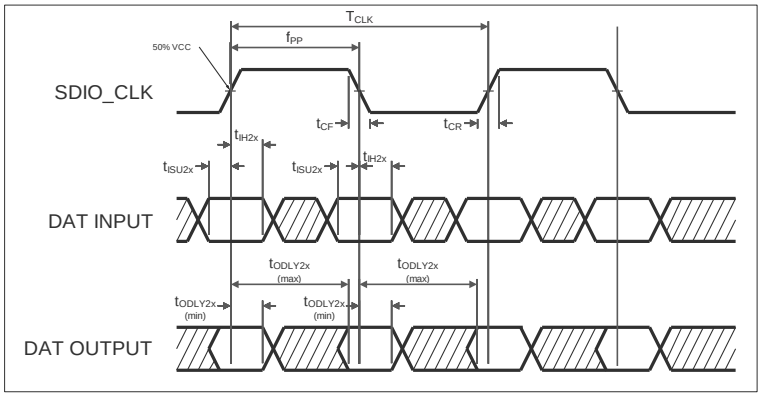

Figure 8: SDIO DAT[3:0] timing diagram – DDR50 mode (50 MHz)

Symbol	Parameter	Condition	Min.	Typ	Max.	Units
Clock						
T_{CLK}	Clock time 50 MHz (max) between rising edges	DDR50	20	-	-	ns
t_{CR}, t_{CF},	Rise time, fall time T_{CR}, T_{CF} < 4.00 ns (max) at 50 MHz C_{CARD} = 10 pF	DDR50	-	-	0.2*T_{CLK}	ns
Clock Duty		DDR50	45	-	55	%
CMD Input (referenced to clock rising edge)						
t_{IS}	Input setup time $C_{CARD} \leq$ 10 pF (1 card)	DDR50	6	-	-	ns
t_{IH}	Input hold time $C_{CARD} \leq$ 10 pF (1 card)	DDR50	0.8	-	-	ns
CMD Output (referenced to clock rising edge)						

Symbol	Parameter	Condition	Min.	Typ	Max.	Units
t_{ODLY}	Output delay time during data transfer mode $C_L \leq 30$ pF (1 card)	DDR50	-	-	13.7	ns
t_{OHLD}	Output hold time $C_L \geq 15$ pF (1 card)	DDR50	1.5	-	-	ns
DAT[3:0] Input (referenced to clock rising and falling edges)						
t_{IS2x}	Input setup time $C_{CARD} \leq 10$ pF (1 card)	DDR50	3			ns
t_{IH2x}	Input hold time $C_{CARD} \leq 10$ pF (1 card)	DDR50	0.8			ns
DAT[3:0] Output (referenced to clock rising and falling edges)						
$t_{ODLY2x\,(max)}$	Output delay time during data transfer mode $C_L \leq 25$ pF (1 card)	DDR50			7.5	ns
$t_{ODLY2x\,(min)}$	Output hold time $C_L \geq 15$ pF (1 card)	DDR50	1.5			ns

Table 12: SDIO timing data – DDR50 mode (50 MHz)

2.3 PCI Express interface

The PCI Express interface complies with the PCIe v3.0 standard at Gen1 speed and allows a host controller using the PCIe bus protocol to access Wi-Fi functionality of the JODY-W1 series modules. The following table shows the parameters for the PCI Express interface.

Parameter	Symbol	Comments	Min.	Typ	Max.	Units
General						
Baud rate	BPS	-	-	2.5	-	Gbaud
Reference clock amplitude	Vref	LVPECL, AC coupled	1	-	-	V
Receiver						
Differential termination	ZRX-DIFF-DC	Differential termination	80	100	120	Ω
DC impedance	ZRX-DC	DC common-mode impedance	40	50	60	Ω
Power down termination (POS)	ZRX-HIGH-IMP-DC-POS	Power-down or RESET high impedance	100 k	-	-	Ω
Power down termination (NEG)	ZRX-HIGH-IMP-DC-NEG	Power-down or RESET high impedance	1 k	-	-	Ω
Input voltage	VRX-DIFFp-p	AC coupled, differential p-p	175	-	-	mV
Jitter tolerance	TRX-EYE	Minimum receiver eye width	0.4	-	-	UI
Differential return loss	RLRX-DIFF	Differential return loss	10	-	-	dB
Common-mode return loss	RLRX-CM	Common-mode return loss	6	-	-	dB
Unexpected electrical idle enter detect threshold integration time	TRX-IDEL-DET-DIFF-ENTERTIME	An unexpected electrical idle must be recognized no longer than this time to signal an unexpected idle condition	-	-	10	ms
Signal detect threshold	VRX-IDLE-DET-DIFFp-p	Electrical idle detect threshold	65	-	175	mV
Transmitter						
Output voltage	VTX-DIFFp-p	Differential p-p, programmable in 16 steps	0.8	-	1200	mV
Output voltage rise time	VTX-RISE	20% to 80%	0.125 (2.5 GT/s) 0.15 (5 GT/s)	- -	- -	UI
Output voltage fall time	VTX-FALL	80% to 20%	0.125	-	-	UI

Parameter	Symbol	Comments	Min.	Typ	Max.	Units
			(2.5 GT/s) 0.15 (5 GT/s)	-	-	
RX detection voltage swing	VTX-RCV-DETECT	The amount of voltage change allowed during receiver detection	-	-	600	mV
TX AC peak common-mode voltage (5 GT/s)	VTX-CM-AC-PP	TX AC common mode voltage (2.5 GT/s)	-	-	100	mV
TX AC peak common-mode voltage (2.5 GT/s)	VTX-CM-AC-P	TX AC common mode voltage (5 GT/s)	-	-	20	mV
Absolute delta of DC common-mode voltage during L0 and electrical idle	VTX-CM-DC-ACTIVE-IDLE-DELTA	Absolute delta of DC common-mode voltage during L0 and electrical idle	0	-	100	mV
Absolute delta of DC common-mode voltage between D+ and D-	VTX-CM-DC-LINE-DELTA	DC offset between D+ and D-	0	-	25	mV
Electrical idle differential peak output voltage	VTX-IDLE-DIFF-AC-p	Peak-to-peak voltage	0	-	20	mV
TX short circuit current	ITX-SHORT	Current limit when TX output is shorted to ground	-	-	90	mA
DC differential TX termination	ZTX-DIFF-DC	Low impedance defined during signaling (parameter is captured for 5.0 GHz by RLTX-DIFF)	80	-	120	Ω
Differential return loss	RLTX-DIFF	Differential return loss	10 (min) for 0.05: 1.25 GHz	-	-	dB
Common-mode return loss	RLTX-CM	Common-mode return loss	6	-	-	dB
TX eye width	TTX-EYE	Minimum TX eye width	0.75	-	-	UI

Table 13: PCI Express interface parameters

2.4 High Speed UART interface

JODY-W1 series modules support a high speed Universal Asynchronous Receiver/Transmitter (UART) interface that complies with the industry standard 16550 specification. The main features of the UART interface are:

- 1040-bytes receive and transmit FIFO
- Automatic baud rate detection
- Bluetooth standard compliant 4-wire HCI UART interface
- 2 pins for transmit and receive operations
- 2 flow control pins
- Interrupt triggers for low-power, high throughput operation
- High throughput (4 Mbps)

Baud rate				
9600	115200 (default)	1000000	2100000	4000000
19200	230400	1382400	2764800	
38400	460800	1500000	3000000	
57600	500000	1843200	3250000	
76800	921600	2000000	3692300	

Table 14: Supported UART Baud rates

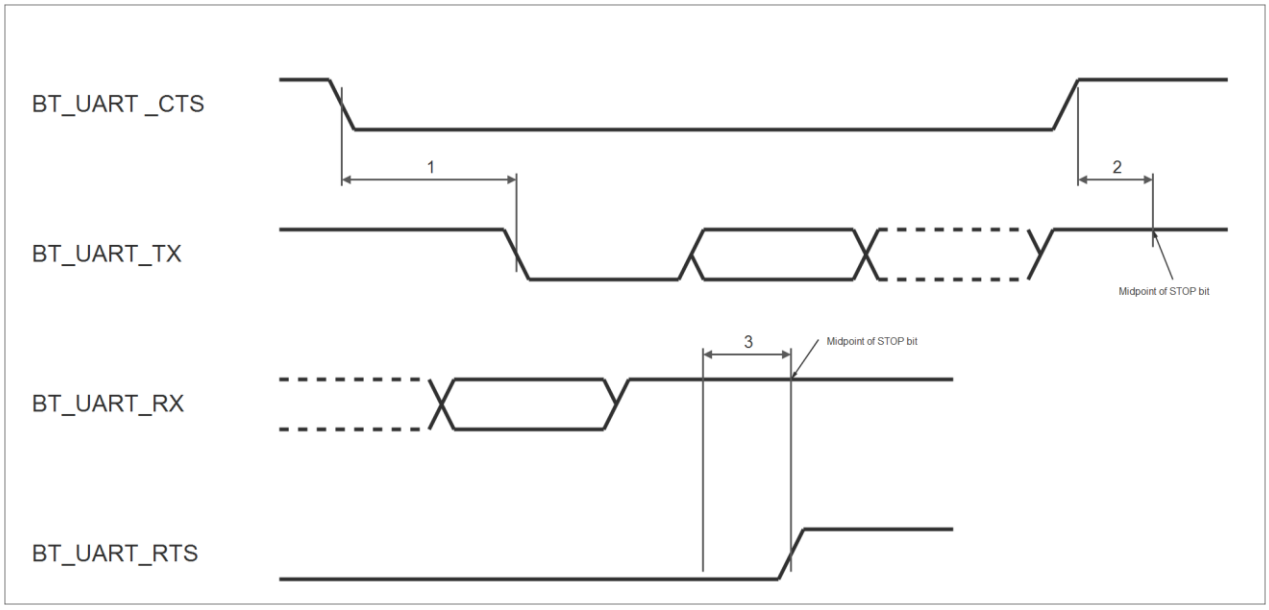

Figure 9: UART Timing

Reference	Characteristic	Min.	Typ	Max.	Units
1	Delay time, BT_UART_CTS low to BT_UART_TX valid	-	-	1.5	Bit period
2	Setup time, BT_UART_CTS high before midpoint of stop bit	-	-	0.5	Bit period
3	Delay time, midpoint of stop bit to BT_UART_RTS high	-	-	0.5	Bit period

Table 15: UART Timing Specification

2.5 PCM Interface

JODY-W1 series modules include a Pulse Code Modulation (PCM) interface that supports:

- Master or slave mode
- PCM bit width size of 8 bits or 16 bits
- Up to 16 slots with configurable bit width and start positions
- Short frame and long frame synchronization
- Burst PCM mode

The PCM pins of JODY-W1 series modules can be configured to either PCM or I2S interface through HCI commands. For pin mapping information, see also I2S interface.

2.5.1 PCM Interface specifications

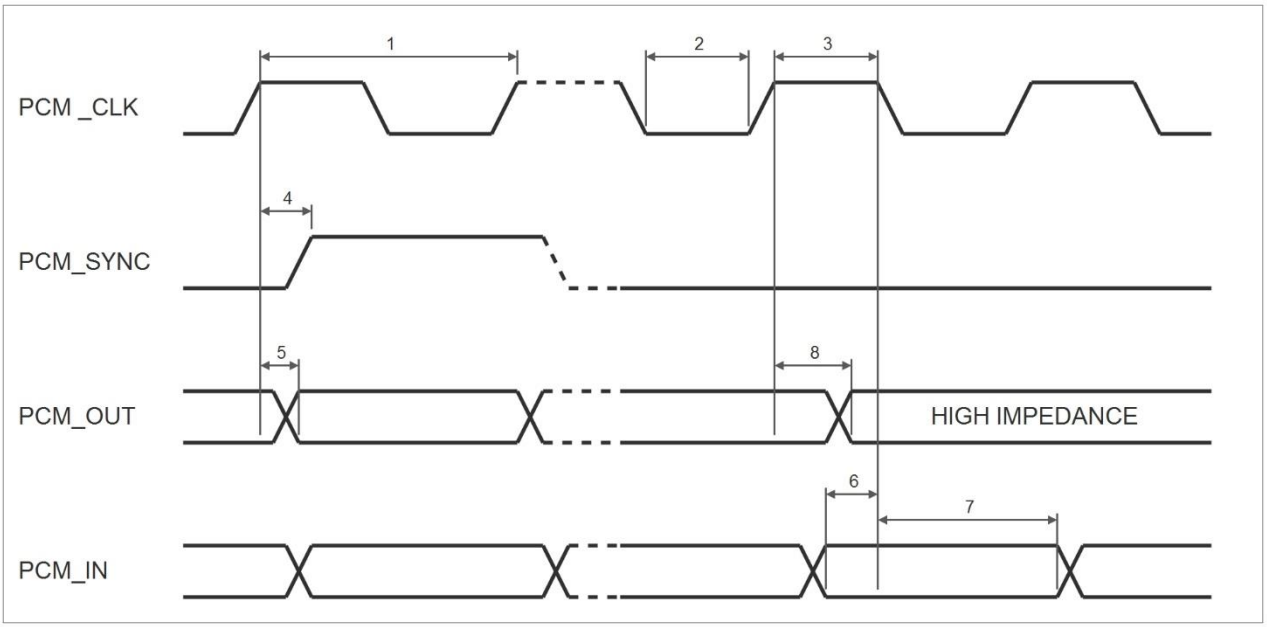

Figure 10: PCM timing specification – short frame sync., master mode

Symbol	Parameter	Condition	Min.	Typ	Max.	Units
1	PCM clock frequency	-	-	-	12	MHz
2	PCM bit clock LOW	-	41	-	-	ns
3	PCM bit clock HIGH	-	41	-	-	ns
4	PCM_SYNC delay	-	0	-	25	ns
5	PCM_OUT delay	-	0	-	25	ns
6	PCM_IN setup	-	8	-	-	ns
7	PCM_IN hold	-	8	-	-	ns
8	Delay from rising edge of PCM_CLK during last bit period to PCM_OUT becoming high impedance	-	0	-	25	ns

Table 16: PCM timing specification – short frame sync., master mode

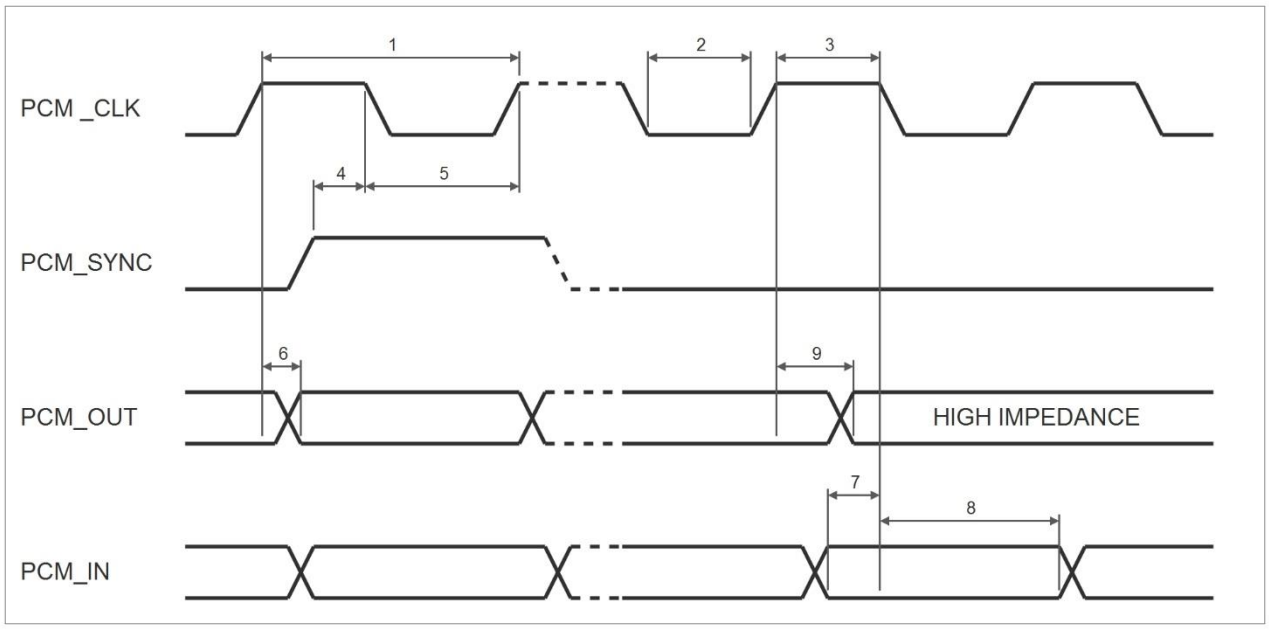

Figure 11: PCM Timing specification – short frame sync., slave mode

Symbol	Parameter	Condition	Min.	Typ	Max.	Units
1	PCM clock frequency	-	-	-	12	MHz
2	PCM bit clock LOW	-	41	-	-	ns
3	PCM bit clock HIGH	-	41	-	-	ns
4	PCM_SYNC setup	-	8	-	-	ns
5	PCM_SYNC hold		8	-	-	ns
6	PCM_OUT delay	-	0	-	25	ns
7	PCM_IN setup	-	8	-	-	ns
8	PCM_IN hold	-	8	-	-	ns
9	Delay from rising edge of PCM_CLK during last bit period to PCM_OUT becoming high impedance	-	0	-	25	ns

Table 17: PCM Timing specification – short frame sync., slave mode

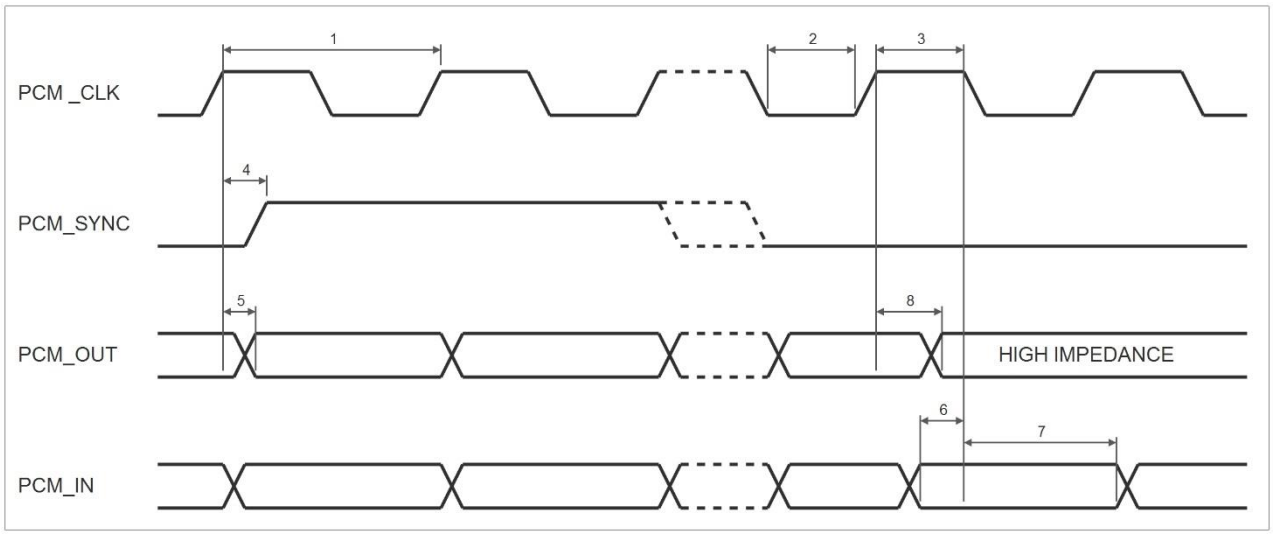

Figure 12: PCM timing specification – long frame sync., master mode

Symbol	Parameter	Condition	Min.	Typ	Max.	Units
1	PCM clock frequency	-	-	-	12	MHz
2	PCM bit clock LOW	-	41	-	-	ns
3	PCM bit clock HIGH	-	41	-	-	ns
4	PCM_SYNC delay	-	0	-	25	ns
5	PCM_OUT delay	-	0	-	25	ns
6	PCM_IN setup	-	8	-	-	ns
7	PCM_IN hold	-	8	-	-	ns
8	Delay from rising edge of PCM_CLK during last bit period to PCM_OUT becoming high impedance	-	0	-	25	ns

Table 18: PCM timing specification – long frame sync., master mode

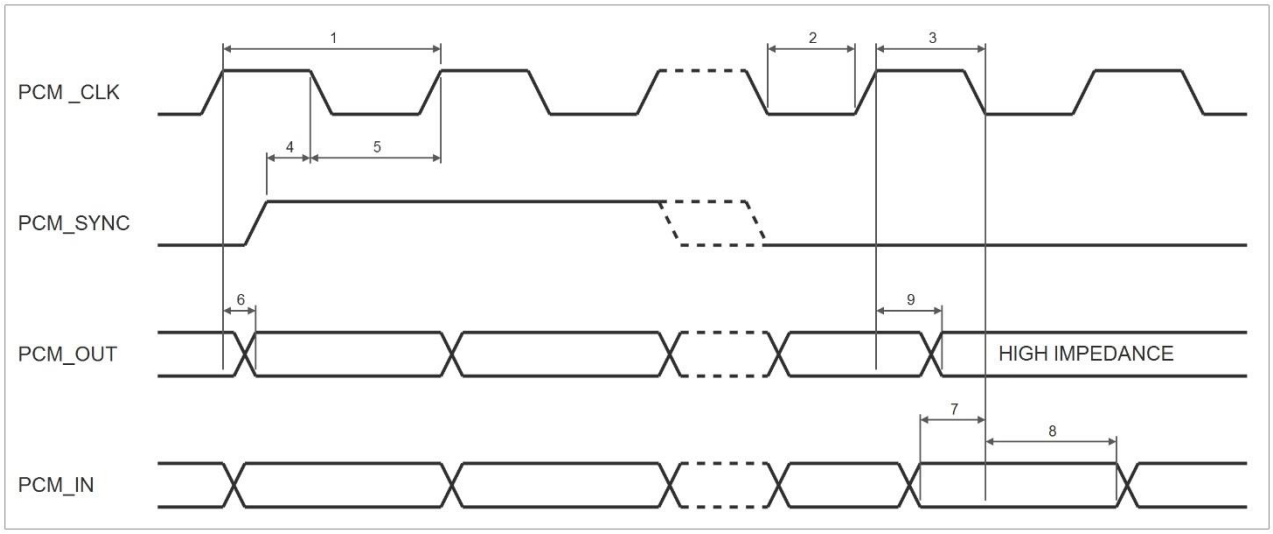

Figure 13: PCM timing specification – long frame sync., slave mode

Symbol	Parameter	Condition	Min.	Typ	Max.	Units
1	PCM clock frequency	-	-	-	12	MHz
2	PCM bit clock LOW	-	41	-	-	ns
3	PCM bit clock HIGH	-	41	-	-	ns
4	PCM_SYNC setup	-	8	-	-	ns
5	PCM_SYNC hold		8	-	-	ns
6	PCM_OUT delay	-	0	-	25	ns
7	PCM_IN setup	-	8	-	-	ns
8	PCM_IN hold	-	8	-	-	ns
9	Delay from rising edge of PCM_CLK during last bit period to PCM_OUT becoming high impedance	-	0	-	25	ns

Table 19: PCM timing specification – long frame sync., slave mode

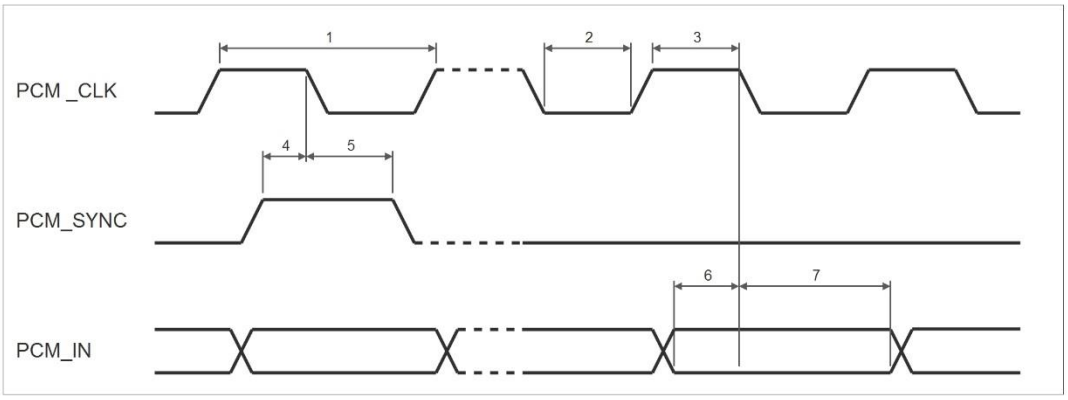

Figure 14: PCM burst mode timing specification – short frame sync., receiver only

Symbol	Parameter	Condition	Min.	Typ	Max.	Units
1	PCM clock frequency	-	-	-	24	MHz
2	PCM bit clock LOW	-	20.8	-	-	ns
3	PCM bit clock HIGH	-	20.8	-	-	ns
4	PCM_SYNC setup	-	8	-	-	ns
5	PCM_SYNC hold		8	-	-	ns
6	PCM_IN setup	-	8	-	-	ns
7	PCM_IN hold	-	8	-	-	ns

Table 20: PCM burst mode timing specification – short frame sync., receiver only

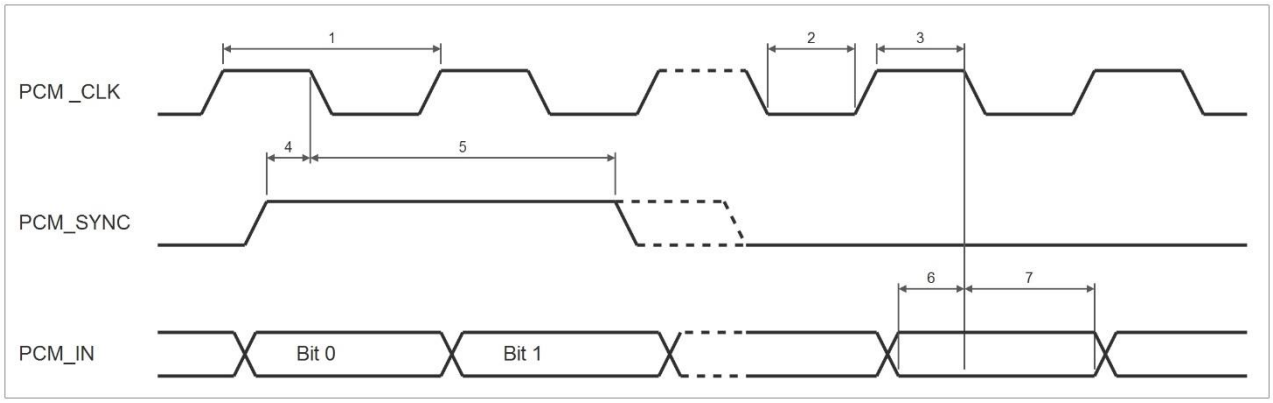

Figure 15: PCM burst mode timing specification – long frame sync., receiver only

Symbol	Parameter	Condition	Min.	Typ	Max.	Units
1	PCM clock frequency	-	-	-	24	MHz
2	PCM bit clock LOW	-	20.8	-	-	ns
3	PCM bit clock HIGH	-	20.8	-	-	ns
4	PCM_SYNC setup	-	8	-	-	ns
5	PCM_SYNC hold		8	-	-	ns
6	PCM_IN setup	-	8	-	-	ns
7	PCM_IN hold	-	8	-	-	ns

Table 21: PCM burst mode timing specification – long frame sync., receiver only

2.6 I2S interface

JODY-W1 series modules support an I2S interface that provides clock rate in master mode 1.536 MHz (32 bits per frame) or 2.400 MHz (50 bits per frame).

This interface is addressable over the PCM pins, which can be routed to the I2S interface through HCI commands. The following I2S signals are mapped with the PCM pins:

- **PCM_CLK** I2S clock, can be master (output) or slave (input)
- **PCM_SYNC** I2S WS, can be master (output) or slave (input)
- **PCM_OUT** I2S data output
- **PCM_IN** I2S data input

2.6.1 I2S interface specifications

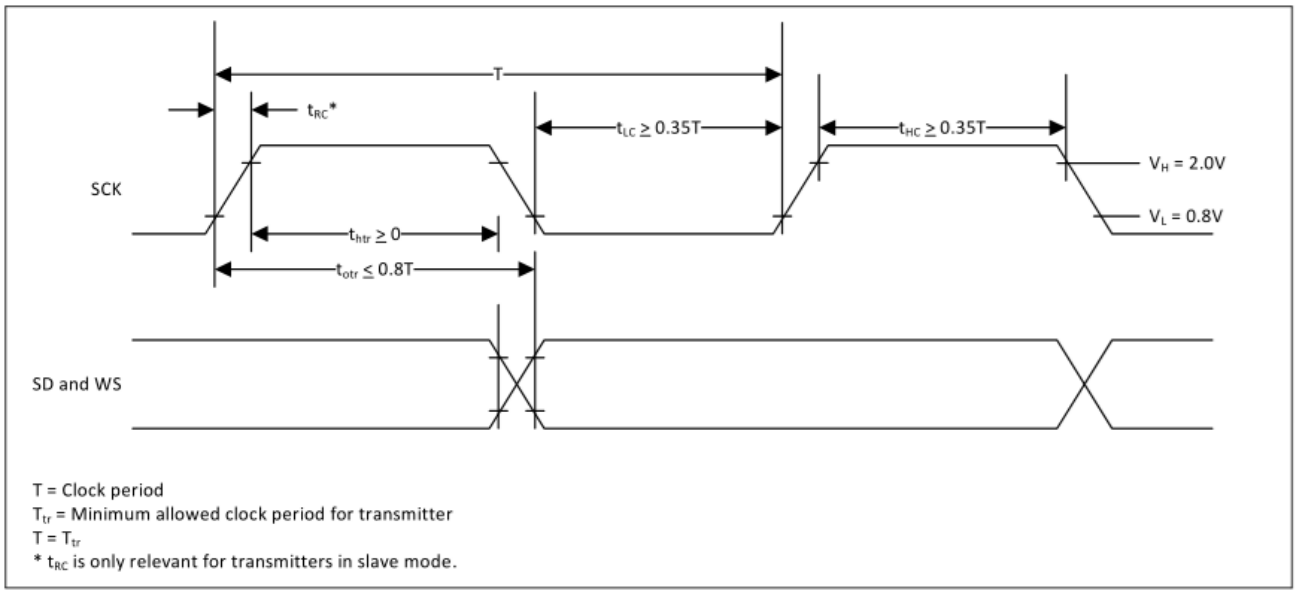

Figure 16: I2S transmitter timing

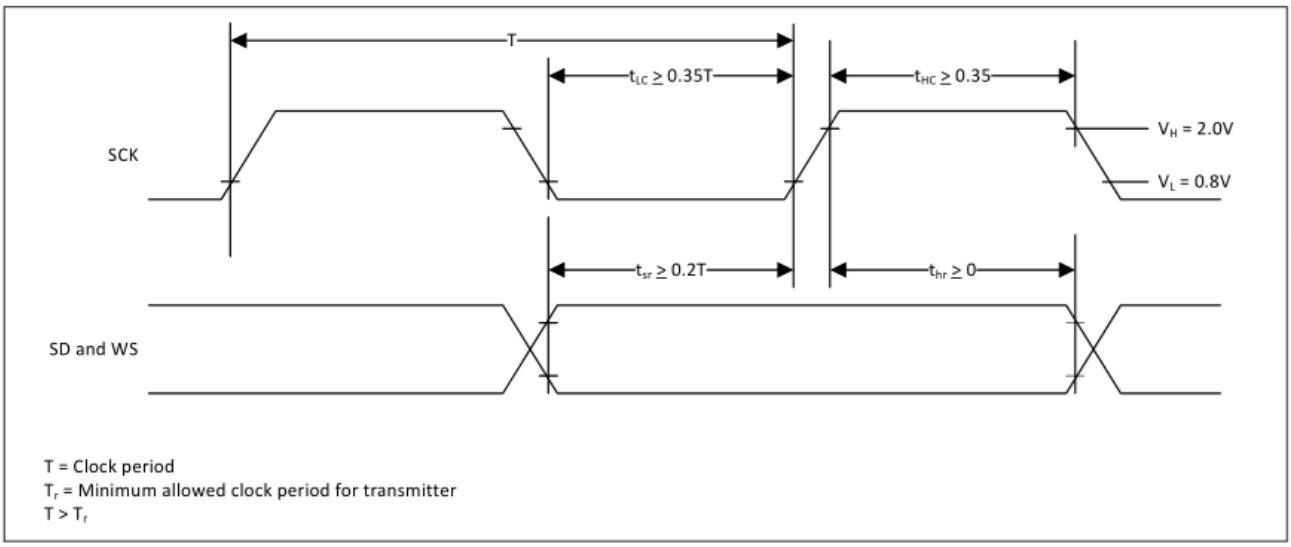

Figure 17: I2S receiver timing

Parameter	Transmitter				Receiver				Notes
	Lower limit		Upper limit		Lower limit		Upper limit		
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Clock Period T	T_{tr}	-	-	-	T_r	-	-	-	a
Master Mode: Clock generated by transmitter or receiver									
HIGH t_{HC}	$0.35T_{tr}$	-	-	-	$0.35T_{tr}$	-	-	-	b
LOW t_{LC}	$0.35T_{tr}$	-	-	-	$0.35T_{tr}$	-	-	-	b
Slave Mode: Clock accepted by transmitter or receiver									
HIGH t_{HC}	-	$0.35T_{tr}$	-	-	-	$0.35T_{tr}$	-	-	c
LOW t_{LC}	-	$0.35T_{tr}$	-	-	-	$0.35T_{tr}$	-	-	c
Rise time t_{RC}	-	-	$0.15T_{tr}$	-	-	-	-	-	d
Transceiver									
Delay t_{dtr}	-	-	-	0.8T	-	-	-	-	e
Hold time t_{htr}	0	-	-	-	-	-	-	-	d
Receiver									
Setup time t_{sr}	-	-	-	-	-	$0.2T_r$	-	-	f
Hold time t_{hr}	-	-	-	-	-	0	-	-	f

Table 22: Timing for I2S transmitters and receivers

a. The system clock period T must be greater than T_{tr} and T_r because both the transmitter and receiver must be able to handle the data transfer rate.
b. At all data rates in master mode, the transmitter or receiver generates a clock signal with a fixed mark/space ratio. For this reason, t_{HC} and t_{LC} are specified with respect to T.
c. In slave mode, the transmitter and receiver need a clock signal with minimum HIGH and LOW periods so that they can detect the signal. So long as the minimum periods are greater than $0.35T_r$, any clock that meets the requirements can be used.
d. Because the delay (t_{dtr}) and the maximum transmitter speed (defined by T_{tr}) are related, a fast transmitter driven by a slow clock edge can result in t_{dtr} not exceeding t_{RC} which means t_{htr} becomes zero or negative. Therefore, the transmitter has to guarantee that t_{htr} is greater than or equal to zero, so long as the clock rise-time t_{RC} is not more than t_{RCmax}, where t_{RCmax} is not less than $0.15T_{tr}$.
e. To allow data to be clocked out on a falling edge, the delay is specified with respect to the rising edge of the clock signal and T, always giving the receiver sufficient setup time.
f. The data setup and hold time must not be less than the specified receiver setup and hold time.

2.7 LTE coexistence interface

For optimal performance, an external, co-located, wireless device can be used to manage wireless medium sharing.[3] JODY-W1 supports an external UART handshake interface to enable signaling between the module and the external device.

[3] External coexistence interface is not supported in current firmware.

3 Pin definition

3.1 Pin description

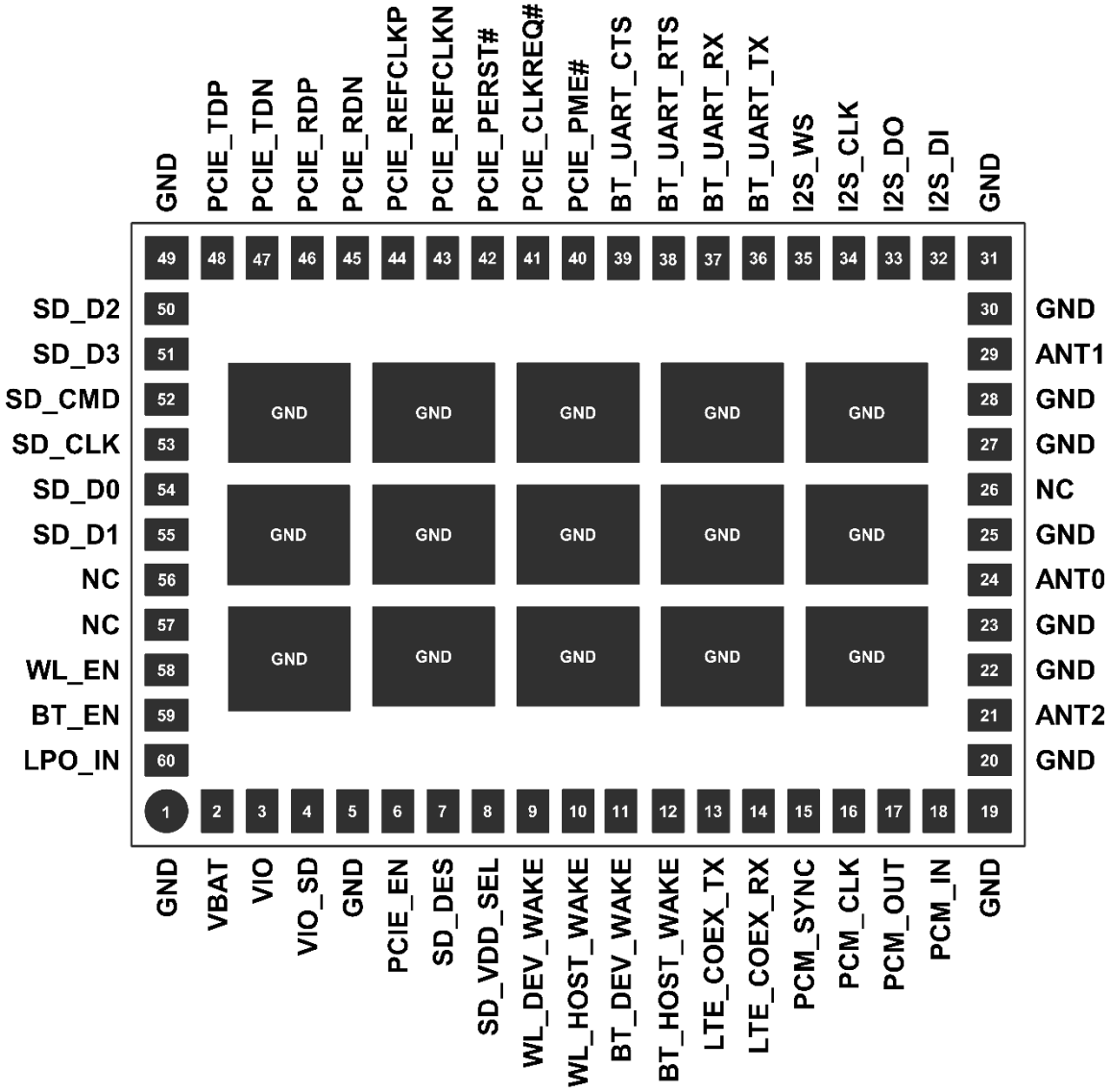

Figure 18: Pin assignment (top view)

No.	Name	Pin type	Description	Power supply domain
1	GND	Ground	Ground	
2	VBAT	Power	3.2 V < VBAT < 4.8 V	
3	VIO	Power	VIO Supply (1.8 V or 3.3 V)	
4	VIO_SD	Power	VIO Supply (1.8 V or 3.3 V) for SDIO and PCIe Out-of-Band signals	
5	GND	Ground	Ground	
6	PCIE_EN	I	See Table 8 for Host Interface selection	VIO
7	SD_DES	I	See Table 8 for Host Interface selection	VIO
8	SD_VDD_SEL	I	See Table 8 for Host Interface selection	VIO
9	WL_DEV_WAKE	I	Wi-Fi device wake-up signal. Asserted: Wi-Fi device must wake-up or remain awake	VIO

No.	Name	Pin type	Description	Power supply domain
			De-asserted: Wi-Fi device may sleep when the sleep criteria is met	
10	WL_HOST_WAKE	O	Wi-Fi HOST wake-up signal Asserted: Host device must wake-up or remain awake De-asserted: Host device may sleep when the sleep criteria is met	VIO
11	BT_DEV_WAKE	I	Bluetooth device wake-up signal: Asserted: Bluetooth device must wake-up or remain awake De-asserted: Bluetooth device may sleep when sleep criteria are met.	VIO
12	BT_HOST_WAKE	O	Bluetooth Host wake-up signal: Asserted: Host device must wake-up or remain awake De-asserted: Host device may sleep when sleep criteria are met	VIO
13	LTE_COEX_TX	O	Coexistence WCI-2 interface. TX signal	VIO
14	LTE_COEX_RX	I	Coexistence WCI-2 interface. RX signal	VIO
15	PCM_SYNC	I/O	PCM sync, can be output (master) or input (slave)	VIO
16	PCM_CLK	I/O	PCM clock, can be output (master) or input (slave)	VIO
17	PCM_OUT	O	PCM data output	VIO
18	PCM_IN	I	PCM data input	VIO
19	GND	Ground	Ground	
20	GND	Ground	Ground	
21	ANT2	I/O, RF	Antenna pin (see also Block diagrams)	
22	GND	Ground	Ground	
23	GND	Ground	Ground	
24	ANT0	I/O, RF	Antenna pin (see also Block diagrams)	
25	GND	Ground	Ground	
26	NC	-	Reserved antenna pin. Do not connect.	
27	GND	Ground	Ground	
28	GND	Ground	Ground	
29	ANT1	I/O, RF	Antenna pin (see also Block diagrams)	
30	GND	Ground	Ground	
31	GND	Ground	Ground	
32	I2S_DI	I/O	Reserved for I2S interface. Do not connect! To connect a I2S interface the PCM pins can be used. The PCM interface can be configured as an I²S interface. See also PCM Interface.	VIO
33	I2S_DO	I/O		VIO
34	I2S_CLK	I/O		VIO
35	I2S_WS	I/O		VIO
36	BT_UART_TX	O	Fast UART serial data output for the Bluetooth device	VIO
37	BT_UART_RX	I	Fast UART serial data input for the Bluetooth device	VIO
38	BT_UART_RTS	O	Fast UART active-low request-to-send signal for the Bluetooth device	VIO
39	BT_UART_CTS	I	Fast UART active-low clear-to-send signal for the Bluetooth device	VIO
40	PCIE_PME#	OD	PCI power management event output	VIO_SD
41	PCIE_CLKREQ#	OD	PCIe clock request signal	VIO_SD
42	PCIE_PERST#	I	PCIe System reset	VIO_SD
43	PCIE_REFCLKN	I	PCIe 100 MHz clock differential input, AC coupling capacitors 100 pF included in the module.	
44	PCIE_REFCLKP	I		
45	PCIE_RDN	I	PCIe receiver differential input, DC coupled inputs, use 100 nF AC coupling capacitors placed closer to the Host TDN/TDP differential output	
46	PCIE_RDP	I		

No.	Name	Pin type	Description	Power supply domain
47	PCIE_TDN	O	PCIe transmitter differential output, AC coupling capacitors 100 nF included in the module, connect to the Host RDN/RDP input directly	
48	PCIE_TDP	O		
49	GND	Ground	Ground	
50	SD_D2	I/O	SDIO Data line bit [2]	VIO_SD
51	SD_D3	I/O	SDIO Data line bit [3]	VIO_SD
52	SD_CMD	I/O	SDIO Command line	VIO_SD
53	SD_CLK	I	SDIO Clock input	VIO_SD
54	SD_D0	I/O	SDIO Data line bit [0]	VIO_SD
55	SD_D1	I/O	SDIO Data line bit [1]	VIO_SD
56	NC	-	Leave unconnected (internally connected to the USB interface, debugging only)	
57	NC	-	Leave unconnected (internally connected to the USB interface, debugging only)	
58	WL_EN	I	Power up or power down the Wi-Fi section of the chipset (like a reset)	VIO
59	BT_EN	I	Power up or power down the Bluetooth section of the chipset (like a reset)	VIO
60	LPO_IN	I	Clock input for external sleep clock source (32.768 kHz)	
EP	GND	Ground	15 Ground/Thermal exposed pins, connect to the ground	

Table 23: JODY-W1 series pin description

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 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
VBAT	Power supply voltage	-0.5	6.0	V
VIO	I/O supply voltage 1.8V/3.3V	-0.5	3.9	V
VIO_SD	SDIO supply voltage 1.8V/3.3V	-0.5	3.9	V
$T_{STORAGE}$	Storage temperature	-40	+85	°C

Table 24: Absolute maximum ratings

⚠ The product is not protected against overvoltage or reversed voltages. If necessary, voltage spikes exceeding the power supply voltage specification, given in table above, must be limited to values within the specified boundaries by using appropriate protection devices.

4.2 Maximum ESD ratings

JODY-W1 modules are manufactured using a highly automated process, which complies with IEC61340-5-1 [8] (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 precautions[4] for handling the modules.

Table 25 describes the target ESD ratings of the JODY-W1 pins – subject to module qualification.

Applicability		Immunity level[5]
All pins except ANTx	Human Body Model (HBM), ANSA/ESDA/JEDEC JS-001-2014[6].	±1000 V
	Charged Device Model (CDM), JESD22-C101.	±250 V
ANTx pins	Human Body Model (HBM), AEC-Q200-002 Rev B.	±1000 V
	Charged Device Model (CDM), JESD22-C101.	±500V

Table 25: ESD immunity rating for pins of the JODY-W1 module

[4] Minimum ESD protection level for safe handling is specified in JEDEC JEP155 (HBM) and JEP157 (CDM) for ±500 V and ±250 V respectively.
[5] Target values.
[6] In compliance with AEC-Q100-002 Rev E requirements.

4.3 Operating conditions

Symbol	Parameter	Min.	Typ	Max.	Units
VBAT	Power supply voltage	3.2	-	4.8	V
VIO	I/O supply voltage 1.8V/3.3V	1.62	-	3.63	V
VIO_SD	SDIO supply voltage 1.8V/3.3V	1.62	-	3.63	V
T_A	Ambient operating temperature	-40	-	+85	°C
Ripple Noise	Peak-to-peak voltage ripple on VBAT and VIO supply lines.	-	-	10	mV

Table 26: Operating conditions

☞ For temperature above 55 °C, the radio transceiver autonomously monitors the junction temperature and employs transmit duty cycle throttling to regulate power dissipation and thereby ensure that the junction temperature is safely below 115 °C. Transmit duty cycle throttling can lower throughput to up to 25% of maximum throughput at nominal temperature.

4.4 Digital pad ratings

Table 27 describes the digital pad ratings for the SDIO interface I/O pins and PCIe out-of-band signals (PCIE_PERST#, PCIE_PME# and PCIE_CLKREQ#).

Symbol	Parameter	VIO_SD	Min.	Max.	Units
V_{IH}	Input high voltage	1.8 V	1.27	-	V
		3.3 V	0.625*VIO_SD	-	V
V_{IL}	Input low voltage	1.8 V	-	0.58	V
		3.3 V	-	0.25*VIO_SD	V
V_{OH}	Output high voltage @ 2mA	1.8 V	1.4	-	V
		3.3 V	0.75*VIO_SD	-	V
V_{OH}	Output low voltage @ 2mA	1.8 V	-	0.45	V
		3.3 V	-	0.125*VIO_SD	V

Table 27: DC characteristics SDIO digital I/O pins

Table 28 describes the digital pad ratings are for all other digital I/O pins including GPIOs.

Symbol	Parameter	VIO	Min.	Max.	Units
V_{IH}	Input high voltage	1.8 V	0.65*VIO	-	V
		3.3 V	2.0	-	V
V_{IL}	Input low voltagea	1.8 V	-	0.35*VIO	V
		3.3 V	-	0.8	V
V_{OH}	Output high voltage @ 2mA	1.8 V	VIO-0.45	-	V
		3.3 V	VIO-0.4	-	V
V_{OH}	Output low voltage @ 2mA	1.8 V	-	0.45	V
		3.3 V	-	0.4	V

Table 28: DC characteristics digital I/O pins

4.5 Wi-Fi power consumption

Operation mode: 2.4 GHz and 5 GHz Wi-Fi, Bluetooth powered down	Typical peak VBAT (3.3 V) current [mA]	Typical peak VBAT (3.3 V) idle current [mA]	Typical peak VIO (1.8 V) current [µA]
TX modes			
CCK 11 Mbps, BW20, Ch7, Core2, 18 dBm	360	110	60
MSC7, HT20, Ch7, Core2, 14dBm	270	110	60
BPSK, 6 Mbps, HT20, Ch100, Core1, 17 dBm	520	135	60
BPSK, 6 Mbps, HT20, Ch100, Core2, 17 dBm	450	135	60
MCS7, HT20, SGI, CH100, Core1, 14 dBm	440	135	60
MCS7, HT20, SGI, CH100, Core2, 14 dBm	420	135	60
MCS7, HT40, SGI, Ch100, Core1, 14 dBm	460	165	60
MCS7, HT40, SGI, Ch100, Core2, 14 dBm	430	165	60
MCS9, VHT40, SGI, Ch100, Core1, 12 dBm	430	165	60
MCS9, VHT40, SGI, Ch100, Core2, 12 dBm	420	165	60
MCS9, VHT80, SGI, Ch100, Core1, 12 dBm	470	240	60
MCS9, VHT80, SGI, Ch100, Core2, 12 dBm	470	240	60
MCS9, VHT40, SGI, Ch100, 2 streams, 12 dBm	760	165	60
MCS9, VHT80, SGI, Ch100, 2 streams, 12 dBm	820	240	60
RX modes			
MCS7, HT40, Ch100, Core2	190	165	60
MCS7, HT20, Ch7, Core2	120	110	60
1 Mbps, BW20, Ch7, Core2	110	110	60
6 Mbps, BW20, Ch100, Core2	140	135	60
MCS7, HT20, Ch100, Core2	140	135	60
MCS7, HT20, Ch100, Core1	140	135	60
MCS0, HT80, Ch100, Core1	245	240	60

Table 29: Current consumption for different Wi-Fi TX- and RX-modes at 25 °C

Operation mode: Power save modes	Typical VBAT (3.3 V) current [mA]	Typical VIO (1.8 V) current [µA]	Typical VIO_SD (1.8 V) current [µA]
Sleep (Idle, not associated), FW not loaded	13	30	35
Sleep (Idle, not associated), FW loaded	0.005	340	52
Wi-Fi power save, DTIM 1	2.5	280	52
Wi-Fi power save, DTIM 2	1.3	305	52
Wi-Fi power save, DTIM 3	0.85	315	52

Table 30: Current consumption for Wi-Fi power-save modes at 25 °C

4.6 Bluetooth power consumption

Operation mode: Bluetooth mode with Wi-Fi powered down	Typical VBAT (3.3 V) current [µA]	Typical VIO (1.8 V) current [µA]	Typical VIO (3.3 V) current [µA]
Sleep	5.3	130	170
Standard 1.28s inquiry scan	150	150	185
DM5/DH5	56000	40	50
BLE scan	160	150	185
BLE advertising, unconnectable 1 sec	60	150	185

Table 31: Current consumption for Bluetooth operation at 25 °C

4.7 Radio specifications

4.7.1 Bluetooth

Parameter	Specifications
RF Frequency Range	2.402 – 2.480 GHz
Supported Modes	Bluetooth BR/EDR and Bluetooth LE
Number of channels	79
Modulation	1 Mbps: GFSK (BDR) 2 Mbps: π/4 DQPSK (EDR) 3 Mbps: 8DQPSK (EDR)
Transmit Power	BDR: +12 dBm ± 2 dB EDR: +10 dBm ± 2 dB BLE: +8 dBm ± 2 dB
Receiver Sensitivity	BDR: -93 dBm ± 1.5 dB EDR@2M: -95dBm ± 1.5 dB EDR@3M: -89 dBm ± 1.5 dB BLE: -95 dBm ± 1.5 dB

Table 32: Bluetooth radio parameters

4.7.2 Wi-Fi

JODY-W1 series modules support dual-band Wi-Fi with 802.11a/b/g/n/ac operation in the 2.4 GHz and 5 GHz radio bands.

Parameter		Operation Mode	802.11 EVM limit	Specification (typ. output power tolerance ± 2 dB)
Maximum transmit power	2.4 GHz	DSSS/CCK	-9 dB	18 dBm
		OFDM, BPSK	-8 dB	15 dBm
		OFDM, QPSK	-13 dB	15 dBm
		OFDM, 16-QAM	-19 dB	15 dBm
		OFDM, 64-QAM, 3/4	-25 dB	13 dBm
		OFDM, 64-QAM, 5/6	-28 dB	13 dBm
	5 GHz	OFDM, BPSK	-8 dB	15 dBm
		OFDM, QPSK	-13 dB	15 dBm
		OFDM, 16-QAM	-19 dB	15 dBm
		OFDM, 64-QAM, 3/4	-25 dB	13 dBm[7]
		OFDM, 64-QAM, 5/6	-28 dB	13 dBm[7]
		OFDM, 256-QAM, 3/4	-30 dB	8 dBm
		OFDM, 256-QAM, 5/6	-32 dB	8 dBm

Table 33: Wi-Fi Radio maximum transmit power parameter

[7] 11 dBm for JODY-W164-27A-11A

Table 34 describes the operating mode and specification Wi-Fi radio parameters for JODY-W1.

Parameter		Operation mode			Specification
RF Frequency range		802.11b/g/n			2.400 – 2.500 GHz
		802.11a/n/ac			4.900 – 5.845 GHz
Modulation		802.11b			CCK and DSSS
		802.11a/g/n/ac			OFDM
Supported data rates		802.11b			1, 2, 5.5, 11 Mbps
		802.11a/g			6, 9, 12, 18, 24, 36, 48, 54 Mbps
		802.11n SISO			MCS0 - MCS7 (150 Mbps)
		802.11n MIMO			MCS8 – MCS15 (300 Mbps)
		802.11ac SISO			MCS0 – MCS9 (433 Mbps)
		802.11ac MIMO			MCS0 – MCS9 (867 Mbps)
Supported channel bandwidth		2.4 GHz band 5 GHz band			20 MHz 20, 40, 80 MHz
Supported guard interval (GI)		802.11n			400, 800 ns
		802.11ac			Short guard interval supported
Receiver sensitivity	2.4 GHz	802.11b		1 Mbps	-98 dBm ± 1 dB
				11 Mbps	-90 dBm ± 1 dB
		802.11g SISO		6 Mbps	-95 dBm ± 1 dB
				54 Mbps	-78 dBm ± 1 dB
		802.11n SISO	20 MHz	MCS0	-95 dBm ± 1 dB
				MCS7	-75 dBm ± 1 dB
		802.11n MIMO	20 MHz	MCS0	-96 dBm ± 1 dB
				MCS7	-79 dBm ± 1 dB
	5 GHz	802.11n SISO	40 MHz	MCS0	-89 dBm ± 1 dB
				MCS7	-70 dBm ± 1 dB
		802.11n MIMO	40 MHz	MCS8	-90 dBm ± 1 dB / core
				MCS15	-70 dBm ± 1 dB / core
		802.11ac SISO	20 MHz	MCS0	-92 dBm ± 1 dB
				MCS8	-68 dBm ± 1 dB
		802.11ac MIMO	20 MHz	MCS0	-92 dBm ± 1 dB / core
				MCS8	-68 dBm ± 1 dB / core
		802.11ac SISO	40 MHz	MCS0	-89 dBm ± 1 dB
				MCS9	-64 dBm ± 1 dB
		802.11ac MIMO	40 MHz	MCS0	-89 dBm ± 1 dB / core
				MCS9	-64 dBm ± 1 dB / core
		802.11ac SISO	80 MHz	MCS0	-86 dBm ± 1 dB
				MCS9	-60 dBm ± 1 dB
		802.11ac MIMO	80 MHz	MCS0	-86 dBm ± 1 dB / core
				MCS9	-60 dBm ± 1 dB / core

Table 34: Wi-Fi radio parameters

4.8 LTE Coexistence performance

4.8.1 Wi-Fi receiver performance with LTE coexistence filter

Figure 19 shows the Wi-Fi sensitivity of JODY-W1 modules including dedicated high performance coexistence filter in the presence of an LTE interferer allocated in any of the bands 7, 38, 40 or 41. The modules are specified according to Table 2.

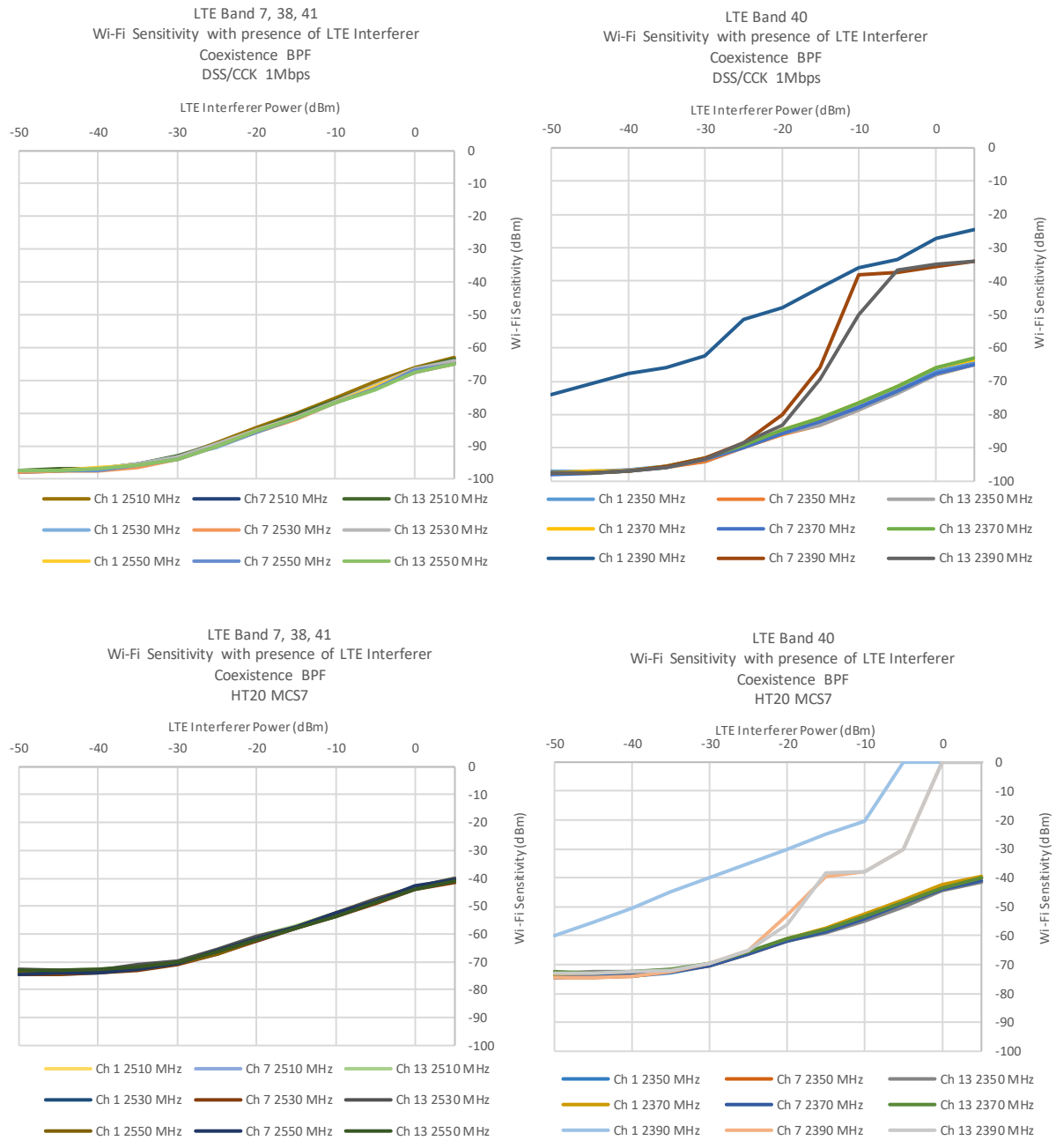

Figure 19: Wi-Fi sensitivity of JODY-W1 modules with dedicated high-performance coexistence filter

4.8.2 Wi-Fi receiver performance with ordinary Wi-Fi Band pass filter

Figure 20 shows the Wi-Fi sensitivity of JODY-W1 modules, including data for a standard Wi-Fi band pass filter in the presence of an LTE interferer allocated in bands 7, 38, 40, and 41. JODY-W1 modules are specified in accordance with Table 2.

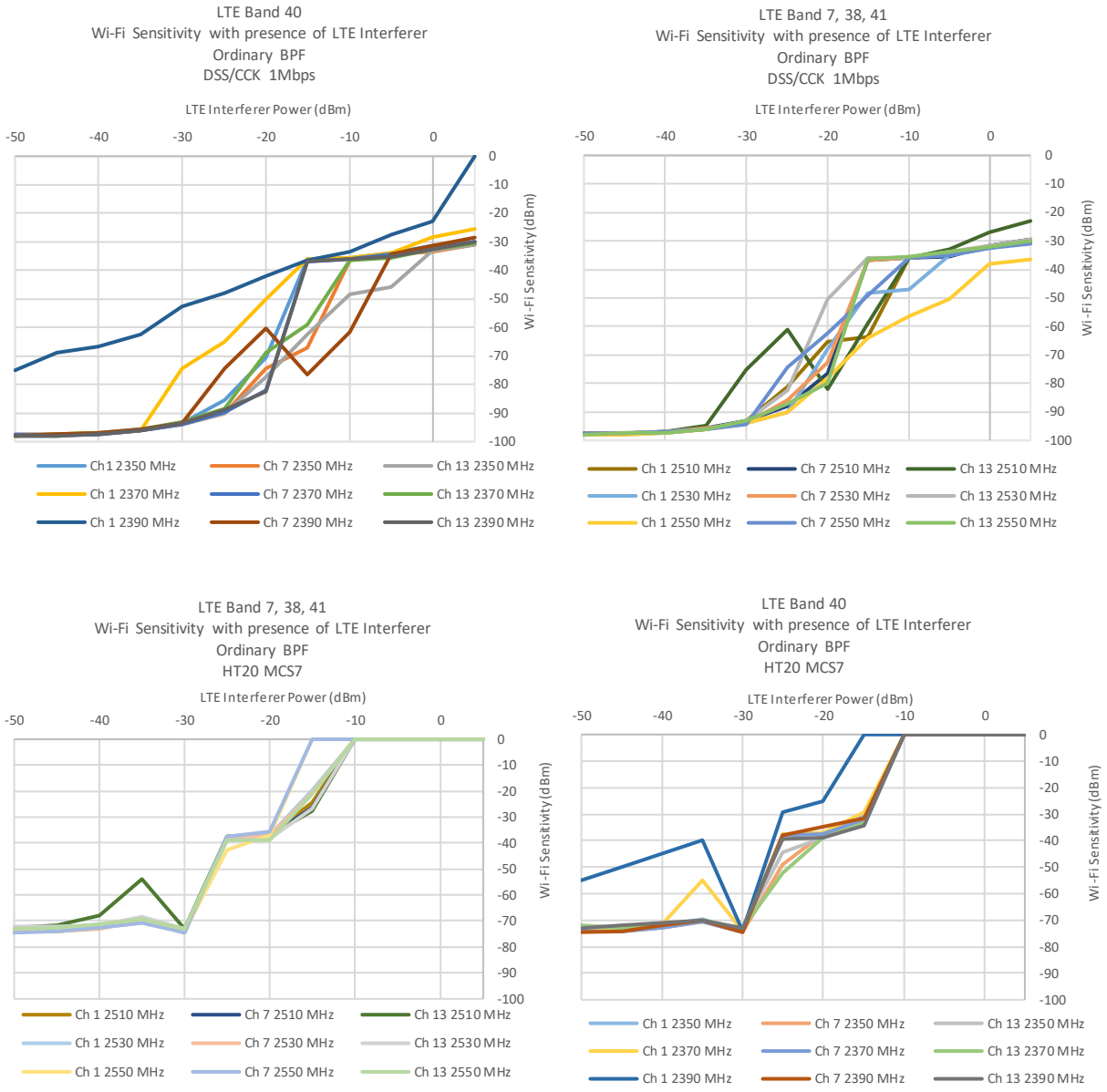

Figure 20: Wi-Fi sensitivity of JODY-W1 modules with standard Wi-Fi band pass filter

4.9 Thermal measurements

All measurements are done according to the JEDEC standards - JESD51-2A for the junction to ambient, JESD51-8 for the junction to board and JESD51-14 for the junction to case values. For the measurements, a 2S2P board with the dimension of 101.5 x 114.5 mm was used.

Symbol	Parameter	Condition	Value	Units
θ_{JA}	Junction to ambient thermal resistance $\theta_{JA} = (T_J - T_A) / P_H$ T_J = Junction temperature T_A = Ambient temperature P_H = Dissipated power from device	JESD51-2A JEDEC 2S2P board inside thermal chamber, No air flow	19.4	°C/W
Ψ_{JT}	Junction to top of package thermal characterization parameter $\theta_{JA} = (T_J - T_T) / P_H$ T_T = Top of package temperature	JESD51-2A JEDEC 2S2P board inside thermal chamber, No air flow	13.6	°C/W
Ψ_{JB}	Junction to bottom thermal characterization parameter $\theta_{JA} = (T_J - T_B) / P_H$ T_B = Board temperature	JESD51-2A JEDEC 2S2P board inside thermal chamber No air flow	13.4	°C/W
θ_{JC}	Junction to case shielding thermal resistance $\theta_{JA} = (T_J - T_C) / P_H$ T_C = Case temperature	JESD51-14 JEDEC 2S2P board with ring cold plate, No air flow	12.5	°C/W
θ_{JB}	Junction to board thermal resistance $\theta_{JA} = (T_J - T_B) / P_H$ T_B = Board temperature	JESD51-8 JEDEC 2S2P board with ring cold plate, No air flow	12.3	°C/W

Table 35: Module thermal information

5 Host drivers and firmware

5.1 General principle

JODY-W1 series modules do not contain any persistent software. A firmware binary is downloaded by the host operating system driver during the system start-up. Separate driver packages, including the firmware binaries, are available for PCIe and SDIO Wi-Fi host interface operation.

☞ Always use the latest available firmware to ensure the best performances of the module.

5.2 Supported operating systems

5.2.1 Linux

Linux device drivers are available free of charge from the chipset manufacturer. A Software License Agreement (SLA) must be signed with the chipset manufacturer to obtain the driver package. This package includes:

- Dedicated Kernel driver, to bind the Wi-Fi device to the kernel. The driver sources will be provided.
- A dedicated Wi-Fi firmware image, which will be uploaded during initialization of the Wi-Fi device.
- A dedicated Bluetooth firmware image, which will be uploaded during initialization of the Bluetooth device.
- Laboratory and manufacturing tools.

For a detailed description of the driver packages, refer to JODY-W1 series System integration manual [2].

6 Mechanical specifications

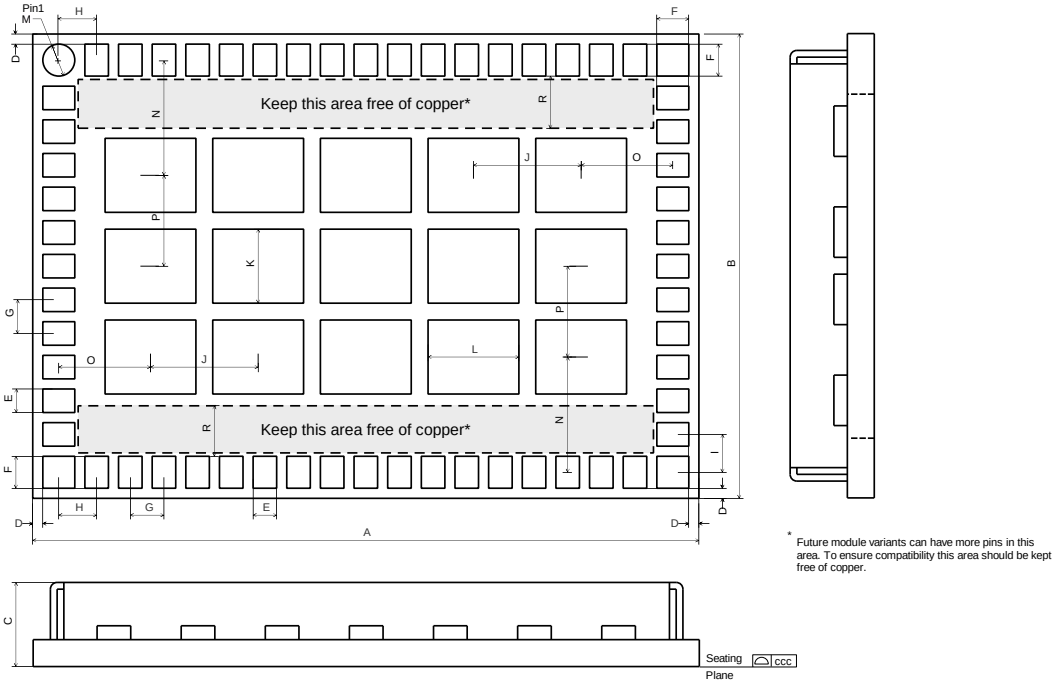

Figure 21: JODY-W1 series dimensions (bottom view)

Parameter	Description	Typical		Tolerance	
A	Module Length [mm]	19.8	(779.5 mil)	+0.35/-0.1	(+13.8/-3.9 mil)
B	Module Width [mm]	13.8	(543.3 mil)	+0.1/-0.1	(+3.9/-3.9 mil)
C	Module Thickness [mm]	2.5	(98.4 mil)	+0.2/-0.2	(+7.9/-7.9 mil)
ccc	Seating Plane Coplanarity [mm]	<0.1	(3.94 mil)		
D	PCB Edge to Pin Edge [mm]	0.3	(11.8 mil)	+0.20/-0.20	(+7.9/-7.9 mil)
E	Pin Width [mm]	0.7	(27.6 mil)	+0.05/-0.05	(+2.0/-2.0 mil)
F	Pin Length [mm]	0.95	(37.4 mil)	+0.05/-0.05	(+2.0/-2.0 mil)
G	Pin to Pin Pitch [mm]	1.0	(39.4 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
H	Horizontal Corner Pin to Pin Pitch [mm]	1.125	(44.3 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
I	Lateral Corner Pin to Pin Pitch [mm]	1.125	(44.3 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
J	Horizontal Thermal Pads Pitch [mm]	3.2	(126.0 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
K	Thermal Pad Height [mm]	2.2	(86 6 mil)	+0.1/-0.1	(+3.9/-3.9 mil)
L	Thermal Pad Length [mm]	2.7	(106.3 mil)	+0.1/-0.1	(+3.9/-3.9 mil)
M	Pin 1 Diameter [mm]	0.95	(37.4 mil)	+0.05/-0.05	(+2.0/-2.0 mil)
N	Horizontal Pin to Thermal Pad Pitch [mm]	3.425	(134.8 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
O	Lateral Pin to Thermal Pad Distance [mm]	2.725	(107.3 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
P	Lateral Thermal Pads Pitch [mm]	2.7	(106.3 mil)	+0.02/-0.02	(+0.8/-0.8 mil)
R	Reserved area for future module variants	1.55	(61.0 mil)	+0.05/-0.05	(+2.0/-2.0 mil)

7 Approvals

☞ The approvals for JODY-W174-A are still pending.

JODY-W1 series modules comply with the regulatory demands of Radio Equipment Directive (RED), Federal Communications Commission (FCC), Innovation Science and Economic Development (ISED).

⚠ See JODY-W1 series system integration manual [2] for detailed information about regulatory compliance requirements of end products that use JODY-W1 series module.

7.1 European Union regulatory compliance

JODY-W1 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 JODY-W1 series modules against requirements and provisions in the European Union, see the JODY-W1 EU Declaration of Conformity [6].

7.1.1 Compliance with the RoHS directive

The JODY-W1 series modules comply with the Directive 2011/65/EU (EU RoHS 2) and its amendment Directive (UE) 2015/863 (EU RoHS 3).

7.2 Great Britain regulatory compliance

For information about the regulatory compliance of JODY-W3 series modules against requirements and provisions in Great Britain, see also the JODY-W3 UKCA Declaration of Conformity [7].

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.

JODY-W1 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).

Guidance about using the UKCA marking: https://www.gov.uk/guidance/using-the-ukca-marking

7.3 United States (FCC) and Canada (ISED)

This section contains the FCC and ISED compliance information for the JODY-W1 series modules.

Table 36 shows the FCC and ISED IDs allocated to JODY-W1 series modules.

Model[8]	FCC ID	ISED ID
JODY-W164-27A, JODY-W163-04A, JODY-W164-15A	XPYJODYW164-07A	8595A-JODYW16407A
JODY-W164-03A, JODY-W163-13A, JODY-W164-13A	XPYJODYW164	8595A-JODYW164
JODY-W167-00A, JODY-W167-03A	XPYJODYW167	8595A-JODYW167
JODY-W174-03A, JODY-W174-12A	Pending	Pending
JODY-W174-13A, JODY-W174-15A	Pending	Pending

Table 36: FCC and ISED IDs for different variants of JODY-W1 series modules

[8] The model name is identical to the ordering code (cf. Table 42)

7.3.1 FCC compliance statement

The JODY-W1 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 JODY-W1 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.

In accordance with 47 CFR § 15.19, the end product into which this module is integrated 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:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation."

When the end-product is so small or for such use that it is not practical to place the above statement on it, the information shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or on the container in which the device is marketed. However, the FCC ID label must be displayed on the device.

If the end-product will be installed in locations where the end-user is not able to see the FCC ID and/or this statement, the FCC ID and the statement shall also be included in the end-product manual.

☞ The outside of final products containing the JODY-W1 module must display in a user accessible area a label referring to the enclosed module[9]. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: XPYJODYW164" or "Contains FCC ID: XPYJODYW164".

7.3.2 ISED compliance statement

The JODY-W1 series module complies with ISED (Innovation, Science and Economic Development Canada)[10] 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.

☞ 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.

[9] The FCC and ISED IDs for the JODY-W1 series module variants are shown in Table 36. Select the applicable ID.
[10] Formerly known as IC (Industry Canada).

This radio transmitter IC: 8595A-JODYW164 / IC: 8595A-JODYW16407A / IC: 8595A-JODYW167 has been approved by ISED to operate with the antenna types listed below 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 (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.

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-JODYW164”[11].

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-JODYW164 / IC: 8595A-JODYW16407A / IC: 8595A-JODYW167 été approuvé par ISED pour fonctionner avec les types d’antenne énumérés ci-dessous 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.-àutilisateurs 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.

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-JODYW164 ».

This radio transmitter IC: 8595A-JODYW164 / IC: 8595A-JODYW16407A / IC: 8595A-JODYW167 has been approved by ISED to operate with the antenna types listed below 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.

[11] The FCC and IC IDs for the JODY-W1 series module variants are shown in Table 36. Select the applicable ID.

Le présent émetteur radio IC: 8595A-JODYW164 / IC: 8595A-JODYW16407A / IC: 8595A-JODYW167 a été approuvé par ISED pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

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.

☞ The approval type for all the JODY-W1 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.

7.4 Approved antennas

Refer to the JODY-W1 antenna reference design [3] for the specifications that must be fulfilled in the end product that uses radio type approval of the JODY-W1 module. The JODY-W1 antenna reference design provides PCB layout details and electrical specifications.

The approved antennas that can be connected to the JODY-W1 series module are described in this section.

7.4.1 Wi-Fi operation

For Wi-Fi operation in the 2.4 GHz band and Wi-Fi operation in the 5 GHz band, the JODY-W1 series module has been tested and approved for use with the antennas listed in Table 37.

Manufacturer	Part number	Antenna type	Peak gain [dBi]		Validated regulatory domain
			2.4 GHz band	5 GHz band	
Any	N/A	Dipole antenna	2	2	FCC/IC
Any	N/A	Dipole antenna	0	0	ETSI

Table 37: List of approved Wi-Fi antennas

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

7.4.2 Bluetooth operation

For Bluetooth operation, the JODY-W1 series module has been tested and approved for use with the antennas listed in Table 38.

Manufacturer	Part number	Antenna type	Peak gain [dBi]		Validated regulatory domain
			2.4 GHz band	5 GHz band	
Any	N/A	Dipole antenna	2	2	FCC/IC
Any	N/A	Dipole antenna	0	0	ETSI

Table 38: List of approved Bluetooth antennas

7.5 Bluetooth qualification

☞ JODY-W163/-W164/-W167 modules have been qualified as “Controller Subsystem” according to the Bluetooth 5.0 specification and are listed with the qualified design ID, QDID: 114915.

This means that there is no need for any further qualification if the module is combined with a host stack that is Bluetooth-qualified as "Host Subsystem".

7.5.1 Bluetooth host stack

Several Bluetooth host stacks are available in the market. These host stacks are suited for different tasks and environments. These host stacks could differ based on their system requirements, supported Bluetooth profiles, cost, Bluetooth qualification, support and so on.

8 Product handling

8.1 Packaging

JODY-W1 series modules are delivered as hermetically sealed, reeled tapes to enable efficient production, production lot set-up and tear-down. For more information about packaging, see the u-blox product packaging reference guide [1].

8.1.1 Reels

JODY-W1 series modules are deliverable in quantities of 500 pieces on a reel. JODY-W1 series modules are shipped on reel Type A4 as described in the u-blox package information guide [1].

8.1.2 Tapes

Figure 22 shows the position and orientation of JODY-W1 series modules as they are delivered on tape. The dimensions of the tapes are specified in Figure 23.

Figure 22: Orientation of JODY-W1 modules on tape

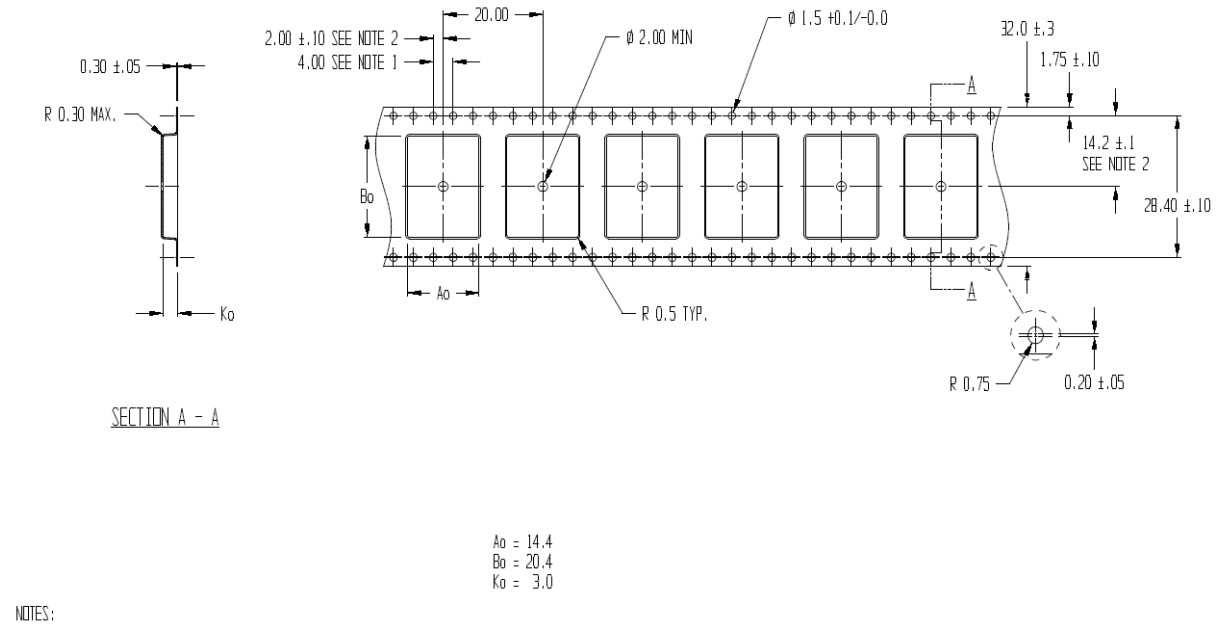

Figure 23: JODY-W1 tape dimensions

8.2 Moisture sensitivity levels

⚠ JODY-W1 series modules are Moisture Sensitive Devices (MSD) as described in accordance with the IPC/JEDEC specification.

JODY-W1 automotive grade modules are are rated at MSL3. See moisture sensitive warning label on each shipping bag for detailed information.

After opening the dry pack, the modules with MSL 3 must be mounted within 168 hours in factory conditions of maximum 30 °C/60%RH or must be stored at less than 10%RH.

The modules require baking if the humidity indicator card shows more than 10% when read at 23±5°C or if the conditions mentioned above are not met. Please refer to J-STD-033B standard for the bake procedure.

8.3 Reflow soldering

JODY-W1 series modules are approved for a single reflow cycle only.

⚠ Reflow soldering profiles must be selected in accordance with u-blox soldering recommendations described in the system integration manual [2]. Failure to observe these recommendations can result in severe damage to the product.

8.4 ESD handling precautions

JODY-W1 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. See also Maximum ESD ratings.

Proper ESD handling and packaging procedures must be applied throughout the processing, handling, and operation of any application that incorporates the JODY-W1 series module.

For further information about the handling the modules, see also the JODY-W1 system integration manual [1].

9 Labeling and ordering information

9.1 Product labeling

The labels displayed on JODY-W1 series include important product information.

Figure 24 shows the label applied to JODY-W1 series modules. Each of the given label references are described in Table 39.

Figure 24: JODY-W1 series sample label

Reference	Description
1	Text in bold font: “Model:” type number with the product version
2	Minor product version (xx)
3	Date of production encoded YY/WW (year/week)
4	FCC/ISED ID with which the module has been listed.
5	Data Matrix with unique serial number comprising 19 alphanumeric symbols: - The first 3 symbols are used for production tracking and are an abbreviated representation of the Type number that is unique to each module variant. - The following 12 symbols represent the unique hexadecimal Bluetooth address of the module AABBCCDDEEFF, and - The last 4 symbols represent the hardware and firmware version encoded HHFF. See also Reserved MAC addresses.
6	u-blox logo with red dot to indicate the position of pin 1

Table 39: JODY-W1 series label description

9.2 Product identifiers

Table 40 describes the three product identifiers, namely the Type number, Model name and Ordering code.

Format	Description	Nomenclature
Model name	Describes the form factor, platform technology and platform variant. Used mostly in product documentation like this data sheet, the model name represents the most common identity for all u-blox products	PPPP-TGVV
Ordering code	Comprises the model name – with additional identifiers to describe the major product version and quality grade	PPPP-TGVV-TTQ
Type number	Comprises the model name and ordering code – with additional identifiers to describe minor product versions.	PPPP -TGVV-TTQ-XX

Table 40: Product code formats

Table 41 explains the parts of the product code.

Code	Meaning	Example
PPPP	Form factor	JODY
TG	Platform T – Dominant technology, For example, W: Wi-Fi, B: Bluetooth G - Generation	W1
VV	Variant based on the same platform; range [00...99]	64
TT	Major Product Version	00
Q	Quality grade A: Automotive B: Professional C: Standard	A
XX	Minor product version (not relevant for certification)	00

Table 41: Part identification code

9.3 Ordering information

Ordering code	Product
JODY-W163-13A	Automotive grade module based on CYW89359 transceiver, 2-antenna version, and RSDB operation on a single antenna. Support for 5 GHz MIMO. LTE filter for 2.4 GHz Wi-Fi. SDIO host interface.
JODY-W164-03A	Automotive grade module based on CYW89359 transceiver, 2-antenna version, and RSDB operation on a single antenna. Support for 5 GHz MIMO. PCIe host interface.
JODY-W164-13A	Automotive grade module based on CYW89359 transceiver, 2-antenna version, and RSDB operation on a single antenna. Support for 5 GHz MIMO. LTE filter for 2.4 GHz Wi-Fi. PCIe host interface.
JODY-W163-04A	Automotive grade module based on CYW89359 transceiver, 2-antenna version, and RSDB operation on a single antenna. No MIMO support. SDIO host interface.
JODY-W164-27A	Automotive grade module based on CYW88359 transceiver, 2-antenna version, and RSDB operation on a single antenna. No MIMO support. LTE filter for 2.4 GHz Wi-Fi. SDIO host interface.
JODY-W164-15A	Automotive grade module based on CYW88359 transceiver, 2-antenna version, and RSDB operation on a single antenna. No MIMO support. LTE filter for 2.4 GHz Wi-Fi. PCIe host interface.
JODY-W167-00A	Automotive grade module based on CYW88359 transceiver, 3-antenna version, and 2x2 MIMO. PCIe host interface.
JODY-W167-03A	Automotive grade module based on CYW89359 transceiver, 3-antenna version, and 2x2 MIMO. PCIe host interface.
JODY-W174-03A	Automotive grade module based on CYW89459 transceiver, 2-antenna version, and RSDB operation on a single antenna. Support for 5 GHz MIMO. PCIe host interface.
JODY-W174-12A	Automotive grade module based on CYW88459 transceiver, 2-antenna version, and RSDB operation on a single antenna. Support for 5 GHz MIMO. LTE filter for 2.4 GHz Wi-Fi. PCIe host interface.
JODY-W174-13A	Automotive grade module based on CYW89459 transceiver, 2-antenna version, and RSDB operation on a single antenna. Support for 5 GHz MIMO. LTE filter for 2.4 GHz Wi-Fi. PCIe host interface.
JODY-W174-15A	Automotive grade module based on CYW88459 transceiver, 2-antenna version, and RSDB operation on a single antenna. No MIMO support. LTE filter for 2.4 GHz Wi-Fi. PCIe host interface.

Table 42: Product IDs and ordering codes

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

Appendix

A Glossary

Abbreviation	Definition
AC	Alternating current
BT	Bluetooth
CMD	Command
DC	Direct current
DDR	Double data rate
ESD	Electrostatic sensitive devices
FCC	Federal Communications Commission
FIFO	First in, First out
GI	Guard interval
GND	Ground
GPIO	General-purpose input/output
HD	High definition
HCI	Host controller interface
ISED	Innovation, Science and Economic Development Canada
ISM	Industrial, scientific and medical
LE	Low energy
LTE	Long Term Evolution
LULA	Limited use license agreement
MAC	Medium access control
MIMO	Multiple input multiple output
MWS	Mobile Wireless Standards
MSL	Moisture sensitivity level
NFC	Near-Field Communication
OEM	Original equipment manufacturer
P2P	Peer-to-peer
P2P (GC)	P2P Client
P2P (GO)	P2P Group Owner
PCB	Printed circuit board
PCI	Peripheral component interconnect
PCIe	PCI Express
PCN	Product change notification
PCM	Pulse-code modulation
POR	Power-on reset
RED	Radio Equipment Directive
RF	Radio frequency
RSDB	Real simultaneous dual band
RSS	Radio Standards Specification
RH	Relative humidity
RoHS	Restriction of Hazardous Substances
SAR	Specific absorption rate
SCO	Synchronous connection-oriented

Abbreviation	Definition
SDIO	Secure digital input output
SDR	Single data rate
SISO	Single-input single-output
SMD	Surface-mount device
STA	Station
TBD	To be defined
USB	Universal serial bus
UART	Universal Asynchronous Receiver/Transmitter
VSDB	Virtual simultaneous dual band
WAPI	WLAN Authentication and Privacy Infrastructure
WLAN	Wireless local area network

Table 43: Explanation of the abbreviations and terms used

Related documents

[1] u-blox packaging guide, UBX-14001652
[2] JODY-W1 series system integration manual, UBX-16012621
[3] JODY-W1 antenna reference design, UBX-18017767
[4] JODY-W1 reflow mounted upside down, information note, UBX-18021974
[5] Radio Equipment Directive; ec.europa.eu/growth/sectors/electrical-engineering/red-directive; July 2017
[6] JODY-W1 EU Declaration of Conformity, UBX-18053850
[7] JODY-W1 UKCA Declaration of Conformity, UBX-22030006
[8] IEC61340-5-1 – Protection of electronic devices from electrostatic phenomena – General requirements

☞ For product change notifications and regular updates of u-blox documentation, register on our website, www.u-blox.com.

Revision history

Revision	Date	Name	Comments
R01	11-Jul-2016	vdyk	Initial release.
R02	2-Nov-2016	vdyk, ishe, este, kgom	Removed support for USB interface (section 2.5). Modified the block diagram of JODY-W165 and Pin assignment (Figure 17), and Physical dimensions (Figure 18). Updated the key features (Table 1), module configuration (Table 5), and pin description of JODY-W1 series (Table 19).
R03	29-Nov-2016	mhei, ddie	Updated Figure 16.
R04	2-Mar-2017	ddie, ishe, kgom	Removed reference to JODY-W165 (Professional grade with 2 antenna pins) and included JODY-W167-A (Automotive grade with 3 antenna pins) product variant. Updated Table 1. Included information about supported RSDB and MIMO configurations (section 1.5). Corrected pin names (Figure 16). Removed Reset configuration section. Updated FCC and IC IDs (section 7.3) and ordering codes (section 9.3). Replaced document status with disclosure restriction.
R05	4-May-2017	ddie, ishe, mzes, kgom	Added JODY-W164-A product variant and included block diagram, FCC/IC ID, ordering code for this variant. Updated section 1.1 and Table 1. Included information about Extended operation mode configuration (section 2.1). Updated product description (1.1). Updated Figure 9 and Figure 10. Corrected pin names (Figure 18). Included detailed pin description for antenna pins. Updated Mechanical specification (section 6). Updated FCC and IC IDs (section 7.3) and ordering codes (section 9.3).
R06	08-Sep-2017	mzes, ishe, shoe, ddie	Updated support for 802.11 standards (section 1.7.1). Added information about PCIe pins in Table 21. Included information about RED certification. Added information about JODY-W164-07A. Updated JODY-W164-A block diagram (Figure 1). Added support for RSDB over SDIO.
R07	23-Feb-2018	ddie, mhei, mzes, kgom	Removed the product variant - JODY-W165-A and modified the product status for most of the variants to Engineering Sample in the last table on page 2. Removed support for UART H5 (section 2.4). Updated Pin definition table (Table 23), added Wi-Fi and Bluetooth current consumption specifications (Table 29, Table 30, and Table 31). Included a note with respect to temperature derating in section 4.3. Updated the mechanical specifications (Figure 21). Updated Approvals (section 7.1). Updated the product label drawing in Section 9.1 and corrected the data matrix code content (section 9.1).
R08	5-Mar-2018	mhei, kgom	Updated section 1.1, Table 1 and pin assignment (top view) (Figure 18).
R09	29-Mar-2018	kgom	Updated Table 1. Included footnote related to support of SDIO interface for Automotive grade variants only.
R10	6-Jul-2018	ishe, mzes, ddie, mhei	Updated Table 1, Table 28 and Table 29. Added product variants - JODY-W163-04A, JODY-W163-05A, JODY-W163-13A, and JODY-W167-00B. Removed all references to some of the product variants that have been removed. Updated the product description for JODY-W167(-A). Updated support of a single host interface only (SDIO or PCIe) per product variant. Updated the chipset information. Major updates in Approvals section (standards references, approved antennas, Bluetooth qualification). Added Table 40. Updated the current consumption for Wi-Fi power-save modes (Table 30). Added information on the permitted number of reflow processes for JODY-W164-04A and the reference to the related Information Note [4].
R11	27-Sep-18	mzes	Updated supported Wi-Fi operation modes in section 1.5. Removed soldering profile in section 8.3 and provided reference to JODY-W1 System integration manual instead. Added new FCC/IC IDs in Table 36 and Table 40. Added Bluetooth QDID in section 7.5.
R12	14-Dec-18	mzes, kgom	Updated the product status for JODY-W163-A and JODY-W164-A to Initial Production. Updated the country certifications (sections 1.7.4). Included moisture sensitivity level for professional grade modules (section 8.2). Fixed a formatting error in Table 31.
R13	19-Mar-19	lber	Updated Table 1. Added information about LTE band support for LTE coexistence bandpass filter in section 1.4 and LTE Coexistence performance.

Revision	Date	Name	Comments
R14	13-May-19	mzes, kgom	Added new product variants - JODY-W164-13A and JODY-W164-15A. Updated FCC/ISED certification status in section 7.3.
R15	10-Jul-19	mhei	Updated the product status for JODY-W163-13A, JODY-W164-13A, JODY-W164-15A and JODY-W167 to Initial Production. Removed the footnotes/notes related to pending approvals respectively. Included information about position and orientation of JODY-W1 modules in section 8.1.2. Made a few minor changes in section 9.1.
R16	22-Oct-2019	mzes, este, kgom	Added Product selection guidelines in section 1.5. Removed the product variant - JODY-W167-00B. Updated Table 1.
R17	22-Nov-2019	mhei	Changed product status for JODY-W164-03A-01 to mass production.
R18	23-Apr-2020	mzes, mhei	Replaced product variant JODY-W164-07A with JODY-W164-27A. Added reserved MAC addresses in section 1.7.5. Removed LTE/MWS coexistence interface from supported features. Replaced ISO 60950 with EN 62368 and updated EN 300 328 to V2.2.2. Defined Bluetooth transmit output power for BDR, EDR and BLE in section 4.7.1.
R19	5-Feb-2021	mzes, frca	Updated mechanical specifications (Figure 21) and broadened document scope to include other product variants in Document information, page 2.
R20	28-May-2021	mzes	Updated product status and removed product variants JODY-W163-05A, JODY-W164-04A, and JODY-W164-05A (following End of Life announcement) from Document information. Revised Labeling and ordering information.
R21	17-Aug-2022	mhei, mzes, frca	Added JODY-W174-A product variants. Bluetooth specification updated to v5 with v4.2 feature level support for JODY-W16x. Removed ambiguous description of operating condition ranges in Electrical specifications and information describing ESD handling precautions duplicated in the system integration manual [2]. Added Maximum ESD ratings. Updated information describing Moisture sensitivity levels, Reflow soldering, and Packaging. Updated contact information. Included other minor editorial changes throughout the document.
R22	27-Feb-2022	mzes, frca, lber	Added new products (JODY-W17412A-11 and JODY-W174-15A-11) in Document information and other relevant sections of the document. Corrected host interface described for JODY-W164-27A product variant in Table 2, revised Bluetooth receiver sensitivity in Radio specifications. Added Great Britain regulatory compliance statement (UKCA).

Contact

For further support and contact information, visit us at www.u-blox.com/support.