

ODIN-W160

Host-based multiradio module with Wi-Fi and Bluetooth

Data Sheet

Abstract

This technical data sheet describes the ODIN-W160 short range multiradio wireless modules. The modules are host-based multiradio modules that support dual-band IEEE 802.11a/b/g/n on 2.4 GHz and 5 GHz channels 36-165 (U-NII bands 1, 2, 2e, 3), as well as dual-mode Bluetooth v4.0, which includes Bluetooth low energy and Classic Bluetooth (Bluetooth "Smart Ready").



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1 Functional description

1.1 Overview

The ODIN-W160 host-based multiradio module is ready-to-embed for demanding industrial, vehicle, medical, and security applications. The ODIN-W16 compact 15 x 22 x 3 mm modules support dual-band IEEE 802.11a/b/g/n on 2.4 GHz and 5 GHz channels 36-165 (U-NII bands 1, 2, 2e, 3), as well as dual-mode Bluetooth v4.0, which includes Bluetooth low energy and Classic Bluetooth (Bluetooth “Smart Ready”). The host-based modules are designed for a long life cycle and ultra-low power consumption. Together with the open-source Linux host driver, the modules minimize development time to implement short range wireless communications in end-devices.

1.2 Product features

Model	Standard Specs							Interfaces		Power	Connectors	Features					Grade			
	Bluetooth qualification	Bluetooth profiles	Wi-Fi IEEE 802.11 version	Max output power incl. antenna	Max range	2.4 GHz channels 1-13	5 GHz channels 36-165	Antenna type	UART	SDIO, SPI	Power supply: 3.0 – 3.6 V	Solder pins	Android connectivity	iOS connectivity	Wi-Fi security	RF parameters in EEPROM	MAC addresses in EEPROM	Standard	Professional	Automotive
ODIN-W160	v4.0	H	a/b/g/n	19dbm	500m	•	•	E	B	W	•	•	•	W/LE	Sec	•	•			

H = HCI

E = U.FL connector(s) for external antenna

B = Bluetooth

LE = Bluetooth Low Energy

W = Wi-Fi

Sec = WPA2, Enterprise, EAP-TLS

Table 1: Key features of ODIN-W160

1.3 Block diagram

The block diagram of the ODIN-W160 is provided below.

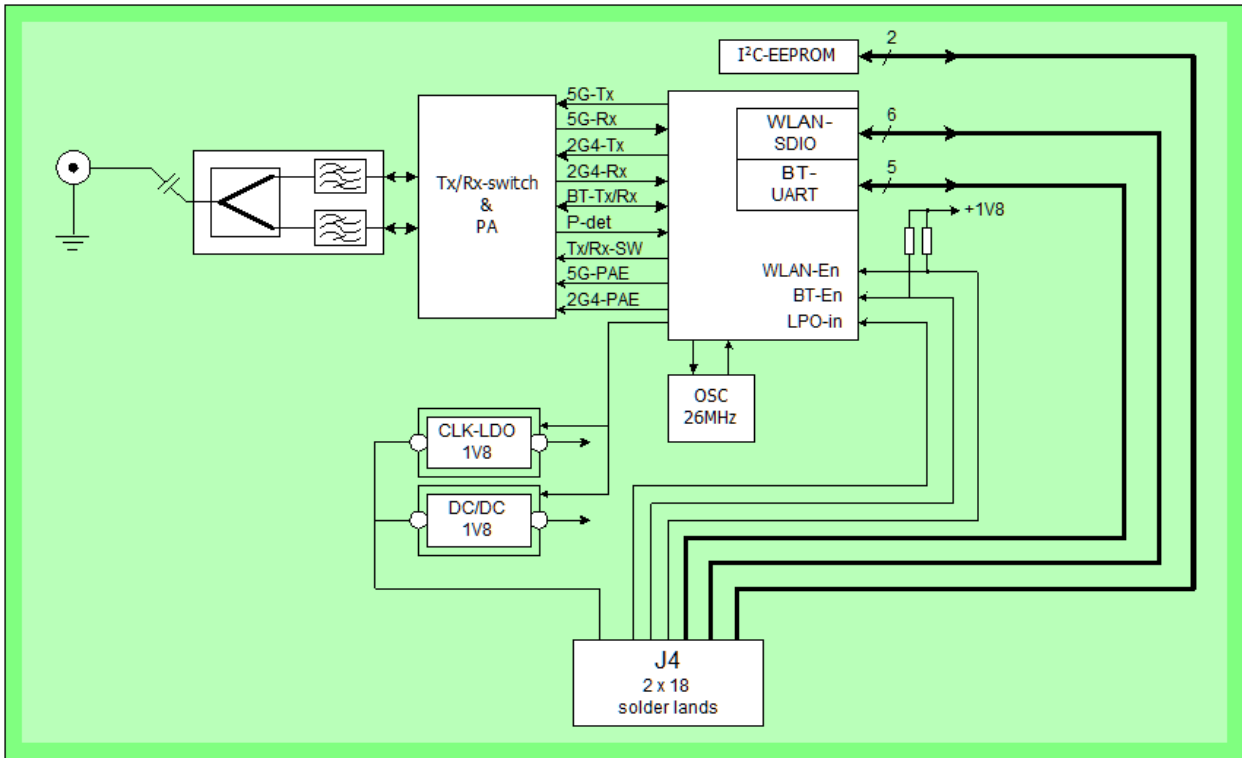


Figure 1: Block diagram of ODIN-W160

1.4 Product description

The ODIN-W160 module supports Wi-Fi, Classic Bluetooth and Bluetooth low energy (Dual Mode / Bluetooth Smart Ready). The Wi-Fi support conforms to IEEE 802.11 a/b/g/n and has support for dual-band 2.4 GHz and 5 GHz operation.

Wi-Fi	Classic Bluetooth	Bluetooth Low Energy
IEEE 802.11 a/b/g/n	Bluetooth 2.1 Classic Bluetooth+EDR Maximum number of slaves: 7	Bluetooth 4.0
Band support 2.4 GHz, channel 1-13 5 GHz, channel 36-165	Band support 2.4 GHz, 79 channels	Band support 2.4 GHz, 39 channels

Table 2: ODIN-W160 Wi-Fi and Bluetooth characteristics

1.4.1 Supported features

- Multiradio module:
 - Dual-band Wireless LAN operation (IEEE 802.11-2007a/b/g and single stream IEEE 802.11n)
 - Bluetooth 4.0
- Ready-to-use:
 - No RF trimming or tuning is required during manufacturing
 - Contains MAC addresses for Wi-Fi and Bluetooth
- Host interfaces:

- Wireless LAN: SDIO or SPI
- Bluetooth: UART
- RF parameters and MAC addresses: I²C
- Small footprint
 - 22.3 x 14.8 x 2.9 mm
- WEP and AES hardware accelerators
- WPA and WPA2 support - both personal and enterprise modes
- Quality of Service: 802.11e and WMM
- Infrastructure mode
- Radio type approved for Europe, US (FCC), Canada (IC), and Japan (MIC)
- Compliant with EMC standards
- Compliant with EN 60601-1-2 (Medical electrical equipment, EMC requirements and tests)
- Industrial temperature range -40 to +85 °C
- Support for low power modes
- External antenna via U.FL connector

2 Interfaces

2.1 Power management

2.1.1 Module supply input (VDD and VIO)

The DC power supply for ODIN-W160 module is provided through the VDD and VIO pins. Voltages must be stable, because during operation the current drawn from VDD and VIO can vary significantly, based on the power consumption profile of the BT/Wi-Fi technologies.

It is important that the system power supply circuit can support peak power.

2.1.2 Module power on/off

The Bluetooth part and the Wireless LAN part are controlled by separate enable pins, BT-EN and WL-EN. There are also dedicated sleep pins, BT-Wake-Up and Host-Wake-Up for Bluetooth Low Energy.

See ODIN-W160 System Integration Manual [2] for more information on how to control the module.

2.2 Antenna interfaces

Different types of external antennas are available for ODIN-W160. Care must be taken while mounting the unit so that it does not interfere with radio communication.

See ODIN-W160 System Integration Manual [2] for the external antennas that can be used and for other RF and antenna issues.

2.2.1 Antenna connectors

The ODIN-W160 is equipped with a U.FL. connector for the external antenna.

The U.FL. connector has the impedance of 50Ω. The antenna port supports both Bluetooth and dual band Wi-Fi.

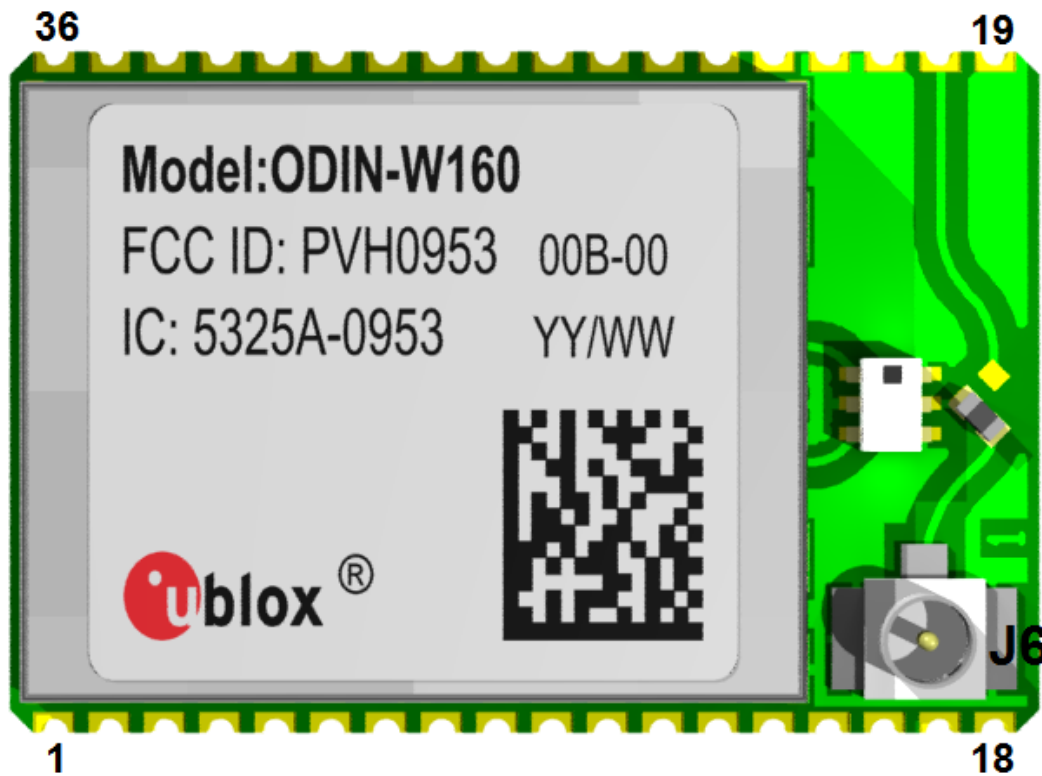


Figure 2: ODIN-W160 antenna connector for external antenna (J6)

2.3 Serial communication

The module has the following two primary host interfaces:

- SDIO or SPI for the Wireless LAN section
- UART for the Bluetooth section

Additionally, the module has an on-board I²C memory for configuration parameters.

2.3.1 UART interface

The module incorporates one UART dedicated to the Bluetooth Host Controller Interface (HCI) transport layer. The HCI interface is used to transport commands, events, ACL and synchronous data between the device and its host using HCI data packets.

The following HCI transport layers are supported and detected automatically when communication starts:

- HCI four-wire (H4)

The HCI interface has a 256 byte receive buffer and supports most baud rates, including all normal PC rates, up to a maximum of 4 Mbps. After power-up, the baud rate is set for 115.2 kbps. The supported maximum baud rate deviation is -2.5%, +1.5%.

The baud rate can be changed with a vendor specific command. The module responds with a Command Complete Event (still at 115.2 kbps), after which the baud rate change takes place. The only parameter needed is the desired baud rate.

HCI hardware includes the following features:

- Receiver detection of break, idle, framing, FIFO overflow, and parity error conditions
- Transmitter underflow detection
- CTR/RTS hardware flow control (H4)

Parameter	Values
Baud rates	Min: 37.5 kbps Maximum: 4000 kbps
Default baud rate	115.2 kbps
Data bits	8
Stop bits	1
Parity	none
Flow control	None, CTS/RTS

Table 3: ODIN-W160 UART characteristics

2.3.2 SDIO Interface

The interface between the host and the module is a standard SDIO interface (See SDIO spec Version 2.0) with Out Of Band interrupt, supporting maximum clock rate of 25MHz. The SDIO interface also supports the following features:

- Both 1 and 4 bit data bus
- Functions number 0 and 2
- Multi-Block data transfer

The Wi-Fi block uses function 2. Function 0 is used for the common I/O area.

2.3.3 SPI interface

The SPI master should use polarity falling to rising with phase sampling on rising edge, shift on falling edge. Bitorder is MSB to LSB. Maximum clock frequency is 48 MHz.

2.3.4 Configuration Parameters I²C

The I²C bus is connected to an on-board persistent storage. The storage holds module configuration parameters such as RF tuning parameters and MAC addresses.

The I²C bus has the following features:

- Memory specification: 24C64 type
- Maximum SCL clock frequency: 400 kHz @ CLOAD < 20pF
- I²C address: 0x51 or 0x55

Parameters are stored in the EEPROM as a list of TLV (type, length, value) objects without any padding.

Icon



I²C address is selectable by signal I²C-E2, pin J4-6. See Table 4: ODIN-W16 pin-out for more information.

3 Pin definition

3.1 Pin assignment

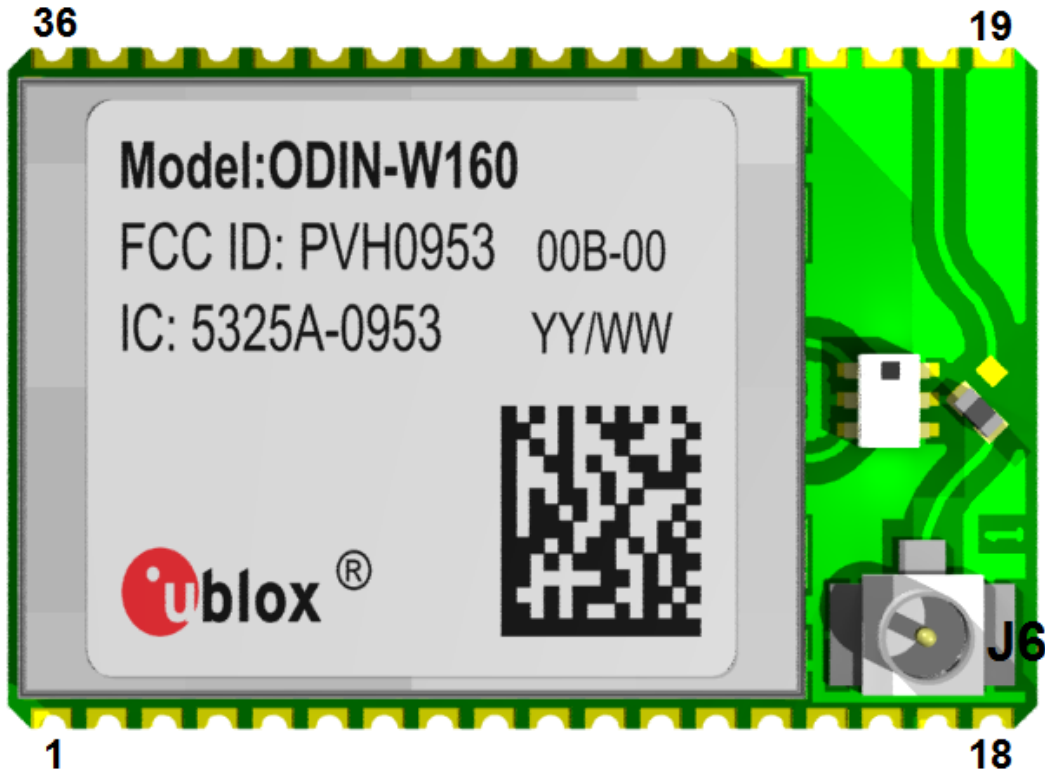


Figure 3: ODIN-W160 pin assignment - front

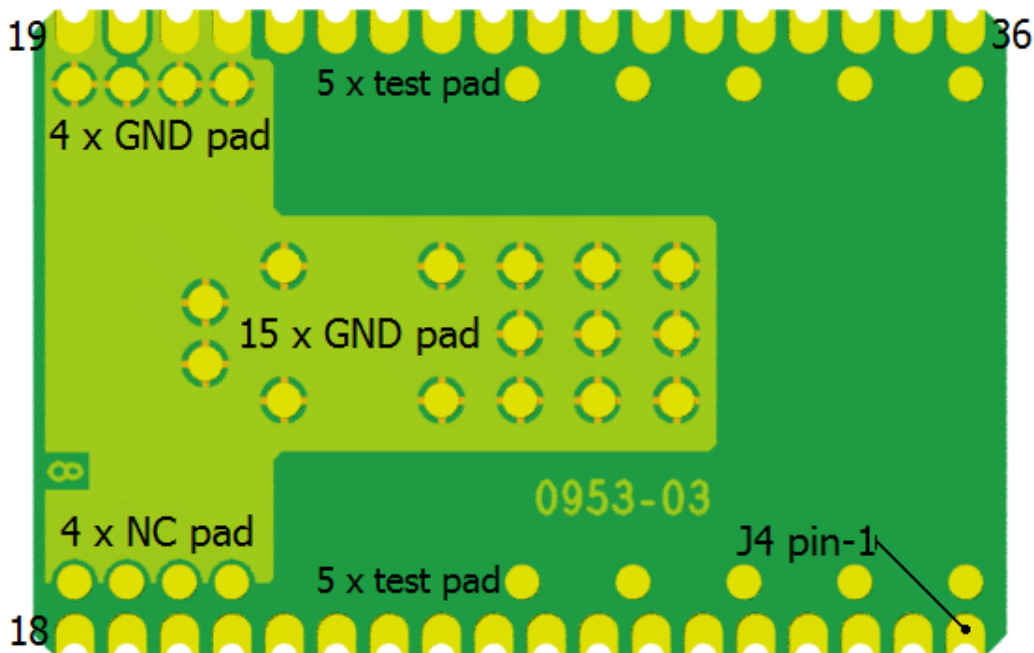


Figure 4: ODIN-W160 pin assignment - back



The signals are available on castellation pads on the edge of the PCB. Test pads are for test and production and are not used in customer application.

J4	Signal name	Signal level	Type	Description
-	NC pad	-	-	These 4 NC pads are not connected to any signal but they function as force balance during the solder process to compensate for the 4 x GND pads on the opposite side of the PCB.
-	test pad	-	-	These 2 x 5 test pads must not be connected; failing to do so may cause undesirable operation.
6	I ² C-E2	CMOS	I	Controls the third bit of the 7-bit device select code. Internal weak pull down.
10	BT-UART-CTS	CMOS	I	Bluetooth UART CTS
13	BT-UART-RxD	CMOS	I	Bluetooth UART RxD
16	WL-EN	CMOS	I	Wireless LAN enable signal. Internal 120 kohm pull-up
17	BT-EN	CMOS	I	Bluetooth enable signal. Internal 120 kohm pull-up
18	BT-Wake-Up	CMOS	I	Bluetooth wake up signal.
34	LPO-32KHz	CMOS	I	Sourcing of external 32kHz LPO clock. See "LPO Requirements" in Electrical Characteristics section in ODIN-W160 Electrical and Mechanical Data Sheet.
35	I ² C-SCL	CMOS	I	I ² C clock, 15 kohm internal pull-up On-board flash memory for RF tuning parameters and MAC address.
23	SDIO-DAT1	CMOS	I/O	Wireless LAN SDIO - DAT1, external pull-up to V _{io} is mandatory Wireless LAN SPI - Connect to GND
36	I ² C-SDA	CMOS	I/O	I ² C data, 15 kohm internal pull-up On-board flash memory for RF tuning parameters and MAC address.
28	SDIO-CMD SPI-MOSI	CMOS	I/O I	Wireless LAN SDIO - CMD, external pull-up to V _{io} is mandatory Wireless LAN SPI - MOSI (Master output / slave input)
29	SDIO-DAT3 SPI-CSn	CMOS	I/O I	Wireless LAN SDIO - DAT3, external pull-up to V _{io} is mandatory. Wireless LAN SPI - Chip select for wireless LAN baseband.
30	SDIO-DAT2	CMOS	I/O I	Wireless LAN SDIO - DAT2, external pull-up to V _{io} is mandatory Wireless LAN SPI - connect to GND
24	SDIO-DAT0 SPI-MISO	CMOS	I/O O	Wireless LAN SDIO - DAT0, external pull-up to V _{io} is mandatory Wireless LAN SPI - MISO (Master input / slave output)
26	SDIO-CLK SPI-CLK	CMOS	I I	Wireless LAN SDIO - Clock input. Max 25 MHz Wireless LAN SPI - Clock input. Max 48 MHz
5	Host-Wake-Up	CMOS	O	Bluetooth host wake up signal
11	BT-UART-TxD	CMOS	O	Bluetooth UART TxD
12	BT-UART-RTS	CMOS	O	Bluetooth UART RTS
31	WL-IRQ	CMOS	O	Wireless LAN SDIO - out of band interrupt for external wake up Wireless LAN SPI - Interrupt
2	V _{io}	1.8VDC	Power	I/O domain supply voltage. minimum ramp up time for I/O power supply = 100 us See "LPO Requirements" in Electrical Characteristics section in ODIN-W160 Electrical and Mechanical Data Sheet.
3	GND	GND	Power	Ground
4	V _{DD}	3.3 VDC	Power	Supply voltage See "LPO Requirements" in Electrical Characteristics section in ODIN-W160 Electrical and Mechanical Data Sheet.
25	GND	GND	Power	Ground
27	V _{DD}	VDD	Power	Supply voltage See "LPO Requirements" in Electrical Characteristics section in ODIN-W160 Electrical and Mechanical Data Sheet.

J4	Signal name	Signal level	Type	Description
-	GND pad	GND	POWER	These 19 (4 x GND pad + 15 x GND pad) solder lands are supplemental RF-GND and should be connected to GND. They are also required for thermal relief.
1	-			Reserved. Do not connect.
7	-			Reserved. Do not connect.
8	-			Reserved. Do not connect.
9	-			Reserved. Do not connect.
14	-			Reserved. Do not connect.
15	-			Reserved. Do not connect.
19	RF-GND			RF ground.
20	-			Reserved. Do not connect.
21	RF-GND			RF ground.
22	RF-GND			RF ground.
32	-			Reserved. Do not connect.
33	-			Reserved. Do not connect.

Table 4: ODIN-W16 pin-out

4 Electrical specifications

Stressing the device above one or more of the ratings listed in the Absolute Maximum Rating section may 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 section of this document should be avoided. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Where application information is given, it is advisory only and does not form part of the specification.

4.1 Absolute maximum ratings

Parameter	Minimum	Maximum	Unit	Remarks
Storage temperature	-40	+95	°C	
Operating temperature	-40	+85 ¹	°C	
V_{DD}^2	-0.5	5.5	V	
V_{IO}	-0.5	2.1	V	
ESD sensitivity for all pins except ANT pin		1000	V	Human Body Model (HBM) JESD22-A114 - Class 1C
ESD sensitivity for ANT pin		250	V	Human Body Model (HBM) JESD22-A114 - Class 1A
ESD immunity for ANT pin		+/-6000	V	Contact discharge to GND terminal of antenna connector IEC 61000-4-2
		+/-6000	V	Indirect discharge to a coupling plane IEN 61000-4-2

Table 5: ODIN-W160 maximum ratings

4.2 Operating conditions

Operating condition ranges define those limits within which the functionality of the device is guaranteed.

4.2.1 Temperature range

Parameter	Minimum	Maximum	Unit
Storage temperature	-40	+95	°C
Operating temperature	-40	+85	°C

Table 6: Temperature range

4.2.2 Power supply

Read the safety notes in section Guidelines for Efficient and Safe Use before using the modules.

Symbol	Parameter	Minimum	Type	Maximum	Unit
V_{DD}	Supply voltage	3.00	3.30	3.60	V
V_{DD}	IO Supply voltage	1.75	1.8	1.9	V

Table 7: Power supply voltage

¹ The module can be reliably operated for 5000h cumulative active-WLAN @ $t_{amb} = +85^{\circ}C$

² Maximum allowed depends on accumulated time, 4.8 V for 7 years, 5.5 V for 6 hours cumulative.

4.2.3 I/O DC characteristics

Symbol	Parameter	Minimum	Type	Maximum	Unit
V_{IL}	LOW level input voltage			$0.35 \times V_{IO}$	V
V_{IH}	HIGH level input voltage	$0.65 \times V_{IO}$		V_{IO}	V
V_{OL}	LOW level output voltage	0.0		0.45	V
V_{OH}	HIGH level output voltage	$V_{IO} - 0.45$		V_{IO}	V
I_{IO}	Sink and source current			8.0	mA
C_{IO}	Input capacitance		8		pF

Table 8: I/O DC characteristics

4.2.4 LPO clock

The ODIN-W160 module does not have an internal low power oscillator (LPO) required for low power modes. An LPO can be supplied from an external oscillator if low power modes are required.

Symbol	Parameter	Minimum	Type	Maximum	Unit
LPO-32 kHz	Input clock frequency	32.763	32.768	32.773	kHz
	Input slow clock accuracy			± 150	ppm
Tr/Tf	Input transition time Tr/Tf -10% to 90%			100	ns
	Frequency input duty cycle	20	20	80	%

Table 9: External LPO clock characteristics

4.3 Power consumption

4.3.1 Power consumption Wi-Fi-2.4 GHz

($V_{DD} = 3.3$ V, $V_{IO} = 1.8$ V, $T_{amb} = 25$ °C)

Mode	State	WL-EN	BT-EN	Modulation	Symbol	Average ^{3a}	Peak ⁴	Unit
General	Reset	L	L	-	I_{IO}	0.0	0.0	mA
					I_{VDD}	0.014	0.014	mA
	Start-up	H	L	-	I_{IO}	0.31	2.6	mA
					I_{VDD}	19	190	mA
Idle	Not connected	H	L	-	I_{IO}	0.051	1.0	mA
					I_{VDD}	0.077	34	mA
Sleep	Connected DTIM = 1 TBTT = 100 ms $T_{beacon} = 1.6$ ms	H	L	-	I_{IO}	0.34	1.8	mA
					I_{VDD}	2.9	200	mA
Deep sleep	Connected DTIM = 5 TBTT = 100 ms $T_{beacon} = 1.6$ ms	H	L	-	I_{IO}	0.34	1.8	mA
					I_{VDD}	0.7	200	mA
Rx-data Ch-13 (2472 MHz)	Throughput: 500 kbit/s	H	L	802.11b Rate = 1 Mbit	I_{IO}	0.38	1.8	mA
					I_{VDD}	110	200	mA
	Throughput: 3,38 Mbit/s	H	L	802.11g Rate = 6 Mbit/s	I_{IO}	0.38	1.8	mA
					I_{VDD}	110	210	mA
	Throughput: 4,0 Mbit/s	H	L	802.11n Rate = 6.5 Mbit/s	I_{IO}	0.38	1.8	mA
					I_{VDD}	110	230	mA

³ Average is the cycle mean value for one transmission period.

⁴ Measured at maximum output power.

Mode	State	WL-EN	BT-EN	Modulation	Symbol	Average ³⁴	Peak ⁴	Unit
Tx-data Ch-13 (2472 MHz)	Throughput: 400 kbit/s	H	L	802.11b Rate = 1 Mbit	I_{IO}	0.38	1.8	mA
					I_{VDD}	190	200	mA
	Throughput: 4 Mbit/s	H	L	802.11b Rate = 11 Mbit/s	I_{IO}	0.35	1.8	mA
					I_{VDD}	160	200	mA
	Throughput: 3,5 Mbit/s	H	L	802.11g Rate = 6 Mbit/s	I_{IO}	0.35	1.8	mA
					I_{VDD}	210	240	mA
	Throughput: 4 Mbit/s	H	L	802.11g Rate = 54 Mbit/s	I_{IO}	0.34	1.8	mA
					I_{VDD}	130	230	mA
	Throughput: 4 Mbit/s	H	L	802.11n Rate = 6.5 Mbit/s	I_{IO}	0.35	1.8	mA
					I_{VDD}	180	230	mA
	Throughput: 4 Mbit/s	H	L	802.11n Rate = 65 Mbit/s	I_{IO}	0.34	1.8	mA
					I_{VDD}	140	240	mA

Table 10: Power consumption Wi-Fi-2.4 GHz

4.3.2 Power consumption Wi-Fi-5 GHz

($V_{DD} = 3.3\text{ V}$, $V_{IO} = 1.8\text{ V}$, $T_{amb} = 25\text{ °C}$)

Mode	State	WL-EN	BT-EN	Modulation	Symbol	Average ³⁴	Peak ⁴	Unit
General	Reset	L	L	-	I_{IO}	0.0	0.0	mA
					I_{VDD}	0.014	0.014	mA
	Start-up	H	L	-	I_{IO}	0.31	2.6	mA
					I_{VDD}	19	130	mA
Idle	Not connected	H	L	-	I_{IO}	0.051	1.0	mA
					I_{VDD}	0.077	34	mA
Sleep	Connected DTIM = 1 TBTT ⁵ = 100 ms $T_{beacon} = 1.6\text{ ms}$	H	L	-	I_{IO}	0.34	1.8	mA
					I_{VDD}	2.6	260	mA
Deep sleep	Connected DTIM = 5 TBTT ⁵ = 100 ms $T_{beacon} = 1.6\text{ ms}$	H	L	-	I_{IO}	0.34	1.8	mA
					I_{VDD}	1.4	260	mA
Rx-data Ch-36 (5180 MHz)	Throughput: 4 Mbit/s	H	L	802.11g Rate = 6 Mbit/s	I_{IO}	0.34	1.8	mA
					I_{VDD}	110	240	mA
	Throughput: 4 Mbit/s	H	L	802.11n Rate = 6.5 Mbit/s	I_{IO}	0.34	1.8	mA
					I_{VDD}	110	240	mA
Tx-data Ch-36 (5180 MHz)	Throughput: 4 Mbit/s	H	L	802.11g Rate = 6 Mbit/s	I_{IO}	0.44	1.9	mA
					I_{VDD}	210	240	mA
	Throughput: 4 Mbit/s	H	L	802.11g Rate = 54 Mbit/s	I_{IO}	0.38	1.7	mA
					I_{VDD}	120	240	mA
	Throughput: 4 Mbit/s	H	L	802.11n Rate = 6.5 Mbit/s	I_{IO}	0.4	1.9	mA
					I_{VDD}	210	240	mA
	Throughput: 4 Mbit/s	H	L	802.11n Rate = 65 Mbit/s	I_{IO}	0.34	1.8	mA
					I_{VDD}	130	240	mA

Table 11: Power consumption Wi-Fi-5 GHz

⁵ Target Beacon Transmission Time

4.3.3 Power consumption Classic Bluetooth

($V_{DD} = 3.3\text{ V}$, $V_{IO} = 1.8\text{ V}$, $T_{amb} = 25\text{ °C}$)

Mode	State	WL-EN	BT-EN	Modulation	Symbol	Average ³⁴	Peak ⁴	Unit
General	Reset	L	L	-	I_{IO}	0.0	0.0	mA
					I_{VDD}	0.014	0.014	mA
	Start-up	L	H	-	I_{IO}	0.55	2.5	mA
					I_{VDD}	2.9	190	mA
Idle	Sleep, not discoverable not connectable	L	H	-	I_{IO}	0.46	1.9	mA
					I_{VDD}	4.3	9.3	mA
	Deep-sleep, not discoverable not connectable	L	H	-	I_{IO}	0.25	1.7	mA
					I_{VDD}	0.065	6.8	mA
Not connected	discoverable, connectable, Scan interval = 1.28 s Scan window = 11,25 ms	L	H	-	I_{VDD}	0.52	1.7	mA
					I_{IO}	2.1	190	mA
Inquiry		L	H	-	I_{IO}	0.48	1.7	mA
					I_{VDD}	22	57	mA
Connected, RFCOMM	Idle	L	H	-	I_{IO}	0.55	1.7	mA
					I_{VDD}	3.7	66	mA
	Rx-data Throughput: 600 kbit/s	L	H	GFSK	I_{IO}	0.48	1.7	mA
					I_{VDD}	25	56	mA
	Rx-data Throughput: 800 kbit/s	L	H	EDR	I_{IO}	0.48	1.7	mA
					I_{VDD}	24	56	mA
	Tx-data Throughput: 600 kbit/s	L	H	GFSK	I_{IO}	0.48	1.7	mA
					I_{VDD}	42	56	mA
Tx-data Throughput: 1 Mbit/s	L	H	EDR	I_{IO}	0.48	1.7	mA	
				I_{VDD}	34	56	mA	

Table 12: Power consumption Classic Bluetooth

4.3.4 Power consumption Bluetooth Low Energy

($V_{DD} = 3.3\text{ V}$, $V_{IO} = 1.8\text{ V}$, $T_{amb} = 25\text{ °C}$)

Mode	State	WL-EN	BT-EN	Modulation	Symbol	Average ³⁴	Peak ⁴	Unit
General	Reset	L	L	-	I_{IO}	0.0	0.0	mA
					I_{VDD}	0.014	0.014	mA
	Start-up	L	H	-	I_{IO}	0.55	2.5	mA
					I_{VDD}	2.9	190	mA
Central	Idle, not discoverable not connectable	L	H	-	I_{IO}	0.32	1.2	mA
					I_{VDD}	1.1	6.8	mA
	Scan, Scan interval = 10 ms Scan window = 10 ms	L	H	$P_{OUT} = 4\text{ dBm}$	I_{IO}	0.28	1.1	mA
					I_{VDD}	21	67	mA
Connection event Interval = 1 s	L	H	GFSK $P_{OUT} = 4\text{ dBm}$	I_{IO}	0.36	1.7	mA	
				I_{VDD}	1.2	77	mA	
Peripheral	Idle	L	H	-	I_{IO}	0.32	1.2	mA

Mode	State	WL-EN	BT-EN	Modulation	Symbol	Average ³⁴	Peak ⁴	Unit
					I_{VDD}	1.1	6.8	mA
	Advertising, Advertising interval = 1,28 s	L	H	GFSK $P_{OUT} = 4$ dBm	I_{IO}	0.32	1.2	mA
					I_{VDD}	1.2	63	mA

Table 13: Power consumption Classic Bluetooth

4.4 RF characteristics

4.4.1 Wi-Fi receiver characteristics 2.4 GHz

($V_{DD} = 3.3$ V, $V_{IO} = 1.8$ V, $T_{amb} = 25$ °C)

Parameter	Test conditions	Frequency [MHz]	IEEE limit [dBm]	Type	Unit
Rx sensitivity	802.11b, Rate = 1 Mbit PER ≤ 8%	2437	-76	-95	dBm
	802.11b, Rate = 11 Mbit PER ≤ 8%	2437	-76	-88	dBm
	802.11g, Rate = 6 Mbit PER ≤ 10%	2437	-82	-90	dBm
	802.11g, Rate = 54 Mbit PER ≤ 10%	2437	-65	-74	dBm
	802.11n, Rate = 6.5 Mbit PER ≤ 10%	2437	-82	-88	dBm
	802.11n, Rate = 65 Mbit PER ≤ 10%	2437	-64	-72	dBm

Table 14: Wi-Fi receiver characteristics 2.4 GHz

4.4.2 Wi-Fi receiver characteristics 5 GHz

($V_{DD} = 3.3$ V, $V_{IO} = 1.8$ V, $T_{amb} = 25$ °C)

Parameter	Test conditions	Frequency [MHz]	IEEE limit [dBm]	Type	Unit
Rx sensitivity	802.11a, Rate = 6 Mbit PER ≤ 10%	5200	-82	-85	dBm
		5300		-85	dBm
		5500		-85	dBm
		5805		-85	dBm
	802.11a, Rate = 54 Mbit PER ≤ 10%	5200	-65	-69	dBm
		5300		-69	dBm
		5500		-70	dBm
		5805		-69	dBm
	802.11n, Rate = 6.5 Mbit PER ≤ 10%	5200	-82	-84	dBm
		5300		-84	dBm
		5500		-85	dBm
		5805		-84	dBm
802.11n, Rate = 65 Mbit PER ≤ 10%	5200	-64	-66	dBm	
	5300		-66	dBm	
	5500		-66	dBm	
	5805		-66	dBm	

Table 15: Wi-Fi receiver characteristics 5 GHz

4.4.3 Wi-Fi transmitter characteristics 2.4 GHz

($V_{DD} = 3.3\text{ V}$, $V_{IO} = 1.8\text{ V}$, $T_{amb} = 25\text{ °C}$)

Parameter	Test conditions	Frequency [MHz]	IEEE EVM limit [dB]	EVM [dB]	Conducted ⁶	e.i.r.p. ⁶	Unit
Tx output power	802.11b Rate = 1 Mbit	2437	-14	-23.1	14.0	17.0	dBm
	802.11b Rate = 11 Mbit	2437	-14	-31.2	14.0	17.0	dBm
	802.11g Rate = 6 Mbit	2437	-5	-31.7	16.0	19.0	dBm
	802.11g Rate = 54 Mbit	2437	-25	-31.7	16.0	19.0	dBm
	802.11n Rate = 6.5 Mbit	2437	-5	-30.8	15.8	18.8	dBm
	802.11n Rate = 65 Mbit	2437	-27	-32.5	15.5	18.5	dBm

Table 16: Wi-Fi transmitter characteristics 2.4 GHz

4.4.4 Wi-Fi transmitter characteristics 5 GHz

($V_{DD} = 3.3\text{ V}$, $V_{IO} = 1.8\text{ V}$, $T_{amb} = 25\text{ °C}$)

Parameter	Test conditions	Frequency [MHz]	IEEE EVM limit [dB]	EVM [dB]	Conducted ⁶	e.i.r.p. ⁶	Unit
Tx output power	802.11a Rate = 6 Mbit	5200	-5	-29.3	12.1	15.1	dBm
		5300	-5	-28.4	15.1	18.1	dBm
		5500	-5	-29.5	12.9	15.9	dBm
		5805	-5	-25.4	16.1	19.1	dBm
	802.11a Rate = 54 Mbit	5200	-25	-29.8	11.6	14.6	dBm
		5300	-25	-29.8	12.1	15.1	dBm
		5500	-25	-30.0	11.3	14.3	dBm
		5805	-25	-29.1	11.1	14.1	dBm
	802.11n Rate = 6.5 Mbit	5200	-5	-30.2	12.1	15.1	dBm
		5300	-5	-28.4	15.1	18.1	dBm
		5500	-5	-29.0	12.8	15.8	dBm
		5805	-5	-24.5	16.0	19.0	dBm
	802.11n Rate = 65 Mbit	5200	-27	-31.4	9.2	12.2	dBm
		5300	-27	-31.6	9.7	12.7	dBm
		5500	-27	-30.8	8.8	11.8	dBm
		5805	-27	-29.5	8.6	11.6	dBm

Table 17: Wi-Fi transmitter characteristics 5 GHz



The conducted output power is measured at the antenna port. The e.i.r.p. includes a +3 dBi antenna gain that corresponds to the highest gain of the listed antennas.

⁶ Measured at maximum output power

4.4.5 Bluetooth receiver sensitivity

($V_{DD} = 3.3\text{ V}$, $V_{IO} = 1.8\text{ V}$, $T_{amb} = 25\text{ °C}$)

Symbol	Test conditions	Specification limit [dBm]	Type	Maximum	Unit
Rx sensitivity	GFSK BER $\leq 0.1\%$	-70	-90		dBm
	EDR-2 PER $\leq 0.1\%$	-70	-89		dBm
	EDR-3 PER $\leq 0.1\%$	-70	-84		dBm
Maximum input level	GFSK PER $\leq 0.1\%$	-20		-5	dBm
	EDR-2 PER $\leq 0.1\%$	-		-10	dBm
	EDR-3 PER $\leq 0.1\%$	-		-10	dBm

Table 18: Bluetooth receiver sensitivity

4.4.6 Bluetooth transmitter output power

($V_{DD} = 3.3\text{ V}$, $V_{IO} = 1.8\text{ V}$, $T_{amb} = 25\text{ °C}$)

Parameter	Conducted ⁷	e.i.r.p. ⁷	Unit
Classic Bluetooth	9	12	dBm
Bluetooth Low Energy	5	8	dBm

Table 19: Bluetooth transmitter output power

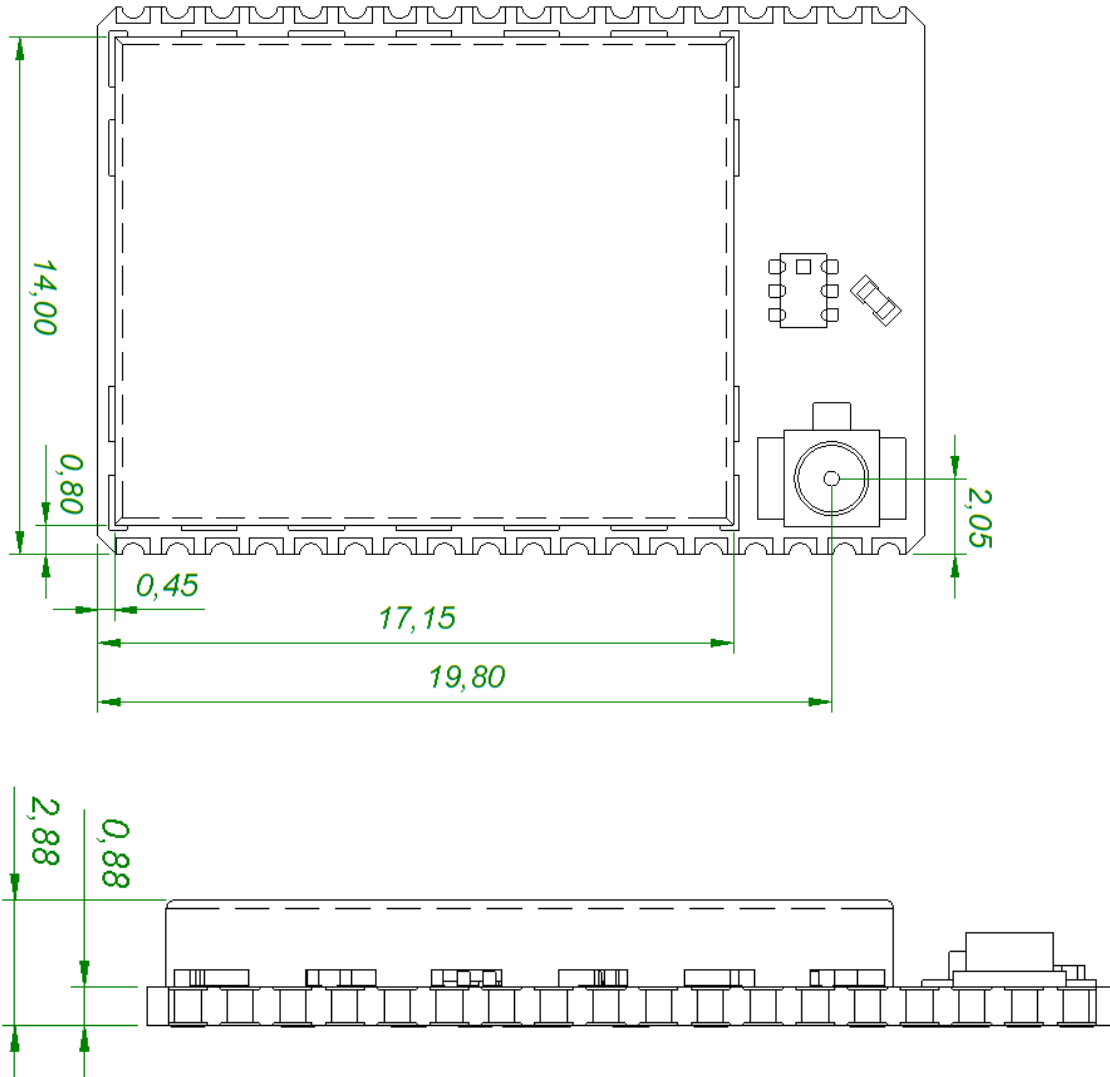


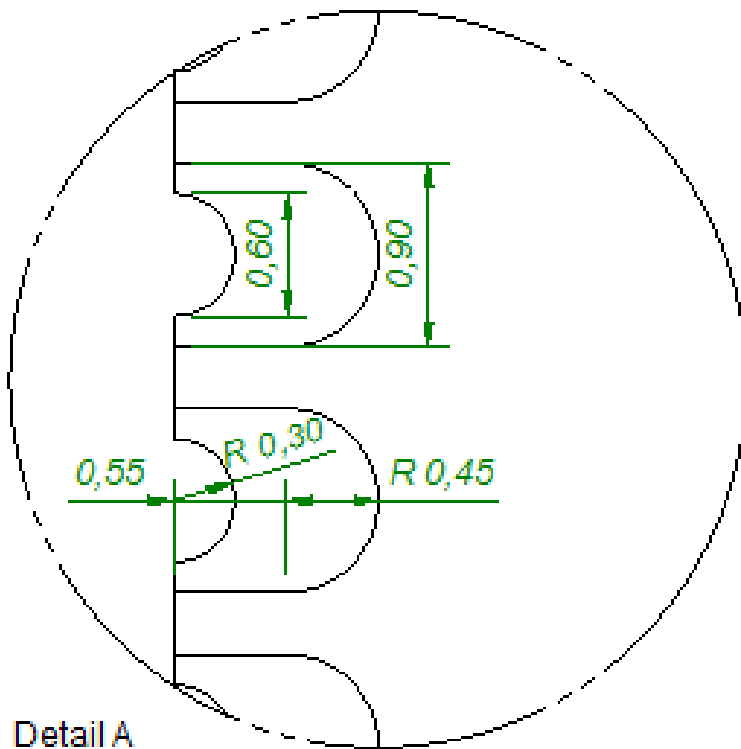
The conducted output power is measured at the antenna port. The e.i.r.p. includes a +3 dBi antenna gain that corresponds to the highest gain of the listed antennas.

⁷ Measured at maximum output power

5 Mechanical specifications

5.1 Dimensions





Detail A

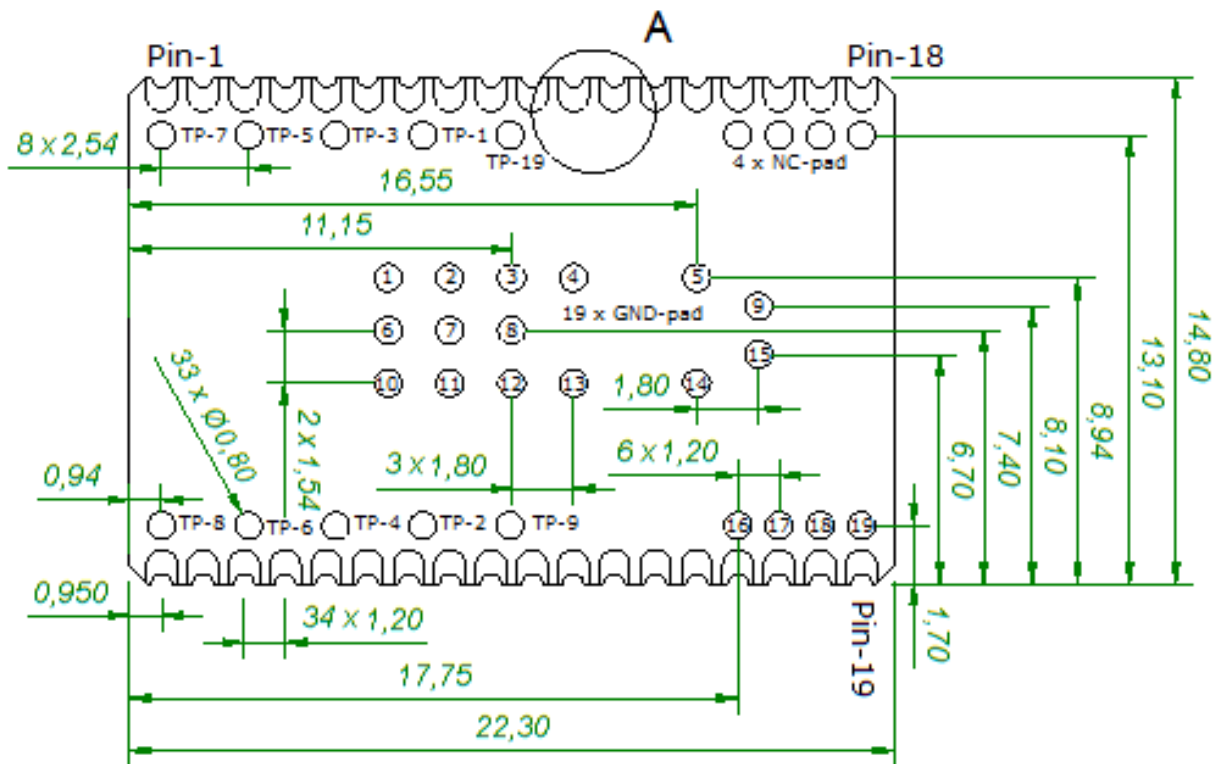


Figure 5: ODIN-W160 dimensions

5.2 Module weight

Parameter	Type	Unit
ODIN-W160	1.5	g

Table 20: Module weight

6 Approvals

The ODIN-W160 modules comply with the regulatory demands of Federal Communications Commission (FCC), Industry Canada (IC), the CE mark, and Japanese Ministry of Internal Affairs and Communications (MIC).

 See **ODIN-W160 System Integration Manual [2]** to obtain information and requirements regarding regulatory compliance of end-products using the ODIN-W160 module.



Products marked with this lead-free symbol on the product label comply with the "Directive 2002/95/EC of the European Parliament and the Council on the Restriction of Use of certain Hazardous Substances in Electrical and Electronic Equipment" (RoHS).

ODIN-W160 Wi-Fi modules are RoHS compliant. No natural rubbers, hygroscopic materials, or materials containing asbestos are employed.

6.1 European Union regulatory compliance

Information about regulatory compliance of the European Union for ODIN-W160 is available in the ODIN-W160 Declaration of Conformity [3].

6.2 FCC and IC compliance

This section contains the FCC and IC compliance information for the ODIN-W160 multiradio module.

6.2.1 FCC and IC certification IDs

Model	FCC ID	IC ID
ODIN-W160	PVH0953	5325A-0953

6.2.2 IC compliance statement

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

Operation is subject to the following two conditions:

1. This device may not cause interference, and
2. This device must accept any interference, including interference that may cause undesired operation of the device.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference with other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

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

Operation in the 5600-5650 MHz band is not allowed in Canada. High-power radars are allocated as primary users (that is, 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.

This equipment complies with IC 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 & your body.

Cet appareil est conforme à la(aux) norme(s) RSS sans licence d'Industry Canada.

Son utilisation est soumise aux deux conditions suivantes :

1. Cet appareil ne doit pas causer d'interférences et
2. il doit accepter toutes interférences reçues, y compris celles susceptibles d'avoir des effets indésirables sur son fonctionnement.

Conformément aux réglementations d'Industry Canada, cet émetteur radio ne peut fonctionner qu'à l'aide d'une antenne dont le type et le gain maximal (ou minimal) ont été approuvés pour cet émetteur par Industry Canada. Pour réduire le risque d'interférences avec d'autres utilisateurs, il faut choisir le type d'antenne et son gain de telle sorte que la puissance isotrope rayonnée équivalente (p.i.r.e) ne soit pas supérieure à celle requise pour obtenir une communication satisfaisante.

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, le gain d'antenne maximal autorisé pour les appareils dans les bandes 5250-5350 MHz et 5470-5725 MHz doit se conformer à la pire limite, et le gain d'antenne maximal autorisé pour les appareils dans la bande 5725-5825 MHz doivent être conformes avec le pire limites spécifiées à point-à-ponctuelles et non point-à-point de fonctionnement selon qu'il convient.


Opération dans la bande 5600-5650 MHz n'est pas autorisée au Canada. Haute puissance radars sont désignés comme utilisateurs principaux (c.-à-utilisateurs prioritaires) des bandes 5250-5350 MHz et 5650-5850 MHz et que ces radars pourraient causer des interférences et / ou des dommages à dispositifs LAN-EL.

Cet équipement respecte les limites d'exposition aux rayonnements IC RSS-102 définies pour un environnement non contrôlé. Il doit être installé et utilisé en maintenant une distance minimum de 20 cm entre le radiateur et votre corps.

6.2.3 FCC statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

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


 **ODIN-W160 has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:**


- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected

Consult the dealer or an experienced radio/TV technician for help.

 **Any changes or modifications NOT explicitly APPROVED by u-blox could cause the ODIN-W160 module to cease to comply with FCC rules part 15 thus void the user's authority to operate the equipment.**

 **Any notification to the end user of installation or removal instructions about the integrated radio module is NOT allowed.**

 **Within the frequency band 5150 to 5250 MHz, the module type ODIN-W160 is restricted to indoor operations to reduce any potential for harmful interference to co-channel MSS operation.**


 **§15.407 statement; in case of absence of information to transmit or operational failure the module type ODIN-W160 will automatically discontinue transmission.**


6.3 Japan radio equipment compliance

The ODIN-W1 module complies with the Japanese Technical Regulation Conformity Certification of Specified Radio Equipment (ordinance of MPT N°. 37, 1981), Article 2, Paragraph 1:

- Item 19 "2.4 GHz band wide band low power data communication system"
- Item 19-3 "Low power data communications system in the 5.2/5.3 GHz band"
- Item 19-3-2 "Low power data communications system in the 5.6 GHz band"

 The ODIN-W1 MIC certification number is 204-510008.

 The ODIN-W1 module is restricted on the Japanese market to be used indoors only, if operating in the 5.2/5.3 GHz band.

 The very small size of the module makes it not reasonable to fit the GITEKI mark and certification number onto the module label. Instead the Giteki mark and certification number is available in the ODIN-W160 System Integration Manual Guide [2] on the ODIN-W1 package.

6.4 Bluetooth qualification

 The ODIN-W160 module is Bluetooth qualified as "Controller Subsystem" - QD ID 58171.

This means that you do not need to do any further qualification if the module is combined with a host stack that is Bluetooth qualified as "Host Subsystem".

6.4.1 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.

7 Product handling & soldering

7.1 Packaging

ODIN-W160 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 Package Information Guide [1].

7.1.1 Reels

ODIN-W160 modules are deliverable in quantities of 200 pieces on a reel. The modules are shipped on Reel Type B, as specified in the u-blox Package Information Guide [1].

Parameter	Specification
Reel type	B
Delivery quantity	200

Table 21: Reel information for ODIN-W160 modules

7.1.2 Tapes

Figure 6 below shows the position and the orientation of ODIN-W160 modules as they are delivered on the tape. The tape dimensions are specified in Figure 7.

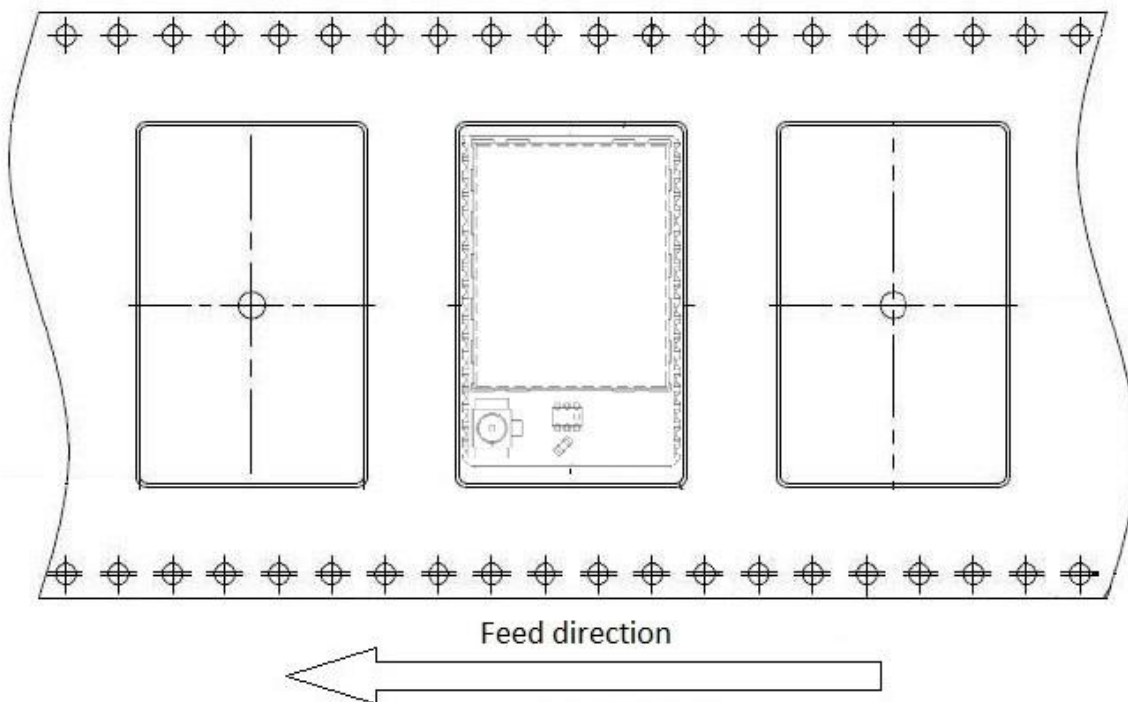


Figure 6: Orientation for ODIN-W160 modules on tape

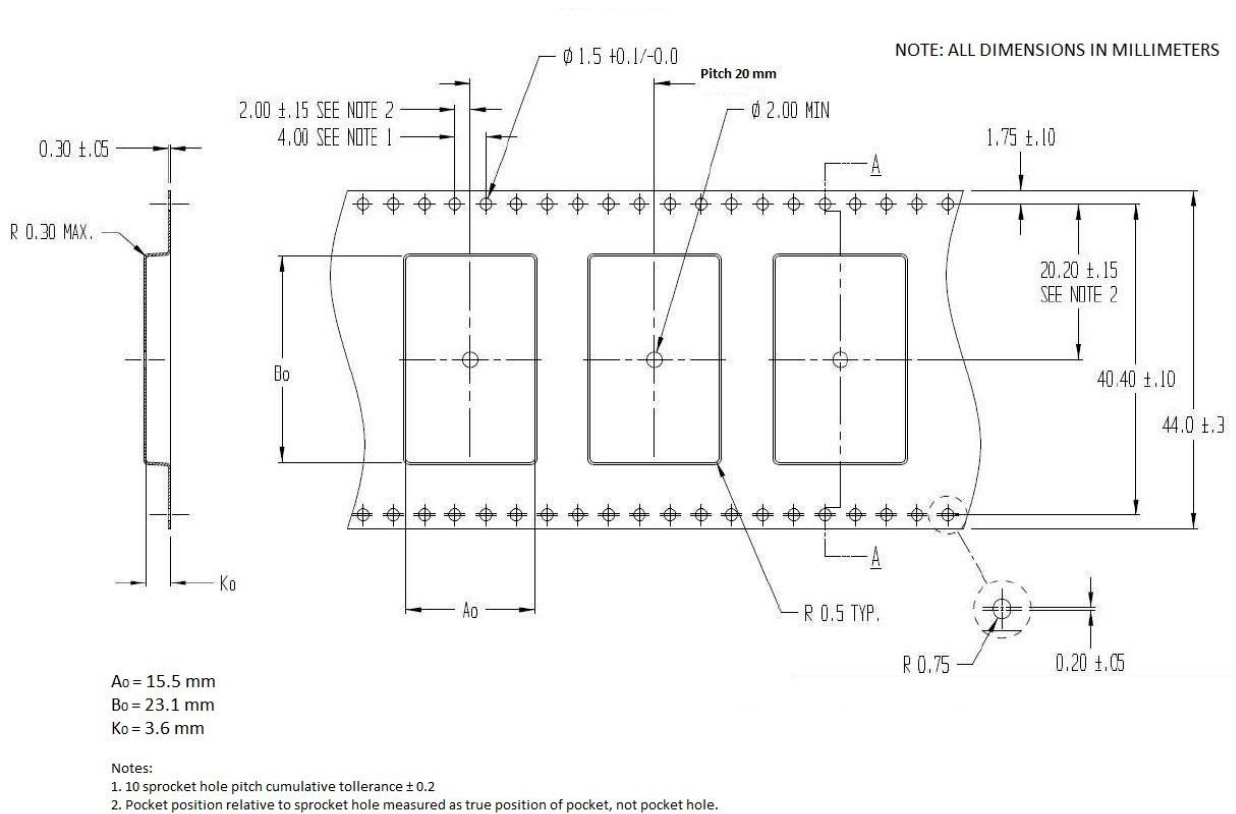


Figure 7: ODIN-W160 modules tape

7.2 Moisture Sensitivity Levels

⚠ ODIN-W160 modules are Moisture Sensitive Devices (MSD) in accordance with the IPC/JEDEC specification.

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions required. ODIN-W160 modules are rated at MSL level 4. For more information regarding moisture sensitivity levels, labeling, storage and drying see the u-blox Package Information Guide [1].

👉 See IPC/JEDEC J-STD-020 for MSL standard (can be downloaded from www.jedec.org).

7.3 Reflow soldering

Select the reflow profiles as per the recommendations from u-blox.

⚠ Failure to observe these recommendations can result in severe damage to the device!

7.4 ESD precautions

⚠ ODIN-W160 modules contain highly sensitive electronic circuitry and are Electrostatic Sensitive Devices (ESD). Handling ODIN-W160 series modules without proper ESD protection may destroy or damage them permanently.

ODIN-W160 modules are Electrostatic Sensitive Devices (ESD) and require special ESD precautions typically applied to ESD sensitive components.

The Absolute maximum ratings section provides the maximum ESD ratings of the ODIN-W160 modules.

Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates ODIN-W160 module.

ESD precautions should be implemented on the application board where the module is mounted.



Failure to observe these recommendations can result in severe damage to the device!

8 Labeling and ordering information

8.1 Product labeling

The labels of ODIN-W160 modules include important product information as described in this section.

Figure 8 illustrates the label of ODIN-W160 modules and includes: the u-blox logo, production lot, product type number, and certification ID numbers (if applicable).

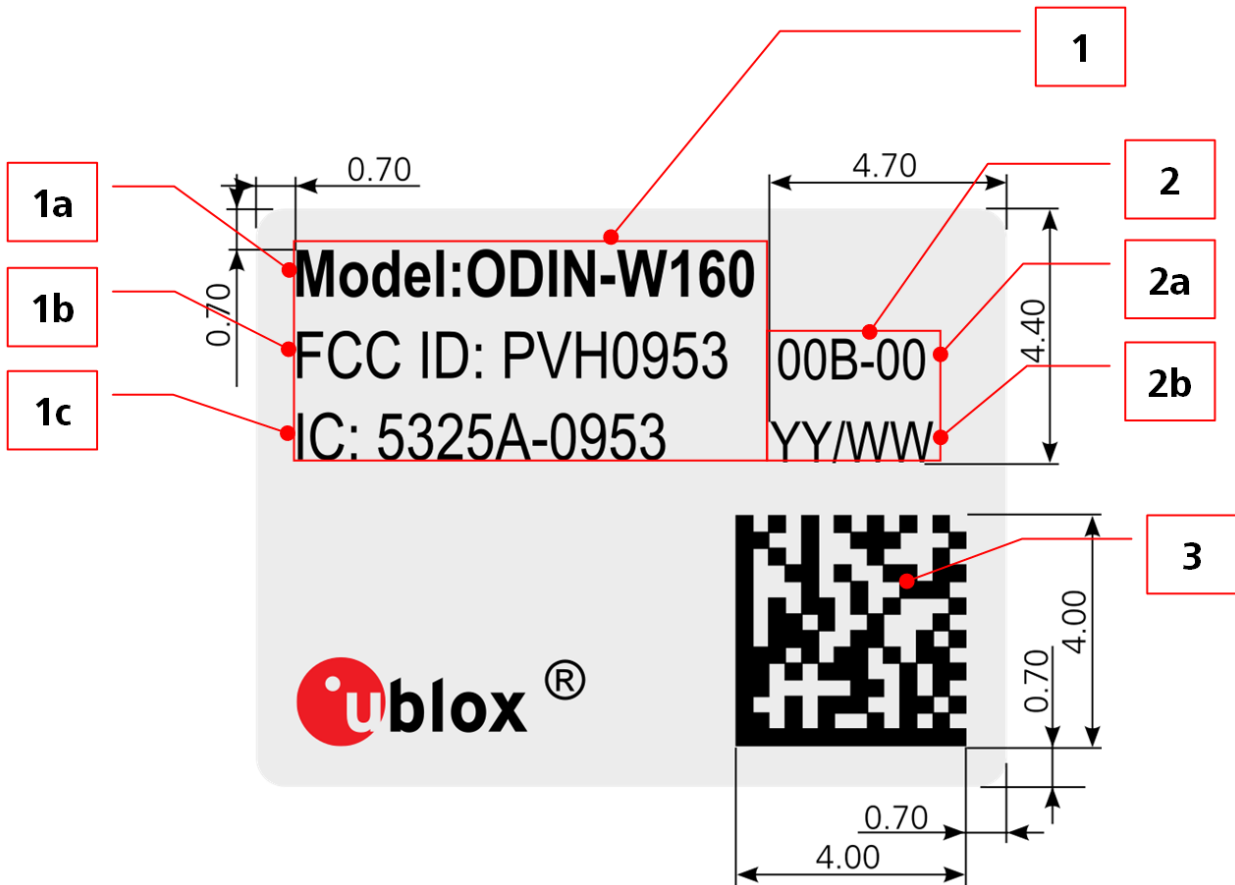


Figure 8: ODIN-W160 sample label

Reference	Description
1	Text box containing Product Name and approval ID:s
1a	Product Name (ID)
1b	FCC ID:
1c	IC: Company Number (CN)-Unique Product Number (UPN)
2	Text box containing Product Revision and date of production
2a	Product Revision
2b	Date of unit production encoded YY/WW (year, week)
3	DataMatrix: unit serial number, hardware version

Table 22: ODIN-W160 label description

8.2 Explanation of codes

Three different product code formats are used. The **Product Name** is used in documentation such as this data sheet and identifies all u-blox products, independent of packaging and quality grade. The **Ordering Code** includes options and quality, while the **Type Number** includes the hardware and firmware versions. Table 23 below details these three different formats:

Format	Structure
Product Name	PPPP-TGVV
Ordering Code	PPPP-TGVV-TTQ
Type Number	PPPP-TGVV-TTQ-XX

Table 23: Product Code Formats

Table 24 explains the parts of the product code.

Code	Meaning	Example
PPPP	Form factor	ODIN
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]	60
TT	Major Product Version	00
Q	Quality grade A: Automotive B: Professional C: Standard	B
XX	Minor product version (not relevant for certification)	Default value is 00

Table 24: Part identification code

8.3 Ordering information

Ordering Number	Product
ODIN-W160-00B	Wi-Fi IEEE 802.11a/b/g/n (Dual band) and Bluetooth Dual Mode module with single U.FL. coaxial antenna connector.

Table 25: Product ordering codes

Appendix

A Glossary

Name	Definition
BT	Bluetooth
CTS	Clear To Send
DC	Direct Current
GND	Ground
H	High
I	Input (means that this is an input port of the module)
IEEE	Institute of Electrical and Electronics Engineers
I ² C	Inter-Integrated Circuit
L	Low
LPO	Low Power Oscillator
O	Output (means that this is an output port of the module)
PCN / IN	Product Change Notification / Information Note
PD	Pull-Down
PU	Pull-Up
RTS	Request To Send
RXD	Receive Data
SDIO	Secure Digital Input Output
SPI	Serial Peripheral Interface
TXD	Transmit Data
UART	Universal Asynchronous Receiver-Transmitter serial interface

Table 26: Explanation of abbreviations and terms used

Related documents

- [1] u-blox Package Information Guide, document number UBX-14001652
- [2] ODIN-W160 System Integration Manual, document number UBX-15011025
- [3] ODIN-W160 Declaration of Conformity, document number UBX-15011537



For regular updates to u-blox documentation and to receive product change notifications please register on our homepage.

Revision history

Revision	Date	Name	Status / Comments
R01	20-Nov-2014	fbro	Initial release
R02	28-Aug-2015	fbro	First Advance Information release
R03	21-Jun-2016	shoe, lalb, ovik	Updated document status to Early Production Information. Removed Bluetooth HCI three-wire (H5) transport layer feature as this is no longer supported by the chip provider. Corrected typo of the delivery quantity per reel from 250 pcs to 200 pcs in section 7.1.1. Added certification for Japan in section 6.
R04	7-Oct-2016	sbia, kgom	Corrected the feed direction in the tape orientation figure (Figure 6). Removed the information in Declaration of Conformity (section 6.1) and provided reference to the ODIN-W160 Declaration of Conformity (UBX-15011537).

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