OWL253 and OWS451

Wi-Fi SPI and UART modules

Electrical Mechanical Data Sheet

Abstract

This document describes the electrical and mechanical data of the IEEE 802.11 a/b/g/n OEM Modules developed for integration in industrial devices.

www.ublox.com

UBX-15021499 - R21

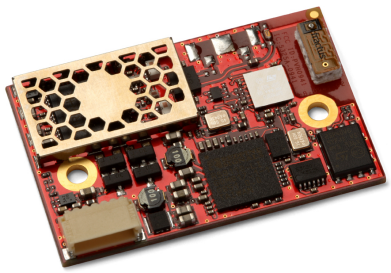
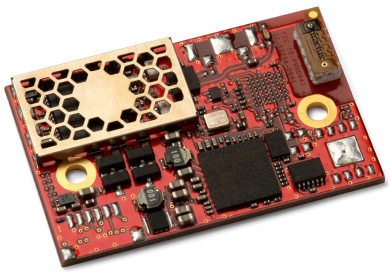
Document Information	
Title	OWL253 and OWS451
Subtitle	Wi-Fi SPI and UART modules
Document type	Electrical Mechanical Data Sheet
Document number	UBX-15021499
Revision and date	R21 4-Dec-2018
Document status	Production Information

Contents

1 Introduction

The IEEE 802.11a,b,g,n OEM Modules from u-blox has been developed for integration in industrial devices. The modules are providing state of the art low power features, compatibility, robustness, and reliability. The modules minimizes the work needed to implement IEEE 802.11 in a device as it provides, together with the driver package, all software, hardware, type approval, EMC certification etc. It is developed for reliable, high demanding industrial devices and applications and delivers high performance. The u-blox wireless LAN modules are available in different versions (see Product variants).

The wireless LAN modules are complete IEEE 802.11 implementations. The IEEE 802.11 modules has small form factors and the interface layout is the same as the Bluetooth and IEEE 802.15.4 modules from u-blox, which enables customers to prepare their device for both wireless LAN, IEEE 802.15.4, and Bluetooth.

cB-0941 (OWS451i-06)	cB-0941 (OWL253i-04)
	

This electrical & mechanical data sheet is applicable to the following wireless LAN modules from u-blox:

- cB-0941 (OWS451 and OWL253)

1.1 Key features

- Dual-band operation (IEEE 802.11-2007, a,b,g, incl. single stream IEEE 802.11n)
- WEP, AES, and CRC-32 hardware accelerators
- WPA and WPA2 support - both personal and enterprise modes
- LEAP support
- PEAP support
- EAP-TLS support (OWS451)
- High speed UART host interface (OWS451)
- SPI host interface (OWL253)
- Quality of Service: 802.11e and WMM
- Bluetooth co-location with PTA (Packet Traffic Arbitration) support

- Ad-hoc and infrastructure mode
- Radio type approved for Europe
- Unlicensed Modular Transmitter Approval for US (FCC) and Canada (IC)
- Radio type approved for Japan (2.4 GHz band only)
- Compliant with EMC standards.
- Industrial operating temperature range -40 to +85 °C (JST version limited to -25 to +85°C)
- Support for low power modes.
- Compatible with u-blox Bluetooth and IEEE 802.15.4 modules
- Internal or external U.FL. antenna connectors
- Receive diversity

1.2 Product variants

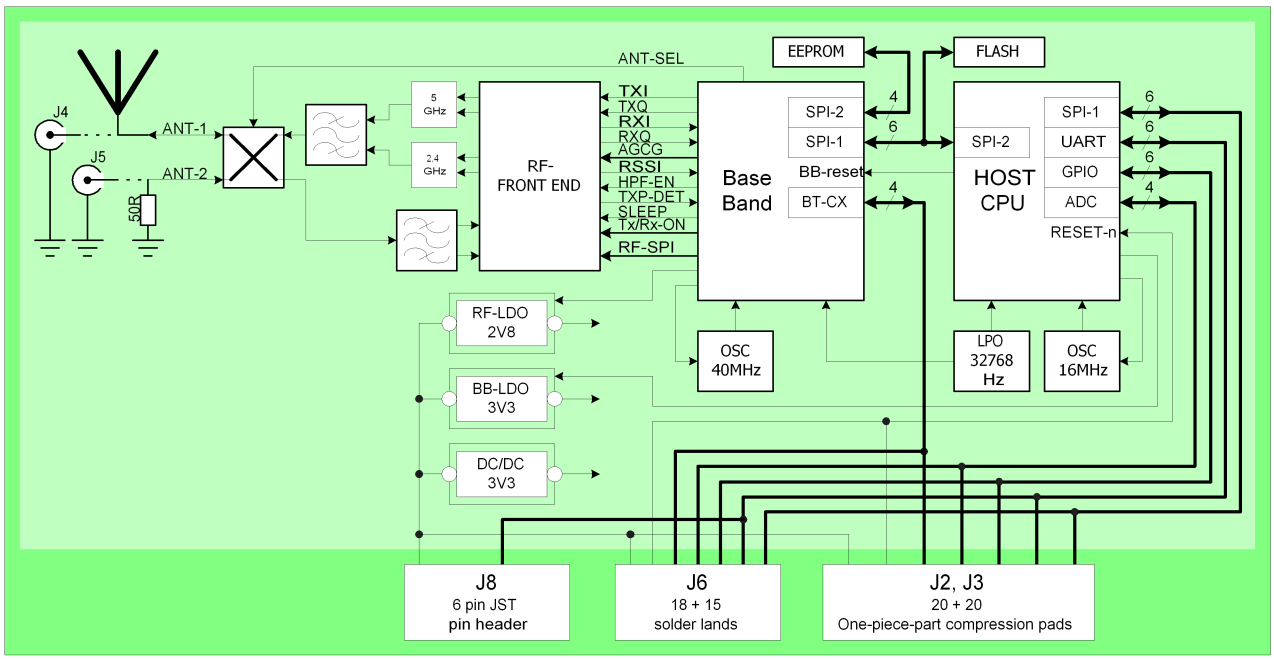
The different mounting options of cB-0941 hardware (OWS451i/x -04/06 and OWL253i/x-04) are all based on the same PCB.
The module is Type Approved and referred in this document with the model name cB-0941.

Product name	Regulatory ID FCC ID IC ID MIC ID	Description
OWL253i-04	cB-0941 PVH0941 5325A-0941 204-310004	IEEE802.11a,b,g,n LAN module with internal antenna, board-to-board connector, solder-lands, high-speed SPI host interface
OWL253x-04	cB-0941 PVH0941 5325A-0941 204-310004	IEEE802.11a,b,g,n LAN module with dual external antenna U.FL. connectors, board-to-board connector, solder-lands, high-speed SPI host interface
OWS451i-04	cB-0941 PVH0941 5325A-0941 204-310005	IEEE802.11a,b,g,n Serial Port Adapter module with internal antenna, board-to-board connector, solder-lands, UART host interface
OWS451x-04	cB-0941 PVH0941 5325A-0941 204-310005	IEEE802.11a,b,g,n Serial Port Adapter module with dual external antenna U.FL. connectors, board-to-board connector, solder-lands, UART host interface

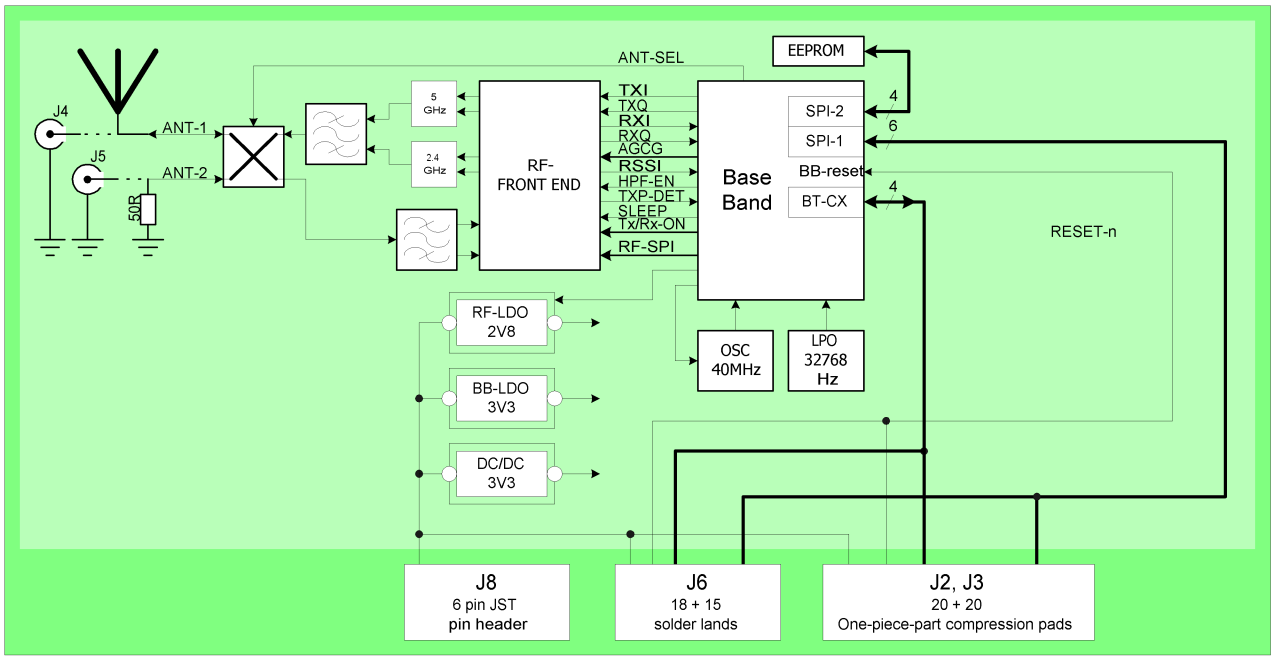
Product name	Regulatory ID FCC ID IC ID MIC ID	Description
OWS451i-06	cB-0941 PVH0941 5325A-0941 204-310005	IEEE802.11a,b,g,n Serial Port Adapter module with internal antenna, board-to-board connector, solder-lands, JST connector, UART host interface
OWS451x-06	cB-0941 PVH0941 5325A-0941 204-310005	IEEE802.11a,b,g,n Serial Port Adapter module with dual external antenna U.FL. connectors, board-to-board connector, solder-lands, JST connector, UART host interface

1.3 Block diagram cB-0941

1.3.1 OWS451



1.3.2 OWL253



2 Electrical interface and connectors

This section describes the signals available on the module interface connectors. There are three ways of connecting:

- Via J6, PCB solder lands on the edge of the PCB. For more information see sections 3.2 and 5.5. (see the figure in section 3.1.2 Secondary side connectors).
- Via connectors J2 and J3, 20 x 2-pin 1mm pitch board-to-board (one piece part).
  The J2 and J3 connectors exist on the module only as compression pads.
  (see the figure in section 3.1.2 Secondary side connectors).
  These pads mates with the carrier board one-piece part connector.
  For more information see section 3.2 and 5.2.

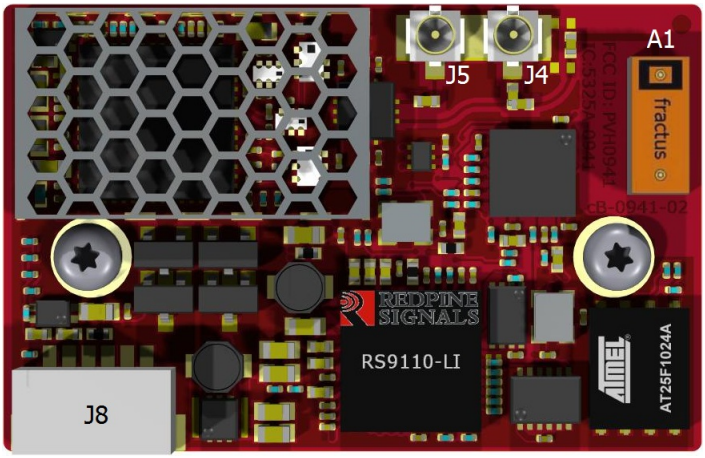
Optional (OWS451 only):

- Via J8, JST connector (see the figure in section 3.1.1 Primary side connectors).
  The connector is a 6 x 1 shrouded pin header, 1 mm pitch.
  The JST part number is SM06B-SRSS-TB and the mating part is wire connector SHR-06V-S.
  Other connector options are also available from JST.
  For more information see section J8 Connector Description.
  Note: The JST connector affects temperature range. See environmental characteristics for details.

2.1 Pin numbering

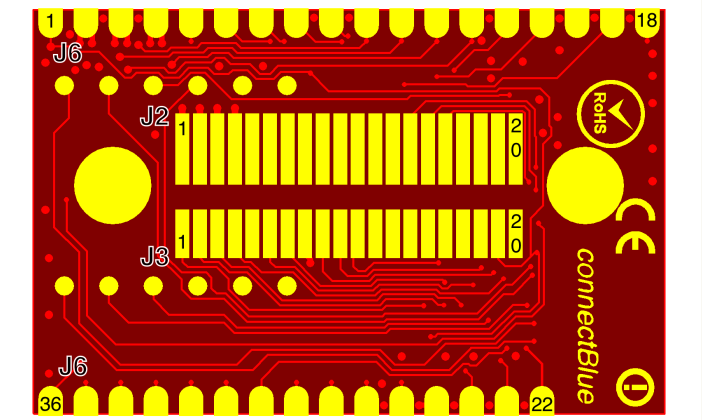
2.1.1 Primary side connectors

J8 is the JST connector located on the primary side of the module. A1 is the internal antenna.
J4 and J5 are U.FL connectors for external antennas. J4 is the primary antenna connector and J5 the auxiliary antenna connector.



2.1.2 Secondary side connectors

J2 and J3 is the u-blox board-to-board one piece part connector. The pin layout of the connector is compatible with all OEM Serial Port Adapters from u-blox. J6 designates the solder land connector.



The solder lands of connector (J6) have a new layout compared to cB-OWSPA311g.

2.2 Pin description

2.2.1 J2, J3, J6, J8 connector description

J2	J3	J6	J8	Signal name	Signal level	Type	Module	Description
1,2	8	3, 25(1)	1	VSS	Ground	Power	All	GND
3,4	-	4	2	VDD	3.3 V	Power	All	3.3 - 5.5 VDC power supply
11	-	7	-	RED/Mode	CMOS/ Weak pull-up	Out/In	OWS451	This signal is multiplexed: RED: red LED logic signal valid 600ms after power-up, active low with internal weak pull-up. Mode: Not used, available on u-blox products with internal RS232 transceiver to select logic level mode (disable RS232). Check the data sheet for these products to remain compatible.
12	-	6	-	Switch-0	CMOS/ Weak pull-up	In	OWS451	Switch-0/Function switch. Used by the "Connect on external event" function, see the Wireless LAN Serial Port Adapter AT command Specification for more information. Secondary function: If switch-0 and switch-1 is active (LOW) at power-up the module will enter boot loader mode.
13	-	8	-	GREEN/ Switch-1	CMOS/ Weak pull-up	Out/In	OWS451	This signal is multiplexed: GREEN: green-LED signal valid 500ms after power-up, active low. Switch-1/restore switch: Switch-1 signal is valid as input only during the first 500ms during power-up, after that its function changes to green LED. If this pin is active (LOW) during power-up the unit restores all settings to factory defaults.
14	-	9	-	BLUE	CMOS	Out	OWS451	Logic Blue LED Signal (see the Operating status section). Active low. Note:Blue LED will flash when data is transferred.
15	-	10	5	UART-CTS	CMOS	In	OWS451	UART Clear To Send, active low.
16	-	11	3	UART-TxD	CMOS	Out	OWS451	UART Transmit Data, "0" = Low, "1" = High
17	-	12	6	UART-RTS	CMOS	Out	OWS451	UART Request To Send, active low.
18	-	13	4	UART-RxD	CMOS	In	OWS451	UART Receive Data, "0" = Low, "1" = High
19	-	5	-	UART-DTR	CMOS	Out	OWS451	UART Data Terminal Ready, active low.
20	-	18, 30(1)	-	UART-DSR	CMOS	In	OWS451	UART Data Set Ready, active low.
-	6	28	-	SPI-CS0n	CMOS	In	OWL253	SPI chip select, active low.
-	7	27	-	SPI-MOSI	CMOS	In	OWL253	SPI Master Output Slave Input
-	9	36	-	SerialSelect-0	CMOS	Out	OWS451	Control signal for external serial transceivers. See Appendix Serial Interface section for more info.
-	10	35	-	SerialSelect-1	CMOS	Out	OWS451	Control signal for external serial transceivers. See Appendix Serial Interface section for more info.
-	11	26	-	SPI-CLK	CMOS	In	OWL253	SPI Clk input

J2	J3	J6	J8	Signal name	Signal level	Type	Module	Description
-	13	24	-	SPI-MISO	CMOS	Out	OWL253	SPI Master Input Slave Output
-	14	23	-	SPI-Int	CMOS	Out	OWL253	SPI external interrupt.
-	15	14	-	PRI	CMOS	In	All	Bluetooth Priority arbitration signal. This pin indicates to a wireless LAN module that a Bluetooth module is, or will be, active to do high priority TX/RX. Wireless LAN does not transmit as long as this signal remains asserted. The pin should be left open when Bluetooth co-existence feature is not enabled.
-	17	15	-	WL	CMOS	Out	All	Wireless LAN Active arbitration signal. This pin indicates to a Bluetooth module that a wireless LAN module is, or will be, active to do TX/RX. When Bluetooth co-existence feature is not enabled this pin should be left open.
-	19	1	-	Reset-n	CMOS	In	All	Hardware reset. Active low. internal 270k ohm pull-up
-	20	2	-	3V3	3.3 V	Out	All	Regulated output to supply voltage level shifting interface, max load10mA.
5-10	1-5, 12,16, 18	16,17;-19-21, 29, 31-34						Reserved, do not connect.

(1) Alternative signal pin recommended to use in new designs (both signal pins should be connected).
CMOS signals characteristics: - 0.3 V < V_{IL} < 0.8 V, 2 V < V_{IH} < 3.6 V, V_{OL} < 0.4 V, V_{OH} > 2.4 V

2.2.2 J4 Primary external antenna connector

J4 is the primary external antenna connector. It is used for both transmit and receive. The port impedance to match is 50 ohm.

J4 pin nr	Pin name	Signal level	Type	Description
1	Ant-1	RF	I/O	Primary external antenna port (50 ohm)

This connector is only available on OWS451x and OWL253x.

2.2.3 J5 Auxiliary external antenna connector

J5 is the auxiliary external antenna connector. It is used only for receiving and if the unit is configured for receive diversity mode. The unit never transmits RF through this antenna connector. The port impedance to match is 50 ohm.

J5 pin nr	Pin name	Signal level	Type	Description
1	Ant-1	RF	I	Auxiliary external antenna port (50 ohm)

This connector is only available on OWS451x and OWL253x.

2.3 Electrical characteristics

The cB-0941 family is designed to be fully interchangeable with the u-blox Bluetooth product range. If the host product has space for the board, it is possible to choose freely between Bluetooth modules, e. g. cB-OEMSPA311i/x or cB-OEMSPA331i/x, or Wireless LAN modules, e.g. OWSPA311gi/x, without any change of the host product. If you design your power supply for OWS451i/x the modules will be fully interchangeable.

2.3.1 Power supply

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

Supply voltage

Symbol	Parameter	Min	Typ.	Max	Unit
VDD	Supply voltage	3.3		5.5	V

Current consumption

OWS451 (VDD = 3.3 V)

Symbol	Power Mode	State	Band	DTIM	Min	Typ.	Max	Unit
IDD	Global	Reset				16		mA
		Start-up				130	150	mA
		Peak					350	mA
	Sleep	Idle, no connection				22		mA
		Managed, connected	2.4GHz	1		34		mA
		Managed, connected	5GHz	1		29		mA
		Managed, connected	2.4GHz	5		29		mA
		Managed, connected	5GHz	5		25		mA
		Managed, data throughput 1 Mbit/s	2.4GHz			180		mA
		Managed, data throughput 1 Mbit/s	5GHz			222		mA
	Online	Idle, no connection				22		mA
		Managed, connected	2.4GHz	1		180		mA
		Managed, connected	5GHz	1		222		mA

Symbol	Power Mode	State	Band	DTIM	Min	Typ.	Max	Unit
		Managed, connected	2.4GHz	5		180		mA
		Managed, connected	5GHz	5		220		mA
		Managed, data throughput 1 Mbit/s	2.4GHz			180		mA
		Managed, data throughput 1 Mbit/s	5GHz			222		mA
	Stop	Idle, no connection				9		mA
		Managed, connected	2.4GHz	1		34		mA
		Managed, connected	5GHz	1		18		mA
		Managed, connected	2.4GHz	5		26		mA
		Managed, connected	5GHz	5		14		mA
		Managed, data throughput UART 1 Mbit/s	2.4GHz			180		mA
		Managed, data throughput UART 1 Mbit/s	5GHz			222		mA
	Ad-Hoc	Connected	2.4GHz	-		180		mA
		Data throughput 1Mbit/s	2.4GHz	-		180		mA

Power consumption in sleep, online, and stop mode are measured in managed mode using firmware release 2.17.13310.

OWL253 (VDD = 3.3 V)

Symbol	Power Mode	State	Band	DTIM	Min	Typ.	Max	Unit
IDD	Global	Reset				16		mA
		Start-up				130	150	mA
		Peak					350	mA
	Power save	Idle, no connection				11		mA
		Managed, connected	2.4GHz	1		20		mA
		Managed, connected	5.0GHz	1		20		mA
		Managed, data throughput UDP 1Mbit/s	2.4GHz	1		230		mA
		Managed, data throughput UDP 1Mbit/s	5.0GHz	1		240		mA

Power consumption in power save mode (standard IEEE802.11 power save) is measured using firmware release 2.10.1. *IPerf* was used for throughput measurements. Configuration: iperf -c 192.168.0.1 -u -b 1M

2.3.2 I/O DC characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_{IL}	LOW level input voltage	-0.3		0.8	V
V_{IH}	HIGH level input voltage	2		3.6	V
V_{OL}	LOW level output voltage			0.4	V
V_{OH}	HIGH level output voltage	2.4			V
I GPIO	Sink and source current			4.0	mA
C GPIO	Input capacitance		8		pF

2.3.3 UART (OWS451)

Parameter	Values
Standard baud rates	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600
High speed baud rates	1382400, 2764800
Data bits	8
Stop bits	1 or 2
Parity	none, odd, even
Hardware flow control	off or CTS/RTS

2.3.4 SPI (OWL253)

The SPI master should use polarity falling to rising with phase sampling on rising edge, shift on falling edge. Bit order is MSB to LSB.

The SPI slave has the possibility to use both normal SPI mode, with shift and sample on rising and falling edges respectively, and an enhanced high speed mode where the shift and sample are both done on the rising edge. Since this moves the shift half a SPI cycle forward, the clock frequency can approximately be increased by a factor of two given that the signal path can handle this.

Using the high speed mode does not change the setup for the master.

In order to determine the SPI clock frequency that can be used, the signal propagation delay also need to be taken into consideration. These propagation delays has to be measured for each individual setup. The clock frequency can then be approximated according to the following formulas.

```
Tclk = (Tod + Tprop + Tfall) * 2
Tclk_high = Tod + Tprop + Trise
```

Values measured on u-blox development board cb-0940-02 with a Cheetah SPI master in room temperature can be seen in table below.

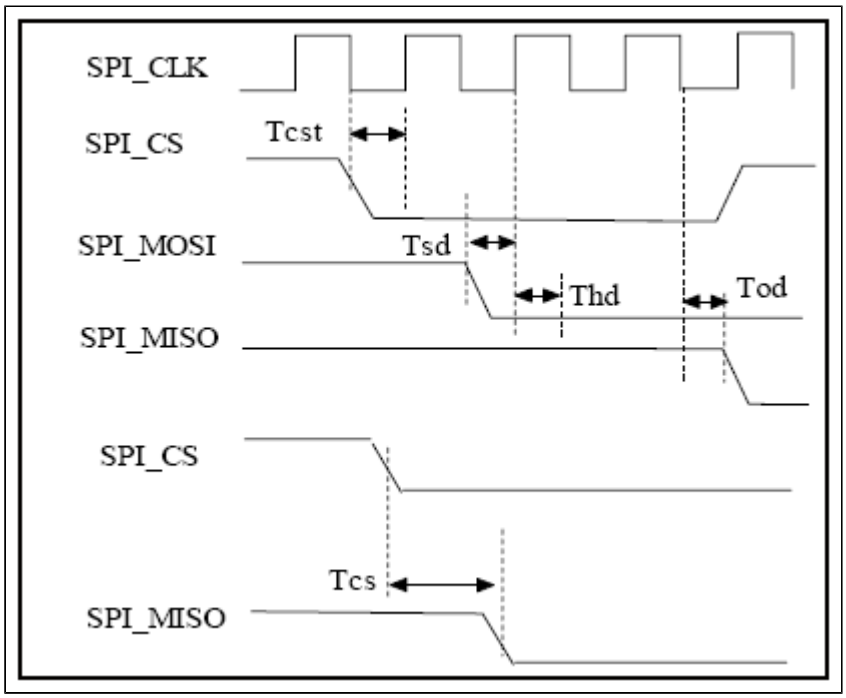
Parameter	Symbol	Typ.	Units
SPI_CLK, Clock rise time	T_{rise}	4.0	ns
SPI_CLK, Clock fall time	T_{fall}	4.0	ns
SPI_MISO, MISO propagation delay	T_{prop}	4.0	ns
SPI_CLK, Max clock freq. normal mode	F_{max}	40.0	MHz
SPI_CLK, Max clock freq. high speed mode	F_{high_max}	50.0 (limited by Cheetah)	MHz
SPI_CLK, Max clock freq. high speed mode	F_{high_max}	75.0 (theoretical)	MHz

Note that the measured F_{max} is very close to the limit of what is possible with respect to electrical properties and propagation delays on this particular setup and there is a significant risk for bit errors. A reasonable limit using the above formula with the T_{od} from the chip specification below gives F_{max} as follows:

```
Tclk = (Tod_max + Tprop + Tfall) * 2 = (9.0 + 4.0 + 4.0) * 2 => Fmax = ~29.4 MHz
Tclk_high = Tod_max + Tprop + Trise = 9.5 + 4.0 + 4.0 => Fmax = ~57.1 MHz
```

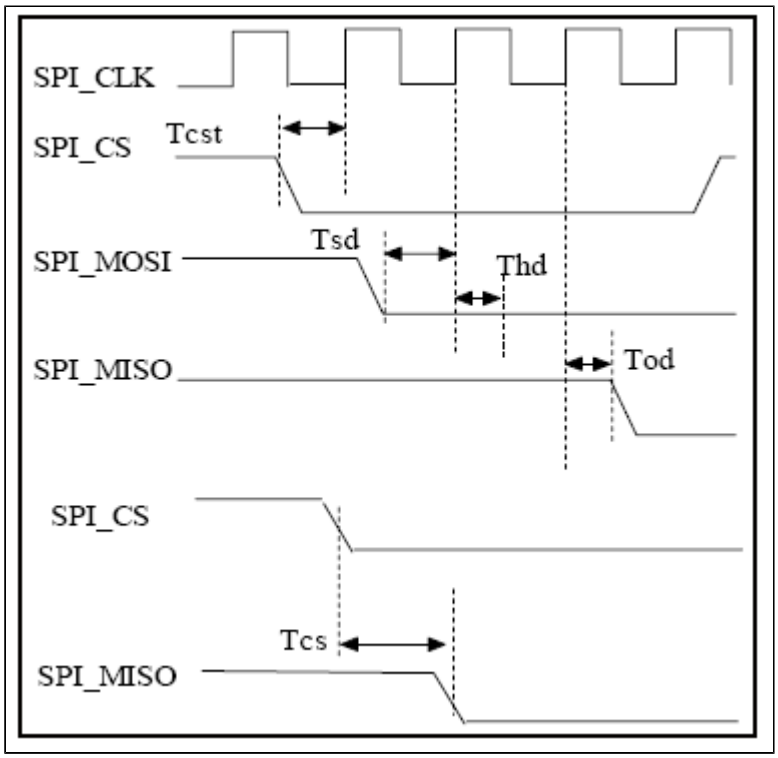
SPI chip specifications - Normal mode

Parameter	Symbol	Min	Max	Units
SPI_CLK	Tspi	0	25	MHz
SPI_CS, to output valid	Tcs	3.5	7.5	ns
SPI_CS, input setup time	Tcst	5.5		ns
SPI_MOSI, input setup time	Tsd	1		ns
SPI_MOSI, input hold time	Thd	1.5		ns
SPI_MISO, clock to output valid	Tod	4	9	ns



SPI chip specifications - High speed mode

Parameter	Symbol	Min	Max	Units
SPI_CLK	Tspi	25	75	MHz
SPI_CS, to output valid	Tcs	3.5	7.5	ns
SPI_CS, input setup time	Tcst	5.5		ns
SPI_MOSI, input setup time	Tsd	1		ns
SPI_MOSI, hold time	Thd	1.5		ns
SPI_MISO, clock to output valid	Tod	4	9.5	ns



2.4 Environmental characteristics

Parameter	Product variant	Min	Typ	Max	Unit
Storage temperature	OWL253	-40		+125	°C
	OWS451i-04 OWS451x-04	-40		+125	°C
	OWS451i-06 OWS451x-06	-25		+85	°C
Operating temperature	OWL253	-40		+85	°C
	OWS451i-04 OWS451x-04	-40		+85	°C
	OWS451i-06 OWS451x-06	-25		+85	°C

When OWS451 is equipped with J8 (JST connector) the temperature range is reduced to -25 to +85 °C.

2.5 Mechanical characteristics

Parameter	Product variant		Value	Unit
Weight	cB-OWL253-04	Typ	3.5	g
	cB-OWS451-04	Typ	3.5	g
	cB-OWS451-06	Typ	3.8	g
Dimension	cB-OWL253-04	Typ	36 x 23 x 3.1	mm
	cB-OWS451-04	Typ	36 x 23 x 3.1	mm
	cB-OWS451-06	Typ	36 x 23 x 4.1	mm

2.6 Hardware reset

A hardware-reset input is available on J1 and J3 connectors. An external reset source must be open drain or collector. The RESET-n pin is pulled-up internally with 220 kOhm (OWL253) or 56 kOhm (OWS451).

2.7 Power control

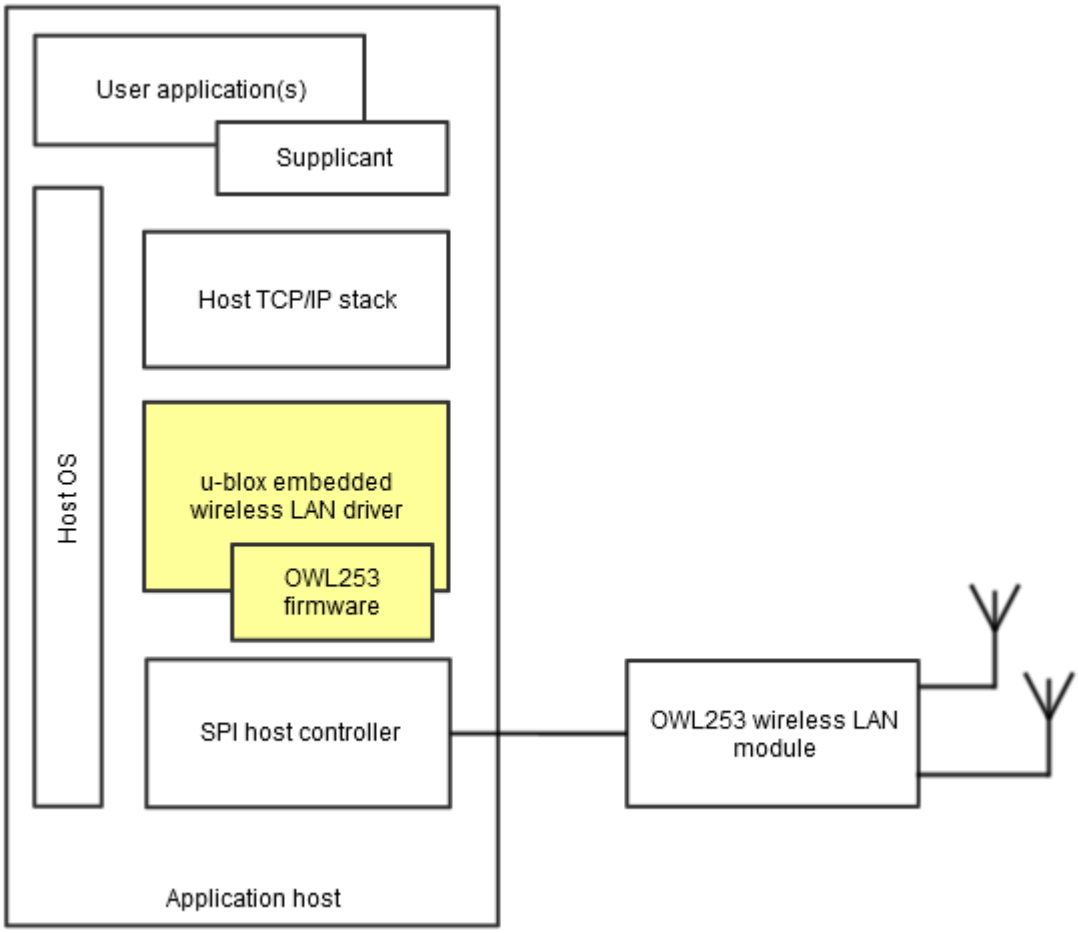
The wireless LAN modules can be operated in several different power modes.

- Standard IEEE802.11 power save
- UAPSD/WMM Power Save Support

2.8 Software overview

2.8.1 cB-0941 (OWL253)

Wireless LAN driver for OWL253 consists of a host driver in binary format or source code, and target firmware in binary format. In the overview picture below these two software parts are represented by the yellow boxes.



The host needs to be able to hold the target firmware since targets does not have on-board non-volatile memory. At startup, and at every reset or power cycle, the host driver will download firmware binaries to target before any wireless LAN operations can begin.

OS support

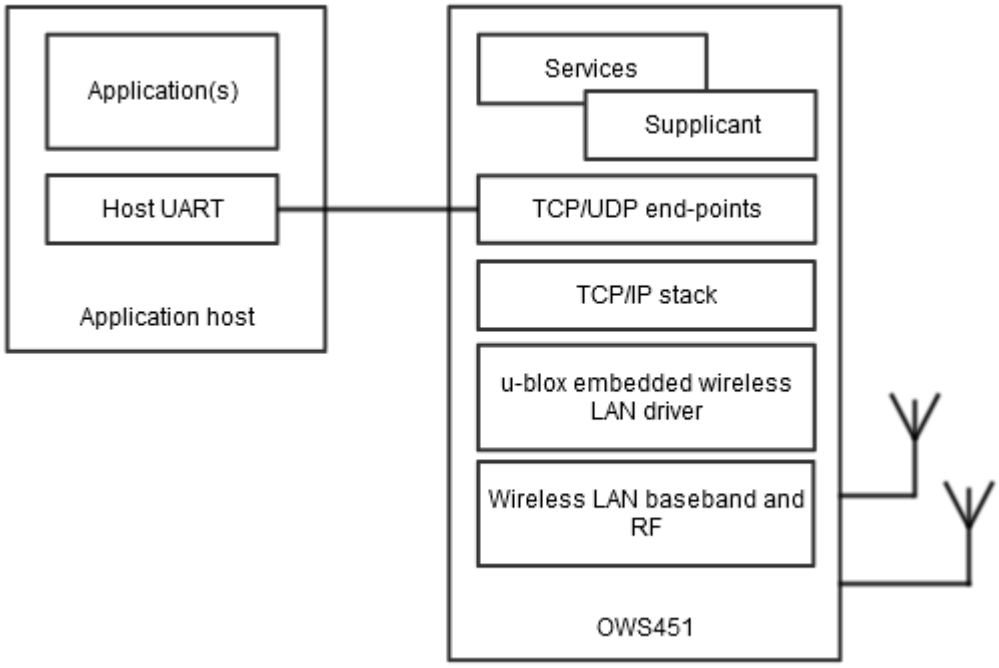
Software and drivers are available for the following operating systems:

1. Linux 2.6
2. WinCE 6.0
3. Embedded RTOS

Customized drivers for use in embedded systems are available upon request. Contact u-blox for more information.

2.8.2 cB-0941 (OWS451)

The OWS451 is a serial port adapter with an UART interface and fully embedded TCP/IP stack and driver. The module is presented as a serial port/UART to the host. Raw serial data is sent to the module, which will package the data into TCP/UDP packages and transmit via Wireless LAN.



3 Antenna information

This chapter gives a quality overview of the different antenna options.

There are 2 different antenna options available:

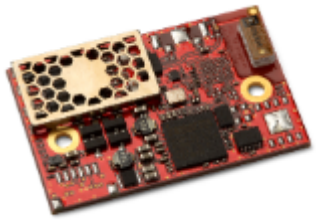
- An internal surface mounted (SMD) dual band antenna.
- Two U.FL connectors for external antennas. Different types of external antennas are available.

3.1 Caution

This radio transmitter IC: 5325A-0941 cB-0941 has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type 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.

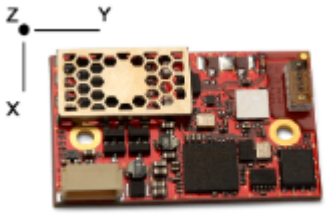
Cet émetteur radio IC: 5325A-0941 cB-0941 a été approuvé par Industry Canada pour fonctionner avec les types d'antenne énumérés ci-dessous avec le gain maximum autorisé et l' impédance nécessaire pour chaque type d'antenne indiqué. Les types d'antenne ne figurant pas dans cette liste et ayant un gain supérieur au gain maximum indiqué pour ce type-là sont strictement interdits d'utilisation avec cet appareil.

3.2 Surface mounted antenna (internal)

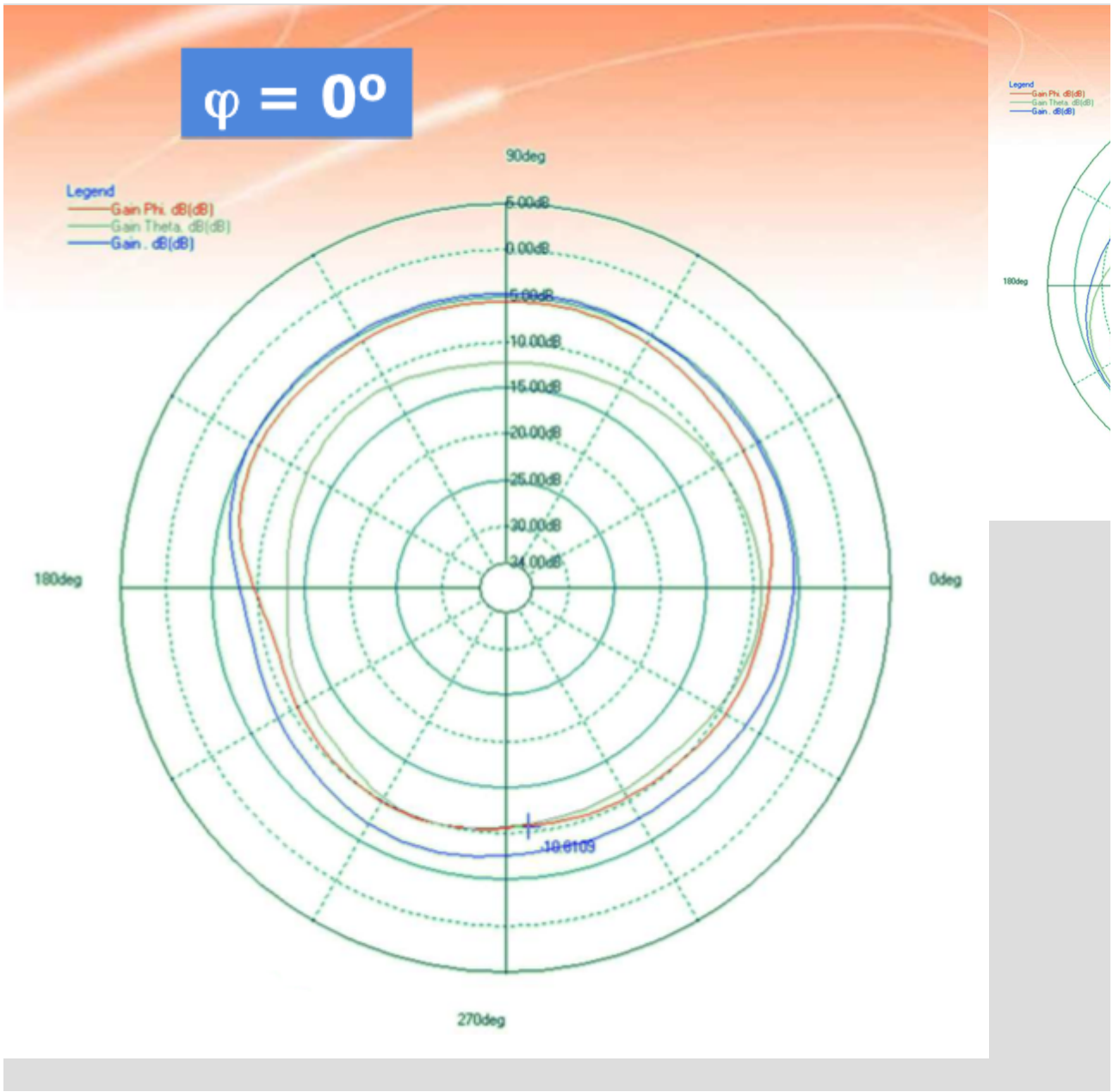


Part number	cB-0941 (OWL253i / OWS451i)
Antenna	FR05-S1-NO-1-004
Manufacturer	Fractus
Gain	0 dBi @ 2.4GHz 3 dBi @ 5GHz
avg. VSWR	3.1 @ 2.4GHz 2.3 @ 5GHz
avg. Efficiency	22% @ 2.4GHz 39% @ 5GHz
Antenna size (LxWxH)	7 x 3 x 2 mm
Comments	The antenna gain is very dependent of the mounting of the module. The unit cannot be mounted in a metal-shielded enclosure with this antenna.

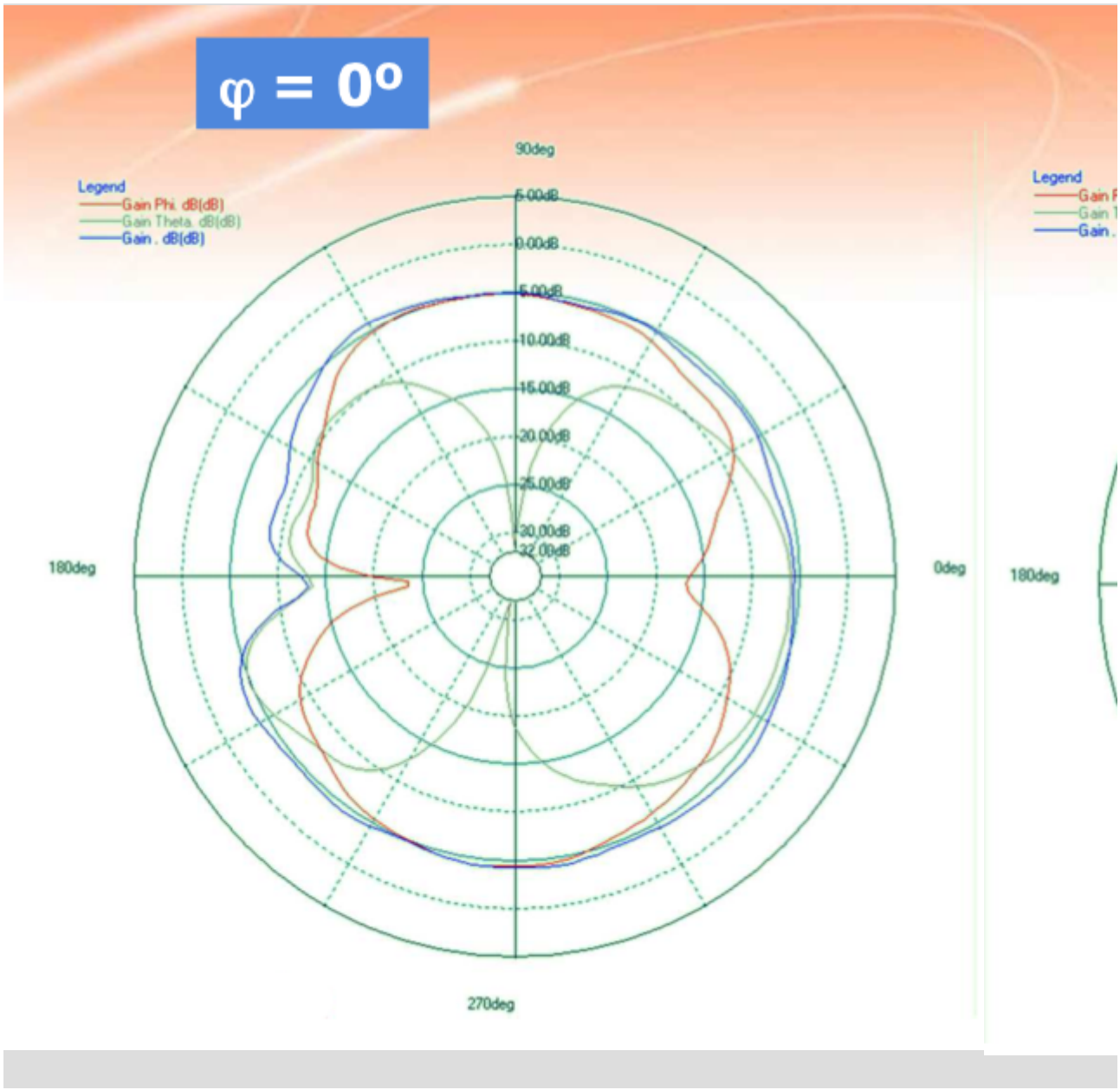
3.2.1 Radiation patterns



Radiation Pattern Cuts @2450 MHz – Free Space



Radiation Pattern Cuts @5400 MHz – Free Space



3.3 External antennas

The external antennas are connected to the module with the on board U.FL connectors. Some antennas are connected directly to the U.FL connector and some are connected via a U.FL to SMA (cB-ACC-18 or cB-ACC-48) or U.FL to reversed polarity SMA (cB-ACC-38) adapter cable.

The sections below lists the antennas that are included in the radio type approvals of the module. For each antenna the "Approvals" field defines in what country/region the antenna is allowed to use. Definitions of the "Approvals" field are:

- **FCC** - The antenna is included in the FCC test reports, and thus approved for use in countries that accept the FCC radio approvals, primarily US.
- **IC** - The antenna is included in the IC (Industrie Canada) test reports, and thus approved for use in countries that accept the IC radio approvals, primarily Canada.
- **RED** - The antenna is included in the RED test reports, and thus approved for use in countries that accept the RED radio approvals, primarily the European countries.
- **TELEC** - The antenna is included in the Japanese government affiliated TELEC test reports, and thus approved for use in the Japanese market.

In general, antennas with Reverse Polarity SMA connector or U.FL connector are included in FCC, IC and RED radio tests.
Antennas with SMA connector are not allowed to be used in Canada and USA due to FCC/IC regulations but are in general included in RED radio tests.

Antennas with a part number in the form "cB-ACC-XX" used to be available for orders via the connectBlue distribution network. Since the acquisition of connectBlue by u-blox antennas can not be ordered from u-blox. To order antennas please contact the manufacturer or the manufacturer distribution network.

For information about other antennas please contact u-blox.

3.4 Antenna accessories

Part Number	**cB-ACC-18 / cB-ACC-48**
Name	U.FL to SMA adapter cable cB-ACC-18 manufacturer part number: K123249002 cB-ACC-48 manufacturer part number: K1994/01
Manufacture/supplier	cB-ACC-18: Stig Wahlström cB-ACC-48: IMS Connector Systems
Connector	U.FL and SMA jack (outer thread and pin receptacle)
Cable length	120 mm
Cable loss	Less than 0.5 dB
Comment	The SMA connector can be mounted in a panel
Approval	RED, TELEC

Part Number	**cB-ACC-38**
Name	U.FL to Reverse Polarity SMA adapter cable Manufacturer part number: K123743001

Part Number	cB-ACC-38

Manufacture /supplier	Stig Wahlström
Connector	U.FL and Reverse Polarity SMA jack (outer thread and pin)
Cable length	120 mm
Cable loss	Less than 0.5 dB
Comment	The Reverse Polarity SMA connector can be mounted in a panel
Approval	FCC, IC, RED, TELEC

3.5 Antennas

3.5.1 Recommended antennas

Part Number	cB-ACC-53
Name	Ex-IT WLAN RP-SMA (dual-band)

Manufacture	ProAnt
Polarization	Vertical
Gain / Imp.	+3.0 dBi / 50ohm @ 2.4 GHz +3.0 dBi / 50ohm @ 5 GHz
Size	Ø 10 x 107 mm
Connector	Reverse Polarity SMA plug (inner thread and pin receptacle)
Comment	To be used together with the U.FL to RP-SMA adapter cable (cB-ACC-38)
Approval	FCC, IC, RED, TELEC

Part Number	cB-ACC-63
Name	Ex-IT 2400-MHF 28-001

Manufacture	ProAnt
Polarization	Vertical
Gain / Imp.	+2.0 dBi / 50ohm @ 2.4 GHz
Size	Ø 12 x 28 mm
Cable length	100 mm
Connector	U.FL
Comment	To be connected to the U.FL connector on the PCB
Approval	FCC, IC, RED, TELEC

Part Number	cB-ACC-61
Name	Ex-IT 2400-RP-SMA 28-001

Manufacture	ProAnt
Polarization	Vertical
Gain / Imp.	+2.0 dBi / 50ohm @ 2.4 GHz
Size	Ø 12 x 28 mm
Connector	Reverse Polarity SMA plug (inner thread and pin receptacle)
Comment	To be used together with the U.FL to RP-SMA adapter cable (cB-ACC-38)
Approval	FCC, IC, RED, TELEC

Part Number	cB-ACC-64
Name	Ex-IT 2400-RP-SMA 70-002

Manufacture	ProAnt
Polarization	Vertical
Gain / Imp.	+3.0 dBi / 50ohm @ 2.4 GHz
Size	Ø 10 x 86 mm
Connector	Reverse Polarity SMA plug (inner thread and pin receptacle)
Comment	To be used together with the U.FL to RP-SMA adapter cable (cB-ACC-38)
Approval	FCC, IC, RED, TELEC

Part Number	**cB-ACC-60**
Name	Ex-IT 2400-MHF 70-001

Manufacture	ProAnt
Polarization	Vertical
Gain / Imp.	+3.0 dBi / 50ohm @ 2.4 GHz
Size	Ø 10 x 70 mm
Cable length	100 mm
Connector	U.FL
Comment	To be connected to the U.FL connector on the PCB
Approval	FCC, IC, RED, TELEC

Part Number	**cB-ACC-55**
Name	InSide WLAN (dual band)

Manufacture	ProAnt
Polarization	Vertical
Gain / Imp.	+3.0 dBi / 50ohm @ 2.4 GHz +3.0 dBi / 50ohm @ 5 GHz
Size	27 x 12 mm (triangular)
Cable length	100 mm
Connector	U.FL
Comment	To be connected to the U.FL connector on the PCB
Approval	FCC, IC, RED, TELEC

Part Number	**cB-ACC-67**
Name	OutSide-2400

Manufacture	ProAnt
Polarization	Vertical
Gain / Imp.	+3.0 dBi / 50ohm @ 2.4 GHz
Size	36 x 18 x 16 mm
Cable length	70 mm
Connector	U.FL
Comment	To be connected to the U.FL connector on the PCB
Approval	FCC, IC, RED, TELEC

Part Number	**cB-ACC-66**
Name	FlatWhip 2400

Part Number	cB-ACC-66

Manufacture	ProAnt
Gain / Imp.	+3.0 dBi / 50ohm @ 2.4 GHz
Size	Ø 50.0 x 30.0 mm
Connector	SMA plug (inner thread and pin)
Comment	To be used together with the U.FL to SMA adapter cable (cB-ACC-18 or cB-ACC-48)
Approval	RED, TELEC

3.5.2 Alternative antennas

The alternative antennas are available for backward compability but not recommended for new designs.

Part Number	cB-ACC-27
Name	WCR-2400-IP04

Manufacture	Centurion
Polarization	Vertical
Gain / Imp.	+2.0 dBi / 50ohm @ 2.4 GHz
Size	Ø 12 x 76 mm
Cable length	100 mm
Connector	U.FL
Comment	To be connected to the U.FL connector on the PCB
Approval	FCC, IC, RED, TELEC

Part Number	cB-ACC-54
Name	Ex-IT WLAN SMA (dual-band)

Part Number	cB-ACC-54

Manufacture	ProAnt
Polarization	Vertical
Gain / Imp.	+3.0 dBi / 50ohm @ 2.4 GHz +3.0 dBi / 50ohm @ 5 GHz
Size	Ø 10 x 107 mm
Connector	SMA plug (inner thread and pin)
Comment	To be used together with the U.FL to SMA adapter cable (cB-ACC-18 or cB-ACC-48)
Approval	RED, TELEC

Part Number	cB-ACC-36
Name	WCR-2400-RP-SMRP

Manufacture	Centurion
Polarization	Vertical
Gain / Imp.	+2.0 dBi / 50ohm @ 2.4 GHz
Size	Ø 12 x 76 mm
Connector	Reverse Polarity SMA plug (inner thread and pin receptacle)
Comment	To be used together with the U.FL to RP-SMA adapter cable (cB-ACC-38)
Approval	FCC, IC, RED, TELEC

Part Number	**—**
Name	PSTG0-2400HS

Manufacture	MobileMark
Polarization	Vertical
Gain / Imp.	+0 dBi / 50ohm @ 2.4 GHz
Size	Ø 12 x 32 mm
Connector	Reverse Polarity SMA plug (inner thread and pin receptacle)
Comment	To be used together with the U.FL to RP-SMA adapter cable (cB-ACC-38)
Approval	FCC, IC, RED, TELEC

Part Number	**cB-ACC-21**
Name	R380.500.127

Manufacture	Pulse
Polarization	Vertical
Gain / Imp.	+2.0 dBi / 50ohm @ 2.4 GHz
Size	Ø 14.3 x 61.4 mm
Connector	SMA plug (inner thread and pin)
Comment	To be mounted on the U.FL to SMA adapter cable (cB-ACC-18 or cB-ACC-48)
Approval	RED, TELEC

Part Number	—

Name R380.500.125

Manufacture	Pulse
Polarization	Vertical
Gain / Imp.	+2.0 dBi / 50ohm @ 2.4 GHz
Size	Ø 14.3 x 61.4 mm
Connector	Reverse Polarity SMA plug (inner thread and pin receptacle)
Comment	To be used together with the U.FL to RP-SMA adapter cable (cB-ACC-38)
Approval	FCC, IC, RED, TELEC

Part Number	—

Name R380.500.124

Manufacture	Pulse
Polarization	Vertical
Gain / Imp.	+2.0 dBi / 50ohm @ 2.4 GHz

Part Number	—
Size	Ø 14.3 x 61.1 mm
Connector	SMA plug (inner thread and pin)
Comment	The difference compared to the R380.500.127 antenna is that the R380.500.124 antenna has a seal ring. To be mounted on the U.FL to SMA adapter cable (cB-ACC-18 or cB-ACC-48)
Approval	RED, TELEC

Part Number	—
Name	R380.500.139

Manufacture	Pulse
Polarization	Vertical
Gain / Imp.	+2.0 dBi / 50ohm @ 2.4 GHz
Size	Ø 14.3 x 61.1 mm
Connector	Reverse Polarity SMA plug (inner thread and pin receptacle)
Comment	The difference compared to the R380.500.125 antenna is that the R380.500.139 antenna has a seal ring. To be used together with the U.FL to RP-SMA adapter cable (cB-ACC-38)
Approval	FCC, IC, RED, TELEC

Part Number	**cB-ACC-28**
Name	NanoBlue-IP04

Manufacture	Centurion

Part Number	cB-ACC-28
Polarization	Vertical
Gain / Imp.	+2.0 dBi / 50ohm @ 2.4 GHz
Size	47.8 x 12.7 mm
Cable length	100 mm
Connector	U.FL
Comment	To be connected to the U.FL connector on the PCB
Approval	FCC, IC, RED, TELEC

Part Number	cB-ACC-17
Name	PlanTec m70cxr

Manufacture	Reel
Polarization	Vertical
Gain / Imp.	+1.0 dBi / 50ohm @ 2.4 GHz
Size	Ø 76.0 x 20.7 mm
Cable length	20/100/300 cm
Connector	SMA plug (inner thread and pin receptacle)
Comment	To be used together with the U.FL to SMA adapter cable (cB-ACC-18 or cB-ACC-48)
Approval	RED, TELEC

Part Number	cB-ACC-37
Name	PlanTec m70cxr

Manufacture	Reel
Polarization	Vertical

Part Number	cB-ACC-37
Gain / Imp.	+1.0 dBi / 50ohm @ 2.4 GHz
Size	Ø 76.0 x 20.7 mm
Cable length	20/100/300 cm
Connector	Reverse Polarity SMA plug (inner thread and pin receptacle)
Comment	To be used together with the U.FL to RP-SMA adapter cable (cB-ACC-38)
Approval	FCC, IC, RED, TELEC

3.5.3 Customer specific antennas

Part Number	—
Name	InSide EPA WLAN
Manufacture	ProAnt
Polarization	Circular
Gain / Imp.	+3.0 dBi / 50 ohm @ 5 GHz
Size	66 x 90 x 36 mm
Connector	U.FL-R-SMT
Comment	Frequency 5150 - 5350 MHz (5.0 - 6.0 GHz)
Approval	FCC, IC, RED

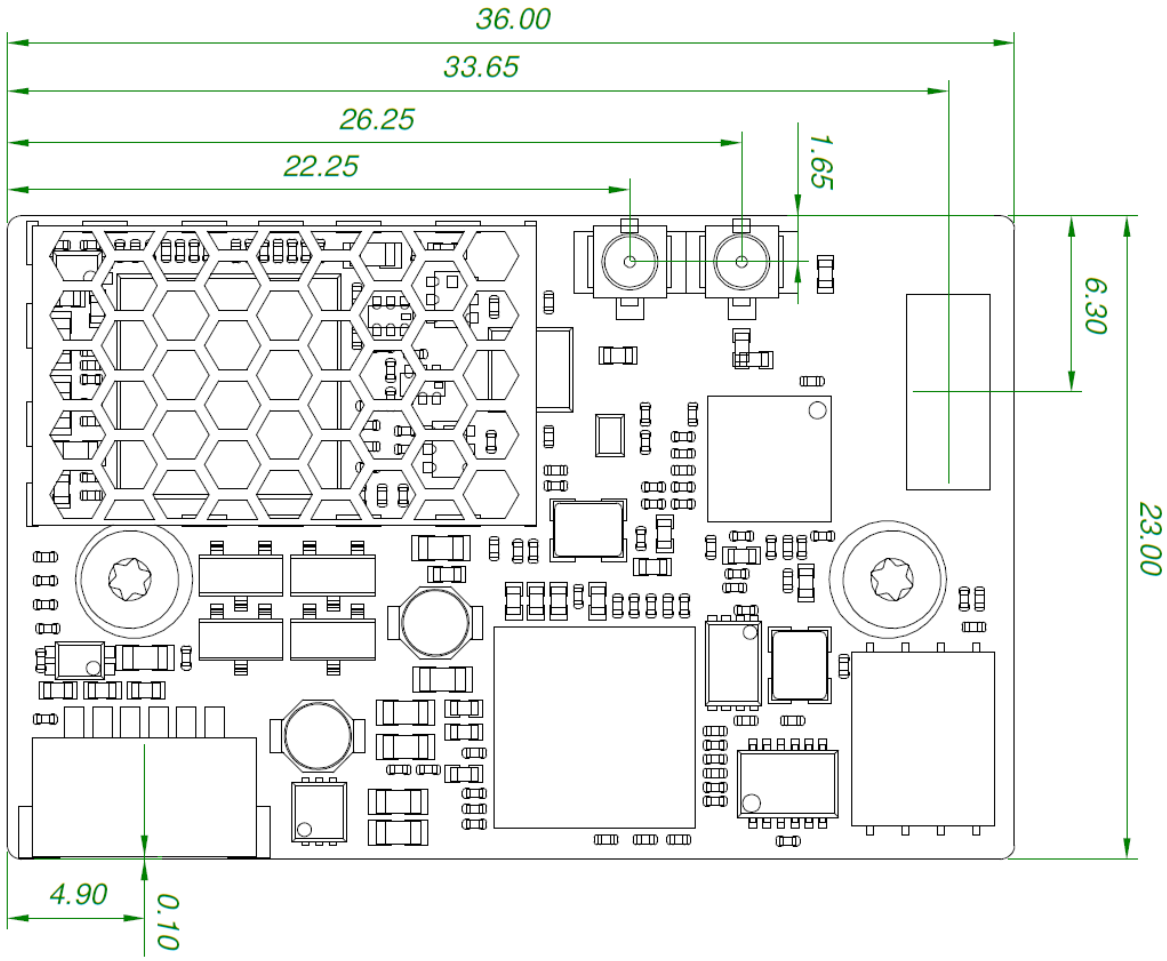
Part Number	—
Name	Inside EPA 2400
Manufacture	ProAnt
Polarization	Mixed horizontal and vertical
Gain / Imp.	+3.0 dBi / 50 ohm @ 2.4 GHz
Size	66 x 90 x 36 mm
Connector	U.FL-RSMT
Comment	Frequency 2400 - 2485 MHz
Approval	FCC, IC, RED, TELEC

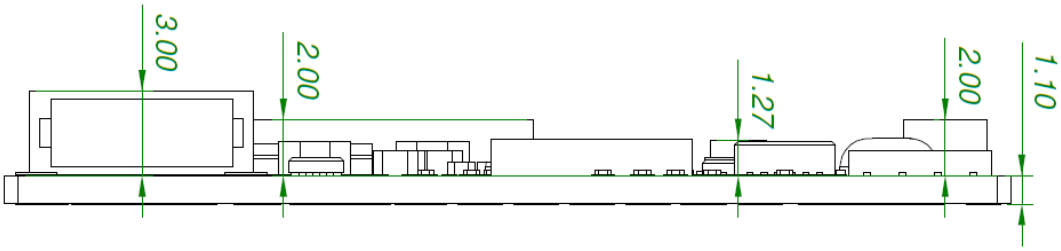
Part Number	—
Name	SDM2-2400 / 1575
Manufacture	Mobile Mark
Polarization	Vertical
Gain / Imp.	+2.0 dBi / 50 ohm @ 2.4 GHz

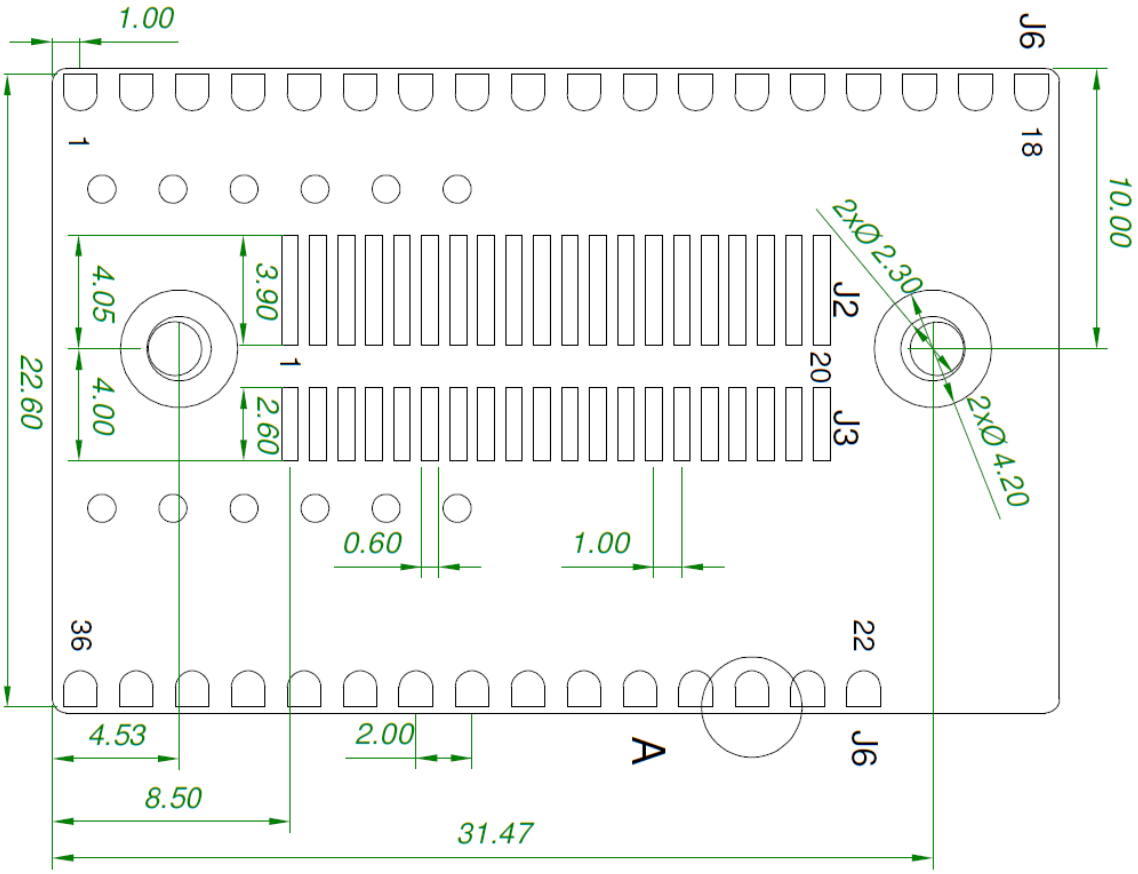
Part Number	—
Size	Ø 65.0 x 28.6 mm
Cable length	200 mm
Connector	U.FL
Comment	Frequency 2400 - 2500 MHz
Approval	FCC, IC, RED, TELEC

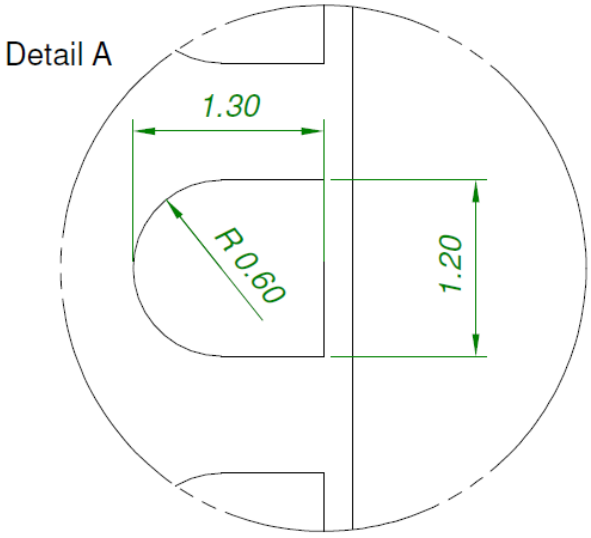
4 Mounting information

4.1 Module dimensions




3.00
2.00
1.27
2.00
1.10


1.00
J6
1
18
10.00
2xØ 2.30
4.05
3.90
J2
1
20
22.60
4.00
2.60
J3
2xØ 4.20
0.60
1.00
36
22
4.53
2.00
A
J6
8.50
31.47

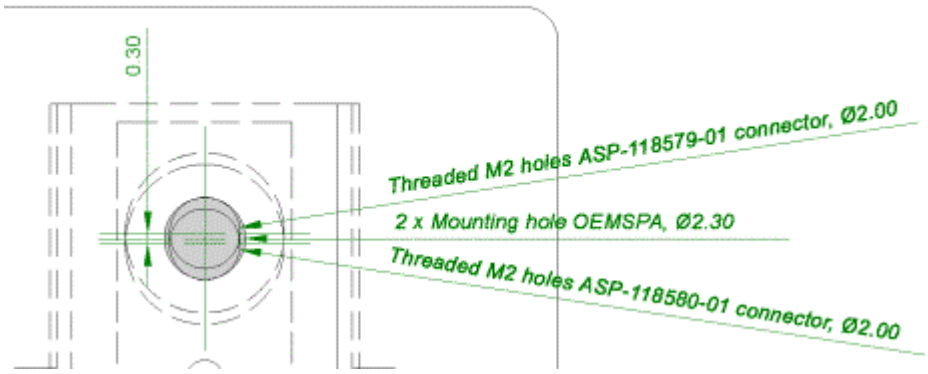


Tolerances:

1. Outline dimensions +/- 0.1mm
2. Drilled hole to outline: +/- 0.05mm

4.1.1 Mounting holes

There are 2 x 2.3mm mounting holes on cB-0941. The reasons for the 2.3mm holes are that the threaded M2 holes on the single and double row connectors are not aligned. The outer tangents of the 2.3mm holes align the module if the single row connectors are used and the inner if double row connectors are used (see Figure 11).
Choose the outer tangent (CC distance 27.24mm) if the module is aligned and mounted with some other technique based on M2 screws (e.g. press-fit nuts), see Figure 12.



4.2 Using the J2/J3 board-to-board connectors

The board-to-board connector should be a 1 mm pitch one-piece part connector. The recommended manufacture is Samtec with many connector options available.
Chapter 3 contains more information about the connector and the electrical interface.

4.2.1 Single row connectors

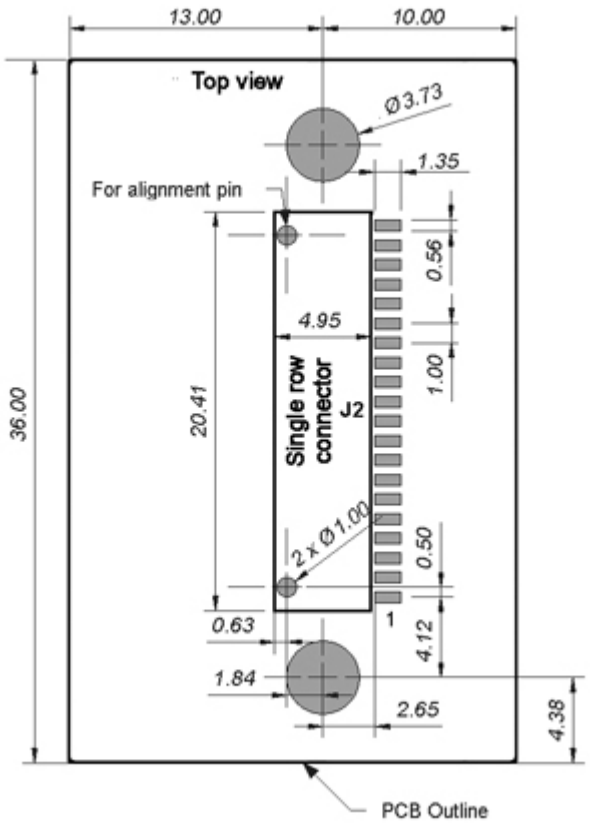
The single row connector SEI-120-02 can be used if only J2 is needed.
This connector has a profile height of 1.65 mm and this has to be considered if components are to be mounted on the motherboard under the OEM Serial Port Adapter board.
There are alignment pins on the bottom side of the connector.
The connector is available with M2 threaded inserts that fit the mounting holes on the board (see section Suitable One-Piece Part Connectors). You may screw the OEM Serial Port Adapter board directly into these inserts. If you want to have a tighter and more secure mounting, you may use longer screws and secure it using a nut on the backside of the motherboard.
Another way to mount the module is to use press-fit nuts on the motherboard and skip the M2 threads on the connector, see section Using Press-Fit Nuts for Mounting the Module for more information about press-fit nuts.

Table 8: Single row connectors from Samtec.

Samtec order number	Quote number	Equivalent part	Package	Remark
ASP-118645-01	55392	SEI-120-02-GF-S-AB	Tube	Align pin on bottom side only
ASP-118645-02	55392	SEI-120-02-GF-S-AB-TR	Tape-n-Reel	Align pin on bottom side only
ASP-118579-01	55392	SEI-120-02-GF-S-M-AB	Tube	With M2 threaded inserts and align pin on bottom side only
ASP-118579-02	55392	SEI-120-02-GF-S-M-AB-TR	Tape-n-Reel	With M2 threaded inserts and align pin on bottom side only

For technical questions regarding the Samtec connectors please contact u-blox or Samtec at Scandinavia@samtec.com

See Figure 10 for more information about the connector and necessary measurements on the motherboard. The large mounting holes on the motherboard are designed for press-fit nuts and could be smaller if press-fit nuts are not used. The mounting holes are aligned with the outer tangent of the 2.3mm mounting holes of the module (see section #Mounting Holes).



Host PCB layout [mm] for single row connector.

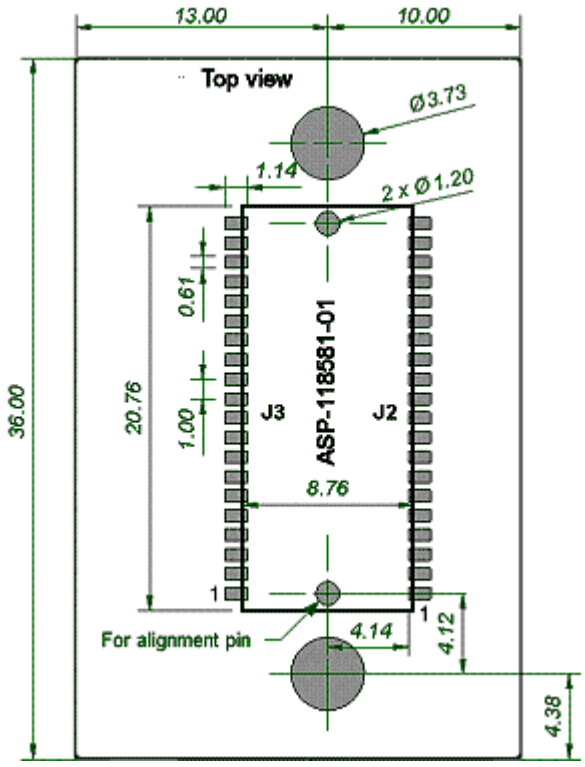
4.2.2 Double row ASP-118580-01 connector

This connector is a double row connector and connects both J2 and J3. It connector has a height of 3.0 mm and this has to be considered if components are to be mounted on the motherboard under the board. The connector is also available with a height of 6.0 mm and 10.0 mm (The FSI-120 serie from Samtec).
There are alignment pins on the bottom side of the connector.
The connector is available with M2 threaded inserts (ASP-118580-01) that fit the mounting holes on the board. You may screw the board directly into these inserts. If you want to have a tighter and more secure mounting you may use longer screws and secure it using a nut on the backside of the motherboard.

Samtec order number	Quote number	Equivalent part	Package	Remark
REF-120018-01	55392	FSI-120-03-G-D-M-AB	Tube	With M2 threaded inserts and align pin on bottom side only
REF-120018-02	55392	FSI-120-03-G-D-M-AB-K-TR	Tape-n-Reel	With M2 threaded inserts and align pin on bottom side only

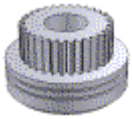
For technical questions regarding the Samtec connectors please contact u-blox or Samtec at Scandinavia@samtec.com

See figure below for more information about the connector and necessary measurements on the motherboard. The large mounting holes on the motherboard are designed for press-fit nuts and could be smaller if press-fit nuts are not used.



4.3 Using press-fit nuts for mounting the module

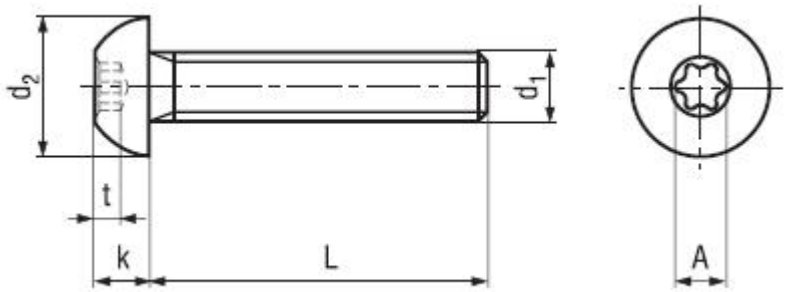
A press-fit nut is pressed into the PCB from the bottom side with a special press tool. M2 sized press-fit nuts are suitable for the modules (see Figure 10 and Figure 11) and are manufactured by PEM Fastening Systems (www.pemnet.com), part no KFS2-M2 (see Figure 12). Be careful with the distance between the nuts regarding alignment, see the #Mounting Holes section.



Spacer-pipes are recommended to use between the PCBs when press-fit nuts are used.

4.4 Recommended M2 screw

If a double-row connector with threaded inserts or press-fit nuts are used, then recommended for mounting of modules is a ISO 7380 M2 compatible screw. A suitable screw is the BN6404 from Bossard, www.bossard.com, with TORX T6 head cap. See figure below.



Parameter	Value	Unit
d2	3.5	mm
k max	1.3	mm
t max	0.8	mm
A	2.0	mm

If other type of screw is used please ensure that d2 is less than 3.8 mm otherwise components near the mounting holes can be damaged.

4.5 Using the J6 PCB solder pads

4.5.1 Host board

The host PCB footprint should not contain any traces or vias under the module except the pads interfacing the J6 pads to avoid contact with traces/vias on the module. The host pads which are soldered to the J6 pads should reach 0.5-1.0mm under the PCB and some mm outside the module. No other pads than the J6 should be soldered to the host PCB. See section #Secondary side connectors for more info about the J6 pads.

4.5.2 Mounting process

We strongly recommend the modules not being soldered more than 1 time after shipping from u-blox and that the modules are mounted just before the host product is being soldered the last time. Although, u-blox devices will withstand up to two reflows to an absolute maximum temperature of 250°C.

- The PCB in our modules is made of Isola PCL-FRP-370HR with Chemical Gold Pads.
- The modules are produced in a lead-free process with a lead-free soldering paste.
- It is recommended that the customers make their own electrical, climate, stress and vibration tests on the final assembled product to secure that the manufacturing process hasn't damaged or affected the module in any way.

- The modules are delivered without labels on each module when packaged on tape-and-reel. However, if they are delivered with labels on each module, the labels should be removed before the module is processed since the labels do not withstand the heat of soldering.
- The device recommended maximum re-flow temperature is 245°C for 10 sec.
- The device absolute maximum re-flow temperature is 250°C for 3 sec.

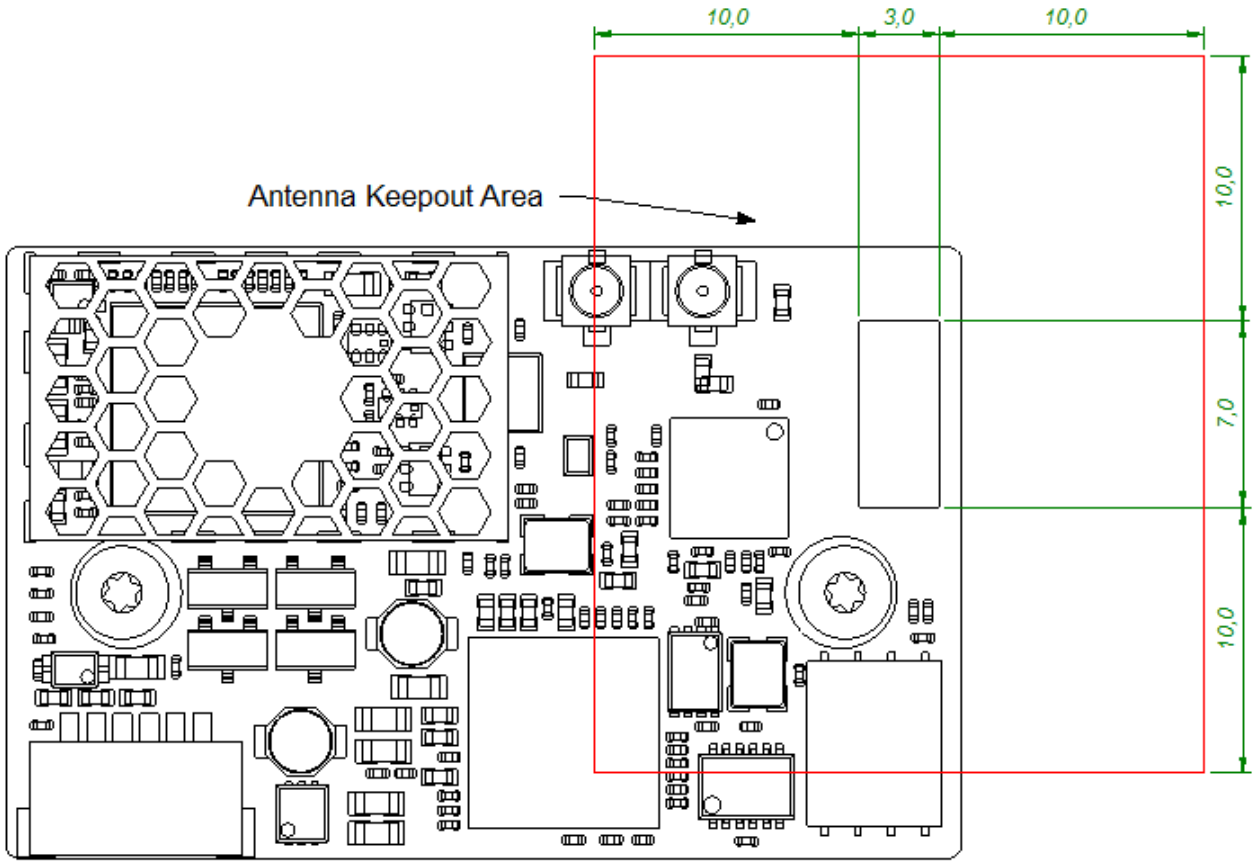
4.6 Antenna issues

To ensure not to cause negative influence on the RF-performance of the unit it cannot be arbitrarily mounted. This concerns the choice of enclosure material and objects in the vicinity of the unit.

A unit with an internal surface mounted antenna cannot be mounted in a metal enclosure. This restriction also includes the use of plastic with metal flakes and metallic based paint or lacquer.

The Antenna keep out Area in the picture below marks a recommended area of 10 mm clearance around the antenna that should be kept free from metal and Cu-wiring.
If a metal enclosure is required, one of the external antenna options has to be used.

See section 3.2 for more information on the antenna options available.



5 Wireless LAN information

In the tables below you can find information about wireless LAN properties.

Parameter	Data
Radio	Redpine Signals RS9110 + Airoha 8230
RF output power 2.4 GHz	802.11b (DSSS): +17dBm (typ.) 802.11g (OFDM): +15dBm (typ.) 802.11n (OFDM): +15dBm (typ.)
RF output power 5 GHz	802.11a (OFDM): +9dBm (typ.) 802.11n (OFDM): +9dBm (typ.)
Receiver sensitivity	See table below
Receive input level (max)	-10 dBm
Output frequency 2.4 GHz	2.412 - 2.462 GHz, channel 1 - 11 (FCC, IC domain) 2.412 - 2.472 GHz, channel 1 - 13 (ETSI, TELEC domain) 5 MHz channel separation
Output frequency 5 GHz	5.180 - 5.240 GHz, U-NII-1 Channel 36, 40, 44, 48 (FCC, IC, ETSI[1] domain) 5.260 - 5.320 GHz, U-NII-2 Channel 52, 56, 60, 64 (FCC, IC, ETSI[1] domain) 5.500 - 5.700 GHz, U-NII-2e Channel 100, 104, 108,112, 116, 120, 124, 128, 132, 136, 140 (FCC, ETSI[1] domain) 5.500 - 5.700 GHz, U-NII-2e Channel 100, 104, 108,112, 116, 132, 136, 140 (IC domain) 5.745 - 5.825 GHz, U-NII-3 [3] Channel 149, 153, 157, 161, 165 (FCC, ETSI[2] domain) TPC and DFS slave/client operation on 5.260 - 5.320 GHz, 5.500 - 5.700 GHz 20 MHz channel separation
Bluetooth co-existence	Basic 2-wire

[1] Compliant until June 12, 2018 with the essential requirements and other relevant provisions of Radio Equipment Directive (RED) 2014/53/EU for operation in the frequency bands 5.180 - 5.240 GHz (U-NII-1), 5.260 - 5.320 GHz (U-NII-2) and 5.500 - 5.700 GHz (U-NII-2e)

[2] Compliant after June 12, 2018 with the essential requirements and other relevant provisions of Radio Equipment Directive (RED) 2014/53/EU for operation in the frequency band 5.745 - 5.825 GHz (U-NII-3)

[3] Frequency band 5.745 - 5.825 GHz, U-NII-3, are only supported by modules shipped after September 1, 2013.

Due to FCC rules it is not possible to upgrade modules shipped prior to the date above to get the additional channels.

5.1 Radio sensitivity OFDM

Data rate	802.11gn (channel 6, 2437MHz, dBm)	802.11an (channel 36, 5180MHz, dBm)
MCS7	-69	-68
MCS6	-70	-70
MCS5	-72	-72
MCS4	-76	-76
MCS3	-79	-79
MCS2	-82	-82
MCS1	-84	-83
MCS0	-87	-86
54	-73	-72
48	-75	-73
36	-78	-78
24	-83	-80
18	-85	-83
12	-87	-85
9	-88	-86
6	-89	-87

5.2 Radio sensitivity DSSS

Data rate	802.11b (channel 6, 2437MHz, dBm)
11	-86
5.5	-89
2	-91
1	-94

6 Regulatory information

6.1 European Union Regulatory Compliance

6.1.1 Declaration of conformity

Information about the regulatory compliance of the European Union for OWS451 and OWL253 is available in the *OWS451 OWL253 Declaration of Conformity (UBX-15015229)* available at www.u-blox.com.

6.1.2 Equipment classes

Depending on which frequency bands this WLAN module can operate in it is defined as either class-1 or class-2 radio equipment.
The End-product that utilise the module inherits the equipment class of the module.

- Class-1 radio equipment can be placed on the market and put into service without restrictions. (article 1 of Commission Decision 2000/299/EC of April 6 2000)
- Class-2 radio equipment is equipment for which Member States apply restrictions as indicated in Article 1(2) of the Decision.

This WLAN module is defined as class-1 radio equipment when it is restricted to operate in the following frequency band

- WLAN, ISM band 2400 – 2483.5 MHz
- WLAN, U-NII band-3 5745 - 5825 MHz

Guidance on how the End product that utilise this module is marked in accordance with the RED directive can be found in the RED guide

https://ec.europa.eu/docsroom/documents/29782

The WLAN module uses harmonised frequency bands thus it is comprised by subclass H01 of class 2 equipment, for which notification in accordance with the RED directive is not necessary.

The table below shows the restrictions when operating the module within the European countries

band	Channel number	Channel frequency	Indoor Use allowed	Outdoor Use allowed	Radio Equipment Class
ISM	1 - 11	2412 - 2462 MHz	Yes	Yes	1
U-NII 1	36 - 48	5180 - 5240 MHz	No	No	2
U-NII 2	52 - 64	5260 - 5320 MHz	No	No	2
U-NII 2e	100 - 140	5500 - 5700 MHz	No	No	1
U-NII 3	149 - 165	5745 - 5825 MHz	Yes	Yes	1

6.2 IC and FCC compliance

See #Product variants for information about the different product variants.

> To be allowed to refer to the u-blox FCC ID / IC certification number for products integrating the OWL253 module the integrator must sign the u-blox Software Configuration Control Declaration to confirm that the requirements of FCC OET KDB 594280 are fulfilled. Contact support@u-blox.com to request the agreement.

6.2.1 IC compliance

This device complies with Industry Canada licence-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 to 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 (i.e. priority users) of the bands 5250-5350 MHz and 5650-5850 MHz and that these radars could cause interference and/or damage to LE-LAN devices.

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.

6.2.2 Conformité aux normes d'IC

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.-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.

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.

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

End product labelling requirements

For an end product using the product cB-0941 there MUST be a label containing, at least, the following information:

This device contains
FCC ID: PVH0941
IC: 5325A-0941

The label must be affixed on an exterior surface of the end product such that it will be visible upon inspection in compliance with the modular approval guidelines developed by the FCC.

FCC end product labelling

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

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

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

In case, where the final product will be installed in locations where the end-consumer 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.

IC end product labelling

User manuals for licence-exempt LPDs shall contain the following or equivalent statements in a conspicuous position:

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.

Étiquetage du produit final conforme à IC

Les manuels d'utilisation d'appareils de faible puissance, sans licence, feront figurer à un endroit bien visible les mentions suivantes ou équivalentes:

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.

Antenna

Our module cB-0941 are for OEM integrations only. In the end-user product the module shall be professionally installed in such a manner that only the authorized antennas can be used.

Caution

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

Within the 5150 to 5250 MHz band (5 GHz radio channels 34 to 48) the module type cB-0941 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 types cB-0941 will automatically discontinue transmission.

Ad-hoc frequencies

Module cB-0941 when operating under the definition of a client in 47 CFR §15.202 is preconfigured to use the most restrictive regulatory domain. For this reason the available operating frequency range is limited to channel 1 - 11 (2412 - 2462 MHz) for IEEE802.11b/g. For IEEE802.11a the available operating frequency range is limited to channels 36 - 48 (5180 - 5240 MHz).

RF-exposure statement

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

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 équipement est conforme aux limites d'exposition de rayonnement d'IC 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.

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

6.3 Japan Radio Equipment Compliance (TELEC)

The cB-0941 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, "2.4GHz band wide band low power data communication system".

The Japan radio equipment compliance for cB-0941 is for 2.4 GHz (channel 1 - 13) only. The operation of this module in 5 GHz band is thus prohibited in Japan.

The cB-0941 MIC certification numbers are:

- OWL253: 204-310004

- OWS451: 204-310005

When a product is placed on the Japanese market, the cB-0941 module product must be affixed with the following Specified Radio Equipment marking:

OWL253	OWS451
	

The minimum size of the logo is Ø3.0mm. The end product holder should also include a copy of the Japan Radio Certificate to the end product technical documentation, contact support@u-blox.com for a copy of the Radio Certificate.

The end product is recommended to be marked with:

OWL253	OWS451
Contains MIC ID: R 204-310004	Contains MIC ID: R 204-310005

6.4 UL listing information

If a customer intends to UL list a product including the cB-0941 this information is useful.
The printed circuit board is produced according to the following specification:

- UL recognized ZPMV2 min. 130 °C flame class V-0 or better.

6.5 Compliance with RoHS directive

The cB-0941 are produced according to the RoHS (Restriction of the use of certain Hazardous Substances in electrical and electronic equipment) directive and complies with the directive.

7 Guidelines for efficient and safe use

7.1 General

Read this information before using your cB-0941 module.
For any exceptions, due to national requirements or limitations, when using your wireless LAN module cB-0941, please contact u-blox.

Changes or modifications to the product not expressly approved by u-blox will void the user's authority to operate the equipment.

7.2 Product care

- Do not expose your product to liquid or moisture.
- Do not expose you product to extreme hot or cold temperature.
- Do not expose your product to lit candles, cigarettes, cigars, open flames, etc.
- Do not drop, throw or try to bend your product since rough treatment could damage your product.
- Do not attempt to disassemble your product. Doing so will void warranty. The product does not contain consumer serviceable or replaceable components. Service should only be performed by u-blox.
- Do not paint your product as the paint could prevent normal use.
- If you will not be using your product for a while, store it in a place that is dry, free from damp, dust and extreme heat and cold.
- The clearance and creepage distances required by the end product must be withheld when the module is installed.
- The cooling of the end product shall not negatively be influenced by the installation of the module when the module is installed.
- The package type of the host MCU is Wafer Level Chip Size Package (WLCSP). WLCSP components must be handled with extra care as active silicon substrate is not protected against aggressive mechanical actions. WLCSP components must also be protected from light exposure when operating. The use of a no-clean flux is highly recommended to avoid any cleaning operation, including ultrasonic cleaning methods.
- Do not store the module in direct sunlight, IR- or UV light.

7.3 Radio frequency exposure

The cB-0941 wireless LAN module contains a small radio transmitter and receiver.
During communication with other wireless LAN products the cB-0941 module transmits and receives radio frequency (RF) electromagnetic fields (microwaves) in the frequency range 2412 - 2462 MHz and 5180 - 5825 MHz.
The output power of the radio transmitter is very low.
When using the cB-0941, you will be exposed to some of the transmitted RF energy. This exposure is well below the prescribed limits in all national and international RF safety standards and regulations.

7.4 Electronic equipment

Most modern electronic equipment, for example, in hospitals and cars, is shielded from RF energy. However, certain electronic equipment is not. Therefore:

This equipment emits RF energy in the ISM (Industrial, Scientific, Medical) band. Please insure that all medical devices used in proximity to this device meet appropriate susceptibility specifications for this type of RF energy.

7.5 Potentially explosive atmospheres

Turn off your electronic device before entering an area with potentially explosive atmosphere. It is rare, but your electronic device could generate sparks. Sparks in such areas could cause an explosion or fire resulting in bodily injury or even death.
Areas with a potentially explosive atmosphere are often, but not always, clearly marked. They include fuelling areas, such as petrol station, below deck on boats, fuel or chemical transfer or storage facilities, and areas where the air contains chemicals or particles, such as grain, dust, or metal powders.

7.6 Safety compliance

In order to fulfill the safety standard EN 60950-1:2006 the wireless LAN module cB-0941 must be supplied by a Class-2 Limited Power Source.

8 Revision history

Revision	Date	Comments
R21	4-Dec-2018	Added RED compliance for operation in the 5.8 GHz frequency band (U-NII-3). Added note to clarify that U-NII-1, U-NII-2 and U-NII-2e are RED compliant only until June 12, 2018.

Contact

For complete contact information visit us at www.u-blox.com

u-box Offices

North, Central and South America

u-blox America, Inc.
Phone: +1 703 483 3180
E-mail: info_us@u-blox.com

Regional Office West Coast:
Phone: +1 408 573 3640
E-mail: info_us@u-blox.com

Technical Support:
Phone: +1 703 483 3185
E-mail: support_us@u-blox.com

Headquarters Europe, Middle East, Africa

u-blox AG
Phone: +41 44 722 74 44
E-mail: info@u-blox.com
Support: support@u-blox.com

Asia, Australia, Pacific

u-blox Singapore Pte. Ltd.
Phone: +65 6734 3811
E-mail: info_ap@u-blox.com
Support: support_ap@u-blox.com

Regional Office Australia:
Phone: +61 2 8448 2016
E-mail: info_anz@u-blox.com
Support: support_ap@u-blox.com

Regional Office China (Beijing):
Phone: +86 10 6813 3545
E-mail: info_cn@u-blox.com
Support: support_cn@u-blox.com

Regional Office China (Chongqing):
Phone: +86 23 6815 1588
E-mail: info_cn@u-blox.com
Support: support_cn@u-blox.com

Regional Office China (Shanghai):
Phone: +86 21 6090 4832
E-mail: info_cn@u-blox.com
Support: support_cn@u-blox.com

Regional Office China (Shenzhen):
Phone: +86 755 8627 1083
E-mail: info_cn@u-blox.com
Support: support_cn@u-blox.com

Regional Office India:
Phone: +91 959 1302 450
E-mail: info_in@u-blox.com
Support: support_in@u-blox.com

Regional Office Japan (Osaka):
Phone: +81 6 6941 3660
E-mail: info_jp@u-blox.com
Support: support_jp@u-blox.com

Regional Office Japan (Tokyo):
Phone: +81 3 5775 3850
E-mail: info_jp@u-blox.com
Support: support_jp@u-blox.com

Regional Office Korea:
Phone: +82 2 542 0861
E-mail: info_kr@u-blox.com
Support: support_kr@u-blox.com

Regional Office Taiwan:
Phone: +886 2 2657 1090
E-mail: info_tw@u-blox.com
Support: support_tw@u-blox.com