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Contents

1	Introduction	4
1.1	Document Overview	4
1.2	Key Features	4
1.3	Product Variants	5
2	Electrical Interface and Connectors	6
2.1	Primary Side Connector	6
2.2	Secondary Side Connector	7
2.3	J4-20 RF-port solder land	7
2.4	Electrical Characteristics	7
2.4.1	Power Supply	7
2.4.2	I/O DC Characteristics	8
2.4.3	LPO Requirements	8
2.5	Host Interface	8
2.5.1	Wireless LAN and SDIO	8
2.5.2	Bluetooth UART	8
2.6	Environmental Characteristics	9
2.7	Mechanical Characteristics	9
3	Antenna Information	9
3.1	Caution	9
3.2	External Antennas	10
3.2.1	Antennas	10
4	Mounting Information	11
4.1	Module Dimensions	11
4.2	PCB Solder Lands	12
4.2.1	Host Board	12
4.2.2	Mounting Process	13
5	Regulatory Information	13
5.1	CE compliance	13
5.1.1	Equipment classes	13
5.1.2	Declaration of Conformity	14
5.2	IC and FCC compliance	15
5.2.1	IC compliance	15
5.2.2	Conformité aux normes d'IC	15
5.2.3	FCC statement	16
5.3	Compliance with RoHS Directive	19

6	Guidelines for Efficient and Safe Use	19
6.1	General	19
6.2	Product Care	19
6.3	Radio Frequency Exposure	19
6.4	Electronic Equipment	20
6.5	Potentially Explosive Atmospheres	20
6.6	Safety Compliance	20

1 Introduction

The ODIN-W161 is a Multi Radio Module providing both IEEE 802.11a,b,g,n Wireless LAN and Bluetooth 4.0, including Classic Bluetooth and Bluetooth low energy. It has been developed for integration in industrial devices. The module provides features such as low power, robustness, reliability and compatibility. By using the module the work needed to implement IEEE 802.11 and/or Bluetooth in a device is minimized 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 Wireless LAN section of the module can be operated on 5 frequency bands and conforms to IEEE 802.11a,b,g and 802.11n single stream.

- ISM Band (2412 – 2462 MHz), 11 channels with a separation of 5MHz
- UNII band-1 (5180 – 5240 MHz), 4 channels with a separation of 20MHz
- UNII band-2 (5260 – 5320 MHz), 4 channels with a separation of 20MHz
- UNII band-2e (5500 – 5700 MHz), 8 channels with a separation of 20MHz
- UNII band-3 (5745 – 5825 MHz), 5 channels with a separation of 20MHz

The Bluetooth section of ODIN-W160 operates in the unlicensed ISM band between 2402 – 2480 MHz and has two operating modes with somewhat different behaviour.

- Bluetooth Classic (BT+EDR)
In this operating mode it uses 79 RF channels with 1 MHz spacing
- Bluetooth Low Energy (BLE)
In this operating mode it uses 39 RF channels with 2 MHz spacing

ODIN-W161



1.1 Document Overview

This User Manual is applicable to the following Wireless LAN module:

- ODIN-W161

1.2 Key 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 production tests required
 - RF tuned from factory
 - Contains own MAC address
- Host interfaces:
 - Wireless LAN: SDIO
 - Bluetooth: UART
 - RF parameters and MAC address: I²C
- Small footprint
 - 22.3 x 14.8 x 2.9 mm
- WEP, AES hardware accelerators
- WPA and WPA2 support - both personal and enterprise modes
- Quality of Service: 802.11e and WMM
- Ad-hoc and infrastructure mode
- Radio type approved for Europe
- Unlicensed Modular Transmitter Approval for US (FCC) and Canada (IC)
- Compliant with EMC standards
- Medical approval
- Industrial temperature range -40 to +85 °C
- Support for low power modes
- RF-port via solder land

1.3 Product Variants

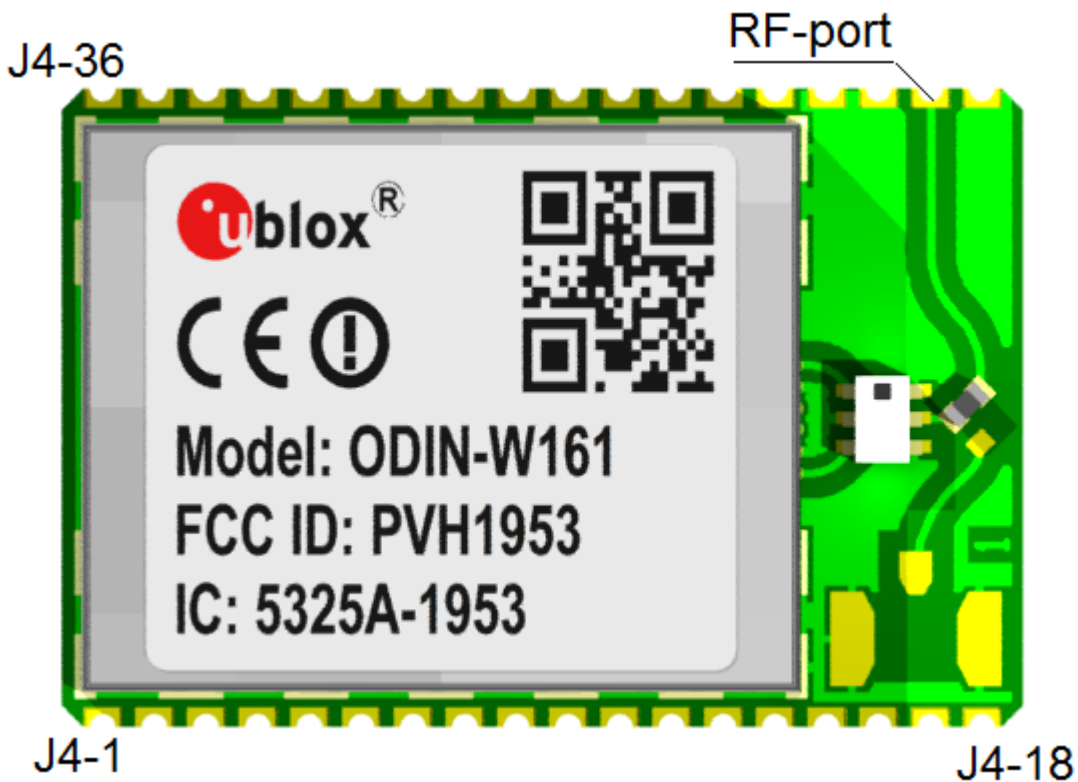
Product name	Regulatory ID FCC ID IC ID	Description
ODIN-W161	Model: ODIN-W161 PVH1953 5325A-1953	Multi Radio Module with solder land RF-port

2 Electrical Interface and Connectors

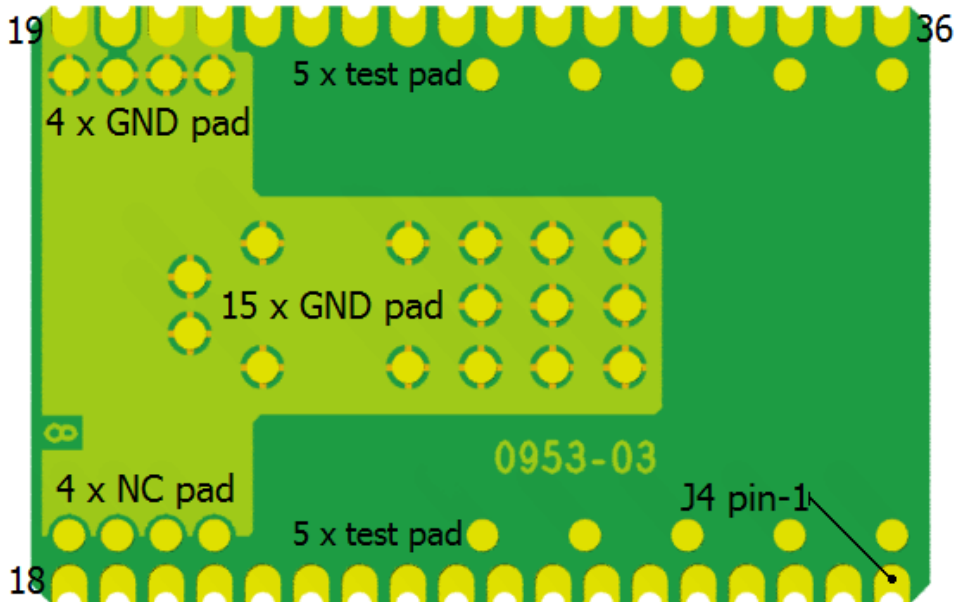
Host interface and control signals are accessible via PCB solder lands at the edge of the PCB.

2.1 Primary Side Connector

Top view of module, J4 is the 2 x 18 pin solder lands.



2.2 Secondary Side Connector



2.3 J4-20 RF-port solder land

The RF-port of the module is accessed via solder land J4-20, it is for both transmit and receive. The port impedance to match is 50 ohm.

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

2.4 Electrical Characteristics

2.4.1 Power Supply



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

Supply Voltage Requirements

Symbol	Parameter	Min	Typ.	Max	Unit
V_{DD}	Supply voltage	3.0	3.3	3.6	V
V_{IO}	IO Supply voltage	1.75	1.8	1.9	V

2.4.2 I/O DC Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_{IL}	LOW level input voltage	0		$0.35 \times V_{IO}$	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

2.4.3 LPO Requirements

Symbol	Parameter	Min	Typ	Max	Unit
LPO-32kHz	Frequency	32763	32768	32773	Hz

2.5 Host Interface

The module has two primary host interfaces, SDIO for the Wireless LAN section and UART for the Bluetooth section.

2.5.1 Wireless LAN and SDIO

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 WLAN block uses function 2. Function 0 is used for the common I/O area.

2.5.2 Bluetooth UART

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 (detected automatically when communication starts):

- HCI four-wire (H4)
- HCI three-wire (H5)

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 115.2kbps. The maximum baud rate deviation supported 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 115.2kbps), 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)
- XON/XOFF soft flow control (H5)

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

2.6 Environmental Characteristics

Parameter	Min	Typ	Max	Unit
Storage temperature	-40		+95	degC
Operating temperature	-40		+85	degC

2.7 Mechanical Characteristics

Parameter	Value type	Value	Unit
Weight	Typ	1.5	g
Outline dimension	Typ	22.3 x 14.8 x 2.9 (+/- 0.1 mm)	mm

3 Antenna Information

This chapter gives an overview of the different external antennas that can be fitted to the module.

3.1 Caution



This radio transmitter IC: 5325A-1953 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-1953 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 External Antennas

External antennas are connected to the module via the solder land RF-port (J4 pin-20). The section below shows the antenna reference design as one type example of how to connect the antenna to the solder land RF-port via a 50-ohm stripline and an impedance matching network.

3.2.1 Antennas

Part Number -

Name ODIN-W161 Antenna Reference design UBX15010679



Manufacture Fractus SMD antenna, FR05-S1-NO-1-003

Polarization Linear

Gain / Imp. +3.0 dBi / 50ohm @ 2.4 GHz
+3.0 dBi / 50ohm @ 5 GHz

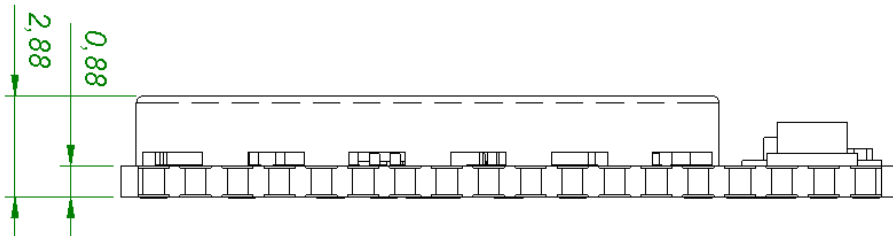
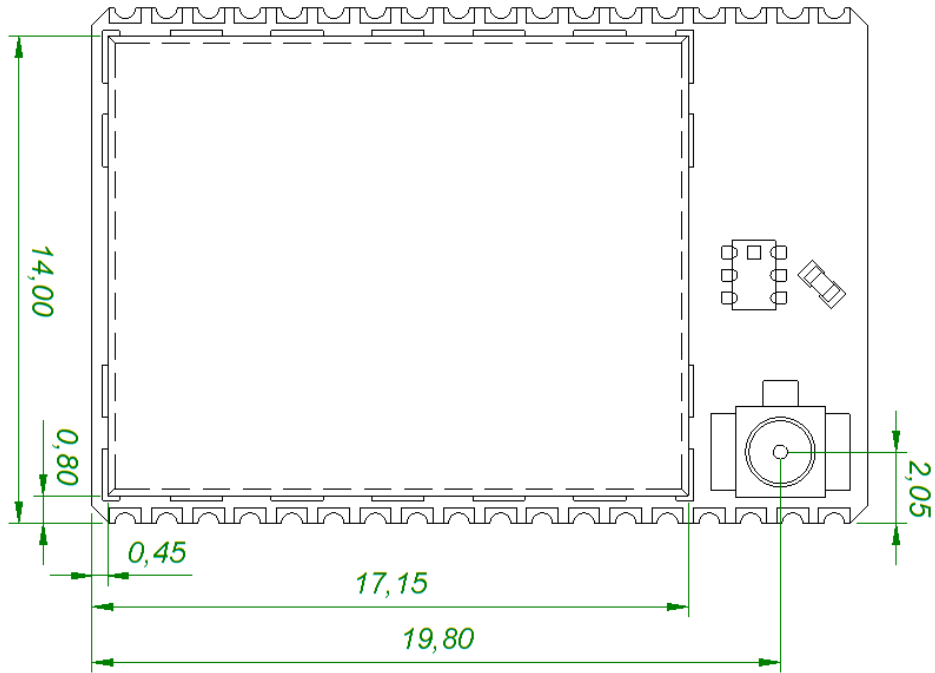
Size 27 x 36 mm

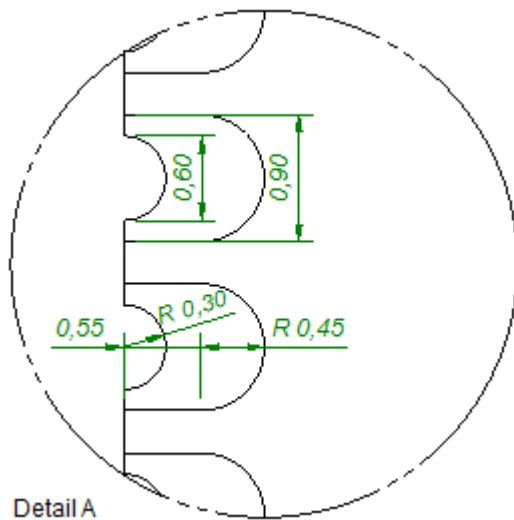
Comment The reference design must be in strict accordance with ODIN-W161 Antenna reference design UBX15010679

Approval FCC, IC, R&TTE

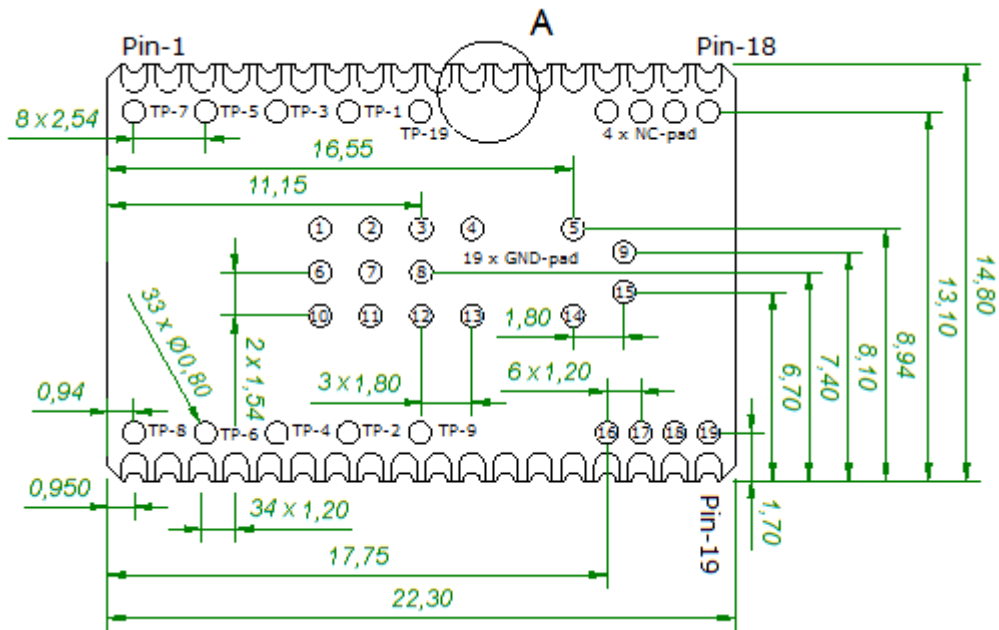
4 Mounting Information

4.1 Module Dimensions





Detail A



Tolerances:

1. Outline dimensions +/- 0.2mm

4.2 PCB Solder Lands

4.2.1 Host Board

The host PCB footprint should not contain any traces or vias under the module except the pads connecting to the solder lands of connector J4- and the 19 supplementary GND-pads. TP- and NC-pads are not mandatory but can be used to get a better balance of the solder process.

4.2.2 Mounting Process

Although u-blox devices will withstand two re-flow soldering processes ($T_{\max} < 250^{\circ}\text{C}$) we strongly recommend the modules not being subjected to more than one soldering process after being shipped from u-blox thus the modules are populated on the host product in the final solder processing step.

- The PCB in our modules is UL recognized ZPMV2 min. 130 °C flame class V-0 with ENIG coated solder lands.
- 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 in ESD bags (for small quantities) or tape-on-reel
 - Modules delivered on tape-on-reel are packaged in sealed drypack" bags, MSL-3
 - Modules delivered in ESD bag are not in a sealed drypack
- 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.

5 Regulatory Information

5.1 CE compliance

5.1.1 Equipment classes

Depending on which frequency bands this multi-radio 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, which also assigns the "Alert Sign" as "Equipment Class Identifier" for this class.

This multi-radio module is defined as class-1 radio equipment when it is restricted to operate in the following frequency bands:

- Bluetooth *classic*, ISM band 2400 – 2483.5 MHz
- Bluetooth *Low Energy*, ISM band 2400 – 2483.5 MHz
- WLAN, ISM band 2400 – 2483.5 MHz
- WLAN, U-NII band-2e 5470 – 5725 MHz

If the end product allows the multi radio module to be operated in the band 5150 – 5350 MHz (WLAN channel: 36 – 64) it is defined as class-2 radio equipment and must be marked accordingly.

Class-2 radio equipment must have the "alert" sign affixed on the equipment, packaging and printed in the user instruction manual.



Guidance on how the End product that utilise this module is marked in accordance with the R&TTE directive is found in the following links:

http://ec.europa.eu/enterprise/sectors/rtte/documents/index_en.htm#h2-5
http://ec.europa.eu/enterprise/sectors/rtte/documents/guidance/index_en.htm

A direct link to the quick guide to the marking requirements can be found here:
http://ec.europa.eu/enterprise/sectors/rtte/files/guidance/guidance_en.pdf

The ODIN-W161 uses harmonised frequency bands thus it is comprised by subclass H01 of class 2 equipment, for which notification in accordance with article 6(4) of the R&TTE directive is not necessary.

A definition of subclasses of Class 2 equipment can be found in the following link:

http://ec.europa.eu/enterprise/sectors/rtte/files/rtte-subclass2_en.pdf

The table below shows the restrictions when operating the module in WLAN mode 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	Yes	No	2
U-NII 2	52 - 64	5260 - 5320 MHz	Yes	No	2
U-NII 2e	100 - 140	5500 - 5700 MHz	Yes	Yes	1
U-NII 3	149 - 165	5745 - 5825 MHz	No	No	-

5.1.2 Declaration of Conformity



We, u-blox Malmö AB, of
Östra Varvsgatan 4, 5tr
SE-211 75 Malmö, Sweden

declare under our sole responsibility that our product:

- ODIN-W161

to which this declaration relates, conforms to the following product specifications:

R&TTE Directive 1999/5/EC

Effective use of frequency spectrum:
EN 300 328 V1.8.1 (2012-06)
EN 301 893 V1.7.1 (2012-06)

EMC:

EN 301 489-1 V1.9.2 (2011-09)
EN 301 489-17 V2.2.1 (2012-09)
EN 61000-6-2 (2005)

Health and safety:

EN 60950-1:2006 + A11:2009
IEC 60950-1:2005
EN 62311:2008 (WLAN)
EN 62479:2010 (BT + BLE)

Medical Electrical Equipment

IEC 60601-1-2 : 2007

5.2 IC and FCC compliance

5.2.1 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.

5.2.2 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-point 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.

5.2.3 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.

i 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 ODIN-W161 there MUST be a label containing, at least, the following information:

This device contains
FCC ID: PVH1953
IC: 5325A-1953



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 ODIN-W161 is for OEM integrations only.

The module must in the end-product be installed in such manner that only the authorized antennas can be used.

Caution



Any changes or modifications NOT explicitly APPROVED by u-blox Malmö AB 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 frequency band 5150 to 5250 MHz the module type ODIN-W161 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 ODIN-W161 will automatically discontinue transmission.

Ad-hoc frequencies

When operating at the frequencies of U-NII band-2 (5260 -5320 MHz), U-NII band-2e (5500 – 5700 MHz) and U-NII band-3 (5745 – 5825 MHz) the module is configured to function under the definition of a client in 47 CFR §15.202.

As a DFS client without radar detection using passive scan ODIN-W161 is not able to select channel or initiate a network.

Active scan and ability to initiate network (Ad-hoc) is only supported for operation on channels 1 - 11 (2412 - 2462 MHz) and 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

5.3 Compliance with RoHS Directive



The ODIN-W161 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.

6 Guidelines for Efficient and Safe Use

6.1 General

Read this information before using your ODIN-W161 module.

For any exceptions, due to national requirements or limitations, when using your WLAN module, please contact u-blox Malmö AB.

6.2 Product Care

- Do not expose your product to liquid or moisture.
- Do not expose your 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 connectBlue AB.
- Do not paint your product as the paint could prevent normal use.
- If your product is not to be used for a longer period, store it in a dry place free from damp, dust and not subjected to extreme temperatures.
- 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.

6.3 Radio Frequency Exposure

The ODIN-W161 WLAN module contains a small radio transmitter and receiver.

During communication with other WLAN products the ODIN-W161 module transmits and receives radio frequency (RF) electromagnetic fields (microwaves) in the frequency range 2412 - 2462 MHz, 5180 - 5240 MHz, 5260 - 5320 MHz, and 5500 - 5700 MHz.

The output power of the radio transmitter is very low. When using the module, 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.

6.4 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. Please insure that all medical devices used in proximity to this device meet appropriate susceptibility specifications for this type of RF energy.

6.5 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 fueling 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.

6.6 Safety Compliance

In order to fulfil the safety standard EN 60950-1:2006 the WLAN module ODIN-W161 must be supplied by a Class-2 Limited Power Source.



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