

1. WiFi and Bluetooth

MS-01 Integrated Qualcomm WCN3990 to support WLAN 2x2 802.11a/b/g/n/ac with DBS and 160 MHz, Bluetooth 5.0.

- 2 × 2 802.11ac with MU-MIMO
- DBS support
- 160 MHz bandwidth support
- Bluetooth 5.0

1.1 WLAN RF Characteristics

1.1.1 2.4 GHz WLAN Transmitter Characteristic

Parameter	Test Conditions	Typ	Unit
1 Mbps DSSS (b) TX Output power	1 Mbps BPSK 802.11(b) Mask Compliance 35% EVM RMS power over TX packet, 20 MHz	18 +/- 1.5	dBm
11 Mbps DSSS (b) TX Output power	11 Mbps CCK 802.11(b) Mask Compliance 35% EVM RMS power over TX packet, 20 MHz	18 +/- 1.5	dBm
6 Mbps OFDM (g) TX Output power	6 Mbps BPSK 802.11(g) Mask Compliance -5 dB EVM RMS power over TX packet, 20 MHz	16 +/- 1.5	dBm
54 Mbps OFDM (g) TX Output power	54 Mbps 64-QAM 802.11(g) Mask Compliance -25 dB EVM RMS power over TX packet, 20 MHz	14 +/- 1.5	dBm
MCS0 OFDM (n) TX Output power, 20 MHz	6.5 Mbps BPSK 802.11(n) Mask Compliance -5 dB EVM RMS power over TX packet, 20 MHz	16 +/- 1.5	dBm
MCS7 OFDM (n) TX Output power, 20 MHz	65 Mbps 64-QAM 802.11(n) Mask Compliance -27 dB EVM RMS power over TX packet, 20 MHz	13 +/- 1.5	dBm
MCS0 OFDM (n) TX Output power, 40 MHz	13.5 Mbps BPSK 802.11(n) Mask Compliance -5 dB EVM RMS power over TX packet, 40 MHz	16 +/- 1.5	dBm
MCS7 OFDM (n) TX Output power, 40 MHz	135 Mbps 64-QAM 802.11(n) Mask Compliance -27 dB EVM RMS power over TX packet, 40 MHz	13 +/- 1.5	dBm

1.1.2 2.4 GHz WLAN Receiver Characteristic

Parameter	Test Conditions	Min	Typ	Max	Unit
1 Mbps DSSS (b) Rx Sensitivity	8% PER, 20 MHz	-	-96	-	dBm
11 Mbps DSSS (b) Rx Sensitivity	8% PER, 20 MHz	-	-88	-	dBm
6 Mbps OFDM (g) Rx Sensitivity	10% PER, 20 MHz	-	-91	-	dBm
54 Mbps OFDM (g) Rx Sensitivity	10% PER, 20 MHz	-	-74	-	dBm
MCS0 OFDM (n) Rx Sensitivity	10% PER, 20 MHz	-	-91	-	dBm
MCS7 OFDM (n) Rx Sensitivity	10% PER, 20 MHz	-	-71	-	dBm
MCS0 OFDM (n) Rx Sensitivity	10% PER, 40 MHz	-	-88	-	dBm
MCS7 OFDM (n) Rx Sensitivity	10% PER, 40 MHz	-	-69	-	dBm
802.11b RX Overload Level - 20MHz	8% PER, 11 Mbps	-10	-	-	-
802.11g RX Overload Level - 20MHz	10% PER, 54 MHz	-20	-	-	-
802.11n RX Overload Level - 20MHz	10% PER, MCS7	-20	-	-	-

1.1.3 5 GHz WLAN Transmitter Characteristics

Parameter	Test Conditions	Typ	Unit
6 Mbps OFDM (a) TX Output power	6 Mbps BPSK 802.11(a) Mask Compliance -5 dB EVM RMS power over TX packet, 20 MHz	16 +/- 1.5	dBm
54 Mbps OFDM (a) TX Output power	54 Mbps 64-QAM 802.11(a) Mask Compliance - 25 dB EVM RMS power over TX packet, 20 MHz	14 +/- 1.5	dBm
MCS0 OFDM (n) TX Output power, 20 MHz	6.5 Mbps BPSK 802.11(n) Mask Compliance -5 dB EVM RMS power over TX packet, 20 MHz	16 +/- 1.5	dBm
MCS7 OFDM (n) TX Output power, 20 MHz	65 Mbps 64-QAM 802.11(n) Mask Compliance - 27 dB EVM RMS power over TX packet, 20 MHz	13 +/- 1.5	dBm
MCS0 OFDM (n) TX Output power, 40 MHz	13.5 Mbps BPSK 802.11(n) Mask Compliance -5 dB EVM RMS power over TX packet, 40 MHz	16 +/- 1.5	dBm
MCS7 OFDM (n) TX Output power, 40 MHz	135 Mbps 64-QAM 802.11(n) Mask Compliance - 27 dB EVM RMS power over TX packet, 40 MHz	13 +/- 1.5	dBm
MCS0 OFDM (ac) TX Output power, 20 MHz	BPSK 802.11(ac) Mask Compliance -5 dB EVM RMS power over TX packet, 20 MHz	16 +/- 1.5	dBm
MCS8 OFDM (ac) TX Output power, 20 MHz	64-QAM 802.11(ac) Mask Compliance - 30 dB EVM RMS power over TX packet, 20 MHz	12 +/- 1.5	dBm
MCS0 OFDM (ac) TX Output power, 40 MHz	13.5 Mbps BPSK 802.11(ac) Mask Compliance -5 dB EVM RMS power over TX packet, 40 MHz	16 +/- 1.5	dBm

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MCS9 OFDM (ac) TX Output power, 40 MHz	180 Mbps 256-QAM 802.11(ac) Mask Compliance -32 dB EVM RMS power over TX packet, 40 MHz	11 +/- 1.5	dBm
MCS0 OFDM (ac) TX Output power, 80 MHz	29.3 Mbps BPSK 802.11(ac) Mask Compliance -5 dB EVM RMS power over TX packet, 80 MHz	16 +/- 1.5	dBm
MCS9 OFDM (ac) TX Output power, 80 MHz	390 Mbps 256-QAM 802.11(ac) Mask Compliance -32 dB EVM RMS power over TX packet, 40 MHz	11 +/- 1.5	dBm

MS-01 SOM

1.1.4 5 GHz WLAN Receiver Characteristics

1. Parameter	Test Conditions	Min	Typ	Max	Unit
6 Mbps OFDM (a) Rx Sensitivity	10% PER, 20 MHz	-	-92	-	dBm
54 Mbps OFDM (a) Rx Sensitivity	10% PER, 20 MHz	-	-75	-	dBm
MCS0 OFDM (n) Rx Sensitivity	10% PER, 20 MHz	-	-91	-	dBm
MCS7 OFDM (n) Rx Sensitivity	10% PER, 20 MHz	-	-73	-	dBm
MCS0 OFDM (n) Rx Sensitivity	10% PER, 40 MHz	-	-88	-	dBm
MCS7 OFDM (n) Rx Sensitivity	10% PER, 40 MHz	-	-70	-	dBm
MCS0 OFDM (ac) Rx Sensitivity	10% PER, 20 MHz	-	-91	-	dBm
MCS8 OFDM (ac) Rx Sensitivity	10% PER, 20 MHz	-	-68	-	dBm
MCS0 OFDM (ac) Rx Sensitivity	10% PER, 40 MHz	-	-88	-	dBm
MCS9 OFDM (ac) Rx Sensitivity	10% PER, 40 MHz	-	-64	-	dBm
MCS0 OFDM (ac) Rx Sensitivity	10% PER, 80 MHz	-	-84	-	dBm
MCS9 OFDM (ac) Rx Sensitivity	10% PER, 80 MHz	-	-59	-	dBm

2. Bluetooth RF Characteristics

MS-01 Integrated Qualcomm WCN3990 to Support Bluetooth 5.0 and is backwards compatible with previous BT standard revisions.

2.1 Bluetooth RF Characteristics

The following tables show the Bluetooth transmitting and receiving performance

Transmitter Performance			
Packet Types	DH5	2-DH5	3-DH5
Transmitting Power	11 +/- 1.5 dB	8 +/- 1.5 dB	8 +/- 1.5 dB

Receiver Performance			
Packet Types	DH5	2-DH5	3-DH5
Receiving Sensitivity	-93 dBm	-93 dBm	-86 dBm

OEM/Integrators Installation Manual

Important Notice to OEM integrators

1. This module is limited to OEM installation ONLY.
2. This module is limited to installation in mobile or fixed applications, according to Part 2.1091(b).
3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations
4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part 15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s).

Antenna Installation

- (1) The antenna must be installed such that 20 cm is maintained between the antenna and users,
- (2) The transmitter module may not be co-located with any other transmitter or antenna.
- (3) To comply with FCC/IC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain including cable loss in a mobile exposure condition must not exceed:

Standalone Condition:

- 1.44 dBi in 2.4 GHz Band
- 2.16 dBi in 5.2GHz Band
- 2.16 dBi in 5.3GHz Band
- 2.16 dBi in 5.5GHz Band
- 2.16 dBi in 5.8GHz Band

In the event that these conditions cannot be met (for example certain laptop configurations or co- location with another transmitter), then the FCC/IC authorization is no longer considered valid and the FCC ID/IC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC/IC authorization.

Federal Communication Commission Interference 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 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.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Radiation 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 20cm between the radiator & your body.

This device is intended only for OEM integrators under the following conditions:

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains FCC ID: COF-MS01". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

This device is intended only for OEM integrators under the following conditions:

- 1) The antenna must be installed with 20 cm is maintained between the antenna and users **in mobile or fixed applications.**
- 2) **The Antenna for Module (MS-01) is Non-detachable and the maximum antenna gain allowed for use with this device is 3.62 dBi.@2.4GHz band & 4.9dBi@5GHz band.**
- 3) The transmitter module may not be co-located with any other transmitter or antenna.
- 4) **OEM integrators Must** demonstrate SAR test and meet compliance before end-product with module **(MS-01)** marketed **in portable application.**

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

OEM integrators Must demonstrate Part 15B test and meet compliance before end-product with module **(MS-01)** marketed.

List of applicable FCC rules

This module has been tested and found to comply with 15.247 and 15.407 requirements for Modular Approval.

US Information

Name of the company: USI America, Inc

Address of the company: 2000 Regency Parkway, Suite 420, Cary, NC

27518 Phone number: 919-466-8688 Ext. 109

General

The SOM module uses Dipole **and PIFA** antenna to do EMC official test then antenna gain and trace design, please refer to antenna information and antenna trace design.

Antenna Information

Antenna Type: Dipole

Antenna gain: 1.44dBi@2.4GHz and 2.16dBi@5GHz

AntennaType: PIFA

Antenna gain: 3.62@2.4GHz and 4.9dBi@5GHz

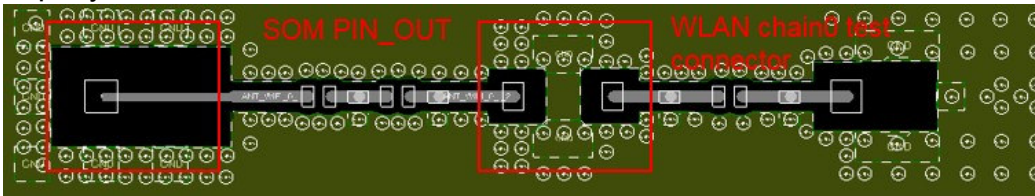
Important Note

notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify to USI that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the USI, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Antenna Trace Design

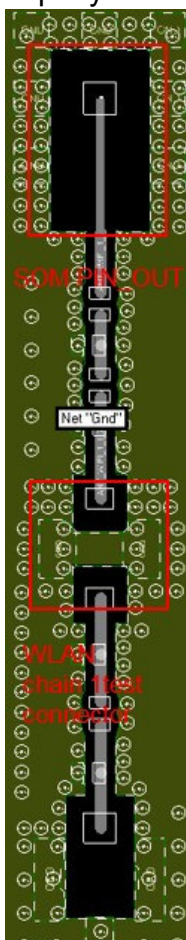
WLAN chain0/BT

Top layer



WLAN chain1

Top layer



The Land Pattern and Dimensions should be compliance with USI's Standard PCB Design. The characteristics of products may vary depending on the pattern drawing method, grounding method, land dimensions, land forming method of the NC terminals and the PCB material and thickness.

Therefore, be sure to verify the characteristics in the actual set. When using non-standard lands, contact Universal Global Scientific Industrial Co., Ltd. Beforehand.

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Specifications

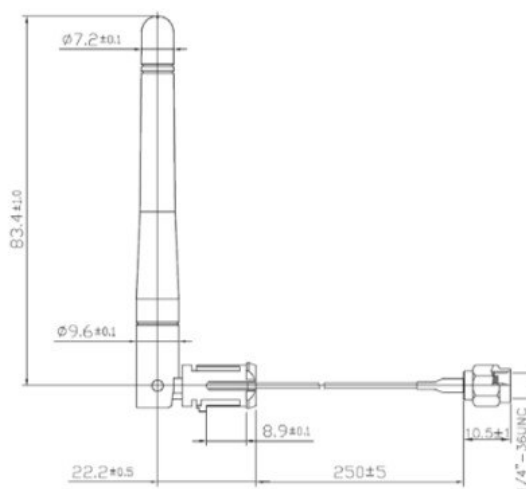
RFA-25-C2H1-70-250A1

Specifications

Frequency range	2400 – 2500 MHz	5150 – 5875 MHz
Peak gain	1.44 dBi	2.16 dBi
Average gain	-0.27 dBi	0.13 dBi
VSWR	2.0 : 1 Max.	2.0 : 1 Max.
Polarization	Linear, vertical	
Impedance	50 Ω	
Connector	SMA PLUG	
Cable	$\varnothing 1.13$ / L=250mm	
Antenna color	Black	

Environment & Mechanical Characteristics

Temperature	- 10°C to +55°C
Humidity	95% @ 25°C



USI uses various test mode programs for test set up which operate separate from production firmware. Host integrators should contact USI for assistance with test modes needed for module/host compliance test requirements.

The MS-01 modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Industry Canada statement:

This device complies with ISED's licence-exempt RSSs. 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.

Le présent appareil est conforme aux CNR d'ISED applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

Radiation Exposure Statement:

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

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

This device is intended only for OEM integrators under the following conditions: (For module device use)

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

- 1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
- 2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or co- location with another transmitter), then the Canada authorization is no longer considered valid and the IC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains IC:10293A-MS01".

Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 10293A-MS01 ".

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

RSS-247 Section 6.4 (5) (6) (for local area network devices, 5GHz)

The device could automatically discontinue transmission in case of absence of information to transmit, or operational failure. Note that this is not intended to prohibit transmission of control or signaling information or the use of repetitive codes where required by the technology.

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.

L'appareil peut interrompre automatiquement la transmission en cas d'absence d'informations à transmettre ou de panne opérationnelle. Notez que ceci n'est pas destiné à interdire la transmission d'informations de contrôle ou de signalisation ou l'utilisation de codes répétitifs lorsque cela est requis par la technologie.

Le dispositif utilisé dans la bande 5150-5250 MHz est réservé à une utilisation en intérieur afin de réduire le risque de brouillage préjudiciable aux systèmes mobiles par satellite dans le même canal; Le gain d'antenne maximal autorisé pour les dispositifs dans les bandes

5250-5350 MHz et 5470-5725 MHz doit être conforme à la norme e.r.p. limite; et

Le gain d'antenne maximal autorisé pour les appareils de la bande 5725-5825 MHz doit être conforme à la norme e.i.r.p. les limites spécifiées pour un fonctionnement point à point et non point à point, selon le cas.

CE RF exposure

RF Exposure Information (MPE)

This device has been tested and meets applicable limits for Radio Frequency (RF) exposure. To comply with the RF exposure requirements, this module must be installed in a host platform that is intended to be operated in a minimum of 20 cm separation distance to the user.

Hereby, **USI** declares that the radio equipment type WiFi SOM Module is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address: <https://www.usiglobal.com/tw/MS-01/DoC.pdf>

In all cases assessment of the final product must be met against the Essential requirements of the RE Directive Articles 3.1(a) and (b), safety and EMC respectively, as well as any relevant Article 3.3 requirements.

1. The Dipole antenna (WLAN/BT: 1.44dBi@2.4GHz, 2.16dBi@5GHz) and PIFA antenna

(WLAN/BT: 3.62dBi@2.4GHz, 4.9dBi@5GHz) verified in the conformity testing, and for compliance the antenna shall not be modified. A separate approval is required for all other operating configurations, including different antenna configurations.

2. If any other simultaneous transmission radio is installed in the host platform together with this module, or above restrictions cannot be kept, a separate RF exposure assessment and CE equipment certification is required.

The device is restricted to indoor use only when operating in the 5150 to 5350 MHz frequency range.

	AT	BE	BG	HR	CY	CZ	DK
	EE	FI	FR	DE	EL	HU	IE
	IT	LV	LT	LU	MT	NL	PL
	PT	RO	SK	SI	ES	SE	UK