



翰揚生理感測股份有限公司
Biological Sensing System Co., Ltd.

規格書 Specification

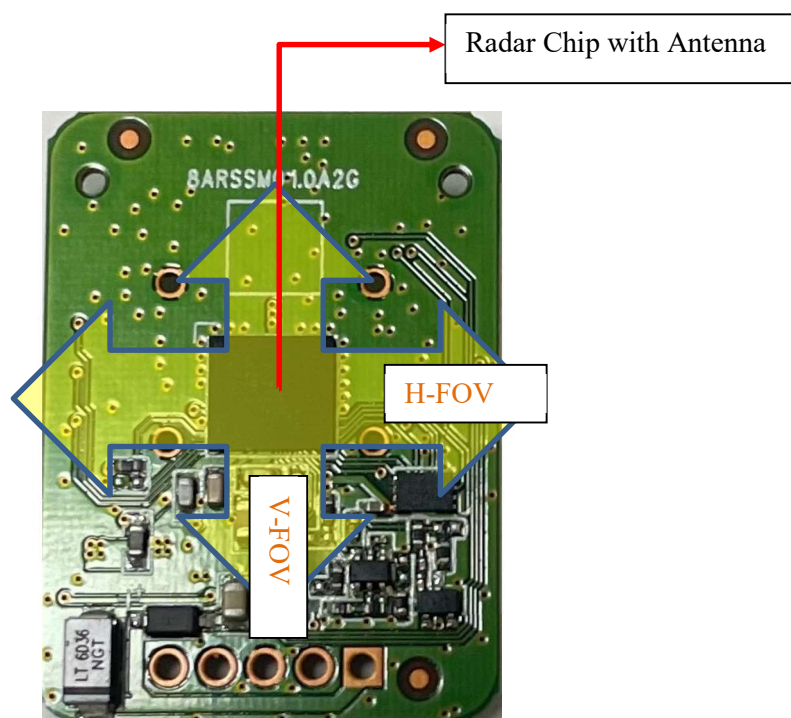
型號 Type : TK0020

77GHz Radar Sensor

版本：4.0

2022/6/1

1 Introduction



項目 Item	規格 Spec.
操作頻率 Frequency	76 GHz ~ 81 GHz (CW mode : 79 GHz)
發射功率 Transmit Power	6 dBm
天線波束寬度 Beam Width	H/V : 130° / 60°
偵測距離 Distance	Short range: 5 m Extended Range: 20m
雷達IC尺寸 IC Dimension 雷達模組尺寸Module Dimension	6.52x6.02x0.8mm(WxLxH) 24.32 x 32.88 x 10.5mm(WxLxH)
輸出 Output	UART (2.54mm pitch connector)
電源/功耗 Power Supply	12V/0.85W(MAX)

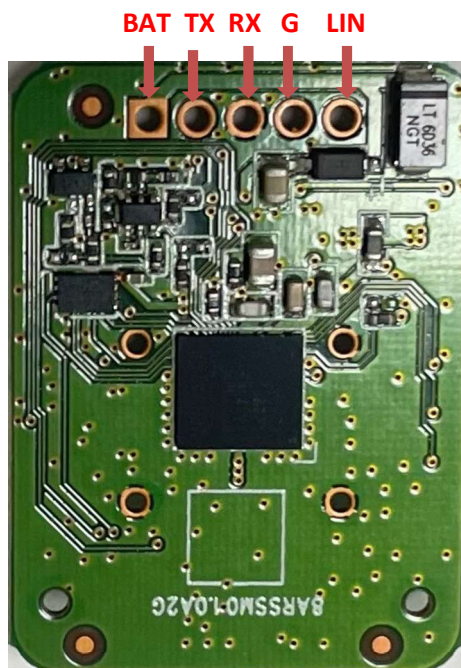


Fig 1 The Radar Sensor PCB Outline

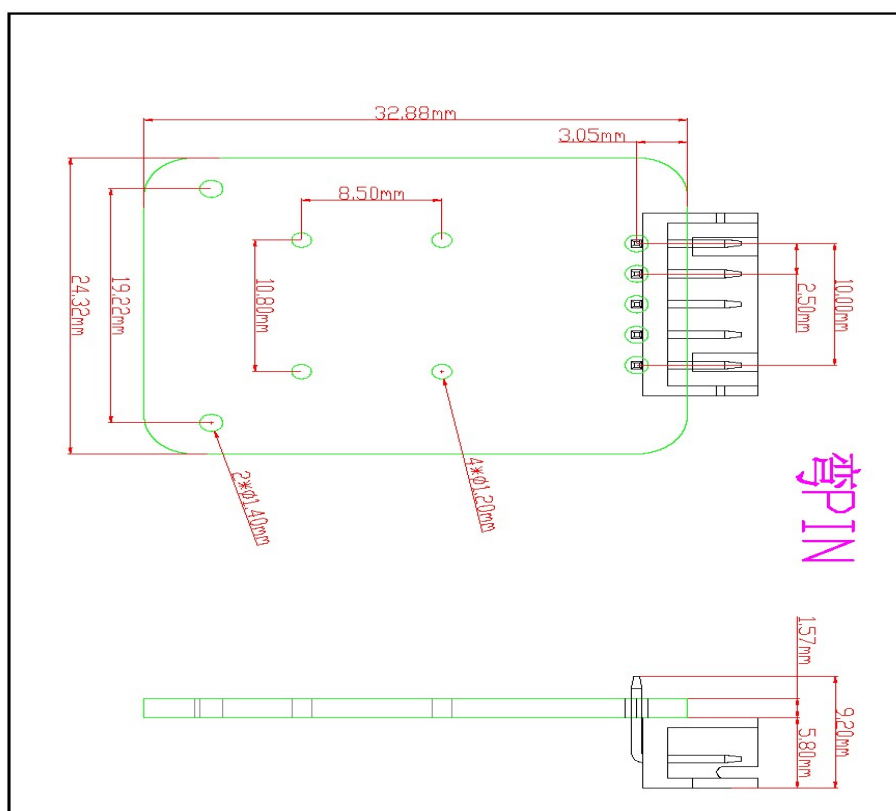


Fig 2 The Radar Sensor PCB Dimension



Electrical Specifications

All-in-One 79GHz Radar sensor enabling motion and distance detection

■ Features

- Easy to use, built-in motion/distance detection function enables only UART/OWI connection for settings & result acquisition.
- Wide FOV for detection. Detection area (75mm plastic pole) : 5m (ver. S) or more (ver. E), FOV-H/V: 130° / 60°

■ Applications

- Simple anti-collision protection for vehicles.
- Object detection, e.g. in confusing or unclear areas.
- Distance/velocity detection, e.g. altitude measurement.

■ System Block Diagram

■ Pin Description

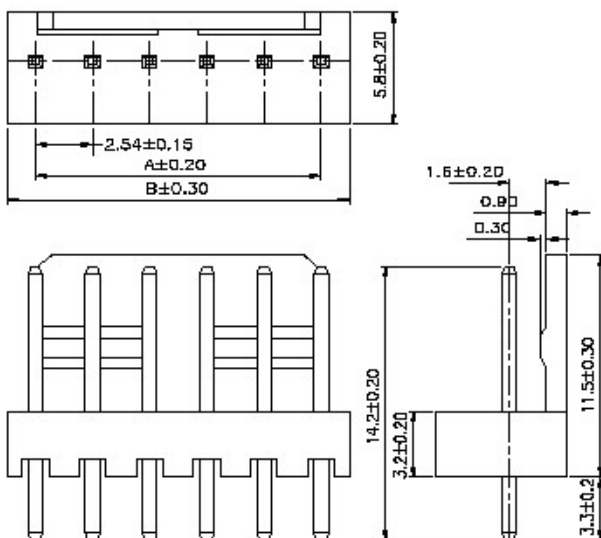
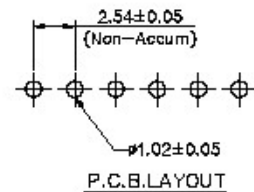
Pin name	Description
BAT	DC 12V input
TX	UART Transmission output, TTL 3.3V
RX	UART Received input, TTL 3.3V
G	Ground
LIN	Reserved for OWI interface (Optional)

CONNECTOR

Poles: 2-20
Material: Post: Brass, Tin/Plated
Base: Nylon 66, UL94V-2
COLOR : IVORY

SPECIFICATIONS

Voltage Rating: AC 250V
Current Rating: AC DC 3A
Withstand Voltage: AC 1000V/Min.
Insulation Resistance: 1000M Ω Min.
Temperature Range: -25°C ~ +85°C
Contact Resistance: Initial Value/10m Ω Max.
After Environmental Testing/20m Ω Max.



Poles	Part No.	Dimension in.(mm)	
		B	A
2	2542-WS-2	0.20(5.08)	0.10(2.54)
3	2542-WS-3	0.30(7.62)	0.20(5.08)
4	2542-WS-4	0.40(10.16)	0.30(7.62)
5	2542-WS-5	0.50(12.70)	0.40(10.16)
6	2542-WS-6	0.60(15.24)	0.50(12.70)
7	2542-WS-7	0.70(17.78)	0.60(15.24)
8	2542-WS-8	0.80(20.32)	0.70(17.78)
9	2542-WS-9	0.90(22.86)	0.80(20.32)
10	2542-WS-10	1.00(25.40)	0.90(22.86)
11	2542-WS-11	1.10(27.94)	1.00(25.40)
12	2542-WS-12	1.20(30.48)	1.10(27.94)
13	2542-WS-13	1.30(33.02)	1.20(30.48)
14	2542-WS-14	1.40(35.56)	1.30(33.02)
15	2542-WS-15	1.50(38.10)	1.40(35.56)
16	2542-WS-16	1.60(40.64)	1.50(38.10)
17	2542-WS-17	1.70(43.18)	1.60(40.64)
18	2542-WS-18	1.80(45.72)	1.70(43.18)
19	2542-WS-19	1.90(48.26)	1.80(45.72)
20	2542-WS-20	2.00(50.80)	1.90(48.26)

Fig 3 Connector drawing

2 Radar sensor installation

2.1 The radar sensor

Fig 4 shows the side view and transparent view of the radar sensor, where the mechanical design is very critical. The Dk/Df material of the plastic housing and the PCB position affect performance a lot. Especially the front side area, since it is in the antenna near field and the dimension/assembly affects the antenna pattern serious, the radome thickness = $\frac{\lambda}{2\sqrt{\epsilon_r}}$, the radome to radar sensor package space = $\frac{\lambda}{\sqrt{\epsilon_r}}$, the PCB size/Housing shape and the housing/ radome's Dk($\epsilon_r = 3$) should be well controlled and followed the reference design.

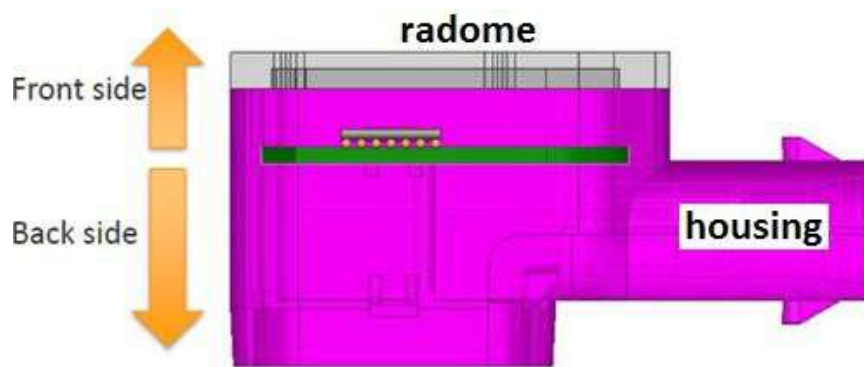


Fig 4 The side view of the radar sensor

The radome thickness is designed as $(\frac{\lambda}{2\sqrt{\epsilon_r}} \times N)$, where $N = 1, 2, 3 \dots$. Therefore, it controls the transmitted waves all in phase to obtain the minimum reflected signal through the impedance discontinuous of the radome. For instance, if the $\epsilon_r = 3$ and $N = 1$, the radome thickness is 1.09 mm.

Fig 5 shows the minimum reflection happened when the space between radome to top of Radar sensor package is λ , i.e. 3.79 mm.

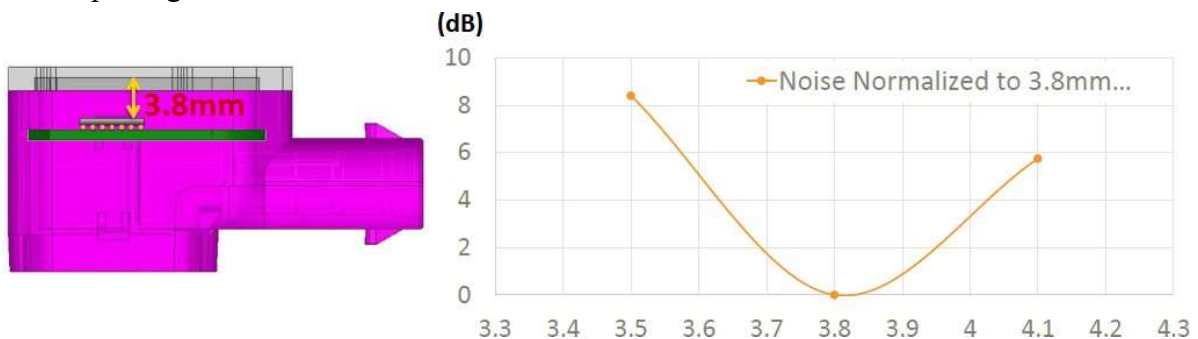


Fig 5 The assembly space control

3 Radar System Development Kit(SDK) Functionality Description

3.1 Electric Car

Fig 6 shows the application situations of electric cars. Radars can be installed in the front and side of cars, and detection area diameter is up to 3m. The functionality description as below:

- Presence detection (objects and people)
- Automatic adjustment of alert volume with distance

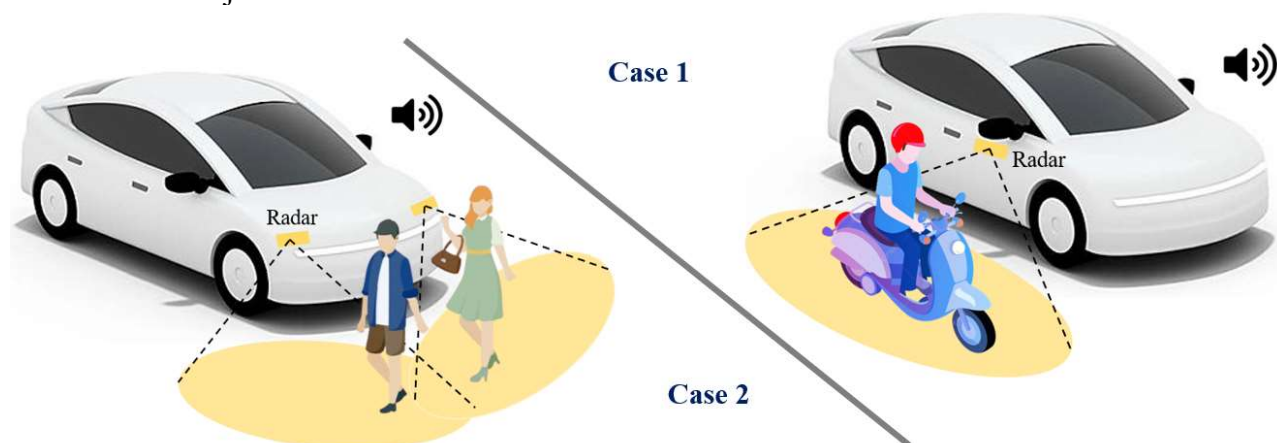


Fig 6 The scenario diagram of electric cars

3.2 Bicycle

Fig 7 shows the application situations of bicycles. Radars can be installed in the back of bicycles, and detection area diameter is up to 3m. The functionality description as below:

- Presence detection (objects and people)
- Display road conditions by using smart devices (mobile phones, helmets, glasses)

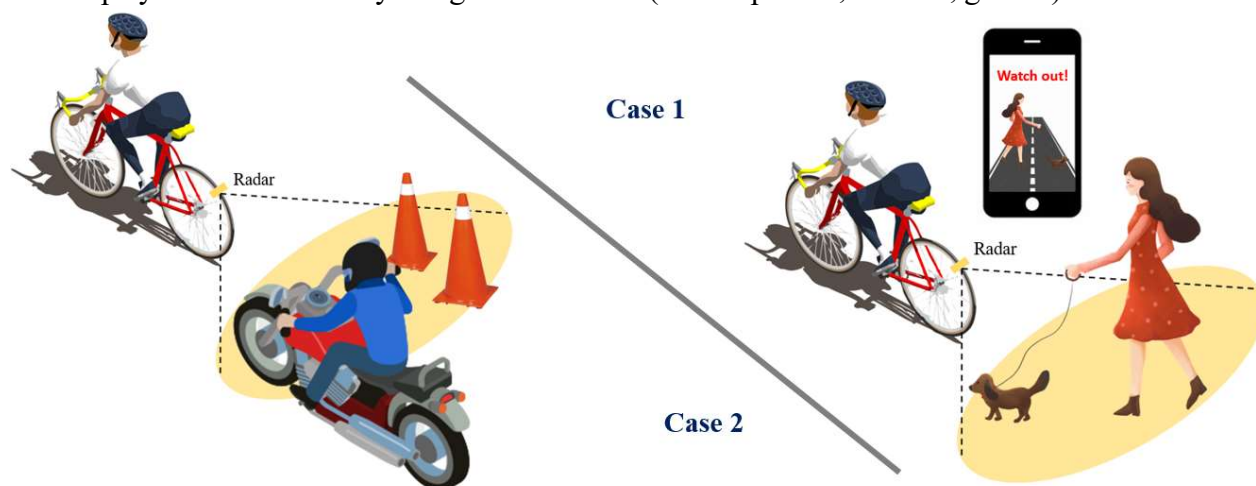


Fig 7 The scenario diagram of bicycles



注意事項 Notice

1.1 啟動時間 Start Time

由於本模組在初始上電開始工作時，需要對模組內部電路完全重定，並對環境雜訊進行充分評估，才能保證模組正常工作。因此模組初始上電工作時，需要開機穩定時間 $\geq 30s$ ，才能保證後續輸出參數的有效性。
Since the module starts to work when it is initially powered on, it is necessary to completely reset the internal circuit of the module and fully evaluate the environmental noise in order to ensure the module can work as expected. Therefore, when the module is initially powered on, it needs a setting time of $\geq 30s$ to ensure the validity of subsequent output parameters.

1.2 有效探測距離 Effective Detection Range

雷達模組的探測距離與目標 RCS、環境因素關聯較大，有效探測距離可能隨著環境及目標改變而變化，本模組暫時不具備測距功能，因此有效探測距離在一定範圍波動屬於正常現象。
The detection range of the radar module is greatly related to the target RCS and environmental factors. The effective detection range may change with changes in the environment and the target. This module does not have a ranging function so far, therefore it is normal for the effective detection range to fluctuate within a certain range.

1.3 雷達生物探測性能 Radar Biodetection Performance

由於人體生物特徵屬於超低頻、弱反射特徵信號，雷達處理中需要相對長時間累積處理，在累積過程中，可能諸多因素影響雷達參數，因此偶發性的探測失效是正常現象。
Since human biological characteristics are signals of ultra-low frequency and weak reflection characteristic, radar processing requires a relatively long cumulative processing. During the cumulative process, many factors may affect the radar parameters, so an occasional detection failure is normal.

1.4 電源 Power

雷達模組對電源品質的要求，高於常規低頻電路。在對模組供電時，要求電源無門限毛刺或紋波現象，且有效遮罩附件設備所帶來的電源雜訊。
雷達模組需良好的接地，由於其他電路帶來的地雜訊，也可能引起雷達模組性能下降甚至工作異常；最常見的是導致探測距離變近或誤報率增加。
為了保證模組內部 VCO 電路的正常工作，對本模組供電要求為+12V 供電，電源電壓紋波 $\leq 80mV$ 。外部電源必須提供足夠的電流輸出能力和瞬態回應能力。
The Radar module requires higher power quality than conventional low-frequency circuits. When supplying power to the module, it is required that the power supply has no threshold glitches or ripples, and effectively shields the power supply noise caused by the accessory equipment.
The radar module needs to be well grounded. Due to the ground noise brought by other circuits, the performance of the radar module may also be degraded or even work abnormally; the most common one is to shorten the detection distance or increase the false alarm rate.
In order to ensure the normal operation of the VCO circuit within the module, the power supply for this module is required to be +12V power supply, and the power supply voltage ripple should be less than or equal to 80mV. The external power supply must provide sufficient current output capability and transient response capability.

1.5 屏蔽 Shield Case

本產品已經過測試並符合 FCC part 15 Class B 法規。
模組本身無Shield case 設計，對應平台主機需具備有屏蔽功能以防干擾。客戶可以將模組設計成自己的終端產品。



This product has been tested and found to comply with FCC part15 Class B regulations.

The module itself has no Shield case design, and the corresponding platform host needs to have a shielding function to prevent interference. Customers could design the modules into their own terminal products.

1.6 常見問題 FAQs

干擾因素：**Interference factors：**

雷達屬於電磁波探測感測器，活動的非生命體會導致誤報。金屬，液體的運動，會導致誤判。通常，電風扇，貼近雷達的寵物，金屬窗簾的晃動都會引起誤判。雷達需要在安裝角度做規劃。

Radar is an electromagnetic wave detection sensor, and moving inanimate objects will cause false alarms. The movement of metals and liquids will lead to misjudgments. Usually, electric fans, pets close to the radar, and the shaking of metal curtains will cause misjudgments. Radar needs to be planned for the installation angle.

非干擾因素：**Non-interference factors**

雷達電磁波會穿透人體的衣物，窗簾，薄木板，玻璃。需要根據應用，決定雷達的安裝角度以及性能。

Radar electromagnetic waves can penetrate human clothing, curtains, veneer, and glass. It is necessary to determine the installation angle and performance of the radar according to the application.

半干擾因素：**Semi-interference factors:**

雷達判斷人體存在，不適合直接面對空調。空調內部電機會導致雷達誤判。

雷達產品不宜直接面對空調。或者同空調同一方向。

When the radar judges the presence of a human body, it is not suitable for directly facing the air conditioner. The motor inside the air conditioner will cause the misjudgment. Therefore, it is recommended that radar products should not face the air conditioner directly, or be in the same direction as the air conditioner.

FEDERAL COMMUNICATIONS COMMISSION INTERFERENCE STATEMENT

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.

CAUTION:

Any changes or modifications not expressly approved by the grantee of this device could void the user's authority to operate the equipment.



This module is intended for OEM integrator. The OEM integrator is responsible for the compliance to all the rules that apply to the product into which this certified RF module is integrated. Additional testing and certification may be necessary when multiple modules are used

USERS MANUAL OF THE END PRODUCT

In the users manual of the end product, the end user has to be informed to keep at least 20 cm separation with the antenna while this end product is installed and operated.

The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled Environment can be satisfied.

The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

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.

LABEL OF THE END PRODUCT

The final end product must be labeled in a visible area with the following " Contains FCC ID: 2A6LN-TK0020"

This radio transmitter FCC ID: 2A6LN-TK0020 has been approved by FCC 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.

Antenna List :

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	MTK	MT2706	Integrated Antenna	5 dBi

RF Exposure warning

This equipment must be installed and operated in accordance with provided instructions and the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. End-users and installers must be provide with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.