

# **XC6XXX Datasheet**

## ***Single Mode Bluetooth Low Energy SoC Preliminary Specification***

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*Disclaimer: Descriptions of specific implementations are for illustrative purpose only, actual hardware implementation may differ.*

## 1 General Description

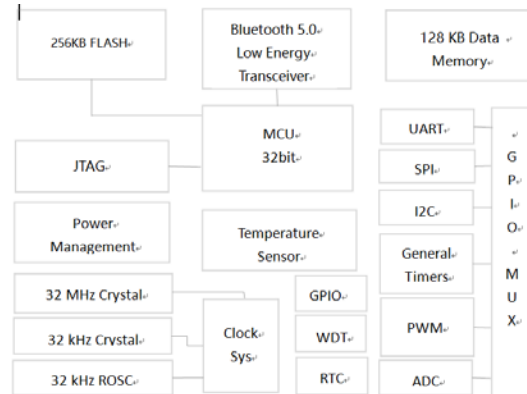
### 1.1 Overview

The XC6XXX chip is a very low power, high performance and highly integrated SoC with Bluetooth 5.0 BLE transceiver. It integrates a high-performance 2.4GHz RF transceiver, rich features baseband, 32 bit MCU and various peripheral IOs. It support 256KByte FLASH and 128KByte RAM to enable programmable protocol and profile to support customized applications.

The XC6XXX is manufactured using advanced 55nm CMOS low leakage process, which offers highest integration, lowest power consumption, lowest leakage current and reduced BOM cost while simplifying the overall system design. Rich peripherals include an 8 channel general purpose ADC, power-on-reset(POR), 3axis Q-decoder, UART/SPI/I2C and up to 19 GPIOs, which further reduce overall system cost and size.

The XC6XXX operates with a power range from 1.8 to 5.5V and very low power consumption in both Tx and Rx modes, enabling long lifetimes in battery-operated systems while maintaining excellent RF performance. The device can enter an ultra low power sleep mode in which the registers and retention memory content are retained while low power oscillator and sleep timer are ON. The QFN4x4\_32 (up to 19 GPIOs) Package is available

### 1.2 Block Diagram



### 1.3 Application

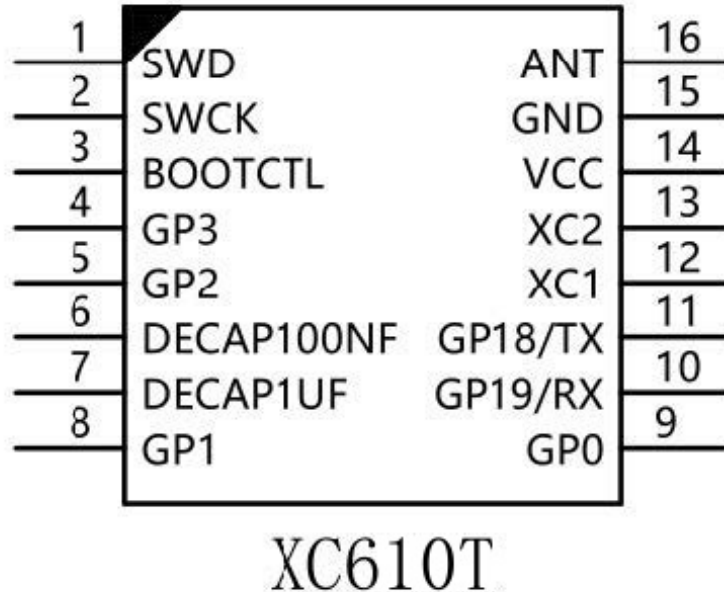
- HID Application
- Lighting Control
- Wireless Sensor Networks
- 3D Glassed
- Proximity and Find Me

### 1.4 Features

- Bluetooth 5.0 BLE RF SOC
- Operation voltage 1.8 V to 3.6 V
- Operation voltage 3.1 V to 5.5 V (ON-CHIP 5V LDO)
- -94 dBm Sensitivity@1Mbps
- Maximum 6 dBm output power
- Low Jitter 32K RC oscillator
- 32bit MCU Integrated
- 4-wires ext.-FLASH Interface
- 128 KByte data RAM
- I2Cs, SPI and 2路 UART Interface
- 10-channel 10-bit General ADC
- PWM(max 6, 2 wi inv)
- keyscan
- 3 axis Q-decoder
- Low Power Real Time Counter
- 1 uA in Sleep Mode
- 14 uA in Suspend Mode
- 16 mA Transceiver RX Active
- 15 mA Transceiver TX Active
- QFN 4x4 32-pin Package

## 2 Pin Information (XC6XXX SOP16)

The pin assignment for SSOP16 package is shown in picture below.



NO	Name	Description
1	SWD	SWI data/ General I/O/PWM5
2	SWCK	SWI clk/ General I/O/PWM4
3	BOOTCTL	Chip boot mode control/ General I/O/PWM0(PWM0 INVERTING can mux to pin1,2,4,5,8,9,10,11)
4	GPIO3	General I/O/ PWM
5	GPIO2	General I/O/12M clkoutput
6	DECAP1	The output of digital LDO, 100nF decap cap
7	DECAP2	The output of digital LDO, 1uF decap cap
8	GPIO1	General I/O/GADC input5/PWM3
9	GPIO0	General I/O/GADC input4/PWM2
10	GPIO19	General I/O/GADC input2/uart_rx
11	GPIO18	General I/O/GADC input3/uart_tx
12	XC1	The input of 32M crystal oscillator
13	XC2	The output of 32M crystal oscillator
14	AVDD	3V power supply
15	VSS	GND
16	ANT	The input of RF

Note: max 6 PWM, PIN1=PWM5, PIN2=PWM4, PIN8=PWM3, PIN9=PWM2. PWM0,1(wi INV) can mux to PIN3,4,5,10,11. Can be waked up by alarm & GPIO0~1(pin8,9) in deepsleep mode. Can be waked up by sleep timer & any GPIO in sleep mode.

### 3 Electrical Specifications

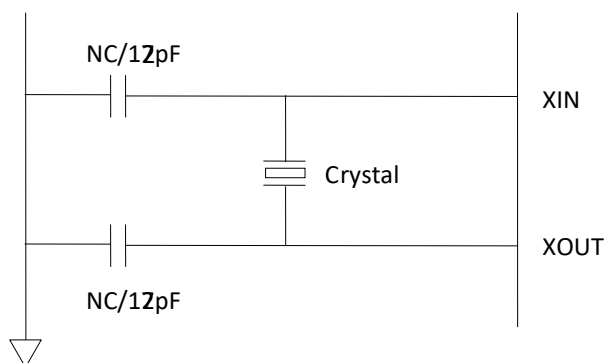
Name	Parameter(condition)	Min	Typ	Max	Unit	Com ment
<b>Power Supplies</b>						
HVIN	Voltage Input, typically 4.7uF decouple cap	3.1	5	5.5	V	(1)
HVOUT	Voltage Output, typically 1uF decouple cap, maximum 50mA load capability	2.4	2.9	3.3	V	
IQ_HV	Quiescent Current of high voltage LDO		600		nA	
AVDD	Voltage Input, typically 1uF decouple cap	1.7		3.6	V	(2)
AVDD	Voltage Input, typically 1uF decouple cap	1.7		3.6	V	
AVDD	Voltage Input	1.7		3.6	V	
VDDIO	Voltage Input	1.7		3.6	V	(3)
VDD	Voltage Output, typically 100nF decouple cap	1.1	1.2	1.3	V	
VDD	Voltage Output, typically 100nF decouple cap,	1.1	1.2	1.3	V	
<b>Temperature</b>						
TEMP	Temperature	-40		+125	°C	
<b>Digital Input Pin</b>						
VIH	High Level	VIO-0.3		VIO+0.3	V	
VIL	Low Level	VSS		VSS+0.3	V	
<b>Digital Output Pin</b>						
VOH	High Level	VIO-0.3		VIO+0.3	V	
VOL	Low Level	VSS		VSS+0.3	V	
<b>Current Consumption</b>						
IVDD	Deep sleep mode (LPO, POR, alarm, I/O interrupts on), <b>can be waked up by alarm &amp; GPIO0~4</b>		1		uA	(4)
IVDD	Suspend mode (LPO, 128kB retention RAM, POR, sleep timer, I/O interrupts on), <b>can be waked up by sleep timer &amp; any GPIO</b>		14		uA	
IVDD	RX mode, BLE , 100% on(wo DCDC @3V)		16		mA	(5)
IVDD	TX mode, BLE mode, 100% on(wo DCDC @3V)		15		mA	(6)
IVDD	Average Current, 500ms sniff, hold connection			32	uA	
<b>Normal RF Condition</b>						
FOP	Operating Frequency	2400		2480	Mhz	
FXTAL	Crystal Frequency	16	32			(7)
<b>Transmitter Characteristics</b>						
PRF	RF output power	-24	0	-1	dBm	
CD	Carrier Drift Rate		5		kHz/50us	
PRF1	Out of band emission 2Mhz(GFSK)		-40		dBm	

PRF2	Out of band emission 3Mhz(GFSK)		-48		dBm	
BW	20dB bandwidth		0.9		Mhz	
PRF1	Out of band emission 2Mhz ( $\pi/4$ DQPSK & 8PSK)		-30	-20		
PRF2	Out of band emission 3Mhz ( $\pi/4$ DQPSK & 8PSK)		-42	-40		
Receiver Characteristics						
<b>BT4.0 (BLE)</b>						
SEN	High Gain mode, Sensitivity @0.1%		-94		dBm	
MaxIn	Maximum Input Power		5		dBm	
C/ICO	Co-channel C/I, Basic Rate, GFSK		7		dB	
C/I1ST	ACS C/I 1Mhz, Basic Rate, GFSK		5.5	7	dB	
C/I2ND	ACS C/I 2Mhz, Basic Rate, GFSK		-36	-34	dB	
C/I3RD	ACS C/I 3Mhz, Basic Rate, GFSK		-43		dB	
C/I1STI	ACS C/I image channel, Basic Rate, GFSK		-34		dB	
C/I2NDI	C/I 1 MHz adjacent to image channel, Basic Rate, GFSK		-28		dB	

- (1) HVIN & HVOUT are input & output of a high voltage LDO which is integrated, input voltage range from 3.1~5.5V, and maximum load 10apability up to 50mA. Typically used in Li\_BAT(3.0~4.2V) or USB\_Power(4.5~5.5V) applications. If input voltage is lower than 3.6V, HVIN & HVOUT should be left unconnected and should be powered by AVDD,VDDIO directly.
- (2) If RF output power should be larger than -4dBm, AVDD should be larger than 2.4V..
- (3) VDDIO should always be powered on in all working cycles..
- (4) By default, 128kB retention memory is on in retention mode, 64/96/128kB retention memory is surported.
- (5) Result based on standard gain mode.
- (6) Result based on 0dBm Pout.
- (7) 16M, 32M crystal supported, 32M by default.

## 4 Crystal Oscillator

The crystal oscillator requires a crystal with an accuracy of  $\pm 40$ ppm as defined by the Bluetooth specification. Without external load capacitors are required to work with the crystal oscillator. The selection of the load capacitors is crystal dependent. The recommended crystal specification shows below.



Recommended Oscillator Configuration – 12 pF Load Crystal

Reference Crystal Electrical Specifications

Name	Parameter (condition)	Min	Typ	Max	Unit	Comment
Frequency			32		Mhz	
Oscillation mode			Fundamental			
Frequency tolerance	@25°C		± 10	± 40	ppm	
Tolerance stability over temp	@0°C to @70°C		± 10	± 40	ppm	
Load capacitance			12		pF	
Operating temperature range		-40		+125	degree	
Drive level			100		uW	

## 5 Power consumption

W/O DC-DC	Parameter	Average Current	Unit
Sleep	/	1	uA
Sniff	500ms interval	32	uA
Discoverable	ADV interval:640ms Scan interval: 1280ms Scan window:11.25ms	137	uA

## 6 Bluetooth Security

### 6.1 Pairing

- Pin Code

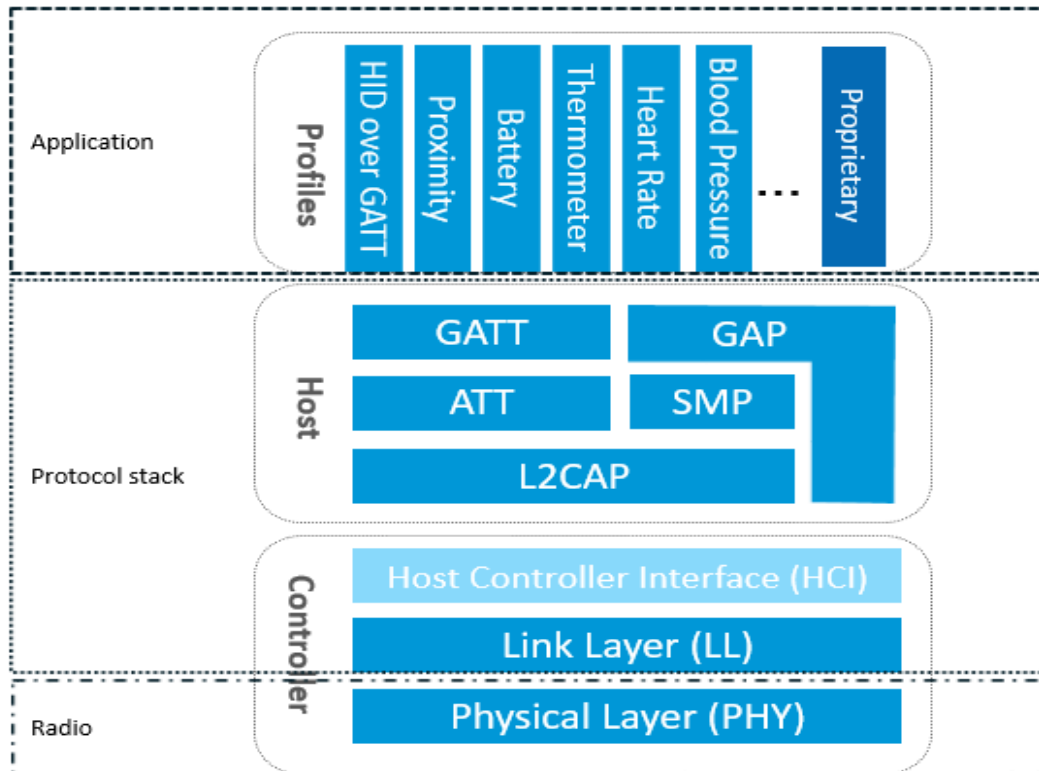
### 6.2 Security Simple Pairing

- Just Work(No input)
- Keyboard
- DisplayYesNo

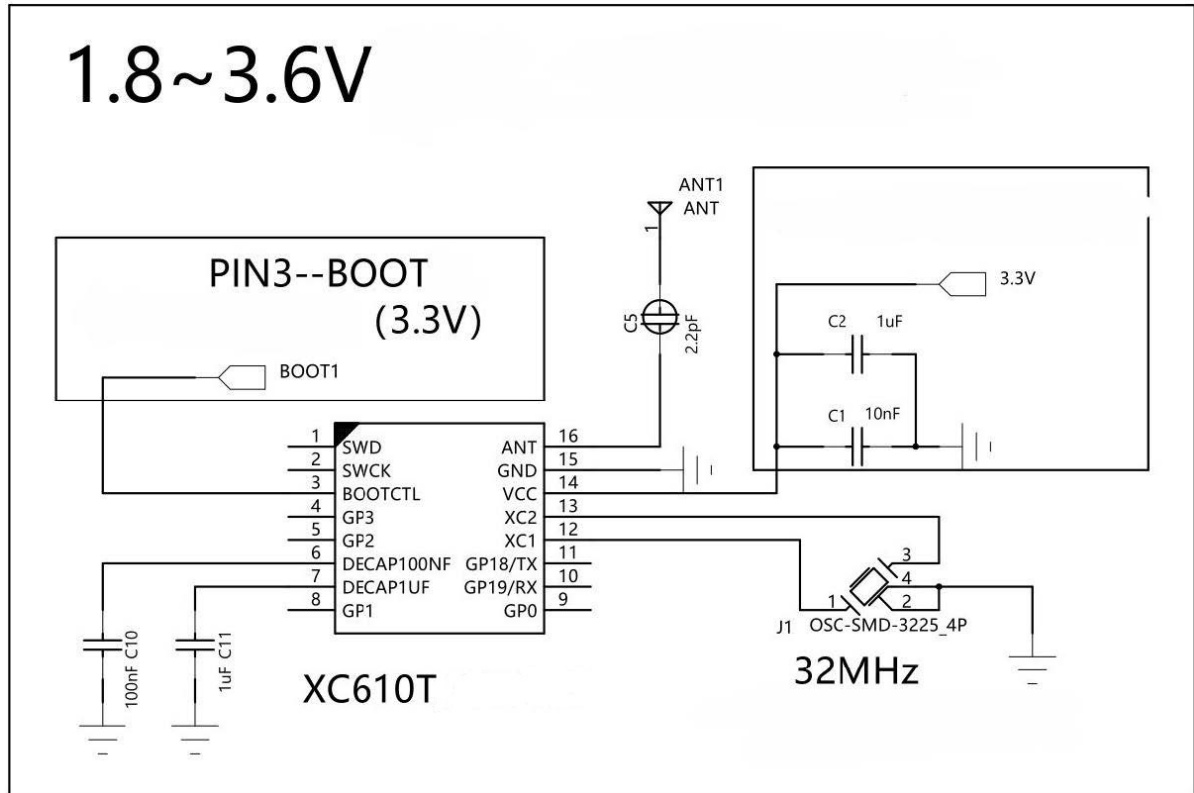
## 7 Mfi

Support Apple’s Mfi authentication and iAP1/iAP2 protocols.

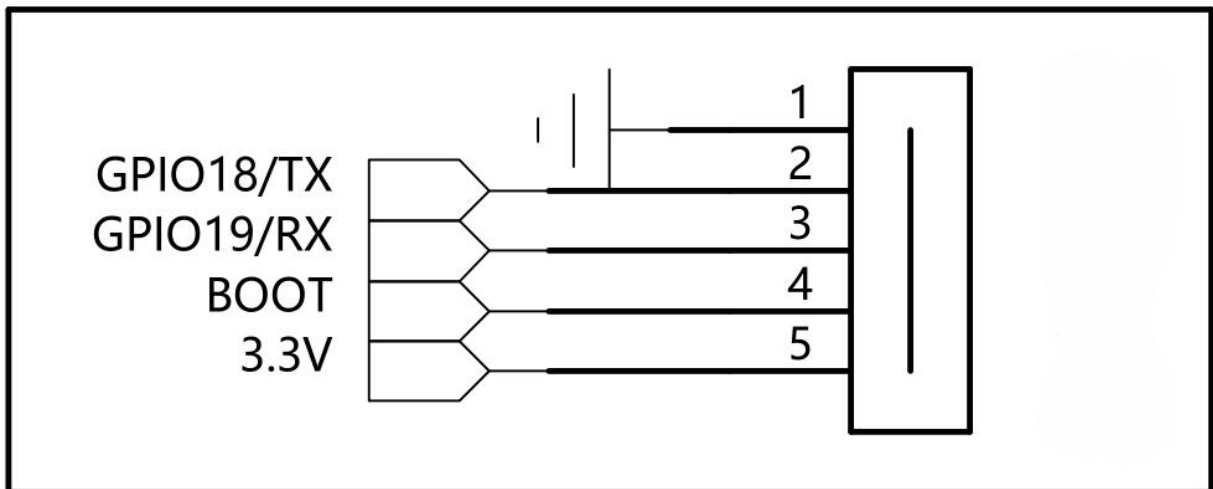
## 8 Bluetooth Stack



## 10 Application Schematic(XC6XXX SSOP16/SOP16)

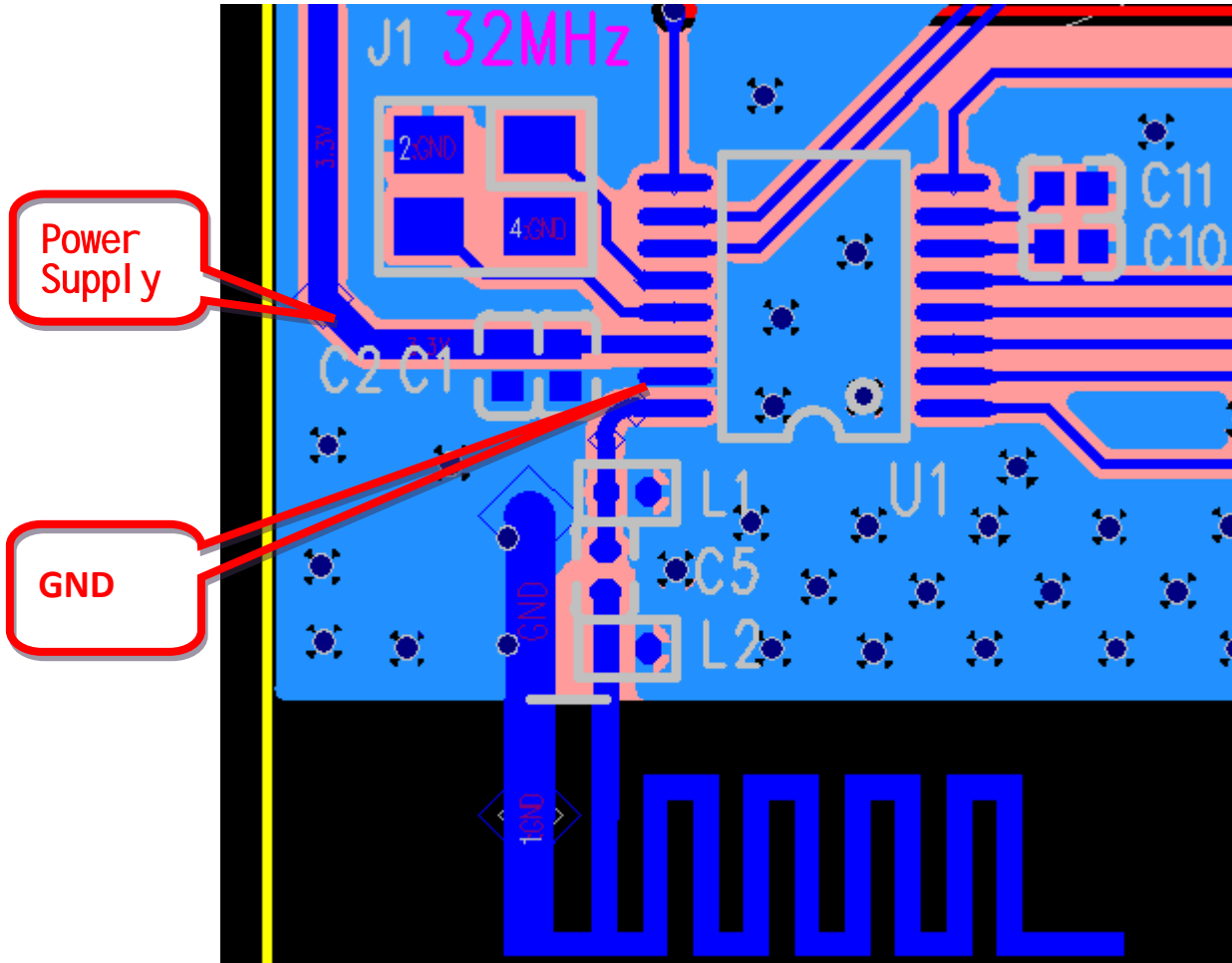


**Programing port:**





Note : The power supply and grounding pad should be as large as possible (as shown in the following figure), and the power supply and grounding trace should be as wide as possible. If the power supply and grounding trace cannot be widened at the same time, the grounding trace should be widened first.



## 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.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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 important announcement

## Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

### 2.2 List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C has been investigated. It is applicable to the modular transmitter

### 2.3 Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

### 2.4 Limited module procedures

Not applicable

### 2.5 Trace antenna designs

Not applicable

### 2.6 RF exposure considerations

The device has been evaluated to meet general RF exposure requirement. The device can be used installed and operated with minimum distance 0mm between the radiator and your body.

### 2.7 Antennas

This radio transmitter **2AFWP-XC6XXX** has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Model	Type	Peak Gain(dBi)
2402-2480MHz BT	PCB antenna	0 dBi

### 2.8 Label and compliance information

The final end product must be labeled in a visible area with the following "Contains FCC ID: 2AFWP-XC6XXX".

### 2.9 Information on test modes and additional testing requirements

Host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

**2.10 Additional testing, Part 15 Subpart B disclaimer**

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.

## ISED Statement

-English: This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) This device may not cause interference, and (2) This device must accept any interference, including interference that may cause undesired operation of the device. The digital apparatus complies with Canadian CAN ICES-3 (B)/NMB-3(B).

-French: Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

L'appareil numérique est conforme à CAN ICES-3 (B) / NMB-3 (B).

This radio transmitter (ISED certification number: 21116-XC6XXX) has been approved by Industry Canada to operate with the antenna types listed with the maximum permissible gain 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.

Le présent émetteur radio (ISED certification number: 21116-XC6XXX) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

## Radiation Exposure Statement

*The device has been evaluated to meet general RF exposure requirement. The device can be used installed and operated with minimum distance 0mm between the radiator and your body.*

## Déclaration d'exposition aux radiations

L'appareil a été évalué pour répondre aux exigences générales d'exposition aux RF. Cet équipement

doit être installé et utilisé avec une distance minimale de 0 mm entre le radiateur et votre corps.

### **This device is intended only for OEM integrators under the following condition:**

The transmitter module may not be co-located with any other transmitter or antenna.

As long as the condition above is 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:

Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 1 condition 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.

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the Canada authorization is no longer considered valid and the ISED 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 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' ISED 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**

The final end product must be labeled in a visible area with the following: Contains IC: 21116-XC6XXX.

Plaque signalétique du produit final

Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: Contient des IC: 21116-XC6XXX.

## **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.