LA02301 Module User Manual

1. Introduction

1.1 Overview

The LA02301 is a Leedarson-developed universal Wi-Fi and Bluetooth SMART (BLE) combo module. It uses the Espressif Inc. ESP32-U4WDH System in Package that integrates an embedded 4MB flash.

Figure 1.1. LA02301 Module

The LA02301 module is designed for a variety of IOT products such as Power Drivers, Sensors, Plugs, Lighting, Switches, etc.

Plug Switch Sensor Down Light Power Driver

Figure 1.2. Product Application

1.2 Key features

- Embedded Xtensa® 32-bit LX6 microprocessor, with clock up to 160MHz
- Data Memory: 520KB internal SRAM and 448KB internal ROM,4MB Flash
- Power supply voltage: 3.0V～3.6V
- Operating temperature: -40～105 Deg-C
- Frequency of crystal oscillator: 40MHz\32.768KHz
- Operating frequency: 2400～2483.5MHz
- Support WIFI 802.11b/g/n up to 150Mbps
  Compliant with Bluetooth LE specifications
  Wi-Fi 802.11 b/g/n and BLE can't transmission simultaneous
- Interface:
  - Vertical Mount (Plug-In)
    - 5 PWMs (GPIOs)
    - 2 GPIOs
    - 1 Available UART
    - 1 ADC
    - 1 Dedicated Triac Dimmer Detection Pin
  - Horizontal (SMD)

- 5 PWMs (GPIOs)
- 4 GPIOs
- 1 Available UART
- 1 ADC
- 1 Dedicated Triac Dimmer Detection Pin

1.3 Block Diagram

The LA02301 module is a highly-integrated, high-performance system with all the hardware components needed to enable 2.4GHz wireless connectivity and support Wi-Fi and BLE protocols.

Built around the ESP32-U4WDH Wireless SoC, the LA02301 includes a built-in PCB trace antenna, supply decoupling and filtering components, a 40MHz reference crystal, a 32.768KHz crystal, and an RF shield. A general block diagram of the module is shown as below.

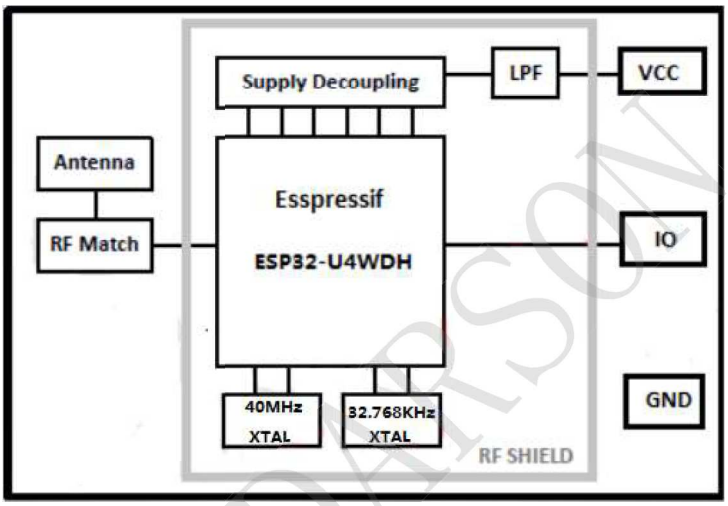


Figure 1.3. LA02301 Block Diagram

1.4 Power Supply

The LA02301 requires a single nominal supply level of 3.3V. All the necessary decoupling and filtering components are included in the module. The supply voltage noise tolerance of the module should be less than 100mVpp and the supply current should be more than 500mA.

1.5 Module Certification Information

Table 1.1. Module Certification Information

Module	Certification Type	Certification Information
LA02301	FCC	2AB2Q-LA02301
	IC	10256A-LA02301

2. Electrical characteristics

2.1 Absolute maximum ratings

Stresses above those listed below may cause permanent damage to the device. This is a stress rating only and functional operation of the devices at those or any conditions above those indicated in the operation listing of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Table 2.1. Absolute maximum ratings

Symbol	Parameter	Min.	Max.	Units
VCC	Power Supply	-0.3	+3.6	V
GND	Ground of Module		0	V
VIO	Voltage of Module IO	-0.3	+3.6	V
Storage temperature		-40	+125	Deg-C
MSL	Moisture Sensitivity Level	3		
ESD HBM	Human Body Mode		±1.5	KV
ESD CDM	Charge Device Mode		±500	V

2.2 General Operating Conditions

This table specifies the general operating temperature range and supply voltage range for all supplies, the minimum and maximum values of all other tables are specified over this operating range, unless otherwise noted.

Table 2.2. General Operating Conditions

Symbol	Parameter	Min.	Typ.	Max.	Units
VCC	Supply voltage, normal	3.0	3.3	3.6	V
TA	Operation temperature[1]	-40	25	105	Deg-C
ICC peak	Supply Current Peak[2]	-	400	450	mA
ICC average	Supply Current average[2]	-	150		mA

Note:
1. It refers in particular to the surface temperature on 40MHz reference crystal of the LA02301 when it is working, if the surface temperature of 40MHz reference crystal is above 105 Deg-C, the RF parameters will be worse.
2. It is measured when the module runs the RF test Firmware @ 10% duty cycle and 25 Deg-C ambient temperature.

2.3 DC Specifications

Unless otherwise indicated, typical conditions are: VCC=3.3V.TA=25 Deg-C。

Table 2.3. DC Specifications

Symbol	Parameter(condition)	Min.	Typ.	Max.	Units
VIH	Input high voltage	0.75xVCC	-	VCC	V

VIL	Input low voltage	GND	-	0.25xVCC	V
VOH	Output high voltage	0.8xVCC	-	-	V
VOL	Output low voltage	-	-	0.1xVCC	V
IOH	Output high current	-	40	-	mA
IOL	Output low current	-	28	-	mA
RPU	Pull-up resistance	-	45	-	kΩ
RPD	Pull-down resistance	-	45	-	kΩ
ITX 802.11b peak	Transmit 11b DSSS 1Mbps Pout=+19dBm	-	382		mA
ITX 802.11b average	Transmit 11b DSSS 1Mbps Pout=+19dBm	-	148	-	mA
ITX 802.11b peak	Transmit 11b DSSS 11Mbps Pout=+19dBm	-	378	-	mA
ITX 802.11b average	Transmit 11b DSSS 11Mbps Pout=+19dBm	-	146	-	mA
ITX 802.11g peak	Transmit 11g OFDM 6Mbps Pout=+17dBm	-	332	-	mA
ITX 802.11g average	Transmit 11g OFDM 6Mbps Pout=+17dBm	-	139	-	mA
ITX 802.11g peak	Transmit 11g OFDM 54Mbps Pout=+13 dBm	-	272	-	mA
ITX 802.11g average	Transmit 11g OFDM 54Mbps Pout=+13 dBm	-	130	-	mA
ITX 802.11n peak	Transmit 11n OFDM MCS0 Pout=+17.5 dBm	-	328	-	mA
ITX 802.11n average	Transmit 11n OFDM MCS0 Pout=+17.5 dBm	-	140	-	mA
ITX 802.11n peak	Transmit 11n OFDM MCS7 Pout=+12 dBm	-	256	-	mA
ITX 802.11n average	Transmit 11n OFDM MCS7 Pout=+12 dBm	-	128	-	mA
IRX 802.11b/g/n	Rx average current	-	108	-	mA
ITX BLE	Pout=8 dBm	-	236	-	mA
ITX BLE average	Pout=8 dBm	-	184	-	mA
IRX BLE	Rx average current	-	115	-	mA
Note: The current is measured with the module running the RF test Firmware @ 10% duty cycle					

2.4 RF Specifications

Unless otherwise indicated, typical conditions are: VCC=3.3V TA=25 Deg-C。

Table 2.4. Wi-Fi Specifications

Symbol	Description	Min.	Typ.	Max.	Units
Fop	Operating frequencies	2412	-	2484	MHz
PRF11b	11b DSSS 1Mbps output power	-	19	-	dBm
	11b DSSS 11Mbps output power	-	19	-	dBm
PRF11g	11g OFDM 6Mbps output power	-	17	-	dBm
	11g OFDM 54Mbps output power	-	13	-	dBm
PRF11n	11n OFDM HT20 MCS0 output power	-	17	-	dBm
	11n OFDM HT20 MCS7 output power	-	12	-	dBm
	11n OFDM HT40 MCS0 output power	-	16	-	dBm
	11n OFDM HT40 MCS7 output power	-	11	-	dBm

PSENS11b	Receiver sensitivity @11b DSSS 1Mbps	-	-95	-	dBm
	Maximum receiving level @11b DSSS 1Mbps	-	5	-	dBm
	Receiver sensitivity @11b DSSS 11Mbps	-	-86	-	dBm
	Maximum receiving level @11b DSSS 11Mbps	-	5	-	dBm
PSENS11g	Receiver sensitivity @11g OFDM 6Mbps	-	-91	-	dBm
	Maximum receiving level @11g OFDM 6Mbps	-	0	-	dBm
	Receiver sensitivity @11g OFDM 54Mbps	-	-73	-	dBm
	Maximum receiving level @11g OFDM 54Mbps	-	-8	-	dBm
PSENS11n	Receiver sensitivity @11n OFDM HT20 MCS0	-	-90	-	dBm
	Maximum receiving level @11n OFDM HT20 MCS0	-	0	-	dBm
	Receiver sensitivity @11n OFDM HT20 MCS7	-	-71	-	dBm
	Maximum receiving level @11n OFDM HT20 MCS7	-	-8	-	dBm
	Receiver sensitivity @11n OFDM HT40 MCS0	-	-88	-	dBm
	Maximum receiving level @11n OFDM HT40 MCS0	-	0	-	dBm
	Receiver sensitivity @11n OFDM HT40 MCS7	-	-68	-	dBm
	Maximum receiving level @11n OFDM HT40 MCS7	-	-8	-	dBm

Table 2.5. BLE Specifications

Symbol	Description	Min.	Typ.	Max.	Units
Fop	Operating frequencies	2402	-	2480	MHz
PRFLE	LE Output Power	-	8	-	dBm
	LE Out Power Control range	-	24	-	dB
	LE Out Power Control step	-	3	-	dB
PSENSLE	LE Receiver sensitivity	-	-90	-	dBm
	LE Maximum receiving level	-	0	-	dBm

3. Pin Definition

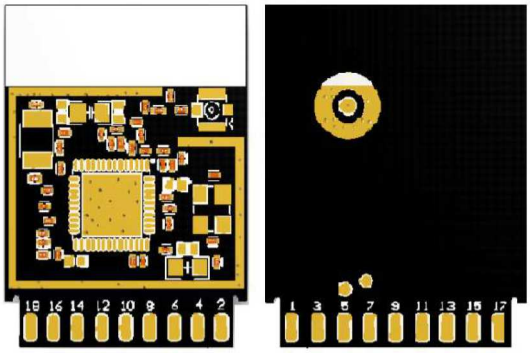


Figure 3.1. Vertical Mount (Plug-In)

Table 3.1. Plug-In pin definition

Module No	Pin of IC	Pin Definition	Pin Function Description	Direction
1	1,3,4,19,26,37,43,46	VCC	Power Supply	--
2	40_U0RXD	RX0	FACTORY_UART_RX data in (RX)	I
3	49	GND	ground of module	--
4	41_U0TXD	TX0	FACTORY_UART_TX data out (TX)	O
5	17_MTMS	PWM1/IO0	PWM channel 1 output / GPIO 0	I/O
6	14_GPIO25	RX1	HOST_UART_TX (data in to ESP32) , need an external pull up	I
7	15_GPIO26	PWM2/IO1	PWM channel 2 output / GPIO 1	I/O
8	16_GPIO27	TX1	HOST_UART_RX (data out from ESP32) , need an external pull up	O
9	20_MTCK	PWM3/IO2	PWM channel 3 output / GPIO 2	I/O
10	23_GPIO0	IO5	GPIO 5 and BM_SEL for UART boot; Default: weak pull up	I/O
11	21_MTDO	PWM4/IO3	PWM Channel 4 output / GPIO 3; Default: weak pull up	I/O
12	36_GPIO23	IO6	GPIO6	I/O
13	24_GPIO4	PWM5/IO4	PWM Channel 5 output / GPIO 4; Default: weak pull down	I/O
14	9_CHIP_PU	/Reset	Reset, Low Active	I
15	10_VDET_1	FACTORY_MODE_N	FACTORY MODE enable, low active	I
16	11_VDET_2	AC_TRIAC_DETECT[1]	Triac Dimmer Detect 0 - VCC (0 - 3.3V)	I
17	5_SENSOR_VP	ADC	Analog-to-Digital Converter	I
18	49	GND	ground of module	--

Note:

1. AC_TRIAC_DETECT is used to detect if a device is powered through a triac dimmer and to determine the dimmer settings. The circuit that feeds this signal should give a scaled DC voltage representation of the average AC voltage integrated over approximately 200ms. If the triac is set to chop the AC waveform 50%, the AC_TRIAC_DETECT signal should be at 50% of VCC.If the triac dimmer is turned up completely, the AC waveform will be minimally chopped and the AC_TRIAC_DETECT signal should be at 100% of VCC.

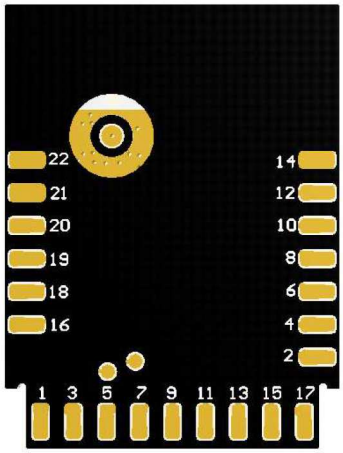


Figure 3.2. Horizontal (SMD)

Table 3.2. SMD pin definition

Module No	Pin of IC	Pin Definition	Pin Function Description	Direction
1	1,3,4,19,26,37,43, 46	VCC	Power Supply	--
2	9_CHIP_PU	/Reset	Reset, low active	I
3	GND	GND	ground of module	--
4	23_GPIO0	IO5	GPIO 5 and BM_SEL for UART boot; Default: weak pull up	I/O
5	17_MTMS	PWM1/IO0	PWM channel 1 output / GPIO 0	I/O
6	35_GPIO18	IO7	GPIO7	I/O
7	15_GPIO26	PWM2/IO1	PWM channel 2 output / GPIO 1	I/O
8	16_GPIO27	TX1	HOST_UART_RX (data out from ESP32), need an external pull up	O
9	20_MTCK	PWM3/IO2	PWM channel 3 output / GPIO 2	I/O
10	14_GPIO25	RX1	HOST_UART_TX (data in to ESP32), need an external pull up	I
11	21_MTDO	PWM4/IO3	PWM channel 4 output / GPIO 3 Default: weak pull up	I/O
12	11_VDET_2	AC_TRIAC_DETECT[1]	Triac Dimmer Detect 0 - VCC (0 - 3.3V)	I
13	24_GPIO4	PWM5/IO4	PWM Channel 5 output / GPIO 4; Default: weak pull down	I/O
14	GND	GND	ground of module	--
15	10_VDET_1	FACTORY_MODE_N	FACTORY MODE enable, Low Active	I

16	41_U0TXD	TX0	FACTORY_UART_TX data out (TX)	O
17	5_SENSOR_VP	ADC	Analog-to-Digital Converter	I
18	40_U0RXD	RX0	FACTORY_UART_RX data in (RX)	I
19	42_GPIO21	IO8	GPIO8	I/O
20	36_GPIO23	IO6	GPIO6	I/O
21	GND	GND	ground of module	--
22	GND	GND	ground of module	--

Note:

1. AC_TRIAC_DETECT is used to detect if a device is powered through a triac dimmer and to determine the dimmer settings. The circuit that feeds this signal should give a scaled DC voltage representation of the average AC voltage integrated over approximately 200ms. If the triac is set to chop the AC waveform 50%, the AC_TRIAC_DETECT signal should be at 50% of VCC.If the triac dimmer is turned up completely, the AC waveform will be minimally chopped and the AC_TRIAC_DETECT signal should be at 100% of VCC.

4. Package Specifications

4.1 Dimension

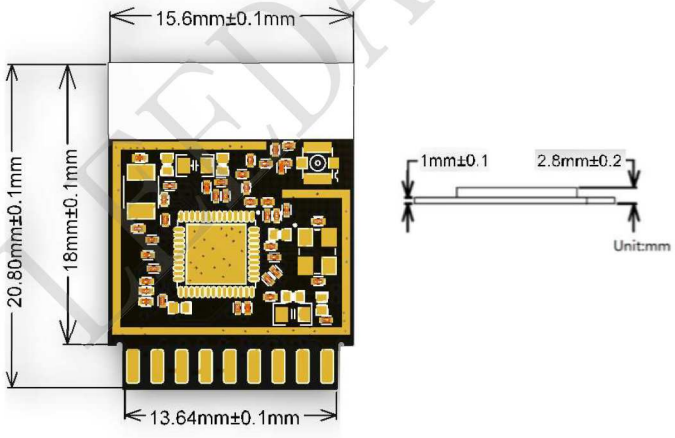
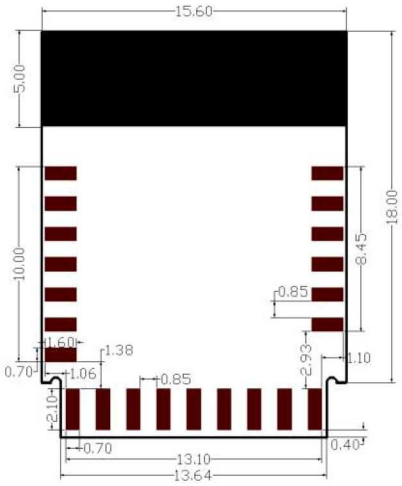


Figure 4.1. Module Dimensions (Unit: mm)

4.2 PCB Pads Information



Perspective view

Figure 4.2. Pad Size (Unit: mm)

Note:

1. Shaded part is Antenna Trace.
2. The sizes of pads on the component side are the same to the opposite side.

4.3 Plug-in Land pattern example

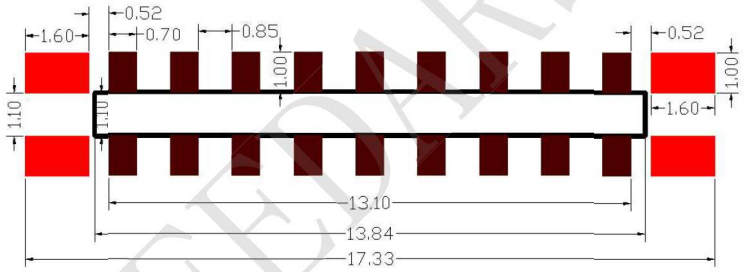


Figure 4.3. Plug-in PCB Land Pattern (Unit: mm)

Note:

Please see below lay-out:

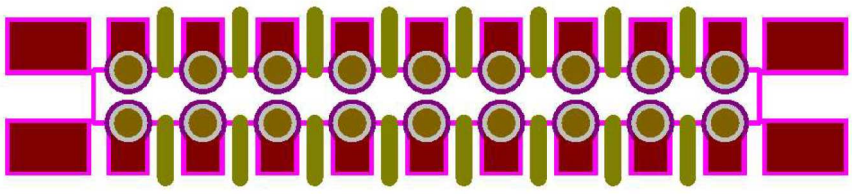


Figure 4.4. Plug-in PCB Land Pattern (Unit: mm)

4.4 SMD Land pattern example

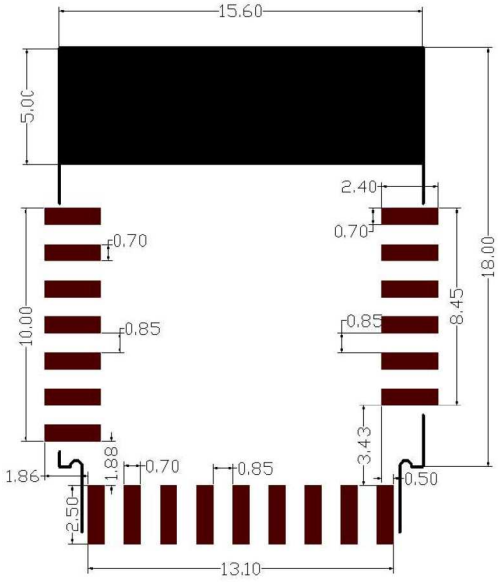


Figure 4.5. SMD PCB Land Pattern (Unit: mm)

Note:

Shaded part is Antenna Trace.

5. Soldering Recommendations

Refer to below information for SMT temperature settings. Note that the number of times of reflow should not above 2 times.

Table 5.1. SMT temperature setting

Set points(℃)										
Zone	1	2	3	4	5	6	7	8	9	10
Top	140	180	190	180	180	190	245	260	265	210
Bottom	140	180	190	180	180	190	245	260	265	210
Conveyor Speed（cm/min）： 130.0										

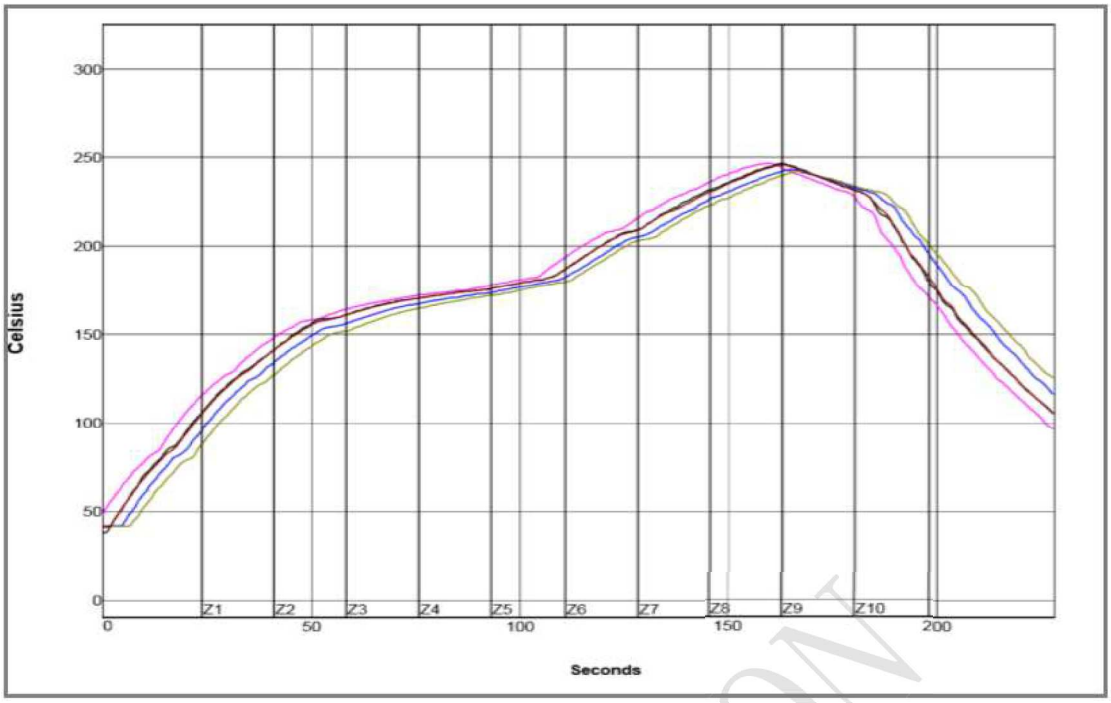


Figure 5.1. SMT temperature setting curve

6. Declaration

FCC Statement

1. 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.
(2) This device must accept any interference received, including interference that may cause undesired operation.

15.21

Note: The grantee is not responsible for any changes or modifications not expressly approved by the party responsible for compliance. Such modifications could void the user's authority to operate the equipment.

15.105(b)

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

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 of 20 cm between the radiator and your body.

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two

conditions:
1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique 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;
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Host labeling requirement:"Contains transmitter module
FCC ID：2AB2Q-LA02301" and IC: 10256A-LA02301