User Manual

V.1.0.0

Model: TLM991

FCC Application Use

History

Date	Version	Revision Description	Writer
2017/5/03	V.1.0.0		LiuKen

FCC Application Use

Table of Contents

1. TLM991 1
   - 1.1. Features 1
   - 1.2. Applications 1
   - 1.3. Characteristics 2
   - 1.4. PCB 3
   - 1.5. Pin Assignment 4
   - 1.6. Module Dimension and Recommend Footprint 6
2. Software Setup 8

FCC Application Use

1. TLM991

TLM991 is based on LoRa technology of Semtech, it is a multi-channel high performance transmitter/receiver designed to simultaneously receive several LoRa packets using random spreading factors on random channels. The device is mainly intended for the ISM (Industrial, Scientific, and Medical) frequency bands at 902~928 MHz. The module integrated many RF functions and PA to make the maximum output power up to +27dBm and signal coverage can reach up 10km.

1.1. Features

- LoRa Modem
- Frequency bands :902~928MHz
- Programmable output power up to +27dBm for all supported frequencies，the communication distance is above 10km in sight of sight.
- Programmable baseband modulator with LoRa.
- High sensitivity: down to -142.5dBm
- Small dimension: 63.08mm×30mm×11.45 mm

1.2. Applications

- Automated meter Reading
- Home and Building automation
- Wireless Alarm and security systems
- Industrial monitoring and control
- Long Range irrigation systems
- Machine to Machine(M2M)
- Internet of Things(IoT)

FCC Application Use

1.3. Characteristics

Test operating conditions：Ta=25℃ · VCC=3.3V if nothing else stated.

Parameter	Typical	Condition/Note
Operating supply voltage	DC IN 5V DC IN 3.3V	
Frequency	902~928MHz	
Frequency accuracy	±10KHz	
Modulation	LoRa	Programmable
Transmit power	+27dBm	Output power programmable
Data rate	0.244 ~ 4.55Kbps(LoRa)	Programmable
Spurious emissions and harmonics	< -30dBm	TX power @+27dBm
Communication distance	10Km	0.244Kbps Baud data rata, BW=125K Output power = +27dBm.
Antenna impedance	50ohm	
Operating temperature	-40 ~ +85 ℃	
Storage temperature	50 ~ +125℃	
Dimension	63.08mm×30mm×11.45 mm	

Accessories

1. N Jack to IPEX Φ1.37 300mm
2. N Jack to N Jack cable 300mm
3. Antenna

Antenna Type：

(1)

Manufacturer: ARISTOTLE ENTERPRISES INC.

Model: RFA-WAVE-C55-U-B70-1

Type:dipole

Gain: 2.0 dBi

(2)

Manufacturer: GSC-TECH

Model: OMA-G01

Type: dipole

Gain: 8.0 dBi

Note：

1. The module transmission data rate will affect Transmission distance, the higher the data rate, the closer the distance, and the lower the receiving sensitivity.
2. The supply voltage to the module will affect TX power, in the operating supply voltage range, the lower the voltage to get the lower the TX power.
3. The antenna will strongly affect the communication distance, please select matched antenna and connect it correctly.

The module mount will affect the communication distance.

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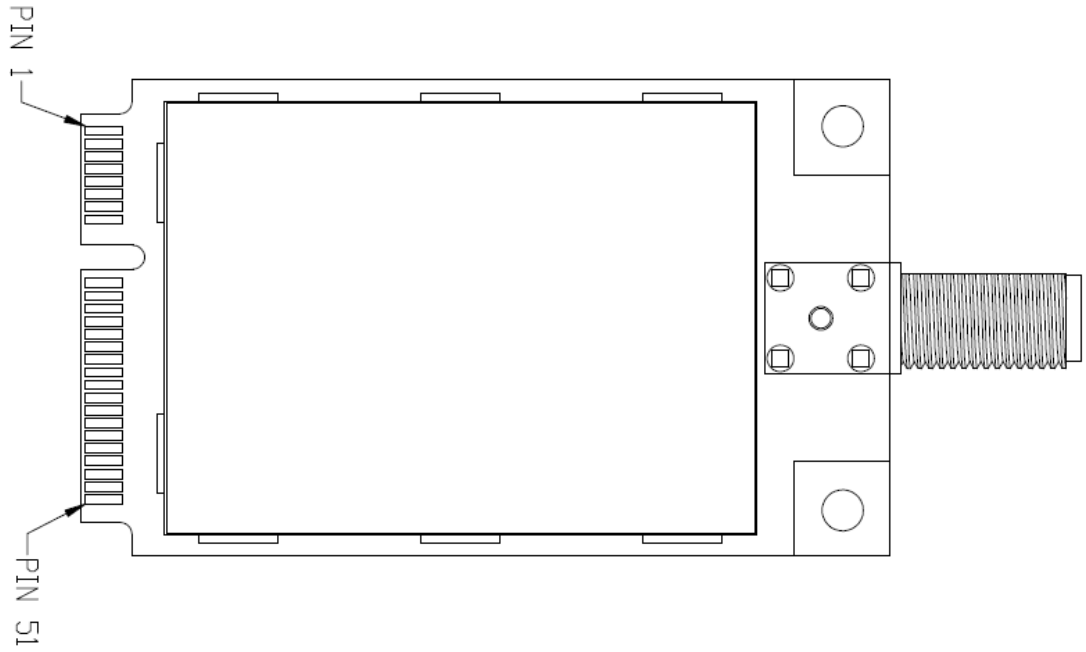
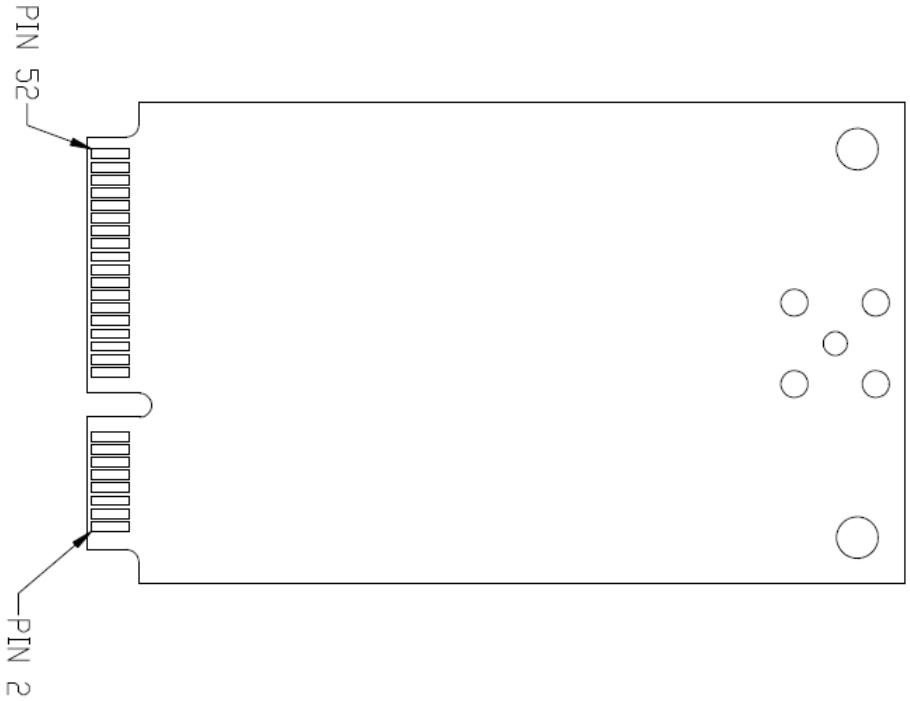
1.4. PCB





1.5. Pin Assignment

PIN	Accessory port signal name	Signal Direction	Original PCIe Signal(4)	PCIe Direction	Accessory Port Signal Description
1	DC_NINT2	O	WAKE#	O	Interrupt Output from Accessory Card(4)
2	3.3V	S	+3.3V	S	3.3V (from base board)
3	DC-NINT1	O	COEX1	I/O	Interrupt Output from Accessory Card(4)
4	GND	R	GND	R	Ground
5	SDIO_CMD/SPI_MOSI	I	COEX2	I	SDIO Command or SPI Master Out Slave In (1,2,3,4)
6	TBD1	I	+1.5V	S	Uncommitted (Connected to processor GPIO pin)
7	SDIO_D0/SPI_MISO	I/O or O	CLKREQ#	O	SDIO Data 0 or SPI Master In Slave Out(1,2,3,4)
8	TBD2	I	UIM_PWR	O	Uncommitted (Connected to processor GPIO pin)
9	GND	R	GND	R	Ground
10	TBD3	O	UIM_DATA	I/O	Uncommitted (Connected to processor GPIO pin)
11	SDIO_D3/SPI_NCS0	I/O or I	REFCLK-	O	SDIO Data 3 or SPI Chip Select 0 (1,2,3,4)
12	SDIO_D2/SPI_NCS2	I/O or I	COEX2	I/O	SDIO Data 2 or SPI Chip Select 2 (1,2,3,4)
13	SDIO_CLK/SPI_CLK	I	REFCLK+	I	SDIO Data2 or SPI clock (1,2,3,4)
14	GPIO1	I/O	UIM_RESET	O	General Purpose I/O 1
15	GND	R	GND	R	Ground
16	SDIO_D1/SPI_NCS1	I/O or I	COEX1	I/O	SDIO Data 1 or SPI Chip Select1 (1,2,3,4)
17	TBD5	R	UIM_C8	U	Uncommitted (Connected to processor GPIO pin)
18	GND	R	GND	R	Ground
19	TDB6	R	UIM_C4	U	Uncommitted (Connected to processor GPIO pin)
20	SPI_NCS3/W_DIASABLE#	I/O	W_DISABLE#	I	SPI Chip Select 3 or W_DISABLE# depending on build option (1,2,3,4)
21	GND	R	GND	R	GND
22	NDC_RESET	I	PERST#	I	Low Active Reset
23	5V	R	PERn0	I/O	5V (From Base Board) (4)
24	3.3V	S	+3.3V	S	3.3V (From Base Board)(4)
25	5V	R	PERp0	I/O	5V (From Base Board)(4)
26	GND	R	GND	R	Ground
27	EEPROM A1	R	GND	R	ID EEPROM Address Bit 1(4)
28	GPS_PPS	I	+1.5V	S	GPS Pulse Per Second (4)
29	EEPROM A2	R	GND	R	ID EEPROM Address Bit 2(4)
30	I2CCLK	I/O	SMB_CLK	I/O	I2C Clock

FCC Application

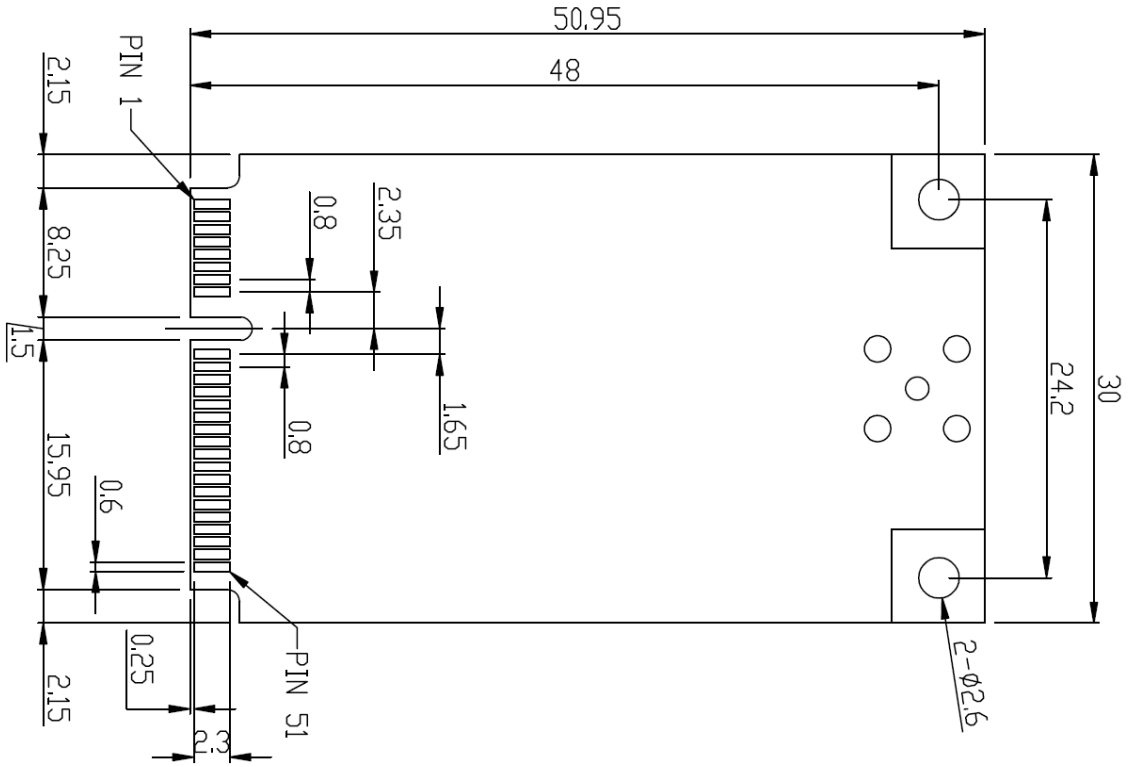
31	GPIO3/DIBP	I/O	PETn0	I/O	General Purpose I/O 3 or Soft modem DIBP depending on build option(4)
32	I2CDA	I/O	SMB_DATA	I/O	I2C Data
33	GPIO4/DIBM	I/O	PETp0	I/O	General Purpose I/O 4 or Soft modem DIBM depending on build option(4)
34	GND	R	GND	R	Ground
35	GND	R	GND	R	Ground
36	USB_D-	I/O	USB_D-	I/O	USB Negative Data
37	GND	R	GND	R	Ground
38	USB_D+	I/O	USB_D+	I/O	USB Positive Data
39	3.3V	S	+3.3V	S	3.3V (From Base Board)
40	GND		GND		Ground
41	3.3V	S	+3.3V	S	3.3V(From Base Board)
42	GPIO2/LED_WWAN#	I/O	LED_WWAN#	O	General Purpose I/O or LED_WWAN# depending on build option
43	GND	R	GND	R	Ground
44	DCD	O	LEDWLAN#	O	UART DCD
45	CTS	O	Reserved	U	UART CTS
46	RI	O	LED_WPAN	O	UART RI
47	RTS	I	Reserved	U	UART RTS
48	DTR	I	+1.5V	S	UART DTR
49	RXD	O	Reserved	U	UART Receive data
50	GND	R	GND	R	Ground
51	TXD	I	Reserved	U	UART transmit data
52	3.3V	S	+3.3V	S	3.3V (from Base Board)

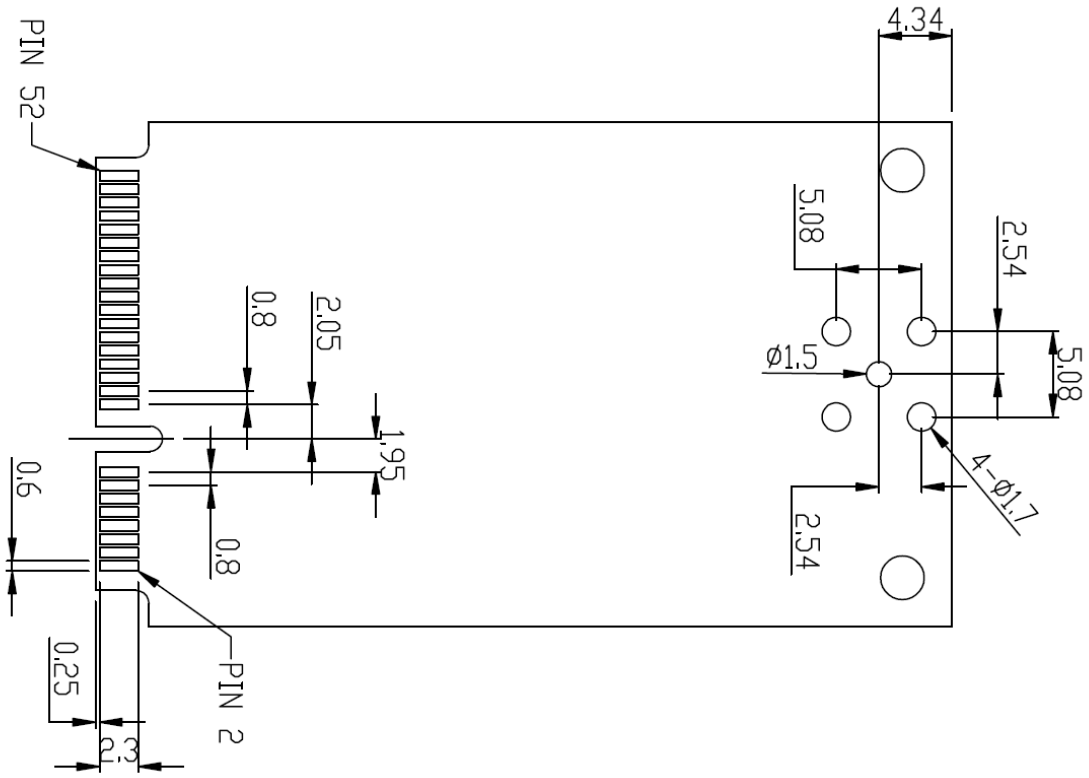
Note:

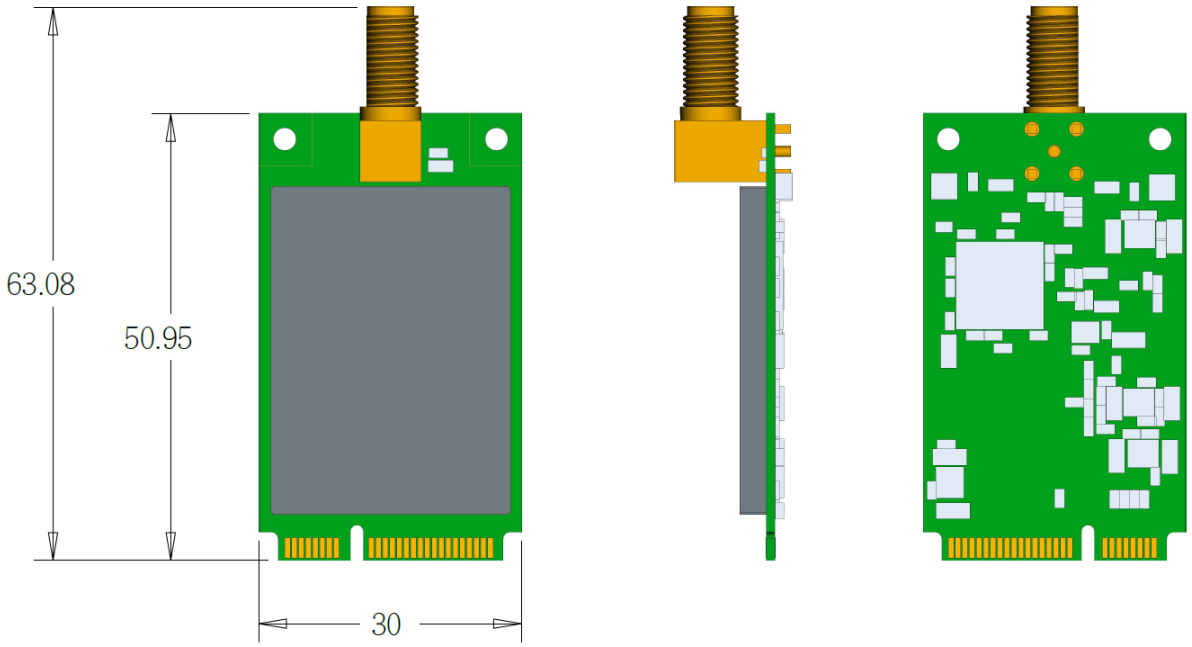
1. SPI device on daughter card can be slave only.
2. SDIO interface may be on only 1 port of Base Board, depending on Base Board design.
3. If a Base Board support an SDIO interface, it must be able to be shared with an SPI Master interface.
4. The Accessory Port interface is not 100% compatible with the PCIe standard. The PCIe channel has been replaced with an SPI/SDIO interface, and additional voltage are being supplied.
5. Signal Direction definitions
   - O = Output
   - I = Input
   - I/O = Bidirectional
   - S = Power Source
   - R = Power Return
   - U = Undefined

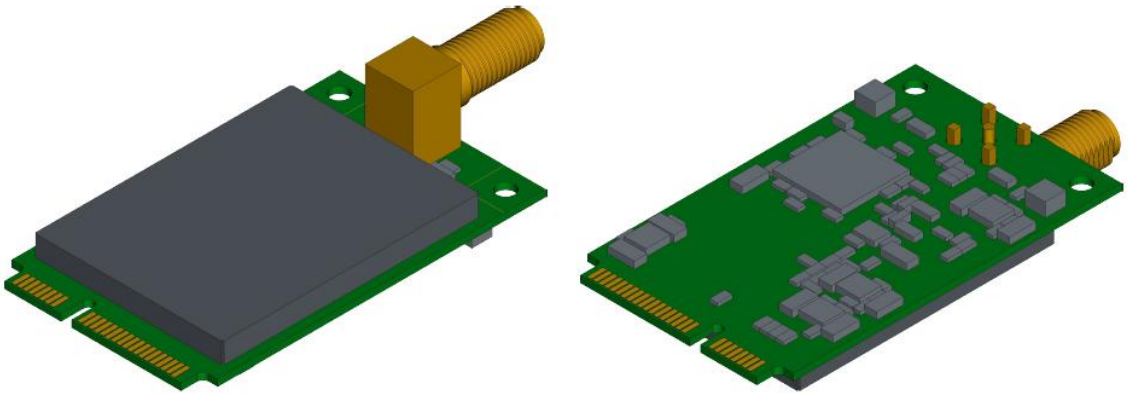
FCC Application Use

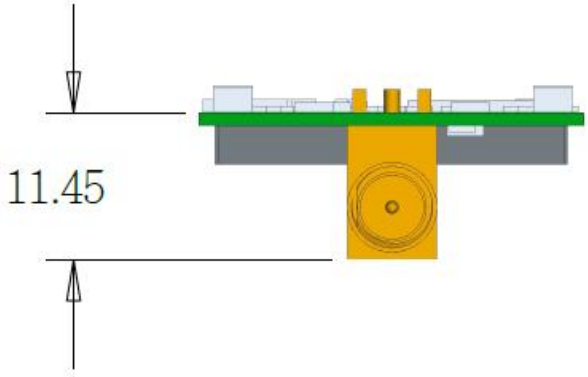
1.6. Module Dimension and Recommend Footprint






63.08
50.95
30




11.45

2. Software Setup

TLM991 can only be used on Linux-based operating system. For driving TLM991 on Linux, the source code of TLM991 can be download from https://github.com/Lora-net/lora_gateway. Please use the following command to download the source code. Note that, due to FDTI's SPI interface being removed, the source code above v3.2.0, including v3.2.0, would not work with TLM991.

```
# git clone https://github.com/Lora-net/lora_gateway.git
# cd lora_gateway
# git checkout -b v3.1.0
```

Before building the source code, some modification is needed for driving TLM991:

1. Editing **libloragw/library.cfg**

```
CFG_SPI= ftdi
```

2. Editing **libloragw/src/loragw_spi.ftdi.c**, changing following

```
a = PinHigh(mpsse, GPIOL1);
b = PinLow(mpsse, GPIOL1);
```

to

```
a = PinLow(mpsse, GPIOL1);
b = PinHigh(mpsse, GPIOL1);
```

The last step is installed **libftdi** and related header files on host operating system. Then, you can proceed to compile the source code.

More detail can also be founded on https://github.com/mirakonta/lora_gateway/wiki.

FCC Application Use

Notice:

Any changes or modifications not expressly approved by the party responsible for compliance could void your 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.

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 complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body.

For a host using a certified modular with a standard fixed label, if (1) the module's FCC ID is not visible when installed in the host, or (2) if the host is marketed so that end users do not have straightforward commonly used methods for access to remove the module so that the FCC ID of the module is visible; then an additional permanent label referring to the enclosed module: "Contains Transmitter Module FCC ID: 2AKIBTLM991 " or "Contains FCC ID: 2AKIBTLM991 " must be used. The host OEM user manual must also contain clear instructions on how end users can find and/or access the module and the FCC ID.