

Lierda KB32 Series SX1302 LoRa Gateway Module Hardware Design Manual

Version: Rev3.0

Date: 25/03/18

Status: Released

Legal Statement

If you receive this document from Lierda Science & Technology Group Co., Ltd. (hereinafter referred to as "Lierda"), it means that you have agreed to the following terms. If you do not agree to the following terms, please stop using this document.

This document is the property of Lierda Science & Technology Group Co., Ltd. All rights not expressly granted in this document are reserved. The document contains proprietary information of Lierda. Without prior written permission from Lierda, no entity or individual may copy, transmit, distribute, use, or disclose this document and any images, tables, data, and other information contained in this document.

This product meets the design requirements for environmental protection and personal safety. The storage, use, and disposal of the product should be carried out in accordance with the product manual, relevant contracts, or relevant laws and regulations.

The company reserves the right to modify and improve the products described in this manual without prior notice; and also reserves the right to revise or withdraw this manual at any time.

Revision History

Document Version	Change date	Reviser	Reviewer	Change content
Rev2.0	24-03-14	WFY	LXY	Modify module pins, Modify "reset" description, Modify specification parameters, etc.
Rev2.1	24-12-11	CSZ	LXY	Modify dimension annotations
Rev3.0	25-01-16	CSZ	LXY	Add the power configuration table parameters for modules LSD4WN-2K830NE0 and LSD4WNC-2K930NE0 (Chapter 4.4).

Lierda
利 尔 达

Safety Instructions

Users are responsible for complying with the relevant regulations on wireless communication modules and devices in other countries, as well as specific environmental regulations for use. By following the safety principles below, personal safety can be ensured and help protect products and work environments from potential damage. Our company is not liable for any losses resulting from customers' failure to comply with these regulations.



Safety first on the road! Do not use handheld mobile devices while driving unless they have hands-free capabilities. Please pull over before making a call!



Please turn off your mobile devices before boarding. The wireless function of mobile devices is prohibited on the plane to prevent interference with the aircraft communication system. Ignoring this prompt may compromise flight safety and even violate the law.



When in a hospital or healthcare facility, pay attention to whether there are restrictions on the use of mobile terminal devices. RF interference can cause medical devices to malfunction, so it may be necessary to turn off mobile terminal devices.



Mobile terminal devices do not guarantee effective connection in all circumstances, such as when there is no phone credit or the SIM card is invalid. When you encounter the above situation in an emergency, remember to use emergency calls, and ensure that your device is turned on and in an area with sufficient signal strength.



Your mobile terminal device will receive and emit radio frequency signals when it is powered on, which may cause radio frequency interference when it is close to a TV, radio, computer, or other electronic devices.



Please keep mobile terminal devices away from flammable gases. When you are near gas stations, oil depots, chemical plants, or explosive operation sites, please turn off the mobile terminal devices. Operating electronic devices in any potentially explosive hazardous area poses a safety risk.

Module selection for application

Serial number	Module model	Feature symbol	Support frequency band	Dimensions (mm)	Module introduction
1	LSD4WN-2K730NE0	-	470~510MHz	50.95*31*3.3	
2	LSD4WN-2K830NE0	-	863~870MHz	50.95*31*3.3	
3	LSD4WNC-2K930NE0	-	902~928MHz	50.95*31*3.3	

Lierda
利 尔 达

Content

Legal Statement	2
Revision History	3
Safety Instructions	4
Module selection for application	5
Content	6
1 Introduction	7
2 Product Overview	8
2.1 Key Features	9
2.2 Function block diagram	10
2.3 Pinout diagram	10
2.4 Pin Description Table	11
3 Job characteristics	14
3.1 Power	14
3.2 Reset	14
3.3 SPI interface	14
3.4 Antenna interface	16
4 Specifications	17
4.1 Absolute maximum limit	17
4.2 Job parameters	17
4.3 Start the process	17
4.4 Transmit Power Configuration	19
5 Mechanical dimensions	20
6 Packaging information	21
7 Warning	22

1 Introduction

This document mainly provides a detailed description of the hardware parameters, pin functions, interface function definitions, mechanical dimensions, production process requirements, etc. of the KB32 series SX1302 LoRa gateway module. Users can quickly familiarize themselves with the hardware design related content of the product by reading this document.



2 Product Overview



Module appearance schematic

The KB32 series SX1302 LoRa gateway module is a Mini PCIE interface gateway module designed based on Semtech's new generation baseband processing chip SX1302. The module features long transmission distance, strong anti-interference ability, large network capacity, high cost performance, etc. It uses a serial SPI interface to interact with user devices, providing users with convenient and fast LoRa network access and LoRa wireless services. It is suitable for a variety of applications: Internet of Things low-power applications (IoT), automatic meter reading, smart cities, industrial automation, smart homes, etc.

2.1 Key Features

Main parameters	Gateway module model		
	LSD4WN-2K730NE0	LSD4WN-2K830NE 0	LSD4WNC-2K930NE 0
Operating voltage	4V~5.5V, typical value 5V		
Operating temperature	-40~+85℃		
Storage temperature	-40~+85℃		
Working frequency band	TX:470~510MHz RX:470~480MHz	TX:863~870MHz RX:863~870MHz	TX:902~928MHz RX:902~928MHz
Frequency offset	±2.4ppm		
Sensitivity to receive	Avg.-127dBm @475.3MHz _SF7_BW125	Avg.-124dBm @_868.1MHz _SF7_BW125	Avg.-126dBm @923.3MHz _SF7_BW125
Transmission power	MAX. 22dBm @475.3MHz	MAX. 27dBm @868.1MHz	MAX. 27dBm @923.3MHz
Launch current	Avg.200mA@5V_22dBm	Avg.520mA@5V_27dBm	
Receive current	Avg.87mA@5V	Avg.38mA@5V	
Communication interface	1*SPI、1*I2C		

Note

Unless otherwise specified, the above test environments are all under +25 ° C conditions.

2.2 Function block diagram

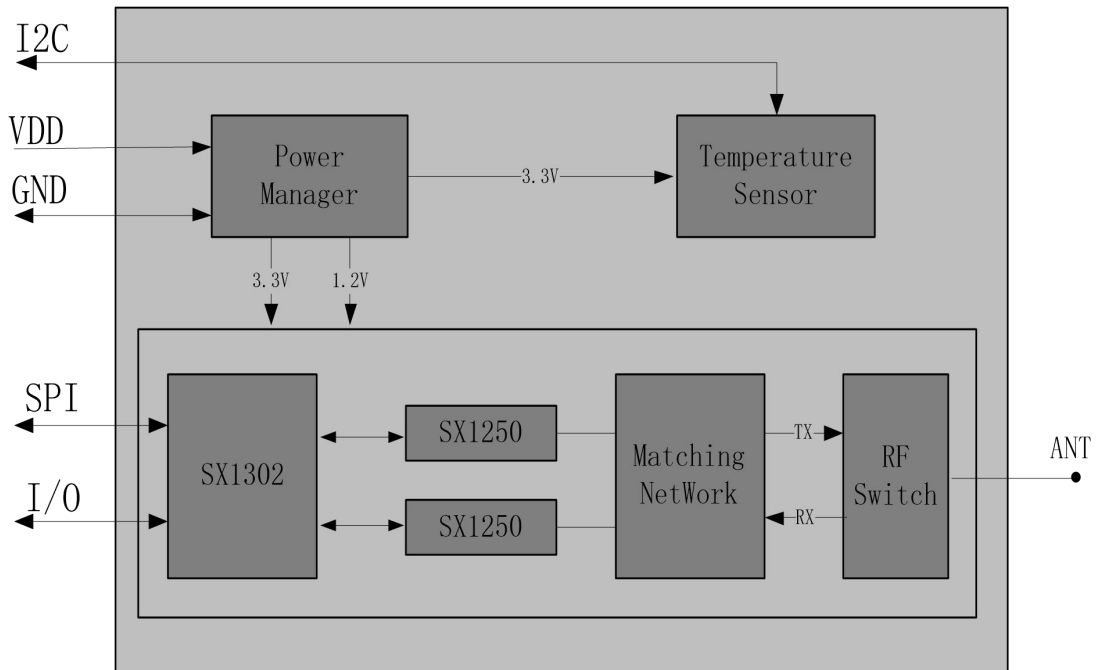


Figure 2.1 Hardware System Diagram

2.3 Pinout diagram

The module is externally connected using the standard Mini PCI Express interface, it is recommended to use the AAA-PCI-073-P02 card socket connector, and it needs to be fixed with two hex standoffs (M2*4) or clips. For detailed pin descriptions, please refer to the "Pin Description Table" section.

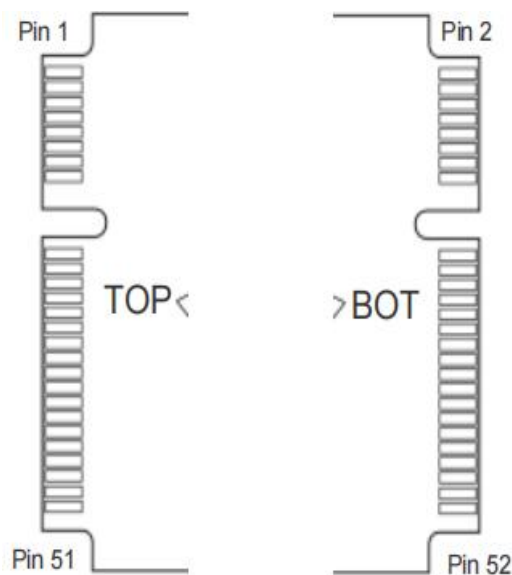


Figure 2.2 Mini PCIE pinout

2.4 Pin Description Table

Table 2-1 Pin Description Table

Pins	Lierda module name	Standard Mini-PCIE	Type	Description
1	NC	MIC_P	-	In use, suspend.
2	VCC	VCC	PI	Power input, input voltage range 4~5.5V
3	NC	MIC_N	-	In use, suspend.
4	GND	GND	PI	GND of the power supply
5	NC	SPK_P	-	Use in suspension
6	RESERVED	GPIO1	-	Reserved
7	NC	SPK_N	-	Suspended during use
8	NC	UIM_PWR	-	Suspended during use
9	GND	GND	PI	System power GND
10	NC	UIM_DATA	-	Use hanging
11	NC	VCC_MSM26_DI G	-	Use suspended
12	NC	UIM_CLK	-	Use while suspended
13	NC	NC6	-	Use in suspension
14	NC	UIM_RESET	-	Suspended during use
15	GND	GND	PI	System power GND
16	POWER_ON ⁽¹⁾	GPIO2	I	RF chip power enable, high-level enable, default high-level
17	SPI_SCK	NC	I	Serial peripheral interface clock line
18	GND	GND	PI	System power GND
19	SPI_MISO	NC4	I/O	Serial peripheral interface host input/slave output data line
20	NC	W_DISABLE#	-	Use while suspended

Pins	Lierda module name	Standard Mini-PCIE	Type	Description
21	GND	GND	PI	System power GND
22	SX1302_RESE T	PERST#	I	Reset pin of SX1302, internal 47K pull-down resistor, high level reset
23	SPI_MOSI	NC3	I/O	Serial peripheral interface host output/slave input data line
24	NC	NC7	-	Suspended during use
25	SPI_CSN	NC2	I	Serial peripheral interface device enable signal line, low level enable effective
26	GND	GND	PI	System power GND
27	GND	GND	PI	System power GND
28	NC	GPIO3	-	Suspended during use
29	GND	GND	PI	System power GND
30	I2C_SCL ⁽²⁾	NC8	I	Temperature sensor I2C clock line
31	PPS	NC1	I	GPS pulse per second signal input. If using LoRaWAN CLASS B mode, this pin should be connected to the PPS pin of the GNSS module.
32	I2C_SDA ⁽²⁾	NC9	I/O	Temperature sensor I2C data line
33	NC	MDL_RESET_N	-	Suspended during use
34	GND	GND	PI	System power GND
35	GND	GND	PI	System power GND
36	RESERVED	USB_D-	-	Reserved, hang in the air when in use.
37	GND	GND	PI	System power GND
38	RESERVED	USB_D+	-	Reserved, hang in the air when in use.
39	NC	VCC	-	In use, suspend.
40	GND	GND	PI	System power GND
41	NC	VCC	-	Use suspended
42	NC	LED_WWAN	-	In use, suspend

Pins	Lierda module name	Standard Mini-PCIE	Type	Description
43	GND	GND	PI	System power GND
44	NC	GPIO4	-	Use hanging
45	NC	PCM_CLK	-	Suspended during use
46	NC	GPIO5	-	Use with suspension
47	NC	PCM_DIN	-	Suspended during use
48	NC	GPIO6	-	Suspended during use
49	NC	PCM_DOUT	-	Suspended during use
50	GND	GND	PI	System power GND
51	NC	PCM_SYNC	-	Use suspended
52	NC	VCC	-	Use while suspended

Note

(1) Except for the LSD4WN-2K730NE0 module, which does not have the power switch control function, the Pin16 pin is floating (NC);

(2) There is a 10K pull-up resistor on the I2C bus of the internal temperature sensor in the LSD4WN-2K730NE0 module.

The I2C bus of the internal temperature sensor in the LSD4WN-2K830NE0 and LSD4WNC-2K930NE0 modules is equipped with a 4.7K pull-up resistor.

(3) PI represents the power input pin; I represents the digital signal input pin; O represents the digital signal output pin; I/O

It means digital signal input/output pin; NC means floating inside the module, it is recommended to handle it as floating.

3 Job characteristics

3.1 Power

VCC is the power supply input for the entire module, and the quality of the power supply directly affects the performance of the module. When designing, it is necessary to select a power supply that can provide sufficient current capability. It is recommended that the power supply for the LSD4WN-2K730NE0 module can meet 0.5A@5V, and the power supply for the LSD4WN-2K830NE0 and LSD4WNC-2K930NE0 modules can meet 1A@5V. Ensure that the input voltage to the module is not lower than the minimum operating voltage of the module when supplying power to the module to prevent abnormal operation of the module due to voltage drop.

If the voltage difference between the input voltage and the power supply voltage of the module is not very large, it is recommended to choose LDO as the power supply. If there is a relatively large voltage difference between the input and output, then use DC-DC for power conversion, and pay attention to the EMI issues brought by DC/DC.

In PCB design, the longer the power supply line for VCC, the wider the trace width should be. It is recommended to keep the power supply lines as short as possible. The GND plane of the power supply section should be as complete as possible with multiple GND vias, and capacitors should be placed as close as possible to the VCC power pins of the module.

3.2 Reset

The SX1302_RESET pin of the module is used for resetting the module, with internal weak pull-down. The reset effective signal keeps the high level for $\geq 100\text{ms}$ before keeping the SX1302_RESET pin low.

3.3 SPI interface

The module communication interface is SPI slave, and the clock rate can be changed

according to user configuration. SPI mode: Motorola/Freescale CPOL=0, CPHA=0, data can be transmitted when CSN is low.

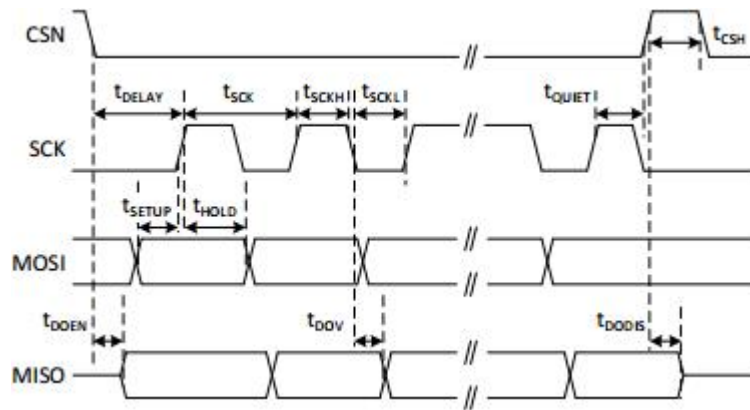


Figure 3.1 SPI Timing Diagram

Symbol	Description	Minimum	Typical	Maximum	Unit
Timing constraints in SPI inputs					
$t_{\text{SPI,SCK}}$	SCK period	100			ns
$t_{\text{SPI,SCKH}}$	SCK high duration	40			ns
$t_{\text{SPI,SCKL}}$	SCK low duration	40			ns
$t_{\text{SPI,SCKR}}$	SCK rise time (10% VCC_IO -> 90% VCC_IO)	0	2.5		ns
$t_{\text{SPI,SCKF}}$	SCK fall time (90% VCC_IO -> 10% VCC_IO)	0	2.5		ns
$t_{\text{SPI,DELAY}}$	SCK lead time	40			ns
$t_{\text{SPI,QUIET}}$	SCK trail time	40			ns
$t_{\text{SPI,CSH}}$	Time between two successive CSN chip select	250			ns
$t_{\text{SPI,CSR}}$	CSN rise time (10% VCC_IO -> 90% VCC_IO)	0	2.5		ns
$t_{\text{SPI,CSF}}$	CSN fall time (90% VCC_IO -> 10% VCC_IO)	0	2.5		ns
$t_{\text{SPI,SETUP}}$	Data in setup time	5			ns
$t_{\text{SPI,HOLD}}$	Data in hold time	5			ns
SPI output timing specification					
$t_{\text{SPI,DOEN}}$	SPI output enable time	0		10	ns
$t_{\text{SPI,DODIS}}$	SPI output disable time	0		10	ns
$t_{\text{SPI,DOV}}$	SCK out falling edge to MISO delay			15	ns

Figure 3.2 SPI timing parameter requirements

3.4 Antenna interface

The RF antenna interface of the module uses an I-PEX connector, which can directly connect to the I-PEX header to install the antenna, as shown in the following figure.

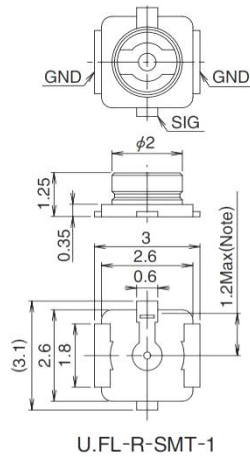


Figure 3.3 IPEX connector

Recommend using U.FL series of connection cables, as shown in the following picture:

	U.FL-LP-040HF	U.FL-LP-066HF U.FL-LP-068HF	U.FL-LP(V)-040HF	U.FL-LP-062HF	U.FL-LP-088HF
Part No. Size					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm	Dia. 1.13mm and Dia. 1.32mm	Dia. 0.81mm	Dia. 0.95mm	Dia. 1.37mm
Weight (mg)	54	59	35	45.5	72

Figure 3.4 U.FL series connection cable

4 Specifications

4.1 Absolute maximum limit

Table 4-1 Module Limit Parameters

Main parameters	Minimum value	Maximum value	Unit	Note
Power supply voltage	-0.3	6	V	
Maximum RF input power	-	+10	dBm	

4.2 Job parameters

Table 4-2 Digital I/O Specifications

Main parameters	Minimum value	Typical value	Maximum value	Note
VIH(V)	$0.7 \times VCC_IO$		VCC_IO	VCC_IO is 3.3V
VIL(V)	0		$0.3 \times VCC_IO$	
VOH(V)	$VCC_IO - 0.4$			
VOL(V)			0.4	

4.3 Start the process

Users configure system parameters according to their needs. After the configuration is completed, they send a start command, and the module will start according to the configured parameters. Before the start, the module is reset through the reset pin. Then, configure parameters such as frequency and clock. After the start is completed, data interaction can be performed. The start-up process is as follows:



Figure 4.1 Startup Process Diagram

The "configuration parameters" required for module startup are as follows:

Table 4-3 Minimum Configuration for Module Startup

Serial number	Parameters
1	RadioA enable
2	RadioA center frequency
3	RadioB enable
4	RadioB center frequency
5	Configure parameters using channels (channel 0-7) for reception.
6	Start

Note

1、Parameters are not saved. If power is lost or the module is reset, the parameters will be lost and need to be reconfigured. For complete configuration details, please refer to the SX1305 driver code.

4.4 Transmit Power Configuration

The LSD4WN-2K830NE0 and LSD4WNC-2K930NE0 modules are equipped with RF PA, and the actual required transmission power can be obtained by referring to the parameter configuration in the table.

Table 4-4 Transmitter Power Parameter Configuration Table

Expected transmission power in dBm	pa_gain	pwr_idx
27	1	13
26	1	12
25	1	11
24	1	9
23	1	8
22	1	7
21	1	6
20	1	5
19	1	4
18	1	3
17	0	18
16	0	17
15	0	16
14	0	15

5 Mechanical dimensions

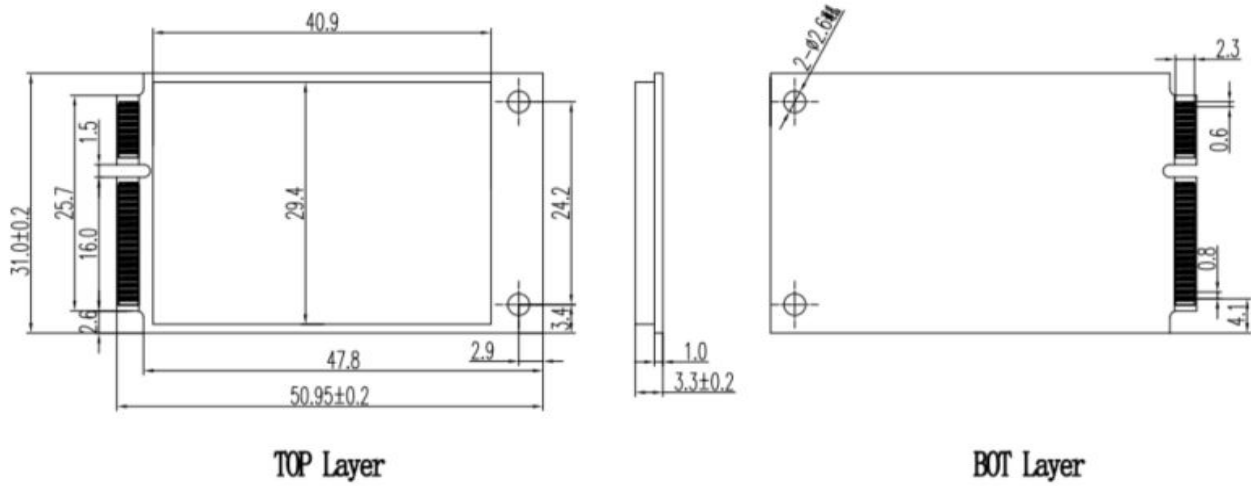


Figure 5.1 Module Dimensional Diagram

Lierda
利 尔 达

6 Packaging information

- ◆ Anti-static bag plastic sealed independent packaging.



7 Warning

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 radiofrequency 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.

Federal Communication Commission (FCC) Radiation Exposure Statement When using the product, maintain a distance of 20cm from the body to ensure compliance with RF exposure requirements.

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.

ORIGINAL EQUIPMENT MANUFACTURER (OEM) NOTES

The OEM must certify the final end product to comply with unintentional radiators (FCC Sections 15.107 and 15.109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID:

N8N4WNC-2K930NE0. Additionally, the following statement should be included on the label and in the final product's user manual: "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 interferences, and
- (2) this device must accept any interference received, including interference that may cause undesired operation."

The module is allowed to be installed in mobile and portable applications A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end - use operational conditions, including simultaneous transmission operations. When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application. When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a

module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.

