Product Manual of MMJ05-1B-015 LoRa Module



Shenzhen Star Instrument Co., Ltd.

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1.Overview

MMJ05-1B-015 module is a "pole" series LoRa RF terminal module developed by Star. This module integrates LoRa's core radio frequency chip LLCC68 and its peripheral circuit, adopts serial interface to interact with user equipment for data and instruction, and can conveniently provide users with fast LoRa wireless terminal communication and other services.

MMJ05-1B-015 module size is 20mm*8.9mm*2.7mm, which has the characteristics of small volume, low power consumption, long transmission distance and strong anti-interference ability, suitable for a variety of applications: low power applications of the Internet of things (IoT), automatic meter reading, smart city, industrial automation, smart home, wearable devices, etc.

1.1 Specification

- ➤ Voltage: 1.8V ~ 3.6 V
- ► Frequency band: 902~928MHz
- ➤ Tx Power: 20±1dBm (Standard power, up to 21dBm)
- Rx sensitivity: -129dBm (Typical value, SF=9, BW_L=600KHz@LoRa)

Effective communication distance: 3km (Urban highway environment, non-wilderness environment @SF9, 20dBm)

▶ Power Consumption: $\leq 2\mu A$ (Sleep current)

1.2 Electrical parameters

DC characteristic parameters							
Main	Minimum value	Typical value	Maximum value	Unit	Remark		
Parameters							
Voltage	1.8	3.3	3.6	V	-		
Current							
Standby current	-	2.7	-	mA	-		
Sleep current	-	2	-	μΑ	-		

Тх		RF				
characteristic		characterist	tic			
		parameters				
Main	Testing	Minimum	Typical value	Maximum	Unit	Remark
Parameters	condition	value		value		
Operating	902~928 MHz					
frequency						
Тх	LoRa mode, car	rier output, ambien	t temperature of 25	$^{\circ}C$, supply voltage	e of 3.3V	
characteristic	,	• ·	•			

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Testing condition	Minimum value	Typical value	Maximum value	Unit	Remark	Remark
Operating	-	-40	-	85	°C	-
temperature						
Storage	-	-40	-	125	°C	-
temperature						
Operating	-	5	-	95	%	-
humidity						

Tx Power		19.5	20	21	dBm	Actual output of 22dBm Tx power
SHG	< -40 dBm					
Tx current (RF)	-	-	120	-	mA	22dBm Tx power, load impedance 50Ω

Rx characteristic

Main Parameters	Testing condition	Minimum value	Typical	value	Maximum value	Unit	Remark
Rx sensitivity	SF9	-	-129		-	dBm	Flatness ≤ 0.5 dB
Rx current (RF)	-	-	5		-	mA	,
Frequency characteristicFrequency stability: 15ppm@-40°C~85°C							

Environmental characteristics

2.Interface

When the module is connected to the user mainboard, it mainly includes serial port interface, reset, wake up, mode control, status output and power supply interface, etc. Figure 2-1 shows the module pins.



Figure 2-1 Module pins

2.1 Module pin definition

Pin	Function	Port Type	Description
1	NSS	Ι	SPI chip selection
2	M0SI	Ι	SPI data input
3	MISO	0	SPI data output
4	SCK	Ι	SPI clock
5	NC	-	Serial port receiver (RX)
6	DIO3	I/O	Interrupt the I/O port
7	NC		Ground
8	DIO1	I/O	Interrupt the I/O port
9	3.3V	POWER	System power supply,
			power supply range
			1.8~3.6V
10	GND	POWER	Ground
11	C1	-	Reserved
12	C2	-	Reserved



13	BUSY	0	Indicates busy or idle state
14	NRESET	I/O	Reset module, internal
			weak pull up, active low,
			if the user does not use, it
			can be suspended
			processing.
15	GND	POWER	Ground
16	GND	POWER	Ground
17	ANT	OUTPUT	RF output

2.2 Hardware interface description

When using LSD4WN-2R717M90 module for hardware design, according to the actual application, it is necessary to select and design the required interface and its peripheral circuit reasonably. LSD4WN-2R717M90 module application interfaces include the following:

- External power supply
- ≻ Reset
- ≻ SPI
- Module status indicator
- ➤ Interrupt GPIO

2.2.1 External power supply

Before using the module, the user must first ensure that the external power supply has sufficient power load capacity and the power supply range must be strictly controlled between 1.8V and 3.6V. If the value is higher than the power supply range of the module, the main chip of the module will be damaged. If the value is lower than the power supply range of the module, the RF circuit will be affected and the maximum output power cannot be guaranteed.

2.2.2 Reset

The reset pin is low reset. The user provides a low pulse of at least 1ms (or directly pulls it down) to the NRST pin of the module to reset the module. In normal mode, it is suggested to add a $4.7k\Omega$ resistor to the power supply.

2.2.3 SPI

The SPI interface is a four-line SPI, which provides the data interactive interface for the user

platform to the module.

2.2.4 Module status indicator

Module status indicator pin is the 13 busy pin. If the user sends serial port data to the module, check the level status of the BUSY pin. The user can send serial port data to the module only when the BUSY pin is high level (idle state). After the module receives user data, BUSY pins will be lower, indicating that the module will carry out data communication. After the data communication ends, the BUSY pin will be pulled up again, indicating that the user has completed the data communication.

2.2.5 Interrupt GPIO

Interruption GPIO ports DIO1 and DIO3 are used for data transmission with internal chip, and cannot be used as extended IO ports.

2.3 Module application diagram



3. Antenna design suggestions

Antenna design is directly related to the communication performance of the product. Different types of antennas are selected for different terminals according to the antenna size, cost, and performance. Common short-range antennas include PCB antenna, chip (ceramic) antenna, spring antenna, whip antenna, etc. When selecting an antenna, the following most important parameters should be considered: radiation variation in different directions around the antenna, antenna efficiency, bandwidth required for antenna operation, and power to be provided to the antenna, etc.



The typical definition of antenna bandwidth is the frequency range where the reflected wave attenuation is less than -10dB or VSWR is less than 2, that is, the frequency range where the reflected power of the antenna is less than 10%.

4.Product material object

Module size: 20mm*8.9mm*2.7mm, and the actual product is as follows: The front view:



The back view:



FCC Caution.

§15.19 Label requirements.

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.

§15.21 Information to user.

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

§15.105 Information to the user.

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

Modular Approval:

The 915MHz Module module is designed to comply with the FCC statement. FCC ID is 2A2X4MMJ051B015. The host system using this module, should have label indicated it contain FCC ID: 2A2X4MMJ051B015.

KDB996369 D03 Requirements

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.

Explanation: this module meets all the requirements of FCC part 15 -247

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host

manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

Explanation: The EUT uses an unchangeable PCB antenna with a maximum gain of 2.0dBi. There is no restriction on the installation method.

2.4 Limited module procedures

If a modular transmitter is approved as a —limited module,II then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module

must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module

manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval. This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host



as a specific host also approved with the module.

Explanation: this module is a Single approval module

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);

b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wave length, and antenna shape (traces in phase) can affect antenna gain and must be considered);

c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;

d) Appropriate parts by manufacturer and specifications;

e) Test procedures for design verification; and

f) Production test procedures for ensuring compliance.

Explanation: No. this module without trance antenna designs, use fixed-length PCB antenna

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure

information: (1) to the host product manufacturer, to define the application conditions (mobile, portable

- xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are

not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment at a 20cm distance separation to human body. This module is designed to comply with the FCC statement, FCC ID: 2A2X4MMJ051B015

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an —omnidirectional antennal is not considered to be a specific —antenna type!)).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: This module use PCB antenna. Antenna Gain:2.0dBi

2.8Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC IDII with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: On the metal shielding shell, there is space for printing basic information such as the name and model of the product, and the FCC ID

2.9 Information on test modes and additional testing requirements

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host

product. The grantee should provide information on how to configure test modes for host product evaluation for differentoperational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host. Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify ahost manufacturer's determination that a module as installed in a host complies with FCC requirements.

Explanation: Data transfer module demo board can control the EUT work in RF test mode at specified test channel.

2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuity, so the module do not require an evaluation by FCC part15 subpart B. The host should be evaluated by the FCC subpart B.