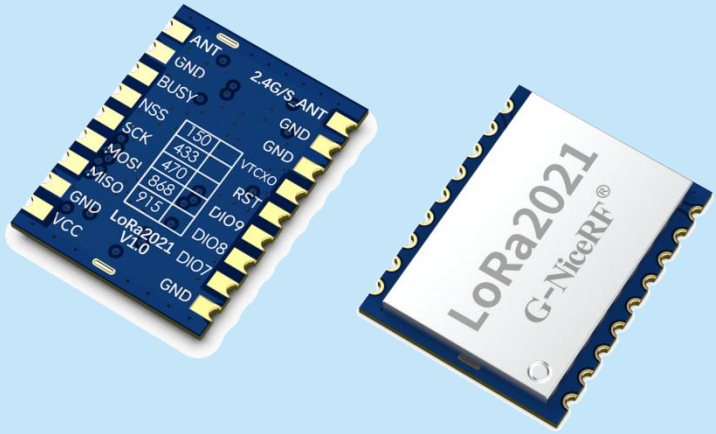
- Multi-Band: Sub-GHz, 2.4GHz, and S band (satellite communication)
- Supports LoRaWAN protocol and Sigfox protocol
- Superior anti-interference: LR-FHSS technology
- Supports RTToF ranging
- Up to 2.6 Mbps data rate
- Full compatibility with multiple modulation schemes

Product Specification



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Note: Revision History

Revision	Date	Comment
V1.0	2025-11	First release

1. Descriptions

The LoRa2021 module is based on SEMTECH's LR2021 chip, an ultra-low power, long-range LoRa transceiver. It supports terrestrial ISM band communication in the Sub-GHz and global 2.4GHz spectrums, as well as the S-band for satellite connectivity.

The LoRa2021 supports LoRa, (G)FSK, (G)MSK, FLRC, 4-FSK, O-QPSK, and LR-FHSS (transmit-only). The LR2021 supports the LoRaWAN communication protocol. When integrating with third-party products, it is compatible with various low-power wireless protocols, including Amazon Sidewalk, W-MBUS, Wi-SUN FSK, and Z-Wave.

The LoRa2021 is produced and tested strictly using lead-free processes and is compliant with RoHS and REACH standards

2. Features

- Sub-GHz Bands: 433/470/868/915MHz
  Customizable frequency range: 150~960 MHz
  2.4G band: 2400-2500MHz
  S band: 1900-2200MHz
- Transmission distance: >5000 meters at sub-GHz in open area
- S band sensitivity: up to -131 dBm @ BW=125KHz, SF=10
- 2.4GHz reception sensitivity: up to-137dBm @ BW=203.125KHz, SF=12
  Sub-GHz reception sensitivity: up to -144dBm @ BW=62.5 KHz, SF=12
- Built-in electrostatic protection circuit
- Supports LR-FHSS
- FLRC: modulation rate up to 2.6 Mbps
- LoRa: modulation rate up to 200 kbps
- 4th Generation LoRa IP technology
- Simultaneous reception with multiple Spreading Factors (SF)
- Enhanced CAD (Channel Activity Detection)
- Higher frequency offset tolerance (for harsh RF environments)
- Supports multiple communication protocols:
  LoRa / LoRaWAN® (Sub-GHz + 2.4GHz)
  Bluetooth® LE 5.0
  IEEE® 802.15.4 (Thread®/Zigbee™)
  Wi-SUN, Wireless M-BUS, Z-Wave, etc.
- Transmit power is adjustable, up to 22dBm
- Sleep current ≤ 2μA
- Receive current < 7mA
- Small size, stamp hole design

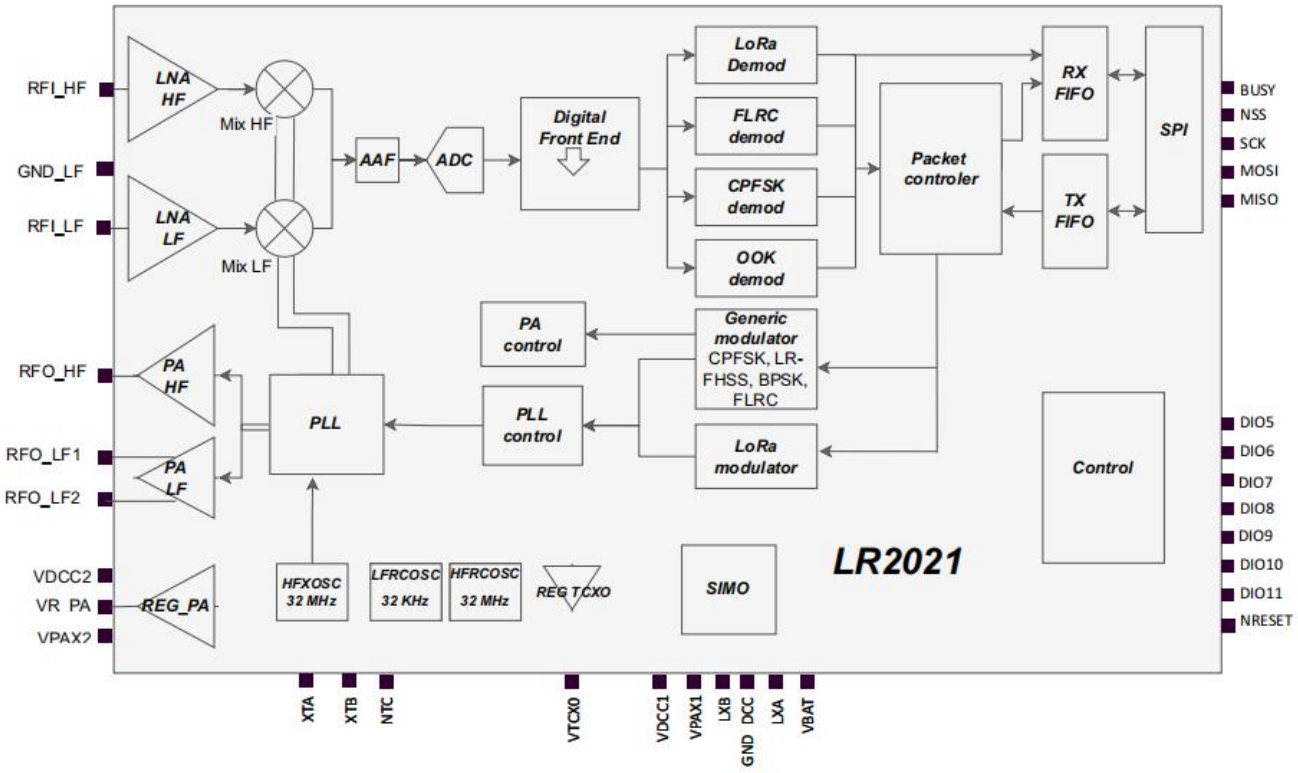
3. Applications

- Drones/ UAV Applications
- Smart home/Smart agriculture
- Remote irrigation
- Industrial manufacturing

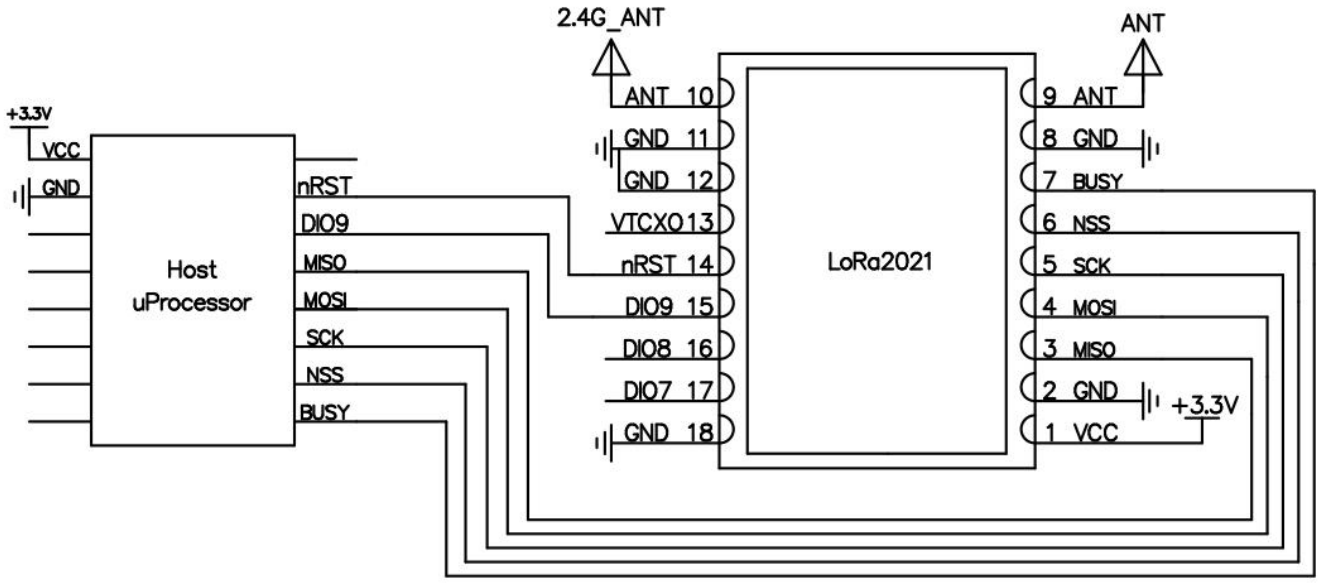
4. Electrical Characteristics

Parameters	Test condition	Min.	Typ.	Max	Unit
Voltage range		1.8	3.3	3.6	V
Operating Temperature		-40	25	85	℃
Maximum Input Signal			10		dBm
Current Consumption					
Transmit Current	@433MHz		< 110		mA
	@2.4GHz		< 35		mA
Receive Current	@3.3V,2.4GHz		< 7		mA
	@3.3V,433MHz		< 6		mA
Sleep Current	@3.3V		≤2		uA
RF Parameters					
Frequency Range	@433MHz	400		460	MHz
	@470MHz	470		510	MHz
	@868MHz	850		890	MHz
	@915MHz	900		940	MHz
Transmit Power	@Sub-GHz	19	21		dBm
	2.4GHz	10	11		dBm
Receive Sensitivity	BW=62.5KHz,SF=12 @Sub-GHz		-142		dBm
	BW=125KHz,SF=10 @Sub-GHz		-134		
	BW=125KHz,SF=10 @S frequency band		-131		dBm
	BW=406KHz,SF=12 @2.4GHz		-134		dBm
Frequency Error	@Crystal		10		ppm
	@TCXO		0.5		ppm
Modulation Rate (@sub-GHz)	@LoRa	0.091		62.5	Kbps
	@FRLC	260		2600	Kbps
	@FSK,@863-2.5GHz	0.6		2500	Kbps
Modulation Rate (@S Frequency bands)	@LoRa	0.292		87.5	Kbps
Modulation Rate (@2.4GHz)	@LoRa	0.476		87.5	Kbps

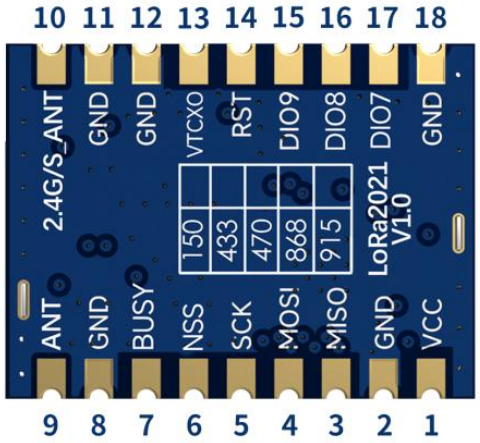
5. Block Diagram



6. Typical Schematic Circuit:



7. Pin definition



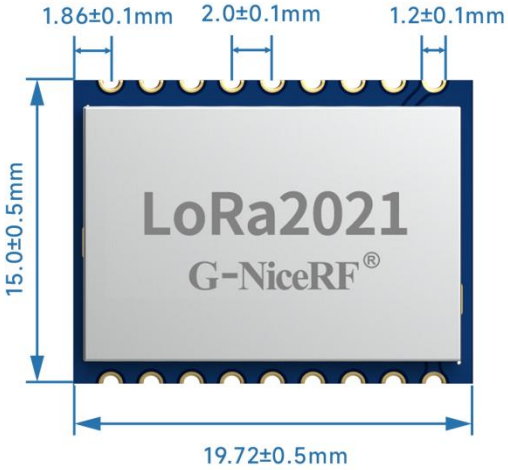
Pin NO.	Pin name	I/O	Description
1	VCC		Connect to the positive power supply.
2,8,11,12,18	GND		Connect to the negative power supply.
3	MISO	O	SPI data output
4	MOSI	I	SPI data input
5	SCK	I	SPI clock input
6	NSS	I	SPI chip select input
7	BUSY	O	Used for status indication, refer to the chip datasheet for details.
9	ANTA ANT		@sub-GHz band antenna interface, external 50-ohm antenna.
10	2.4/S_ANTA		2.4G and S band antenna interface,external 50-ohm antenna.
13	VTCXO	O	Can provide power for an external TCXO.
14	RST	I	Reset trigger input, refer to the chip datasheet for details.
15	DIO9	IO	Multipurpose digital interface, refer to the chip datasheet for details.
16	DIO8	IO	Multipurpose digital interface, refer to the chip datasheet for details.
17	DIO7	IO	Multipurpose digital interface, refer to the chip datasheet for details.

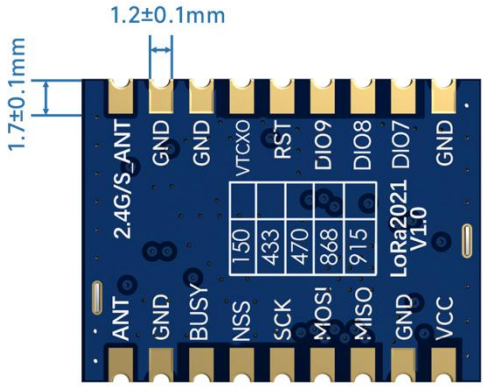
8. Power and Current Comparison Table

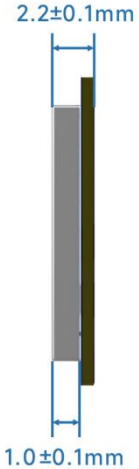
Power Levels of the DEMO Board		0	1	2	3	4	5	6	7	8	9
Sub GHz Register Values		-10	-4	2	8	14	20	26	32	38	44
@868MHz @3.3V	Power(dBm)	6.9	8.3	10	11.5	13.1	14.7	16.3	17.7	19.2	21.2
	Current(mA)	24.2	26.8	30.3	32.4	36.2	43.5	54.7	70.4	90.1	120
1.9GHz/2.4GHz Register Values		-12	-8	-4	0	-4	8	12	16	20	24
@1.9GHz @3.3V	Power(dBm)	-6.2	-4.1	-2.3	0	1.5	3.6	5.6	7.7	9.8	12.0
	Current(mA)	9.0	9.5	10.1	10.9	11.2	12.2	13.5	15.1	17.1	21.0
@2.4GHz @3.3V	Power(dBm)	-5.0	-3.0	-1.4	0.6	2.4	4.5	6.4	8.4	10.3	12.2
	Current(mA)	11.4	12.3	13.3	14.4	15.3	17.2	19.3	21.9	25	31.3

Register Value 1: TxPower in the SetTxParams(0x0203) Command

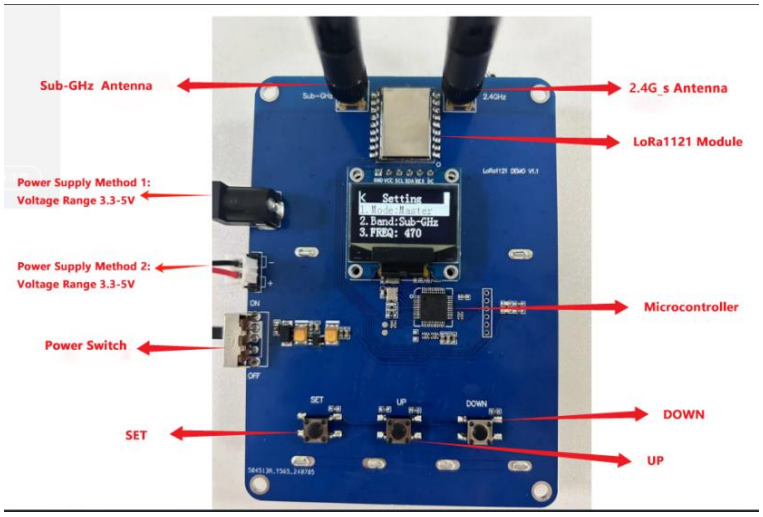
9. Mechanism Dimension (Unit: mm)

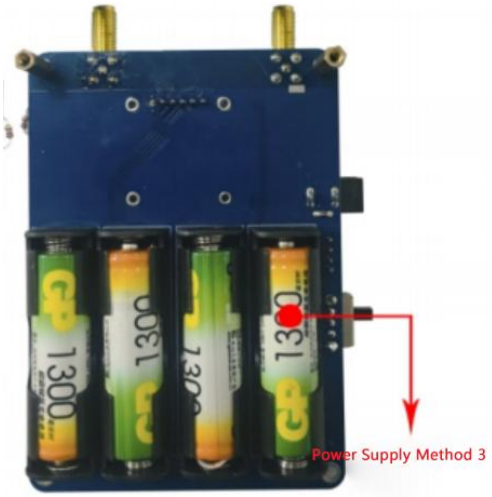






Appendix 1: Function Demonstration Board





Note: Only one power supply method can be selected

1. Function Description

The LoRa2021 wireless module demo board primarily implements bidirectional communication (Master and Slave) in LoRa mode, along with sleep (Sleep), transmit power (TxTest), and receiver sensitivity (RxTest) testing functions.

Note: Transmit power and receiver sensitivity must be tested with instruments.

2. Key Functions

The demo board has three buttons: SET, UP, and DOWN. Their functions are as follows:

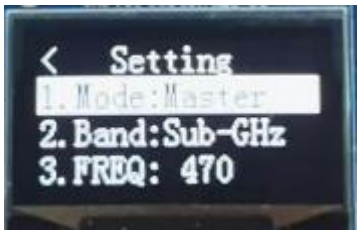
Buttons	Functions
SET Key Short Press	Confirm or enter the next level of the interface
SET Key Long Press	Return to the previous interface
UP Key Short Press	Move cursor up or increase parameter by 1
UP Key Long Press	Increase parameter
DOWN Key Short Press	Move cursor down or decrease parameter by 1
DOWN Key Long Press	Decrease parameter

Operation Method:

With normal power supply, toggle the power switch to turn on the device. The LCD screen on the demo board will display the "Setting" interface. Briefly press the UP or DOWN key to move the cursor. When the cursor is on the parameter you wish to modify, press the SET key briefly to make the cursor flash. Then, use the UP or DOWN key to adjust the parameter. Press the SET key again to confirm the modification.

To enter the test function corresponding to the "Mode" parameter, long-press the SET key. Briefly press the SET key to return to the "Setting" interface.

3. Setting Interface Description

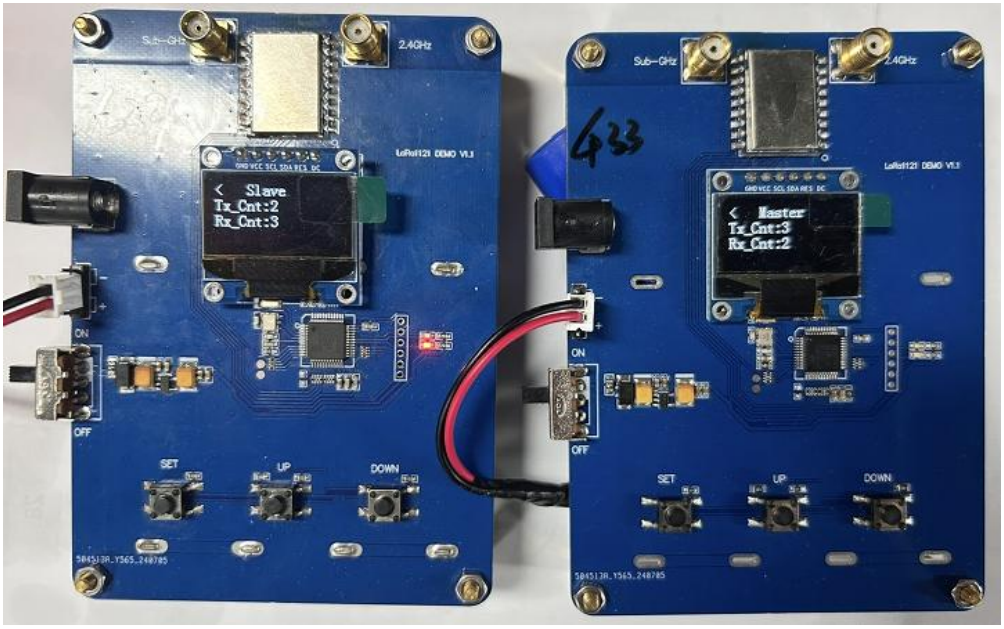


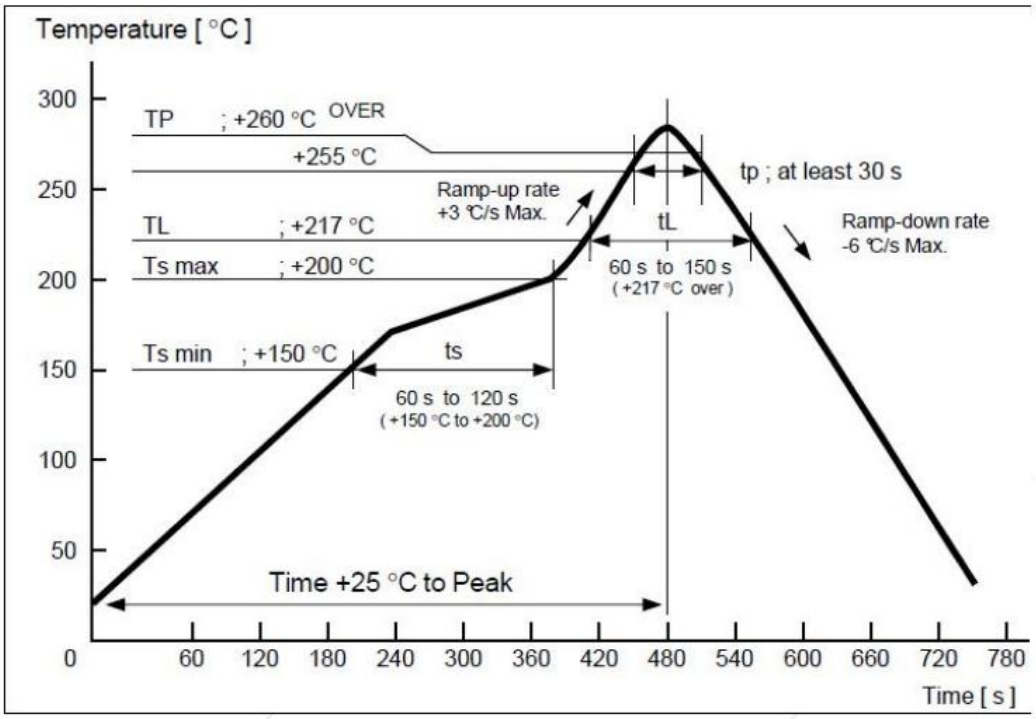
- Mode: Function
- Band: Frequency Band
- FREQ: Frequency
- SF: Spreading Factor
- BW: Bandwidth
- POWER: Power
- CR: Coding Rate

4. Communication Test

Prepare two LoRa2021 demo boards. Set one to Master mode as the communication host, and the other to Slave mode as the communication slave. (Set the LoRa communication parameters: FREQ, SF, BW, and CR to be the same; otherwise, communication will fail.)

On the LoRa communication interface screen, the Tx_cnt and Rx_cnt values will keep increasing. (The red indicator light represents a successful transmission, and the blue indicator light represents a successful reception.)



Appendix 2: SMD Reflow Chart

Below reflow profile is recommended for SMT technology: