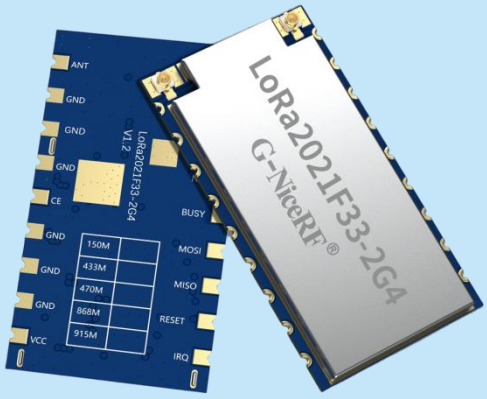
- Dual-Band Frequency Coverage: 150-960MHz and 1.9-2.5GHz
- Data Rate up to 2.6Mbps @FLRC, 125Kbps @LoRa
- Multiple Modulation Modes: FSK, LoRa, LR-FHSS, FLRC, O-QPSK, OOK
- Compatible with Various Low-Power Wireless Protocols: Amazon Sidewalk, Wireless M-BUS, Wi-SUN FSK, and Z-Wave
- Supports LoRaWAN Protocol and RTToF Ranging
- Sub-GHz 2W Output Power; 2.4GHz 1W Output Power @5V. The 2.4GHz band features a built-in LNA, improving sensitivity by 6dB
- Industrial-grade TCXO Crystal Oscillator 0.5PPM

Product Specification



Catalogue

Note: Revision History

Revision	Date	Comment
V1.0	2026-2	First release
V1.1	2026-3	Added specifications for selected frequency bands

1. Descriptions

The LoRa2021F33-2G4 is a transceiver module based on SEMTECH's LR2021 chip, which integrates the 4th-generation LoRa IP core and supports operation in the Sub-GHz and 1.9-2.5 GHz frequency bands, the L-band, and licensed S-band frequencies, making it suitable for both terrestrial and satellite communication (SATCOM) networks.

In addition, the Lora2021F33-2G4 features extended physical-layer modulation capabilities to support Fast Long-Range Communication (FLRC). When integrated with third-party protocol stacks, it is compatible with a wide range of low-power wireless protocols, including Amazon Sidewalk, Wireless M-BUS, Wi-SUN FSK, and Z-Wave. The LoRa2021F33-2G4 is manufactured and tested using strictly lead-free processes and is fully compliant with RoHS and REACH standards.

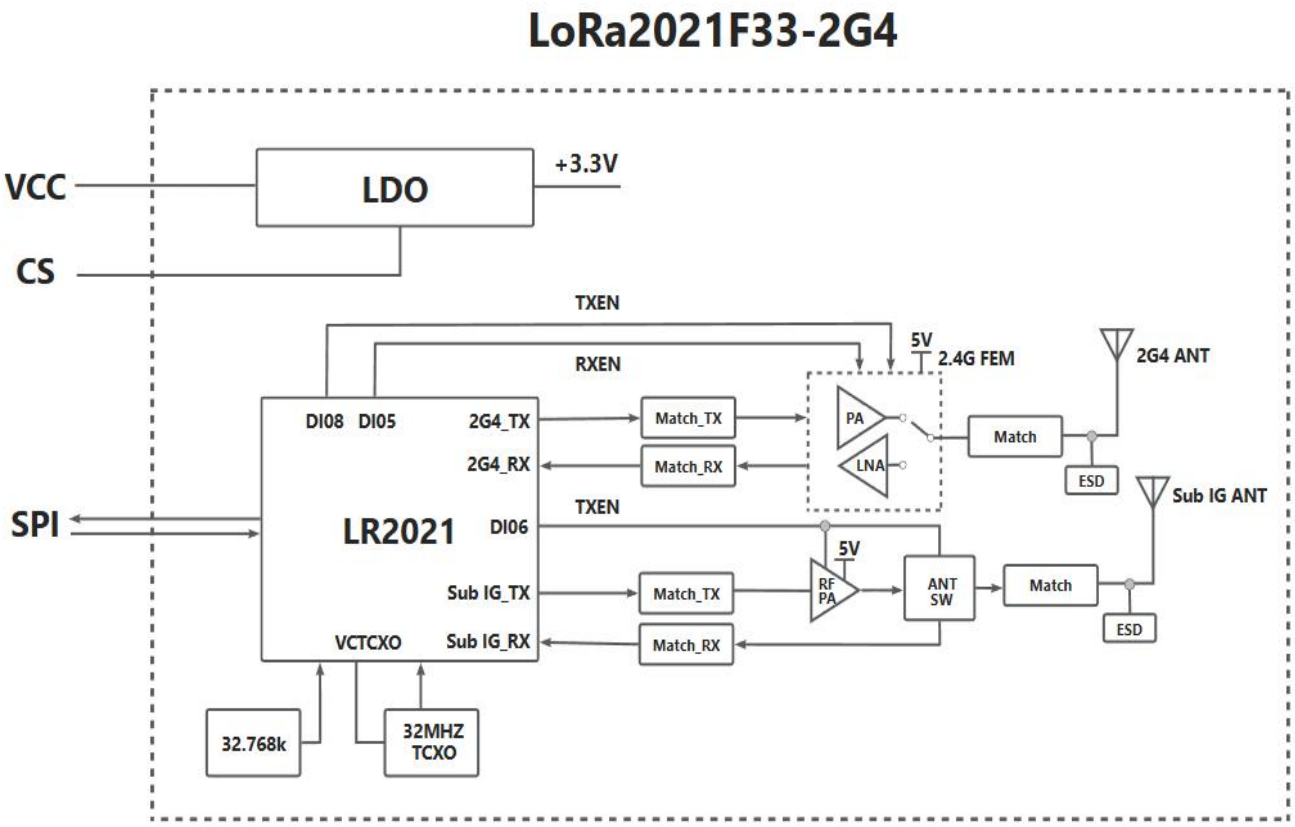
2. Features

- Sub-GHz Bands: 433/470MHz 2W
  Sub-GHz Bands: 868/915MHz 1W
  (Customizable range: 150~960 MHz)
- 1.9-2.5 GHz band: 1W
- 1.9-2.5 GHz sensitivity: up to-136dBm @ BW=125KHz, SF=10
- Sub-GHz 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 125 kbps
- 4th Generation LoRa IP technology
- Simultaneous detection of 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.
- Transmission distance: >10km at Sub-GHz in open area
- Sleep current < 20μA
- Small size, stamp hole design

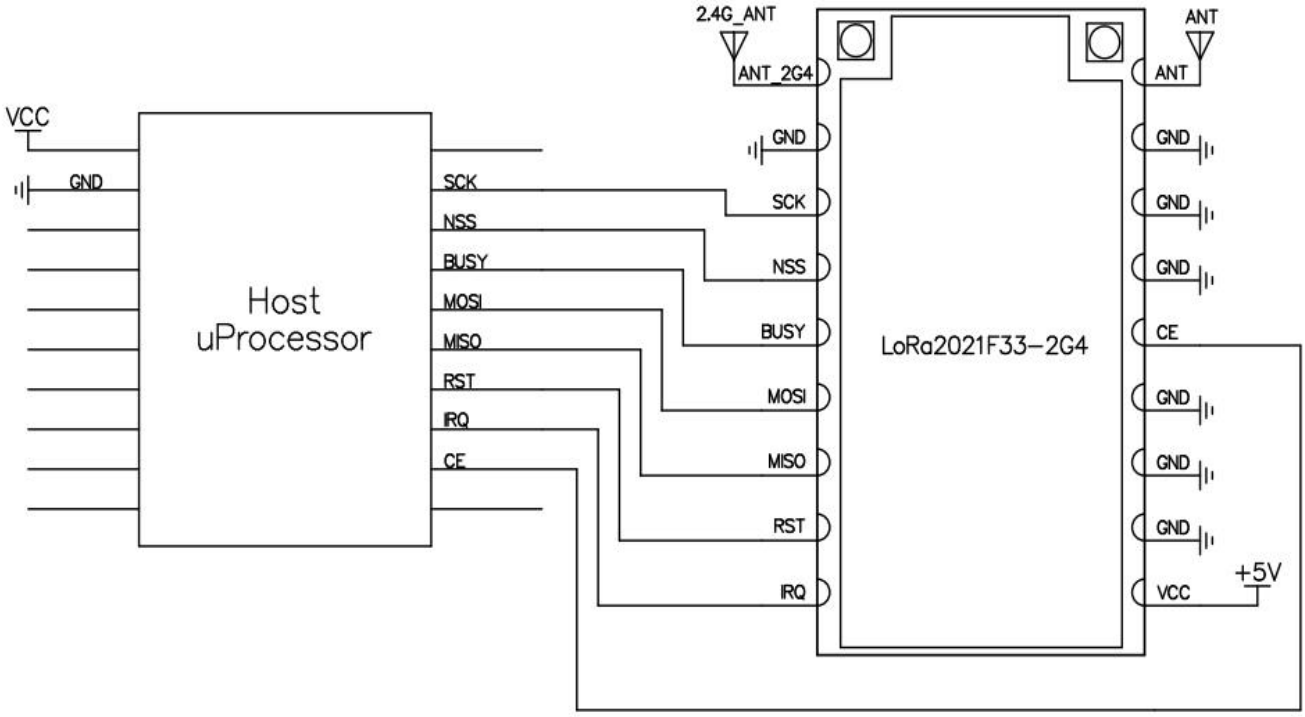
3. Applications

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

4. Block Diagram



5. Typical Schematic Circuit

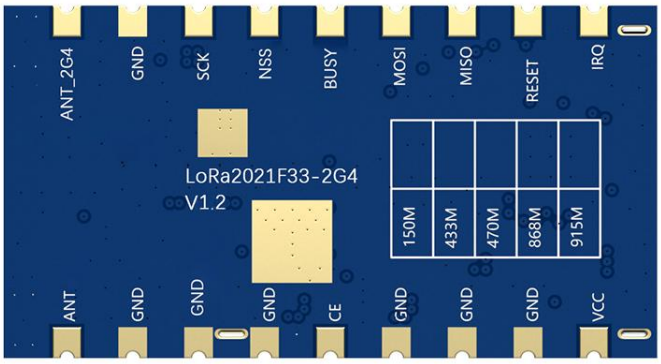


6. Electrical Characteristics

Parameters	Test condition	Min.	Typ.	Max	Unit
Voltage Range		3.0	5	5.5	V
Operating Temperature		-40	25	85	℃
Maximum Input Signal			10		dBm
Current Consumption					
Transmit Current	@433MHz, 5V, 2W		< 1200		mA
	@868/915MHz,5V,1W		< 800		mA
	@2.4GHz,5V, 1W TxPower=5		< 900		mA
Receive Current	@Sub-GHz		< 8		mA
	@2.4G bypass ON		< 9		mA
	@2.4G bypass OFF		<42		mA
Sleep Current			<20		uA
RF Parameters					
Frequency Range	@433MHz	410		450	MHz
	@470MHz	470		510	MHz
	@868MHz	800		880	MHz
	@915MHz	890		950	MHz
Transmit Power Adjustable Range	@Sub-GHz@433MHz	18		33	dBm
	@Sub-GHz@868MHz	10		31	dBm
	@Sub-GHz@915MHz	8		31	dBm
	@1.9-2.5 GHz	11		30	dBm
Transmit Power Output	@433/470MHz	31.5	33	34	dBm
	@868/915MHz	28.5	30	31	dBm
	@1.9-2.5GHz	28.5	30	31	dBm
Receive Sensitivity	BW=62.5KHz,SF=12 @Sub-GHz		-143		dBm
	BW=125KHz,SF=10 @Sub-GHz		-136		dBm
	BW=125KHz,SF=10 @2.4GHz, Bypass ON		-124		dBm
	BW=125KHz,SF=10 @2.4GHz, Bypass OFF		-136		dBm
Frequency Error			0.5		ppm
Modulation Rate (@Sub-GHz)	@LoRa	0.0458		125	Kbps
	@FSK	0.2		2000	Kbps
Modulation Rate (@2.4GHz)	@LoRa	0.476		101.5	Kbps

Note: For the 2.4GHz LNA (DIO5), it should normally be set to high level (Bypass OFF). If set to low level, sensitivity will decrease by 12dB (Bypass ON).

7. Pin definition



Pin NO.	Pin name	I/O	IO Voltage	Description
1	VCC			Connect to the positive power supply.
2,3,4,6, 7,8,11	GND			Connect to the negative power supply.
5	CE	I	0-5.5V	Internal LDO Enable Control Pin: Operation: Drive high or leave floating (internal pull-up ensures high).Sleep Mode: The module must be powered off by pulling the CE pin low. Additionally, all MCU pins connected to the module (including SPI NSS and RESET) must be configured as low level to prevent current leakage.
9	ANT			Sub-GHz Antenna Port, External 50Ω Antenna
10	ANT-2G4			2.4 GHz Antenna Port, External 50Ω Antenna
12	SCK	I	0-3.3V	SPI clock input
13	NSS	I	0-3.3V	SPI chip select input
14	BUSY	O	0-3.3V	Used for status indication, refer to the chip datasheet for details.
15	MOSI	I	0-3.3V	SPI data input
16	MISO	O	0-3.3V	SPI data output
17	RESET	I	0-3.3V	Reset trigger input, refer to the chip datasheet for details.
18	IRQ	O	0-3.3V	Multipurpose digital interface, refer to the chip datasheet for details.

8. Performance Indicators

■ Power Level Table

433/470MHz @BW=125KHZ,SF=12			2.4-2.5GHz @BW=203KHz,SF=12		
Register Value[1]	Output Power (dBm)	Transmit Current (mA)	Register Value[1]	Output Power (dBm)	Transmit Current(mA)
-11	17.3	430	-18	10.8	247
-5	20.8	460	-14	16.3	294
1	22.7	560	-11	20.1	356
7	25.1	550	-7	23.6	458
13	27.3	628	-3	27.1	620
19	29.3	730	1	29.1	770
25	31.4	900	4	30.1	790
31	32.4	1000	7	30.1	810
37	33.1	1100	10	30.1	820
44	33.1	1150	13	29.5	820
868/915MHz @BW=125KHZ,SF=12			1.9-2.1GHz @BW=125KHZ,SF=12		
Register Value1	Output Power (dBm)	Transmit Current(mA)	Register Value1	Output Power (dBm)	Transmit Current(mA)
-11	10.4	177	-18	12.9	260
-5	13.3	184	-14	18.4	307
1	16.2	197	-11	23.0	400
7	18.9	221	-7	26.6	500
13	21.4	265	-3	29.4	760
19	24.0	336	1	29.4	760
25	26.5	432	4	29.5	760
31	28.3	540	7	29.5	770
37	29.3	637	10	29.5	770
44	29.8	724	13	29.5	780

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

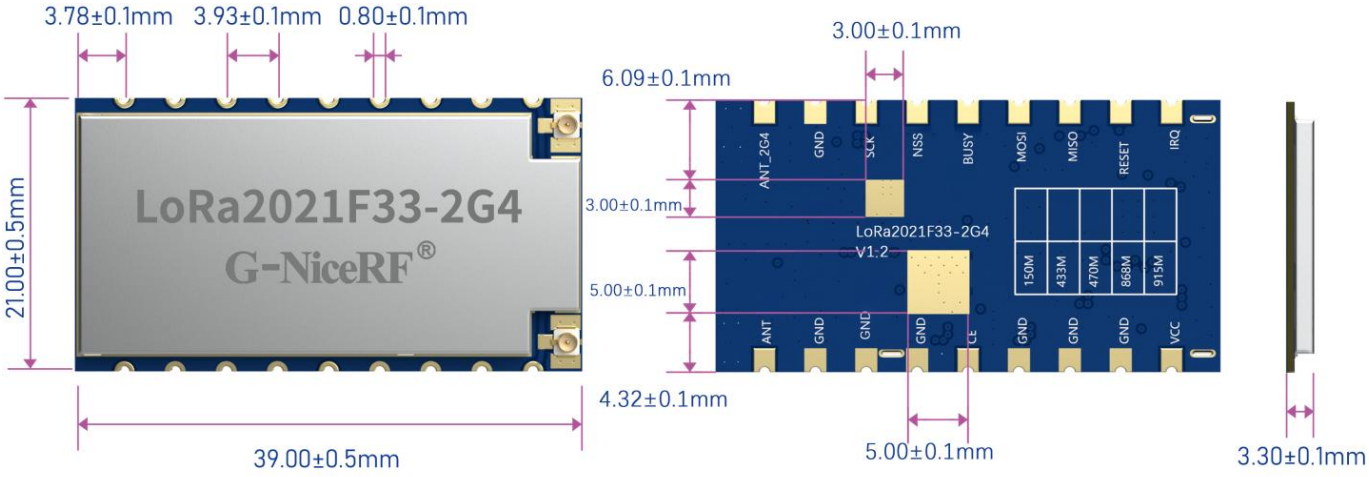
Notes:

1. For 433 MHz, setting the register value to 36 is sufficient to achieve optimal efficiency.
2. For 1.9–2.5 GHz, it is recommended not to set TxPower beyond 4 for optimal efficiency. Setting the power to the maximum level may result in lower output power and higher current consumption. Additionally, continuous long-duration transmission at maximum power could potentially damage the power amplifier.

■ Voltage vs. Power Table

Working Voltage (V)	433/470MHz		868/915MHz		1.9/2.5GHz	
	Power (dBm)	Transmit Current (mA)	Power(dBm)	Transmit Current (mA)	Power (dBm)	Transmit Current (mA)
3.3	28.9	770	26.2	540	26.4	590
3.6	30.3	903	27.2	576	27.3	650
4.0	31.2	994	28.2	626	28.3	730
4.5	31.8	1008	29.0	669	29.5	820
5.0	33.0	1100	29.7	711	30.0	840
5.5	33.3	1118	30.4	759	30.2	860

9. Mechanism Dimension (Unit: mm)



Appendix 1: Function Demonstration Board

1. Function Description

The LoRa2021F33-2G4 High-Power Wireless Module DEMO Board primarily implements bidirectional communication (Master and Slave) in LoRa mode, along with sleep mode (Sleep), as well as testing functions for Transmit Power (TxTest) and Receive Sensitivity (RxTest).

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.

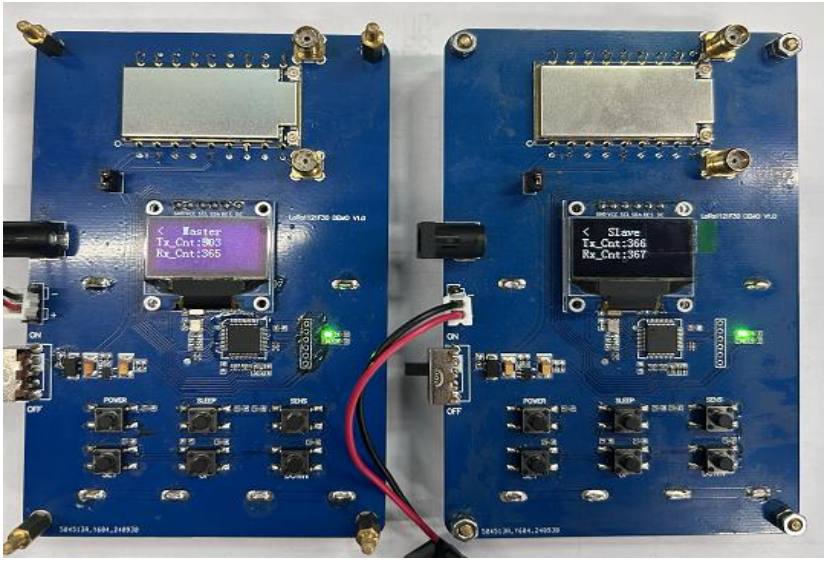
3. Setting Interface Description

Parameter Name	Description	LoRa Mode	FLRC Mode
Mod	Modulation	LoRa	FLRC
Mode	Function	Master, Slave, TXTEST, RXTEST, SLEEP	
Band	Frequency Band	LF: 150-960MHz, HF: 1500-2500MHz	
FREQ	Frequency(MHz)	Set value (MHz)	
POWER	TX Power	0-9 Levels	
SF(LoRa)	Spreading Factor	5-12	N/A
BW(LoRa)	Bandwidth	62.5/125/250/500/1000(Sub-GHz) 203/406/812(2.4G)	N/A
CR(LoRa)	Coding Rate	4/5-4/8	N/A
DR_BW(FLRC)	Data rate, Bandwidth(Mbps)	N/A	0.26/0.32/0.52/0.65 /1.04/1.3/2.08/2.6
CR(FLRC)	Coding Rate	N/A	1/2, 3/4, 1, 2/3
Shape(FLRC)	Pulse shape	N/A	BT_05, BT_1, OFF

4. Communication Test

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

On the 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: