FL22-C8

LoRa 868/915MHz SPI Passive crystal standard modules

The FL22-C8 is a new generation of LORA spread spectrum RF transceiver module from Lierda Technology Group, with smaller size, lower power consumption and higher transmitting power. Based on SEMTECH's RF integrated chip LLCC68 development block. It is a high-performance IoT wireless transceiver, and its special LoRa debugging method can greatly increase the communication distance, which can be widely used in various occasions in the field of short-range IoT wireless communication. It has the characteristics of small size, low power consumption, long transmission distance and strong anti-interference ability, etc. A variety of antenna solutions are available according to the actual application, and the module is not equipped with a micro-control chip, which is mainly used for secondary development by customers.

Product features

•**Operating frequency band**

- Operating frequency band 860-930MHz（902.3-924.9MHZ for FCC application）

•**Multiple modulation options**

- Supports LoRa,GFSK, FSK and other modulation methods

•**Ultra-low power consumption**

- Supports 1.8V to 3.7V power supply (transmit power at +18dBm configuration, must not fall below 3.1V)
- Transmit current ≤ 125mA (maximum transmit power configuration)
- Receive current ≤ 6.5mA (DC-DC mode)
- 600uA standby current
- 600nA sleep current (register value saved)

•**High Link Budget**

- Sensitivity -124dBm±1dBm (SF=7, BW_L=125KHz)
- Transmit power Max. 18 dBm

•**Size**

- 18.4*18.4*3.0mm

•**Ultra-long transmission range**

- 6Km@250bps (urban environment, LoRa modulation, maximum transmitting power)

•**High confidentiality**

- Using LoRa modulation, which cannot be captured and parsed by conventional wireless devices

•**Communication interface**

- SPI communication interface, can be directly connected to various microcontrollers, software programming is very convenient

Applicable scenarios

-Automated Building Circulation System

-Smart Home

-Temperature and humidity sensors

-Wireless remote control, drones

-For applications requiring high communication distance

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Document revision history

Version	Date	Change description
Rev01	2021-03-31	Initial version
Rev02	2021-04-21	Add packet length parameter table
Rev03	2021-09-09	Add EU regional parameter description
Rev04	2022-05-31	Revised product name

1 Specification

Table 1-1 Module limit parameters

Main parameters	Performance		Remarks
	Minimum value	Maximum value	
Supply voltage (V)	-0.5	+3.9	
Maximum RF input power (dBm)	-	+10	
Operating temperature (° C)	-40	+85	

Table 1-2 Module operating parameters [1]

Main parameters	Performance			Remarks
	Minimum value	Typical values	Maximum value	

1, the above test conditions are, temperature: 25 ℃, centre frequency: 915MHz, operating voltage: 3.3V
2, the output power must be set in accordance with the optimization recommendations, if the settings do not match the recommended value, the power and power consumption may not be excellent, or even damage to the module, see Table 1-3 & Table 1-4 for configuration.

Operating voltage (V)		1.8	3.3	3.7	
Operating temperature (° C)		-40	-	85	
Initial frequency offset (KHz)		-11	-	+11	
Operating Frequency Band (MHz)		860		930	902.3-924.9MHz for FCC application
Power consumption	Emission status (mA)	90	110	125	DC-DC Mode, 18dBm transmit
		-	50	60	DC-DC Mode, EU868, max14dBm transmit
	Receiving status (mA)	-	5.5	6.5	DC-DC Mode, Rx Boosted BW_L=125kHz
	Sleep state (uA)	-	0.6	2	Register value storage
Transmit power (dBm)		17	18	-	Setting the actual output at maximum output power
Reception sensitivity (dBm)		-	-124	-	BW_L=125KHz,SF=7
Communication Rate	LoRa (bps)	-	-	62.5K	User programmable customisation
	FSK (bps)	-	-	150K	User programmable customisation
Modulation method		LoRa/GFSK/FSK			User programmable customisation
Interface type		Stamp hole			2 mm Spacing
Communication protocols		SPI			SPI communication allows a maximum rate of 16MHz
Dimensions (mm)		18.4*18.4*3.0mm (Figure 2-1 for details)			-
Dimensional accuracy		Level GB/T1804-C			Meets dimensional tolerance class C requirements

Table 1-3 PA operating mode optimisation settings I

Output power (dBm)	paDutyCycle	hpMax	deviceSel	paLut	Value in SetTxParams
18	0x04	0x07	0x00	0x01	22

Note: For example, 915MHz, maximum 18dBm power, when using, you can go to the configuration to change the SetTxParams parameter value size to change the actual output power size, the maximum value is 22.

Table 1-4 PA operating mode optimisation settings II

Output power (dBm)	paDutyCycle	hpMax	deviceSel	paLut	Value in SetTxParams
14	0x02	0x02	0x00	0x01	21

Note: If 868MHz, 14dBm power is used, the SetTxParams parameter can be configured to change the actual output power.

2 Dimensional drawings and pin definitions

2.1 Dimensional drawings

Unit: mm

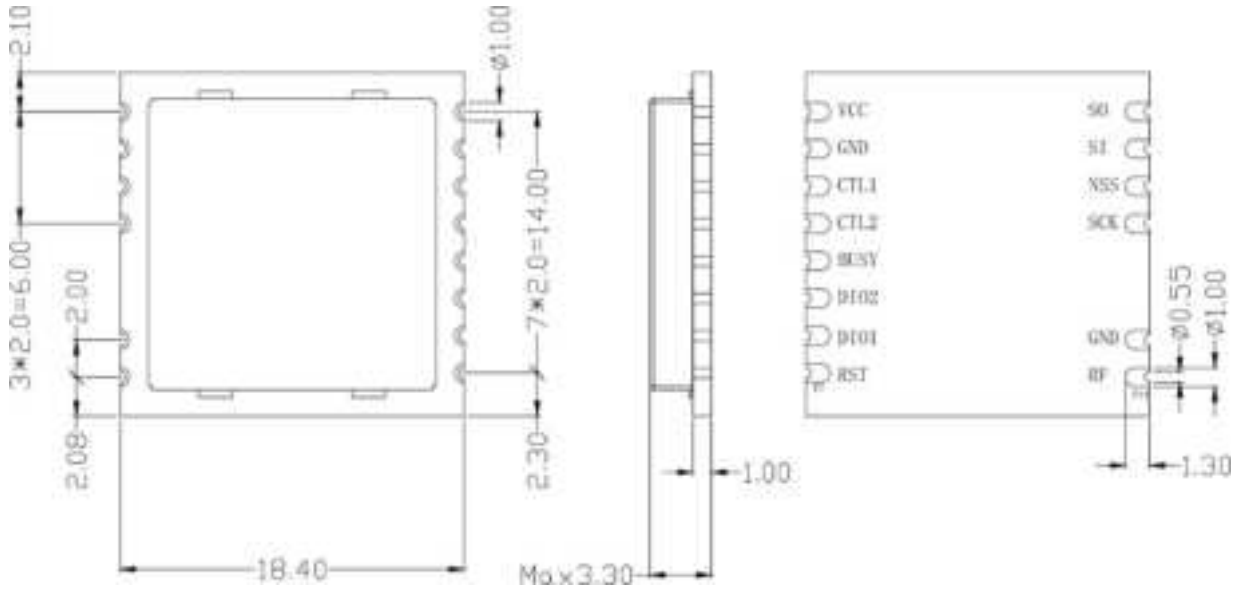

Figure 2-1 Dimensional drawing of FL22-22

2.3 Pin definitions

Table 2-1 Pin definitions

PIN	Interface name	Function
P1	NRESET	Reset pin, active low

P2	DIO1	Interrupt source mapping pins (see LLCC68 datasheet for details)
P3	DIO2	Interrupt source mapping pins (see LLCC68 datasheet for details)
P4	BUSY	Line Occupancy Indicator
P5	SW_CTL2	RF switch control pin 2,TX：SW_CTL1=0，SW_CTL2=1 RX：SW_CTL1=1，SW_CTL2=0 Sleep：SW_CTL1=0，SW_CTL2=0
P6	SW_CTL1	RF switch control pin 1，TX：SW_CTL1=0，SW_CTL2=1 RX：SW_CTL1=1，SW_CTL2=0 Sleep：SW_CTL1=0，SW_CTL2=0
P7	GND	Power ground
P8	VCC	Power supply VCC
P9	MISO	SPI data output
P10	MOSI	SPI data input
P11	NSS	Chip SPI enable
P12	SCK	SPI clock input
P13	GND	Power ground
P14	RF	RF output

3 Basic operation

3.1 Packet size selection

The maximum packet byte setting can support 255 bytes. Considering the actual usage, a packet with a larger number of bytes will last longer in the air and be susceptible to interference, especially at low rates which may have a greater impact, and this module may even fail to communicat

Table 3-1 FL22-22 LoRa mode supported rate configuration and recommended maximum packet length

BW / PL[2] / SF	125kHz
5	255 bytes (136ms)
6	255 bytes (229ms)
7	255 bytes (394ms)
8	255 bytes (696ms)
9	255 bytes (1250ms)
10	Not supported
11	Not supported
12	Not supported

3.2 Hardware layout considerations

1. 1. DIO port as far as possible to connect to the MCU with external interrupt IO port.
2. 2. The RF exit to the antenna pad part of the alignment as short as possible, to go 50Ω impedance line, and need to wrap the ground, the alignment around the more perforated.
3. 3. If possible, add π circuitry from the RF exit to the antenna pad.
4. 4. The antenna should be surrounded by clear space, leaving at least 5mm of clear space. 5.
5. 5. Pay attention to a good amount of grounding, preferably ensure a large area of grounding.
6. 6. Keep away from high voltage circuits, high frequency switching circuits.

7. can refer to the application document "RF PCB LAYOUT design rules (for sub-1GHZ and Bluetooth modules)" for layout and routing.

3.3 Software operation

By inserting the module on the user's board, using the microcontroller to communicate with the module via SPI, and manipulating its registers and transceiver cache via API commands, the wireless data transmission and reception function can be completed. Please refer to the latest LLCC68 data sheet for the timing of the module register read/write operations.

The API instructions are detailed in the LLCC68 datasheet and the corresponding API instruction functions are provided in the Lierda demo routines.

4 Frequently Asked Questions

4.1 Modules cannot communicate even at close range

- Confirm that the configuration of the transmit and receive sides do not match, different configurations do not communicate properly.
- Voltages are abnormal, low voltages can lead to transmission abnormalities.
- Low battery, low battery voltage will be pulled down when transmitting causing a

PL indicates the recommended maximum packet length or the time required to transmit the next packet of that packet length (calculated as CR=4/5, Preamble length is 8 symbol); "not supported" means that the LLCC68 chip itself does not support this configuration.

transmission abnormality.

• Antenna soldering abnormality RF signal is not reaching the antenna or π circuit is soldered incorrectly.

4.2 Module power consumption anomaly

• The module is damaged due to static electricity, etc., resulting in abnormal power consumption.

• hen doing low-power reception, incorrect timing configuration etc. leads to module power consumption does not achieve the expected effect.

• Individually measured module or MCU are normal, the power consumption abnormalities appear in the joint tuning is due to the MCU and RF module connection pins are not handled properly.

• The working environment is harsh, in high temperature, high humidity, low temperature and other extreme environment module power consumption will fluctuate.

4.3 Insufficient module communication distance

• The antenna impedance is not matched properly resulting in low power being transmitted.

- There are objects such as metal around the antenna or the module is inside metal causing severe signal attenuation.
- There are other interfering signals in the test environment causing the module to communicate at a close distance.
- Insufficient power supply causes the module to transmit at an abnormal power level.
- The test environment is harsh and the signal attenuation is high.
- Module through the wall and other environments and then communicate with the other end, the wall, etc. on the signal attenuation is very large, most of the signal is bypassed through the wall signal attenuation is large.
- The module is too close to the ground is absorbed and reflected resulting in poor communication.

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

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.

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.

RF Exposure Statement
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 and your body.

FCC Label Instructions
If using a permanently affixed label, the modular transmitter must be labeled with its own FCC identification number, and, if the FCC or IESD identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains FCC ID: 2AOFDFL22-C8".
Any similar wording that expresses the same meaning may be used. The Grantee may either provide such a label, an example of which must be included in the application for equipment authorization, or, must provide adequate instructions along with the module which explain this requirement.

OEM Guidance

1. Applicable FCC rules

This device complies with part 15.247 of the FCC Rules.

2. The specific operational use conditions

This module can be used in IoT devices. The input voltage to the module is **nominally 3.3 V DC. The operational ambient temperature of the module is -40 °C ~ 85 °C**. the e**xternal** antenna is allowed**, such as dipole antenna**.

3. Limited module procedures

N/A

4. Trace antenna design

N/A

5. RF exposure considerations

The 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 and your body. If the equipment built into a host as a portable usage, the additional RF exposure evaluation may be required as specified by 2.1093.

6. Antenna

Antenna type: Dipole antenna; Peak antenna gain : 2 dBi

7. Label and compliance information

An exterior label on OEM's end product can use wording such as the following: "Contains Transmitter Module FCC ID: 2AOFDFL22-C8" or "Contains FCC ID: 2AOFDFL22-C8"

8. Information on test modes and additional testing requirements

a) The modular transmitter has been fully tested by the module grantee on the required number of channels,modulation types, and modes, it should not be necessary for the host installer to re-test all the available transmitter modes or settings. It is recommended that the host product manufacturer, installing the modular transmitter,perform some investigative measurements to confirm that the resulting composite system does not exceed the spurious emissions limits or band edge limits (e.g., where a different antenna may be causing additional emissions).

b) The testing should check for emissions that may occur due to the intermixing of emissions with the other transmitters, digital circuitry, or due to physical properties of the host product (enclosure). This investigation is especially important when integrating multiple modular transmitters where the certification is based on testing each of them in a stand-alone configuration. It is important to note that host product manufacturers should not assume that because the modular transmitter is certified that they do not have any responsibility for final product compliance.

c) If the investigation indicates a compliance concern the host product manufacturer is obligated to mitigate the issue. Host products using a modular transmitter are subject to all the applicable individual technical rules as well as to the general conditions of operation in Sections 15.5, 15.15, and 15.29 to not cause interference. The operator of the host product will be obligated to stop operating the device until the interference have been corrected .

9. Additional testing, Part 15 Sub part B disclaimer The final host / module combination need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

The host integrator installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation and should refer to guidance in KDB 996369. For host products with certified modular transmitter, the frequency range of investigation of the composite system is specified by rule in Sections 15.33(a)(1) through (a)(3), or the range applicable to the digital device, as shown in Section 15.33(b)(1), whichever is the higher frequency range of investigation
When testing the host product, all the transmitters must be operating.The transmitters can be enabled by using publicly-available drivers and turned on, so the transmitters are active. In certain conditions it might be appropriate to use a technology-specific call box (test set) where accessory 50 devices or drivers are not available. When testing for emissions from the unintentional radiator, the transmitter shall be placed in the receive mode or idle mode, if possible. If receive mode only is not possible then, the radio shall be passive (preferred) and/or active scanning. In these cases, this would need to enable activity on the communication BUS (i.e., PCIe, SDIO, USB) to ensure the unintentional radiator circuitry is enabled. Testing laboratories may need to add attenuation or filters depending on the signal strength of any active beacons (if applicable) from the enabled radio(s). See ANSI C63.4, ANSI C63.10 and ANSI C63.26 for further general testing details.
The product under test is set into a link/association with a partnering device, as per the normal intended use of the product. To ease testing, the product under test is set to transmit at a high duty cycle, such as by sending a file or streaming some media conte**nt.**