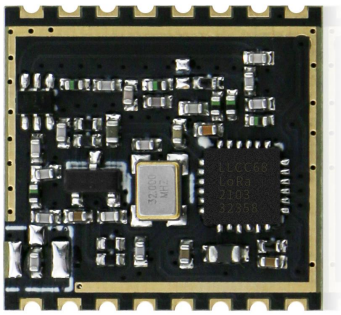
LoRa Wireless Transceiver Module Specification

Product Model: DL-LLCC68-S-868S (Shielding Cover)

File version: V1.3



DL-LLCC68-S-868

DL-LLCC68-S-868S

433/470/868/915MHz

Document Preparation/Revision/Abolition Record

date	Software Version	Develop/revise content	Formulate
2021-01-01	V1.0	DL-LLCC68-S Standard Module	Fagan
2021-09-16	V1.1	Corrected pin definition and description	Fagan
2021-12-10	V1.2	Correction parameters and instructions	Fagan
2023-03-15	V1.3	New shielding cover version	Fagan

Disclaimer:

This specification is only for guidance. Please refer to actual measurements for details. All statements and suggestions in this specification do not constitute any express or

The company does not assume any responsibility for personal injury or property damage caused by improper operation of the user.

1. Module Introduction

1.1 Product Overview

DL-LLCC68-S is a wireless RF module designed based on Semtech's RF chip LLCC68. It uses the new generation of LoRa™ Spread spectrum modulation technology is used for ultra-long distance spread spectrum communication. The module has small size, ultra-low receiving power consumption, strong anti-interference ability, and The transmission distance is longer than that of traditional modulation methods, and it can be widely used in various wireless communication fields of the Internet of Things.

DL-LLCC68-S has the highest sensitivity of -129dBm@LoRa, ultra-low receiving current and sleep current, and the transmit power can be adjusted. Through software configuration, the maximum power can reach +22dBm. Compared with traditional modulation technology, LoRa™ modulation technology has advantages in anti-blocking and selection. It has obvious advantages and solves the problem that traditional design solutions cannot take into account distance, anti-interference and power consumption at the same time.

1.2 Product Features

- Supports modulation modes such as (G)FSK and LoRa™;
- The chip supports a frequency range of 150~960MHz;
- Module design frequency band: 300~510MHz——433M/470M module; 800~960MHz——868/915M module;
- Working voltage 3.3V, maximum output transmission power +22dBm, maximum working current 130mA;
- It has low power consumption in receiving state, with the lowest receiving current of 5.3mA and sleep current of 1uA;
- Maximum sensitivity -129dBm @LoRa 1.76Kbps;
- Support fast automatic channel detection (CAD);
- Supported bandwidth BW: 125kHz 250kHz 500kHz;
- Support spreading factor SF: SF5/SF6/SF7/SF8/SF9/SF10/SF11;

  Note: BW = 125kHz Support SF5 - SF9

  BW = 250kHz Support SF5 - SF10

  BW = 500kHz Support SF5 - SF11 (See Table 4 below for details)

1.3 Typical Applications

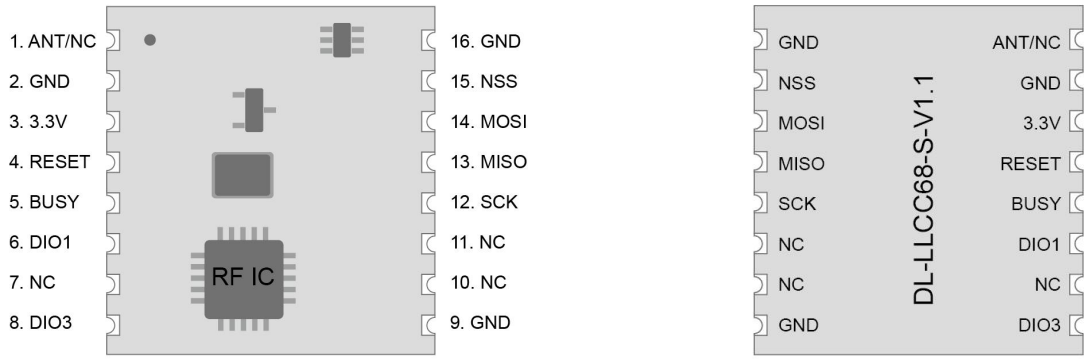
- Wireless automatic meter reading (water meter, electricity meter, gas meter)
- Ultra-long distance data communication
- Smart Home System
- Intelligent security monitoring
- Smart Building Automation
- Industrial controllers, sensors
- Agricultural Automation Solutions
- Smart parking system
- Automotive industry applications
- Supply Chain Logistics

2. Technical parameters

parameter	Minimum	typical	maximum	unit	Remark
Operating conditions					
Operating voltage and IO voltage range	1.8	3.3	3.7	V	Stable voltage ⩾3.1V To ensure maximum chip performance
Operating temperature range	- 40	25	85	℃	
Current consumption					
Receiving current	4.5	5.2	5.4	mA	The software adopts CAD working mode Can effectively reduce the overall operating current
Emission current		115 90 75		mA	@433MHz @DCDC ANT output +22dBm ANT output +21dBm ANT output +17dbm
		125 110 98		mA	@868MHz @915MHz @DCDC ANT output +21.5dBm ANT output +20dBm ANT output +17dbm
Sleep current	0.4	1.2	1.5	uA	@Register Save
RF parameters					
Module design frequency band	300	433/470	510	MHz	@433MHz/470MHz Module
	779	868/915	960	MHz	@868MHz/915MHz Module
Transmit power range	- 9	twenty two	twenty two	dBm	Software configurable see data sheet 13.4.4 SetTxParams
LoRa maximum receiving sensitivity			- 129	dBm	@BR_L=1.76Kbps SF9, BW_L = 125 kHz
FSK maximum receiving sensitivity			- 125	dBm	@BR_F = 0.6 kbps, FDA = 0.8 kHz, BW_F = 4 kHz
LoRa rate range	1.76		62.5	Kbps	@Effective Load Rate Min. for SF9, BW_L = 125 kHz Max. for SF5, BW_L = 500 kHz
FSK rate range	0.6		300	Kbps	

(Table 1)

3. Pin Definition



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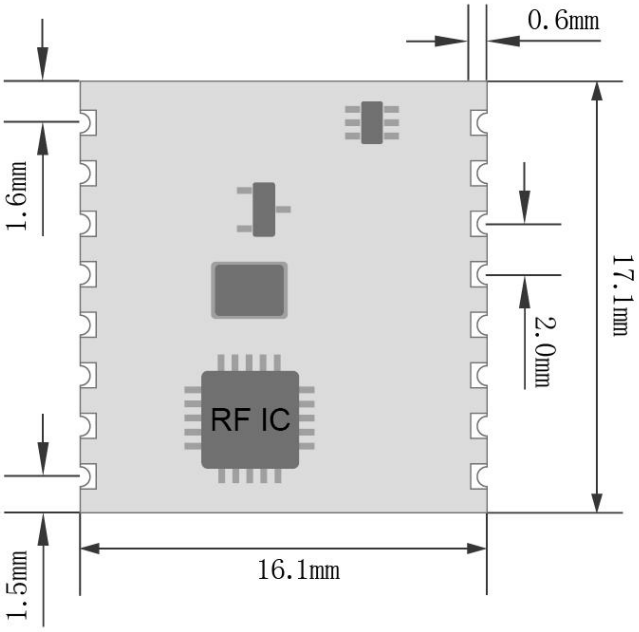
Pin Diagram

Pin function definition table

Serial number	Pin Definition	type	Functional Description
1	ANT/NC	AI/AO	RF signal input/output port, ANT port reserved matching circuit, use 50 Ω impedance matching for routing, lay ground and add vias around,
2	GND	PWR	Reliable grounding
3	3.3V	PWR	Stable voltage ⩾ 3.1V can ensure maximum chip performance
4	RESET	I	Hardware reset, initialize the chip, increase stability, low level 100uS reset
5	BUSY	O	Chip internal status indication pin, connected to MCU's GPIO
6	DIO1	IO	Digital DIO1 can be configured through the SPI interface
7	NC	NA	Just leave it hanging
8	DIO3	IO	Digital DIO3 can configure its function through SPI interface
9	GND	PWR	Reliable grounding
10	NC	NA	Just leave it hanging
11	NC	NA	Just leave it hanging
12	SCK	I	SPI clock input, connected to the controller SCLK
13	MISO	O	SPI data output, connected to controller MISO
14	MOSI	I	SPI data input, connected to controller MOSI
15	NSS	I	SPI chip select input, connected to the controller CSN
16	GND	PWR	Reliable grounding

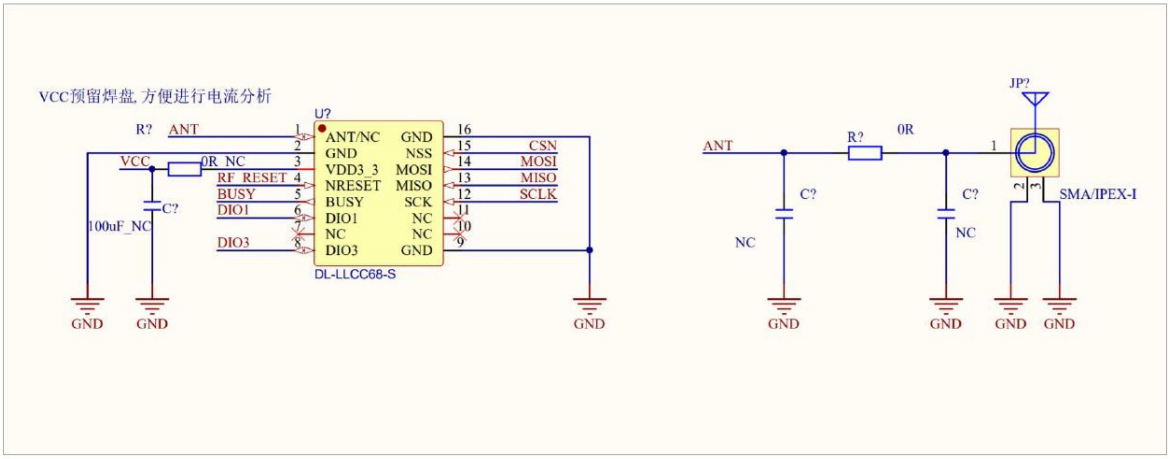
(Table 2)

4. Module size



DL-LLCC68-S Dimensions

5. Basic Circuit



6. Circuit Design

6.1 Power Supply Design

- Please pay attention to the device power supply voltage. Exceeding the recommended voltage range will cause module malfunction and permanent damage;
- Try to use a DC regulated power supply to power the module. The power supply ripple coefficient should be as small as possible, and the maximum transmission power should be considered.

  Power load;
- The module needs to be reliably grounded. Good grounding can achieve better performance output and reduce the impact of RF on other sensitive devices.

6.2 RF routing design

- The module should be away from interference sources such as high-frequency circuit transformers and RF. It is forbidden to directly route the wires under the module, otherwise it may affect the receiving sensitivity.
- When using an onboard antenna, both sides of the antenna need to be clear, and the ground should not be too close to the antenna, otherwise it will absorb the radiated energy;
- Route 50Ω impedance lines, lay ground and drill more ground holes;
- If the PCBA space allows, reserve a π-type matching network and connect it through a 0R resistor first, otherwise the antenna will be open-circuited.

6.3 Antenna Related

- There are many types of antennas, choose the right one according to your needs;
- The antenna needs to be placed in a suitable position according to its polarity. It is recommended to place it vertically upward.
- There must be no metal objects on the antenna radiation path, otherwise the transmission distance will be affected (such as a closed metal casing).

6.4 LLCC68 IO Design

- When designing hardware, for data packet mode (SPI transmission), at least general SPI and RST, BUSY, DIO1 need to be connected to the microcontroller.

  On GPIO;
- In the software, DIO1 and DIO3 can be used to map the interrupt events of the chip and query the interrupt source through the function, but not every module

  For details, please refer to: Chip Manual: 13.3 DIO and IRQ Control Functions

  Chip manual: Table 13-29: IRQ Registers (interrupt source)
- Electronic switch switching of transmit and receive modes

The module uses the chip's DIO2 to automatically control the antenna switch through the circuit inside, so there is no related TXEN RXEN pin.

This facilitates and simplifies software control and saves related pins, but you must ensure that the software is used carefully when writing.

SetDIO2AsRfSwitchCtrl to enable automatic control (SDK default).

7. Software debugging process

7.1 Transplant the HAL interface (SPI interface, and pay special attention to verifying that the reset function is normal);

7.2 Be familiar with the chip register table and related API (data sheet location: 12.1 Register Table);

7.3 Enable DIO2 for internal automatic electronic switch control SetDIO2AsRfSwitchCtrl;

7.4 According to the routine, use two verification boards to complete the communication verification;

7.5 It is recommended to use LoRa modulation. After the communication is normal, the modulation parameters need to be optimized and the spreading factor can be changed according to your needs.

Bandwidth and other parameters are used to control the code transmission time (related to symbol time) and communication distance;

7.6 It can be set through the SetModulationParams function. The commonly used debugging parameters are as follows:

Modulation bandwidth (BW_L)	The higher the BW, the faster the modulation rate, but the larger the signal bandwidth, which will reduce the sensitivity of the receiver.
Spreading Factor (SF)	The higher the SF, the greater the demodulation sensitivity and the longer the distance. The disadvantage is that it will greatly increase the transmission time.
Coding rate (CR)	In the case of severe interference, it can increase the anti-interference ability, but the disadvantage is that the coding efficiency is reduced and the baud rate is slowed down. In normal cases, the default CR = 4/5 is sufficient.
Low Rate Optimization (LDRO)	When the single symbol time is equal to or greater than 16.38 ms, low rate optimization needs to be enabled

(Table 3)

7.7 The maximum transmit power can be +22dbm to provide the maximum link budget;

7.8 If low power consumption is required, the CAD working mode (sleep-detect signal-sleep) can be used in the software to achieve low power consumption

Data sheet: 6.1.5 LoRa® Channel Activity Detection (CAD);

7.9 Spreading factor in LoRa mode, correspondence between the transmitted symbol time and the actual payload bit rate:

SF \ BW	125		250		500	
	Symbol time (ms)	rate (kbps)	Symbol time (ms)	rate (kbps)	Symbol time (ms)	rate (kbps)
5	0.26	15.63	0.13	31.25	0.06	62.50
6	0.51	9.38	0.26	18.75	0.13	37.5
7	1.02	5.47	0.51	10.94	0.26	21.88
8	2.05	3.13	1.02	6.25	0.51	12.5
9	4.10	1.76	2.05	3.52	1.02	7.03
10	Not supported		4.10	1.95	2.05	3.91
11	Not supported		Not supported		4.10	2.15

(Table 4)

Note: Payload data refers to the data you actually transmit, but the actual transmission time includes not only the payload, but also

The preamble, header, and its coding rate, and the check bits of the payload.

For details, please refer to the data sheet: 6.1.3 LoRa® Frame

8.0 About frequency setting:

In order to maximize the performance of the module, you must select the hardware module corresponding to the frequency end, and the software is recommended to use when setting

The frequency range is as follows:

430 ~ 440 MHz, 470 ~ 510 MHz, 779 ~ 787 MHz, 863 ~ 870 MHz, 902 ~ 928 MHz

8. Notes

（1）This module is an electrostatically sensitive product. Please operate on an anti-static workbench during installation and testing;

（2) When installing the module, nearby objects should be kept at a safe distance from the module to prevent short circuit damage;

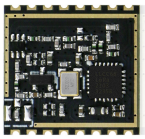
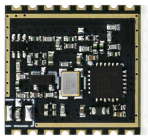
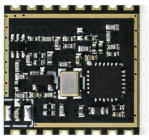
（3）Never allow any liquid to come into contact with this module. This module should be used in a dry environment;

（4）Use an independent voltage stabilizing circuit to power this module, avoid sharing with other circuits, and the error of the power supply voltage should not be greater than5%;

（5）The indicators of this module meet the common international certifications. If the products of customers using this module need to pass certain special certifications, our company will

Adjust certain indicators according to customer needs.

IX. Order Model Table

Order Model	Product images	Appearance	Product frequency
DL-LLCC68-S-433		Without shielding cover	433MHz
DL-LLCC68-S-868		Without shielding cover	868MHz
DL-LLCC68-S-915		Without shielding cover	915MHz
DL-LLCC68-S-433S		With shielding cover	433MHz
DL-LLCC68-S-868S		With shielding cover	868MHz
DL-LLCC68-S-915S		With shielding cover	915MHz

10. Contact Information

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