LoRa wireless transceiver module specification sheet

Product model: DL-LLCC68-S

File version: V1.2

DL-LLCC68-S
433/470MHz

DL-LLCC68-S
868/915MHz

Document creation/revision/abolition resume

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 definitions and descriptions	Fagan
2021-12-10	V1.2	Correction parameters and instructions	Fagan

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This specification is only used as a guide, please refer to actual measurement for details. All statements and recommendations in this specification do not constitute any express or IMPLIED WARRANTIES. The company does not assume any responsibility for personal injury or property damage caused by improper operation by the user.

1. Module introduction

1.1 Product Overview

DL-LLCC68-S is a wireless radio frequency module designed based on Semtech's radio frequency chip LLCC68. Adopt new generation LoRa™ Spread spectrum modulation technology, used for ultra-long distance spread spectrum communications. The module has small size, ultra-low receiving power consumption, strong anti-interference ability, and The transmission distance is farther than 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 Through software configuration, the maximum power can reach +22dBm. Compared with traditional modulation technology, LoRa™ modulation technology has the advantages of anti-blocking and selection. The obvious advantage 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

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

Note: BW = 125kHz supports SF5 - SF9

BW = 250kHz supports SF5 - SF10

BW = 500kHz supports SF5 - SF11 (see Table 4 below for details)

1.3 Typical applications

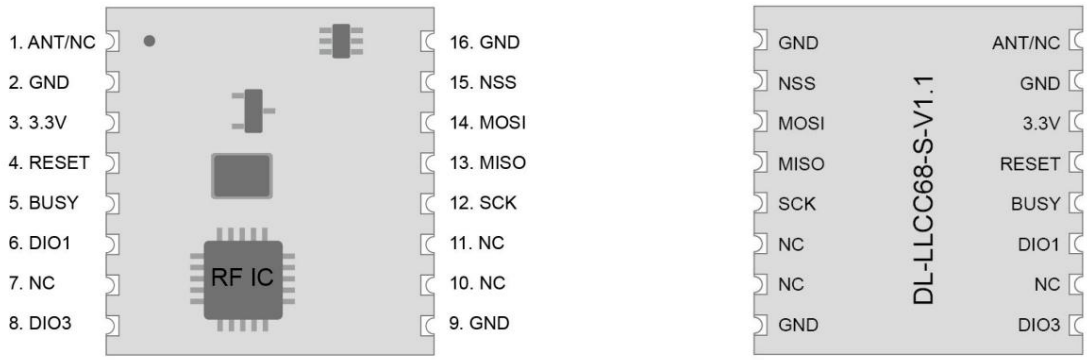
- Wireless automatic meter reading (water meter, electricity meter, gas meter)
- Ultra-long distance data communication
- Smart home system
- Intelligent security monitoring
- Intelligent building automation
- Industrial controllers and sensors
- Agricultural automation solutions
- Intelligent parking 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	IN	Stable voltage ÿ3.1V To ensure maximum chip performance
range of working temperature	-40	25	85 ÿ		
Current consumption					
receive 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	22	22	dBm	See data sheet for software configurability 13.4.4 SetTxParams
LoRa highest receiving sensitivity			-129 dBm		@BR_L=1.76Kbps SF9, BW_L = 125 kHz
FSK highest 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		@payloadrate 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



front back

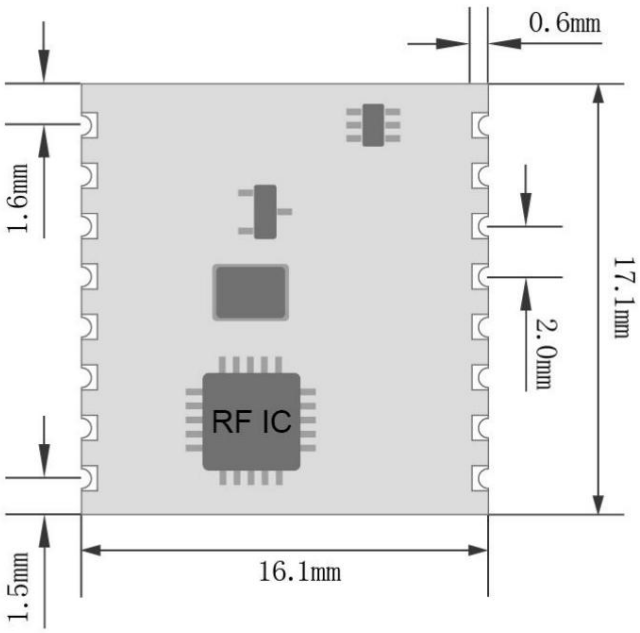
Pin diagram

Pin function definition table

Serial number pin definition type			Function Description
1	ANT/NC	AI/AO	RF signal input/output port, ANT port reserved matching circuit, use 50 ÿ impedance matching for wiring, lay the ground and add vias around it.
2	GND	PWR	Reliable grounding
3	3.3V	PWR	Stable voltage ÿ3.1V can ensure maximum chip performance
4	RESET	I	Hardware reset, initialize chip, increase stability, low level 100uS reset
5	BUSY	O	The internal status indication pin of the chip is connected to the GPIO of the MCU
6	DIO1	IO	Digital DIO1 can configure its function through the SPI interface
7	NC	THAT	Just leave it floating
8	DIO3	IO	Digital DIO3 can configure its functions through the SPI interface
9	GND	PWR	Reliable grounding
10	NC	THAT	Just leave it floating
11	NC	THAT	Just leave it floating
12	SCK	I	SPI clock input, connected to controller SCLK
13	MISO	O	SPI data output, connected to controller MISO
14	SMOKE	I	SPI data input, connected to controller MOSI
15	NSS	I	SPI chip select input, connected to controller CSN
16	GND	PWR	Reliable grounding

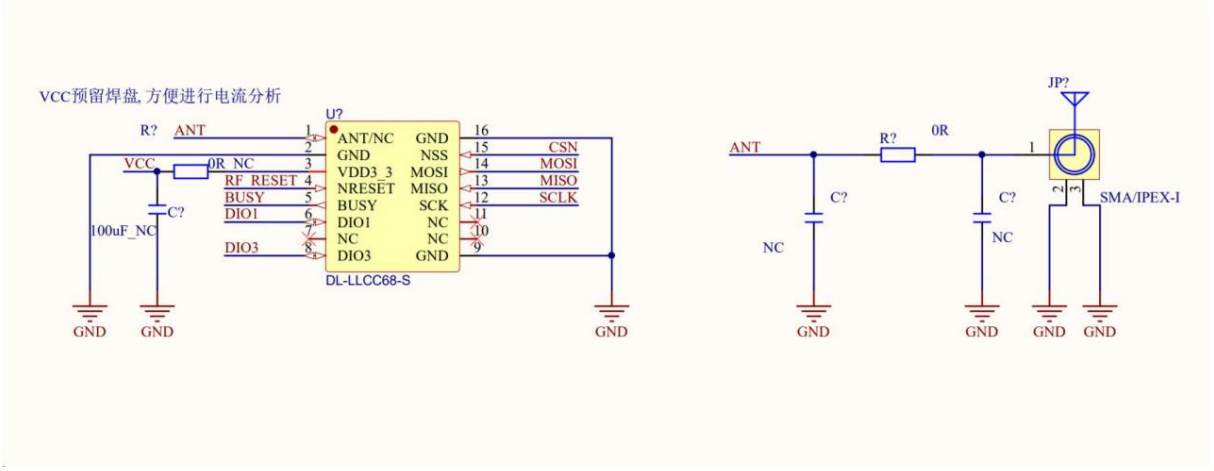
(Table 2)

4. Module size



DL-LLCC68-S Dimensional drawing

5. Basic circuit



6. Circuit design

6.1 Power supply design

- Please pay attention to the power supply voltage of the device. Exceeding the recommended voltage range may cause abnormal module function and permanent damage;
- Try to use a DC regulated power supply to power the module, keep the power supply ripple coefficient as small as possible, and consider the maximum transmit power.

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

6.2 RF wiring design

- The module is far away from interference sources such as high-frequency circuit transformers and RF. It is prohibited to route wires directly on the lower layer of the module, otherwise it may affect the receiving sensitivity;
- When using the onboard antenna, the antenna requires clearance on both sides, and the floor cannot be too close to the antenna, otherwise the radiated energy will be absorbed;
- Route 50ÿ impedance lines, lay the ground and drill more ground holes;
- If the PCBA space allows, reserve a ÿ-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 appropriate antenna according to your needs;
- The antenna needs to be placed in a suitable position according to the polarity, and it is recommended to be vertically upward;
- There should be no metal objects in 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 the general SPI and RST, BUSY, and DIO1 need to be introduced to the microcontroller.

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

  The formulas are common. For specific reference: Chip Manual: 13.3 DIO and IRQ Control Functions

  Chip manual: Table 13-29: IRQ Registers (interrupt sources)
- About electronic switch switching of transceiver mode

  The DIO2 of the chip is used for automatic control of the antenna switching switch through a circuit inside the module, so there is no relevant TXEN RXEN pin.

This facilitates and simplifies software control . Save related pins . But make sure you use it carefully when writing the software

SetDIO2AsRfSwitchCtrl to enable automatic control (SDK default).

7. Software debugging process

7.1 Migrate the HAL interface (SPI interface, and pay special attention to verify 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 verification of sending and receiving communication;

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

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

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

Modulation bandwidth (BW_L)	The higher the BW, the faster the modulation rate, but the large signal bandwidth will reduce the sensitivity of the receiver.
Spreading factor (SF)	The higher the SF, the greater the sensitivity of demodulation and 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 performance. The disadvantage is that the coding efficiency is reduced and the baud rate becomes slower. Under normal circumstances, use the default CR = 4/5.
Low Rate Optimization (LDRO)	When a single symbol time is equal to or greater than 16.38 ms . Low rate optimization needs to be turned on

(table 3)

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

7.8 If low power consumption is required, the CAD working mode (sleep-detection 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 Correspondence table between spreading factor, transmitted symbol time and actual payload bit rate in LoRa mode:

BW / SF	125		250		500	
	Symbol tim ÿmsÿ	rate ÿkbpsÿ	Symbol tim ÿmsÿ	rate ÿkbpsÿ	Symbol tim ÿmsÿ	rate ÿkbpsÿ
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 support		4.10	1.95	2.05	3.91
11	not support		not support		4.10	2.15

(Table 4)

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

The preamble, header, and its encoding rate, and the parity bits of the payload.

Specific reference data sheet: 6.1.3 LoRa® Frame

8.0 About frequency setting:

In order to ensure the maximum performance of the module, be sure to select the hardware module corresponding to the frequency end, and the software is recommended during setting

The frequency range is as follows:

430 ~ 440 MHz ÿ470 ~ 510 MHz ÿ779 ~ 787 MHz ÿ863 ~ 870 MHz ÿ902 ~ 928 MHz

8. Precautions

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

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

(3) Never allow any liquid material 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 and avoid sharing it with other circuits. The error of the power supply voltage should not be greater than 5%;

(5) All indicators of this module comply with commonly used international certifications. If the products used by customers in this module need to pass certain special certifications, our company will

Adjust certain indicators based on customer needs.

9. Contact information

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