MAXIIOT

DL7812 LoRa Module

Datasheet

Version: LoRa_DL7812_Datasheet_V1.0.1

Date: 2017-12-12

Maxiiot Ltd.

Document Revision Record

Version	Date	Description	
V1.0.1	2017-12-12	Preliminary version	Ming

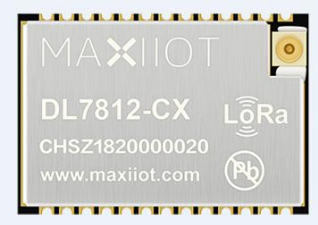
Copyright Notice

Disclaimer

Maxiiot Ltd reserves the right to change, modify or improve the document and product described herein . Its contents are subject to change without notice. These instructions are intended for you use at your own risk .

Overview

DL7812 is a low power,LoRaWAN based wireless communication module for 433MHz/470-510MHz band. It integrated with Semtech SX1278 RF chip and ambiQ micro Apollo1 MCU, DL7812 can achieve a sensitivity of over -139dBm,The high sensitivity combined with the integrated +18.6dBm power amplifer yields industry leading link budget making it optimal for any application requiring range or robustness.



Product Features

- ✓ LoRaWAN technique
- ✓ Frequency： ISM band, 433MHz/470-510MHz Optional.
- ✓ Hig sensitivity: down to -139dBm
- ✓ +18.6dBm constant RF output
- ✓ 25mW RF transimission, 7 level adjustable
- ✓ Effective communication range : 3~5KM
- ✓ Ultral low power consumption, a single battery pack can work 3-5 years
- ✓ Small size designed for quick integration of end nodes to LoRaWAN
- ✓ Dimensions:22.0*15.0*2.7mm (W*L*H)
- ✓ RoHS compliant

Application

- ✓ Low power consumption IoT application
- ✓ Home and Building Automation
- ✓ Wireless Alarm and Security Systems
- ✓ Industrial Monitoring and Control
- ✓ Long range Irrigation Systems
- ✓ Smart Environmental Monitoring
- ✓ Smart Cities
- ✓ Smart Agriculture
- ✓ Automated Meter Reading
- ✓ Location Monitoring

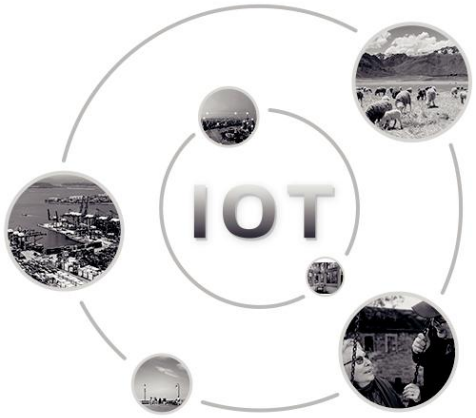


Table Of Contents

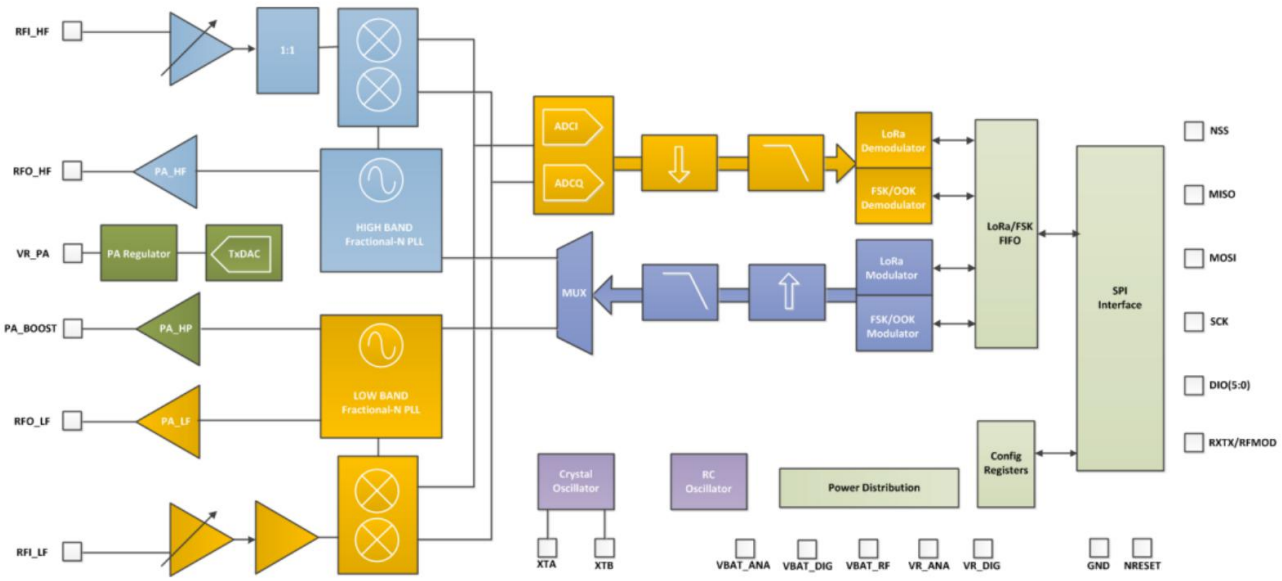
1. Description

The DL7812 incorporates the LoRa® spread spectrum modem which is capable of achieving significantly longer range than existing systems based on FSK modulation. At maximum data rates of LoRa® the sensitivity is 8dB better than FSK, but using a low cost bill of materials can improve receiver sensitivity. LoRa® also provides significant advances in selectivity and blocking performance, further improving communication reliability. For maximum flexibility the user may decide on the spread spectrum modulation bandwidth (BW), spreading factor (SF) and error correction rate (CR). Another benefit of the spread modulation is that each spreading factor is orthogonal - thus multiple transmitted signals can occupy the same channel without interfering. This also permits simple coexistence with existing FSK based systems.The DL7812 offer bandwidth options ranging from 7.8 kHz to 500 kHz with spreading factors ranging from 6 to 12, and covering lower UHF bands.

DL7812 LoRa module are available in 2 product variants

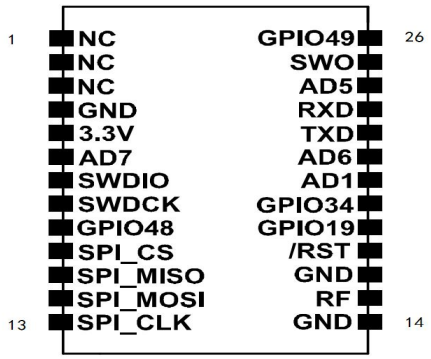
No.	Part No.	Description	Remark
1	DL7812-W	433MHz,Suitable for China, Europe	
2	DL7812-C	470-510MHz,Suitable for China	

1.1 Simplified Block Diagram



1.2 Pin Diagram

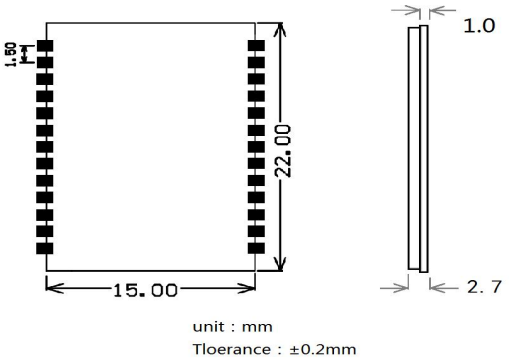
1.2.1 Pin Arrangement Diagram



1.2.2 Pin Description

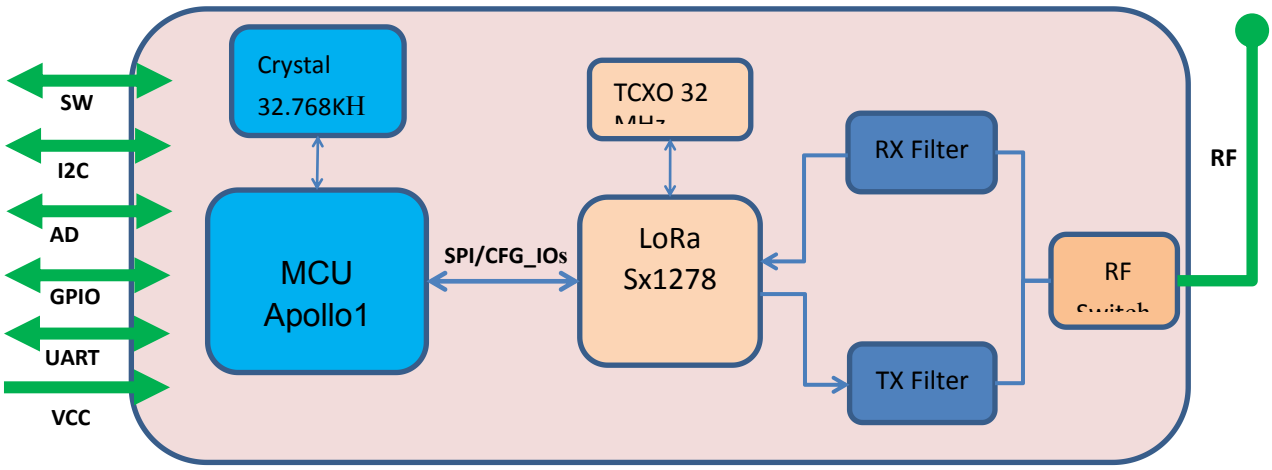
No.	Name	I/O	Description
1	NC		Not Connected
2	NC		Not Connected
3	NC		Not Connected
4	GD		GROUND
5	3.3V		VCC_3.3V
6	AD7		AD in / GPIO
7	SWDIO		MCU Debug Port
8	SWDCK		MCU Debug Port
9	GPIO48		GPIO
10	SPI_CS		SPI_CS
11	SPI_MISO		SPI_MISO
12	SPI_MOSI		SPI_MOSI / I2C_SDATA
13	SPI_CLK		SPI_CLK / I2C_SCLK
14	GND		GROUND
15	RF		RF Tx/Rx
16	GND		GROUND
17	/RST		Module Negative Reset
18	GPIO19		GPIO
19	GPIO34		GPIO
20	AD1		AD in / GPIO
21	AD6		AD in / GPIO
22	TXD		U(S)ART_TX
23	RXD		U(S)ART_RX
24	AD5		AD in / GPIO
25	SWO		MCU Debug
26	GPIO49		GPIO

1.3 Dimensions

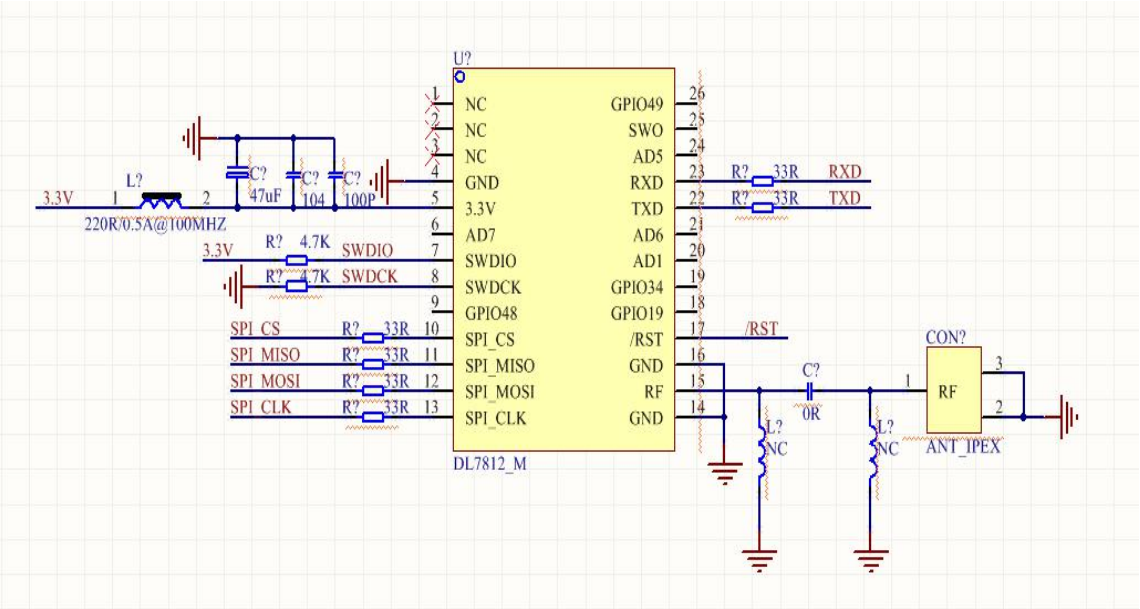


Item	Length	Width	Thickness	Unit	Remark
Size	22.0	15.0	2.7	mm	

1.4 Function Block Diagram



1.5 Reference Circuit



2. Electrical characteristics

2.1 ESD Notice

DL7812 is a high performance radio frequency device. It satisfies:

- ✓ Class 2 of the JEDEC standard JESD22-A114 (Human Body Model) on all pins.
- ✓ Class III of the JEDEC standard JESD22-C101 (Charged Device Model) on all pins

It should thus be handled with all the necessary ESD precautions to avoid any permanent damage

2.2 Absolute Maximum Ratings

Item	Min	TyP	Max	Unit
Supply Voltage	-0.3	+3.3	+3.9	V
Storage Temperature	-40		+125	℃

Table 1 Absolute Maximum Ratings.

Exposure to absolute maximum ratings for extended periods may affect device reliability.

2.3 Operating Range

Item	Min	TyP	Max	Unit
Supply Voltage	+3.0	+3.3	+3.6	V
Operation Temperature	-40		+85	℃

Table 2 Operating Range

2.4 Operating Environment

Item	Desription
Modulation	LoRa®
WAN Protocol	ISM Band – LoRa®
Operating Humidity	10%～90%
Dimensions	TYP. 22*15*2.7mm (W*L*H)
ESD	JEDEC JS-001 Standard ±1kV, Class 2

Table 3 Opertatng Environment

2.5.Electrical Specification

Supply voltage VDD = 3.3 V， temperature=25°C， FXOSC= 32 MHz， FRF = 433MHz/470~510MHz Pout =+18.6dBm, shared Rx and Tx path matching.

Item	Description
Frequency	433MHz/470-510MHz
Tx Power	+18.6dBm
Receive Sensitivity	Down to -139dBm
Supply Voltage	+3.3V

Average Tx Current	≤120mA
Sleeping Current	≤1uA
Average Rx Current	≤25mA
Link Budget	Up to 157.6dB

Table 4 Module Specification

2.5.1 Power Consumption

Description	Conditions	Min	TyP	Max	Unit
Supply Current in Sleep Mode		-	0.2	1	uA
Supply Current in Standby Mode	Crystal oscillator enabled	-	1.6	1.8	mA
Supply Current in Receive Mode	LNA off	-	10.8	-	
	LNA on	-	11.5	-	mA
	RFOP = +17 dBm,	-	87	-	mA
	RFOP = +13 dBm,	-	29	-	mA
	RFOP = + 7 dBm,	-	20	-	mA

Table 5 Power consumption specification

2.5.2 Frequency Synthesis

Description	Conditions	Min	TyP	Max	Unit
Frequency Range	Programmable	-	433	-	MHz
		470	-	510	MHz
Crystal Oscillator frequency	-	-	32	-	MHz
Crystal Oscillator wake-up time	-	-	250	-	us
Frequency synthesizer wake-up time to PIILock signal	From standby mode	-	60	-	us
Bit Rate, FSK		1.2	-	300	kbps
Bit Rate Accuracy, FSK	ABS	-	-	250	ppm
Bit Rate , OOK		1.2	-	32.768	kbps
Bit Rate , LoRa Mode	From SF6,BW500KHz To SF12,BW=7.8KHz	0.018	-	37.5	kbps
Frequency diviation , FSK		0.6	-	200	KHz

Table 6 Frequency Synthesizer Specification

2.5.3. FSK / OOK Mode Receiver

All receiver tests are performed with RxBw = 10 kHz (Single Side Bandwidth) as programmed in RegRxBw . Sensitivities are reported for a 0.1% BER (with Bit Synchronizer enabled), unless otherwise specified. Blocking tests are performed with an unmodulated interferer. The wanted signal power for the Blocking Immunity, ACR, IIP2, IIP3 and AMR tests is set 3 dB above the receiver sensitivity level.

Description	Conditions	Min	TyP	Max	Unit
LNA gain	FDA=5KHz， RB=1.2kbs	-	-121	-	dBm
	FDA=5KHz， RB=4.8kbs	-	-117	-	dBm
	FDA=40KHz， RB=38.4kbs	-	-107	-	dBm
	FDA=40KHz， RB=38.4kbs	-	-95	-	dBm
	FDA=62.5KHz， RB=250kbs***	-	-	-	dBm
OOK sensitivity， highest LNA gain	BR=4.8kbs/s	-	-117	-	dB
	BR=32kbs/s	-	-108	-	dB
Blocking immunity	offset=±1MHz	-	71	-	dB
	offset=±2MHz	-	76	-	dB
	offset=±10MHz	-	84	-	dB
RSSI Dynamic Range	AGC Enabled Min	-	-127	-	dBm
	Max	-	0	-	dBm

Table 7 FSK / OOK Recevier Specification

2.5.4.FSK / OOK Mode Transmitter

Description	Conditions	Min	TYP	Max	Unit
PA_ RF output Power	Max	-	+20	-	dBm
	Min	-	-1	-	dBm
Transmitter Phase Noise	10KHz	-	-110	-	dB
	50KHz	-	-110	-	dB
	400KHz	-	-122	-	dB
	1MHz	-	-129	-	dBm

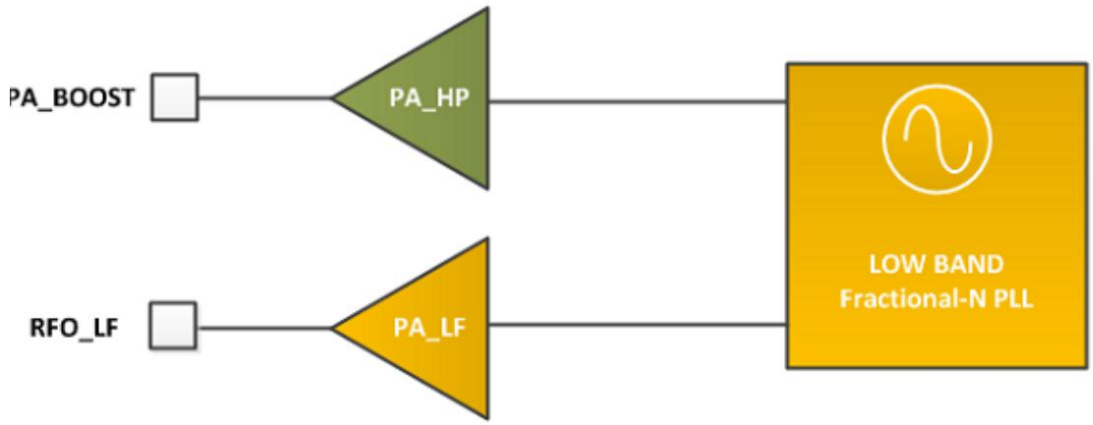
Table 8 FSK / OOK Transmitter Specification

3. Transmitter Description

The transmitter of DL7812 comprises the frequency synthesizer, modulator (both LoRa® and FSK/OOK) and power amplifier blocks, together with the DC biasing and ramping functionality that is provided through the VR_PA block

3.1 Architecture Description

The architecture of the RF front end is shown in the following diagram:



3.2. RF Power Amplifiers

PA_HF and PA_LF are high efficiency amplifiers capable of yielding RF power programmable in 1 dB steps from -4 to +18.6dBm directly into a 50 ohm load with low current consumption. PA_LF covers the lower bands (433~510MHz).

The output power is sensitive to the power supply voltage, and typically their performance is expressed at 3.3V.

PA Slect	Mode	Power Range	Pout Formula
0	PA_HF or PA_LF on RFO_HF or RFO_LF	-4dBm to +18.6dBm	Pout=Pmax-(15-OutputPower) Pmax=10.8+0.6 x MaxPower [dBm]

Table 9 Power Amplifier Mode Slection Truth Table

Notes

- For +18.6dBm restrictions on operation please consult the following .
- To ensure correct operation at the highest power levels ensure that the current limiter OcpTrim is adjusted to permit delivery of the requisite supply current.
- If the PA_BOOST pin is not used it may be left floating.

4. Recevier Description

4.1 Overview

DL7812 features a digital receiver with the analog to digital conversion process being performed directly following the LNA-Mixers block. The receiver also has automatic gain calibration, this improves the precision of RSSI measurement and enhances image rejection.

4.2 Receiver Enabled and Receiver Active States

In the receiver operating mode two states of functionality are defined. Upon initial transition to receiver operating mode the receiver is in the 'receiver-enabled' state. In this state the receiver awaits for either the user defined valid preamble or RSSI detection criterion to be fulfilled. Once met the receiver enters 'receiver-active' state. In this second state the received signal is processed by the packet engine and top level sequencer.

4.3 Automatic Gain Control In FSK/OOK Mode

The AGC feature allows receiver to handle a wide Rx input dynamic range from the sensitivity level up to maximum input level of 0dBm or more, whilst optimizing the system linearity.

RX input level (Pin	Gain Setting	LnaGain	Relative LNA Gain [dB]	NF Lower/Higher Band [dB]	IIP3 Lower/Higher band [dBm
Pin <= AgcThresh1	G1	'001'	0 dB	4/5.5/7	-15/-22/-11
AgcThresh1 < Pin <= AgcThresh2	G2	'010'	-6 dB	6.5/8/12	-11/-15/-6
AgcThresh2 < Pin <= AgcThresh3	G3	'011'	-12 dB	11/12/17	-11/-12/0
AgcThresh3 < Pin <= AgcThresh4	G4	'100'	-24 dB	20/21/27	2/3/9
AgcThresh4 < Pin <= AgcThresh5	G5	'110'	-26 dB	32/33/35	10/10/14
AgcThresh5 < Pin	G6	'111'	-48 dB	44/45/43	11/12/14

Table 10 LNA Gain Control and Performances

4.4 RSSI in LoRa® Mode

The RSSI values reported by the LoRa® modem differ from those expressed by the FSK/OOK modem.The following formula shows the method used to interpret the LoRa® RSSI values:

RSSI[dBm]= -137+RSSI

5. List of AT Command

Pls take reference to document《MAXIIOT-DL7612&DL7812-AT-CMD-V1.6》

6. Package

Module	Package			Article number
	Form	QTY	Size	
DL7812	Tape & Reel	As required	As required	Undertermined
	Trays	As required	As required	Undetermined

Table 11 Packing information

7. Contact Us

Maxiiot Ltd
Web: http://www.maxiiot.com/English_Pages/index.html
Tel:+86-755-2645-9429
Fax: +86-755-2947-6513
Office address : Room 302,3F, No. 16, Lane 1,Liuxian No.2 Road,
Bao'an District. 518100 Shenzhen, China