Ra-01H Specification

Version V1
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Versions records

Dates	Version	Author	Version information
2019.9.20	V1.0	FAE.Junx	Original

一、 Product Overview

Ai-Thinker lora Series Module (ra-01) designed and developed by Ai-Thinker .This module is used for long distance spread spectrum communication.，Its RF chip SX1276（as show as figure 1）Mainly used LoRa^{TM} remote modem，for ultra-long-distance spread spectrum communication，strong anti-interference，can minimize current consumption. With the help of the SEMTECH the patent technology of LoRaTM, SX1276 with -148dBm high sensitive，with +20dBm power output, long range transmission, high reliablity. Meantime，relative traditional modulation technique，LoRa^{TM} modulation technique has obvious advantages in anti-blocking and selection, It solves the problem that traditional design scheme can not consider distance, anti-interference and power consumption simultaneously.

Its application can be automatic meter reading, home building automation, security system, remote irrigation system.
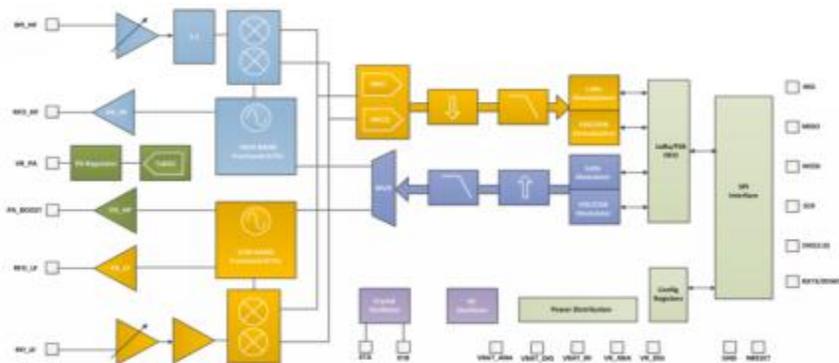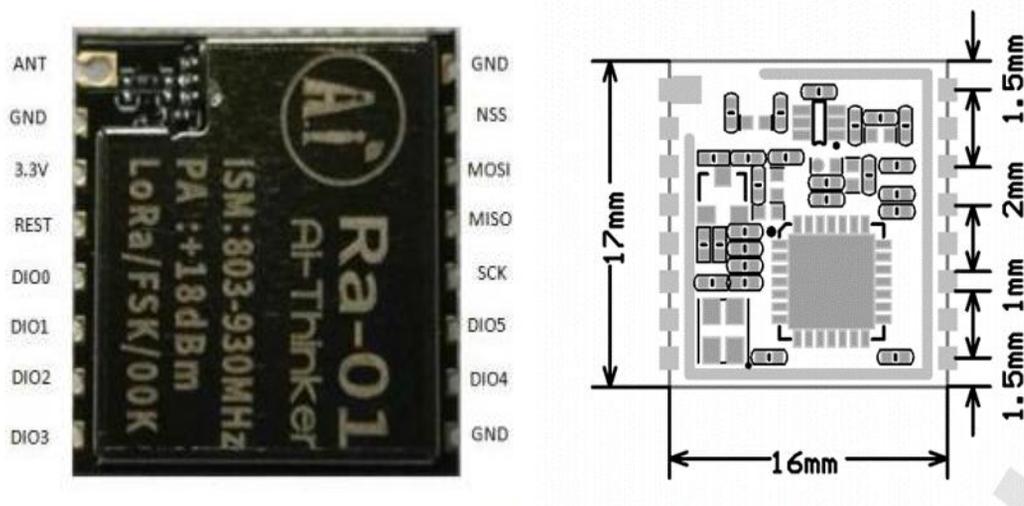

Figure 1 SX1276 Functional block diagram

Apperance

Features

- LoRa^{TM} modem .

- support FSK、GFSK、MSK、GMSK、- LoRa^{TM} and OOK mode

- Low power consumption in a received stat,the received current is12.5mA，stand-by current is 1.6mA

- support 868/915MHz

- operating voltage is 3.3V,maximum output

+19dBm，the maximum output current is105mA.

- high sensitivity：as low as-140dBm

- Small volume double row stamp hole patch package

- SPI interface，using half duplex communication, With CRC、up to 256-byte packet engine

Main parameters

Charter 1.1 main parameters instruction

Module name	Ra-01
package	SMD-16
Size	17*16*3.2mm
Certificate	-
Support port	SPI interface
Programmable bit rate	Up to 300kbps
Spectrum range	803-930MHz
Antenna	Spring antenna
Power supply	3.3V
Average operating current(Unit：mA)	868MHz Tx:103mA,Rx:12.15mA,Stanbdby:1.6mA; 915MHz Tx:97mA,Rx:12.15mA,Stanbdby:1.5mA;
Working temperature	-20 ℃ ~ 85℃
Storage environment	-40 ℃ ~ 125℃ , ＜ 90%RH
weight	0.46g

二、 Pin definition

Ra-01 module with 16 interface，show as figure 2.1，table 2.2 is the interface definition.
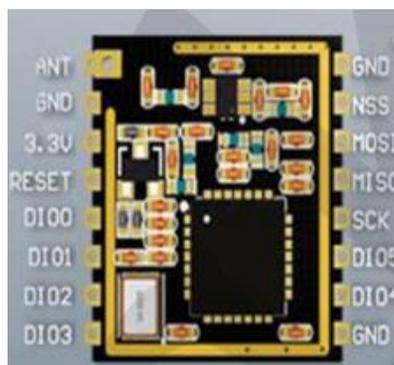
ΙFigure 2.1 Ra-01Pin diagram

Table 2.2 Pin function definition

No	Pin name	Function instruction
1	ANT	Antenna
2	GND	Ground
3	3.3V	3.3V power supply（VDD）
4	RESET	Reset
5	DIO0	Digital IO0 software configuration
6	DIO1	Digital IO1 software configuration
7	DIO2	Digital IO2 software configuration
8	DIO3	Digital IO3 software configuration
9	GND	ground
10	DIO4	Digital IO4 software configuration
11	DIO5	Digital IO5 software configuration
12	SCK	SPI clock input
13	MISO	SPI data output
14	MOSI	SPI data input
15	NSS	SPI Selection input
16	GND	ground

The six general IO pin of SX1276 can be available in LoRaTM mode.
Their mapping depends on the configuration of the two registers RegDioMapping1 and RegDioMapping2.

Operation modu	DIOx Mapping	DIO5	DIO4	DIO3	DIO2	DIO1	DIO0

le							
all	00	ModeReady	CadDetected	CadDone	FhssChange Channel	RxRimeout	RxDone
	01	ClkOut	PllLock	ValidHeader	FhssChange Channel	FhssChange Channel	TxDone
	10	ClkOut	PllLock	PayloadCrc Error	FhssChange Channel	CadDetected	CadDoe
	11	–	–	–	–	–	–

三、 Functional description

Transmitter

The SX1276's shooter consists of a frequency synthesizer, a modulator (LoRaTM and FSK/OOK modulator), and a power amplifier module---DC voltage offset and ramp up and ramp down via VR_PA.

Receiver

The SX1276 is equipped with a digital receiver that simulates the digital conversion process after the LNA and mixing module.
In addition to the LoRaTM modulation scheme, the low IF receiver can demodulate ASK, OOK, (G)FSK, and (G)MSK modulated signals.
Programs such as filtering, demodulation, gain control, synchronization, and packet processing are all digitally executed and more flexible to configure. The receiver also performs automatic gain calibration, which improves RSSI measurement accuracy and improves image rejection.

LoRaTM modem

The LoRaTM modem uses spread spectrum modulation and forward error correction. Compared with the traditional FSK or OOK modulation technology, this technology not only expands the coverage of the wireless communication link, but also improves the robustness of the link. Designers can adjust the spread factor and error correction rate to achieve a better balance between bandwidth usage, data rate, link budget improvement, and interference immunity. Another important feature of the LoRaTM modem is its greater immunity to interference. The rejection of the co-channel GMSK interference signal is 20 dB. Because of this strong anti-interference, the LoRaTM modulation system can not only use the frequency band with higher spectrum usage rate, but also can be used in the hybrid communication network to expand the coverage when the original modulation scheme fails in the network. After starting LoRaTM mode (ie setting the LongRangeMode bit of RegOpMode), you can view LoRaTM modulation.
The mode of operation of the demodulator. The range of functions and register accesses provided depends on the selected mode of operation, as detailed in the table below: send feedback history record

Operation mode	Description
Sleeping mode	Low power mode. In this mode, only the SPI and configuration registers are accessible and the LoRa FIFO is not accessible. This is the only mode of operation that allows switching between FSK/OOK mode and LoRa mode.
Working	The crystal oscillator and LoRa baseband module are turned on,

mode	while the RF section and PLL are turned off.
FSTx mode	This is a frequency synthesis mode for transmission. The selected transmit PLL is locked and remains active on the transmit frequency. The RF section is turned off.
FSRx mode	This is a frequency synthesis mode for reception. The selected receive PLL is locked and remains active on the receive frequency. The RF section is turned off.
TX mode	When this mode is activated, the SX1276 will turn on all modules required for transmission, turn on the power amplifier (PA), send packets, and switch back to standby mode.
RXconstant mode	When this mode is activated, the SX1276 will open all modules required for reception and process all received data until the client requests a change in operating mode.
RX single mode	When this mode is activated, the SX1276 will turn on all modules required for reception, maintain this state until a valid data packet is received, and then switch back to standby mode.
CAD mode	In CAD mode, the device will detect the known channel to detect the LoRa preamble signal.

You can switch from one mode to another by changing the value of the RegOpMode register.

四、 electrical parameters

Recommended working condition：

Working condition	Name	Minimum value	Typical value	Maxmum value	Unit
Working temperature	TOPR	−40	20	85	℃
Power supply	VDD	1.8	3.3	3.6	V

Digital port characteristics：

IO	Name	Minimum value	Typical value	Maxmum value	Unit
IO Level	VIO	1.8	3.3	3.6	V
Low input logic level	VIL	–	–	0.2	V
High input logic level	VIH	0.8	–	–	V
Low output logic level	VOL	–	–	0.1	V
High output logic level	VOH	0.9	–	–	V

SPI interface features：

| Symbol	Description	Condition	Minimum value	Typical value	Maxmum value	Unit
Fsck	SCK frequency	–	–	–	10	MHz
tch	SCK High time	–	50	–	–	ns
t_{cl}	SCK low time	–	50	–	–	ns
t_{rise}	SCK Rise Time	–	–	5	–	ns
t_{fall}	SCK fall Time	–	–	5	–	ns
t_{setup}	MOS time setting	Change from MOSI to the rising edge of SCK	30	-	-	ns
t_{hold}	MOSI Duration	From the rising edge of SCK to the change of MOSI	20	-	-	ns
t_{nsetup}	NSS time setting	From the falling edge of NSS to the rising edge of SCL	30	-	-	ns
t_{nhold}	NSS duration	From the falling edge of SCL to the rising edge of NSS,	100	-	-	ns

		Normal mode				
t_{nhigh}	SPIAccess interval NSS High time	-	20	-	-	ns
T_DATA	DATA maintenance and setup time	-	250	-	-	ns

五、 Flow soldering graph

Refer to IPC/JEDEC standard：Peak Temperature : <250℃ ： Number of Times: ≤2 times：
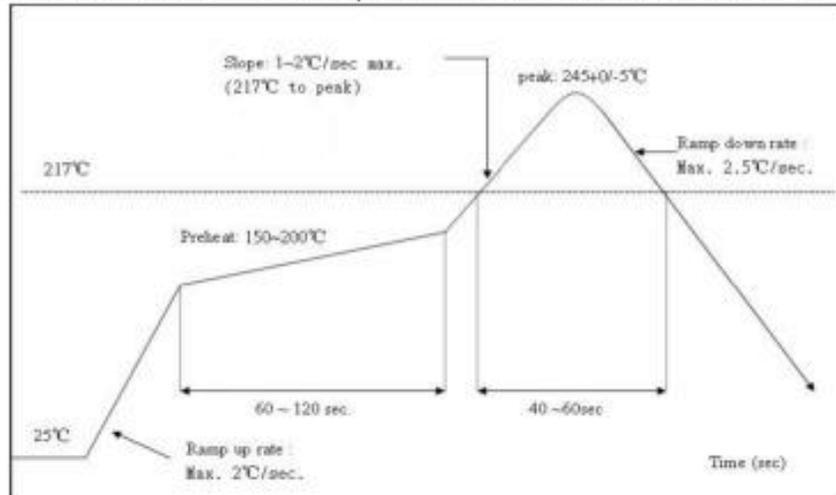
六、 Circuit application
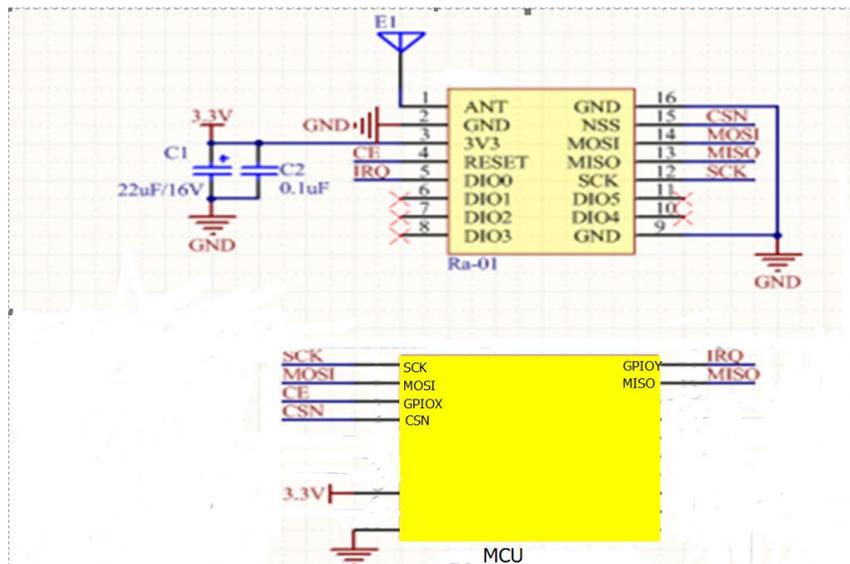
SX1276 chip requirements for MCU:

parameters	Minimum requirements	Recommended requirements
MCU RAM	8KB	16KB
MCU FLASH	128KB	256KB
AES 128bits	AES decryption	Secure Element
Radio DIOs connected to MCU IRQ inputs	DIO0,DIO1,DIO2	DIO0,DIO1,DIO2,DIO3
SPI(4wires:SCK,MOSI,MISO,NSS)	Mandatory	
RTC(32.768kHz XTAL)	Recommended for accurate time keeping	Mandatory for Class B nodes smd

七、 Contacts

Company website：https://www.ai-thinker.com

Developer Wiki：http://wiki.ai-thinker.com

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