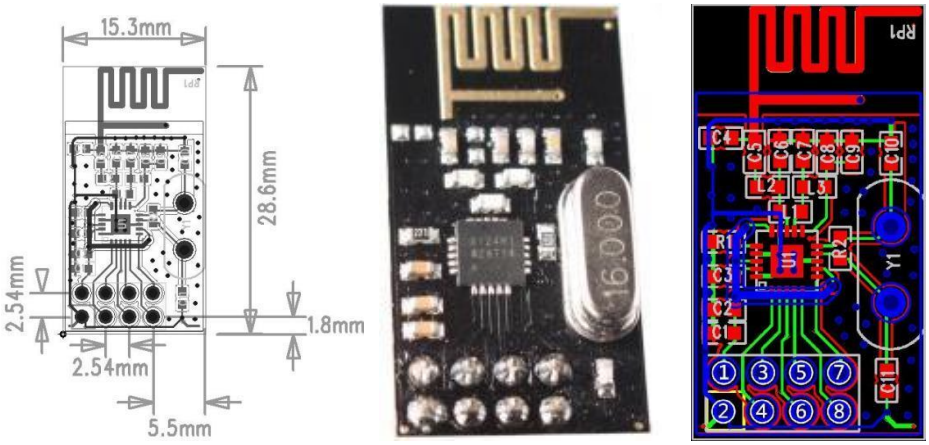
Introduction Freenove NRF-01 Module

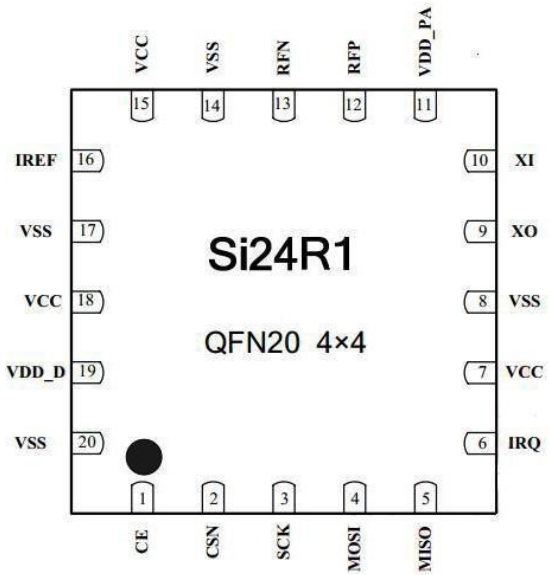
Embedded with Si24R1 RF chip, NF-01-S Wireless Transceiver is a 5mW power 2.4G module with high airspeed (up to 2Mbps), SPI interface, high stability and high cost performance. With DIP-8 package, it can be quickly connected to existing products. As an ideal product for IoT applications, NF-01-S is widely used in wireless mouse, wireless remote control, somatosensory devices, active RFID, NFC, low-power ad hoc network wireless sensor nodes, etc.

Appearance and Size

Physical Map of the Chip



Appearance Drawing of the Module



Specifications

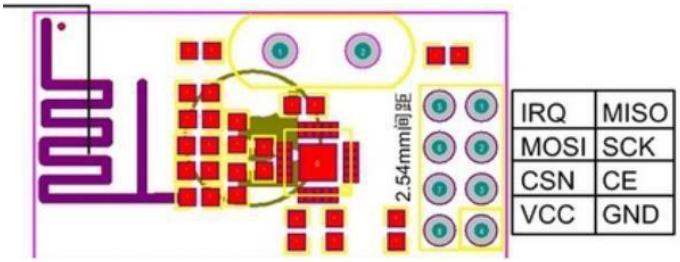
No.	Parameters	Value	Note
01	Chip Type	Si24R1	Made in China
02	Module Size	28.6*15.3	±0.2mm
03	Modulation Methods	GFSK/FSK	GFSK/FSK
04	Package	DIP-8	Dual In-line
05	Interface	Four-line SPI	Max rate ⩽10M
06	Transmit Power	Max: 7dBm	Refer to the chip manual for details.
07	RSSI	Support	Detection of received signal strength
08	Operating Frequency	2.402GHz~2.480GHz	Adjustable; Stepping: 1MHz
09	Voltage Range	1.9~3.6V	Common: 3.3V Too high voltage will damage the module.
10	Data Rate	2Mbps/1Mbps/250Kbps	Refer to the chip manual for details.
11	Communication Channel	79 RF Channel	Each channel is spaced by 1MHz.
12	Testing Distance	240m	Sunny, Obstacle-free; Max transmit power
13	Receiver Sensitivity	-96dBm@250Kbps	Refer to the chip manual for details.
14	Antenna Interface	On-board PCB Antenna	Characteristic Impedance: 500
15	Transmitting Rate	Signle Date Package 1~32 byte	3-Tier FIFO
16	Receiving Rate	Signle Date Package 1~32 byte	3-Tier FIFO
17	Operating Temperature	-20 ~ +70℃	Module will be damaged if temperature is too high.
18	Storage Temperature	-40 ~ +125℃	Module will be damaged if temperature is too high.
19	Turn-off Current	0.7 μA	Refer to the chip manual for details.
20	Standby Current	15μA	Refer to the chip manual for details.
21	Receiving Current	15Ma(2Mbps)	Refer to the chip manual for details.
22	Transmitting Current	25mA (7dBm)	Refer to the chip manual for details.

Definition of Pins

Name	Type	Use
VCC	-	Power Supply; Range: 1.9V~3.6V
GND	-	Ground, connected to the power reference point

CSN	Input	Chip Select Pim, used to start an SPI communication.
CE	Input	Chip Enable; When CE is at low level, the module is at standby mode.
MOSI	Input	SPI Data Input Pin
SCK	Input	SPI Bus Clock
IRQ	Output	Interrupt Signal Output, active at low level
MISO	Output	SPI Data Output Pin

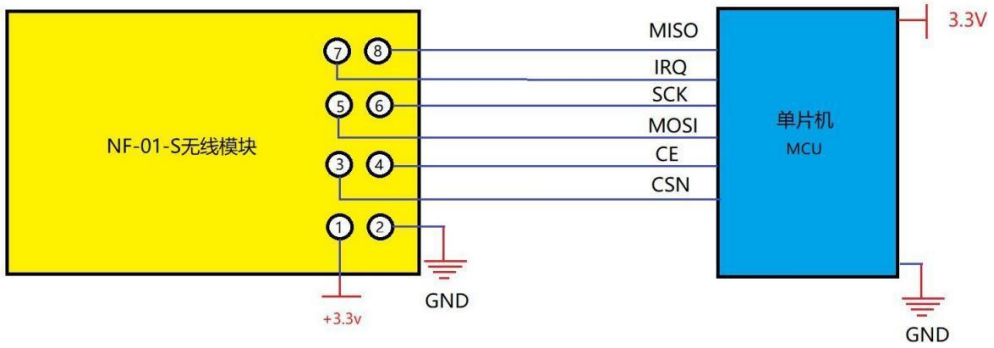
Pin Definition



Cautions

No.	Category	Cautions
01	Static Electricity	High-frequency analog devices are sensitive to static electricity, please avoid human body contact with electronic components on the module.
02	Power Supply	Ensure that the power supply must have a small ripple to avoid large jumps in the power supply voltage value. It is recommended to use a π-type filter (ceramic capacitor//Tantalum capacitor + inductor
03	Ground	The module uses a single-point grounding method. It is recommended to use a 0 ohm resistor or a 0mH inductor. The reference ground of other parts of the circuit is separated.
04	Antenna	Whether the antenna is covered by a metal shell. Some components, like relays, will affect the performance of the antenna. At the same time, it is necessary to ensure that the antenna is exposed, preferably vertically upward
05	Interference	If there are wireless modules of other frequency bands in the same product, it is necessary to plan the frequency reasonably and adopt measures such as shielding to reduce the influence of harmonic interference and intermodulation interference.
06	Crystal Oscillator	If there is a crystal oscillator near the module circuit board, please increase the straight-line distance between the module and the crystal oscillator as much as possible

Typical Circuit



Schematic Diagram of the connection between MCU and NF-01-S

Descriptions

- CE can be connected to high level for a long time, but the module must be set to power-down mode when writing the register. It is recommended that the CE pin be connected to the GPIO of MCU.
- IRQ can be disconnected, and the interrupt status of the STATUS register can be obtained by SPI query. However, it is recommended to use the hardware external interrupt of the MCU. Connect the IRQ to the external trigger pin of the MCU to trigger the MCU interrupt.
- The RF chip model used by NF-01-S is Si24R1. Please read and write the chip registers according to the timing of the chip manual. For details, please refer to the Si24R1 chip manual or download the sample STM32 and 51 MCU drivers on the official website.
- Make sure the ground is connected well. Ensure a tiny power supply ripple coefficient and reliable ground.The filter capacitor should be added and placed as close as possible to the VCC and GND pins of the module.
- For information of other 2.4G modules , please visit this website: https://docs.ai-thinker.com/2.4g

The Power Consumption of the Chip

Modes	Min	Typical	Max	Unit
Power-off	-	0.7	-	μA
Standby	-	15	-	μA
Receiver(2Mbps)	-	15	-	mA
Transmitter(7dBm)	-	25	-	mA

Common Problems

The communication distance is short, not reaching the ideal distance

NO.	Reasons	Description
01	Obstacles	Due to its physical characteristics, the 2.4G frequency band has poor penetration. When there are obstacles in straight-line communication, the communication distance will be greatly shortened.
02	Interruption Source	Temperature, humidity, and electromagnetic wave interference at the same frequency end will increase the packet loss ratio of communication.
03	Antenna	The antenna uses 50 ohm impedance wiring, which can cause signal attenuation if the antenna is near a metal object or if the module is placed in a shielded housing.
04	CE Pin	The transmitter device is not kept high in the program configuration, resulting in reduced sensitivity when the response model is received
05	Transmitting Power	When configuring the register, the higher the transmit power configuration, the farther the transmit distance will be.
06	Transmitting Rate	If the configured transmission rate is too high, the transmission distance will be relatively reduced.
07	Low Voltage	The power supply voltage is less than 3.3v, resulting in insufficient power supply of the module, which relatively affects the transmit power of the module

The module is overheated and damaged

NO.	Reasons	Description
01	Power Supply	Please check the power supply to make sure it is between 1.9~3.6V, over 3.6V will cause damage to the module.
02	Stability	Check the stability of the power supply; the voltage should not fluctuate too much.

03	Anti-static	Ensure the anti-static operation during the installation and use of the power supply as high-frequency devices are electrostatically sensitive
04	Solder	The module cannot be reflowed and wave soldered, otherwise it will damage the module.

FCC Statement

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) thi s device may not cause harmful interference, and (2) this device must accept any interference received, incl uding interference that may cause undesired operation.

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

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursua nt to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful inte rference in a residential installation. This equipment generates uses and can radiate radio frequency energy a nd, if not installed and used in accordance with the instructions, may cause harmful interference to radio com munications. 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 turn ing 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 important announcement

Important Note:

Radiation 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 0cm between the radiator and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Country Code selection feature to be disabled for products marketed to the US/Canada.

This device is intended only for OEM integrators under the following conditions:

1. The antenna must be installed such that 0 cm is maintained between the antenna and users, and
2. The transmitter module may not be co-located with any other transmitter or antenna,

As long as the three conditions above are met, further transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Important Note:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

The final end product must be labeled in a visible area with the following" Contains FCC ID: **2A4TN-FN-NRF-01**"

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C has been investigated. It is applicable to the modular transmitter

2.3 Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

2.4 Limited module procedures

Not applicable

2.5 Trace antenna designs

Not applicable

2.6 RF exposure considerations

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 & your body.

2.7 Antennas

This radio transmitter FCC ID:**2A4TN-FN-NRF-01** has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna No.	Model No. of antenna:	Type of antenna:	Gain of the antenna (Max.)	Frequency range:
2.4G	/	PCB Antenna	0.5dBi for 2402-2480MHz;	

2.8 Label and compliance information

The final end product must be labeled in a visible area with the following" Contains FCC ID: 2A4TN-FN-NRF-01".

2.9 Information on test modes and additional testing requirements

Host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

2.10 Additional testing, Part 15 Subpart B disclaimer

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.

ISED Statement

- English: This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) This device may not cause interference, a nd (2) This device must accept any interference, including interference that may cause undesired operation of the device.

The digital apparatus complies with Canadian CAN ICES-3 (B)/NMB-3(B).

- French: Le présentappareilestconforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitationestautorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareildoit accepter tout brouillageradi oélectriquesubi, mêmesi le brouillageest susceptible d'encompromettre le fonctionnement.

l'appareil numérique du ciem conforme canadien peut - 3 (b) / nmb - 3 (b).

This device meets the exemption from the routine evaluation limits in section 2.5 of RSS 102 and compliance with RSS 102 RF exposure, users can obtain Canadian information on RF exposure and compliance.

cet appareil est conforme à l'exemption des limites d'évaluation courante dans la section 2.5 du cnr - 102 et conformité avec rss 102 de l'exposition aux rf, les utilisateurs peuvent obtenir des données canadiennes sur l'exposition aux champs rf et la conformité.

This equipment complies with Canada radiation exposure limits set forth for an uncontrolled environment.

Cet équipement est conforme Canada limites d'exposition aux radiations dans un environnement non contrôlé.

This equipment should be installed and operated with minimum distance 0cm between the radiator & your body.

Cet équipementdoit être installé et utilisé à une distance minimale de 0 cm entre le radiateur et votre corps.

ISED Modular Usage Statement

NOTE 1: When the ISED certification 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 the wording ”Contains transmitter module IC: 28247-FNNRF01” or “Contains IC: 28247-FNNRF01”.

NOTE 1: Lorsque le numéro de certification ISED n'est pas visible lorsque le module est installé dans un autre appareil, l'extérieur de l'appareil dans lequel le module est installé doit également afficher une étiquette faisant référence au module inclus. Cette étiquetteextérieure peut être libellée Contient le module émetteur IC: 28247-FNNRF01 ou Contient IC: 28247-FNNRF01.