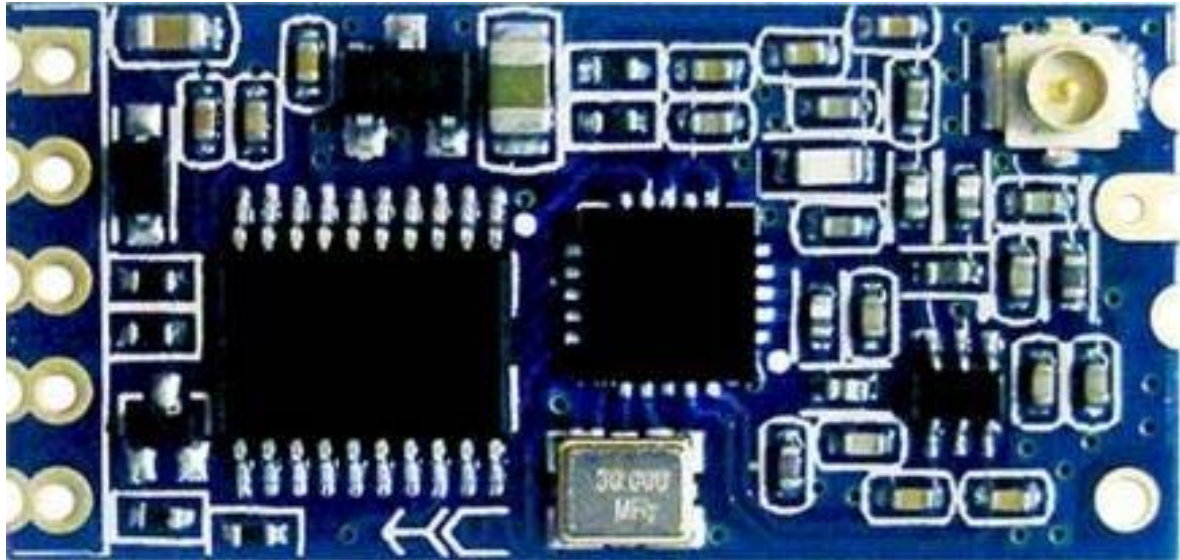


# HC-12 WIRELESS RF UART COMMUNICATION MODULE V2.4 USER MANUAL



**Version**

HC-12V2.4

**Date**

2016-12-02

## Specifications

- Long communication distance (About 1000 meters at default setting)
- Operating frequency range (433.4—473.0MHz)
- Transmit power (max: 20dBm)
- Power supply voltage (DC 3.2V ~5.5V)

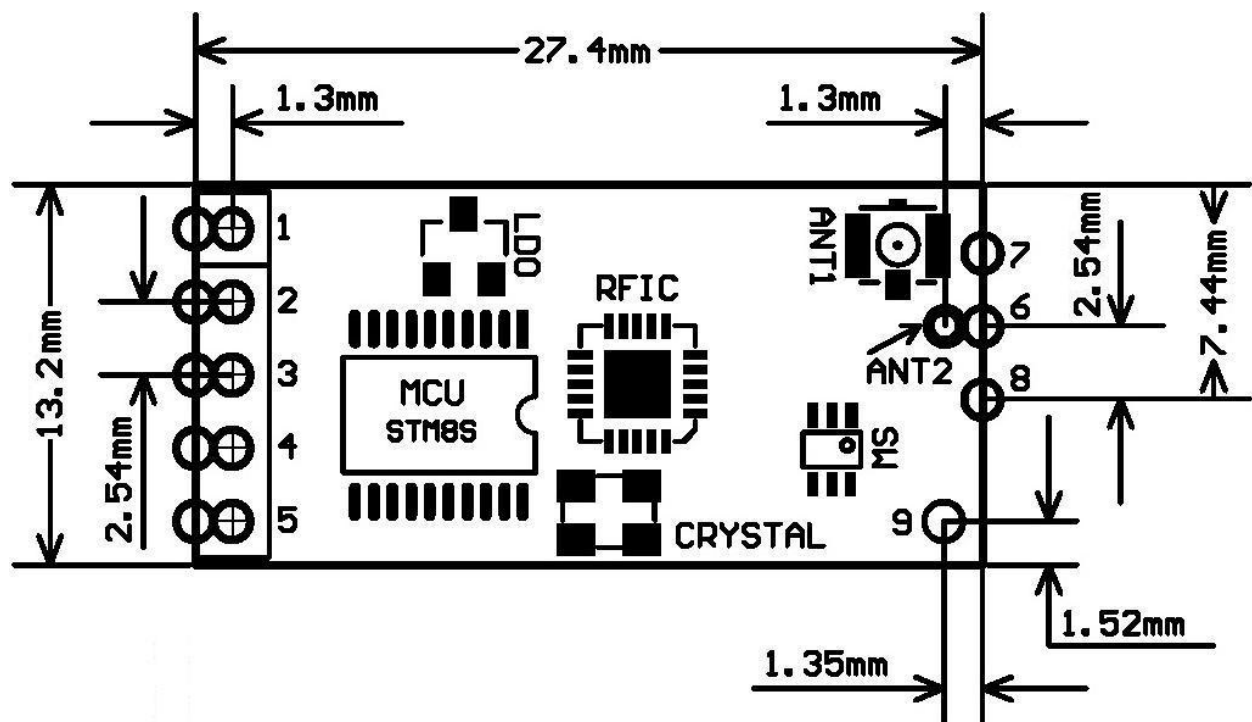
## Product introduction

HC-12 wireless RF UART communication module is a new generation of multi channel embedded wireless data transmission module. Radio frequency of 433.4 - 473.0MHz, can be setting communication channel, step is 400kHz, a total of 100 channel. The module maximum transmit power is 100mW (20dBm), and -116dBm receiver sensitivity air of the 5000bps baud rate, communication distance about 500 meters.

The module adopts a stamp hole encapsulation method, which can be welded. The module size is 27.4mm\*13.2mm \*4mm (including antenna seat, not including the spring antenna), which is convenient for the customer to be embedded in the application system. The module has a PCB antenna seat ANT1, users can use the coaxial cable, the use of 433MHz band external antenna. The module also has antenna welding hole ANT2, convenient user welded spring antenna. The user can choose one kind of antenna according to the request.

The module contains MCU, users do not need to program in addition, just send and receive UART data. The module uses a variety of UART transmission mode, the user can choose according to the requirements of the use of AT command. The four UART modes of FU1, FU2, FU3, FU4, the average operating current is 3.6mA, 80μA, 16mA and 16mA, the maximum operating current is 100mA (full power transmit state).

## Product size



**Pin definition**

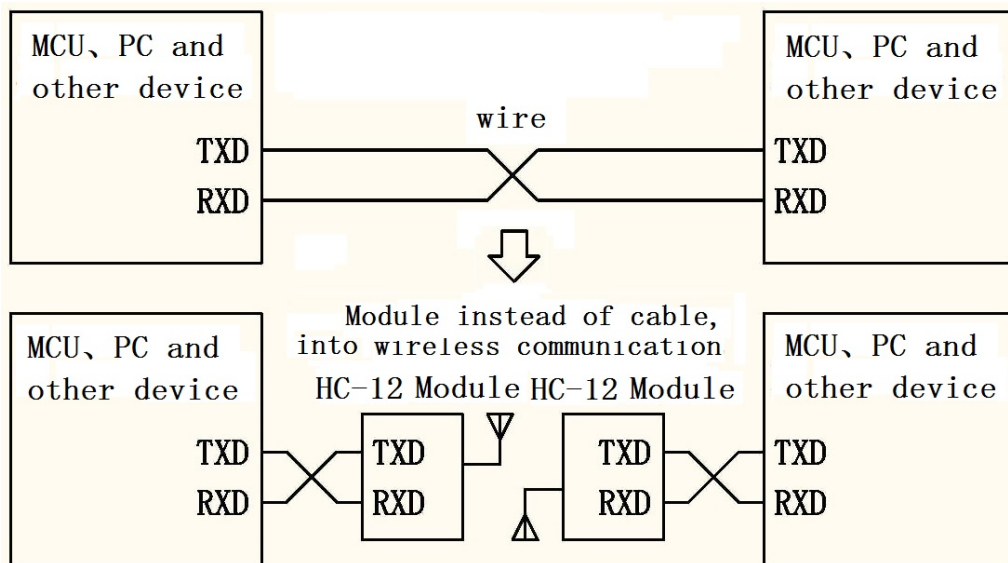
The HC-12 module consists of 9 pins and a RF antenna block ANT1, which is defined as the following table:

pin	definition	I/O	explain
1	VCC		Power pin, the requirements of 3.2V to 5.5V DC power supply, the supply current is not less than 200mA. (Note: If the module is to work for a long time in the transmit state, it is recommended that the power supply voltage of more than 4.5V when connected to a 1N4007 diode, to avoid the module built-in LDO fever.)
2	GND		Ground
3	RXD	input, with pull up resistor to internal power supply	UART input, 3.3V TTL level, internal 1K resistor in series
4	TXD	Output, with pull up resistor to external VCC	UART output, 3.3V TTL level, internal 1K resistor in series
5	SET	input, internal 10K pull up resistor	Parameter setting pin, the low level is effective, internal 1K resistor in series
6	ANT	RF input/output	433MHz antenna pin
7	GND		Ground
8	GND		Ground
9	NC		NC
ANT1	ANT	RF input/output	IPEX20279-001E-03 antenna seat
ANT2	ANT	RF input/output	433MHz spring antenna welding hole

Pin1- 6 have two pads each, by the outside of the half hole pad for the patch welding. Pin 6 on the inside of the pad ANT2 for module chip welding, you can hand welding spring antenna. Pin 1 - 5 by hole inside the pads used for welding 2.54mm row spacing, can be plugged directly into the user PCB row seat.

## Wireless UART transmission

### (1) Brief introduction of the working principle



As shown in the figure above, the HC-12 module is used to replace the physical connection in half duplex communication. On the left side of the device to send UART data to module, the module's RXD port after receiving the UART data, the data automatically transmitted to the air in the way of radio. On the right side of the module can automatically receive, and restore the original left device from the TXD UART data send. From right to left is the same. Module can only work in half duplex state, can not send and receive data at the same time.

### (2) UART transparent transmission characteristics

HC-12 module has four UART transparent transmission mode: FU1, FU2, FU3 and FU4. When in use, various modes are just to send and receive UART data can be, without air wireless transmission part, but only in the same air baud rate can communicate with each other under the sky! The system default in FU3 full speed mode, this mode can automatically adjust the air according to the baud rate of serial baud rate, low baud rate communication distance.

Different mode can not transmission data each other, the user can choose the best mode according to the actual situation.

Modules are generally used in pairs to transmit data to each other in half duplex mode. At the same time, the transparent transmission mode, the baud rate, the wireless communication channels must be set the same. Factory default is set to FU3, 9600bps (8 bits data, no parity, 1 stop bit), CH001 (433.4MHz).

The number of bytes send to the module UART port is generally not limited in use. But in view of the environmental interference and other factors, a continuous transmission of a large number of data, it is possible to lose some of the bytes. So, it is best to have a answer response and retransmission mechanism, to avoid the loss of information.

### (3) The four kinds of UART transmission mode

HC-12 module UART transmission mode default is FU3. At this point, the module works at full speed, the idle current is about 16mA. In this mode, the wireless transmission module will automatically adjust the air baud rate according to the baud rate of UART baud rate, the corresponding relations are shown in the following table:

UART baud rate	1200 bps	2400 bps	4800 bps	9600 bps	19200 bps	38400 bps	57600 bps	115200 bps
air baud rate	5000bps		15000bps		58000bps		236000bps	

In order to make the communication distance as far as possible, can be set to low UART baud rate. If it is short time to transfer large amounts of data, the UART baud rate for high baud rate, at the expense of communication distance.

The receiving sensitivity of different air conditions the baud rate module as shown in the following table:

air baud rate	500bps	5000bps	15000bps	58000bps	236000bps/250000bps
receiving sensitivity	-124dBm	-116dBm	-111dBm	-106dBm	-100dBm

Generally, the reception sensitivity decreases by 6~10 dB, and the communication distance is reduced by half.

In the module "SET" pin is low level, you can set the UART transmission mode through the AT command (see the introduction of the following chapters).

**FU1 mode is more power saving mode**, at this time, the idle work current of the module is about 3.6mA. This mode can also set up 8 kinds UART baud rate is shown in the table above, but the air uniform 250000bps baud rate, short communication distance.

**FU2 mode is power saving mode**, at this time the module idle work current is about 80 $\mu$ A. This mode module supports only 1200 bps, 2400 bps and 4800 bps UART baud rate, air baud rate is uniform 250000bps, short communication distance. At the same time, in the FU1 and FU3 mode set to FU2 mode, more than 4800 UART baud rate will be automatically reduced to 4800 bps. FU2 mode, only the transfer of a small amount of data (each packet within 20 bytes), packet transmission time interval can not be too short (preferably in more than 2 seconds), otherwise it will result in data loss.

**FU4 mode for ultra long distance communication mode**, the UART baud rate is fixed at 1200 bps, the air baud rate is 500bps. From the other mode to FU4, the serial baud rate will be automatically converted to 1200bps. In this mode, only a small amount of data is transferred (each packet is within 60 bytes), the packet transmission time interval can not be too short (preferably in more than 2 seconds), otherwise it will result in data loss.

Here are some of the characteristics of the reference value of a variety of modes:

mode	FU1	FU2	FU3	FU4	note
idle work current	3.6mA	80 $\mu$ A	16mA	16mA	average value
transfer delay	15~25mS	500mS	4~80mS	1S	Send 1 bytes
loop delay measurement 1	31mS				The UART baud rate of 9600, Send 1 bytes
loop delay measurement 2	31mS				The UART baud rate of 9600, Send 10 bytes

Note: the test loop delay is short circuit the module of the TX and RX pins, sending UART data to another module, sending UART data to another module of TX pin for this period of time to return to the data from the beginning.

### Module parameter setting AT command

AT command is used to set the parameters of the module and switch the function of the module. At the same time, the parameters and functions of the modification, power off will not be lost.

#### (1) To enter into the AT command mode

The first entry way - the normal use (already on the power), the fifth pin "SET" set the low level.

Second entry way - power off, the fifth pin "SET" connect to ground (low level), then power on.

These two ways can make the module into the AT command mode, release ("SET" pin is not connected to the low level) then exit the command mode. After exiting the AT command mode, if you change the function of the module, you will be cut to the corresponding functional status.

Second ways to fix the 9600, N, 1 of the UART format into the command mode.

Note: after the withdrawal of the AT command mode, the module is in a reset state, at least wait for 200mS before entering the AT command mode again, otherwise the module may into the AT command mode in second way!

### **(2) Command explain**

#### **① AT**

Test command

Example:

Send the module command “AT”, module returns “OK”。

#### **② AT+Bxxxx**

Change the UART baud rate command. Can set the baud rate of 1200bps, 2400bps, 4800bps, 9600bps, 19200bps, 38400bps, 57600bps and 115200bps. Factory defaults to 9600bps.

Example:

Setting module UART baud rate is 19200bps, please send the module command "AT+B19200", module returns "OK+B19200".

#### **③ AT+Cxxx**

Change the channel of the wireless communication, from 001 to 127 (more than 100 after the wireless channel, communication distance is not guaranteed). The default value of the wireless channel is 001, and the working frequency is 433.4MHz. The step of the channel is 400KHz, the frequency of channel 100 is 473.0MHz.

Example:

Set the module to work to channel 21, please send the module command "AT+C021", the module returns "OK+C021". After exiting the AT command mode, the module works in the channel 21, and the operating frequency is 441.4 MHz.

Note: due to the wireless receiver sensitivity of HC-12 module is relatively high, when the UART baud rate is greater than 9600 bps, must be staggered 5 adjacent channels to use. When the UART baud rate is less than 9600 bps, if the short distance (10 meters) communication, also need to stagger 5 adjacent channels.

#### **④ AT+FUx**

Change module UART transmission mode, there are FU1, FU2, FU3 and FU4 four modes. Module default mode is FU3, the UART transmission mode of the two module must be set to the same as the normal communication. Please see the above "wireless UART transmission" section of the introduction.

Example:

Send the module command "AT+FU1", the module returns "OK+FU1".

### ⑤ AT+Px

Set the transmit power level of the module, the x is 1-8, the module corresponding transmit power is as follows:

x value	1	2	3	4	5	6	7	8
transmit power (dBm)	-1	2	5	8	11	14	17	20

Default setting is 8, the transmit power is the biggest, the communication distance is the most distant. In general, the transmit power per drop 6~10dB, communication distance will be reduced by half.

Example:

Send the module command "AT+P5", the module returns "OK+P5".

After exiting the AT command mode, the module transmit power is +11dBm.

### ⑥ AT+Ry

Acquisition module of the individual parameters. y for B, C, F, P in any of the letters, respectively: baud rate, communication channel, transmission mode, transmit power.

Example 1:

Send the module command "AT+RB", if the module returns "OK+B9600", then the UART baud rate is 9600bps.

Example 2:

Send the module command "AT+RC", if the module returns "OK+RC001", then the communication channel is 001.

Example 3:

Send the module command "AT+RF", if the module returns "OK+FU3", then check the module to work in the UART transmission mode 3.

Example 4:

Send the module command "AT+RP", if the module returns "OK+RP:+20 dBm", then the module's transmit power is +20dBm.

### ⑦ AT+RX

Get all parameters of the module. In order to return to the UART transmission mode, UART baud rate, communication channel, transmit power and other information.

Example:

Send the module command "AT+RX", the module returns "OK+FU3 \r\n OK+B9600 \r\n OK+C001 \r\n OK+RP: +20 dBm \r\n". ("r\n" is CRLF)



### **⑧ AT+Uxxx**

Set the data bits, parity bits and stop bits of UART communication. In the parity check bit, N represents the non parity check, O represents the odd parity check, E represents the even parity check. Stop, 1 on behalf of the 1 stop bit, 2 on behalf of the 2 stop, 3 on behalf of the 1.5 stop bit.

Example:

To set the UART communication format to 8 data bits, odd parity, 1 stop bit, please send the module command "AT+U8O1", the module returns "OK+U8O1".

### **⑨ AT+V**

Query module firmware version information, return the official website address and firmware version.

Example:

Send the module command "AT+V", the module returns " [www.hc01.com](http://www.hc01.com) HC-12\_V2.4 ".

### **⑩ AT+SLEEP**

After receiving the command, the module enters the sleep mode when exiting AT command mode, the operating current is about 22 $\mu$ A, and the module can not carry on the UART data transmission. Once again into the AT command mode state, the module automatically exit the sleep mode.

Example:

When no wireless data transmission, in order to save energy, you can send the module command "AT+SLEEP", the module returns "OK+SLEEP".

### **⑪ AT+DEFAULT**

The UART baud rate, UART communication channel, transmission mode restore factory default.

Example:

Send the module command "AT+DEFAULT", the module returns "OK+DEFAULT", restore the factory default value. The UART baud rate of 9600bps, C001, UART communication channel for the transmission mode is FU3, transmit power is +20dBm.

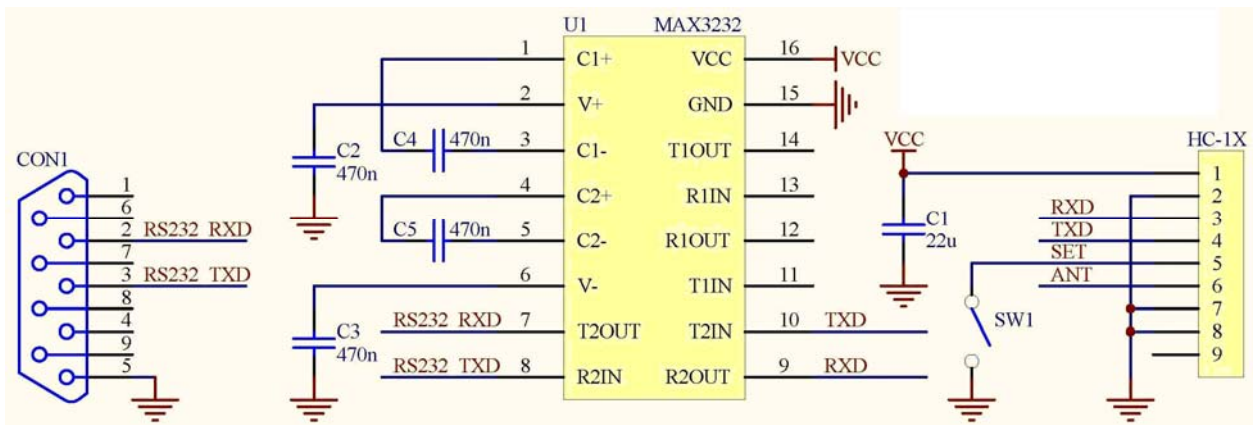
## NOTE

① Do not directly connect the light emitting diode and resistor between the TX and the power supply side of the module, otherwise it may affect the module UART communication.

② Using MCU to dynamically modify the module parameters, set the module fifth pin "SET" low level, need to wait for the 40ms to send AT command to the module. Set the fifth pin "SET" high level, need to wait for the 80ms to enter the UART transmission mode.

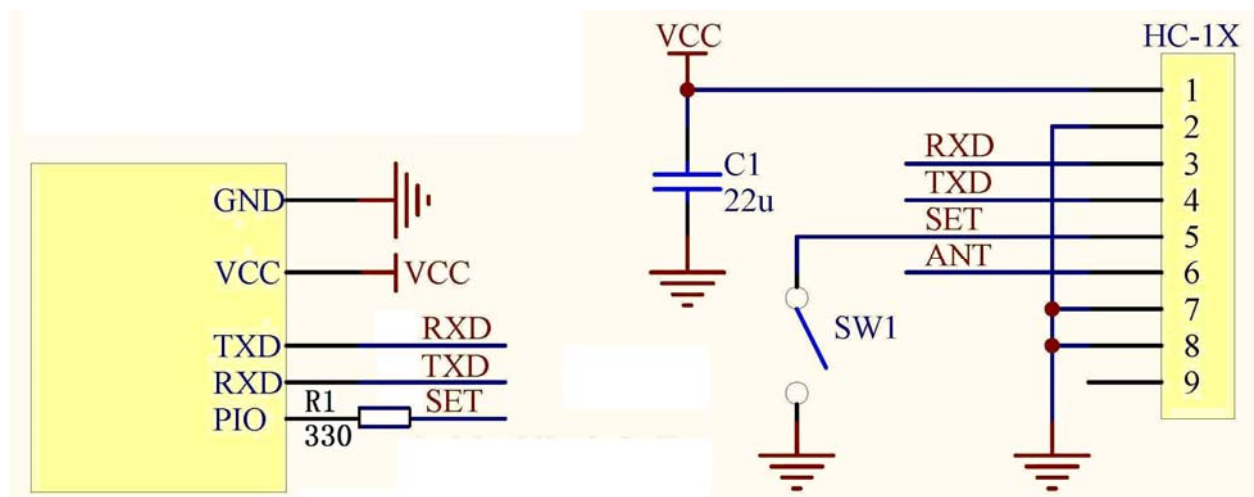
## Application example and circuit

### ① HC-12 module connect to the computer UART port



"SET" pin through the switch SW1 grounding can enter the parameter setting state, left hanging out.

### ② HC-12 module connect to the MCU UART port



Please set the "SET" control pin to high level or hanging out in normal times, and set to low level in setting parameters state.