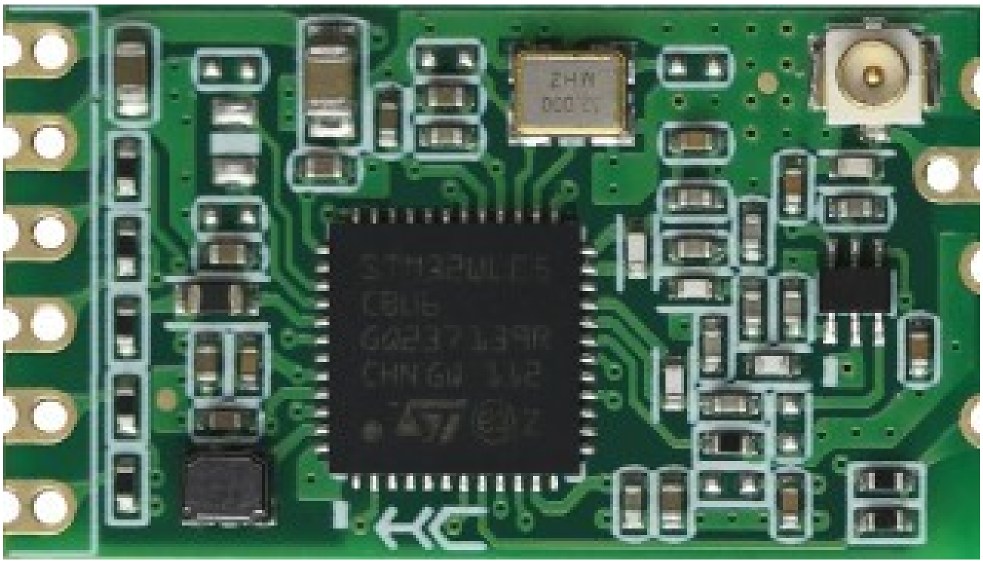
HC-15 Wireless Serial Communication Module User Manual **V1.0**



Product Applications

Wireless sensors, residential and commercial building security
Robot Wireless Control
Industrial Remote Control, Telemetry, and Automation
Data Collection
Container Information Management
POS Systems
Gas Meter Data Wireless Collection
Vehicle Keyless Entry System
PC Wireless Networking
…

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Version Information

HC-15V1.0

Release Date

September 30, 2024

Change Log

Product Features

LoRa technology for long-range wireless transmission (up to 3,500 meters in open areas at S1 data rate) Operating frequency range (415.09–449.86 MHz, 50 communication channels)

Built-in MCU, communicates with external devices via serial port, supporting multiple serial port baud rates from 1200 to 115200.

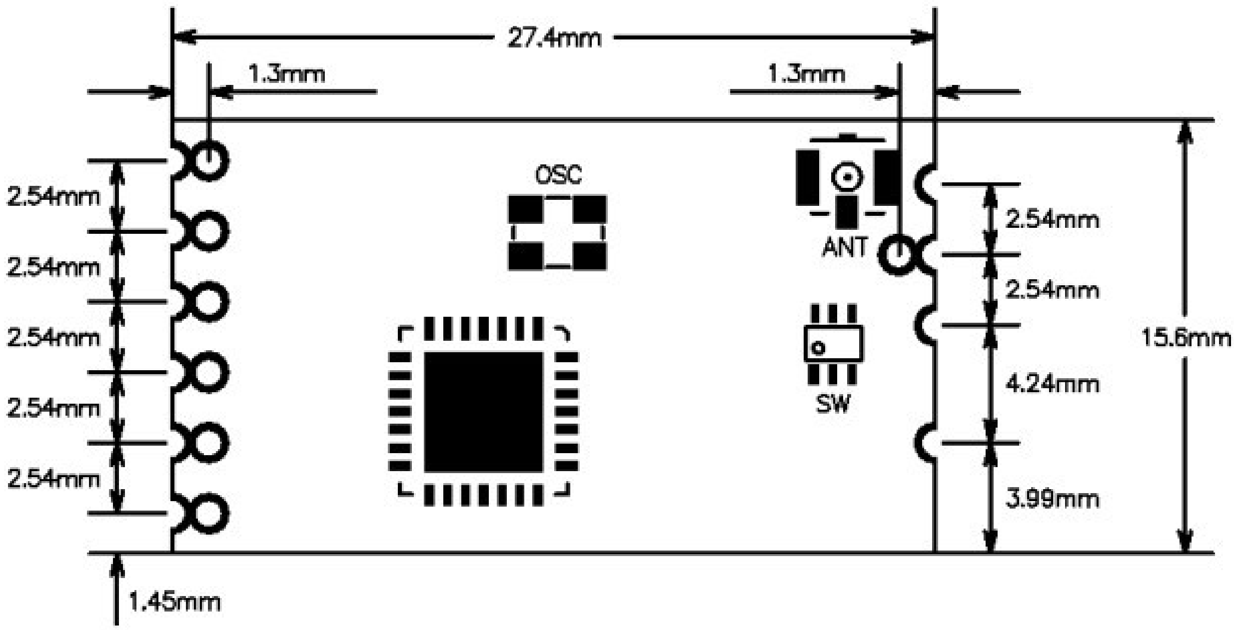
Product Introduction

The HC-15 wireless serial communication module is the next-generation LORA wireless data transmission module. The wireless operating frequency band is 433 MHz, with support for up to 50 communication channels. The module's maximum transmit power is 130 mW (22 dBm), utilizing advanced LoRa technology to achieve a receive sensitivity of -140 dBm under S1 wireless speed conditions, with an open-field communication range of 3,500 meters.

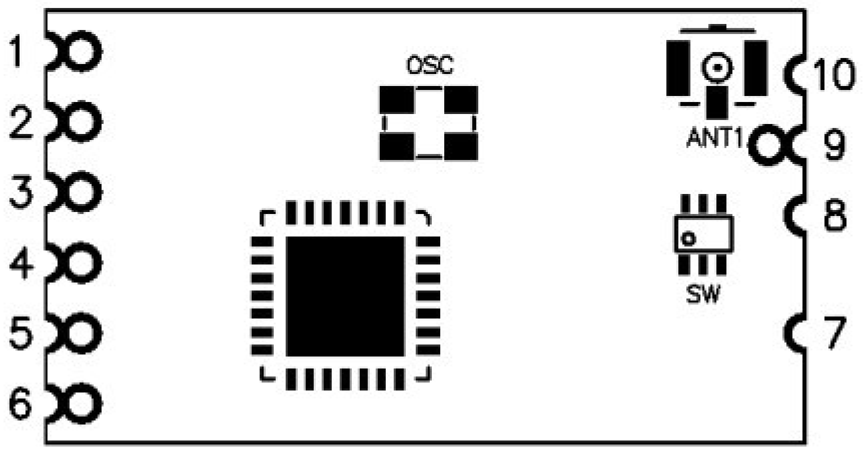
The module is packaged in a surface-mount package, enabling surface-mount soldering. Its dimensions are 27.4mm × 15.6mm × 4mm (including the antenna cap, excluding the spring antenna) making it highly convenient for integration into customer application systems. The module features a PCB antenna connector ANT1, allowing users to connect an external antenna via a coaxial cable using the 433MHz frequency band. The module also includes an antenna soldering pad ANT2 for users to solder a spring antenna. Users can select one of the two antenna options based on their requirements (only one antenna can be selected at a time; both cannot be used simultaneously)

The module incorporates a LoRa SOC, eliminating the need for additional programming. Users can simply transmit and receive serial data in various transparent modes, ensuring convenient operation.

Product dimensions



Pin Definition



The HC-15 module can be surface-mounted or soldered to a 2.54mm pitch header, which can be directly inserted into the user's PCB. The module has 10 pins and one RF antenna connector ANT1, with the specific definitions as shown in the table below:

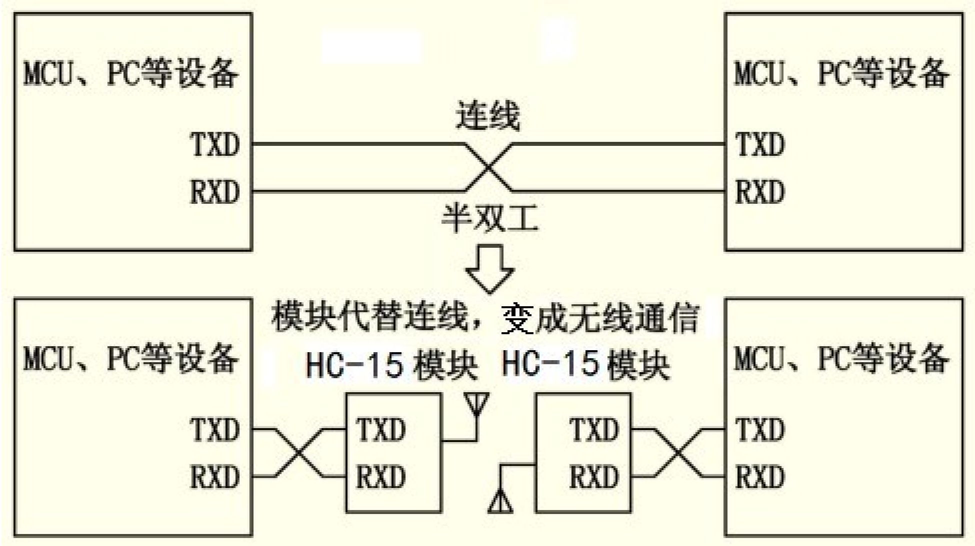
Pin	Definition	I/O Direction	Description
	VCC		Power input: DC 3.0V to 3.6V, with a load capacity of no less than 300mA
2	GND		Common Ground
3	RXD	Serial input	URAT input port, internally connected to a 200 Ω resistor, high-level voltage is the same as VCC
4	TXD	Serial output	URAT output port, internally connected with a 200 Ω resistor, high-level voltage Voltage is the same as VCC
5	KEY	Input, internally pulled up	Parameter setting control pin, internally connected to a 1 kΩ resistor, low active
6	STA	Output	High-level voltage is typically slightly lower than the VCC voltage, internally connected in series with a 200 Ω resistor internally, can be connected to an MCU input pin or an external LED (this pin serves as a busy indicator output, normally outputting a high voltage level; when the module is busy, it outputs a low voltage level; do not send data to the module's serial port RXD pin while the module is busy)
7	NC		Currently unused; leave floating.
8	G		Common ground
9	ANT	RF Input/Output	433MHz antenna pin, spring antenna solder holes
10	GND		Common Ground
ANT1	ANT	RF Input/Output	IPEX20279-001E-03 Antenna socket

Pins 1–6 and 9 each have two solder pads. The outer half-hole solder pads are used for surface mount soldering. Pins 1–6 use the inner round hole solder pads for soldering 2.54mm pitch header pins, which can be directly inserted into the user's PCB header; Pin 9 uses the inner solder pad for module surface mount soldering, allowing for hand soldering of spring antennas.

The operating current of the module is approximately 9 mA in receive mode and approximately 125 mA in transmit mode. The operating voltage is DC 3.0 V to 3.6 V, with a power supply load capacity of at least 300 mA. A capacitor of at least 47 μF must be connected in parallel near the module's power supply pins.

Wireless serial port transparent transmission

Brief introduction to the working principle



As shown in the figure above, the HC-15 module is used to replace the physical connection for half-duplex communication. The device on the left sends serial data to the module. When the module's RXD port receives the serial data, it automatically transmits the data via radio waves into the air. The module on the right automatically receives the data and restores the original serial data sent by the left device via the TXD port. The process is the same from right to left. The modules can only operate in half-duplex mode and cannot transmit and receive data simultaneously.

The module supports 8 wireless data rates, and different rates cannot transmit data to each other. The default rate is S3. S1 is the lowest rate, at which the module has the highest reception sensitivity and the longest communication distance. As the rate increases, the reception sensitivity decreases, and the communication distance becomes shorter. Users can select the optimal rate based on actual conditions.

Modules are typically used in pairs to transmit data to each other in half-duplex mode. When in use, there is a limit on the number of bytes that can be continuously sent to the module's serial port in a single transmission. The default maximum packet size is 1000 bytes, and any data exceeding this limit will be lost. Additionally, due to environmental interference and other factors, some bytes may be lost during continuous transmission of large amounts of data. Therefore, the host computer should have acknowledgment and retransmission mechanisms to prevent data loss.

Module Parameter Settings AT Commands

AT commands are used to set module parameters and switch module functions. Changes take effect only after exiting the parameter setting mode. Additionally, parameter and function modifications are not lost upon power loss.

(1) Entering Command Mode

First method: During normal operation (already powered on), set pin 5 "KEY" to a low level.

Second method: Power off, then set pin 5 "KEY" to a low level before powering on again.

Both methods allow the module to enter AT command mode. Releasing the "KEY" pin (not connected to a low level) exits command mode. After exiting command mode, if module functions have been modified, the module will switch to the corresponding functional state.

The second method always enters command mode using the serial port format 9600, N, 1.

Note: After exiting command mode, the module is in reset state. Wait at least 250 ms before attempting to enter command mode again; otherwise, the module may enter command mode using the second method!

(2) Command Description

① Test Communication

Command	Response	Description
AT	OK	AT command test

Example:

Check if the module has entered AT mode Send to the module: AT

Module response: OK

② Restore factory default settings

Command	Response	Description
AT+DEFAULT	OK+DEFAULT	Restores serial port baud rate and other parameters to factory default values.

Example:

Send to the module: AT+DEFAULT

Module response: OK+DEFAULT

③ Command to query or change the serial port baud rate

Command	Response	Description
AT+B?	OK+B:xxxx	Query baud rate
AT+Bxxxx	OK+B:xxxx	Set baud rate Default: 9600

Change the serial port baud rate command. The baud rate can be set to **1200 bps**, **2400 bps**, **4800 bps**, **9600 bps**, **19200 bps**, **38400 bps**, **57600 bps**, and **115200 bps**. The factory default is **9600 bps**.

Example:

To set the module's serial port **baud rate to 19200 bps**, send the command "**AT+B19200**" to the module. The module will respond with "**OK+B:19200**".

④ **Command to query or change the serial port parity bit**

Command	Response	Description
AT+PARITYBIT?	OK+PARITYBIT?	Queries the parity bit of the module's serial port
AT+PARITYBITx		Set the parity bit of the module's serial port 0: No parity (default) 1: Odd parity 2: Even parity

Example:

Query:

Send command AT+PARITYBIT?

Return command OK+PARITYBIT0

Set:

Send command AT+PARITYBIT1

Return command OK + PARITY BIT 1

⑤ **Query or change serial stop bit command**

Command	Response	Description
AT+STOPBIT?	OK+STOPBIT?	Query the stop bit of the module's serial port
AT+STOPBITx		Set the stop bit of the module serial port 1: 1 bit (default) 2: 1.5 3: 2

Example:

Query:

Send command AT+STOPBIT?

Return command OK+STOPBIT1

Set:

Send command AT+STOPBIT3

Return command OK+STOPBIT3

⑥ **Query or change the module's wireless channel**

Command	Response	Description
AT+C?	OK+C:xxx	Query the wireless channel of the Lora module
AT+Cxxx		Set the wireless channel of the Lora module Wireless frequency modification range: 001~050 Default: 028 (434.00 MHz)

Example:

Query wireless channel

Send to the module: **AT+C?**
Module response: **OK+C:xx**

Set wireless channel

Send to module: AT+C028 Module
response: **OK+C:28**

Appendix: Correspondence between wireless channels and frequencies

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	415.09	11	422.41	21	429.73	31	435.83	41	442.54
2	415.70	12	423.63	22	430.34	32	436.44	42	443.15
3	416.31	13	424.24	23	430.95	33	437.05	43	443.76
4	416.92	14	424.85	24	431.56	34	437.66	44	444.37
5	417.53	15	425.46	25	432.17	35	438.27	45	445.59
6	418.14	16	426.07	26	432.78	36	438.88	46	446.20
7	419.36	17	426.68	27	433.39	37	440.10	47	446.81
8	420.58	18	427.29	28	434.00	38	440.71	48	447.42
9	421.19	19	427.90	29	434.61	39	441.32	49	448.64
10	421.80	20	429.12	30	435.22	40	441.93	50	449.86

⑦ Query or modify the wireless rate of the module

Command	Response	Description
AT+S?	OK+S:x	Query the wireless speed of the LoRa module
AT+Sx		Set the wireless data rate of the LoRa module Wireless data rate modification range: 1–8 Default: 3

Example:

Query wireless speed

Send to the module: **AT+S?**
Module response: **OK+S:x**

Set wireless speed

Send to the module: AT+S1
Module response: **OK+S:1**

The module has 8 wireless speeds, and different speeds cannot transmit data to each other. S1 is the lowest speed, with the slowest communication speed and the highest wireless reception sensitivity is highest, and the communication distance is farthest. The higher the rate, the shorter the communication distance. Users can select the optimal rate based on actual conditions.

Appendix: Corresponding wireless sensitivity and serial communication speed for various wireless speeds (serial port baud rate is 9600; other baud rates require user testing)

Wireless speed	Receiving Sensitivity (Reference value)	Serial communication speed (Time from when the data is sent from the transmitter to when it is received by the receiver)
1	-140 dBm	Sending 1 byte takes approximately 2.5 seconds to receive the information; sending 10 bytes takes approximately 3.2 seconds to receive the information; sending 20 bytes takes approximately 3.9 seconds to receive the information; sending 40 bytes takes approximately 5.2 seconds to receive the information. Sending more than 40 bytes will be received in packets (maximum 40 bytes per packet) with the next packet received approximately 5.2 seconds later. 1 packet, followed by delayed reception based on the number of bytes per packet (maximum 40 bytes/4.9 seconds)
2	-137 dBm	Send 1 byte, receive the message approximately 1.35 seconds later; send 10 bytes, receive the message approximately 1.7 seconds later; send 20 bytes, receive the message approximately 2.05 seconds later; send 40 bytes, receive the message approximately 2.9 seconds later. If more than 40 bytes are sent, the data will be received in packets (maximum 40 bytes per packet) with a delay of 2.9 seconds between packets. Receive the first packet, followed by subsequent packets with delays based on the number of bytes per packet (maximum 40 bytes per packet, with a delay of 2.7 seconds per packet)
3	-134 dBm	Send 1 byte, receive the message approximately 0.75 seconds later; send 10 bytes, receive the message approximately 0.95 seconds later; send 40 bytes, receive the message approximately 1.5 seconds later; send 80 bytes, receive the message approximately 2.35 seconds later. When sending more than 80 bytes, the data will be received in packets (maximum 80 bytes per packet) with the first packet received approximately 2.35 seconds later, and subsequent packets received with delays based on the number of bytes per packet (maximum 80 bytes per packet, with a delay of 2.7 seconds per packet) after the first packet is received, with subsequent packets received with delays based on the number of bytes per packet (maximum 80 bytes/2.1 seconds)
4	-131.5 dBm	Send 1 byte, receive the message approximately 0.45 seconds later; send 10 bytes, receive the message approximately 0.55 seconds later; send 40 bytes, receive the message approximately 0.9 seconds later; send 80 bytes, receive the message approximately 1.25 seconds later. Sending more than 80 bytes will result in packet segmentation (maximum 80 bytes per packet) with the first packet received approximately 1.25 seconds after the first packet is received, with subsequent packets received based on the number of bytes per packet (maximum 80 bytes per packet, 1.0 seconds)
5	-129 dBm	Send 1 byte, receive the response approximately 0.3 seconds later; send 10 bytes, receive the response approximately 0.37 seconds later; send 80 bytes, receive the response approximately 0.8 seconds later; send 160 bytes, receive the response approximately 1.25 seconds later. If more than 160 bytes are sent, the data will be received in packets (maximum 160 bytes per packet) with a delay of 1.25 seconds between packets. after the first packet is received, with subsequent packets received based on the number of bytes in each packet (maximum 160 bytes per packet, with a delay of 0.9 seconds per packet)
6	-126.5 dBm	Send 1 byte, receive the message approximately 0.23 seconds later; send 10 bytes, receive the message approximately 0.27 seconds later; send 80 bytes, receive the message approximately 0.55 seconds later; send 160 bytes, receive the message approximately 0.85 seconds later. Sending more than 160 bytes will be received in packets (maximum 160 bytes per packet) 0.85 seconds after sending 160 bytes, the first packet will be received, with subsequent packets received with delays based on the number of bytes per packet (maximum 160 bytes per 0.5 seconds)
7	-124 dBm	Sending 1 byte results in receiving the information approximately 0.2 seconds later; sending 10 bytes results in receiving the information approximately 0.22 seconds later; sending 160 bytes results in receiving the information approximately 0.63 seconds later; sending 250 bytes results in receiving the information approximately 0.87 seconds later. Sending more than 250 bytes will be received in packets (maximum 250 bytes per packet) with the first packet received approximately 0.87 seconds after sending 1 byte, with subsequent packets received based on the number of bytes per packet (maximum 250 bytes per packet, with a delay of 0.42 seconds per packet)
8	-121 dBm	Send 1 byte, receive the response approximately 0.17 seconds later; send 10 bytes, receive the response approximately 0.2 seconds later; send 160 bytes, receive the response approximately 0.5 seconds later; send 250 bytes, receive the response approximately 0.6 seconds later. If more than 250 bytes are sent, the data will be received in packets (maximum 250 bytes per packet) with the next packet received approximately 0.6 seconds later. receive the first packet, with subsequent packets received with delays based on the number of bytes per packet (maximum 250 bytes per packet, 0.3 seconds)

⑧Query the firmware version information of the query module

Command	Response	Description
AT+V	www.hc01.com HC-15V1.0 2024.09.30	Return the official website URL and firmware version number

Example:

Send to the module: AT+V

Module response: www.hc01.com HC-15V1.0 2024.09.30

⑨Retrieve the module's basic parameters

Command	Description
AT+RX	Return the current module's serial port baud rate, wireless channel, wireless data rate, wireless transmission power, and other information.

Example:

Send to the module: AT+RX

Module response: OK+B:9600

OK+C:28 OK+S:3

OK+P:22dBm

⑩ Query or change the module's wireless transmission power

Command	Response	Description
AT+P?	OK+P:X	Query transmission power
AT+PX	OK+P:X	Set transmit power Setting range: -6 to 22 dBm Default: 22 dBm

The factory default setting is 22 dBm, which provides the maximum transmission power and the longest communication range. Setting the transmission power to -6 dBm results in the minimum transmission power.

Example:

Query wireless frequency

Send module command "AT+ P?"

Module response "OK+ P:22dBm"

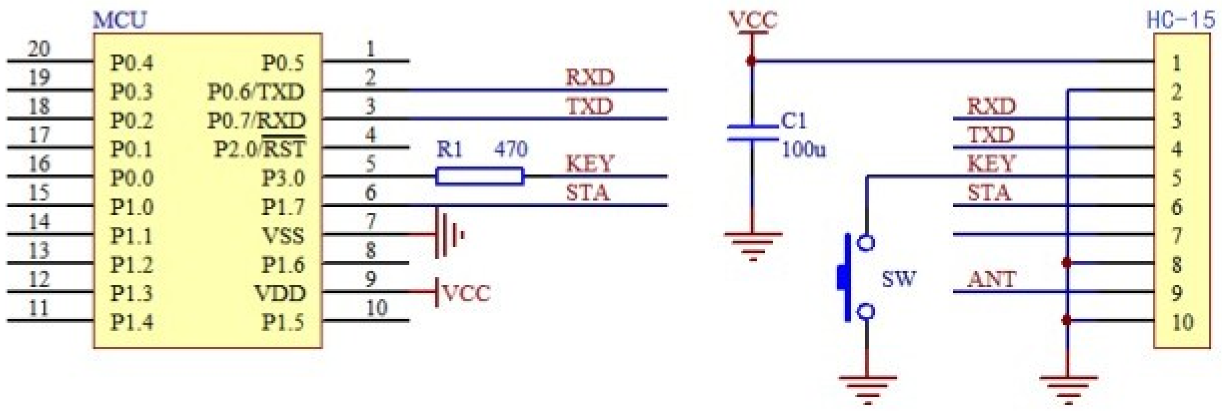
Set wireless frequency

Send module command "AT+ P-5"

Module response "OK+ P:-5dBm"

Application example and circuit

Connection between the HC-15 module and the MCU serial port



In the MCU, the "KEY" control pin should be set to high-impedance state or high-level output under normal conditions; when configuring parameters, set it to low level;

The "STA" pin in the MCU should be configured as an input pin or left floating and unconnected.