



HAC-HM Series Data Radios V1.2





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I. Features of HAC-HM Series

1. Large power transmission with the transmission power of 5W, 10W and 25W.
2. The carrier frequency is 433MHz.
3. High receiving sensitivity, the maximum receiving sensitivity is -124dBm@1200bps.
4. High anti-interference and low BER(Bit Error Rate)

Based on the GFSK modulation mode, the high-efficiency forward error correction channel encoding technology is used to enhance data's resistance to both burst interference and random interference and the actual bit error rate of $10^{-5} \sim 10^{-6}$ can be achieved when channel bit error rate is 10^{-2} .

5. Long transmission distance

Within the range of visibility, when the antenna height is more than 10m, the reliable transmission distance for the module with 5W is more than 10km (BER= 10^{-3} /1200bps), and the reliable transmission distance for the module with 25W is more than 25Km (BER= 10^{-3} /1200bps).

6. Industry

By using the high quality components and high reliable crystal, the working temperature is from -35°C to +80°C.

7. High shock resistance and low aging excursion

Using high-performance and high-frequency dielectric filler to fill the RF circuit cavity, it will get good anti-shock effects. At the same time, it will make the RF parameter which can't be changed according to the time more stable, it will get good corrosion resistance.

8. Transparent data transmission

Transparent data interface is offered to suit any standard or nonstandard user protocol. Any false data generated in the air can be filtrated automatically (What has been received is exactly what has been transmitted).

9. Multi-channel

The standard HAC-HM configuration provides 8 channels. If the user needs, it can be extended to 16/32 channels, meeting the multiple communication combination mode of the user.

10. Three interface modes(TTL、RS-232、RS-485).

11. Large data buffer zone

The interface baud rate is 1200/2400/4800/9600/19200/38400bps with format of 8N1/8E1 and user self-definition.

12. Intelligent data control and the user doesn't need to prepare excessive programs
Even for semi duplex communication, the user doesn't need to prepare excessive programs, only receiving/transmitting the data from the interface. HAC-HM will automatically complete the other operations, such as transmission/receiving conversion in the air.
13. HAC-HM can indicate the intensity of magnetic field, the power source and the transmission and receive of data.
14. HM series can be compatible with other radio modules with different power. In the same air baud rate and working frequency, HM series can be compatible with UM, LM, UEM, LEM series which are made by us.

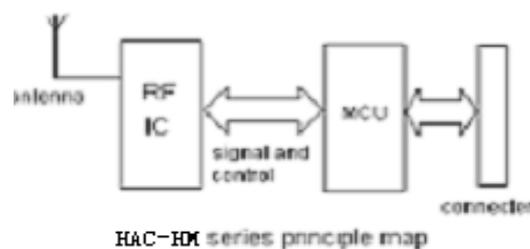
II. Application of HAC-HM Series

HAC-HM series is suitable for:

- * Communication for army and police
- * Communication for railway and electric power network
- * Remote control and telemetry, automatic data collecting system

III. How to use HAC-HM Series

HAC-HM series data radios provides three interface modes including standard RS-232, RS-485 and UART/TTL levels allowing direct connection with computer, user's RS-485 device, monolithic processor and other UART components for application.



1. Power supply
HAC-HM uses DC power supply with voltage of +13.8V. We suggest not use the switch power. But if you must, please pay more attention to the interference of switch pulse on the module, and you'd better use the switch power supply with high frequency. Of cause the

linearity power is better. If you can separate module from other equipment by optocoupler, meanwhile separate module power from other equipment power by linearity power, the communication quality will be better.

2. Definition of HAC-HM connector

HAC-HM can supply one 2P power connector and 9-pin connector (male DB9), and its definitions as well as connection method for terminals are shown in Table 1 and Table 2.

Table 1: Definition of 2P power supply interface pins and connection method

Pin No.	Pin Name	Description	Level	Connected to the terminal	Remarks
1	GND	Black wire	—	Ground	
2	VCC	Red wire	+	DC13.8V@6A	

Table 2: Definition of male DB9 interface and connection method

Pin No	Pin Name	Description	Level	Connected to the terminal	Remarks
1	NC				
2	RxD	The RxD of RS-232	RS-232	TxD	Connect to the 3 rd pin of computer
3	TxD	The TxD of RS-232	RS-232	RxD	Connect to the 2 nd pin of computer
4	NC				
5	SGND	Signal ground			Connect to the 5 th pin of computer
6	TxD	TxD of TTL	TTI	RxD	
7	RxD	RxD of TTL	TTL	TxD	
8	A	The A of RS-485	RS-485	A	
9	B	The B of RS-485	RS-485	B	

3. Setting of channel, interface and data format:

Before using HAC-HM, the user needs to make simple configuration based on its own needs to determine the channel, interface mode and data format.

There is a switch of 8 bits on the HAC-HM. When turn it to “ON”, it means 0 and the opposite

means 1.

Note: Any changes of switch will be effective after restarting the module.

a. Channel configuration:

The 1,2,3 bit on the switch provide 8 channel options, and the user can choose to use 0-7 channels through them. Within one small communication network, as long as the operation of switch mode is same, there can be mutual communication.

The standard set in factory is channel 7,321=111(7). Frequency is: 433.926MHZ

The standard frequency is a designative one which can be chosen by the customer.

Table 3: Corresponding frequency points of 0~7 channels

Channel No.	Frequency	Channel No.	Frequency
321=000(0)	430.2000 MHz	321=100(4)	434.6940 MHz
321=001(1)	431.4288 MHz	321=101(5)	434.2332 MHz
321=010(2)	431.7360 MHz	321=110(6)	433.1580 MHz
321=011(3)	430.5072 MHz	321=111(7)	433.9260MHz

b. Parity mode selection:

HAC-HM can support no-parity or even parity modes, i.e. 8N1/8E1. It can choose parity mode through the fifth bit of the switch:

The standard set in factory: 5=1, 8E1 (even parity)

5=1 Parity: 8E1 (even parity)

5=0 Parity: 8N1 (no parity)

c. Selection of interface data rate:

We can set the interface baud rate to satisfy different demands of customers. It can be set through the 7,8 bit on the switch.

To get the best communication effect, the air baud rate of HM series is related to the hardware of the module, it is fixed before out of the factory. So the number following the HM means the air baud rate. For example HAC-HM12 means the air baud rate is 1200bps.

The interface baud rate is different from the air baud rate. Every HM module can offer 4 kinds of interface baud rate for users' selection. Please refer to the Table 4 for more information.

Table 4: Selection for interface baud rate

Type	Value of SW8 and SW7	Interface baud rate
HAC-HM12	00	1200bps
HAC-HM48	01	2400bps
HAC-HM96	10	4800bps
	11	9600bps
HAC-HM192	00	2400bps
	01	4800bps
	10	9600bps
	11	19200bps
HAC-HM384	00	4800bps
	01	9600bps
	10	19200bps
	11	38400bps

For the HAC-HM12 and HAC-HM48, when the interface baud rate is higher than the air baud rate, users need to transmit large data in one time, the buffer will overflow and cause some data missing because the RAM buffer of HM is limited. So in such condition, users should not send the big data package. The maximum data package allowed in one time is shown as follow:

Table 5: Maximum data package allowed in one time

Type	Interface baud rate	Maximum data package allowed in one time
HAC-HM12	2400bps	500Byte
	4800bps	400Byte
	9600bps	300Byte
HAC-HM48	9600bps	500Byte

When the interface baud rate is smaller than the air baud rate, theoretically, you can send infinitude long data packet but we advise you not to send the long data packet. We suggest the data length for each packet is between 60 Bytes and 100 Bytes. It should be no more than 120 Bytes, meanwhile, it is better for user to use the ARQ mode to resend the mistake

data packet.

The analysis is as follows:

Assume the real error rate is 10^{-4} , the user need to transmit the 1KB data , if you want to send the 1KB date as one packet , theoretically, there will be 1 error bit at least when receiving , while the 1KB data can not be received correctly forever.

If we divide the 1KB data to 10 packets, that is mean every packet including 100B data, after transmit 10 packets, it will be only one error packet, then resending the error one. Though you transmit the one more packet and the efficiency decreased 10%, you can transmit all of the data correctly.

4. The indicator of the magnetic field intensity, power supply and the transmission of data;

There are some LED indicators, the state definition are shown as follow:

Table 6: State of the LED indicator

State	POWER	TxD	RxD	RSSI1	RSSI2	RSSI3
Electrify	on					
Transmitting data	on	on				
Receiving data	on		On			
Intensity not good	on		On	on		
Intensity good	on		On	on	on	
Intensity excellent	on		On	on	on	on

Note: Connected to the power supply, the system keeps receiving data. If the magnetic density LED is dark and the light for receiving data is on, it demonstrates the density of magnetic field is not very good.

IV. Networking Application of HAC-HM Series

The communication channel of HAC-HM is semi duplex, which is most suitable for the communication mode of point to multi-point. Under this mode, one master station must be set, and all of the rest are slave stations. A unique address is given to each station. The coordination of communication is controlled by master station that uses data frames containing address code to



transmit data or command. Slave station will receive all of the data and command and compare the received address code with local address code. If they are different, the data will be deserted without any response. If those address codes are the same, it means the data is sent to the local. Slave station will make different responses according to the transmitted data or command and send back the data of response. All these jobs must be performed by upper protocol, and it is assured that there is only one transmitter-receiver in the state of transmission in the communication network at any instant moment so as to avoid the cross-interference.

HAC-HM can also be used for point-to-point communication with easier operation. For the programming of serial port, all you have to do is to remember that its communication mode is semi duplex while always observing the time sequence of come-and-go for receiving and transmitting.

V. Technical specification of HAC-HM Series

Modulation mode: GFSK

Working frequency: 429.00~434.90MHz (customize 410~450MHz)

Frequency stability: $\leq \pm 2.5\text{PPm}$

Transmission power: 5W(37dBm)

10W(40dBm)

25W(44dBm)

Receiving sensitivity: -113~ -124dBm, -118dBm@9600bps (1%BER)

Channel bandwidth: 100KHZ@9600bps, 12.5KHZ@9600bps

Baud rate: 1200~38400bps (set by factory)

Working temperature: -35°C~80°C (industry level)

Transmitting current: 5W $\leq 1.5\text{A}$

10W $\leq 2\text{A}$

25W $\leq 5\text{A}$

Receiving current: $\leq 100\text{mA}$

Working humidity: 10%~90% relative humidity without condensation

Interface data format: 8E1/8N1

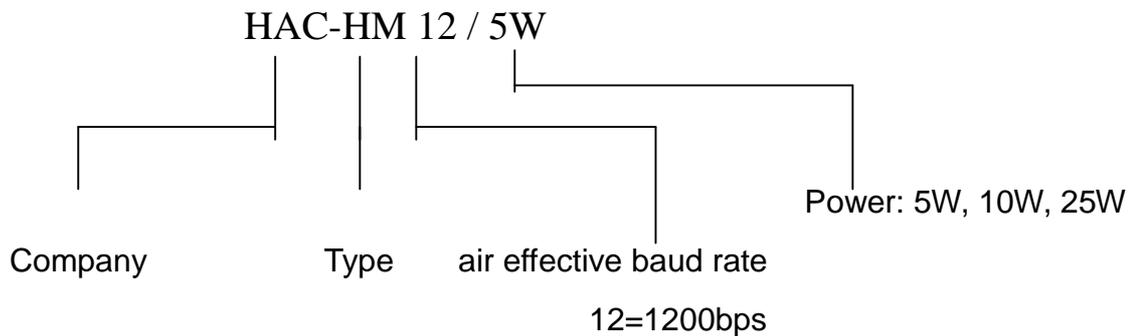
Power supply: +13.8V@6A

Structural Size : 138×84×25mm (not including the antenna connector)

138×84×52mm (including radiator)

VI. Description of type

For product type HAC-HM Series, HAC- indicates the name of manufacturer Shenzhen HAC Technology Co., Ltd., HM indicates high power, i.e. transmission power is 37dBm, and 12 indicates that the baud rate in the air is 1200bps set before out of factory. Users can select the baud rate such as 2400bps, 4800bps, 9600bps, 19200bps, 38400bps before placing the order. 5W means the transmitting power. Different power should be confirmed before placing the order.



VII. Fittings

1. Antenna

HAC-HM series uses the BNC antenna connector, it can meet various kinds of antenna requirements. When choosing the antenna, the users must notice the compatibility of the 50Ω impedance matching and the frequency should be the same. In addition, the antenna can stand the transmission power of 25W.

The standard configuration for HM series doesn't include the antenna. Users can buy the following antenna according to their requirements.

- a. Omni-directional fiberglass antenna with high gain
- b. Omni-directional big magnetic antenna
- c. Directional antenna.
- d. If you use 5W data radio with LX433-18-ZSMA helical antenna, it can not achieve the desired effect transmission.

If select a high gain antenna or a directional antenna, fixed outdoor and in a high place, it can greatly enhance the distance.

2. Data line

- a. single female DB9 line

Because the standard DB9 can support RS232/RS485/TTL three ports at the same time, it is different from the standard RS232 serial port wire. So it can't use with the standard DB9 converting wire directly. Users should make line according to the pin definition and using serial port.

Standard single female DB9 line, the corresponding cable color is shown as follow:

b.

Female DB9	Corresponding cable color	Female DB9	Corresponding cable color
1	Blue	6	Gray
2	White	7	Green
3	Brown	8	Black
4	Red	9	Yellow
5	Orange	Ground for enclosure	Purple

If users only

need the RS232 interface, they can buy the DB9 converting wire.



3. Radiator

Standard configuration for HM/10W and HM/25W include the radiator, but the HM/5W doesn't include. Please refer to the following picture for more information.

