

HAC-LEM Series Data Radio module



SHENZHEN HAC TELECOM TECHNOLOGY CO., LTD



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I. Features of HAC-LEM series Data Radio Module

1. The transmission power is 500mW (27dB), users can customize 1W (30dBm).
2. High receiving sensitivity: the maximal sensitivity is $-124\text{dBm}/1200\text{bps}$.
3. 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, meanwhile the actual bit error rate can be achieved $10^{-5} \sim 10^{-6}$ when channel bit error rate is 10^{-2} .

4. Long transmission distance

Within the range of visibility, the maximal reliable transmission distance is 4Km (BER= $10^{-3}/1200\text{bps}$) when the antenna height is greater than 2m, the reliable transmission distance is more than 2Km (BER= $10^{-3}/9600\text{bps}$).

5. Use for industry/army

Because of adopting the high quality component and high reliable TCXO crystal, the temperature can achieve from -35 to $+80$ (industry grade).

6. Transparent data transmission

Transparent data interface is offered to meet any standard users' protocols. Any false data generated in the air can be filtrated automatically (What has been received is exactly what has been transmitted).

7. Multi-channel

The standard HAC-LEM series 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.

8. Three kinds of interface modes(TTL、RS-232、RS-485)

RS232, RS485 interface diversion chip, DB9 standard interface connector and special power connector are used.

9. large data buffer zone

Interface baud rate is 1200/2400/4800/9600/19200/38400bps with format of 8N1/8E1 and user can define them by himself. It can transmit unlimited data when Interface baud rate is no more than air effective baud rate band.

10. Intelligent data control and the user don'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-LEM series will



automatically complete the other operations, such as sending/receiving conversion in the air, controlling, etc.

11 HAC-LEM can indicate the power source and the data's sending and receiving.

II. Application of HAC-LEM series Data Radio Module

HAC-LEM series data RF module is suitable for:

Matching for the exports

Communication of army and police

Data transmission system for railway, electricity and oil field

Industrial remote controlling and remote testing, automatic data collecting system

III. How to use HAC-LEM series Data radio module

HAC-LEM Series Radio provides three interface modes including standard RS-232, RS-485 and UART/TTL levels allowing direct connection with computer, user's RS-232/RS-485 device, SCM or other UART components for application. The using method is showing as follows:

1. Power supply

HAC-LEM uses DC power supply with voltage of +4.75V~5.25V. We suggest not to use the switch power or boosted circuit. But if you have to use, please pay more attention to the interference of power switch pulse on RF module. You had better choose the switch power of higher 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-LEM series connector

HAC-LEM series can supply one 2P power connector and one (DB9) data pin connector, 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	+	DC5V@500mA	



Table 2: Definition of DB9(male) interface pins and connection method

Pin No	Definition	Instruction	Level	Connected to the terminal	Connecting with the computer
1	sleep	Sleep control (input)	TTL	Sleep signal	Don't open
2	RxD	The RxD of RS-232	RS-232	TxD	Connect to 3 rd pin of computer
3	TxD	The TxD of RS-232	RS-232	RxD	Connect to 2 nd pin of computer
4	Reset	Reset signal (input)	TTL		Reset by negative pulse
5	SGND	Signal ground			Connect to 5 th pin of computer
6	TxD	TxD of TTL	TTL	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	

The sleep function is unavailable in our standard products. If you want to use it, Please inform us when you order.

3. Setting of channel, data format and the interface baud rate:

Before using HAC-LEM, the user needs to make simple configuration based on his own needs to determine the channel, data format and the additional function.

There is a switch of 8 bits on the HAC-LEM. When turn it to "ON", it means 0 and the opposite means 1. The configuration method is shown as follow:

Note: Every changes of the DIP switch will be effective after the power supply reset.

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 communication network, as long as the operation mode of switch is the same, it can communicate with each other.

The standard set in factory is 7 channels, SW321=111(7). Frequency: 433.926MHz

The corresponding frequencies of the other channel are shown as follow in Table 3.



Table 3: Corresponding frequency of 0 ~ 7 channels

Channel No.	Frequency	Channel No.	Frequency
SW321=000(0)	430.2000 MHz	SW321=100(4)	434.6940 MHz
SW321=001(1)	431.4288 MHz	SW321=101(5)	434.2332 MHz
SW321=010(2)	431.7360 MHz	SW321=110(6)	433.1580 MHz
SW321=011(3)	430.5072 MHz	SW321=111(7)	433.9260 MHz

b. Parity mode selection:

HAC-LEM can support no parity and even parity mode, that is 8N1/8E1. You can choose parity mode through the fifth bit of the switch:

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

5th bit=1 8E1 (even parity)

5th bit=0 8N1 (no parity)

c. Selection of interface data's baud rate:

We can set the interface baud rate in order to satisfy different demands of customers.

It can be set through the 7,8 bit on the switch.

In order to achieve the best communication quality, the air communication baud rate of HAC-LEM serial is correlative to the hardware of HAC-LEM, so it can't be changed after selling. The data following the LEM is air effective baud rate, for example:

HAC-LEM12 means the efficiency baud rate in air is 1200bps

HAC-LEM192 means the efficiency baud rate in air is 19200bps

The model of the LEM serial in our company is as follows:

HAC-LEM12,

HAC-LEM48,

HAC-LEM96,

HAC-LEM192,

HAC-LEM384.

Interface baud rate is different from the air baud rate. Each kind of LEM provide 4 kinds of interface baud rate for the selection of customer, as table 4

Table 4: The selection of interface baud rate

Type	Switch SW8,SW7	Interface baud rate
HAC-LEM12	00	1200bps
HAC-LEM48	01	2400bps
HAC-LEM96	10	4800bps



	11	9600bps
HAC-LEM192	00	2400bps
	01	4800bps
	10	9600bps
	11	19200bps
HAC-LEM384	00	4800bps
	01	9600bps
	10	19200bps
	11	38400bps

Because the buffer zone is limited in RAM of LEM, when the interface baud rate is bigger than air efficiency baud rate for HAC-LEM12 and HAC-LEM48, if the user want to send the long data at one time, the data may be lost because of the overflow of the buffer zone. So it is better for user to send the smaller data packet. the longest data you can send each time is as table 5.

Table5: the longest data time as different the interface baud rate

Type	Interface baud rate	Allowed longest data
HAC-LEM12	2400bps	500Byte
	4800bps	400Byte
	9600bps	300Byte
HAC-LEM48	9600bps	500Byte

When the interface baud rate is smaller than the air efficiency 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 for ever.

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 power supply and the data transmission and receiving:

Indicator of power: red light is on after supplying the electricity

Indicator of data sending & receiving: when receiving the air signal, the green light is on; when receiving the serial data, the red light is on.

5. Antenna Configuration

HAC-LEM series wireless data module uses the SMA type of antenna connector to satisfy customer's different requirements about antenna.

When choosing the antenna, the customer must notice the compatibility of the 50 impedance matching and the working frequency of antenna must be in accordance with the order frequency. If you use the high gain and the directional YAGI antenna, the transmitting distance will be further improved.

In addition, the 0.5w transmission power must be supported by antenna.

IV. Networking application of HAC-LEM series

The communication channel of HAC-LEM 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 every 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-LEM 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.

. Technical specification of HAC-LEM series Radio Data Module

Frequency range: 429.00-434.90MHz (410~472MHz can be customized.)

Frequency reliable : $\pm 2.5\text{ppm}$

Modulation mode: GFSK

Transmission power: 27dBm (500mw)/1W (30dBm)

Receiving sensitivity: -113 ~ -124dBm

(-118dBm@9600bps/ BER= 10^{-3} , -124dBm@1200bps/ BER= 10^{-3})

Air baud rate : 1200 ~ 38400bps (confirm before ex-factory)

Format of the interface data: 8E1/8N1

Working temperature: -35 ~ 80

Power: +4.75V~+5.25V

Transmitting current: 450mA

Receiving current: 50mA

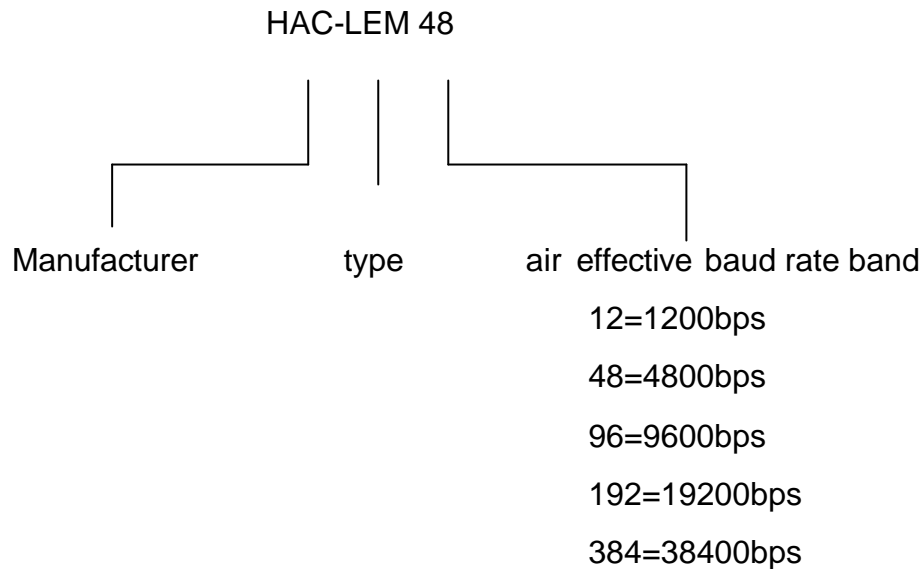
Working humidity: 10%~90% relative humidity without condensation

Dimension : 78 mm × 56 mm × 15mm (the size exclude antenna and DB9 connector)



. Type Description of HAC-LEM series Data radio module

For product type HAC LEM, HAC- indicates the name of manufacturer Shenzhen HAC Technology Co., Ltd, L indicates low frequency 20dB ~ 29dB, E indicates that the products are used for industry/army. M indicates 430M frequency band. The other definition is as follows:



We can make the module which can satisfy CE, FCC and RoHS under given specifically transmitting power and frequency as 458MHZ.