E34-2G4H27D User Manual

nRF24L01+ 2.4GHz TTL Auto Frequency Hopping Module



Chengdu Ebyte Electronic Technology Co.,Ltd.

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1.Overview

1.1 Introduction

E34 (2G4H27D) is a 500mW wireless transceiver module, which operates at 2.4-2.518GHz. The outstanding advantages of this module is concentrated power densities, long transmission range, automatic frequency hopping and TTL level, compatible with 3.3V and 5V.

With auto frequency hopping communication, the module has a good anti-interference ability with low latency, even if there are some frequency interference, it still can communicate on the undisturbed frequency point.



1.2 Features

- Support automatic frequency hopping, greatly improve communication anti-interference ability;
- Support fixed frequency communication, fast transmission speed and low latency;
- Support automatic packet retransmission after packet loss;
- Support fixed-point transmission, easy to start network communication;
- Built-in PA+LNA with 500mW power，communication distance tested is up to 5km;
- It works at ISM 2.4GHz;
- Air data rate:250k～2Mbps；
- With advanced GFSK modulation；
- Support 3.3V~5.5V power supply, power supply over 5.0 V can guarantee the best performance；
- Industrial grade standard design, support -40 ~ 85 °C for working over a long time；
- With SMA-K connector, easy connection of IPEX cable or external antenna.

1.3 Application

- Home security alarm and remote keyless entry；
- Smart home and industrial sensors；
- Wireless alarm security system；
- Building automation solutions；
- Wireless industrial-grade remote control；
- Health care products；
- Advanced Meter Reading Architecture(AMI)；
- Automotive industry applications.

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2. Specification and parameter

2.1 Limit parameter

Main parameter	Performance		**Remark**
	Min.	Max.	
Power supply（V）	0	5.5	Voltage over 5.5V will cause permanent damage to module
Blocking power（dBm）	-	-10	Chances of burn is slim when modules are used in short distance
Operating temperature（℃）	-40	85	

2.2 Operating parameter

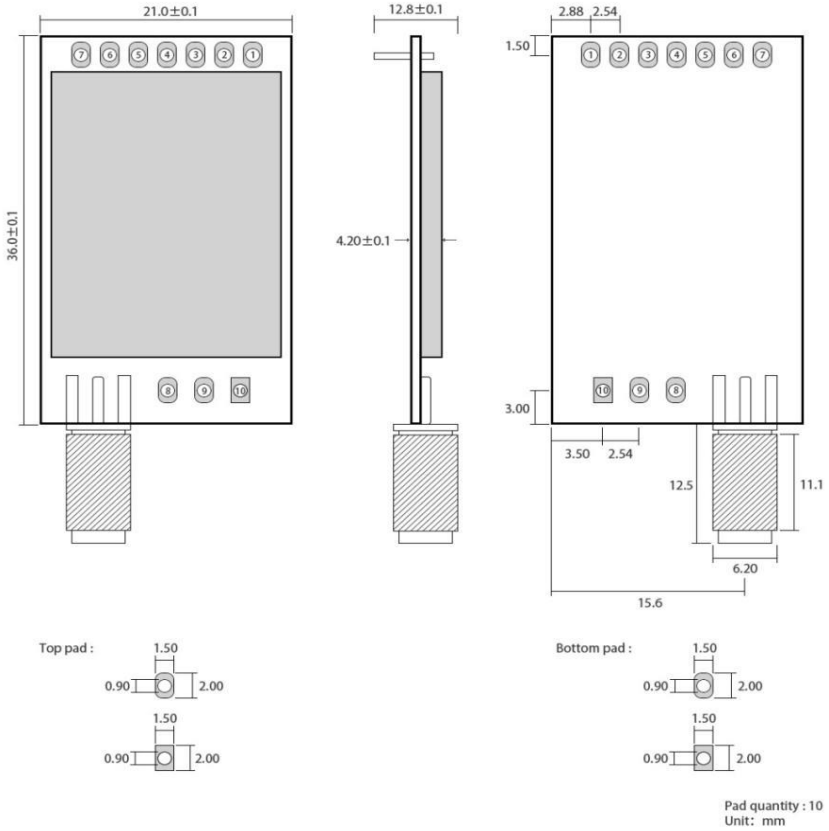
Main parameter		**Performance**			**Remark**
		Min	**Typ.**	**Max.**	
Operating voltage（V）		3.3	5.0	5.5	≥5.0 V ensures output power
Communication level（V）			3.3		For 5V TTL, it may be at risk of burning down
Operating temperature（℃）		-40	-	+85	Industrial design
Operating frequency（MHz）		2400	-	2518	
Power consumption	Transmitting current [mA]		400		Instant power consumption
	Receiving current [mA]		21		
	Turn-off current [μA]		510		Software is shut down
Max Tx power（dBm）		26.5	27.0	27.5	
Receiving sensitivity（dBm）		-101	-102	-103	Air data rate is 250kbps
Air data rate（bps）		250k	250k	2M	The higher the rate, the lower the distance

Main parameter	**Description**	**Remark**
Distance for reference	5000m	Test condition：clear and open area, antenna gain: 5dBi， antenna height: 2.5m， air data rate: 250kbps
TX length	27 Byte	Maximum capacity of single package
Buffer	256 Byte	
Modulation	GFSK	
Communication interface	UART	TTL level
Package	DIP	
Connector	2.54mm	
Size	21*36mm	
Antenna	SMA-K	50 ohm impedance

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3 Size and pin definition

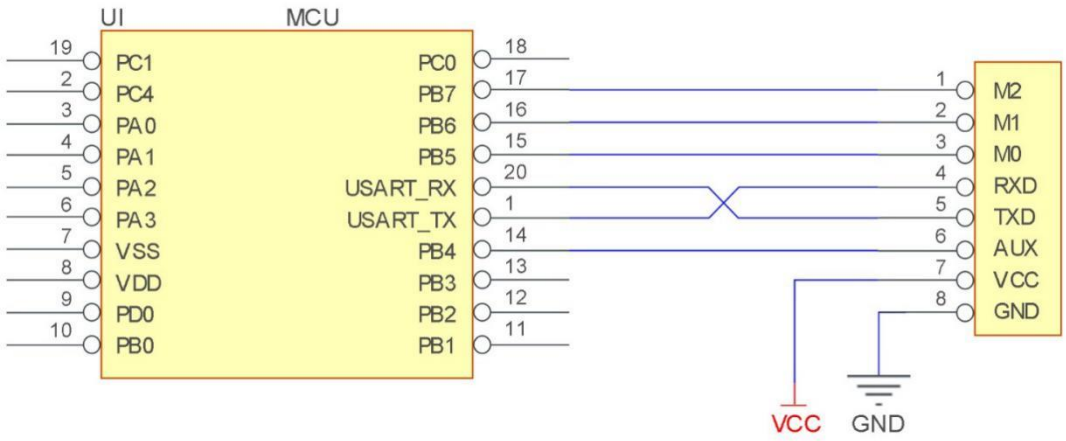


NO	Pin	Pin direction	Pin application
1	M0	Input (weak pull-up)	Work with M1 & decide the four operating modes. Floating is not allowed, can be ground.
2	M1	Input (weak pull-up)	Work with M0 & decide the four operating modes. Floating is not allowed, can be ground.
3	RXD	Input	TTL UART inputs, connects to external (MCU, PC) TXD output pin. Can be configured as open-drain or pull-up input.
4	TXD	Output	TTL UART outputs, connects to external RXD (MCU, PC) input pin. Can be configured as open-drain or push-pull output
5	AUX	Output	To indicate module's working status & wakes up the external MCU. During the procedure of self-check initialization, the pin outputs low level. Can be configured as open-drain output or push-pull output (floating is allowed).
6	VCC		Power supply 3.3V-5.5V DC
7	GND	Input	Ground
8	Fixing hole	Input	Fixing hole
9	Fixing hole		Fixing hole
10	Fixing hole		Fixing hole

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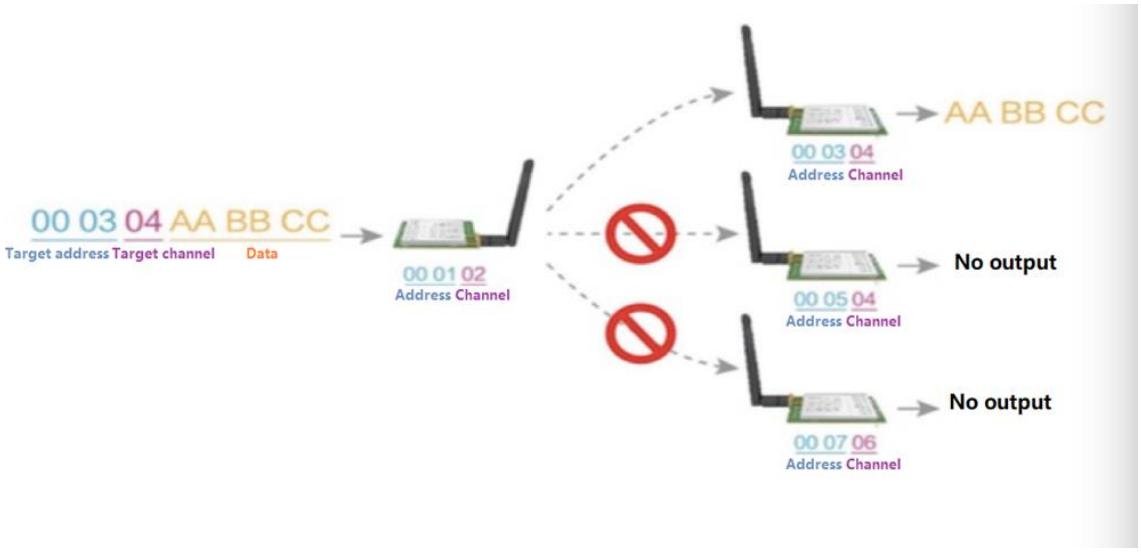
4 Connect to MCU



No.	Description（STM8L MCU）
1	The UART module is TTL level.
2	For some MCU works at 5VDC, it may need to add 4-10K pull-up resistor for the TXD & AUX pin.

5 Function description

5.1 Fixed transmission



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5.2 Reset

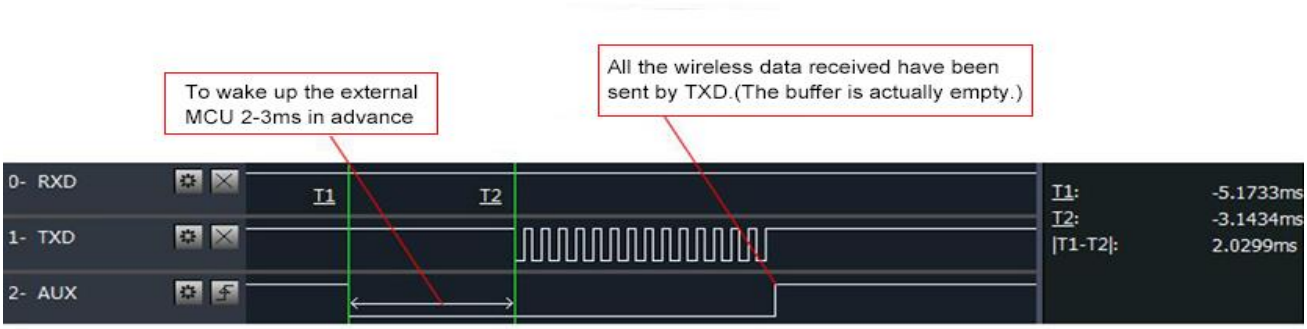
- When the module is powered, AUX outputs low level immediately, conducts hardware self-check and sets the operating mode based on user's parameters. During the process, the AUX remains low level. After the process completed, the AUX outputs high level and starts to work as per the operating mode combined by M1 and M0. Therefore, users need to wait the AUX rising edge as the start of module's normal work.

5.3 AUX description

- AUX Pin can be used as indication for wireless send & receive buffer and self-check.
- It can indicate whether there are data that are not sent yet via wireless way, or whether all wireless data has been sent through UART, or whether the module is still in the process of self-check initialization

5.3.1 Indication of UART output

- To wake up external MCU



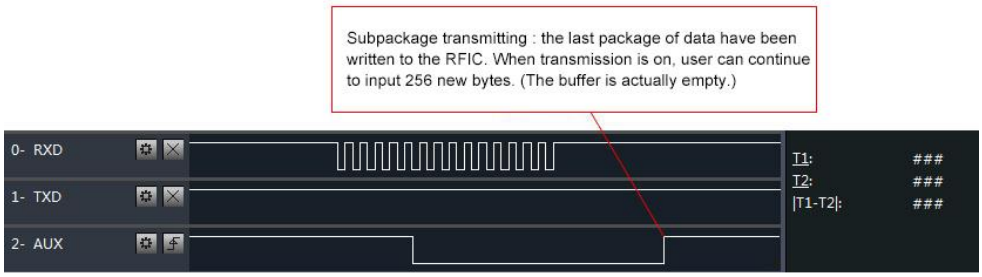
Timing Sequence Diagram of AUX when TXD pin transmits

5.3.2 Indication of wireless transmitting

- Buffer (empty): the internal 256 bytes data in the buffer are written to the RFIC (Auto sub-packaging).
- When AUX=1, the user can input data less than 256 bytes continuously without overflow. Buffer (not empty): when AUX=0, the internal 256 bytes data in the buffer have not been written to the RFIC completely. If the user starts to transmit data at this circumstance, it may cause overtime when the module is waiting for the user data, or transmitting wireless sub package.
- When AUX = 1, it does not mean that all the UART data of the module have been transmitted already, perhaps the last packet of data is still in transmission.

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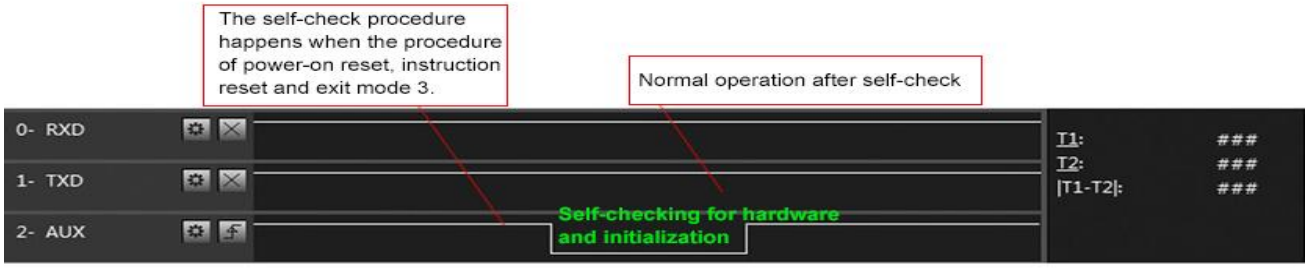
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Timing Sequence Diagram of AUX when RXD pin receives

5.3.3 Configuration procedure of module

- Only happened when power-on resetting or exiting sleep mode



Timing Sequence Diagram of AUX when self-check

5.3.4 Notes for AUX

- For function 1 & function 2 mentioned above, the priority should be given to the one with low level output, which means if it meets each of any low level output condition, AUX outputs low level, if none of the low level condition is met, AUX outputs high level.
- When AUX outputs low level, it means the module is busy & cannot conduct operating mode checking. Within 1ms since AUX outputs high level, the mode switch will be completed.
- After switching to new operating mode, it will not work in the new mode immediately until AUX rising edge lasts for 2ms . If AUX stays on the high level, the operating mode switch can be effected immediately.
- When the user switches to other operating modes from mode 3 (sleep mode) or it's still in reset process, the module will reset user parameters, during which AUX outputs low level.

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6 Operating mode

There are four operating modes set via pin M0 and M1, see details below：

Mode（0-3）	M0	M1	Mode introduction	Remark
Mode 0 Fixed frequency mode	0	0	UART and wireless channel are open, transparent transmission is on.	The receiver must work in mode 0 or mode 2
Mode 1 Frequency hopping mode	1	0	The difference from Mode 0 is: the frequency will change in send &receive process according to certain algorithm rules, the scope is not limited to the basic frequency of user setting, the module has a specific spread sequence.	The receiver must work in mode 1
Mode 2 Reservation mode	0	1	Reservation mode	Same with mode 0
Mode 3 Sleep	1	1	Parameter setting	

6.1 Mode switch

- Users can combine M1 and M0 for high and low levels to determine the operating mode.
  Two mode GPIOs of the MCU can be used to control mode switching;
  After changing M1 and M0: If the module is idle, after 1ms, it can start working according to the new mode;
  If the serial port data of the module has not been transmitted wirelessly, the new operating mode can be entered after the transmission is completed;
  If the module receives wireless data and sends out data through the serial port, it needs to be sent before entering the new working mode.
  Therefore, the mode switch can only be valid when the AUX output is 1, otherwise the switch will be delayed.
- For example, in mode 0 or mode 1, the user continuously inputs a large amount of data and simultaneously performs mode switching, and the switching mode operation at this time is invalid;
  The module will process all user data before performing new mode detection;
  Therefore, the general recommendation is to detect the output state of the AUX pin and wait for 2ms to switch after the AUX output is high.

6.2 Fixed Frequency Mode (Mode 0)

Type	When M1 = 0 & M0 = 0, module works in mode 0

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Transmitting	The module can receive the user data via serial port, and transmit wireless data package of 27 bytes. When the data inputted by user is up to 27 byte, the module will start wireless transmission. During which the user can input data continuously for transmission. When the required transmission bytes are less than 27 bytes, the module will wait 3-byte time and treat it as data termination unless continuous data inputted by user. Then the module will transmit all the data through wireless channel. When the module receives the first data packet from user, the AUX outputs low level. After all the data are transmitted into RF chip and transmission is started , AUX outputs high level. At this time, it means that the last wireless data package transmission is started, which enables the user to input another 256 bytes continuously. The data package transmitted from the module working in mode 0 can only be received by the module working in mode 0 or 2.
Receiving	The wireless receiving function of the module is on, the data packet transmitted from the module working in mode 0 & mode 2 can be received. After the data packet is received, the AUX outputs low level, 5ms later the module starts to transmit wireless data through serial port TXD pin. After all the wireless data have been transmitted via serial port, the AUX outputs high level.
Notes	Module can not receive data when transmitting and can not transmit data when receiving.

6.3 Frequency hopping mode (Mode 1)

Type	**When M0 = 1，M1 = 0，module works in mode 1.**
Transmitting	The condition of data packet transmission & AUX function is the same as mode 0. The only difference is that the module will according to certain algorithm rules, the frequency will change in send &receive process, the scope is not limited to the basic frequency of user setting, the module has a specific spread sequence. Therefore, the data package transmitted from mode 1 can be received by mode 1.
Receiving	The same as that in mode 0.
Notes	Module can not receive data when transmitting and can not transmit data when receiving.

6.4 Reservation mode (Mode 2)

Type	**When M0 = 0，M1 = 1，module works in mode 2.**
Transmitting	The same as that in mode 0.
Receiving	The same as that in mode 0.

6.5 Sleep mode (Mode 3)

Type	**When M0 = 1，M1 = 1，module works in mode 3.**

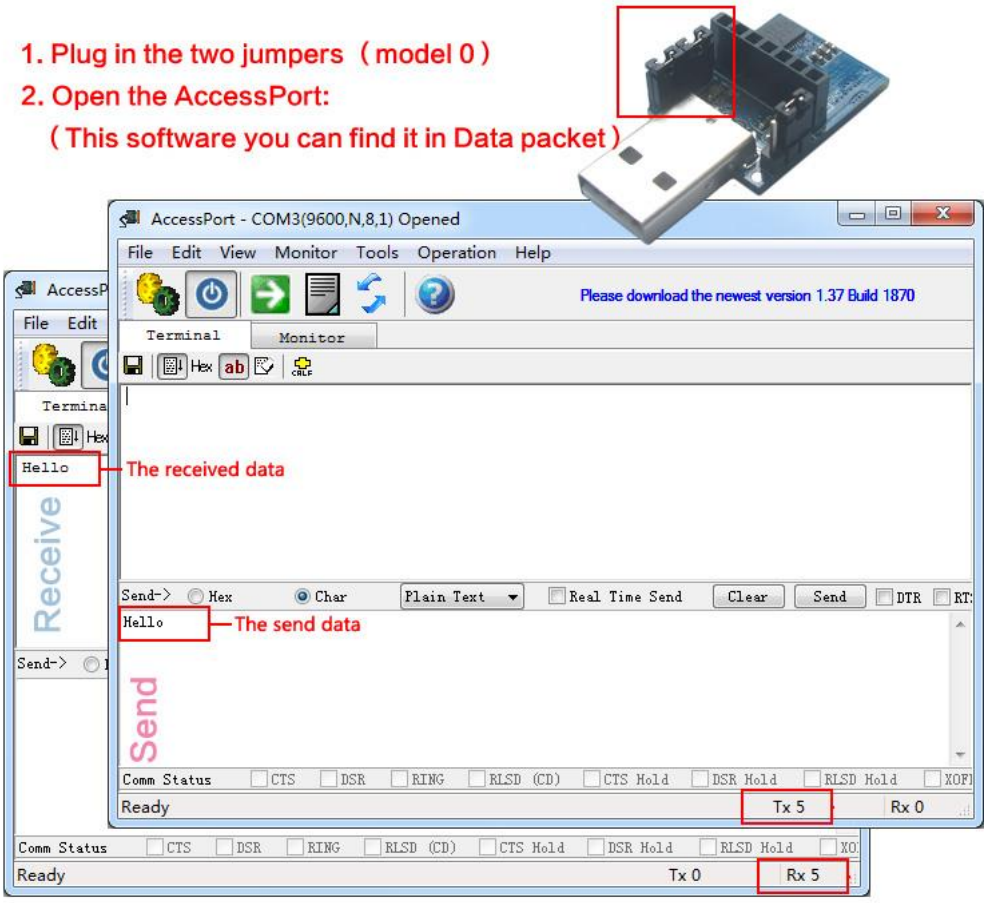
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Transmitting	Cannot send data
Receiving	Cannot receive data
Parameter setting	This mode can be used for parameter setting. It uses serial port 9600 & 8N1 to set module working parameters through specific instruction format.
Notes	When the mode changes from stand-by mode to others, the module will reset its parameters, during which the AUX keeps low level and then outputs high level after reset completed. It is recommended to check the AUX rising edge for user.

6.6 Quick communication test

Steps	Operation
1	Plug the USB test board (E15-USB-T2) into computer, make sure the driver is installed correctly. Plug mode-select jumper in the USB test board (M1 = 0 , M0 = 0), make the module work in mode 0.
2	Optional power supply, 3.3V or 5V (it supports 3.3V ~ 5.5V).
3	Operate AccessPort software and select the correct serial port code.



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7. Instruction format

In sleep mode（mode 3：M1=1, M0=1）, it supports below instructions.

(**Only support 9600 and 8N1 format when setting**)

No.	Instruction format	Description
1	C0+working parameters	C0 + 5 bytes working parameters are sent in hexadecimal format. 6 bytes in total and must be sent in succession. (Save the parameters when power-down)
2	C1 +C1 +C1	Three C1 are sent in hexadecimal format. The module returns the saved parameters and must be sent in succession.
3	C2+working parameters	C2 + 5 bytes working parameters are sent in hexadecimal format. 6 bytes in total and must be sent in succession. (Do not save the parameters when power-down)
4	C3 +C3 +C3	Three C3 are sent in hexadecimal format. The module returns the version information and they must be sent in succession.
5	C4+ C4 +C4	Three C4 are sent in hexadecimal format. The module will reset one time and they must be sent in succession.

7.1 Default parameters

	Default parameter values：**C0 00 00 18 00 40**						
Model	Frequency	Address	Channel	Air data rate	Baud rate	Parity	Transmitting power
E34-2G4H27D	2.4GHz	0x0000	0x00	250kbps	9600	8N1	500mW

7.2 Reading operating parameters

Instruction format	Description
C1+C1+C1	In sleep mode（M0=1，M1=1），User gives the module instruction (HEX format): C1 C1 C1, Module returns the present configuration parameters. For example, C0 00 00 18 00 40.

7.3 Reading version number

Instruction format	Description
C3+C3+C3	In sleep mode（M0=1，M1=1）， User gives the module instruction (HEX format): C3 C3 C3, Module returns its present version number, for example C3 34 xx yy. 32 here means the module model (E34 series); xx is the version number and yy refers to the other module features.

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7.4 Reset instruction

Instruction format	Description
C4+C4+C4	In sleep mode（M0=1，M1=1）， User gives the module instruction (HEX format): C4 C4 C4, the module resets for one time. During the reset process, the module will conduct self-check, AUX outputs low level. After reset completing, the AUX outputs high level, then the module starts to work regularly which the working mode can be switched or be given another instruction.

7.5 Parameter setting command

No.	Item	Description				Remark
0	HEAD	Fix 0xC0 or 0xC2, it means this frame data is control command				● Must be 0xC0 or 0xC2 C0: Save the parameters when power-down C2: Do not save the parameters when power-down
1	ADDH	7, 6, 5, 4: resend times （only valid under mode 0 & 2）				Default 15 times (default F). Lost data will be resent. When multiple same addresses exist, conflict may occur, please set as 0.
		3, 2, 1, 0: high address（default F0H)				Default 0
2	ADDL	Low address of module (default 00H)				00H-0FFH
3	SPED	7	6	UART parity bit		UART mode can be different between communication parties
		0	0	8N1 (default)		
		0	1	8O1		
		1	0	8 E1		
		1	1	8N1 (equal to 00)		
		5	4	3	TTL UART baud rate（bps）	UART baud rate can be different between communication parties; The UART baud rate has nothing to do with wireless transmission parameters & won't affect the wireless transmit / receive features.
		0	0	0	1200	
		0	0	1	2400	
		0	1	0	4800	
		0	1	1	9600 (default)	
		1	0	0	19200	
		1	0	1	38400	
		1	1	0	57600	
		1	1	1	115200	
		2	N/A			0 is recommended
		1	0	Air data rate（bps）		The lower the air data rate, the longer the transmitting distance, the better the anti-interference performance and the longer the transmitting time; The air data rate must keep the same for both communication parties.
		0	0	250k（default）		
		0	1	1M		
		1	0	2M		
		1	1	2M（same to 10）		

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<table>
<tr><td></td><td></td><td colspan="3"></td><td></td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">CHAN</td><td colspan="3">7、6、5、4 N/A</td><td>0 is recommended</td></tr>
<tr><td colspan="3">3、2、1、0 Communication level</td><td rowspan="2">00H～0BH, 12 channels in total；</td></tr>
<tr><td colspan="3">Fixed frequency mode（Mode 0）
0-5 Communication frequency：2400M + CHAN * 2M
6-11 Communication frequency：2508M + (CHAN-6）* 2M
Frequency hopping mode（Mode 1）
0-11 Communication frequency：2412M + CHAN * 2M</td></tr>
<tr><td rowspan="10">5</td><td rowspan="10">OPTION</td><td>7</td><td colspan="2">Fixed transmission（similar to MODBUS)</td><td rowspan="3">In fixed transmission mode, the first three bytes of each user's data frame can be used as high/low address and channel. The module changes its address and channel when transmit. And it will revert to original setting after complete the process.</td></tr>
<tr><td>0</td><td colspan="2">Transparent transmission mode（default）</td></tr>
<tr><td>1</td><td colspan="2">Fixed transmission mode</td></tr>
<tr><td>6</td><td colspan="2">IO drive mode (default 1)</td><td rowspan="3">This bit is used to the module internal pull-up resistor. It also increases the level’s adaptability in case of open drain. But in some cases, it may need external pull-up resistor.</td></tr>
<tr><td>1</td><td colspan="2">TXD and AUX push-pull outputs,RXD pull-up inputs</td></tr>
<tr><td>0</td><td colspan="2">TXD、AUX open-collector outputs;RXD open-collector inputs</td></tr>
<tr><td colspan="3">5、4、3、2 N/A</td><td>0 is recommended</td></tr>
<tr><td>1</td><td>0</td><td>Transmission power (approximation)</td><td rowspan="5">The external power must make sure the ability of current output more than 800mA and ensure the power supply ripple within 100mV;
Low power is not recommended for power supply is not effective</td></tr>
<tr><td>0</td><td>0</td><td>27dBm（Default）</td></tr>
<tr><td>0</td><td>1</td><td>21dBm</td></tr>
<tr><td>1</td><td>0</td><td>15dBm</td></tr>
<tr><td>1</td><td>1</td><td>9dBm</td></tr>
</table>

For example: The meaning of No.3 "SPED" byte:

The binary bit of the byte	7	6	5	4	3	2	1	0
Configures by user	0	0	0	1	1	0	1	0
Meaning	UART parity bit 8N1		UART baud rate is 9600			Air data rate is 250k		
Corresponding hexadecimal	1				8			

8. Hardware design

- It is recommended to use a DC stabilized power supply. The power supply ripple factor is as small as possible, and the module needs to be reliably grounded. ;
- Please pay attention to the correct connection of the positive and negative poles of the power supply. Reverse connection may cause permanent damage to the module ;
- Please check the power supply to ensure it is within the recommended voltage otherwise when it exceeds the maximum value the module will be permanently damaged ;
- Please check the stability of the power supply, the voltage can not be fluctuated frequently ;
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the

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margin, so the whole machine is beneficial for long-term stable operation.；

- The module should be as far away as possible from the power supply, transformers, high-frequency wiring and other parts with large electromagnetic interference.；
- High-frequency digital routing, high-frequency analog routing, and power routing must be avoided under the module. If it is necessary to pass through the module, assume that the module is soldered to the Top Layer, and the copper is spread on the Top Layer of the module contact part(well grounded), it must be close to the digital part of the module and routed in the Bottom Layer；
- Assuming the module is soldered or placed over the Top Layer, it is wrong to randomly route over the Bottom Layer or other layers, which will affect the module's spurs and receiving sensitivity to varying degrees；
- It is assumed that there are devices with large electromagnetic interference around the module that will greatly affect the performance. It is recommended to keep them away from the module according to the strength of the interference. If necessary, appropriate isolation and shielding can be done；
- Assume that there are traces with large electromagnetic interference (high-frequency digital, high-frequency analog, power traces) around the module that will greatly affect the performance of the module. It is recommended to stay away from the module according to the strength of the interference.If necessary, appropriate isolation and shielding can be done.
- If the communication line uses a 5V level, a 1k-5.1k resistor must be connected in series (not recommended, there is still a risk of damage)；
- Try to stay away from some physical layers such as TTL protocol at 2.4GHz , for example: USB3.0；
- The mounting structure of antenna has a great influence on the performance of the module. It is necessary to ensure that the antenna is exposed, preferably vertically upward. When the module is mounted inside the case, use a good antenna extension cable to extend the antenna to the outside.

9 FAQ

9.1 Communication range is too short

- The communication distance will be affected when obstacle exists.
- Data lose rate will be affected by temperature, humidity and co-channel interference.
- The ground will absorb and reflect wireless radio wave, so the performance will be poor when testing near ground.
- Sea water has great ability in absorbing wireless radio wave, so performance will be poor when testing near the sea.
- The signal will be affected when the antenna is near metal object or put in a metal case.
- Power register was set incorrectly, air data rate is set as too high (the higher the air data rate, the shorter the distance).
- The power supply low voltage under room temperature is lower than 2.5V, the lower the voltage, the lower the transmitting power.
- Due to antenna quality or poor matching between antenna and module.

9.2 Module is easy to damage

- Please check the power supply to ensure that it is between the recommended power supply voltage. If the maximum

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value is exceeded, the module will be permanently damaged.

- Please check the stability of power source, the voltage cannot fluctuate too much.
- Please make sure anti static measure are taken when installing and using, high frequency devices have electrostatic susceptibility.
- Please ensure the humidity is within limited range, some parts are sensitive to humidity.
- Please avoid using modules under too high or too low temperature.

9.3 BER(Bit Error Rate) is high

- There are co-channel signal interference nearby, please be away from interference sources or modify frequency and channel to avoid interference.
- Poor power supply may cause messy code. Make sure that the power supply is reliable.
- The extension line and feeder quality are poor or too long, so the bit error rate is high.

10 Production guidance

This type is DIP module, when the welder welds the module, he must be welding according to the anti-static regulation. This product is allergic to static, randomly welding the module will have the chance of damaging it permanently.

11 E34 series

Model No.	Core IC	Frequency Hz	Tx power dBm	Distance km	Data Rate	Package	Size mm	Feature
E34-2G4D20D	nRF24L01+	2.4G	20	2.0	250k～2M	DIP	21 * 36	Full duplex，file transfer
E34-2G4H20D	nRF24L01+	2.4G	20	2.5	250k～2M	DIP	21 * 36	Auto frequency hopping, anti-interference
E34-2G4H27D	nRF24L01+	2.4G	27	5.0	250k～2M	DIP	21 * 36	Auto frequency hopping, anti-interference

12 Antenna recommendation

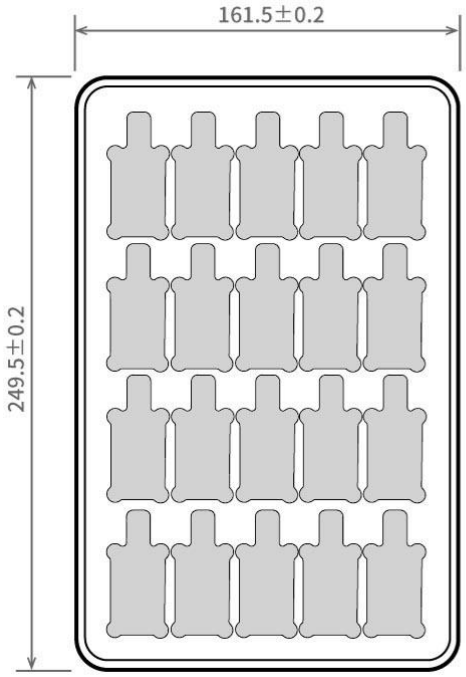
The antenna is an important role in the communication process. A good antenna can largely improve the communication system. Therefore, we recommend some antennas for wireless modules with excellent performance and reasonable price.

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Model No.	Type	Frequency	Gain	Size	Feeder	Interface	Feature
		Hz	dBi	mm	cm		
TX2400-NP-5010	FPC antenna	2.4G	2.0	10x50	-	IPEX	FPC antenna
TX2400-JZ-3	Rubber antenna	2.4G	2.0	30	-	SMA-J	Short straight &omnidirectional
TX2400-JZ-5	Rubber antenna	2.4G	2.0	50	-	SMA-J	Short straight &omnidirectional
TX2400-JW-5	Rubber antenna	2.4G	2.0	50	-	SMA-J	Fixed bending &omnidirectional
TX2400-JK-11	Rubber antenna	2.4G	2.5	110	-	SMA-J	Flexible &omnidirectional
TX2400-JK-20	Rubber antenna	2.4G	3.0	200	-	SMA-J	Flexible &omnidirectional
TX2400-XP-150	Sucker antenna	2.4G	3.5	150	150	SMA-J	Small sucker antenna

13 Package for batch order





Unit: mm
Each Layer: 20 pcs
Each Package: 5 layers

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Version	Date	Description	Issued by
v1.0	2018-07-20	Initial version	huaa
v1.1	2019-03-19	Content update	Ray

About us

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Fax: 028-64146160

Web: www.ebyte.com

Address: Innovation Center B333-D347, 4# XI-XIN Road,Chengdu, Sichuan, China

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