E34-2G4D20D User Manual

nRF24L01+ 2.4GHz TTL Full Duplex Wireless Module

Chengdu Ebyte Electronic Technology Co.,Ltd.

Contents

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1. Overview

1.1 Introduction

E34-2G4D20D is based on nRF24l01+, working at 2.4 ~ 2.518GHz, TTL output.It's compatible with 3.3V and 5V IO port voltage, using serial port for data transmission and reception, reducing the threshold of wireless applications.

The E34-2G4D20D is characterized by high-speed transmission. It can achieve full-duplex (two-way simultaneous transmission and reception) under various baud rates. It is not limited to packet length, supports uninterrupted transmission, and supports file transmission.

The module has data encryption and compression capabilities. The data transmitted by the module in the air is random, and the data interception loses its meaning through strict encryption and decryption algorithms. The data compression function has the probability of reducing the transmission time, reducing the probability of interference, improving reliability and transmission efficiency.

1.2 Features

- Supports full-duplex performance at up to 57600 baud rate (two-way simultaneous transmission and reception);
- Supports uninterrupted transmission, unlimited packet length;
- Support file transfer;
- Maximum transmission power 100mW, multi level adjustable through software;
- Support for the global license-free ISM 2.4GHz band;
- Air rate automatically adapts to baud rate;
- Support advanced GFSK modulation;
- Support low power mode for battery applications;
- Support 2.3 ~ 5.5V power supply, greater than 3.3V power supply can guarantee the best performance;
- Industrial grade standard design, support -40 ~ 85 °C for working over a long time;
- SMA-K interface for easy connection to coaxial cable or external antenna.

1.3 Application

- Wearable device;
- Smart homes, industrial sensors, etc.;
- Security system, positioning system;
- Wireless remote control, drone;
- Wireless game remote control;
- Health care products;
- Wireless voice, wireless headset;
- Automotive industry applications.

2. Specification and parameter

2.1 Limit parameter

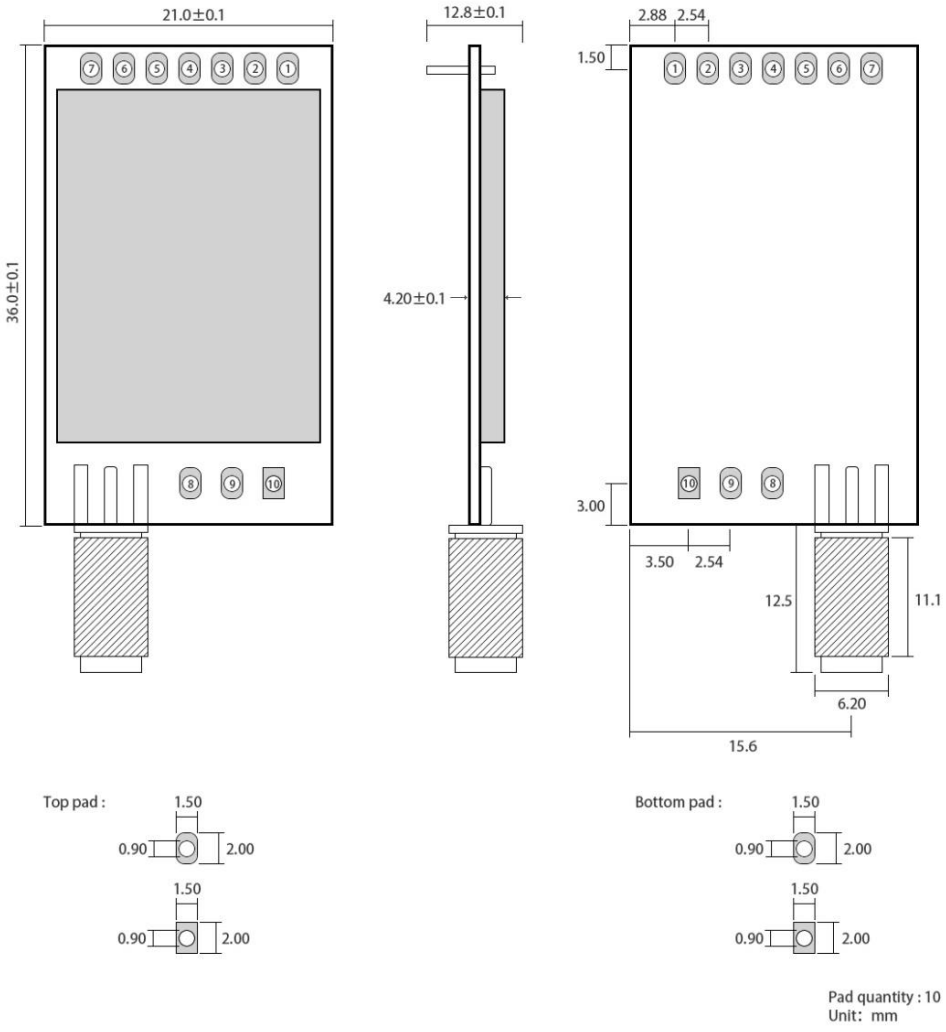
Main parameter	Performance		Remark
	Min.	Max.	
Power supply (V)	0	5.5	Voltage over 5.5V will cause permanent damage to module
Blocking power (dBm)	-	10	Chances of burn is slim when modules are used in short distance
Operating temperature (℃)	-40	85	Industrial grade

2.2 Operating parameter

Main parameter		Performance			Remark
		Min.	Typ.	Max.	
Operating voltage (V)		2.3	5.0	5.5	It's recommended to use 5.0V
Communication level (V)			3.3		For 5V TTL, it may be at risk of burning down
Operating temperature (℃)		-40	-	85	Industrial design
Operating frequency (GHz)		2400	-	2518	Support ISM band
Power consumption	TX current (mA)		110		Instant power consumption
	RX current (mA)		21.5		
	Sleep current (μA)		75		Software is shut down
Max Tx power (dBm)		19.5	20.0	21.4	
Receiving sensitivity (dBm)		-101	-102	-103	Air data rate is 0.3kbps
Air data rate (bps)		-	Not adjustable	-	Automatic software optimization, automatic adaptation to baud rate

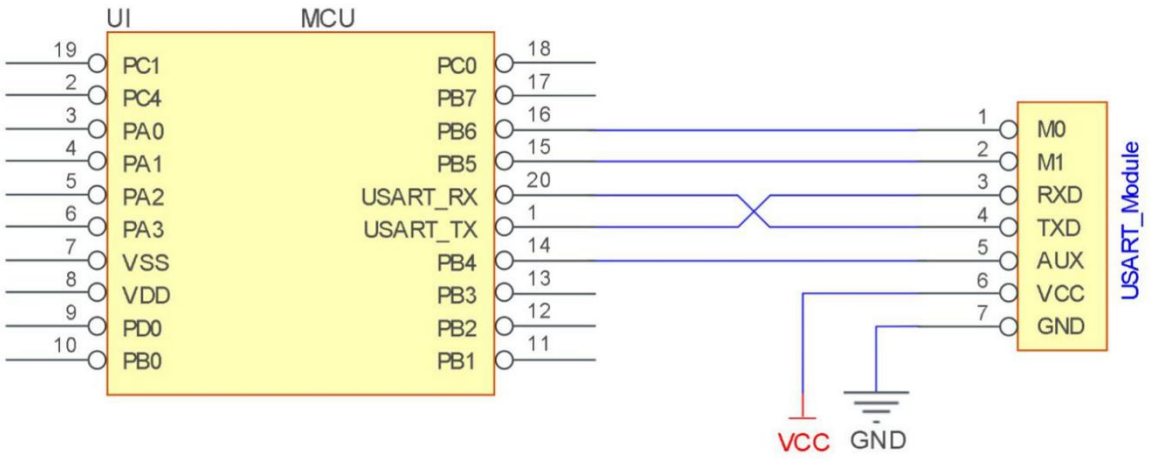
Main parameter	Description	Remark
Distance for reference	2000m	Test condition：clear and open area, antenna gain: 5dBi，antenna height: 2.5m，baud rate 9600
FIFO	29Byte	Maximum length of single transmission
Buffer Size	1024 Btye	Unlimited length
Modulation	GFSK	
Package	DIP	
Connector	2.54mm	
Communication interface	UART	TTL
Size	21*36mm	
Antenna	SMA-K	50 ohm impedance

3. Size and pin definition



No.	Name	Direction	Function
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 2.3V~5.5V DC
7	GND	Input	Ground
8	Fixing hole	Input	Fixing hole
9	Fixing hole		Fixing hole
10	Fixing hole		Fixing hole

4. Recommended wiring diagram



No.	Description（STM8L MCU）
1	The UART module is TTL level, please connect with the MCU of 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. Functional Details

5.1 Module Reset

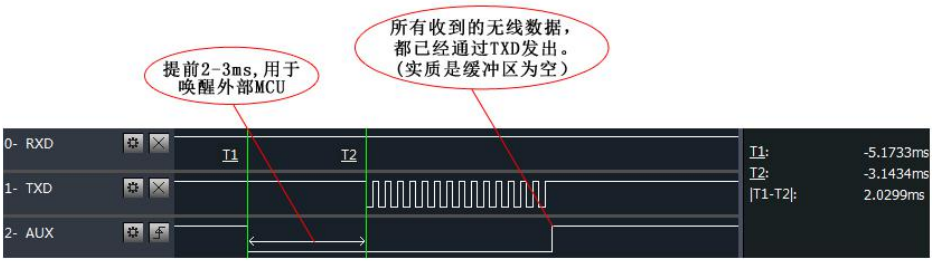
When the module is powered, AUX outputs low level immediately, conducts hardware self-check and sets the operating mode on the basis of the user parameters. During the process, the AUX keeps low level. After the process completed, the AUX outputs high level and starts to work as per the operating mode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

5.2 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 yet to send 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.

5.2.1. Indication of UART output

It's used to wake up external MCU.



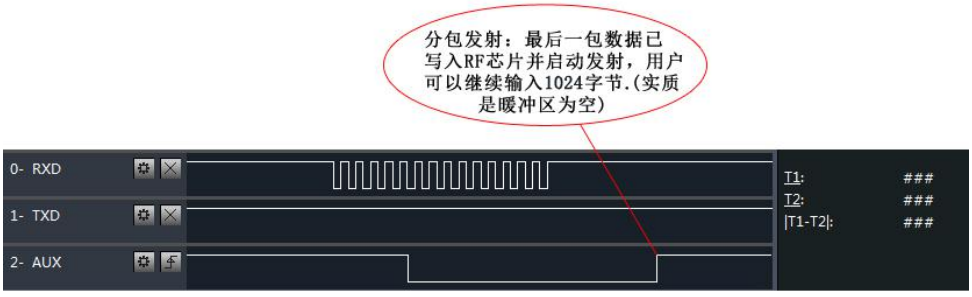
模块串口外发数据时，AUX引脚时序图

5.2.2. Indication of wireless transmitting

Buffer (empty): the internal 1024 bytes data in the buffer are written to the RFIC (Auto subpackage). When AUX=1, the user can input data less than 1024 bytes continuously without overflow.

Buffer (not empty): when AUX=0, the internal 1024 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 subpackage.

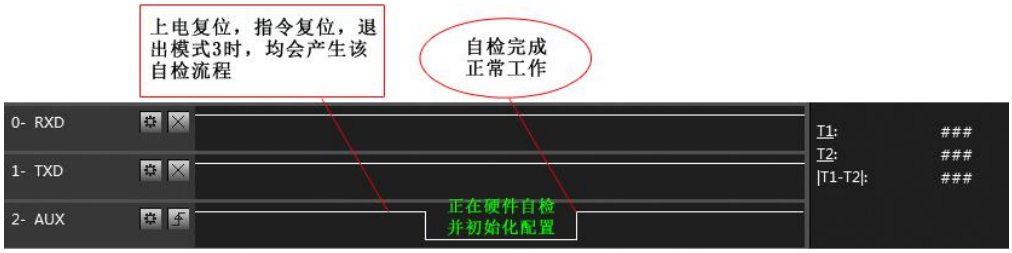
Notes: When AUX = 1, it does not mean that all the UART data of the module have been transmitted already, perhaps the last packet of data is still in transmission.



模块接收串口数据时，AUX引脚时序图

5.2.3.Configuration procedure of module

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



自检期间，AUX引脚时序图

5.2.4. 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 won't be work in the new mode immediately until AUX rising edge 2ms later. If AUX is 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.

6. Operating mode

The module has 4 operation mode, which decided by the status of M1 & M0. Below are the details:

Mode (0-3)	M0	M1	Description	Remark
Mode 0 Half-Duplex	0	0	UART and wireless channel are open, transparent transmission is on , half- duplex operation	The receiver must work at same address, channel and same baud rate.
Mode 1 Full-Duplex	1	0	UART and wireless channel are open, transparent transmission is on , full- duplex operation	The receiver must work at same address, channel and same baud rate.
Mode 2 Reservation Mode	0	1	Reservation Mode	The same as that in mode 0.
Mode 3 Setting Mode	1	1	Parameter setting	

6.1 Mode switching

- The user can decide the operating mode by the combination of M1 and M0. The two GPIO of MCU can be used to switch mode. After modifying M1 or M0, it will start to work in new mode 1 ms later if the module is free. If there are any serial data that are yet to finish wireless transmitting, it will start to work in new mode after the UART transmitting finished. After the module receives the wireless data & transmits the data through serial port, it will start to work in new mode after the transmitting finished. Therefore, the mode-switch is only valid when AUX outputs 1, otherwise it will delay.
- For example, in mode 0 or mode 1, if the user inputs massive data consecutively and switches operating mode at the same time, the mode-switch operation is invalid. New mode checking can only be started after all the user's data process completed. It is recommended to check AUX pinout status and wait 2ms after AUX outputs high level before switching the mode.

6.2 Half-Duplex (Mode 0)

	When M1 = 0 & M0 = 0, module works in mode 0
Transmitting	The module can receive the user data via serial port, and transmit wireless data package of 29 bytes. When the data inputted by user is up to 29 bytes, the module will start wireless transmission. During which the user can input data continuously for transmission. When the required transmission bytes are less than 29 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 1024 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 1 or mode 2
Receiving	The wireless receiving function of the module is on, the data packet transmitted from the module working in mode 1 & mode 2 can be received.After receiving the data packet, the AUX outputs low level, 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.
Note	Module cannot receive data in the process of transmitting. Also, module cannot transmit data in the process of receiving.

6.3 Full-Duplex (Mode 1)

	When M1 = 0 & M0 = 1, 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 add preamble code before each data packet automatically. The preamble code length depends on the wake-up time set in the user parameters. The purpose of the preamble code is waking up the receiving module works in mode 2. Therefore, the data package transmitted from mode 1 can be received by mode 0, mode1 and mode 2.
Receiving	The same as that in mode 0.
Note	Module can receive data in the process of transmission. Also, module can transmit data in the process of receiving.

6.4 Reservation Mode (Mode 2)

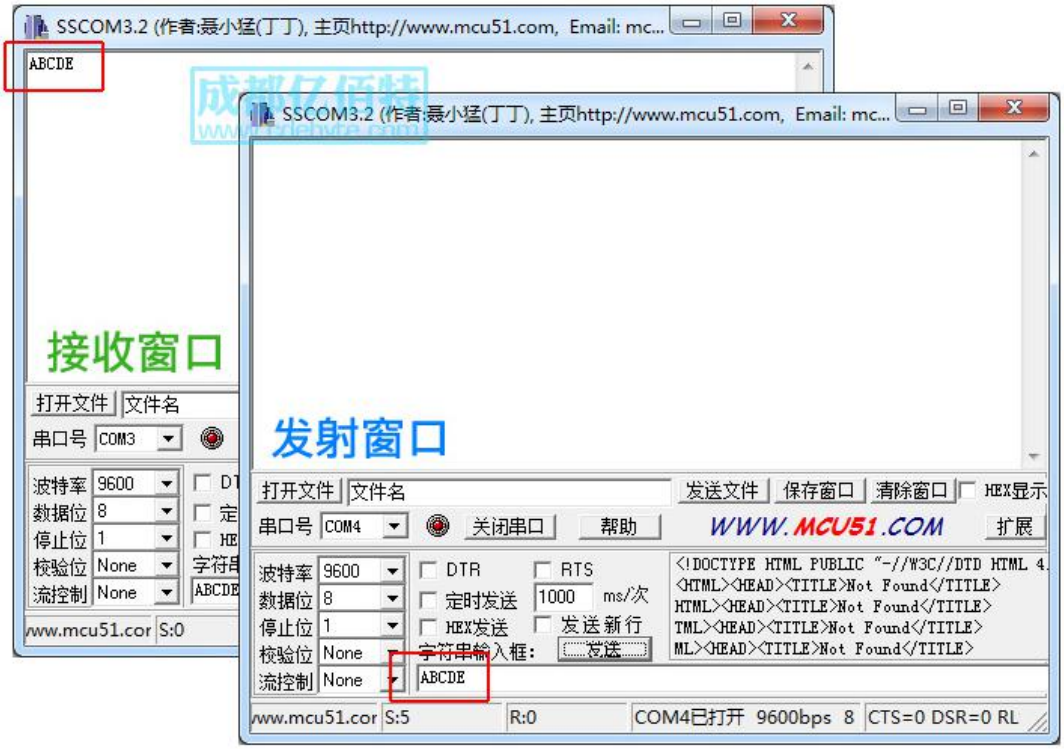
	When M1 = 1 & M0 = 0, module works in mode 2.
Transmitting	The same as that in mode 0
Receiving	The same as that in mode 0

6.5 Setting mode (Mode 3)

	When M1=1, M0=1, module works in mode 3
Transmitting	N/A
Receiving	N/A
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. (pls refer to parameters setting for details)
Notes	When the mode changes from setting 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. (Module supports 2.3V-5.5V)
3	Operate AccessPort software and select the correct serial port code.



7. Instruction format

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

(Only support 9600 and 8N1 format when setting)

No.	Instruction format	Illustration
1	C0 + working parameters	C0 + 5 bytes working parameters are sent in hexadecimal format. 6 bytes in total and must be send 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 send in succession.
3	C2 + working parameters	C2 + 5 bytes working parameters are sent in hexadecimal format. 6 bytes in total and must be send in succession. (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 must be send in succession.
5	C4+C4+C4	Three C4 are sent in hexadecimal format. The module will reset one time and they must be send in succession.

7.1 Default parameter

	Default parameter values：C0 00 00 18 00 40						
Model	Frequency	Address	Channel	Air data rate	Baud rate	Parity	Transmitting power
E34-2G4D20D	2.4GHz	0x0000	0x00	-	9600	8N1	100mW

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 setting mode（M0=1，M1=1）， User gives the module instruction (HEX format): C3 C3 C3, Module returns its present version number, for example C3 39 xx yy. 39 here means the module model (E39 series); xx is the version number and yy refers to the other module features.

7.4 Reset instruction

Instruction format	Description
C4+C4+C4	In setting 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 instruction

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-off C2: Do not save the parameters when power-off
1	ADDH	High address byte of module （the default 00H）				00H-FFH
2	ADDL	Low address byte of module （the default 00H）				00H-FFH
3	SPED	7	6	UART parity bit		● UART mode can be different between communication parties
		0	0	8N1（Default）		
		0	1	8O1		
		1	0	8E1		
		1	1	8N1（equal to 00）		
		5	4	3	TTL Serial port 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	Serial port baud rate 1200	
		0	0	1	Serial port baud rate 2400	
		0	1	0	Serial port baud rate 4800	
		0	1	1	Serial port baud rate 9600（Default）	
		1	0	0	Serial port baud rate 19200	
		1	0	1	Serial port baud rate 38400	
		1	1	0	Serial port baud rate 57600	
		1	1	1	Serial port baud rate 115200	
		2	1	0	Reserved	0 (recommended)
4	CHAN	General model				
		7、6、5、4 reserved				0 (recommended)
		communication channel				00H-1FH,16 channels in total; Corresponds to 2400MHz+CHAN * 7MHz
		3、2、1、0 ,default00H（2400MHz）				
5	OPTION	7	Reserved			0(recommended)
		6	IO Drive mode（Default 1）			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.
		1	TXD、AUX push-pull output，RXD pull up input			
		0	TXD、AUX open output，RXD open input			
		5	4	3	reserved	0(recommended)
		2	reserved			0(recommended)

		1	0	Transmitting power(Approximate value)	The external power must make sure the ability of current output more than 200mA and ensure the power supply ripple within 100mV; Low power transmission is not recommended due to its low power supply efficiency.
		0	0	20dBm（default）	
		0	1	17dBm	
		1	0	14dBm	
		1	1	10dBm	

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

The binary bit of the byte	7	6	5	4	3	2	1	0
The specific value (user configures)	0	0	0	1	1	0	0	0
Meaning	UART parity bit 8N1		UART baud rate is 9600			Air rate adaptation		
Corresponding hexadecimal	1			8				

8. Hardware Design

- It is recommended to use DC stabilized power supply to supply power to the module. The power supply ripple coefficient 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. If the reverse connection is connected, the module may be permanently damaged.
- Please check the power supply to ensure that between the recommended supply voltage, if exceeding the maximum, the module will be permanently damaged.
- Please check the stability of the power supply, the voltage can not be significantly frequent.
- When designing the power supply circuit for the module, it is often recommended to reserve more than 30% of the margin, and 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 traces, high-frequency analog traces, and power traces 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(All copper-covered and well grounded), and must be close to the digital part of the module and routed in the Bottom Layer.
- Assuming the module is soldered or placed in the Top Layer, it is also wrong to randomly route the Bottom Layer or other layers, which will affect the module's spurs and receiving sensitivity to varying degrees.
- Assuming that there are devices with large electromagnetic interference around the module, the performance of the module will also be greatly affected. According to the intensity of the interference, it is suggested to stay away from the module appropriately. If circumstances permit, appropriate isolation and shielding can be done.
- Assume that there are traces with large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power trace), which 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 and also have a 2.4GHz TTL protocol, for example: USB3.0
- The antenna must not be installed inside the metal case, which will greatly reduce the transmission distance.

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).
- When the power supply at room temperature is lower than the recommended low voltage, the lower the voltage is, the lower the transmitting power is.
- Due to antenna quality or poor matching between antenna and module.

9.2 Module is easy to damage

- Please check the power supply and ensure it is within the recommended range. Voltage higher than the peak will lead to a permanent damage to the module.
- Please check the stability of power supply and ensure the voltage not to fluctuate too much.
- Please make sure anti-static measures are taken when installing and using, high frequency devices have electrostatic susceptibility.
- Please ensure the humidity is within limited range for some parts are sensitive to humidity.
- Please avoid using modules under too high or too low temperature.

9.3 High bit error rate

- There are co-channel signal interference nearby, keep away from interference sources or modify frequency, channel to avoid interference.
- Unsatisfactory power supply may also cause garbled characters, and ensure the reliability of the power supply.
- If the extension cable or feeder is of poor quality or too long, the bit error rate will be high.

10.Welding operation guidance

This product is a DIP type module. When welding the module, the welding personnel must work in accordance with the static discharge operation specifications;
This product is a static-sensitive product. The module may be permanently damaged if it is not welded according to the rules.

11.Related Model

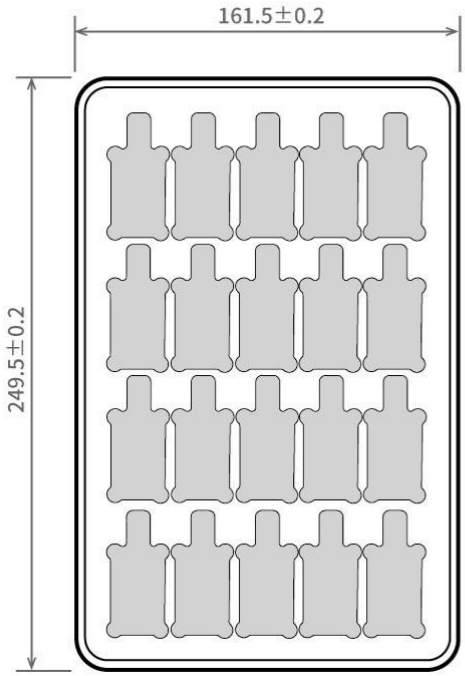
Model	Chip	Frequency Hz	Transmit power dBm	Test distance km	Air data rate Bps	Packaging	Size mm	Communication Interface
E34-2G4D20D	nRF24L01+	2.4G	20	2.0	250k ~ 2M	DIP	21 * 36	Full duplex，file transfer
E34-2G4H20D	nRF24L01+	2.4G	20	2.5	250k ~ 2M	DIP	21 * 36	frequency hopping,anti-interference
E34-2G4H27D	nRF24L01+	2.4G	27	5.0	250k ~ 2M	DIP	21 * 36	frequency hopping,anti-interference

12.Antenna Type

The antenna plays an important role in the communication process. The inferior antenna often has a great impact on the communication system. Therefore, we recommend some antennas that support our wireless modules and have excellent performance and reasonable price.

Product	Type	Frequency	Gain	Size	Feeder	Interference	Features
		Hz	dBi	mm	cm		
TX2400-NP-5010	Soft antenna	2.4G	2.0	10x50	-	IPEX	Flexible FPC Soft Antenna
TX2400-JZ-3	Rubber antenna	2.4G	2.0	30	-	SMA-J	Ultrashort Straight, Omnidirectional Antenna
TX2400-JZ-5	Rubber antenna	2.4G	2.0	50	-	SMA-J	Ultrashort Straight, Omnidirectional Antenna
TX2400-JW-5	Rubber antenna	2.4G	2.0	50	-	SMA-J	Flexible omnidirectional Antenna
TX2400-JK-11	Rubber antenna	2.4G	2.5	110	-	SMA-J	Flexible rubber omnidirectional Antenna
TX2400-JK-20	Rubber antenna	2.4G	3.0	200	-	SMA-J	Flexible rubber omnidirectional Antenna
TX2400-XPL-150	Sucker antenna	2.4G	3.5	150	150	SMA-J	Sucker antenna with magnetic base

13.Batch packaging



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

Revision history

Version	Date	Description	Issued by
v1.0	2018-01-08	Original version	huaa
v5.0	2018-07-20	Content added	Huaa
v6.0	2018-10-24	Model No. split	Huaa
V6.1	2019-3-19	Content added	Ray
V6.2	2021-4-2	Parameter correction	Linson

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