E28-2G4T20SX/E28-2G4T27SX UserManual

SX1281　2.4GHz TTL High-Speed LoRa Module



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1.Product Overview

1.1 Brief Introduction

The E28-2G4TxxSX series is a wireless serial port module (UART) based on the SEMTECH SX1281 RF chip. It supports transparent transmission, operates in the 2.4GHz band, and features LoRa, FLRC, and GFSK modulation/demodulation technologies, with TTL level output.

The module includes data encryption and compression functions. Data transmitted over the air is random; robust encryption and decryption algorithms enhance data transmission security. Data compression reduces transmission time and the probability of interference, improving reliability and transmission efficiency.

Dual antennas (IPEX/stamp hole) are optional, facilitating secondary development and integration.

Two models, E28-2G420SX and E28-2G4T27SX, are available with 20dBm and 27dBm respectively.





1.2 Features

- Support various modulation such as GFSK Mode，FLRC Mode，LoRa Mode;
- Supporting high-speed continuous transmission;
- Support RSSI for evaluating signal quality；
- Support fixed transmission/broadcast/monitoring；
- Communication distance tested is up to 6km/7km in ideal condition;；
- Maximum transmitting power of 20dBm/27dBm, Software adjustable；
- Support the global license-free ISM 2.4GHz；
- Support air data rate of 1kbps～2Mbps;
- Low power consumption for battery supplied applications；
- It supports power supply from 2.3/2.5 to 5.5V, and can guarantee optimal performance with power supply greater than 5V;
- Industrial grade standard design, support -40 ~ 85 °C for working over a long time；

1.3 Application

- Smart Home and Industrial Sensors;
- Security system, location System
- Wireless remote control; UAV；
- Wireless Game Remote Controller
- Health care products；
- Wireless voice, wireless headset;
- Automotive industry applications.

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2. Technical Parameters

2.1 Limit parameter

Main parameter	Performance		Note
	Min	Max	
Voltage supply [V]	2.3/2.5	5.5	E28-2G4T20SX: Min 2.3V,E28-2G4T27SX:Min 2.5V; 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

E28-2G4T20SX Work Parameter Table					
Main parameter		Performance			Note
		Min	Typ	Max	
Voltage supply [V]		2.3	5.0	5.5	≥5.0V ensures output power
Communication level [V]		-	3.3	-	For 5V TTL, it may be at risk of burning down
Operating temperature [℃]		-40	-	+85	Industrial-grade design
Frequency [MHz]		2400	-	2500	Support ISM band
Power consumption	Transmitting current[mA]	116.5	160.2	162.6	Instant power consumption
	Receiving current [mA]	19.6	21.8	21.7	-
	Turn-off current [μA]	10.5	14.2	14.2	Software is shut down
Transmitting power [dBm]		15.3	20.4	20.7	
Receiving sensitivity [dBm]		-130	-134	-134	
Air data rate（bps）		1Kbps	1Kbps	2Mbps	Default 10Kbps
Reference distance		6km			Test condition：clear and open area, antenna gain: 5dBi，antenna height: 2.5m，air data rate: 1kbps
FIFO		121 Btye			Normal mode, using 1Mbps airspeed
		221 Btye			Continuous transmission mode
Cache		2048 Byte			-
Modulation		GFSK			-
		LoRa			-
		FLRC			-
Interface		UART			TTL
Package		SMD			-
Size		16*26mm			-
Antenna		IPEX-1/stamp perforation			50Ω Impedance

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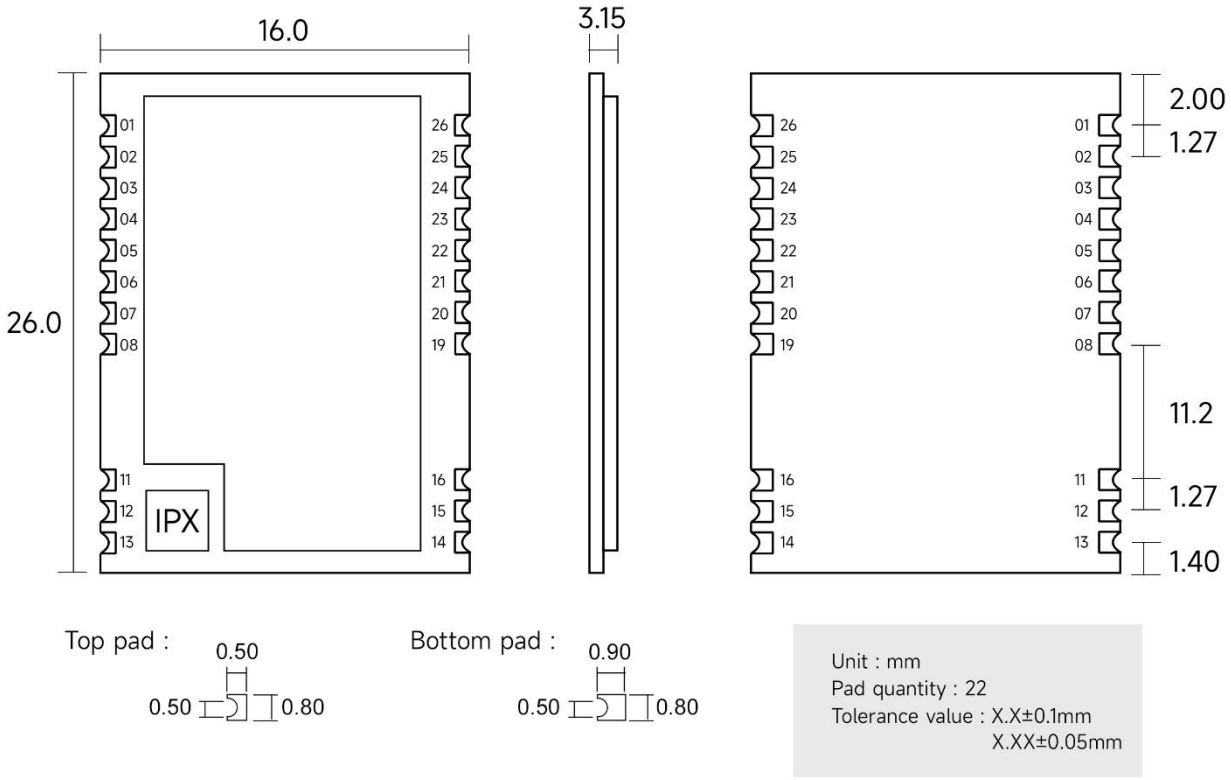
E28-2G4T27SX Work Parameter Table					
Main parameter		Performance			Note
		Min	Typ	Max	
Voltage supply [V]		2.5	5.0	5.5	≥5.0V ensures output power
Communication level [V]		-	3.3	-	For 5V TTL, it may be at risk of burning down
Operating temperature [℃]		-40	-	+85	Industrial-grade design
Frequency [MHz]		2400	-	2500	ISM band
Power consumption	Transmitting current[mA]	-	500	-	Instant power consumption
	Receiving current [mA]	-	27	-	-
	Turn-off current [μA]	-	10	-	Software is shut down
Transmitting power [dBm]		26.5	27	27.5	
Receiving sensitivity [dBm]		-130	-134	-134	
Air data rate（bps）		1k	1k	2M	Default 10Kbps
Reference distance		7km			Test condition：clear and open area, antenna gain: 5dBi，antenna height: 2.5m，air data rate: 1kbps
FIFO		121 Btye			Normal mode, using 1Mbps airspeed
		221 Btye			Continuous transmission mode
Cache		2048 Byte			-
Modulation		GFSK			-
		LoRa			-
		FLRC			-
Interface		UART			TTL
Package		SMD			-
Size		40.5*25mm			-
Antenna		IPEX-1/stamp perforation			50Ω Impedance

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3. Mechanical Characteristics

3.1. E28-2G4T20SX Mechanical Characteristics



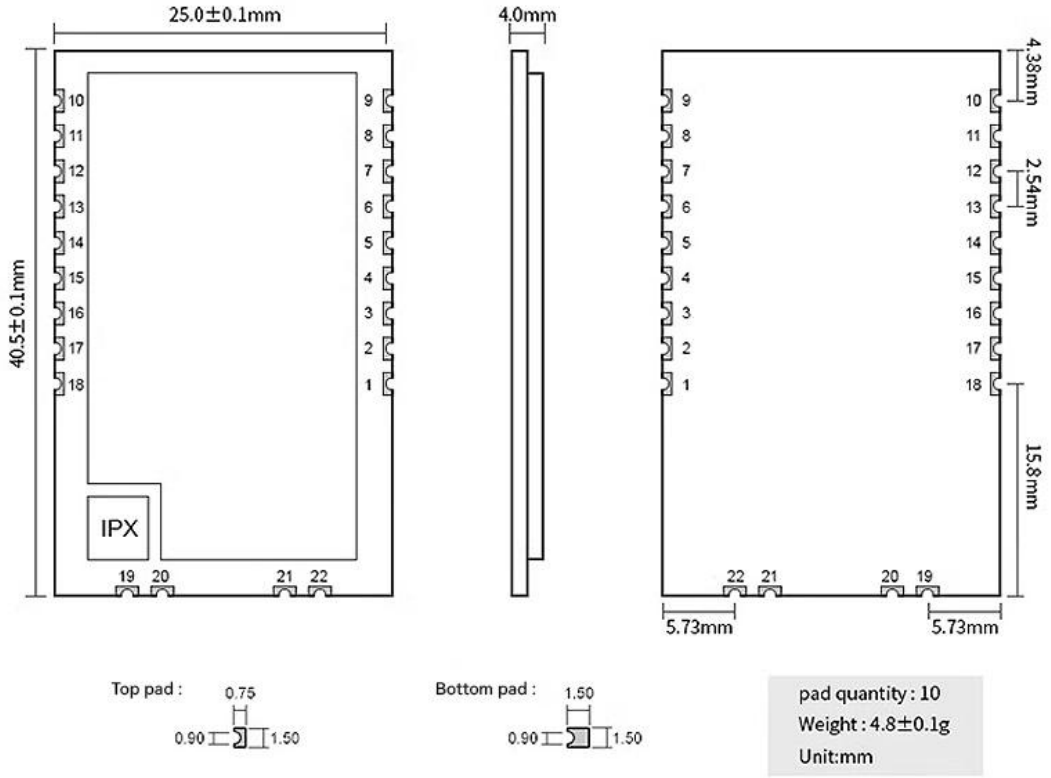
Pin No.	Pin Name	Pin Direction	Function
1	NRST	Input	Module reset , reset at low level.
2	GND	Ground	Module ground wire
3	M2	Input (very weak pull-up)	The combination of M2, M1, and M0 determines the module's 8 operating modes (must not be left floating; if not in use, it can be grounded).
4	NC	-	Empty foot (not yet available; users do not need to concern about it).
5	NC	-	Empty foot (not yet available; users do not need to concern about it).
6	NC	-	This pin needs to be left floating (for programming pin SWDIO, it is recommended to bring it out if possible, for easier future maintenance or firmware customization).
7	NC	-	This pin needs to be left floating (the SWCLK pin is recommended to be brought out if possible, for easier future maintenance or firmware customization).
8	GND	Ground	Module ground wire
11	GND	Ground	Module ground wire
12	ANT	-	Antenna interface (50 Ω characteristic impedance)
13	GND	Ground	Module ground wire
14	GND	Ground	Module ground wire
15	GND	Ground	Module ground wire
16	GND	Ground	Module ground wire

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19	GND	Ground	Module ground wire
20	M0	Input (very weak pull-up)	The combination of M2, M1, and M0 determines the module's 8 operating modes (must not be left floating; if not in use, it can be grounded).
21	M1	Input (very weak pull-up)	The combination of M2, M1, and M0 determines the module's 8 operating modes (must not be left floating; if not in use, it can be grounded).
22	RXD	Input	TTL serial input, connected to external RXD output pin; It can be configured as an open-drain or pull-up input; see parameter settings for details.
23	TXD	Output	TTL serial port output, connected to the external RXD input pin; configurable as open-drain or push-pull output, see parameter settings for details.
24	AUX	Output	Used to indicate the module's operating status; When the user wakes up the external MCU, it outputs a low level during the power-on self-test initialization; (this level can be left floating).
25	VCC	-	Module power source positive reference. Voltage range: 2.3V ~ 5.5V DC
26	GND	-	Module ground wire

3.2. E28-2G4T27SX Mechanical Characteristics



3.3. Pin Definition

Pin No.	Pin Name	Pin Direction	Function

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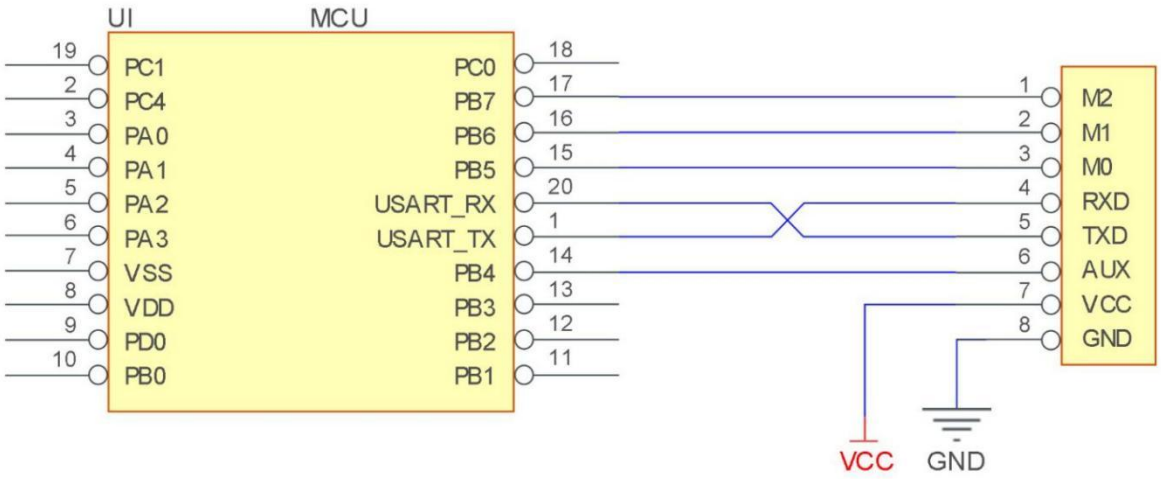
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1	GND	Ground	Module ground wire
2	NC	-	This pin needs to be left floating (for future expansion)
3	NC	-	This pin needs to be left floating (for future expansion)
4	NC	-	This pin needs to be left floating (for future expansion)
5	NRST	Input	Module reset pin, low level reset
6	NC	-	This pin must remain unconnected (for future expansion)
7	NC	-	This pin needs to be left floating (the SWCLK pin is recommended to be brought out if possible, for easier future maintenance or firmware customization).
8	GND	Ground	Module ground wire
9	NC	-	This pin needs to be left floating (for programming pin SWDIO, it is recommended to bring it out if possible, for easier future maintenance or firmware customization).
10	GND	Ground	Module ground wire
11	VCC	-	Module power source positive reference. Voltage range: 2.5V ~ 5.5V DC
12	AUX	Output	Used to indicate the module operation status, when user wakes up the external MCU,it outputs low level during initialization after power on and self-check, can be configured as open-drain output or push-pull output, please refer to Parameter Configuration. (can be floated)
13	TXD	Output	TTL serial input, connected to external TXD output pin. Can be configured as open-drain or pull-up input, please refer to Parameter Configuration.
14	RXD	Output	TTL serial input, connected to external RXD output pin; It can be configured as drain open circuit or pull-up input. See parameter setting for details
15	M1	Input	The combination of M2, M1, and M0 determines the module's eight working modes.
16	M0	Input	The combination of M2, M1, and M0 determines the module's eight working modes.
17	M2	Input	The combination of M2, M1, and M0 determines the module's eight working modes.
18	GND	Ground	Module ground wire
19	ANT	-	Antenna interface (50 Ω characteristic impedance)
20	GND	Ground	Module ground wire
21	GND	Ground	Module ground wire
22	GND	Ground	Module ground wire

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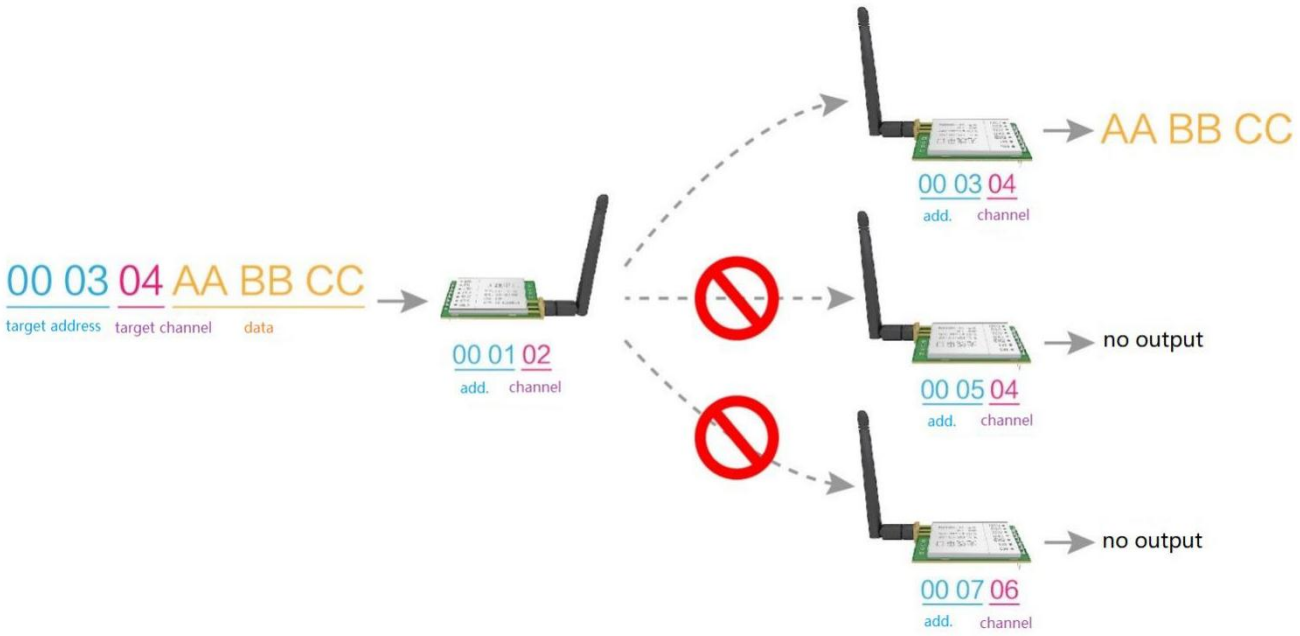
4. Recommended Connection Diagram



No.	Brief description for module and MCU connection (STM8L MCU as example)
1	The wireless UART module adopts TTL level, please connect to MCU with TTL level.
2	For some 5V MCU, 4~10K pull-up resistor may need to be added at the TXD and AUX pins of the module.

5. Functional Description

5.1. Fixed Transmission



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5.2. Broadcast



5.3. Broadcast Address

- i.e.: set the address of module A as 0xFFFF or 0x0000 and channel as 0x04.
- When set A as transmitter (same mode, transparent transmission on), all modules with channel 0x04 will receive broadcast data.

5.4. Monitor Address

- i.,e.: set the address of module A as 0xFFFF or 0x0000 and channel as 0x04.
- When set A as receiver, it will receive the data transmitted by modules with channel 0x04.

5.5. Module Reset

- Upon power-up, the AUX input will immediately output a low level and perform a hardware self-test, as well as configure the operating mode according to user parameters. During this process, the AUX input remains low. After completion, the AUX input will output a high level and begin normal operation according to the operating mode composed of the combinations M2, M1, and M0. Therefore, the user needs to wait for the rising edge of the AUX input as the starting point for normal module operation.

5.6. AUX Description

- AUX Pin can be used as indication for wireless send & receive buffer and self-check. It indicates whether the module has data that has not yet been transmitted wirelessly, or whether the received wireless data has not yet been fully transmitted through the serial port, or whether the module is in the process of initialization self-test.

5.6.1 Indication of serial output

- Used to wake up the external MCU (note: AUX indicates no delay under continuous mode)

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Timing sequence chart of AUX when RF receives data and send to MCU

5.6.2 Indication of wireless transmission

- Under sub-packet transmission mode, the internal buffer size is determined by the sub-packet size, if the packet length is 221 bytes, then the buffer size will be 2048 bytes, when AUX=1, user could continuously initiate transmitting of no more than 2048 bytes.
- Under continuous transmission mode, AUX=1 means the module is busy, but it is not applicable for waking up external MCU, because the data transmission is very quick under continuous transmission mode.
- AUX=1 means all serial data is transmitted through RF, and the module is at idle state.



Timing sequence chart of AUX when MCU receives serial data till MCU starts RF transmission

5.6.3 Module in configuration process

- Only occurs when resetting or when exiting sleep mode



Timing sequence chart of AUX when conducting self-check

6. Operation Modes

The module has 4 operation modes, which are determined accordingly by pins M0, M1. Please refer to below instructions:

Mode（0-3）	M2	M1	M0	Mode Introduction	Remarks
0 - Transmission Mode	1	0	0	Serial port on, RF on, continuous transparent transmission	Airspeed supports manual configuration and adaptive automatic adjustment based on baud rate; in continuous transmission mode, the baud rates of both

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					parties must be consistent.
1 - RSSI Mode	1	0	1	Serial port on, RF on, RSSI on	The module outputs RSSI value through serial port every 100ms
2 - Reserved Mode	1	1	0	Reserved	-
3 - Configuration Mode	1	1	1	Serial port on , RF off, parameter configuration	Baud rate is fixed as 9600 8N1
4 -Low power	0	x	x	lowest power consumption in low power mode	When M2 is set high, it is in normal working condition. when M2 is set low, it is in low power mode

The module has 4 operation modes, which are determined accordingly by pins M0, M1. Please refer to below instructions:

6.1. Mode Switch

- Users can combine high and low levels on M1M0 to determine the module's operating mode. Mode switching can be controlled using the MCU's GPIO. After changing M1M0: if the module is idle (AUX high), it can start working in the new mode; if the module has serial data that has not yet been transmitted wirelessly, it can only enter the new operating mode after the transmission is complete; if the module receives wireless data and then transmits it via serial port, it must complete the transmission before entering the new operating mode. Therefore, mode switching is only effective when AUX outputs 1; otherwise, the switching will be delayed.
- For example: In mode 3, if the user continuously inputs a large amount of data and switches modes at the same time, the mode switching operation is invalid; the module will process all user data before detecting a new mode; therefore, it is generally recommended to detect the AUX pin output status and wait 2ms after the AUX output is high before switching.
- When the module is switched from other modes to configuration mode, if there is any unprocessed data, the module will process this data (including both received and transmitted data) before entering sleep mode. This feature can be used for rapid sleep, thereby saving power. For example, if the transmitter module is operating in mode 0 and the user initiates serial data "12345", it can switch to sleep mode directly without waiting for the AUX pin to be idle (high level), immediately putting the user's main MCU into sleep mode. The module will automatically transmit all user data wirelessly and then automatically enter sleep mode within 1ms, thus saving MCU operating time and reducing power consumption.
- Similarly, this feature can be utilized for any mode switch. After processing the current mode event, the module will automatically enter the new mode within 1ms, thus eliminating the need for the user to query the AUX and achieving rapid switching. For example, switching from transmit mode to receive mode. The user MCU can also enter sleep mode in advance before the mode switch and use external interrupt function to obtain AUX changes, thereby performing the mode switch.
- This operating method is highly flexible and efficient, designed entirely for ease of use with the user's MCU, and can minimize the overall system workload, improve system efficiency, and reduce power consumption.

6.2. Transmission Mode (Mode 0)

- Under this mode, transparent transmission is available, that means the data transmitted from the transmitter will be received by the receiver in the original format. Under normal mode, the two sides could communicate with each other normally based on same air data rate, address and channel; under continuous transmission mode, the baud rates on both sides must be the same, it supports large file continuous transmission under baud rate from 1200bps ~ 115200bps.

6.3. RSSI Mode (Mode 1)

- Under this mode, the module will output current RSSI value of 2.4GHz signal every 100ms so as to check the channel quality, the value is in HEX compliment format.

6.4. Reserved Mode (Mode 2)

- (Reserved)

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6.5. Configuration mode (Mode 3)

- Under this mode, Baud rate is fixed as 9600 8N1.Refer to the corresponding parameters in the instruction format setting module.

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7. Command Format

In configuration mode (Mode 3: M0=1, M1=1, M2=1), the supported command list is as follows (only 9600, 8N1 format is supported during setup):

No.	Command Format	Description
1	C0 + working parameters	Send C0+5 bytes of working parameters in hexadecimal format, for a total of 6 bytes. These must be sent continuously (and saved even after power failure).
2	C1+C1+C1	Send three C1s in hexadecimal format, and the module will return the saved parameters. These must be sent consecutively.
3	C2 + working parameters	Send C2+5 bytes in hexadecimal format as working parameters, a total of 6 bytes, which must be sent continuously (not saved if power is lost).
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.
6	E2+E2+E2	Under transparent transmission mode, send three E2 in HEX format, the module will enter a 10s parameter configuration window period, user could configure the module parameters in the 10s with C0 command, 10s later, the module will work with the new parameters.
7	E3+E3+E3	Under transparent transmission mode, send three E3 in HEX format, the module will enter a 10s parameter configuration window period, user could configure the module parameters in the 10s with 6-byte C0 command, 10s later, the module will work with the new parameters.

7.1. Default parameter values

Model	Default parameter values:						
Model	Frequency	Address	Channel	Air data rate	Baud rate	Parity	Transmitting power
E28-2G4T20SX	2.4GHz	0x0000	0x13	10kbps	9600	8N1	20dbm
E28-2G4T27SX	2.4GHz	0x0000	0x13	10kbps	9600	8N1	27dbm

7.2. Reading Operating Parameters

Command Format	Description
C1+C1+C1	Under configuration,(M0=1,M1=1), send command (HEX format) to the serial: C1 C1 C1, the module will return current parameter values, i.e.: C0 00 00 13 18 04.

7.3. Reading Version Number

Command Format	Description

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C3+C3+C3	Under configuration (M0=1, M1=1), send a command (HEX format) to the module's serial port: C3 C3 C3. The module will return the current configuration parameters, such as: C3 00 47 10 0C 09 01 00; here, 00 47 represents the module model (E28 series), 10 represents the version number, 0C represents the module power, and other parameters represent other characteristics of the module.

7.4. Reset Command

Command Format	Description
C4+C4+C4	Under the configured settings (M0=1, M1=1), send the command (HEX format): C4 C4 C4 to the module's serial port. The module will then perform a reset. During the reset, the module performs a self-test, and the AUX output goes low. After the reset is complete, the AUX output goes high, and the module begins normal operation. At this point, you can switch modes or initiate the next command.

7.5. Parameter Configuration Commands

No.	Item	Description				Remarks
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	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		The serial modes can be different on two sides;
		0	0	8N1 (default)		
		0	1	8O1		
		1	0	8E1		
		1	1	8N1 (equal to 00)		
		5	4	3	TTL UART baud rate (bps)	Under normal mode, the mode can be different; Under continuous transmission mode, the baud rate must be the same.
		0	0	0	1200	
		0	0	1	4800	
		0	1	0	9600 (default)	
		0	1	1	19200	
		1	0	0	57600	
		1	0	1	115200	
		1	1	0	460800	
		1	1	1	921600	
		2	1	0	Air data rate (bps)	Under non-continuous transmission mode, baud rate has nothing to do with RF parameters, and will not affect the transmission characteristics. Under continuous transmission mode, baud rate decides the air data rate. The high the baud rate, the faster the data transmission and the shorter communication range.
		0	0	0	Self-adaptive(continuous transmission)	
		0	0	1	1k	
		0	1	0	5k	
		0	1	1	10k (default)	
		1	0	0	50k	
		1	0	1	100k	
		1	1	0	1M (FLRC)	

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<table>
<tr><td></td><td></td><td>1</td><td>1</td><td>1</td><td colspan="3">2M（GFSK）</td><td>The lower the air data rate, the longer the transmitting distance, the better anti-interference performance and the longer transmitting time.

The air data rates on both sides must be the same.

Note: In non-connected mode, when the air rate is 1 MB, the minimum number of bytes sent by the user must be greater than or equal to 2.</td></tr>
<tr><td rowspan="14">4</td><td rowspan="14">CHAN</td><td colspan="6">Communication Channel（the default 0x13）</td><td rowspan="14">According to the calculation formula, the corresponding frequency point can be calculated by introducing the set channel signal.
e.g：Air data rate is 1k/5k/10kbps：
Normal channel：0x13→Into the frequency calculation formula.
2400+13*1=2413MHz，Get the corresponding frequency point.
Extend channel：0x113→Into the frequency calculation formula.
2400+（113-100）*1-0.5=2412.5MHz，Get the corresponding frequency point.
The same is true in Continuous transmission mode:</td></tr>
<tr><td rowspan="9">Normal mode</td><td rowspan="2">air data rate（bps）</td><td colspan="3">Frequency（MHz）calculation formula</td></tr>
<tr><td colspan="2">Normal channel</td><td>Extend channel</td></tr>
<tr><td rowspan="2">1k/5k/10k</td><td>Channel Num:0~100</td><td>Channel Num:101~200</td></tr>
<tr><td colspan="2">2400 + CHAN * 1</td><td>2400+(CHAN-100)*1-0.5</td></tr>
<tr><td rowspan="2">50k/100k</td><td>Channel Num:0~50</td><td>Channel Num:51~100</td></tr>
<tr><td colspan="2">2400 + CHAN * 2</td><td>2400+(CHAN-50)*2-1</td></tr>
<tr><td rowspan="2">1M</td><td>Channel Num:0~33</td><td>Channel Num:34~66</td></tr>
<tr><td colspan="2">2400 + CHAN * 3</td><td>2400+(CHAN-33)*3-1.5</td></tr>
<tr><td rowspan="2">2M</td><td>Channel Num:0~20</td><td>Channel Num:21~40</td></tr>
<tr><td colspan="2">2400 + CHAN * 5</td><td>2400+(CHAN-20)*5-2.5</td></tr>
<tr><td rowspan="4">Continuous transmission mode</td><td>baud rate</td><td colspan="3">Frequency（MHz）calculation formula</td></tr>
<tr><td>1200/9600/19200</td><td colspan="3">2400 + CHAN * 1</td></tr>
<tr><td>4800/57600/115200</td><td colspan="3">2400 + CHAN * 4</td></tr>
<tr><td>460800/921600</td><td colspan="3">2400 + CHAN * 5</td></tr>
<tr><td rowspan="13">5</td><td rowspan="13">OPTION</td><td>7</td><td colspan="5">Fixed transmission enabling bit (similar to Modbus)</td><td rowspan="3">Under 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.
It is transparent transmission under continuous mode.</td></tr>
<tr><td>0</td><td colspan="5">Transparent transmission mode</td></tr>
<tr><td>1</td><td colspan="5">Fixed transmission mode</td></tr>
<tr><td>6</td><td colspan="5">Reserved</td><td></td></tr>
<tr><td>5</td><td colspan="5">Reserved</td><td></td></tr>
<tr><td>4</td><td colspan="5">Reserved</td><td></td></tr>
<tr><td>3</td><td colspan="5">LBT switch</td><td rowspan="3">When LBT is turned on, channel quality will be checked before sending every data packet; if quality is good, data will be sent directly, if interference exists, data will be sent after interference disappears.
It supports LBT only below air data rate 115200bps, LBT may affect the continuous transmission function.</td></tr>
<tr><td>0</td><td colspan="5">Turn off LBT (default)</td></tr>
<tr><td>1</td><td colspan="5">Turn on LBT</td></tr>
<tr><td>2</td><td colspan="5">IO driving mode</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="5">TXD, AUX push-pull output, RXD pull-up input (default)</td></tr>
<tr><td>0</td><td colspan="5">TXD, AUX open-circuit output, RXD open-circuit input</td></tr>
<tr><td>1</td><td>0</td><td colspan="2">Transmission power (approximated)</td><td colspan="2">The external power source must provide 100mA or above current output and ensure the power ripple is lower than 100mV.</td></tr>
<tr><td></td><td></td><td colspan="2">E28-2G4T20SX</td><td colspan="2">E28-2G4T27SX</td></tr>
<tr><td>0</td><td>0</td><td colspan="2">20dBm（defult）</td><td colspan="2">27dBm（defult）</td></tr>
<tr><td>0</td><td>1</td><td colspan="2">17dBm</td><td colspan="2">23dBm</td></tr>
</table>

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		1	0	14dBm	20dBm	Low power transmission is not recommended due to its low power supply efficiency.
		1	1	10dBm	17dBm	

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 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;
- The antenna must not be installed inside the metal case, which will cause the transmission distance to be
- greatly weakened.

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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 recommended value, 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 source, voltage higher than maximum value will damage the module.
- Please check the stability of power source, the voltage cannot fluctuate too much.
- Please make sure antistatic 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.

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. Welding Operation Instructions

10.1 Reflow soldering temperature

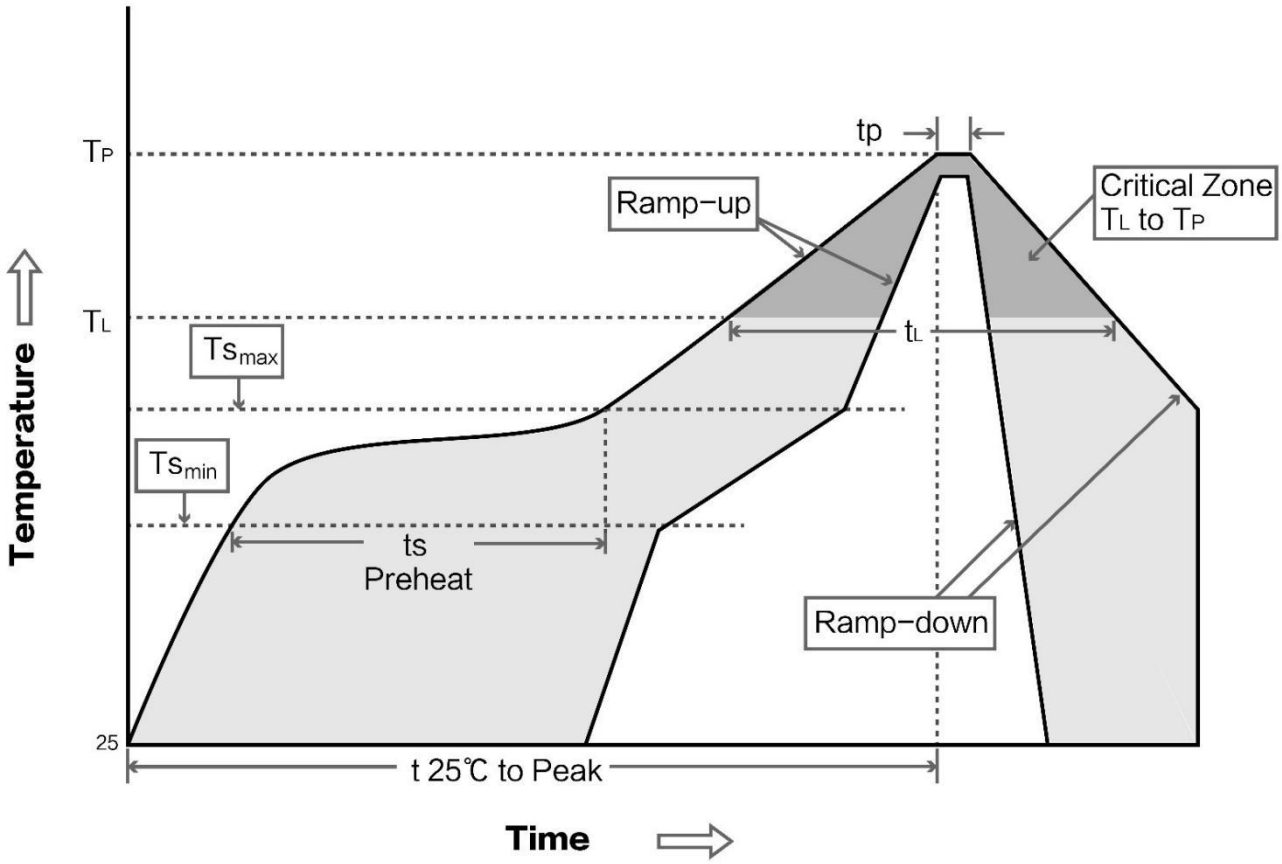
Profile Feature	Curve characteristics	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min （Tsmin）	Min preheating temp.	100℃	150℃
Preheat temperature max (Tsmax)	Max preheating temp.	150℃	200℃
Preheat Time (Tsmin to Tsmax)(ts)	Preheating time	60-120 sec	60-120 sec
Average ramp-up rate(Tsmax to Tp)	Average ramp-up rate	3℃/second max	3℃/second max
Liquidous Temperature (TL)	Liquid phase temp.	183℃	217℃
Time（tL）Maintained Above（TL）	Time above liquid phase line	60-90 sec	30-90 sec
Peak temperature（Tp）	Peak temperature	220-235℃	230-250℃

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Average ramp-down rate（Tp to Tsmax）	Average ramp-down rate	6℃/second max	6℃/second max
Time from 25℃ to peak temperature	Time from 25℃ to peak temperature	6 minutes max	8 minutes max

10.2 Reflow soldering curve



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11.Related products

Type	IC	Frequency	Power	Distance	Size	Package	Interface
		Hz	dBm	km	mm		
E28-2G4T12S	SX1281	2.4G	12	3	17.5*28.7	SMD	TTL
E28-2G4T20SX	SX1281	2.4G	20	6	16*26	SMD	TTL
E28-2G4T27SX	SX1281	2.4G	27	7	40.5*25	SMD	TTL
E28-2G4M12S	SX1281	2.4G	12	3	25*14	SMD	SPI
E28-2G4M20S	SX1281	2.4G	20	6	15*26.5	SMD	SPI
E28-2G4M27S	SX1281	2.4G	27	8	15*26.5	SMD	SPI
E28-2G4M12SX	SX1281	2.4G	12	3	17.8*15	SMD	SPI
E28-2G4M20SX	SX1281	2.4G	20	6	15*20	SMD	SPI
E28-2G4M27SX	SX1281	2.4G	27	8	15*20	SMD	SPI

12. Antenna Guidance

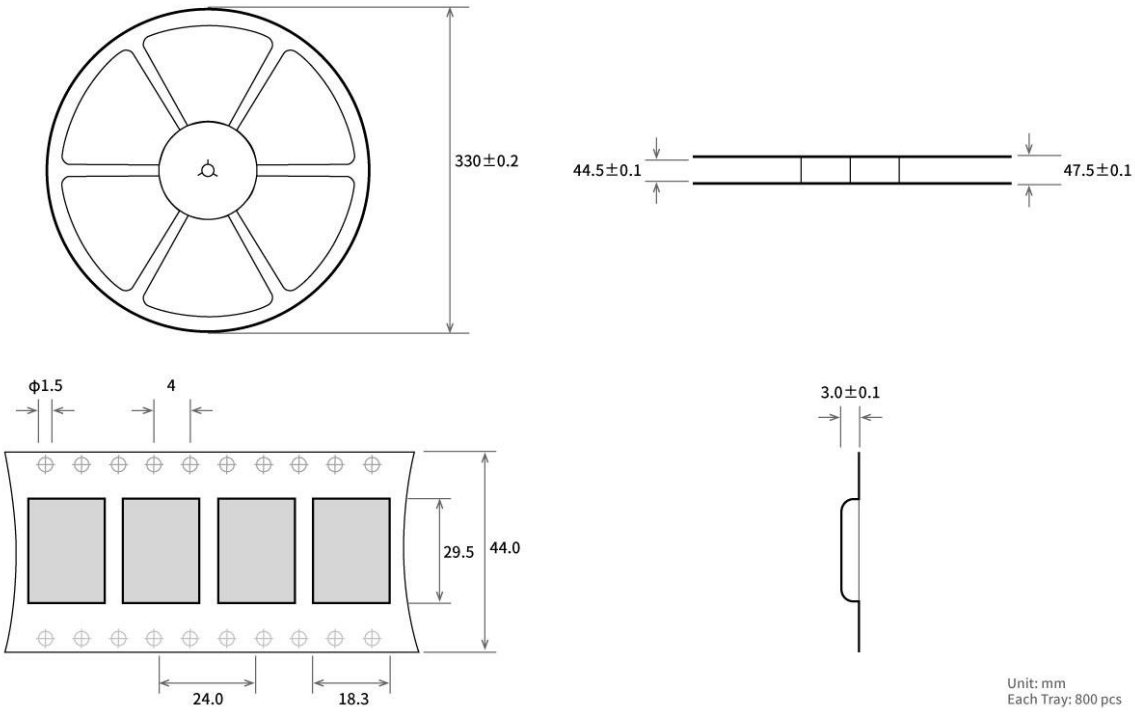
Antenna plays an important role in the communication process. Inferior antennas often have a great impact on the communication system. Therefore, we recommend some antennas that support our wireless modules and have excellent performance and reasonable price.

Model	Type	Frequency	Gain	Size	Feeder	Interface	Feature
		Hz	dBi	mm	cm		
TX2400-JZ-3	Rubber	2.4G	2.0	30	-	SMA-J	Straight antenna,ultra short
TX2400-JZ-5	Rubber	2.4G	2.0	50	-	SMA-J	Straight antenna,ultra short
TX2400-JW-5	Rubber	2.4G	2.0	50	-	SMA-J	Fixed bending antenna
TX2400-JK-11	Rubber	2.4G	2.5	110	-	SMA-J	Flexible antenna, omnidirectional
TX2400-XPL-150	Sucker	2.4G	3.5	150	150	SMA-J	Small sucker antenna,high gain

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13. Package for batch order



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Revision history

Version	Date	Description	Operator
1.0	2020-8-19	Initial Version	Li
1.1	2023-5-12	Bug fixes	Yan
1.2	2023-6-30	Bug fixes	Hao
1.3	2023-12-7	Bug fixes	Hao
1.4	2024-4-18	The ranging function has been changed to reserved mode	Hao
1.5	2024-6-03	Bug fixes	Bin
1.6	2024-6-11	Bug fixes	Bin
1.7	2024-08-26	Extend channel	Lei
1.8	2024-11-29	Add E28-2G4T20SX	Lei
1.9	2025-01-17	Update the links of relevant models	Lei
2.0	2025-11-26	Bug fixes	Hao
2.1	2025-12-29	Bug fixes	Hao

About us

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Documents and RF Setting download link:https:// www.cdebyte.com

Thank you for using Ebyte products! Please contact us with any questions or suggestions: info@cdebyte.com

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