



Wireless UART Module

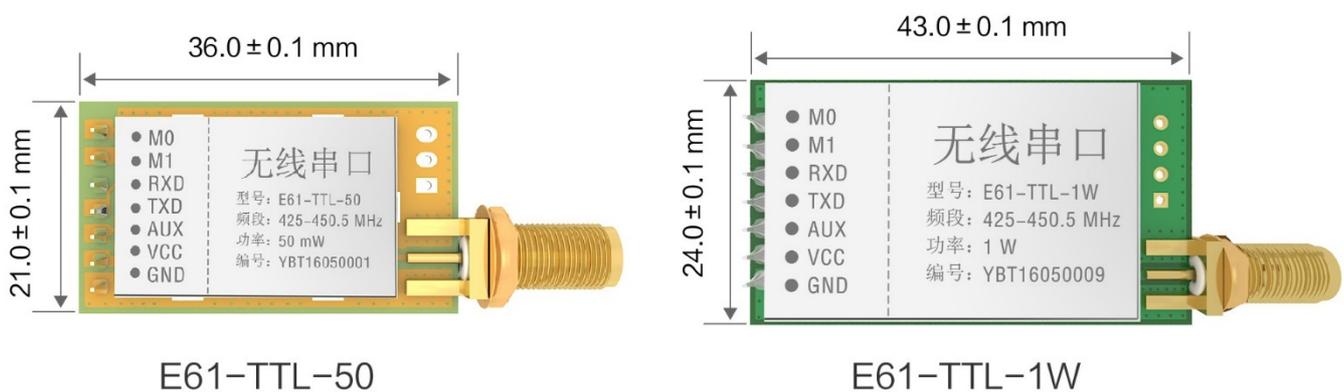
E61 Series

User Manual

This manual may be modified based on product upgrade, please refer to the latest version.
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Version	Date	Description	Issued by
1.00	2017/12/13	Initial version	huaa

Brief Introduction



E61 series are high-speed wireless transceiver modules, operating at 425-450.5MHz (Default: 433MHz). They feature embedded high-performance MCU, high-speed RF chip and transparent transmission.

At continuous transmission mode, the package length is unlimited, which enables continuous transmission for baud rate 57600/38400/19200/9600 etc. Air data rate, FEC, password etc. are configurable for users when module works in fixed-length transmission. Users transmit data to other modules with configured air data rate in the most efficient way, which achieves low-latency and high-response. The high-speed feature of module is suitable for polling sampling, handshake response communication, and supports Modbus protocols.

The data of the module transmitted in the air features randomness. And with the rigorous encryption & decryption, data interception becomes pointless. 65536 configurable addresses are reserved for user to define, which makes the module with matched password receive the data.

Model	Frequency	Transmitting power	Distance	Packing	Antenna
E61-TTL-50	433M	17dBm	1000m	DIP	SMA-K
E61-TTL-1W	433M	30dBm	2500m	DIP	SMA-K

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1. Features

- **Continuous transmission:** At continuous transmission, the length of the data transmitted is unlimited, which enables continuous transmission at baud rate of 57600/38400/19200/9600/4800/2400/1200.
- **Fixed-length transmission:** Air data rate, FEC, password etc. are configurable for users. Users transmit data to other modules with configured air data rate in the most efficient way, which achieves low-latency and high-response.
- **User password:** 65536 configurable addresses are reserved for users to define, which makes the module with matched password receive the data.
- **High speed transmission:** 433M features high speed and low latency. It is suitable for polling sampling, handshake response communication, and supports Modbus protocols.
- **Broadcast transmission:** When the module address is set as 0xFFFF, the module can communicate with other modules in the same channel. That enables broadcast and monitor.
- **FEC:** Forward Error Correction has high coding efficiency & good correction performance. In case of sudden interference, it can correct the interfered data packets proactively, so that the reliability & transmission range are improved correspondingly. Without FEC, those data packets can only be dropped.
- **Sleep mode:** When the module works in sleep mode (Mode 3), it is available for configuration, but not for transmitting & receiving. The typical current is few uA in this mode. It can still receive the configuration from the MCU.
- **Watchdog:** With a built-in watchdog, the module runs precise layout and time. Once an exception occurs, the module will restart in 0.107 second, and continue to work according to the previous parameters.

2. Technical Parameters

Model	IC	Size	Net weight	Operating temperature	Operating humidity	Storage temperature
E61-TTL-50	RF	21*36 mm	6.7±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C
E61-TTL-1W	RF	24*43 mm	8.5±0.1g	-40 ~ 85°C	10% ~ 90%	-40 ~ 125°C

2.1 Electrical Parameters

2.1.1 E61-TTL-50

Parameter	Min	Typ	Max	Unit
Transmitting current	66	70	77	mA
Receiving current	18	19	21	mA
Turn-off current	3	4	5	μA
Transmitting power	29	30	31	dBm
Receiving sensitivity	-124	-126	-128	dBm
Recommended frequency	425	433	450.5	MHz
Voltage supply	2.3	3.3	5.2	V
Communication level	2.5	3.3	3.6	V

2.1.2 E61-TTL-1W

Parameter	Min	Typ	Max	Unit
Transmitting current	445	480	530	mA
Receiving current	18	19	21	mA
Turn-off current	4	5	6	μA
Transmitting power	29	30	31	dBm
Receiving sensitivity	-124	-126	-128	dBm
Recommended frequency	425	433	450.5	MHz
Voltage supply	3.3	5.0	5.2	V
Communication level	2.5	3.3	3.6	V

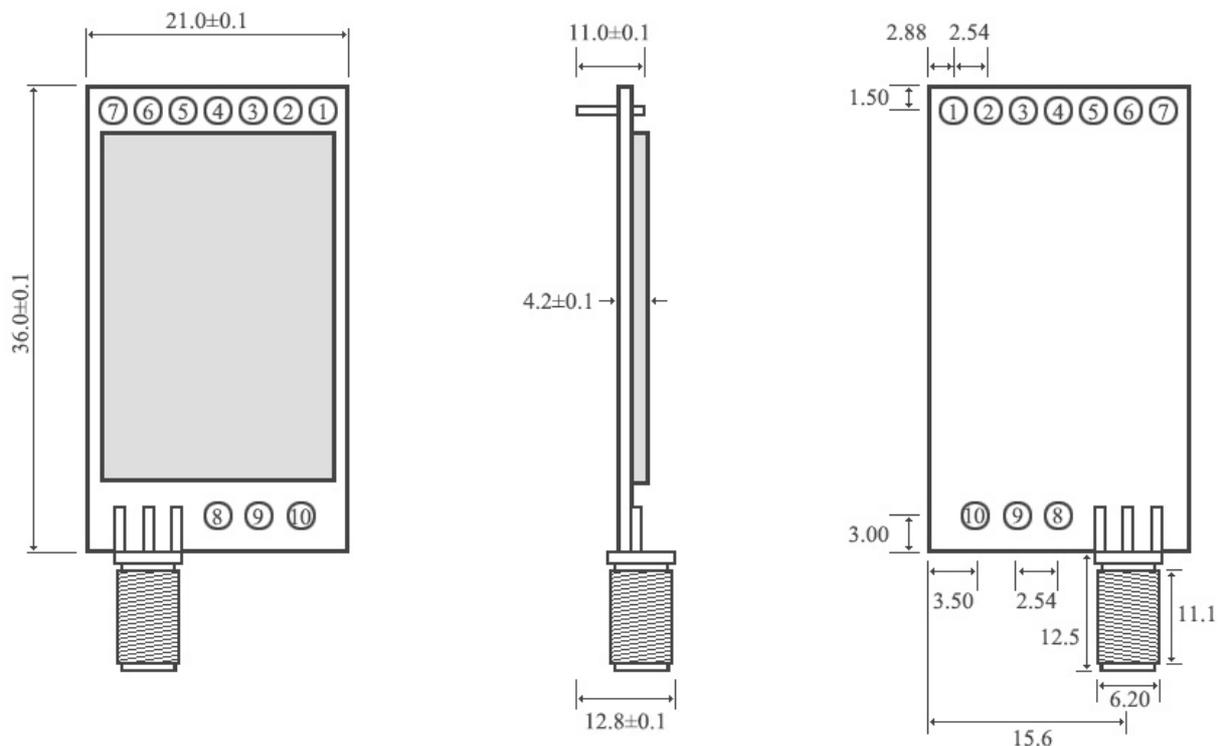
2.3 Parameters Notes

- When designing current supply circuit, 30% margin is recommended to be remained so as to ensure long-term stable operation of the whole module.
- The current at the instant of transmitting may be high, but the total energy consumed may be lower due to very short transmitting time.
- When using external antenna, the impedance matching degree at different frequency points between antenna and module may affect the transmitting current at different levels.
- The current consumed when the RF chip is only working at receiving mode is called as receiving current. The tested receiving current may be higher for some RF chips with communication protocol or when the developers have loaded their own protocol to the whole module.
- The current at pure receiving mode is at mA level. To achieve μA level receiving current, the users need to manage it through firmware development.
- The turn-off current is always lower than the current consumed when the power supply source of the whole module is at no-load status.
- Each LRC component has ±0.1% error, and the error will accumulate since multiple LRC components are used in the whole RF circuit, and the transmitting current will be different at different modules.
- The power consumption can be lowered by lowering the transmitting power, but the efficiency of the internal PA will be decreased by lowering transmitting power due to various reasons.

3. Mechanical Characteristics

3.1 E61-TTL-50

3.1.1 Dimension

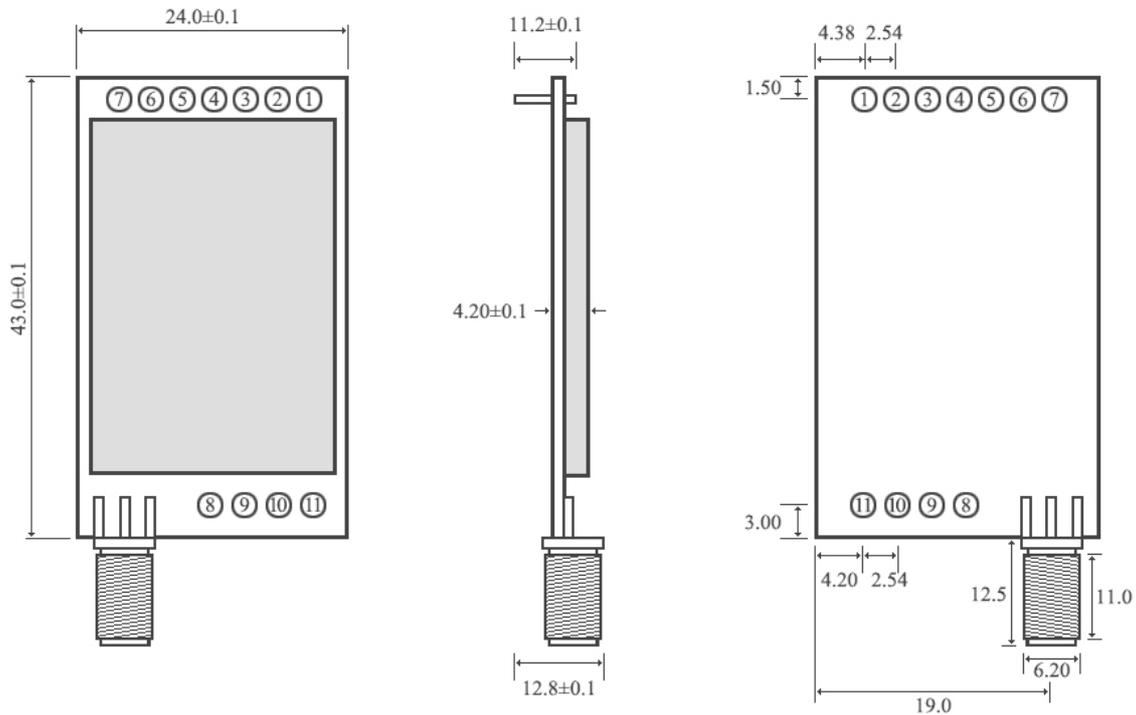


3.1.2 Pin Definition

Pin No.	Pin item	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	Input	Power supply 2.1V-5.5V DC.
7	GND	Input	Ground electrode
8	Fixing hole		Fixing hole
9	Fixing hole		Fixing hole
10	Fixing hole		Fixing hole

3.2 E61-TTL-1W

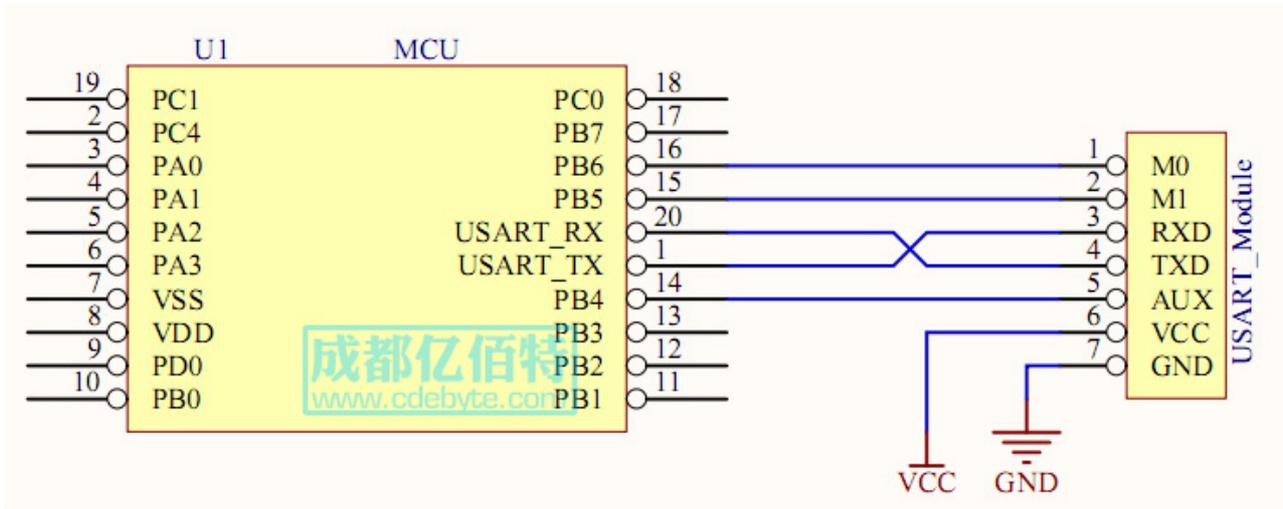
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6	VCC	Input	Power supply 2.8V-5.5V DC.
7	GND	Input	Ground electrode
8	Fixing hole		Fixing hole
9	Fixing hole		Fixing hole
10	Fixing hole		Fixing hole

4. Recommended Circuit Diagram



No.	Description (STM8L MCU)
1	The UART module is TTL level. Please connect to 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. Function Description

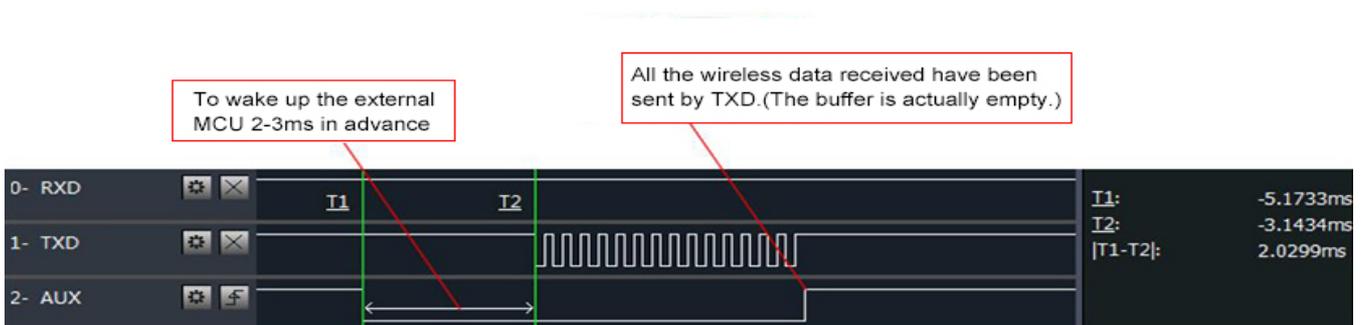
5.1 Reset

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

5.2.1 Indication of UART Output

To wake up external MCU:



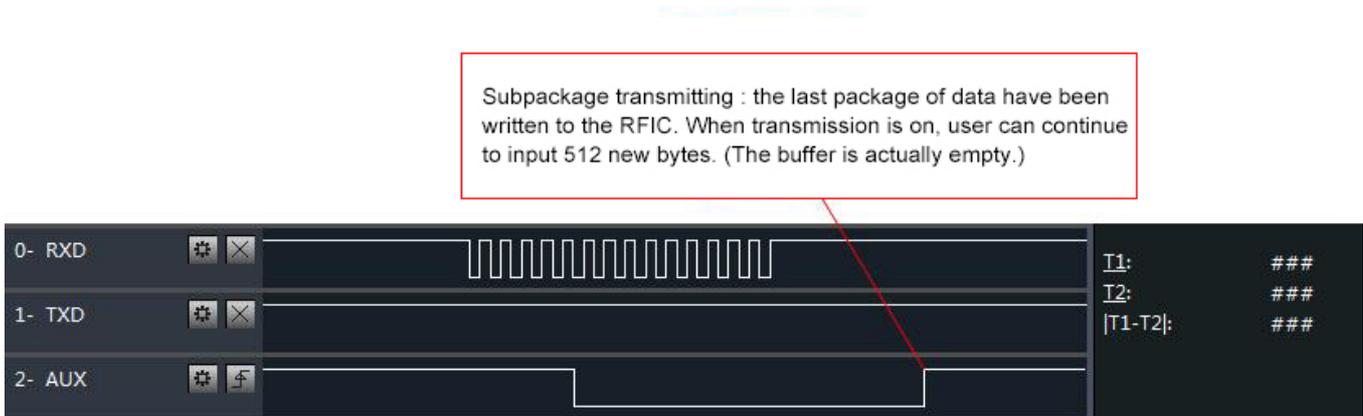
Timing Sequence Diagram of AUX when TXD pin transmits

5.2.2 Indication of Wireless Transmitting

Buffer (empty): the internal 256 bytes data in the buffer are written to the RFIC (Auto sub package). 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.

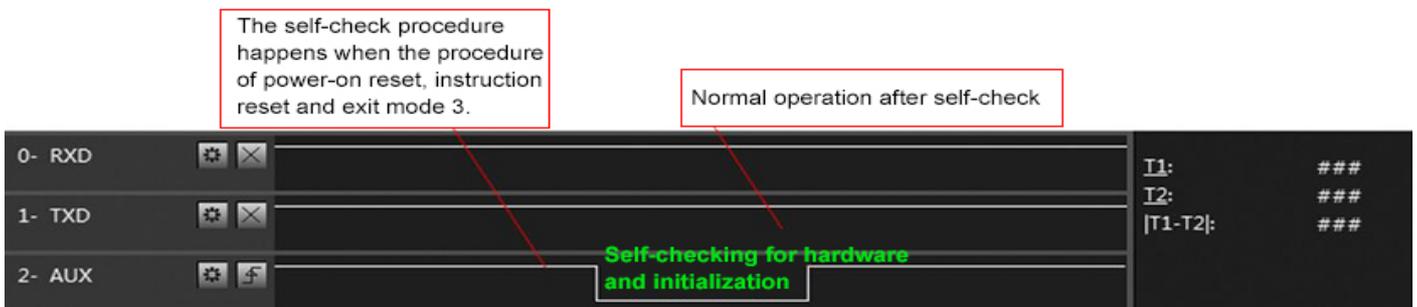
Notes: When AUX = 1, it does not mean that all the UART data of the module have been transmitted already, perhaps the last packet of data is still in transmission.



Timing Sequence Diagram of AUX when RXD pin receives

5.2.3 Configuration Procedure of Module

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



Timing Sequence Diagram of AUX when self-check

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

Contents in the table below are the introduction of input status of M1 & M0 and their corresponding mode:

Mode (0-3)	M1	M0	Mode introduction	Remark
Mode 0 Transmission	0	0	UART and wireless channel are open, transparent transmission is on	Working with the software, the module can be configured as continuous transmission(Default) and fix-length transmission.
Mode 1 Reserve	1	0	N/A	
Mode 2 Instruction	0	1	UART opens and wireless channel closes. Module can accept UART configuration instruction.	To change the configuration.
Mode 3 Sleep	1	1	UART and module are closed.	

6.1 Mode Switch

- The user can decide the operating mode by the combination of M0, M1 and M2. The two GPIOs of MCU can be used to switch mode. After modifying M0, M1 or M2, it will start to work in new mode 1ms 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 2 or mode 4, 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 pin out status and wait 2ms after AUX outputs high level before switching the mode.
- If the module switches from other modes to stand-by mode, it will work in stand-by mode only after all the remained data process completed. The feature can be used to save power consumption. For example, when the transmitter works in mode 0, after the external MCU transmits data "12345" , it can switch to sleep mode immediately without waiting the rising edge of the AUX pin, also the user' s main MCU will go dormancy immediately. Then the module will transmit all the data through wireless transmission & go dormancy 1ms later automatically, which reduces MCU working time & save power.
- Likewise, this feature can be used in any mode-switch. The module will start to work in new mode within 1ms after completing present mode task, which enables the user to omit the procedure of AUX inquiry and switch mode swiftly. For example, when switching from transmitting mode to receiving mode, the user MCU can go dormancy before mode-switch, using external interrupt function to get AUX change so that the mode-switch can be realized.
- This operation is very flexible and efficient. It is totally designed on the basis of the user MCU' s convenience, at the same time the work load and power consumption of the whole system has been reduced and the efficiency of whole system is largely improved.

6.2 Transmission Mode (Mode 0)

Status		When M1 = 0 & M0 = 0, module works in mode 0
Continuous transmission	Transmitting	<p>Air data rate will automatically match with configured baud rate(≤ 57600), which enables user to input data continuously, and module transmits data immediately once it receives user data. Unlimited package length for continuous transmission.</p> <p>Transmission is available when baud rate set as 115200, but not continuous transmission. So baud rate 115200 is not recommended for user when module works in continuous transmission. AUX is the indication for module' s working status, when module receives the first byte of user data, AUX output low level (busy for transmitting).</p> <p>After the module transmit all the data into RF chip & start transmission, AUX outputs high level.</p>
	Receiving	<p>After module receives data form transmitter, AUX outputs low level (busy for receiving), and starts to transmit data package from TXD after 5ms delay.</p> <p>After module transmits all the data from TXD, AUX outputs high level.</p> <p>UART baud rate must keep the same for both transmitter and receiver. When module receives data from transmitter, TXD can transmit data continuously without interspace between bytes.</p> <p>Serial transmission is suitable for low-latency occasion like Modbus.</p>
Fixed-length transmission	Transmitting	<p>UART baud rate, air data rate, address, FEC, password etc. are configurable for user, and the maximum packet length is 77 bytes.</p> <p>The principle module follows: all the data transmit from transmitter to receiver with the shortest time under the current air data rate.</p> <p>When the data package received by RXD is up to or more than 77 bytes, module starts to transmit data (data package is 77 bytes). The data more than 77-byte will be transmitted in the next package. When the required transmission bytes are less than 77 byte, module will wait 3-byte time and treat it as data termination unless continuous data inputted by user. Then module will transmit all the data through wireless channel.</p> <p>For example: if the required transmission byte is 1 byte, module will transmit the 1-byte package after wait 3-byte time. AUX is the indication for module' s working status, when module receives the first byte of user data, AUX output low level (busy for transmitting).</p> <p>After the module transmit all the data into RF chip & start transmission, AUX outputs high level.</p> <p>Due to the 256 bytes buffer for transmission, so it is required that the data inputted by user is less than 256-byte one time. Next package can be inputted after AUX turns low level to high level.</p>
	Receiving	<p>After module receives data form transmitter, AUX outputs low level (busy for receiving), and starts to transmit data package from TXD after 5ms delay.</p> <p>After module transmits all the data from TXD, AUX outputs high level.</p>

6.3 Reserve Mode (Mode 1)

Status	When M1 = 0 & M0 = 1, module works in mode 1.
Remarks	UART and wireless channel are disabled.

6.4 Instruction Mode (Mode 2)

Status	When M1 = 1 & M0 = 0, module works in mode 2.
Transmitting	N/A
Receiving	N/A
Remarks	In this mode, UART baud rate is fixed as 9600 8N1, module can receive command for parameter-setting.

6.5 Sleep Mode (Mode 3)

Status	When M1=1,M0=1,module works in mode 3.
Transmitting	N/A
Receiving	N/A
Notes	The wireless receiver is closed and the MCU is in a sleep state, when the power consumption of the whole machine is about 4 uA.

7. Instruction Format

In command mode (Mode 2 : M1=1, M0=0), it supports instructions below.

(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. (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 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 50 50							
Model	Frequency	Address	Channel	Transmitting methods	Baud rate	Parity	Transmitting power
E61-TTL-50	433MHz	0x0000	0x50	Continuous transmitting	9600	8N1	50mW

Default parameter values : C0 00 00 18 50 50							
Model	Frequency	Address	Channel	Transmitting methods	Baud rate	Parity	Transmitting power
E61-TTL-1W	433MHz	0x0000	0x50	Continuous transmitting	9600	8N1	1W

7.2 Reading Operating Parameters

Instruction format	Description
C1+C1+C1	In instruction mode (M0=0 , M1=1), User gives the module instruction (HEX format): C1 C1 C1, Module returns the present configuration parameters. For example, C0 00 00 18 50 50.

7.3 Reading Version Number

Instruction format	Description
C3+C3+C3	In instruction mode (M0=0 , M1=1), User gives the module instruction (HEX format): C3 C3 C3. Module returns its present version number, for example C3 61 xx yy. 61 here means the module model (E61 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 instruction mode (M0=0 , 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-down C2: Do not save the parameters when power-down
1	ADDH	High address byte of module (the default 00H)	00H-FFH Module address jointly determined by ADDH and ADDL, constitute a 16bit number. Only the module with same addresses can communicate with each other. When ADDH=FFH, ADDL=FFH, broadcast and monitor are available: 1. Module can transmit data to other modules with different addresses when works as transmitter. 2. Module can monitor data package from other modules with different addresses when works as receiver.
2	ADDL	Low address byte of module (the default 00H)	00H-FFH
3	SPED	Rate parameter , including UART baud rate and air data rate 7 , 6 UART parity bit 00 : 8N1 (Default) 01 : 8O1 10 : 8E1 11 : 8N1 (Equal to 00) ----- 5 , 4 , 3 TTL UART baud rate (bps) 000 : 1200bps 001 : 2400bps 010 : 4800bps 011 : 9600bps (Default) 100 : 19200bps 101 : 38400bps 110 : 57600bps 111 : 115200bps ----- 2 , 1 , 0 Air date rate (bps) 000 : 1.2Kbps 001 : 2.4Kbps 010 : 4.8Kbps 011 : 9.6Kbps 100 : 19.2Kbps 101 : 38.4Kbps 110 : 50Kbps 111 : 70Kbps	<ul style="list-style-type: none"> UART mode can be different between communication parties <ul style="list-style-type: none"> UART baud rate can be different between communication parties. The higher UART baud rate, the shorter communication distance. UART baud rate can be different between both two parties when module works in fixed-length transmission. The UART baud rate has nothing to do with wireless transmission parameters & won't affect the wireless transmit / receive features. <ul style="list-style-type: none"> Air data rate setting is invalid when the module works at serial transmission mode. Module will match with it automatically on the basis of UART baud rate. The air date rate must keep the same for both communication parties work in fixed transmission mode. The lower the air date rate, the longer the transmitting distance, better anti-interference performance and longer transmitting time
4	CHAN	Communication frequency (425M + CHAN * 0.1M (default 50H : 433MHz)	<ul style="list-style-type: none"> 00H-FFH, for 425-450.5MHz.

5	OPTION	<p>7, FEC switch 0 : Turn off FEC (Default) 1 : Turn on FEC</p> <p>-----</p> <p>6 IO drive mode (Default 1) 1 : TXD and AUX push-pull outputs, RXD pull-up inputs 0 : TXD、AUX open-collector outputs, RXD open-collector inputs</p> <p>-----</p> <p>5, 4, 3 wireless wake-up time (for the receiver, it means the monitor interval time ,while for the transmitter it means continuously sending preamble code time.) 000 : Fixed-length transmission 001 : Reserved, equal to mode 0 010 : Serial transmission 011 : Reserved, equal to mode 0 100 : Reserved, equal to mode 0 101 : Reserved, equal to mode 0 110 : Reserved, equal to mode 0 111 : Reserved, equal to mode 0</p> <p>-----</p> <p>2, Whether to enable cipher 1 : Enable 1 : Not enable (Default)</p> <p>-----</p> <p>1, 0 transmission power (approximation) 00 : 17dBm (Default) 01 : 14dBm 10 : 10dBm 11 : 7dBm</p> <p>-----</p> <p>1, 0 transmission power (approximation) 00 : 30dBm (Default) 01 : 27dBm 10 : 24dBm 11 : 21dBm</p>	<ul style="list-style-type: none"> ● When FEC turns on, the data transmitting time will be extended while greatly improved the probability of successful sending and receiving data. User can enable this function if your application does not need low-latency transaction. <p>-----</p> <ul style="list-style-type: none"> ● 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 4-10KΩ pull-up resistor. <p>-----</p> <ul style="list-style-type: none"> ● For more details, please refer to other chapters. <p>-----</p> <ul style="list-style-type: none"> ● For users to define. ● Both communication parties must keep on the same pages about this function. <p>-----</p> <ul style="list-style-type: none"> ● For E61-TTL-50 ● The external power must make sure the ability of current output more than 299mA and ensure the power supply ripple within 100mV. ● Low power transmission is not recommended due to its low power supply efficiency. <p>-----</p> <ul style="list-style-type: none"> ● For E61-TTL-1W ● The external power must make sure the ability of current output more than 1A and ensure the power supply ripple within 100mV. ● Low power transmission is not recommended due to its low power supply efficiency.
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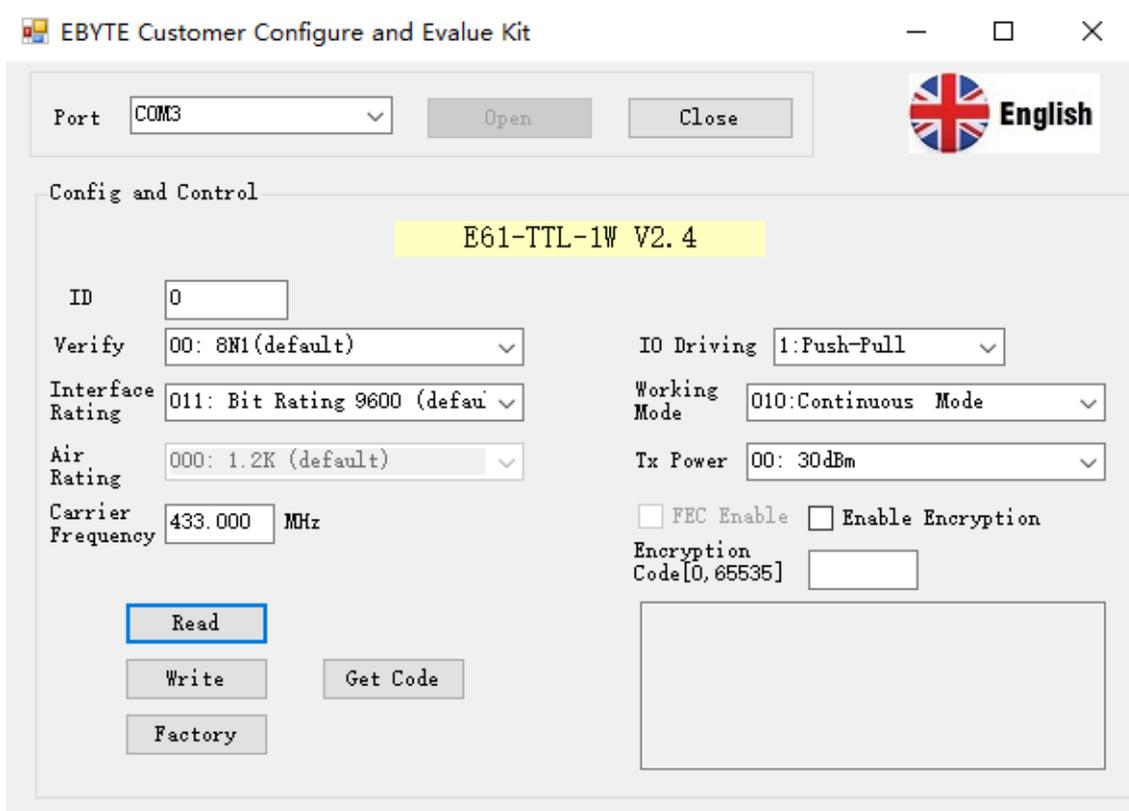
For example: The meaning of No.3 "SPED" byte

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	1	0
Meaning	UART parity bit 8N1		UART baud rate is 9600			Air date rate is 1.2k		
Corresponding hexadecimal	1				8			

8. Parameter Setting

When the module is in Mode 2 (M0=1 M1=0), the parameter can be set by instruction or software in PC.

Please visit www.cdebyte.com to download the software.

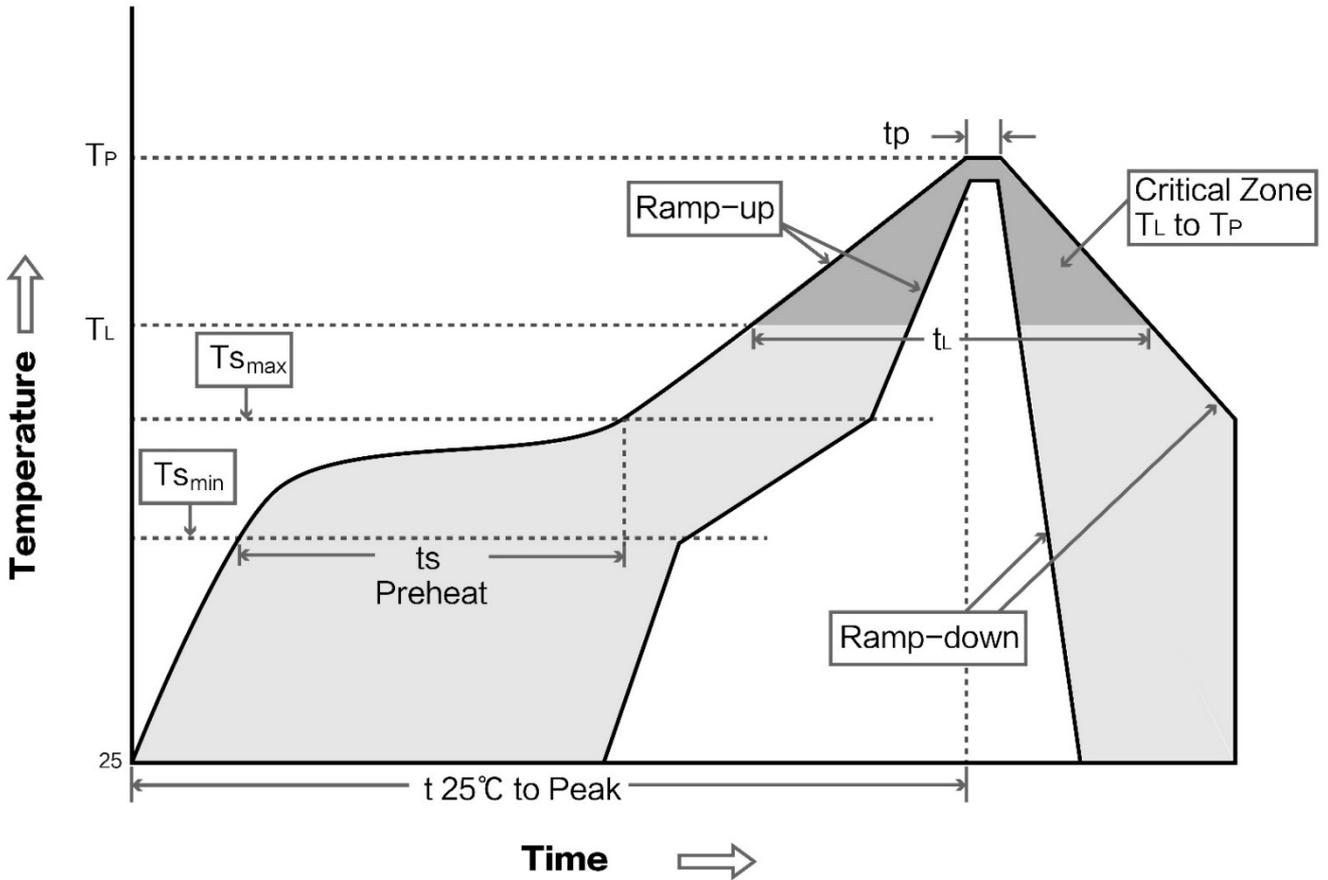


9. Production Guidance

9.1 Reflow Soldering Temperature

Profile Feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Sn63/Pb37	Sn96.5/Ag3/Cu0.5
Preheat Temperature min (T _{smin})	100°C	150°C
Preheat temperature max (T _{smax})	150°C	200°C
Preheat Time (T _{smin} to T _{smax})(ts)	60-120 sec	60-120 sec
Average ramp-up rate(T _{smax} to T _p)	3°C/second max	3°C/second max
Liquidous Temperature (TL)	183°C	217°C
Time (tL) Maintained Above (TL)	60-90 sec	30-90 sec
Peak temperature (T _p)	220-235°C	230-250°C
Average ramp-down rate (T _p to T _{smax})	6°C/second max	6°C/second max
Time 25°C to peak temperature	6 minutes max	8 minutes max

9.2 Reflow Soldering Curve



10. FAQ

10.1 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.
- Seawater 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 the recommended value, the lower the voltage, the lower the transmitting power.
- Due to antenna quality or poor matching between antenna and module.

10.2 Module is easy to damage

- Please check the power supply source, ensure it is within the recommended value, voltage higher than that 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.
- Please avoid using modules under too high or too low temperature.

11. Important Notes

- All rights to interpret and modify this manual belong to Ebyte.
- This manual will be updated based on the upgrade of firmware and hardware, please refer to the latest version.
- Please refer to our website for new product information

12. About Us

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