E36-TTL-100

20dBm Power RF Transceiver Module (900 - 925.5MHz)

Contact Us Email: yihe_liyong@yeah.net Tel: 0086-28- 61399028

Email: chenfang@cdebyte.com

Typical Application

√ Automatic meter reading
√ wireless sensor
√ Smart home
√ Industrial remote control, telemetry
√ Intelligent building
√ high-voltage cable monitor
√ Environmental engineering
√ Expressway
√ Small-size meteorological station
√ Automatic data acquisition
√ Consumer electronics
√ Intelligent robot
√ Street lamp control

Features

√ 2000m distance cover
√ Multiple baud rate
√ Sensitivity (-121dBm)
√ Ultra-low receive power consumption
√ Four operating modes
√Low current at sleep mode (2uA)
√ WOR (wake on radio)
√ Frequency on 900 - 925.5M , 256 channels
√ Dual 256 Bytes circular buffer
√ Multiple power level (100mW maximum)
√ Encryption algorithm + FEC (Forward error correction)
√ Built-in watchdog , system never crash
√ 65536 configurable address (easy for networking)

TO OUR VALUED CUSTOMERS

It is our intention to provide our valued customers with the best documentation to ensure successful use of our products. To this end, we will continue to improve our publications to better suit your needs. Our publications will be refined and enhanced as new volumes and updates are introduced.

If you have any questions or comments regarding this publication, please contact the Marketing Department via E-mail at **chenfang@cdebyte.com.** We welcome your feedback.

Most Current Data Sheet

To obtain the most up-to-date version of this data sheet, please register at our Web site at:
www.cdebyte.com

Customer Notification System

Register on our web site at **www.cdebyte.com** to receive the most current information on all of our products.

Table of contents

Introduction

1.1. Features

E36-TTL-100 is a 100mW wireless transceiver module, which operates at 900-925.5MHz, based on RFIC SI4463 from Silicon Labs. Utilizing serial port to send & receive data hence lower the threshold for wireless application.

The module features FEC (Forward Error Correction) algorithm, which ensure its high coding efficiency & good correction performance. In the case of sudden interference, it can correct the interfered date packets automatically, so that the reliability & transmission range are improved correspondingly. But without FEC, those date packets will be dropped.

The module has the function of data encryption & compression. The data of the module transmits in the air features randomness. But with the rigorous encryption & decryption, it can make the date interception pointless. The function of data compression makes it possible for decreasing transmission time & probability of being interference, while improving the reliability & transmission efficiency.

The module' s operating voltage is 1.9-3.6V, which can meet the battery voltage needs (3.0-6.0V is customizable) . This module can work in four different operating modes, which can be switched unconstrained while operating. In power-saving mode, it only consumes tens uA of current, which is very suitable for ultra-low power application.

1.2. Basic Usage

Transparent data transmission. For example, module A transmits 01 02 03 to module B, then module B will receive 01 02 03.

- Fixed transmission to implement various applications such as network and repeater.
- More usages are described in this datasheet and related application note.

1.3. Module electrical parameters

No.	Parameter item	Parameter details & description
1	Size	21 * 36mm (without antenna)
2	Components	Japan, USA & Germany
4	Connector	1*7*2.54mm
5	Frequency Band	900 - 925.5MHz , 100kHz stepped frequency , Default: 915.0MHz
6	Supply voltage	1.9 – 3.6V DC
7	Communication	UART, USART

	level	
8	Operation Range	About 2200m (test condition : clear and open area& maximum power , antenna gain: 5dBi , height:> 2m , air date rate: 1.2Kbps)
9	Transmitting power	Maximum 20dBm (100mW) | four optional level (0-3) , step by 3dBm
10	Air data rate	Can be configured to 1、2、5、8、10、15、20、25Kbps
11	Standby current	2.0uA (mode 3,M1=1,M0=1)
12	Transmitting current	85mA@100mW
13	Receiving current	16.5mA (mode 0 or mode 1) | minimum 30uA (mode 2 + 2s wake-up time)
14	Communication interface	UART , 8N1、8E1、8O1 , eight kinds of UART baud Rate, from 1200 to 115200 bps
15	Driving mode	UART can be configured to push-pull/high pull, open-drain
16	Transmitting length	256 bytes buffer , 58 bytes per package
17	Receiving length	256 bytes buffer , 58 bytes per package
18	Address	65536 configurable addresses (easy for network, broadcast and fixed transmission)
19	RSSI support	built-in intelligent processing, the user do not need to concern about it
20	Sensitivity	-121dbm@1Kbps (sensitivity has nothing to do with serial baud rate and timing)
21	Antenna type	SMA
22	Operating temperature	-40 ~ +85℃
23	Operating temperature	10% ~ 90%
24	Storage temperature	-40 ~ +125℃

Table 1: Module electrical parameters

2. Functional description

2.1. Pin definition

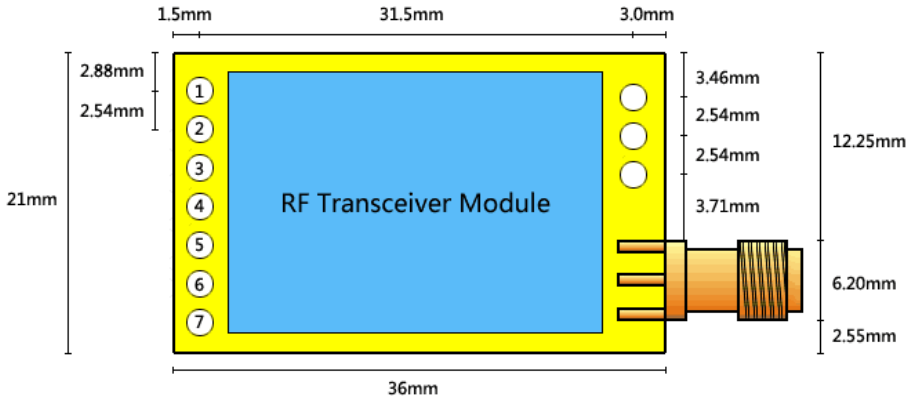

Figure 1: Pinout Top View

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.
2	M1	Input (weak pull-up)	Work with M0 & decide the four operating modes. Floating is not allowed.
3	RXD	Input	TTL UART inputs and connects to external (MCU, PC) TXD output pin. Can be configured as open-drain or pull-up input.
4	TXD	Output	TTL UART outputs and 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.
6	VCC		Power supply 2.1V-5.5V DC
7	GND		Ground

Table 2: Pin definition

2.2. Connection between the module and MCU

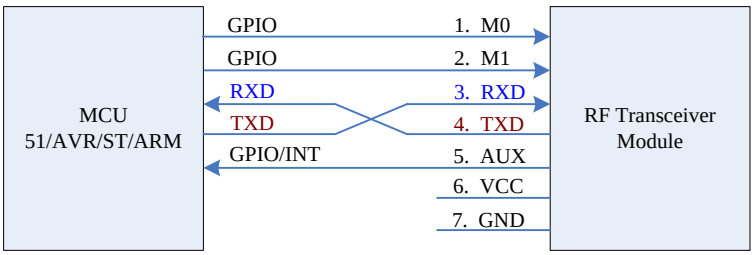

Figure 2: Connection between the module and MCU

- The wireless serial port module is TTL level.
- For some MCU which works at 5VDC, it may need to add 4-10K pull-up resistor for the TXD & AUX pin of the module.

2.3. Reset module

When the module is powered, AUX outputs low level immediately, conducts hardware self-check and set the operating mode on the basis of the user parameters. During the process, the AUX keeps low level. After the process completes, the AUX outputs high level and starts to work as per the operating mode combined by M1 and A0. Therefore, the user needs to wait the AUX rising edge as the starting point of module's normal work.

2.4. 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 through wireless, or whether all wireless data that has sent through UART, or whether the module is still in the process of self-check initialization.

AUX functional explanation

- Function 1 : Indication of the UART outputs data (can be used to wake up the external MCU works in standby mode). See Figure 3.

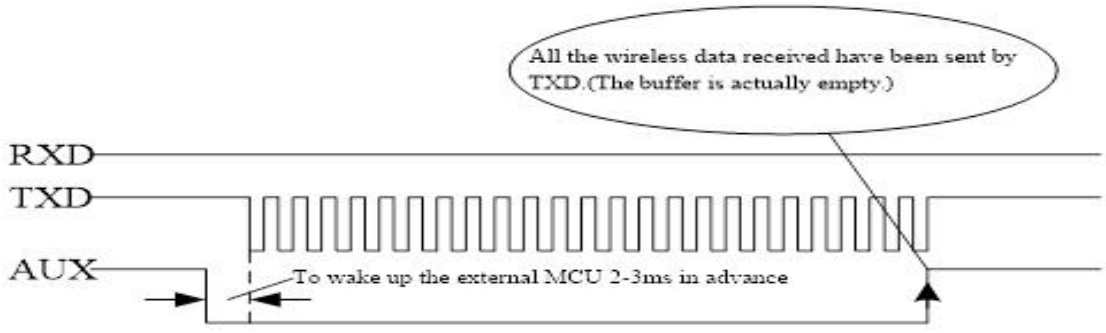

Figure 3: Timing Sequence Diagram of AUX when TXD pin transmits

- Function 2 : Indication of wireless transmitting. See Figure 4.

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

AUX=1, the user can transmit data less than 256 bytes continuously without overflow.

Buffer (not empty): when AUX=0, the internal 256 bytes data in the buffer have not written to the RFIC completely. If the user starts to transmit date at this circumstance, it may cause overtime when the module is waiting for the user date, 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.

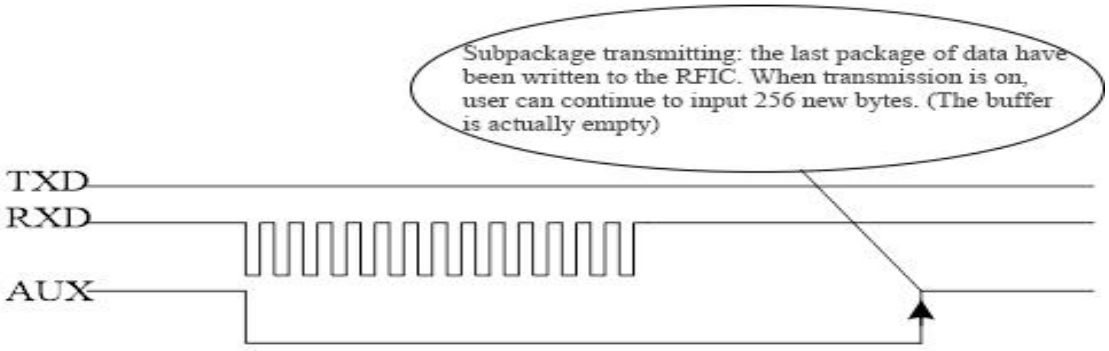

Figure 4: Timing Sequence Diagram of AUX when RXD pin receives

- Function 3: Configuration procedure of module. See Figure 5

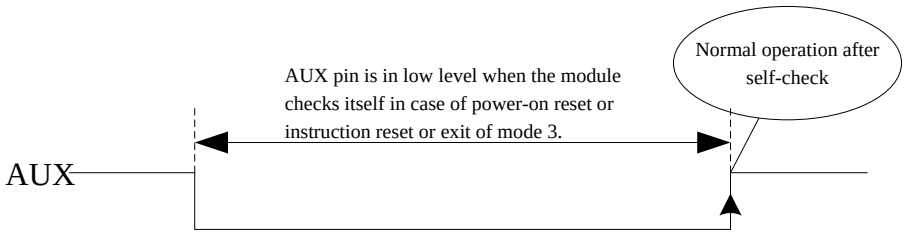

Figure 5: Timing Sequence Diagram of AUX when self-check

➢ **Notes:**

- 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 meet, AUX outputs high level.
- When AUX outputs low level, it means the module is busy & cannot conduct operating mode checking. After AUX outputs high level 1ms later, it will complete the mode-switch task.
- 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 will be effect immediately.
- When the user switches into 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.

3. Operating mode

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

Mode (0-3)	M1	M0	Mode introduction	Remark
Mode 0 Normal	0	0	UART and wireless channel is opened, transparent transmission is on.	The receiver must works in mode 0 or mode 1
Mode 1 Wake-up	0	1	UART and wireless channel is opened. The difference between normal mode and wake-up mode is it will add preamble code automatically before data packet transmission so that it can awaken the receiver works in mode 2.	The receiver can works in mode 0, mode 1 or mode 2.
Mode 2 Power-saving	1	0	UART is closed. Wireless module works at WOR mode (wake on radio). It will open the UART and transmit data after receive the wireless data.	1,the transmitter must works in mode 1 2,transmitting is not allowed in this mode
Mode 3 Sleep	1	1	Parameter setting.	

Table 3: Operating mode

3.1. Mode switch

- The user can decide the operating mode by the combination of M1 and M0. The two GPIO of MCU can be used to control the mode-switch. 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 is yet to finish wireless transmitting, it will start to work in new mode after the UART transmitting finishing. After the module receives the wireless data & transmits the data through serial port, it will start to work in new mode after the transmitting finishing. Therefore, the mode-switch is only workable 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 completing. It is recommended that after check AUX pinout status and wait 2ms after AUX outputs high level, then switch the mode.
- If the module switches from other modes to stand-by mode, it will be work in stand-by mode only after all the remained data process completing. The feature can be used to save power consumption. For example, the transmitter works in mode 0, after the external MCU transmits data "12345". It can switch to stand-by mode immediately but not wait 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 reduce 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 enable the user to omit the procedure of AUX inquiry and switch mode swiftly. For example, when switch from transmitting mode to receiving mode, the user MCU can go dormancy in advance of mode-switch, using external interrupt function to get AUX change so that the mode-switch can be done.
- This operation is very flexible and efficient. It is totally designed on the basis of the user MCU's convenience, at the same time reduce the whole system work load as much as possible, increase the efficiency of system work and reduce power consumption.

3.2. Normal mode (mode 0)

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

- **Transmitting**: The module can receive the user data from serial port, and transmit wireless data package which length is 58 bytes. When the data inputted by user is up to 58 byte, the module will start wireless transmission. During which the user can input data continuously for transmission. But when the required transmission bytes is less than 58 byte, 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 the module transmit all the data into RF chip & start transmission, AUX outputs high level. At this time, it means that the last wireless data package transmission has started, which enable the user to input another 256 bytes continuously. The data package transmitted from the module works in mode 0 can only be received by the module works in mode 0 or 1.

- **Receiving:** The module keeps the wireless receive function on, it can receive the data packet transmitted from the module works in mode 0 & mode 1. After receiving the data packet, 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 module AUX outputs high level

3.3. Wake-up mode (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

3.4. Sleep mode (mode 2)

- When M1 = 1 & M0 = 0, module works in mode 2.
- **Transmitting**: Serial port is closed, the module cannot receive any serial port data from outside MCU. Hence the module works in this mode does not have the function of wireless transmission.

- **Receiving**: In mode 2, it is required the date transmitter works in mode 1. The wireless module monitors the preamble code at regular time. Once it gets the preamble code, it will remain as receive status and wait for the completion of the entire valid date package receives. Then the module lets the AUX outputs low level, 5ms later opens the serial port to transmit received wireless data through TXD. Finally AUX outputs high level after process completing. The wireless module stays in "power-saving – monitoring" working status (polling). By setting different wake-up time, the module can have different receive response delay (2s maximum) and average power consumption (30uA minimum). The user needs to achieve a balance between communication delay time & average power consumption.

3.5. Stand-by mode (mode 3)

- When M1=1,M0=1,module works in mode 3
- **Transmitting**: cannot transmit wireless data
- **Receiving**: cannot receive wireless 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. (pls refer to parameters setting for details)
- **Note**: 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 completing. It is recommended to check the AUX rising edge for user.

3.6. Quick communication test

- Plug the USB test board (our optional accessory) 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. (Illustrated in below highlight bar in red)
- Optional power supply, 3.3V or 5V.
- Operate AccessPort software and select the correct serial port code (See Figure 6).

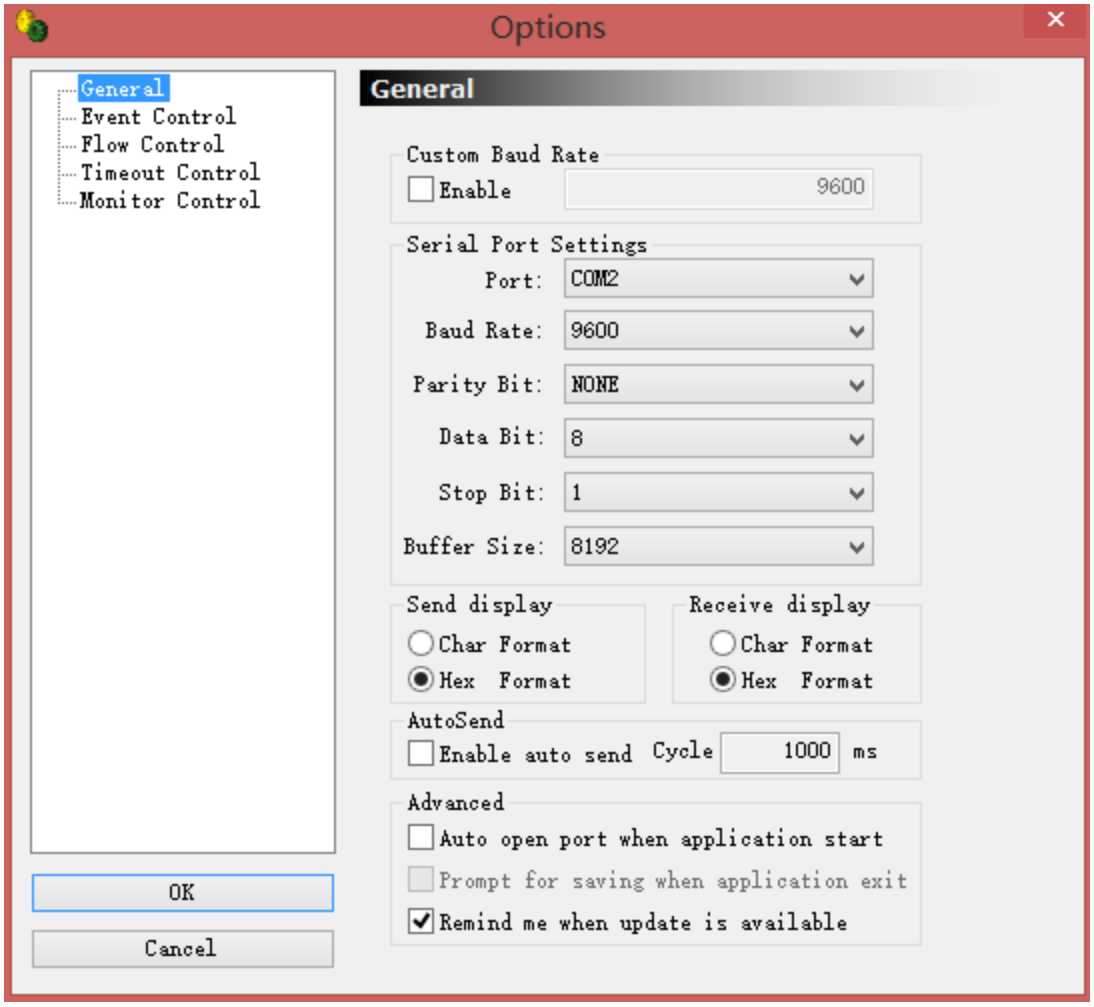

Figure 6: Configure AccessPort software

➢ Then observe the send window & corresponding receive window. See Figure 7.

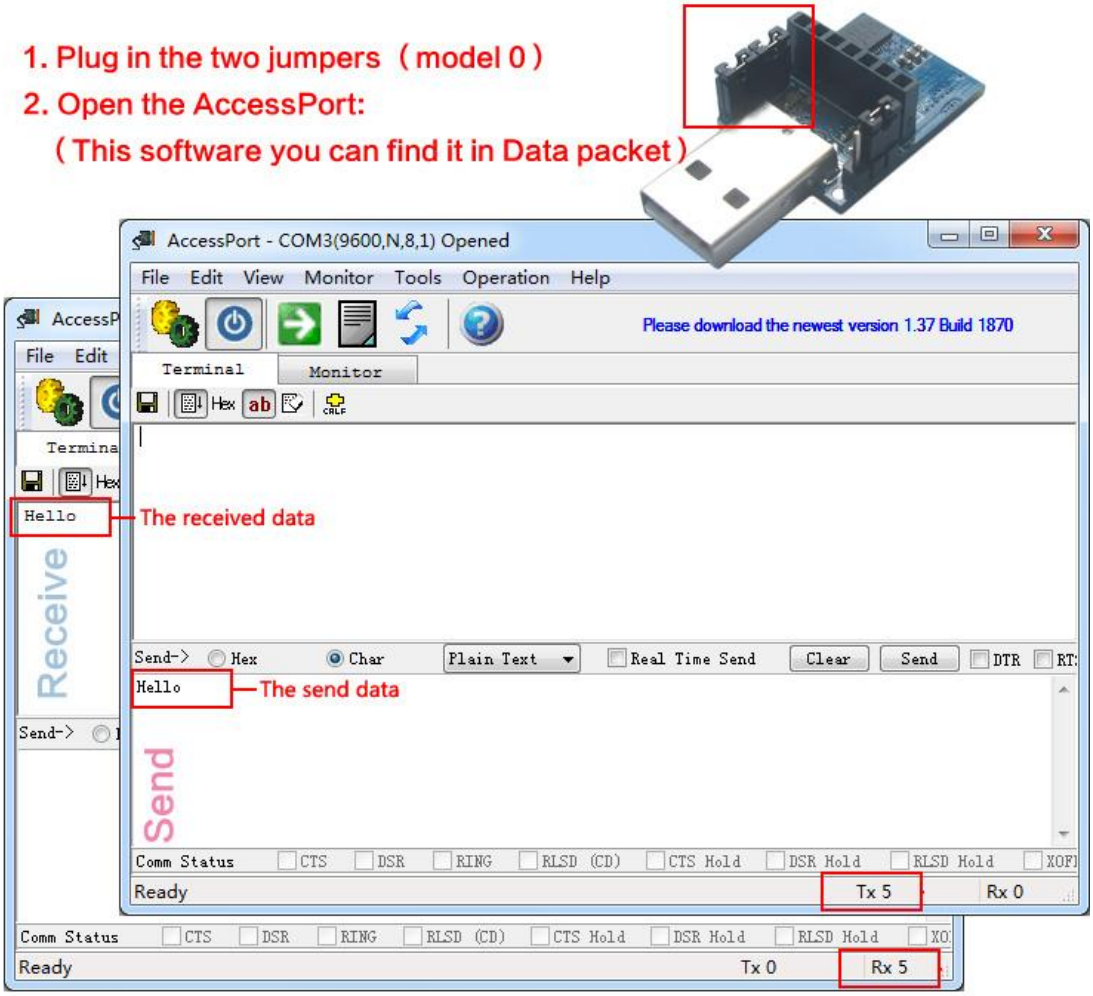

Figure 7: The testing of transmit and receive data

4. Instruction format

In sleep 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 send in succession. (Save the parameters when power-off)
2	C1 C1 C1	Three C1 are sent in hexadecimal format. The module returns the saved parameters and must send in succession.
3	C2 + working parameters	C2 + 5 bytes working parameters are sent in hexadecimal format. 6 bytes in total and must send in succession. (Not save the parameters when power-off)

4	C3 C3 C3	Three C3 are sent in hexadecimal format. The module returns the version information and must send in succession.
5	C4 C4 C4	Three C4 are sent in hexadecimal format. The module will reset one time and must send in succession.

Table 4: Instruction format

4.1. Parameter setting instruction

The difference between C0 command and C2 command is that C0 command will write parameters into the internal flash memory and can be saved when power down, while C2 command cannot be saved when power down, because C2 command is temporarily mend instruction.C2 is recommended for the occasion that need to change the operating parameters frequently, like C2 00 00 18 50 44.

Operating parameters configurable table (Default : C0 00 00 18 50 44)

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: 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	Rate parameter , including UART baud rate and the air date 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 The air date rate (bps) 000 : 1Kbps (default) 001 : 2Kbps 010 : 5Kbps 011 : 8Kbps 100 : 10Kbps 101 : 15Kbps 110 : 20Kbps 111 : 25Kbps	● UART mode can be different between communication parties ---------- ● 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. ---------- ● The lower the air date rate, the longer the transmitting distance, better anti-interference performance and longer transmitting time ● The air date rate must keep the same for both communication parties.

4	CHAN	Communication frequency (900M + CHAN * 0.1M) default 96H (915MHz)	● 00H-FFH , for 900 - 925.5Mhz
5	OPTION	7 , Fixed transmission (similar to MODBUS) 0 : Transparent transmission mode (default) 1 : Fixed transmission mode --- 6 IO drive mode(the default 1) 1 : TXD and AUX push-pull outputs, RXD pull-up inputs 0 : TXD、AUX open-collector outputs, RXD open-collector inputs --- 5 , 4 , 3 wireless wake-up time (for the receiver, it means the monitor interval time ,while for the transmitter it means continuously sending wake-up code time.) 000 : 250ms (default) 001 : 500ms 010 : 750ms 011 : 1000ms 100 : 1250ms 101 : 1500ms 110 : 1750ms 111 : 2000ms ---	● 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. --- ● 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. --- ● The transmit & receive module work in mode 0, whose delay time is invalid & can be arbitrary value. ● The transmitter works in mode 1 can transmit the preamble code of the corresponding time continuously. ● When the receiver works in mode 2, the time means the monitor interval time (wireless wake-up). Only the data from transmitter that works in mode 1 can be received. ● The wake-up time set by transmitter cannot be less than the monitor interval time of receiver; otherwise, it may lead to data loss. In case of two-way communication, both parties should keep the wake-up time the same. ● The longer the wake-up time, the lower the average receive current consumption. ---

		2 , FEC switch 0 : turn off FEC 1 : turn on FEC (default)	● After turn off FEC, the actual data transmission rate increases while anti-interference ability decreases. Also the transmission distance is relatively short. Both communication parties must keep on the same pages about turn-on or turn-off FEC.
		1, 0 transmission power (approximation) 00 : 20dBm (default) 01 : 17dBm 10 : 14dBm 11 : 11dBm	● 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.

Table 5: Operating parameters

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			The air date rate is 1K		
Corresponding hexadecimal	1				8			

Table 6: The meaning of No.3 "SPED" byte

4.2. Reading operating parameters

In stand-by mode (M1=1 , M0=1), the user gives the module instruction (HEX format): C1 C1 C1, then the module returns the present configuration parameters. For example, C0 00 00 18 50 44.

4.3. Reading version number

In stand-by mode (M1=1 , M0=1), the user gives the module instruction (HEX format): C3 C3 C3, the module returns its present version number, for example C3 36 xx yy. 36 here means the module model (E36 series); xx is the version number and cannot be modified and yy refers to the other module features.

4.4. Reset instruction

In sleep mode (M1=1 , M0=1), the 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.