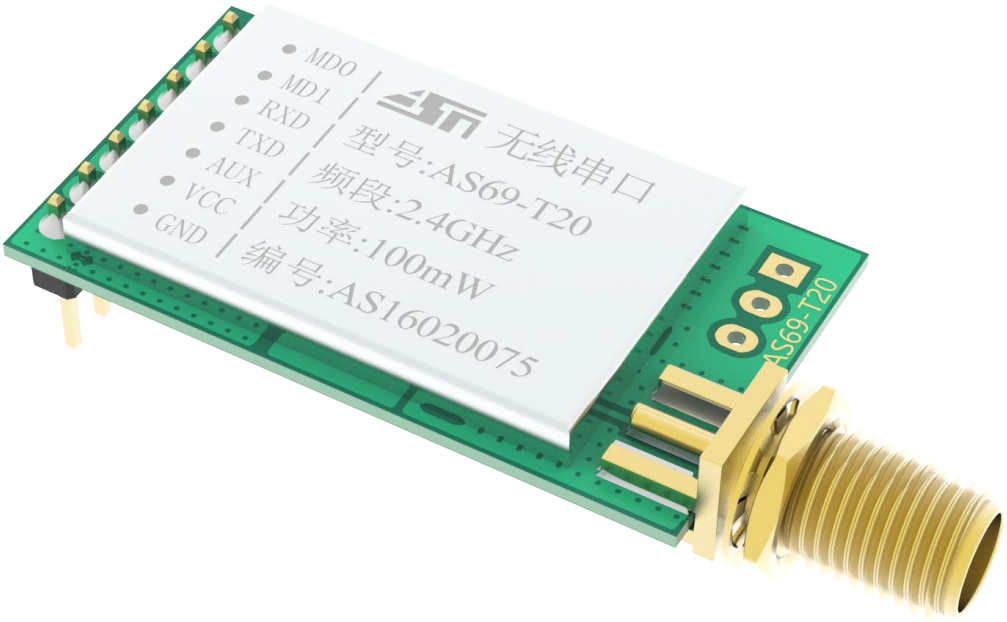
AS69-T20 Data Sheet

2.4GHz, 100mW, Wireless Serial Port Module

Full duplex, Adaptive Airspeed



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1. Product Overview

AS69-T20 is a 100mW industrial wireless data transceiver with high stability, operates at 2.4GHz. The module is designed and developed using imported RF chip nRF24l01P, supports 8 baud rates 1200-115200bps. Wireless airspeed and baud rate are adaptive matching, it supports full-duplex transmission with unlimited packet length at various baud rates. The module has three operating states and can be freely switched at run time.

2. Product Features

- Point-to-point transmission, half-duplex transmission and full duplex transmission
- Receiving sensitivity is up to -102dBm, range 2100 meters
- Built-in multiple exception handling mechanisms ensure the stable operation for a long time
- Airspeed and baud rate are adaptive matching
- Multiple levels of transmitting power
  - 4 power levels adjustable (0-3), each levels steps 6dBm
  - Power Range: 2-20dBm, Max 100mW
- Multiple baud rates [1]
  - 8 commonly used baud rates, default baud rate 9600bps
  - Baud rate range:1200bps~115200bps
- 4 operation modes [2]
  - MD0 = 0 MD1 = 0 half-duplex working mode
  - MD0 = 0 MD1 =1 half-duplex working mode
  - MD0 = 1 MD1 = 0 full duplex working mode
  - MD0 = 1 MD1 = 1 sleep mode
- Frequency 2.4-2.525GHz, providing 16 channels [4]
  - 2.4G + CHAN * 10MHz
  - CHAN:0* 00~0*0CH (corresponding to 2.4G-2.525GHz)
  - Default operation frequency 2.4GHz, application free band
- Supply voltage range
  - 2.0V-5.5VDC
  - Built-in LDO ensures stable power supply, meeting variety system requirements
- Data 1024 circular FIFO
  - 1024 transmitting FIFO (unlimited packet length)
  - 1024 receiving FIFO (unlimited packet length)
  - Automatic subcontracting transmission
- Transparent Broadcasting [5]
  - The data sent by any module can be received by modules with the same address and the same channel. The data transmission is transparent, and what is sent is what is received.
- Half-Duplex Transmission Mode [5]
  - High-speed data transmission, no limit on packet length, one-way transmission.
  - When the module performs high-speed data transmission at the same time, if it is transmitting data, it cannot receive. If it receives, it cannot transmit. The data can only be transmitted in one direction at the same time.
- Full Duplex Transmission [5]
  - High-speed data transmission, without limiting the packet length and bidirectional transmission.
  - When the module performs high-speed data transmission at the same time, it can receive data while transmitting data, and can transmit data while receiving data, enabling simultaneous bidirectional transmission

Remarks:

1) For details, see the SPEED register in Chapter 6.2 of module Parameter Configuration.
2) For details, See the pin definition and function in chapter 5
3) For details, see the CHAN register in Chapter 6.2 of module parameter configuration.
4) For details, See the relationship diagram of voltage and power in Chapter 5
5) For details, See the module function table in Chapter 7.

3. Series Products

Table 3-1 Brief Specification of AS69-T20

Item Model	Carrier Frequency (Hz)	IC	Size (mm)	Max transmit power (dBm)	Range (km)	Package	Antenna
AS69-T20	2.4G-2.525G	nRF24l01P	20*36	20	2.1	In-line package	SMA-K
All models of the AS69 series can communicate with each other							

4. Electrical Parameters

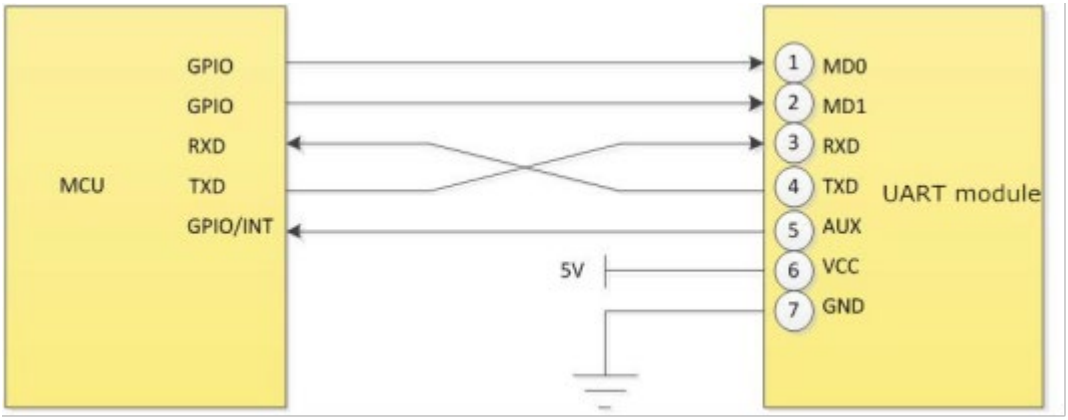
Table 4-1 Electrical Parameters of AS69-T20

Test Condition: Tc=25℃, VCC=3.3V

Item Model	Parameter Name	Description	Min	Typical Value	Max	Units
AS69-T20	Supply voltage	If the power supply voltage is less than 3.6v, the output power will decline, but it has little influence on the received power	2.0		5.5	V
AS69-T20	Transmitting current	SendPower [1] = 0		206		mA
		SendPower= 1		76		mA
		SendPower= 2		70		mA
		SendPower= 3		47		mA
AS69-T20	Receiving current	half-duplex working mode (MD0=0, MD1=0)		1		mA
		Reserved working mode (MD0=0, MD1=1)				mA
		Full duplex working mode (MD0=1, MD1=0)		151		mA
		Sleep mode (MD1=1, MD1=1)		151		
AS69-T20	Sleep current	current measured in sleep mode (MD0=1, MD1=1)		3.8		uA
AS69-T20	Working frequency	2.4G-2.525GHz,1MHz stepping, 16Channels, factory default 2.4GHz	2.4	2.4	2.525	MHz
AS69-T20	Transmit power	SendPower= 0		20		dBm
		SendPower= 1		14		dBm
		SendPower= 2		8		dBm
		SendPower= 3		2		dBm
AS69-T20	Airspeed	Air speed is adaptive matching with baud rate		250k		bps
AS69-T20	Receiving sensitivity	The receiving sensitivity has nothing to do with the serial port rate or delay time		-102		dBm
AS69-T20	Operation temperature	AS69-T20 industrial product	-40		+85	℃
AS69-T20	Operation humidity	Relative humidity, no condensation	10%		90%	
AS69-T20	Storage temperature		-40		+125	℃

5. Module Functions

5.1 Recommended Connection Diagram



0-1 Recommended Connection Diagram

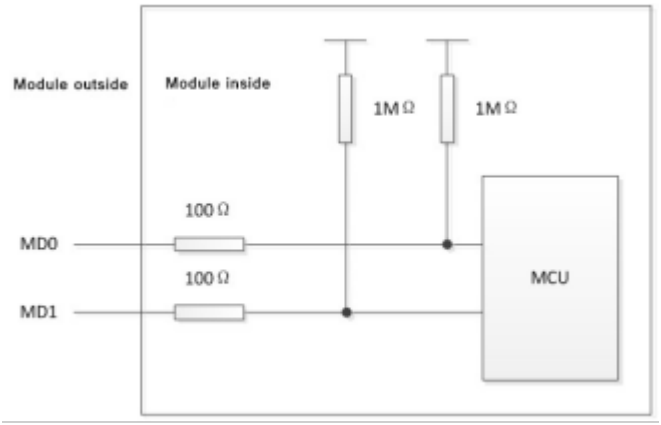
5.2 Pin Definition

Table 5-1 Pin Definition of AS69-T20

Pin Number	Pin Name	Pin Orientation	Pin Usage
1	MD0	Input (weak pull up)	Cooperates with MD1 of low delay to decide four kinds of operation modes
2	MD1	Input (weak pull up)	Cooperates with MD0 of low delay to decide four kinds of operation modes
3	RXD	Input	TTL UART inputs, connects to external TXD output pin. It can be configured as open-drain or pull-up input, see parameter setting for details
4	TXD	output	TTL UART outputs, connects to external RXD input pin. It can be configured as open-drain or push-pull output, see parameter setting for details
5	AUX	output	Indicates the operation status of the module, and wakes up the external MCU. During the procedure of self-test initialization, the pin outputs low level. Can be configured as open-drain output, or push-pull output. see parameter settings for details
6	VCC		power supply, voltage2.0-5.5V
7	GND		Ground line, connected to the power supply reference ground

5.3 Pin Function

5.3.1 Pins Function of MDO and MD1 in Low Latency Mode



Picture 0-2 Internal structure of the MD0 and MD1 pin

The free combinations of the high and low level of pins MD0 and MD1 in low-latency operation mode can determine the four operating modes of the wireless UART module and these four operating modes can be freely switched.

Pay attention to the following two special cases when switching working modes:

1. The module received wireless data and has not finished outputting, and then enters a new mode after the data output is completed.
2. The module sends wireless data has not been sent yet, and then enters the new mode after the data is sent.

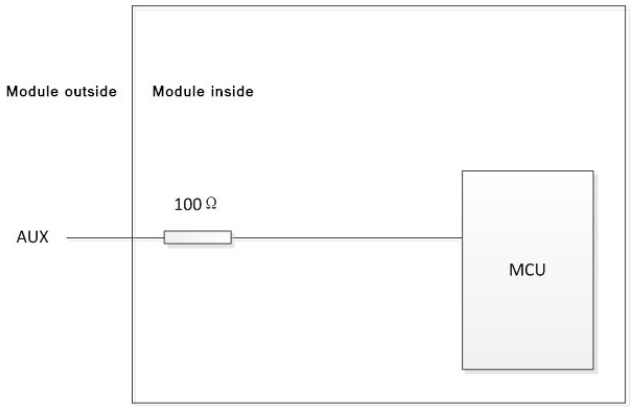
Table 5-2 Operation Mode Form

Operation Mode	MD1	MD0	Mode Introduction
Half-duplex working mode	0	0	UART open, wireless channel open
Reserved working mode	0	1	Reserved, same as half-duplex working mode
Full duplex working mode	1	0	UART open, wireless channel open, Full duplex transmission.
sleep mode	1	1	Module enters into sleep can receive the parameter configuration Command to configure parameter.

Table 5-3 Communication Mode Form

Transmit \ Receive		Operation Mode		Data Transmission Mode
		Half-Duplex Working Mode	Full Duplex Working Mode	Transparent Broadcasting
Operation Mode	Half-Duplex Working Mode	Y	Y	Y
	Full Duplex Working Mode	Y	Y	Y

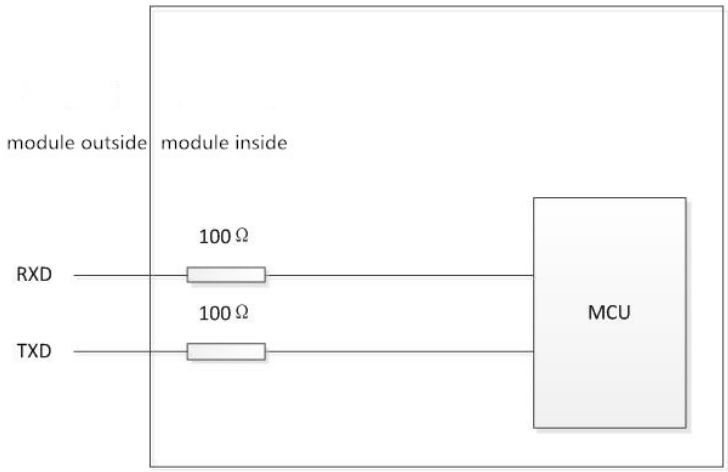
5.3.2 Function of AUX Pin



Picture 0-3 Schematic Diagram of The Internal Structure of The AUX Pin

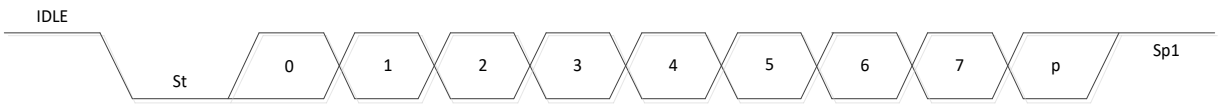
AUX is used as indication for wireless send and receive buffer and self-test. It indicates whether the module has data not sent by wireless, or whether the received data has been sent through the UART, or the module is initializing the self-test.
Mode of AUX pin should be checked before switching operation mode. When the AUX output is low, it indicates that the module is busy. After the AUX output is high for 2ms, it indicates the module is idle and ready to change operation mode. MD0, MD1 in low latency mode start to jump and after that AUX keeps outputting high level for 3ms, the module changes the mode. When AUX outputs high level and maintains for about 2ms, the mode change is done.
In the process of reset, the module will reinitialize the parameters, during which the AUX keep low level.

5.3.3 Function of RXD And TXD Pins



Picture 0-4 Internal Structure of the RXD and TXD Pin

RXD and TXD are serial data transmission and reception pins, at the same time, the UART has 8 common baud rates to choose from, the supported baud rate range is 1200~115200 (bps); the UART parity mode also has odd parity, even parity and No parity. The byte transmission format of UART is shown in Picture:

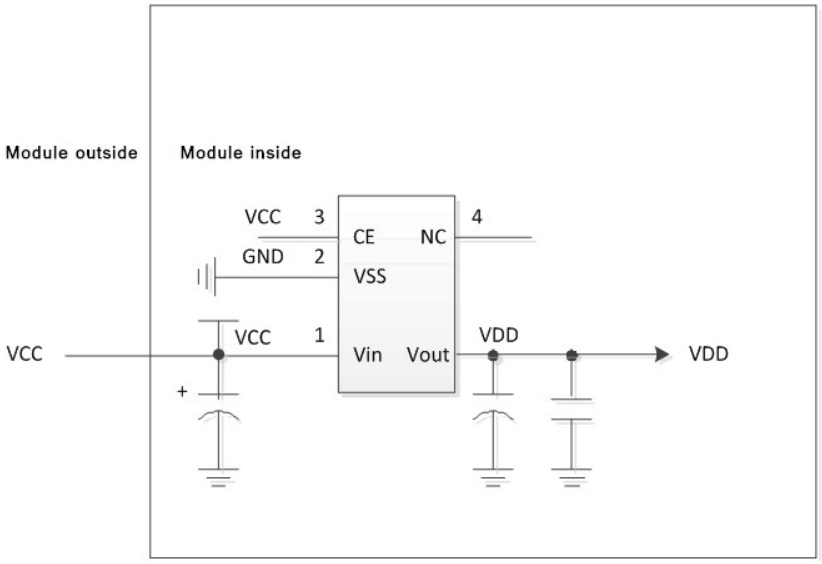


Picture 0-5 Format of UART Byte Transmission

IDLE: High level when idle
St: start bit
P: parity bit
Sp1: stop bit

5.3.4 Function of VCC and GND Pins

GND indicates the ground line, VCC indicates the power supply, and the module power supply has its own LDO. Input voltage range: 2.0V - 5.5VDC. As shown in below Picture

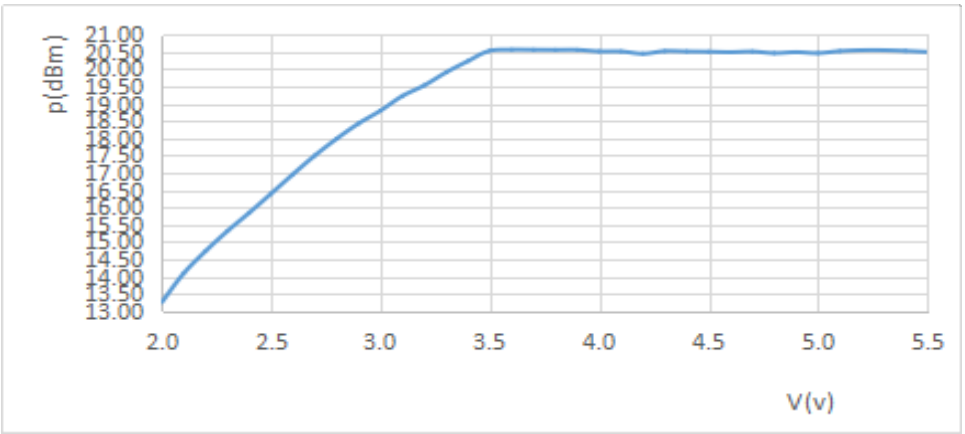


Picture 0-6 Power LDO

Remarks:

The input power ripple coefficient should be controlled within 100mV, and the instantaneous pulse current should be more than 200mA.

When the power supply voltage is less than critical value, the output power declines, but the reception performance is less affected. The relationship between voltage and power is shown in below Picture



Picture 0-7 Relationship diagram of voltage and powe

6. Module Command

6.1 Command Format

The parameter configuration Command is supported in the sleep operation mode, which means that the pins in low latency operation mode are set to high level (MD0 = 1, MD1 = 1).

Table 6-1 Command Overview Form

No.	Command	Command Function
1	0xC0	Set the module parameters. The parameters set by this Command can be saved after power off.
2	0xC2	Set the module parameters. The parameters set by this Command are not saved after power off.
3	0xC1 + 0xC1 + 0xC1	Read module parameters
4	0xC3 + 0xC3 + 0xC3	Read the hardware version of the module
5	0xC4 + 0xC4 + 0xC4	Reset module Command
6	0xC9 + 0xC9 + 0xC9	Restore default parameters
7	0xE1 + 0xE1 + 0xE1	Handshake command
8	0xF3 + 0xF3 + 0xF3	Read the software version of the module

Detailed explanation of the command function, taking the default factory configuration as an example. See the following form for details:

Table 6-2

Command Format	Module Response	Description
0xC0 ADDH ADDL SPEED CHAN OPTION (See the register description of parameter configuration for details)	OK	The configuration succeeds and the ASCII string is returned. The parameters configured can be saved after power-off.
	ERROR	The configuration failed and the ASCII string is returned. The original configuration parameters are not changed.
0xC2 ADDH ADDL SPEED CHAN OPTION (See the register description of parameter configuration for details)	OK	The configuration succeeds and the ASCII string is returned. The parameters configured cannot be saved after power-off.
	ERROR	The configuration failed and the ASCII string is returned. The original configuration parameters are not changed.
0xC6 + 16byte Configure key	OK	Data encryption succeeded
0xC1 0xC1 0xC1	C0 12 34 18 00 40	The module returns the present configuration parameters in hexadecimal format.
0xC3 0xC3 0xC3	AS69-T20-V3.0	The module returns the present hardware version in ASCII format.
0xC4 0xC4 0xC4	OK	The module generates a reset. During the reset process, the module performs a self-test and the AUX outputs a low level. After the reset, the AUX output is high, and the module starts to work normally. At this time, you can switch mode or initiate next Command.
0xC9 0xC9 0xC9	OK	Restore default parameter configuration successfully
0xE1 0xE1 0xE1	OK	When the user forgets the baud rate, it can be used to query by baud rate until 'OK' is received.
0xF3 0xF3 0xF3	69T20-032M-V3.46	The module will return the current software version in ASCII format.

6.2 Module Parameter Register

The module parameters can be modified in the sleep mode (i.e. MD0 = 1, MD1 = 1).

Configuring parameter register (Configuring parameter register cannot be used alone, it must be used according to the command format of the configuration parameter, see Chapter 6, Section 6.1 for details)

Table 6-3 ADDH Module Address High 8-Bit Register

	ADDH [7:0]							
Read and Write Properties	rw	rw	rw	rw	rw	rw	rw	rw
Default Value	0	0	0	1	0	0	1	0

ADDH [7:0]: indicates the module address high byte, factory default 0x12

Table 6-4 ADDL Module Address Low 8-Bit Register

	ADDL [7:0]							
Read and Write Properties	rw	rw	rw	rw	rw	rw	rw	rw
Default Value	0	0	1	1	0	1	0	0

ADDL [7:0]: module address low byte, factory default 0x34

Table 6-5 SPEED Communication Configuration Register

	UART CS [1: 0]		UART BAUD [2: 0]			Reserved		
Read and Write Properties	rw	rw	rw	rw	rw	rw	rw	rw
Default Value	0	0	0	1	1	0	0	0

SPEED [7: 6]
UART CS [1: 0]: UART parity bit
00: 8N1 (default)
01: 8O1
10: 8E1
11: Same as 8N1

SPEED [5: 3]
UART BAUD [2: 0]: UART baud rate
000: UART baud rate is 1200 bps
001: UART baud rate is 2400 bps
010: UART baud rate is 4800 bps
011: UART baud rate is 9600 bps (default)
100: UART baud rate is 19200 bps
101: UART baud rate is 38400 bps
110: UART baud rate is 57600 bps
111: UART baud rate is 115200 bps

SPEED [2: 0]

Reserved [2: 0]: Reserved

Table 6-6 CHAN Channel Register

	Reserved				CHAN [7: 0]			
Read and Write Properties	rw	rw	rw	rw	rw	rw	rw	rw
Default Value	0	0	0	0	0	0	0	0

Reserved [7:4]: Reserved

CHAN [3: 0] ： frequency （2400+ CHAN*10M)
Factory Default: 0x00 (2400MHz)
00000000：0x00 （ Min：2400MHz ）
00001100：0x0C （ Max：2525MHz ）

Table 6-7 OPTION Special Function Register

	Reserved	IOType	Reserved				SendPower [1:0]	
Read and Write Properties	rw	rw	rw	rw	rw	rw	rw	rw
Default Value	0	1	0	0	0	0	0	0

OPTION [7]: Reserved
0: Transparent transmission (default)
1: Point-to-Point transmission

OPTION [6] IOType: IO port drive mode
0: TXD, AUX open output, RXD open input
1: TXD, AUX push-pull output, RXD pull-up input (default)

OPTION [5： 2]: Reserved

OPTION [1:0] SendPower [1:0]: Trans Power
00：20dBm （default)
01：14dBm
10：8dBm
11：2dBm

Remarks:

wireless wake-up time is typical value

6.3 Module Factory Setting

Table 6-9 Factory Configuration Form of Register:

Register Name	ADDH	ADDL	SPEED	CHAN	OPTION
Register Parameter	12	34	18	00	40

Table 6-10 Module Factory Parameter:

Item Model	Operation Frequency (MHZ)	ID Address (HEX)	Factory Channel	Air Speed (Kbps)	Baud Rate (bps)	UART Format	Transmit Power (mW)
AS69-T20	2400	0x1234	150	250	9600	8N1	100

7. Module Functions

7.1 Overview of Module Functions

Table 7-1 Module Function Form

Module Function	Data Format of Transmitter	Data Format of Receiver	Function Introduction
Transparent broadcasting	User data	User data	The data sent by random module can be received by the modules with the same address and channel. The data transmission is transparent. What is sent is what is received.
Half- duplex transmission	user data	User data	The module can only transmit in one direction at the same time, and data transmission and reception cannot be performed simultaneously.
Half- duplex transmission	user data	User data	Module can be transmitted in both directions, data can be sent and received at the same time

7.2 Detailed Module Functions

7.2.1. Transparent Broadcasting

i. Function Description

The data sent by random module can be received by the modules with the same address and channel. The data transmission is transparent. What is sent is what is received.

ii. Module Setting

1. MD0 = 0, MD1 = 0
2. The 7th bit of the OPTION Special Function Register needs to be configured to 0, transparent transmission mode.
3. The addresses of the transmitter and the receiver are set to the same value.
4. The channels of the transmitter and the receiver are set to the same value.

For Example

Table 7-2

Transmitter		Receiver	
Module Address	0x1234 (factory default)	Module Address	0x1234 (factory default)
Module Channel	0x17 (factory default)	Module Channel	0x17 (factory default)
Sending Data	User data	Output Data	User data
	0x11 0x22 0x33		0x11 0x22 0x33

7.2.2 Half-Duplex Transmission

i. Function Description

When the module performs high-speed data transmission, it does not limit the packet length and can only perform one-way transmission. Data cannot be received when sending data, and data cannot be sent when receiving data.

ii. Module Setting

1. MD0 = 0, MD1 = 0
2. The addresses of the transmitter and the receiver can be same.
3. The channels of the transmitter and the receiver can be same.

iii. For Example

Table 7-3

Transmitter		Receiver	
Module Address	0x1234	Module Address	0x1234
Module Channel	0x00	Module Channel	0x00
Sending Data	Receiver address high + receiver address low + receiver channel + data	Output Data	User data
	0x56 0x78 0x18 0x11 0x22 0x33		0x11 0x22 0x33

7.2.3 Full-Duplex Transmission

i. Function Description

When the module performs high-speed data transmission, it does not limit the packet length and transmits in both directions. Sending data can receive data at the same time, and can send data at the same time when receiving data.

ii. Module Setting

1. MD0 = 0, MD1 = 0
2. The addresses of the transmitter and the receiver are set to the same value.
3. The channels of the transmitter and the receiver are set to the same value.

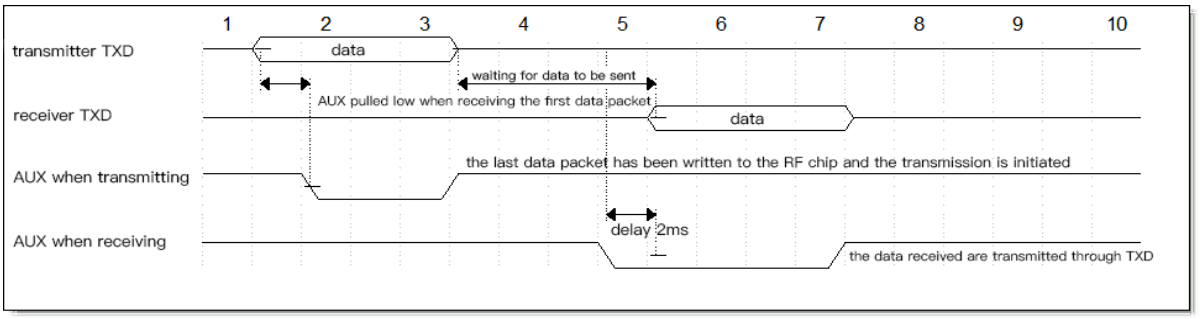
iii. For Example

Table 7-4

Transmitter		Receiver	
Module Address	0x1234	Module Address	0x1234
Module Channel	0x00	Module Channel	0x00
Sending Data	User data	Output Data	user data
	0x11 0x22 0x33		0x11 0x22 0x33

8. Sequence Diagram

8.1 Sequence Diagram of Data Transmission



8.2 Sequence Diagram of Module Switch

When the module switches from any operation mode to the next operation mode, there will be a switching delay T_sc. After switching to the next operation mode, the module will always work in the operation mode after the switching, if the module does not perform other operation mode switching. The operation mode switching has nothing to do with the previous operation mode of the module. The programmer only needs to perform the mode switching delay during the switching process, then selects MD0 and MD1 pins of low latency operation mode for the high- and low-level operations. And you can switch to the desired operation mode.

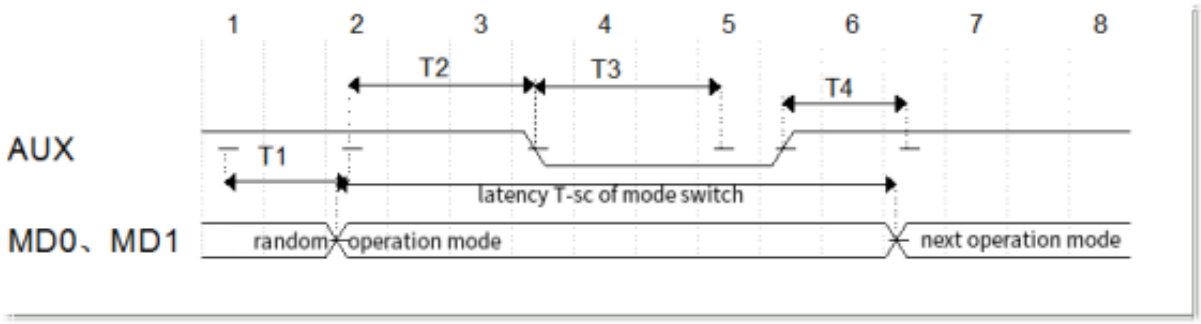


Table 8-1

Symbol	Explanation	Min Value	Typical Value	Max Value	Unit
T1	Wait till the last data packet is transmitted to make sure the module is idle		2		ms
T2	Debounce delay		3		ms
T3	Start modes switch		3		ms
T4	To tell if the mode switch is done		2		ms
T_sc	Mode switch delay				ms

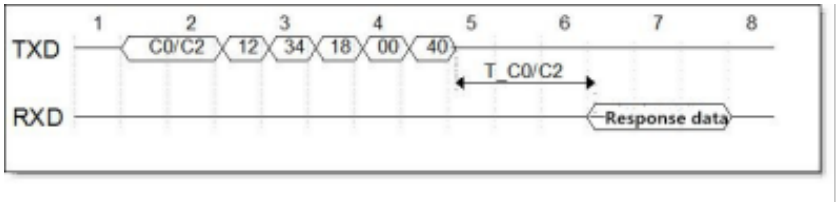
Remarks:

Modes can be switched when AUX is high level, at this time, the module is ideal; If AUX is low level, it means the module is busy. The sending (receiving) is not empty, the data has not been sent (received), and the user needs to add a delay. After waiting for the data to be sent and received, the working mode can be switched.

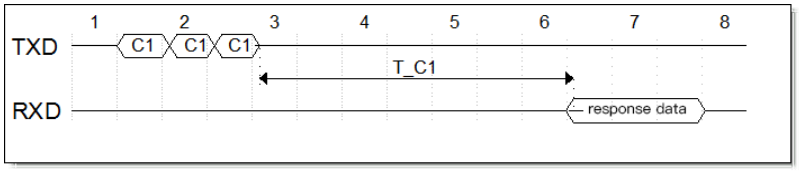
8.3 Sequence Diagram of Module Command

Sequence Diagram of Command as Below:

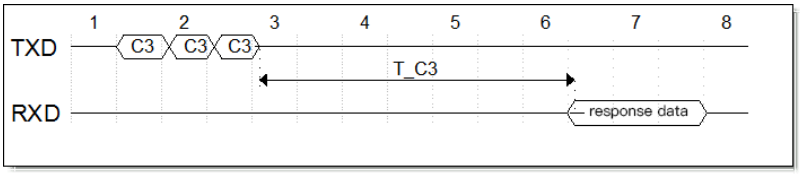
8.3.1 Command of Parameter Configuration



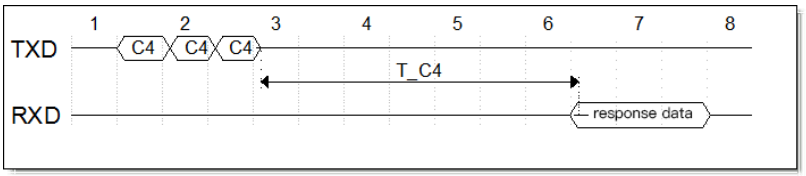
8.3.2 Command of Reading Configured Parameter



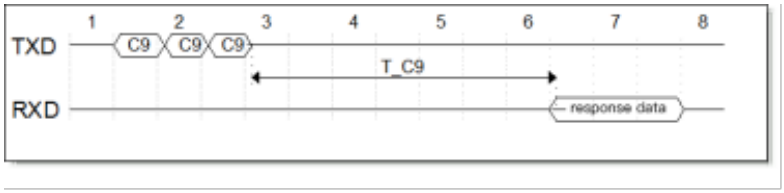
8.2.3 Command of Reading Module Hardware Version



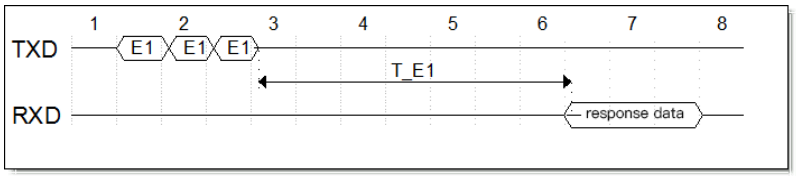
8.2.4 Command of Module Reset



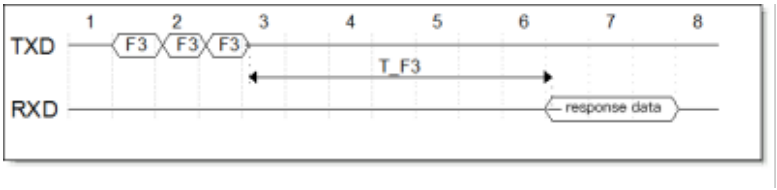
8.3.5 command of restoring default parameters



8.3.6 Handshake Command



8.3.7. Command of reading module software version



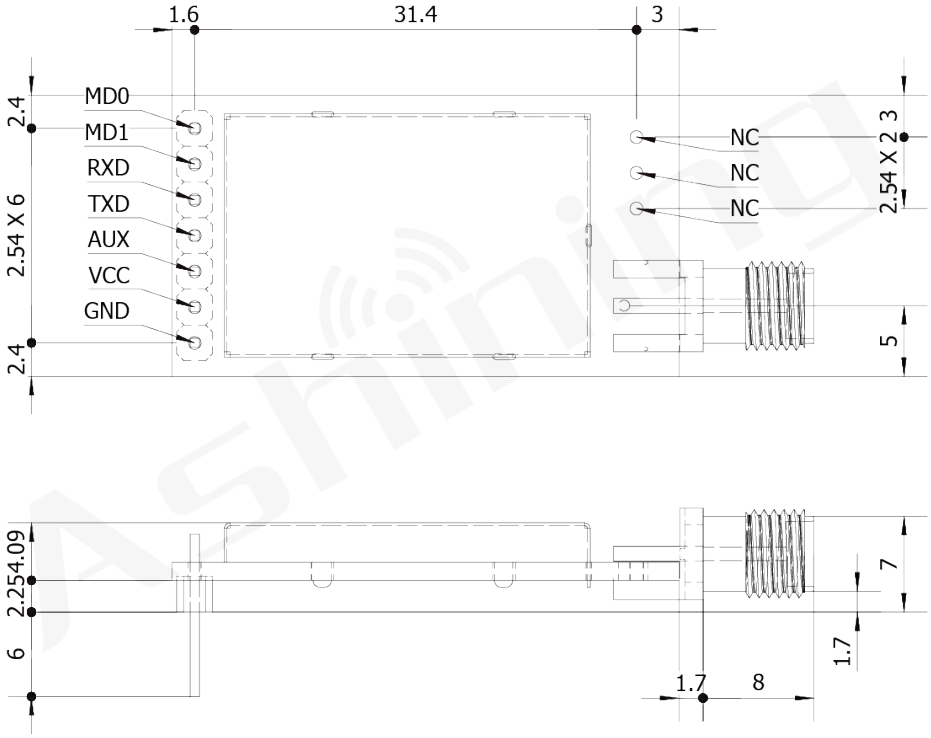
Remarks:

Table 8-1

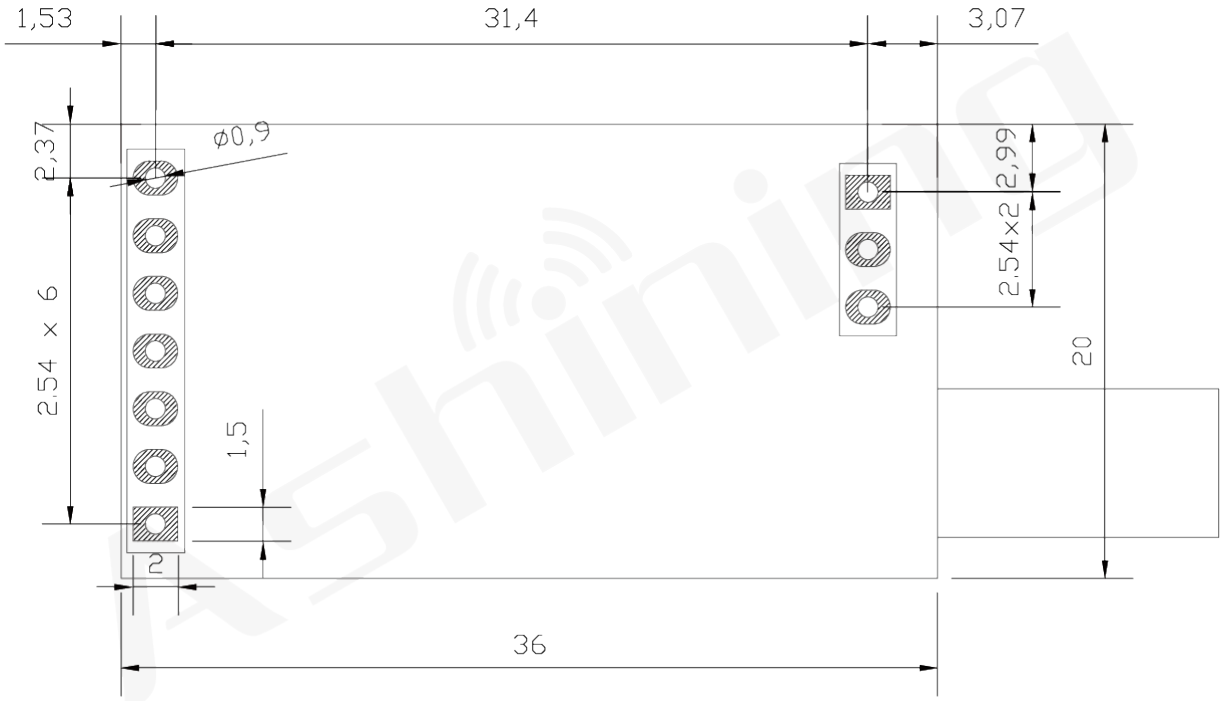
Parameter name	T_answer	Description	Min value	Typical value	Max value	Unit
Command response delay	T_C0/C2	Parameter configuration delay		27.53		ms
	T_C1	Reading module configured parameter delay		3.2		ms
	T_C3	Reading module hardware version delay		3.27		ms
	T_C4	Waiting module reset delay				ms
	T_C5	Reading module voltage delay		27.73		ms
	T_C6	Configuring module encryption key delay				ms
	T_C9	Restoring default parameter delay		3.6		ms
	T_E1	Handshake response delay		27.53		ms
	T_F3	Reading module software version delay		3.2		ms
	T_AF3/AF4	Reading RSSI delay				ms
Delay of waiting for data transmission completion	T_Packet	Delay of one data packet transmission				ms

9. Package Information

9.1 Machine Size (unit: mm)



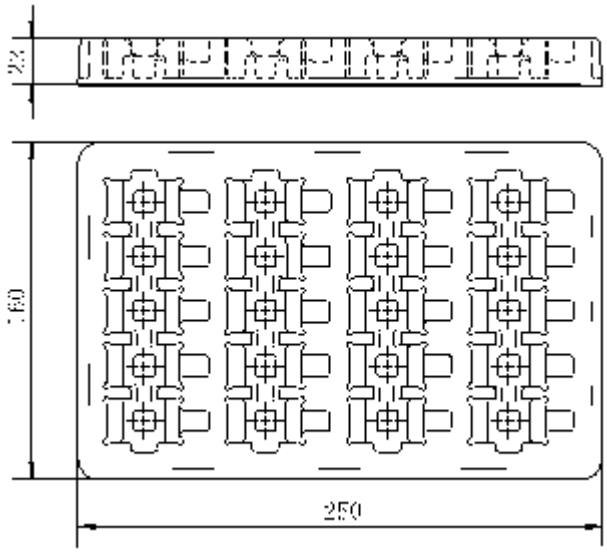
9.2 Reference Pad Design (unit: mm)

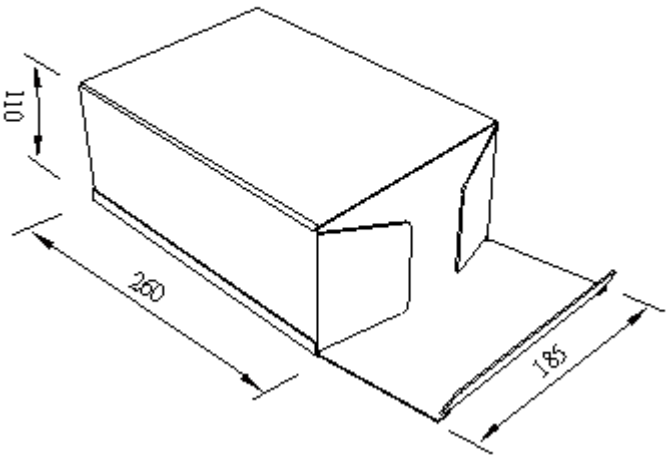


10. Package Manner

10.1 Electrostatic Bag Package

10.2 Pallet Package (unit：mm)





Important Remarks and Disclaimers

As the hardware and software of the product continue to improve, this manual may be subject to change, and the final version of the manual shall prevail.

Users of this product need to pay attention to the product dynamics on the official website, so that users can get the latest information of this product in time.

The pictures and diagrams used in this manual to explain the functions of this product are for reference only.

The measured data in this specification are all measured by our company at room temperature for reference only. Please refer to the actual measurement for details.

Chengdu Ashining Technology Co., Ltd. reserves the right of final interpretation and modification of all contents in this manual