



AS32-DTU-100

RS232/RS485 Interface, Modbus Protocol, 3km Transmission, 433Mhz LoRa Spread Spectrum, Star Networking, Point-to-point Transmission, Communication Encryption



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1. Product Overview

AS32-DTU-100 is a 100mW industrial wireless data radio with high stability, operates at 433MHz. The radio adopts RF chip SX1278 and Lora spread spectrum transmission. It has RS232 and RS485 ports and features long range, strong anti-interference and stable data transmission.

2. Product Features

- Point-to-Point transmission, transparent transmission, wake on radio.
- Receiving sensitivity is up to -130dBm, range 3000 meters
- Automatic relay and continuous transmission
- RSSI ^[2] and voltage are readable
- Built-in multiple exception handling mechanisms ensure the stable operation for a long time
- Multiple transmitting power levels
 - 4 power levels adjustable (0-3), each level increases or decreases 3dBm
 - Power range: 11-20dBm, max 100mW
- Multiple baud rates ^[1]
 - 8 commonly used baud rates, default baud rate 9600bps
 - Baud rate range:1200bps~115200bps
- Multiple air speeds ^[2]
 - 6 air speeds adjustable, default air speed 1Kbps
 - 0.3~19.2kbps (0.3kbps、1.2kbps、2.4kbps、4.8kbps、9.6kbps、19.2kbps)
- Frequency 410~441MHz, providing 32 channels ^[4]. The interval of each channel is 1MHz ^[4]
 - $410M + CHAN * 1MHz$
 - $CHAN:0*00 \sim 0*1FH$ (corresponding to 410~441MHz)
 - Default operation frequency 433MHz, application free band
- Supply voltage range
 - 8V-28VDC
 - Built-in LDO ensures stable power supply, meeting variety system requirements
- Data 256 circular FIFO
 - Transmit FIFO of 256 bytes
 - Receive FIFO of 256 bytes
 - Automatic subcontracting transmission
 - The module can send infinite data packet length with some particular combinations of air rate and baud rate
- Broadcasting data and monitor ^[5]
 - Module address set as 0xFFFF, monitor data transmission of all modules in the same channel (monitor). The data sent can be received by all modules of random address and the same channel (broadcasting).
- Point-to-point transmission ^[5]
 - The data sent by random module can be received by appointed module. Multiple receivers of the same address and channel all can receive the data
 - Can realize networking, relay and other applications.
- Wake on Radio ^[5]
 - When the wireless wake-up time is not 0, the sending radio will automatically add a wake-up code when sending data, and wake up the target module ^[6].
 - Transmit mode is the same as point-to-point transmission

Remarks:

- 1) Test conditions: clear, open, maximum power, antenna gain of 5dBi, height greater than 2m, air speed of 2.4k.
- 2) Radio RSSI is an internal intelligent processing, users do not need to care, special requirements can be read by command
- 3) For details, see the SPEED register in Chapter 7.2 of module parameter configuration.
- 4) For details, see the CHAN register in Chapter 7.2 of module parameter configuration.
- 5) For details, See the module function table in Chapter 8.
- 6) Wireless data transmission station is compatible with our wireless serial port module, which can wake up the wireless serial port module in the air.

3. Series Products

Table 3-1 Brief Specification of AS32-DTU-100

Item model	Carrier frequency (Hz)	IC	Interface	Size (mm)	Max transmit power (dBm)	Range (km)	Antenna
AS32-DTU-100	410~441M	SX1278	RS232/RS485	98*84*25	20	3.0	Rubber antenna, sucker antenna
AS32-DTU-1W	410~441M	SX1278	RS232/RS485	98*84*25	30	8.0	Rubber antenna, sucker antenna
All models of the AS32 series can communicate with each other							

4. Electrical Parameters

Table 4-1 Electrical Parameters of AS32-DTU-100

Test Condition: Tc=25°C, VCC=12V

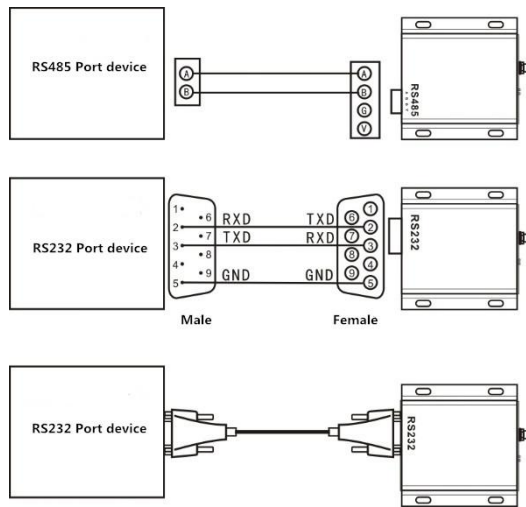
Item Model	Parameter Name	Description	Min	Typical Value	Max	Units
AS32-DTU-100	Supply voltage		8		28	V
AS32-DTU-100	Transmit current	SendPower ^[1] = 0		78		mA
		SendPower = 1		71		mA
		SendPower = 2		54		mA
		SendPower = 3		46		mA
AS32-DTU-100	Receive current			21		mA
AS32-DTU-100	Operation frequency	410~441MHz, 1MHz stepping, 32 channels in total. Factory default 433MHz.	410	433	441	MHz
AS32-DTU-100	Transmit power	SendPower = 0		20		dBm
		SendPower = 1		17		
		SendPower = 2		14		
		SendPower = 3		11		
AS32-DTU-100	Air speed	6 levels adjustable (0.3kbps, 1.2kbps, 2.4kbps, 4.8kbps, 9.6kbps, 19.2kbps)	0.3K	2.4K	19.2K	bps
AS32-DTU-100	Receiving sensitivity	Receive sensitivity has nothing to do with serial baud rate or delay time		-130		dBm
AS32-DTU-100	Operation temperature	AS32-DTU-100 industrial product	-40		+85	°C
AS32-DTU-100	Operation humidity	Relative humidity, no condensation	10%		90%	
AS32-DTU-100	Storage temperature		-40		+125	°C

Remarks:

SendPower = 0 (1, 2, 3), indicating the transmitting power of the radio station. See the radio parameter register for the configuration of transmitting power.

5. Module Functions

5.1 Recommended Connection Diagram



0-1 Recommended Connection Diagram

Remarks:

- 1) Detailed connection methods and procedures are detailed in the DTU product manual.
- 2) RS232 and RS485 can only use one at a time.

6. Radio Reset

The default status of the radio RESET indicator is off. Press and hold the RESET button for 3 seconds until the RESET indicator flashes. Release the button, the device will generate a reset and restore the factory settings.

7. Radio Command

7.1 Command Format

The parameters of our digital radio can be configured to support read and write command operations. The detailed commands are as follows:

Table 7-1 Command Overview Form

No.	Command	Configure Data	Command Function
1	0xC0	5BYTE configuration parameter ^[1] (see parameter configuration register for details)	Set the radio parameters. The parameters set by this command can be saved after power off.
2	0xC1		Read radio parameters
3	0xC3		Read the hardware version of the radio
4	0xC4		Reset radio command
5	0xC5		Read the actual voltage of the radio
6	0xC6	16BYTE encryption key ^[1] (the key can be a random number)	Configure the radio data encryption key
7	0xC7		Read the radio data encryption key
8	0xC9		Restore default parameters

i. Write command (C0/C6)

Command specific format: sync header + ID code + header + command code + command code inversion + data (fixed 16BYTE) + CS + sync header inversion + ID code inversion + head inversion + end code

Table 7-2

Number of the Data	Value	Description
0, 1	0xAF 0xAF	2BYTE Sync header
2, 3	0XX 0XX	2BYTE ID code, can be random number, default 0x00 0x00
4	0x5A	1BYTE header
5	0XX	1BYTE Command code, select the corresponding command code according to the command (0XX: 0xC0/0xC6)
6	0XX	1BYTE Command code inversion (0XX: 0x3F/0x39)
7~22		Configuring data (fixed 16BYTE, fill random number if the data is not used)
23, 24	0XX 0XX	2BYTE check code, the upper eight bits are the lower 8 bits of the sum of all the data before CS, and the lower eight bits are all data XOR before CS.
25, 26	0x50 0x50	2BYTE Synchronization header inversion
27, 28	0XX 0XX	2BYTE ID Code inversion, default 0xFF 0xFF
29	0xA5	1BYTE head inversion
30, 31	0x0D 0x0A	2BYTE end code

ii. Read command (C1/C3/C4/C5/C7/C9/0x73/0x74)

Command specific format: sync header + command code + ID code inversion + check code

Table 7-3

Number of the data	Value	Description
0, 1	0xAF 0xAF	2BYTE Sync header
2	0XX	1BYTE command code (0XX: 0xC1/0xC3/0xC4/0xC5/0xC7/0xC9/0x73/0x74)
3, 4	0x00 0xAF	2BYTE ID code
5	0XX	1BYTE Check code, the value is: the command code +0x80 takes the lower 8 bits (0XX: 0x41/0x43/0x44/0x45/0x47/0x49/0xF3/0xF4)

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

Table 7-4

Command Format	Module Response	Description
0xAF 0xAF 0XX 0XX 0x5A 0xC0 0x3F ADDH ADDL SPEED CHAN OPTION 11BYTE random number 0XX 0XX 0x50 0x50 0XX 0XX 0xA5 0x0D 0x0A	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.
0xAF 0xAF 0XX 0XX 0x5A 0xC6 0x39 16BYTE key 0XX 0XX 0x50 0x50 0XX 0XX 0xA5 0x0D 0x0A	OK	Data encryption succeeded
0xAF 0xAF 0xC1 0x00 0xAF 0x41	C0 00 00 1A 17 00	The radio returns the present configuration parameters in hexadecimal format.
0xAF 0xAF 0xC3 0x00 0xAF 0x43	AS32-DTU-100-V3.5	The radio returns the present hardware version in ASCII format.
0xAF 0xAF 0xC4 0x00 0xAF 0x44	OK	The radio generates a reset
0xAF 0xAF 0xC5 0x00 0xAF 0x45	C5 VH VL	VH and VL are voltage data. For example, the module returns C5 0C 1C, converts 0C 1C to decimal to get 3100, indicating that the current voltage of the module is 3.1V.
0xAF 0xAF 0xC7 0x00 0xAF 0x47	16BYTE encryption key	The radio will return the current encryption key in hexadecimal format
0xAF 0xAF 0xC9 0x00 0xAF 0x49	OK	Restore default parameter
0xAF 0xAF 0x73 0x00 0xAF 0xF3	xx	Read RSSI of the current data signal directly. For example, if the module returns XX and converts it to decimal data, it indicates the current signal strength.
0xAF 0xAF 0x74 0x00 0xAF 0xF4	XX	Read RSSI of the environmental signal directly. For example, if the radio returns XX and converts it to decimal data, it indicates the current signal strength.

Remarks:

- 1) C0 write command, configuration data is 5BYTE parameter, the specific value is detailed in the parameter configuration register, the remaining 11BYTE can be filled with random numbers; C6 write command, the configuration data is 16BYTE encryption key, which can be filled with random numbers.
- 2) 0XX specific values, see the command menu.

7.2 Module Parameter Register

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 7, Section 7.1 for details)

Table 7-5 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	0	0	0	0	0

ADDH [7: 0]: Indicates the module address high byte, factory default 0x00

Table 7-6 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	0	0	0	0	0	0

ADDL [7:0]: module address low byte, factory default 0x00

Table 7-7 SPEED communication configuration register

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

SPEED [7:6] UART CS [1: 0]: UART check digit

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] AIR SPEED [2:0]: airspeed

000: Air speed is 0.3k (default)
001: Air speed is 1.2k
010: Air speed is 2.4k
011: Air speed is 4.8k
100: Air speed is 9.6k
101: Air speed is 19.2k

Remarks:

- 1) The air speeds of receiver and transmitter should be the same.
- 2) Some combinations of air speed and baud rate can send infinite data packet, please see below form for details.

Table 7-8

Baud Rate (bps) Air Speed (bps)	1200	2400	4800	9600	19200	38400	57600	115200
0.3K								
1.2K								
2.4K	√							
4.8K	√	√						
9.6K	√	√	√					
19.2K	√	√	√	√				
√ means supporting transmission of infinite data packet(default close FEC)								

Table 7-9 CHAN channel register

	CHAN [7: 0]							
Read and write properties	rw	rw	rw	rw	rw	rw	rw	rw
Default value	0	0	0	1	0	1	1	1

CHAN [7: 0] : frequency (410 + CHAN*1M)

Factory default: 0x17 (433MHz)

00000000: 0x00 (Min: 410MHz)

00011111: 0x1F (Max: 441MHz)

Table 7-10 OPTION Special Function Register

	FixedTransmitEN	Reserved	WakeTime [2:0]			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] FixedTransmitEN: Point-to-Point Transmission enable

0: Transparent transmission (default)

1: Point-to-Point Transmission

OPTION [6]: Reserved, default 1

OPTION [5:3] WakeTime [2:0]: Wireless wake-up time (it is the listening interval time for the receiver, for the transmitter it is the time of continuous transmission of the wake-up code)

000:0ms (default)

001:500ms

010:750ms

011: 1000ms

100:1250ms

101:1500ms

110:1750ms

111:2000ms

Remarks:

The wireless wake-up time is a typical value

OPTION [2]: Reserved, default 0

OPTION [1:0] Send Power [1:0]: Transmit power

00:20dBm (default)

01:17dBm

10:14dBm

11:11dBm

Remarks:

The power is a typical value

7.3 Radio Factory Settings

Table 7-11 Factory configuration form of Register

Register Name	ADDH	ADDL	SPEED	CHAN	OPTION
Register Parameter	00	00	1A	17	40

Table 7-12 Module factory parameter:

Item Model	Operation Frequency (MHZ)	ID Address (HEX)	Factory Channel	Air Speed (Kbps)	Baud Rate (Bps)	UART Format	Transmit Power (mW)
AS32-DTU-100	433.0	0x0000	23	2.4	9600	8N1	100

Remarks:

- 1) Parameter configuration can use the parameter configuration software ASDS provided by the company. The configuration process and steps are detailed in the DTU product manual.
- 2) For the fast communication test of the radio, please refer to the DTU product manual provided by the company.

8. Radio Functions

8.1 Overview of Radio Functions

Table 8-1 Module function form

Module Function	Data Format of The Transmitter	Data Format of The 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.
Point-to-point Transmission	Receiver address + receiver channel + data	User data	Random module can be the transmitter. When it sends data to random module in point-to-point communication, the data can be transmitted across the channel.
Broadcast and Monitor (In Point-to-point Transmission)	0xFF+0xFF+receiver's channel + data	User data	Broadcast: the data sent by random module can be received by modules in the same channel at the same time; Monitor: A module with a 0xFFFF address can receive data sent by random address module on the same channel.
Wake on Radio	1.In transparent transmission mode: (Auto add wake-up code 0101010101010101.....) +Data 2.In Point-to-Point Transmission mode : (Auto add wake-up code 0101010101010101.....) +receiver's address + receiver's channel + data	User data	1. The radio will automatically add the wake-up code when sending data. 2. The length of the wake-up code can be set by setting the wireless wake-up time.

8.2 Detailed Radio Functions

8.2.1. 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. The 7th bit of the OPTION Special Function Register needs to be configured to 0, transparent transmission mode.
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

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

8.2.2. Point-to-Point Transmission

i. Function Description

The data sent by random module can be received by appointed module. Multiple receivers of the same address and channel all can receive the data.

ii. Radio Setting

1. The 7th bit of the OPTION Special Function Register needs to be configured to 1, Point-to-Point Transmission mode.
2. The addresses of the transmitter and the receiver can be different.
3. The channels of the transmitter and the receiver can be different.
4. The first 3 bytes of the transmitter's data must be the receiver address high + address low + channel

iii. For example

Transmitter		Receiver	
Module Address	0xFFFF	Module address	0x5678
Module Channel	0xFFFF	Module channel	0x18
Sending Data	receiver address high + receiver address low + receiver channel + data	output data	User data
	0x56 0x78 0x18 0x11 0x22 0x33		0x11 0x22 0x33

8.2.3. Broadcast in Point-to-Point Transmission

i. Function Description

The data sent by random module can be received by all modules of the same channel.

ii. Module Setting

1. The 7th bit of the OPTION Special Function Register needs to be configured to 1, Point-to-Point Transmission mode.
2. The addresses of the transmitter and the receiver can be different.
3. The channels of the transmitter and the receiver can be different.
4. The first 3 bytes of the transmitter's data must be 0xFF + 0xFF + receiver channel

iii. For example

Transmitter		Receiver	
Module address	0XXXXX	Module address	0XXXXX
Module channel	0XXXXX	Module channel	0x17 (factory default)
Sending data	0xFF+0xFF+receiver channel + User data	Output data	User data
	0xFF 0xFF 0x17 0x11 0x22 0x33		0x11 0x22 0x33

8.2.4. Monitor in Point-to-Point Transmission

i. Function Description

A module with a 0xFFFF address can receive data sent by modules of any address on the same channel.

ii. Module Setting

1. The 7th bit of the OPTION Special Function Register needs to be configured to 1, fixed t transmission mode.
2. The address of the monitor module must be set to 0xFFFF
3. The channel of the monitor module and the transmitter must be the same.
4. The first 3 bytes of the sending data must be 0xFF+0xFF+ monitor channel

iii. For example

Transmitter		Receiver	
Module address	0x1234 (factory default)	Module address	0xFFFF
Module channel	0x17 (factory default)	Module channel	0x17 (factory default)
Sending data	Random address high + random address low + receiver channel + User data	Output data	User data
	0xFF 0xFF 0x17 0x11 0x22 0x33		0x11 0x22 0x33

8.2.5. Wake on the Radio

i. Function Description

The default working mode of the radio is transparent transmission mode. The transmitting radio sets the length of the wake-up code by setting the wireless wake-up time. It automatically adds the wake-up code when transmitting data. The device in the power-saving working state is always in the "sleep-monitoring" working mode. If a valid wake-up code is received during the "monitoring" process, the device will continue to wake up continuously, waiting for the data packet to be received, the device will re-enter the "sleep-monitoring" mode of operation.

ii. Radio Setting

1. The transmitter sets the wake-up code length by setting the wireless WakeTime [1]. Generally, the wireless wake-up time of the transmitter is greater than or equal to the listening interval of the receiver, ensuring that the receiver in the power-saving state can monitor the wake-up code. If the wake-up code is received and the air wake-up is successful, the receiver will continue to be in the awake state until the data reception is completed. If the wake-up code is not monitored, the air wake-up fails.
2. The receiver is in the power-saving mode
3. Set the listening interval WakeTime [1] of the receiver to ensure that the receiving module can receive a valid wake-up code within the listening interval.

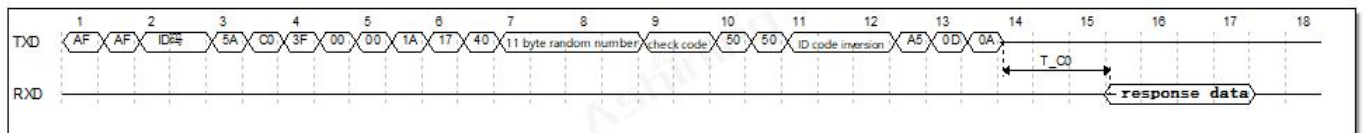
Remarks:

- 1) For the configuration of WakeTime, please see the OPTION register of parameter configuration command in Chapter 7.3
- 2) The WakeTime of the wireless data transmission radio defaults to 0ms, that is, there is no ability to wake up and monitor between digital transmission radios. Our digital radio is compatible with the corresponding series of wireless serial port modules. By setting the WakeTime of the digital radio, the radio will automatically add the wake-up code when transmitting data, thus awakening the serial port module in the power-saving working state in the air.

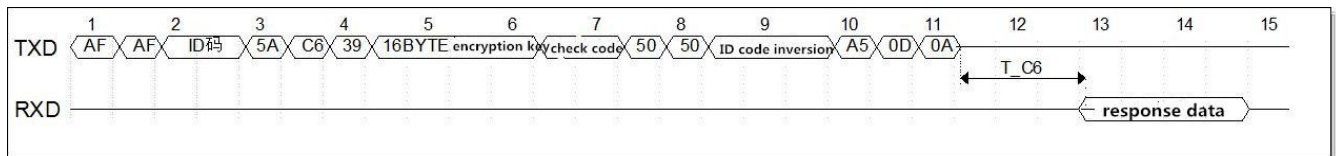
9. Sequence Diagram

9.1 Sequence Diagram of the Command

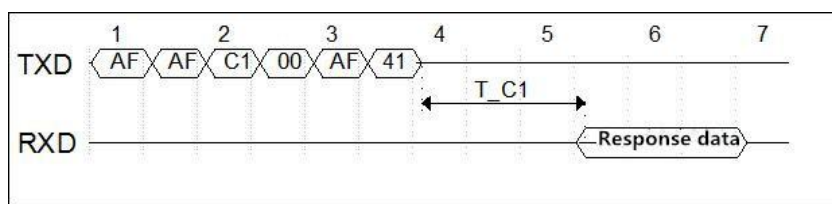
9.1.1 Radio Parameter Configuring Command



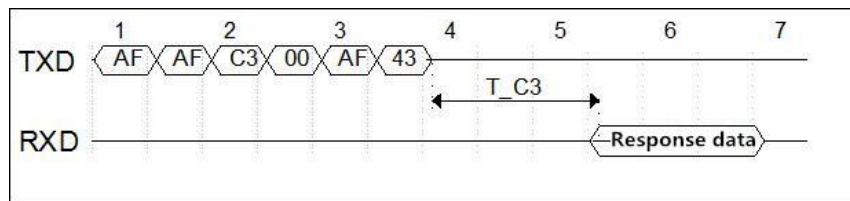
9.1.2 Radio Encryption Command



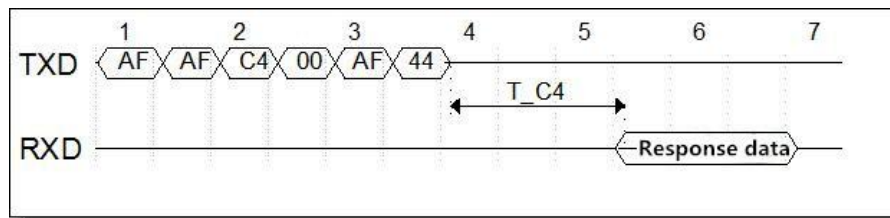
9.1.3 Reading Parameter Command



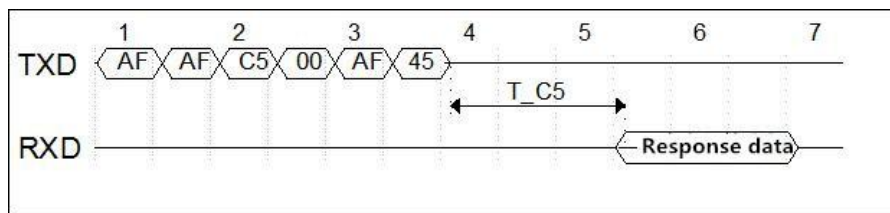
9.1.4 Reading Radio Hardware Version Command



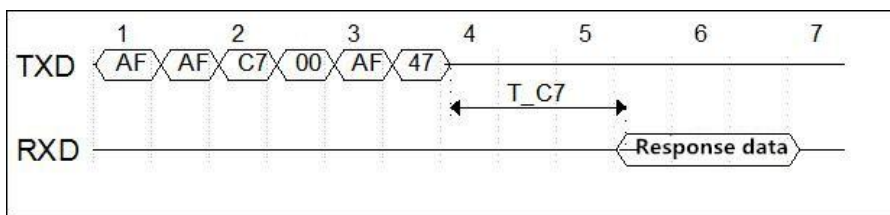
9.1.5 Radio Reset Command



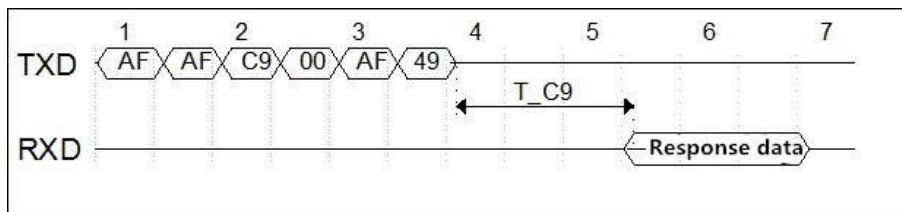
9.1.6 Reading Radio Voltage Command



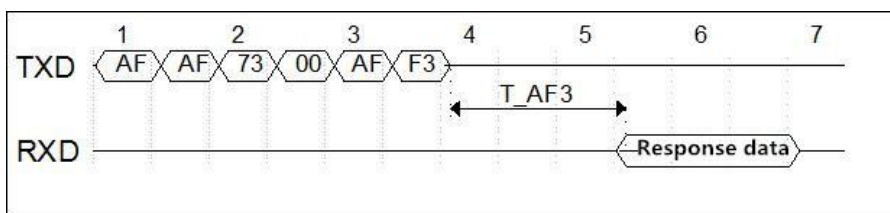
9.1.7 Reading Radio Encryption Key Command



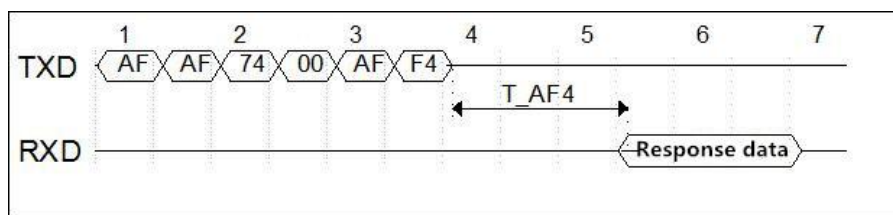
9.1.8 Restoring Radio Default Setting Command



9.1.9 Reading Current Data Signal RSSI Command



9.1.9 Reading Environment Signal RSSI Command



Remarks:

Table 9-1

Parameter Name	T_answer	Description	Minimum Value	Typical Value	Maximum Value	Unit
Command response delay	T_C0	Parameter configuration delay		140		ms
	T_C1	Reading module configured parameter delay		3		ms
	T_C3	Reading module hardware version delay		3		ms
	T_C4	Waiting module reset delay		3		ms
	T_C5	Reading module voltage delay		3		ms
	T_C6	Configuring module encryption key delay		140		ms
	T_C7	Reading module encryption key delay				ms
	T_C9	Restoring default parameter delay		49		ms
	T_AF3	Reading current data signal RSSI delay				ms
	T_AF4	Reading current environment signal RSSI delay				ms

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