
T900-MINI series User Manual

900MHz Data Transmission Module
Version: 20230410V2.0



Contents

1.Product Introduction	3
2.Technical parameters	3
3.Mechanical Drawings.....	4
3.1 T01 Dimension Diagram.....	4
3.2 T02 Dimension Diagram.....	4
4.Product Interface Definition	5
4.1 T01 Interface Diagram.....	5
4.2 T01 Interface Definition	5
4.3 T02 Interface Diagram.....	6
4.4 T02 Interface Definition	6
5.Product Status Light Meaning	7
6.AT Command/Register Description	8
6.1 AT Command.....	8
6.2 AT Command Register List	9
7.Point-to-Point Networks.....	17
7.1 Configuration Preparation	18
7.2 Working Mode	18
7.3 Use Factory Defaults	20
7.4 Master Setting	21
7.5 Slave Setting.....	22
7.6 Repeater Setting	23
8.Point-to-Multipoint Networks.....	24
8.1 Configuration Preparation	25
8.2 Working Mode	25
8.3 Use Factory Defaults	27
8.4 Master setting.....	28
8.5 Slave Setting.....	29
8.6 Repeater Setting	30
8.7 Examples for Configuring Point-to-Multipoint network Addresses.....	31
9.Mesh with Center Networks	32
The central Mesh topology is displayed.....	32
9.1 Configuration Preparation	33
9.2 Working Mode	33
9.3 Use Factory Defaults	34
9.4 Master Setting	35
9.5 Slave Setting.....	36
9.6 Packet Length Limit.....	37

1.Product Introduction

The T900-MINI series is a miniaturized digital radio of the T900 series. The T900-MINI series mainly includes T01 and T02 models. The only difference between the two is the interface. The T01 is mainly used for the UAV end, while the T02 uses the Type C interface for the ground end. Both of them have the characteristics of small size, good integration and high sensitivity. T900-MINI series products work in the frequency band of 902~928MHz. In a good environment, the maximum transmission distance can reach 60KM.

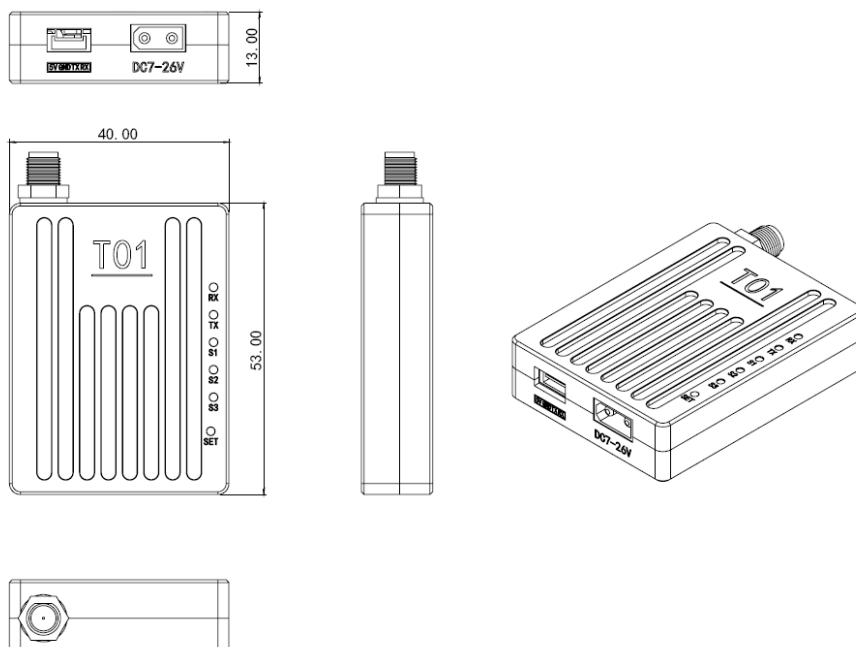
2.Technical parameters

- Frequency Range: 902-928MHz
- Spread Spectrum Mode: FHSS
- Data Encryption: 256-bit physical layer encryption
- Communication Range: Up to 60km
- Output Power: 1W (30dBm)
- Orifice Speed: Up to 276.4kbps
- Serial Port Baud Rate: Up to 921.6kbps
- Working Temperature: -40°C to 70°C
- Sensitivity:

Orifice Speed	10 ⁻⁷ BER	Maximum user rate
276.4kbps	-106 dBm	136kbps
230.4kbps	-107 dBm	116kbps
172.8kbps	-108 dBm	82kbps
115.2kbps	-109 dBm	48kbps
57.6kbps	-110 dBm	14kbps

3.Mechanical Drawings

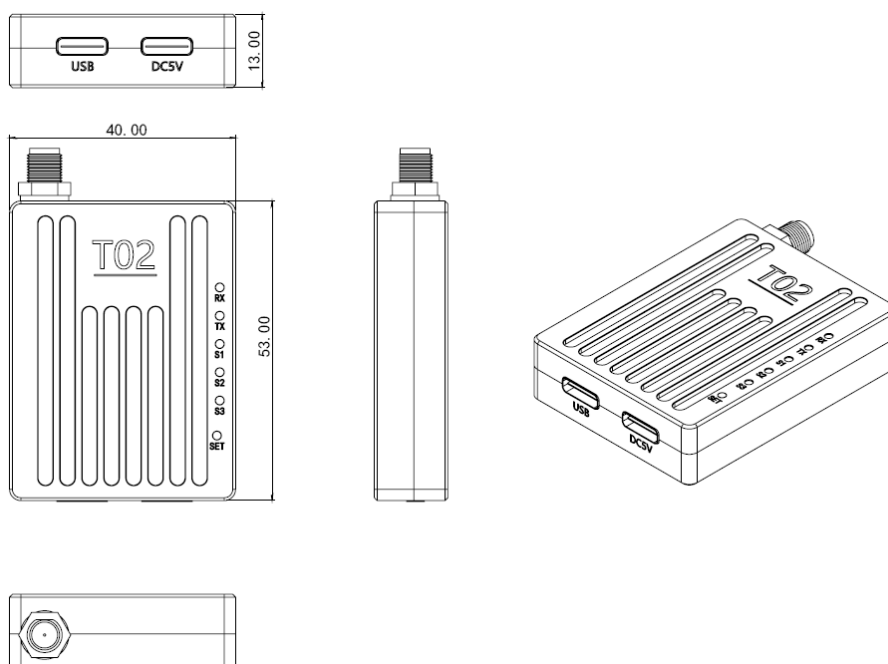
3.1 T01 Dimension Diagram



T01 Size : 62mm*40mm*13mm (including SMA9mm)

T01 Weight : 43.5g

3.2 T02 Dimension Diagram

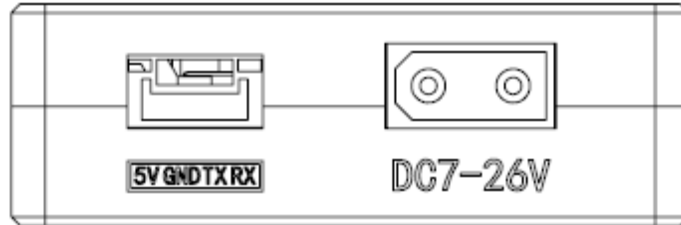


T02 Size : 62mm*40mm*13mm (including SMA9mm)

T02 Weight : 41g

4.Product Interface Definition

4.1 T01 Interface Diagram



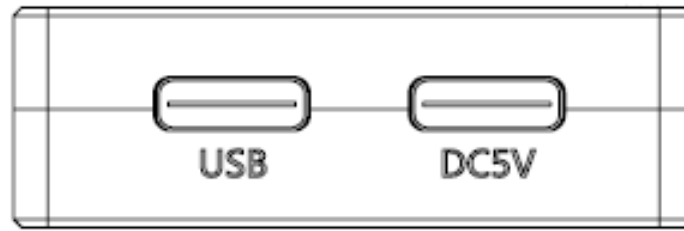
The T01 device has two interfaces, one serial port and one power supply port. When connecting the serial port, note whether the device is TTL level or RS232 level. The power port uses the male head of the XT30 terminal and supports 7 to 26V.

4.2 T01 Interface Definition

T01 Interface Definition			
No.	Interface	Description	Remarks
1	GH1.25-4PIN serial port	Yellow Line: TX White Line: RX Black Line: GND Red Line: 5V@1A output	Note whether the serial port is TTL level or RS232 level
2	XT30 Power male head inner needle	DC7~26V	

The peak current and average current of the T01 device at different voltages		
T01 Power Supply Voltage	100% Data Transmission Peak Current (A)	100% Data Transmission Average Current (A)
7V	1.03A	0.76A
12V	0.60A	0.44A
24V	0.30A	0.22A
26V	0.28A	0.20A

4.3 T02 Interface Diagram

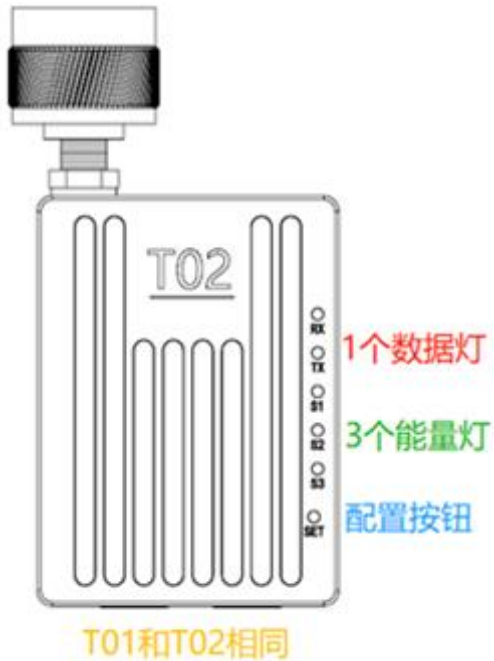


The T02 interface is two Type C ports, both with standard 5V voltage. The USB port supports both power supply and data transmission. The DC5V port provides power supply only.

4.4 T02 Interface Definition

T02 Interface Definition			
No.	Interface	Description	Remarks
1	USB	It can supply power and transmit data and parameter configuration	
2	DC5V	Power Supply Only	

5.Product Status Light Meaning



Emission lamp TX (RED)

When the TX light is on, the module is sending data.

Receiving lamp RX (RED)

When RX lights up, it indicates that the module is receiving data.

Power-on Configuration SET Button

Press and hold the SET button and then power on. The release- button will enter the AT command is used to set parameters.

Receive signal strength light (RSSI green lights)

The greater the number of power lights, the greater the signal receiving strength.

The RSSI lamp represents the strength of the received signal	
Numbers of RSSI energy lights on	Energy received dBm
All three RSSI lights on	About -50dBm
Two RSSI lights on	About -80dBm
One RSSI light on	About -95dBm

Module Type	Mode	T900-MINI Series Indicator Status		
		RX	TX	RSSI 123
All	AT Command Configuration Mode	Turn off	Turn off	Turn off
Master	Normal operation	Flashing when receiving data	Turn on (Steady light)	Proportional to the received signal strength
Slave	No-sync	Lights out	Lights out	Cycle light every 860ms
Slave	Synchronization	Turn on (Steady light)	Flashing when sending data	Proportional to the received signal strength
Repeater	No-sync	Flashing alternately with the sending light	Flashing alternately with the receiving light	Cycle light every 860ms
Repeater	Synchronization	Flashing when receiving data Otherwise on	Flashing when sending data Otherwise on	Proportional to the received signal strength

When the master and slave devices are successfully paired, the power indicator and TX indicator of the master device are steady on, and the power indicator and RX indicator of the slave device are steady on. If the master/salve pairing fails, the RSSI of the salve device is always in the search state. In this case, you should re-check the configured parameters. When data is being sent or received over the serial port, the RX indicator of the master device and the TX indicator of the slave device blink.

6.AT Command/Register Description

6.1 AT Command

AT Command (both upper and lower case accepted)	Description
ATI1	Query the hardware version number
ATI2	Query the firmware version number
ATI3	Query the software version number
ATI4	Query the SN serial number
AT&V	Display the current parameter table
AT&W	Save the current parameter table
ATA	Exit the AT command configuration mode and enter the data mode
ATSxxx?	Query the value of register Sxxx
ATSxxx=yyy	Write the value of register Sxxx as yyy
ATSxxx /?	Display the help documentation for register Sxxx
AT&Fn	Load the factory default configuration: 7 : Factory default settings for point-to-multipoint master. 8 : Factory default settings for point-to-multipoint slave. 9 : Factory default settings for point-to-multipoint repeater. 10: Factory default settings for point-to-point master. 11: Factory default settings for point-to-point slave. 12: Factory default settings for point-to-point repeater.

PS: All register changes take effect only after they are saved using the AT&W command.

6.2 AT Command Register List

Register Number	Description
S101	Operating Mode
S102	Serial Baud Rate
S103	Wireless Link Rate
S104	Network Address (ID)
S105	Unit Address
S108	Output Power (dBm)
S110	Serial Data Format
S113	Packet Retransmissions
S114	Repeater Index
S118	Sync Address
S123	RSSI From Master RSSI (dBm)
S124	RSSI From Slave RSSI (dBm)
S133	Network Type
S140	Destination Address
S141	Repeater Y/N
S142	Serial Channel Mode
S143	Repeater Index Use GPIO
S159	Encryption Enable
S160	Encryption Key

6.2.1 S101 Operating Mode

The operating mode defines the role of each device in the network. Each T900 module can be configured in any mode and play any role in the network.

Values
0 - Master
1 - Repeater
2 - Slave

- Master: There is only one in each network. In point-to-point and point-to-multipoint networks, it is used to synchronize the entire network.
- Repeater: On the network, it is used to extend transmission distance, enhance network coverage, and connect with to a master or repeater.
- Slave: The slave is directly connected to the master or repeater.

6.2.2 S102 Serial Baud Rate

S102 used to set the baud rate of the data serial port. When the serial port rate is changed, change the baud rate of the serial port on the device connected to the T900.

Values (bps)	
0- 230400	6 - 14400
1- 115200	7 - 9600
(default)	
2- 57600	8 - 7200
3- 38400	9 - 4800
4- 28800	15 - 460800
5- 19200	16 - 921600

6.2.3 S103 Orifice Speed

The S103 determines the communication rate of the entire network. Each device on the network must have the same rate. The higher the rate, the higher the network throughput, but the worse the sensitivity. The sensitivity difference between adjacent modes is about 1dB.

Values (bps)
0 - 172800 (default)
1 - 230400
2 - 276480
3 - 57600
4 - 115200

6.2.4 S104 Network Address (ID)

All devices on a network must have the same network address. Devices with different network addresses do not communicate with each other. When multiple networks are operating simultaneously in the same area, the network address of each network must be guaranteed to be unique.

Values (0~4294967295)
Default 1234567890

6.2.5 S105 Unit Address

On the same network, unit addresses are used for identification, and each device should have a unique unit address.

Values (0~65535)
Default 0

For a point-to-point network, the default value is 0. The device automatically

assigns the unit address. You do not need to set this parameter. Users can also manually assign non-0 local addresses. In the same network, if automatic allocation is used, the unit address of all devices is set to 0. If manual assignment is used, you can set the unit address S105, synchronous address S118, and target address S140 for each device to ensure that the network topology is correct.

For a point-to-multipoint networks, each device must be manually assigned a non-0 device address.

For details, see Section 8.7.

6.2.6 S108 Output Power (dBm)

S108 is used to set the transmitting power of the local device.

Values (dBm)
30- 3W
33- 5W
35- 7W
40 - 10W (Default)

6.2.7 S110 Serial Data Format

The data format of the serial port supports only 8N1.

Values
1 - 8N1 (Default)

6.2.8 S113 Packet Retransmissions

This register determines the maximum number of times the packet can be retransmitted. The numbers of retransmission are used to ensure the robustness of the system in complex environment or weak signal. Retransmission can cause additional data transfer, which can reduce system throughput. The maximum transmission times of a packet is the number of data retransmission times plus one.

Values (0~255)
Default 3

6.2.9 S114 Repeater Index

In point-to-point mode, the register takes effect only when the working mode is trunked the unit address is 0.

Values (1~254)
Default 1

This register indicates the relative position of the repeater in the network. Add or remove repeater devices on a point-to-point network. No additional configuration is required on the master and slave ends. When the repeater device is started, it automatically connects to the point-to-point network, and when it is shut down, the network is reconnected.

When multiple repeaters are used, ensure that the serial numbers of the repeaters from the master to the slave end increase monotonically.

6.2.10 S118 Sync Address

You can set the synchronization address of the repeater device and the slave device to specify the synchronization address of the current device from the unit device (S105) to the device (S118).

Values (0~65535)
Default 0

On a point-to-point network, when the unit address (S105) is set to 0, the address is automatically assigned.

When the unit address (S105) is not 0, the synchronous address must be set to determine the network topology.

On a point-to-multipoint network, you must manually set the correct synchronization address for each device.

For details, see Section 8.7.

6.2.11 S123 RSSI From Master RSSI (dBm)

Represents the received signal strength of the slave or repeater, corresponding to pins RSSI1, RSSI2, and RSSI3.

Values (dBm)
-255 ~ 0 (read only)

S123 of the repeater device indicates the signal strength of the upper-level device, and S124 indicates the signal strength of the lower-level device.

6.2.12 S124 RSSI From Slave RSSI (dBm)

Represents the received signal strength of the master or repeater, which corresponds to pins RSSI1, RSSI2, and RSSI3.

Values (dBm)
-255 ~ 0 (Read only)

S123 of the repeater device indicates the signal strength of the upper-level device, and S124 indicates the signal strength of the lower-level device.

6.2.13 S133 Network Type

This register is used to set the network type. On a network, the network type of all devices must be the same.

- Point-to-multipoint: The master broadcasts data to all devices, and all slave devices send data back to the master. (Can have 0 or more repeaters)
- Point-to-point: Only master and slave endpoints communicate to point. (Can have 0 or more repeaters)

Values
0 - Point to Multipoint (point to multipoint)
1 - Point to Point (point to point)

6.2.14 S140 Destination Address

The master and repeater devices can set the destination address, which is used to specify the address of

Values (0~65535)
Default 0

the child device connected to the local device.

On a point-to-point network, when the local address is set to 0, the address is automatically assigned without setting the target address. When the local address is not 0, the destination address must be set to specify the network topology.

On a point-to-multipoint network, you must manually set the correct destination address for each device.

For details, see Section 8.7.

6.2.15 S141 Repeater Y/N

This register is invalid on a point-to-point network where addresses are automatically assigned (local address S105 is 0), but it must be set to 0. In this case, the network automatically identifies whether the repeater exists. You do not need to set this parameter.

Values (0~1)
0 - Without repeater(Valid only on the master side) (Default)
1 - With repeater (Valid only on the master side)

When manually assigning addresses, this register is set based on whether a repeater exists in the current network.

6.2.16 S142 Serial Channel Mode

This register configures the working mode of the data serial port. The default value is RS232. Currently, only RS232 mode is supported. In the future, it will support RS485 full duplex, RS485 half-duplex, and SBUS.

Values
0 - RS232 (Default)

6.2.17 S143 Repeater Index Use GPIO

To change the serial number of the repeater, you can use GPIO [4:1] to configure the serial number of the repeater.

Values
0-Use the S114 register (Default)
1-Use GPIO[4:1] to indicate the repeater number

When S143 is 0, the relay number is S114, ranging from 1 to 254.

When S143 is 1, the relay number is GPIO [4:1]+1, which ranges from 1 to 16.

If GPIO is used as the repeater number, the repeater number ranges from 1 to 16.

A maximum of 16 repeaters can be configured.

6.2.18 S159 Encryption Enable

The T900 provides 256bit data encryption, which is turned on or off through the S159 register.

Values
0-Turn off the encryption (Default)
1-Turn on the encryption

6.2.19 S160 Encryption Key

When using encryption, set a 256bit key for encryption and decryption. To receive correct data, configure the same key on both ends.

Values
256bit secret keys

6.2.20 S244 Channel Access Mode

Channel access mode is used to specify how the slave accesses the network.

In RTS/CTS mode, the secondary end sends data to the primary end. After the primary end agrees to allocate resources, the secondary end sends data. In TDMA mode, the master end distributes data uniformly, and the slave

Values
0 - RTS/CTS
1 - TDMA
2 - TDMA_AUTO

end sends data according to the allocation. The TDMA mode supports only two network types: point-to-multipoint and centered Mesh.

TDMA_AUTO will mainly be adaptive to the amount of user data. Simpler to use than the TDMA mode.

Both modes have their advantages and disadvantages. RTS/CTS mode is more efficient in half-duplex networks, while TDMA mode is more suitable for the situation where master and slave send data independently.

6.2.21 S221 Unit Address Max for TDMA

This register is used to specify the maximum address for primary polling in TDMA mode. In TDMA mode, the master polls the address from the local address S105+1 of the master to the maximum address. The local address S105 set on the slave should be in these addresses; otherwise, the network cannot be accessed.

Values (0~65535)
Default 6

In TDMA mode, for example, one primary terminal + six secondary terminals, S221=7, S244=1:

	Local address S105	Synchronous address S118	Destination address S140
Master	1	0	0
Slave1	2	1	0
Slave 2	3	1	0
Slave 3	4	1	0
Slave 4	5	1	0
Slave 5	6	1	0
Slave 6	7	1	0

In this configuration, the start IP address of the primary end is 1+1=2, ranging from 2 to 7, and the secondary end sends packets one by one.

The polling time of each address is 20ms. Therefore, the total polling time of six addresses is 120ms. In this case, the transmission delay from the end to the primary end

ranges from 0 to 120ms. The primary end is not affected by polling, and the delay ranges from 0 to 20ms.

6.2.22 S220 TDMA tx time slot

This register is used to specify the maximum number of TDMA slots allocated in TDMA_AUTO mode. It is used to allocate the required number of time slots adaptively according to the amount of data sent. The default value is 15.

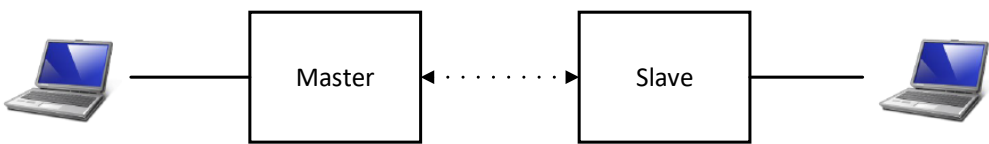
Values (0~65535)
Default 15

For example, if the air port is 276400bps, set 15 to a maximum of 5.1KB/s data can be transmitted continuously. It can occupy 15 time slots consecutively to send data.

7.Point-to-Point Networks

In a point-to-point network, T900 module can be used to establish a data path between point A and point B. Point A could be the master, point B could be the slave. When point A and point B cannot be directly connected, you can add a repeater node. The network type register S133=1 needs to be configured for the point-to-point network.

The point-to-point network can also be used in special scenarios: When multiple slaves or repeaters are deployed, the master selects the desired slave for communication by configuring destination address S140.





7.1 Configuration Preparation

Before configuration, you must use the development board or user-designed hardware to provide power supplies and serial ports for the T900 module. The data serial port can be configured with registers using AT commands, and the control serial port can be configured with registers using API protocols.

For details about interfaces, see Chapter 3 Hardware Description.

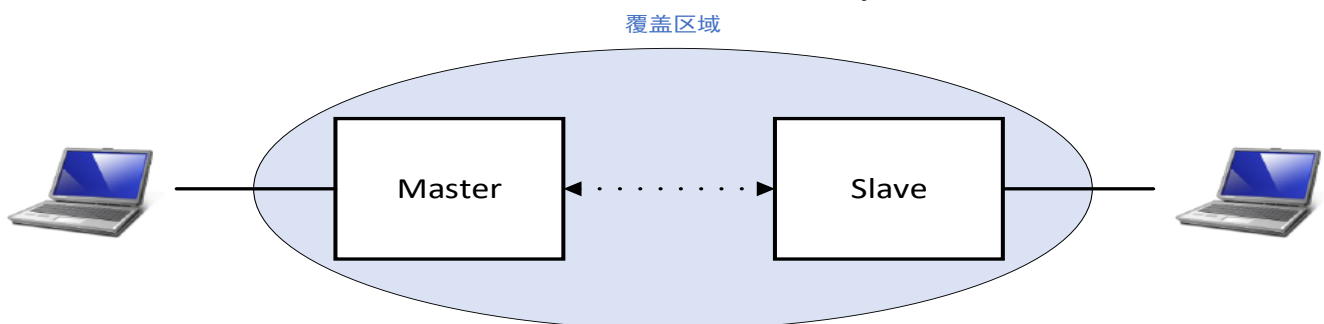
7.2 Working Mode

The T900's point-to-point network works in three modes: master, slave, and repeater.

The master provides synchronization signals for the entire network to ensure normal communication between all devices.

The slave is the final node of the network and communicates directly with the master or repeater.

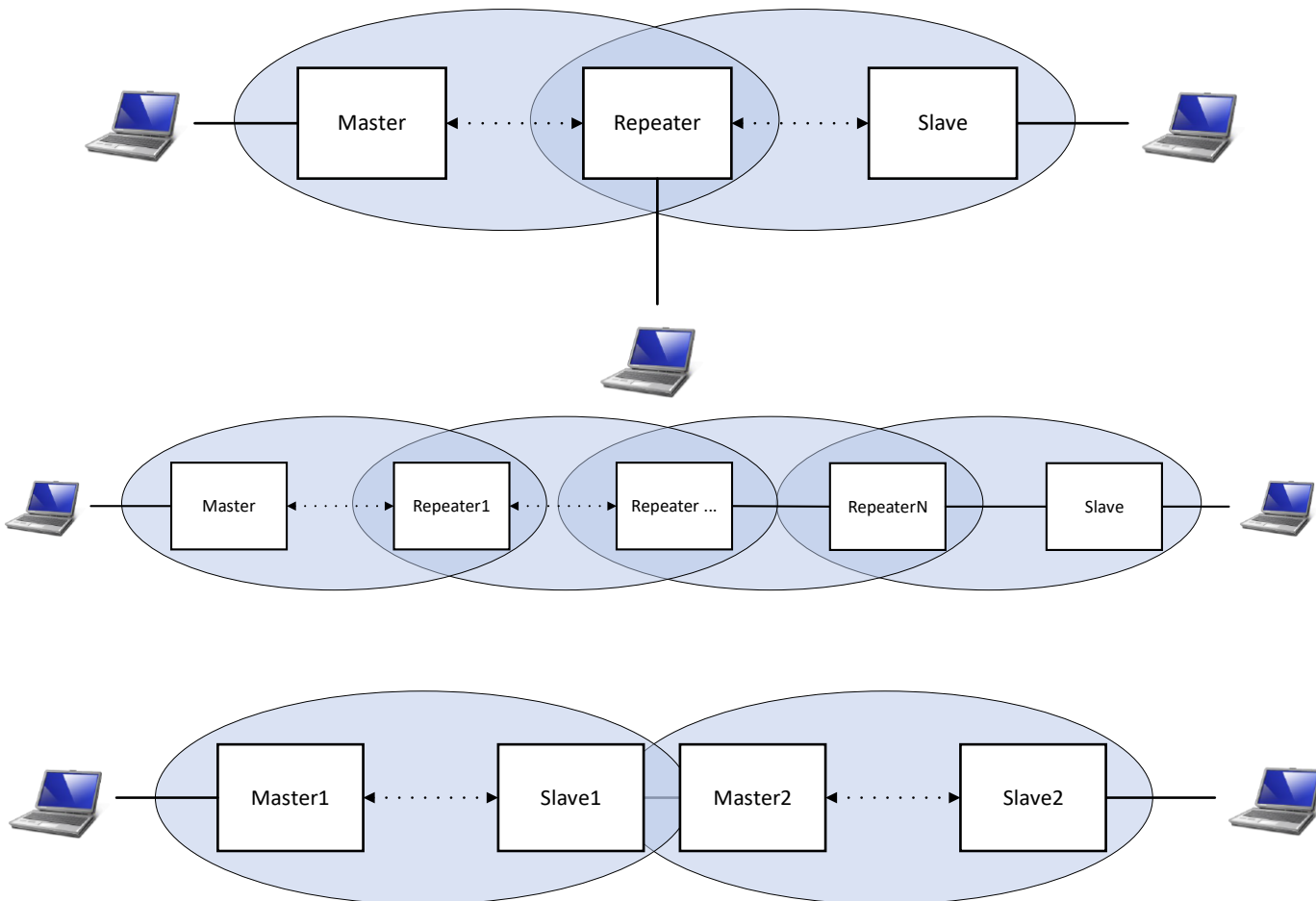
When no user data is transmitted on the P2P network, the slave device synchronizes data with the master device and does not send any information on the network.



A repeater can extend the coverage area of the master and forward data. The repeater synchronizes with the master or an upper-level repeater and sends synchronization signals to lower-level devices. The repeater device can also be used as

the slave to send and receive data through the data serial port. The output data is only the data sent by the upper-level device and does not output the data of the lower-level device. However, the input data will be confused with the data sent by the lower-level device and sent to the upper-level device.

Adding repeaters to the network reduces the total throughput of the network by half, but only by half, and does not decrease as the number of repeaters increases. If the repeater is required and the throughput is considered, another solution is to place two devices back-to-back at the repeater site. One is the slave of the upstream network and the other is the master of the downstream network. The serial ports of the two devices are connected in wired mode.



When the unit address is set to 0 on the P2P network of the T900, the IP address is automatically assigned. Users do not need to set the unit address, synchronous address, and destination address.

The T900's point-to-point repeater mode is very flexible and easy to use. Adding a

repeater device to a point-to-point network requires no additional configuration for the master and the slave. You only need to set the repeater to the same network ID, port rate, and serial number. After the system is powered on, the existing network automatically detects whether a repeater is added to the network. The repeater serial number must increase from the master to the slave in order but can be discontinuous. Pay attention to the repeater location to ensure link stability.

The working mode configuration register is S10, the command is as follows:

- ◆ ATS101=0 --- Master
- ◆ ATS101=1 --- Repeater
- ◆ ATS101=2 --- Slave

7.3 Use Factory Defaults

The factory default settings command can be used to quickly configure and deploy the T900 module, providing a fixed default configuration for each type of configuration. Using factory default settings all registers to default values. Using the default settings has the following benefits:

- To speed up the configuration process and use the default configuration if you don't need it.
- To troubleshoot issues. If communication cannot be established due to adjustments to the settings, simply restore the factory defaults and any incorrect adjustments will be overwritten.

For most networking applications, the factory defaults are sufficient for all the functions required for point-to-point network. No matter how complex the special requirements, can be configured from the factory default settings. All work modes and network types have corresponding factory default settings.

- ◆ AT&F10 --- Factory default settings for the point-to-point master

- ◆ AT&F11 --- Factory default settings for the point-to-point slave
- ◆ AT&F12 --- Factory default settings for the point-to-point repeater

```

通讯端口 串口设置 显示 发送 多字符串 小工具 帮助 回报作者 PCB打样
at&f /?
Factory Defaults
&F7 - PMP Master
&F8 - PMP Slave
&F9 - PMP Repeater
&F10 - PP Master
&F11 - PP Slave
&F12 - PP Repeater
OK

```

7.4 Master Setting

```

通讯端口 串口设置 显示 发送 多字符串 小工具 帮助 回报作者 PCB打样
at&f10 A
OK
at&w B
OK
at&v C
T900
900MHz Hopping Radio System
Hardware Version TZ60136B
Firmware Version 0001-20220623-0A
Software Version 0001-20220623-0A
Serial Number 123456

Network Type           S133=1 D           Operating Mode         S101=0 H
Wireless Link Rate     S103=0 E           Output Power(dBm)     S108=30
Network Address(ID)    S104=1234567890 F  Unit Address           S105=0 I
Synchronous Address    S118=0             Destination Address    S140=0
Serial Baud Rate        S102=7 G           Serial Channel Mode    S142=0
Repeater Y/N           S141=0             Repeater Index Use Gpio S143=0
Encryption Enable       S159=0             Repeaters Index        S114=1
RSSI Form Master(dBm)  S123=-255          RSSI Form Slaver(dBm)  S124=-255

OK

```

- A) AT&F10 - Restore the factory default settings for the point-to-point master.
- B) AT&W - Save setting parameters.
- C) AT&V - Display the current settings.
- D) S133 - The network type must be set to 1, corresponding to point-to-point network.
- E) S103 - The wireless link rate on all devices on the network must be set to the same. The higher the rate, the greater the throughput. The lower the rate, the better the sensitivity.
- F) S104 - The network addresses (IDS) of all devices on the network must be the same. It is strongly recommended not to use the default setting 1234567890. To change the network address use AT\$104=xxxxxxx.
- G) S102 - The baud rate of the serial port matches that of the connected device.
- H) S101 - The working mode must be set to 0, corresponding to the master.
- I) S105 - If the local address is set to 0, the address is automatically assigned.

After the configuration is completed, run the AT&W command to save the current settings. Run the ATA command to exit the AT command mode and the settings take effect.

7.5 Slave Setting

```

通讯端口 串口设置 显示 发送 多字符串 小工具 帮助 回报作者 PCB打样
at&f11 A
OK
at&w B
OK
at&v C
T900
900MHz Hopping Radio System
Hardware Version TZ60136B
Firmware Version 0001-20220623-0A
Software Version 0001-20220623-0A
Serial Number 123456

Network Type           S133=1 D           Operating Mode         S101=2 H
Wireless Link Rate     S103=0 E           Output Power (dBm)    S108=30
NetWork Address(ID)    S104=123456789 F   Unit Address          S105=0 I
Synchronous Address    S118=0
Serial Baud Rate       S102=7 G           Destination Address   S140=0
Repeater Y/N           S141=0
Encryption Enable      S159=0
RSSI Form Master (dBm) S123=-255          Repeater Index Use Gpio S143=0
                                Repeater Index       S114=1
                                RSSI Form Slaver (dBm) S124=-255

OK

```

- J) AT&F11 - Restore the factory default settings for the point-to-point slave.
- K) AT&W - Save setting parameters.
- L) AT&V - Display the current settings.
- M) S133 - The network type must be set to 1, corresponding to point-to-point network.
- N) S103 - The wireless link rate on all devices on the network must be set to the same. The higher the rate, the greater the throughput. The lower the rate, the better the sensitivity.
- O) S104 - The network addresses (ids) of all devices on the network must be the same. It is strongly recommended not to use the default setting 1234567890. To change the network address use AT S104=xxxxxxx.
- P) S102 - The baud rate of the serial port matches that of the connected device.
- Q) S101 - The working mode must be set to 2, corresponding to the slave.
- R) S105 - If the local address is set to 0, the address is automatically assigned.

After the configuration is completed, run the AT&W command to save the current settings. Run the ATA command to exit the AT command mode and the settings take effect.

7.6 Repeater Setting

```
通讯端口 串口设置 显示 发送 多字符串 小工具 帮助 回报作者 PCB打样
at&f12 A
OK
at&w B
OK
at&v C
T900
900MHz Hopping Radio System
Hardware Version TZ60136B
Firmware Version 0001-20220623-0A
Software Version 0001-20220623-0A
Serial Number 123456

Network Type           S133=1 D      Operating Mode         S101=1 H
Wireless Link Rate     S103=0 E      Output Power(dBm)     S108=30
NetWork Address(ID)   S104=1234567890 I      Unit Address          S105=0
Synchronous Address   S118=0        Destination Address   S140=0
Serial Baud Rate       S102=7 G      Serial Channel Mode   S142=0
Repeater Y/N          S141=0        Repeater Index Use Gpio S143=0
Encryption Enable     S159=0        Repeaters Index       S114=1 J
RSSI Form Master(dBm) S123=-255    RSSI Form Slaver(dBm) S124=-255

OK
```

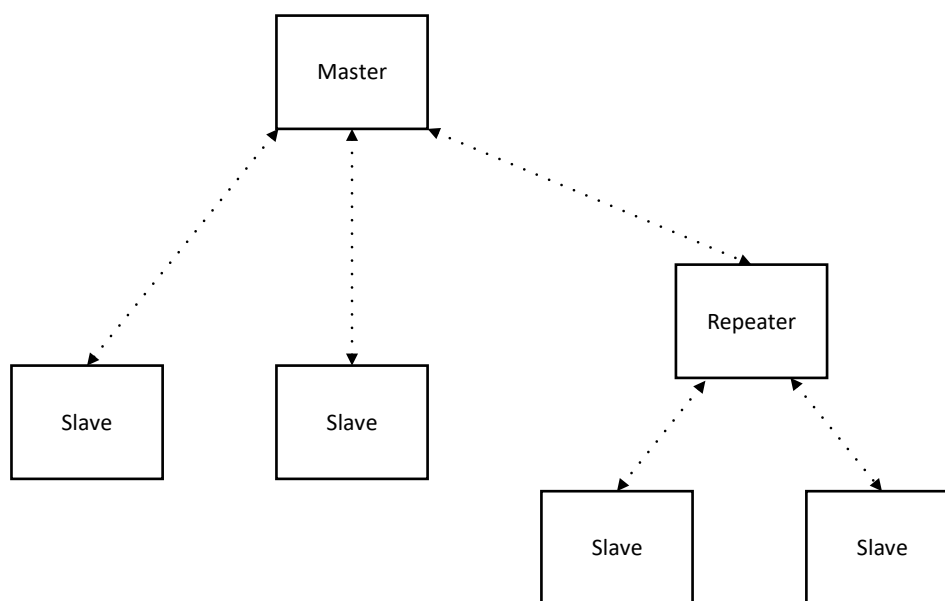
- A) AT&F12 - Restore the factory default settings for the point-to-point repeater.
- B) AT&W - Save setting parameters.
- C) AT&V - Display the current settings.
- D) S133 - The network type must be set to 1, corresponding to point-to-point network.
- E) S103 - The wireless link rate on all devices on the network must be set to the same. The higher the rate, the greater the throughput. The lower the rate, the better the sensitivity.
- F) S104 - The network addresses (ids) of all devices on the network must be the same. It is strongly recommended not to use the default setting 1234567890. To change the network address use AT\$104=xxxxxxx.
- G) S102 - The baud rate of the serial port matches that of the connected device.
- H) S101 - The working mode must be set to 1, which corresponds to the repeater.
- I) S105 - If the local address is set to 0, the address is automatically assigned.
- J) S114 - The repeater number indicates the position of the repeater on the network. The closer the repeater is to the master, the smaller the number is, which can be discontinuous.

After the configuration is completed, run the AT&W command to save the current settings. Run the ATA command to exit the AT command mode and the settings take effect.

8. Point-to-Multipoint Networks

In a point-to-multipoint network, the master can connect to multiple slaves directly or through repeaters. The repeater also has the function of the slave and can communicate with the master, but its uplink data is confused with that of the slave. The network type register $S133=0$ needs to be configured for point-to-multipoint networks.

The master can use destination address $S140$ to temporarily select a specific slave or repeater to communicate with, filtering out data transmission requests from other devices.



点对多点网络拓扑图

8.1 Configuration Preparation

Before configuration, you must use the development board or user-designed hardware to provide power supplies and serial ports for the T900 module. The data serial port can be configured with registers using AT commands, and the control serial port can be configured with registers using API protocols. For details about interfaces, see Chapter 3 Hardware Description.

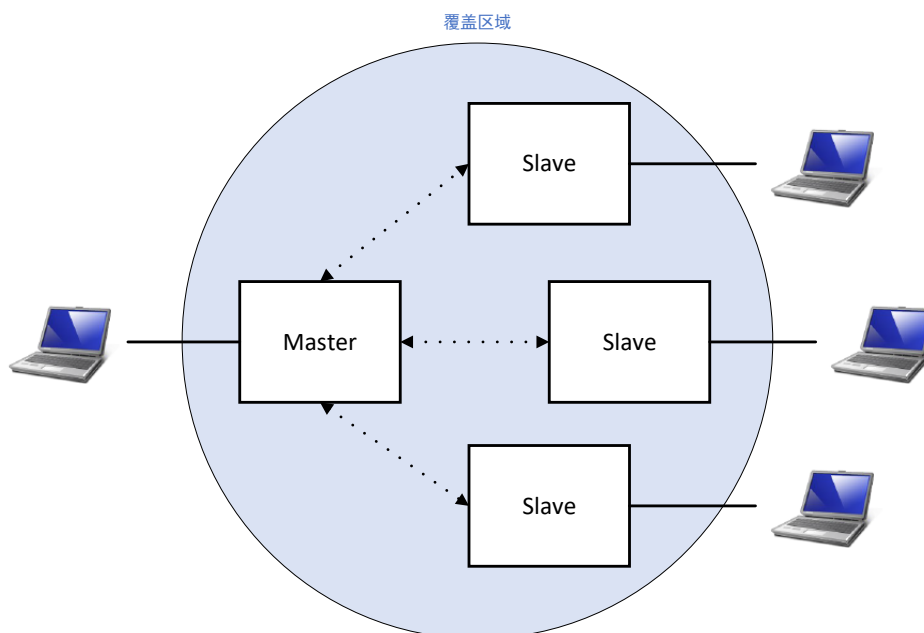
8.2 Working Mode

The T900's point-to-multipoint network works in three modes: master, slave, and repeater.

The master provides synchronization signals for the entire network to ensure normal communication between all devices.

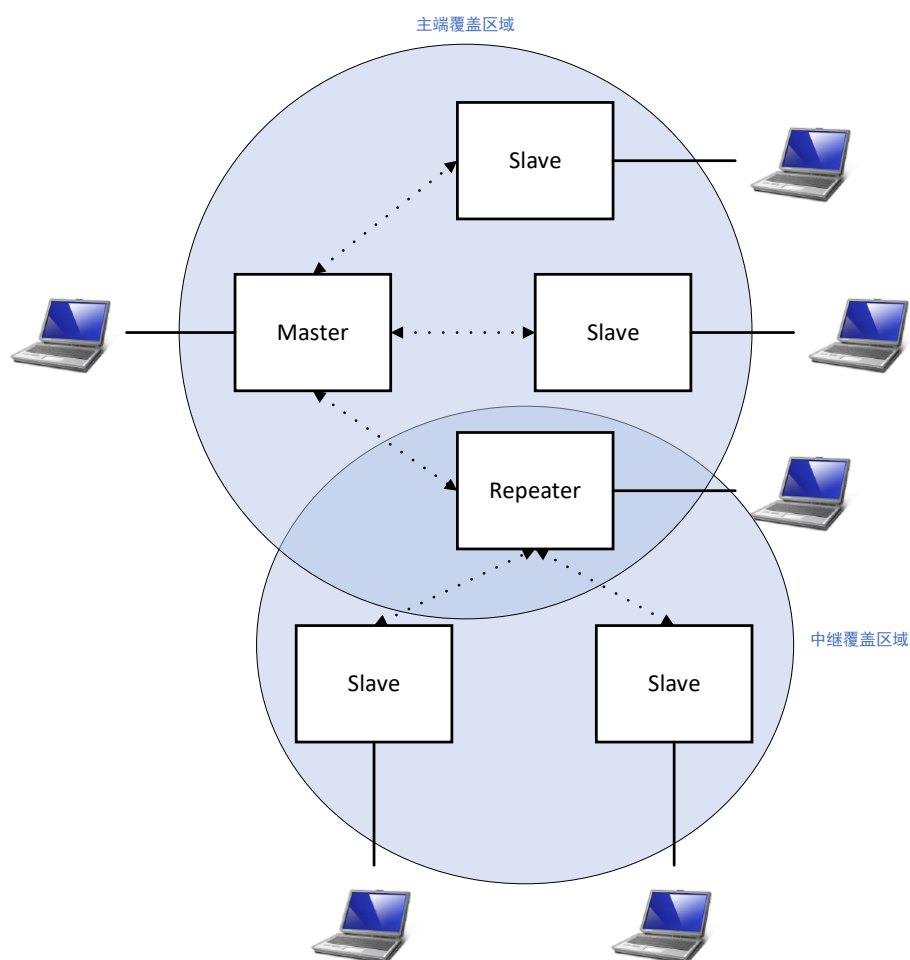
The slave is the final node of the network and communicates directly with the master or the repeater.

When no user data is transmitted on the point-to-multipoint network, the slave device synchronizes with the master and does not send any information on the network.



A repeater can extend the coverage area of the master and forward data. The repeater synchronizes with the master or upper-level repeater and sends synchronization signals to lower-level devices. The repeater device can also be used as the slave to send and receive data through the data serial port. The output data is only the data sent by the upper-level device and does not output the data of the lower-level device. However, the input data will be confused with the data sent by the lower-level device and sent to the upper-level device.

Adding repeaters to the network reduces the total throughput of the network by half, but only by half, and does not decrease as the number of repeaters increases. If the repeater is required and the throughput is considered, another solution is to place two devices back-to-back at the repeater site. One is the slave of the upstream network and the other is the master of the downstream network. The serial ports of the two devices are connected in wired mode.



The repeater of a point-to-multipoint network cannot be automatically added like a point-to-multipoint network. You need to manually configure registers S105, S118, and S140 to determine the network topology.

The working mode configuration register is S101, the command is as follows

- ◆ ATS101=0 --- Master
- ◆ ATS101=1 --- Repeater
- ◆ ATS101=2 --- Slave

8.3 Use Factory Defaults

The factory default settings command can be used to quickly configure and deploy the T900 module, providing a fixed default configuration for each type of configuration. Using factory defaults sets all registers to default values. Using the default settings has the following benefits:

1.To speed up the configuration process. If there is no special requirement, use the default configuration.

2.To troubleshoot issues. If communication cannot be established due to adjustments to the settings, simply restore the factory defaults and any incorrect adjustments will be overwritten.

For most networking applications, the factory defaults provide all the functionality required for point-to-multipoint network. No matter how complex the special requirements, the configuration can be started from the factory default settings. All work modes and network types have corresponding factory default settings.

- ◆ AT&F7 --- Factory default settings for the point-to-multipoint master
- ◆ AT&F8 --- Factory default settings for the point-to-multipoint slave
- ◆ AT&F9 --- Factory default settings for the point-to-multipoint repeater

```

通讯端口 串口设置 显示 发送 多字符串 小工具 帮助 回报作者 PCB打样
at&f /?
Factory Defaults
&F7 - PMP Master
&F8 - PMP Slave
&F9 - PMP Repeater
&F10 - PP Master
&F11 - PP Slave
&F12 - PP Repeater
OK

```

8.4 Master setting

```

通讯端口 串口设置 显示 发送 多字符串 小工具 帮助 回报作者 PCB打样
at&f7 A
OK
at&w B
OK
at&v C
T900
900MHz Hopping Radio System
Hardware Version TZ60136B
Firmware Version 0001-20220623-0A
Software Version 0001-20220623-0A
Serial Number 123456

Network Type           S133=0 D           Operating Mode         S101=0 I
Wireless Link Rate     S103=0 E           Output Power(dBm)     S108=30
NetWork Address(ID)   S104=1234567890 G           Unit Address           S105=0 J
Synchronous Address   S118=0 K           Destination Address    S140=0 L
Serial Baud Rate       S102=7 G           Serial Channel Mode    S142=0
Repeater Y/N          S141=0 H           Repeater Index Use Gpio S143=0
Encrytion Enable       S159=0
RSSI Form Master(dBm) S123=-255           Repeaters Index        S114=1
RSSI Form Slaver(dBm) S124=-255

OK

```

- A) AT&F7 - Restore the factory default settings of the point-to-multipoint master.
- B) AT&W - Save setting parameters.
- C) AT&V - Display the current settings.
- D) S133 - The network type must be set to 0, which corresponds to point-to-multipoint.
- E) S103 - The wireless link rate on all devices on the network must be set to the same. The higher the rate, the greater the throughput. The lower the rate, the better the sensitivity.
- F) S104 - The network addresses (ids) of all devices on the network must be the same. It is strongly recommended not to use the default setting 1234567890. To change the network address use AT\$S104=xxxxxxx.
- G) S102 - The baud rate of the serial port matches that of the connected device.
- H) S141 - Whether a repeater exists on the network.
- I) S101 - The working mode must be set to 0, corresponding to the master.
- J) S105 - For the local address, see section 9.7 for an example.
- K) S118 - For the synchronize addresses, see section 9.7 for example.
- L) S140 - For the target address, see section 9.7 for example.

After the configuration is completed, run the AT&W command to save the current settings. Run the AT command to exit the AT command mode and the settings take effect.

8.5 Slave Setting

```
通讯端口 串口设置 显示 发送 多字符串 小工具 帮助 回报作者 PCB打样
at&f8 A
OK
at&w B
OK
at&v C
T900
900MHz Hopping Radio System
Hardware Version TZ60136B
Firmware Version 0001-20220625-0A
Software Version 0001-20220623-0A
Serial Number 123456

Network Type          S133=0 D      Operating Mode        S101=2 I
Wireless Link Rate    S103=0 E      Output Power(dBm)    S108=30 J
NetWork Address(ID)   S104=123456789G Unit Address          S105=0
Synchronous Address   S118=0 K      Destination Address  S140=0
Serial Baud Rate      S102=7 G      Serial Channel Mode  S142=0
Repeater Y/N          S141=0 H      Repeater Index Use Gpio S143=0
Encryption Enable     S159=0
RSSI Form Master(dBm) S123=-255     Repeater Index       S114=1
RSSI Form Slaver(dBm) S124=-255

OK
```

- A) AT&F8 - Restore the factory default settings of the point - to - multipoint slave.
- B) AT&W - Save setting parameters.
- C) AT&V - Display the current settings.
- D) S133 - The network type must be set to 0, which corresponds to point-to-multipoint.
- E) S103 - The wireless link rate on all devices on the network must be set to the same. The higher the rate, the greater the throughput. The lower the rate, the better the sensitivity.
- F) S104 - The network addresses (ids) of all devices on the network must be the same. It is strongly recommended not to use the default setting 1234567890. To change the network address use AT\$S104=xxxxxxx.
- G) S102 - The baud rate of the serial port matches that of the connected device.
- H) S141 - Whether a repeater exists on the network.
- I) S101 - The working mode must be set to 2, corresponding to the secondary end.
- J) S105 - For the local address, see section 9.7 for an example.
- K) S118 - For the synchronize addresses, see section 9.7 for example.
- L) S140 - For the target address, see section 9.7 for example.

After the configuration is completed, run the AT&W command to save the current settings. Run the AT&A command to exit the AT command mode and the settings take effect.

8.6 Repeater Setting

通讯端口 串口设置 显示 发送 多字符串 小工具 帮助 回报作者 PCB打样

```
at&f9 A
OK
at&w B
OK
at&v C
T900
900MHz Hopping Radio System
Hardware Version TZ60136B
Firmware Version 0001-20220625-0A
Software Version 0001-20220623-0A
Serial Number 123456

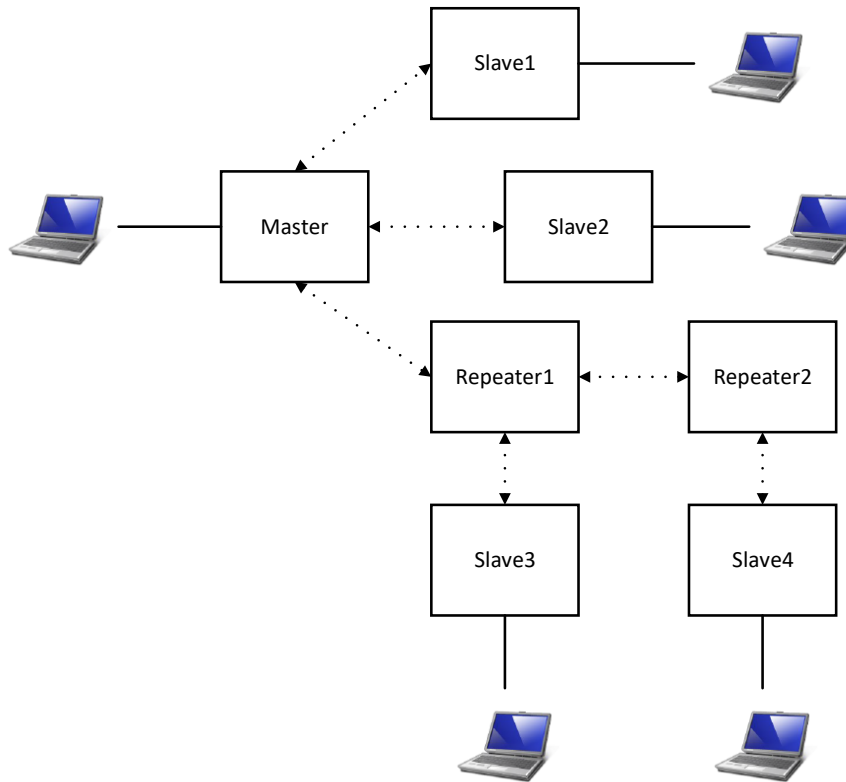
Network Type          S133=0 D      Operating Mode        S101=1 I
Wireless Link Rate    S103=0 E      Output Power (dBm)   S108=30 J
NetWork Address(ID)   S104=1234567890 F  Unit Address         S105=0
Synchronous Address   S118=0 K      Destination Address  S140=0
Serial Baud Rate       S102=7 G      Serial Channel Mode  S142=0
Repeater Y/N          S141=0 H      Repeater Index Use Gpio S143=0
Encryption Enable     S159=0
RSSI Form Master (dBm) S123=-255      Repeater Index       S114=1
RSSI Form Slaver (dBm) S124=-255

OK
```

- A) AT&F9 - Restore the factory default settings for the point-to-multipoint repeater.
- B) AT&W - Save setting parameters.
- C) AT&V - Display the current settings.
- D) S133 - The network type must be set to 0, corresponding to point-to-multipoint network.
- E) S103 - The wireless link rate on all devices on the network must be set to the same. The higher the rate, the greater the throughput. The lower the rate, the better the sensitivity.
- F) S104 - The network addresses (ids) of all devices on the network must be the same. It is strongly recommended not to use the default setting 1234567890. To change the network address use AT\$S104=xxxxxxx.
- G) S102 - The baud rate of the serial port matches that of the connected device.
- H) S141 - Whether a repeater exists on the network.
- I) S101 - The working mode must be set to 1, corresponding to the repeater.
- J) S105 - For the local address, see section 9.7 for an example.
- K) S118 - For the synchronize addresses, see section 9.7 for example.
- L) S140 - For the target address, see section 9.7 for example.

After the configuration is completed, run the AT&W command to save the current settings. Run the AT&A command to exit the AT command mode and the settings take effect.

8.7 Examples for Configuring Point-to-Multipoint network Addresses.



In a point-to-multipoint network, there are one master, four slaves, and two repeaters. Slave 1, slave 2, and repeater 1 are synchronized to the master, repeater 2 is synchronized to repeater 1, slave 3 is synchronized to repeater 1, and slave 4 is synchronized to repeater 2. If S141 of the master is 1, there are repeaters on the network. The unit address and synchronization address of each device are set in the following table.

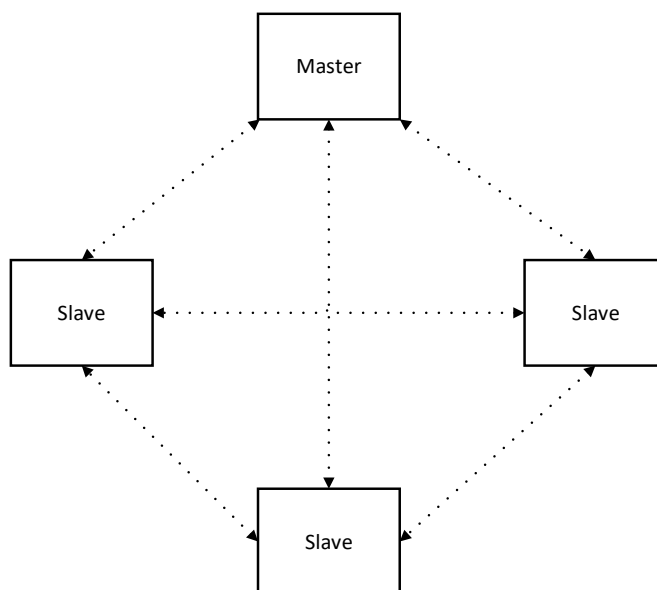
	Unit address S105	Synchronous address S118	Target address S140
Master	1	0	0
Repeater1	2	1	0
Repeater2	3	2	0
Slave 1	4	1	0
Slave 2	5	1	0
Slave 3	6	2	0
Slave 4	7	3	0

In the same point-to-multipoint network, the unit address of each device must be unique and non-zero. The synchronization address is set to the unit address of the parent device of this device. The destination address is usually set to 0, or the unit address of a device if you need to specify receiving a device.

9.Mesh with Center Networks

A central Mesh network is a special point-to-multipoint network. The center of the network is still the master, and all the slaves can exchange data with each other but do not forward data. The Mesh network with a center needs to be configured with the network type register S133=2. This network type does not support repeaters.

The master can use destination address S140 to temporarily select a particular slave to communicate with, filtering out data transmission requests from other devices.



The central Mesh topology is displayed

9.1 Configuration Preparation

Before configuration, you must use the development board or user-designed hardware to provide power supplies and serial ports for the T900 module. The data serial port can be configured with registers using AT commands, and the control serial port can be configured with registers using API protocols.

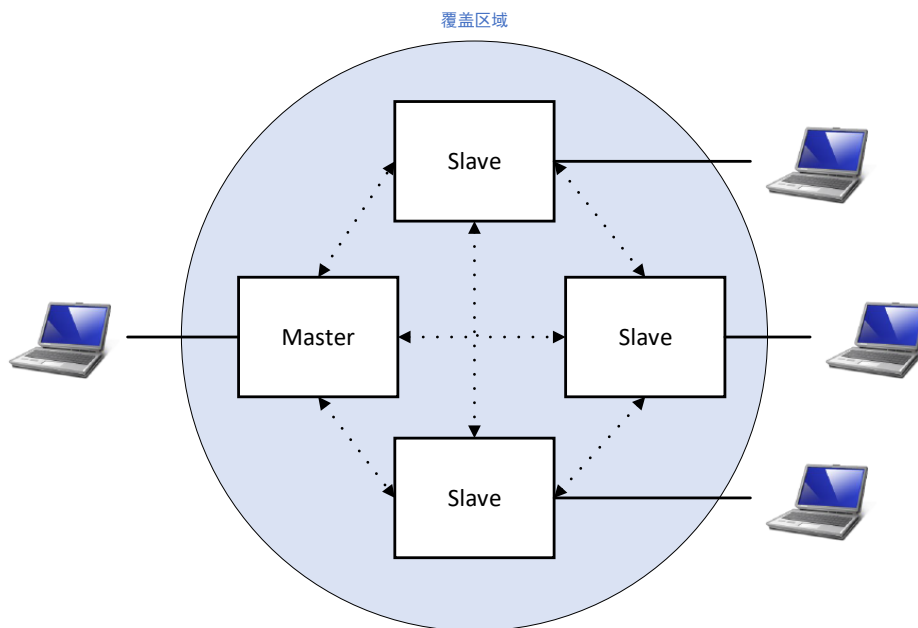
For details about interfaces, see Chapter 3 Hardware Description.

9.2 Working Mode

The T900 centralized Mesh network supports only two working modes: master and slave. No repeater is supported.

The master provides synchronization signals for the entire network to ensure normal communication between all devices.

The slave is the final node of the network and communicates directly with the master or slave. When no user data is transmitted on the point-to-multipoint network, the slave device synchronizes with the master device and does not send any information on the network.



For a Mesh network with a center, registers S105, S118 and S140 need to be configured in advance to determine the network topology.

- ◆ The working mode configuration register is S101. Run the following command:
- ◆ AT&S101=0 -- Master
- ◆ AT&S101=2 --- Slave

9.3 Use Factory Defaults

The factory default settings command can be used to quickly configure and deploy the T900 module, providing a fixed default configuration for each type of configuration. Using factory defaults sets all registers to default values. Using the default settings has the following benefits:

1. To speed up the configuration process. If there is no special requirement, use the default configuration.
2. To troubleshoot issues. If communication cannot be established due to adjustments to the settings, simply restore the factory defaults and any incorrect adjustments will be overwritten.

For most web applications, the factory defaults are sufficient for all the functions required for a centralized Mesh network. No matter how complex the special requirements, the configuration can be started from the factory default settings. All work modes and network types have corresponding factory default settings.

- ◆ AT&F4 --- Factory default settings for the Mesh-with-Center master
- ◆ AT&F5 --- Factory default settings for the Mesh-with-Center slave

```
at&f /?
Factory Defaults
&F4 - Mesh With Center Master
&F5 - Mesh With Center Slave
&F7 - PMP Master
&F8 - PMP Slave
&F9 - PMP Repeater
&F10 - PP Master
&F11 - PP Slave
&F12 - PP Repeater
OK
```

9.4 Master Setting

```
at&f7 A
OK
at&w B
OK
at&v C
T900
900MHz Hopping Radio System
Hardware Version TZ60136B
Firmware Version 0001-20220623-0A
Software Version 0001-20220623-0A
Serial Number 123456

Network Type           S133=0 D           Operating Mode         S101=0 I
Wireless Link Rate     S103=0 E           Output Power (dBm)    S108=30
Network Address (ID)   S104=1234567890 F  Unit Address           S105=0 J
Synchronous Address   S118=0 K           Destination Address   S140=0 L
Serial Baud Rate       S102=7 G           Serial Channel Mode    S142=0
Repeater Y/N          S141=0 H           Repeater Index Use Gpio S143=0
Encryption Enable      S159=0
RSSI Form Master (dBm) S123=-255          Repeaters Index        S114=1
RSSI Form Slaver (dBm) S124=-255
```

- A) AT&F7 - Restore the factory default settings of the mesh-with-center master.
- B) AT&W - Save setting parameters.
- C) AT&V - Display the current settings.
- D) S133 - The network type must be set to 2, corresponding to mesh with center network.
- E) S103 - The wireless link rate on all devices on the network must be set to the same. The higher the rate, the greater the throughput. The lower the rate, the better the sensitivity.
- F) S104 - The network addresses (ids) of all devices on the network must be the same. It is strongly recommended not to use the default setting 1234567890. To change the network address use AT S104=xxxxxxx.
- G) S102 - The baud rate of the serial port matches that of the connected device.
- H) S141 - Whether a repeater exists on the network or not, the value must be set to 0.
- I) S101 - The working mode must be set to 0, corresponding to the master.
- J) S105 - For the unit address, refer to the example in point-to-multipoint networks.
- A) S118 - For the sync address, refer to the example in point-to-multipoint networks.
- B) S140 - For the destination address, refer to the example in point-to-multipoint networks.
- K)

After the configuration is completed, run the AT&W command to save the current settings. Run the ATA command to exit the AT command mode and the settings take effect.

9.5 Slave Setting

```
通讯端口 串口设置 显示 发送 多字符串 小工具 帮助 回报作者 PCB打样
at&f8 A
OK
at&w B
OK
at&v C
T900
900MHz Hopping Radio System
Hardware Version TZ60136B
Firmware Version 0001-20220625-0A
Software Version 0001-20220623-0A
Serial Number 123456

Network Type           S133=0 D           Operating Mode         S101=2 I
Wireless Link Rate     S103=0 E           Output Power(dBm)     S108=30 J
NetWork Address(ID)   S104=1234567890 F  Unit Address          S105=0
Synchronous Address   S118=0 K           Destination Address   S140=0
Serial Baud Rate       S102=7 G           Serial Channel Mode    S142=0
Repeater Y/N          S141=0 H           Repeater Index Use Gpio S143=0
Encryption Enable     S159=0
RSSI Form Master(dBm) S123=-255          Repeater Index        S114=1
RSSI Form Slaver(dBm) S124=-255

OK
```

- A) AT&F8 - Restore the factory default for the mesh-with-center slave.
- B) AT&W - Save setting parameters.
- C) AT&V - Display the current settings.
- D) S133 - The network type must be set to 2, corresponding to mesh with center network.
- E) S103 - The wireless link rate on all devices on the network must be set to the same. The higher the rate, the greater the throughput. The lower the rate, the better the sensitivity.
- F) S104 - The network addresses (ids) of all devices on the network must be the same. It is strongly recommended not to use the default setting 1234567890. To change the network address use AT\$104=xxxxxxx.
- G) S102 - The baud rate of the serial port matches that of the connected device.
- H) S141 - Whether a repeater exists on the network or not, the value must be set to 0.
- I) S101 - The working mode must be set to 2, corresponding to the slave.
- A) S105 - For the unit address, refer to the example in point-to-multipoint networks.
- B) S118 - For the sync address, refer to the example in point-to-multipoint networks.
- J) S140 - For the destination address, refer to the example in point-to-multipoint networks

After the configuration is completed, run the AT&W command to save the current settings. Run the ATA command to exit the AT command mode and the settings take effect.

9.6 Packet Length Limit

In the case of a central Mesh network, when the channel access mode is TDMA, each device communicates with each other. When multiple devices send data, the data output from serial ports will interleave each other. To ensure the integrity of data packets, the length of data packets must be smaller than the maximum length sent by a single time slot. When the channel access mode is selected TDMA-AUTO, there is no limit on the packet length.

Orifice speed	Maximum length of a single packet
276.4kbps	175 bytes
230.4kbps	140 bytes
172.8kbps	100 bytes
115.2kbps	55 bytes
57.6kbps	15 bytes