

# T900 User Manual

900MHz Frequency Hopping Module  
Version: 20221228V1.5



## Important User Information

### Warranty

Zhejiang Tianze Communication Technology Co.,Ltd. warrants that each product will be free of defects in material and workmanship for a period of one (1) year for its products. The warranty commences on the date when the product is shipped by Zhejiang Tianze Communication Technology Co.,Ltd. Zhejiang Tianze Communication Technology Co.,Ltd. 's sole liability and responsibility under this warranty is to repair or replace any product which is returned to it by the Buyer and which Zhejiang Tianze Communication Technology Co.,Ltd. determines does not conform to the warranty. Product returned to Zhejiang Tianze Communication Technology Co.,Ltd. for warranty service will be shipped to Zhejiang Tianze Communication Technology Co.,Ltd. at Buyer's expense and will be returned to Buyer at Zhejiang Tianze Communication Technology Co.,Ltd. 's expense. In no event shall Zhejiang Tianze Communication Technology Co.,Ltd. be responsible under this warranty for any defect which is caused by negligence, misuse or mistreatment of a product or for any unit which has been altered or modified in any way. The warranty of replacement shall thereof terminate. Co.,Ltd.

### Warranty Disclaims

Zhejiang Tianze Communication Technology Co.,Ltd. makes no warranties of any nature of kind, expressed or implied, with respect to the hardware, software, and/or products and hereby disclaims any and all such warranties, including but not limited to warranty of non-infringement, implied warranties of merchantability for a particular purpose, any interruption or loss of the hardware, software, and/or product, any delay in providing the hardware, software, and/or product or correcting any defect in the hardware, software, and/or product, or any other warranty. The Purchaser represents and warrants that Zhejiang Tianze Communication Technology Co.,Ltd. has not made any such warranties to the Purchaser or its agents. Zhejiang Tianze Communication Technology Co.,Ltd. express warranty to buyer constitutes Zhejiang Tianze Communication Technology Co.,Ltd. sole liability and the buyer's sole remedies. except as thus provided, Zhejiang Tianze Communication Technology Co.,Ltd. disclaims all warranties, expressed or implied, including any warranty of merchantability or fitness for a particular promise.

Zhejiang Tianze Communication Technology Co.,Ltd. products are not designed or intended to be used in any life support related device or system related functions, nor as part of any other critical system and are granted no functional warranty.

### Indemnification

The Purchaser shall indemnify Zhejiang Tianze Communication Technology Co.,Ltd. and its respective directors, officers, employees, successors and assigns including any subsidiaries, related corporations, or affiliates shall be released and discharged from any and all manner of action, causes of action, liability, losses, damages, suits, dues, sums of money, expenses (including legal fees), general damages, special damages, including without limitation claims for personal injuries, death or property damage related to the products sold hereunder, costs and demands of every and any kind and nature whatsoever at law.

In no event will Zhejiang Tianze Communication Technology Co.,Ltd. be liable for any indirect, special, consequential, incidental, business interruption, catastrophic, punitive or other damages which may be claimed to arise in connection with the hardware, regardless of the legal theory behind such claims, whether in tort, contract or under any applicable statutory or regulatory laws, rules, regulations, executive or administrative orders or declarations or otherwise, even if Zhejiang Tianze Communication Technology Co.,Ltd. has been advised or otherwise has knowledge of the possibility of such damages and takes no action to prevent or minimize such damages. in the event that regardless of the warranty disclaimers and hold harmless provisions included above Zhejiang Tianze Communication Technology Co.,Ltd. is somehow held liable or responsible for any damage or injury, Zhejiang Tianze Communication Technology Co.,Ltd.'s liability for any damages shall not exceed the profit realized by Zhejiang Tianze Communication Technology Co.,Ltd. on the sale or provision of the hardware to the customer.

### Proprietary Rights

The Buyer hereby acknowledges that Zhejiang Tianze Communication Technology Co.,Ltd. has a proprietary interest and intellectual property rights in the Hardware, Software and/or Products. The Purchaser shall not (i) disclose trade secret, remove any copyright, trademark or other evidence of Zhejiang Tianze Communication Technology Co.,Ltd. 's ownership or proprietary interest or confidentiality, or other proprietary notices contained on, or in the Hardware, Software or Products, (ii) reproduce or modify any Hardware, Software or Products or make any copies thereof, (iii) reverse assemble, reverse engineer or decompile any Software or copy thereof in whole or in part, (iv) sell, transfer or otherwise make available to others the Hardware, Software, or Products or documentation thereof or any copy thereof, except in accordance with this Agreement.

## About This Manual

It is assumed that users of the products described herein have either system integration or design experience, as well as an understanding of the fundamentals of radio communications.

Throughout this manual you will encounter not only illustrations (that further elaborate on the accompanying text), but also several symbols which you should be attentive to:



### **Caution or Warning**

Usually advises against some action which could result in undesired or detrimental consequences.



### **Point to Remember**

Highlights a key feature, point, or step which is noteworthy. Keeping these in mind will simplify or enhance device usage.



### **Tip**

An idea or suggestion to improve efficiency or enhance usefulness.

## Regulatory Requirements

To satisfy FCC RF exposure requirements for mobile transmitting devices, a separation distance of 25cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operation at closer than this distance is not recommended. The antenna being used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.



### **WARNING**

This device can only be used with antennas designed for use with 900 MHz products. Please contact Zhejiang Tianze Communication Technology Co.,Ltd. if you need more information or would like to order an antenna.



### **WARNING**

#### **EQUIPMENT LABELING**

This device has been modularly approved. The manufacturer, product name, and FCC and Industry Canada identifiers of this product must appear on the outside label of the end-user equipment.



### **WARNING**

Caution: The user is cautioned that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

#### **SAMPLE LABEL REQUIREMENT:**

For T900

FCCID: 2A9NZ-T900

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and (2) this device must accept any interference received including interference that may cause undesired operation.

## Version History

Date	Versions	Comments
20220915	V1.1	Initial Version
20221125	V1.2	Added version history Added maximum user rate for each mode
20221205	V1.3	Modified dimensions of the T900 module
20221214	V1.4	Modified description of the S159 command Modified Appendix A: Baseboard Reference Design
20221228	V1.5	Some English names revised

## Contents

Version History .....	5
1 Overview .....	7
2 Performance Features.....	7
2.1 Technical parameters .....	7
3 Hardware Description .....	8
3.1 Mechanical Drawings .....	9
3.2 Pin Descriptions .....	13
3.3 Minimum Connection Requirements.....	15
3.4 Electrical Characteristics .....	15
3.5 I/O Port Features .....	16
4 T900 Enclosed .....	17
4.1 T900-Demo Drawings .....	18
4.2 Device Connectors and LED Indicators.....	19
5 Data Serial Port.....	21
5.1 Data Mode .....	21
5.2 Force into the AT Command Configuration Mode on Power-up .....	21
5.3 Enter the AT Command Configuration Mode in Data Mode .....	21
6 Appendix A: Base Plate reference design .....	22

## 1 Overview

The T900 module uses point-to-point, point-to-multipoint and mesh with center network communication technologies to provide users with high-performance, secure and effective wireless serial communication.

The T900 module can be used in low-cost OEM integrated designs, properly configured and installed to enable high-rate, long-range wireless communication.

The T900 module is a frequency hopping system in the 902-928 MHz ISM band, using FHSS (Frequency Hopping Spread Spectrum) technology, providing serial-based wireless asynchronous data transmission between most devices using serial communication.

The small size and superior performance of the T900 module makes it ideal for many applications. Some typical uses are listed below:

power monitoring system	remote monitoring	robotics
remote telemetry	fleet management	signal display
traffic control	GPS	railroad signals
industrial control	measuring instruments	

## 2 Performance Features

Key performance features of the T900 module include:

- Use the 902-928 MHz frequency band
- Output power up to 1W (30dBm)
- Transparent transmission, low latency, rates up to 276kbps
- Auto Repeater Mode
- Communicate with virtually all serial-based devices
- Wide temperature range
- 16-bit CRC, optional retransmission and forward error correction
- Independent diagnostic port -- real-time remote diagnosis and online network control
- Easy to install and configure -- The T900 uses a subset of the standard AT-style commands, similar to using traditional telephone line equipment
- CMOS 3.3V logic level compatible

### 2.1 Technical parameters

Basic parameters and indicators:

<b>Supported frequencies:</b>	902-928MHz
<b>Spread spectrum mode:</b>	FHSS
<b>Frequency band selection:</b>	Configurable frequency space
<b>Error detection:</b>	16 bit CRC, ARQ, ReedSolomon
<b>Data encryption:</b>	256-bit physical layer encryption
<b>Scope of Communication:</b>	Up to 100km
<b>Output power:</b>	100mW to 1W (20-30dBm)
<b>Wireless Link Rate:</b>	Up to 276.4kbps
<b>Serial port baud rate :</b>	Up to 921.6kbps supported
<b>Sensitivity:</b>	

Link Rate	$10^{-7}$ BER	Maximum User Rate*
276.4 KBPS	-106 dBm	136kbps
230.4 KBPS	-107 dBm	116kbps
172.8 KBPS	-108 dBm	82kbps
115.2 KBPS	-109 dBm	48kbps
57.6 KBPS	-110 dBm	14kbps

Note: The maximum user rate is halved when there is a repeater.

**Environment:**

**Operating temperature:** -40°C to 85°C  
**Humidity:** 5%-95% non-condensing

**Appearance:**

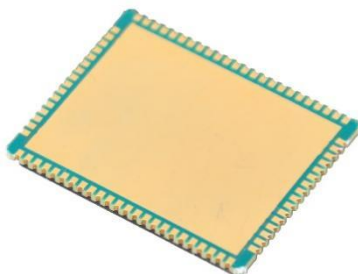
**Dimensions:** 26.5 mm \* 33 mm \* 3.5 mm  
**Weight:** Approx. 5.2g  
**Connector:** Antenna: IPEX  
Data: 80Pin/Pad SMT

### 3 Hardware Description

The T900 module is a low-cost OEM module. The module provides the raw signal required for integration and minimizes area and power consumption for the integration of the module. T900-DEMO provides a convenient evaluation platform for testing and designing modules.



Top view

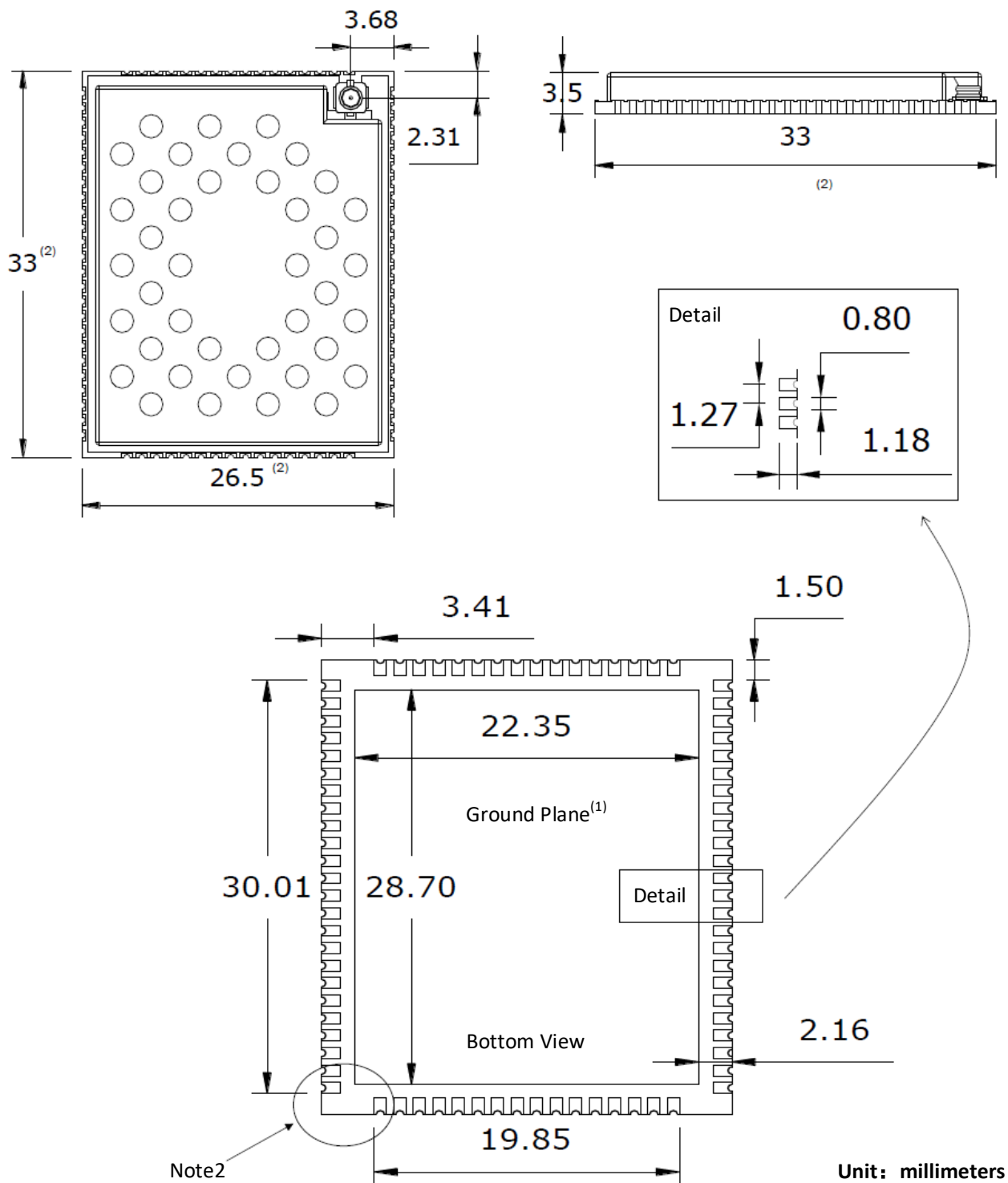


Bottom View



### 3.1 Mechanical Drawings

The dimensions of the T900 module are as follows:

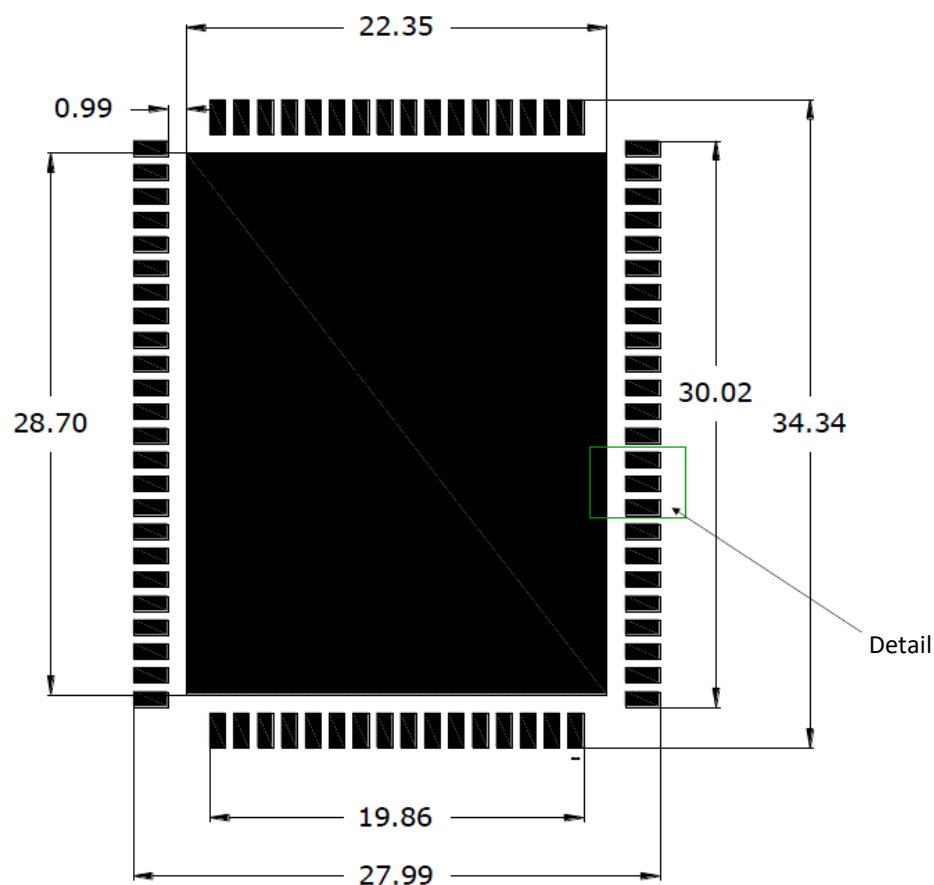


T900 OEM Mechanical

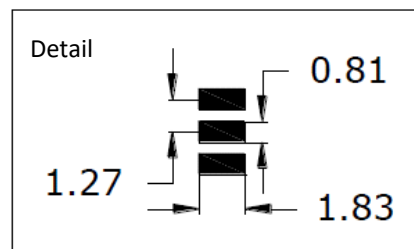
Note 1: Grounding pads must be grounded for heat dissipation.

Note 2: Due to the manufacturing process, there may be excess PCB material on the corners. A tolerance of  $\pm 0.25\text{mm}$  for the excess part should be considered.

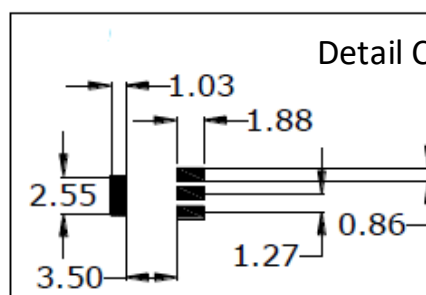
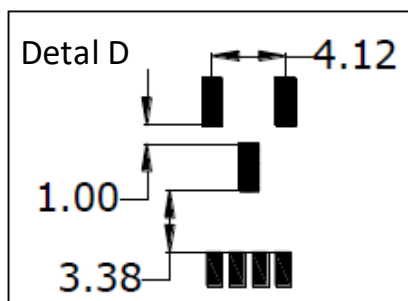
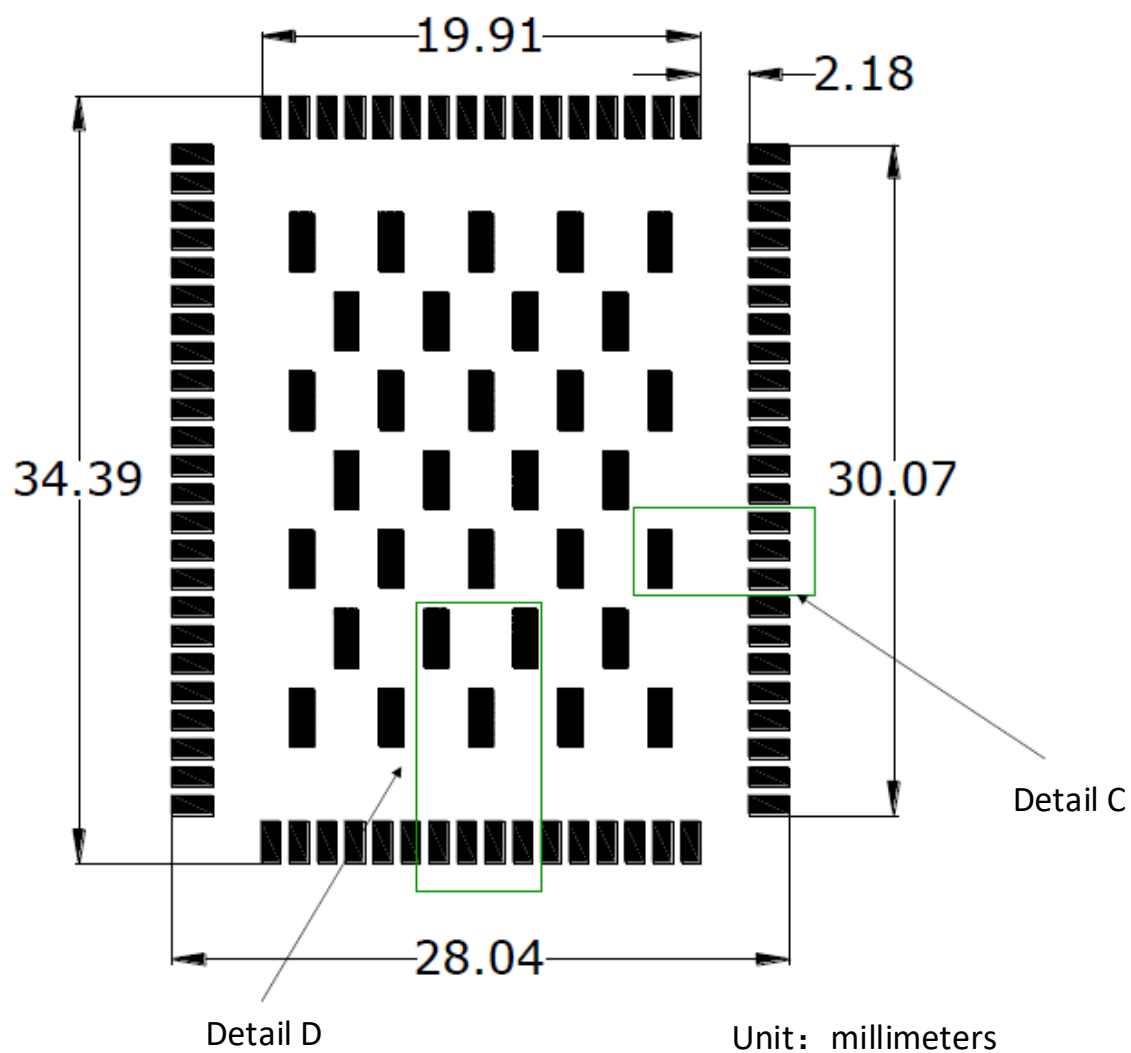
### 3.1.1 Recommended Solder Mask (Pad Landing)



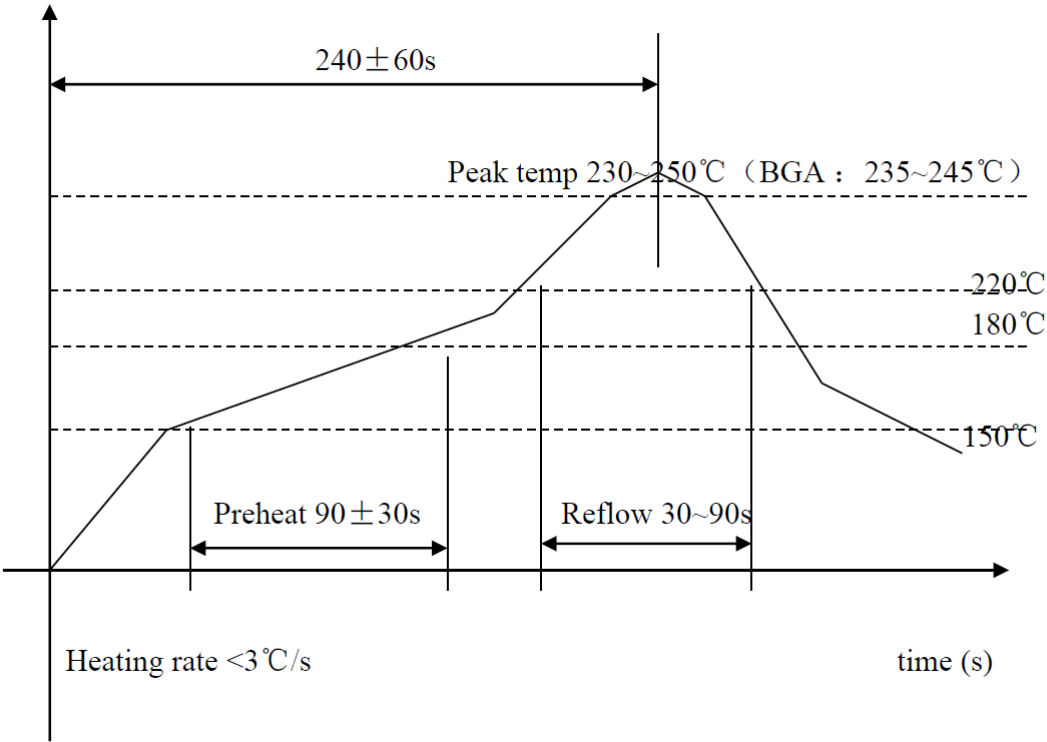
Units: millimeters



### 3.1.2 Recommended Solder Paste



3.1.3 SMT Temperature Profile



Reflow Profile

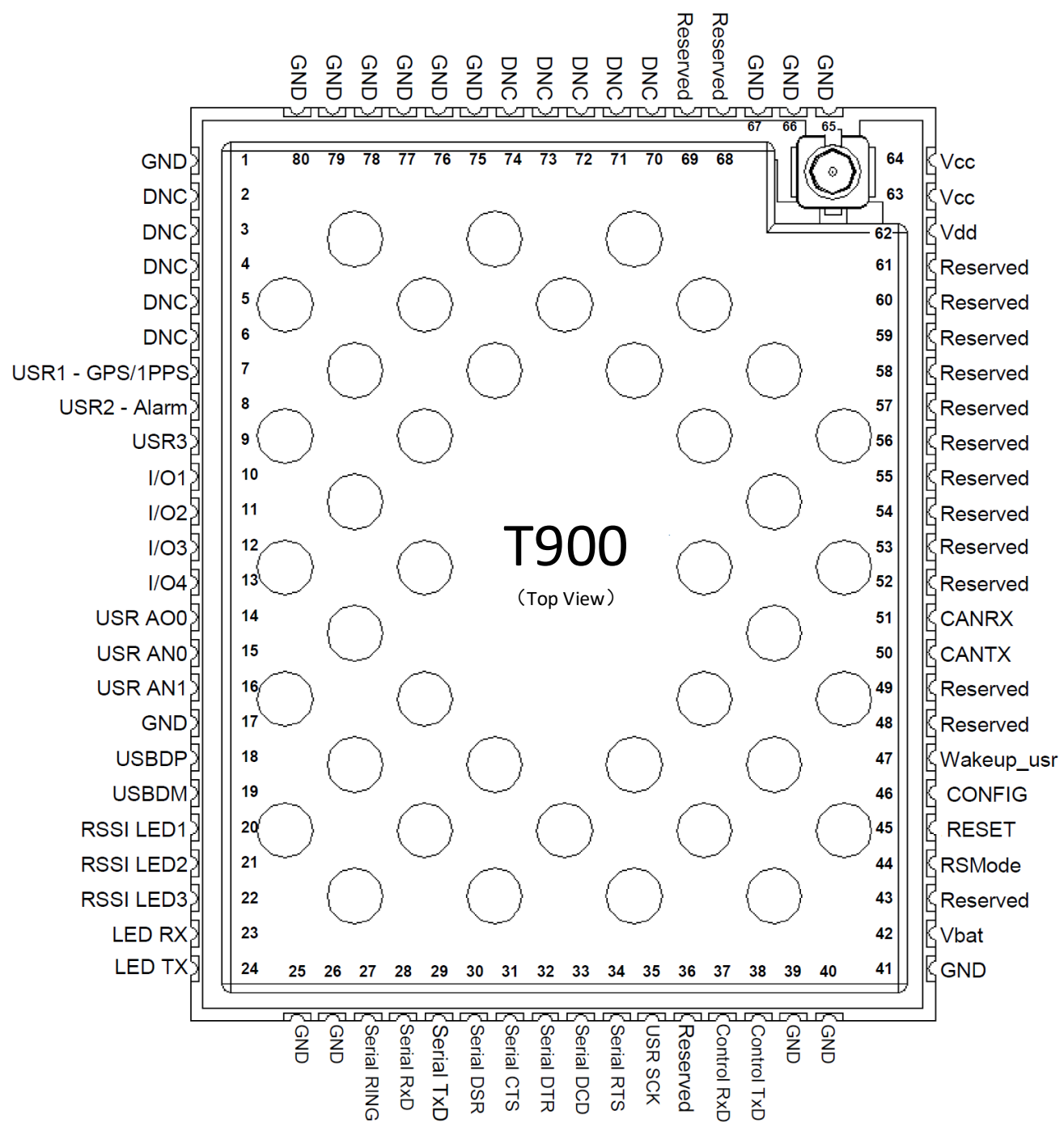
Set Point Control items	Units (slope in degrees/second, time in seconds, temperature in degrees Celsius)
Upward slope	Less than 3s
Soak time (150°C~180°C)	60~100s
Reflow time (>220°C)	30~90s
Maximum temperature	230~250°C

3.1.2 SMT Baking Instructions (MSL)

The T900 module must be baked prior to installation and the following baking instructions should be followed for best results:

- a) At  $125^{\circ}\text{C} \pm 5^{\circ}\text{C}$  for at least 8 to 12 hours.
- b) Unused modules should be stored at a relative humidity  $\leq 10\%$ .

3.2 Pin Descriptions



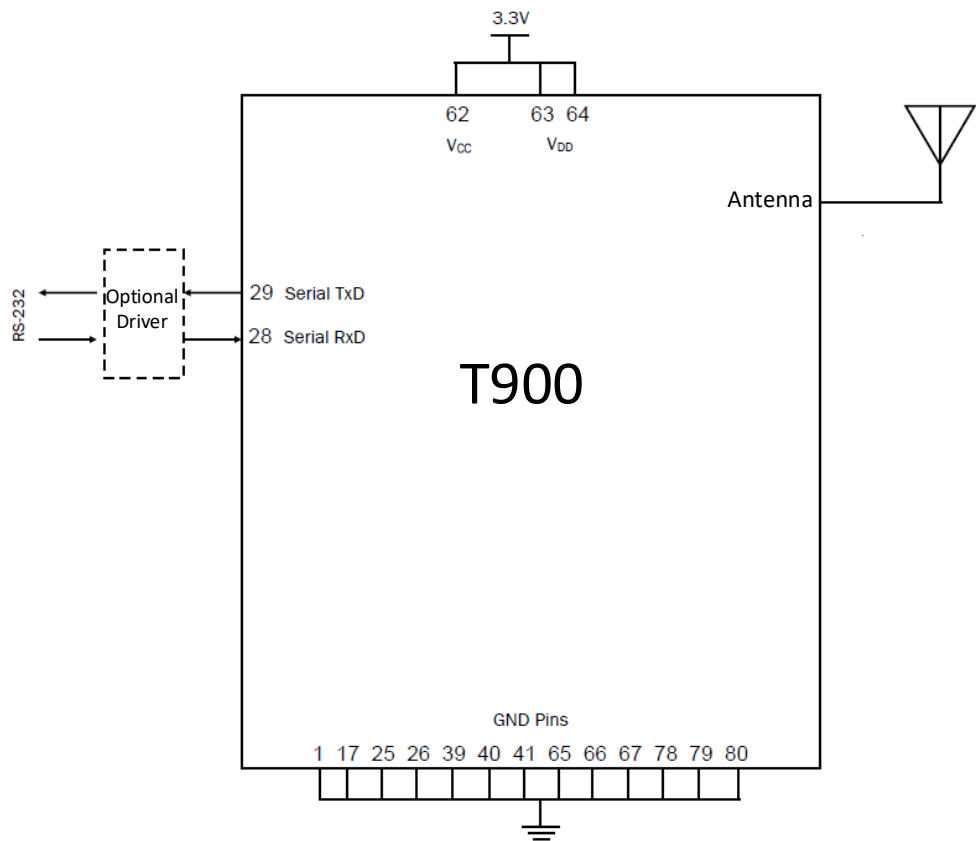
T900 80-pin OEM Connection Info

Above is the top view of the T900 module. The following table shows the function and descriptions of each pin.

Pin Name	No.	Description	Direction
GND	1,17,25-26,75 33-41,65 6-67-80	Reference point.	
DNC	2,3,4,5,6,70-74	Factory reserved pins.	
Reserved	7-9 dec - 19, 35, 36,61,68,69,42,43,44,47 to 59	*Not supported by the current version, reserved*	
GPIO1	10	Repeater number input bit1, CMOS 3.3V.	IO
GPIO2	11	Repeater number input bit2, CMOS 3.3V.	IO
GPIO3	12	Repeater number input bit3, CMOS 3.3V.	IO
GPIO4	13	Repeater number input bit4, CMOS 3.3V.	IO
RS485_RE	14	In 485 mode, data input enabled, active-low.	O
RS485_H/F	15	In 485 mode, half-duplex and full-duplex optional, 0-- full-duplex, 1-- half-duplex.	O
RSSI LED1	20	Receive signal RSSI1, active-high, current limit 5mA.	O
RSSI LED2	21	Receive signal RSSI2, active-high, current limit 5mA.	O
RSSI LED3	22	Receive signal RSSI3, active-high, current limit 5mA.	O
LED RX	23	Receive data indication, active-high, current limit 5mA.	O
LED TX	24	Receive data indication, active-high, current limit 5mA.	O
Serial RING	27	RS485 output enabled, active-high.	O
Serial RxD	28	Data Serial port data reception, CMOS 3.3V.	I
Serial TxD	29	Data Serial port data transmission, CMOS 3.3V.	O
Serial DSR	30	Data serial port DSR, not supported by the current version.	O
Serial CTS	31	Data serial port CTS, not supported by the current version. In 485 mode, data output enabled, active-high.	O
Serial DTR	32	Data serial port DTR, not supported by the current version.	I
Serial DCD	33	Data serial port DCD, not supported by the current version.	O
Serial RTS	34	Data serial port RTS, not supported by the current version.	I
Control RxD	37	Control serial port data reception, CMOS 3.3V.	I
Control TxD	38	Control serial port data transmission, CMOS 3.3V.	O
nRESET	45	Reset pin, active-low.	I
nCONFIG	46	Forced AT command configuration mode pin, active-low. If valid, the default format of the data serial port is 9600/8N1. The pin should be pulled up to Vdd or suspended (internally pulled up to Vdd).	I
ANT_AUX	60	Auxiliary antenna port, can output RF signal directly from the pin (requires supported hardware version).	
Vdd	62	Power supply pin for the digital part of the module (3.3V).	I
Vcc	63,64	Power supply pin for the RF part of the module (3.3V).	I

Note: All serial communication signals are logical level CMOS 3.3V and cannot be directly connected to RS232 level (+ -12V).

### 3.3 Minimum Connection Requirements



### 3.4 Electrical Characteristics

#### 3.4.1 Absolute Maximum Rated Voltage

Permanent damage to the equipment may occur at higher than absolute maximum ratings. These are maximum ratings only and do not imply that the equipment can operate properly under these conditions. Prolonged operation under maximum ratings may affect the reliability of the equipment.

Parameter	Description	Minimum	Maximum
Vcc/Vdd	External main voltage	0V	3.8 V
Vin	Any pin input voltage	-0.3 V	Vdd + 0.3

Absolute maximum voltage

### 3.4.2 Operating Voltage

The parameters given in the table below are the measured values of T900 at room temperature.

Parameter	Description	Minimum	Typical	Maximum
Vcc	External RF power supply voltage	3.3 V	3.3 V	3.6 V
Vdd	External digital supply voltage	3.0 V	3.3 V	3.6 V

Voltage characteristics in normal operation

### 3.4.3 Current Characteristics

The parameters given in the table below are the measured values of T900 at room temperature. Test conditions Vcc=3.3V, Vdd=3.3V, ambient temperature 25°C.

Parameter	Description	Maximum
IVcc(TX)	100% of the RF current sent at 1W power	1270 mA
IVcc(TX)	100% of the RF current sent at 500mW power	900 mA
IVcc(TX)	100% of the RF current sent at 100mW power	490 mA
IVcc(RX)	100% of the received RF current	70 mA
IVdd(TX)	100% of the digital current sent	130 mA
IVdd(RX)	100% of the digital current received	130 mA
IVcc + IVdd	Maximum module operating current	1400mA

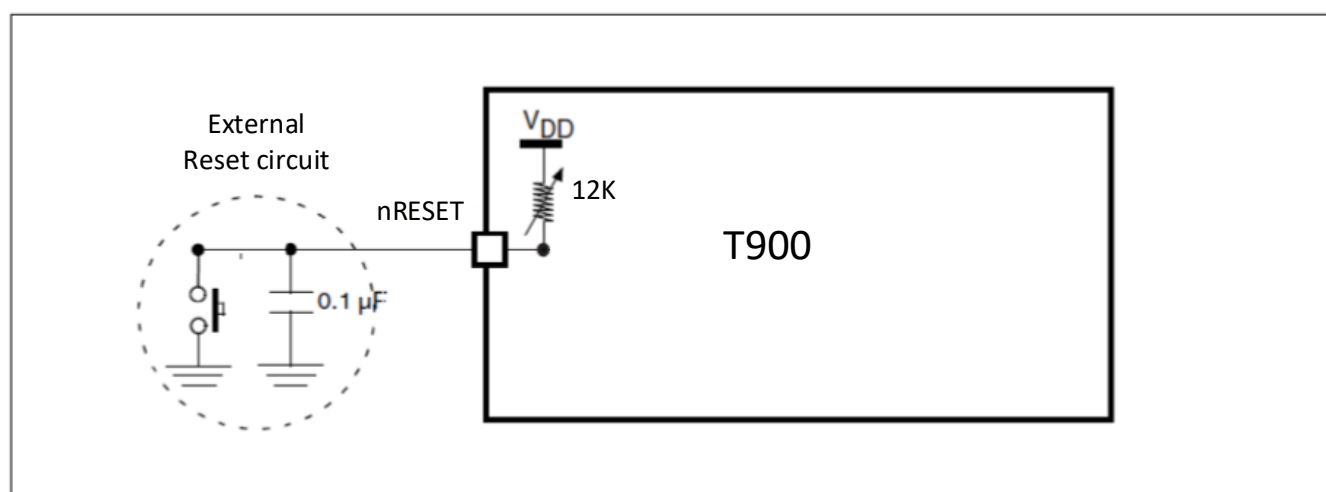
Current characteristics in normal operation

## 3.5 I/O Port Features

### 1) Universal I/O features

All pins of the T900 meet the CMOS3.3V electrical standard.

### 2) nRESET pin reference circuit



nRESET pin reference circuit



## 4 T900 Enclosed

The T900-DEMO provides standard data ports, power supply ports, and antennas for a single T900. The P900 Enclosed is ideal for base stations or applications where complicated integration of the OEM module is not required, but a modem with a small footprint is still required. The T900-DEMO can also be used to quickly evaluate the features and performance of the T900. The development board is the internal circuit board of the complete machine with one T900 module embedded, and all interfaces are the same as those of the complete machine except the antenna interface

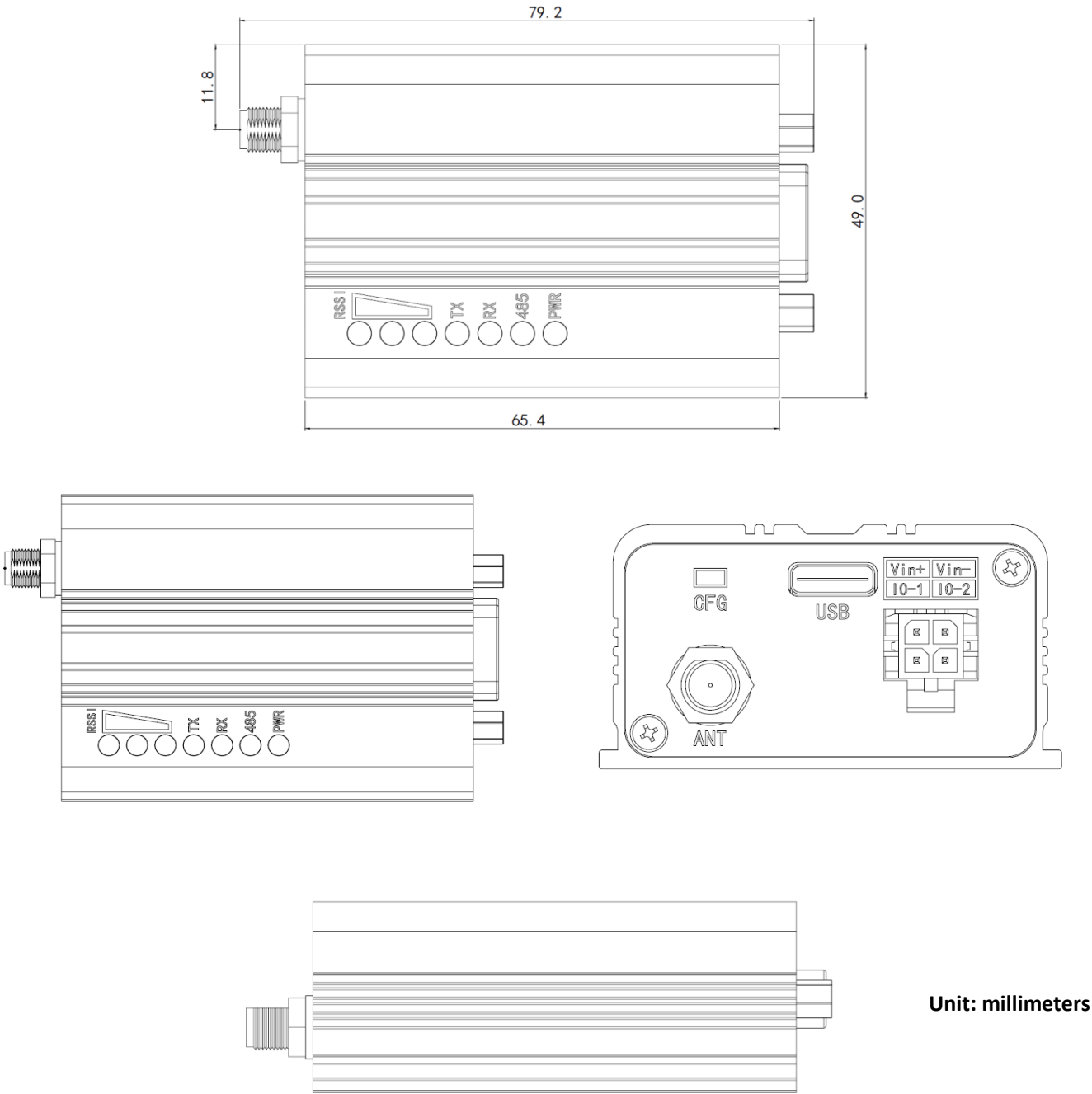
The T900-DEMO provides the following interfaces:

- Input power 12V DC
- Power indicator
- RS232/RS485 data port
- RSSI signal strength indicator
- Transmit/Receive indicators
- Setting button
- The antenna
- USB control serial port
- Reserved I/O ports



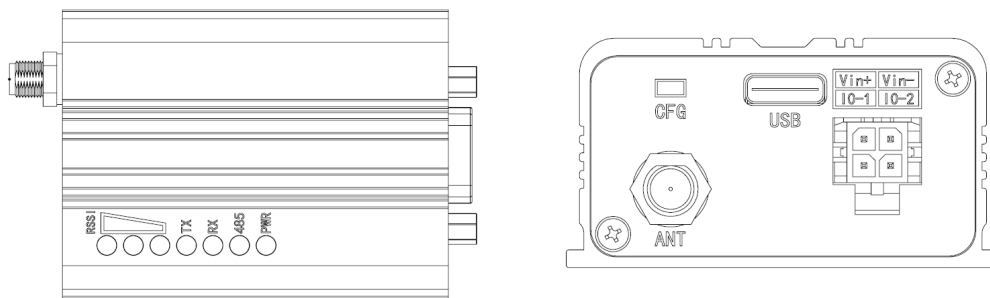
T900-Demo

4.1 T900-Demo Drawings



T900-DEMO Views

## 4.2 Device Connectors and LED Indicators



Connectors and indicators (top and rear view)

### Power supply (blue)

If this indicator is on, the T900-DEMO is powered on (12VDC).

### RS485 (red)

If this indicator is on, the data port of T900-DEMO is configured as RS485.

### Emission light (red)

When the TX light is on, it indicates that the module is transmitting data in the air.

### Receiver light (red)

When the RX light is on, it indicates that the module is synchronized and receives valid data packets.

### Received Signal Strength Indication (RSSI) (three green lights)

Starting with the leftmost RSSI light, the number of lit RSSI indicators increases as the strength of the received signal increases. RSSI can check the S123 and S124 registers at the same time.

Module Type	Model	Indicator Status		
		RX	TX	RSSI 123
all	AT command configuration mode	OFF	OFF	OFF
master	Working	Blinking when receiving data	ON	Proportional to the strength of the received signal
slave	Non-synchronization	OFF	OFF	Cycle light every 860ms
slave	Synchronization	ON	Blinking when transmitting data	Proportional to the strength of the received signal
repeater	Non-synchronization	Alternately flashing with the TX light	Alternately flashing with the RX light	Cycle light every 860ms
repeater	Synchronization	Blinking when receiving data. Otherwise steady on	Blinking when transmitting data. Otherwise steady on	Proportional to the strength of the received signal

LED light status indication

### Setting button

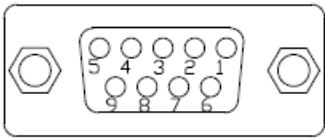
Press and hold this button before powering up. The module will enter the forced AT command configuration mode. The default data serial port is 9600/8N1.

### USB

Type-C USB port. The USB port is converted to a serial port and connected to the control serial port.

### Data serial port

Connects to the data serial port of T900-DEMO for data transmission or AT command control. The current version only supports simple RS232, and only uses RXD and TXD. Other control lines are not supported for the time being. The direction of sending and receiving is based on the T900 module.



pin	RS232	RS485 (Full duplex)	RS485 (Half duplex)
1	DCD		
2	TXD	TX-	Data-
3	RXD	RX+	
4	DTR		
5	GND	GND	GND
6	DSR		
7	RTS	RX-	
8	CTS	TX+	Data+
9			

DB9 Interface Definition

**Vin+/Vin-**

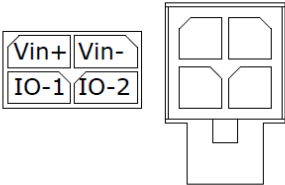
Used to power the module. Input voltage ranges from 9 to 30VDC.

**IO-1/IO-2**

It is not supported by the current version but it can customized.

**ANT**

RF-SMA female antenna connector



## 5 Data Serial Port

The data serial port can be used for AT command configuration mode and data mode, corresponding to the use of pins Serial RxD and Serial TxD. AT command configuration mode can be entered in two ways, one is forced entry into AT command configuration mode on power-up, and the other is entry in data mode.

### 5.1 Data Mode

When the nCONFIG pin is high or suspended during power-up or reset, data mode is then on.

In data mode, the data serial port is used for transparent data transmission without any data processing. The data serial port input buffer is 4096 bytes. When the buffer overflows, it will cause data loss.

### 5.2 Force into the AT Command Configuration Mode on Power-up

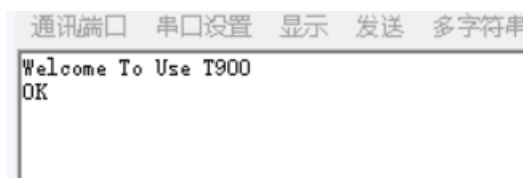
If the nCONFIG pin is low during power-up or reset, the AT command configuration mode is entered.

When you enter the AT command configuration mode in this way, the baud rate of the data serial port is forcibly set to 9600bps 8N1.

### 5.3 Enter the AT Command Configuration Mode in Data Mode

In data mode, you can enter the AT command configuration mode by idling for 1s, then sending "+++", and then idling for another 1s. When you enter the AT command configuration mode, the data serial port displays "Welcome To Use T900 OK".

When you enter the AT command configuration mode in this way, the data serial port baud rate is the serial port baud rate in data mode.



In AT command configuration mode, you can enter the AT command to read and write the internal register, read the required data, or configure the required mode.

When you switch from data mode to AT command mode, the rate and format of the serial port are not changed. The configuration in data mode is retained.

After entering the AT command mode, you can configure it using AT commands. For details about the AT command, see Section 7.

## 6 Appendix A: Base Plate reference design

