DT400A-RS485

1.General information

DT400A is a low-power industrial collector with RS485 interface, built-in battery power supply, and can be connected to external Modbus slaves or non Modbus slaves. Use LoRa spread spectrum wireless communication, support standard LoRaWAN wireless protocol, built-in global regional specifications (such as CN470, CN779, EU433, EU868, US915, AU915, AS923, IN865, etc.). Users can use the LoRaWAN mode without changing software and hardware. They only need to configure to choose different regional specifications and adapt to various LoRaWAN standards in various countries and regions.

Interface	Model	Document
RS-485	DT400A-LF DT400A-HF	DT400A user manualV1.0.pdf

Note
LF: Frequency: 433~510 MHz
HF: Frequency: 863~928 MHz

1.1.Introduction

DT400A supports both non LoRaWAN mode communication and LoRa full parameter open configuration, making it flexible for various LoRa communication application scenarios.
The external RS485 interface only requires a simple configuration of the collector to support the collection of standard Modbus sensors and non Modbus ordinary RS485 sensors,
The device is equipped with a 38Ah high capacity lithium-ion battery, with a service life of 3-5 years. There is no need for on-site wiring, and the installation is simple and reliable. The shell is made of aluminum alloy material, with a high specification waterproof design, suitable for use in industrial environments.

You can user at command for DT400A configuration(http://doc.rejeee.com/web/#/29?page_id=196) or SensorTool. In addition, the product supports serial port firmware upgrade for easy maintenance and functional expansion.

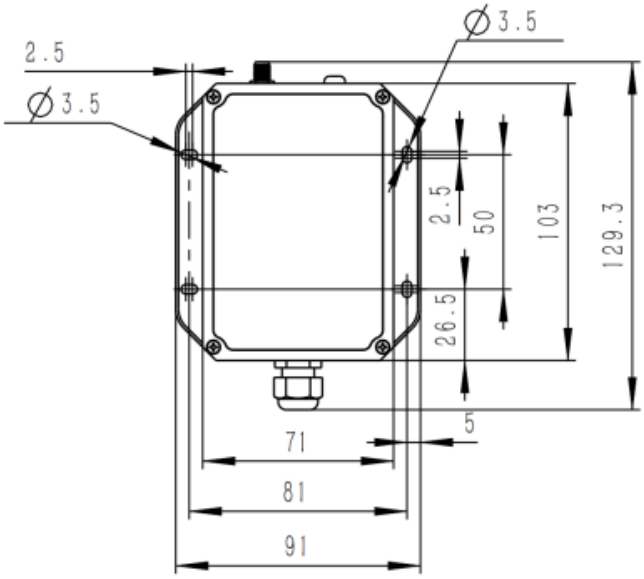
1.2.Features

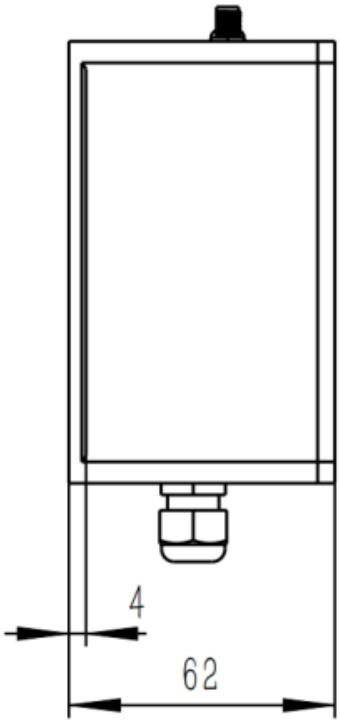
Adopting RS-485 interface and built-in Li-battery, controllable external RS-485 equipment is used for power supply; Can be used as a Modbus host to collect external Modbus slave data;
Support active data reporting of non Modbus devices after power on; RS-485 Baud is configurable (1200~115200), default 9600;
Support AT command and parameter modification; Built in Type-C USB serial port for parameter configuration and firmware upgrade;
Fully industrial grade chip design, working temperature can reach -40 ℃~+85 ℃; IP67 waterproof, easy installation and deployment.

2.Parameter

Feature	Parameter
CPU	Cortex-M0+
Wireless	SX1268/SX1262
Encription	AES128
Sensor power	15V (50mA Max)
Sleeping current	5uA
Peak current	150mA(Sensor consumption not included)
Battery	38Ah
Life span	3 years（External sensor power consumtion within 20mA）
Temperature	-30℃~+ 70℃
Communication	RS485(9600 default bauld rate)
Data speed	300bps-62.5kbps
Size	129mm*91mm*62mm
TX power	22dBm Max
RX sensitivity	-140 dBm（BW=125K，SF=12）
Antenna	SMA
Frequency	433-510 MHz 863~928 MHz

3.Size



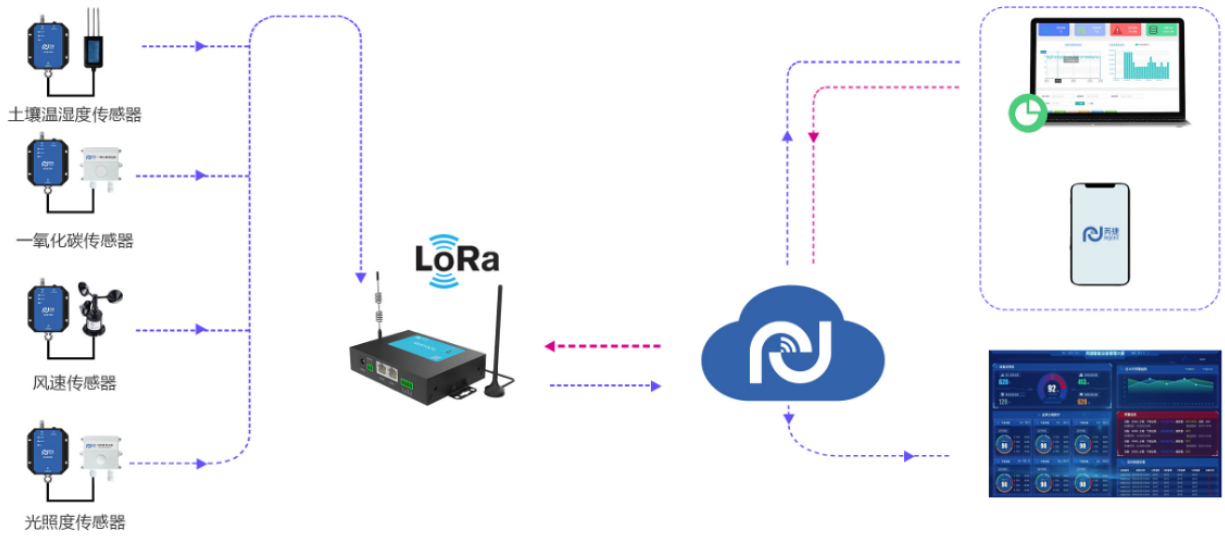


4. Instructions

4.1.Scenario

The device is used to connect various RS-485 sensors externally, mainly using Modbus devices. Conveniently wireless Modbus sensors in various businesses. Convenient transformation and simple deployment. The overall

architecture of the system is shown below.



4.2.Device introduction

4.2.1.Interface

1.Waterfroof PG interface

The sensor is connected to the inside of the device through this connector, and it is recommended to thread the wire with a size of 3-6mm (diameter). If there is a need for special dimensions, please contact Rejeee engineer for confirmation.

2.SMA Antenna interface

The antenna interface adopts an external screw and internal hole form

3.Botton

Pressing the button can perform a soft shutdown on the device and trigger data reporting. Press and hold for 3 seconds to start and shut down the device. Short press (between 0.1-3 seconds), the device immediately collects data and reports it.

4.Indicator

POWER:

When the system is running, press the POWER button to turn on the green light. When you connect this device with PC through type-C, the LED displays red.

SENSOR:

When the device collects sensor data, the green light is on, and if the reading fails, it is displayed in red. Turn off the indicator light after reading is completed.

NET:

When the device is sending data, led is green.

4.2.2.Internal interface

1.Battery connector

Make sure battery is right connected.

2.System power on/off

When the device is stored for a long time, it is recommended to turn the switch to the OFF position and operate normally in the ON position. This switch is a battery usage switch (ON for battery power supply, OFF for no battery use).

When the device battery runs out, if the battery is not replaced. The switch can be set to the OFF position, and users can connect an external USB to power the device.

3.USB-C for configuration

Connect the sensor to PC with USB-C cable, use sensor tool for sensor configuration, and bauld rate is 115200.

4.RS485 connector

To facilitate equipment wiring, spring type PCB wiring terminals are used. The wiring sequence is shown in the figure, which is: ①VCC ②RS485-A③RS485-B④GND

Note: Here, the VCC is boosted to 15V by the internal battery of the device, with a maximum output current of 50mA.

4.3 Operating instructions

1. Using a cross screwdriver, open the device casing and remove the metal waterproof connector. Thread in the sensor cable, connect the RS485 cable to the terminals in sequence, and lock the waterproof PG interface.

2. Connect to PC with USB-C cable.

   > *Note: The serial port driver needs to be installed in advance, and the serial port to USB chip is CH340。*

3. Open the SensorTool upper computer software, use the default Baud of 115200, "Serial port selection" the corresponding COM port of the device, and click "Open serial port" to automatically read the device parameters. Wait for the reading to complete before viewing or modifying parameters.

4. Configuration Item Description
   *Uplink period : This parameter is measured in seconds. When the set time expires, the device actively wakes up and collects RS485 device data. If the collection is successful, it will be sent, but if the collection fails, it will not be sent.

   *Preheating time : This parameter is measured in seconds. During Modbus, it refers to the waiting time from power on to reading. If it is non Modbus, it is the delay waiting for the slave device to actively send data after power on.

4.3.1.Modbus Collecting

Modbus parameter: 1. Start register. 2. Number of registers. 3 start slave. 4. Cut off the slave machine. 5. Function code (currently only supports 0x03/0x04 function codes). Please refer to the register address

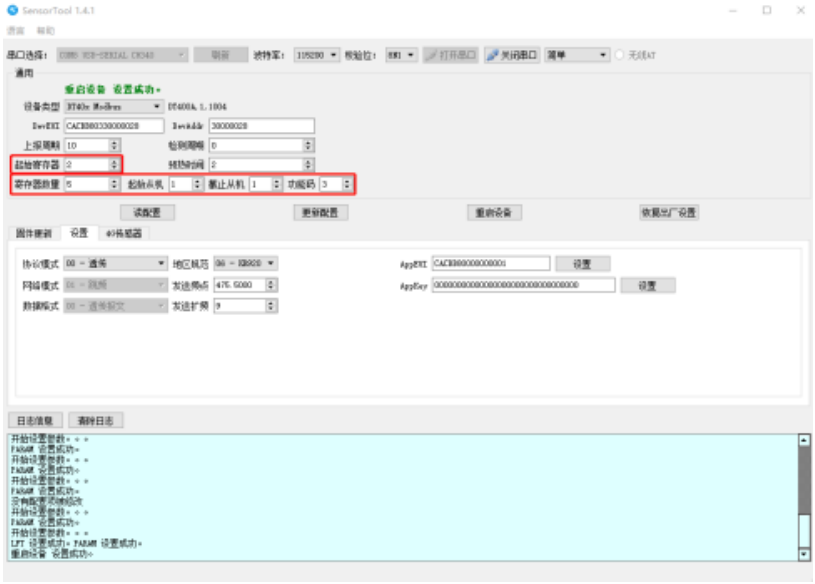
instructions of the Modbus slave device manufacturer for specific configurations.

When the device’ s reporting cycle expires, it will turn on the power in advance, preheat for a short period of time, and then read data from the sensor. The preheating time can be consulted with the corresponding sensor manufacturer. The collector defaults to using a 3-second preheating time, which can be configured.

The example of Modbus configuration is explained below. If a slave address is 1 and the function code 0x03 is used to read the data content of 5 registers from the device’ s register address 2, i.e. 0x0002. According to the standard Modbus format, we can know the corresponding Modbus read instructions as follows.
Collection instructions: 01 03 00 02 00 05 24 09

Address	Function code	Start register(H)	Start register(L)	No. of registers(H)	No. of registers(L)	CRC16(L)	CRC16(H
01	03	00	02	00	05	24	09

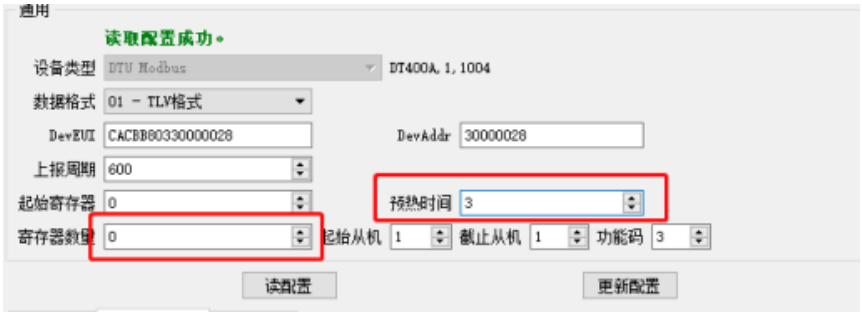
Users can use SensorTool to fill in the configuration through a graphical interface, as shown in the following figure.



4.3.2.Non-Modbus collecting

Non-Modbus collecting, the collector mainly controls the power supply of the slave device. During the warm-up time, the slave device actively outputs data to the host through RS485 for wireless transmission. If there is data output from the slave device or there is no data after the preheating time, the collector will turn off the power of the slave device and wait for the next reporting cycle time before reading.

As shown in the following figure, if the number of registers configured by the user is 0, the acquisition host does not generate Modbus read instructions, but instead waits for the reception of slave data and wireless forwarding by controlling the sensor power supply. The waiting time is the warm-up time.



4.4. Botton instructions

The device comes with a button for easy testing and on/off operation.

4.4.1.Turn on the device

There are two ways to turn on the device

1. Built in on/off botton：Turn the built in power botton from off to on, the device will turn on automatically.
2. If the external button soft shuts down, press and hold for 3 seconds to restart the device (the device indicator lights will light up from top to bottom and then turn off)

> *Under the button startup mode, the device will enter the wireless configuration waiting mode (the POWER green light is always on). At this time, the LoRa Dongle tool provided by Rejeee Intelligent can be used for wireless configuration. Please refer to Rejeee Intelligent’ s wireless AT operation document for details. If the user does not need to modify the configuration, they can press the button to interrupt the configuration and wait to directly enter normal operation mode.*

4.4.2.Turn off the device

There are two ways to turn off the device

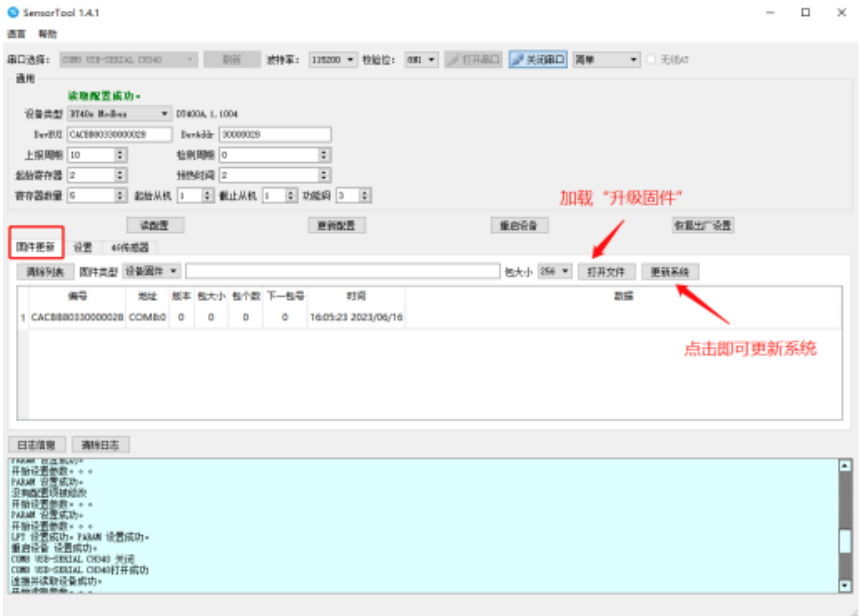
1. Built-in on/off botton, turn the built in power botton from on to offce, the device will turn off.
   2.Soft shutdown through external buttons. When the device is in normal operation, press the button and the POWER green light will light up. Until the button continues for 3 seconds, the device shuts down (the indicator lights are all on, and then turn off from bottom to top).

4.4.3.Trigger for data sending

By briefly pressing the button (between 0.1 and 3 seconds), it can be determined whether the device is in a power on or off state. It can also be used to test RS-485 data communication and wireless performance testing. If the device LED is not displayed by short pressing, the device is in a shutdown state. Otherwise, the device will first remain on, and then collect data and send it.

4.5. Firmware update

You can upte the firmware following this instruction：



5. Wireless data format

5.1.In general

In order to meet different application requirement, this device can support both LoRaWAN and Non-LoRaWAN.

5.1.1.Non-LoRaWAN

Header	DevAddr	FCtrl	SeqNo	Sensor Data1	...	Sensor DataN	CRC
1 Byte	4 Bytes	1 Byte	2 Bytes	Data 1	...	Data N	2 Bytes
Head	Device addr	Control character	Package no.	TLV(Refer to Type)	...	TLV(refer to Type)	CRC16=Header to Sensor DataN(e.g all the infor before CRC)

5.1.2.LoRaWAN

In order to save transmission bytes, duplicate or redundant data items are not reported in LoRaWAN mode, and only sensor data content is uploaded. As shown below, FRMPayload refers to sensor data in non LoRaWAN mode.

MHDR	FHDR	FPort	FRMPayload（SensorData）			MIC
			Data 1	...	Data N	
			TLV(Refer to specific types of SensorData)		TLV(Refer to specific types of SensorData)	

FPort：1
FRMPayload：eg. sensor data(Boday information)

5.2. Sensor data format

5.2.1.Sensor type instruction

Sensor type	Note
0x00~0x0F 和0xFF	Format（T+V), Basic sensor type, fixed data format, omitting length bytes
0x10~0x1F	Format（T+L+V），Universal type, retaining length to meet customized requirements
0x20~0x3F	Format（T+L+V），Customized projects require different content to be adapted to different projects
0x80~No-defined	Format（T+L+V），User parameter configuration and query, adapting different content to different projects

5.2.2.Basic sensor type list

Type	Value	Value description
Universal response 0xFF	2 Bytes	The first byte corresponds to the downstream instruction (the answered command) The second byte corresponds to the result

Type	Value	Value description
Dev informaiton 0x00	2 Bytes	Ignoring the length field to save bytes due to the known content of the device information package

5.2.3.Constomization type

Type 1 Byte	Length 1 Byte	Value N Byte	Value description
Business data 0x21	N	N Byte	Corresponding instructions for different project references
Modbus 0x24	N	N Byte	Modbus Responding info

5.3. Basic sensor data details

5.3.1 Device information（0x00)

Type	Value	Value	Value
1 Byte	3 bit	5bit	1 Byte
0x00	Version	Battery Level	Reserve

5.4.Customized sensor data details

5.4.1.Business data（0x21）

Type	Length	Value
1 Byte	1 Byte	N Byte
0x21	N	Actively reporting data from the slave

5.4.2.Modbus data（0x24）

In order to different Modbus and Non-Modbus business, there are 0x24 data type

Type	Length	Value
1 Byte	1 Byte	N Byte
0x24	N	Modbus reporting data from slave

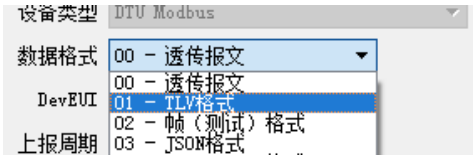
5.5.Device uploading example

DT400A from factory default is Non-LoRaWAN，The data content is a “TLV format” message, which includes the complete content of prefix parts such as protocol header, device address, and CRC suffix parts.

See as below, for the sensor data, mainly for dev infor（0x00) and 0x21（or 0x24)

Header	DevAddr	FCtrl	SeqNo	传感器数据(消息体)			CRC
1 字节	4 字节	1 字节	2 字节	数据 1	…	数据 N	2 字节
协议头	设备地址	控制字	包序号	Type+Data N Bytes	Type+Data N Bytes	Type+Data N Bytes	CRC16=首字节至 Body

If the user only needs sensor content, the data format can be modified to “transparent message”. The reported content will not include device packaging type length, etc., only the original reported content of the external RS485 slave device.



In LoRaWAN mode, the “TLV format” data only has FRMPayload, which is the sensor data section. Report 0x21 or 0x24 by default. If the data format is configured as “transparent message” as above, only the original report content of the external RS485 slave device will be reported.

5.6.CRC16

The CRC verification algorithm is as following:

```
static uint16_t get_crc16(uint16_t inData, uint16_t outData) {
  outData = (outData >> 8) | (outData << 8);
  outData ^= inData;
  outData ^= (outData & 0xff) >> 4;
  outData ^= outData << 12;
  outData ^= (outData & 0xff) << 5;
  return outData;
}

static uint16_t cal_crc16(const uint8_t *pData, const uint32_t len)
{
  uint32_t i = 0;
  uint16_t crc16 = 0xFFFF;
  for (i = 0; i < len; i++) {
    crc16 = get_crc16(*(pData++), crc16);
  }
  return crc16;
}
```

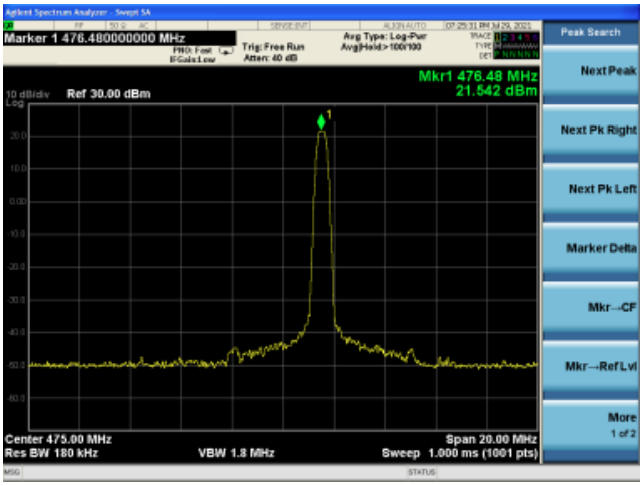
6.Performance testing

6.1.Sensitivity

SF	Sensitivity dBm，@BW=125K，470MHz
SF=7	-126

SF	Sensitivity dBm, @BW=125K, 470MHz
SF=8	-129
SF=9	-131
SF=10	-134
SF=11	-136
SF=12	-139

6.2.TX power testing



7.Package list

1.DT400A device
2.User manual
3.LoRa antenna
If the above accessories are lost, please contact the seller with the original packaging and accessories for replacement.

8. Version

Edit	Version	Note
2023.06	V1.0	First draft release