TZ-CT01 CO_2 Transmitter

User Manual V1.0

1. Overview

TZ-CT01 is a transmitter independently developed by our company to measure CO_2 concentration. The sensing element adopts NDIR dual beam infrared carbon dioxide sensor, which has a fast and sensitive response, avoiding the life and long-term drift problems of traditional electrochemical sensors, and is widely used in agricultural greenhouses, flower cultivation, edible mushroom cultivation and other occasions that require CO_2 monitoring.

TZ-CT01 CO_2 transmitter is designed based on RS485 communication interface, compatible with standard Modbus-RTU protocol, and can be connected to Modbus network to realize the measurement and monitoring of carbon dioxide concentration.

TZ-CT01 adopts the DIP switch to set the address, which avoids the need to use the host computer to set the address in advance, simple, convenient and easy to maintain and replace.

TZ-CT01 adds a display screen and indicator lights, users can see the current carbon dioxide concentration more intuitively.

2. Features

- High long-term stability using dual-beam NDIR sensor
- High sensitivity and strong anti-interference ability
- High precision and good consistency
- Long life and low drift
- Gas sampling compatible with diffusion and vented
- Standard Modbus-RTU protocol
- Strong interface defense capability and stable communication

3. Application areas

Generally used in indoor clean environment, such as:

- Indoor air quality monitoring
- Greenhouse farms, agricultural greenhouses
- Flower cultivation, edible mushroom cultivation

■ HVAC（Heating, ventilation and air conditioning）
■ DCV（Fresh Air Energy Saving System）

4. Technical data

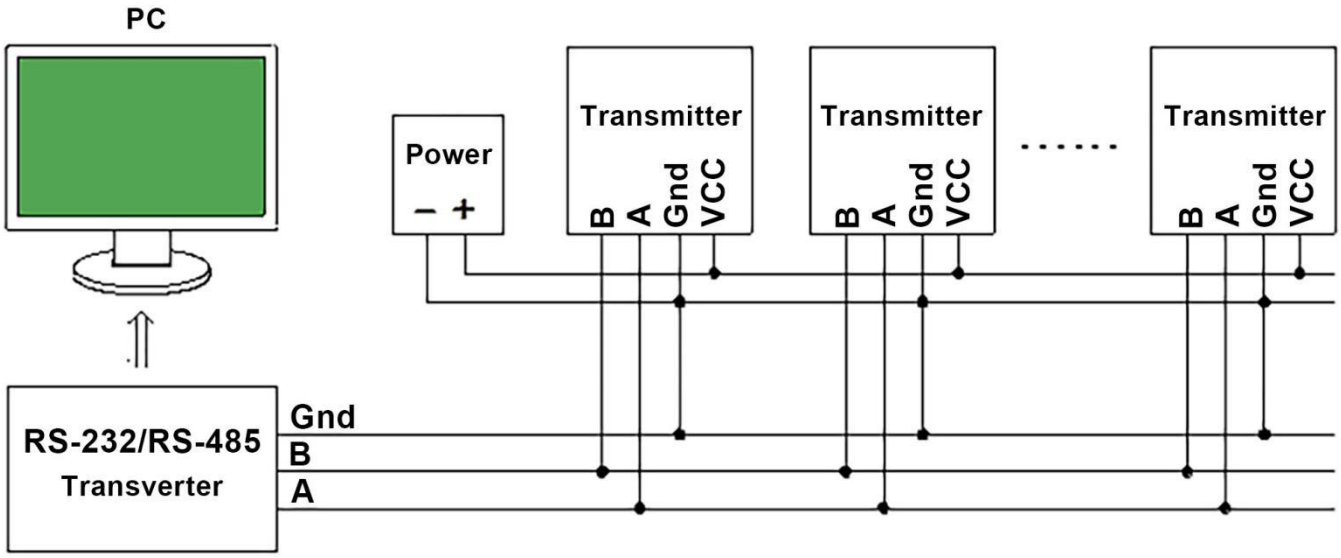
4.1 Specifications

Supply voltage	DC 5～36V
Sensing element	NDIR
Measuring range	0～10000ppm
Measurement period	2s
Measurement accuracy	±（50ppm+3% reading value）
Display screen	Keep the power on and the screen will turn on
Resolution	1ppm
Indicator light	Keep power on, it will be solid red
Transfer protocol	RS485 serial port, standard modbus RTU
Transmission rate	4800bps / 9600bps
Transmission distance	The standard maximum transmission distance is about 1200 meters (depending on the use environment, transmission material and transmission rate)
Number of theoretical nodes	32
Operating temperature range	0~50℃
Storage temperature	-20~60℃
Operating humidity range	0~95%
Storage humidity	0~95%
Dimensions	109mm x 67mm x 40mm

4.2 PC electrical connection

Lead	Label	Function description
Green	B-	RS485 interface B-
Yellow	A+	RS485 interface A+
Black	GND	Public ground (connect to the negative end of the power supply when DC power is supplied)
Red	V+	Power supply positive (connect to the positive end of the power supply when DC power is supplied)

4.3 Schematic diagram of connection with PC

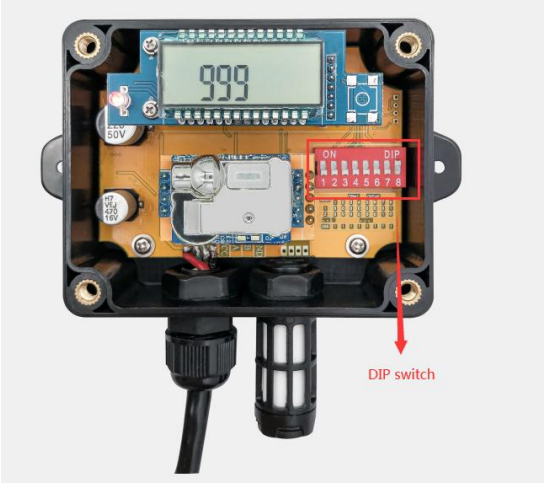


Note:

When setting up a RS485 network, pay attention to the RS485 grounding treatment to eliminate the common mode voltage. Suggest to connect the common ground of each transmitter together, and then connect it to the ground wire of the RS-232/RS-485 transverter, you can use the shielding layer of the shielded wire as the ground wire.

5. DIP switch and address code

Note: The above picture is a schematic diagram of the DIP switch. The DIP switch has 8 DIP positions. The corresponding numbers from 1 to 8 are 128, 64, 32, 16, 8, 4, 2, 1, and these values are added together as the address code. As shown in the figure above, bits 1, 3, and 4 are in the ON position, so the address code is 128+32+16=176, that is, the address code is 176.



First Step

Second Step

The above picture is a schematic diagram of the correct steps to turn on the DIP switch，
Step 1: Use a screwdriver to unscrew the screws in the four corners of the picture, as shown in the first step above.
Step 2: Turn on the DIP switch to set the address, as shown in the second step above.
The part circled on the left is the power communication interface. The connection method has been explained in the electrical connection in 4.3, please read it carefully.

Note:
You can specify when ordering, we will preset it for you.

6. Protocol

For the Modbus-RTU protocol, please refer to the relevant information, here is only a brief introduction.

6.1 Data frame format

Start bit	Data bit	Parity bit	Stop bit
1	8	0	1

Note:
The above is the default format of the transmitter. If you need other formats, please specify when ordering.

6.2 RTU information format

TZ-CT01 follows the RTU information frame protocol. In order to ensure the integrity of the information frame, a pause time of 3.5 characters or more is required at the beginning and end of each information frame (T1-T2-T3-T4, the time can be calculated based on the specified baud rate), each byte of the information frame needs to be transmitted continuously. If there is a pause time greater than 1.5 characters, the transmitter will treat it as invalid information and will not respond.

6.3 Information frame format

Start	Address	Function code	Data area	CRC check	End
T1-T2-T3-T4	1 byte	1 byte	N byte	2 byte	T1-T2-T3-T4

6.4 Register definition

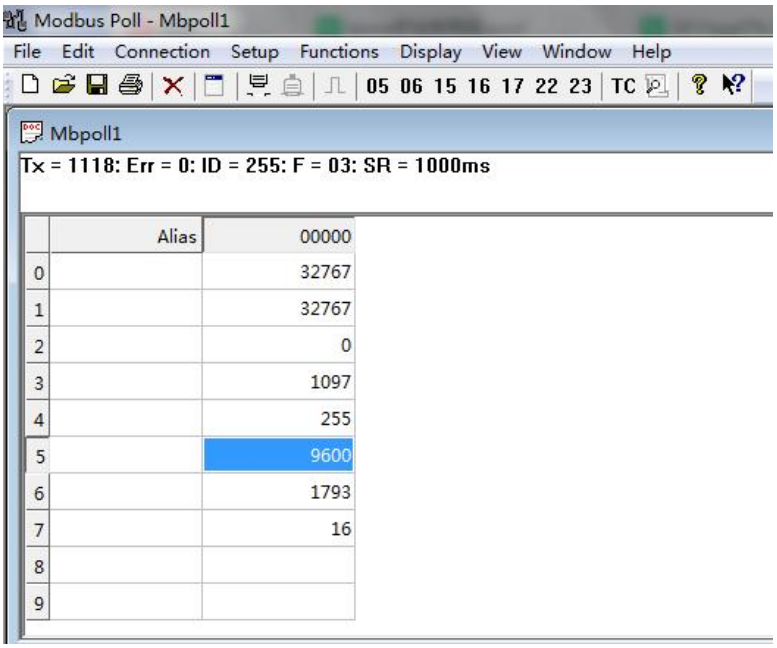
Register Address	Meaning	Description	Read and write
0	Temperature	The unit is 0.1 degree, MSB First, complement format, 7FFF H means the transmitter is abnormal	Read only
1	Relative humidity	The unit is 0.1%, MSB First,complement format, 7FFF H means the transmitter is abnormal	Read only
2	Reserved 1		Read only
3	CO_2 value	Unit ppm, MSB First, FFFFH means the transmitter is abnormal	Read only
4	RS485 address	Set by the DIP switch, the settable range is [1,255]	Read only
5	Baud rate	Support 4800bps/9600bps	Can read and write
6	Hardware version		Read only
7	Software version		Read only

6.5 Address setting

You can specify when ordering, we will preset it for you, or you can modify it by yourself through the dial switch.

6.6 Baud rate setting

You can specify when ordering, we will preset it for you, or you can modify it by yourself through the serial port assistant.



6.7 Host reads transmitter information (function code 03)

The transmitter allows the host to use the function code 03 to read the CO_2 concentration measurement value of the transmitter and other information. The information frame format of the 03 code is as follows：

Host request information frame

Field Description	Example
Slave address	FF
Function code	03
Register address high byte	00
Register address low byte	00
High byte of query quantity	00
Low byte of query quantity	08
CRC check code low byte	51
CRC check code high byte	D2

Transmitter response information frame

Field Description	Example
Slave address	FF
Function code	03
Return the number of bytes	10
Temperature data high byte	7F
Temperature data low byte	FF
Humidity data high byte	7F
Low byte of humidity data	FF
1 high byte reserved	00
1 low byte reserved	00
CO_2 concentration data high byte	04
CO_2 concentration data low byte	59
Address code high byte	00
Address code low byte	FF
Baud rate high byte	25
Baud rate low byte	80
Hardware version high byte	07
Hardware version low byte	01
Software version high byte	00
Software version low byte	10
CRC check code low byte	87
CRC check code high byte	AE

Data parsing

Temperature = 7FFFH = 32767, indicates no temperature data；

Humidity = 7FFFH = 32767, indicates no temperature data；

Reserved 1 = 0000H;

CO_2 concentration = 0459H=1113, indicating that the CO_2 concentration is 1113ppm;

Address code = 00FFH = 255;

Baud rate = 2580H = 9600;

Hardware version = 0701H;

Software version = 0010H = 16 = V1.6

Note! If users only want to read the CO_2 concentration or other registers, they only need to read the corresponding registers.

6.8 Host setting transmitter information (function code 06)

This device can currently set the baud rate (register address is 0005H), and the message frame format is as follows:

Host request information frame

Field description	Example
Slave address	01
Function code	06
Register address high byte	00
Register address low byte	05
Set value high byte	25
Set value low byte	80
CRC check code low byte	82
CRC check code high byte	FB

Transmitter response information frame

Field description	Example
Slave address	01
Function code	06
Register address high byte	00
Register address low byte	05
Set value high byte	25
Set value low byte	80
CRC check code low byte	82
CRC check code high byte	FB

Data parsing: Set the baud rate to 9600

6.9 Abnormal response

When the host sends request information to the transmitter, various errors may occur. At this time, the transmitter sets the highest position of the function code to 1, and then returns an error code. The host can determine whether an error has occurred by detecting whether the highest bit of the function code is 1.

Slave address	Function code	Error code	CRC check
1 byte	1 byte	1 byte	2 byte

Error code

01: Illegal function code

02: Illegal data address

03: Illegal data value

6.10 CRC check code

RTU mode uses CRC-16 check, the check code occupies 2 bytes, if the check code is wrong, the transmitter will ignore the host's request and not respond.

The calculation method of CRC-16 check code is as follows:

① Preset a 16-bit register as hexadecimal FFFF, call this register CRC register;

② XOR the first 8-bit binary data (the first byte of the information frame) with the lower 8 bits of the 16-bit CRC register, and place the result in the CRC register;

③ Shift the content of the CRC register one bit to the right (toward the low bit) and fill the highest bit with 0, check the right shift out position after shift;

④ If the shifted out bit is 0, repeat step ③ (shift one bit to the right again), if the shifted out bit is 1, the CRC register is XORed with the polynomial A001 (1010 0000 0000 0001);

⑤ Repeat steps ③ and ④ until the right shift is 8 times, so that the entire 8-bit data has been processed;

⑥ Repeat steps ② to step ⑤ to process the next byte of the message frame;

⑦ After calculating all the bytes of the information frame according to the above steps, the content of the CRC register obtained is: 16-bit CRC check code.

7. Dimensions (unit: mm)