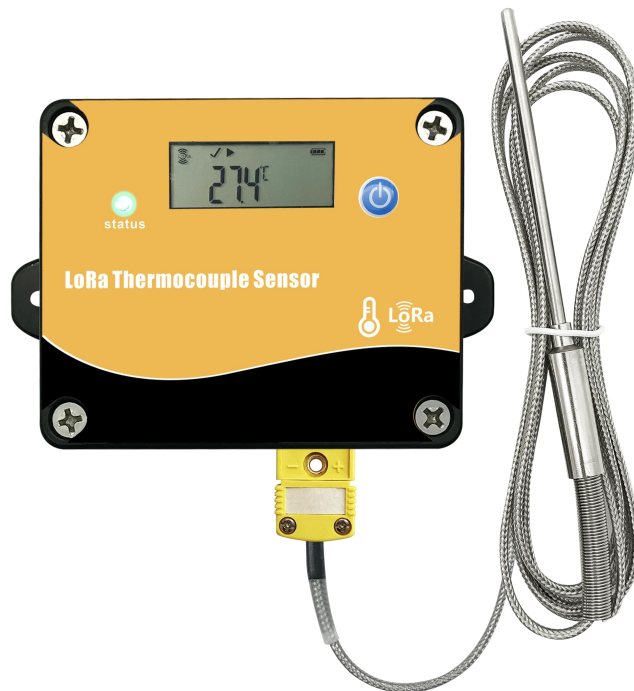


TZ-Tag09 LoRaWAN

---User Guide 1.1



1. Overview

TZ-Tag09 LoRaWAN is a high quality Thermocouple Sensor designed by Tzone Digital Technology Co., Ltd. Its features include long range(5km), compact enclosure (106mm*57mm*33mm), long battery life, simple installation, stable and reliable. The product sends out data by LoRaWAN protocol. TZ-Tag09 collects temperature data and transmits it periodically via LoRaWAN technology. While the gateway receives, packages and sends the data to the cloud. It realizes real-time data transmission and storage at the same time. TZ-Tag09 is equipped with LCD, LED and buzzer for more intuitive viewing of temperature data, RSSI signal strength, battery power, as well as sound and light alarms etc. It could be widely used in temperature monitoring applications with LoRaWAN Gateway.

2. Application

1. Freezer, refrigerator, etc.;
2. Agricultural greenhouse;
3. Plant and workshop;
4. Cold chain reefer and refrigerated trailer;
5. Pharmacy warehouse and laboratory;
6. High temperature area such as steel making furnace and coke oven;
7. Refining petroleum and producing chemical raw materials;
8. Pipe temperature measurement and tank temperature measurement.

3. Feature

1. Dual channels, K-Type thermocouple, strong anti-interference ability, and quick response;
2. Wide measuring range, good linearity, high precision and long service life;
3. LoRa communicating module uses the new generated LoRa chip from American Semtech, with strong sending power, powerful penetrability and low attenuation;
4. The data sending interval could be set by customers from 1 minute to 1440minute, with widely application;
5. The sensor has 3 working modes: Normal mode, low voltage mode, Temp alarming mode, more effective and more intelligent to complete temperature monitoring;
6. Built-in high performance li-socl2 battery, long time stand-by and stable performance. The electricity is less than 5uA when in the sleep mode, it is equipped with a super capacitor to effectively realize the full utilization of the battery, and solve the problem of battery instability at high and low temperatures;
7. All the data collected by the sensor can be stored in memory, and can be read out through USB;

8. Using FDMA, TDMA and other technologies to avoid wireless conflict;
9. Ensure data is not lost with ACK function;
10. When disconnected, it will automatically updates the sending interval to reduce power consumption;
11. It supports to receive the command from gateway to set parameters.
12. With LCD display, the message(temperature data, RSSI signal strength, battery power etc.,)can be visually viewed;
13. The buzzer will alarm when the temperature exceeds the limit.

4. Feature Advantages of LoRaWAN over LoRa proprietary protocols

LoRaWAN is a set protocol standards mainly rely on MAC based on the LoRa physical layer transmission technology .With the standard, LoRaWAN has been a network technology. The technology contains LoRaWAN node, LoRaWAN gateway and LoRaWAN protocol ,data cloud platform. When using the LoRaWAN network products, there are two interface for user:One is a data interface between the underlying sensor and the LoRaWAN node, through which sensor data is passed to the network;the other is LoRaWAN protocol and data cloud platform and the user's application has a data interface between the network data transfer application.

LoRaWAN provides multi-channel access, frequency switching, adaptive rate, channel management, timing send and receive, node access authentication and data encryption, roaming and other features. In addition to the advantages of long distance transmission and low power consumption in the physical layer, the following advantages are obtained compared to the transmission method using only the physical layer of the LoRa:

1. Compatible. Different sensor nodes from different manufacturers can access the same LoRaWAN network, and the interface between the LoRaWAN protocol and the data cloud platform is unified. For application developers in terms of custom development without the development of all sensors, shorten the development cycle, reduce R & D costs, to deliver quickly.

2. Large network capacity. Through multi-channel access, frequency switching, adaptive rate LoRaWAN network relative to the physical layer based on the LoRa point-to-point or multi-point application of data capacity, access nodes can be more scalability. It is good for application developers to develop large-scale applications and continuous upgrade applications.

3. Good safety. LoRaWAN network design nodes access authentication, data encryption and other security mechanisms. These mechanisms, reviewed by industry experts and validated by multiple applications by various technology companies worldwide, are much more secure than ad hoc agreements with application developers. For the application of continuous security protection.

5. Specifications

Item	Feature
Battery	Built-in 4000mAh/3.6V
Range of Thermocouple probe measuring	Type K: 0°C ~ 1000°C
Accuracy of Thermocouple	Type K: [0°C ~ 333°C], ±2.5°C [333°C ~ 1000°C], ±0.75%
Device working environment	-30°C~+60°C ; 0%RH ~ 85%RH(non condensing)
RF Frequency	470/868/915Mhz(optional)
Modulation	LoRa
Communication protocol	LoRaWAN v1.02
Maximum Range in Open Area	5KM
Transmit Power	20dbm(adjustable)
Transmit Interval	1min-1440mins(user definable)
Low Voltage Alarm	Yes (user definable)
Temp/RH Alarm	Yes (user definable)
Stand-by Current	<5uA
IP Level	IP54
Memory Capacity	50000
Battery Life	3 years (in 15mins interval)
N.W.	135g
Dimension	109mm*69mm*40mm

6. Working Mode

Working Mode	Working Status
Normal Mode	LoRa Sensor will collect the temperature at a set collection interval and send it out via the LoRa communicating module.
Low voltage mode	Device will send data each 30mins (adjustable) after entering low voltage mode, voltage lower than 2.2V (adjustable), please change new one ASAP.
Temp alarming mode	When the ambient temperature exceeds the range set by the user, the transmitter can collect and send data at a relatively fast interval, which is convenient for customers to record the change of the ambient temperature.

P.S.: Priority: Temp alarming mode > Low voltage mode > Normal mode

7. Device status when sending data

The device LED will flash once when the device is sending a packet of data, and the Send icon will display on LCD.

LED bright status:

Green: normal.

Red: Something wrong with device, such as temperature exceed the limit, low voltage.

LCD display please refer 9.LCD display indication

8. Function of Button

Mode	Operation	Device status	Indication
ON	Keep button pressed for 3s	1. The green LED bright in 5s 2. LCD display turn on	The device starts sending data

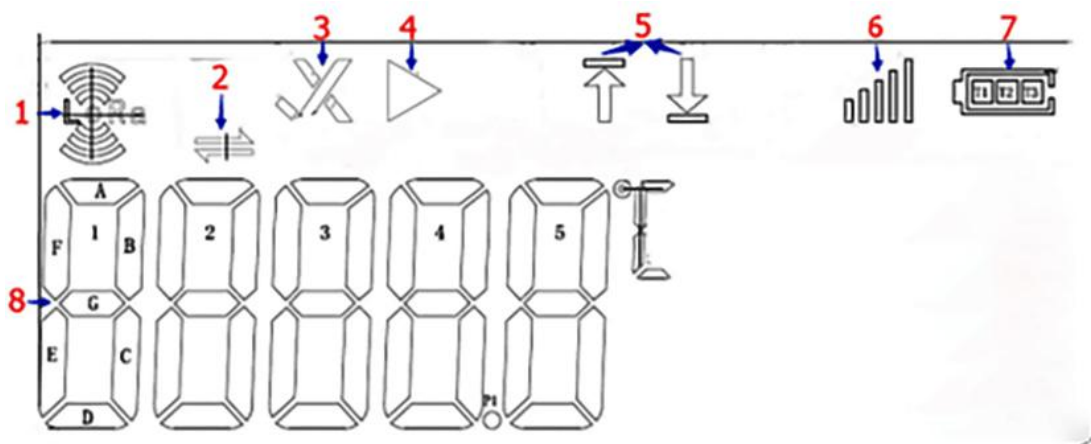
OFF	Keep button pressed for 3s	1. The red LED bright in 5s 2. LCD display turn off	The device stops sending data
Data Send	Press shortly	LED bright one time	Only valid in Boot mode LED flash status when sending data: abnormal(red),normal(green)

9. LCD Display Indication


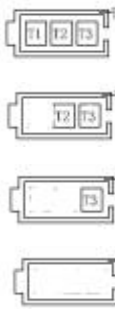
Shutdown mode: the LCD doesn't display.

Boot mode: the LCD displays.

LCD will display LORA icon, Send icon, Temperature alarm icon, Running status, Temperature icon, RSSI signal icon, Battery status, Temperature information.



NO.	Function	Indication
1	LORA icon	LORA Sensor
2	Transmission icon	It flashes when sending data,and then off
3	Temperature alarm icon	Normal: √ Alarm: ×
4	Running status	▷ Start running
5	Temperature icon	Upper limit: ↑ Lower limit: ↓ Upper Lower limit: ↑↓

6	RSSI signal icon	 <p>Very strong signal</p> <p>Strong signal</p> <p>Good signal</p> <p>General signal</p> <p>Poor signal</p> <p>The RSSI value is updated every time the gateway response after receiving the data, so the RSSI value is not displayed,if you don't turn on ACK or no response</p>
7	Battery level	 <p>Full battery</p> <p>High battery</p> <p>Medium</p> <p>Low</p>
8	Temperature	<p>Unit: °C,°F optional (configured by 09 command)</p> <p>Resolution: 0.1</p> <p>When abnormal, it display-----</p>

10. Buzzer working mode

When temperature exceeds the limit, the buzzer rings with bee-bee sound.

Open instruction:1. 03 command

2. 36 command

How to close buzzer:

1.Temperature return to normal

2.Press button shortly;

3.Enter configuration mode;

4.Turn off;

5.The USB sends a close instruction

6.The gateway sends a close instruction

7.The buzzer working time has ended

PS:

The buzzer will not ring again until next abnormal temperature (the temperature returns to normal first and then abnormal).

The buzzer function is off by default. Please turn it on if you need.

The buzzer with high power consumption, it will reduce battery life, Please set this function according to your application.

11. Command list

Note: After setting the command, must set #DS to take effect.

Command	Format	Note
Low voltage alarming function	*01,A,X,Y#	A:0 disable this function 1 enable this function (default) X:low voltage threshold , [2000-3600],unit: 1mV, default 2200 Y:transmit interval after low voltage alarming, [1-60],unit min,default 30
Set heartbeat package interval	*02,X#	X:[1-60],unit min, default 15
Set high/low temperature alarming function	*03,A,X,Y,Z#	A=0: disable this function (default) A=1: enable this function X: high temperature threshold, [-1700-1700], unit: °C, default:100; Y: low temperature threshold, [-1700-1700], unit:°C, default:0; Z:transmit interval after temperature alarming, [1-1440], unit:min, default:1
Set the device time	*04,A,B,C,D,E,F#	A:year, [1976-2099],unit: yer B:month, [1-12],unit: month C:day, [1-31],unit: day D:hour, [0-24],unit: hour

		E:minute, [0-59],unit: minute F:second, [0-59],unit: second
Set up communication channel(868MHz)	*05,A,B,C,D#	A:The default access channel 1 Default:868100000Hz B:The default access channel 2 Default:868300000Hz C:The default access channel 1 Default:868500000Hz D:The default RX2 receiving channel:869525000Hz A、 B、 C、 D[86300000-870000000] unit:Hz
Set up 8 continuous communication channel(915MHz)	*05,A1,A2,A3,A4,A5,A6,A7,A8,RX2#	A1-A8:The number of the channels [0-95]default:0,1,2,3,4,5,6,7 Corresponding to the TX frequency:902.3+A*0.2 RX2: RX2 receiving frequency Default:923300000Hz unit:Hz
Set up 8 continuous communication channel(470MHz)	*05,A1,A2,A3,A4,A5,A6,A7,A8,RX2#	A1-A8:The number of the channels [0-95]default:0,1,2,3,4,5,6,7 Corresponding to the TX frequency:470.3+A*0.2 Corresponding to the RX frequency :500.3+A*0.2 RX2: RX2 receiving frequency Default:505300000Hz unit:Hz
Set transmitting power	*06,A,B#	A:0 disable this function (default) 1 enable this function B:power value, [0,3], default:0 0:20dbm 1:17dbm 2:14dbm 3:11dbm
Set the maximum data sending delay time	*07,X#	X: delay time, [0,300], unit: second, default: 180
Set the time interval for reading temperature	*08,X#	X:[0,65535],unit:second, default:0 0 indicates that temperature and

		humidity data are taken at irregular intervals, and temperature and humidity data are not obtained until the transmission interval
Extend setting	*09,ABCDEFGH#	A=0, disable ACK function ; A=1, enable ACK function, it must be used with the gateway(default); B=0, C=0,The TAG temperature shows Celsius(default); C=1,The temperature data shows Fahrenheit; D=0; E=0; F=0;
Set APPEUI	*11,X#	X: APPEUI 16 digital, default: 545A4C5208170101
Set APPKEY	*12,X#	X: APPKEY 32 digital; default: 2B7E151628AED2A6ABF7158 809CF4F3A
Set work mode	*35,X#	X=0,turn off(default) X=1,turn on
Set buzzer beep time	*36,X#	X:beep time [0,65535],Unit:second,0 means the buzzer is not working(default); 65535 means the buzzer will work until the temperature return to normal
Turn off the buzzer	*37,0#	
Set the sending protocol	*40,X#	X=0,simple data protocol; X=1,included RTC time, humidity unit is %; X=2,not including RTC time, humidity unit is % (default); X=3,included RTC time, humidity unit is 0.1%; X=4,not including RTC time, humidity unit is 0.1%;
Set the temperature	*42,A,X#	A=0, Disable calibration;

and humidity calibration value		(default) A=1, Enable calibration; X:Temperature calibration value; If the calibration value is added to the temperature, it begins with +; If the calibration value is reduction to the temperature, it begins with -; Can support to one decimal point, unit: °C
Set sensor type (Single sensor)	*50,X#	X: The sensor type, 0-K type thermocouple, default; 1-T thermocouple;
Set sensor type (Dual sensor)	*50,X,Y#	X: The first sensor type, 0-K type thermocouple, default; 1-T thermocouple; Y: Type of the second sensor, 0-K type thermocouple, default; 1-T thermocouple; Note: Only the thermocouple version is currently supported;
Save command	#DS	
Search single command	#D5X	X:command
Search all commands	#DE	
Quit configuration	#DQ	
Into firmware upgrade mode	#DU	
Query current temperature	#DT	
Print the stored readings	#DP	Automatically delete log data after reading
Delete all the stored readings	#DA	
Query current time	#DB	
Query Device EUI	#DC	
Query firmware version	#DV	
Default setting	#DO	All commands except 04 05 21 are restored to default Settings
Reboot device	#DR	

12. How to use the device

The sensor is in OTA mode, please register the device in the sever of LoRaWAN after getting it.DEVEUI can be seen in the label of the sensor,APPEUI is 545A4C5208170101,and APPKEY is 2B 7E151628AED2A6ABF7158809CF4F3A,

also can be set by yourself,The sensor needs to be configured with the same APPKEY and APPEUU (commands 11 and 12) as on the server.It can be normally used when the sensor successfully connect to the Internet. Please use 04 command to set RTC time if customer need the correct stored history readings.

The factory setting of the sensor is off mode by default,Please refer to the button function after you get it,press and hold the button for 3s to start up,and the sensor will automatically send data to the gateway,The data transmission interval is 15 minutes by default, if you want to send data quickly,please press the button shortly.TZ-Tag09 is a data sender,which should work with LoRaWAN Gateway.If the sensor is successfully connected to the network, it can be used normally.

If you want configure parameters , Please open the upper cover of device,and insert our configure line,at this time the green LED is bright which indicating the device has entered the configuration mode.For detailed configuration instructions and configuration methods,please refer to"TAG09" Configure Software Manual.

14. Data format

1. The standard data protocol (default)

Single sensor : Start+State + battery voltage + Temperature+RTC time

Dual sensor: Start+State + battery voltage + Temperature1+ Temperature2+RTC time

- Start: 1 byte , 0x11

- TAG status: 1 byte (convert to binary)

bit7: Battery voltage status, 1-low Voltage, 0- Voltage normal;

bit6: Temperature status,1- Temperature more than set high and low temperature threshold, 0-Temp normal;

bit5:The key status,1-Press button,0-don't have press button;

bit4:Whether an ACK reply is required,1-need,0-needn't;

bit3:Whether RTC time is included,1-contains,0-ontains,doesn't contains;

bit2:This packet is the first packet of data on boot,1-yes,0-no;

bit1-bit0: reserved;

- Battery voltage: 1 byte, unit:10mv, this value=actual value-150,

For example:0xce means 3.56v(convert to decimal).

- Temperature:2 byte, convert to binary, the first bit of temperature means

normal/abnormal(0-normal,1-abnormal); the second bit of temperature means positive(+)/negative(-) (0-positive,1-negative) ; after the third bit of temperature means real temperature, unit:0.1°C(convert to decimal);

For example: 01 64 means +35.6°C, 41 64 means -35.6°C, 80 00 means abnormal;

- RTC time:6 byte, format is year+month+day+hour+minute+seconds,this data is optional, set by command 40;

2. The simple data protocol

State + battery voltage + Temperature

- TAG status: 1 byte (convert to binary)

bit7: Battery voltage status, 1-low Voltage, 0- Voltage normal;

bit6: Temperature status,1- Temperature more than set high and low temperature threshold, 0-Temp normal.

bit5:The key status,1-Press button,0-don't have press button

bit3:Whether RTC time is included,1-contains,0-ontains,doesn't contains;

bit2:This packet is the first packet of data on boot,1-yes,0-no;

bit1-bit0: reserved;

- Battery voltage: 1 byte, unit:10mv, this value=actual value-150,

For example:0x0e means 3.56v(convert to decimal).

- Temperature:2 byte, convert to binary, the first bit of temperature means normal/abnormal(0-normal,1-abnormal); the second bit of temperature means positive(+)/negative(-) (0-positive,1-negative) ; after the third bit of temperature means real temperature, unit:0.1°C(convert to decimal);

For example: 01 64 means +35.6°C, 41 64 means -35.6°C, 80 00 means abnormal;

15. LORAWAN Gateway downward command

LORAWAN Gateway downward command

Start+ downward command +command content+Check code

Start:0xF0;

downward command:1 byte;

Command content:X byte;

Check code:1 byte, the previous data sum

Please refer to the following table for the specific format. If there is no special indication, the following table adopts hex format, MSB First.

Command	Command function	downward command	Note

1	Low voltage alarming function	F0 01 A X Y CHECKSUM	A:0 disable this function 1 enable this function X:low voltage threshold, [2000-3600],unit: 1mV,2 byte Y:transmit interval after low voltage alarming, [1-60],unit min,2 byte
2	Set heartbeat package interval	F0 02 X CHECKSUM	X:[1-60],unit min,2byte
3	Set high Temp alarming function	F0 03 A X Y Z CHECKSUM	A:0 disable this function 1 enable this function X:high temp threshold , [-1700-1700],unit: °C, 2 byte; Y:low temp threshold , [-1700-1700],unit: °C, 2 byte; Z:transmit interval after temp alarming , [1-60],unit min,2 byte;
4	Set the device time	F0 04 Y M D H M S CHECKSUM	A:year,unit:year,1 byte B:month,unit:month,1 byte C:day,unit:day,1 byte D:hour],unit:hour,1 byte E:minute,unit:minute,1 byte F:second,unit:second,1 byte
5	Set up communication channel(868M Hz)	F0 05 A B C D CHECKSUM	A:The default access channel 1 B:The default access channel 2 C:The default access channel 3 D:The default RX2 receiving A、 B、 C、 D[86300000-870000000] 4 byte,unit:Hz
5	Set up 8 continuous communication channel(915M Hz)	F0 05 A1 A2 A3 A4 A5 A6 A7 A8 RX2 CHECKSUM	A1-A8:The number of the channels [0-95], 1 byte Corresponding to the TX frequency:902.3+A*0.2 RX2: RX2 receiving frequency 4 byte,unit:Hz
5	Set up 8	F0 05 A B C D	A1-A8:The number of the

	continuous communication channel(470M Hz)	CHECKSUM	channels [0-95], 1 byte Corresponding to the TX frequency: $470.3+A*0.2$ Corresponding to the RX frequency : $500.3+A*0.2$ RX2: RX2 receiving frequency 4 byte,unit:Hz
6	Set transmitting power	F0 06 A B CHECKSUM	A:0 disable this function 1 enable this function B:power value, [0,3], 0:20dbm 1:17dbm 2:14dbm 3:11dbm
7	Set the maximum data sending delay time	F0 07 X CHECKSUM	X: delay time, [0,300], unit: second, 2 byte
8	Set the time interval for reading temperature	F0 08 X CHECKSUM	X:[0,65535],unit:second, default:0 0 indicates that temperature and humidity data are taken at irregular intervals, and temperature and humidity data are not obtained until the transmission interval
11	Set APPEUI	F0 0B X CHECKSUM	X:8byte
12	Set APPKEY	F0 0C X CHECKSUM	X:16byte
40	Set LORA data protocol	F0 28 X CHECKSUM	X=0,simple data protocol; X=1,included RTC time, humidity unit is %,(default); X=2,not including RTC time, humidity unit is %; X=3,included RTC time, humidity unit is 0.1%; X=4,not including RTC time, humidity unit is 0.1%;
50	Set sensor type (Single sensor)	F0 32 X CHECKSUM	X: The sensor type, 0-K type thermocouple, default; 1-T thermocouple;
50	Set sensor type (Dual sensor)	F0 32 X Y CHECKSUM	X: The first sensor type, 0-K type thermocouple, default; 1-T thermocouple;

			Y: Type of the second sensor, 0-K type thermocouple, default; 1-T thermocouple; Note: Only the thermocouple version is currently supported;
253	Search command	F0 FD X CHECKSUM	X:The command to query,1byte
255	Restart the LORA module	F0 FF 00 CHECKSUM	After setting the LoRa parameters (such as command 05,11,12), send this command to restart the LoRa module

Reply to the LORAWAN Gateway downward command

Start+ downward command +command content+Check code

Start:0x30;

downward command:1 byte;

Command content:X byte;

Implementation results:

If the command is set, then 1 byte, 0x00 means successful setting, 0x05 means no command, 0x08 means wrong parameter;

If it is query command, it is the query command+the query result+the contents of the command

Command content: if the query result is 0x05 or 0x08, there is no such data

Check code:1 byte, the previous data sum

16. Notes

1. Being close to a metal object will interfere with the signal, causing the signal to be weakened.
2. Please keep away from water and corrosive chemicals.
3. Please tell us your application and configuration requests, we will try to configure it well before delivery and guide you how to install properly.