# SCM-TP1000
# Temp & PD Monitoring System

## User Manual


**Version: 1.12**

**Revision: 2025.1**

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# Read me

**When you use the product, be sure to read this user manual carefully, and be able to fully understand the implications, the correct guidance of operations in accordance with user manual, which will help you make better use of the product, and help to solve the various problems at the scene.**

1. Before the meter turning on the power supply, be sure that the power supply within the provisions of the instrument;

2. When installation, the current input terminal must non-open, voltage input terminals must Non-short circuit;

3. Communication terminal (RS232/RS485) is strictly prohibited to impose on high pressure;

4. Be sure the instrument wiring consistent with the internal system settings;

5. When communicating with the PC, instrument communication parameters must be consistent with the PC.

- **Please read this user manual carefully**
- **Please save this document**

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# Directory

# 1.- SUMMARIZE

The SCM- TP1000 is an integrated monitoring device combining partial discharge (PD) detection and wireless temperature sensing, developed for medium and high voltage switchgear. It provides real-time monitoring of switchgear partial discharge, ambient temperature/ humidity/ noise and busbar thermal conditions to enhance equipment reliability and safety. High-precision sensors and advanced algorithms ensure accurate detection of PD events and busbar temperature anomalies, with support for historical data logging, fault SOE records, and waveform analysis.

Its modular design supports two display modes: by switchgear or by sensor group. Built-in alarm logic and relay output allow flexible deployment. RS485 with Modbus RTU protocol enables reliable long-distance communication and seamless SCADA integration.

## FEATURE

- Integrated wired/ wireless PD and busbar temperature monitoring;
- Supports RS485 Modbus-RTU communication;
- Switchgear or sensor group display modes;
- Real-time and historical waveform display;
- Max 99 lists fault SOE recording with waveforms;
- Switchgear ambient condition monitoring
- Up to 24 groups temperature sensor;
- Up to 6 groups PD sensor (AA, TEV, UHF);
- Up to 6 switchgear busbar temp & PD status monitoring
- Configurable alarm logic and thresholds;

## APPLICATION

- Medium-voltage switchgear monitoring;
- Distribution transformer compartments;
- Industrial power distribution systems;
- Smart substation environments;
- New energy power stations;
- Remote or unmanned substations;
- Commercial building power distribution;

# 2.- TECHNICAL PARAMETERS

| **HMI electrical specification** | |
|---|---|
| Auxiliary power | 85-265Vac/dc, optional 20-60Vdc, 45-65Hz |
| Power consumption | Max<6W |
| Communication | RS-485, MODBUS-RTU |
| Digital output | 2* relay for alarm/trip, 5A@250VAC, passive node |
| Dimensions (W × H × D) | 144*144*100mm |
| Open install hole | 138*138mm |
| Working environment | -10 ~ +60°C; 20% ~ 95% RH (No condensation) |

**Temperature related parameters**

| **Receiver of Temperature data** | |
|---|---|
| Power supply | 5VDC |
| Wireless communication frequency | 433MHZ |
| Wireless temperature sensor unit | Standard type 3-12 |
| Sampling period | 5min |
| Distance of receiver and HMI | Up to 80m (260 feet) |
| **Wireless temperature sensor** | |
| Temperature monitor range | 0°C ~ 99°C, Accuracy ±1°C |
| Transmit power | Less than 10mW |
| Power supply | Battery powered, 1200mAh for 2-4 years |
| Working environment | -10°C ~ +60°C; 20%~95% RH (No condensation) |
| Storage environment | -25°C ~ +70°C; 20%~95%RH (No condensation) |

**PD related parameters**

| **Wired PD sensor** | |
|---|---|
| Power supply | 12VDC |
| Static power consumption | <10mW |
| Installation method | 4* strong magnet, wall mount |
| Sampling period | 5s |
| Communication | RS485/ Modbus RTU |
| Dimension | 134mm*100*42mm |
| Operating temperature | -40~85°C |

| **Receiver of PD data** | |
|---|---|
| Power supply | 5VDC |
| Networking mode | LORA self-organizing network |
| Uplink communication protocol | RS485/Modbus-RTU |
| Distance of receiver and HMI | Up to 80m (260 foot) |
| **Wireless PD sensor** | |
| Power supply | 7.2V 3000mAh build in battery* |
| Wireless band | 433MHz ~2.4GHz optional |
| Signal transmission distance | Up to 80m (260 feet) |
| Static power consumption | <10mW |
| Installation method | 4* strong magnet, wall mount |
| Sampling period | 2 hours |
| Data upload cycle | 2 hours |

**Wired and wireless PD sensor common parameters**

| | |
|---|---|
| **Ultrasonic data (AA)** | |
| Detect range | 0 ~ 60dBμV |
| Pass band | Center frequency 40 kHz ±1 kHz |
| **TEV data** | |
| Detect range | 0~60dBmV |
| Pass band | 3~100MHz |
| **UHF data** | |
| Detect range | -70~10dBm |
| Pass band | 300~1500MHz |
| Average effective height | ≥10mm |
| **Switchgear ambient data** | |
| Noise detection range | 30~80dB (Class C) |
| Temp. measurement range | -40~85°C; Accuracy±0.5°C |
| Humidity measurement range | 5~95%RH; Accuracy ±2%RH |

# 3.- FUNCTION DESCRIPTION

## 3.1.- Partial Discharge Monitoring

The PD sensor has wired/ wireless version, it integrates ultrasonic (AA), transient earth voltage (TEV), and ultra-high frequency (UHF) detection to monitor diverse partial discharge (PD) phenomena. Each sensor targets specific discharge types: surface, internal, or corona by capturing acoustic, electromagnetic, or UHF signals. Data is locally digitized and transmitted via RS-485 using the Modbus RTU protocol, ensuring reliable, low-latency communication even in high-interference environments.

**-. Wired PD sensor optional model: default SCM-PDS3**

| | |
|---|---|
|  | • **SCM-PDS2:** Any two of AA/TEV/UHF can be selected<br>• **SCM-PDS3**: AA / TEV / UHF Three-in-one PD sensor |

**-. Wireless PD sensor data transmission via LoRa**

The wireless PD sensor communicates with the data receiver through the LoRa double encrypted wireless receiver to monitor the partial discharge signal of the switchgear. The data uploaded includes: partial discharge peak value, partial discharge average value, discharge times, alarm signal and battery power of the device.


| | |
|---|---|
|  | • **SCM-PDS2W:** Any two of AA/TEV/UHF can be selected<br>• **SCM-PDS3W**: AA / TEV / UHF Three-in-one PD sensor |

### 3.1.1- Partial Discharge Monitoring Method

**-. Ultrasonic measurement (AA)**

Partial discharges generate acoustic signals (20-200kHz) through mechanical stress oscillations in dielectrics. This sensor employs piezoelectric ceramic elements to detect vibrations via surface coupling with switchgear structures. Maintaining intimate contact with the switchgear surface is essential for optimal acoustic wave transmission efficiency, making it suitable for surface discharge monitoring in switchgear.

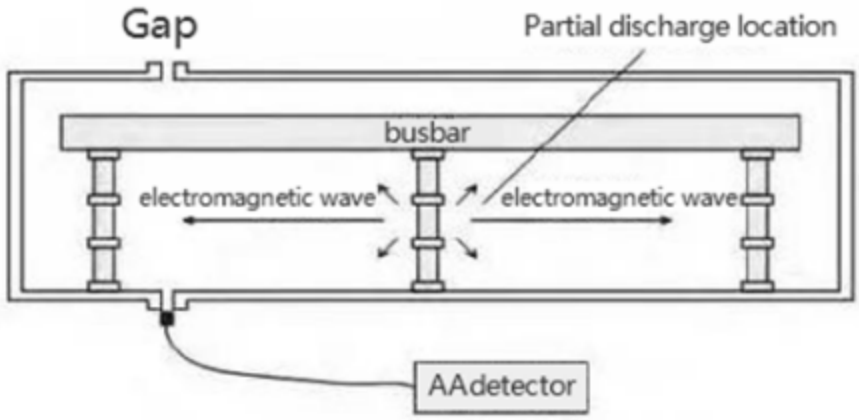



**Figure 1. Ultrasonic detection mechanism**

**Insulation condition of switchgear:**

| Data | Definition |
|---|---|
| -6~0dBuV, no discharge sound | No partial discharge. |
| 0 ~ 60dBuV, short discharge sound | Slight discharge,<br>and attention should be paid to it later. |
| Above 60dBuV, have discharge sound | Obvious discharge,<br>should be judged in combination with TEV. |

**Note:**

The demarcation point (60dBuV) is slightly different in different regions, so it is recommended to use 60dBuV as the demarcation point, so that the operating status of the switchgear can be warned in advance.

**-. TEV measurement**

Partial discharges excite 3-100MHz electromagnetic waves on metal switchgear surfaces, which convert to Transient Earth Voltage (TEV) at insulation discontinuities. Utilizing capacitive coupling sensors for non-intrusive signal acquisition, TEV amplitude correlates with discharge magnitude and attenuation along the propagation path. This method is specifically designed for surface discharge detection in metal-enclosed equipment.

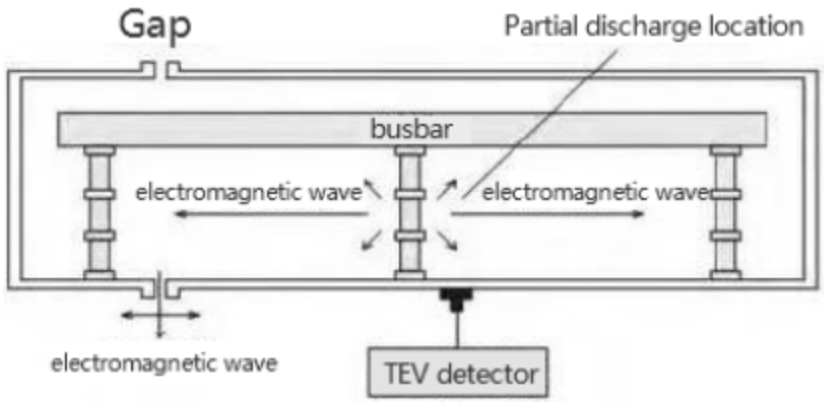



**Figure 2. TEV detection mechanism**

**Insulation condition of switchgear:**

| Data | Definition |
|---|---|
| The reading is <20dB. | No partial discharge, |
| The reading is 20-29dB. | Slight discharge. |
| The reading is 29-40dB. | Moderate partial discharge should report and shorten the inspection cycle. |
| The reading is 40-50dB. | Serious partial discharge should report and shorten the inspection cycle and be checked when power failure. |
| The reading is 50-60dB. | Severe partial discharge, power outage and maintenance as soon as possible. |

**-. UHF measurement**

This technique detects nanosecond-scale discharge pulses (<1ns rise time) by capturing 300MHz-3GHz electromagnetic waves, effectively avoiding corona interference below 300MHz. With high sensitivity and anti-interference capabilities, UHF enables discharge source localization and insulation defect classification. It is particularly effective for internal discharge

detection in power transformers and other dielectric media, mitigating the bandwidth constraints of acoustic and TEV methods.

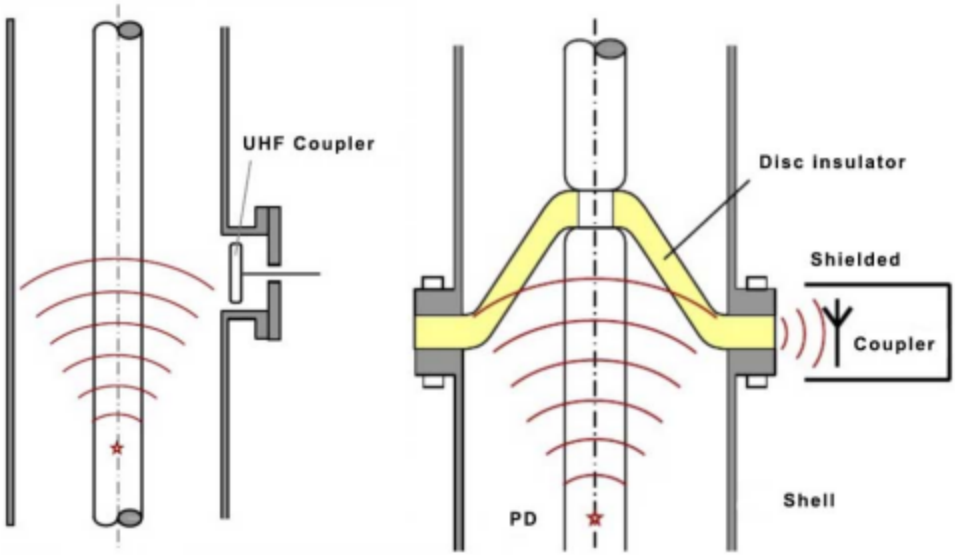



**Figure 3. UHF detection mechanism**

**PD sensor mounting method**

The sensor is equipped with a highly sensitive microphone on top to collect ultrasonic signals from the switchgear. Depending on the application scenario, the microphone's orientation can be adjusted for optimal detection results, by default, the sensor is factory-set to face forward.

**Method-1: Mounting on switchgear surface**

When sensor is mounted on switchgear surface, the microphone must be rotated close to the cabinet, ensuring closely contact. that can enable the microphone to effectively capture ultrasonic signals.

**Method-2: Mounting on switchgear inside**

When sensor is mounted inside the switchgear, the microphone must face the switchgear interior to directly receive the ultrasonic signals.

## 3.2.- Wireless temperature monitoring

The wireless temperature module is designed to monitor up to 24 sensor groups, each consisting of three-phase points (A, B, and C), enabling comprehensive thermal profiling across electrical switchgear or distributed cable systems. SCM-TP1000 provides real-time temperature visualization by switchgear or sensor group, with intuitive red highlighting for over-threshold values.

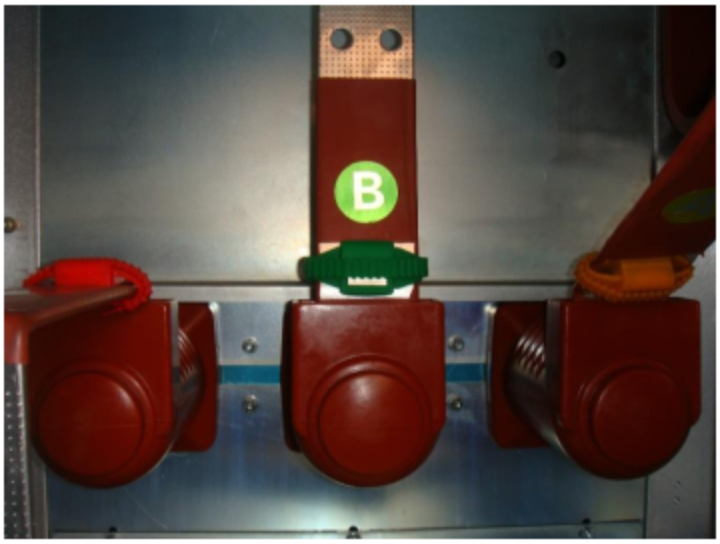
**Note: Before use, please ensure the side power switch is turned to the "ON" position.**

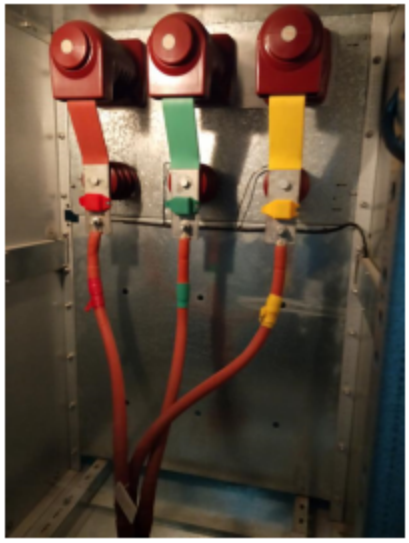
Data logging capabilities allow up to 6 days of continuous temperature records to be stored and displayed in dynamic line graph format. Alarming can be configured via rising-edge or falling-edge trigger modes, and each sensor point can be independently mapped to relay outputs for flexible thermal protection schemes. The wireless design simplifies installation and enhances monitoring coverage in complex or space-constrained environments.

**Temp sensor optional model: default SCM-BAT-S**

| | |
|---|---|
|  | **SCM-BAT-S Remote wireless node**<br>● Battery powered, 1200mAh for 2~4 years<br>● Green/Yellow/Red for three phases<br>● Suitable for flat surfaces or VCB contacts (test under 2min data transmit interval) |
|  | **SCM-SAW-S Remote wireless node**<br>● 0-65℃, accuracy 0.5℃<br>● Maintenance free during life cycle<br>● Suitable for flat surfaces or VCB contacts |
|  | **SCM-SAW-W Remote wireless node**<br>● Surface acoustic wave (SAW)<br>● Maintenance free during life cycle<br>● External wiring probe for irregular surface |

## Installation Example



# 4.- INSTALLATION AND START-UP

The manual you hold in your hand contains information and warnings that the user should respect in order to guarantee a proper operation of all the instrument functions and keep it in safety conditions. The instrument must not be powered on and used until its definitive assembly is on the switchgear's door.

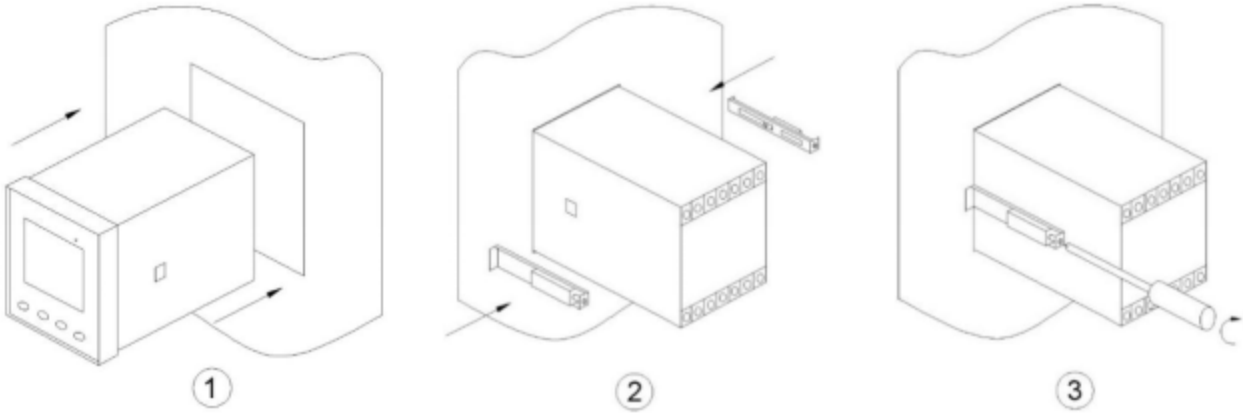
**If the instrument is not used as manufacturer's specifications, the protection of the instrument will be damaged.**

When any protection failure is suspected to exist (for example, it presents external visible damages), the instrument must be immediately powered off. In this case contact a qualified service representative.

## 4.1.- Installation

### Panel mounting

Instrument is to be mounted on panel (cut-out *136.5+0.8 x 136.5+0.8 mm*). All connections keep inside the switchgear.

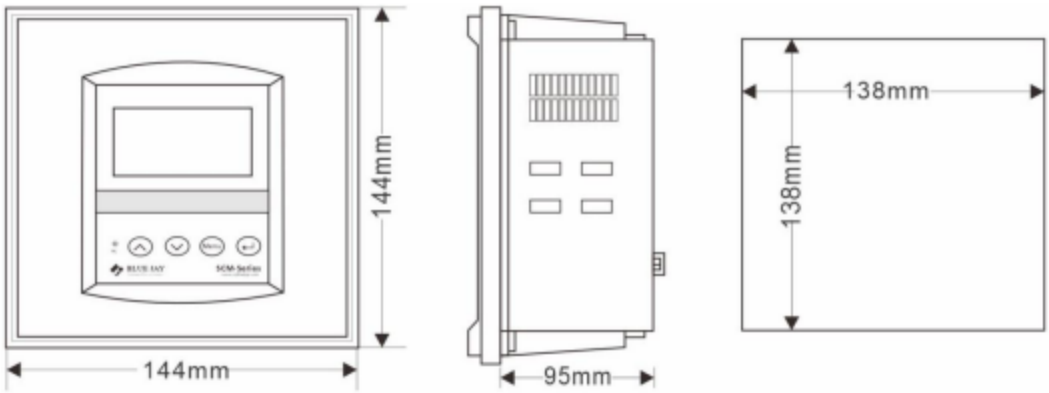



**Note:**

When the instrument powered on, the terminals could be dangerous to touching and cover opening actions or elements removal may allow accessing dangerous parts. Therefore, the instrument must not be used until this is completely installed.

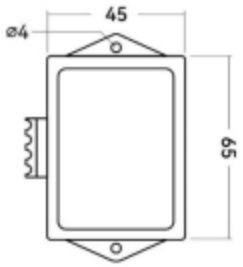
## 4.2.- Dimension (unit: mm)

**HMI dimension:**

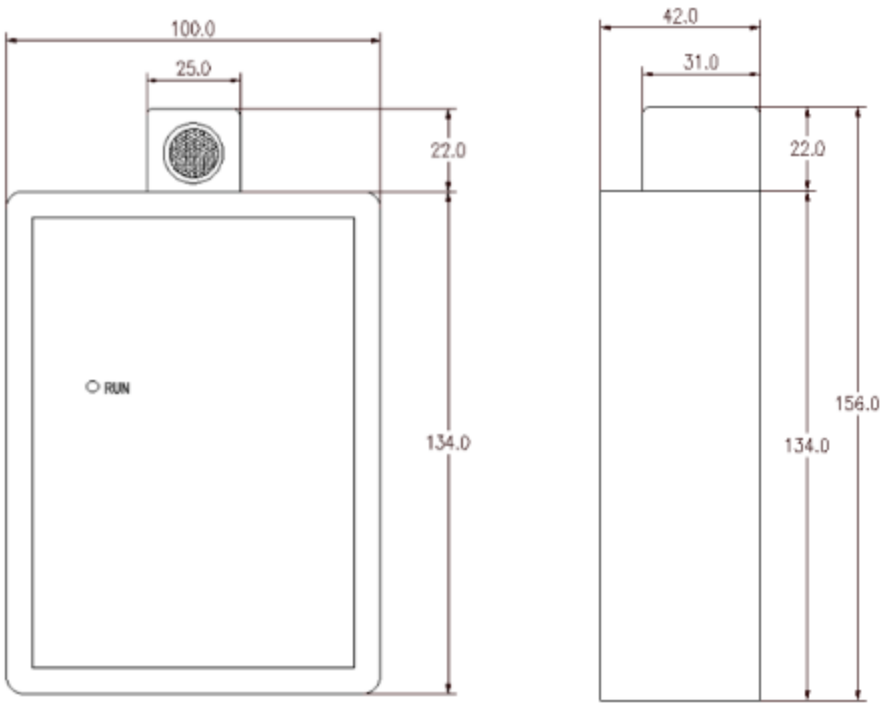



Front View　　Side View　　Install Hole

**PD / Temperature wireless data receiver dimension:**




**Wired/ wireless PD Sensor dimension:**




**Front view**　　**Side view**

## 4.3.- Connection terminal

**HMI terminal:**


| No. | Marked | Notes |
|---|---|---|
| **22-24** | **Alarm** | 1* SPDT relay contact for alarm output |
| **25-26** | **Trip** | 1* SPDT relay contact for trip output |
| **1-2** | **L/N** | Power supply 85-265Vac/dc |
| **4-6** | **RS485** | RS485 communication interface A, B, and Ground. |
| **13-16** | **PD senser (12V)** | **G:** Grounding, 0V (negative pole)<br>**R:** RS485 receive (B) terminal<br>**T:** RS485 transmit (A) terminal<br>**V:** Power supply, +12V (positive pole)<br>**Note: used for wired PD sensor** |
| **17-20** | **Wireless Receiver (5V)** | **G:** Grounding, 0V (negative pole)<br>**R:** RS485 receive (B) terminal<br>**T:** RS485 transmit (A) terminal<br>**V:** Power supply, +5V (positive pole)<br>**Note: used for receiver of temperature & wireless PD** |

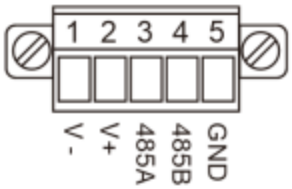
⚠**Warning: Wired PD senser and Wireless receiver use different supply voltages, receiver: 5V/ wired PD sensor: 12 V, Incorrect connection may cause permanent damage to the device or sensors.**

**Auxiliary power:**

SCM- TP1000 with universal (AC / DC) power input, if not for a special statement, we provide the 220VAC/DC or 110VAC/DC power interface for standard products Instruments limit work power supply: AC / DC85-265V, please ensure that the auxiliary power can match for the device to prevent damage to the product.

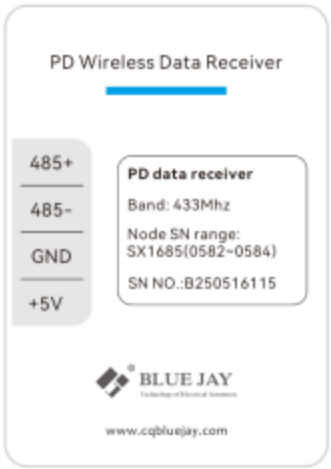
A. Suggest installing 1A fuse on the fire line side.
B. For the areas with poor power quality, suggest installing lightning surge suppressor and rapid burst suppressor to prevent lightning strikes

**PD sensor terminal:**




| No. | Marked | Notes |
|---|---|---|
| **1-2** | **V+/ V-** | Power supply 12Vdc |
| **3-4** | **RS485** | Communication interface A B |
| **5** | **GND** | Grounding |

**Wireless PD sensor and temperature receiver terminal:**



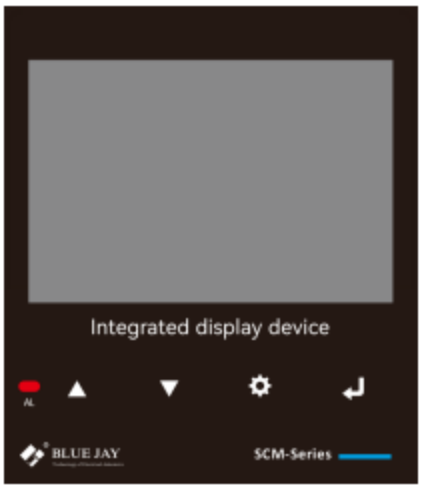


| Marked | Notes |
|---|---|
| **485 +/ -** | Communication interface A B |
| **GND** | Grounding, 0V (negative pole) |
| **+5V** | Power supply, (positive pole), +5V |

**Note:**

The terminal pin definition may change depends on customer order; for correct wiring, please follow the label on the device and only refer to the instructions for your purchased model.

# 5.- OPERATION MODE




**AL LED indicator:** the AL indicator on the device is reserved function and is disabled by default.

<table>
<tr><th>Menu</th><th>▲</th><th>▼</th><th>⚙</th><th>↵</th></tr>
<tr><td>Real time</td><td colspan="2">Switch sensor group NO. /Switchgear NO.</td><td>/</td><td>Switch to wireless PD sensor data in SG mode</td></tr>
<tr><td>Waveform [SG mode]</td><td colspan="2" rowspan="2">Switch time period:<br><br>Temp: 6 hours per page.<br>PD: 10 minutes per page.</td><td rowspan="6">Exit & roll back to up level menu</td><td>Select switchgear 01-06 to enter its waveform; then sequentially switch between temp sensors 01–04 and PD sensors;</td></tr>
<tr><td>Waveform [Group mode]</td><td>Select temp or PD sensor group to enter its waveform; then switch sensor group number;</td></tr>
<tr><td>SOE</td><td colspan="2">Select SOE NO.</td><td>View details SOE info, then press again to view its fault waveform;</td></tr>
<tr><td rowspan="2">Config</td><td></td><td>Select items</td><td rowspan="2">Call out password screen, then Press again to enter the item settings;</td></tr>
<tr><td>Move setting cursor to left</td><td>Scroll to select number 0 ~ 9</td></tr>
<tr><td>Data</td><td colspan="2">/</td><td rowspan="2">Enter this menu</td></tr>
<tr><td>Help</td><td colspan="2">/</td></tr>
</table>

**Note:**

In config. menu, if change the setting value, ⚙ for exit menu, device will prompt “SAVE yes or no”, press ⚙ again will return to configuration page, select “yes or no”, then press ↵ for save/ not save and exit configuration menu.

# 6.- SCREEN DISPLAY

## 6.1.- Overall menu screen


| Menu | Description |
|---|---|
| **Realtime** | Display real time measurements of busbar temperature, partial discharge, and ambient parameters (temperature, humidity, and noise). Data can be displayed in two modes: switchgear or sensor group. |
| **SOE** | 99 lists Alarm/DI/DO fault event records, including fault occur time, fault type, fault location, fault value, and fault waveform. |
| **Config** | Configuration of system parameters, communication, alarms, sensors, and DI/DO functions. Note: DI is reserved function, not enabled now. |
| **Waveform** | Record historical temperature trend curves for up to 6 days and partial discharge trend curves for up to 4 hours. |
| **Data** | Reserved function, not enabled |
| **Help** | Product version information and support email for technical inquiries. |

**Note:**

After power-on, user need first to configure the RTC and following two parameters in **[Config menu]** to ensure correct real-time parameter display, details see **chapter 6.2.4**:

1.- In **[System]- [RTC]**: to set the Real-Time Clock.
2.- In **[System]- [Display mode]**: to select **Switchgear**/ **Group** display mode.
3.- In **[Sensor]**: to set quantities of sensors in the switchgears or the quantities of sensor groups.

**Note:**

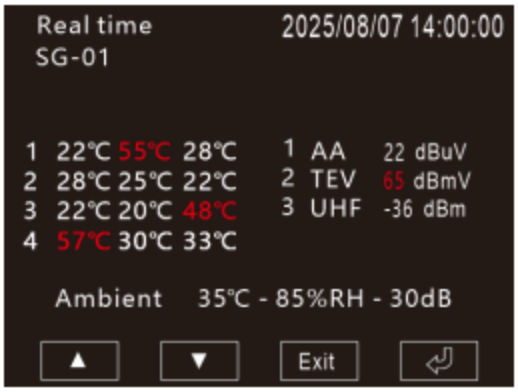
The wireless PD sensor currently only support view real-time measurements value via the HMI or RS485. Details see **Chapter 7.2.2**. It not provides alarm function, DO output, SOE record, and historical waveforms, and not requires sensor quantity configuration. Once the HMI is paired with a wireless PD sensor, its data will be displayed automatically. then press ↵ to view.

## 6.2.- Detail parameter screen

### 6.2.1.- Detail information of menu “Realtime”

SCM-TP1000 supports two display modes: Switchgear / Sensor group.

**[In switchgear mode]**




**Each page shows one switchgear temp& PD real time status**

Busbar temperature: max 4 group* 3 phase, total 12 sensors

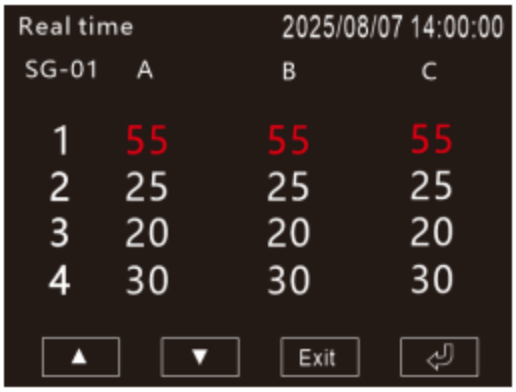
Partial discharge value: 1 group AA, TEV, UHF (three in one) sensor

Ambient temperature, humidity and noise

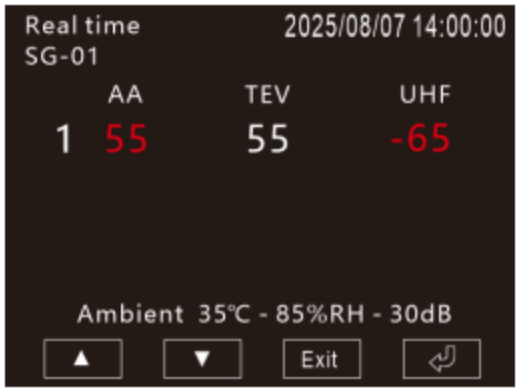
Press ▲▼ to switch between switchgear NO., Max 6 switchgears.

In switchgear mode, the user also can select a single sensor function, and the screen display will adjust accordingly, but the max number of supported sensors remains unchanged.

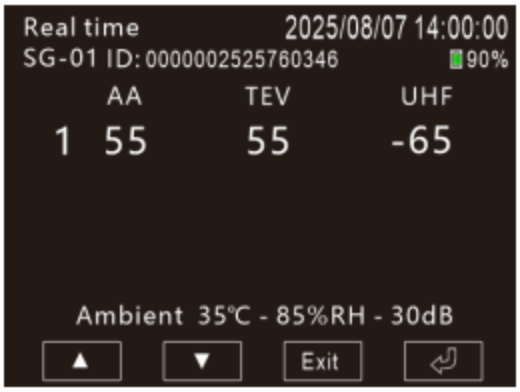
**Only temperature sensor**



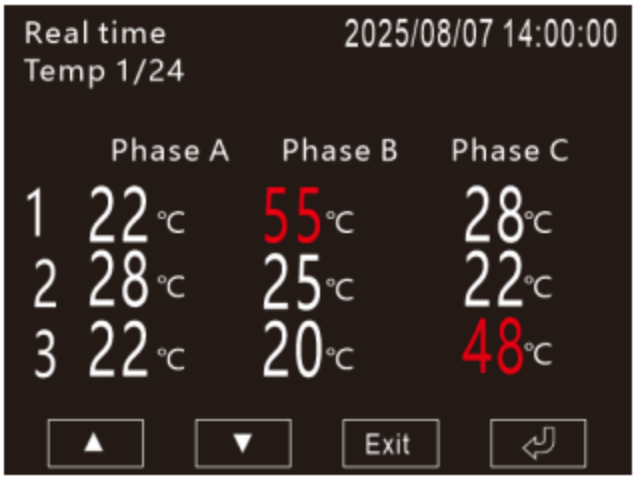

**Only Wired Partial discharge sensor**

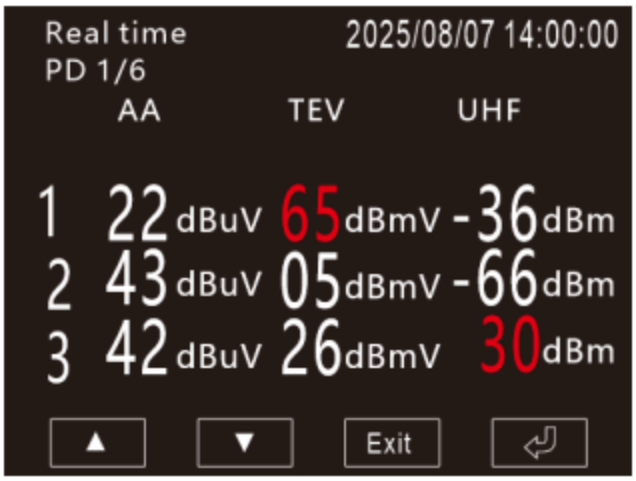



**Wireless Partial discharge sensor**



**[In sensor group mode]**




**Two main pages show temp& PD sensor group real time status**

Press ↵ to switch temp /PD sensor group

Press ▲▼ to switch sensor group NO., Temp sensor max 24 groups, PD sensor max 6 groups.

**Note:**

**In above 2 display modes:**

**Red color font:** means measured value has reached the alarm threshold.

**---:** means no sensor connected.

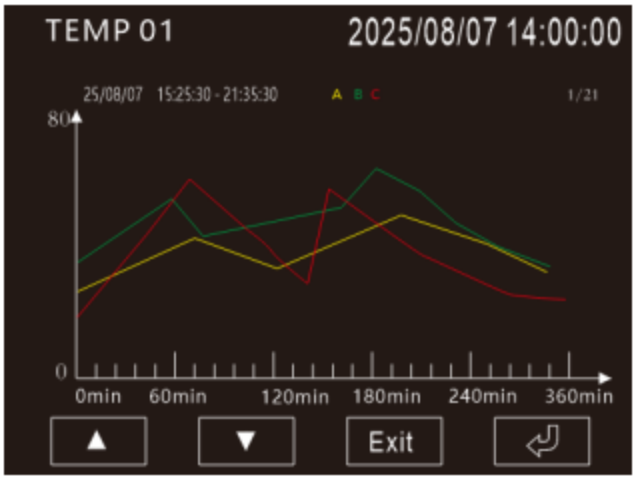
**00:** means data abnormality (abnormally high/low value)

### 6.2.2.- Detail information of menu "Waveform"

**[In switchgear mode]**


Press ▲▼ to select switchgear NO,

Press ↵ enter its waveform.

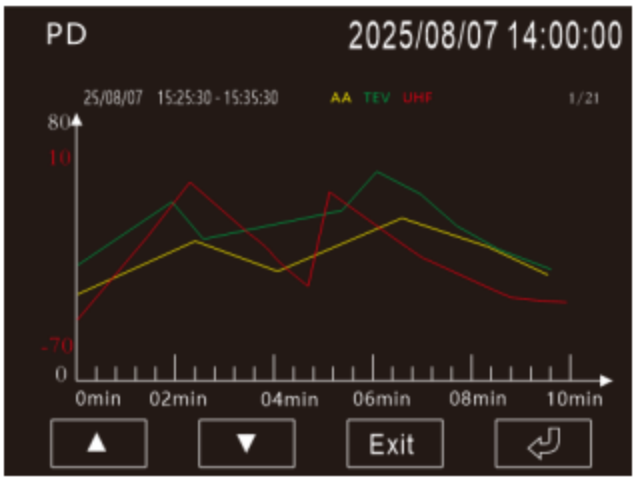



Press ↵ to switch between temp/ PD sensors

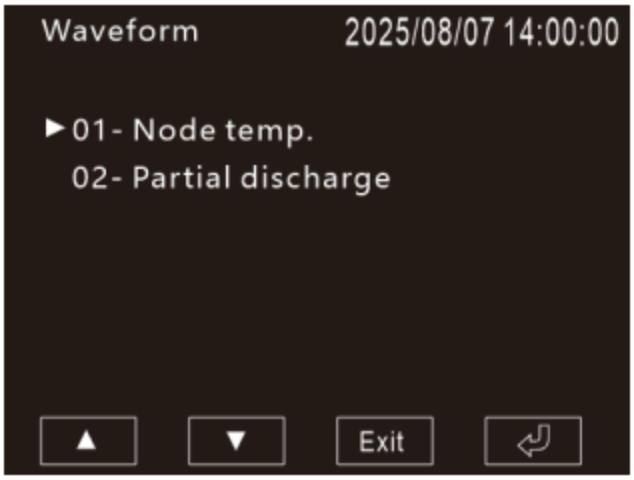
Press ▲▼ to switch time period:

- **-. Temp waveform: 6 hours per page;**
- **-. PD waveform:10 minutes per page;**

Each switchgear up to 4 groups temp sensor and 1 group PD sensor

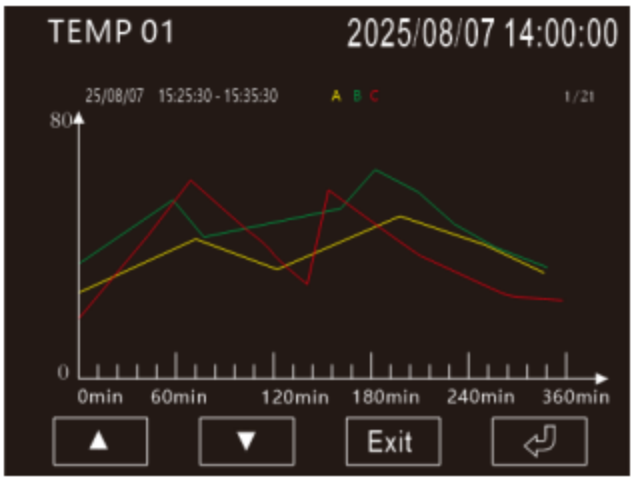


**[In sensor group mode]**




Press ▲▼ to select temp/ PD sensor group

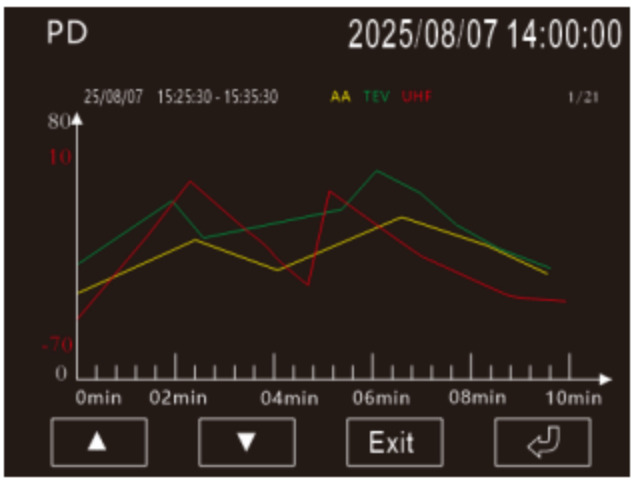
Press ↵ enter its waveform




Press ↵ to switch between temp sensor 01-24

Press ▲▼ to switch time period:

**-. Temp waveform: 6 hours per page;**




Press ↵ to switch between PD sensor 01-06

Press ▲▼ to switch time period:

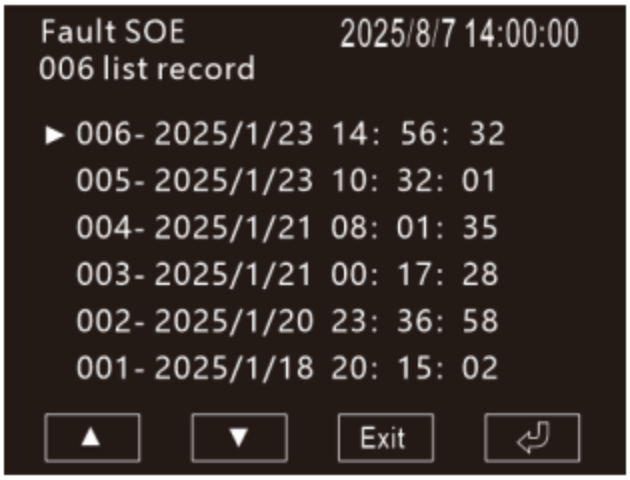
**-. PD waveform:10 minutes per page;**

**Notes:**

-. The Y-axis range adjusts dynamically according to the measured values and is not fixed.

-. Because PD UHF measurement range is –70 to 10 dBm, negative values may occur. so, the UHF range is indicated in red on the Y-axis, while AA and TEV reference the Y-axis in white.

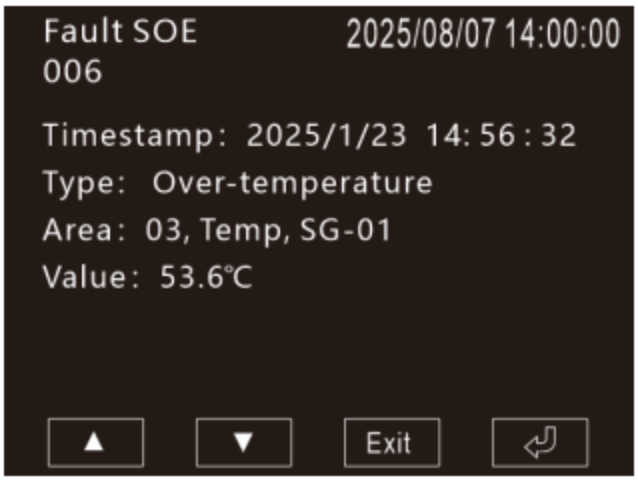
### 6.2.3.- Detail information of menu "SOE"




Up to 99 lists fault sequence of event records.

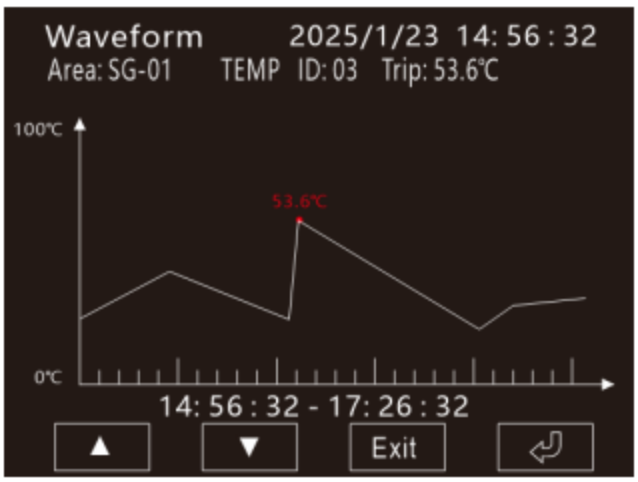
Press ▲▼ to select event NO.

Press ↵ to view its fault details info. and waveform.




Show the fault occurs time, fault type, fault area and fault values.

Press ↵ to view its fault waveform.




**Waveform displays the status before and after the event occurs.**

**Temp waveform:** capture every 5 minutes as a point, total capture 30 points, total capture 150 min data, fault occur at point 14 (at 70min), that is data covers 70 min before and 80 min after the fault.

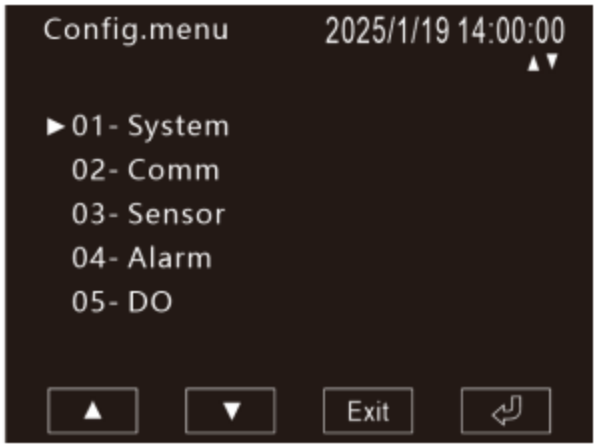
**PD waveform:** capture every 5 seconds as a point, total capture 30 points, total capture 150 second data, fault occur at point 14 (at 70s), that is data covers 70s before and 80s after the fault.

**Note:**

The largest number is the most recent event, and 001 is the oldest event, the oldest event will be discarded when the SOE records > 99.

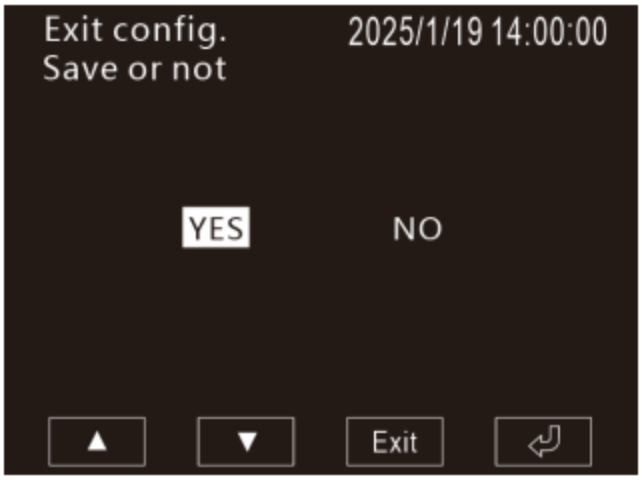
### 6.2.4.- Detail information of menu "Config"

In this menu, enter default password **0001** can enter the parameter configuration:

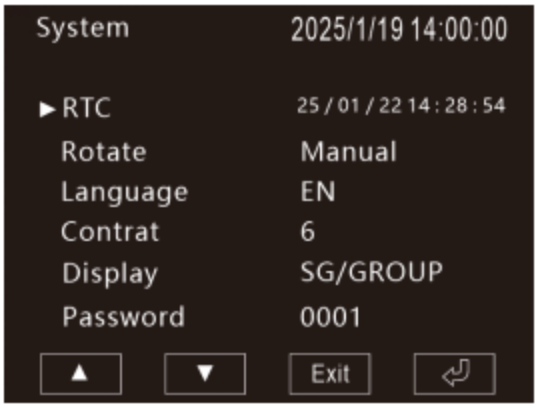




01-System: Device overall system parameter settings.
02-Comm: Communication parameter settings.
03-Sensor: Sensors quantity settings.
04-Alarm: Sensor alarm modes and threshold settings.
05-DO: Digital output settings.

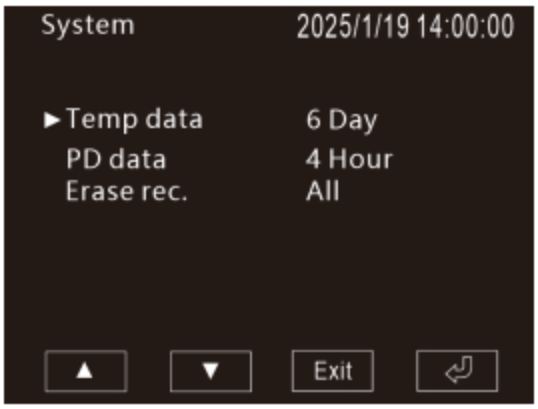
**Exit the settings need to select save or not:**



### 6.2.4.1.- System settings:



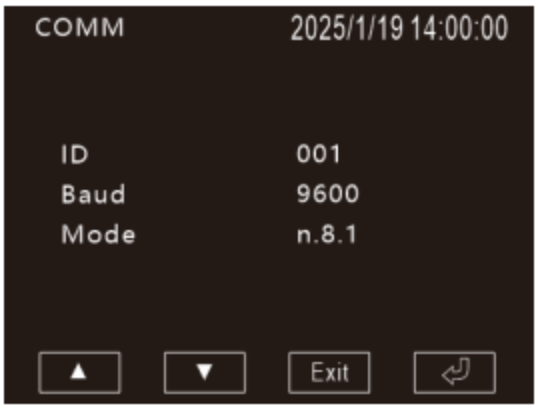

. Time settings (year, month, day, hour, minute, second)
. Screen scroll interval: manual, 3-30s adjustable
. Language: English (not adjustable)
. Screen contrast:1-6 adjustable
. Display mode: switchgear or sensor group
. Change password: default 0001, 0-9999 adjustable




. Historical temp. data record: 6 days (not adjustable)
. Historical PD data record: 4 hours (not adjustable)
. Erase energy record: All

Note: Erase all records means clearing all SOE and waveform storage records, it is Irrevocable.

### 6.2.4.2.- Communication settings:



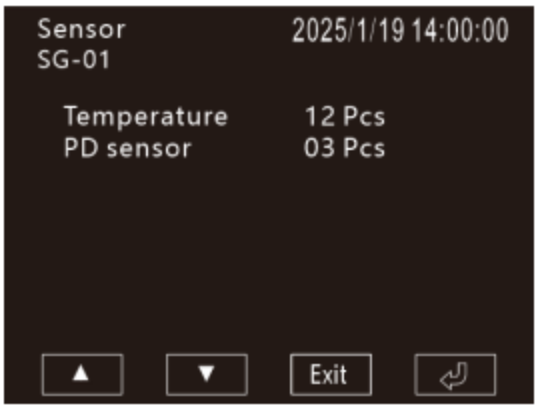

. RS485 communication address: 001-254 adjustable
. RS485 baud rate: default 9600, optional 4800
. RS485 frame format default n.8.1, optional e.8.1, n.8.2

### 6.2.4.3.- sensor quantity settings:

**[Switchgear mode]**


Select switchgear NO. and configure this switchgear's sensors number.

Max support 6 switchgear




**Temp. sensor options:** 0, 3, 6, 9, 12

**PD. sensor options:** 0, 3

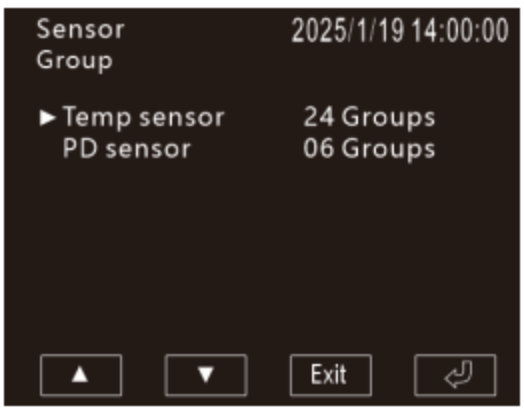
**Note:**

Temp sensor: because busbar has A, B, C phases, three sensors form one set (ABC). So, options are 0, 3, 6, 9, 12, meaning 0-4 sets.

PD sensor: because our PD sensors are 3-in-1 type (AA, TEV, UHF), so options are 0, 3, meaning 0-1 set.

Each switchgear can be configured up to 4 sets of ABC temperature sensors and 1 set of AA, TEV, UHF three in one PD sensors.

**[Sensor group mode]**

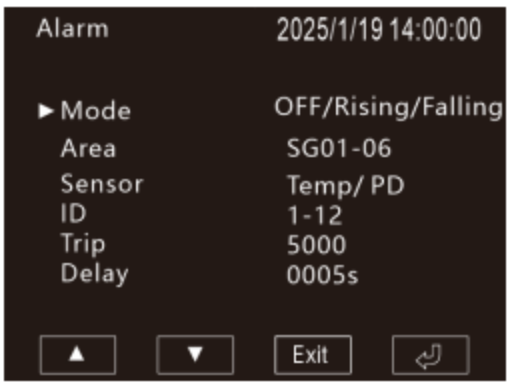



**Temp. sensor options:** 0-24 groups, each group has 3 sensors for busbar A, B, C phases.

**PD sensor options:** 0-6 groups, each group being a 3-in-1 type (AA, TEV, UHF).

### 6.2.4.4.- Sensor alarm setting


Up to 6 alarms can be configured, the same sensor can be selected multiple times with different alarm values, can flexibly configure as user needed.




. Mode: OFF, Rising (upper limit), Falling (lower limit)
. Area: option switchgear 1-6/ sensor group 1-24
. Sensor: select sensor type -temp or PD
. ID: select the alarm sensor serial number
. Trip value: range 0-9999
. Trip delay time: range 0-9999
. Hysteresis value: range 0-9999

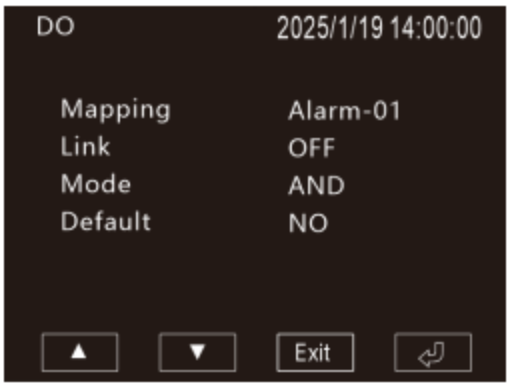
**Note:**

-. [In switchgear mode] – Temp sensors alarm ID range: 1-12, corresponding to sensors 1-12 within the switchgear. PD sensors ID range: 1-3, corresponding to: 1: AA sensor; 2: TEV sensor; 3: UHF sensor.

-. Setting Alarm Values for UHF Sensor (PD ID: 03): The UHF sensor measurement range is −70 to 10 dBm. Since the device cannot accept negative input values, so need set the alarm by adding 70 to the desired value (e.g., −60 dBm → input 10). This adjustment applies only to UHF; AA and TEV sensors do not require it.

### 6.2.4.5.- Digital output settings:


2 Digital outputs can be configured.




**DO settings**

. DO action mapping data: OFF, Alarm 01-06
. DO action link data: OFF, Alarm 01-06
. DO action association logic mode: AND, OR, NOT
. DO default status: 0-NC (normally close)
1-NO (normally open)

**Notes:**

In DO settings:

**Mapping data:** the selected data reaches to set threshold, DO action will be triggered.

**Link data:** means the selected data is link with the mapping data, whether to trigger the DO action need consider the two data with the association logic mode.

# 7.- COMMUNICATION INTERFACE

This document defines the communication protocol specification of SCM-TP1000, please strictly follow this communication protocol to connect with the device. Initial address: 001, baud rate: 9600; data bits: 8; parity bit N; stop bit: 1.

## 7.1.- MODBUS protocol

**Modbus RTU Frame Format:**

**Host inquiry:**

| | | |
|---|---|---|
| **Address code** | **1 BYTE** | Slave device address **1-254** |
| **Function code** | **1 BYTE** | Function codes |
| **Data code** | **4 BYTES** | Starting address, high byte<br>Starting address, low byte<br>Number of registers, high byte<br>Number of registers, low byte |
| **Error Check code** | **2 BYTES** | Cyclical Redundancy Check (**CRC**) |

**Slave response:**

| | | |
|---|---|---|
| **Address code** | **1 BYTE** | Slave device address **1-254** |
| **Function code** | **1 BYTE** | Function codes |
| **Data length** | **N** | Total data length |
| **Data range** | **-** | Data Area |
| **Error Check code** | **2 BYTES** | Cyclical Redundancy Check (**CRC**) |

**MODBUS FUNCTIONS**

| Code | Meaning | Description |
|---|---|---|
| **FUNCTION 03** | **Read holding register** | Read holding registers |
| **FUNCTION 06** | **Write single register** | Writes a value into a single holding register. |
| **FUNCTION 10** | **Write multiple register** | Writes values into multiple holding registers |

**Note:**

Starting address:0X0000, the first byte is the high bit, and the second byte is the low bit.

## 7.2.- Register Map

### 7.2.1.- Read temperature sensor data, read only, Fun 03 to read.

**Switchgear mode:**

| Reg. | Data | Byte mode | | Instruction |
|---|---|---|---|---|
| 0000-000B | SG01 Temp sensor 1-12 | INT | 1 | Temperature sensor 1-12 data of switchgear 01 |
| 000C-000F | Reserved | / | / | / |
| 0010-001B | SG02 Temp sensor 1-12 | INT | 1 | Temperature sensor 1-12 data of switchgear 02 |
| 001C-001F | Reserved | / | / | / |
| 0020-002B | SG03 Temp sensor 1-12 | INT | 1 | Temperature sensor 1-12 data of switchgear 03 |
| 002C-002F | Reserved | / | / | / |
| 0030-003B | SG04 Temp sensor 1-12 | INT | 1 | Temperature sensor 1-12 data of switchgear 04 |
| 003C-003F | Reserved | / | / | / |
| 0040-004B | SG05 Temp sensor 1-12 | INT | 1 | Temperature sensor 1-12 data of switchgear 05 |
| 004C-004F | Reserved | / | / | / |
| 0050-005B | SG06 Temp sensor 1-12 | INT | 1 | Temperature sensor 1-12 data of switchgear 06 |
| 005C-005F | Reserved | / | / | / |

**Sensor group mode:**

| Reg. | Data | Byte mode | | Instruction |
|---|---|---|---|---|
| 00A0-00A2 | Group 01 Temp ABC | INT | 1 | Group 01 temperature sensors data– phase A/B/C |
| 00A3-00A5 | Group 02 Temp ABC | INT | 1 | Group 02 temperature sensors data– phase A/B/C |
| 00A6-00A8 | Group 03 Temp ABC | INT | 1 | Group 03 temperature sensors data– phase A/B/C |
| 00A9-00AB | Group 04 Temp ABC | INT | 1 | Group 04 temperature sensors data– phase A/B/C |
| 00AC-00AE | Group 05 Temp ABC | INT | 1 | Group 05 temperature sensors data– phase A/B/C |
| 00AF | Reserved | / | / | / |
| 00B0-00B2 | Group 06 Temp ABC | INT | 1 | Group 06 temperature sensors data– phase A/B/C |

| | | | | |
|---|---|---|---|---|
| 00B3-00B5 | Group 07 Temp ABC | INT | 1 | Group 07 temperature sensors data– phase A/B/C |
| 00B6-00B8 | Group 08 Temp ABC | INT | 1 | Group 08 temperature sensors data– phase A/B/C |
| 00B9-00BB | Group 09 Temp ABC | INT | 1 | Group 09 temperature sensors data– phase A/B/C |
| 00BC-00BE | Group 10 Temp ABC | INT | 1 | Group 10 temperature sensors data– phase A/B/C |
| 00BF | Reserved | / | / | / |
| 00C0-00C2 | Group 11 Temp ABC | INT | 1 | Group 11 temperature sensors data– phase A/B/C |
| 00C3-00C5 | Group 12 Temp ABC | INT | 1 | Group 12 temperature sensors data– phase A/B/C |
| 00C6-00C8 | Group 13 Temp ABC | INT | 1 | Group 13 temperature sensors data– phase A/B/C |
| 00C9-00CB | Group 14 Temp ABC | INT | 1 | Group 14 temperature sensors data– phase A/B/C |
| 00CC-00CE | Group 15 Temp ABC | INT | 1 | Group 15 temperature sensors data– phase A/B/C |
| 00CF | Reserved | / | / | / |
| 00D0-00D2 | Group 16 Temp ABC | INT | 1 | Group 16 temperature sensors data– phase A/B/C |
| 00D3-00D5 | Group 17 Temp ABC | INT | 1 | Group 17 temperature sensors data– phase A/B/C |
| 00D6-00D8 | Group 18 Temp ABC | INT | 1 | Group 18 temperature sensors data– phase A/B/C |
| 00D9-00DB | Group 19 Temp ABC | INT | 1 | Group 19 temperature sensors data– phase A/B/C |
| 00DD-00DE | Group 20 Temp ABC | INT | 1 | Group 20 temperature sensors data– phase A/B/C |
| 00DF | Reserved | / | / | / |
| 00E0-00E2 | Group 21 Temp ABC | INT | 1 | Group 21 temperature sensors data– phase A/B/C |
| 00E3-00E5 | Group 22 Temp ABC | INT | 1 | Group 22 temperature sensors data– phase A/B/C |
| 00E6-00E8 | Group 23 Temp ABC | INT | 1 | Group 23 temperature sensors data– phase A/B/C |
| 00E9-00EB | Group 24 Temp ABC | INT | 1 | Group 24 temperature sensors data– phase A/B/C |
| 00EC-00EF | Reserved | / | / | / |

### 7.2.2.- Read partial discharge sensor data, read only, Fun 03 to read.

**Wired PD sensor data**

| Reg. | Data | Byte mode | | Instruction |
|---|---|---|---|---|
| 0060-0062 | SG01/ Group01 PD sensor data | INT | 1 | PD sensor AA TEV UHF data of switchgear 01 or Group 01 |
| 0063-0067 | Reserved | / | / | / |
| 0068-006A | SSG02/ Group02 PD sensor data | INT | 1 | PD sensor AA TEV UHF data of switchgear 02 or Group 02 |
| 006B-006F | Reserved | / | / | / |
| 0070-0072 | SG03/ Group03 PD sensor data | INT | 1 | PD sensor AA TEV UHF data of switchgear 03 or Group 03 |
| 0073-0077 | Reserved | / | / | / |
| 0078-007A | SSG04/ Group04 PD sensor data | INT | 1 | PD sensor AA TEV UHF data of switchgear 04 or Group 04 |
| 007B-007F | Reserved | / | / | / |
| 0080-0082 | SG05/ Group05 PD sensor data | INT | 1 | PD sensor AA TEV UHF data of switchgear 05 or Group 05 |
| 0083-0087 | Reserved | / | / | / |
| 0088-008A | SG06/ Group06 PD sensor data | INT | 1 | PD sensor AA TEV UHF data of switchgear 06 or Group 06 |
| 008B-008F | Reserved | / | / | / |

**Wireless PD sensor data**

| Reg. | Data | Byte mode | | Instruction |
|---|---|---|---|---|
| 0300-0303 | Device ID | INT | 4 | Device ID of PD sensor |
| 0304 | Battery power | INT | 1 | Battery power of PD sensor |
| 0305 | AA discharge times | INT | 1 | 0-4095 |
| 0306 | AA discharge amplitude | INT | 1 | 0~60,unit: dBuV |
| 0307 | AA discharge average value | INT | 1 | 0~60,unit: dBuV |
| 0308 | TEV discharge times | INT | 1 | 0-4095 |
| 0309 | TEV discharge amplitude | INT | 1 | 0~60,unit: dBmV |
| 030A | Environmental noise value | INT | 1 | 0~60, unit: dBmV |
| 030B | UHF discharge times | INT | 1 | 0-4095 |

| | | | | |
|---|---|---|---|---|
| 030C | UHF discharge amplitude | INT | 1 | -70~10,unit: dBm |
| 030D | UHF discharge average value | INT | 1 | -70~10,unit: dBm |
| 030E | Noise value | INT | 1 | 30~80, unit: dB |
| 030F | Temperature | INT | 1 | -40~85, unit: ℃ |
| 0310 | Humidity | INT | 1 | 5~95, unit: %RH |

**Note:**

UHF related values read from register are stored in 16-bit two's complement format; positive numbers represent themselves, while negative numbers must be converted from two's complement to signed decimal to obtain the actual value.

## 7.2.3.- Read/ write system settings, Fun 03 to read, Fun 06/10 to write.

**System setting**

| Reg. | Data | Byte mode | | Instruction |
|---|---|---|---|---|
| 0100 | RTC. year | INT | 1 | Range: 0-99<br>Only need set last two digits of year |
| 0101 | RTC. month | INT | 1 | Range: 1-12 |
| 0102 | RTC. date | INT | 1 | Range: 0-31 |
| 0103 | RTC. hour | INT | 1 | Range: 0-23 |
| 0104 | RTC. minute | INT | 1 | Range: 0-59 |
| 0105 | RTC. second | INT | 1 | Range: 0-59 |
| 0106 | Rotate | INT | 1 | Screen scroll interval, range: manual, 3-30s<br>default manual |
| 0107 | Language | INT | 1 | Default English, not adjustable |
| 0108 | Contrast | INT | 1 | Screen contrast, range: manual, 1-6<br>Default 6 |
| 0109 | Display | INT | 1 | Parameter display mode, range: **0:** SG;**1:** Group<br>Default: SG (switchgear) |
| 010A | Password | INT | 1 | Device password, range: 0000-9999<br>Default: 0001 |
| 010B | Temp log | INT | 1 | Historical temperature data record<br>Default 6 days, read only, not adjustable |
| 010C | PD log | INT | 1 | Historical PD data record<br>Default 4 hours, read only, not adjustable |

**Communication setting**

| Reg. | Data | Byte mode | | Instruction |
|---|---|---|---|---|
| 0110 | ID | INT | 1 | RS485 address, range: 001-254<br>Default 001 |
| 0111 | Baud | INT | 1 | Baud rate, range: **0:**4800 **1:**9600<br>Default 9600 |
| 0112 | Mode | INT | 1 | Data format, range: **0:** n.8.1; **1:** e.8.1; **2:** n.8.2<br>Default n.8.1 |

**Sensor setting**

| Reg. | Data | Byte mode | | Instruction |
|---|---|---|---|---|
| 0120 | SG 01 Temp | INT | 1 | Switchgear 01 temperature sensor quantity settings, range: **0, 3, 6, 9, 12** |
| 0121 | SG 02 Temp | INT | 1 | Switchgear 02 temperature sensor quantity settings, range: **0, 3, 6, 9, 12** |
| 0122 | SG 03 Temp | INT | 1 | Switchgear 03 temperature sensor quantity settings, range: **0, 3, 6, 9, 12** |
| 0123 | SG 04 Temp | INT | 1 | Switchgear 04 temperature sensor quantity settings, range: **0, 3, 6, 9, 12** |
| 0124 | SG 05 Temp | INT | 1 | Switchgear 05 temperature sensor quantity settings, range: **0, 3, 6, 9, 12** |
| 0125 | SG 06 Temp | INT | 1 | Switchgear 06 temperature sensor quantity settings, range: **0, 3, 6, 9, 12** |
| 0126 | SG 01 PD | INT | 1 | Switchgear 01 PD sensor quantity settings, range: **0, 3** |
| 0127 | SG 02 PD | INT | 1 | Switchgear 02 PD sensor quantity settings, range: **0, 3** |
| 0128 | SG 03 PD | INT | 1 | Switchgear 03 PD sensor quantity settings, range: **0, 3** |
| 0129 | SG 04 PD | INT | 1 | Switchgear 04 PD sensor quantity settings, range: **0, 3** |
| 012A | SG 05 PD | INT | 1 | Switchgear 05 PD sensor quantity settings, range: **0, 3** |
| 012B | SG 06 PD | INT | 1 | Switchgear 06 PD sensor quantity settings, range: **0, 3** |
| 012C | Group Temp | INT | 1 | Temperature sensor group quantity settings, range: **0-24** |
| 012D | Group PD | INT | 1 | PD sensor group quantity settings, range: **0-6** |

**Note:**

Temp sensor: because busbar has A, B, C phases, three sensors form one set (ABC). So, options are 0, 3, 6, 9, 12, meaning 0-4 sets.

PD sensor: because our PD sensors are 3-in-1 type (AA, TEV, UHF), so options are 0, 3, meaning 0-1 set.

Each switchgear can be configured up to 4 sets of ABC temperature sensors and 1 set of AA, TEV, UHF three in one PD sensors.

**Alarm setting**

| Reg. | Data | Byte mode | | Instruction |
|---|---|---|---|---|
| 0130 | Alarm 01_Mode | INT | 1 | Alarm mode,<br>range: **0:** OFF; **1:** Rising; **2:** Falling<br>Default: OFF |
| 0131 | Alarm 01_Area | INT | 1 | In SG mode range: 1 -6<br>In Group mode range: 1-24<br>Default: 1 |
| 0132 | Alarm 01_Sensor | INT | 1 | Sensor type, range: **0:** temp; **1:** PD<br>Default: temp |
| 0133 | Alarm 01_ID | INT | 1 | **Alarm sensor ID**<br><br>In SG mode: temp sensor range 1-12, PD sensor range 1-3<br>In Group mode: all range 1-3<br>Default: 1 |
| 0134 | Alarm 01_Trip | INT | 1 | Trip value: range 0-9999<br>Default: 0 |
| 0135 | Alarm 01_Delay | INT | 1 | Trip delay time: range 0-9999s<br>Default: 0s |
| 0136 | Alarm 01_Hysteresis | INT | 1 | Hysteresis value: range 0-9999<br>Default: 0 |
| 0140-0146 | Alarm 02 | INT | 1 | The same as Alarm 01 |
| 0150-0156 | Alarm 03 | INT | 1 | The same as Alarm 01 |
| 0160-0166 | Alarm 04 | INT | 1 | The same as Alarm 01 |
| 0170-0176 | Alarm 05 | INT | 1 | The same as Alarm 01 |
| 0180-0186 | Alarm 06 | INT | 1 | The same as Alarm 01 |

**Notes:**

-. [In switchgear mode] – Temp sensors alarm ID range: 1-12, corresponding to temp sensors 1-12 within the switchgear. PD sensors ID range: 1-3, corresponding to: 1: AA sensor; 2: TEV sensor; 3: UHF sensor.

-. UHF negative threshold values (e.g., –30 dBm) must be converted to 16-bit two's complement format before writing to the register.

**DO setting**

| Reg. | Data | Byte mode | | Instruction |
|---|---|---|---|---|
| 0190 | DO 01_Mapping | INT | 1 | DO action mapping data,<br>range: **0:** OFF, **1-6:** Alarm 01-06<br>Default: 1 (Alarm 01) |
| 0191 | DO 01_Link | INT | 1 | DO action link data,<br>**0:** OFF, **1-6:** Alarm 01-06<br>Default: 2 (Alarm 02) |
| 0192 | DO 01_Mode | INT | 1 | DO action association logic mode,<br>**0:** NOT; **1:** OR; **2:** AND<br>Default: AND |
| 0193 | DO 01_Default | INT | 1 | DO default status, 0: NC; 1: NO<br>Default: NC |
| 01A0-01A3 | DO 02 | INT | 1 | The same as DO 01 |

## 7.3.- Command Example

**Function 03 example: Read group 04 PD sensor data**

Host inquiry: 01 03 00 78 00 03 CRC CRC
Slave response: 01 03 00 06 00 3C 00 2D FF C6 CRC CRC
**Means: PD AA value is 60dBμV; TEV value is 45dBmV; UHF value is -58 dBm.**

**Function 06 example: Write switchgear 03 temp sensors quantity to 12**

Host inquiry: 01 06 01 22 00 0C CRC CRC
Slave response: 01 06 01 22 00 0C CRC CRC

**Function 10 example: Write all parameters of alarm 01 (register 0130-0136)**

Host inquiry:
01 10 01 30 00 07 0E 00 01 00 05 00 01 00 01 00 3C 00 05 00 05 CRC CRC
Slave response:
01 10 01 30 00 07 CRC CRC

**Means: set** Alarm 01_Mode= Rising
Alarm 01_Area= Switchgear 05
Alarm 01_Sensor= PD sensor
Alarm 01_ID= PD 01-AA
Alarm 01_Trip= 60dBμV
Alarm 01_Delay= 5s
Alarm 01_Hysteresis=5

# 8.- MAINTENANCE

The SCM-TP1000 does not require any special maintenance. No adjustment, maintenance or repairing action should be done when the instrument is open and powered on, should those actions are essential, high-qualified operators must perform them.

Before any adjustment, replacement, maintenance or repairing operation is carried out, the instrument must be disconnected from any power supply source.

When any protection failure is suspected to exist, the instrument must be immediately put out of service. The instrument's design allows a quick replacement in case of any failure.

# 9.- Ordering Information

| Model | Function description |
|---|---|
| SCM-TP1000 | ● PD monitoring<br>● Temperature monitoring |
| SCM-PD3000 | ● Only PD monitoring (option wired/ wireless sensor) |
| SCM-W3000 | ● Only temperature monitoring |

| Model | Parts list |
|---|---|
| SCM-TP1000 | 1. HMI<br>2. PD sensor (wired PD sensor or wireless PD sensor with receiver)<br>3. Wireless temperature sensor with receiver |
| SCM-PD3000 | 1. HMI<br>2. PD sensor (wired PD sensor or wireless PD sensor with receiver) |
| SCM-W3000 | 1. HMI<br>2. Wireless temperature sensor with receiver |

# 10.- Attachment Contents

| Document |
| --- |
| HMI Firmware Upgrade Guide and Tools |
| Temperature Sensor RS485 Configuration Guide and Tools |
| PD Sensor RS485 Configuration Guide and Tools |

Note: The above documents are not distributed with this manual. Please contact our sales team if needed.

For any inquiry about the instrument performance or any failure,
contact to Blue Jay's technical service.

*Blue Jay - After-sales service*

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