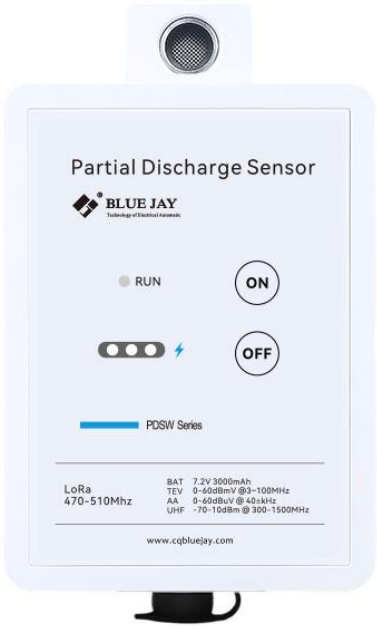
SCM-PDS3W
Wireless Partial Discharge Sensor

User Manual



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Read me

When you use SCM-PDS3W partial discharge sensor, 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 SCM-PDS3W partial discharge sensor, and help to solve the various problems at the scene.

1. Always keep safe distance between the high voltage part and the instrument, probe and operator.

2. Measurements must not be taken when thunderstorms are nearby.

3. Do not operate the instrument or accessories in explosive atmospheres.

4. After the battery alarm of the instrument, please turn off the power to charge.

5. Do not open the instrument without permission, this will affect the warranty of the product. The factory is not responsible for self-disassembly.

6. When the instrument is transported, it should avoid rain erosion and prevent collision and falling.

7. When storing and keeping the instrument, attention should be paid to the ambient temperature and humidity, and it should be protected from dust, moisture, shock, acid, and corrosive gas.

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

Directory

1.- SUMMARIZE

Partial discharge (PD) is closely related to insulating conditions of electrical apparatus in power systems. When PD occur in insulations, small currents arise. Without any treatment, the discharge currents bridge the electrodes completely which certainly results in large short-circuit current and breaks down the equipment. PD phenomenon is an indication of degradation of insulation materials. Thus, the detection of PD at early stages plays a crucial role in increasing the service life of power equipment.

The PDS3W partial discharge sensor integrates ultrasonic, TEV (Transient Earth Voltage) and UHF (Ultra High Frequency) technologies to detect partial discharges in middle-high voltage equipment. PDS3W can monitoring of transformers, high-voltage switchgear, and cable joints. PDS3W is highly portable, offers fast measurement speeds, and boasts strong anti-interference capabilities, making it suitable for various field applications.

FEATURES

- Rugged, compact design;
- Non-intrusive detection method;
- Strong magnets to attach sensor;
- Rapid detection of partial discharge conditions;
- Suitable for extreme environment, outdoor substation;
- Measures PD in high-frequency UHF range;
- Ensures sensitive PD measurements in noisy environments;
- RS485, Modbus-RTU, SCADA systems.

APPLICATIONS

- Factory and on-site testing;
- Power transformers;
- Medium and high voltage connections;
- Power coils, motors;
- Industrial motor equipment;
- High voltage components: sleeves, insulators, containers, coil terminations, bus wires.

2.- TECHNICAL SPECIFICATION

Sensor common	
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	120 minutes
Ultrasonic sensor (AA)	
Detect range	0 ~ 60dBμV
Resolution / Accuracy	1dBμV
Pass band	Center frequency 40 kHz ±1 kHz
TEV sensor	
Detect range	0~60dBmV
Pass band	3~100MHz
Resolution / Accuracy	1dBmV / ±1dBmV
UHF sensor	
Detect range	-70~10dBm
Pass band	300~1500MHz
Average equivalent height	≥10mm
Environmental sensors	
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
Wireless Receiver	
Power supply	12VDC
Networking mode	LORA self-organizing network
Uplink communication protocol	RS485/Modbus-RTU

3.- FUNCTION INTRODUCTION

3.1.- PD measurement technology introduction

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 cabinet structures. Maintaining intimate contact with the cabinet surface is essential for optimal acoustic wave transmission efficiency, making it suitable for surface discharge monitoring in switchgear.

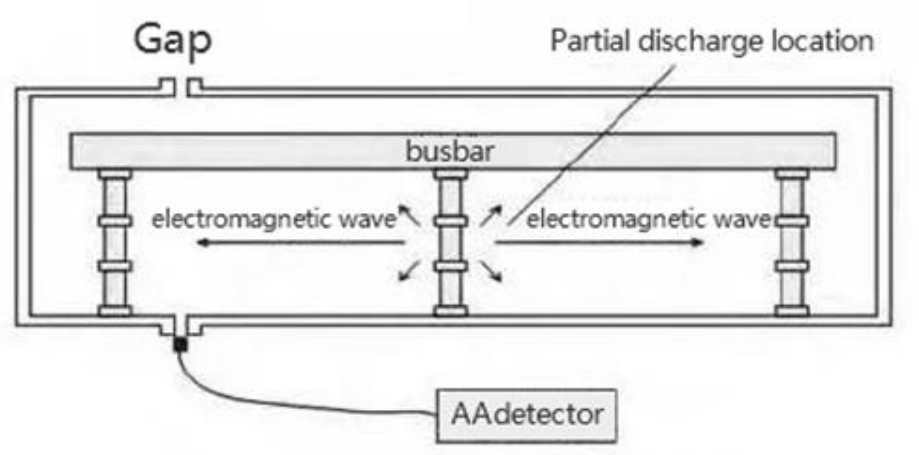


Figure 1. Ultrasonic detection mechanism

Insulation condition of switchgear:

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

Note:

The demarcation point (60dBμV) is slightly different in different regions, so it is recommended to use 60dBμV 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 cabinet 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.

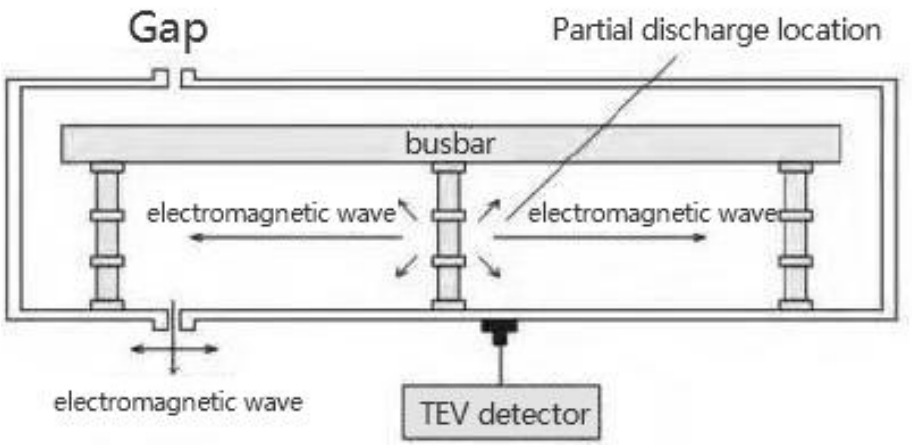


Figure 2. TEV detection mechanism

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.

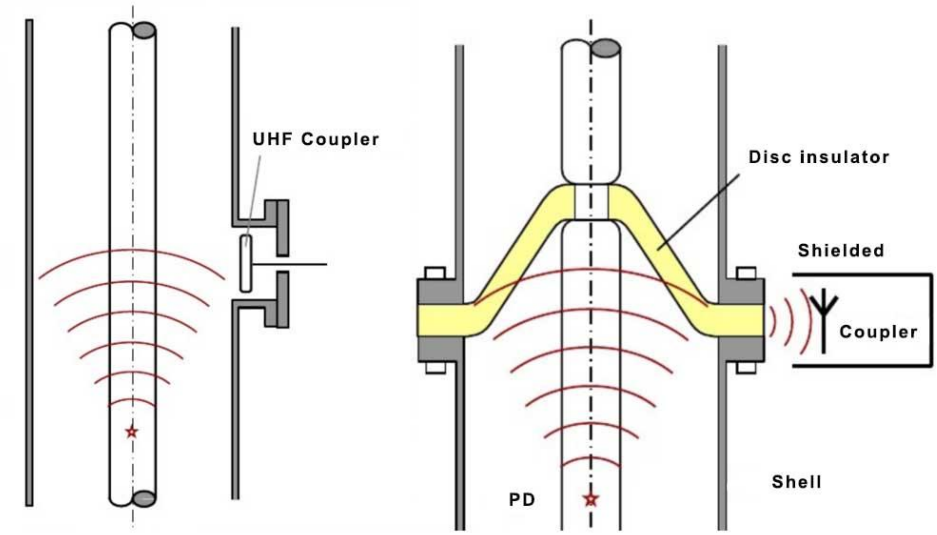


Figure 3. UHF detection mechanism

Note:

All the above sensors are connected through the sensor extension port at the bottom of the host. When the sensor is connected through the same extension port, the host will automatically identify the sensor type, select the sampling channel of the corresponding frequency, and display the relevant parameters of the sensor on the top of the interface.

-. Wireless PD Data Transmission via LoRa

PDS3W communicates with the acquisition terminal 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.

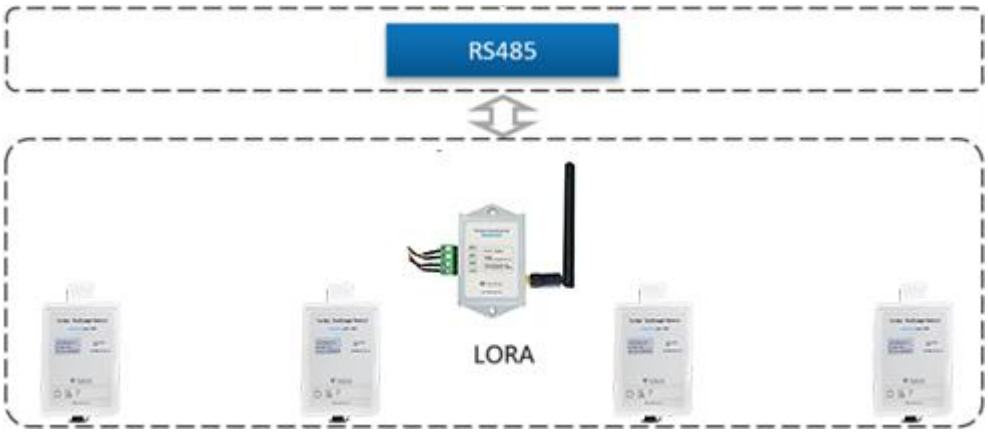
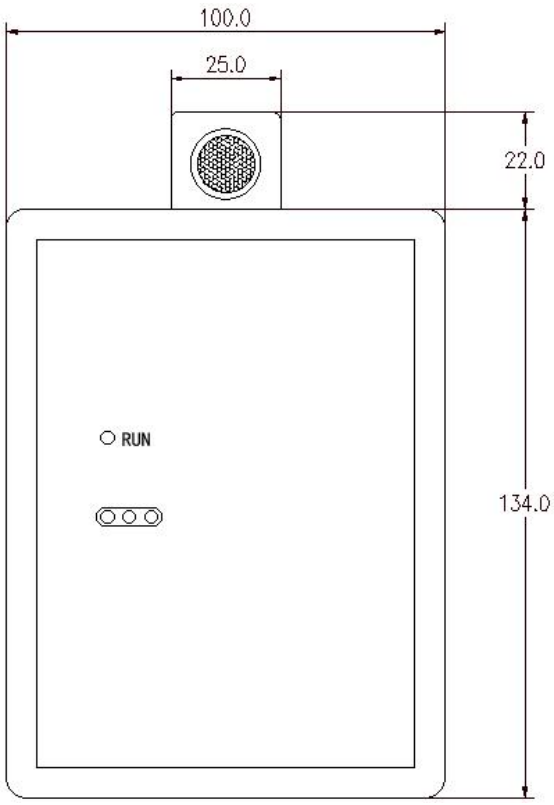


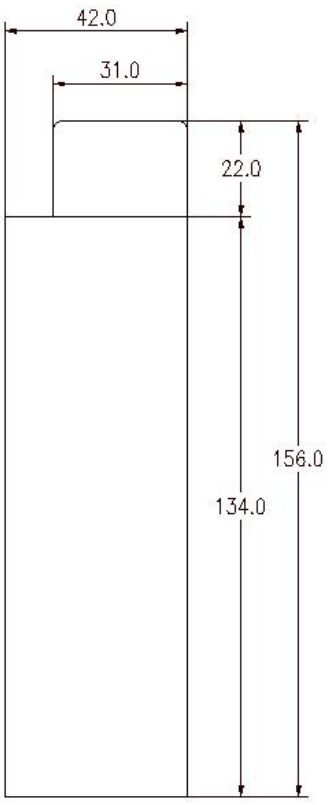
Figure 4. Application diagram

4.- INSTALLATION AND START-UP

4.1.- Dimension



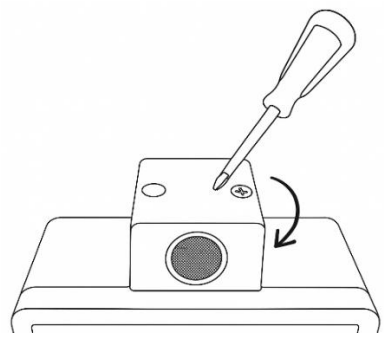
Front view



Side view

4.2.- 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.

5.- COMMUNICATION INTERFACE

This document defines the communication protocol specification of SCM-PDS3, please strictly follow this communication protocol to connect with the device. Baud rate: 9600; data bits: 8; parity bit N; stop bit: 1.

5.1.- MODBUS © protocol

Modbus RTU Frame Format:

Address code	**1 BYTE**	*Slave device address **1-247***
Function code	**1 BYTE**	*Indicates the function codes like read coils / inputs*
Data code	**4 BYTE**	*Starting address, high byte* *Starting address, low byte* *Number of registers, high byte* *Number of registers, low byte*
Error Check code	**2 BYTE**	*Cyclical Redundancy Check (**CRC**)*

MODBUS FUNCTIONS

Code	Meaning	Description
FUNCTION 02	**Read DI status**	*Reads the ON/OFF status of DI*
FUNCTION 03	**Read holding register**	*Read device setting data*
FUNCTION 04	**Read input register**	*Read device measurement data*
FUNCTION 06	**Write Single Register**	*Writes a value into a single holding register.*
FUNCTION 10	**Write Multiple Register**	*Writes values into a sequence of holding registers*

Note:

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

5.2.- Register Map

5.2.1.- Read the device alarm data (Functionx02)

Register	Definition
0	Sensor 1-16 Alarm or not
1	Sensor 17-32 Alarm or not
2	Sensor 33-48 Alarm or not
…	

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Sensor 8	Sensor 7	Sensor 6	Sensor 5	Sensor 4	Sensor 3	Sensor 2	Sensor 1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8
Sensor 16	Sensor 15	Sensor 14	Sensor 13	Sensor 12	Sensor 11	Sensor 10	Sensor 9

5.2.2.- Read the data collected by the receiver (Functionx03)

Register	Definition
0	Sensor 1 Battery powered
1	Sensor 1 AA discharges times
2	Sensor 1 AA discharge peak value
3	Sensor 1 AA discharge average value
4	Sensor 1 TEV discharges times
5	Sensor 1 TEV discharge peak value
6	Sensor 1 TEV discharge average value
7	Sensor 1 UHF discharges times
8	Sensor 1 UHF discharge peak value
9	Sensor 1 UHF discharge average value
13	Sensor 1 Data upload time (year, month)
14	Sensor 1 Data upload time (day, hour)
15	Sensor 1 Data upload time (minute, second)
16~31	Sensor 2 data
32~47	Sensor 3 data
48~63	Sensor 4 data
64~79	Sensor 5 data
...	...

5.2.3.- Read the setting value (Funx04)

Register	Definition
0	Reserved
1	Gateway address
2	Baud rate
3	Parity bit
4	Number of sensors
5	Sensor data upload time (s)
6	Local time (year, month)
7	Local time (day, hour)
8	Local time (minutes, seconds)
9	AA setting value
10	TEV setting value
11	UHF setting value

5.2.4.- Write the single setting value (Funx06)

Register	Definition
0	Reserved
1	Gateway address
2	Baud rate
3	Parity bit
4	Number of sensors
5	Sensor data upload time (s)
6	Local time (year, month)
7	Local time (day, hour)
8	Local time (minutes, seconds)
9	AA setting value
10	TEV setting value
11	UHF setting value

5.2.5.- Write the multiple setting value (Funx10)

Register	Definition
0	Reserved
1	Gateway address
2	Baud rate
3	Parity bit
4	Number of sensors
5	Sensor data upload time (s)
6	Local time (year, month)
7	Local time (day, hour)
8	Local time (minutes, seconds)
9	AA setting value
10	TEV setting value
11	UHF setting value

6.- SAFETY CONSIDERATIONS

All installation specification described at the previous chapters named: **INSTALLATION AND STARTUP, INSTALLATION MODES and SPECIFICATIONS.**

Please note that with the instrument powered on, the terminals could be dangerous to touching and cover opening actions or elements removal may allow accessing dangerous parts. This instrument is factory-shipped at proper operation condition.

◆ The device must have a professional installation and maintenance.
◆ Any operation of the device, you must cut off the input signal and power.

7.- TECHNICAL SERVICE

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

Blue Jay - After-sales service

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