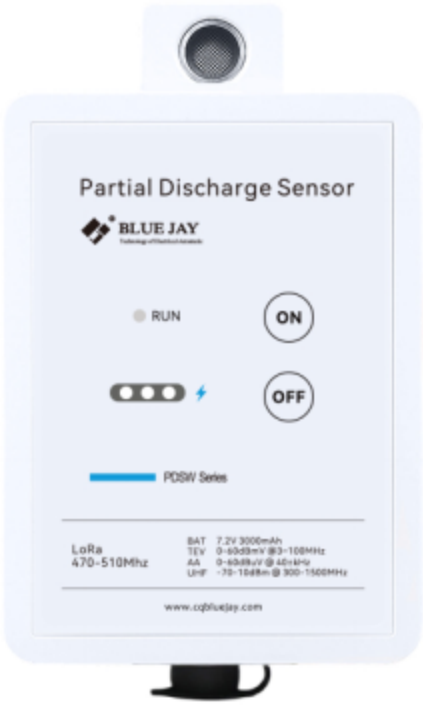
SCM-PDS3W
Wireless Partial Discharge Sensor

User Manual



Version:1.12

Revision: 2026.05

Tel: +0086-023-67628702
www.cqbluejay.com
Add: 1802,Building 2,No.88,Jianxin East Road,Chongqing,400020,China
Email:tech@cqbluejay.com

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**

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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.

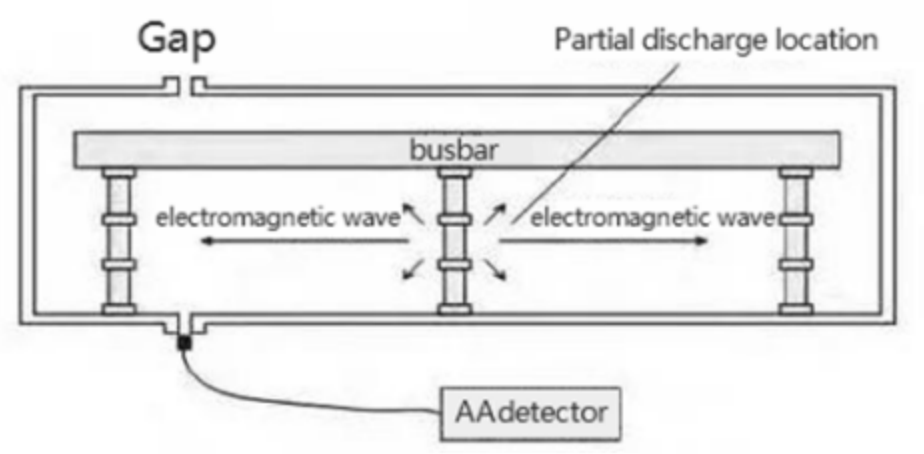


Figure 1. Ultrasonic detection mechanism

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.

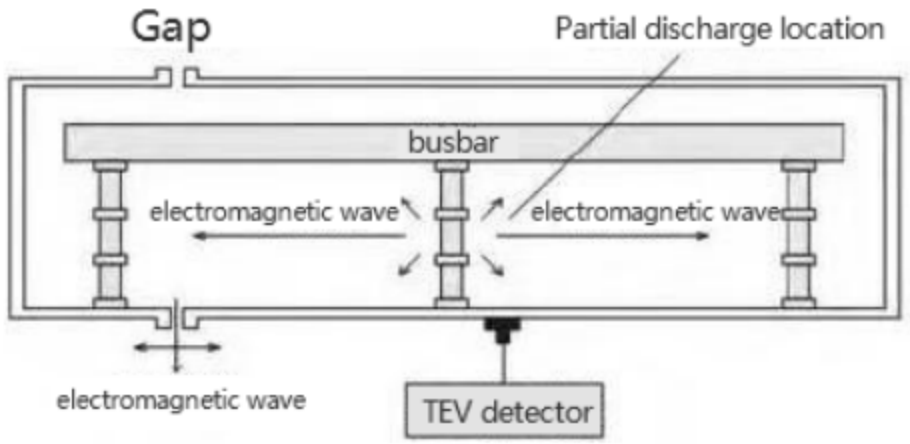


Figure 2. TEV detection mechanism

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.

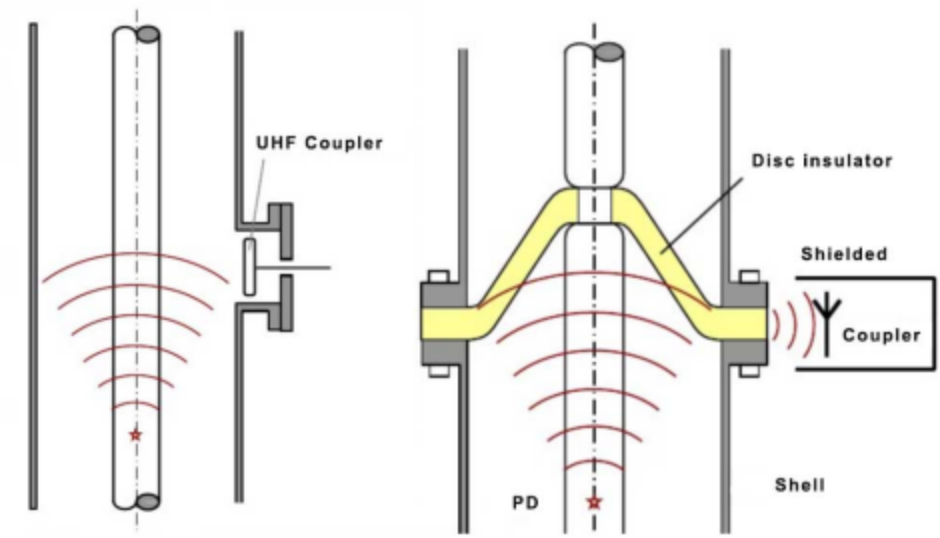


Figure 3. UHF detection mechanism

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 level of the device.

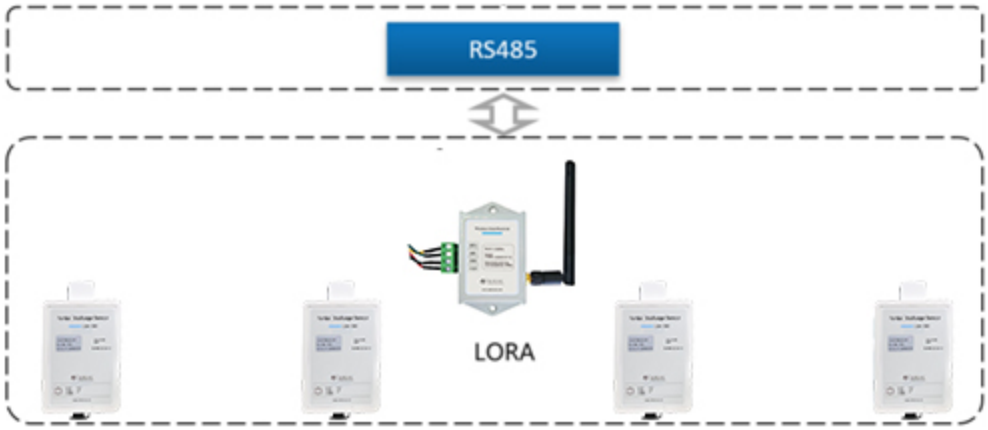
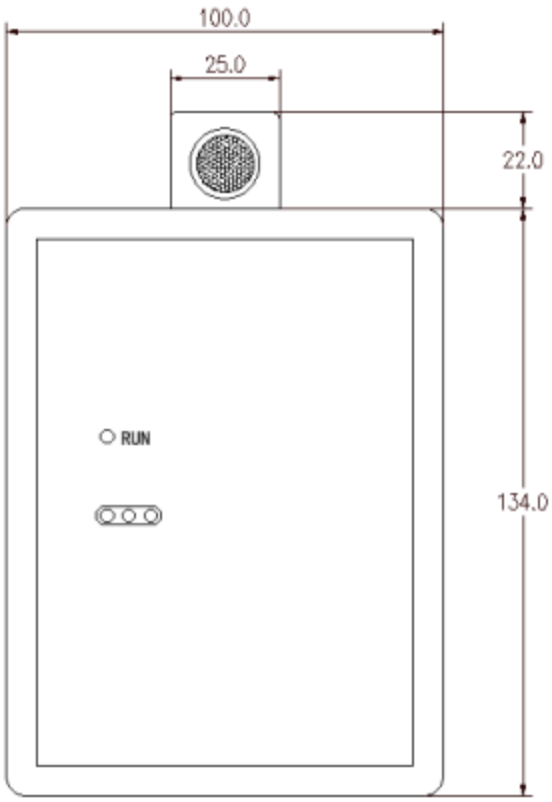


Figure 4. Application diagram

4.- INSTALLATION AND START-UP

4.1.- Dimension

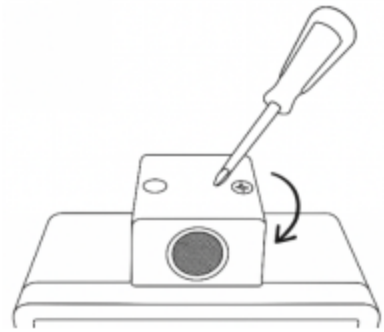


Front view

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 measurement data
FUNCTION 04	Read input register	Read device setting 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 sensor alarm status, read only, Fun 02 to read.

Reg.	Data	Data	Value
00x00	BIT 0	Sensor 1	0: Normal; 1: Alarm
	BIT 1	Sensor 2	0: Normal; 1: Alarm
	BIT 2	Sensor 3	0: Normal; 1: Alarm
	BIT 3	Sensor 4	0: Normal; 1: Alarm
	BIT 4	Sensor 5	0: Normal; 1: Alarm
	BIT 5	Sensor 6	0: Normal; 1: Alarm
	BIT 6	Sensor 7	0: Normal; 1: Alarm
	BIT 7	Sensor 8	0: Normal; 1: Alarm
00x01	BIT 0	Sensor 9	0: Normal; 1: Alarm
	BIT 1	Sensor 10	0: Normal; 1: Alarm
	BIT 2	Sensor 11	0: Normal; 1: Alarm
	BIT 3	Sensor 12	0: Normal; 1: Alarm
	BIT 4	Sensor 13	0: Normal; 1: Alarm
	BIT 5	Sensor 14	0: Normal; 1: Alarm
	BIT 6	Sensor 15	0: Normal; 1: Alarm
	BIT 7	Sensor 16	0: Normal; 1: Alarm
00x02	BIT 0	Sensor 17	0: Normal; 1: Alarm
	BIT 1	Sensor 18	0: Normal; 1: Alarm
	BIT 2	Sensor 19	0: Normal; 1: Alarm
	BIT 3	Sensor 20	0: Normal; 1: Alarm
	BIT 4	Sensor 21	0: Normal; 1: Alarm
	BIT 5	Sensor 22	0: Normal; 1: Alarm
	BIT 6	Sensor 23	0: Normal; 1: Alarm
	BIT 7	Sensor 24	0: Normal; 1: Alarm
00x03	BIT 0	Sensor 25	0: Normal; 1: Alarm
	BIT 1	Sensor 26	0: Normal; 1: Alarm

	BIT 2	Sensor 27	0: Normal; 1: Alarm
	BIT 3	Sensor 28	0: Normal; 1: Alarm
	BIT 4	Sensor 29	0: Normal; 1: Alarm
	BIT 5	Sensor 30	0: Normal; 1: Alarm
	BIT 6	Sensor 31	0: Normal; 1: Alarm
	BIT 7	Sensor 32	0: Normal; 1: Alarm
00x04	BIT 0	Sensor 33	0: Normal; 1: Alarm
	BIT 1	Sensor 34	0: Normal; 1: Alarm
	BIT 2	Sensor 35	0: Normal; 1: Alarm
	BIT 3	Sensor 36	0: Normal; 1: Alarm
	BIT 4	Sensor 37	0: Normal; 1: Alarm
	BIT 5	Sensor 38	0: Normal; 1: Alarm
	BIT 6	Sensor 39	0: Normal; 1: Alarm
	BIT 7	Sensor 40	0: Normal; 1: Alarm
00x05	BIT 0	Sensor 41	0: Normal; 1: Alarm
	BIT 1	Sensor 42	0: Normal; 1: Alarm
	BIT 2	Sensor 43	0: Normal; 1: Alarm
	BIT 3	Sensor 44	0: Normal; 1: Alarm
	BIT 4	Sensor 45	0: Normal; 1: Alarm
	BIT 5	Sensor 46	0: Normal; 1: Alarm
	BIT 6	Sensor 47	0: Normal; 1: Alarm
	BIT 7	Sensor 48	0: Normal; 1: Alarm
... ...			

5.2.2.- Read the data collected by receiver, read only, Fun 03 to read.

Reg.	Data	Byte mode		Value range
00x00	Sensor 1 Battery level	INT	1	0-100%
00x01	Sensor 1 AA discharge times	INT	1	0-4095
00x02	Sensor 1 AA discharge amplitude	INT	1	0~60, unit: dBuV
00x03	Sensor 1 AA discharge average value	INT	1	0~60, unit: dBuV
00x04	Sensor 1 TEV discharge times	INT	1	0-4095
00x05	Sensor 1 TEV discharge amplitude	INT	1	0~60, unit: dBmV
00x06	Sensor 1 Environmental noise value	INT	1	0~60, unit: dBmV
00x07	Sensor 1 UHF discharge times	INT	1	0-4095
00x08	Sensor 1 UHF discharge amplitude	INT	1	-70~10, unit: dBm
00x09	Sensor 1 UHF discharge average value	INT	1	-70~10, unit: dBm
00x0A	Sensor 1 Noise value	INT	1	30~80, unit: dB
00x0B	Sensor 1 Temperature	INT	1	-40~85, unit: ℃
00x0C	Sensor 1 Humidity	INT	1	5~95, unit: %RH
00x0D	Sensor 1 Receive time (year, month)	INT	1	
00x0E	Sensor 1 Receive time (date, hour)	INT	1	
00x0F	Sensor 1 Receive time (minute, second)	INT	1	
00x10	Sensor 2 Battery level	INT	1	0-100%
00x11	Sensor 2 AA discharge times	INT	1	0-4095
00x12	Sensor 2 AA discharge amplitude	INT	1	0~60, unit: dBuV
00x13	Sensor 2 AA discharge average value	INT	1	0~60, unit: dBuV
00x14	Sensor 2 TEV discharge times	INT	1	0-4095
00x15	Sensor 2 TEV discharge amplitude	INT	1	0~60, unit: dBmV
00x16	Sensor 2 Environmental noise value	INT	1	0~60, unit: dBmV
00x17	Sensor 2 UHF discharge times	INT	1	0-4095
00x18	Sensor 2 UHF discharge amplitude	INT	1	-70~10, unit: dBm
00x19	Sensor 2 UHF discharge average value	INT	1	-70~10, unit: dBm
00x1A	Sensor 2 Noise value	INT	1	30~80, unit: dB

00x1B	Sensor 2 Temperature	INT	1	-40~85, unit: ℃
00x1C	Sensor 2 Humidity	INT	1	5~95, unit: %RH
00x1D	Sensor 2 Receive time (year, month)	INT	1	
00x1E	Sensor 2 Receive time (date, hour)	INT	1	
00x1F	Sensor 2 Receive time (minute, second)	INT	1	
00x20	Sensor 3 Battery level	INT	1	0-100%
00x21	Sensor 3 AA discharge times	INT	1	0-4095
00x22	Sensor 3 AA discharge amplitude	INT	1	0~60, unit: dBuV
00x23	Sensor 3 AA discharge average value	INT	1	0~60, unit: dBuV
00x24	Sensor 3 TEV discharge times	INT	1	0-4095
00x25	Sensor 3 TEV discharge amplitude	INT	1	0~60, unit: dBmV
00x26	Sensor 3 Environmental noise value	INT	1	0~60, unit: dBmV
00x27	Sensor 3 UHF discharge times	INT	1	0-4095
00x28	Sensor 3 UHF discharge amplitude	INT	1	-70~10, unit: dBm
00x29	Sensor 3 UHF discharge average value	INT	1	-70~10, unit: dBm
00x2A	Sensor 3 Noise value	INT	1	30~80, unit: dB
00x2B	Sensor 3 Temperature	INT	1	-40~85, unit: ℃
00x2C	Sensor 3 Humidity	INT	1	5~95, unit: %RH
00x2D	Sensor 3 Receive time (year, month)	INT	1	
00x2E	Sensor 3 Receive time (date, hour)	INT	1	
00x2F	Sensor 3 Receive time (minute, second)	INT	1	
… …				

5.2.3.- Read the setting value, read only, Fun 04 to read.

Reg.	Data	Byte mode		Value range
00x00	Reserved	INT	1	0-100%
00x01	Gateway address	INT	1	1-255
00x02	Baud rate	INT	1	1: 4800; 2:9600 **(Default)** 3:19200; 4:38400; 5:115200
00x03	Parity bit	INT	1	
00x04	Quantity of terminal sensors	INT	1	0-255
00x05	Sensor data upload time (s)	INT	1	
00x06	Local time (year, month)	INT	1	
00x07	Local time (day, hour)	INT	1	
00x08	Local time (minute, second)	INT	1	
00x09	AA setting value	INT	1	
00x0A	TEV setting value	INT	1	
00x0B	UHF setting value	INT	1	

5.2.4.- Write the setting value, Fun 06 to write single register, Fun 10 to write multiple

Reg.	Data	Byte mode		Value range
00x00	Reserved	INT	1	0-100%
00x01	Gateway address	INT	1	1-255
00x02	Baud rate	INT	1	1: 4800; 2:9600 **(Default)** 3:19200; 4:38400; 5:115200
00x03	Parity bit	INT	1	
00x04	Quantity of terminal sensors	INT	1	0-255
00x05	Sensor data upload time (s)	INT	1	
00x06	Local time (year, month)	INT	1	
00x07	Local time (day, hour)	INT	1	
00x08	Local time (minute, second)	INT	1	
00x09	AA setting value	INT	1	
00x0A	TEV setting value	INT	1	
00x0B	UHF setting value	INT	1	

Notes:

1.- Initial alarm logic (alarm are triggered independently when each condition is met.):

When AA reach set threshold 30dBμV and simultaneous discharge count exceeds 10 pulses.
When TEV reach set threshold 30dBμV and simultaneous discharge count exceeds 10 pulses.
When UHF reach set threshold -30dBm and simultaneous discharge count exceeds 10 pulses.

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

3.- Noise value refers to the environmental noise value, only for user reference, not to participate in the calculation of AA and TEV measurement 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

1802, Building 2, No.88, Jianxin East Road,
Chongqing,400020, China

Tel - + 0086 023 67628702
E-mail: tech@cqbluejay.com