

APD 系列局放监测装置

使用说明书 V1.5

APD series Partial Discharge Detector

Operation Manual V1.5

申 明

DECLARATION

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1. 安装使用

1 Installation Guide

1.1 产品概述

1.1 Product Introduction

现阶段，电力系统对于电能的质量提出越来越高的要求，不仅要确保供电稳定可靠，而且供电的安全性也是重要要求。电力系统中，金属封闭开关设备得到广泛应用，因此开关柜运行的是否稳定可靠是重中之重，电气设备在运行的过程中由于受到高温、电压、振动以及其他化学作用，将会使得其绝缘性能降低，会产生局部放电现象，同时又会加速绝缘的恶化情况，会给电力系统造成较大的经济损失。但是，由于开关柜内部空间狭小、零件繁多、结构复杂，绝缘距离小，因此比其它电力设备更容易出现绝缘缺陷，从而对设备安全运行带来巨大隐患。

At present, the power system has increasingly high requirements for the quality of electricity, not only to ensure stable and reliable power supply, but also to ensure the safety of power supply. In the power system, metal enclosed switchgear is widely used, so the stability and reliability of the switchgear operation is of utmost importance. Electrical equipment, due to high temperature, voltage, vibration, and other chemical effects during operation, will have a reduced insulation performance, resulting in partial discharge and accelerating the deterioration of insulation, causing significant economic losses to the power system. However, due to the narrow internal space, numerous components, complex structure, and small insulation distance of the switchgear, it is more prone to insulation defects than other power equipment, which poses a huge hidden danger to the safe operation of the equipment.

高压电气设备的绝缘内部如气泡间隙、杂质、尖刺等缺陷，在强电场作用下使得开关柜绝缘内部的电场分布不均匀，在缺陷部位的电场强度会增大，从而容易导致该部位发生未贯穿整个绝缘的放电，即局部放电。

Defects such as bubble gaps, impurities, and spikes in the insulation of high-voltage electrical equipment can cause uneven distribution of electric field inside the switchgear insulation under the action of strong electric fields. The electric field strength at the defect area will increase, which can easily lead to partial discharge that does not penetrate the entire insulation, that is, partial discharge.

局部放电一般不会引起开关柜内部绝缘的穿透性击穿，但是却会导致绝缘介质的局部损坏。若其长期存在，则会在一定条件下造成绝缘装置电气强度的破坏，最终造成开关柜内部绝缘击穿。因而对于电气设备而言，电气设备发生局部放电现象是导致其绝缘老化或劣化甚至损坏从而引发设备损毁及电力系统事故的重要原因之一，同时局部放电也是设备绝缘完整性退化的标志。因此对电气设备的局部放电进行检测是评估设备绝缘状况的重要手段，也是发现设备潜伏性故障，最终实现故障预警，避免故障发生的有效措施之一。

Partial discharge generally does not cause penetrating breakdown of the insulation inside the switchgear, but it can lead to local damage to the insulation medium. If it exists for a long time, it will cause damage to the electrical strength of the insulation device under certain conditions, ultimately leading to insulation breakdown inside the switchgear. Therefore, for electrical equipment, the occurrence of partial discharge is one of the important reasons for insulation aging, deterioration, and even damage, leading to equipment damage and power system accidents. At the same time, partial discharge is also a

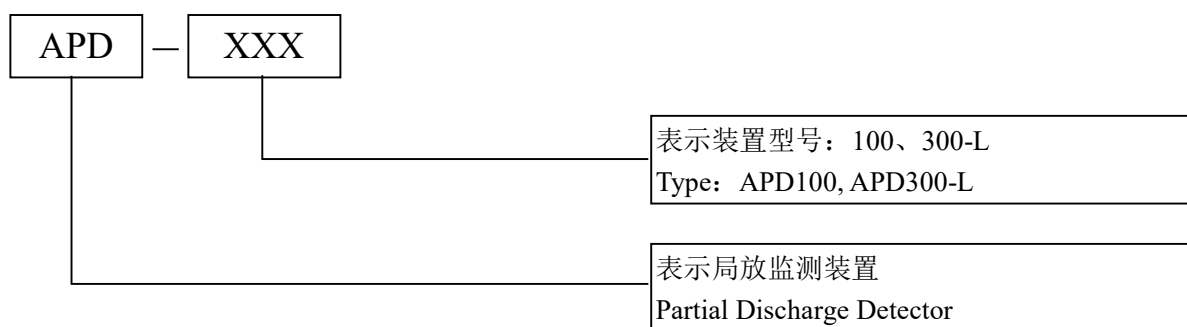
sign of equipment insulation integrity degradation. Therefore, monitoring and detecting partial discharge of electrical equipment is an important means to evaluate the insulation status of equipment, and is also one of the effective measures to detect potential faults in equipment, ultimately achieve fault warning, and avoid the occurrence of faults.

APD系列高压开关柜局部放电监测装置通过通过特高频传感器、地电波传感器和超声波传感器监测检测电气设备运行时的局部放电信号，从而判断高压电气设备内部是否存在绝缘隐患，提前预警。

The APD series high-voltage switchgear partial discharge monitoring device monitors partial discharge signals during the operation of electrical equipment through ultra-high frequency sensors, ground wave sensors, and ultrasonic sensors, thereby determining whether there are insulation risks inside high-voltage electrical equipment and providing early warning.

1.2 型号说明

1.2 Type Introduction



1.3 技术指标

1.3 Technical Features

型号 Type 参数 Parameters	APD100
检测通道 Number of channels	1 路 One
测量范围 Measuring range	-60dBm~+10dBm
测量内容 Measurement content	放电幅值、放电频次 Discharge amplitude and frequency
匹配阻抗 Matching impedance	50 Ω
工作电源 Power supply	DC10~30V
功耗 Power dissipation	≤3W

通信方式 Communication interface		RS485 * 1、Lora * 1
波特率(bps) Baud rate		2400、4800、9600、19200 (RS485)
通信协议 Communication protocol		MODBUS-RTU (RS485)
继电器输出 Relay output		1 路常开; 5A/AC250V, 5A/DC30V 1 circuit normally open relay
安装方式 Installation		35mm 导轨式安装 35mm guide rail installation
工作环境 Usage environment		温度: -25 ℃~+70 ℃; 相对湿度≤95% Temperature: -25 ℃~+70 ℃; Relative humidity ≤ 95%
特高频 传感器 UHF sensor	检测带宽 Bandwidth	300MHz~1600MHz
	等效高度 Effective height	≥10.5mm
	接口类型 Interface	SMA
	连接电缆 Connecting cables	同轴电缆 Coaxial cable
	防护等级 Protective class	IP65
	安装方式 Installation	磁吸式 Magnetic

参数 Parameters			型号 Type	APD300-L
电源 Power				DC 9-36V
数据输出 Data output				RS485 (MODBUS-RTU)
采样周期 Sampling period				4S
	特高频 UHF	测量范围 Measuring range		-70~10dBm
		测量频段		300MHz~1500MHz

局放监测 传感器 PD monitoring sensors		Bandwidth	
		平均等效高度 Average equivalent height	≥10mm
	超声波 AE	测量范围 Measuring range	0～70dBμV
		谐振频率 Resonant frequency	40kHz±1kHz
	地电波 TEV	测量范围 Measuring range	0～60dBmV
		测量信号带宽 Bandwidth	3MHz～100MHz
	环境 Environment	噪声测量范围 Noise measuring range	30dB～130dB
		温度测量范围 Temp measuring range	-40℃～85℃
		湿度测量范围 Humidity measuring range	0～100%RH
工作环境 Usage environment		温度 Temperature	-40℃～85℃
		湿度 Relative humidity	≤95%RH
尺寸 Size	终端外形尺寸 Terminal form factor	135mm*100mm*42mm	
安装 Installation	安装方式 Installation	磁吸式 Magnetic	

1.4 产品安装及尺寸

1.4 Product installation and size

1.4.1 APD100 安装及尺寸

1.4.1 APD100 installation and size

APD100 特高频局放监测装置采用导轨（DIN35mm）安装方式，可安装在开关柜二次仪表室；特高频传感器采用磁吸安装方式，吸附在开关柜电缆室柜壁。产品详细尺寸见图，单位 mm。

The APD100 UHF partial discharge detector adopts a guide rail (DIN35mm) installation method and can be installed in the secondary instrument room of the switchgear; The UHF sensor adopts a magnetic

suction installation method and is adsorbed on the wall of the switchgear cable room. The detailed dimensions of the product are shown in millimeters.

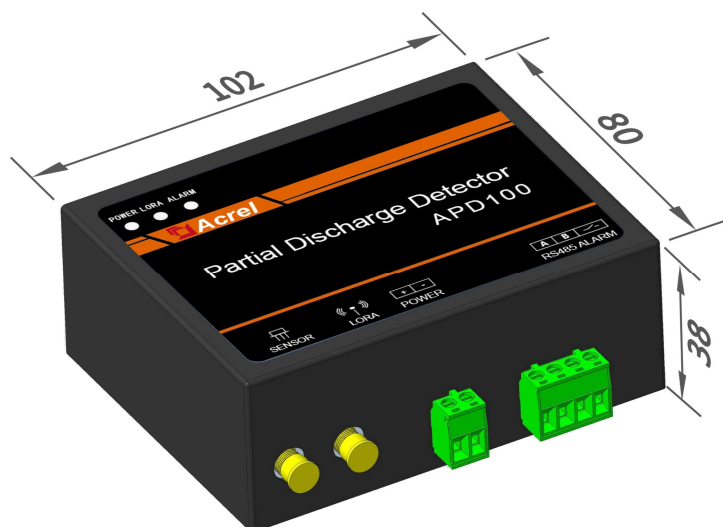


图 1.1 APD100 局放监测装置

Figure 1.1 APD100 Partial Discharge Detector

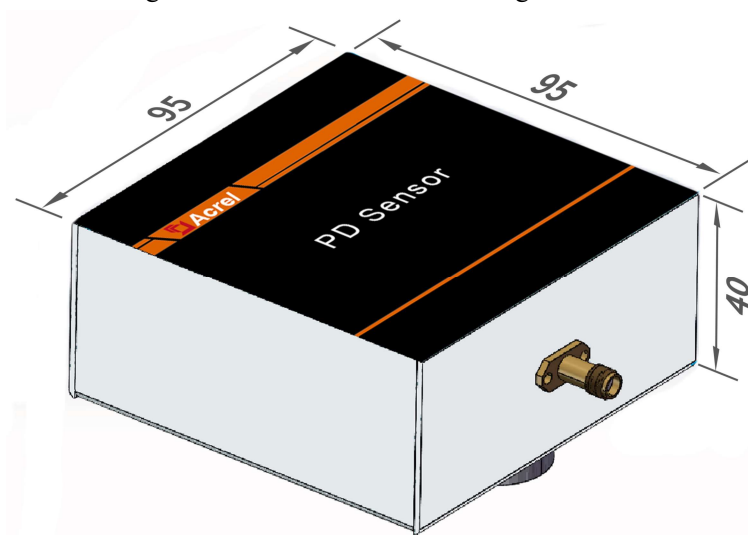


图 1.2 特高频局放传感器

Figure 1.2 UHF Sensor

1.4.2 APD300 安装及尺寸

1.4.2 APD300 installation and size

APD300 监测智能终端采用强磁吸附安装方式，吸附在开关柜电缆室柜壁。产品详细尺寸见图，单位 mm。

The APD300 monitoring intelligent terminal adopts a strong magnetic adsorption installation method and adsorbs on the wall of the cable room of the switchgear. The detailed dimensions of the product are shown in the figure, in mm.

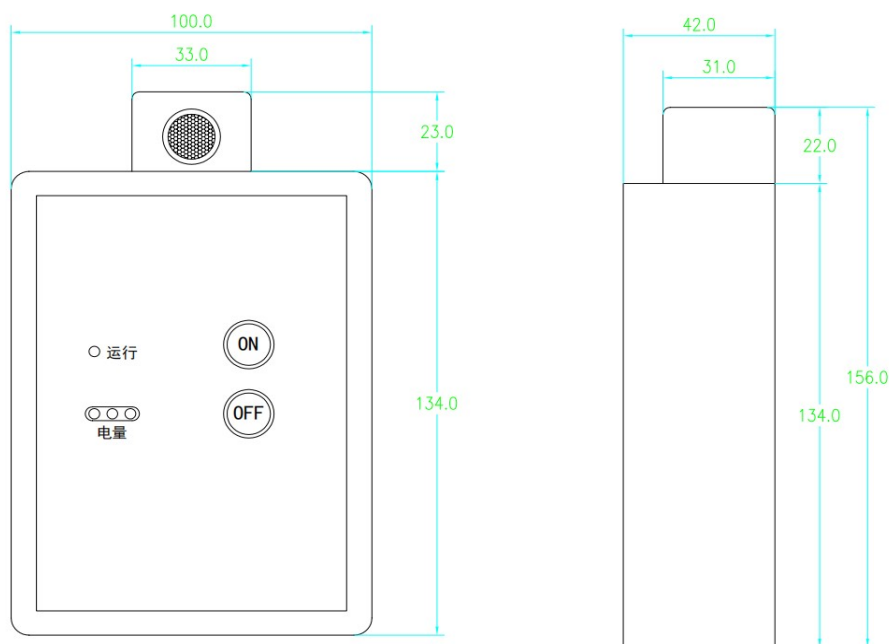


图 1.3 APD300 尺寸图

Figure 1.3 APD300 Dimensional drawings



图 1.4 APD300 局放监测智能终端

Figure 1.4 APD300 Partial Discharge Detector

1.5 接线方法

1.5 Wiring method

特高频局放监测装置 APD100 接线端子示意图如下，“SENSOR”接口通过同轴电缆连接特高频传感器；“POWER”接口为装置的工作电源接入，可接入 DC10~30V 电压；通信接口包括 RS485

通信口和 LORA 无线（无线通信需配合我司无线收发器使用）；“ALARM”为告警干接点输出。

The schematic diagram of the APD100 wiring terminal is as follows. The "SENSOR" interface is connected to the UHF sensor through a coaxial cable; The "POWER" interface is used to connect the working power supply of the device, which can be connected to DC10~30V voltage; The communication interface includes RS485 communication port and LORA wireless (wireless communication needs to be used in conjunction with our wireless transceiver); "ALARM" is the alarm dry contact output.

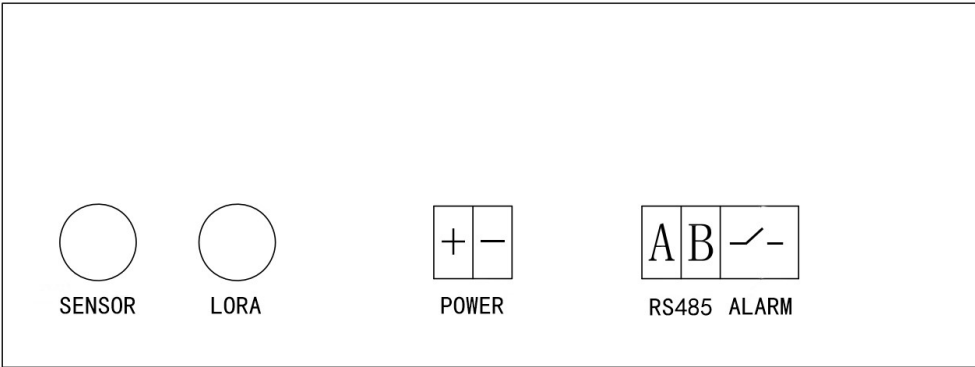


图 1.5 APD100 端子图

Figure 1.5 APD100 terminal diagram

局放智能监测终端 APD300-L 有线模式接线端子示意图如下，针脚定义：端口 1：电源正极；端口 2：电源负极；端口 3：RS485 通信 A；端口 4：RS485 通信 B。通信接口 RS485，波特率 9600。

The schematic diagram of the partial discharge intelligent monitoring terminal APD300-L wired mode terminal is as follows, and the pin definition: port 1: power supply positive; Port 2: Power Negative; Port 3: RS485 communication A; Port 4: RS485 communication B. Communication interface RS485, baud rate 9600.

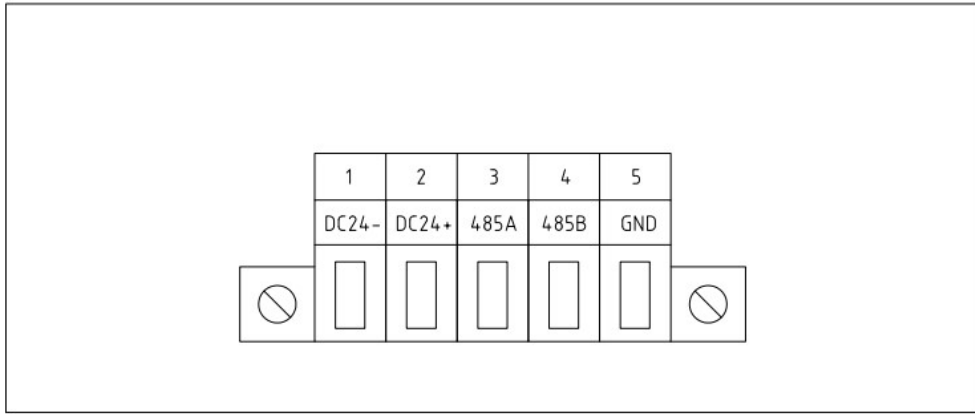


图 1.6 APD300-L 端子图

Figure 1.6 APD300-L terminal diagram

2. 通讯指南

2 Communications

在本章主要讲述如何利用软件通过通讯口来读写 APD 局放监测装置的数据。本章内容的掌握

需要您具有 MODBUS 协议的知识储备并且通读了本册其他章节所有内容，对本产品功能和应用概念有较全面的了解。本章内容包括：通讯应用格式详解，本机的参量地址表。

This chapter mainly discusses how to use software to read and write data of APD partial discharge detector through communication port. Mastering the content of this chapter requires you to have a knowledge base of the MODBUS protocol and have read through all other chapters of this volume to have a comprehensive understanding of the product's functions and application concepts. This chapter includes a detailed explanation of communication application formats and a parameter address table for this machine.

2.1 通讯格式详解

2.1 Detailed Explanation of Communication Format

本节所举实例将尽可能的使用如下表所示的格式，数据为十六进制。

The examples presented in this section will use the format shown in the following table as much as possible, with data in hexadecimal.

2.1.1 读取数据（功能码 03H/04H）

2.1.1 Read Data (Function code 03H/04H)

此功能允许用户获得设备采集与记录的数据及系统参数。主机一次请求的数据个数没有限制，但不能超出定义的地址范围。

This function allows users to obtain data and system parameters collected and recorded by the device. There is no limit to the number of data requested by the host at once, but it cannot exceed the defined address range.

例如，主机发送查询数据帧：

For example, master send data frame:

地址 Address	功能码 Fun	起始地址 Start address		寄存器数量 Register Count		CRC16 校验码 CRC16	
		高 Hi	低 Lo	高 Hi	低 Lo	低 Lo	高 Hi
01H	03H	00H	01H	00H	02H	95H	CBH

装置返回响应数据帧：

Slave answer data frame:

地址 Address	功能码 Fun	字节数 Byte count	数据 1 Data 1		数据 2 Data 2		CRC16 校验码 CRC16	
			高 Hi	低 Lo	高 Hi	低 Lo	低 Lo	高 Hi
01H	03H	04H	00H	01H	00H	04H	AAH	30H

2.1.2 预置单个寄存器（功能码 06H）

2.1.2 Preset Single Register (Function code 06H)

此功能码允许用户改变单个寄存器的内容，可通过此功能码将工作参数写入装置。

User can write active parameter into the single register with this function code.

例如，主机发送：

For example, master send data frame:

地址 Address	功能码 Fun	寄存器地址 Start address		预置值 Value		CRC16 校验码 CRC16	
		高 Hi	低 Lo	高 Hi	低 Lo	低 Lo	高 Hi
01H	06H	00H	01H	00H	02H	59H	CBH

装置返回响应数据帧：

Slave answer data frame:

地址 Address	功能码 Fun	寄存器地址 Start address		预置值 Value		CRC16 校验码 CRC16	
		高 Hi	低 Lo	高 Hi	低 Lo	低 Lo	高 Hi
01H	06H	00H	01H	00H	02H	59H	CBH

2.2 通讯地址表

2.2 Parameter address table

2.2.1 APD100 地址表

2.2.1APD100 address table

地址 Address	参数 Parameter	属性 Attribute	数值范围 Range	数据类型 Data type
0000H	预留 Reserve	R	预留，不可修改 Reserve, Unmodifiable	Uint16
0001H	通讯地址 Address	R/W	1-247，默认为 1 1-247, Default is 1	Uint16
0002H	通讯波特率 Baud rate	R/W	01:1200; 02:2400; 03:4800; 04:9600; 05:14400; 06:19200; 07:115200;默认 9600; Default value is 0x00FF,Baud rate is 9600	Uint16
0003H ~0004H	预留 Reserve	R	预留，不可修改 Reserve, Unmodifiable	Uint16
0005H	放电量报警阈值 PD alarm threshold	R/W	-60dBm~+15dBm，默认-20dBm; Default is -20dBm	Int16
0006H ~0008H	预留 Reserve	R	预留，不可修改 Reserve, Unmodifiable	Uint16
0009H	放电次数 PD frequency	R	0~65535	Uint16

000AH	放电量 PD capacity	R	-60dBm~+15dBm	Int16
000BH	放电量报警状态 PD alarm status	R	0, 无报警; 1, 报警; 0,Normal; 1,Alarm	Uint16
000CH ~000EH	预留 Reserve	R	预留, 不可修改 Reserve, Unmodifiable	Uint16
000FH	报警使能 PD alarm enable	R/W	0, 不使能; 1, 使能; 默认 1; 0,OFF; 1,ON; Default is 1	Uint16
0010H ~0012H	预留 Reserve	R	预留, 不可修改 Reserve, Unmodifiable	
0013 ~0016H	产品序列号 Product ID	R/W	产品序列号, 7 个字节 Product ID, 7 bytes	UINT16
0017H	LORA 信道 Lora channel	R/W	0~22, 默认 0: 470750000Hz Default is 0:470750000Hz	UINT16
0018H	LORA 带宽 Lora bandwidth	R/W	7~9,125kHz,250kHz,500kHz; 默认 9:500kHz; Default is 9:500kHz	UINT16
0019H	LORA 扩频因子 Lora SF	R/W	6~10, 默认 10: 1024; Default is 10:1024	UINT16
001AH	LORA- ERRORCODING	R/W	ERRORCODING,1~4 默认 2; [1: 4/5, 2: 4/6, 3: 4/7, 4: 4/8]; Default is 2:4/6	UINT16
001BH	Lora CRC 使能 Lora CRC enable	R/W	0~1, 默认 1; [0: OFF, 1: ON]; Default is 1:ON	UINT16
001CH	LORA 包头模式 Lora Header	R/W	0~1 默认 0; [0: OFF, 1: ON]; Default is 0:OFF	UINT16
001DH	LORA 发射功率 Lora transmitting power	R/W	0~20, 默认 20dBm; Default is 20dBm	UINT16

2.2.2 APD300-L 地址表

2.2.2APD300-L address table

1、读取全遥测数据

1. Read full telemetry data

该命令用于请求装置采集到的模拟量, 功能码为 0x04, 寄存器分布如下:

This command is used to request the analog quantity collected by the device, the function code is 0x04, and the register distribution is as follows:

地址 Address	参数 Parameter	属性 Attribute	数值范围 Range	数据类型 Data type
---------------	-----------------	-----------------	---------------	-------------------

0000H	AE 放电次数 AE frequency	R	0~4095	Int16
0001H	AE 放电幅值 AE capacity	R	0dBμV~60dBμV	Int16
0002H	AE 放电均值 AE average capacity	R	0dBμV~60dBμV	Int16
0003H	AE 告警 AE alarm status	R	0, 无报警; 1, 报警; 0,Normal; 1,Alarm	Int16
0004H	TEV 放电次数 TEV frequency	R	0~4095	Int16
0005H	TEV 放电幅值 TEV capacity	R	0dBmV~60dBmV	Int16
0006H	TEV 环境基值 TEV average capacity	R	0dBmV~60dBmV	Int16
0007H	TEV 告警 TEV alarm status	R	0, 无报警; 1, 报警; 0,Normal; 1,Alarm	Int16
0008H	UHF 放电次数 UHF frequency	R	0~4095	Int16
0009H	UHF 放电幅值 UHF capacity	R	-70dBm~+10dBm	Int16
000AH	UHF 放电均值 UHF average capacity	R	-70dBm~+10dBm	Int16
000BH	UHF 告警 UHF alarm status	R	0, 无报警; 1, 报警; 0,Normal; 1,Alarm	Int16
000CH	噪声值 Noise level	R	30dB~130dB	Int16
000DH	温度值 Temperature value	R	-40℃~85℃ (×10);	Int16
000EH	湿度值 Humidity value	R	0%RH~100%RH (×10);	Int16

备注：报警初始判定逻辑放电次数 10，超声波定值 30 dBuV 同时放电次数超过 10 次，TEV 定值 30 dBmV 同时放电次数超过 10 次，UHF 定值-30 dBm 同时放电次数超过 10 次。

Note: The initial judgment of the alarm is that the number of logical discharges is 10, the number of simultaneous discharges of ultrasonic value of 30 dBuV is more than 10 times, the number of simultaneous discharges of TEV value of 30 dBmV is more than 10 times, and the number of simultaneous discharges of UHF value of -30 dBm is more than 10 times.

2、读写定值数据

2. Read and write fixed value data

读取功能码为 0x03，写单个功能码为 0x06，写多个功能码为 0x10，寄存器分布如下：

The function code is 0x03 for reading, 0x06 for writing a single function code, and 0x10 for writing multiple function codes, and the register distribution is as follows:

地址 Address	参数 Parameter	属性 Attribute	数值范围 Range	数据类型 Data type
0000H	通讯地址 Address	R/W	1-255	Uint16
0001H	通讯波特率 Baud rate	R/W	01:4800; 02:9600; 03:19200;04:38400; 05:115200; 默认 9600;Baud rate is 9600	Uint16
0002H	AE 定值 AE alarm value	R/W	10dBμV~60dBμV, 默认值: 30dBμV Default is 30dBμV	Int16
0003H	TEV 定值 TEV alarm value	R/W	1dBmV~60dBmV, 默认值: 30dBmV Default is 30dBmV	Int16
0004H	UHF 定值 UHF alarm value	R/W	-70dBm~+10dBm, 默认值: -30dBm Default is -30dBm	Int16

注: [1] R—只读; W—只写; R/W—读/写。

Note:[1]R—Read;W—Write; R/W—Read/Write.