

APD 系列特高频局放监测装置

使用说明书 V1.2

APD series UHF Partial Discharge Detector

Operation Manual V1.2

申 明

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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。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监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

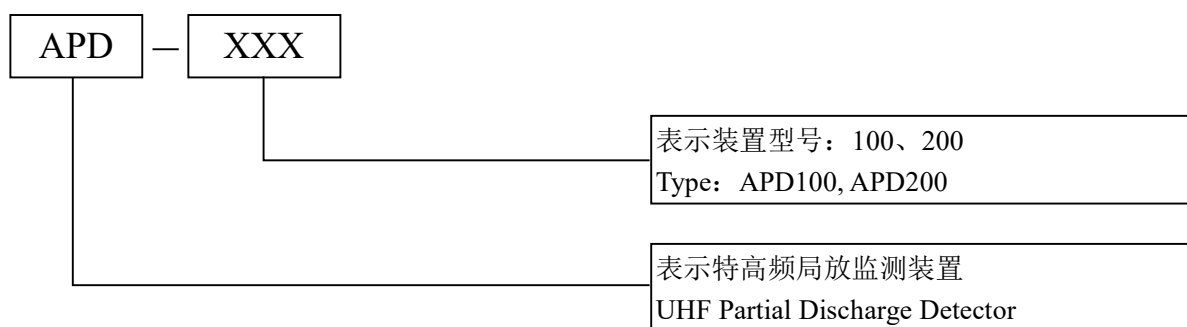
sign of equipment insulation integrity degradation. Therefore, monitoring and detecting partial discharge of electrical equipment is an important means to evaluate the insulation status of equipment, and is also one of the effective measures to detect potential faults in equipment, ultimately achieve 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检测伴随局部放电而产生的电磁波辐射并自动确定现场局部放电的实际检测频率，随后将检测的局部放电的放电次数和放电频次等数据上传至服务器。

The APD series high-voltage switchgear partial discharge monitoring device detects the electromagnetic wave radiation generated along with partial discharge and automatically determines the actual detection frequency of on-site partial discharge. Then, data such as the number and frequency of partial discharge detected are uploaded to the server.

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	APD200
检测通道 Number of channels	1 路 One	1 路 One
测量范围 Measuring range	-60dBm~+10dBm	-60dBm~+10dBm
测量内容 Measurement content	放电幅值、放电频次 Discharge amplitude and frequency	放电幅值、放电频次 PRPD 图谱、PRPS 图谱 Discharge amplitude and frequency PRPD, PRPS
工频同步 Phase synchronization	——	内同步（交流电源） Internal synchronization (AC power)

诊断类型 Discharge type recognition		自由金属颗粒放电、悬浮电位放电、 绝缘气隙放电/污秽放电、电晕放电 Free metal particle discharge, suspended potential discharge, insulation air gap discharge/pollution discharge, corona discharge
连接电缆 Connecting cables		同轴电缆 Coaxial cable
匹配阻抗 Matching impedance		50 Ω
工作电源 Power supply		DC10~30V AC/DC220V、AC/DC110V
功耗 Power dissipation		≤3W
通信方式 Communication interface		RS485 * 1、Lora * 1 RS485 * 1、USB-C * 1
波特率(bps) Baud rate		2400、4800、9600、19200 (RS485) 9600、115200 (RS485)
通信协议 Communication protocol		MODBUS-RTU (RS485) 需配合局放分析软件使用 To be used in conjunction with partial discharge analysis software
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
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1.4 产品安装及尺寸

1.4 Product installation and size

APD 系列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 APD series 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.

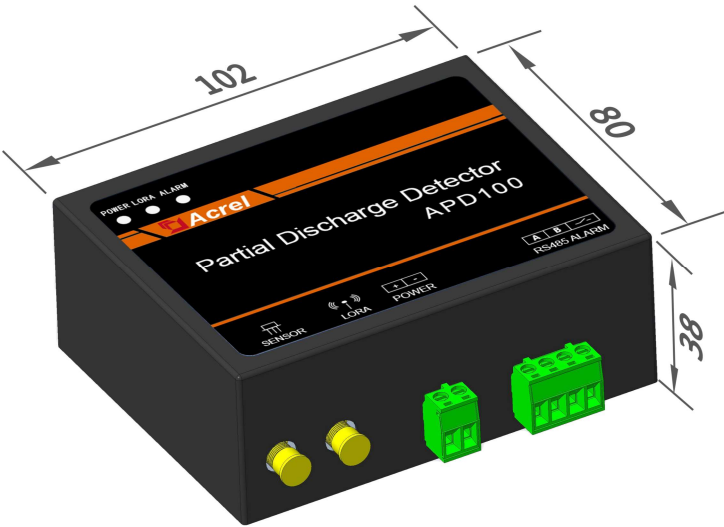


图 1.1 APD100 局放监测装置
Figure 1.1 APD100 Partial Discharge Detector



图 1.2 APD200 局放监测装置
Figure 1.2 APD200 Partial Discharge Detector

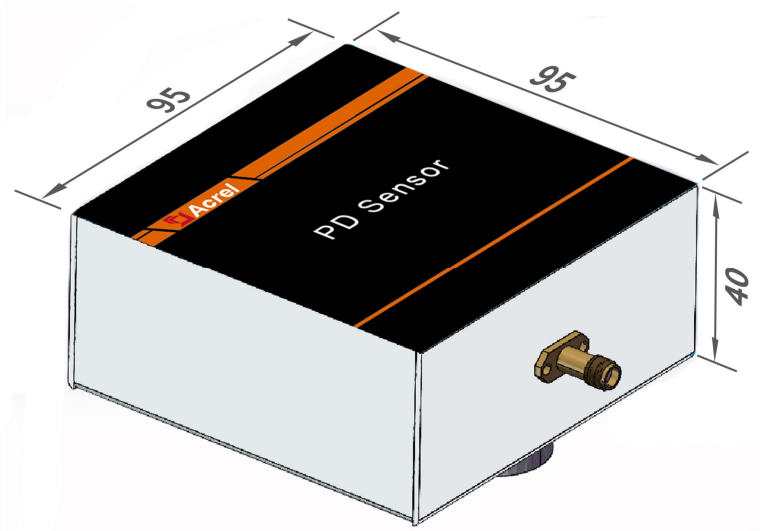


图 1.3 特高频局放传感器

Figure 1.3 UHF Sensor

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.

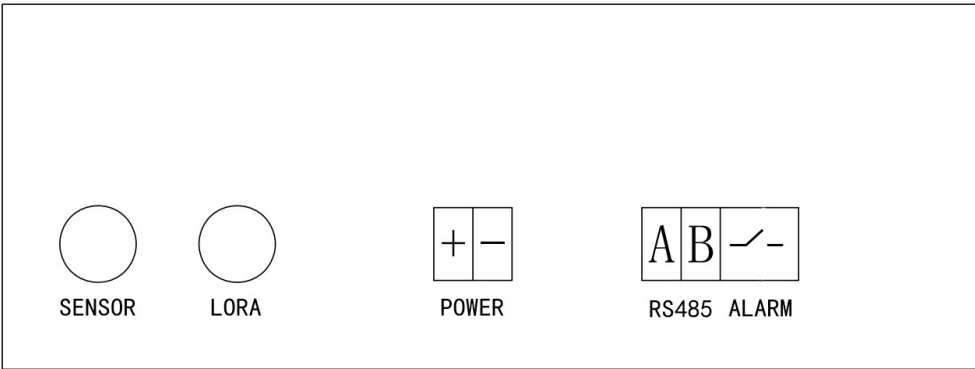


图 1.4 APD100 端子图

Figure 1.4 APD100 terminal diagram

特高频局放监测装置 APD200 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 AC/DC110V 或 AC/DC220V 电压；通信接口包括 RS485 通信口和 USB 接口；“ALARM”为告警干接点输出。

The schematic diagram of the APD200 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 AC/DC110V or AC/DC220V voltage; The communication interface includes RS485 communication port and USB interface; "ALARM" is the alarm dry contact output.

communication interface includes RS485 communication port and USB interface; "ALARM" is the alarm dry contact output.

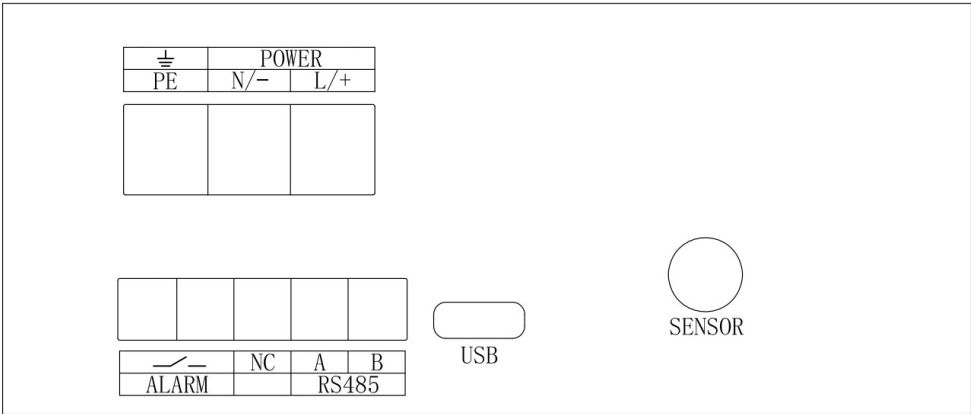


图 1.5 APD200 端子图

Figure 1.5 APD200 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 APD100 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 APD100 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

注: [1] R—只读; W—只写; R/W—读/写。

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