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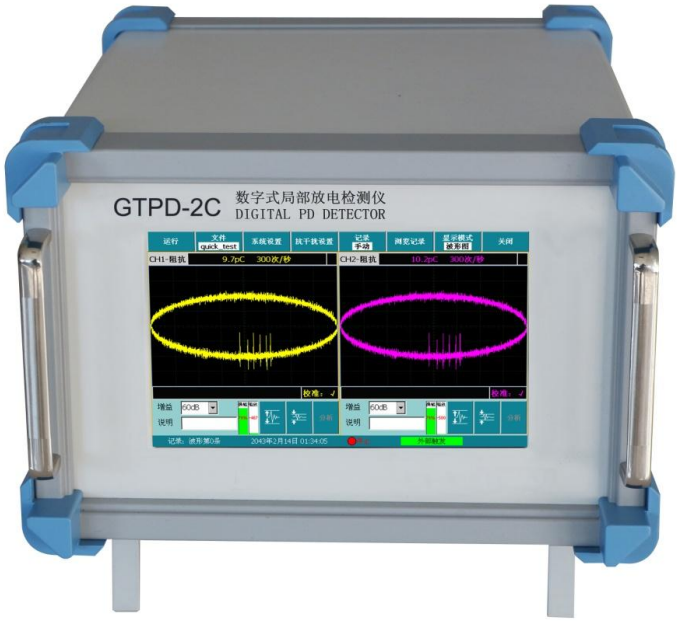
KINGRUN INSTRUMENT CO., LTD

Tel: 0086 312 5959618 / Fax: 0086 312 5959618

info@kritester.com www.kritester.com

Operation Manual

GTPD-2C
Digital Partial Discharge Tester



安全声明　　Security Assertions

警告 Warning：

- 始终保持高压部分与仪器、探头和操作人员之间的安全距离。
- Keep instruments, probes and operators in a safe distance of the high voltage part.
- 严格遵守当地安全规则。
- Follow the local safety rules rigorously.
- 附近有雷暴天气时，不得进行测量。
- Don’t make the measurement when there is lighting storm nearby.
- 切勿在测试过程中以机械方式（比如晃动或敲击）、电气方式（比如增加电压）或物理方式（比如加热）来干扰设备。
- Be sure not to interfere with the instrument during the measurement by mechanical ways(eg. Shaking or knocking), electrical ways(eg. Increasing voltage), physical ways(eg. Heating).
- 不得在爆炸环境中操作仪器或附件。
- Don’t operate the instrument or the attachment in the explosion environment.
- 该装置不属于用户自己维修的零件，如果需要维护与修理，请联系本公司进行维修。
- Users have no rights to maintain the instrument by yourselves, if necessary, please contact us to carry out maintaince.
- 设备加电之前，应首先将仪器接地端子用接地线可靠接地，以免损坏仪器设备或造成人身伤害！！！
- Before turning on the instrument, first users should connect the landing terminals and the ground together with landing wires to make sure that it won’t do harm to the instrument or operators.

目　录

1. 产品概述

I. Product overview

GTPD-2C 数字式局部放电检测仪(以下简称为**局放仪**)是采用全新技术实现的新一代高性能数字化局放测量分析仪器，是传统模拟局放仪的替代产品。其各种独创的抗干扰技术使您可以在强干扰环境下进行准确测量；友好的用户界面和高速采样刷新速率，具有模拟式局放仪的视觉效果；提供的多种波形分析、记录手段使您很容易判断放电的性质；各种试验数据的自动记录和处理，能够很快生成图文并茂的测试报告；采用双通道嵌入式系统，TFT 触摸屏，系统稳定可靠，故障率低。系统综合运用了计算机技术、模拟电子技术、高速信号采集技术和先进的数字信号处理及图形显示技术，完成局部放电的自动测量和分析。

The **GTPD-2C** digital partial discharge tester (hereinafter referred to as PD) is a new generation of high-performance digital PD measurement and analysis instrument, which is implemented by new technology. It is an alternative product of the traditional analog PD instrument. Anti interference technology of its various original so that you can accurately measure under the condition of strong interference; friendly user interface and high-speed sampling and refresh rate, with analog PD instrument visual effects; analysis, waveform records provided means to make you very easy to judge the nature of discharge; automatic recording and processing of test data that will soon be able to generate and test report; double channel embedded system, TFT touch screen, the system is stable and reliable, low failure rate. The system uses computer technology, analog electronic technology, high-speed signal acquisition technology, advanced digital signal processing and graphic display technology to complete partial discharge automatic measurement and analysis.

本局放仪采用 WINDOWS 系列操作平台,可以自由选择椭圆、直线、正弦波显示，二维、三维图形分析方式以及频谱视窗、Q-V-F 三维特性窗，可静态对一周波试验电压的局放脉冲详细测量、观察、分析。可以进行数字开窗操作，任意相位开窗，单窗、双窗任选，椭圆 360°旋转，以避免干扰对测量的影响。多通道测量及数字差分技术，可灵活组成脉冲极性鉴别或平衡测量回路，有效地抑制干扰脉冲信号。先进的频谱分析处理可以有效地降低背景干扰。多路输入通道，可一次升压测量试品的六个局放信号（可扩充），可方便地分析局放信号的来源。在全汉字操作平台下，能方便的进行频带选择、增益变换、频谱分析以及二维、三维图形显示。另外系统还可以打印或保存单幅图形,保存连续时间的图形数据,以供分析。

The discharge device uses WINDOWS series operating platform, can choose the ellipse, straight line, sine wave display, 2D and 3D graphics analysis and spectral window and Q-V-F window on the static three-dimensional characteristics, a frequency voltage test and partial discharge pulses with measurement, observation and analysis. It can be operated by digital window, at any phase, single window and double window are chosen, ellipse is rotated at 360 degrees in order to avoid the influence of interference on measurement. Multichannel measurement and digital differential technology can flexibly make up the pulse polarity identification or balance measurement circuit, and effectively suppress the interference pulse signal. The advanced spectrum analysis can effectively reduce the background interference. A multichannel input channel, which can be boosted by six sets of signals (extensible), can easily be used to analyze the source of the signal. In the operation platform of the whole Chinese character, the frequency band selection, the gain transformation, the spectrum analysis and the two-dimensional and three-dimensional graphic display can be conveniently carried out. In addition, the system can also print or save single graphics to save continuous time graphic data for analysis.

本局放仪适用范围、检测方法、试验回路、技术性能参数等完全符合国际标准 IEC270、国家标准 GB7354-2003《局部放电测量》（Partial Discharge measurements）和《电力设备局部放电现场测量导则》DL 417-91 标准要求。

The discharge device applicable scope, test method, test circuit, technical performance parameters fully meet the national standard, the international standard IEC270 GB7354-2003 "measurement of partial discharge (Partial Discharge measurements)" and "requirements" guidelines for the measurement of partial discharge of power equipment DL 417-91 standard field.

2.引用标准

II. Quoted Standard

- IEC60270《局部放电测量》
- IEC60270 / *Partial Discharge Measurements*
- IEC6067.11《干式变压器》
- IEC6067.11 / *Dry Type Transformer*
- IEC60885-3《整根挤包电缆局放试验》

- IEC60885-3 / *Whole Extruded Cable Partial Discharge Tests*
- GB1094《电力变压器》
- GB1094 / *Power Transformer*
- GB1207《电压互感器》
- GB1207 / *Potential Transformer*
- GB12706.4《电力电缆附件试验要求》
- GB12706.4 / *Power Cable Attachment Test Requirements*
- GB/T3048.12《电线电缆电性能试验方法局放试验》
- GB/T3048.12 / *Cable Electrical Performance Partial Discharge Tests*
- GB/T16927《高电压试验技术》
- GB/T16927 / *High Voltage Test Technique*
- GB/T7354《局部放电测量》
- GB/T7354 / *Partial Discharge Measurements*
- GB1208《电流互感器》
- GB1208 / *Current Transformer*
- DL417《电力设备局部放电现场测量导则》
- DL417 / *EPU Partial Discharge Measurement Guides*

2. 技术参数

III. Technical Parameter

技术特性 Technical characteristics	
通道数 Number of interfaces	2 个电信号接口，一个外同步接口 2 electric signal interfaces, 1 external synchronization interface
采样精度 Sampling accuracy	12bit 12bit
量程切换 Range changing	60dB、50dB、40dB、30dB、20dB、10dB、0dB、-10dB 共 8 档

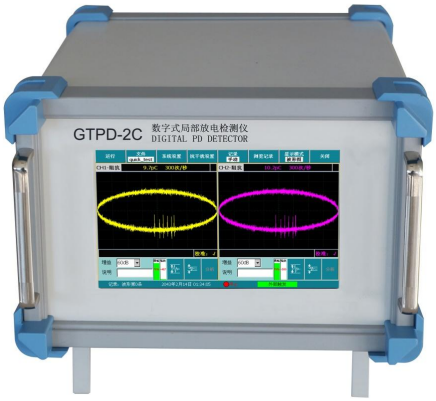
	60dB、50dB、40dB、30dB、20dB、10dB、0dB、-10dB, totally 8 types
频带范围 Range of measurement frequency	80k-200kHz、40k-300kHz 80k-200kHz、40k-300kHz
本量程非线性误差 Nonlinear error in the range	5% 5%
量程范围 Measurement range	0.1pC~100000pC 0.1pC~100000pC
灵敏度 Sensibility	0.1pC 0.1pC
可测试品的电容量范围 Capacity range of the measured product	6pF～250μF 6pF～250μF
试验电源频率范围 Frequency range of test power	50～400Hz 50～400Hz
显示 Display	
显示屏 Display screen	7” TFT 真彩色触摸液晶显示屏 7” TFT true color touchable LCD screen
分辨率 Resolution	800×480 800×480
存储 **Storage**	
物理存储 Physical storage	256MB　DDR2，为运行内存 256MB DDR2, RAM
SD 卡存储 SD card storage	标配 4G 卡，可升级为 32G，用于存储试验记录及试验数据

	Standard 4G card, can be upgraded to 32G, using to save test records and test data.
接口 Interface	
RS232 RS232	用于与 PC 机同步传输接口 Use of synchronizing the transformation interface with PC.
USB USB	可外接鼠标键盘，以及外接移动存储设备 Use of external mouse, keyboard and other USB devices.
电源模式 Power mode	AC 220V AC220V
电信号接口 Electric signal interface	2 路 BNC 接口，用于信号输入 2 BNC interfaces, use of signal input.
SMA 接口 SMA interface	外同步接口 External synchronization interface.
SD 卡插槽 SD card interface	可插入最大支持 32G 的 SD 卡 Can insert the SD card of maximum 32G.
网口 Network interface	可扩展 Expandable
接地钮 Landing button	外部接地用 External landing
通用说明 General instruction	
CPU CPU	主频 533MHz Basic frequency 533MHz
系统 System	WINCE6.0 WINCE6.0
使用环境温度 Operating environment temperature	-20℃至 45℃ -20℃ to 45℃
存储环境温度	-20℃至 60℃

Storage environment temperature	-20℃ to 60℃
尺寸 Size	长×宽×高：350mm × 245mm × 175mm Length×width×height: 350mm × 245mm × 175mm
重量 Weight	5.8kg 5.8kg

3. 系统构成

IV. System constitution

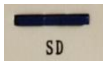
主机		配件	
GTPD-2C 数字式局部放电检测仪 **GTPD-2C** Digital PD tester		阻抗 Impedance	
		校准脉冲发生器 Calibration pulse generator	
		校准连接线 Calibration connecting line	
		同轴电缆 Calibration cable	

4.1 局部放电检测仪主机

4.1 Partial discharge tester host

图 4-1 **GTPD-2C** 后面板

Figure 4-1 **GTPD-2C** back panel

标识 Sign	说明 Description
	电源开关 Power switch
	AC 220V AC 220V
	USB 接口，可外接鼠标键盘，以及外接移动存储设备 USB interface, use of external mouse, keyboard and other USB devices
	同步调试口 Interface of synchronization debugging.
	SD 卡槽，可插入最大支持 32G 的 SD 卡 SD card interface, use of maximum 32G SD card
	RS232 接口，用于与 PC 机同步传输接口 RS232 interface, use of synchronizing the transformation interface with PC
	网口，可扩展 Network interface, expandable.

	SMA 接口，外同步接口 SMA interface, external synchronization interface
	CH2 信号输入接口，用于信号输入 CH2 input signal interface, use of the signal input.
	CH1 信号输入接口，用于信号输入 CH1 input signal interface, use of the signal input.
	接地按钮，外部接地用 Landing button, use of external landing.

4.2 输入单元

4.2 Input Unit

输入单元的结构为 RLC 型，是一种调谐阻抗，用于常规的局部放电检测，具有较高的检测灵敏度。输入单元共分为多个类型，在检测微弱放电信号时，应选择合适的输入单元，以保证足够的灵敏度。

The input unit structure is RLC type, it is a kind of tuning impedance with high sensibility, used in normal partial discharge measurement. The input unit is divided into many types, when detecting weak discharge signal, we should choose the right input unit to make sure the sensibility adequate.

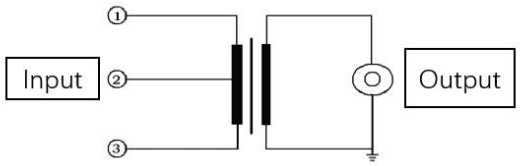


图 4-2 基本输入单元面板示意图

Figure 4-2 Basic input unit panel

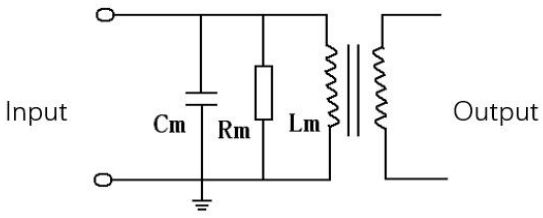


图 4-3 输入单元原理示意图

Figure 4-3 The principle of input unit

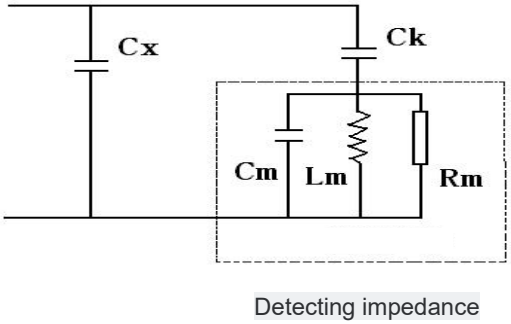


图 4-4 RLC 型输入单元的检测回路及等效电路示意图（并联法）

Figure 4-4 The detecting circuit and equivalent circuit of RLC type input unit (Parallel connection)

◆输入单元原理：

◆The principle of input unit

1）如图 4-4 所示为 RLC 型输入单元的检测回路及等效电路，其中 Cx 为试品电容，Ck 为耦合电容。当产生一次局部放电时，试品 Cx 两端产生一个瞬时电压变化 Δu，此时若经过 Ck 耦合到输入单元上，回路就会产生一脉冲电流 I，局放仪将脉冲电流经输入单元产生的脉冲电压信息，予以检测、放大和显示等处理，就可以测定局部放电的一些基本参量（主要是放电量 q）。

1) As figure 4-4, it is a detecting circuit and a equivalent circuit of RLC type input unit, Cx is the sample capacity, Ck is a coupling capacity. When it is discharged, there will be a instantaneous voltage variation between sample Cx, if it couples to the input unit through Ck, there will be the pulse current I come into being in the circuit. Partial discharge meter can detect, amplify and display the pulse voltage information generated by the pulse current through the input unit, so that we can measure some basic parameters of partial discharge.(Main parameter is the discharge of electricity ‘q’.)

虚线框内为 RLC 型输入单元等效电路，它是由一电感 Lm、电容 Cm、电阻 Rm 并联电路，当检测回路工作时，Cx、Ck、Lm 谐振，在输入单元上会产生较高的谐振电压。选择合适的输入单元(主要考虑电感 Lm，电容 Cm 很小，计算时可忽略)，使检测回路的谐振频率落在测量系统的测量范围以内(即检测回路的谐振电容 Ct 落在输入单元调谐电容(Ct′)的范围)，便可达到足够高的测量灵敏度。

The dotted line frame in the figure is the RLC type input unit equivalent circuit. It is a parallel circuit that consist of the inductance ‘Lm’, the capacity ‘Cm’, the resistance ‘Rm’. When the

detecting circuit works, there will be a pretty high resonant voltage come into being in the input unit and Cx, Ck and Lm will be resonant. Select the appropriate input unit (mainly considering inductance Lm, capacitance Cm is very small, the calculation can be ignored), the resonant frequency detection circuit falls within the measurement range of the measurement system (for testing resonant capacitor Ct circuit falls on the input unit tuning capacitor (Ct) range), can achieve enough sensitivity high.

检测回路谐振频率　　$f = 1/2\pi\sqrt{LmCt}$

Detecting circuit resonance frequency　　$f = 1/2\pi\sqrt{LmCt}$

谐振电容　　**Ct** = Cx*Ck/(Cx+Ck)

Resonance capacity　　**Ct** = Cx*Ck/(Cx+Ck)

2）输入单元一般可分为平衡阻抗和普通阻抗两大类，平衡阻抗可以有多种功能：

2) The input unit can be divided into two types: balanced impedance and common impedance, there are many functions of balanced impedance:

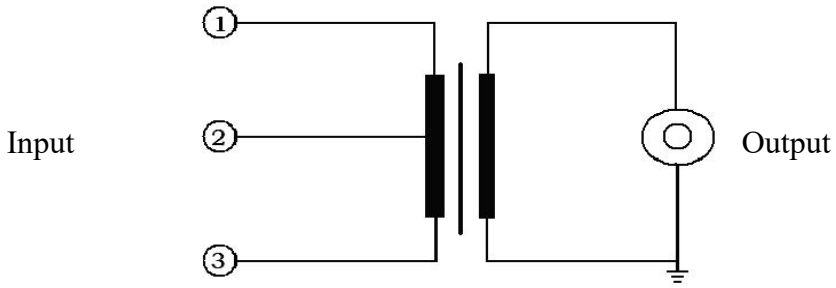


图 4-5　平衡输入单元面板示意图

Figure 4-5 Balanced input unit panel

①为初级首端，②为中心抽头，③为初级末端。

‘①’ is the beginning of the first, ‘②’ is the center tap, ‘③’ is the end of the first

平衡测量回路使用：

The usage of balanced detecting circuit:

一路输入接①，另一路接③，②接地，此时构成平衡测量回路，可以提高抗干扰能力。

One input connects to ‘①’, the other one connects to ‘③’, ‘②’ connects to the ground, this is the balanced detecting circuit and it can improve the ability of the anti-interference.

作为普通输入单元使用（不平衡回路）：

Use as the common input unit (Unbalanced circuit):

输入信号接①，③接地，忽略②时，平衡输入单元可以作为普通输入单元使用；

Input signal connects to '①', '③' connects to the ground, '②' is ignored. Balanced input unit can be used as common input unit.

同时测量试品电压和局放信号（分压输入单元）：

Detect the sample voltage and the discharge signal simultaneously (Partial voltage input unit)

输入的①、③接入电容分压器回路，可以同时测量试品上的电压和局放。

Input interfaces '①' and '③' connect to the capacitive voltage divider circuit, it can detect the sample voltage and the partial discharge signal simultaneously.

3）输入单元的选择：

3) Selection of the input unit

有 12 个独立输入单元，每个输入单元上都有调谐电容(Ct′)的范围，只要检测回路的谐振电容 Ct 落在调谐电容(Ct′)的范围，就足以满足测试选择的要求。

There are 12 independent input units, each input unit has a range of the tunable capacity (Ct'), if the value of the resonant capacity in the detecting circuit is in the range, it may satisfy the selection requirement of the measurement.

根据耦合电容 C_K 和试品电容 C_X 可粗略估算谐振电容 Ct，从而确定单元序号：

According to the value of the coupling capacity Ck and the sample capacity Cx can estimate the value of the resonant capacity Ct so that we can confirm the unit number:

表 1 独立输入单元技术参数表

Sheet 1 Independent input unit technical parameter sheet

输入单元序号 Input unit No.	调谐电容 Ct′ Tunable capacity Ct'	灵敏度 非平衡输入 Sensibility Unbalanced input	最大电流(RMS) Maximum current(RMS)	
			非平衡输入 Unbalanced input	平衡输入 Balanced input
1	6pF-25pF-100pF	0.01pc	30mA	0.25A
2	25pF-100pF-400pF	0.02pc	60mA	0.5A
3	100pF-400pF-1500pF	0.04pc	120mA	1A
4	400pF-1500pF-6000pF	0.08pc	250mA	2A
5	1500pF-6000pF-0.025μF	0.15pc	0.5A	4A

6	6000pF-0.025μF-0.10μF	0.3pc	1A	8A
7	0.025μF-0.10μF-0.4μF	0.5pc	2A	15A
8	0.10μF-0.4μF-1.5μF	1.0pc	4A	30A
9	0.4μF-1.5μF-6.0μF	1.5pc	8A	60A
10	1.5μF-6.0μF-25μF	2.5pc	15A	120A
11	4.0μF-15μF-60μF	5.0pc	25A	200A
12	15μF-60μF-250μF	10pc	50A	300A

注：一般测试油浸电流互感器或电压互感器时，选择 2 号输入单元，测试环氧电流互感器或电压互感器时，选择 3 号输入单元，测试小型变压器时，选择 4 号输入单元。

Tips: when detecting the oil-immersed current transformer or oil-immersed voltage transformer, we should choose No.2 input unit, when detecting the epoxy resin current transformer or epoxy resin voltage transformer, we should choose No.3 input unit, when detecting small transformer, we should choose No.4 input unit.

◆零标输入

◆Zero mark input

零标输入单元（即外同步模块）作为局部放电检测系统的相位基准，对识别局部放电和干扰有重要作用，外部零标输入时，系统的相位可以和外零标输入严格同步，且无频率间隔要求，故可以和无局放串联谐振电源相配合。

As the phase datum of the partial discharge detecting system, Zero mark input unit(Also called external synchronization module) plays an important role in identifying partial discharge and anti-interference. When inputting the external zero mark, The phase of the system can be synchronized with it strictly, there is also no frequency interval requirement. So it may work in with non local-discharge series resonant power supply

外零标的输入范围为：交流 10∽380V，30Hz∽300Hz。

Input range of external zero mark: AC 10∽380V, 30Hz∽300Hz.

在实际试验中，可以将试验电源电压经分压器降至 10∽380V 再接入零标单元。如果在屏幕上输入分压器的变比，可以直接测量出试验电源电压。

In the test, the test can be supply voltage divider to 10 ~ 380V and zero access standard unit. If the ratio of the divider is input on the screen, the voltage of the test power supply can be measured

directly.

◆分压式输入单元原理：

◆The principle of partial voltage input unit

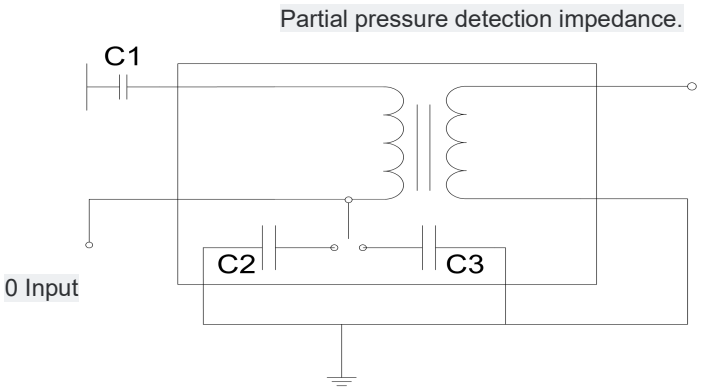


图 4-6 同时测量局放和试验电压的接线示意图

Figure 4-6 Partial discharge and test voltage detecting circuit simultaneously

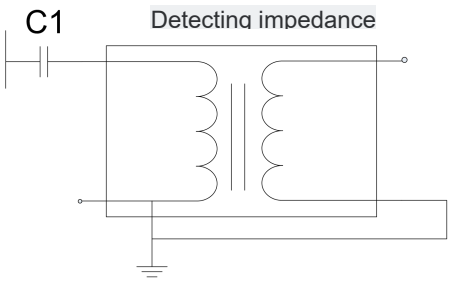


图 4-7 仅测量局放的接线示意图

Figure 4-7 Partial discharge detecting circuit

分压式输入单元可以完成如下功能：

Partial voltage input unit has following functions:

测量局放：C1 作耦合电容使用，其右端接输入单元；C2、C3 不用。

Detecting partial discharge: C1 is used as coupled capacity, the right side is connected to the input unit, C2 and C3 are ignored.

测量试验电压：C1 右端和单刀双掷开关上端连接，作普通分压器使用。

Measuring test voltage: The right side of C1 is connected to the upper side of single-pole, double-throw switch, and it is used as the common voltage divider.

同时测量局放和试验电压：C1 右端接阻抗输入①，单刀双掷开关上端接阻抗输入③，测电压时，可根据需要选择 C2 或 C3，③再通过零标输入单元（对应的外同步模块）接到主机。

Detecting partial discharge and test voltage simultaneously: The right side of C1 is

connected to the impendence input '①', the upper side of the single-pole, double-throw switch is connected to the impendence input '③'. When measuring test voltage, we may choose C2 or C3 according to the requirement, '③' is connected to the host through the zero mark input unit(Also called external synchronization module).

4.3 校准脉冲发生器

4.3 Calibration pulse generator

型号 Model	HCPD-02	HCPD-03	HCPD-04
输出脉冲上升沿 Upper side of output pulse	<30nS		
Lower side of output pulse	>100uS		
输出电量 Quantity of output electricity	10pC，50 pC， 100 pC，500 pC	50 pC，100 pC，200 pC，500 pC，1000 pC	1000 pC ，2000 pC ， 5000 pC ， 10000 pC
脉冲重复频率 Pulse repeating frequency	50Hz-1000Hz		
输出内阻 Internal output resistance	<100Ω		

5. 主机功能
V. Host function

5.1 基本功能
5.1 Basic function

5.1.1 试验档案管理
5.1.1 Test files management

用户可以根据自己的需求，利用系统软件，为每次试验建立试验档案，填写检测说

明信息，保存检测数据，以便将检测数据与检测信息对应起来。

Users can use system software to set the test file for every single test according to your own requirements, fill the detecting illustration and save the test data in order to match with the test.

当软件第一次启动时，系统会出现“试验设置”对话框，提醒用户填写试验信息，同时可以对试验列表进行查看和删除某个试验，当单击试验列表中某个试验时，试验信息区将显示对应试验信息,试验项目区将显示试验项目的相关信息。

When users start software first, The system will appear "test settings" dialog box, to remind users to fill in the information of the test, can be used to test the list view and delete a test, click the test when a test list, information of the test area will display the corresponding test information, test project area will display the relevant information of test items.

如果你点击取消按钮，不建立自己的试验档案，系统软件也可以快速建立默认数据库 qucik_test.db3，保证完成试验数据的存储。试验项目将采用默认选项。

If you click the Cancel button and do not establish your own test files, the system software can also quickly set up the default database qucik_test.db3 to ensure that the storage of test data is completed. The test project will use the default options.

软件会在SD卡中建立存储目录以保存数据，例如：

The software will create a storage directory in the SD card to save the data, for example:

试验名称为：HCPD

Test name: HCPD

则检测数据存储路径为：Storage Card\ 试验管理\HCPD\

The test data storage path is: Storage Card\ Test management\HCPD\

所有的检测原始数据都以二进制方式保存以节省存储空间，所有的记录数据都存储在SQLite数据库中，以备生成报告使用。

All test data are saved in binary mode to save storage space, and all recorded data are stored in SQLite database, so as to prepare report generation.

利用本系统进行检测数据都存储在SD卡中，SD卡最大支持32G，可以导出到PC机进行备份。历史数据可以被加载入系统进行追踪分析。

The test data are stored in the SD card with this system, and the SD card is most supported by 32G. It can be exported to the PC machine for backup. Historical data can be loaded into the system for tracking and analysis.

试验设置对话框：

Test setting dialog box:

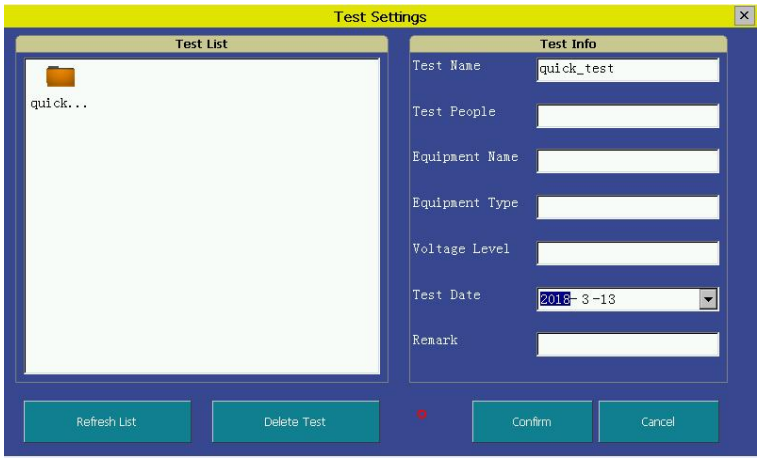


图 5-1 试验设置对话框

Figure 5-1 Test setting dialog box

当上述参数均设置完毕后，点击确定进行试验。

When all the above parameters are set up, the test is determined by clicking.

图 5-2 点击进行试验设置

Figure 5-2 Click the button to make test setting

“试验档案”对话框在停止运行状态下可以打开，只需点击图 5-2中文件按钮控件即可。

The ‘test file’ dialog box can be opened in the stop running state, just clicking on the file button control in Figure 5-2.

5.1.2 系统软件主窗口

5.1.2 Software Main Interface

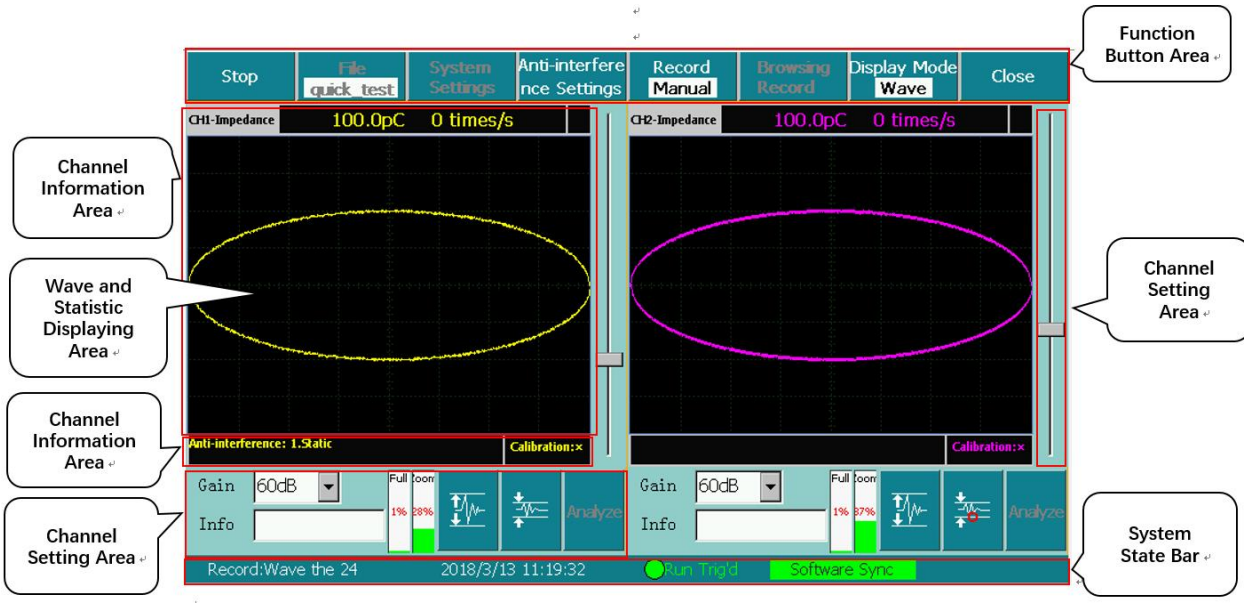


图 5-3 主界面

Figure 5-3 Main Interface

➢ **功能按钮区 Function Button Area**

主要完成测量开始/停止、试验设置、系统设置、抗干扰设置、记录、浏览记录、显示模式切换以及退出软件功能。

Main function of Start/Stop, Test Setting, System Setting, Anti-interference Setting, Recording, Records Browsing, Display Mode Changing and Quit.

➢ **通道信息区 Channel Information Area**

上部的显示区主要显示当前通道测量传感器的状态、放电水平、增益是否溢出（溢出会出现★）、放电次数、开相位窗状态（开窗后显示开窗个数）。

Top displaying area mainly displays sensor state, discharge level, gain spillover (★ appears with spillover), discharge times, window state(display window quantity) of current channel.

下部的显示区主要显示抗干扰启动的项目和通道校准状态，如果未校准为，校准后为√。

Bottom area mainly displays anti-interference and channel calibration state, not calibrated with ×and calibrated with √.

➢ **通道控制区 Channel Setting Area**

主要完成增益的控制（档位）、增益是否合适指示、通道信息说明、采样满幅比例（量

程）及波形显示缩放（包括“波形及统计图显示区”旁的波形显示缩放条）域频域分析功能等。

Channel setting area mainly do with gain control (gear), gain display, channel information description, sampling full amplitude proportion (range), wave displaying zoom(including wave displaying zoom bar beside the ‘Wave and Statistic displaying area’) and frequency domain analysis.

- **波形及统计图显示区 Wave and Statistic Displaying Area**

波形图、二维图和三维图形的显示区域。

Wave, 2D and 3D picture displaying area.

- **系统状态条 System State Bar**

记录存储状态：提示当前存储的是波形记录还是统计记录，同时提示当前存储总条数。

Record saving state: Notice current saving of wave record or statistic record and notice total quantity of records.

系统时间：显示当前系统日期及时间。

System time: Display current system date and time.

触发模式：提示当前触发方式，从而保证系统根据触发方式正确的使用。

Synchronization mode: Notice current Sync-mode to ensure the correct using according to Sync-mode.

5.1.3 系统设置

5.1.3 System Setting

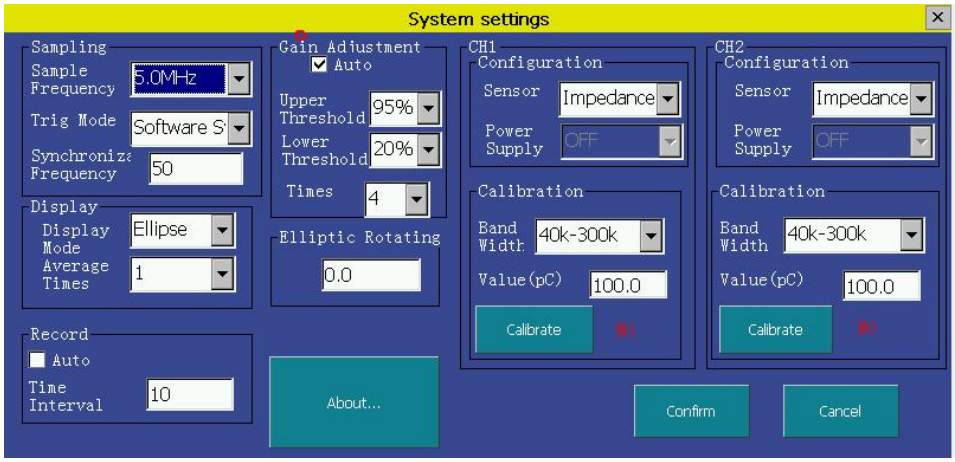


图 5-4 系统设置

Figure 5-4 System Setting

➢ 采样 Sampling

a) 触发方式：软件自动、外部触发和软件同步（默认）三种方式。

Synchronization mode: Internal synchronization, external synchronization and software synchronization (default).

b) 同步频率：系统工作频率（50Hz~400Hz）

Synchronization Frequency: System running frequency （50Hz~400Hz）.

➢ 显示 Display

a) 显示方式：波形显示模式下，可选择直线、正弦和椭圆三种方式来显示时域波形。

Display mode: In wave mode, it has Line, Sine and Ellipse to display time domain wave.

b) 平均次数：显示 N 次测量数据的平均值（N 即为选择的平均次数）。

Average times: Display average of N times data(N is selected times)

➢ 记录 Record

a) 自动记录：☑为开启自动记录，☐为禁止自动记录。

Auto Recording: ☑ means auto record, ☐means not to auto record.

b) 时间间隔：自动记录开启后，记录的间隔，单位为 s

Time interval: Intervals of records with auto recording opened, unit is s.

➢ 增益调节 Gain Setting

a) 自动调节：☑为开启自动增益，☐为禁止自动增益。

Auto adjust: ☑means auto adjust gain, ☐means not to auto adjust gain

b) 上阈：采样满度百分比，当高于此阈值时达到设定次数后向放大倍数低的档位切换。

Up threshold: Percentage of Sampling. If it's higher than threshold it will move to lower magnification when set times is reached.

c) 下阈：采样满度百分比，当低于此阈值时达到设定次数后向放大倍数高的档位切换。

Down threshold: Percentage of Sampling. If it's lower than threshold it will move to higher magnification when set times is reached.

d) 次数：采样周期数。

Times: Period times of sampling.

➢ 关于… About…

显示公司信息和软件版本信息。

Information of our company and software version.

图 5-5 关于...

Figure 5-5 About…

对于系统的两个检测通道，其参数配置可以分别设置。对每个通道有下列参数：

For the two channels of the system, the parameters can be set respectively. Parameters for each channel are as follows:

- 配置 Setting

传感器默认为阻抗且系统设置里不显示。

Impedance is default sensor and is not displayed in system setting.

- 校准Calibration

a) 带宽：可选带宽为80k-200kHz、40k-300kHz，默认带宽为40k-300kHz，当用户需要选择其他带宽时，可手动切换，进行试验。当系统重启后，带宽将恢复至出厂默认带宽。

Frequency band: Selectable frequency band are 80k-200kHz, 40k-300kHz (default).Users can manually select other frequency band and do the test when needed. Frequency band will be reset to default if system is rebooted.

b) 量值：输入校准时传感器对应的校准值。

Value: Calibration value when input to calibrate.

c) 校准：该按钮对阻抗和选中频带进行校准，亦可进行现场校准。

Calibrate: This button is used to calibrate impedance and selected frequency band. Users can also calibrate it at the scene.

5.2 高级功能

5.2 Advanced Features

5.2.1 开相位窗

5.2.1 Switch the phase window

每一个通道的波形显示窗口内，可以同时开两个红色子窗口（相位窗）。此功能，一般用来避开某些相位的干扰，对所开窗相位内的波形进行读数，以下称开窗。

Each channel waveform display window, you can simultaneously open two sub-windows at different times (phase window). This function, generally used to avoid some of the phase interference, the window within the window to read the waveform, hereinafter referred to as the window.

- 开窗操作 Open the phase window operation

将鼠标的光标放置在图形显示区的适当位置，按下鼠标左键并保持，同时拖动鼠标到另一位置释放鼠标左键，即完成开窗操作。重复以上操作可在同一通道开另一个相位窗，同一通道最多显示两个相位窗。注意开窗时，开窗区域必须框选住基线，否则开窗无效。有相位窗时，读数显示的是相位窗口内的最大放电量，同时信息区提示当前开窗个数。

Place the mouse cursor in the appropriate position in the graphics display area, press the left mouse button, drag the mouse to another position while holding down to release the left mouse button, you can form a red rectangular box frame of the baseline, that is, to complete the open Window operation. In the same channel graphic display area, up to two phase windows, repeat the above operation. When there is a phase window, the reading shows the maximum amount of discharge in the phase window.

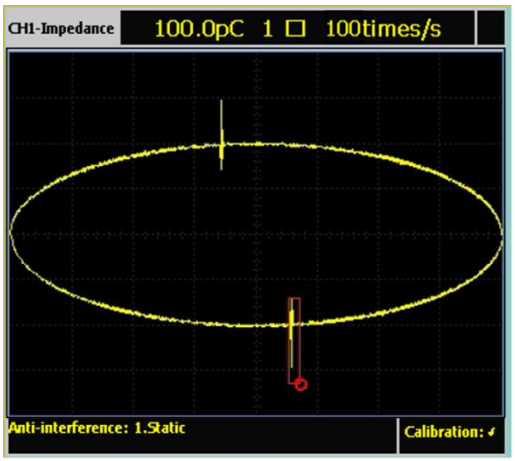


图 5-6 开窗操作

Figure 5-6 Window operation

a) 关窗操作 Close window operation

需要关闭哪一个相位窗口，就将鼠标的光标放置在哪一个相位窗（红色矩形框）内，单击鼠标左键，即可关闭该窗口。在存在两个相位窗口的情况下，再进行开窗操作可以关闭前两个相位窗口。

Which phase window needs to be closed, the mouse cursor placed in which phase window (red rectangle), click the left mouse button, you can close the window. In the presence of two phase windows, a windowing operation may be performed to close the first two phase windows.

5.2.2 脉冲分析

5.2.2 Pulse analysis

运行过程中还可以对局放数据进行脉冲分析，即对已经采集的数据可以详细查看波形形状，从而分析放电波形的性质。

In the process of operation, users can do pulse analysis to discharge data which is to check details of waves to analyze characteristics of discharge wave.

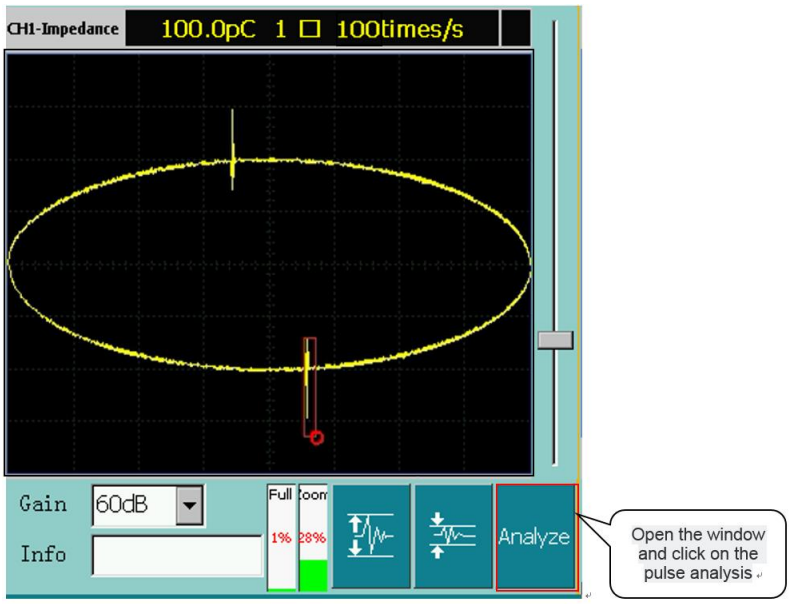


图 5-7 开相位窗并进行单脉冲分析

Figure 5-7 Open window and pulse analysis

要进行脉冲分析，首先要进行开窗操作，并保证开一个相位窗，把要分析的波形选进所开窗口内，然后点击图 5-7 中“分析”按钮，即弹出开窗分析界面。

To do pulse analysis, firstly open a window and only a single phase window. Select wave

to be analyzed in to the window and press ‘Analyze’ button in picture 5-7 to pop up Window analysis interface.

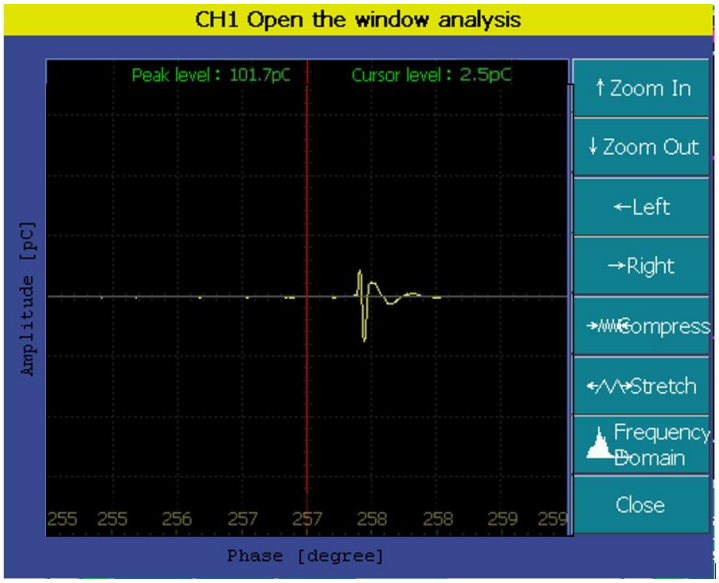


图 5-8 开窗分析

Figure 5-8 Window analysis

开窗分析提供了对幅值显示的动态缩放，脉冲左右移动和水平压缩拉伸功能，按键均采用可加速处理，长按自动加速。脉冲分析窗口中提供了峰值显示和光标处放电幅值水平显示。点击脉冲显示区，光标随之移动，同时水平拉伸和压缩以其为基准进行缩放，从而实现快速对脉冲信号的捕捉和展开。

Dynamic zoom-in and zoom-out is supported. Pulse left and right movement and horizontal compression stretching function buttons are accelerated which will speed up when long pressed. Pulse analysis window provides peak value displaying and sensor location discharge value displaying. Click pulse displaying area, move cursor, and horizontally tense and compress to zoom in and out, and this can quickly acquire and unfold the pulse signal.

5.2.3 频谱分析

5.2.3 Spectrum analysis

在图 5-8 中点击“频域”按钮就进入频谱分析窗口。它是对脉冲分析窗口内波形的频谱展开分析。

Click ‘Spectrum’ to enter Spectrum analysis window. This is to analyze the spectrum of wave in the pulse analysis window.

图 5-9 频谱分析窗口

Figure 5-9 Spectrum analysis window

按[频域]/[时域]按钮，就可在频谱分析窗口和脉冲分析窗口之间切换。

Press[Spectrum][Time domain] button, to switch between the spectrum analysis window and the pulse analysis window.

5.2.4 查看采样满幅比例以及显示缩放

5.2.4 View the full scale of sampling and display zoom

对于采样数据，软件提供了对采样数据满幅比例的指示（即量程）。在波形图模式下软件提供对波形缩放比例的调整，调整方法有两种，即点击调整和滚动条调整，其中当缩放比例为最大值时，点击放大模块变为灰色，当缩放比例为最小值时，点击缩小模块变为灰色；滚动条则是为了方便用户在两通道对比时将缩放比例放在同一位置。

For sampling data, the software provides an indication of the full scale of the sampled data (i.e., the range). In the wave mode for wave zoom ratio adjustment, there are two ways, click adjustment and on the scrollbar adjustment. Enlarge module becomes grey when the zoom ratio is the maximum value; Narrow module becomes grey when the zoom ratio is the minimum value. Scroll bars are put in the same position for the convenience of users when comparing the two channels.

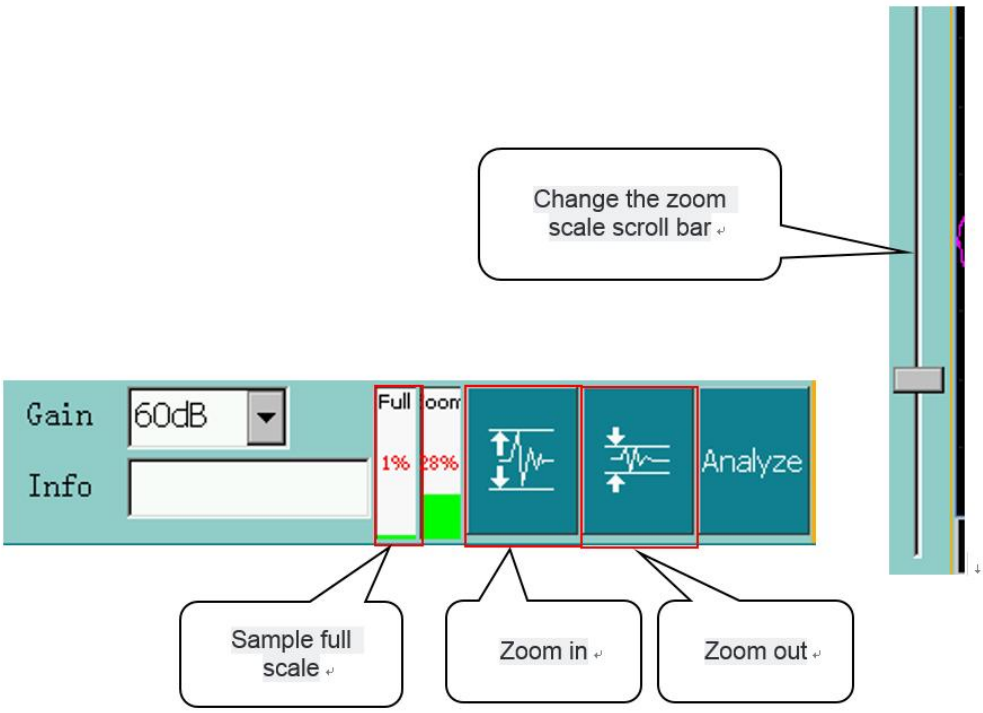


图 5-10 采样满幅和缩放比例

Figure 5-10 Sampling full scale and scaling ratio

5.2.5 数据存储

5.2.5 Data storage

主要用于事后查看波形、pC 值、频谱分析及试验报告的生成。系统状态条显示记录次数，此时通道说明框可以输入相应次数的描述，如当时电压情况等。

It is mainly used to view the waveform, pC value, spectrum analysis and test report generation after the test. The system state bar shows the number of records, at this time the channel description box can input the description of the number of times, such as the voltage situation at that time.

- 手动记录 Manually record

在“系统设置”界面中将“自动记录”改为未选中即可。软件会在 SD 卡中建立存储数据库和原始数据文件，例如：

In the ‘System settings’ interface, the "automatic record" is changed to unselected. The software will set up the storage database and the original data file in the SD card, for example:

试验名称为：HCPD

Test name: HCPD

则记录存储数据库为：Storage Card\试验管理\HCPD\数据\HCPD.db3

Record storage database: Storage Card\Test management\HCPD\Data\HCPD.db3

记录原始数据为：Storage Card\试验管理\HCPD\数据\%d-%d-%d_%02d-%02d-%02d.dat

The original data of record: Storage Card\ Test management \HCPD\data\

%d-%d-%d_%02d-%02d-%02d.dat

其中%d-%d-%d_%02d-%02d-%02d 为当前记录存储时刻。

%d-%d-%d_%02d-%02d-%02d is the storage time of current record.

原始记录可供时域脉冲分析使用。

The original data can be used to do time domain pulse analysis.

- 自动记录 Automatic record

自动存数只是在“系统设置”界面中选中“自动记录”即可。此操作的效果是：根据系统设置界面中自动记录的时间间隔自动保存数据，保存内容与手动保存数据相同。

5.2.6 浏览记录回放分析及发送

5.2.6 Browsing record playback analysis and sending

软件提供对记录的分析和查看功能，方便用户对已检测记录数据的事后分析处理，同时提供蓝牙发送接口。

The software provides an analysis and viewing function for the record, which facilitates the user's post analysis and processing of the recorded data, and provides a Bluetooth transmission interface.

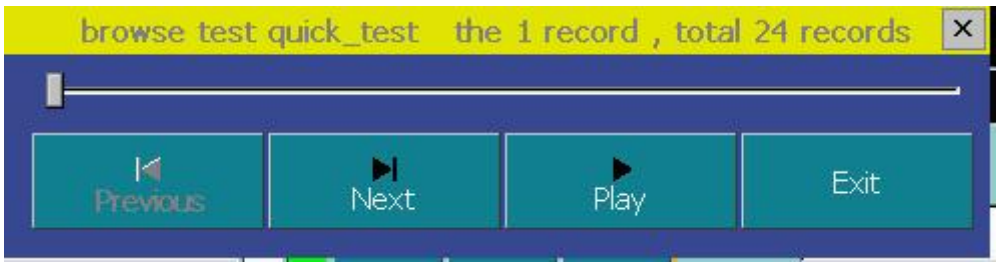


图 5-11 记录查看功能

Figure 5-11 Record view function

查看记录可自动播放，也可逐条浏览，也可定位某一记录进行脉冲分析。

The records can be played automatically, also can be viewed one by one, and can also be located in a certain record for pulse analysis.

5.2.7 谱图分析 Mapping analysis

点击图 5-12 中 “显示模式”按钮，切换波形图到二维和三维谱图模式。

Click ‘Display mode’ button in figure 5-12

图 5-12 显示模式循环切换按键

Figure 5-12 Display mode cyclic switching button

- 波形图 Wave Mapping

在该模式下可对波形进行开窗分析。

Windowing analysis is supported in this mode.

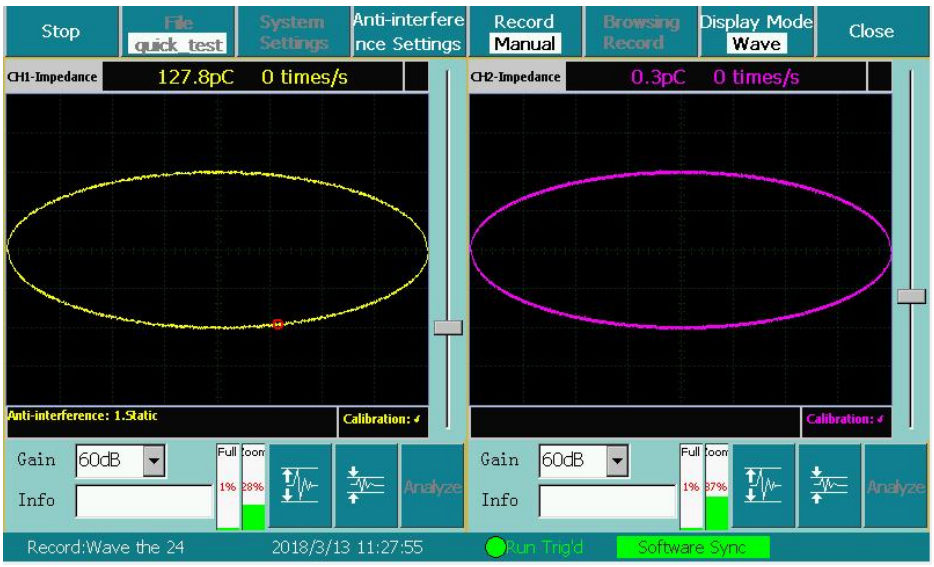


图 5-13 波形图模式

Figure 5-13 Wave mode

- 二维图谱（指纹图） 2D Mapping (Finger print mode)

该模式下纵轴代表放电水平，横轴代表相位，像素的不同颜色代表不同的放电次数。

In this mode, the longitudinal axis represents the discharge level, the transverse axis represents the phase, and the different colors of the pixels represent different times of discharge.

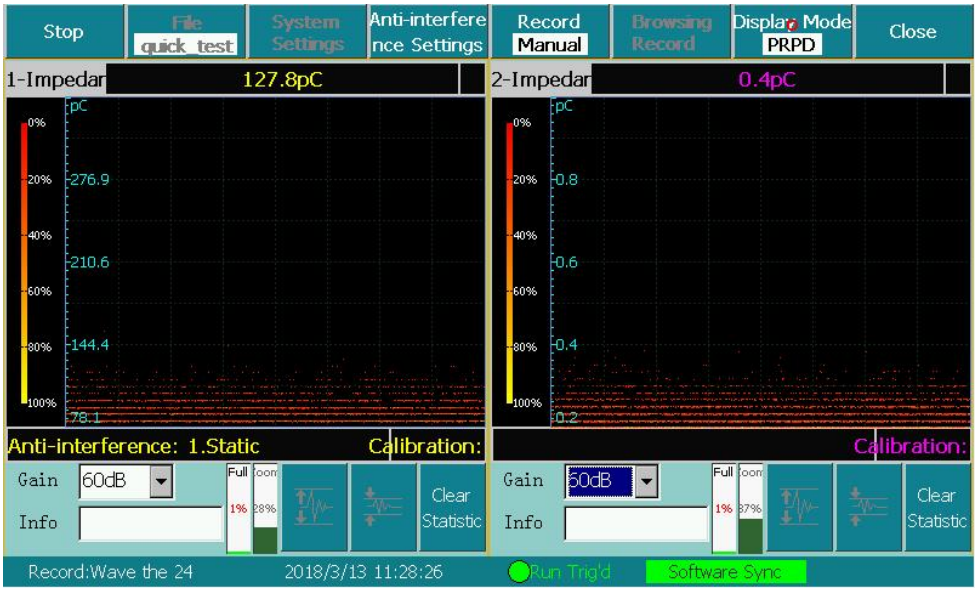


图 5-14 指纹图模式

Figure 5-14 Finger print mode

➢ 二维图谱（N-Φ） 2D Mapping (N-Φ)

纵轴代表放电次数，横轴代表相位，该模式将若干周波局部放电信号进行统计和处理，反应出放电次数与发生放电相位的关系。

The longitudinal axis represents the number of discharges and the transverse axis represents the phase. This mode processes and calculates several period partial discharge signals, and reflects the relationship between the discharge times and the discharge phases.

图 5-15 N-Φ图模式

Figure 5-15 N-Φmode

➢ 二维图谱（Q-Φ）2D Mapping (Q-Φ)

纵轴代表放电水平，横轴代表相位，该模式将若干周波局部放电信号进行统计和处理，反应出局部放电量与发生放电相位的关系。

The longitudinal axis represents the discharge level, and the transverse axis represents the phase. This mode processes and calculates some Zhou Bo partial discharge signals, and reflects the relationship between the local discharge and the discharge phase.

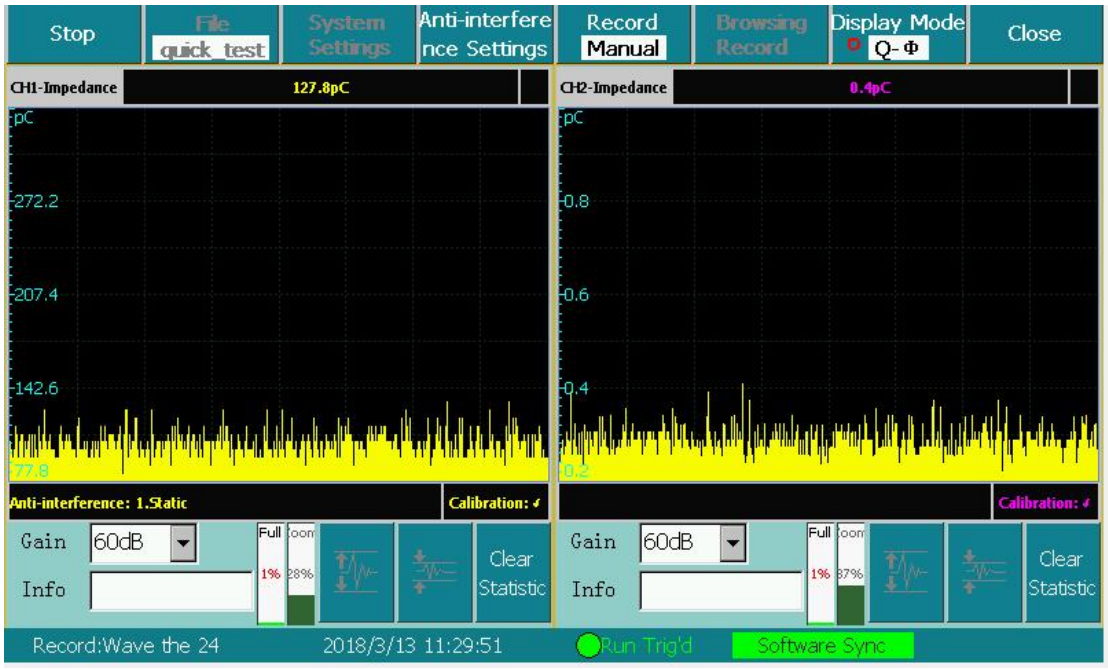


图 5-16 Q-Φ图模式

Figure 5-16 Q-Φ mode

➢ 三维图谱（Q-Φ-T）3D Mapping

该模式纵轴代表放电水平，横轴代表相位，Z 轴代表时间，脉冲不同颜色代表放电水平的大小不同，右侧颜色标识代表纵轴不同的百分比所使用的不同颜色。通过该模式可以区分干扰和放电，以及随时间变化不同相位信号的变化。

The longitudinal axis represents the discharge level, the horizontal axis represents the phase, the Z axis represents the time, and the different colors of the pulse represent different discharge levels. The right color identification represents the different colors used by the different percentages of the longitudinal axis. The mode can distinguish between interference and discharge, and the change of different phase signals over time.

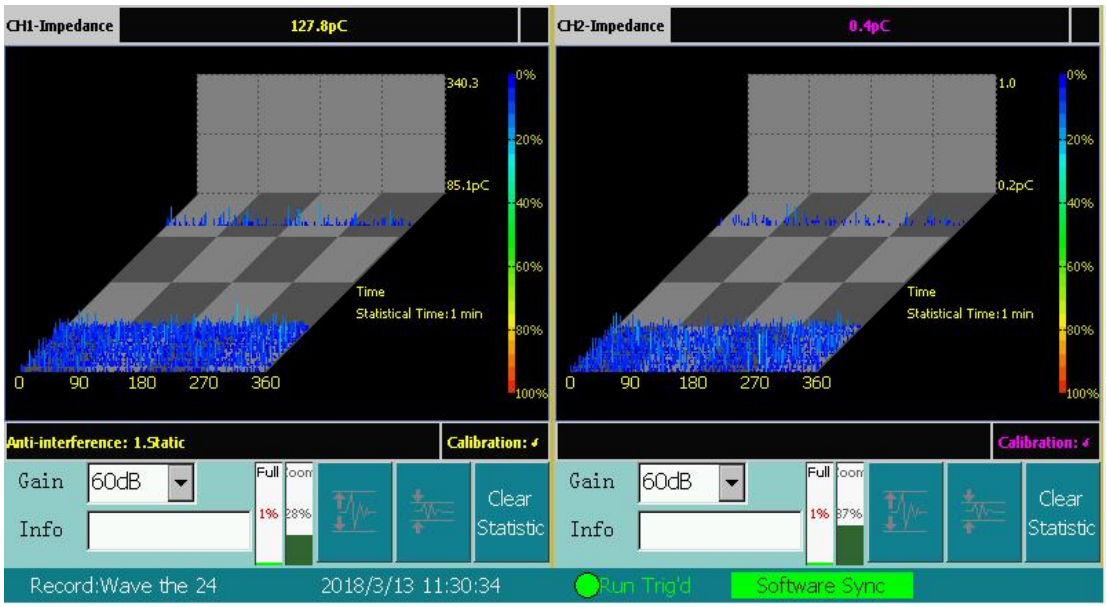


图 5-17 Q-Φ-T 图模式

Figure 5-17 Q-Φ-T mode

5.2.8 干扰抑制

5.2.8 Interference suppression

在现场测量试品的局部放电时，干扰信号的串入是不可避免的，如果干扰信号的幅度大于放电信号的幅度时，将不能测出放电的量值。而实际试验过程中要完全消除这些干扰信号往往是不可能的，只要将干扰抑制在一定水平下，能有效的测量试品内部局部放电量就可以了。针对现场干扰强这一特点，本系统通过接线方式、局放仪增加了若干种抗干扰措施。

When measuring the partial discharge of the sample in the field, it is unavoidable that the crosstalk of the interference signal is inevitable. If the magnitude of the interference signal is greater than the magnitude of the discharge signal, the magnitude of the discharge can not be measured. For the site of strong interference with this feature PDI increased the following a number of anti-jamming measures.

1）干扰或非正常放电的情况

Interference or abnormal discharge situation

(1) 悬浮电位物体放电波形特点

Object floating discharge potential waveform characteristics

在电压峰值前的正负半周两个象限里出现幅值。脉冲数和位置均相同，成对出现。放电可移动，但它们间的相互间隔不变，电压升高时，根数增加，间隔缩小，但幅值不变。有时电压升到一定值时会消失，但降至此值又重新出现。

The amplitude appears in two quadrants in the positive and negative half weeks before the voltage peak. The number of pulses and position are the same, appear in pairs. Discharge can be moved, but the mutual spacing between them unchanged, the voltage increases, the root number increases, the interval decreases, but the magnitude of the same. Occasionally, the voltage disappears when it reaches a certain value, but dropping to this value reappears.

原因：金属间的间隙产生的放电，间隙可能是地面上两个独立的金属体间（通过杂散电容耦合）也可能在样品内，例如屏蔽松散。

Cause: Discharges due to interstitial gaps between metals. The gap may be between two separate metal bodies on the ground (coupled by stray capacitances) or within the sample, for example loosely shielded.

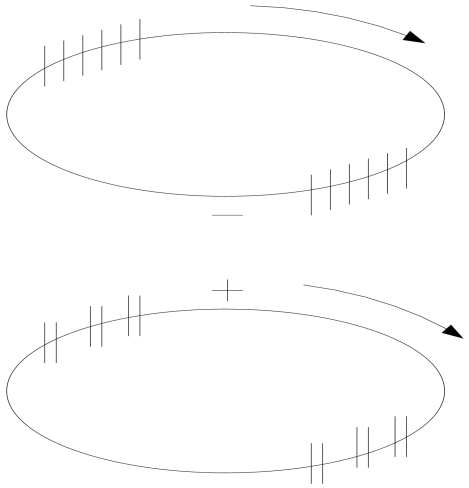


图 5-18

Figure 5-18

⑵ 外部尖端电晕放电波形特点：

External cutting-edge corona discharge waveform features:

起始放电仅出现在试验电压的一个半周上，并对称地分布在峰值两侧。试验电压升高时，放电脉冲数急剧增加，但幅值不变，并向两侧伸展。

The initial discharge occurs only for a half weeks of the test voltage and is symmetrically distributed on both sides of the peak. As the test voltage increases, the number of discharge pulses increases sharply, but with the same amplitude, and spreads to both sides.

原因：空气中高压尖端或边缘放电。如果放电出现在负半周，表示尖端处于高压，如果放电出现在正半周则尖端处于地电位。

Cause: High voltage tip or edge discharge in air. If the discharge appears in the negative

half-cycle, indicating that the tip is at high voltage, if the discharge occurs in the positive half-cycle then the tip is at ground potential.

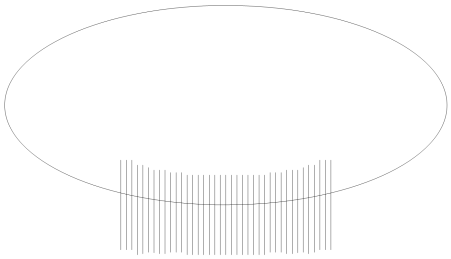


图 5-19

Figure 5-19

⑶ 液体介质中的尖端电晕放电波形特点

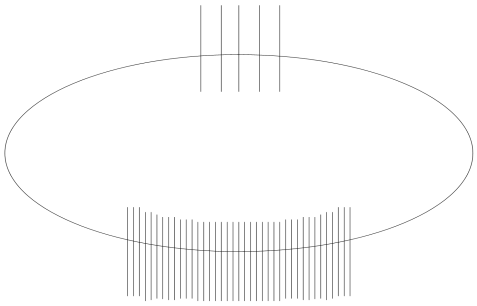
Characteristics of the waveforms of the corona discharge in liquid medium

放电出现在两个半周上，对称地分布在峰值两侧。每一组放电均为等间隔，但一组幅值较大的放电先出现，随试验电压升高而幅值增大，不一定等幅值；一组幅值小的放电幅值相等，并且不随电压变化。

Discharge appears in two half weeks, symmetrically distributed on both sides of the peak. Each group of discharge are equal intervals, but a group of larger discharges first appeared, with the test voltage increases and the amplitude increases, not necessarily equal amplitude; a group of small discharge amplitude equal, and Does not change with voltage.

原因：绝缘液体中尖端或边缘放电。如一组大的放电出现在正半周，则尖端处于高压；如出现在负半周，则尖端处于地电位。

Cause: Insulating liquid tip or edge discharge. If a set of large discharges occur in the positive half-cycle, the tip is at high voltage; if it appears in the negative half-cycle, the tip is at ground potential.



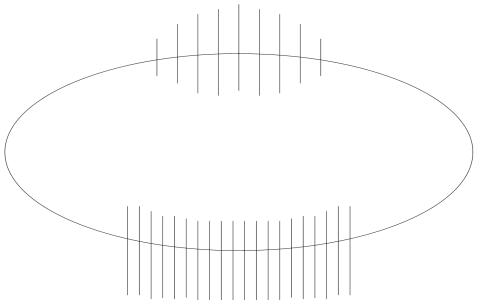


图 5-20

Figure 5-20

⑷ 接触不良的干扰图形

The Interference graphics of poor contact

波形特点：对称地分布在实验电压零点两侧，幅值大致不变，但在实验电压峰值附近下降为零。波形粗糙不清晰，低电压下即出现。电压升高时，幅值缓慢增加，有时在电压达到一定值后会完全消失。

Waveform characteristics: Symmetrically distributed on both sides of the zero voltage in the experiments, the amplitude is roughly the same, but dropped to zero near the peak of the experimental voltage. The waveform is rough and unclear, which appears under low voltage. When the voltage is increased, the amplitude slowly increases, sometimes disappearing completely after the voltage reaches a certain value.

原因：实验回路中金属与金属不良接触的连接点；塑料电缆屏蔽层半导体粒子的不良接触；电容器铝箔的插接片等（可将电容器充电然后短路来消除）。

Reason: The junction of poor contact with metal and metal in an experimental circuit; Poor contact of semiconductor particles in plastic cable shields.

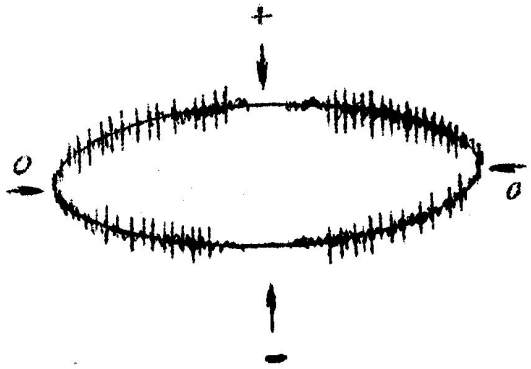


图 5-21

Figure 5-21

⑸ 可控硅元件的干扰图形

The Interference graphics of thyristor element

波形特点：位置固定，每只元件产生一个独立讯号。电路接通，电磁耦合效应增强时讯号幅值增加，试验调压时，该脉冲讯号会发生高频波形展宽，从而占位增加。

Waveform characteristics: Fixed position, Each element produces an independent signal. Circuit connected, The signal amplitude increases when the electromagnetic coupling effect increases, When the test is pressed, the pulse signal will be widened with high frequency waveform, thus occupying an increase.

原因：邻近有可控硅元件在运行。

Reason: The adjacent thyristor element is running.

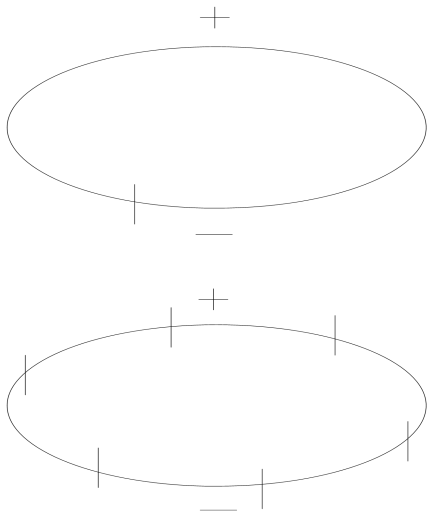


图 5-22

Figure 5-22

⑹ 继电器、接触器、辉光管等动作的干扰

The actions interference of relay, contactor, glow tube, etc.

波形特点：分布不规则或间断出现，同试验电压无关。

Waveform characteristics: distribute irregularity or Appear intermittently, has nothing to do with the test voltage.

原因：热继电器、接触器和各种火花试验器及有火花放电的记录器动作时产生。

Reason: recorder action of thermal relay, contactor, various spark tester or spark discharge lead to the actions interference.

图 5-23

Figure 5-23

⑺ 荧光灯的干扰图形

The Interference graphics of fluorescent lamp

波形特点：栏栅状，幅值大致相同的脉冲，伴有正负半波对称出现的两簇脉冲组。

Waveform characteristics: Fence-like, roughly the same amplitude of the pulse, the two cluster of pulse groups appear accompanied by positive and negative semi - wave symmetry.

原因：荧光灯照明

Reason: Fluorescent lighting

图 5-24

⑻ 无线电干扰的干扰图形

The Interference graphics of radio interference

波形特点：幅值有调制的高频正弦波，同试验电压无关。

Waveform characteristics: Amplitude modulated high frequency sine wave ,has nothing to do with the test voltage

原因：无线电话、广播话筒、载波通讯等。

Reason: wireless phone, radio receiver, carrier communication etc.

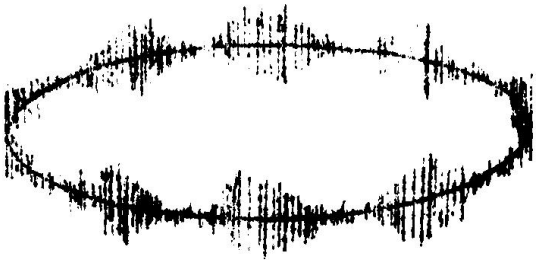


图 5-25

⑼ 电动机干扰的干扰图形。

The Interference graphics of motor interference

波形特点：放电波形沿椭圆基线均匀分布，单个讯号呈“山”字形。

Waveform characteristics: The discharge waveform is evenly distributed along the elliptical baseline, the single signal is shaped like a mountain

原因：带换向器的电动机，如电扇、电吹风运转时的干扰。

Reason: The motor with a commutator, such as the interference in the operation of electric fan and hair dryer.

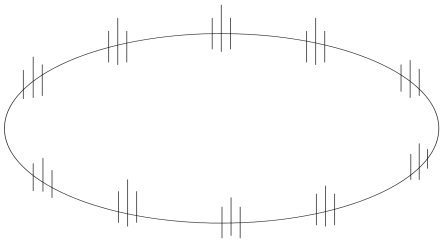


图 5-26

⑽ 中高频工业设备的干扰图形。

The Interference graphics of high-frequency industrial equipment

波形特点：连续发生，仅出现在电源波形的半周内。

Waveform characteristics: Continuous occurrence, only appear within half a week of the power waveform

原因：感应加热装置和频率接近检测频率的超声波发生器等。

Reason: Induction heating device and Ultrasonic generator with frequency close to detection frequency etc.

图 5-27

⑾ 铁芯磁饱和谐波的干扰图形。

The Interference graphics of core magnetic saturation harmonic

波形特点：较低频率的谐波振荡，出现在两个半周上，幅值随试验电压升高而增大，不加电压时消失，有重现性。

Waveform characteristics: Lower frequency harmonic oscillation, appears in two half cycles

原因：试验系统各种铁芯设备（试验变压器、滤波电抗器、隔离变压器等）磁饱和产生的谐振。

Reason: various core equipment of Test system (Test transformer, Filter reactor, Isolating transformer etc.) magnetic saturation lead to resonance.

图 5-28

⑿ 电极在电场方向机械移动的干扰图形

The Interference graphics of electrode moves mechanically in the direction of the electric field

波形特点：仅在试验电压的半周（正或负）上出现的与峰值对称的两个放电响应，幅值相等，而脉冲方向相反，起始电压时两个脉冲在峰值处靠得很近，电压升高时逐渐分开，并可能产生新的脉冲讯号对。

Waveform characteristics: The Two discharge responses with peak symmetry are present only on the half-cycle (positive or negative) of the test voltage Amplitude is equal, Pulse direction is opposite, The two pulses are very close at the peak at the start voltage, Gradually separate as voltage increases

原因：电极的部分（尤其是金属箔电极）在电场作用下运动。

Reason: Part of the electrode (especially the foil electrode) moves under the action of an electric field.

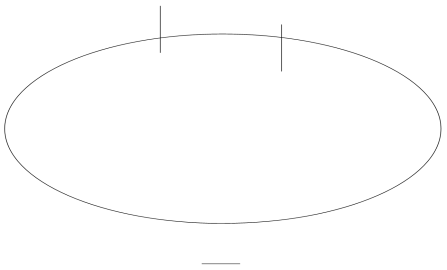


图 5-29

⒀ 漏电痕迹和树枝放电

Leakage traces and branch discharges

原因：玷污了的绝缘上漏电或绝缘局部过热而导致的碳化痕迹或树枝通道。

在放电测试中必须保证测试回路中其它元件（试验变压器、阻塞线圈、耦合电容器、电压表电阻等）均不放电，常用的办法是用与试品电容数量级相同的无放电电容或绝缘结构取代试品试验，看看有无放电。

Reason: Tainted insulation leakage or Insulation local overheating lead to carbonation marks or branches of the channel. In the discharge test must ensure that other components in the test circuit (test transformer, blocking coil, coupling capacitors, voltmeter resistance, etc.) are not discharged, The commonly used method is to replace the test with the same non-discharge capacitor with the same magnitude of capacitance or insulation structure in experiment, to see if there is any discharge.

2）滤波抗干扰 Filtering for anti-interference

在加压之前，如果通道波形中有较强干扰，可对干扰开窗进行频谱分析，查看干扰主要频段范围，从而选择能够抑制干扰的合适频带，同时针对该频带应校准，如果该频带已经校准，在环境条件相同的条件下无需重新校准。

If strong interference exists in channel before applying voltage, users can do spectrum analysis by windowing. Check the main frequency of interference to select appropriate frequency band which can suppress it. If this frequency band has been calibrated, then there is no need to re-calibrate it.

3）抑制静态干扰 Static interference suppression

在加压之前，如波形显示框中有较强干扰，并且波形的相位基本固定，则可采取静态抗干扰方式。如图 5-30 中 CH1 在加压前存在固定相位干扰脉冲。

If strong interference exists in channel before applying voltage, and the phase is relatively stable, choose static interference suppression. Example: stable pulse interference exists in CH1 before applying voltage.

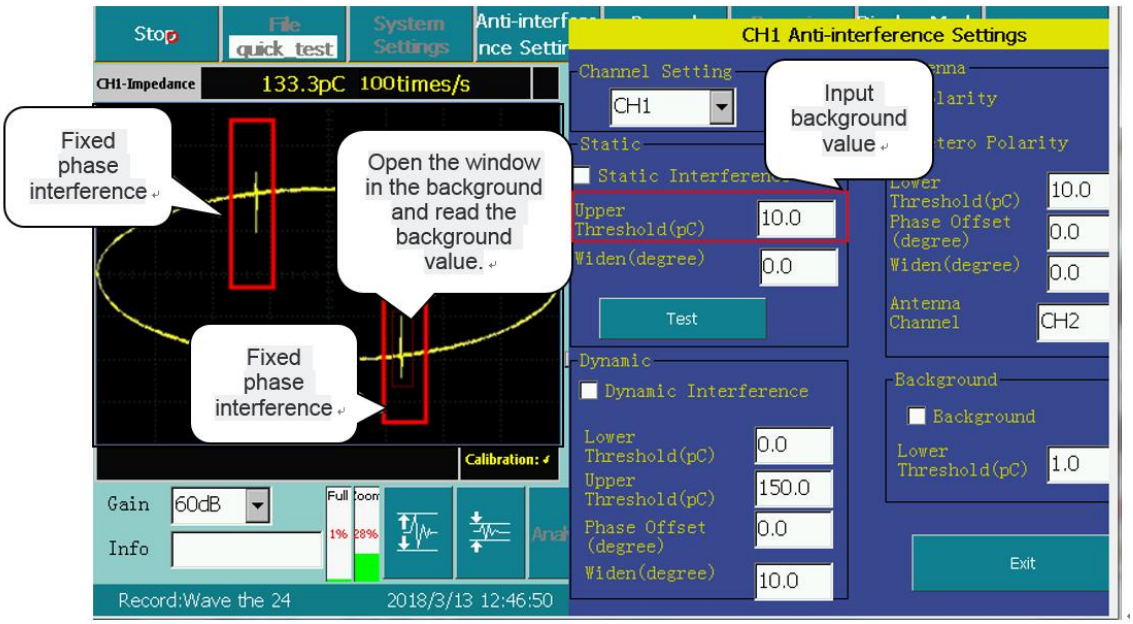


图 5-30 CH1 消静态干扰前

Figure 5-30 Before static interference suppression in CH1

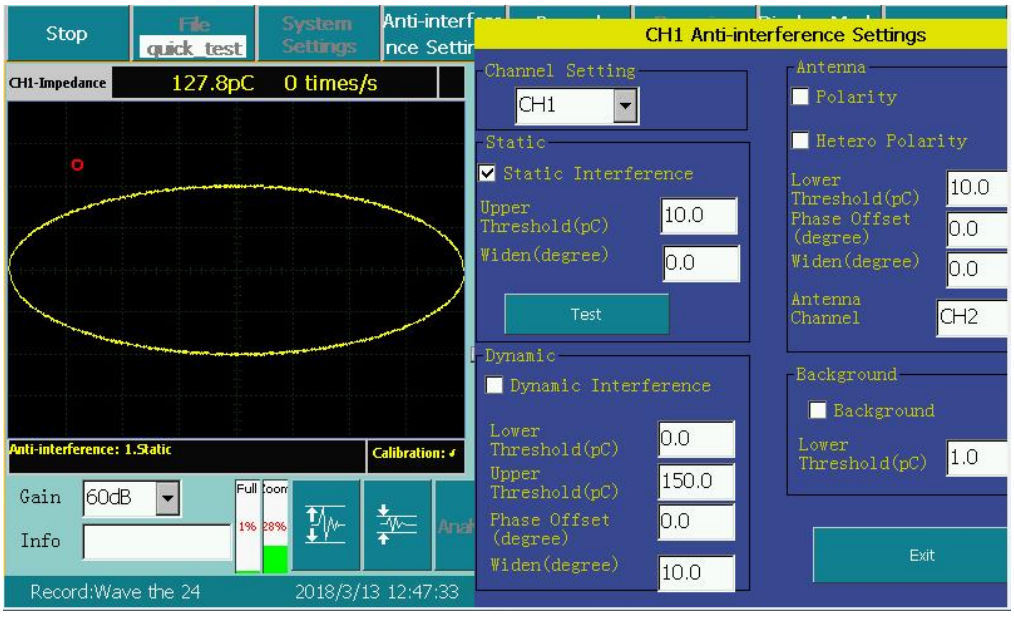


图 5-31 CH1 消静态干扰后

Figure 5-30 After static interference suppression in CH1

按“停止”按钮，框选中较低的背景噪声波形处，将波形窗口上方显示的 pC 值输入到“静态”抗干扰的“上阈”内，按“测试”按钮，随即该按钮变为“保存”，几秒钟后再按该按钮保存即可。运行过程中可以选中静态抗干扰，以消除静态干扰。

Press ‘Stop’ button, select wave area of low background noise, input pC value displayed in upper area of wave window into ‘Up threshold’ of ‘Static’ anti-interference, press ‘Testing’ button and this button will become ‘Save’, press ‘Save’ after several seconds. Static interference suppression can be selected in the process to eliminate static interference.

注：静态抗干扰按钮可在多个通道同时生效，各个通道的阈值可能不同，需要逐个测试。
Note: Static interference suppression can be applied in several channels and threshold values may be different which need to be tested respectively.

4）天线门控抑制干扰 Antenna gated interference suppression

试验现场，各种无线电波以及其它设备产生的放电，都属于外部干扰，如果这些干扰通过空间串入试验回路而影响到试验时，可以采用天线门控抗干扰的措施。

At the scene, all kinds of radio wave and discharge from other equipment are external interference. If these interference can go into testing system and influent the testing, users can apply antenna gated interference suppression.

首先将某个通道接入天线（一般为 CH2），将图 5-32 中的天线通道选为 CH2，使用相位开窗，框住 CH2 信号比较小的部分（大于该值为干扰），读出 pC 值后，输入到“天线”的“上阈”编辑框中。在试验当中，选中“同极性”和“异极性”，即可利用天线通道的干扰信号屏蔽其它通道的相同相位的干扰，同时取消选中“同极性”和“异极性”可恢复干扰的对照显示。

Firstly connect antenna to one channel (CH2 commonly), select CH2 for antenna channel in picture 5-32, use phase window, select low signal area in CH2 (higher signals are interference), read pC value and input it to ‘Up threshold’ in ‘Antenna’. In the testing, select Polarity and Hetero polarity to use signals from antenna to eliminate same phase interference in other channels. Deselect Polarity and Hetero polarity at the same time to make an interference comparison.

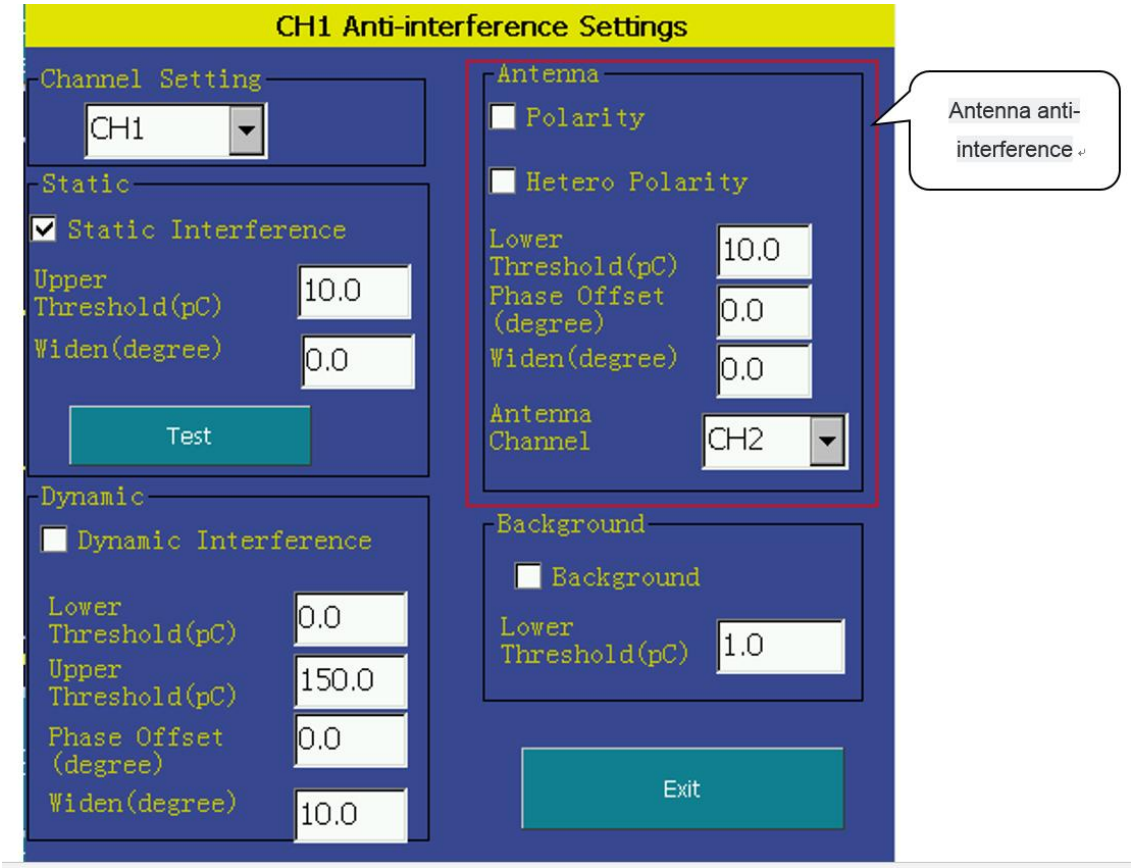


图 5-32 天线及极性判别干扰设置

Figure 5-32 Antenna and polarity judge interference setting

当两个通道信号之间产生变异，可通过相移（0—±360℃）和加宽（0—±360℃，0℃不加宽）来调整相位和宽度，以便消除空间干扰，方法是：将 CH1 的干扰信号开窗分析，在脉冲分析画面得到其相位度数，同理得到另一通道的相位度数，两者之差值输入到“相移”框内，并适当修改干扰相移和干扰加宽的值。

When differences exist in the two channels, special interference can be eliminated by phase shift (0—±360℃) and broadening (0—±360℃，no broadening of 0℃) which can adjust phase and width. The way goes: analysis CH1signals by widowing and get the degree in pulse analysis. Get the other channel’s phase degree in the same way and input the difference into ‘ Phase shift’ . Change values of interference phase shift and interference broadening.

5） 极性判别抑制干扰 Polarity discrimination anti-interference

➢ **原理** The principle

外部干扰由引线串入变压器内部，其传输回路分别经过套管接地线和铁心接地线汇入大地，如下图 a,b 所示两条回路。而变压器内部放电的传输回路可以由放电点经套管地屏、大地、铁心接地到放电点构成回路，如右图 c 所示回路。所以，外部干扰在套管接地线和铁心接地线上产生的电流极性相同，而变压器内部放电在套管接地线和铁心接地线上产生的电流

极性相反。

External interference by wire string into the transformer, whose transmission circuit respectively passes through the casing grounding wire and the core grounding wire into the earth, the two loops shown in Figure 6.17 a, b. The transmission circuit of the internal discharge of the transformer can form the circuit from the discharge point to the ground screen, the earth, the core and the discharge point, as shown in Figure 6.17 c. Therefore, the polarity of the current generated by the external interference is the same on the bushing grounding wire and the iron core grounding wire, while the internal polarity of the transformer's internal discharge is opposite to that of the bushing grounding wire and the iron core grounding wire.

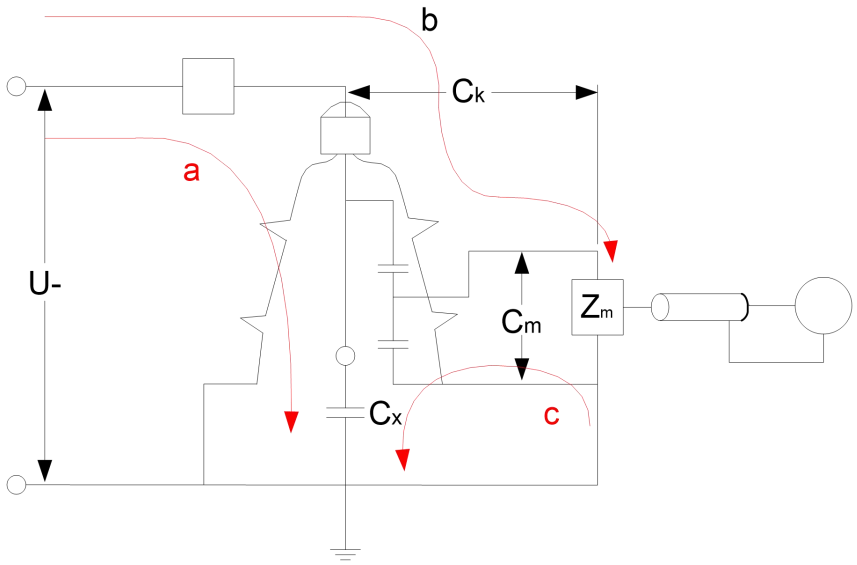


图 5-33 极性判别示意图

Figure5-33 Polarity discrimination

➢ **接线** The wiring

先按局放测量的接线方法将输入单元的信号接入 CH1，然后从铁心接地线引出一根电缆，面对高频电流互感器有文字的正面圆形孔中将电缆穿入，从背面穿出之后接到地线上，用同轴电缆把“高频电流互感器”耦合过来的信号接到局放仪的 CH2 即可。

Firstly, connect input unit's signal to CH1 according to the wiring method of the Bureau, and then draw a cable from the core to the ground wire，In the front face circular hole of a wide-band current transformer with a word penetrate the cable. then through the back to the ground line, The signal coupled by the "wide-band current transformer" with a coaxial cable to CH2.

注：铁心接地线一定要穿过高频电流互感器的正面，反之会导致信号极性错误。（参见附录接线图 2、4 左下部高频电流互感器的连接方法，方向要正确）

(Note: The core grounding wire must pass through the front of HFCT PD sensor, On the other hand, it can lead to a signal polarity error.(See the connection method of the appendix wiring diagram 2 and 4 left bottom wide band current transformer, The direction must be correct)

- **操作方法** The method of operation

① 在注入方波校准时，利用波形分析功能观察两个通道同相位的方波信号的极性。

At the time of injection square wave calibration, the polarity of the square wave signals with the same phase of the two channels is observed by using the waveform analysis function.

② 测量时，将稍微大于 CH2 的背景值输入到天线的“上阈”框内，然后根据极性选中同极性或异极性，CH1 会根据极性来判别是否去除，从而读出正确的放电量。

When Measuring, input the background slightly greater than the first channel into the "upper threshold" frame of the antenna, then according to the polarity of the selected polar or hetero polarity, the corresponding channel will be judged to be removed according to the polarity, So as to read the correct discharge.

6）开窗读数抑制干扰 Read values in opened window to reduce interference

最简单、最常用的抗干扰方法是使用框选开子窗口的方法。在波形显示区内开窗，框住有效的放电信号，此时实际的放电值就显示在通道顶端的显示框中。每个波形显示区内可同时开两个子窗口。两个子窗口中的波形的最大值显示在通道顶端的显示框中。

Opening sub-window is the most simple and common anti-interference method. Open a window in wave displaying area. Select useful discharge signals and the current practical discharge value is displayed in display box of the channel. Two windows are allowed at the same time in every wave display area. The highest value is displayed on top of the channel.

7）抑制动态干扰 Dynamic interference suppression

在试验中，如果随时有很强的动态干扰（包括其它设备的放电）影响局放测量读数时，只要在“抗干扰设置”的“下阈”中输入大于背景噪声的 pC 值，在“抗干扰设置”的“上阈”中输入小于干扰的 pC 值，开启动态抗干扰，即可去掉欲屏蔽的动态较大的干扰，同时保留中间部分的放电信号。阈值可根据干扰的具体情况随时修改，以使读数更为准确。

In experiments, if there is strong dynamic interference at any time, including the discharge of other devices, which affects the pC reading of PD measurement, just enter the pC value larger than the background noise in the "down threshold" box of "dynamic anti-interference setting", Input the pC value less than interference in the "up threshold" box of "dynamic anti-interference setting".

Press the "dynamic" check box button to eliminate interference of big range and keep the discharge signal. Threshold values can be set according to specific situation to make the read more accurate.

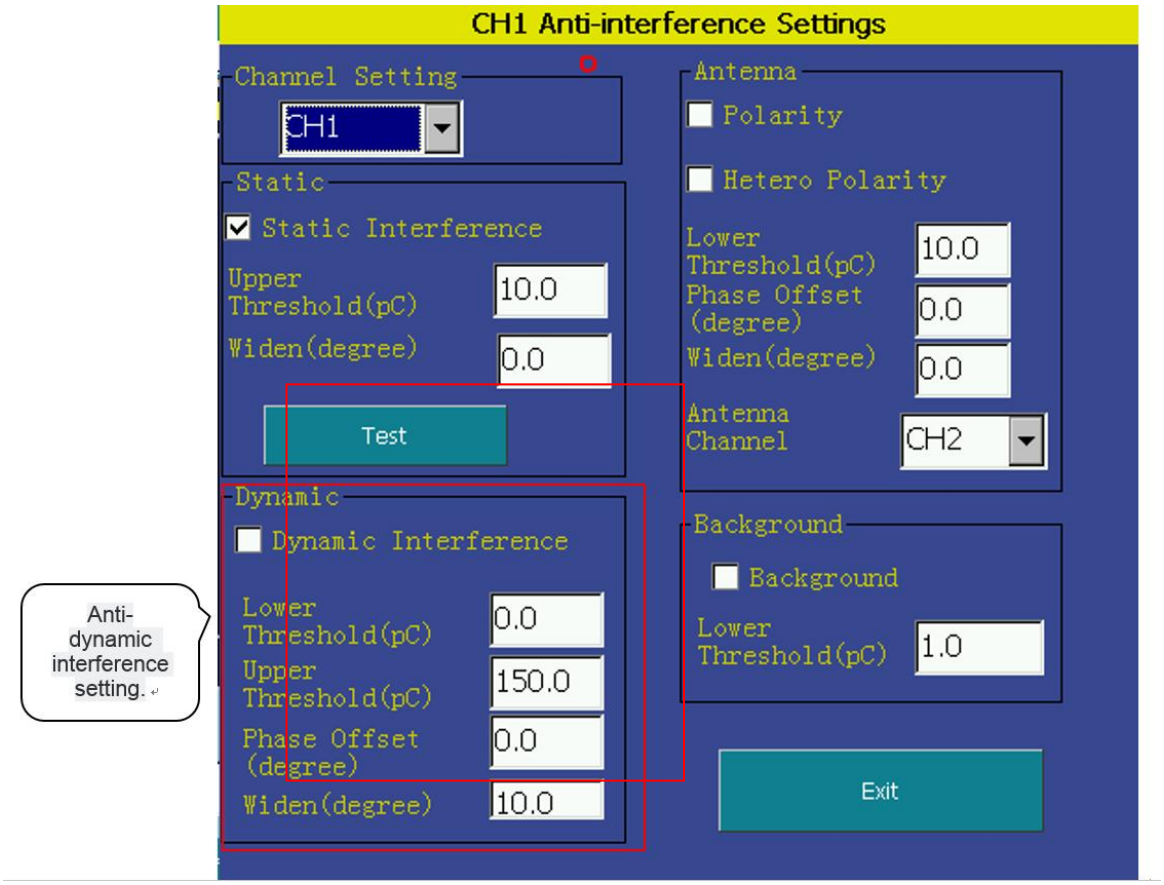


图 5-34 抑制动态干扰设置

Figure 5-34 Dynamic interference suppression setting

8）背景消除 Eliminate background noise

当现场环境存背景噪声时，而用户又想呈现出比较干净的放电脉冲时，可开启背景抗干扰。只需要在背景的下阈值中输入背景值即可。

Open anti-interference when background noise occurs and clear discharge pulse is needed. Set threshold value in anti-interference dialog box.

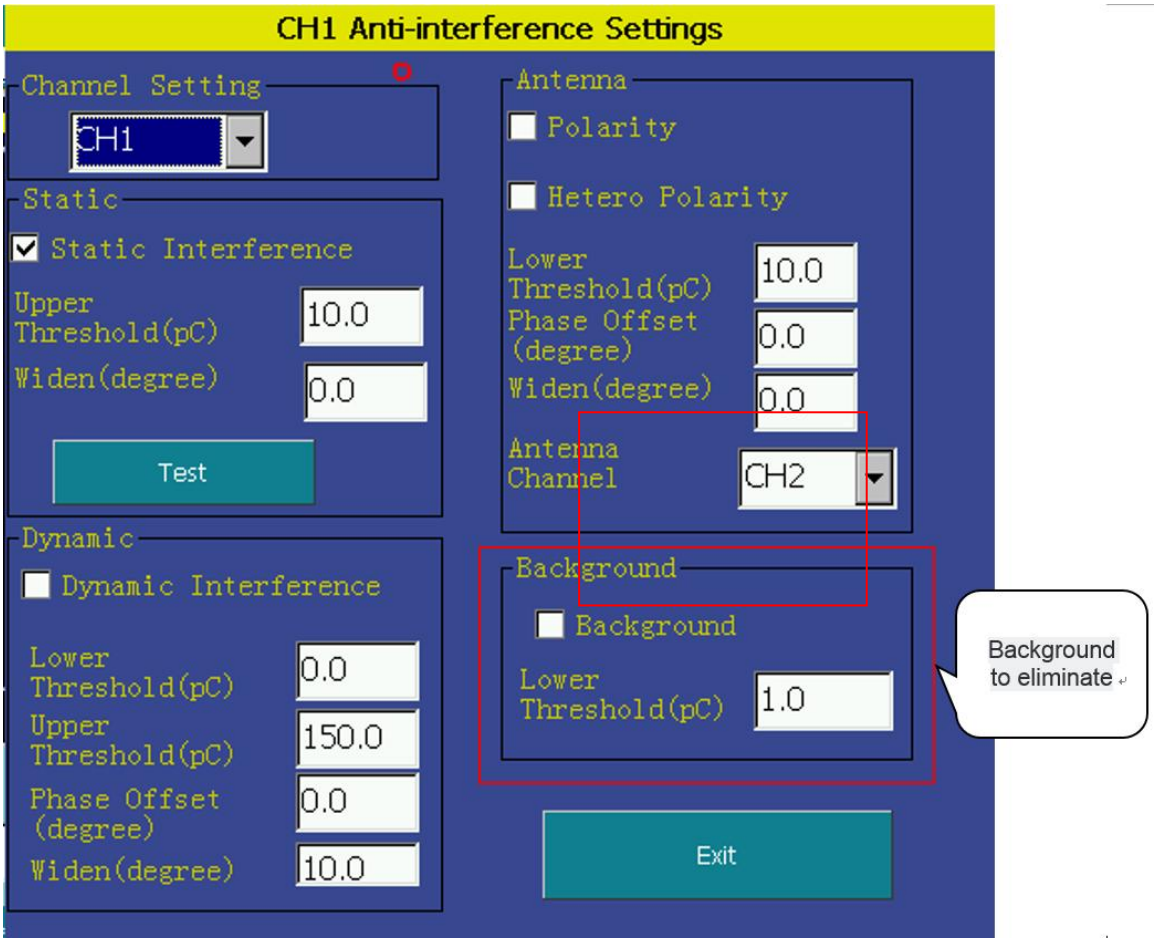


图 5-35 背景消除设置

Figure 5-35 Background elimination Settings

5.2.9 外部触发的使用

5.2.9 Using of external synchronization

在现场试验时，为了得到稳定而且准确的相位，可以采用外部触发方式，在系统设置里，将触发方式改成外部触发，主机后面板接线如图，将外同步模块接到试验电源上，点击运行，此时放电相位为稳定而准确的相位。

When testing at the scene, users can use external synchronization to acquire stable and accurate phase. Change to external-sync mode in System Option. Wiring of back panel is as follows. Connect external synchronization module to testing power supply and click to run, the discharge phase is stable.

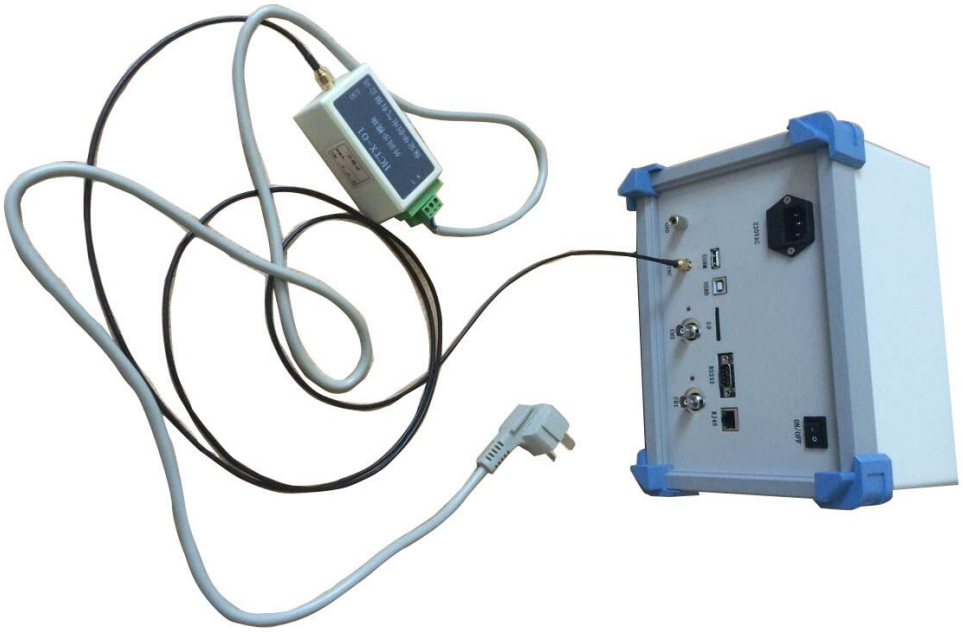


图 5-36 外同步接线图

Figure 5-36 External synchronization connection

5.3 试验报告

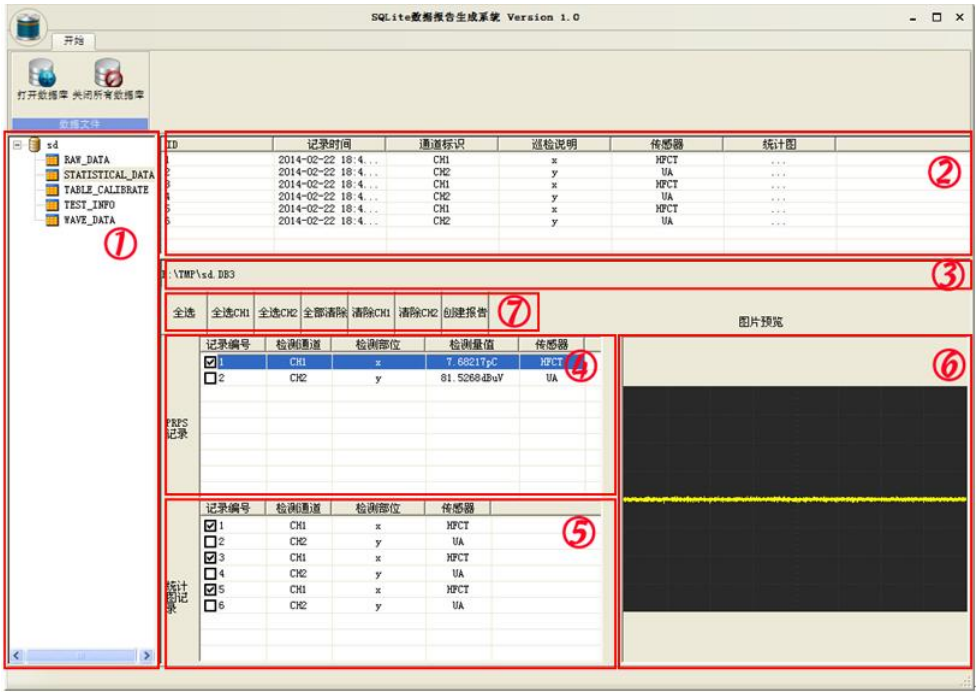
5.3 Test Report

试验数据可通过 SD 卡导出到 PC 机中，从而完成用户报告的创建。报告生成要求 PC 机应安装 Microsoft Word2003 和 SQLite 数据报告生成系统 Version1.0。

Test data can be moved to PC via SD card and users can build a test report. Microsoft Word2003 and SQLite Report generation system is required on PC.

SQLite 数据报告生成系统 Version1.0 主界面如下:

Main interface of SQLite data report generation system Version 1.0 is as follows:



标识 Mark	说明 Description
①	已打开数据库树列表，点击根节点刷新④及⑤列表，点击表节点刷新②列表。The database tree list has been opened, click the root node to refresh ④&⑤ list, click table node to refresh the ② list
②	数据库文件表详查。 Database files list details.
③	显示当前数据库路径。Display current path of database.
④	PRPS 记录列表，点击记录可进行图片预览。List of PRPS records, click records to preview pictures.
⑤	统计图记录列表，点击记录可进行图片预览。List of statistic records, click records to preview pictures.
⑥	图片预览显示区。Pictures preview area.
⑦	选中、清除以及创建报告功能按键。Select, clear and build reports function buttons.

6. 操作步骤

Ⅵ. Operation Steps

6.1 接线

6.1 Wiring

◆局部放电测试电路的三种基本接法及优缺点。

◆ Partial discharge test circuit of the three basic connection and advantages and disadvantages.

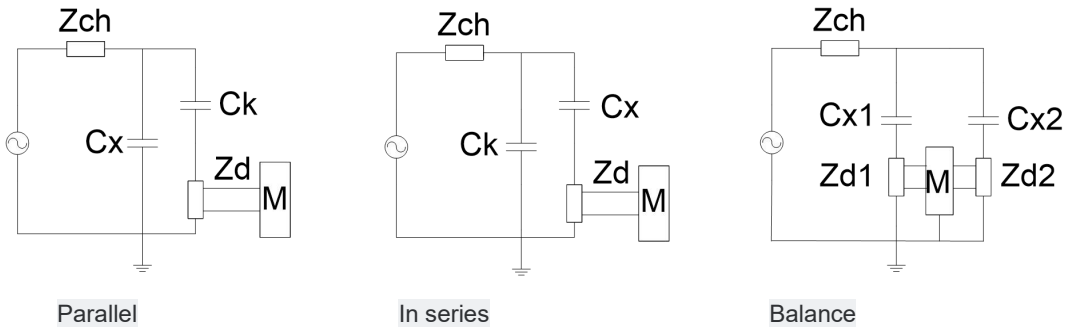


图 6-1 三种基本接法及优缺点

Picture 6-1 Three kinds of basic connection and advantages and disadvantages

（1）标准试验电路，又称并联法。适应于必须接地的试品。

（1）Standard test circuit, also known as parallel method. Adapt to the test must be grounded.

其缺点是高压引线对地杂散电容并联在 CX 上，会降低测试灵敏度。

The disadvantage is that the high-voltage lead to ground stray capacitance in parallel on the CX, will reduce the test sensitivity.

（2）串联法，其要求试品低压端对地浮置。

（2）Series connection method, which requires low-voltage test-side floating ground.

其优点是变压器入口电容、高压线对地杂散电容与耦合电容 CK 并联，有利于提高试验灵敏度；缺点是试样损坏时会损坏输入单元。

The advantage is that the transformer inlet capacitance, high-voltage line stray capacitance and coupling capacitor CK are in parallel, which help to improve the test sensitivity. The disadvantage is that the sample will damage the input unit when it is damaged.

（3）平衡法试验电路：要求两个试品相接近，至少电容量为同一数量级。

（3）Balance method test circuit: Requires two samples close, at least the same amount of capacitance.

其优点是外干扰强烈的情况下，可取得较好抑制干扰的效果，并可消除变压器杂散电容的影响，而且可做大电容试验；缺点是需要两个相似的试品，且当产生放电时，需设法判别是哪个试品放电。

The advantage is strong external interference case, can achieve better interference suppression effect, and can eliminate the influence of transformer stray capacitance, and can do a large capacitance test; The disadvantage is that two similar test pieces are required, and when discharging occurs, it is necessary to try to determine which test piece discharges.

注：由于现场试验条件的限制（找到两个相似的试品且要保证一个试品无放电不太容易），所以在现场平衡法比较难实现，另外，由于采用串联法时，如果试品击穿，将会对设备造成比较大的损害，所以出于对设备保护的想法，在现场试验时一般采用并联法。

Note: Due to the limitations of field test conditions (finding two similar samples and ensuring that a sample does not discharge too easily), field balancing is more difficult to achieve. In addition, due to the tandem method, Wear, will cause greater damage to the equipment, so out of the idea of equipment protection, in the field when the test is generally used in parallel.

◆采用并联法的整个系统的接线原理图

◆The entire system wiring diagram using the parallel method

该系统采用脉冲电流法检测高压试品的局部放电量，由控制台控制调压器和变压器在试品的高压端产生测试局放所需的预加电压和测试电压，通过无局放耦合电容器和输入单元将局部放电信号取出并送至局部放电检测仪显示并判断和测量。系统中的高压滤波器可以防止在测试过程中试品击穿而损坏其他设备，阻塞放电电流进入试验变压器，并且可以抑制从高压电源进入的谐波干扰，隔离滤波器是将电源的干扰和整个测试系统分开，降低整个测试系统的背景干扰。

The system uses the pulse current method to detect the partial discharge of the high-voltage test sample. The control console and the transformer control the pre-voltage and test voltage required for the test PD at the high-voltage end of the test sample. No PD coupling capacitors and the input unit will be partial discharge signal removed and sent to the partial discharge tester display and determine and measure. High-voltage filters in the system can prevent the breakdown of the test

sample during the test to damage other devices, blocking the discharge current into the test transformer, and can inhibit the harmonic interference from entering the high-voltage power supply, the isolation filter is the power supply interference and the entire Test systems are separated to reduce the background noise of the entire test system.

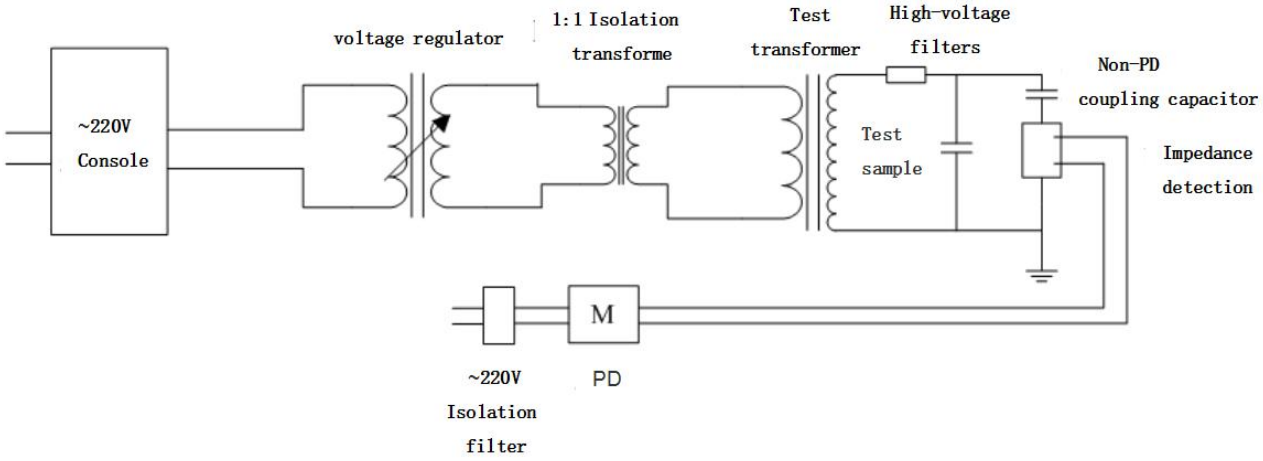


图 6-2　采用并联法系统接线原理图

Figure 6-2 Using parallel method system wiring diagram

◆几种典型的局部放电测量回路连接方法

◆Several typical method of connecting partial discharge measurement loop

a 电压互感器:

a Voltage transformer:

电压互感器的试验方法可归结为两大类，即在被试品高压侧加压或低压侧加压(即二次绕组自励磁产生)，一般推荐采用高压侧加压，但在现场若受到客观条件的限制，无适当的电源设备，则采用低压侧加压。

Voltage transformer test methods can be attributed to two broad categories, namely the high voltage side of the test object is pressurized or low voltage side of the voltage (that is, the secondary winding self-excitation), generally recommended high-voltage side of the voltage, Objective conditions, without appropriate power equipment, the use of low-voltage side of the voltage.

高压侧加压：

High voltage side applying voltage:

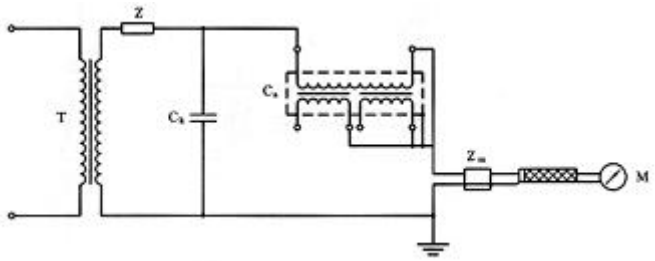


图 6-3-A 输入单元和电压互感器串接

Figure 6-3-A Input unit and voltage transformer connected in series

T—试验变压器； Ck 为耦合电容器； Zm 为输入单元；

Z 为电源滤波阻抗（也可位于低压侧） M 为局放检测仪

T—Test transformer; Ck is a coupling capacitor; Zm is the input unit; Z is the filter impedance of power supply(also located at the low voltage side) M is the PD tester

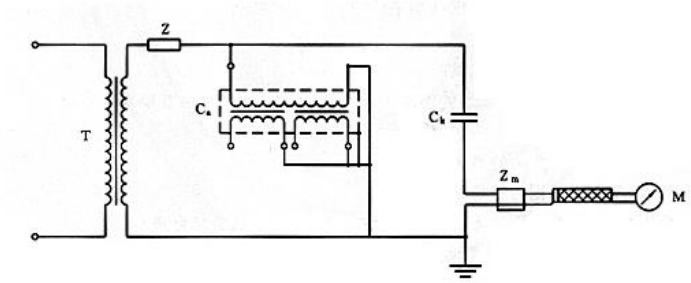


图 6-3-B 输入单元和耦合电容器 Ck 串接

Figure 6-3-B Input unit and Coupling Capacitor Ck in series

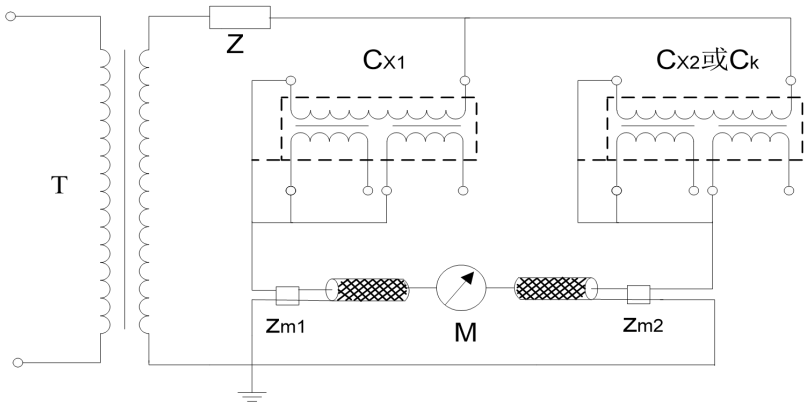


图 6-3-C 平衡回路

Figure 6-3-C Balance circuit

注：电压互感器高压线圈首末两端绝缘水平相等的，应向两个高压端子轮流施加电压，共进行两次试验。当一个高压端子加压时，另一个高压端子应接到低压端子上。

Note: The voltage transformer high-voltage coil insulation at both ends of the first level equal

to the voltage should be applied to two high-voltage terminals, a total of two tests. When a high voltage terminal is pressurized, the other high voltage terminal should be connected to the low voltage terminal.

低压侧加压:

Low voltage side voltage:

1） 输入单元和互感器串接，以杂散电容 Cs 取代耦合电容器 Ck，其试验接线如图 6-4-A 所示。外壳可并接在 X 处，也可直接接地。

1) The input unit and the transformer are connected in series with a stray capacitor Cs instead of the coupling capacitor Ck. The test connection is shown in Figure 6-4-A. Shell can be connected in parallel X, can also be directly grounded. Shell can be connected in parallel X, can also be directly grounded.

2） 当干扰影响测量时，可采用邻近相的互感器或性能相近的互感器连接成平衡回路的接线，如图 6-4-B 所示，被试互感器励磁，非被试互感器不励磁，以降低干扰。此时采用脉冲鉴别系统测试效果更佳。

2) When the influence of interference measurement, the adjacent phase transformer or similar performance of the transformer can be connected as a balance circuit wiring, as shown in Figure 6-4-B, the tested transformer excitation, non-tested transformer is not excited to reduce interference. At this point the use of pulse identification system test better.

3） 输入单元和耦合电容器 Ck 串接，其试验接线如图 6-4-C 所示。外壳可直接接地。

3) Input unit and coupling capacitor Ck series, the test wiring shown in Figure 6-4-C. Shell can be directly grounded.

为防止励磁电流过大，电压互感器试验的预加电压，可采用 150Hz 或其它合适的频率作为试验电源。

To prevent the excitation current is too large, the voltage transformer test pre-voltage, 150Hz or other suitable frequency can be used as the test power.

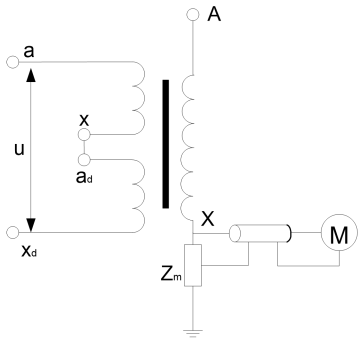


图 6-4-A 无耦合电容器 C_k 试验接线

Figure 6-4-A Uncoupled capacitor Ck test connection

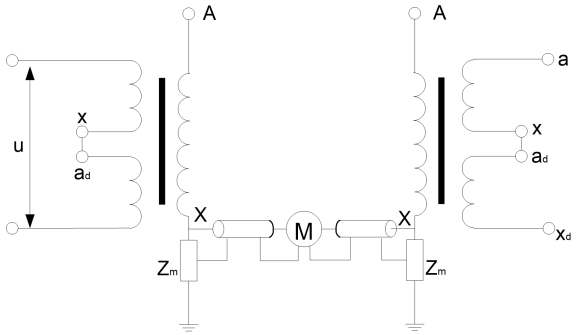


图 6-4-B 抑制干扰的平衡回路接线

Figure 6-4-B Balance circuit wiring for interference suppression

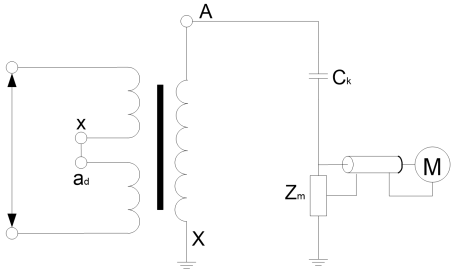


图 6-4-C 接有耦合电容器 Ck 的试验接线

Fig. 6-4-C Test connection with a coupling capacitor Ck

b 电流互感器:

b Current transformer:

电流互感器局部放电试验，试验电压由外施电源产生，一般有三种检测方法：

Current transformer partial discharge test, the test voltage generated by the external power

supply, there are three general detection methods:

1）输入单元和互感器串接，以杂散电容 Cs 取代耦合电容器 Ck，其试验接线如图 6-5-A 所示。试验变压器一般按需要选用单级变压器串接(例如单级电压为 60kV 的 3 台变压器串接)，其内部放电量应小于规定的允许水平。互感器若有铁芯 C 端子引出，则并接在 B 处。电容式互感器的末屏端子也并接在 B 处。外壳最好接 B，也可直接接地。

1）The input unit and the transformer are connected in series with a stray capacitor Cs instead of the coupling capacitor Ck. The test connection is shown in Figure 6-5-A. est transformers are generally used in accordance with the need to use single-stage transformer series (for example, the single-stage voltage of 60kV 3 transformers series), the internal discharge should be less than the specified allowable level. If the iron core C terminal lead leads, and then in the B Department. The end of the capacitive transformer terminal is also connected to the B at the end. The shell is best then B, can also be directly grounded.

2）当干扰影响测量时，可采用邻近相的互感器或性能相近的互感器连接成平衡回路的接线，如图 6-5-B 所示，被试互感器施加高压，非被试互感器不施加高压，以降低干扰。此时采用脉冲鉴别系统测试效果更佳。

2 ） When the interference affects the measurement, the adjacent phase transformers or transformers with similar performance can be used to connect the balanced circuits. As shown in Figure 6-5-B, the tested transformers exert high voltage and the non-tested transformers do not apply high voltage to reduce interference. At this point the use of pulse identification system test better.

3）输入单元和耦合电容器 Ck 串接，其试验接线如图 6-5-C 所示。外壳可直接接地。

3）Input unit and coupling capacitor Ck series, the test wiring shown in Figure 6-5-C. Shell can be directly grounded

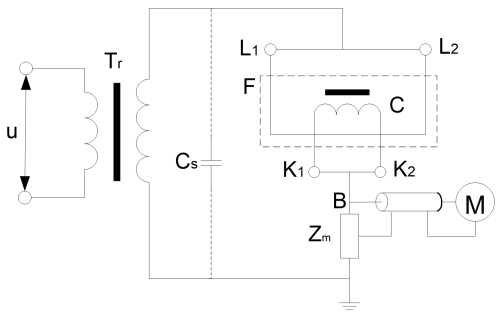


图 6-5-A 电流互感器试验接线

Figure 6-5-A Current transformer test wiring

Tr—试验变压器；C—铁芯；F—外壳

Tr—Test transformer; C—Iron core; F—Shell

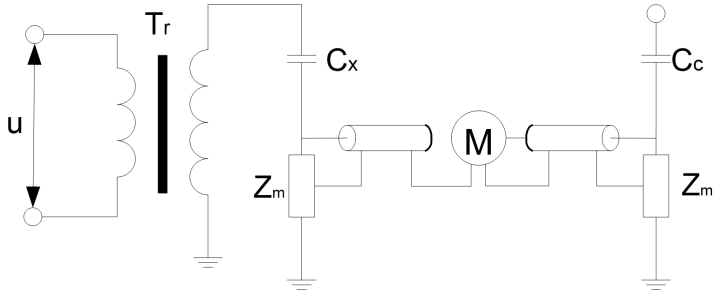


图 6-5-B 抑制干扰的平衡法接线

Figure 6-5-B Interference suppression balanced wiring

Cx—被试互感器；Cc—邻近相互感器

Cx—Test transformer; Cc—Adjacent phase transformer

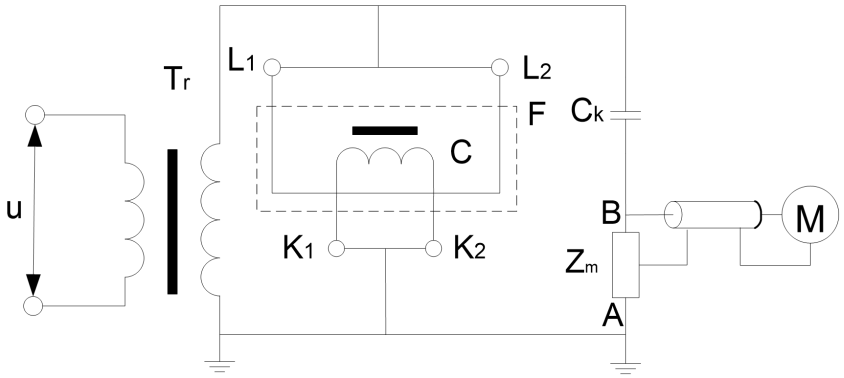


图 6-5-C 接有耦合电容器 C_k 的试验接线

Figure 6-5-C Connected with the coupling capacitor Ck test wiring

c 变压器套管接线

c Transformer bushing wiring

变压器或电抗器套管局部放电试验时，其下部必须浸入一合适的油筒内，注入筒内的油应符合油质试验的有关标准，并静止 48h 后才能进行试验。试验时以杂散电容 Cs 取代耦合电容器 Ck，试验接线如图 6-6 所示。

Transformer or reactor casing partial discharge test, the lower part must be immersed in a suitable oil cylinder, the oil injected into the cylinder should meet the relevant standards of oil test,

and static 48h before the test. Test to replace stray capacitor Cs coupling capacitor Ck, test wiring shown in Figure 6-6.

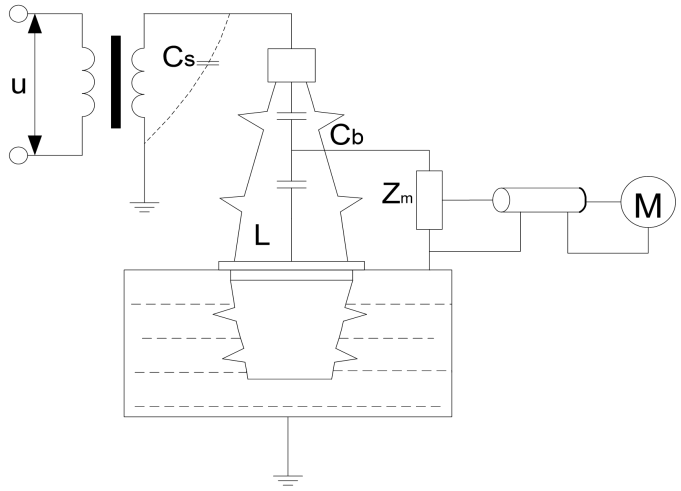


图 6-6 变压器套管接线

Figure 6-6 Transformer Bushing Connections

C_b—套管电容； L—电容末屏

C_b—Casing capacitance; L—Capacitor terminal screen

d 发电机的局放测试接线原理图

d Generator PD test wiring diagram

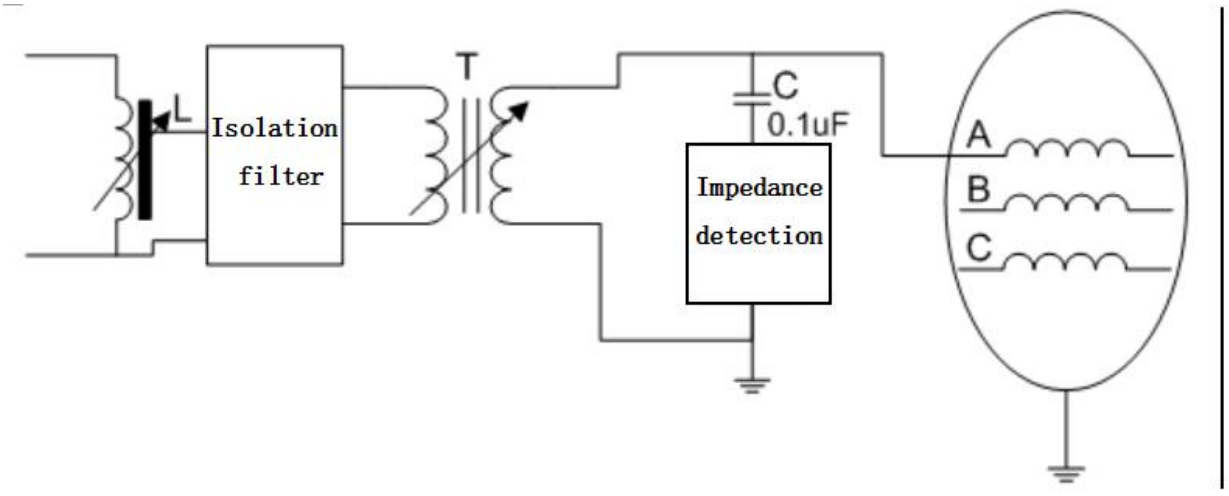


图6-7 发电机的局放测试接线

Figure 6-7 Generator PD test wiring

e 变压器的局放测试接线原理图

e Transformer PD test wiring diagram

变压器试验电源一般采用50Hz的倍频或其它合适的频率。三相变压器可三相励磁，也可单相励磁。变压器局部放电试验的基本原理接线，如图6-8所示：

Transformer test power supply generally 50Hz multiplier or other suitable frequency. Three-phase transformer can be three-phase excitation, but also single-phase excitation. Transformer partial discharge test of the basic principles of wiring, as shown in Figure 6-8:

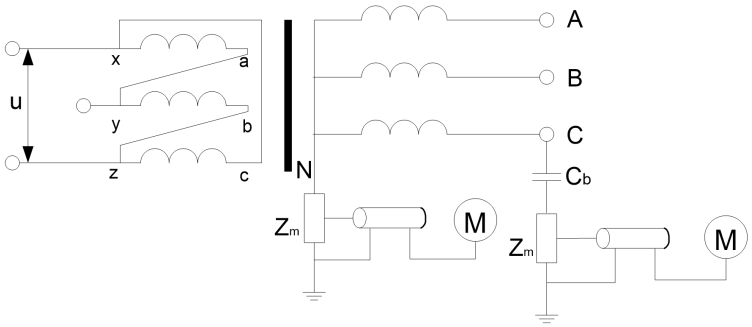


图6-8-A单相励磁基本原理接线

Figure 6-8-A A single-phase excitation of the basic principles of wiring

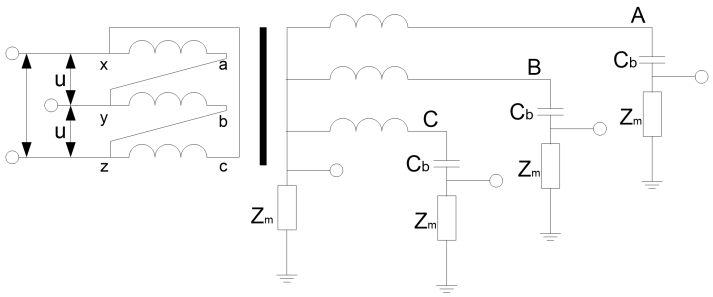


图6-8-B 三相励磁基本原理接线

Figure 6-8-B three-phase excitation of the basic principles of wiring

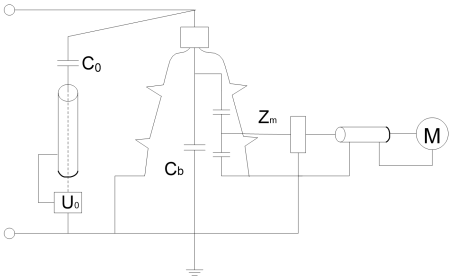


图6-8-C 套管抽头测量和校准接线

Figure 6-8-C Catch Taps Measurement and Calibration Wiring

图6-8 变压器局部放电试验的基本原理接线

其中 C_b—为变压器套管电容

Figure 5.14 Transformer partial discharge test of the basic principles of wiring

C_b— transformer sleeve capacitance

f. Cable partial discharge testing diagram of wiring

◆ **通道电信号的连接方式：**

◆ Channel electrical signal connection

首先将仪器的接地端子用电缆线可靠接地；

First, connect the grounding terminal of the instrument to the ground with a cable.

将交流 220V 电源线插接在仪器标有(AC220V)的电源插口上；

Plug the AC 220V power cord into the power socket (marked AC 220V);

将输入单元（检测阻抗）的初级末端和接地端子短接并接地（非平衡输入）；

Short the primary end of the input unit (input impedance) to the ground terminal and ground (unbalanced input), the primary primary side to the low side of the coupling capacitor;

用 50 欧姆同轴电缆将仪器通道 BNC 口与输入单元的“至局放仪”端子连接。

Connect tester’s BNC to ‘To tester’ on input unit with a 50-ohm coaxial cable.

两通道连接方式相同。

Each channel is connected in the same way.

用试品的高压套管末屏作为耦合电容，进行局放测试：（参见附录图 3 局放试验接线图）

With the end of the test tube of the high-voltage casing as a coupling capacitor, PD test: (see Appendix Figure 3 PD test wiring diagram)

将输入单元的初级首端与被测试品的高压套管末屏连接（接线尽量短）；

Connect the primary end of the input unit to the end shield of the high voltage bushing of the product under test;

这种连接方式下，需要校准仪器时，将校准脉冲发生器输出的红线夹子，夹至高压套管的顶端，同时将其黑线接地。**（参见附录图 1 校准接线图）**

In this connection mode, when the instrument needs to be calibrated, clip the red clip of the calibration pulse generator to the top of the high voltage bushing while grounding its black line. **(See Appendix Figure 1 calibration wiring diagram)**

用专用高压耦合电容进行局放测试：（参见附录图 4 局放试验接线图）

Partial high voltage coupling capacitors for PD test: (see Appendix Figure 4 PD test wiring diagram)

对于已配装输入单元的耦合电容，用 50 欧姆同轴电缆将耦合电容下端标有“至局放仪”

的 BNC 口接至局放仪的信号输入端；将耦合电容的高压端子用带均压管的电缆接至被测试品的高压端子。

For a coupling capacitor with an input unit, connect the BNC port on the lower side of the coupling capacitor labeled PD to the signal input terminal of the PD with a 50 ohm coaxial cable; connect the high voltage terminal of the coupling capacitor The tubing of the tubing is connected to the high voltage terminal of the product under test.

对于未配装输入单元的耦合电容，应将耦合电容的低压端用短线与输入单元的初级首端连接，输入单元的初级末端与接地端连接后接地。输入单元上“至局放仪”的端子用 50 欧姆同轴电缆接至局放仪信号输入端；将耦合电容的高压端子用带均压管的电缆接至被测试品的高压端子。

For a coupling capacitor not equipped with an input unit, connect the low voltage terminal of the coupling capacitor with the primary first terminal of the input unit with a short line and the primary terminal of the input unit with the ground terminal. Input unit to the amplifier terminal with a 50-ohm coaxial cable connected to PD signal input; the coupling capacitor high voltage terminal with a voltage equalizer tube connected to the high voltage terminal of the test object.

以上两种接线方式在校准时，校准脉冲发生器的接线是相同的，应将校准脉冲发生器输出的红线夹子，夹至试品的高压端子上，同时将黑线夹子接地。**（参见附录图 2 校准接线图）**

When the above two wiring methods are used for calibration, the wiring of the calibration pulse generator should be the same. The red clamp output from the calibration pulse generator should be clamped to the high voltage terminal of the test sample, and the black clamp should be grounded at the same time. **(See Appendix Figure 2 calibration wiring diagram)**

（注意：在加高压前，请将“校准脉冲发生器”取下,否则可能造成重大事故！！）

(Note: Please remove the "calibration pulse generator" before applying high voltage, otherwise it may cause serious accidents!!)

6.2 开机

6.2 Boot

先打开仪器后面板上的电源开关，仪器自动进入软件主界面，点击主界面 

进行试验档案的建立以及试验信息的输入。

First open the main power switch, the instrument automatically enter the main interface. Click the desktop icon 

to build new file and input testing information.

6.3 系统设置

6.3 System options

点击主界面 

按钮,进入“系统设置”界面，进行您需要的设置。

Click 

button on main interface to enter System Option interface, set as you need.

- [触发方式]：软件自动、外部触发、软件同步（默认）
- [Synchronization]: Software Synchronization, Internal synchronization (default), external synchronization
- [同步频率]：50 Hz ~400Hz，默认 50Hz
- [Synchronization Frequency]: 50 Hz ~400Hz(50 default)
- [带宽]：80kHz-200kHz、40kHz-300kHz
- [Frequency Band]: 80kHz-200kHz、40kHz-300kHz
- 其他设置按照自己习惯进行设置如[记录]、[显示]、[增益调节]、[平椭圆旋转（°）]等
- Other Settings Set according to your own habits such as [Voltage change ratio], [Voltage], [Auto Record], [Auto Gain], etc.

6.4 增益选择

6.4 Gain Selection

- 自动增益：软件根据设定，自动调节增益状态。
- Adjust the gain automatically: According to software setting, adjust gain automatically.
- 手动调节增益：软件提供了对当前增益状态指示，提示用户手动调节至合适的增益，保

证测量的准确性。

- Manually adjust the gain: Current gain state is provided which can notice user to adjust to appropriate gain to guarantee the accuracy.

增益放大倍数过高：提示向低放大倍数方向调节。

Over-high gain: Notice to adjust to lower gain.

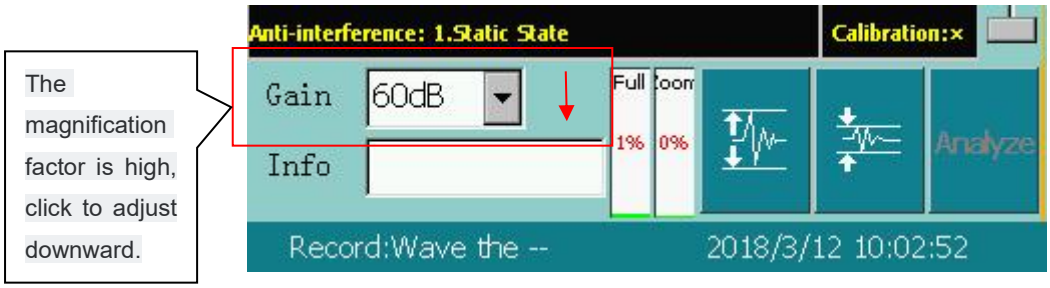


图 6-9 增益偏高指示

增益放大倍数过低：提示向高放大倍数方向调节。

Over-low gain: Notice to adjust to higher gain.

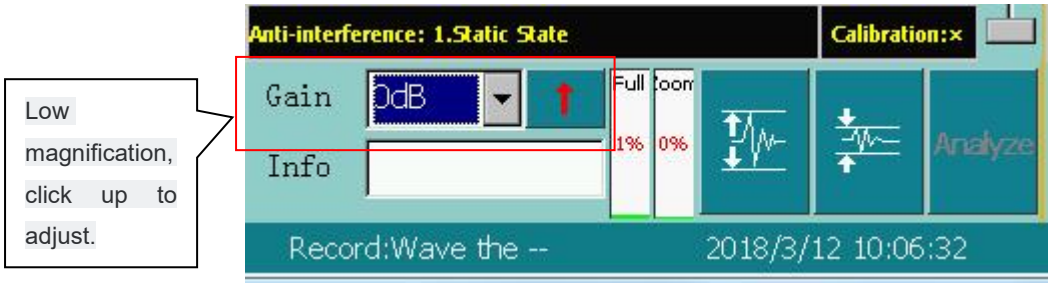


图 6-10 增益偏低指示

Figure 6-11 low gain instructions.

增益合适：无需调节。

Appropriate gain: Don’t need adjustment.

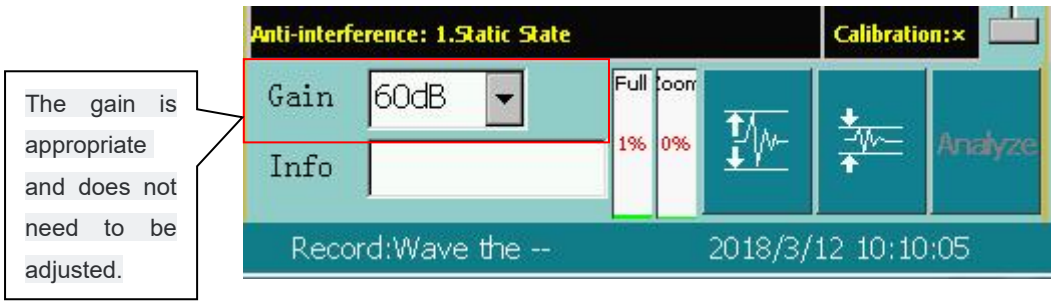


图 6-11 增益合适指示

Figure 6-11 Gain appropriate indication

6.5 试验回路校准

6.5 Test circuit calibration

仪器在每次接线完毕开始试验前，都必须先进行校准以获得准确的检测结果。

The instrument must be calibrated to obtain accurate test results before starting the test after each wiring.

校准的过程如下 Calibration process is as follows：

将校准脉冲发生器按规定方法接入试验回路，确认回路没有电压，校准脉冲发生器的电池充足(工作红灯亮)，然后，施加适当的放电脉冲。

Connect the calibration pulse generator to the test circuit as specified, make sure no voltage exists in the circuit and calibration pulse generator batteries sufficient(Working light red), apply the appropriate discharge pulse.

打开 “系统设置”，选中“增益调节”中的“自动调节”。

Open the "System Settings" interface and select ‘Auto Adjust’

根据施加在被测试产品两端的已知电荷量，在通道设置域的“量值（pC）”内输入需要校准的放电值(应与校准脉冲发生器选择的数值相等)。

Enter the value of the discharge (pC) to be calibrated (equal to the value selected by the calibration pulse generator) in the "Calibration Amount" of the channel setup area, based on the known amount of charge applied across the product under test.

按通道设置区域的“**校准**”按钮，校正过程开始，并弹出确认框。

Click the "Calibration" button in the channel setup area to start the calibration process and pop up confirm dialog.

持续几秒后，观察“电量值”与校准脉冲发生器所选数值是否相等，待其显示数据稳定后按确认框中的“保存”按钮，保存所选择通道的校准结果。

Hold for several seconds to observe ‘Discharge Value’ and check it whether meets values on calibration pulse generator or not. Press ‘save’ button until displayed data is stable to save calibration result of selected channel.

重复上述过程校准其他通道。

Calibrate other channels as above.

校正完毕后应拆除校准脉冲发生器，准备正式检测。

After calibration, the calibration pulse generator should be removed and ready for formal testing.

可以根据现场的实际情况，在校准的过程中，有选择的进行如下操作，以便使校准更加准确：

According to the actual situation on site, in the calibration process, the following options for the calibration to be more accurate:

如果出现固定频率的干扰信号，可以选择合适的频带将其滤除。改变滤波频带后，必须重新进行校准。

If there is a fixed frequency interference signal, you can select the appropriate frequency band to filter it. After changing the filter band, you must recalibrate.

如果出现较大的静态干扰，可采用静态抗干扰方法，并重新进行校准。

Use static anti-jamming, dynamic anti-jamming and other anti-jamming technology to exclude interference if large electrostatic interference ocuurs.

6.6 检测

6.6 Testing

基本检测步骤如下 Basic detect steps are as follows：

校正完毕后，即可进入检测阶段。

After calibration, you can enter the testing phase.

按下“运行”（主界面）按钮，进入测量状态，运行按钮此时显示为“停止”。这时在波形显示区应该可以观察到仪器的背景。如未拆除校准脉冲发生器，则在最后校准通道的波形显示区将出现均匀规则的波形，此时，拆除校准脉冲发生器后，即可进行正常测试。

Press the "Run" button in the main interface to enter the measurement status. The Run button is displayed as "Stop". At this time in the main interface waveform display area should be able to observe the background of the instrument. If the calibration pulse generator is not removed, a uniform and regular waveform will appear in the waveform display area of the last calibration channel. At this time, remove the calibration pulse generator and the normal test can be performed.

当待测试产品具备施加试验电压的条件后，开始加压。**（注意在加压前一定要取下校准脉冲发生器！）**

When the product to be tested has the condition to apply the test voltage, start to pressurize. **(Be sure to remove the calibration pulse generator before applying voltage!)**

加压后，若有局部放电发生，波形显示区出现局部放电波形，同时在波形显示区上方显示本通道的局部放电量峰值。若没有局部放电发生，波形显示区出现的是该试验回路的背景波形，在波形显示区上方显示本通道的背景读数。

After the voltage is applied, if partial discharge occurs, the partial discharge waveform appears in the waveform display area. At the same time, the local discharge peak value of this channel is displayed at the upper left of the waveform display area. If no partial discharge occurs, the background waveform of the test circuit appears in the waveform display area, and the background reading of the channel is displayed above the waveform display area.

在运行过程中，可根据需要，随时选用如下功能：

During operation, the following functions can be selected at any time as needed:

开窗技术、手动保存数据、自动保存数据、各种抗干扰、波形分析、频谱分析 (各功能的操作方法见“高级功能”章节)。

Windowing technology, save data manually, save data automatically, various anti-interference, spectrum analysis and waveform scaling, etc. **(For the operation of each function, see the "Advanced Features" section).**

如果要结束测量，只需按下主画面“停止”按钮即停止试验，或直接按“退出”按钮，退出检测程序。

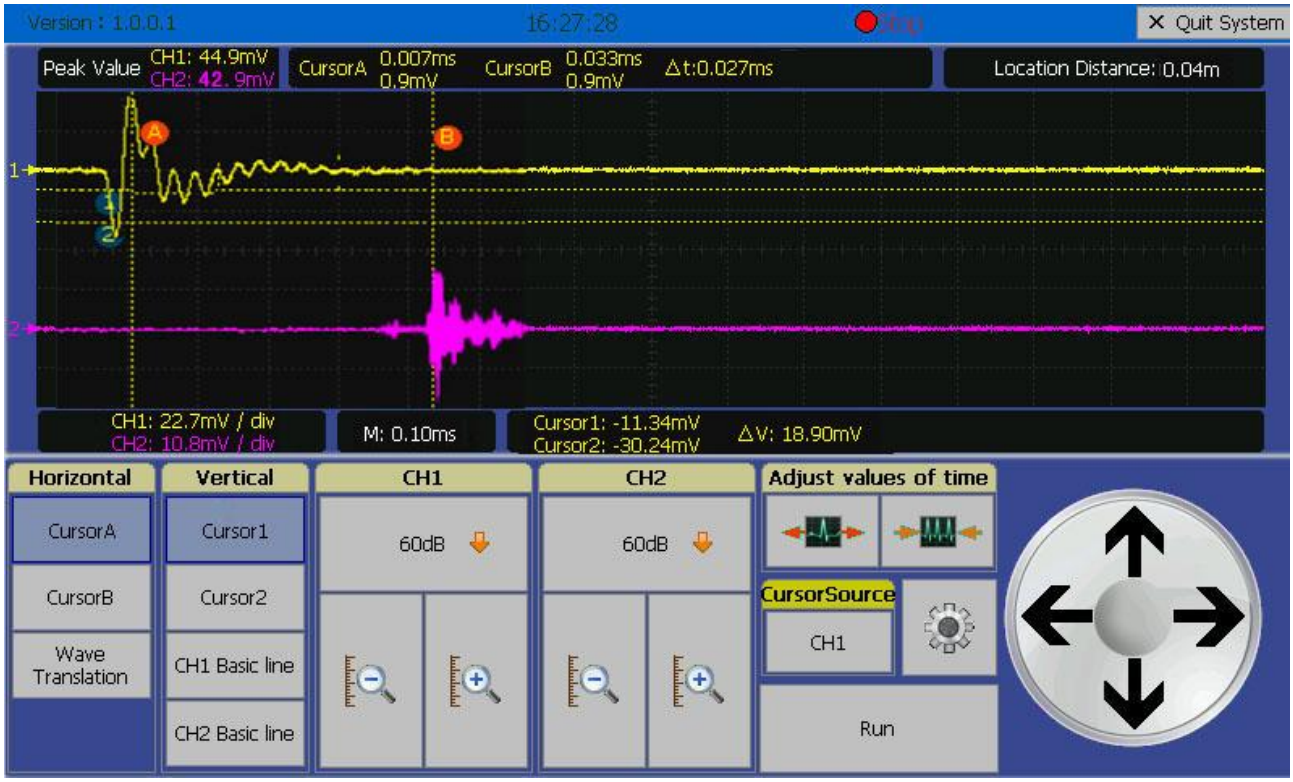
To stop the measurement, simply press the "Stop" button on the main screen to stop the experiment or simply press the "Exit" button to exit the test.

7. 局部放电定位系统基本操作

Ⅶ. Basic operations of Partial Discharge tester

7.1 定位主界面介绍

7.1 Main Interface of Detecting



定位主界面

1) Version : 1.0.0.1 版本号——当前系统的版本

Version——Current Version of the system

2) 16:27:28 时间——显示当前系统时间

Time——Current system time

3) Stop 运行情况——显示当前软件所处的状态运行或者停止

Running Circumstance——Current system state, Running or Stop

4) ✕ Quit System 退出系统——退出当前系统的按钮

Quit System——Button of quitting current system

5) Peak Value CH1: 44.9mV CH2: 42.9mV 峰值——显示通道 CH1 和 CH2 峰值，颜色分别与相应的通道波形颜色相一致

Peak Value——Peak values of CH1&CH2, colors in accordance with channels' wave colors.

6) 

CursorA——显示当前图谱中光标 A 的坐标值，分别为时间和幅值；CursorB——显示当前图谱中光标 B 的坐标值，分别为时间和幅值；△t——显示当前图谱中光标 A 和光标 B 时间差

Cursor A——Coordinates of cursor A in current picture, Time and Value; Cursor B——Coordinates of cursor B in current picture, Time and Value; △t——Time difference of Cursor A and Cursor B.

7) 

定位距离——显示距离局部放电源的距离

Location Distance——Distance from partial discharge source.

8) 1——显示通道 CH1 波形的基线； 
2——显示通道 CH2 波形的基线

1——Basic line of CH1; 2——Basic line of CH2.

9) 
A——指示光标 CursorA； 
B——指示光标 CursorB

A——Indicates Cursor A; B——Indicates Cursor B.

10) ①——指示光标 Cursor1； 
②——指示光标 Cursor2

① ——Indicates Cursor 1; ②——Indicates Cursor 2.

11) 

——通道 CH1 和 CH2 在图谱中每个方格的幅值，随着增益的变化也会发生变化

——Division value of CH1 and CH2, differs with changing of gains.

12) 

——显示当前采样时长

——Current duration of sampling.

13) 

Cursor1——显示当前光标 1 的幅值；Cursor2——显示当前光标 2 的幅值；△V——显示当前 Cursor1 与 Cursor2 的幅值差

Cursor1——Value of current cursor 1； Cursor2——Value of current cursor 2； △V——Value difference of current cursor 1 and 2.

14) 按键介绍 Button Introduction

15) 

——按键未选中状态 ——Button not selected

16) 

——按键选中状态——Button selected

17) 

与 

——点击可选中按钮可以配合 
与 
左右调整光标 
与 
的位置

And ——Click to select, with  and  to adjust left and right of cursors A and B .

18) 

——点击选中按键可以配合 
与 
左右调整波形位置

Wave Translation——Click this button with  and  to adjust wave left and right.

19) 

与 

——点击选中按键可以配合 
与 
使用 上下调整光标 
与 
位置

And ——Click button with  and  to move up and down positions of cursors 1 and 2

20) 

与 

——点击选中按键可以配合 
与 
分别调整基线垂直位置，从而更好的对信号进行对比。

——Click button with  and  to adjust up and down positions of Basic line to compare signals.

21) 

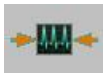
与 

——点击可以手动调节增益值，分为-20dB,0dB,20dB,40dB,60dB 总共 5 个档位。

—— Click to adjust gains, divided into 5 gains of -20dB,0dB,20dB,40dB,60dB.

22) 
与 
——点击按键或按住按键可以调整幅值

—— Click or press to adjust values

23) 
与 
——调整横轴即时间轴的值

——Adjust values of time

24) 

——切换光标信源，CH1 图谱部分对应黄色，切换 CH2 变为玫红色

——Change source of cursor, CH1’s wave is yellow, CH2’s is rose red.

25)  ——系统设置按键 ——System Options

26) 

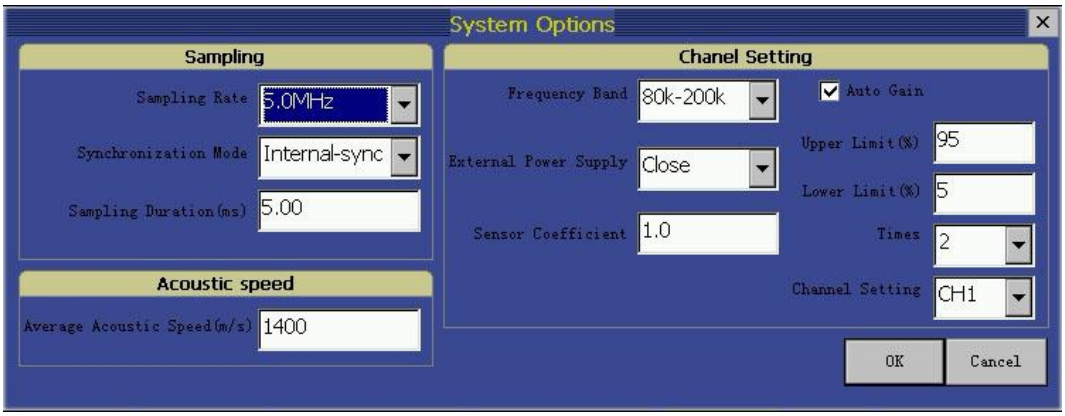
——点击运行，系统启动 Run——Click Run, system runs.

7.2 系统设置

7.2 System Options

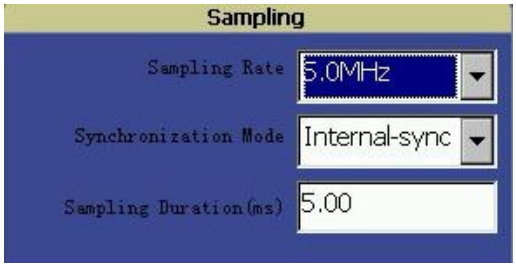
进入局部放电定位系统，点击按键  系统设置按键，系统弹出系统设置对话框。可以分别设置采集、声速、通道参数等信息。

Run Partial Discharge Locating System, click System Options button, pop up System Option dialog box. Set Sampling Rate, Acoustic speed, Channel and other information.



系统设置图

- 采集部分 Sampling



采集设置 Sampling Setting

1) 采样率：分为 0.5MHz,1.0 MHz,2.5 MHz,5.0 MHz,10.0 MHz,20.0 MHz 六档。

   Sampling Rate: Divided into 0.5MHz,1.0 MHz,2.5 MHz,5.0 MHz,10.0 MHz,20.0 MHz.

2) 同步方式：分为内同步和外同步两种方式

   Synchronization Mode： Internal-sync and External-sync

3) 采样时长： 采样时长默认为 5 秒，也可以根据具体情况在输入框中输入采样时长，点击

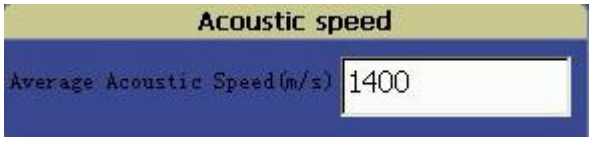
输入法中的按键  即可完成输入。

Sampling Duration: Default Sampling Duration is 5 seconds. Users can input Sampling Duration into Input Box, press to finish inputting.

- 声速部分 Acoustic speed

在系统设置，声速输入框中输入平均声速，其中不同的材料的声速不同，详细的声速表参见表 7-1 不同材料的声速参考表。

Input acoustic speed into Acoustic Speed Input Box in System Options. Speed differs in different materials. For details please see Table 7-1



声速设置 Acoustic Speed Setting

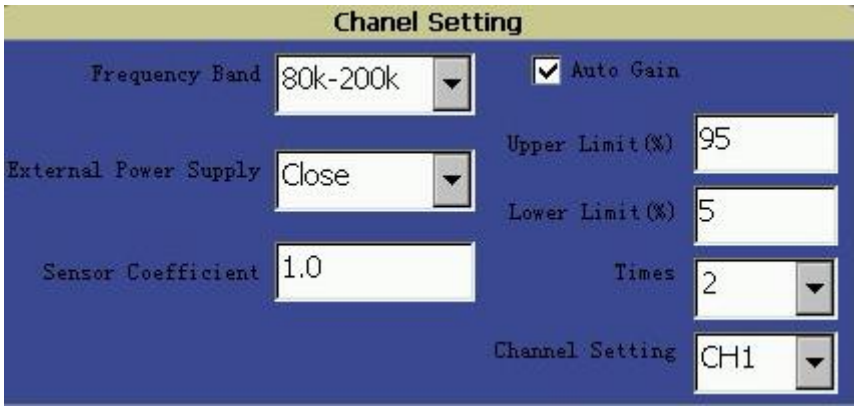
表 7-1 不同材料的声速参考表

Table 7-1 Acoustic Speed in different materials

序号 Number	材料 Material	密度 x103(kg/m3) Density	声速（纵波）m/s Speed (Longitudinal wave)	声速（横波）m/s Speed (Transverse wave)
1	铝 Al	2.7	6370	3110
2	铜 Cu	8.93	4760	2320
3	黄铜（Cu70%,Zn30%）	8.5	4370	2100
4	金 Au	19.32	3240	1200
5	铁 Fe	7.7	5900	3230
6	银 Ag	10.5	3600	1590
7	钢（40CrNiMoa）	7.8	5850	3240
8	碳钢（退火）	7.85	5940	3240
9	锆 Zr	6.48	4650	2250
10	丙烯酸树脂	1.18	2670	1120
11	聚苯乙烯	1.05	2400	1150
12	聚四氟乙烯	2.18	1380	550

13	变压器油	0.92	1390	-
14	甘油（100%）	1.27	1880	-
15	油浸纸	1.0	1420	-
16	油浸纸板	1.2	2300	-
17	油浸硅钢片	7.65	5050	

- 通道设置部分 Chanel Setting



通道参数设置

1) 频带：分为 40KHz-300KHz、80KHz-200KHz、20KHz-100KHz

   Frequency Band: Divided into 40KHz-300KHz、80KHz-200KHz、20KHz-100KHz

2) 对外供电：默认为关，如果采用通道供电，需打开对外供电设置

   External power supply: Default disable, open it when channel power supply is needed.

3) 传感器系数：传感器放大倍数，默认 1.0，可以根据需要在输入框中输入传感器系数

   Sensor Coefficient: Sensor magnification, default 1.0, input it into input box when needed.

4) 自动增益：根据现场情况，定位过程中，我们首先选用自动增益，如果信号周期性出现，可以关闭自动增益，改为手动调节。

   Auto Gain: At the scene, use auto gain firstly. If signals appear periodically, close auto gain and use manual adjustment.

5) 上限：采样满度百分比，当高于此阈值时达到设定次数后向放大倍数低的档位切换。

   Upper limit: Percentage of sampling, adjust to lower magnification when higher than threshold value and meet setting times.

6) 下限：采样满度百分比，当低于此阈值时达到设定次数后向放大倍数高的档位切换。

   Lower limit: Percentage of sampling, adjust to higher magnification when lower than threshold

value and meet setting times.

7) 次数：采样周期个数。

Times: Sampling period times.

8) 设置通道：通常 1 通道为电信号通道，2 通道为超声信号通道。

Channel Setting: Normally CH1 is electric signal while CH2 is acoustic signal.

7.3 局放定位检测流程

7.3 Detect Process of Partial Discharge Locating

1) 将 CH1 接电信号，CH2 连接超声信号，注意如果采用通道供电，需打开对外供电设置。

Connect CH1 to electric signal and CH2 to acoustic signal. Use channel power supply, please open external power supply.

2）设定采样中的采样率，同步方式，采样时长

Set sampling rate, sync mode and sampling duration.

3）设定声速：根据所使用的材料设置响应的声速

Set acoustic speed: Set acoustic speed according to material.

4）设置通道参数：根据 7.2 系统设置中的通道参数设置部分设置通道参数。

Set channels: Set channel parameters according to channel setting part of 7.2 System Options.

5）完成设置后点击运行，当信号出现并稳定后，点击停止，按照 7.1 中按键介绍部分介绍的方法分别移动 

与 

光标的位置到 CH1 和 CH2 对应波形出现的其起始位置，系统将自动计算出定位距离，此时定位距离显示的数值即为当前位置到局部放电源的距离。

Click Run after settings, click Stop when signals appear and stabilize. Move cursor A and cursor B to start point of waves in CH1 and CH2 according to Button Introduction part in 7.1. System will automatically calculate the distance, and value displayed in Locating Distance is the distance between sensor position and discharge source.

8. 售后服务

Ⅷ. After-sale Service

仪器自购买之日起一年内，属产品质量问题免费包修包换，终身提供维修和技术服务。如发现仪器有异常情况或故障请与公司及时联系，以便为您安排最便捷的处理方案。

Instrument from the date of purchase within one year, the quality of products is guaranteed free of problems, lifetime maintenance and technical services. Please contact company in time if there is abnormal condition or malfunction of the instrument, in order to arrange the most convenient processing program for you.

附录

Appendix: Wiring Diagram

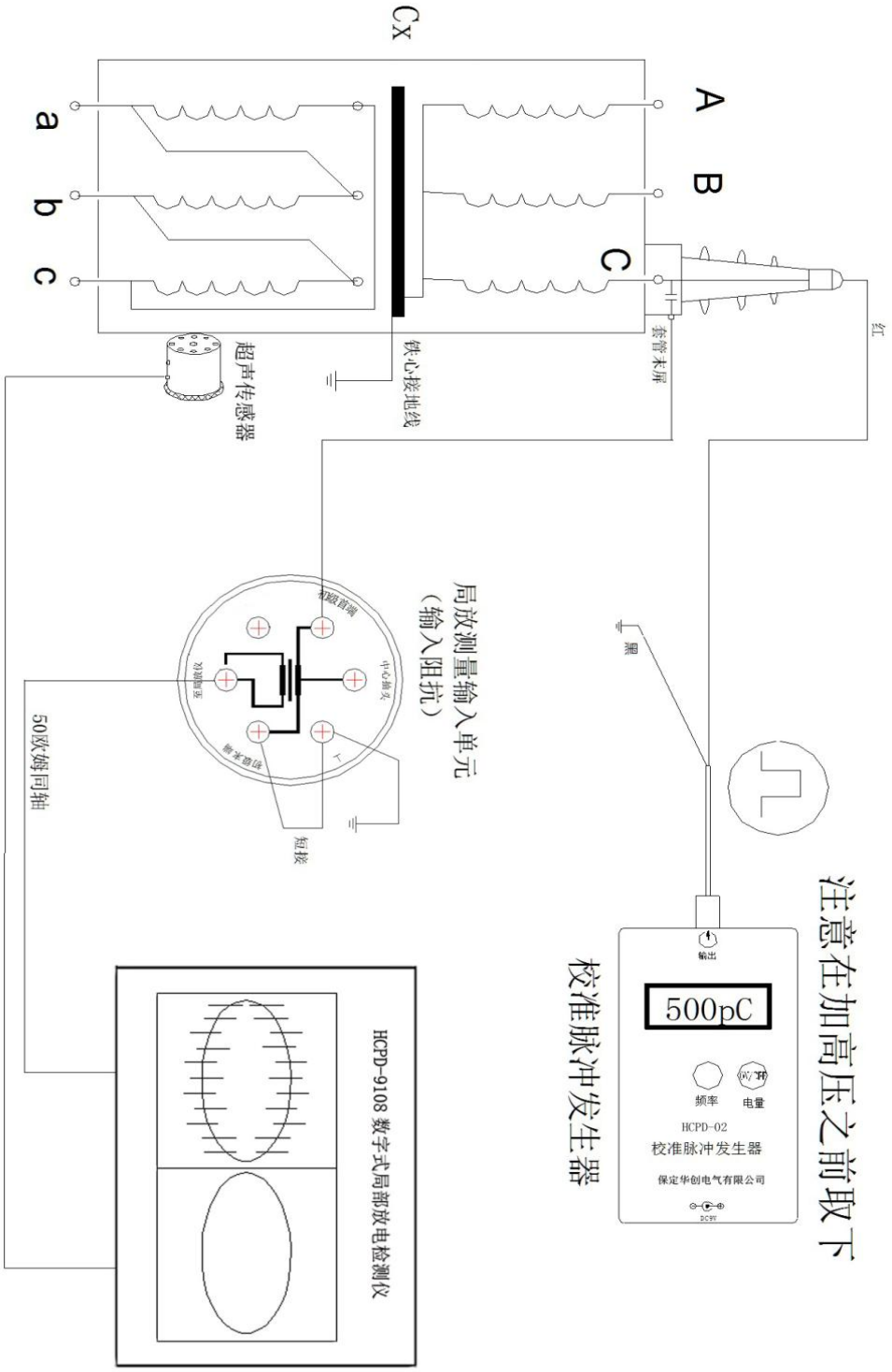


图 1 校准接线（利用高压套管电容传输放电信号）

Pic 1 Adjustment Wiring (Using High Voltage Bushing capacitor send discharge signal)

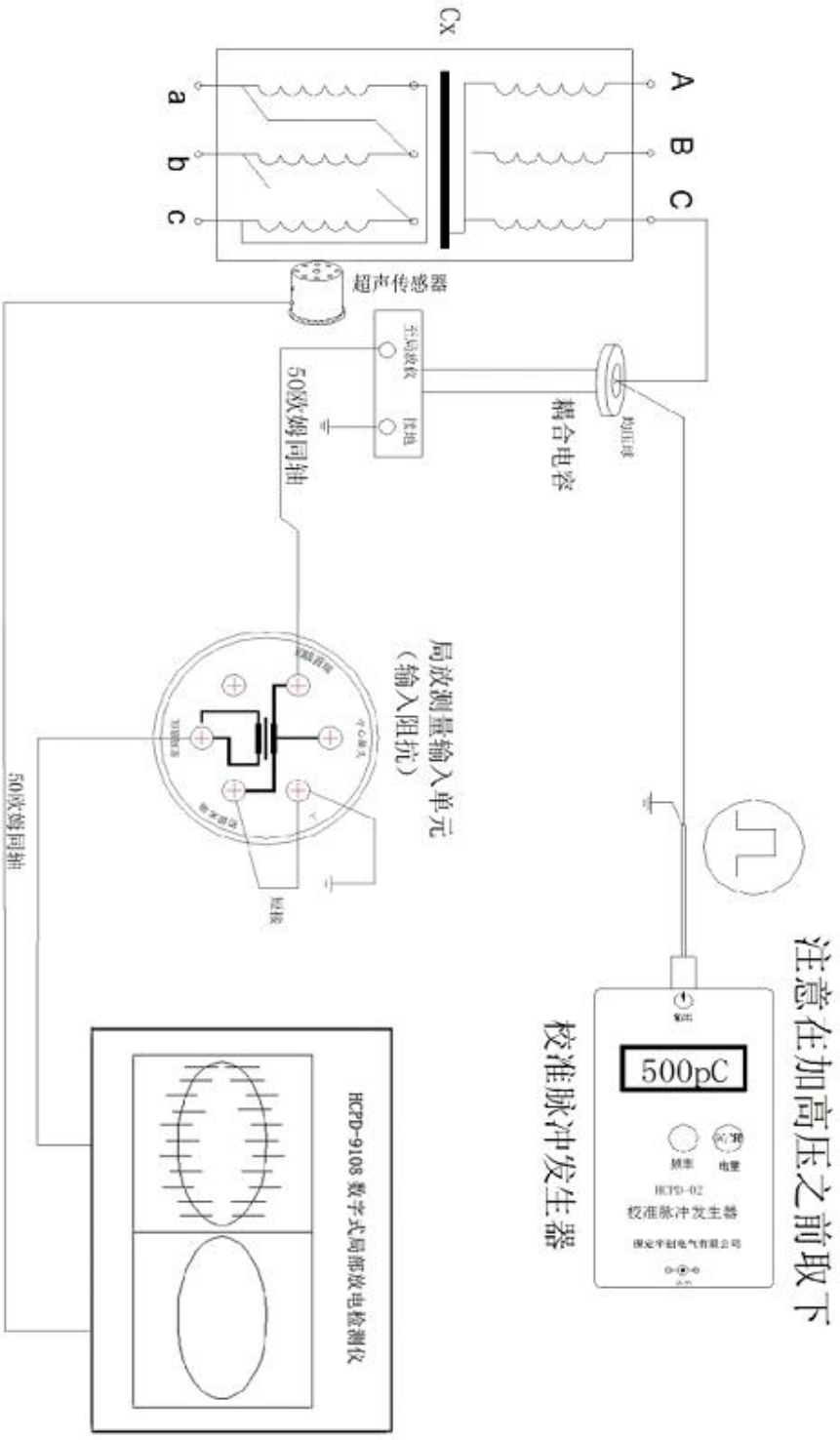


图 2 校准接线(外接耦合电容传输放电信号)

Pic 2 Adjustment Wiring (Using external coupling capacitor send discharge signal)

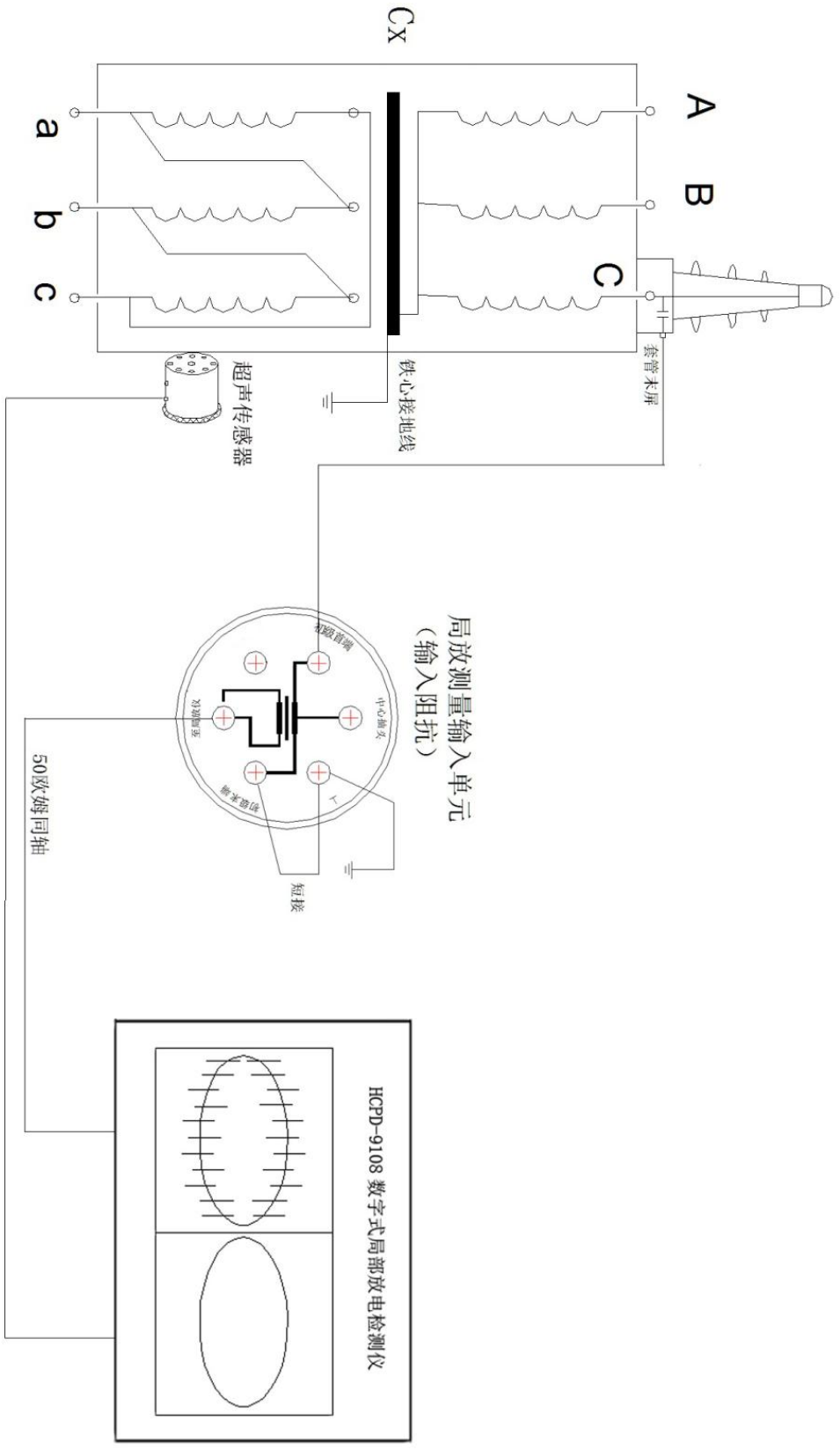


图 3 局放仪试验接线（利用高压套管电容传输放电信号）

Pic 3 Partial Discharging Testing Wiring (Using High Voltage Bushing capacitor send discharge signal)

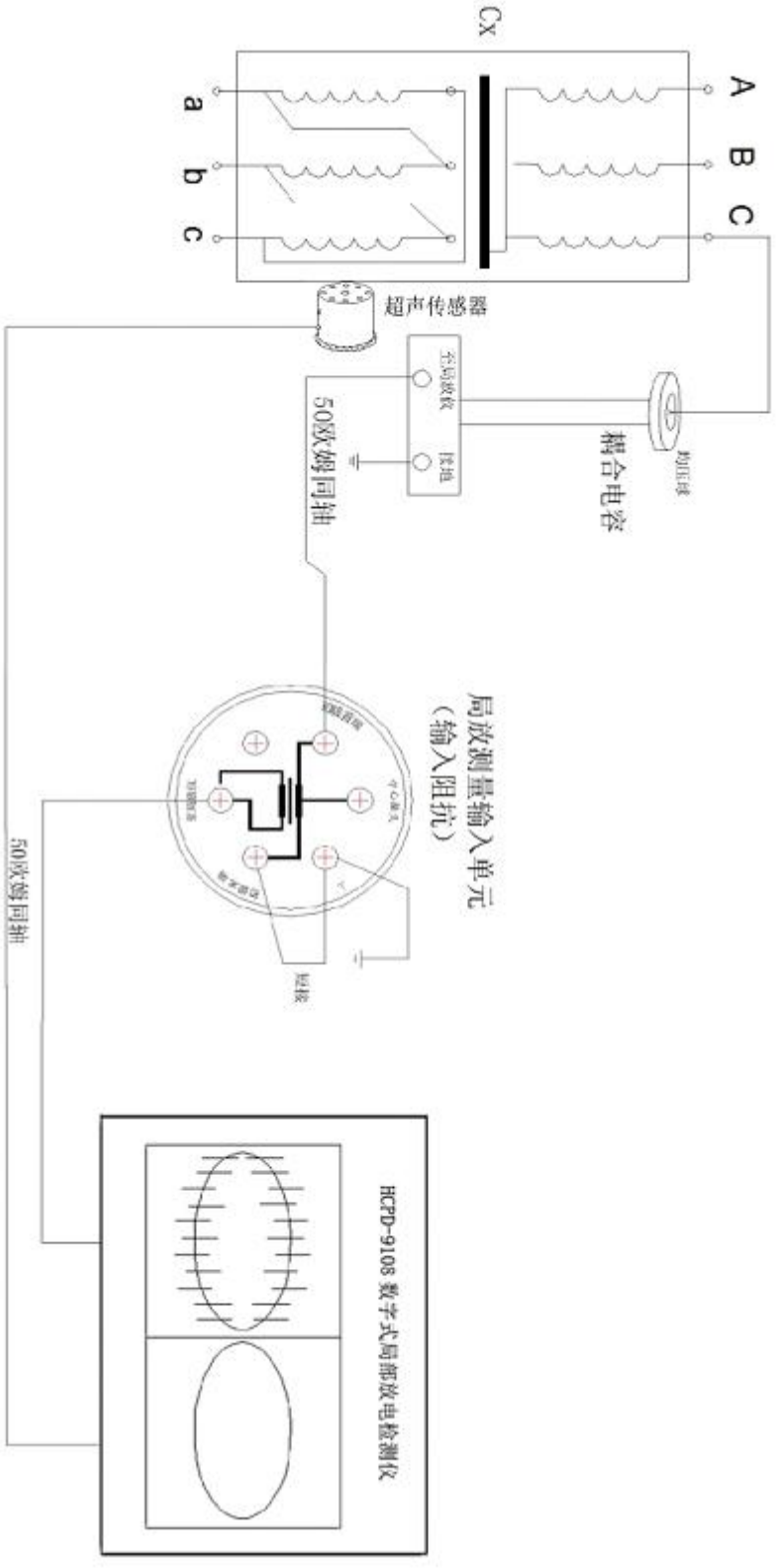


图 4 局放仪接线(外接耦合电容传输放电信号)

Pic 3 Partial Discharging Testing Wiring (Using external capacitor send discharge signal)