Type 601 / 990 Contact current-terminal discharge tester Technical specification

1, overview

This instrument is a medical electronic equipment, information technology equipment and electronic and electrical contact current, leakage current and terminal discharge instrument.Contact current (leakage current) and terminal discharge volume are general measuring instruments in the laboratory engaged in electronic and electrical product safety testing, widely suitable for electronic and electrical product safety standards compliance tests, e. g. (not limited to this):IEC60065/GB8898;IEC60950/GB4943;IEC60335/GB7000;IEC62109-1;IEC60598/GB7000.1;IEC61010/GB4793;IEC60601; IEC60060 and other electronic and electrical safety standards.

On the basis of the general measurement function of contact current and terminal discharge of electronic and electrical products, the current situation of measurement and analysis design of medical electronic equipment system

in China and the world, and the measurement unit of contact current of medical electronic equipment system / leakage current. The measurement principle and basic circuit of the unit are fully designed in accordance with the international standards IEC60601-1 Basic Requirements for the Safety of Medical Electronic Equipment and IEC60990 Human Contact Current and Protection Conductor Current Measurement Method, considering the use experience and requirements of the authoritative safety regulation laboratory, simple operation, safe and reliable;

- Human current measurement of doctor-patient personnel includes the current of patient perception, patient auxiliary sensing current, human contact current and protective ground current; the measurement configuration includes all measurement wiring arrangement of IEC60601-1 Figure 4 to 19. The functional distribution of instrument operation interface is clear and reasonable to ensure standardized measurement. The measurement network adopts the special network MD of IEC60601-1, while the contact current follows the

measurement principle of IEC60990 Protection Conductor current and contact current measurement, and adopts the U specified in IEC60990$_1$、U$_2$、U$_3$The three circuit fault setting states specified in the measurement network and standards are applicable not only to the special measurement requirements of the patient current of medical electronic devices, but also to the contact current of electronic and electrical products (these standards are also known as the leakage current), to protect the conductor current test;

- The measurement principle of the terminal discharge quantity is the measurement principle of locking the discharge test point and the sinine wave phase. The measurement principle is the "terminal discharge measurement method of locking the negative phase of the sine wave" as recommended by the CTL resolution of IECEE-CB System 267. The advantage is accurate and a one-time measurement, replacing the traditional random capture test, which is applicable not only for IEC60065, IEC60950, but also for other electrical products.

Therefore, two sets of test systems (systems 1 and system 2) are designed to realize the terminal discharge quantity measurement and contact current measurement. System 1 is the test principle of the data acquisition card. The test system has high measurement accuracy and automatically locks in the negative peak of the sinine wave for measurement, which meets the requirements of the IECEE-CTL resolution. The contact current measurement adopts the "root mean square principle" to obtain the true effective value. The method can accurately measure the irregular contact current. Due to the input of data acquisition card difference, the acquisition card reads the contact current envelope waveform, which effectively solves the effect of superimposed interference pulse on the peak of contact current measurement by oscilloscope.

The system 2 adopts a built-in 100MHzUSB oscilloscope, whose use functions, technical parameters and calibration are the same as the traditional oscilloscope. Compared to the data acquisition card

measurement principle of system 1, the advantage of the oscilloscope is to measure the high frequency, the contact current at high frequency, and is calibrated by a general method, however, the operation and setting are relatively complex, and the accuracy is slightly lower, and the waveform is susceptible to interference.

The functions and technical parameters of this instrument are as follows:

I, Contact current test function

- The built-in power supply module for samples can provide sample working voltage of 100V-250V, 50Hz / 60Hz and output power of 2000W; suitable for multi-standard test power supply in the EU, North American Middle East and Southeast Asian countries;
- With external power port and connecting to the external power supply for 0-250V / 160 / 16A (4kW power);
- SensercMeasurement Network specified by IEC60990 (Fig.3), "The weighted measurement network" (Fig.4), "Off the current measurement network" (Fig.5), See

IEC60990 for the technical parameters;

Test circuit layout with single-phase power supply of TN or TT power supply network specified in IEC60990, including protection conductor on, off state (PE ON / OFF), midline conductor on, off state (N ON / OFF); and power supply phase line, midline polarity conversion state; (L-N Polarity reverse);

- Use the data acquisition card first test system built in this measurement instrument (Sys.1), The U can be measured$_1$Voltage (valid value and peak) and U_2, U_3Voltage (valid value and peak).The test system adopts the principle of root mean MS measurement, which can accurately measure the effective value of periodic contact current and voltage of irregular waveform, and can effectively eliminate the interference superimposed on the leakage current waveform and directly read the waveform envelope, with high measurement accuracy.
- When the leakage current frequency is above 10kHz, to have weighted the limit according to the standard, the second test system (Sys.2) The USB oscilloscope

measurement system to monitor the peak, effective value and frequency of the leakage current.

- The Second Test System (Sys.2) For a built-in 100MHz USB oscilloscope, the U1 voltage (effective value or peak) and U2, U3 voltage (effective value or peak) are measured as specified in IEC60990, with a measurement frequency of 100MHz.The test system uses the operational method and the measurement error exactly like the traditional oscilloscope.The system also has a synchronous output port, where the user can externally attach their own oscilloscope for measurement or calibration.
- The instrument uses a 4-digit half-dual display digital voltage / current meter to measure the U1 current effective value and the U1 current effective value and the DC components of the U1 voltage and current, respectively.

Second, the terminal discharge quantity test function

- The measured voltage of the built-in power supply for the sample is 100V-250V continuously adjustable, 50Hz / 60Hz power supply frequency, and power for the

isolation transformer, the output power of 2000W;

- With external power port and connecting to the external power supply for 0-250V / 160 / 16A (4kW power);
- Card first test system for data acquisition built-in with this measurement instrument (Sys.1). The system uses the RC secondary phase shift circuit and the threshold voltage control circuit to control the trigger time of the data acquisition system to accurately adjust and control the terminal discharge measurement point at the sample supply voltage sine wave, so as to accurately measure the terminal negative or positive discharge amount (priority negative peak discharge) at one time.The measurement principle is the terminal discharge measurement recommended by each CB international laboratory in the form of CTL resolution.
- A second test system with a built-in 100MHz USB oscilloscope (Sys.2) The discharge of sample power terminals can be measured as per IEC60065 / GB8898; IEC60950 / GB4943; the test time can be 20ms to 1s and recommended as 100ms.The test system uses the

operational method and the measurement error exactly like the traditional oscilloscope.The test system is a traditional method of randomly grasping discharge waveforms, typically, measuring at least 10 times, and if a negative half week is considered, more than 20 times to capture the maximum discharge waveform.

measuring accuracy:

- The measured U was displayed using a 4-bit half-dual-display digital voltmeter$_1$Voltage and U$_1$Current, including the AC and DC components, is measured with an accuracy of:

  0—9999V dc, 0.3%F.S.±2 digit

- The measurement system adopts a 2048-bit data acquisition card, and the corrected display voltage error of the software is 0.5%,

  Display time error is 0.5%.

- A USB oscilloscope with 100MHz built-in, shows a voltage error of 1% and a display time error of 1.5%.
- Measure network elements

Resistance error: 0.5%,

Capacacitive error: 1.0%,

- Terminal discharge measurement circuit internal resistance: 100 MΩ (in series);
- Terminal discharge measurement circuit capacitance: 15pF (signal port, in parallel)

testing software

- This instrument system 1 uses the measurement and control system developed based on Labview and requires the computer to install the windows operating system. The measurement & control system is easy to operate and friendly interface; the computer requires Windows98 / ME / 2000 / XP / 7 (flagship version) / VISTA;
- The USB oscilloscope built in this instrument system 2 can use the randomly provided DSO2250 operating system (built-in driver), and the operating system environment required by the driver and application is: Windows98 / ME / 2000 / XP / VISTA;

safety precautions:

- The backplane of this instrument is equipped with 25A overload / leakage protector. When the short circuit of the test circuit occurs, or the protective conductor current exceeds 30mA, the circuit breaker will quickly cut off the instrument high-voltage power supply at 0.2s to protect the operator safety and protect the instrument.After troubleshooting, the circuit breaker needs to be manually reset to resume normal operation.
- This measuring instrument installation requirements meets IEC61010 / GB4793, designed as Class I protection equipment and must be connected with power cord with protected ground and 3-foot plug to the grid.
- Based on the leakage current measurement practice, the measurement network is often caused by misoperation of the engineer. This instrument has set up overcurrent circuit breaker protection (500mA) and excessive pressure limit protection (40V) in the measurement network. After the fuse is fused, you must replace the fuse with the same electrical specifications.
- Protection level: IP20

- The power socket fuse is F2A / 250V and shall be replaced as per this specification after the circuit breaker.
- Pressure resistance strength: 1,500 V a.c/1min
- Insulation resistance: 100 MΩ / 500Vd.c


601/990 泄漏电流测量仪
065 放电量测试单元

This instrument is equipped with two test systems, Sys.1, and Sys.2。

Sys.1 The measurement principle of the data collector is to accurately control the measurement phase of the terminal discharge volume to achieve rapid and accurate measurements as per the IECEE-CTL resolution.In terms of measuring the leakage current, the leakage current and the leakage voltage U can be accurately given$_1$、U_2、U_3The peak and true effective values of the.

Sys.2 The traditional oscilloscope measurement method is used, the DSO2250 type USB100M oscilloscope is embedded inside the instrument, and the method and calibration method are completely identical to the universal oscilloscope.

Before testing, the measurement software system is first installed for the computer, including the data acquisition system Sys.1 Measurement software and USB oscilloscope test system Sys.2 Measurement software DSO2250; then determine that the leakage protection switch of the backplane is placed in the open position, and the

internal and external power conversion switch is located in the internal power supply is (In).

System 1 measurement operation

1 Terminal discharge volume measurement

1.1 Panel function settings:

a) System selector switch is placed in Sys.One

b) Place the function selector switch on the terminal discharge amount (Discharge V.) Position

c) The Polar switch as for the + bit;

1.2 Connect to the measuring computer

A) Connect the system 1 (the USB port on the left side of the panel) to the computer with a randomly provided USB measurement line. After the computer is turned on, the green light on the side of the USB port flashes, indicating that the data communication is normal.

1.3 Instrument power supply connection and sample connection

a) The test sample can be connected to the corresponding socket of the panel frequency conversion voltage regulating power supply module, and the test sample can

also be connected through the external connection panel. If the sample consumes more than 250W, the external power supply shall be selected and the maximum power output is 250W. See the connection of the external power supply in Article No.

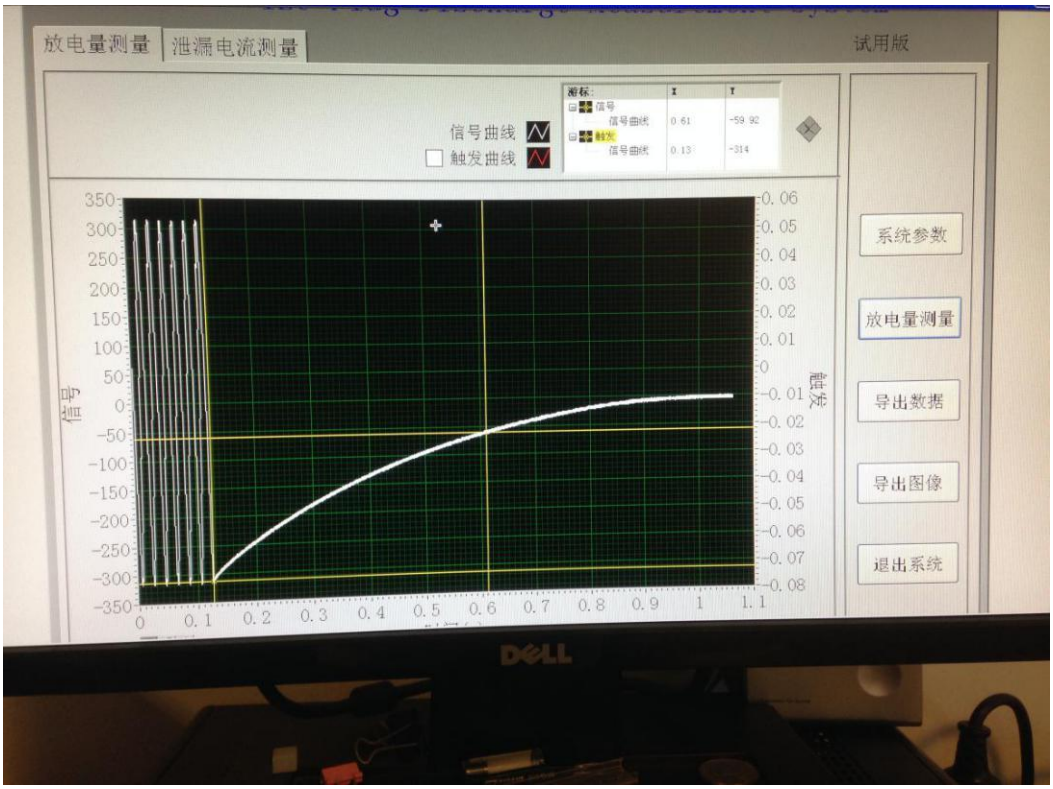
b) After confirming that the power supply of the instrument and the connection of the tested sample are correct, press the panel power switch, the power switch is red, and the two instruments are also on.

The inverter AC voltage module of the panel will display an AC voltage, the sample test voltage, with the adjusted voltage adjustment knob, which can vary between 0 and 250V. Adjust the voltage to the desired test voltage, e. g., 220V. Also do not forget to adjust the power frequency to the required test frequency, for example: 60Hz.

1.4 Measurement operation

a) After confirming that the instrument is correctly connected to the external monitor (desktop computer or laptop computer) (the panel green indicator flashes), open the data collection card operating system, enter

the test application, and click the "discharge measurement" button in the system parameter bar. If normal, the computer shall display the following figure.



If there is a series of sine wave, usually because the trigger level is not high enough, adjust the right knob and adjust the trigger level displayed by the right instrument to about 110V, both the default value.

b) System parameter settings

The initial value of the operating system software shall

be set as follows:

- The conversion coefficient of the terminal discharge quantity is 666.6.
- If you want to observe the trigger waveform, trigger the waveform in the software system.
- Setting up the operating system can change the waveform color and shape.
- Through the operating system, the waveform can be saved.

2. Contact current and leakage current measurement

2.1 Panel function settings:

d) System selector switch is placed in Sys.One

e) Place the function selector switch on the contact current (Touch C.) Measuring position

f) The Polar switch as for the + bit;

2.2 Connect to the built-in industrial control machine

A) Connect system 1 (USB port on the left side of the panel) to the built-in controller with a randomly provided USB measurement line. After opening the controller, the green light on the side of the USB port flashes, indicating that

the data communication is normal.

2.3 Instrument power supply connection and sample connection

a) The tested sample can be connected to the corresponding socket of the panel frequency conversion voltage regulating power supply module, and the tested sample can also be connected through the external connection panel. If the sample consumes more than 250W, the external power supply shall be selected and the maximum power output is 250W. See the connection of the external power supply in Article No.

b) After confirming that the power supply of the instrument and the connection of the tested samples are correct, press the panel power module switch, the power switch is red, and the two instruments are also on. The instrument on the left side of the panel will display an AC voltage, the sample test voltage, with the adjusted voltage adjustment knob, varying between 0 and 250V. Adjust the voltage to the desired test voltage, e. g., 220V.

2.4 Measurement operation

A) After confirming that the instrument is correctly connected to the external monitor (desktop computer or laptop) (panel green indicator light flashing), open the data collection card operating system and enter the contact current test bar;

The b) Conduct self-verification (if necessary).Use voltage is 12Vr.m.The external AC power supply of s is input to the leakage current test input port and, normally, the instrument shall display 3Vr.m.s voltage effective value and the corresponding peak of 4.22Vp (1 / 4 of the input voltage), show the self-calibration current of 6mAr.m.And 8.4mAp (sampling resistance at 500 Ω), as shown in Fig.

c) Use the measuring line with the crocodile clip, connect the red terminal of the measuring port to the measured part of the measured sample, and then click the "leakage current measurement" button in the system parameter bar. If normal, the computer shall display the following figure.

The d) respective measurement limit ports of the panel are configured in accordance with FIGS. 4-19 of IEC60601-1 and IEC60990, and identify the respective measurement ports of

the panel according to the standard test diagram. The user directly connects the test samples according to the standard test circuit, and makes the above measurements under different fault settings and different network settings to obtain the corresponding contact current peak and effective value.

e) System parameter settings

The initial value of the operating system software shall be set as follows:

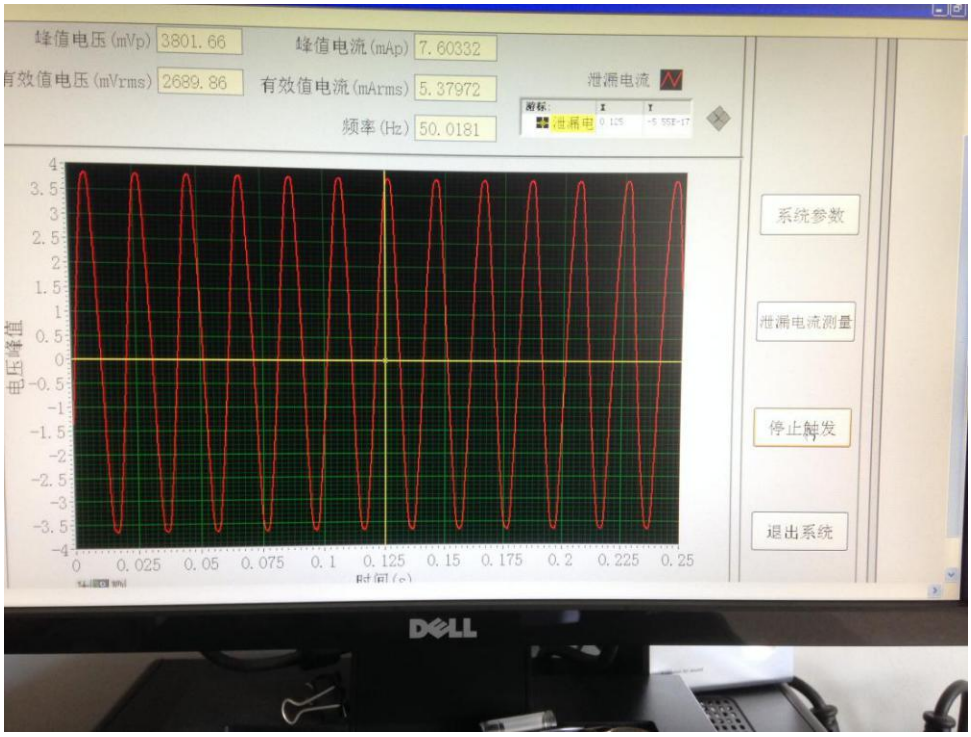
This test software reads the peak voltage on the 500 Ω resistance and the true effective value voltage read by the root mean square principle, and then divided by 500 to obtain the peak contact current and the true effective value current.

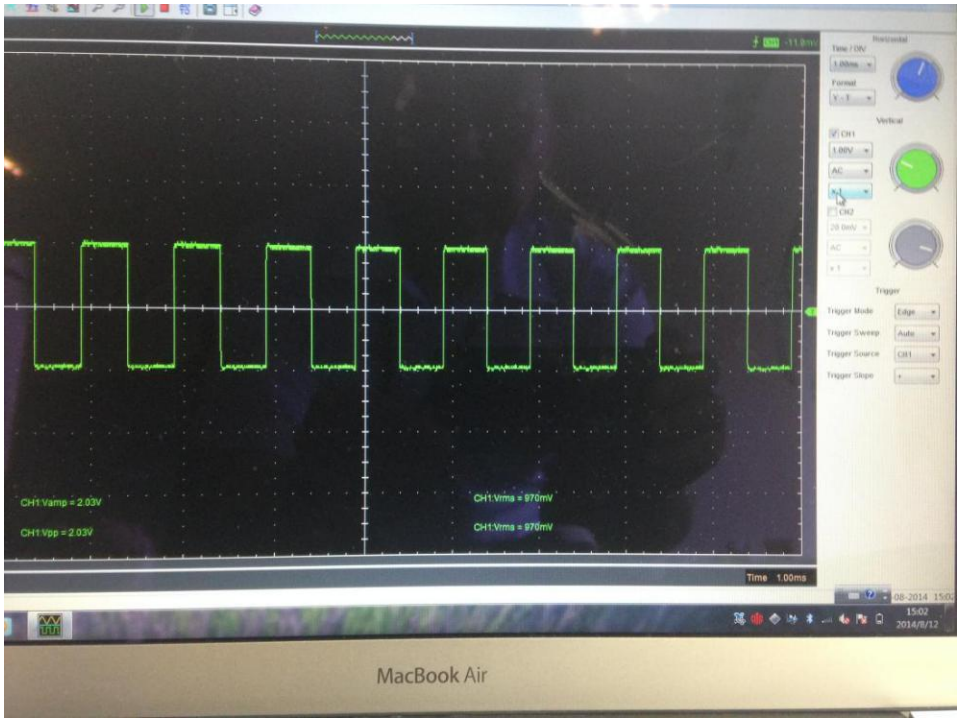
The default conversion coefficient of the voltage of this test software is 1, and the user can modify it itself, however, if there is no determined data support, it is not recommended to modify the voltage conversion coefficient by itself.

Setting up the operating system can change the waveform

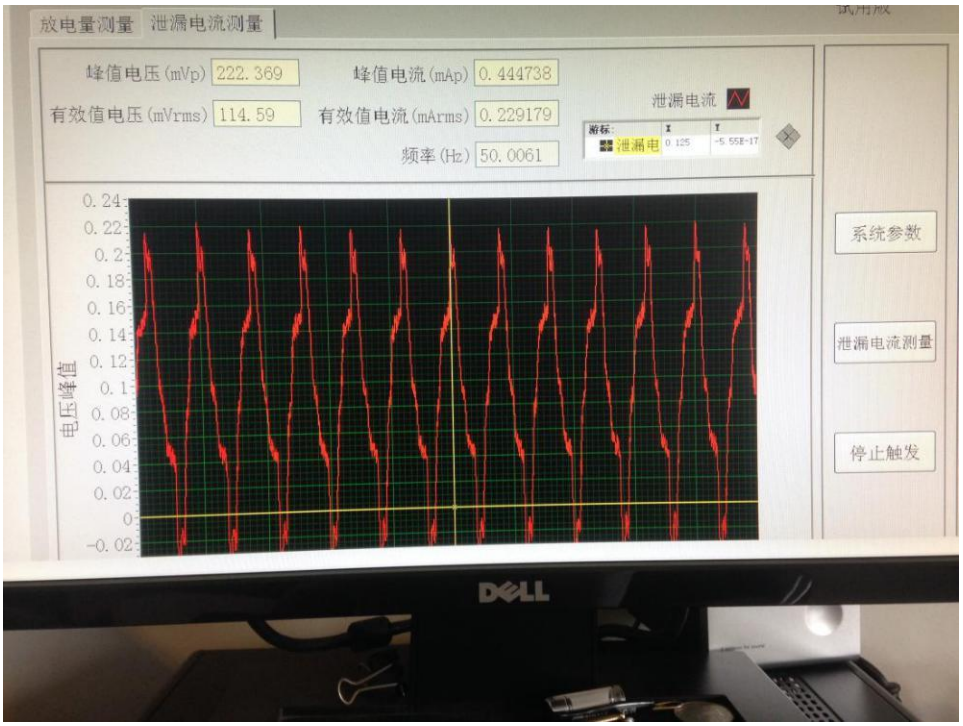
color and shape.

Through the operating system, the waveform can be saved.





Self-check waveform



Measured leakage current waveform

Measurement operation of system 2

1 Terminal discharge volume measurement

1.1 Panel function settings:

a) Switch the Polar switch as to the median;

b) Test system selector switch is placed in Sys.Two

c) Place the function selector switch on the terminal discharge amount (Discharge V.) Position,

1.2 Power supply connection and sample connection

a) Connect the instrument to a 220V power supply voltage

b) The tested sample can be connected to the corresponding socket of the back panel, and the tested sample can be connected through the external junction panel.If the sample consumes more than 250W, the external power supply shall be selected and the maximum power output is 250W.See the connection of the external power supply in Article No.

c) After confirming that the power supply of the instrument and the connection of the tested sample are correct, press the panel power switch, the power switch is red,

and the two instruments are also on. The instrument on the left side of the panel will display an AC voltage that changes with the adjusted left voltage adjustment knob. Adjust the voltage to the desired test voltage, e. g., 220V.

1.3 Installation of the USB oscilloscope

a) Install the DSO2250 drivers and operators on the computer

b) Connect the USB port on the right side of the instrument to the USB external display (laptop or desktop computer of the U S B oscilloscope) (no order, no black bonus), and the panel is red light. Click on the Operation USB2250 icon to enter the USB oscilloscope application. The green light flashes.

1.4 USB oscilloscope settings

a) Terminal discharge measurements were fixed using the CH1 channel

b) Start CH1

c) Set the CH1 to the DC

d) Set the CH1 voltage axis to 1V / DIV,

e) Set the CH1 timeline to 100ms

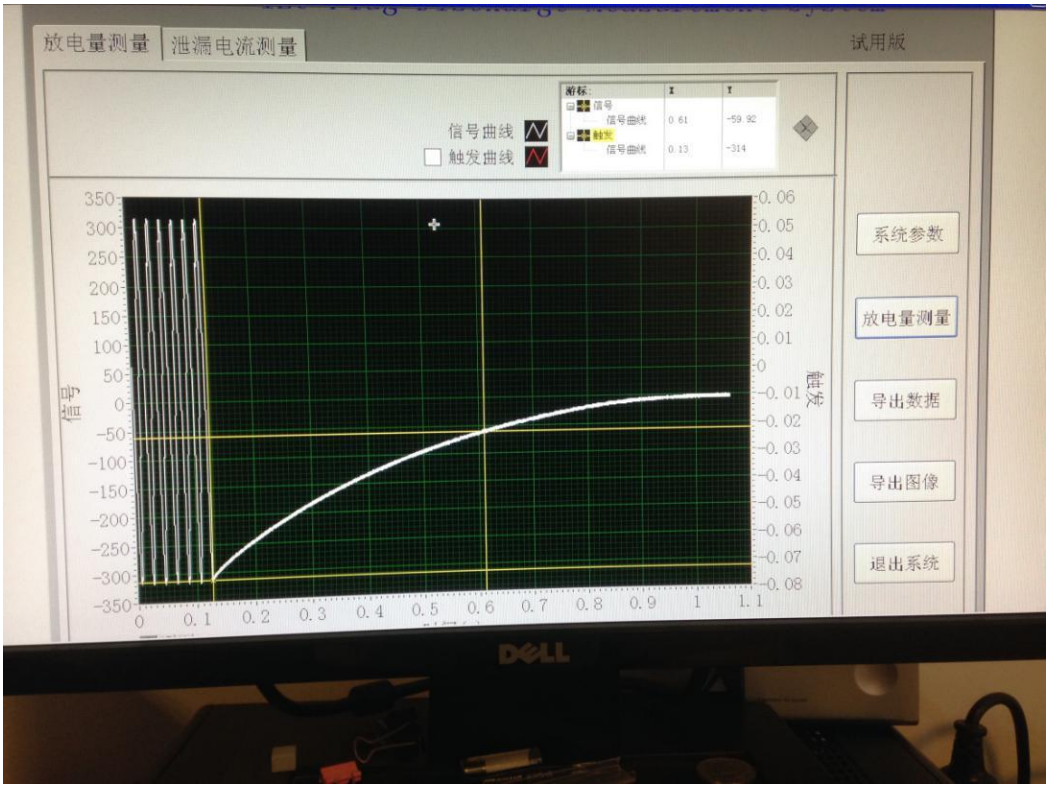
f) Set CH1 trigger to edge trigger, auto trigger, CH1 trigger and + trigger; trigger level pointer to one grid, slightly above 0 level.

g) Display the waveform position adjustment: Move the screen waveform position vertical pointer to the left to the first case, with the horizontal pointer placed in the center of the screen

h) If willing, close the CH2 scan line (yellow),

i) Place the polar switch in the + position, then the oscilloscope display should display the full screen sine wave, and the amplitude peak value should correspond to the effective value of the sample operating voltage.Place the polar switch back to the median or lower position to see the discharge waveform.To see stable waveforms, the CH1 mode should be triggered from Automatic Trigger (Auto) to Normal Trigger (Normal);

Since the sample supply voltage sine wave is not necessarily at the peak when dialing the "polar switch" for the measurement, repeated measurements are required to obtain the ideal discharge waveform for the peak discharge.


放电量测量
泄漏电流测量
试用版
信号曲线
触发曲线
系统参数
放电量测量
导出数据
导出图像
退出系统
信号
触发
DELL

The power recorder of the current leakage current measurement unit of medical device is a comprehensive study of electronic Weihai information technology

The center is suitable for the rapid development of China's medical and electronic industry and the relevant international standards

A measurement and analysis system developed for the serious shortage of safety detection capability.

The system is IEC 60601 for the medical equipment, Special measurement equipment developed for international standards like GB9706 and national mandatory standards, can complete tests of all patient contact current, patient auxiliary current and patient contact current specified by international standard IEC60601.

the key technical indexes

Figure 15 The same type of patient was applied to the same type of patient currents connected together

Figure 16 Patient current after patient application of external voltage

Inputs and outputs of FIG. 17 ME are applied with a patient current after an external voltage

FIG. 18 ME The unprotected grounded housing is applied to the patient current after an external voltage

Figure 19 ME total patient current after ligation by all patients

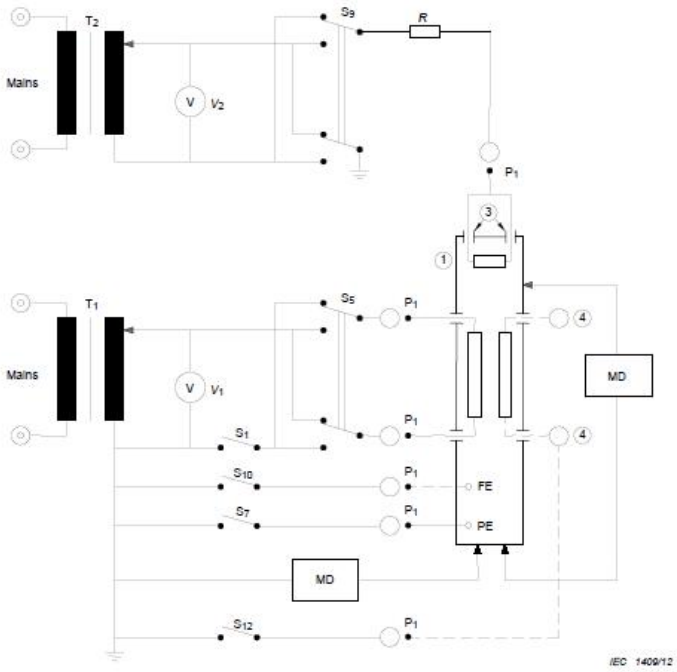
R to input / output terminal, contact current measurement, Figure 14,

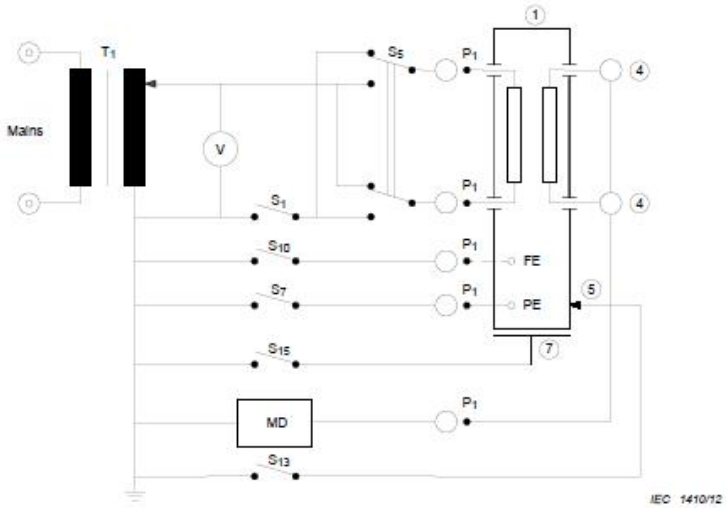
R to input / output terminal, patient current measurement, Figure 17

R to metal shell, patient current measurement, Figure 18

R to patient current MD, the other end of MD to class F patient applied terminals, Figure 16

Standard reference figure:


T2
Mains
V
V2
S9
R
P1
3
1
T1
Mains
V
V1
S5
P1
4
MD
S1
P1
S10
P1
FE
S7
P1
PE
MD
S12
P1
IEC 1409/12



For legends, see Table 5.

Key

Measure (with S_7 closed if CLASS I ME EQUIPMENT) under all possible combinations of positions of S_1, S_5, S_{10}, S_{13} and S_{15}.

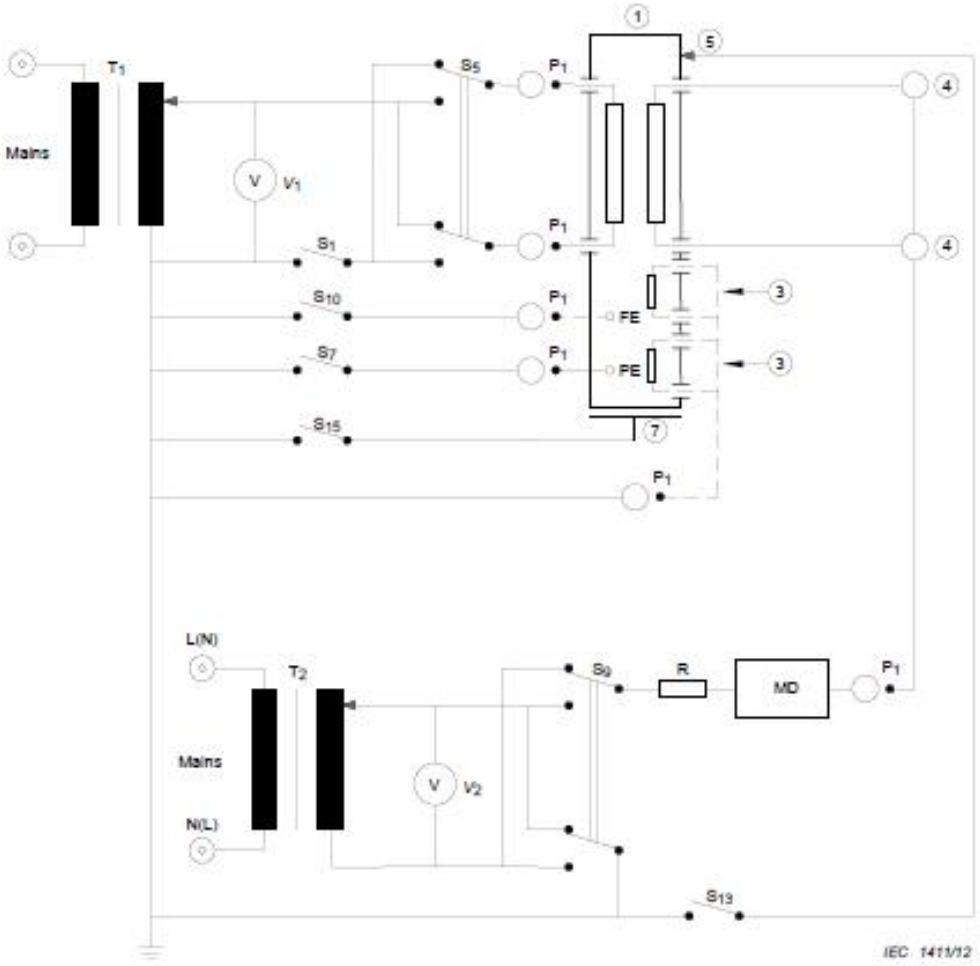
S_1 open is SINGLE FAULT CONDITION.

CLASS I ME EQUIPMENT only:
Measure with S_7 open (SINGLE FAULT CONDITION) and with S_1 closed under all possible combinations of S_5, S_{10}, S_{13} and S_{15}.

For CLASS II ME EQUIPMENT, the PROTECTIVE EARTH CONNECTION and S_7 are not used.

Example with the measuring supply circuit of Figure F.1.

Figure 15 – Measuring circuit for ~~the~~ PATIENT LEAKAGE CURRENT from the PATIENT CONNECTION to earth



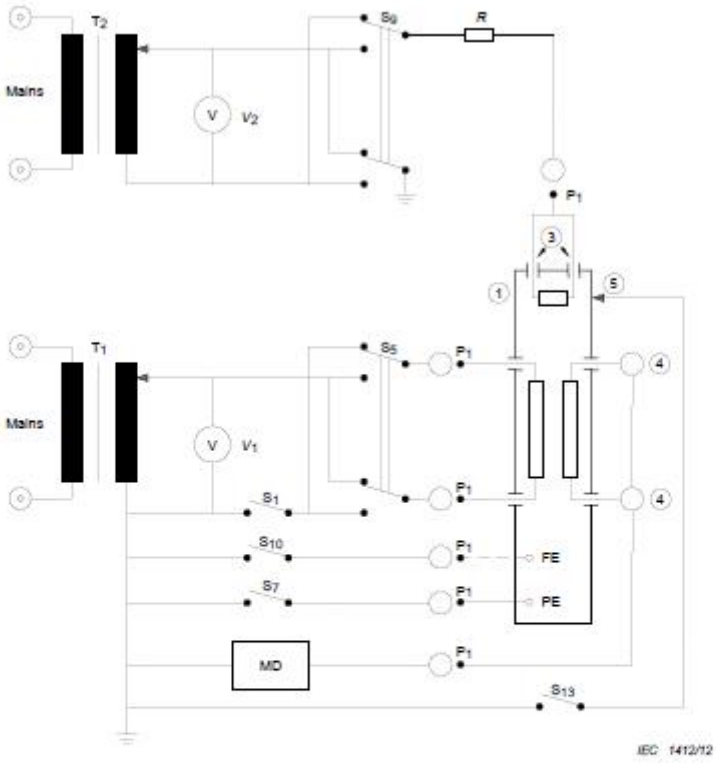
For legends, see Table 5.

Key

Measure (with S_7 closed, if CLASS I ME EQUIPMENT) WITH S_1 closed under all possible combinations of positions of S_5, S_9, S_{10} and S_{13}.

For CLASS II ME EQUIPMENT, the PROTECTIVE EARTH CONNECTION and S_7 are not used.

Example with the measuring supply circuit of Figure F.1.



For legends, see Table 5.

Key

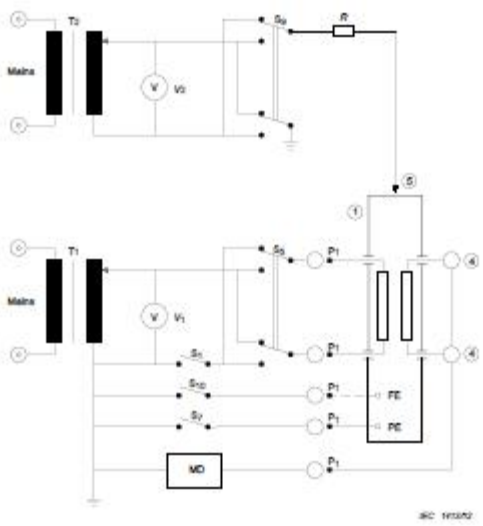
Measure (with S_7 closed, if CLASS I ME EQUIPMENT) under all possible combinations of positions of S_1, S_5, S_9, S_{10} and S_{13} (S_1 open is SINGLE FAULT CONDITION).

CLASS I ME EQUIPMENT only:
Measure with S_7 open (SINGLE FAULT CONDITION) and with S_1 closed under all possible combinations of S_5, S_9, S_{10} and S_{13}.

For CLASS II ME EQUIPMENT, the PROTECTIVE EARTH CONNECTION and S_7 are not used.

Example with the measuring supply circuit of Figure F.1.

Figure 17 – Measuring circuit for ~~the~~ PATIENT LEAKAGE CURRENT from PATIENT CONNECTION(S) to earth caused by an external voltage on a SIGNAL INPUT/OUTPUT PART (see 8.7.4.7 c))



For legends, see Table 5.

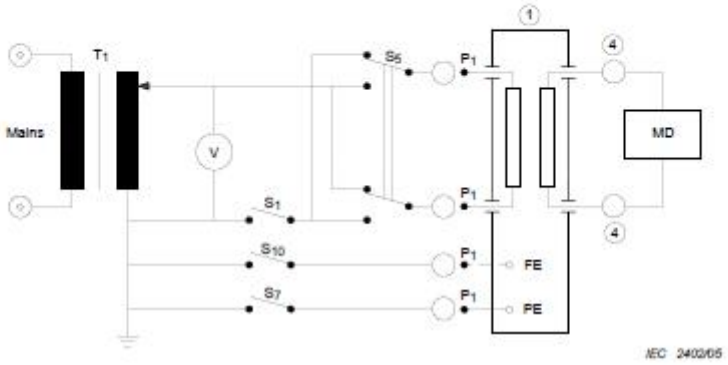
Key

Measure with S_1 closed (and with S_7 closed, if CLASS I ME EQUIPMENT) under all possible combinations of positions of S_8, S_9 and S_{10}.

For CLASS II ME EQUIPMENT, the PROTECTIVE EARTH CONNECTION and Sr are not used.

Example with the measuring supply circuit of Figure F.1.

Figure 18 – Measuring circuit for ~~the~~ PATIENT LEAKAGE CURRENT from PATIENT CONNECTION(S) to earth caused by an external voltage on a metal ACCESSIBLE PART that is not PROTECTIVELY EARTHED
(see 8.7.4.7 d))



For legends, see Table 5.

Key

Measure (with S_7 closed if CLASS I ME EQUIPMENT) under all possible combinations of positions of S_1, S_5, and S_{10}.

S_1 open is a SINGLE FAULT CONDITION.

CLASS I ME EQUIPMENT only:
Measure with S_7 open (SINGLE FAULT CONDITION) and with S_1 closed under all possible combinations of positions of S_5, and S_{10}.

For CLASS II ME EQUIPMENT, the PROTECTIVE EARTH CONNECTION and S_7 are not used.

Example with the measuring supply circuit of Figure F.1.

Figure 19 – Measuring circuit for ~~the~~ PATIENT AUXILIARY CURRENT
(see 8.7.4.8)

IV. Waveform output monitoring:

International standards and national standards require the measurement of the true effective value of patient current, and the waveform coefficients of patient current / patient contact current are different, which cannot use the known fixed relationship between "effective value and peak". Therefore, this instrument is equipped with two ways to monitor the effective value and peak of leakage current in real time:

- Peak leakage current and discharge volume waveform were monitored with a data acquisition card and a USB oscilloscope;
- The true effective value is measured with the digital ammeter / voltmeter of the integral principle, which can be compared with the peak of the data acquisition card for the conversion, if necessary.

The above features can operate on the selector switch on the panel:

Pulse output waveforms were monitored in real-time using data acquisition cards

The data acquisition card time coordinate is set to four gears:

CH1 60990 contact current, used for monitoring the contact current pulse waveform monitoring;

The CH2 60601 contact current, the patient current, was used to monitor the patient current peak waveform monitoring;

CH3 60601 patient auxiliary current, used to monitor patient auxiliary current peak waveform monitoring;

CH4 60065 terminal discharge, used to monitor terminal discharge peak waveform monitoring;

The data collector (the USB oscilloscope can be used) to monitor the frequency conversion voltage and the current output waveform. When the nonlinear steep increase in the waveform occurs, the insulation breakdown or deterioration of the tested sample occurs.

Charge and discharge time was used to select and control the data collector software, number of pulses, and time coordinates.

Peak current waveforms were monitored in real-time using an oscilloscope

The USB oscilloscope is built-in. The user can choose the oscilloscope to monitor and calibrate the output waveform. When the acquisition rate of the data collector is not high enough, the monitoring waveform curve point is not dense enough.

Built-in adjustment is used to monitor the pulse waveform with a USB oscilloscope and touch

Hair adjustment is identical to the ordinary oscilloscope.The pulse output interval and pulse output number are still controlled by the data collector software interface.

This instrument uses the industrial controller waveform display, can be controlled through the panel port external mouse, or screen touch.

V. Measurement error (precision)

Paper less recorder: monitoring voltage, current: 0.5%F.S. ±2 digit

USB oscilloscope: 4-channel 60MHz

Base accuracy of horizontal system: ± 50 ppm

Vertical resolution: 8 Bit

Vertical gain accuracy: ± 3%

Self-calibrated signal output: 1Hz square wave / 2Vp-p

USB collector:

Acquisition rate: 500KS / s

± 10V full-range absolute accuracy:

14.7mV（25℃）;

138mV (unconventional temperature maximum)

Six, protection measures

The instrument is a Class I safety protection design, and all operator-contact metal parts of the enclosure are subjected to the electric resistance strength voltage of 1500VAC;

The measuring circuit of this instrument is floating ground design and can be directly connected to oscilloscope, etc;

This instrument is equipped with a leakage protection switch, which provides cut-off protection for the measurement of the circuit overload short circuit or the ground leakage current exceeds the limited value, requiring manual reset;

A 3A fuse is built in the power input socket of this instrument for circuit protection when an overload short circuit occurs in the non-measuring load circuit inside the instrument.

The frequency conversion power supply output is equipped with an overcurrent alarm, which will be automatically cut off when the current is too large.

Seven, the use of the environment

temperature:0-50℃

Humidity: 80%R.H.(No condensation)

Air pressure: 96-106kPa

Power supply: 220V ± 10%, single-phase + protection gr ound

Each channel has the corresponding output port, please sel ect correctly.

Seven, operating system

The randomly provided application requires the following operating system: Windows 7 (recommended)

Eight, operating system

The randomly provided application requires the following operating system: Windows 7 (recommended)

The NI USB-6009 collector requires an NI operating syste m installation and can be downloaded from the following offici al website:

https://www.ni.com/zhcn/support/downloads/drivers/download.nidaqmx.html#311818

The USB oscilloscope requires the operator software that can be installed from a random disc or downloaded from the following website:

http://www.hantek.com.cn/ProductDetail_6_94.html