

HTCJ-V 800kV/40kJ Automatic Impulse Voltage Generator

HTCJ-V 800kV/40kJ Automatic Impulse Voltage Generator Solution



HTCJ-V 800kV/40kJ Automatic Impulse Voltage Generator

I. Equipment Technical Parameters and Accessory Functions, Layout System Diagram and Equipment Design Drawing

1. General

1.1 This parameter is applicable to conduct the impulse withstand voltage test for 110kV or smaller voltage level high voltage equipment. It is the technical description of functional design, structure, performance, installation and test of the equipment

1.2 This equipment meets the current international standards, national standards and relevant industry standards.

2. Reference Standard

GB311.1-1997: <<Insulation coordination of high voltage transmission and transformation equipment>>

GB/T16927.1-1997:<< General test requirements of high voltage test technology>>

GB/T16927.2-1997: <<Measurement system of high voltage test technology>>

GB/T16896.1-1997: << High voltage impulse test digital recorder>>

ZB F24 001-90: <<Implementation rules of impulse voltage measurement>>

GB191 :<<Packing and shipping marks>>

GB4208 <<Enclosure protection class>>

GB813-89 <<Oscilloscope and peak meter for impact test>>

3. Working Condition

The test system of impulse voltage generator is mainly applicable to impulse full wave withstand voltage test and full wave test of 110kV and below high voltage equipment, and can also be used for impulse test for other products.

3.1 The altitude shall not exceed 1500m

3.2 Ambient temperature: - 15 ~ + 50 °C

3.3 Air relative humidity: ≤ 90%

3.4 Installation and use location: indoor use, movable

3.5 There must be a reliable grounding point and grounding resistance0.5Ω !

4. Impulse Voltage Generator (Model: HTCJ-800/40)

4.1 Impulse Voltage Generator Main Parameters

4.1.1 Nominal lightning impulse voltage: HTCJ-800kV

4.1.2 Nominal Capacitance (Energy): 40kJ

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4.1.3 Stage Capacitance: 1.0 μ F,100kV (MWF100kV-1.0 μ F),Dry type full insulation package

4.1.4 Stage Voltage: ± 100 kV

4.1.5 Pole number /Stage capacity: 8/ 5kJ

4.1.6 Output waveform:

1.2 μ s \pm 30%/50 μ s \pm 20%Standard lightning impulse voltage full wave, efficiency \geq 90%

2 \sim 6 μ sStandard lightning impulse clipped wave.

4.1.7 Synchronization range: $>20\%$

4.1.8 Working Time:

When the working voltage is less than 80% of rated working voltage, it can work continuously

When the working voltage is higher than 80% of rated working voltage, it can work intermittently

4.1.9 The error voltage difference of amplitude regulation is less than 1%, and the minimum output power is not more than 10% of the nominal voltage of the equipment..

4.1.10 Synchronization error rate: $<1\%$

4.1.11 Base: 2m \times 1.5m (Caster movement) Hight: about 6.5 m, Weight: about 450kg

4.2 Technical description of impulse voltage generator

4.2.1 Impulse voltage generator Structure

4.2.1.1 the main circuit design of SGS series of haefely company in Switzerland is adopted, so as to realize the overall super small size.

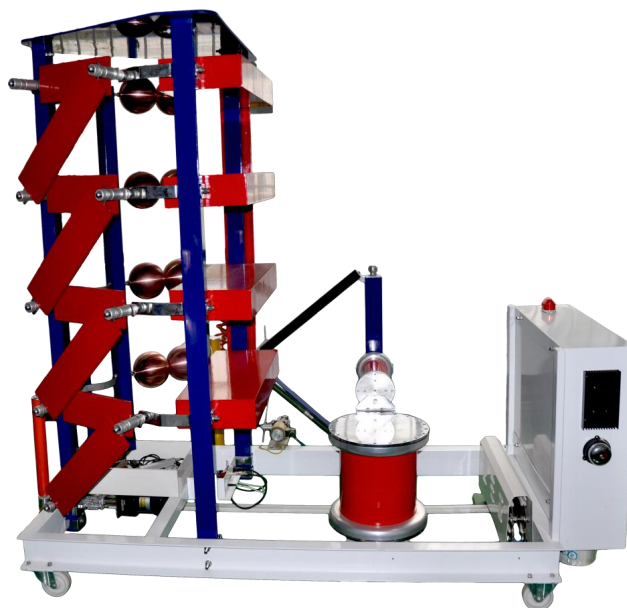
4.2.1.2 the low-speed rack and pinion transmission mechanism with one revolution per minute is adopted to adjust the ball clearance at all levels, which not only has no noise and little wear, but also has fast and accurate positioning.

4.2.1.3 the fixed mechanism of wave adjusting resistor with spring crimping and convenient plug-in is adopted to ensure the reliability of contact and make the output waveform smooth without burr.

4.2.1.4 with the pulse amplifier of igcs-2008 control system, the trigger range of synchronous ball gap can be more than 20%, which ensures the reliability of trigger, and the automatic control is convenient and reliable.

4.2.1.5 the triggering of synchronous ball gap has no polarity effect, and it does not need bilateral triggering.

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Main structure reference picture(this picture is for 400kV, 800kV will be different)

4.2.2 Main capacitor

4.2.2.1 the main capacitor adopts high-density solid capacitor, the capacitance of each capacitor is $1.0 \pm 0.05 \mu F$, and the DC working voltage is $\pm 100 kV$. The capacitor has small intrinsic inductance and smaller than $0.20.2 \mu H$, light weight and small volume, which is the first in China.

4.2.2.2 the concave convex deformation of capacitor is less than 1 mm under normal working condition and working environment.

4.2.2.3 the capacitor is packaged with solid insulation medium and shell dry insulation, without oil leakage and deformation.

4.2.3 Wave modulator

4.2.3.1 the resistance of wave head and wave tail has enough heat capacity to ensure long-term continuous operation of generator.

4.2.3.2 the charging resistor has enough thermal capacity to ensure the generator to operate continuously for a long time.

4.2.3.3 the resistance of wave head and wave tail adopts plate structure, which is made of Kang copper wire without induction. The external part is made of insulating resin vacuum casting. The joint is of spring compression type, which is easy to install.

4.2.3.4 the connector of wave head and wave tail resistance is made of 3mm stainless steel wire cutting.

4.2.3.5 there are 8 groups of wave head resistance and 8 groups of wave tail resistance for

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lightning impulse, 1 group of wave modulation inductor , and 1 group of charging resistance and protection resistance.

4.2.4 control and protection system

IGCS-2008 automatic control system is used to provide various controls for the main part of impulse voltage generator, which can fully meet the various control functions of impulse test. IGCS-2008 control system adopts imported devices, and two core optical cable is used for connection with equipment body.

4.2.4.1 IGCS-2008 automatic control system takes FX2N series programmable controller of Mitsubishi company of Japan as the core device, so the volume of the controller is very small, and the controller can realize manual control and automatic control. The special software package can be used for computer control to realize intelligent operation. The special software package can be used together with peak voltmeter and oscilloscope for measurement and waveform analysis to realize the integration of computer measurement and control of impulse voltage test system.

4.2.4.2 the control system has the following control functions:

- a. Using PLC technology, using two core optical fiber to transmit control commands and Feedback equipment status, thus avoiding electromagnetic interference and improving the safety of control system and computer.**
- b. The control function has manual, automatic and program control functions. The functions of each level are relatively independent to ensure the reliability of the system.**
- c. The thyristor voltage regulation mode is adopted, and the charging voltage feedback measurement system is provided.**
- d. The distance between ignition ball gap and chopper ball gap can be adjusted manually and automatically, and displayed on LCD panel.**
- e. It also has the feedback system of the generator ignition trigger.**
- f. The stability of charging voltage can reach 0.5% by using function control constant current charging mode.**
- g. The LCD panel can indicate the charging voltage and charging process of the impact generator with an accuracy of 1%.**
- h. Charging voltage and charging time can be input directly by LCD panel.**
- l. It has the function of abnormal charging protection, and can send trigger ignition pulse automatically or manually**
- j. Indication of the working state of the impact generator, such as spontaneous combustion, non triggering, abnormal charging, stable charging, etc.**
- k. Grounding and grounding release control of equipment body and charging part.**
- l. The polarity of charging voltage can be automatically changed through the button on the controller**
- m. The charging process of charging voltage can be controlled automatically or manually**

Alarm can be manually or automatically

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n. It has over-current and over-voltage automatic protection Isolation filter shielding design

4.2.4.3 The first stage of synchronous ball gap is triggered by three electrode ball gap, and the trigger range is more than 20%.

4.2.5 Safety grounding system

4.2.5.1 The first stage capacitor of the generator is grounded through a grounding resistance by using an electromagnet automatic grounding mechanism.

4.2.5.2 Grounding operation and charging control have interlock protection to ensure safe and normal operation.

4.3 Main configuration of equipment

4.3.1 Rectifier charging power supply (integrated with voltage impulse generator body)

Model: HTGR-100 / 50

Rated voltage: $U_n = \pm 100\text{kV DC}$ (positive or negative)

Rated current: $I_n = 50\text{mA}$ (under rated voltage)

Voltage control thyristor module voltage regulation, voltage regulation range 0 ~ 100% U_n

Polarity conversion: changing the direction of high voltage silicon stack

Input voltage: 220 V single phase voltage

Power frequency: 50 / 60 Hz

Power consumption: 5kVA

4.3.2 Weakly damped capacitive voltage divider

Model: HTCR-800 / 600

Rated voltage: 800kV

Rated capacitance: 600pF

Number of capacitance: 1

Capacitance per section: 600pF (MWF400-600 Impulse Capacitor)



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Square wave response: partial response time less than 100ns, overshoot less than 10%

Partial pressure ratio: 250

Accuracy: less than 2%

Uncertainty of partial pressure ratio: less than 1%

4.3.3 Truncation device

Model: HTMC-800kv

Rated voltage:800kV

Form of ball gap: 300 mm diameter ball gap

Trigger mode: three electrode discharge trigger

(using high performance pulse amplifier to output 15kV, 100ns trigger pulse)

Time delay mode: 2 ~ 6us electronic delay circuit with adjustable time delay provides chopping trigger pulse(with IGCS-2008 control system, the potentiometer adjusts the cutoff delay time)

Dispersion: the standard deviation of cutoff time is less than 0.1 μ s

4.3.4 Measuring equipment

Model: DIMS-1000 Digital Impulse Voltage Measurement System

Input range: 120V ~ 1600V (impulse voltage)

Measurement uncertainty: less than 1%

Waveform measurement: TBS2012 high voltage digital oscilloscope

The highest sampling rate is 1.0gs/s, the bandwidth is more than 100MHz, the resolution is 8bit,

The record length is 10k bytes, 2 channels



Waveform analysis:

- a. Industrial control computer (including display screen)
- b. Special software package for Impulse Voltage shock measurement:
- c. Calculation and display of shock wave parameters
- d. Waveform comparison function
- e. Amplification, reduction and translation of waveform
- f. Storage and calling of waveform
- g. Waveform mapping and report writing
- h. Accessories:

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(1) 2 pcs high performance 100 times special attenuator

(2) Isolation filter shield design

IGCS-2008 Automatic control system main components:

Name	Function	Mounting position
Control cabinet	Provide various control commands	Installed on the base of generator body
Pulse amplifier 1	Ball gap trigger of generator body	Installed on the base of generator body
Isolating capacitor	DC high voltage to isolate trigger pulse	Installed near the first ball gap of the generator
Ignition feedback voltage divider	Detect the trigger condition of generator ball gap	Installed on the base of generator body
DC voltage divider	Measure the generator charging voltage	Installed on the wave cutting base
Pulse amplifier 2	Chopped wave ball gap trigger	Installed on the wave cutting base
Secondary Operation unit (Option)	Input and status display of various control commands and parameters	Installed on the control cabinet
Main operation unit	Input and status display of various control commands and parameters	installed on the console in the control room.
2-core multimode fiber	Connecting control cabinet and main operation unit	Connecting control cabinet and main operation unit

It can realize manual control, automatic control and program control. The main measurement and control functions are as follows:

Measurement display quantity:

DC charging voltage

Primary side current of transformer

Ball gap distance of generator body

Cut off clearance ball gap distance

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State display quantity:

Switching state of main power contactor

Switching status of grounding device

Trigger state of generator ball gap

Polarity state of generator charging voltage

Control:

The control function has manual, automatic and program control functions, and each level function is relatively independent.

The thyristor voltage regulation mode is adopted, and the charging voltage feedback measurement system is provided.

The distance between ignition ball gap and chopper ball gap can be adjusted manually and automatically, and displayed on LCD panel.

It also has the feedback system of the generator ignition trigger.

The stability of charging voltage can reach 0.5% by using function control constant current charging mode.

The LCD panel can indicate the charging voltage and charging process of the impact generator with an accuracy of 1%.

Charging voltage and charging time can be input directly by LCD panel.

With the function of abnormal charging protection, it can automatically or manually send trigger ignition pulse

Indication of the working state of the impact generator, such as spontaneous combustion, non triggering, abnormal charging, stable charging, etc.

Grounding and grounding release control of equipment body and charging part.

The polarity of charging voltage can be automatically changed through the button on the controller

The charging process of charging voltage can be controlled automatically or manually

It can alarm automatically or manually

Protection and interlock:

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Over current protection

Overvoltage protection

Abnormal charging protection

Door switch interlock

Grounding mechanism interlock

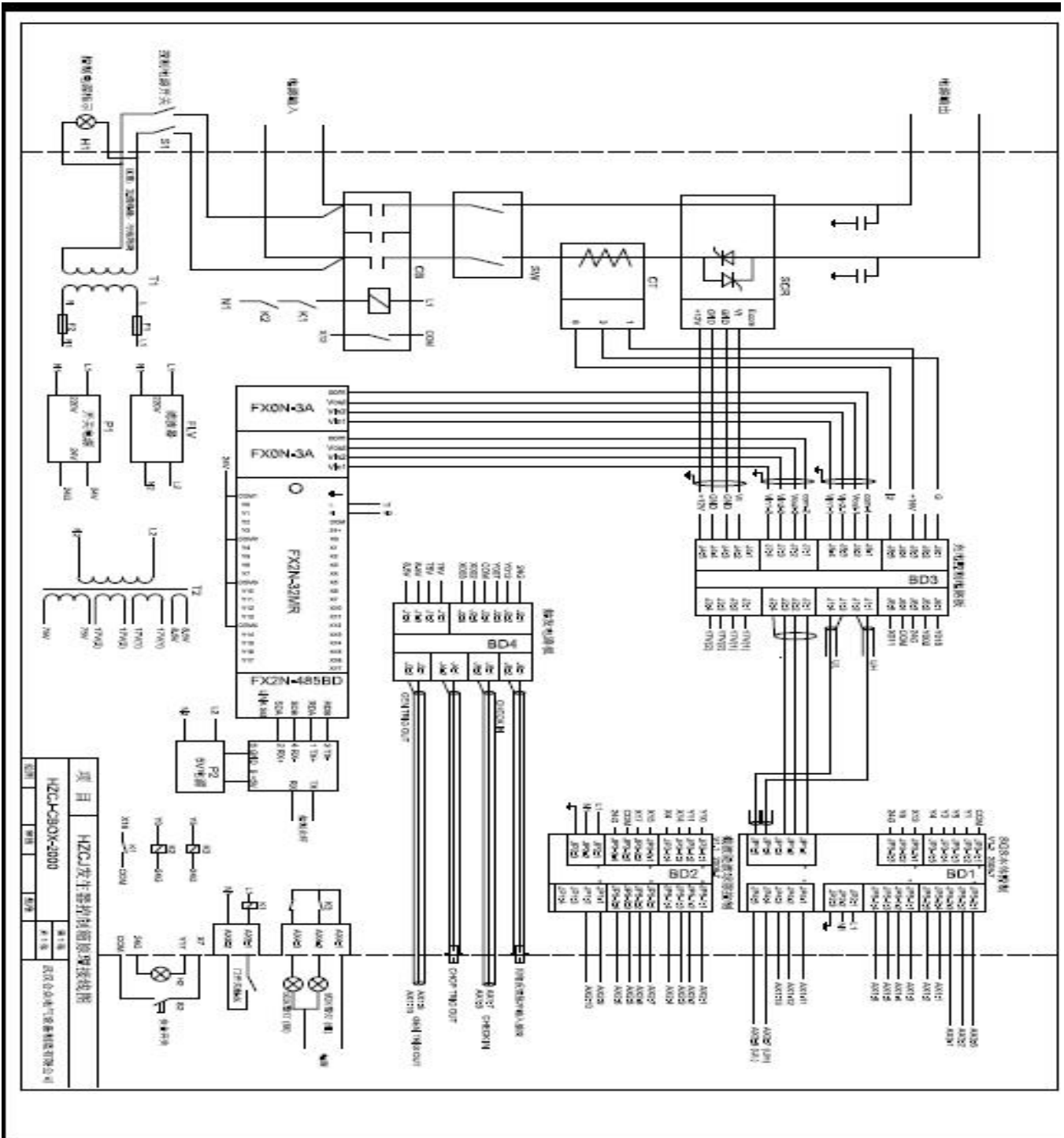
Polarity switching interlock

Operation tips:

The system has designed a special program operation interface, with various operation prompt screen, when the system fault or operation is not correct, the corresponding prompt dialogue screen will pop up. It is convenient to carry out full wave and cut-off wave test of power electrical equipment and transformer products, greatly simplifies the operation of test personnel, and can effectively prevent artificial mistake.

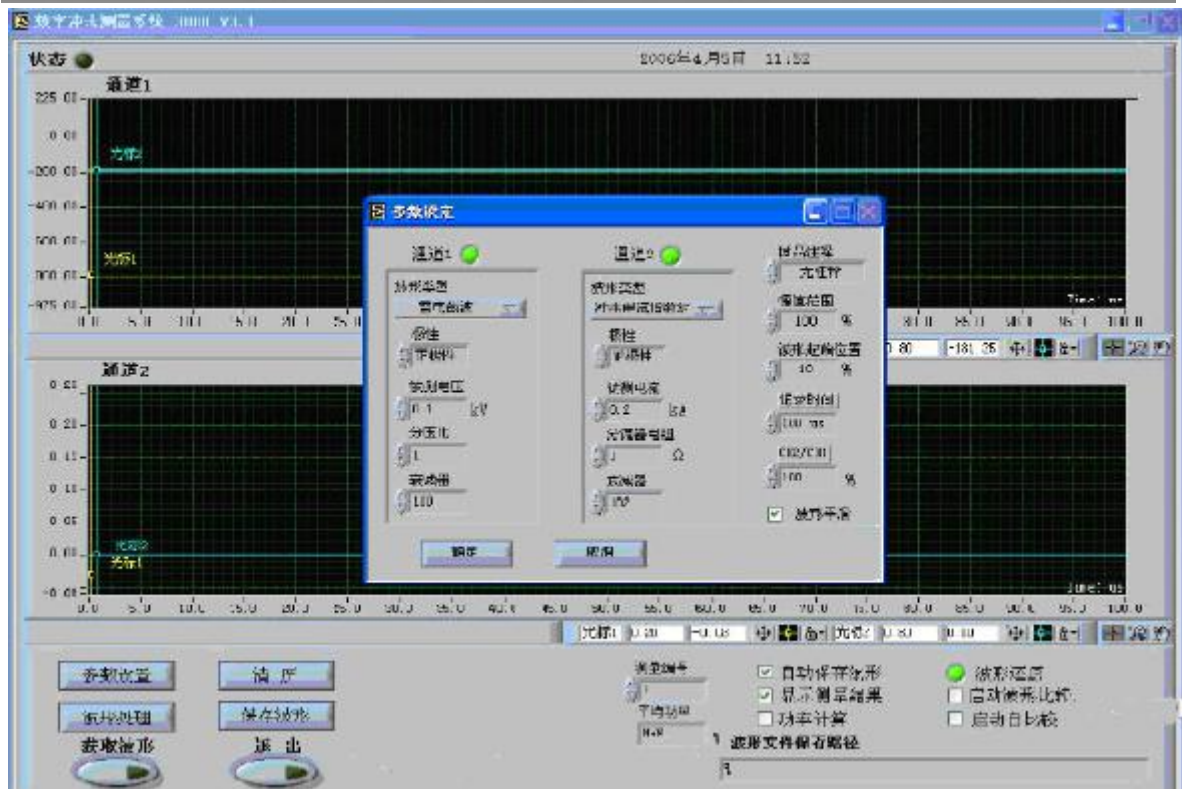
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HTCJ-V 800kV/40kJ Automatic Impulse Voltage Generator Diagram



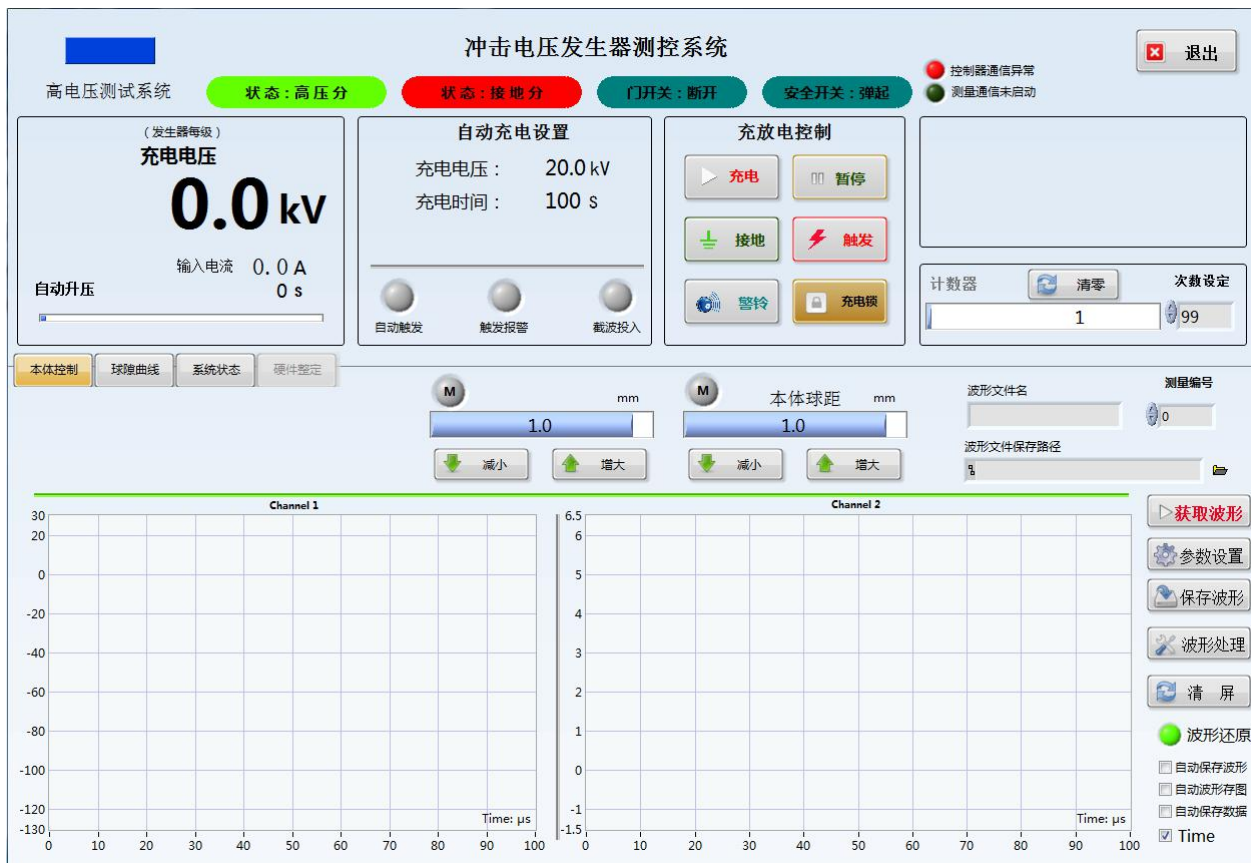
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Automatic Impulse Voltage Generator's waveform measurement and recording analysis software operation screen:



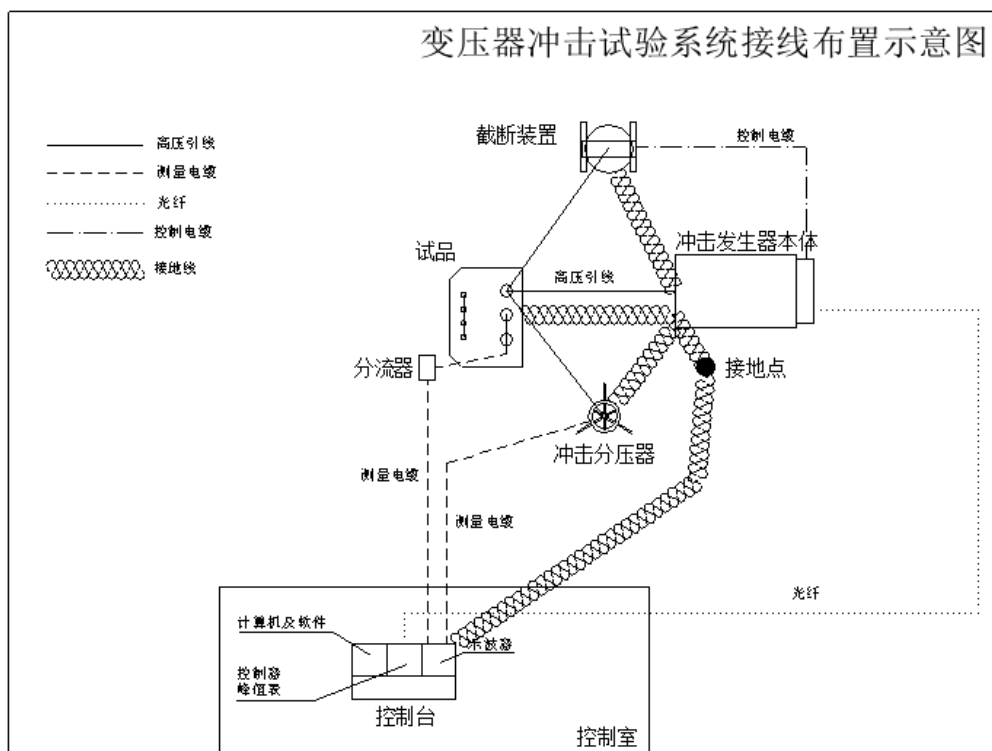
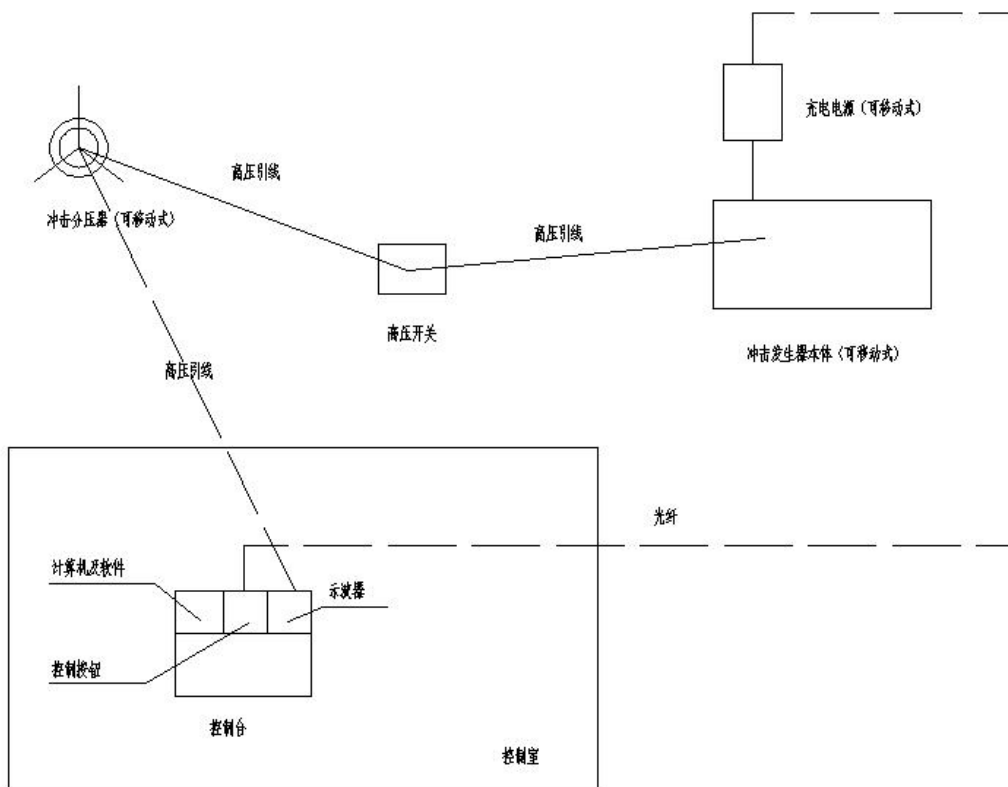
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Automatic Impulse Voltage Generator's control and operation screen



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Layout of Switch Cabinet and Transformer lightning impulse test



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Main Equipment Effect



**IGCS-2008 Automatic Lighting Impulse Shock Control system &
DIMS-1000 Digital Lighting Impulse Shock Measurement System**



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II Description of Technical Scheme Features

1. The SGS generator voltage of 100kV is the best, which is in line with the current development trend at home and abroad. The main structure adopts the structure design of the world famous company haefly, which is the most compact generator in China at present, with the characteristics of small inherent inductance and convenient wave modulation.

2. The control and measurement system adopted in the scheme is the leading product in domestic technology, the core device is FX series programmable controller of Mitsubishi company of Japan, almost all control functions are realized by software programming, so the system structure is simple, the peripheral circuit board is very few, and the reliability is very high.

3. The measurement and control structure of the scheme is integrated with an industrial computer with liquid crystal display, which can realize automatic control, measurement and analysis. The measurement and control system uses LCD touch screen operation, with a variety of status prompt screen, to realize the intelligent operation of man-machine dialogue. The system cancels the multi-core control cable, uses the optical fiber communication line, does not need to open the cable trench, makes the control room layout more simple and convenient.

4. The optical fiber control transmission system adopted in the scheme is the first one among the domestic high-voltage test equipment. It realizes the optical fiber connection between the control measurement equipment and the high-voltage main equipment, effectively solves the harm of the ground potential elevation in the high-voltage test to the measurement and control system, eliminates the electromagnetic interference caused by the control lead, and greatly improves the reliability of the system, especially in the process of cutting The safety is better in wave and steep wave shock tests.

5. The operation interface of IGCS-2008 control and measurement system adopted in the scheme fully considers the habitual characteristics of high voltage test, which is simple and clear,

It is convenient for test personnel to operate. The system has designed a special program operation screen, which is convenient for full wave and cut-off wave test of transformer

The operation of the tester is simplified and human error can be effectively prevented.

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6. This set of impulse voltage generator test system adopts the most advanced technology, good technology and high-quality raw materials, which can ensure long-term use, and the service life is more than 20 years. The operating cost is also very low.

III. Equipment and Accessories Configuration List

No.	Item name & model	Unit	QTY	Remark
1	HTCJ-800kV/40kJ Impulse Voltage Generator	set	1	
2	HTGR±100kV/50mA DC Charging Power Supply (Integrated with Impulse Voltage Generator)	set	1	
3	HTCR800kV/600pF Weakly Damped Capacitor Voltage Divider	set	1	
4	DIMS-1000: Digital Lightning Impulse Shock Measurement System (Including American Tektronix oscilloscope)	set	1	
5	MC800kV Single Stage Cut-off Device	set	1	
6	IGCS-2008 Automatic Lightning Impulse Shock Control system	set	1	
7	HTCJ Wave Modulation Resistance: There are 8 groups of wave head resistance, 8 groups of wave tail resistance for lightning impulse, 1 group of Wave modulation inductor and 1 group of charging resistance and protection resistance	set	1	
8	High performance 100 times dedicated attenuator	pc	2	