KvTester
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ZCVF-C 240kVA/240kV

Adjustable Inductance Series Resonant Test System

User Manual

KVtester Electronics Technology Co., Ltd.

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Dear Customers

Thank you for purchasing our ZCVF-C 240kVA/240kV Adjustable Inductance Series Resonant Test System Booster device. Before you use the product for the first time, please carefully read this Manual which can help you skillfully use the Tester.

Our aim is to improve our products continuously, so that the product you use may be a little bit different from the Manual. In case of any changes, we will inform you in the attached sheets! Thanks for your understanding. If anything is unclear, please contact the After-Sale Service Department in our company, and we will certainly meet your requirements.

Since the I/O terminal, testing column and etc. may carry voltage, electric spark may be produced when you insert and unplug the test lead, power socket and etc.. Please do be careful of electric shock and avoid hazards. Pay attention to your personal safety!

Prudent Warranty

If the product is defective because of product quality itself within one year (including one year) from delivery, free maintenance will be implemented. If the product is defective for more than one year, a paid lifetime maintenance will be implemented.

◆ Safety Requirements

Please carefully read the following safety precautions so as to avoid personal injury and prevent the product or any other products connected thereto from being damaged. In order to avoid the possible dangers, the product can only operate within a specified range.

Only the qualified technicians can implement the maintenance.

Prevent Fire or Personal Injury

Use appropriate power cables. Only the dedicated power cables which conform to the specifications of the product can be used.

Correct connection and disconnection. When the test lead is connected to the charged terminal, please don't connect or disconnect the test lead arbitrary

Product is grounded. In addition to grounding the product through the grounding wire of the power cord, the grounding column of the product casing must be grounded. To prevent electric shock, the ground conductor must be connected to ground. Before connecting to the input or output terminals of this product, make sure that this product is properly grounded

Pay attention to the rated values of all terminals. In order to prevent fire or electric shock, please pay attention to all the rated values and marks of the product. Before the connection, please read this Manual so as to gain more insight into the information on rated values.

Never operate the product without an instrument cover. If the cover or panel has been removed, never operate the product.

Use appropriate fuses. Use the fuses of the type and rated value specified for the product.

Avoid touching the exposed circuits or charged metal. When the product is electrified, never touch the exposed contacts or parts.

Do not operate if there is a suspicious fault. If the product is suspected to be damaged, please contact the maintenance personnel for examination and never operate the product.

Never operate the product in a humid environment.

Never operate the product in an explosive environment.

Keep the surface of the product clean and dry.

Safety Terminology

Warning messages indicate the conditions or practices that may cause loss of life or personal injury.

Caution messages indicate the conditions or practices that may cause the damages to the product or other properties.

CONTENT

I. Summary

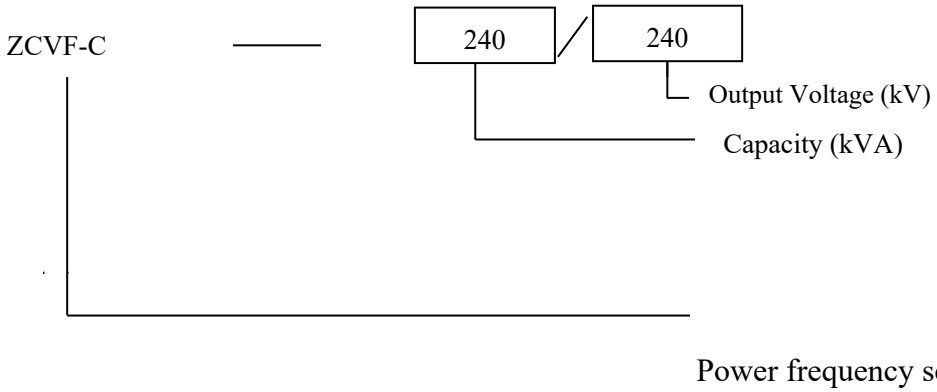
With the vigorous development of the power system, the single-machine capacity of each power operating equipment in the system is getting larger and larger, and the voltage level of the transmission is getting higher and higher, so the requirements for the test equipment of the operating equipment are also increasing. If conventional high-voltage test equipment is used, the capacity of the required test power supply and the capacity of the test equipment are as high as several thousand kVA Due to the large capacity of the test equipment, for the field test, the equipment is cumbersome and unsuitable to carry ; and as the test power supply The capacity is large, and it is very inconvenient to find a suitable power supply on site.

In order to meet the test needs of large-capacity, high-voltage (ultra-high voltage) electrical equipment, this booster device adopts the principle of series resonance, and uses an adjustable reactor to match the capacitance or compensation capacitor of the device under test (capacitive) to form resonance. In this way, the test power supply only bears the active power component, which is only 1/Q times the capacity required by the subject, and the capacity and weight of the test equipment are greatly reduced. It is an ideal high voltage source.

This device is mainly designed and manufactured for the AC withstand voltage of CVT (Capacitive Voltage Transformer). The reactor is designed with a single section manual inductance adjustment method, which has a wide range of applications and is an ideal withstand voltage equipment for high-voltage testing departments and power installation and maintenance engineering units.

The device mainly consists of an electric control box, a power frequency voltage regulator cabinet, an excitation transformer, and an adjustable reactor.

II. Model Naming



III. Main Features

1. The required power capacity is greatly reduced. Series resonant power supply generates high voltage and high current through resonance between resonant reactor and the tested capacitor. In the entire system, the power supply only needs to provide the active consumption part of the system. Therefore, the required power supply for the experiment is only 1/Q of the test capacity.

2. The weight and volume of the equipment have been greatly reduced. In a series resonant power supply, not only is the bulky high-power voltage regulating device and ordinary high-power power frequency test transformer eliminated, but the resonant excitation power supply only requires 1/Q of the test capacity, greatly reducing the weight and volume of the system, usually 1/10 of ordinary test devices.

3. Improve the waveform of the output voltage. A resonant power supply is a resonant filtering circuit that can improve the waveform distortion of the output voltage, obtain a good sine waveform, and effectively prevent the accidental breakdown of the test sample by harmonic peaks.

4. Prevent large short-circuit currents from burning the fault point. In the series resonance state, when the weak point of the insulation of the test sample is broken down, the circuit immediately disengages and the loop current rapidly drops to 1/Q of the normal test current. However, when conducting voltage withstand tests in parallel resonance or test transformer mode, the breakdown current immediately increases by several tens of times. Compared with the two, the short-circuit current is hundreds of times different from the breakdown current. So,

series resonance can effectively identify insulation weaknesses without the concern of large short-circuit currents burning the fault point.

5. There will be no overvoltage recovery. When the test sample breaks down, due to the loss of resonance conditions, the high voltage immediately disappears, the arc immediately extinguishes, and the process of re establishing the recovery voltage is long. It is easy to disconnect the power supply before reaching the flashover voltage again. This voltage recovery process is an intermittent oscillation process of energy accumulation, which is long and does not result in any recovery overvoltage.

6. Counterattack overvoltage and transmission overvoltage protection: This device uses proper wiring, complete protection links, and step-by-step energy absorption to prevent the harm of counterattack overvoltage and transmission overvoltage. After years of on-site practice, it has been proven that the test sample can avoid the damage and threat of overvoltage to the complete testing equipment and on-site testing personnel during flashover or breakdown. At the same time, it can also avoid the failure point of the test sample from not expanding the damage after flashover or breakdown.

7. The main functions of the inductive resonance device are:

(1) Voltage endurance time to automatic voltage reduction function:

The voltage endurance timer adopts a digital display timer. And when the withstand voltage time is reached, the system will automatically reduce the voltage

(2) Zero position closing and zero start boost function:

It has a zero position limit function. If the regulator is not at zero position, the high voltage output button cannot be closed, ensuring that the voltage is boosted from zero.

(3) Overcurrent protection function:

The system is equipped with an electronic overcurrent relay, which has strong anti-interference ability, fast action, and avoids damage caused by overcurrent during testing.

(5) Real time monitoring function for experimental data:

Real time monitoring of the voltage and current on the low-voltage side of the transformer can provide a visual understanding of the test situation.

IV. Main Technical Parameters

4.1 System Technical Parameters

1. Operating ambient temperature: -10℃~+45℃
2. Relative humidity: ≤90%（25℃）
3. Working frequency: 50Hz
4. Rated input capacity: 240kVA
5. Rated input voltage: 220V
6. Rated input current: 120A
7. Rated output voltage: 240kV (6 pcs Reactors)
8. Rated output current: 1A

4.2 Technical Parameters of Testing Bench

1. Power Supply：220V±10%, 50Hz
2. Rated Capacity：30kVA
3. Range of Voltage output：0~250V
4. Range of Current output：0~120A

4.3 Technical Parameters of Exciting Transformer

1. Voltage Input：0~250V
2. Voltage Output：20kV
3. Current Output：1.5A
4. Rated Capacity：30kVA

4.4 Technical Parameters of Adjustable Reactors

1. Rated working voltage：40kV
2. Rated working capacity：40kVA
3. Rated working current：1A
4. Single reactor inductance adjustment range：125-500H

V. Resonance principle

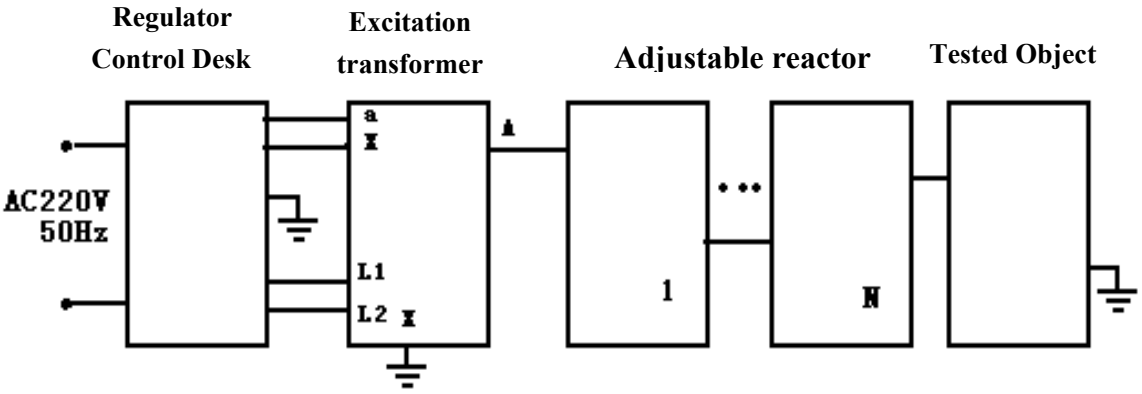


Fig 5.1 Wiring Diagram

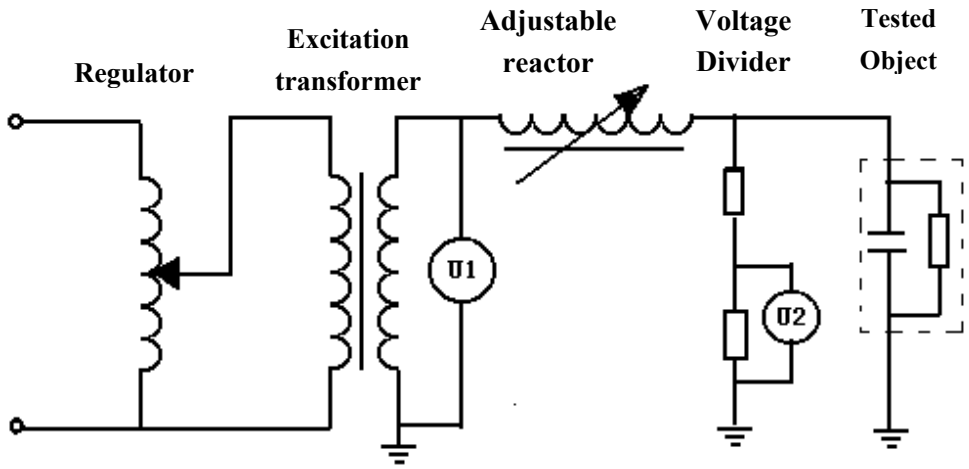


Fig 5.2 Resonance principle Diagram

Add a certain voltage to the test transformer (excitation transformer) through the test transformer (excitation transformer); by changing the core air gap of the adjustable reactor, the inductive resistance of the adjustable reactor matches the tolerance resistance of the test product (capacitive load) to form series resonance between the reactor and the subject product will generate the high voltage U2, and the U2 is Q times to U1.

When the system is in full resonance, the quality factor Q=2 π fL/R. At this time, the system is purely resistive, and the voltage on the inductor is equal to the voltage on the capacitor and opposite in sign. Since the main impedance of the system is concentrated on the inductor, the inductor will bear the same voltage as the test sample. If the system is placed in the capacitor Under harmonic state, the sum of the voltage on the inductor and the resistive voltage is equal to the voltage of the test product. At this time, the voltage on the inductor is lower than the voltage

of the test product. The system will withstand a smaller voltage and improve the safety factor. We recommend this way.

When conducting the AC withstand voltage test of the test object with small capacitance, a capacitor with a certain capacity should be equipped to make the system resonant. It is recommended to use a 5000pF compensation capacitor when the capacitance of the test object is less than 4000pF.

The test transformer (excitation transformer) has three high-voltage output terminals. For different voltages required by the system, the number of reactor sections is correspondingly different, and the capacity and output voltage of the test transformer (excitation transformer) are also different. During the test, the lower output voltage of the test transformer (excitation transformer) should be used first. Only when the test voltage cannot meet the required requirements, the higher output voltage of the test transformer (excitation transformer) should be used.

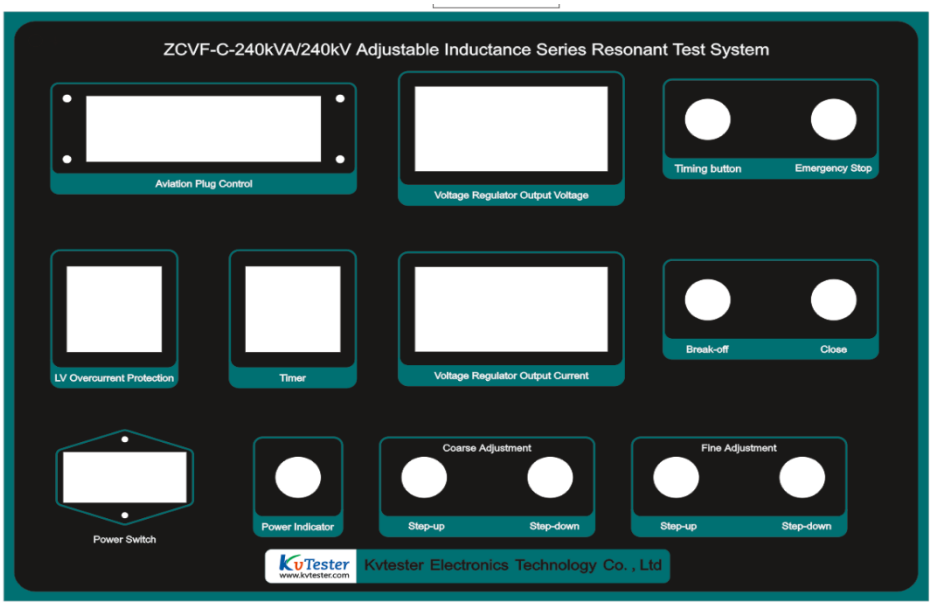
VI. Operation Instructions

6.1 Basic Instructions for Equipment Use

6.1.1 Power Supply:

Connect the two 220V wires directly to the power "input" end of the Testing Bench.

6.1.2 Instructions for the control box panel



Break-off button: responsible for cutting off the power output of the voltage regulating cabinet.

Close button: responsible for supplying power to the output of the voltage regulating cabinet.

Step-up button coarse adjustment: responsible for quickly increasing the output voltage of the voltage regulator.

Step-down button coarse adjustment: responsible for quickly reducing the output voltage of the regulator.

Step-up button fine adjustment: responsible for slowly increasing the output voltage of the voltage regulator.

Step-down button fine adjustment: responsible for slowly reducing the output voltage of the voltage regulator.

Power indicator: Close the external power switch, and the power indicator light on the electric voltage regulator cabinet will turn on.

Voltage regulator output voltage: indicates the voltage output from the voltage regulating cabinet to the input terminal of the excitation transformer.

Voltage regulator output current: indicates the current output from the voltage regulating cabinet to the input terminal of the excitation transformer.

Timer: refers to the time record of reaching the test voltage of the test object.

Timing button: press this button to start timing for voltage withstand

Emergency stop button: an emergency measure in case of (personal or equipment) abnormalities during testing.

6.1.3 Other operation guidance

(1) Control box power voltage indicator: Close the control box power switch, the control box power indicator light will turn on, and the power supply voltage will be displayed.

(2) Manually adjust the cross handle counterclockwise to increase clearance: responsible for reducing the inductance of the adjustable reactor.

(3) Manually adjust the cross handle clockwise to reduce clearance: responsible for increasing the inductance of the adjustable reactor.

VII. Operation Method

7.1 Method for adjusting the inductance of adjustable reactors

Firstly, determine the number of adjustable reactors based on the voltage level of the test sample.

Next, calculate the corresponding inductance based on the capacitance of the test sample. Divide the corresponding inductance by the number of sections of the reactor to obtain the inductance of a single adjustable reactor. According to the correspondence table between the gap and inductance on the nameplate of the single adjustable reactor, find the corresponding gap of the required inductance corresponding to the adjustable reactor. The specific adjustment method is to use a stainless steel cross adjustment handle to adjust the adjustment screw in the middle of the moving iron core of the single adjustable reactor counterclockwise. When adjusting clockwise, the gap increases and the inductance decreases. At this time, the inductance increases. The specific operation is: first, use the cross adjustment handle to loosen the adjustable reactor moving iron core counterclockwise, adjust the fastening nuts on both sides of the moving iron core to the corresponding gap with the inductance of the reactor, and finally adjust and tighten the screw rod clockwise.

7.2 Overcurrent protection and timing setting

7.2.1 The overcurrent protection setting is set at 1.1 times the rated current on the low-voltage side of the excitation transformer.

Example: If the rated current on the low-voltage side of the excitation transformer is 120A and the configured transformer is 300/5, the current relay should be adjusted to 044, which means it will operate at 132A.

7.2.2 Voltage endurance time setting: Set the dial code on the time relay to the desired test time value.

7.3 Testing operation

7.3.1 Connect the test wiring according to the device instructions, check for errors, then turn on the power switch on the voltage regulator cabinet, and then turn on the control power switch on the control box. If the voltage regulator is not in the zero position at this time, it will automatically return to zero.

7.3.2 Press the close button to turn on the main power supply, then press the "boost" coarse adjustment button to make the voltage regulator output around 50V. At this point, a high

voltage should be obtained between the adjustable reactor and the test object. If the output voltage of the regulator reaches half but the high voltage is less than half, it may be due to low quality factors, mismatched inductance, or inability to reach the target voltage value. At this point, it is necessary to reduce the voltage and stop the machine, and then adjust the gap of the adjustable reactor to change the inductance to achieve a higher output voltage. After adjusting the gap of the adjustable reactor, the voltage can be boosted again. When the voltage reaches 95% of the test voltage value, press the "Boost" fine adjustment button again. When the test target voltage is reached, press the withstand voltage timer button again to start timing. When the set withstand voltage time is reached, the equipment automatically drops voltage to zero and disconnects the main power supply.

7.3.3 After the experiment is completed, click the disconnect button, cut off the external main power switch, remove the power cord, dismantle the complete set of equipment connection wires, and clean the site.

Attention: During the experiment, relevant personnel should strengthen the monitoring of the tested equipment. Once any abnormal phenomenon occurs, the emergency stop button should be pressed to quickly reduce the pressure of the regulator back to zero.

VIII. Precautions

1. In order to ensure the safety and correctness of the test, in addition to being familiar with the equipment manual, the test operation must be carried out in strict with the relevant national standards and regulations.
2. The connection wires cannot be connected wrongly, especially the ground wire cannot be connected wrongly. Failure to do so may result in damage to the booster.
3. The impedance value of a single reactor must be adjusted to XL/N, otherwise the resonance will not be ideal. In severe situation, the output current of the device is too large, which damages the booster device, or the voltage cannot rise to the required voltage value.
4. When the device is in use, the output is high voltage or ultra-high voltage, which must be grounded reliably and pay attention to safe operation.
5. When adjusting the reactor, we should ensure that the air gap of each reactor is basically equal, otherwise, the uneven voltage distribution on the reactors will cause a certain section of reactors to be destroyed by overvoltage.

IX. After sales service

This test system can be repaired free of charge for any quality defects within one year from the date of shipment. But for quality problems caused by improper operation, or instrument damage caused by improper storage and transportation, our company will only provide the possible repair service, and will charge based on repair cost.

The lifetime repair and technical services will be provided on reasonable charges. For any abnormality or malfunction, please contact our company in time so that we can arrange the most convenient solution.

Any damage caused by the following circumstances will not be covered by warranty responsibility.

(1) Due to negligence, failure to follow operating procedures, and misuse, the equipment was damaged.

(2) Damage caused by dismantling equipment or replacing parts without consent.

(3) Damage caused by improper handling during transportation or other handling processes.

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