

CY-D Dynamic Reactive Power Compensation Device

Operating Manual

Ceayea Electric Technology (Shanghai) Co., Ltd.

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I. Summary

The CY-D dynamic reactive power compensation device is to provide reactive power compensation for specific power grid. The reactive power compensation can improve the quality of electric energy, reduce line loss, enhance the output of transformer, prolong the service life of production equipment, improve the power factor, reduce the waste of electric energy, save electric charge and improve the economic returns of enterprise.

The product can be widely used in the fields with medium and strong harmonic waves requiring reactive power compensation, such as the metallurgy and smelting, tire manufacturing, cement product, plastic packing, steel and copper rolling, coal mining and so on.

In the CY-D dynamic reactive power compensation device, the LC circuit is adopted, and the thyristor is used as the solid-state switch for the capacitor switching. The device is resistant to harmonic waves and fast in response, and has no contacts. Besides, it produces no noises, surge current and overvoltage.

II. Fundamental Principle for Reactive Power Compensation

The reactive power compensation is classified into the centralized compensation, disperse compensation and random compensation.

The principle of overall planning, reasonable layout, graded compensation and local compensation shall be followed. There shall be a combination of the centralized compensation and the disperse compensation, with the disperse compensation playing a major role. There shall be a combination of the high-voltage compensation and the low-voltage compensation, with the low-voltage compensation playing a major role. The voltage regulation shall combine with loss reduction, with loss reduction playing a major role.

III. Operating Principle for Reactive Power Compensation

The power delivered from the power grid includes the active power and reactive power. The active power directly consumes the electric energy to convert it into mechanical energy, thermal energy, chemical energy or acoustic energy or to apply work. The reactive power does not consume electric energy, but converts it into another form of energy which is necessary for the electric equipment to apply work and has a periodic switch between itself and the electric energy in the power grid. When applying work in the inductance element, the current is 90° ahead of the voltage. When applying work in the capacitor element, the current is 90° behind the voltage. In the same circuit, the inductive current goes contrary to the capacitive current, thus producing a difference of 180° . The reactive power compensation is to install capacitor elements in the electromagnetic circuit proportionally to offset the currents of the two and to reduce the included angle between the current vector and the voltage vector, so as to enhance the working capacity of electric energy.

IV. Service Environment

1. Ambient temperature: Maximum 40°C (not above 35°C within 24 hours)

Minimum -10°C ; Maximum daily temperature difference 25K ;

Notes: It is allowed to be stored and transported under the temperature of 35°C .

2. Humidity: The average daily relative humidity is not more than 95%; the average monthly relative humidity is not more than 90%.

3. Altitude: Not higher than 1,000 meters above sea level

4. Pollution severity: Grade III

5. Environment with strong harmonic waves: Total harmonic distortion of voltage: 10%-15%; total harmonic distortion of current: above 30%;

V. Main Technical Parameters:

1. The minimum response time: 20ms;

2. Fifth harmonic absorption rate $\geq 20\%$;

3. In the process of compensation, the voltage fluctuation in the power grid meets

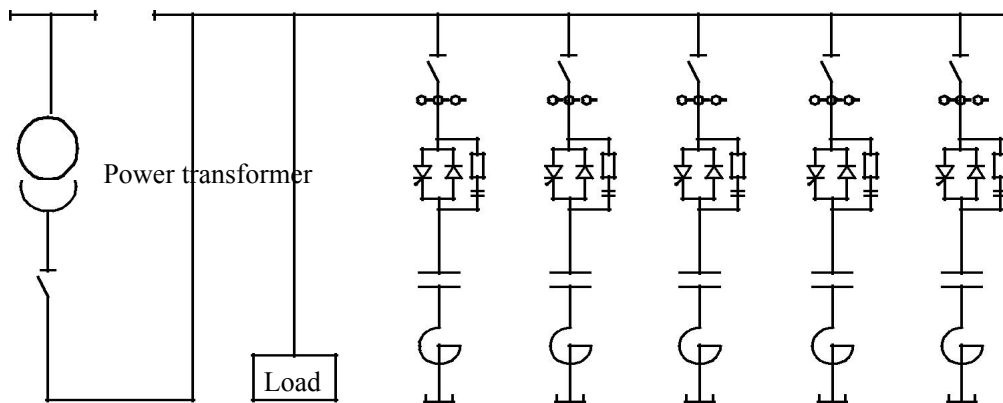
GB12326-90 national standard.

4. No surge current and vibration in the process of switching;
5. Providing the over-current protection, over-voltage protection, overheating protection, ground protection and so on;
6. The long-time running under 1.1 UN allowed; the long-time running under 1.3 UN allowed;
7. Physical parameter sampled: Reactive power;
8. Display: 11 parameters including the power factor PF, U, I, S, Q, P and so on;
9. Mode of operation: Automatic and continuous operation.

VI. Basic Circuit of Reactive Power Compensation Device

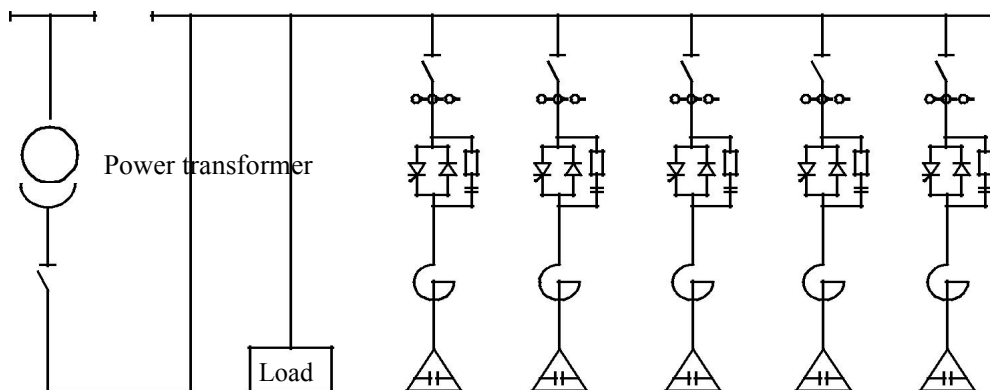
1. Y Wiring:

High-voltage side Low-voltage side

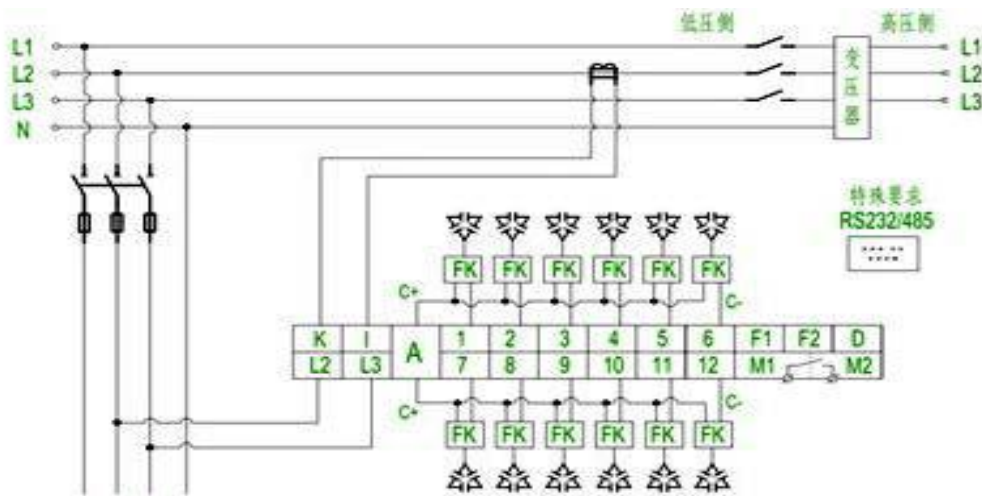


2. Δ Wiring:

High-voltage side Low-voltage side



3. Control Mode of the Controller



VII. Application of CY-D Dynamic Reactive Power Compensation Device

1. Reactive Power Compensation for Unstable Load

In plants, the electric equipment is largely used, such as the plastic extruding machine and injection molding machine used in the plastic plant, and the lifter, punching machine, elevator, electric welding machine, conveyor belt in mines and so on in other fields, all of which have a greatly changeable reactive power loss. There are also loads with rapid or extremely fast change of reactive power, such as the reactive power compensation for the spot welder, seam welder and welding machine in automobile manufacturer, motor manufacturer and so on. In the automobile manufacturer, the spot welder's load changes very rapidly and produces a lot of reactive power. The reduction of total voltage will lead to a poor welding quality and affect the welding efficiency. Hence, it is quite necessary to stabilize the current, so as to improve the welding quality, eliminate flicker, make full use of the existing equipment and reduce costs.

2. Centralized Current Compensation in Concentrated Motor Startup

When the cage motor starts up, it consumes the amperage of current about 6 to 7 times higher than that consumed during normal operation. Most of the startup current is the reactive component, and the routine contactor system fails to compensate it, thus resulting in a dramatic voltage drop. Whereas, the CY-D system is able to follow the reactive current, compensate it and reduce it to a required range. In the power grid, the optimum capacity

input can rapidly provide proper amount of reactive power to the system in real time, thus protecting the electric equipment. Currently in many occasions, the dynamic compensation product has replaced the original reduced-voltage starter and the motor soft starter.

3. Reactive Power Compensation for Steelworks and Port Facilities

For the rolling mill in the steelworks, bridge crane in the port, crane in the plant and other occasions, plenty of reactive power is needed in their operation cycles. The active loss (P_{cu}) caused by a high reactive current can result in a remarkable voltage drop on the high-voltage side and low-voltage side of the transformer. Especially, in the rolling and lifting process, the voltage flickers and fluctuates significantly. For the occasions with a low power factor in which the great inductive load change affects the normal operation of other equipment, the device is able to complete all the reactive power compensation within 20ms, dynamically stabilize the voltage, improve the load capacity, eliminate the voltage flicker and fluctuation, effectively inhibit the harmonic waves and greatly lower the temperature of rectifier transformer, thus achieving a remarkable power-saving effect and gaining a considerable economic benefit.

VIII. Control of the CY-D Dynamic Reactive Power Compensation

Device

1. The model of the controller is CYJK-200. The controller makes the voltage and current as the input physical parameters, and adopts the alternating sampling, with the sampling frequency of 3.2KHZ. The electric power parameters are extracted by means of the numerical algorithms. With an output accuracy of 1% and display accuracy of 1%, the controller can achieve accurate control in spite of serious voltage and current distortion. The controller can display 11 kinds of parameters in real time, such as PF, U, I, S, Q, P, CT ratio, voltage threshold, time delay and reactive power threshold.

2. Operating Mode of Controller

A. Automatic Operation

Once started up correctly, the controller will enter into the automatic operation state, and display the power factor. Following the operation instructions for the controller, you

can observe the voltage, current, active power, reactive power, apparent power and so on.

Under the normal running state, the system will operate by following the set procedures.

B. Manual Operation

By switching to the manual state, the compensation controller can be switched from the automatic operation state to the manual operation state. A smooth switch between the automatic state and manual state can be achieved.

Notes: In case of manual operation, the electric power parameters will not be displayed.

No matter by the automatic operation or the manual operation, the indicator (milk white) for corresponding loop on the controller panel is on when the loop is used, and is off when the loop is cut off.

IX. Precautions for Installation and Maintenance

1. The device operates in parallel with the load. Please pay attention to the correspondence in connecting the busbar of the incoming end and the busbar at the low-voltage side of the main transformer.

2. The controller current shall be sampled from the master outgoing line at the low-voltage side. The transformation ratio of the current transformer shall correspond to that of the controller. The sectional area of the sampled wire shall be above 2.5mm².

3. Each equipment cabinet has the grounding points. The cabinet shall be properly grounded.

4. After the installation, you shall carefully check the circuit, connecting end, insulation and grounding to ensure a correct wiring, reliable connection and safe insulation and grounding.

5. Please pay attention to the ventilation and heat dissipation effect in the place where the device operates. The ventilation opening on the device panel shall be cleaned at regular interval.

6. No dust or oil shall gather on the main components (such as the breaker, AC contactor, electronic switch, capacitor and electric reactor).

7. The construction and maintenance shall be carried out when the power is off !!!

X. Others

Table for the Comparison Between CY-D Low-voltage Reactive Power Compensation Cabinet (Dynamic Compensation) and AC Contactor (Static Compensation)

Device Name and Comparison Items	CY-D Dynamic Reactive Power Compensation Cabinet	Contactor-type Compensation Device
Capacitor switching switch	Power semiconductor module	Contactor
Switching-in surge current	None	Serious
Response time	<20ms, rapid track of switching	1-10s, failure to achieve rapid track of switching
Switching mode	Thorough compensation, and to complete compensation at one go	Gradual tentative switching, and slowly-approached compensation
Vibration in switching	None	There may be vibration in low load.
Compensation effect	Minimum reactive power	The reactive power is not small in heavy load.
Maintenance amount	Small	Great
Service life	Long	Short
Operation place	No limit	In the place with stable load and stable voltage
Development tendency	To be vigorously developed	To be eliminated

XI. Appendix

Schematic diagram for primary circuit and schematic diagram for secondary circuit

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