HIGH VOLT
Test with the best.®

HVDC TEST SYSTEMS AND POWER SUPPLIES

- DC voltage tests on components of HVDC transmission (transformers, bushings, thyristor valves, cables)
- DC voltage power supplies for charging of capacitor banks

HVDC TEST SYSTEMS

Fig. 1 **HVDC test system type GP 50/2000**

Fig. 2 **HVDC power supply type GE 200/900**

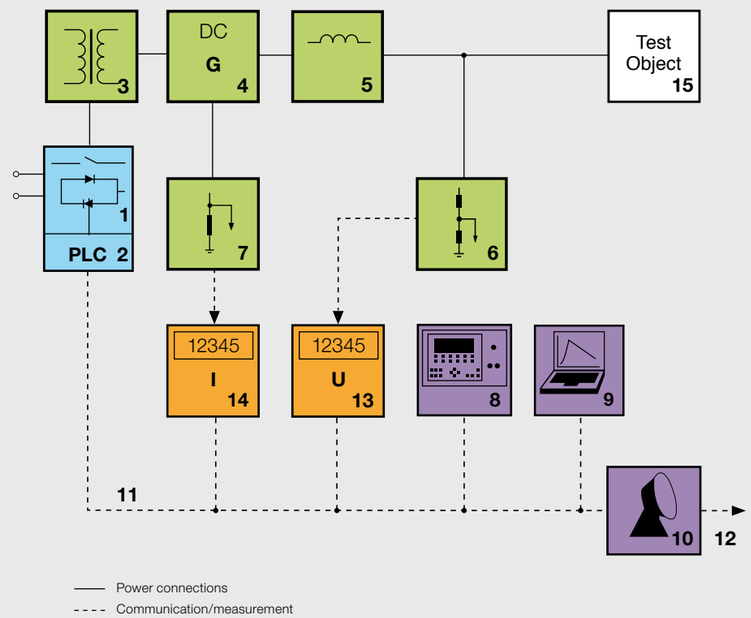

Fig. 3 **Block diagram of HVDC test system**

Power supply

1 Switching cubicle including thyristor controller
2 Programmable logic controller

HV circuit

3 AC transformer
4 DC generator
5 Damping resistor
6 Voltage divider
7 Current shunt

Control system

8 Operator panel
9 Industrial computer
10 Remote access module
11 PROFIBUS / Ethernet
12 LAN, Internet

Measuring systems

13 Peak voltmeter
14 Current meter

15 Transformers, bushings, HVDC valves, cables

FACTS IN BRIEF

HIGHVOLT offers two types of HVDC sources:
HVDC test systems and HVDC power supplies.

HVDC test systems are used to generate high-voltage DC test voltages for routine, type, and development tests on components of HVDC transmission systems. They are used for withstand testing or polarity reversal testing according to IEC 60060-1.

An HVDC test system consists of an HVAC transformer, doubling capacitors, rectifiers, smoothing capacitors, and a resistive voltage divider. The HVAC voltage will be rectified to the HVDC test voltage by means of an appropriate electric circuit (e.g., Cockcroft-Walton).
The HVDC test systems allow polarity reversal testing according to relevant standards. They feature a reliable electrical and robust mechanical design. The state-of-the-art control system supports the operator during automatic test procedures.

The following features are available to match the customers' requirements:

- Feeding of the HVDC test system by means of a thyristor controller for fast voltage adjustment in comparison to a regulating transformer
- High-voltage coupling capacitor for PD measurement
- Air-cushions for easy positioning

HVDC test systems are available for both indoor and outdoor applications.

HVDC power supplies are mainly used for charging of capacitor banks at high-power laboratories. They have a design similar to that of the HVDC test systems, but there is no need for a smoothing capacitor.

BENEFITS

- LOW RIPPLE (< 3 % ACC. TO IEC)
- LOW PD LEVEL BY PROVEN DESIGN
- FAST POLARITY REVERSAL TESTS
- HIGH LEVEL OF SAFETY FOR PERSONNEL DUE TO AUTOMATIC EARTHING SYSTEM
- HIGHEST VOLTAGES AND CURRENTS FOR POWERFUL TESTING
- DESIGNED FOR CONTINUOUS OPERATION UP TO ONE YEAR

APPLICATION

HIGHVOLT offers standard HVDC test systems with a rated current from 5 mA to 1000 mA and rated voltage up to 2400 kV. They are adapted to the following test applications.

Main applications for HVDC test systems are:

- Testing on HVDC cables
- Testing on DC bushings according to IEC 62199
- Testing on converter transformers according to IEC 61378-2
- Electrical testing on thyristor valves according to IEC 60700-1
- Testing on overhead lines and their components

Main application for HVDC power supplies is:

- Charging of capacitor banks for synthetic test circuits at high-power laboratories

- MAINTENANCE-FREE
- LOW LIFE-CYCLE COSTS
- TIME SAVING DUE TO AUTOMATIC TESTING PROCEDURES

SYSTEM AND COMPONENTS

The HVDC test system is supplied with the feeding power via a switching cubicle including thyristor controller **(1)** [see *fig.* 3]. The thyristor controller **(1)**, or optionally a separate regulating transformer, serves to adjust the generated test voltage. An adapted AC transformer **(3)** feeds the DC generator **(4)** with the designated high voltage. The DC generator with its rectifiers and capacitors generates the DC test voltage by means of an appropriate electric circuit. A resistive voltage divider **(6)** and a peak voltmeter **(13)** represent the voltage measurement system. A current shunt **(7)** and a current meter **(14)** are used to display the DC test current. The test object is connected via an external damping resistor **(5)**. This damping resistor protects the DC generator against transient overvoltage occurring after a possible breakdown of the test object.

Two HIGHVOLT control and measurement systems are available. The basic control system is based on an operator panel **(8)** with a SIMATIC software package for controlling the programmable logic controllers **(2)** connected by an optical PROFIBUS **(11)**. This enables manual and automatic operation of the test system. The advanced computer control system is a combination of the basic control and an industrial personal computer **(9)** with the WGMS software package preinstalled. It enables you to print customized test records. Furthermore, it can be connected to the user's LAN and via the Internet **(12)** to the HIGHVOLT Service Center for technical support, software updates, and troubleshooting.

HVDC TEST SYSTEMS

TECHNICAL PARAMETERS

HVDC test systems are designed to generate HVDC test voltages according to IEC 60060-1. The test systems [see *fig.* 1] are applied for withstand or polarity reversal tests on components for HVDC transmission. For technical parameters of standard HVDC test systems, see *table 1*.

Table 1 **Standard HVDC test systems**

Test system	Rated current mA	Rated voltage kV	Rated power kW	Ripple %
GP 10/300	10	300	3	<3
GP 20/500	20	500	10	<3
GP 20/700	20	700	14	<3
GP 20/1000	20	1000	20	<3
GP 50/1000	50	1000	50	<3
GP 20/1500	20	1500	30	<3
GP 50/1500	50	1500	75	<3
GP 20/2000	20	2000	40	<3
GP 50/2000	50	2000	100	<3

Note: The given ripple also applies to a pure resistive load without additional capacitance of the object under test. During high-voltage testing the ripple voltage will decrease due to the capacitance of the test object.

The extension of the rated current up to 100 mA at a ripple of <3 % can be achieved by using additional smoothing capacitors. Power supply components have to be increased accordingly.

HIGHVOLT offers further test systems according to the customer's specific needs such as HVDC extension units type GZ. In this case the customer's HVAC test transformer and its control system will be used. Together with the HVDC extension unit they form a complete HVDC test system.

HVDC power supplies are suitable for quick charging of large capacitor banks (e.g., up to 10 µF at rated voltage of 900 kV) as part of synthetic test circuits at high-power laboratories. HIGHVOLT's HVDC power supplies usually feature a voltage-doubling circuit [see *fig.* 2].

HVDC power supplies are designed for short-term operation (e.g., 120 sec ON/180 sec OFF) with a high charging current but numerous of duty cycles.

Table 2 **Standard HVDC power supplies**

Power supply	Rated current mA	Rated voltage kV	Rated power kW
GE 200/500	200	500	100
GE 200/700	200	700	140
GE 200/900	200	900	180

Note: The HVDC power supplies do not need to fulfill voltage shape requirements (e.g., ripple) based on the standard IEC 60060-1.

CUSTOMIZED OUTDOOR APPLICATION

Certain HV tests (e.g., overhead lines, insulator chains, etc.) are often carried out under outdoor conditions. For this purpose HIGHVOLT provides suitable outdoor test systems that are designed according to the proven circuit principles of an indoor test system. Outdoor test systems are available as unipolar or double-pole apparatus. *Fig. 4* shows a double-pole test system with 200 mA and 600 kV that is used to test bipolar overhead lines.
The constructive design of the outdoor test system is adapted to the atmospheric conditions. For example, the test system in *fig. 4* consists of composite insulators with silicone rubber sheds.

HIGHVOLT customized outdoor applications are available for rated currents up to 1000 mA and rated voltages up to 1500 kV. Outdoor HVDC test systems with higher voltages and currents will be designed according to the customer's specific requirements.

Fig. 4 **Double-pole 600 kV outdoor HVDC test system type FGP 200/600**

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