HV TEST SYSTEMS BASED ON TRANSFORMERS

TECHNICAL PARAMETERS

HIGHVOLT offers two different designs of HV transformers

Insulating case transformer
(HIGHVOLT type PEOI)

Fig. 3 **Insulating case transformer cascade type WP 1000/1000**

Insulating case transformers are well suited for single operation, for operation in parallel connection, and also in series connection (cascading). Therefore they are also called „modular type transformers“. The oil-filled case is made of fiberglass reinforced plastic (FRP) tube with steel covers. It is suitable for indoor operation and outdoor operation under fair weather conditions.

Metal tank transformer
(HIGHVOLT type PEO)

Fig. 4 **Metal tank transformer type WP 300/300**

Test systems with **metal tank transformer** are a very space-saving solution. Thanks to the grounded metal tank, the test system can be set up close to the wall within the test field. If the positioning is outside, the high-voltage bushing of the transformer is routed through the wall, thus establishing a connection to the test field. The transformers can be operated in parallel or in a series connection as a high-voltage cascade. In the case of the series connection, the additional transformers are installed on insulated frames. Metal tank transformers are better suited for higher test powers and higher test loads, which are required e.g. for pollution tests. Their design and construction allows them to be operated under difficult ambient conditions, e.g. in open air test fields or under humid or tropical climatic conditions.

Test system with	insultag case transformer	metal tank transformer
Rated voltage Single transformer Cascade	 100 to 600 kV 600 to 1000 kV	 50 to 1000 kV 1000 to 1800 kV
Rated current	up to 2 A	up to 10 A
Duty cycle	short term operation (interval operation)	continuous operation
Installation	indoor (outdoor under fair weather)	indoor and outdoor
Building/shielded room	clearance to walls required	no clearance between tank and wall required
Mobility	wheels or air cushion	wheels or air cushion
Special design		oil-SF_6-bushing for GIS/GIL testing

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HIGH VOLT
Test with the best.®

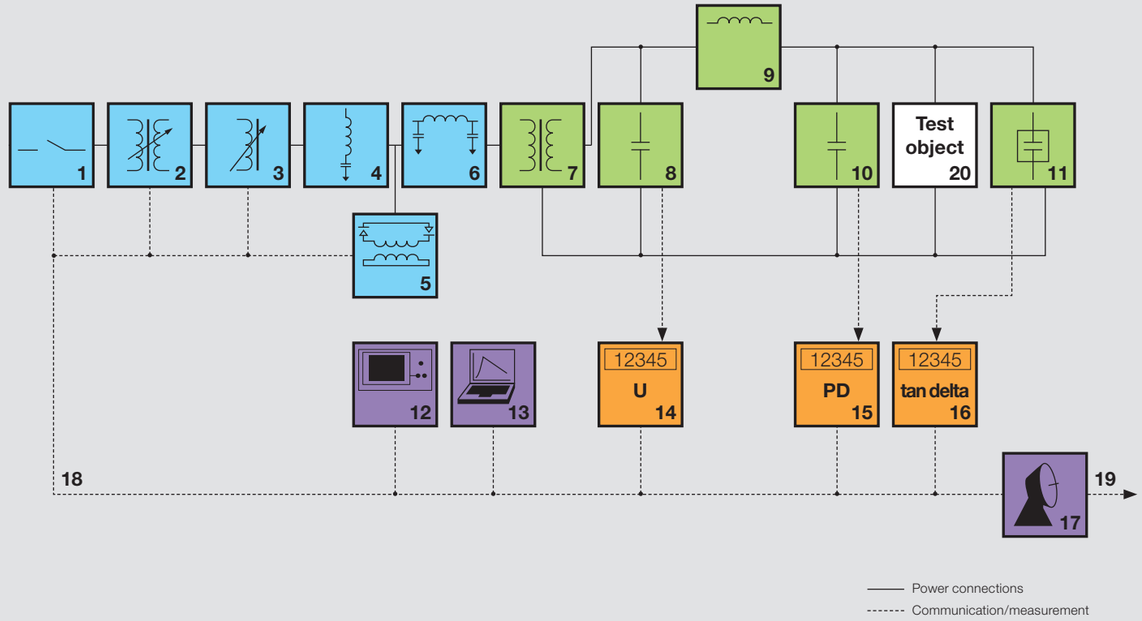
1.10/5 WP

HVAC TEST SYSTEMS BASED ON TRANSFORMERS

- AC HV withstand tests on insulators
- Suitable for dry, wet and pollution tests
- AC HV withstand tests on GIS and cable samples
- Multi-purpose test system for R&D and education

HV TEST SYSTEMS BASED ON TRANSFORMERS

Fig. 1 **HVAC cascade based on insulating case transformers type WP 1000/1000**



Power supply
- 1 Switchgear cubicle
- 2 Voltage regulator
- 3 LV compensation reactor
- 4 Filter unit for harmonics
- 5 Fast switch-off unit
- 6 LV filter for PD noise suppression

HV circuit
- 7 HV transformer
- 8 HV divider
- 9 Blocking impedance
- 10 Coupling capacitor
- 11 Standard capacitor

Control system
- 12 Operator panel, PLC
- 13 Industrial personal computer
- 17 Remote access module
- 18 PROFIBUS/Ethernet
- 19 LAN/Internet

Measuring system
- 14 Peak voltmeter
- 15 PD measuring device
- 16 Tan delta measuring device

- 20 Cable, transformer, capacitor, generator, motor, GIS/GIL

Fig. 2 **Block diagram of HVAC test systems**

FACTS IN BRIEF

HVAC test systems are intended to generate a continuously variable AC test voltage at power frequency. They are designed for testing all types of electrical insulations up to the highest voltages, preferably of electrical apparatus used in power transmission and distribution systems.
When the test object is a pure capacitance (e.g. cable, GIS) the HVAC can also be generated by a resonant test system (HIGHVOLT types WR, WRM, WRV). When a resistive current must also be supplied (e.g. due to heavy partial discharges or leakage currents) a test system based on an HV transformer (HIGHVOLT types WP, FWP) is the only possible source. Therefore such systems with transformers are the basic testing equipment of all multi-purpose HV test fields and laboratories. For the need of EHV and UHV labs the HV transformers are cascaded to double or triple respectively the output voltage.

An HIGHVOLT HVAC test system type WP generates test voltages fully in line with IEC 60060-1 characterized by:
- Sinusoidal output voltage in a frequency between 45 and 65 Hz
- Low content of harmonics, total harmonic distortion THD < 5 %
- Voltage stability within ± 1 % (for test duration 1 min)
- Short-circuit current > 0.1 A for dry and internal insulation tests, > 0.5 A for rain tests and up to 15 A for pollution tests
- Low PD noise level to enable sensitive PD measurements at the test object

APPLICATION

Test systems based on HV transformers are used in a wide application range due to their capability to supply not only reactive (capacitive) power but also active power. Generally they are therefore suited for HV tests under dry, wet, and polluted conditions not only in industry, but also for research, development and student training. Transformer test systems are also well suited for combined and composite HV tests e.g. on HV disconnectors.

Some applications are
- HV withstand tests on **insulators** (dry, wet, polluted)
- Applied voltage test on **power transformers**
- HV withstand and PD tests on **GIS** and **GIS/GIL components**
- Type and prequalification tests on **cable samples**
- Various HV tests on **power switches** and **disconnectors**
- HV tests on **current** and **voltage transformers**
- Different HV tests including PD and C/tand δ measurement in **R&D** and **education**

SYSTEM AND COMPONENTS

The main component of an HVAC test system is the HV generator (7) [see *fig. 2*] consisting of a single test transformer or a transformer cascade including a base frame (e.g. for air cushion transportation) and top electrode. The HV generator is fed via the switchgear cubicle (1) and the voltage regulator (2) which can be combined with a booster transformer. To reduce the mainly capacitive load currents, compensation reactors on the LV side (3) (in special cases also on the HV side) can be applied. To guarantee the sinusoidal voltage shape, filters for harmonics (4) are arranged on the LV side (for cascades also on the intermediate HV stages). When the system shall be used for PD measurement the application of a low-pass filter (6) for suppressing noise signals from the mains is useful.

In addition to the voltage divider (8) an HV filter including blocking impedance (9) and a coupling capacitor (10) are applied when sensitive PD are measured. For C/tand δ measurement, a compressed gas standard capacitor (11) is necessary. In the case of a breakdown, the energy flow and the overvoltage are limited by the fast switch-off unit (5).
The control and measuring system includes the operator device (12) and/or an industrial PC (13) as well as the measuring instruments for voltage (14), partial discharge (15) and C/tan δ (16). The communication links (PROFIBUS or Ethernet) between these components as well as with the programmable logic controllers (PLC) in the feeding components are realized by optic links (18).
The control system can be connected via the Remote Diagnostics and Access Module (17) to the user's LAN or via Internet (19) to the HIGHVOLT Service Department.

BENEFITS

- SINUSOIDAL OUTPUT VOLTAGE
- LOW CONTENT OF HARMONICS THD < 5 %
- SUITED FOR DRY, WET, AND POLLUTION TESTS
- ADAPTED DESIGNS FOR SHORT TERM AND CONTINUOUS OPERATION
- HIGH OUTPUT VOLTAGE STABILITY
- LOW INTERNAL PD NOISE LEVEL