HIGH VOLT
Test with the best.®

9.12/3 Type WV

TRANSFORMER TEST SYSTEM

- Induced AC voltage test
- Measurement of no-load loss and current
- Measurement of short-circuit impedance and load loss
- Temperature-rise test
- Special tests

TRANSFORMER TEST SYSTEM

Fig. 1 **Transformer test system for induced voltage tests, based on static frequency converter, type WV 2000-4000/170**

FACTS IN BRIEF

The transformer test system is able to perform induced AC voltage tests, measurements of no-load losses and no-load currents, measurements of short-circuit impedances and load losses, temperature-rise tests and special tests according to the international standard IEC 60076 parts 1 to 3. The test system is based on a state-of-the-art static frequency converter and carries out tests implementing the precise waveform with a total harmonic distortion (THD) < 5 % and a partial discharge (PD) noise level < 10 pC. The test system is maintenance-free. And with its low investment costs and minimal installation requirements it has particularly low lifecycle costs. The test system is highly efficient due to fully-automatic testing procedures. Furthermore, the modular design of the test system allows for future expansions.

APPLICATION

1) Induced AC voltage test by exciting the low-voltage winding of the transformer under test for the HVAC test voltage on its HV side. The frequency converter supplies the excitation three-phase or single-phase voltage of ≥ 100 Hz, which can be adapted to different transformer LV windings by a finely graduated step-up transformer with numerous taps. The standard output voltages of the step-up transformer range from 1.5 kV to 170 kV.

2) Measurement of no-load loss and current at rated voltage and power frequency (50/60 Hz) in three-phase and single-phase mode. For the loss measurement the appropriate equipment is connected to the LV side of the transformer under test.

BENEFITS

- THD < 5 %
- PD NOISE LEVEL < 10 pC
- FREELY ADJUSTABLE FREQUENCY 40 TO 200 Hz
- MODULAR DESIGN ALLOWS FOR FUTURE EXPANSIONS
- ACCURATE LOSS MEASUREMENT DUE TO QUARTZ OSCILLATOR STABLE TEST FREQUENCY

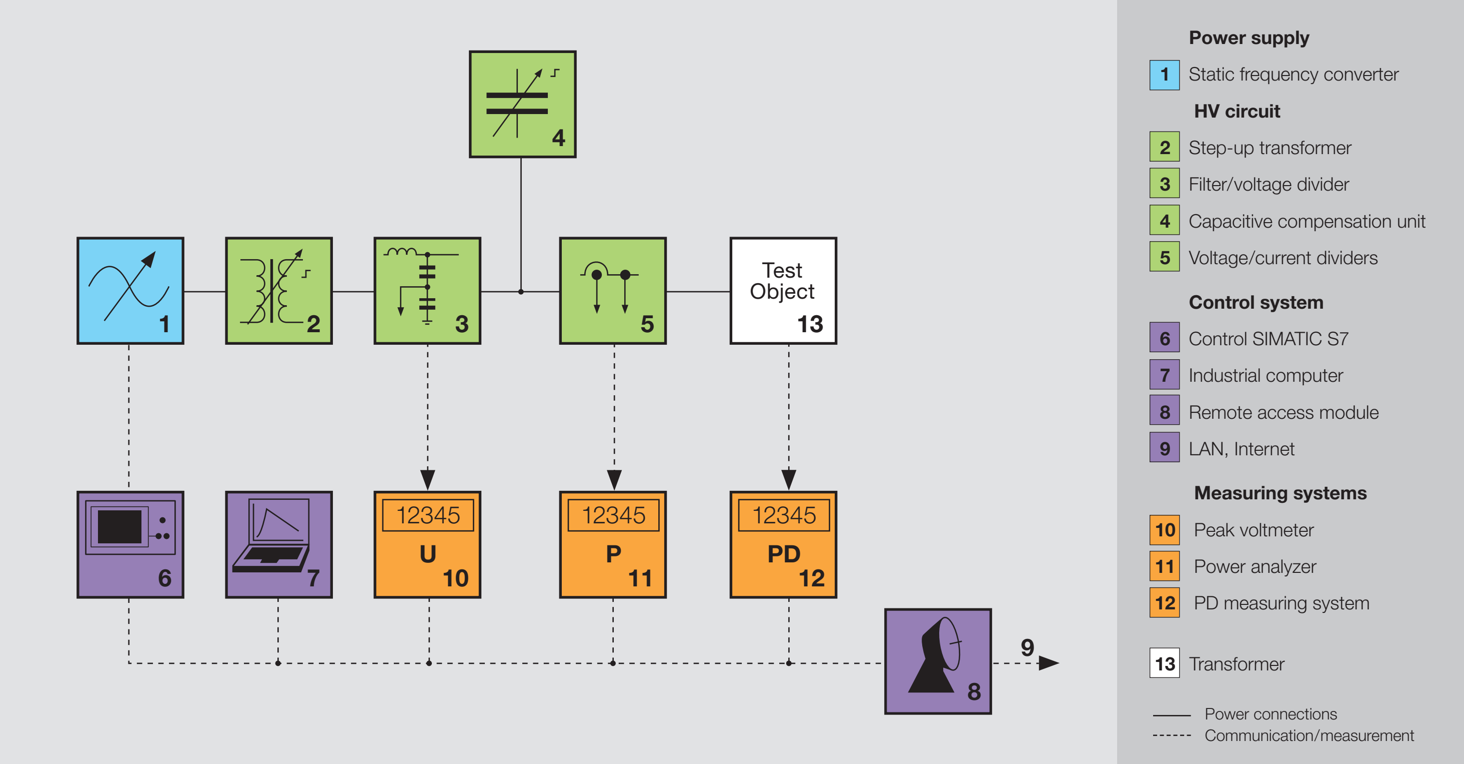

Fig. 2 **Block diagram of on-site transformer test system**

3) Measurement of short-circuit impedance and load loss at rated current and power frequency (50/60 Hz) in three-phase and single-phase mode using a loss-measuring system. A capacitive compensation unit is required.

4) Temperature-rise test with increased feeding power to heat up the test object with the sum of load and no-load losses at 50/60 Hz. A capacitive compensation unit is required.

5) Special tests such as for example the determination of sound levels under no-load and load conditions or the measurement of the zero-sequence impedance(s) at 50/60 Hz.

SYSTEM AND COMPONENTS

The central feeding source is the static frequency converter (1) [see *fig. 2*]. It supplies the active as well as the reactive power with variable amplitude and frequency to the test circuit. The output voltage of the converter is adjusted to the required test voltage level by the finely graduated step-up transformer (2). The EMC interferences are smoothened by the filter (3). The associated filter capacitor is built as a divider and gives an input signal to the peak voltmeter (10) for the test voltage measurement and control. An adapted and finely graduated HV capacitive compensation unit (4) enables compensation of the reactive power during the measurement of load losses or the temperature-rise test. A measuring system consisting of voltage and current measuring units (5) and a power analyzer (11) are applied for precision power measurements. The computer control (7) together with the control Simatic S7 (6) enables automatic execution of complex test procedures as well as data storage in a central database for further evaluation or even generation of a complete transformer test protocol (HIGHVOLT-Suite®). The test system is rounded off by a multi-channel PD measurement system (12).

- LOW NOISE EMISSION
- MAINTENANCE-FREE
- LOW INVESTMENT AND LIFE-CYCLE COSTS

TRANSFORMER TEST SYSTEM

TECHNICAL PARAMETERS

1 Power ratings

One of the most important parameters of a transformer test system is the available active and reactive power for exciting the transformer under test. The required test power depends on the power and voltage rating of the transformers under test and the specific design as well as on the tests to be performed. During the induced AC voltage test the transformer under test is a linear, mostly ohmic-capacitive load. The required test power is low but increases with increasing test frequency.
In case of the measurement of no-load loss at 50/60 Hz, the transformer under test is fully excited and the no-load current contains a considerable amount of harmonics. The transformer under test represents a non-linear load. The required test power is low but the test power source should behave like a very stiff AC power supply to avoid interferences from the noload current harmonics on the test voltage wave shape. In contrast, the transformer under test represents a linear and ohmic-inductive load during the measurement of short-circuit impedances and load loss and the temperature-rise test. The temperature-rise test requires the highest values of active and reactive power to be fed to the test object. The static frequency converter delivers the active and a minor part of the required reactive power. The main part of the reactive power has to be provided by an adapted and fine graduated capacitor bank (HVC). *Fig. 3* illustrates the reactive-active characteristic of a 2 MW/4 MVA test system at 50 Hz, as well as with a HV capacitor bank of approximately 100 Mvar. Each point under the curves is one available combination of active and reactive power of the test system. For standard test systems and corresponing test parameters refer to *table 1.*

2 Sine wave shape

The test system completely fulfills the requirements of IEC 60076 defining a THD < 5 % of the test voltage. *Fig. 4* shows a typical oscillogram of the output voltages of the transformer test system while testing a power transformer at 150 MVA. Despite an extreme non-linear current consumption (THD of transformer current 52 %), the achieved THD of the test output voltage does not exceed 3.5 %.

3 PD level

The maximum PD noise level measured according to IEC 60270 does not exceed a level of 20 pC. The test system therefore completely fulfills the requirements of IEC 60076-3.

4 Frequency

One of the major advantages using a static frequency converter as heart of the transformer test system is the continuously variable frequency from 40 to 200 Hz. As a result, only one static frequency converter is used as central power source for all the loss measurements at 50/60 Hz as well as for the induced voltage test with usual test frequencies ≥ 100 Hz. The test system has a quartz-oscillator-stable output frequency (±0,01 Hz) which is the basis for precise measuring results.

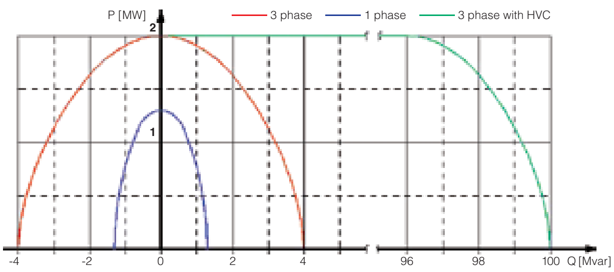

Fig. 3 **P-Q diagram of test system (three-phase and single-phase at 50 Hz)**

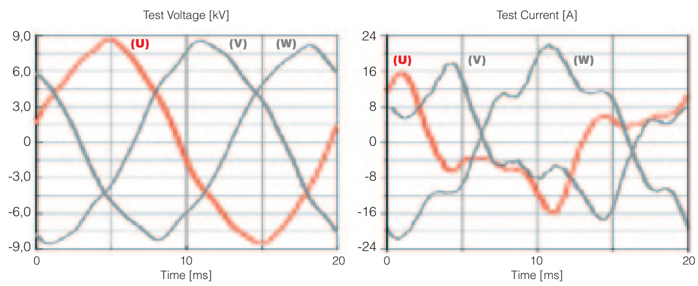

Fig. 4 **Test voltage and current waveform – no-load loss measurement with THDu < 3.5 % and THDi = 52 % (150 MVA transformer)**

Table 1 **Standard test systems and corresponding parameters**

Test system	WV 620/1200	WV 1000/2000	WV 1500/3000	WV 2000/4000	2x WV 2000/4000
Active power	620 kW	1000 kW	1500 kW	2000 kW	4000 kW
Apparent power (converter)	1200 kVA	2000 kVA	3000 kVA	4000 kVA	8000 kVA
Reactive power (compensation)	12 Mvar	24 Mvar	48 Mvar	100 Mvar	200 Mvar
Max. output voltage	80 kV	80 kV	80 kV	170 kV	170 kV
Transformer to be tested	50–100 MVA	100–220 MVA	220–400 MVA	400–630 MVA	630–1000 MVA

For further information please contact:

HIGHVOLT Prüftechnik Dresden GmbH
Marie-Curie-Straße 10
01139 Dresden
Germany

Phone +49 351 8425-700
Fax +49 351 8425-679
E-mail sales@highvolt.de
Web www.highvolt.de