

## PHG 70 TD PD / PHG 80 TD PD

### BAUR VLF test and diagnostics system

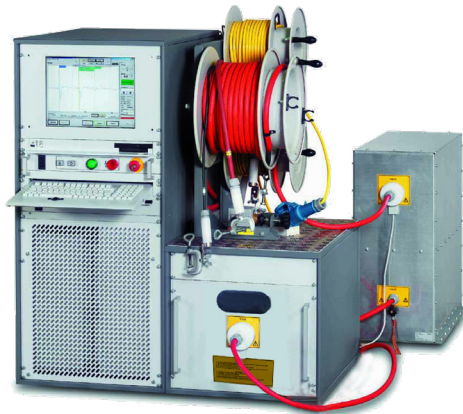


Figure: PHG 80 TD PD

### Universal test and diagnostics system – flexible, modular, extendable

- Cutting-edge testing and diagnostics technology: VLF truesinus®
- High performance test generator with three voltage shapes
- Comprehensive cable analysis by means of partial discharge and dissipation factor measurement

The modular BAUR PHG test and diagnostics system is used for cable testing, dissipation factor measurement and partial discharge testing. The modular design allows the system configuration to be tailored exactly to your needs and extended as required at any time.

**PHG 70 / PHG 80:** Used for cable and cable sheath testing of electrical equipment and medium-voltage cables up to 50 kV. With the VLF truesinus® and VLF square wave voltage as well as the DC voltage, the PHG 70 and PHG 80 offer a stable and load-independent voltage source for a broad range of possible applications and various cable types.

**PHG 70 TD / PHG 80 TD:** Extend the range of functions of the PHG to include dissipation factor measurement. Dissipation factor diagnostics with VLF truesinus® at 0.1 Hz delivers reliable information on the ageing condition of plastic- and paper-insulated mass-impregnated cables, and makes it possible to differentiate between new, slightly or heavily aged cable systems.

**PHG 70 TD PD / PHG 80 TD PD:** Additionally offer partial discharge testing. Partial discharge testing allows a fast and reliable evaluation of partial discharge activity and the location of PD faults in a cable. Potential faults can thus be recognised early and further damage reduced.

#### Functions

##### Cable testing: PHG 70 / PHG 80

- VLF truesinus® up to 38 / 57 kV<sub>rms</sub>
- VLF square wave voltage up to 57 / 80 kV
- DC voltage up to ±70 / ±80 kV
- Cable testing according to IEC 60502, DIN VDE 0276-620/621 (CENELEC HD 620/621), IEC 60060-3, IEEE 400.2, IEEE 400-2012
- Cable sheath testing according to IEC 60229
- Testing of generators, transformers and switchgear
- Load-independent, reproducible sinusoidal high voltage by means of VLF truesinus® testing technology
- Programmable, fully automatic test sequences

##### Dissipation factor measurement: PHG 70 TD / PHG 80 TD

- Dissipation factor testing of electrical equipment and medium-voltage cables up to 50 kV operating voltage
- Highly precise dissipation factor measurement with precision of  $1 \times 10^{-4}$
- Measurement results take leakage currents into consideration
- Adjustable threshold values for measurement evaluation and stop criteria
- Easy to understand numeric and graphic presentation of measurement results

##### Partial discharge testing: PHG 70 TD PD / PHG 80 TD PD

- Partial discharge testing and calibration of the measurement setup according to IEC 60270
- Measurement of
  - PD level
  - PD inception and extinction voltages
  - PD frequency
- Exact location of PD activities in cable insulation, joints and terminations
- PD phase resolving for classification of PD faults (option)

## PHG 70 / PHG 80

### High performance test generator with VLF truesinus® technology

#### VLF truesinus® – A voltage shape for all methods and method combinations

VLF truesinus® is the only voltage shape that enables both the reliable voltage tests as well as precise dissipation factor measurements and partial discharge testing. Unlike other voltage shapes, the VLF truesinus® voltage is load-independent, symmetrical and continuous. This is a prerequisite for high precision as well as reproducibility and comparability of measurement results.

#### The key features

The high performance HV generator fulfils all requirements with regard to safety, durability and operational convenience. All of the key cable data can be stored in the user-friendly software. The results of every test and every measurement are saved along with these cable data, which creates a comprehensive cable database that allows the operational evaluation on the basis of historical trends.

- Single voltage source for all tests, dissipation factor and partial discharge measurements
- Symmetrical voltage prevents any undesired effects (e.g. space charge)
- Actual and trend analysis of the cable conditions thanks to the cable database
- Control panel with intuitive software
- Comprehensive safety concept with automatic discharge unit
- Compact design
- Suitable for installation in cable test vans



Installation in cable test vans

# PHG 70 TD / PHG 80 TD

## Cost-optimised maintenance through cable diagnostics

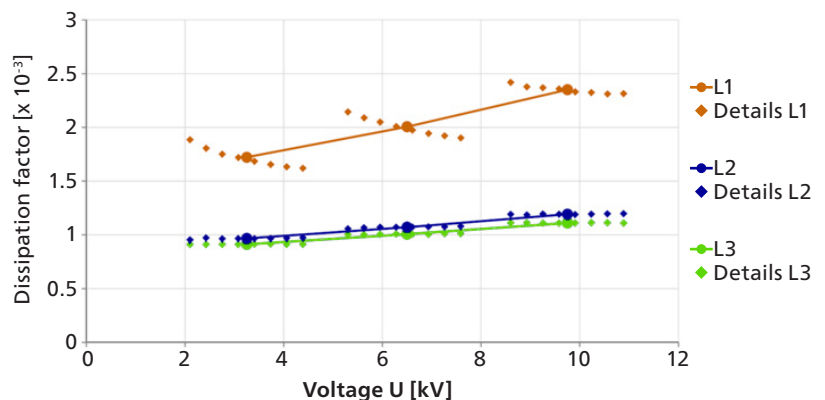
### Precise dissipation factor measurement with PHG TD – important addition for partial discharge testing

The dissipation factor measurement is a non-destructive and integral procedure that serves to evaluate the condition of an entire cable route. With the dielectric dissipation factor  $\tan \delta$ , the relation of effective power to reactive power of the cable is measured. The measurement provides clear information on the condition of the insulation and its ageing condition.

The dissipation factor measurement can identify the following weak points:

- Areas in the insulation of XLPE cables that are damaged by water (water trees) which lead to electrical trees and represent the natural cause of a cable fault
- Faults in the insulation of paper-insulated mass-impregnated cables due to drying
- Insufficient insulation of paper-insulated mass-impregnated cables due to moisture
- Moisture in accessories (joints/terminations)
- Possible partial discharges

### Condition evaluation even during the ramp-up stage\*



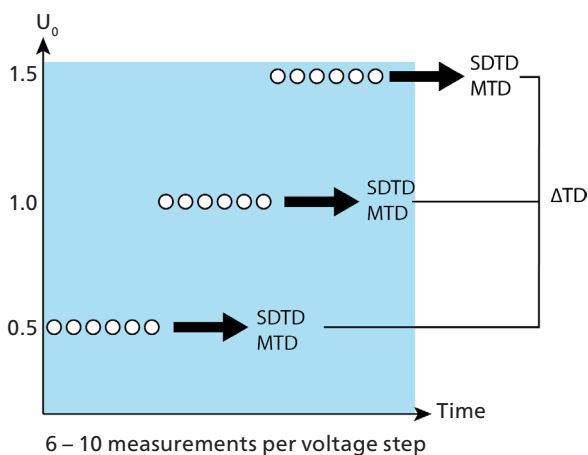
Example: Falling dissipation factor values in L1 indicate moisture in a joint

### Continuous evaluation and monitoring of three criteria

SDTD: Standard deviation (dissipation factor stability)

MTD: Mean value of dissipation factor

$\Delta$ TD: Change of the dissipation factor between successive voltage steps.



### The key features

- Fast and efficient assessment of cable insulation (in a few minutes)
- Trend analysis by means of long-term comparison of dissipation factor values
- Reliable, reproducible measurement results using the load-independent VLF truesinus® voltage
- High measurement accuracy ( $1 \times 10^{-4}$ ) and significance thanks to:
  - Detection of leakage currents
  - High resolution (up to  $1 \times 10^{-6}$  (mean value of the dissipation factor))
- Individual adjustment of evaluation criteria, stop criteria and automatic measurement sequences
- Easy evaluation of measurement results with the incorporated evaluation criteria for various cable types
- Easy to understand numeric and graphic presentation of measurement results

\* Incremental increase in voltage; dissipation factor values measured at each voltage step

## PHG 70 TD PD / PHG 80 TD PD

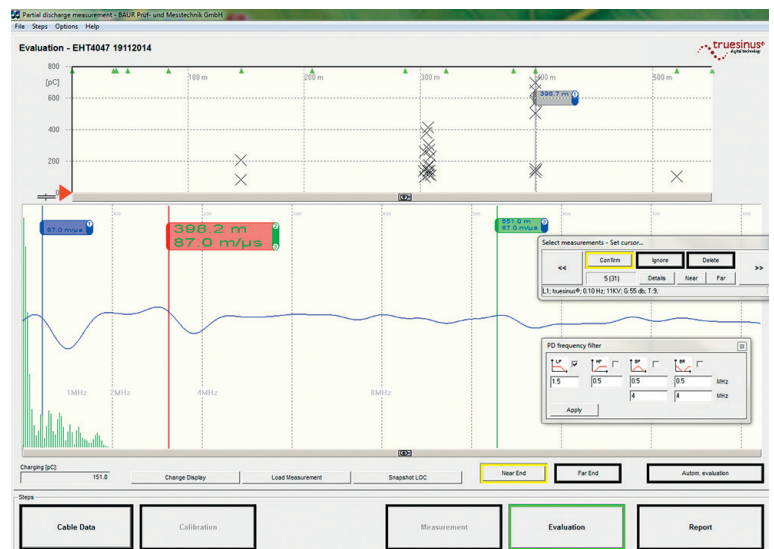
### Cost-optimised maintenance through cable diagnostics

#### Conclusive partial discharge testing with the PHG TD PD

Partial discharges (PD) are local electrical discharges that occur at faults or inhomogeneities in the insulation, e.g. at joints and terminations. In many cases, partial discharges are the preliminary stage for a breakdown of the insulation. Therefore, the occurrence of partial discharges is an essential criterion for assessing the insulation quality. Partial discharge testing is performed after laying a new cable, making repairs and to verify the operational reliability of aged cables as it is capable of identifying the following faults:

- Faults in new and old cable accessories (e.g. incorrectly mounted joints)
- Faults in the insulation of plastic-insulated cables (e.g. electrical trees)
- Insufficient mass-impregnated paper insulation due to drying
- Mechanical damage to the cable sheath

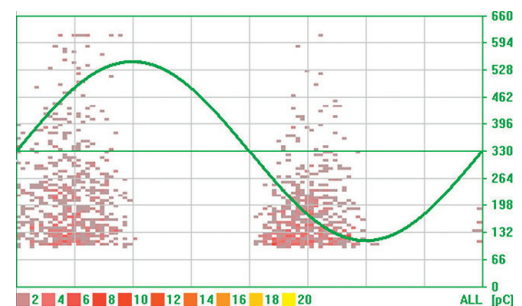
**Advantages of combinations:** Dissipation factor measurement and partial discharge testing are ideal complements, because on the one hand you can detect the overall condition and on the other, you can locate individual faults in the cable.



Example: Results of PD testing with a parasitic frequency filter

#### Phase-resolved PD presentation (PRPD)\*

The phasing of partial discharges can be determined through state-of-the-art analysis methods. The type of fault can be isolated and subsequent measurements and repairs can be targeted, thus saving time and money.



Example: Phase-resolved display of a partial discharge activity at 0.1 Hz

#### The key features

- Partial discharge testing and calibration according to IEC 60270
- PD level measurement and the exact location of PD activities in cable insulation, joints and terminations
- Measurement of the inception voltage and extinction voltage of partial discharges
- Simple and fast evaluation of the measurement results, including automatic evaluation mode and frequency filter
- Overview presentation of PD activity over the whole cable length
- Precise determination of the type of fault by means of the phase-resolved display of the partial discharges\*

\* Option

## Technical data

Output voltage	PHG 70	PHG 80
VLF truesinus®	0 – 38 kV <sub>rms</sub> 1.4 – 53.7 kV <sub>peak</sub>	0 – 57 kV <sub>rms</sub> 1.4 – 80.6 kV <sub>peak</sub>
VLF square wave voltage	0 – 57 kV	0 – 80 kV
Frequency range	0.01 – 1 Hz	0.01 – 1 Hz
DC voltage	0 to ±70 kV	0 to ±80 kV
Max. capacitive load	Up to 20 µF	Up to 20 µF 1.2 µF @ 0.1 Hz @ 57 kV <sub>rms</sub> 3 µF @ 0.1 Hz @ 38 kV <sub>rms</sub> 4 µF @ 0.1 Hz @ 30 kV <sub>rms</sub>
Resolution	0.1 kV	0.1 kV
Accuracy	1%	1%
Output current	PHG 70	PHG 80
Output current	10 mA @ DC 70 kV 60 mA @ DC 50 kV 90 mA @ DC 20 kV	1.8 mA @ DC 80 kV 60 mA @ DC 50 kV 90 mA @ DC 20 kV
Max. burn current	120 mA	120 mA
Resolution	10 µA	10 µA
Accuracy	1%	1%
Dissipation factor measurement	PHG 70 TD	PHG 80 TD
VLF truesinus®	0 – 38 kV <sub>rms</sub>	0 – 57 kV <sub>rms</sub>
Load range	≥10 nF	
Measurement range	0.1 x 10 <sup>-3</sup> – 1,000 x 10 <sup>-3</sup>	
Accuracy	1 x 10 <sup>-4</sup>	
Resolution	1 x 10 <sup>-6</sup> (mean value of the dissipation factor)	
Detection and compensation of leakage currents	Automatically via the VSE box	

Partial discharge testing	PHG 70 TD PD	PHG 80 TD PD
VLF truesinus®	0 – 38 kV <sub>rms</sub>	0 – 57 kV <sub>rms</sub>
Theoretical measurement range	10 – 12,800 m (at v/2 = 80 m/µs)	
Velocity of propagation (v/2), adjustable	50 – 120 m/µs	
Sampling rate	100 MSamples/s (10 ns)	
PD measurement range	1 pC – 100 nC	
Accuracy	Approx. 1% of cable length	
Resolution	0.1 pC / 0.1 m	
Calibrator		
Electrical charge (pulses)	<ul style="list-style-type: none"> <li>▪ CAL1B: 0.1 / 0.2 / 0.5 / 1 / 2 / 5 / 10 nC</li> <li>▪ CAL1E: 0.5 / 1 / 2 / 5 / 10 / 20 / 50 nC</li> </ul>	
Power supply	9 V block battery, DIN/IEC 6F22	
General		
Display	TFT monitor, 15.1"	
User interface languages	Arabic, Chinese (CN), Chinese (TW), Czech, Danish, Dutch, English, Finnish, French, German, Greek, Italian, Korean, Malay, Norwegian, Polish, Portuguese, Romanian, Russian, Serbian, Spanish, Swedish	
Power supply	200 – 260 V, 50/60 Hz	
Option	100 – 140 V, 50/60 Hz (with auto transformer)	
Max. power consumption	3,500 VA	
Ambient temperature (HV generator)	-20°C to +55°C	
Storage temperature (HV generator)	-30°C to +70°C	
Relative humidity	> 90%, non-condensing	
Dimensions (W x H x D) (HV generator)	Approx. 483 x 623 x 775 mm	
Weight		
HV generator	Approx. 160 kg	
Total	From 250 kg (depending upon equipment)	
Safety and EMC	CE-compliant in accordance with Low Voltage Directive (2014/35/EU), EMC Directive (2014/30/EU), EN 60068-2-ff Environmental testing	

\* from 45°C with reduction in performance

## Standard delivery

### PHG 70 TD, PHG 80 TD VLF test and diagnostics system

- BAUR PHG 70 or PHG 80 HV generator
- Dissipation factor measuring unit
- Industrial PC with pre-installed Windows 7 Ultimate and BAUR system software, without monitor
- TFT monitor, 15.1"
- PC keyboard
- SCU safety control unit
- DU 80 integrated discharge unit
- KTG M3 cable drum rack with HV connection cable, mains supply cord and earth cable, each 25 m
- Connection set including G-clamp and anti-corona protection
- VSE connection kit (VSE box) for dissipation factor measurement
- GR 80 earth rod
- 19" rack for PHG 70 TD/PHG 80 TD and DU 80
- User manual

### Options

- External emergency off unit with signal lamps, incl. connection cable, 25 m
- External emergency off unit with signal lamps, incl. connection cable, 50 m
- GDR 80-500 discharge and earth rod
- Connection cable, 50 m, for KTG M3 cable drum rack
- External auto transformer 110/230 V, 3 kVA

### PHG 70 TD PD, PHG 80 TD PD VLF test and diagnostics system

- BAUR PHG 70 or PHG 80 HV generator
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- Industrial PC with pre-installed Windows 7 Ultimate and BAUR system software, without monitor
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### Options

- PD phase resolving
- External emergency off unit with signal lamps, incl. connection cable, 25 m
- External emergency off unit with signal lamps, incl. connection cable, 50 m
- GDR 80-500 discharge and earth rod
- Connection cable, 50 m, for KTG M3 cable drum rack
- External auto transformer 110/230 V, 3 kVA
- CAL1B or CAL1E calibrator

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