PDC-ANALYSER-1MOD

User's Guide

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Caution

The PDC-ANALYSER-1MOD contains an externally accessible high voltage source producing up to 2 kV and up to 5mA (internal current limit).

The instrument must be operated only by skilled persons.

The operators are responsible for protecting the test site against the hazards related to high voltages. All the elements of a test setup, which are connected to this high voltage source or which could be set under voltage by any insulation breakdown, must be protected against being contacted by the operator or by any other person as long as the mains power is supplied to the instrument.

Also, the PDC-ANALYSER-1MOD must be stored and operated in a mechanically secured position and all the cables connected to it must be protected against making anyone fall over them or accidentally pull on them.

Content

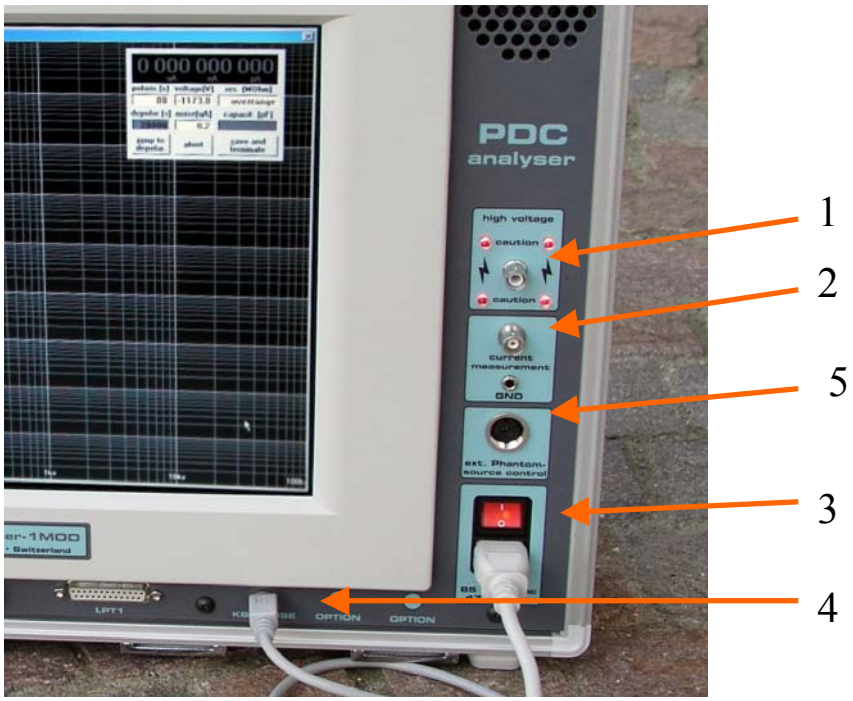


Figure 1: The connections of the **PDC-ANALYSER-1MOD**.

1 Hardware

Please connect the keyboard to jack "4" before turning on the **PDC-ANALYSER-1MOD**.

Use switch "3" to turn on the instrument.

The high voltage cable, which has a SHV plug, is connected to jack "1" and the current sensing cable with the BNC plug is connected to the jack "2" labelled "current measurement".

Plug "5" is for connecting the optional PDC-Phantom-1000XE voltage source, see separate instruction sheet.

For an accurate measurement, a warm-up time period of 60 min is recommended.

2 Measuring program

To perform a measurement with the **PDC-ANALYSER-1MOD**, start "PDC Measurement" by double clicking on this icons on the desktop of the instrument.

On the first window after invoking the program, the measuring parameters can be set:

- The name of directory, where the generated files will be saved.
- The name prefix for generated files (see Appendix A).
- The temperature value (important for the evaluation).
- The test voltage.
- The duration of an initial delay period before the measurement.
- The duration of the polarisation.
- The duration of the depolarisation.
- The description of the test object (only for information).

After the desired measuring parameters have been set, the measurement can be started by clicking "start measurements".

A new display appears and the instrument is internally initialised (this takes about seven seconds).

Then the first delay duration is counted down and the current from the current sensing cable is displayed. The measurement can be aborted anytime by pressing ALT-F4. The delay duration can be prematurely cancelled by pressing "jump to measurements".

Caution: As soon as the delay duration has been counted down or brought to end by pressing "jump to measurements", the high voltage source is turned on.

Now the polarisation takes place and the polarisation duration is counted down. During this period, the high voltage is indicated with four red lamps around the high voltage SHV jack "1". The polarisation period can be automatically jumped over by setting the polarisation duration to zero on the setup screen. The measurement program can be aborted anytime by pressing ALT-F4. If the accumulated data should be stored, click on "save and terminate" to terminate the program.

After the polarisation duration has been counted down, the high voltage source is set to exactly zero volts and the depolarisation duration is started. Still, the measurement program can be aborted anytime by pressing ALT-F4, but all the data will be lost. If the accumulated data should be stored, click on "save and terminate".

3 Evaluation program

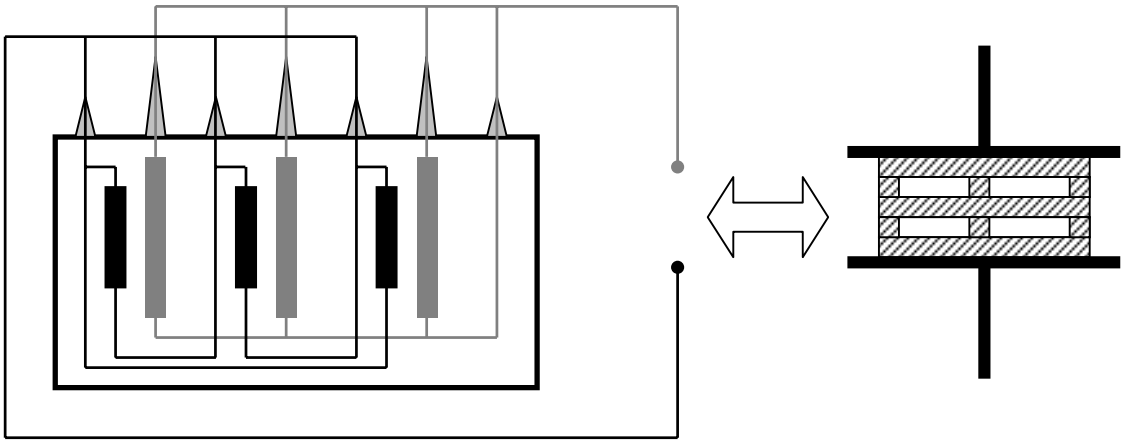
The measured polarisation and depolarisation currents can be evaluated with the *PDC-Evaluation* program. The basic version of this program permits the determination of the resistance, polarisation index (PI), recovery voltage and derived polarisation spectrum in the time domain and the complex capacitance $\underline{C} = C'(\omega) - jC''(\omega)$ and the derived $\tan\delta(\omega)$ in the frequency domain. For more information, see the User's Guide of *PDC-Evaluation* program.

4 Performing a measurement

To perform an accurate measurement, it is important to connect the test object to be investigated as long as possible to **PDC-ANALYSER-1MOD** before starting the measurement, because both the high voltage supply and the current sense input are normally short circuited to ground. Thus, the capacitances of the test object are well discharged.

Now, a 3-phase power transformer is taken as an example of a test object.

The transformer must be connected to the **PDC-ANALYSER-1MOD** as a capacitor (see figure 2). To obtain such an arrangement, all the high voltage bushings could be connected together, the high voltage windings behave as a first electrode of the capacitor under investigation. The second electrode of the capacitor is formed by connecting all the "low" voltage bushings together. The relaxation currents are sensed from the low voltage windings to ground. During the measurement the tank of transformer must be grounded (see figure 3).



Power transformer *Multi-layer capacitor*

Figure 2: How to connect a power transformer as capacitor for the dielectric investigation of the main insulation.

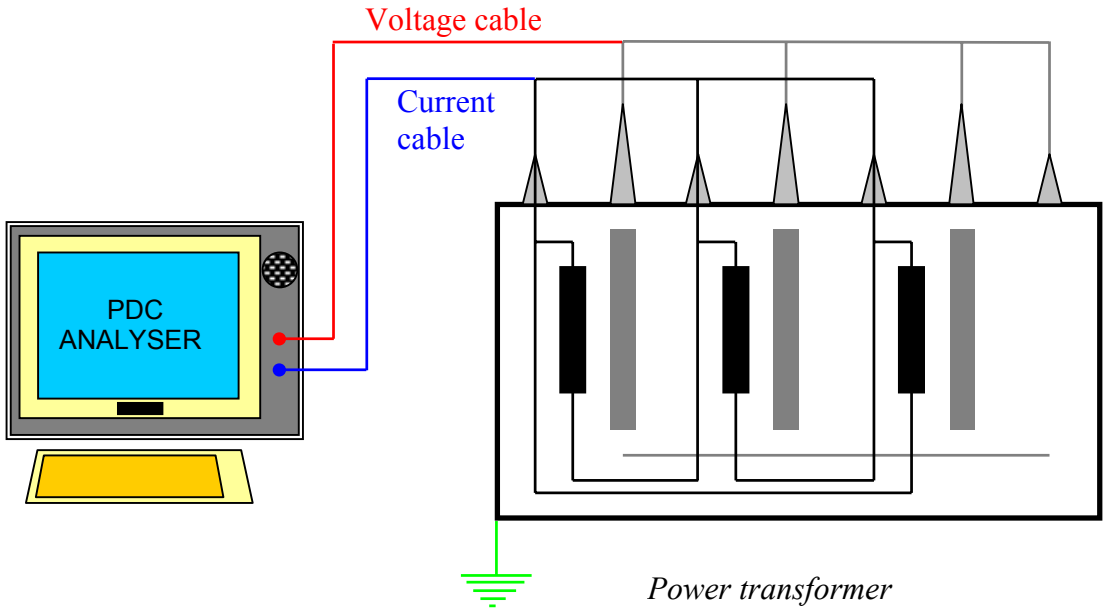


Figure 3: Connection of a power transformer to **PDC-ANALYSER-1MOD**.

For an accurate measurement, it is necessary to determine the initial condition of the test object before any application of excitation voltage.

The initial condition (or charging state) of a test object can be determined by monitoring the initial current which flows through it. For visualisation of this current, it is sufficient to start a current measurement with a polarisation duration of zero seconds. It is important, that the initial current is low and at least in a steady state. In case of a high, but constant amplitude of initial current, this current can be considered as an "offset" for the evaluation: it can be subtracted from the measurements.

Before starting the main measurement, it is recommended to carry out control measurements with a short charging duration e.g. 5 seconds to control the whole setup. Verify the amplitudes of measured currents and the value of the capacitance. Such a short control measurement will not affect the main measurement, because the relaxation currents induced by a short charging duration can be neglected after a few minutes of waiting time.

The main measurement can be performed after the *control* measurement by choosing adequate values for the charging voltage amplitude and for the duration of polarisation and depolarisation.

For new power transformers, a charging voltage amplitude of up to 500 V is recommended. Used transformers are less sensitive to the non-linear effects due to their high conductivity of oil. So, for used transformers the excitation voltage can be increased up to 1'000 V. In general, a polarisation duration of 5'000 to 7'000 seconds is sufficient to assess the insulation quality of a power transformer, the same duration is also recommended for the depolarisation duration.

In general, it is important to avoid non-linear effects by keeping the amplitude of the applied excitation voltages as low as possible. It is also recommended to keep the discharge periods between the successive dc voltage applications long enough to avoid any superposition of dielectric responses.

5 Specifications

Electrical Insulation Diagnostic System **PDC-ANALYSER-1MOD**

Current measurement

range	±1 mA
resolution (current display when measuring)	1 pA
resolution (recorded data)	0.1 pA
accuracy	0.5 % of the measured value ±1 pA after 1 hour warming up
impedance	10 kΩ
protection	up to 100 mA respectively 1kV for 50ms
noise suppression	up to 10 μA eff at 50 / 60 Hz mains frequency
filtering (current display when measuring)	mean value in 1 s intervals
filtering (recorded data)	mean value in intervals increasing proportionally with the time from the voltage source switching moment

Voltage source

voltage range when switched on	+30 ... +2000 V
maximum current sourcing when switched on	<+5 mA
impedance when switched on	< 20 kΩ
impedance when switched to zero	< 0.2 Ω
current limiting when switching cap. loads	< ±100 mA for 20 ms

Capacitance measurement

the load capacitance is indirectly measured by computing the ratio charge to voltage when the voltage source is switched off for measuring of the depolarisation current. However the current measurement is not impaired by a load capacitance depassing the range listed below.

	source voltage			
	2 kV	1 kV	500 V	100 V
accuracy	±2 % ±5 pF	±2 % ±10 pF	±2 % ±20 pF	±2 % ±100 pF
maximum load capacitance	25 nF	50 nF	100 nF	500 nF

Computer

display	15” TFT, 262’144 colours, resolution 1024 x 786 pixels
processor	Intel Pentium III 1 GHz
memory	SDRAM 256 MB
hard disk	40 GB
standard interfaces	DVD+/-RW, 3½” Floppy, 2 x PCMCIA, parallel and serial ports, Ethernet
options	additional serial ports, Audio in/out, external monitor out

Software

operating system	windows XP home SP2
measuring and control program	installed ready to use, outputs for each measurement one file with polarisation data, one file with depolarisation data and one file with general measurement descriptions
standard evaluation software	installed ready to use, easy to use, extensive possibilities to postprocess, to display, to print and to export the measured data, computation of the complex capacitance in function of frequency, computation of a lumped equivalent circuit of the measured insulation, computation of recovery voltages and the derived "polarisation spectrum", computation of polarisation indexes and of insulation resistances according to all known standards and definitions
advanced evaluation software	quality assessment of oil-paper insulation systems, quantitative determination of moisture content in pressboard and of oil conductivity for power transformers

Miscellaneous

weight	17.3 kg
power supply	90 ... 260 V, 47 ... 63 Hz, <160 VA
size	514 × 185 × 428 (width × depth × height in mm)
temperature (use)	0 ... 35 °C
temperature (stock)	-10 ... 50 °C
pressure	70 ... 106 kPa
humidity	5 ... 80 % non condensing
acceleration	< 2 g
length of standard measurement cables	15 m

Appendix A

The **PDC-ANALYSER-1MOD** generates 3 files for each measurement.

These files are stored in the directory as entered during setup.

The polarisation current data are registered in a *p.dat file. The depolarisation current data are registered in a *d.dat file. Information about the measurement are registered in a *c.txt file.

The name of each generated file is composed of 3 different parts.

Example: The name of a file could be **testa14p.dat**

testa: is a name prefix, which identifies a measurement series.

14: is a number between 01 to 99, which identifies a single measurement in a measurement series with a given name prefix (in this example, testa). This number increments automatically for each further measurement performed in this series.

p: indicates the type of the file, in this example, polarisation current data file.

