

Instrument for Measuring the Electric Resistivity on Oil Samples

VZ220A



Introduction

The measuring instrument type VZ220A conforms to the new IEC 61620 standard

This instrument is based on the so-called "low amplitude, low frequency, alternate square wave method" and permits accurate measurement of volume conductivity and relative permittivity. The measurement of volume conductivity in the range of 0.01 pS/m to 20'000 pS/m allows the use of this instrument for quality assessment of high resistive liquids even at ambient temperature.

The VZ220A works with low voltage and low current levels and represents no danger at all for its operators.

Measuring method

The liquid in the test cell is excited with a low amplitude (30 V) low frequency (0.5 Hz) alternate square wave voltage without any DC component (see figure 1).

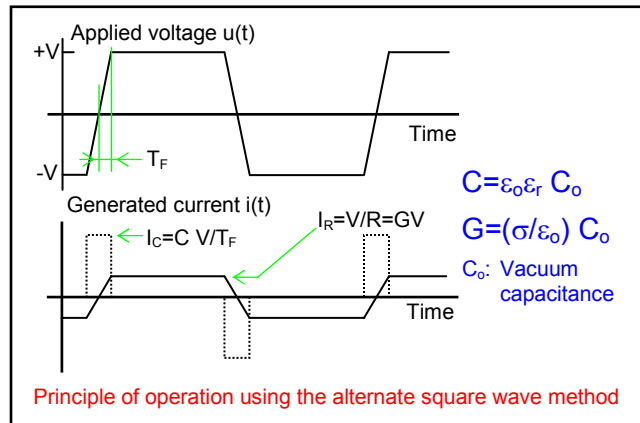


Figure 1

By measuring the current through the liquid the capacitance C and the conductance G can be determined and the values of relative permittivity ϵ_r and volume conductivity σ are given according to the following equations:

$$\epsilon_r = C/C_0$$

$$\sigma = \epsilon_0 \cdot G/C_0$$

The derived dissipation factor $\tan\delta$ for a given frequency f can be determined according to the following equation:

$$\tan\delta = G/C \cdot 2\pi f$$

For determination of conductivity or $\tan\delta$, the alternate square wave method is, by far, more sensitive than the classic bridge method. It permits the determination of conductivity values down to 0.01 pS/m respectively $\tan\delta$ values down to 1E-6 (at 50 Hz). This high sensitivity allows accurate measurements of conductivity and $\tan\delta$ at low temperatures and consequently the characterisation of liquids at room temperature can be carried out with confidence .

Test cell

The application of a square wave excitation voltage with low amplitude of only ± 30 V permits the development of a test cell with simple design, easy to use and to clean. The compact test cell of the LCM-8716 is composed of only two parts, a container and an active part. Two coaxial electrodes (stainless steel) are attached on a cap (also stainless steel). This cap also supports two BNC connectors coupled to the two electrodes. The electrodes possess a clean, polished surface. The vessel and the active part can be cleaned according to procedures described in the appendix A. It is not possible and not necessary to disassemble the active part for cleaning purposes.

The required amount of liquid for a test is about 210 ml. To reach this amount, fill in the liquid to be tested up to 23 mm from the top edge of the vessel

The temperature of the tested liquid can be determined by introducing the electronic thermometer in the cell through the cover orifice.

Application

A typical application of VZ220A is the quality assessment of mineral oil used in high voltage apparatus e.g. power and instrument transformers, bushings, capacitors, etc.

Several investigations have demonstrated that the conductivity of oil is influenced by impurities and ionic components, which are introduced or produced in it. Therefore, the oil conductivity characterizes well the quality of oil.

Further, it has been shown that the moisture in oil has no significant influence on its conductivity.

The following values of conductivity given at ambient temperature are typical for a mineral oil in its different states of use.

- New oil (laboratory quality).....	≤ 0.05	pS/m
- New oil (industrial quality).....	0.05...0.1	pS/m
- Light used oil in good condition.....	0.1...1.0	pS/m
- Middle used oil in acceptable condition.....	1.0...5.0	pS/m
- Heavily used oil in bad condition.....	> 5.0	pS/m

Specifications

Electronic measuring instrument

- conductivity measurement range.....10-14 ... 2×10^{-8} S/m on four ranges
- uncertainty of conductivity measurements..... ± 1 digit $\pm 1\%$ of indicated value
- relative permittivity measurement range.....up to 5.00
- resolution of permittivity measurements.....0.001 for relative permittivity up to 1.999
- uncertainty of permittivity measurements..... ± 1 digit $\pm 0.2\%$ of indicated value
- frequency of the measurement voltage.....0.5 Hz
- amplitude of the measurement voltage..... ± 30 V square wave with no dc part
- analogue outputs.....2 V for 0 to 100%
- weight.....2.6 kg
- size(width × depth × height in mm).....260 × 283 × 115
- power supply in the field.....four batteries type AA
- power supply in the lab.....100 ... 240 Vac 50/60 Hz
- operating temperature.....0...35°C

Test cell

- required amount of liquid.....210 ml
- vacuum capacitance..... ≈ 60 pF
- capacitance drift with temperature..... < 50 ppm/°C
- electrode gap.....1.5 mm
- temperature measurement.....electronic thermometer
- weight.....1.2 kg
- size (height × diameter in mm).....125 × 82