

ALPHA

ALPHA High Grade Dielectric Analyzer

- Self-sufficient analyzer for frequency-dependent measurements without compromises
- Ultra-wide frequency range: 3 μ Hz ... 40 MHz
- Ultra-wide impedance range: 10 m Ω ... 100 T Ω , covered in one single measurement set-up
- Highest phase resolution of 0.001° to capture even the smallest losses in materials ($\tan \delta > 3 \times 10^{-5}$)
- Fast data acquisition rate: 60 ms/point
- Optionally 6 ms/point in direct mode
- User-performed and software-assisted automatic self calibration and diagnosis compensates long term internal drift and verifies functionality.
- Harmonics measurements to analyze non-linearity effects
- High level command set for easy programming
- Powerful WinIMP/WinDETA software package for turnkey applications

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The fastest route to new materials

The Novocontrol ALPHA broadband dielectric/impedance analyzer provides access to the full electrical characterisation of materials and devices. Complex parameters like impedance, admittance, permittivity, conductivity, are easily accessible with ultra-high precision and accuracy.

Electrical impedance measurements on materials analyze the property to store and transfer electrical charge. Materials properties are analyzed in terms of complex properties, e.g., the permittivity ϵ or conductivity σ . In the permittivity representation, δ denotes the phase angle between its imaginary and real parts, and $\tan \delta = \epsilon''/\epsilon'$ represents dielectric loss.

When it comes to low-loss materials, the crucial property of a frequency response analyzer is its phase resolution. In this respect, the ALPHA offers unsurpassed performance, i.e., a very high phase resolution of less than 0.001° , equivalent to a $\tan \delta$ resolution of 10^{-5} .

Ultra-Wide Impedance Range

The ALPHA broadband dielectric analyzer offers a unique measurement solution which covers up to sixteen decades of impedance. Values between $10 \text{ m}\Omega$ and $100 \text{ T}\Omega$ are determined continuously, i.e., without changing the setup. The ALPHA series analyzers (models differ in their maximum frequency) are thus capable to fully characterize a wide range of materials spreading from the best insulators to good conductors.

Ultra-High Phase Resolution

In order to reach ultimate accuracy, especially with respect to low-loss materials, the ALPHA uses a particular **reference technique**. For each selected frequency, the measured sample impedance is compared to the measured impedance of a precision low-loss reference capacitor. The reference measurement eliminates all linear systematic deviations from the sample impedance. This technology, in combination with a straightforward digital design, achieves the highest level of accuracy required for materials analysis, particularly for broadband spectroscopy of low-loss dielectrics.

Harmonics Analysis

In general, the electrical behavior of materials is expected to be linear. Some materials, however, exhibit an intrinsic non-linear behavior or are deliberately made non-linear for certain purposes or applications. The ALPHA analyzes higher harmonics of such materials by complex Fourier transformation. This opens the way to a new range of experiments, known as non-linear spectroscopy.

Specifications:

Ranges

Frequency: $3 \mu\text{Hz} \dots 40 \text{ MHz}$ (13.1 decades)*

Impedance: $10^{-2} \dots 10^{14} \Omega$ (16 decades)

Capacitance: $1 \text{ fF} \dots 10 \text{ F}$ (16 decades)

Loss factor $\tan(\delta)$: $10^{-5} \dots 10^4$

AC signal out: $100 \mu\text{V} \dots 3 \text{ Vrms}$

DC bias out: $-40 \text{ VDC} \dots +40 \text{ VDC}$, 70 mA max^{**}

Signal generator output impedance: 50Ω

Voltage input: $< \pm 4.3 \text{ Vp}$ dc or ac coupled

Base Accuracy

Relative Impedance, Relative Capacity,

Loss factor $\tan(\delta)$: $< 3 \cdot 10^{-5}$ ***

Phase Angle: $< 0.002^\circ$ ***

Resolution

Relative Impedance, Relative Capacity,

Loss factor $\tan(\delta)$: $< 10^{-5}$

Phase Angle: $< 0.0006^\circ$

User Calibrations

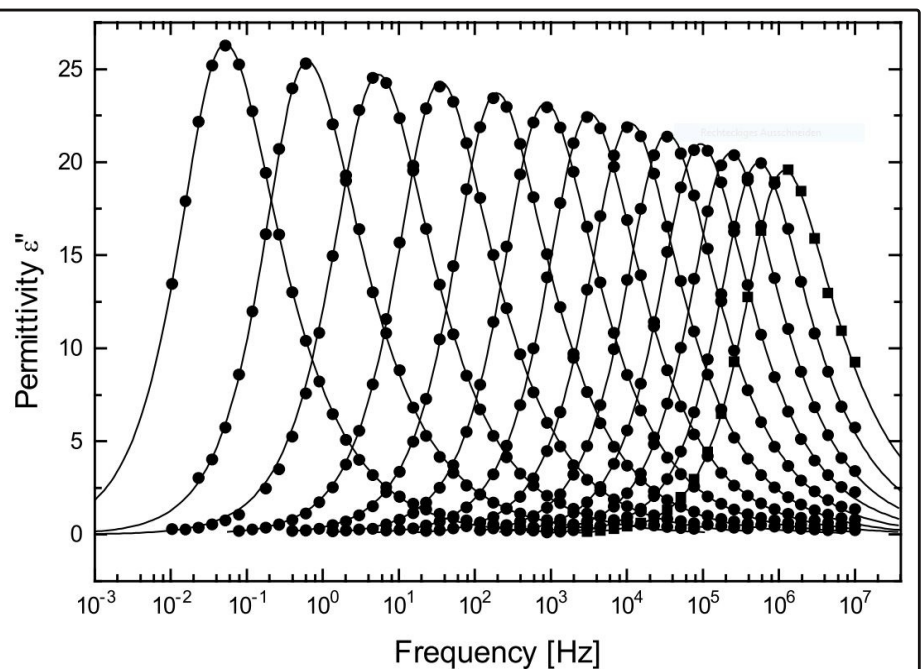
load, short, open, internal self calibration and diagnostics

System Interface: GPIB/IEEE488

* for the top-model ALPHA-T

** requires dc bias option B of the ALPHA

*** for details refer to specification charts



The imaginary part of the permittivity, ϵ'' , of glycerole, measured with the ALPHA analyzer. Temperatures from -80°C to 20°C in 5°C steps; peak positions shift to higher frequency with increasing temperature.