DAK-R Low-Loss Measurement Remastered

What is DAK-R?

The DAK resonator (DAK-R) is the world's first true multi-frequency resonator cavity for accurate low-loss material characterization at 10, 17, 26, 35, and 45 GHz – all in a single measurement!

DAK-R covers the 5G/6G frequency ranges 2 and 3 (FR2/FR3) and is the optimal, fully compatible addition to DAK-TL2. The combination of DAK-R and DAK-TL2 creates a new benchmark for broadband dielectric characterization.

DAK-R

Accurate Characterization of Low-Loss Dielectrics at Multiple Frequencies

Description

At the core of DAK-R is the novel split-cylinder resonator design that connects to a vector network analyzer (VNA) for two-port (S_{12}) measurements. After the resonance frequency and quality (Q-) factor of the closed cylindrical cavity are measured in the empty state, the sample is placed in the gap between the split cylinders, and the loaded resonance frequency and Q-factor are measured. The frequency shift depends on the in-plane component of permittivity and sample thickness. As sample loss and thickness increase, the loaded Q-factor decreases. The permittivity and loss are calculated in the DAK-R software based on the sample thickness, cavity dimensions, and the shifts in resonance frequency and Q-factor.

Applications

- Dielectric measurement for 5G/6G applications to minimize signal loss and reduce signal latency
- Characterization of low-loss printed circuit boards, microwave substrates, antennas, and casing materials
- Material development and characterization to guide synthesis of new materials for diverse applications, including sensors, energy storage devices, and insulating materials
- Evaluation of medical device compatibility with electromagnetic fields for magnetic resonance imaging scanners, diagnostic tools, and therapeutic devices

Hardware

- Cavity diameter: 42 mm
- TE_{01n} resonance modes of closed empty cavity: 10, 17, 26, 35 and 45 GHz
- Connector type: 1.85 mm female
- High Q-factor (Q > 25000) cavities made of oxygen-free copper to ensure highly accurate low-loss measurements
- Base dimensions: 170 × 95 × 115 mm
- Weight: 4.5 kg

Software

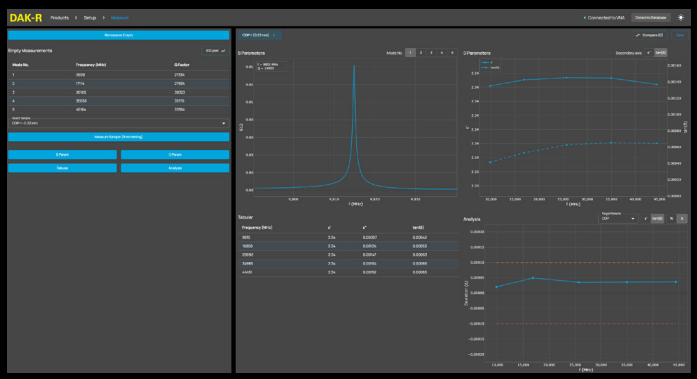
- Full-featured software for automated peak finding and Q-factor calculation
- Seamless data acquisition and accurate dielectric parameter computation
- Modern, web-based intuitive graphical user interface (GUI)
- Flexible permittivity parameter options, including ε', ε'', and $\tan(\delta)$
- Advanced data analysis tools for comparing results against target parameters with defined tolerance and uncertainty ranges
- Optimized workflow for efficient dielectric measurements
- High-speed, reliable VNA control
- Compatible with DAK-TL2 software

Sample Requirements

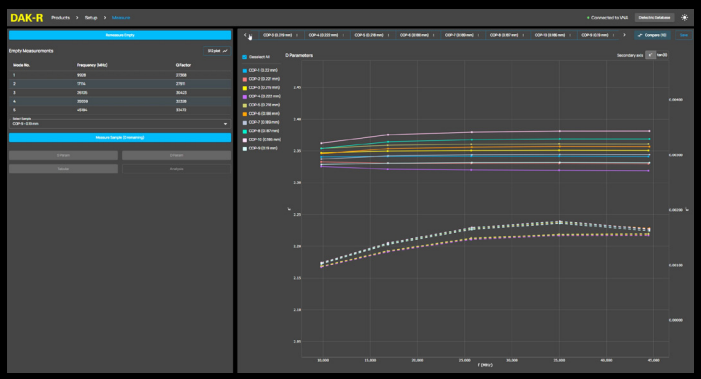
- Non-magnetic, homogeneous, with uniform thickness and flat parallel sides
- Dimensions: 60 × 60 mm or larger
- Thickness range: 0.05 – 3 mm; thinner samples can be stacked
- $\tan(\delta) < 0.01$, $\varepsilon_r < 100$

Features and Benefits

- Novel cavity design that suppresses unwanted resonances, enabling measurements across multiple frequencies (TE_{01n} modes)
- Vertical cavity structure for high-precision measurements and easy sample handling
- Robust and easy to operate
- Non-destructive to the material under test
- Quality factor of more than 25000 for outstanding measurement accuracy ε_r: ±1%, $\tan(\delta) < 0.0001$
- Temperature sweep measurement range of 0 – 50 °C
- VNA compatibility like other DAK products (requires 2-port)
- Compliant with IPC test method TM-650 2.5.5.13
- DAK-R combined with DAK-TL2 is the best-in-class solution for broadband, low-uncertainty characterization of dielectric materials



Measurement results of a Cyclic Olefin Polymer (COP) sample at 10, 17, 26, 35 and 45 GHz as shown on the DAK-R GUI.



Comparison results of 10 COP samples are shown. With DAK-R software, users can easily compare measurements by clicking 'Compare' and selecting samples.

For further information and technical specifications, visit **www.speag.swiss/products/dak**

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