

## DAK-R for Accurate Characterization of Low-Loss Dielectrics at Multiple Frequencies

The DAK-R is a cutting-edge solution for non-destructive dielectric measurement of thin, low-loss substrates (0.05 – 3 mm). Resonator methods are the most accurate techniques for determining the dielectric properties of low-loss materials. DAK-R is based on an advanced implementation of split-cylinder resonator (SCR). Unlike conventional SCRs, which operate only at fundamental frequencies, DAK-R features an innovative cavity design paired with a state-of-the-art solver. This suppresses unwanted resonances, extends the permittivity measurement range, and makes DAK-R the only resonator on the market capable of accurate, broadband measurements at 10, 17, 26, 35, and 45 GHz all in a single instrument.

Compliant with IPC test method TM-650 2.5.5.13, DAK-R consists of a cavity divided into two equal halves. A sample is positioned in the gap between these sections, where a TE<sub>01n</sub> resonance is excited. By analyzing the resonance frequency and quality factor (Q), the relative permittivity and loss tangent of the sample are determined. The resonance frequency of the resonator is a function of the relative permittivity and thickness of the substrate. Thicker substrates and higher values of relative permittivity shift the resonance to lower frequencies.

The DAK-R and DAK-TL2 combo delivers the ultimate solution and sets a new standard for accurate, broadband dielectric characterization.



### System



- Cavity diameter: 42 mm
- Cavity Length: 30 mm
- TE<sub>01n</sub> resonance modes of closed empty cavity: 10, 17, 26, 35 and 45 GHz
- Connector type: 1.85 mm female
- High Q-factor cavities made of gold-coated Oxygen-free Copper to ensure highly accurate low-loss measurements
- Beam dimensions: 170 × 95 × 115 mm
- Base dimensions: 146 × 32 × 40 mm
- Weight: 4.5 kg

<b>Applications</b>	<ul style="list-style-type: none"> <li>▪ Evaluation of printed circuit board materials</li> <li>▪ Characterization of microwave and antenna substrates</li> <li>▪ Evaluation of protective, covering and enclosure materials</li> <li>▪ Analysis of dielectric materials for electronic components, e.g., capacitors, coils, resonators</li> </ul>
<b>Calibration</b>	<p>Calibration according to SPEAG's high-quality standards; DAK probe calibration included within the scope of SPEAG's <a href="#">ISO/IEC 17025 accreditation</a>; suitable for measurements with small and known tolerances</p>
<b>Sample Requirements</b>	<ul style="list-style-type: none"> <li>▪ Non-magnetic, homogeneous, with uniform thickness and flat parallel sides</li> <li>▪ Dimensions: 50 × 50 mm or larger</li> <li>▪ Thickness range: 0.05 – 3 mm; thinner samples can be stacked</li> <li>▪ <math>\tan \delta &lt; 0.01</math>, <math>\epsilon_r &lt; 100</math></li> </ul>
<b>Components</b>	<p>SPEAG provides all necessary components to perform high-precision measurements with DAK-R:</p> <ul style="list-style-type: none"> <li>▪ DAK-R verification set</li> <li>▪ High-precision cables to connect the probe beam to the vector network analyzer (VNA) port</li> </ul>
<b>VNA Compatibility</b>	<p>DAK-R requires a 2-port measurement and is compatible with the most popular VNAs on the market (please see our list of <a href="#">currently supported VNAs</a>)</p>
<b>Software</b>	<p>The software provides the following functionalities:</p> <ul style="list-style-type: none"> <li>▪ Modern, web-based intuitive graphical user interface (GUI)</li> <li>▪ Flexible permittivity parameter options, including <math>\epsilon'</math>, <math>\epsilon''</math>, and <math>\tan(\delta)</math></li> <li>▪ Advanced data analysis tools for comparing results against target parameters with defined tolerance and uncertainty ranges</li> <li>▪ Optimized workflow for efficient dielectric measurements</li> <li>▪ High-speed, reliable VNA control</li> <li>▪ seamless data acquisition and accurate dielectric parameter computation</li> </ul>
<b>Computer Requirements</b>	<p>The software must be run on an external computer, not on the VNA and runs only on 64 bit Windows operating systems. Operating system: Windows 10 or later</p> <p>Minimal hardware requirements:</p> <ul style="list-style-type: none"> <li>▪ Processor: Intel Core i9, Xeon (or AMD equivalent), 8 cores minimum</li> <li>▪ 4 GB of RAM</li> <li>▪ Dedicated 3D accelerated graphics display adapter card with at least 128 MB of on-board memory that supports the latest OpenGL drivers (v3.2 or higher); note: graphics cards of the AMD Radeon™ HD 7500M/7600M Series must run on the latest driver version</li> <li>▪ A display with 32-bit color depth and a resolution of 1280 × 1024 pixels or better (optimum size: 1920 × 1200 pixels)</li> </ul>

<b>Unique Features</b>	
Novel Cavity combined with Advanced Solver	Suppressed unwanted resonance for multiple frequency analysis with one cavity
Vertical Cavity Structure	Easy handling of samples during measurement
High Quality factor Resonator	$Q > 25000$ for the most accurate loss measurement
VNA compatibility	Similar to other DAK products (requires 2-port)
Wide range of Dielectric Properties	$\epsilon_r$ : 1-100, $\tan \delta$ : 0.00001 - 0.01
Optimal Combination with DAK-TL2	Offer best-in-class solution to achieve broadband low-uncertainty characterization of dielectric materials
<b>Benefits</b>	
Broadband	The only SCR on the market capable of performing measurements at multiple points with a single cavity
Easy-to-Use	Vertical cavity arrangement for easy sample handling Guided user experience with an all-new modern GUI
Accurate, Repeatable, and Reliable	Outstanding measurement accuracy and precision $\epsilon_r$ : $\pm 1\%$ , $\tan \delta < 0.0001$
<b>Standard Compatibility</b>	DAK-R Software is compatible with the IPC test method TM-650 2.5.5.13
<b>Release Date</b>	20250304

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