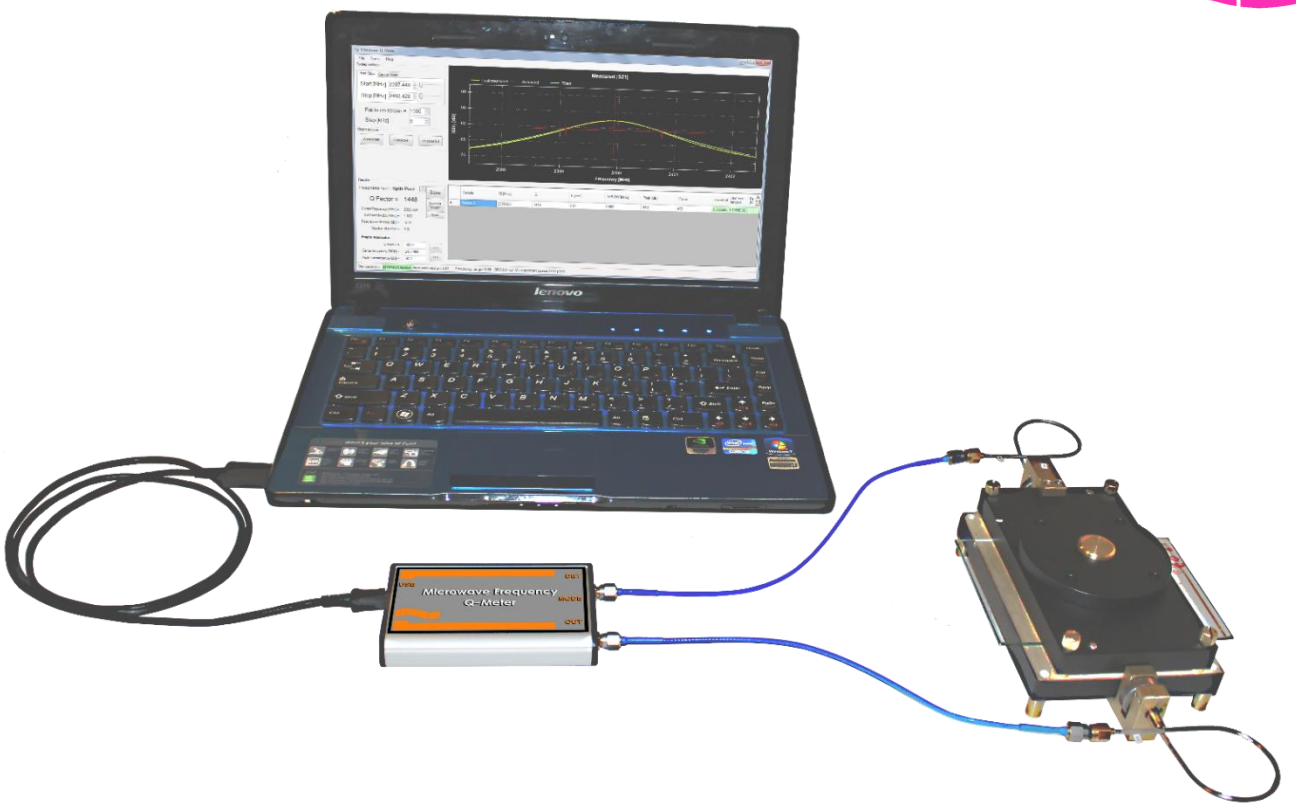


MEASUREMENT SETUPS

PRECISE MEASUREMENT OF ELECTROMAGNETIC PROPERTIES OF MATERIALS

DIELECTRIC RESONATORS

MICROWAVE Q-METER

SURFACE MAPPING

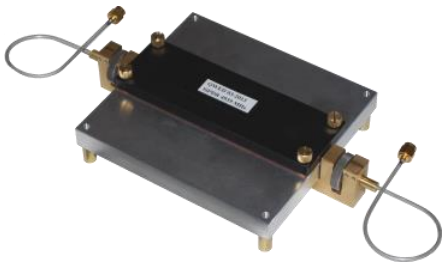
DIELECTRIC RESONATORS

QWED manufactures several types of resonators (also referred to as test fixtures) for precise measurements of electromagnetic properties of materials at microwave frequencies. Each resonator is equipped with specialised software for extracting the relevant data (typically, complex permittivity or real permittivity and loss tangent) from measurements. The resonators and the accompanying software are based on decades of research led by QWED's world famous expert Prof. Jerzy Krupka and documented in dozens of worldwide-appreciated scientific and technical publications.
QWED offers **Split Post Dielectric Resonators** (SPDR) and **Single Post Dielectric Resonators** (SiPDR) which are intendent for measurements of complex permittivity of laminar dielectrics and thin ferroelectric films, surface resistance and conductivity of conducting materials such as resistive layers, thin conductive polymer films or high resistivity semiconductors, surface impedance of metamaterials and resistive films, as well as for the contact-less measurements of the conductivity of semiconductor wafers.
The SPDR users who have access to one of the PNA/ENA Series network analysers by Keysight Technologies equipped with N1500A Material Measurement Suite Option 003 (or earlier Agilent Technologies 85071E Materials Measurement Software with Option 300) may upload QWED software to the network analyser and obtain the final results directly on its display.

SPLIT POST DIELECTRIC RESONATOR

Split Post Dielectric Resonators are intended for the measurements of the complex permittivity of laminar dielectric materials including LTCC substrates, but also thin ferroelectric films deposited on low loss dielectric substrates. Additionally, SPDRs can be used for the measurements of surface resistance and conductivity of various conducting materials such as commercial resistive layers, thin conductive polymer films or high resistivity semiconductors. Such measurements are only possible for large surface resistance samples with Rs > 5 kΩ/square.
The nominal frequencies of the basic line of SPDRs are: 1.1 GHz, 1.9 GHz, 2.45 GHz, 5.1 GHz, 10 GHz and 15 GHz.

SINGLE POST DIELECTRIC RESONATOR

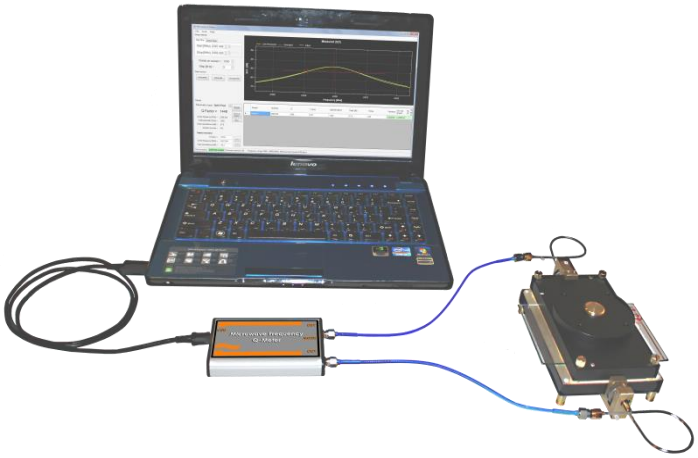


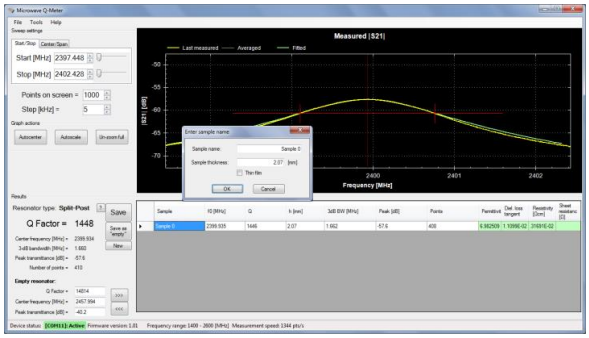
Single Post Dielectric Resonator is intended for the measurements of the surface impedance of metamaterials and resistive films as well as for the contactless measurements of the conductivity of semiconductor wafers. The range of thin film materials that can be measured includes resistive layers, thin metal films and conductive polymer films with the surface resistance Rs < 20 kΩ/square. For semiconductor wafers the upper limit for resistivity measurements is about 1000 Ωcm. Semiconductors with higher resistivity can be conveniently measured with SPDRs. This resonator has nominal resonant frequency around 5 GHz.

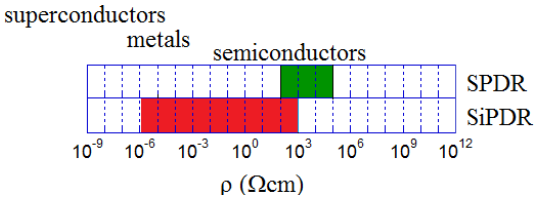
$TE_{01\delta}$ DIELECTRIC RESONATOR

$TE_{01\delta}$ mode dielectric resonator technique is intended for very precise complex permittivity measurements of bulk low loss disc or cylinder shape dielectric ceramics. Additionally, with this technique the thermal coefficients of permittivity and the dielectric loss tangent can be measured. Measurement frequency depends on the diameter, height and permittivity of the sample under test, and for typical samples is in the range of 1 GHz ÷ 10 GHz. Measurements at higher frequencies are possible by employing either smaller cavities and samples or higher order quasi TE_{0mn} modes.

QWED also produces **Microwave Frequency Q-Meter**, which is a pocket -size device allowing quick and automatic measurements of material properties with a dedicated Split Post Dielectric Resonator and Single Post Dielectric Resonator. In such applications it proves a cost-effective substitute for expensive Vector Network Analysers.



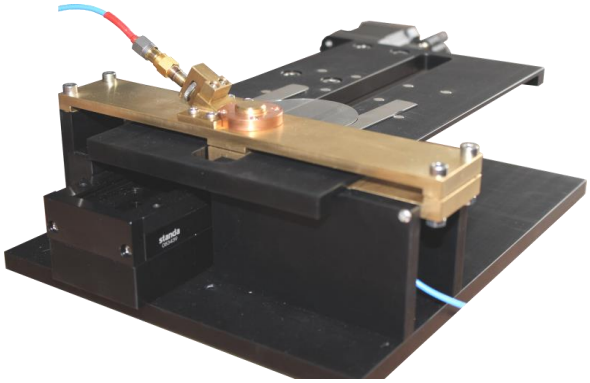


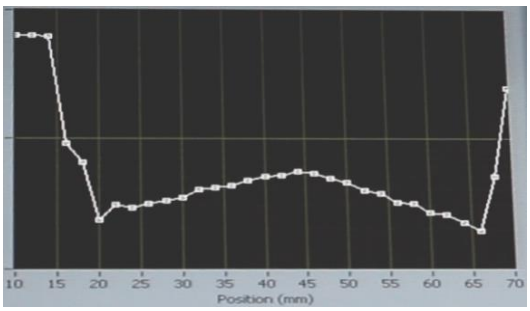


Range of resistivity measurements for SPDR and SiPDR.

SURFACE MAPPING

The homogeneity of semiconductors wafers is important for the industry from the production effectiveness and costs point of view. QWED developed the prototype of Resistivity Scanner with SPDR 15 GHz, which allows the resistivity measurements using contactless method over a large area of semiconductor wafers. The second prototype will use Single Post Dielectric Resonator. For semiconductor wafers the upper limit for resistivity measurements with SiPDR is about 1000 Ωcm. Semiconductors with higher resistivity values can be conveniently measured with SPDRs.





Resistivity across the sample measured with the prototype of Resistivity Scanner with SPDR 15 GHz.

If you are interested in devices for precise measurements
of electromagnetic properties of materials visit us at www.qwed.eu

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