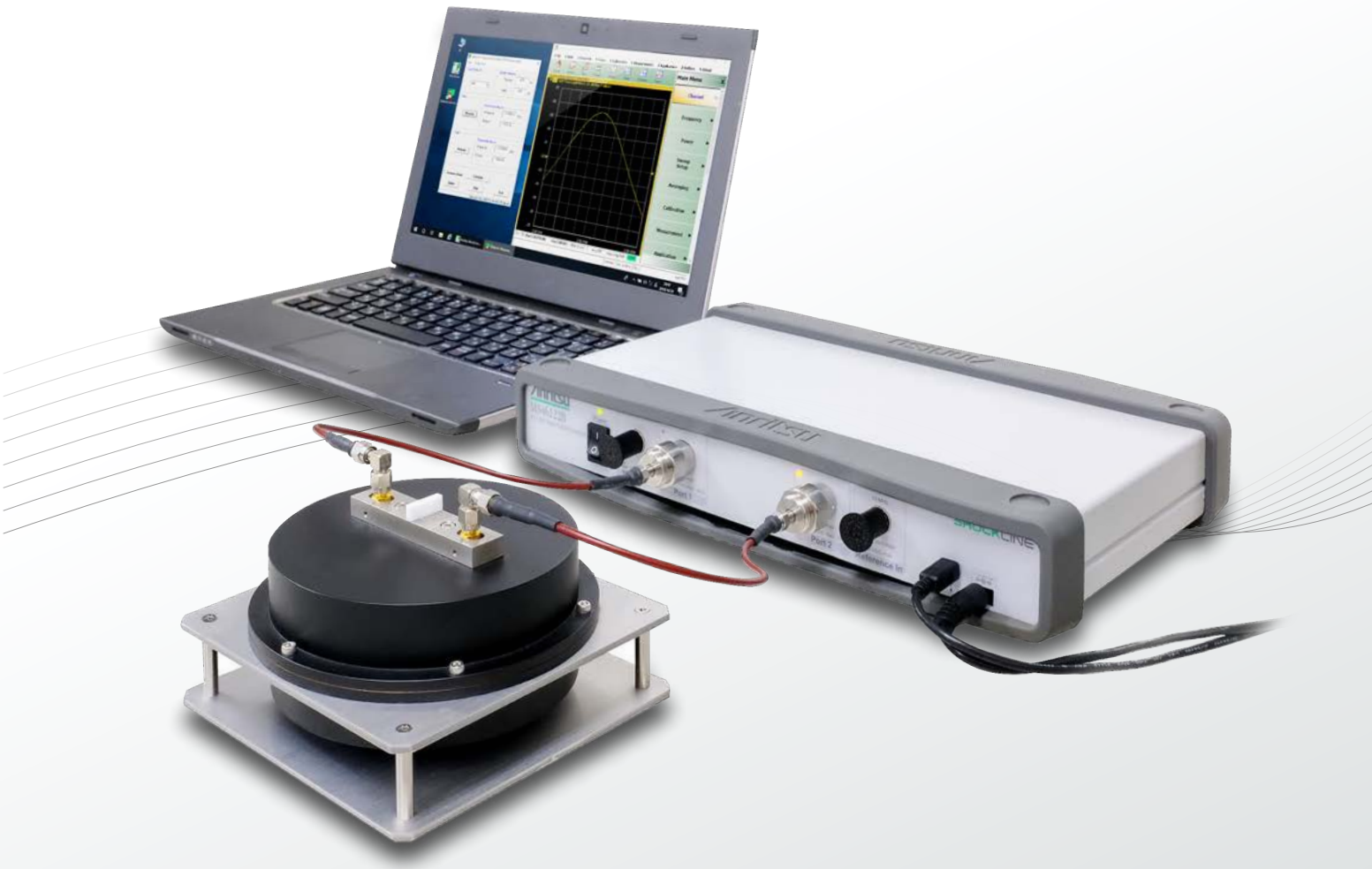
Dielectric measurement system

Microwave Dielectrometer

Simple • *Low cost* • *Accurate*



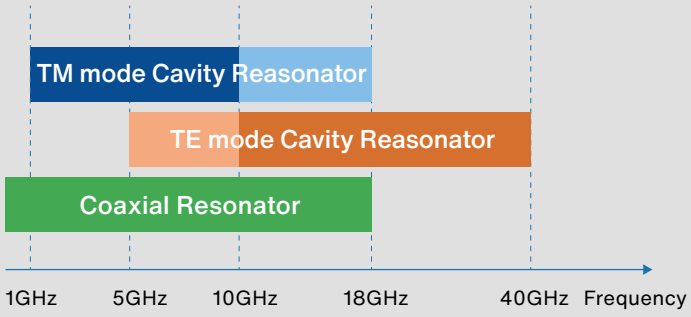
Measurement innovation with smart design

The dielectric properties are the essential parameters for the design of wireless and high-speed digital devices.
In order to meet the growing demand for fast and accurate measurements, AET offers a highly precise dielectric measurement system for various samples easily, accurately with reasonable cost.

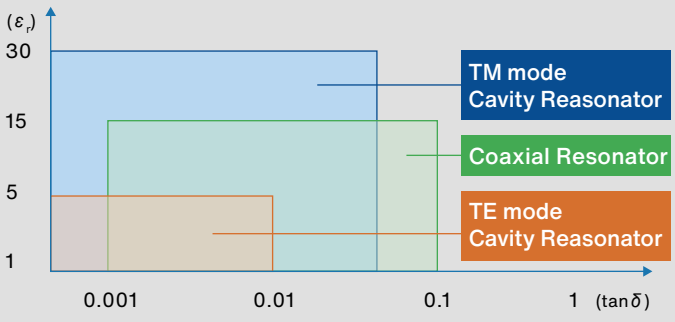
System lineup

AET offers several methods to meet various requirements for frequency and materials.

Frequency



Measurement Range



Selection Chart

Selection chart guides the best method for your samples.

Film
Substrate

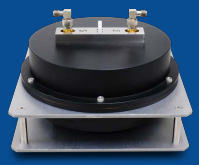
Plastics
Molding

Glass
Ceramics

Powder
Cable, etc.

TM mode Cavity Resonator

Versatile method for
strip-shaped samples



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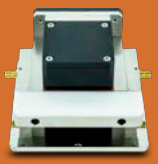
TE mode Cavity Resonator

Optimized for films
samples Up to 40GHz



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Open Coaxial Resonator

Non-destructive method
for arbitrary shape samples

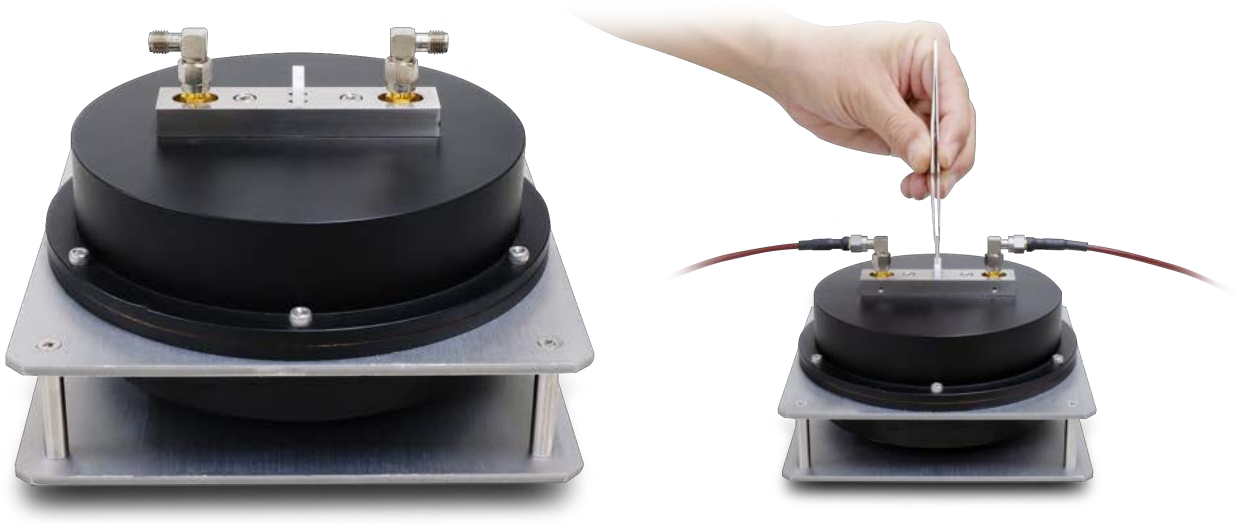
(Page 8)

Special system

For powder
For cable
Dielectric Resonator

(Page 10)

TM mode Cavity Resonator



TM mode Cavity Resonator measures strip-shaped samples.
The high Q factor resonator enables the stable measurement with high resolution of low dielectric loss materials such as PTFE and high-purity ceramics.

This method is compliant with JIS C2565, ASTM D2520.

This method is suitable for

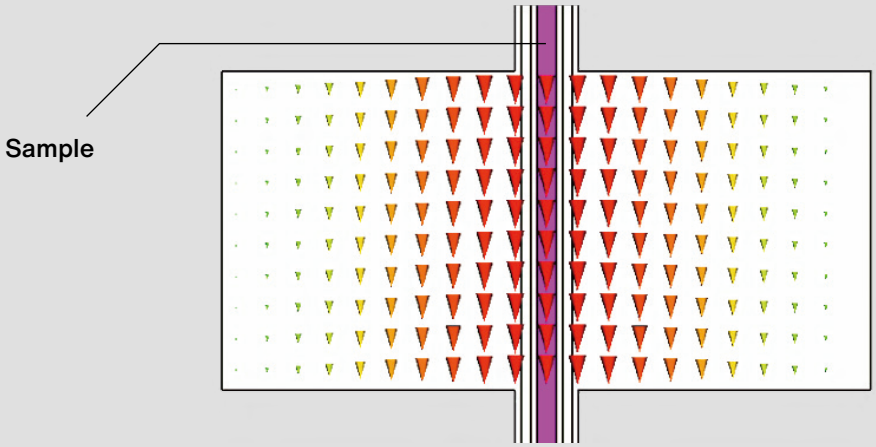
PCB substrates, Thin films, Plastics, Ceramics

Specification

Frequency range	1GHz - 10GHz
Frequency point	1 frequency point per resonator
Measurement range	εr (Dk); 1 - 30 tanδ (Df); 0.1 - 0.0001
Measurement accuracy	εr (Dk); ±1% tanδ (Df); ±5%
Sample shape	Strip, larger than 80mm (L) × 3mm (W) × 0.05mm - 1mm (T)
Compliant standard	JIS C2565, ASTM D2520

Feature: TM mode Cavity Resonator

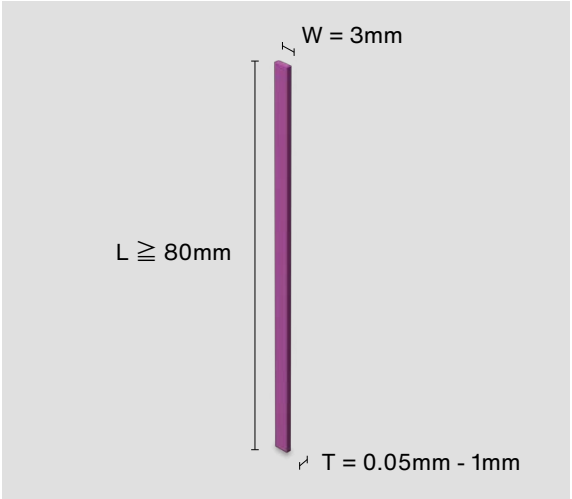
TM mode cavity resonator uses the TM resonant mode (TM010 / 011), where the electric field vector is parallel to the rotational axis of the cylindrical cavity.
By inserting the measurement sample along with the center axis of the cylinder, the resonance changes according to its dielectric constant.



Electric field of TM mode resonance

Shape and size of sample

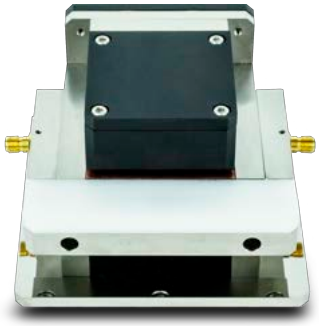
The shape of the measurement sample is a strip. The dielectric constant in the longitudinal direction of the strip is measured.



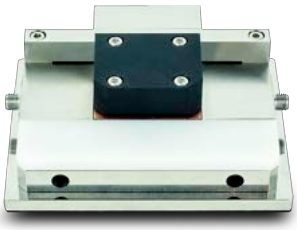
Cutting machine for film (Optional Item)

The dedicated cutting machine is available for film materials (thickness is 0.2mm or less).

TE mode Cavity Resonator



10GHz



20GHz

28GHz

40GHz

This measurement method specializes in measuring films.
This resonator is also known as “split cylinder” resonator, a sheet sample is inserted into the gap between the resonators.
This method supports frequencies up to 40GHz, therefore it fulfills the demands for 5G (5th generation mobile communication system).

Our TE mode resonator has a fixed gap for inserting the measurement samples, which enables better measurement stability against other products. It can measure the various materials such as soft and brittle samples.

This method is suitable for

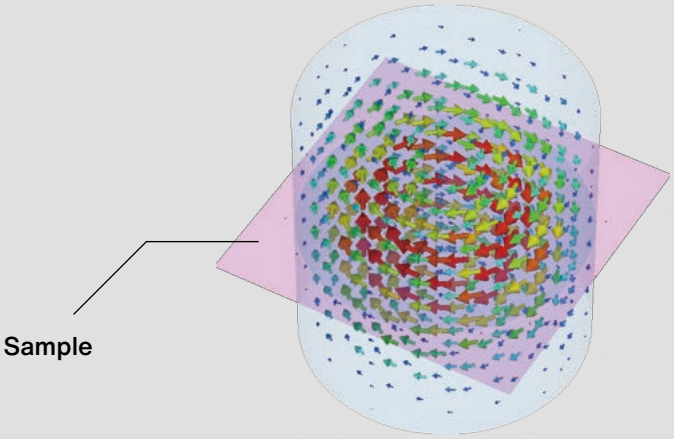
Materials for 5G, Flexible substrate, etc.

Specification

Frequency range	10GHz - 40GHz
Frequency point	1 frequency point per resonator
Measurement range	εr (Dk); 1 - 5 $\tan\delta$ (Df); 0.01 - 0.0001
Measurement accuracy	εr (Dk); ±1% $\tan\delta$ (Df); ±5%
Sample shape	Sheet (Thickness is less than 0.3mm)
Compliant standard	JIS R1641, IPC-TM650 2.5.5.13

Feature: TE mode Cavity Resonator

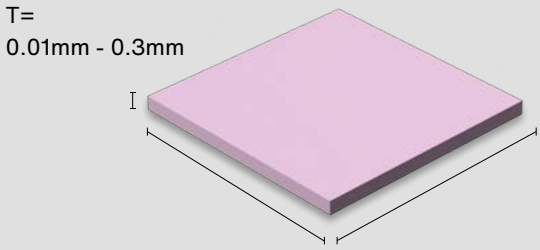
TE mode cavity resonator uses the TE resonant mode (TE011), where the electric field vector is circulating around the rotation center axis of the cylindrical cavity.
This mode is maintained even when the cavity is separated up and down, therefore it enables measurement by inserting a sheet-shaped sample.



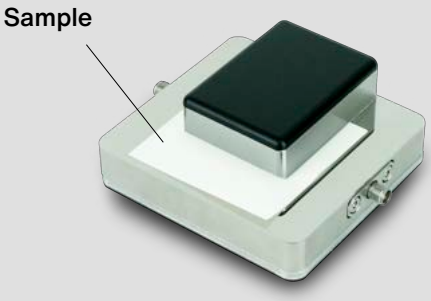
Electric field of TE011 mode resonance

Shape and size of sample

This method has high resolution for loss and is suitable for low loss film measurement.
The measurement direction of the dielectric constant is in-plane.

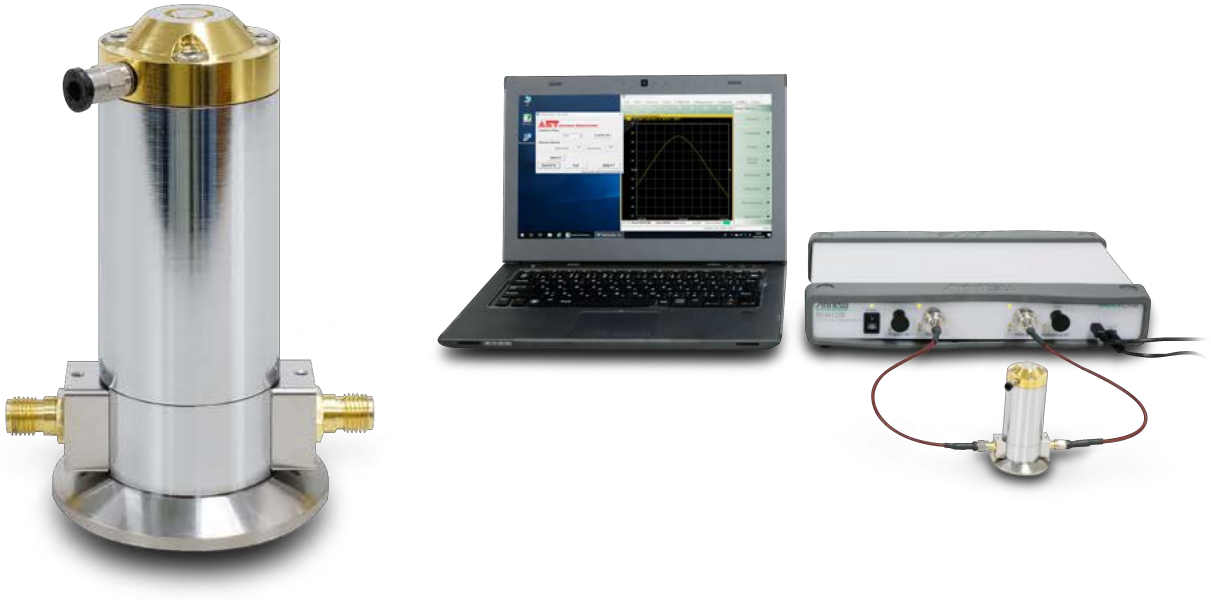


Size in plane	10GHz	≧ 50mm
	20GHz	≧ 40mm
	28/40GHz	≧ 30mm



28GHz resonator with film sample inserted

Open Coaxial Resonator



For samples having one flat surface, non-destructive dielectric measurement can be performed simply by placing it on the resonator.
This revolutionary measurement method is achieved by the unique technology using a near field called an evanescent wave.

Since no sample processing is required before measurement, measurement can be performed easily.

This method is suitable for

Smart Phone case, Molding plastics, etc.

Specification

Frequency range (5 discrete frequency points / resonator)	Type A	0.8 / 2.45 / 4.2 / 5.8 / 7.6GHz
	Type B	1 / 3.1 / 5.2 / 7.3 / 9.4GHz
	Type C	2 / 6.1 / 10.2 / 14.3 / 18.4GHz
Measurement range	εr (Dk); 1 - 15 $\tan\delta$ (Df); 0.1 - 0.001	
Measurement accuracy	εr (Dk); ±1% $\tan\delta$ (Df); ±5%	
Sample shape	Arbitrary shape with at least one flat surface. 10mm x 10mm x 0.5mm or larger	

This device was developed in cooperation with Maeda Laboratory of Graduate School of The University of Tokyo. PATENT No. 3691812

Measurement using evanescent wave

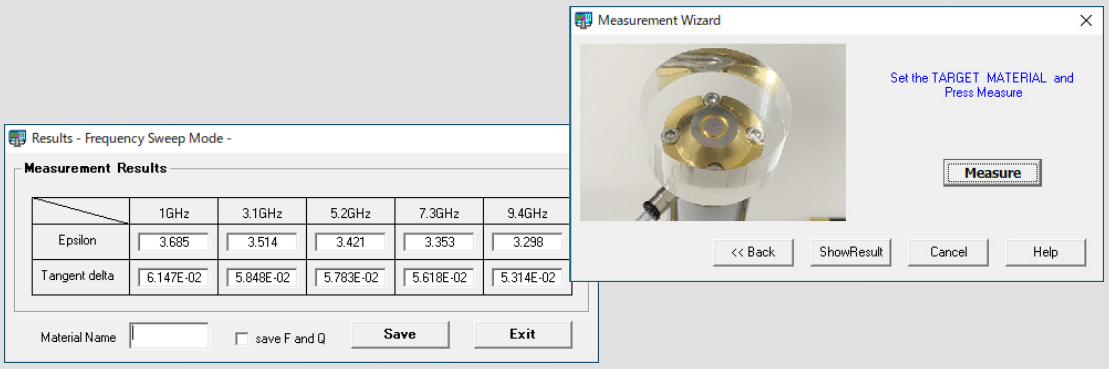
The near field called the evanescent wave leaking from the small opening of the open coaxial resonator penetrates in the measurement sample, and the resonance characteristics change depending on the dielectric properties of the sample.

[Caution]
This resonator measures the dielectric properties at a local area near the surface of the measurement sample.
The measurement target must be of uniform composition. If the layered materials or composite materials such as printed circuit boards are measured, the results will be influenced by the material properties at the surface of the sample.

Electric field in coaxial resonator

Simple operation by Easy-to-use Software

AET's measurement software is designed to use intuitively without any expert knowledge about dielectric measurements or microwave electronics.



Measurement wizard and Result view

Cavity Resonator for Powder

Powder samples can be measured by loading into the quartz tube.
The system calculates the dielectric constant of the powder itself by the volume filling rate from the true density of the sample.
This system also supports accurate measurement of non-polar solvents with low dielectric constant and low dielectric loss.

Dedicated vibrator enables dense filling of powder samples.

Cavity Resonator for Powder

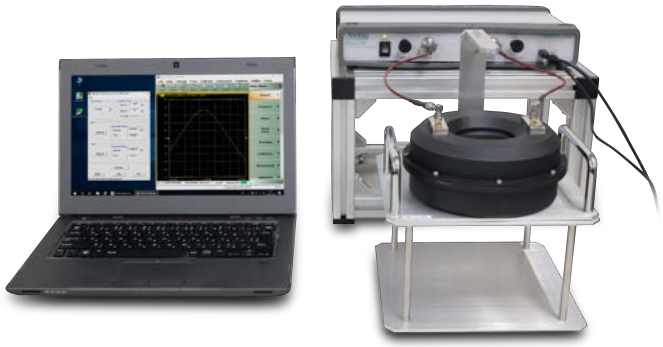
Dedicated vibrator

Specification

Frequency range	1GHz (Ask for other frequencies)
Sample form	Powder, Liquid
Measurement range (Volume averaged)	εr (Dk); 1 - 6 $\tan\delta$ (Df); 0.01 - 0.0001
Measurement accuracy	εr (Dk); ±1% $\tan\delta$ (Df); ±5%
Required amount	more than 3 cc (for 1GHz)

Cavity Resonator for Cables

The dedicated resonator enables the high-resolution measurement for the low-loss insulation materials in the form of cable (ex. Foamed PTFE).
The special design makes it easy to set up soft cable insulators.



Please contact for details.

Dielectric Resonator for Ceramics

This system is designed for low loss dielectrics with high dielectric constant.
Dielectric cylinder sample is short-circuited at both ends by parallel conducting plates.
The dielectric cylinder resonates in TE011 mode by microwave feeding with loop antenna.

Specification

Measurement frequency	Lower than 20GHz (Frequency depends on size and dielectric properties of sample)
Measurement range	εr (Dk); 5 - 200 tanδ (Df); 0.001 - 0.00001
Measurement accuracy	εr (Dk); ±1% tanδ (Df); ±5%
Sample shape	Cylinder
Compliant standard	JIS R1627, IEC 61338-1-3

Dielectric Measurement Service

We offer the reliable measurement services by utilizing most suitable measurement method according to your specification (material kind, size and shape, frequency)

Inquiry ▶ Propose the best suitable method ▶ Quote for service ▶ Measure your samples ▶ Results provided

System Configuration

The dielectric measurement system consists of, 1. Resonator 2. Vector Network Analyzer (VNA), and 3. Windows PC.

① Resonator	② Vector Network Analyzer	③ Windows PC
		

Vector Network Analyzer

Our measurement system is compatible with various network analyzers. (Keysight Technologies / ANRITSU / Rohde & Schwarz / Copper Mountain)
The measurement software controls the network analyzer with optimal parameter, no operation experience is required for stable and high accuracy measurement.

Compact USB Vector Network Analyzer MS46122B

SHOCKLINE™ Anritsu envision:ensure

Model lineup
- MS46122B-010 (1MHz - 8 GHz)
- MS46122B-020 (1MHz - 20 GHz)
- MS46122B-043 (1MHz - 43.5 GHz)

ANRITSU ShockLine™ VNA Series MS46122B is a PC controlled compact USB vector network analyzer. One of the most suitable for this system as a new generation VNA that combines low cost and high accuracy.

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