Cavity resonator method to measure the complex permittivity of low-loss dielectric plates

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EESTI STANDARDI EESSÕNA	NATIONAL FOREWORD
Käesolev Eesti standard EVS-EN 62562:2011 sisaldab Euroopa standardi EN 62562:2011 ingliskeelset teksti.	This Estonian standard EVS-EN 62562:2011 consists of the English text of the European standard EN 62562:2011.
Standard on kinnitatud Eesti Standardikeskuse 31.03.2011 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.	This standard is ratified with the order of Estonian Centre for Standardisation dated 31.03.2011 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.
Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 18.02.2011.	Date of Availability of the European standard text 18.02.2011.
Standard on kättesaadav Eesti standardiorganisatsioonist.	The standard is available from Estonian standardisation organisation.

ICS 17.220

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 62562

February 2011

ICS 17.220

English version

Cavity resonator method to measure the complex permittivity of low-loss dielectric plates
(IEC 62562:2010)

Méthode de la cavité résonante pour mesurer la permittivité complexe des plaques diélectriques à faibles pertes
(CEI 62562:2010)

Hohlraumresonanzverfahren zum Messen der komplexen Permittivität von verlustarmen dielektrischen Platten
(IEC 62562:2010)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Ref. No. EN 62562:2011 E

Foreword

The text of document 46F/118/CDV, future edition 1 of IEC 62562, prepared by SC 46F, R.F. and microwave passive components, of IEC TC 46, Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62562 on 2011-01-02.

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The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2011-10-02
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2014-01-02

Endorsement notice

The text of the International Standard IEC 62562:2010 was approved by CENELEC as a European Standard without any modification.

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CAVITY RESONATOR METHOD TO MEASURE THE COMPLEX PERMITTIVITY OF LOW-LOSS DIELECTRIC PLATES

1 Scope

The object of this International Standard is to describe a measurement method of dielectric properties in the planar direction of dielectric plate at microwave frequency. This method is called a cavity resonator method. It has been created in order to develop new materials and to design microwave active and passive devices for which standardization of measurement methods of material properties is more and more important.

This method has the following characteristics:

- the relative permittivity ε' and loss tangent $\tan\delta$ values of a dielectric plate sample can be measured accurately and non-destructively;
- temperature dependence of complex permittivity can be measured;
- the measurement accuracy is within 0,3 % for ε' and within 5×10^{-6} for $\tan\delta$;
- fringing effect is corrected using correction charts calculated on the basis of rigorous analysis.

This method is applicable for the measurements on the following condition:

– frequency : 2 GHz < f < 40 GHz;

– relative permittivity: 2 < ε' < 100;

– loss tangent : $10^{-6} < \tan\delta < 10^{-2}$.

2 Measurement parameters

The measurement parameters are defined as follows:

$$\varepsilon_r = \varepsilon' - j\varepsilon'' = D/(\varepsilon_0 E) \tag{1}$$

$$\tan\delta = \varepsilon''/\varepsilon' \tag{2}$$

$$TC\varepsilon = \frac{1}{\varepsilon_{ref}} \frac{\varepsilon_T - \varepsilon_{ref}}{T - T_{ref}} \times 10^6 \qquad (1\times10^{-6}/\text{K}) \tag{3}$$

where

D	is the electric flux density;
E	is the electric field strength;
ε_0	is the permittivity in a vacuum;
ε' and ε''	are the real and imaginary components of the complex relative permittivity ε_r;
$TC\varepsilon$	is the temperature coefficient of relative permittivity;
ε_T and ε_{ref}	are the real parts of the complex relative permittivity at temperature T and reference temperature T_{ref} (= 20 °C to 25 °C), respectively.