IEC 61338-1-5

Edition 1.0 2015-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Waveguide type dielectric resonators – Part 1-5: General information and test conditions – Measurement method of conductivity at interface between conductor layer and dielectric substrate at microwave frequency

Résonateurs diélectriques à modes guidés – Partie 1-5: Informations générales et conditions d'essais – Méthode de mesure de la conductivité au niveau de l'interface entre une couche conductrice et un substrat diélectrique fonctionnant aux hyperfréquences

IEC 61338-1-5:2015-06(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 31.140

ISBN 978-2-8322-2721-3

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Part 1-5: General information and test conditions – Measurement method of conductivity at interface between conductor layer and dielectric substrate at microwave frequency

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61338-1-5 has been prepared by IEC technical committee 49: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection.

This first edition cancels and replaces IEC PAS 61338-1-5 published in 2010.

This edition includes the following significant technical changes with respect to the previous edition:

a) description of technical content related to patents (Japanese patent numbers JP3634966, JP3735501) in the Introduction;
b) changes to normative references;
c) addition to bibliography.

The text of this standard is based on the following documents:

CDV	Report on voting
49/1089/CDV	49/1103/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61338 series, published under the general title *Waveguide type dielectric resonators,* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

IEC 61338 consists of the following parts, under the general title *Waveguide type dielectric resonators*:

– Part 1: Generic specification

– Part 1-3: General information and test conditions – Measurement method of complex relative permittivity for dielectric resonator materials at microwave frequency

– Part 1-4: General information and test conditions – Measurement method of complex relative permittivity for dielectric resonator materials at millimeter-wave frequency

– Part 2: Guidelines for oscillator and filter applications

– Part 4: Sectional specification

– Part 4-1: Blank detail specification

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning:

– The use of a $TE_{01\delta}$ mode dielectric rod resonator for the interface resistance and the interface conductivity measurement, given in Clause 4;

– The use of a substrate/conductor/substrate layer structure, where a conductor is formed between two dielectric substrates, for the interface resistance and interface conductivity measurement, given in Clause 5.

IEC takes no position concerning the evidence, validity and scope of this patent right.

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KYOCERA Corporation

6 Takeda Tobadono-cho, Fushimiku, Kyoto 612-8501, Japan

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WAVEGUIDE TYPE DIELECTRIC RESONATORS –

Part 1-5: General information and test conditions – Measurement method of conductivity at interface between conductor layer and dielectric substrate at microwave frequency

1 Scope

Microwave circuits are popularly formed on multi-layered organic or non-organic substrates. In the microwave circuits, the attenuation of planar transmission lines such as striplines, microstrip lines, and coplanar lines are determined by their conductor loss, dielectric loss and radiation loss. Among them, the conductor loss is a major factor in the attenuation of the planar transmission lines. A new measurement method is standardized in this document to evaluate the conductivity of transmission line on or in the substrates such as the organic, ceramic and LTCC (low temperature co-fired ceramics) substrates. This standard describes a measurement method for resistance and effective conductivity at the interface between conductor layer and dielectric substrate, which are called interface resistance and interface conductivity.

This measurement method has the following characteristics:

– the interface resistance R_i is obtained by measuring the resonant frequency f_0 and unloaded quality factor Q_u of a $TE_{01\delta}$ mode dielectric rod resonator shown in Figure 2;

– the interface conductivity σ_i and the relative interface conductivity $\sigma_{ri} = \sigma_i / \sigma_0$ are calculated from the measured R_i value, where $\sigma_0 = 5{,}8 \times 10^7$ S/m is the conductivity of standard copper;

– the measurement uncertainty of σ_{ri} ($\Delta\sigma_{ri}$) is less than 5 %.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61338-1-3: *Waveguide type dielectric resonators – Part 1-3: General information and test conditions – Measurement method of complex relative permittivity for dielectric resonator materials at microwave frequency*

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

3 Measurement and related parameters

The IEC 61338-1-3 described the measurement method for the surface resistance R_s and effective conductivity σ on the surface of the conductor. The term σ is designated as σ_s in this standard, and is called surface conductivity (Figure 1). This standard describes a measurement method for resistance and effective conductivity at the interface between conductor layer and dielectric substrate designated as R_i and σ_i respectively, and are called interface resistance and interface conductivity.