

**Harmonized system of quality
assessment for electronic
components**

Generic Specification: Waveguide type dielectric resonators

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British Standard

ICS 31.140

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National foreword

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 27 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

This British Standard, having been prepared under the direction of the Electrotechnical Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 December 1999

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ISBN 0 580 35076 2

Amendments issued since publication

Amd. No.	Date	Comments

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English version

Generic Specification: Waveguide type dielectric resonators

Spécification générique:
Résonateurs diélectriques à
modes guidés

Fachgrundspezifikation:
Dielektrische Resonatoren
vom Wellenreitertyp

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

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 49, Piezoelectric devices for frequency control and selection.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 170000 on 1999-08-01.

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) 2000-05-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2002-05-01

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1 General

1.1 Scope

This Generic Specification applies to waveguide type dielectric resonators of assessed quality using either capability approval or qualification approval procedures. It also lists the test and measurement procedures which may be selected for use in detail specifications for such resonators.

1.2 Normative references

This European Standard incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

CECC 00109	1974	<i>Rule of procedure 9: Certified Test Records</i>
CECC 00111-3	1994	<i>Rule of procedure 11-3: Regulations for CECC specifications for components for general and professional (civil and military) usage (excluding Detail Specifications)</i>
CECC 00114-2	1994	<i>Rule of procedure 14: Quality assessment procedures</i> <i>Part 2: Qualification approval of electronic components</i>
CECC 00114-3	1993	<i>Part 3: Capability approval of an electronic component manufacturing activity</i>
EN 100114-1	1996	<i>Part 1: CECC requirements for the approval of an organization</i>
EN 60068-1	1994	<i>Environmental testing</i> <i>Part 1: General and guidance</i> (IEC 60068-1:1988 + corr. October 1988 + A1:1992)
EN 60068-2-1	1993	<i>Part 2: Tests — Tests A: Cold</i> (IEC 60068-2-1:1990)
EN 60068-2-2	1993	<i>Tests B: Dry heat</i> (IEC 60068-2-2:1974 + IEC 60068-2-2A: 1976)
EN 60068-2-6	1995	<i>Test Fc: Vibration (sinusoidal)</i> (IEC 60068-2-6:1995 + corr. March 1995)
EN 60068-2-7	1993	<i>Test Ga and guidance: Acceleration, steady state.</i> (IEC 60068-2-7:1983 + A1:1986)
EN 60068-2-21	1997	<i>Test U: Robustness of terminations and integral mounting devices</i> (IEC 60068-2-21:1983 + corr. Nov. 1991 + A1:1985)
+ A2	1997	(IEC 60068-2-21:1983/A2:1991)
+ A3	1997	(IEC 60068-2-21:1983/A3:1992)
EN 60068-2-27	1993	<i>Test Ea and guidance: Shock</i> (IEC 60068-2-27:1987)
EN 60068-2-29	1993	<i>Test Eb and guidance: Bump</i> (IEC 60068-2-29:1987 + corr.)
EN 60617	series	<i>Graphical symbols for diagrams</i> (IEC 60617 series)
HD 323.2.3 S2	1987	<i>Test Ca: Damp heat, steady state</i> (IEC 60068-2-3:1969 + A1:1984)
HD 323.2.13 S1	1987	<i>Test M: Low air pressure</i> (IEC 60068-2-13:1983)
HD 323.2.14 S2	1987	<i>Test N: Change of temperature</i> (IEC 60068-2-14:1984 + A1:1986)
HD 323.2.20 S3	1988	<i>Test T: Soldering</i> (IEC 60068-2-20:1979 + A2:1987)
HD 323.2.30 S3	1988	<i>Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle)</i> (IEC 60068-2-30:1980 + A1:1985)
HD 323.2.58 S1	1991	<i>Test Td: Solderability, resistance to dissolution of metallization and to soldering heat of Surface Mounting Devices (SMD)</i> (IEC 60068-2-58:1989)
IEC 60027-1	1992	<i>Letter symbols to be used in electrical terminology</i> <i>Part 1: General</i>

IEC 60050	series	<i>International Electrotechnical Vocabulary (IEV)</i>
IEC 61338-1-3 ^a		<i>Waveguide type dielectric resonators</i> <i>Part 1-3: Measurement method of complex relative permittivity for dielectric resonator materials at microwave frequency</i>
ISO 1000	1992	<i>SI units and recommendation for the use of their multiples and of certain other units</i>

^a In preparation.

1.3 Units, symbols and terminology

Units, graphical symbols, letter symbols and terminology shall whenever possible, be taken from the following documents:

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units*.

EN 60617, *Graphical symbols for diagrams* (IEC 60617).

IEC 60027, *Letter symbols to be used in electrical technology*.

IEC 60050, *International electrotechnical vocabulary*.

Any other units, symbols and terminology peculiar to one of the components covered by this generic specification, shall be taken from the relevant IEC or ISO documents listed under **1.2**, Normative references.

The following paragraphs contain additional terminology applicable to waveguide type dielectric resonators.

1.3.1 dielectric material

material which predominantly exhibits dielectric properties

NOTE The dielectric material defined herein is intended to be used for resonator applications at high frequency, i.e. UHF or SHF range. Therefore, the dielectric material is required to have high dielectric constant, a low loss factor and a low temperature coefficient of permittivity.

1.3.2 absolute permittivity (ϵ)

quantity which when multiplied by the electric field strength E is equal to the electric flux density D

$$D = \epsilon E, \epsilon = \epsilon_0 \epsilon_r$$

1.3.3 electric constant (ϵ_0)

constant equal to $8,8542 \times 10^{-12} \text{ As V}^{-1} \text{ m}^{-1}$, defined by the permittivity of vacuum

1.3.4 relative permittivity (ϵ_r)

absolute permittivity of a material or medium divided by the electric constant ϵ_0

NOTE The complex relative permittivity ϵ is defined as:

$$\epsilon = \epsilon' - j\epsilon'', \epsilon' = \text{Re}(\epsilon), \epsilon'' = -\text{Im}(\epsilon)$$

where

ϵ' is usually called dielectric constant;

ϵ'' corresponds to the dielectric loss of the material.

1.3.5 loss angle (δ)

phase displacement between the component of the electric flux density and the electric field strength

1.3.6 loss factor

tangent of the loss angle δ

$$\tan \delta = \epsilon''/\epsilon'$$

NOTE The loss factor can be determined by the ratio of the magnitude of the negative part to the real part of the complex relative permittivity.

1.3.7**quality factor of a material (Q_o)**

reciprocal of the tangent of the loss angle,

$$Q_o = \varepsilon'/\varepsilon'' = 1/\tan \delta$$

NOTE The quality factor of a material is also defined as 2π times the ratio of the stored electromagnetic energy to the energy dissipated in the material per cycle. It is frequency dependent.

1.3.8**temperature coefficient of permittivity ($TC\varepsilon$)**

fractional change of permittivity due to a change in temperature divided by the change in temperature

$$TC\varepsilon = \frac{\varepsilon_T - \varepsilon_{ref}}{\varepsilon_{ref} (T - T_{ref})} \times 10^6 \quad [1 \times 10^{-6}/K]$$

where

ε_T is the permittivity at temperature T ;

ε_{ref} is the permittivity at reference temperature T_{ref} .

1.3.9**coefficient of linear thermal expansion (δ)**

fractional change of dimension due to a change in temperature divided by the change in temperature

$$\delta = \frac{I_T - I_{ref}}{I_{ref} (T - T_{ref})} \times 10^6 \quad [1 \times 10^{-6}/K]$$

where

I_T is the dimension at temperature T ;

I_{ref} is the dimension at reference temperature T_{ref} .

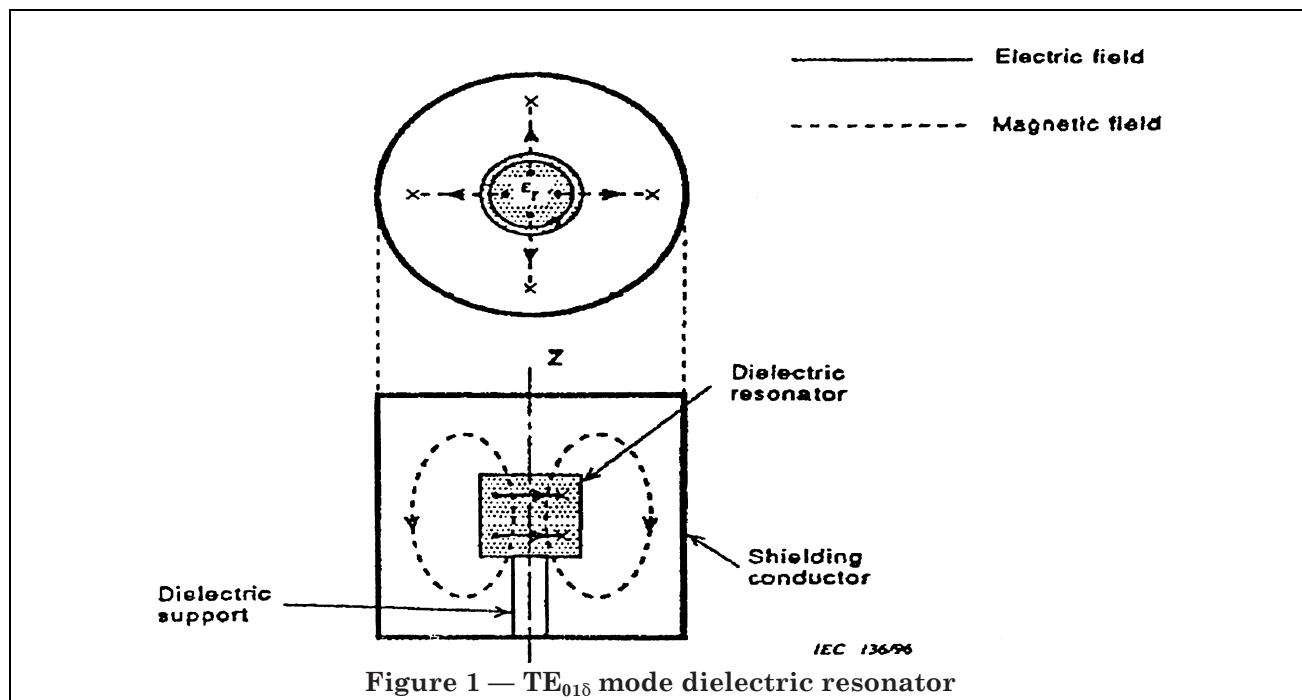
1.3.10**dielectric resonator**

resonator using dielectrics with a high dielectric constant and the structure of which is a dielectric waveguide of finite length

NOTE The dielectric resonators in use are always shielded with conductors.

1.3.11**dielectric support**

element supporting a dielectric resonator. The support is generally used for $TE_{01\delta}$ mode resonators and has a low dielectric constant (see Figure 1)



1.3.12

TE mode dielectric resonator

dielectric resonator characterized by a transverse electric mode (TE mode) field distribution and usually having a high unloaded quality factor Q_u

1.3.13

$TE_{01\delta}$ mode dielectric resonator

dielectric resonator characterized by a dominant TE mode field distribution, whose field leaks in the direction of wave propagation (see Figure 1)

1.3.14

TM mode dielectric resonator

dielectric resonator characterized by a transverse magnetic mode (TM mode) field distribution (see Figure 2)