

Waveguide type dielectric resonators —

Part 1: Generic specification

The European Standard EN 61338-1:2005 has the status of a
British Standard

ICS 31.140

National foreword

This British Standard is the official English language version of EN 61338-1:2005. It is identical with IEC 61338-1:2004. It supersedes BS EN 170000:1999 which will be withdrawn on 2007-12-01.

The UK participation in its preparation was entrusted to Technical Committee EPL/49, Piezo-electric devices for frequency control and selection, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 32, an inside back cover and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 10 March 2005

© BSI 10 March 2005

ISBN 0 580 45579 3

EUROPEAN STANDARD

EN 61338-1

NORME EUROPÉENNE

EUROPÄISCHE NORM

January 2005

ICS 31.140

Supersedes EN 170000:1999

English version

Waveguide type dielectric resonators
Part 1: Generic specification
(IEC 61338-1:2004)

Résonateurs diélectriques
à modes guidés
Partie 1: Spécification générique
(CEI 61338-1:2004)

Dielektrische Resonatoren
vom Wellenleitertyp
Teil 1: Fachgrundspezifikation
(IEC 61338-1:2004)

This European Standard was approved by CENELEC on 2004-12-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

© 2005 CENELEC - All rights of exploitation in any form and by any means reserved worldwide for CENELEC members.

Ref. No. EN 61338-1:2005 E



Documents
Document Sharing Hub

Foreword

The text of document 48/690/FDIS, future edition 1 of IEC 61338-1, prepared by IEC TC 49, Piezoelectric and dielectric devices for frequency control and selection, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61338-1 on 2004-12-01.

This European Standard supersedes EN 170000:1999.

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) | 2005-09-01 |
| – latest date by which the national standards conflicting with the EN have to be withdrawn | (dow) | 2007-12-01 |

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61338-1:2004 was approved by CENELEC as a European Standard without any modification.

CONTENTS

1	General	4
1.1	Scope.....	4
1.2	Normative references	4
1.3	Order of precedence.....	5
2	Terminology and general requirements	5
2.1	General	5
2.2	Definitions	6
2.3	Preferred values for ratings and characteristics.....	16
2.4	Marking	17
3	Quality assessment procedures	17
3.1	General	17
3.2	Primary stage of manufacture	17
3.3	Structurally similar components	17
3.4	Sub-contracting	17
3.5	Manufacturer's approval	18
3.6	Approval procedures.....	18
3.7	Procedures for capability approval	19
3.8	Procedures for qualification approval	19
3.9	Test procedures	20
3.10	Screening requirements	20
3.11	Rework and repair work	20
3.12	Certified records of released lots	20
3.13	Validity of release	20
3.14	Release for delivery	20
3.15	Unchecked parameters	20
4	Test and measurement procedures	21
4.1	General	21
4.2	Test and measurement conditions.....	21
4.3	Visual inspection.....	21
4.4	Dimension and gauging procedure	21
4.5	Electrical test procedures.....	22
4.6	Mechanical and environmental test procedures.....	28
	Annex ZA (normative) Normative references to international publications with their corresponding European publications	31
	Figure 1 – TE ₀₁₈ mode dielectric resonator	8
	Figure 2 – TM mode dielectric resonator.....	8
	Figure 3 – TM ₀₁₈ mode dielectric resonator	9
	Figure 4 – Hybrid mode dielectric resonator.....	10
	Figure 5 – Multimode dielectric resonators.....	11
	Figure 6 – TEM mode coaxial dielectric resonator.....	12
	Figure 7 – Half wavelength stripline resonator	13
	Figure 8 – Half wavelength microstripline resonator	14
	Figure 9 – Coplanar resonator	15
	Figure 10 – Transmission measurement.....	22
	Figure 11 – Resonator test fixture	25
	Figure 12 – Frequency response for test fixture A, B and D	26
	Figure 13 – Frequency response for test fixture C.....	26

WAVEGUIDE TYPE DIELECTRIC RESONATORS –

Part 1: Generic specification

1 General

1.1 Scope

This part of IEC 61338 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

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

IEC 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050(561):1991, *International Electrotechnical Vocabulary (IEV) – Chapter 561: Piezo-electric devices for frequency control and selection*

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1:1990, *Environmental testing – Part 2: Tests – Tests A: Cold*

IEC 60068-2-2:1974, *Environmental testing – Part 2: Tests – Tests B: Dry Heat*

IEC 60068-2-6:1995, *Environmental testing – Part 2: Tests – Tests Fc: Vibration (sinusoidal)*

IEC 60068-2-7:1983, *Environmental testing – Part 2: Tests – Tests Ga and guidance: Acceleration, steady state*

IEC 60068-2-13:1983, *Environmental testing – Part 2: Tests – Tests M: Low air pressure*

IEC 60068-2-14:1984, *Environmental testing – Part 2: Tests – Tests N: Change of temperature*

IEC 60068-2-20:1979, *Environmental testing – Part 2: Tests – Tests T: Soldering*

IEC 60068-2-21:1999, *Environmental testing – Part 2: Tests – Tests U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27:1987, *Environmental testing – Part 2: Tests – Tests Ea and guidance: Shock*

IEC 60068-2-29:1987, *Environmental testing – Part 2: Tests – Tests Eb and guidance: Bump*

IEC 60068-2-30:1980, *Environmental testing – Part 2: Tests – Tests Db and guidance: Damp heat, cyclic (12 +12 hour cycle)*

IEC 60068-2-58:2004, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

IEC 60068-2-78, *Environmental testing – Part 2: Tests – Test Cab: Damp heat, steady state*

IEC 60617, *Graphical symbols for diagrams*

IEC 61338-1-3:1999, *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 61338-4, *Waveguide type dielectric resonators of assessed quality – Part 4: Sectional specification*¹

ISO 1000:1992, *SI units and recommendation for the use of their multiples and of certain other units*

QC 001001:2000, *IEC Quality Assessment System for Electronic Components (IECQ) – Basic Rules*

QC 001002-1:1998, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of Procedure – Part 1: Administration*

QC 001002-2:1998, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of Procedure – Part 2: Documentation*

QC 001002-3:1998, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of Procedure – Part 3: Approval Procedures*

QC 001005:2000, *Register of Firms, Products and Services approved under the IECQ System, including ISO 9000*

1.3 Order of precedence

Where any discrepancies occur for any reason, documents shall rank in the following order of priority:

- detail specification;
- sectional specification;
- generic specification;
- any other international documents (for example, of the IEC) to which reference is made.

The same order of preference shall apply to equivalent national documents.

2 Terminology and general requirements

2.1 General

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
IEC 60617	Graphical symbols for diagrams
IEC 60027	Letter symbols to be used in electrical technology
IEC 60050	International Electrotechnical Vocabulary

¹ To be published.

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.

2.2 Definitions

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

2.2.1 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.

2.2.2 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.

2.2.3 Relative permittivity (ϵ_r)

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

NOTE The complex relative permittivity ϵ_r is defined as

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

where

ϵ' is usually called dielectric constant;

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

2.2.4 Absolute permittivity (ϵ)

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

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

2.2.5 Loss angle (δ)

Phase displacement between the component of the electric flux density and the electric field strength.

2.2.6 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.

2.2.7 Quality factor of a material (Q_0)

Reciprocal of the tangent of the loss angle,

$$Q_0 = \varepsilon' / \varepsilon'' = 1 / \tan \delta$$

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.

2.2.8 Temperature coefficient of permittivity ($TC\varepsilon$)

Fractional change of permittivity due to a change in temperature divided by the change in temperature.

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

where

ε_T is the permittivity at temperature T ;

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

2.2.9 Coefficient of linear thermal expansion (α)

Fractional change of dimension due to a change in temperature divided by the change in temperature.

$$\alpha = \frac{\ell_T - \ell_{\text{ref}}}{\ell_{\text{ref}}(T - T_{\text{ref}})} \times 10^6 \quad \left(1 \times 10^{-6} / \text{K}\right)$$

where

ℓ_T is the dimension at temperature T ;

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

2.2.10 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.

2.2.11 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).

2.2.12 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 .

2.2.13 $TE_{01\delta}$ 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).

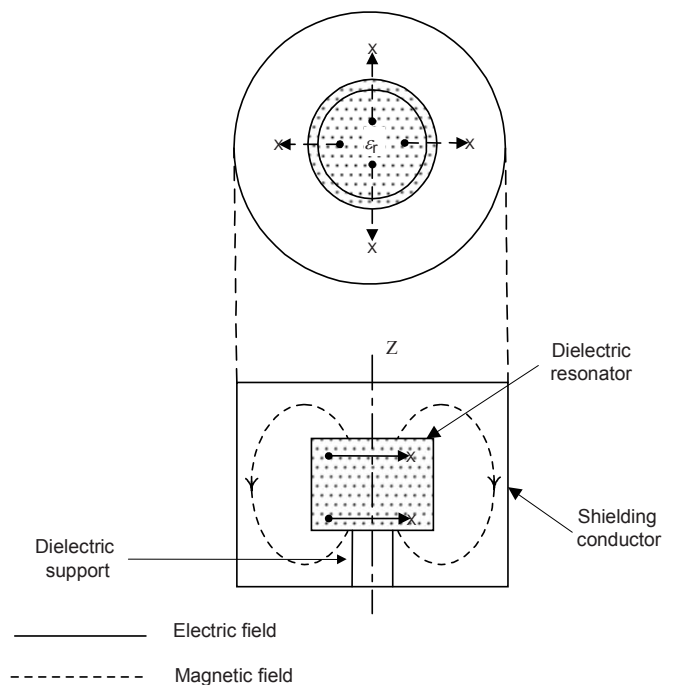


Figure 1 – $TE_{01\delta}$ mode dielectric resonator

2.2.14 TM mode dielectric resonator

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

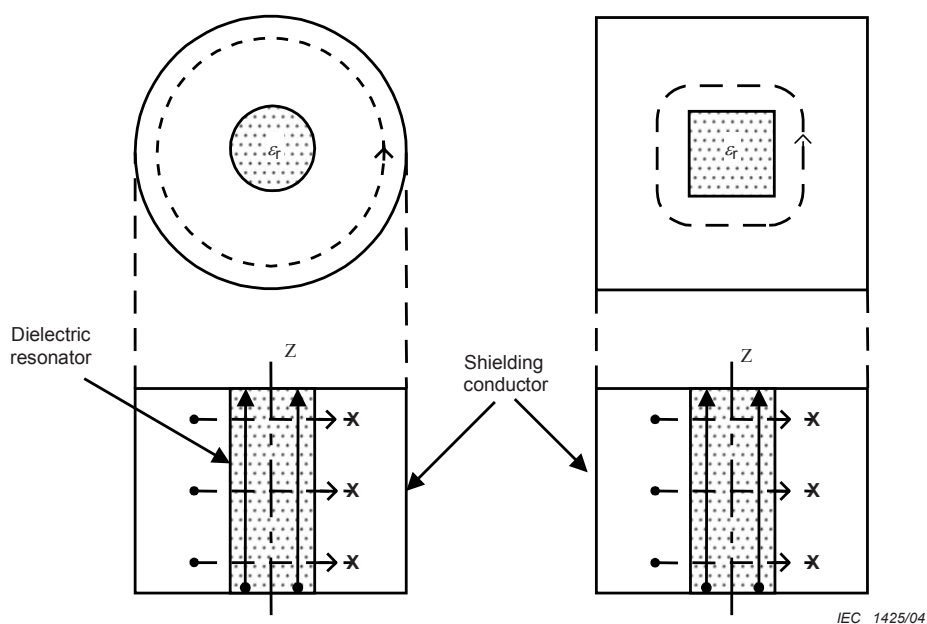


Figure 2 – TM mode dielectric resonator

2.2.15 $TM_{01\delta}$ mode dielectric resonator

Dielectric resonator characterized by a dominant TM mode field distribution, whose field leaks in the direction of wave propagation (see Figure 3).

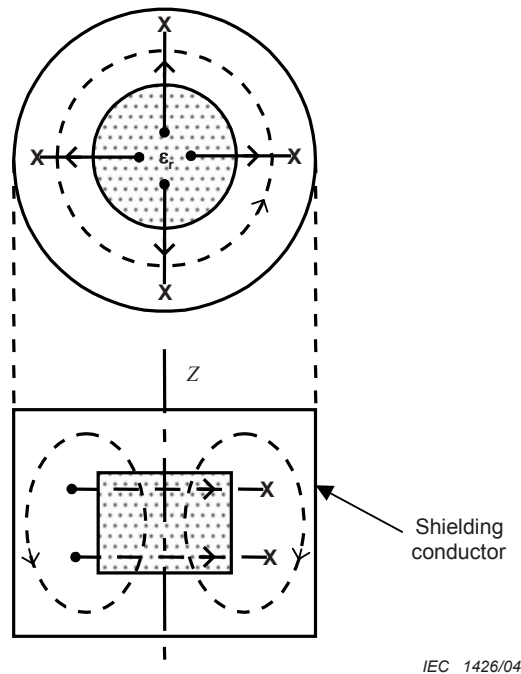


Figure 3 – $TM_{01\delta}$ mode dielectric resonator

2.2.16 Hybrid mode dielectric resonator

Dielectric resonator characterized by a hybrid mode field distribution. Hybrid mode is the mode which has axial components both of the electric and magnetic fields (see Figure 4).