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TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection – Glossary – Part 4-2: Piezoelectric and dielectric materials – Piezoelectric ceramics

Dispositifs piézoélectriques, diélectriques et électrostatiques et matériaux associés pour la commande, le choix et la détection de la fréquence – Glossaire – Partie 4-2 : Matériaux piézoélectriques et diélectriques – Céramiques piézoélectriques

IEC/TS 61994-4-2:2011

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PIEZOELECTRIC, DIELECTRIC AND ELECTROSTATIC DEVICES AND ASSOCIATED MATERIALS FOR FREQUENCY CONTROL, SELECTION AND DETECTION – GLOSSARY –

Part 4-2: Piezoelectric and dielectric materials – Piezoelectric ceramics

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 61994-4-2, which is a technical specification, has been prepared by IEC technical committee 49: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection.

This second edition of IEC 61994-4-2 cancels and replaces the first edition published in 2003 This edition constitutes a technical revision.

The main changes with respect to the previous edition are :

– definitions updated;
– terminology given in orderly sequence;
– drawing inserted for easier understanding the vibration modes.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
49/924/DTS	49/932/RVC

Full information on the voting for the approval of this technical specification 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 of IEC 61994 under the general title [1]: *Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection – Glossary* can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

1 The general title is changed from *Piezoelectric and dielectric devices for frequency control and selection – Glossary*: to this title based on the change of the title of TC49 in 2009.

PIEZOELECTRIC, DIELECTRIC AND ELECTROSTATIC DEVICES AND ASSOCIATED MATERIALS FOR FREQUENCY CONTROL, SELECTION AND DETECTION – GLOSSARY –

Part 4-2: Piezoelectric and dielectric materials – Piezoelectric ceramics

1 Scope

This part of IEC 61994 specifies the terms and definitions for piezoelectric ceramics representing the present state-of-the-art, which are intended for use in the standards and documents of IEC technical committee 49.

2 Normative references

Void

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
aging
irreversible changes with time in the properties of the material

3.2
bulk acoustic wave
elastic wave propagating in solid material such as piezoelectric ceramics

3.3
coupling coefficient
the coupling coefficient(electro-mechanical coupling coefficient) is a constant representing the piezoelectric efficiency of a piezoelectric ceramic. More specifically, it represents the efficiency of converting electrical energy into mechanical energy, and it is defined as the square root of the ratio of mechanical energy exited to electrical energy transferred.

$$k = \sqrt{\frac{\text{mechanical energy excited}}{\text{electrical energy transferred}}}$$

3.4
Curie temperature
temperature at which a ferroelectric material undergoes a structural phase transition to a state where a spontaneous polarisation vanishes

3.5
electric polarisation
$\boldsymbol{P}$
at a given point within a domain of quasi-infinitesimal volume V, vector quantity equal to the electric dipole moment $\boldsymbol{p}$ of the substance contained within the domain divided by the volume, V

$$\boldsymbol{P} = \boldsymbol{p} / V$$

NOTE The electric polarization $\boldsymbol{P}$ satisfies the relation

$$\boldsymbol{D} = \varepsilon_0 \boldsymbol{E} + \boldsymbol{P}$$

where

$\boldsymbol{D}$ is the electric flux density;

$\boldsymbol{E}$ is the electric field strength and

ε_0 is the dielectric constant in free space.

[IEC 60050-121: 1998, 121-11-37]

3.6
expansion vibration
vibration mode of a disc or plate where the displacement is in the plane surface (see Figure 1)

3.7
ferroelectric material
material that exhibits, over some range of temperature, a spontaneous electric polarization that can be reversed or reoriented by application of an electric field

3.8
flexural vibration
for a resonator shaped as a thin narrow bar, displacements appearing in a direction perpendicular to the length of the bar (see Figure 1)

3.9
frequency constant
product of the resonance frequency and the vibrating piece dimension which determines the resonance frequency.

NOTE For fundamental mode the frequency constant equals to the velocity of an acoustic wave.

3.10
insulation resistance
resistance under specified conditions between two conductive elements separated by insulating materials

[IEC 60050-151: 2001,151-15-43]

3.11
length vibration
for a resonator shaped as a thin and narrow bar, the dominant deformation which appears only along the longitudinal axis (see Figure 1)

3.12
(absolute) permittivity
ε
scalar or tensor quantity the product of which by the electric field strength $\boldsymbol{E}$ in a medium is equal to the electric flux density $\boldsymbol{D}$:

$$\boldsymbol{D} = \varepsilon \times \boldsymbol{E}$$

NOTE For an isotropic medium the permittivity is a scalar quantity; for an anisotropic medium it is a tensor quantity.

[IEC 60050-121: 1998, 121-12-12]

3.13
piezoelectric ceramics
ceramics with a high dielectric constant which are given piezoelectricity by polarising property.

3.14
piezoelectric effect
piezoelectricity is the ability to generate an electric field in response to applied mechanical stress. The piezoelectric effect is reversible in that materials exhibiting the direct piezoelectric effect (the production of an electric field when stress is applied) also exhibit the reverse piezoelectric effect (the production of stress and/or strain when an electric field is applied).

[IEC 60050-121: 1998, 121-12-86, modified]

3.15
poling
process by which a d.c. electric field exceeding the coercive field is applied to a multi-domain ferroelectric to produce a net remanent polarisation

3.16
remanent polarisation
polarisation electric that remains after an applied electric field is removed

3.17
spontaneous polarization
electric polarization within a single ferroelectric domain

3.18
trapped vibration mode
vibration mode the wave energy of which is trapped in the electrode region on the piezoelectric ceramic resonator shaped as a thin plate and vibrating in a thickness mode (see Figure 1)

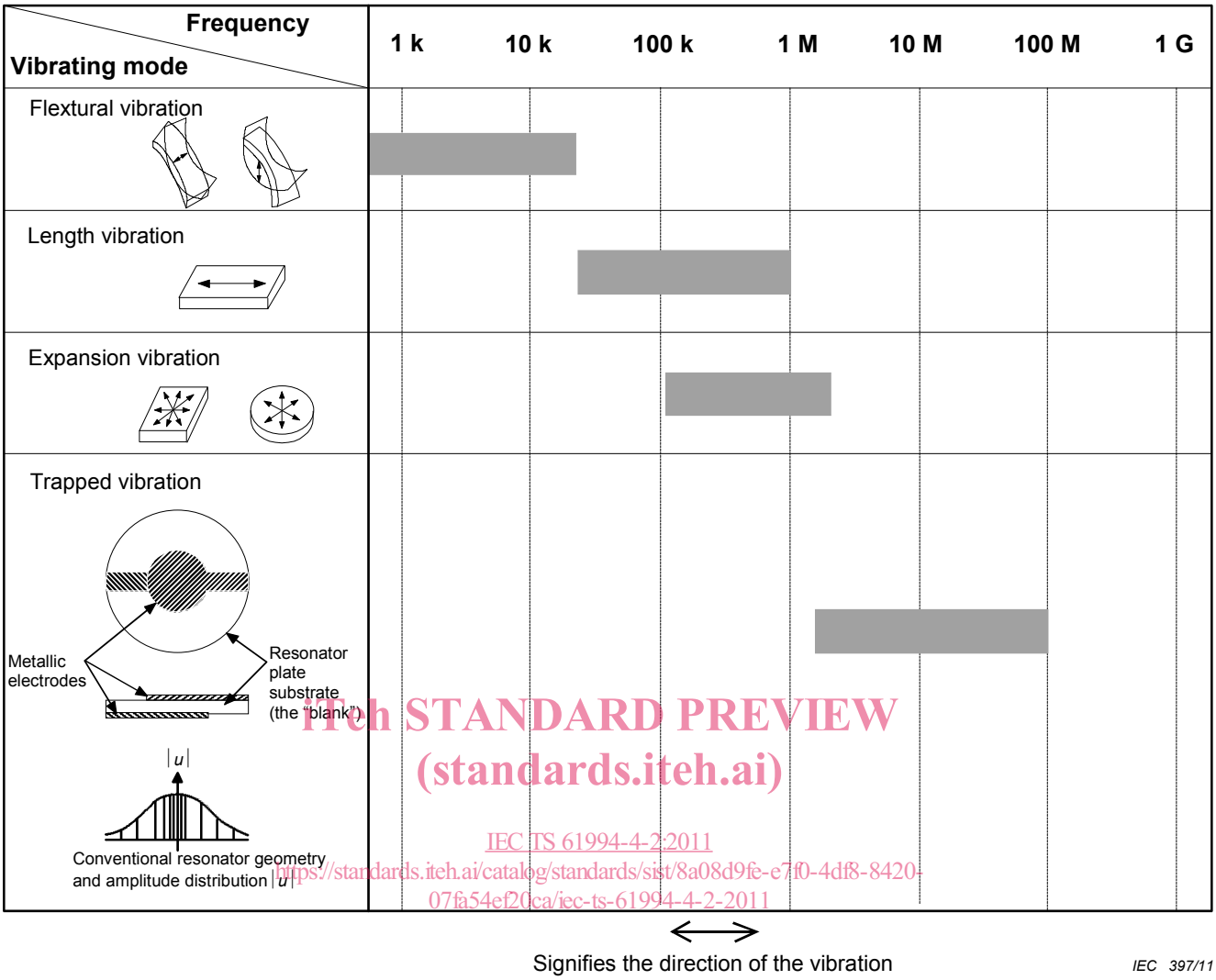

Figure 1 – Vibrating modes and their application frequencies

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