Piezoelectric properties of ceramic materials and components - Part 1: Terms and definitions

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EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 50324-1:2003 sisaldab Euroopa standardi EN 50324-1:2002 ingliskeelset teksti. Käesolev dokument on jõustatud 15.01.2003 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes. Standard on kättesaadav Eesti standardiorganisatsioonist.	This Estonian standard EVS-EN 50324-1:2003 consists of the English text of the European standard EN 50324-1:2002. This document is endorsed on 15.01.2003 with the notification being published in the official publication of the Estonian national standardisation organisation. The standard is available from Estonian standardisation organisation.

Käsitlusala: This European Standard relates to piezoelectric transducer ceramics for application both as transmitters and receivers in electroacoustics and ultrasonics over a wide frequency range. They are used for generation and transmission of acoustic signals, for achievement of ultrasonic effects, for transmission of signals in communication electronics, for sensors and actuators and for generation of high voltages in ignition devices.	**Scope:** This European Standard relates to piezoelectric transducer ceramics for application both as transmitters and receivers in electroacoustics and ultrasonics over a wide frequency range. They are used for generation and transmission of acoustic signals, for achievement of ultrasonic effects, for transmission of signals in communication electronics, for sensors and actuators and for generation of high voltages in ignition devices.

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English version

Piezoelectric properties of ceramic materials and components
Part 1: Terms and definitions

Propriétés piézoélectriques des matériaux et composants en céramique
Partie 1: Termes et définitions

Piezoelektrische Eigenschaften von keramischen Werkstoffen und Komponenten
Teil 1: Begriffe

This European Standard was approved by CENELEC on 2001-12-01. 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.

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CENELEC
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 CENELEC BTTF 63-2, Advanced technical ceramics.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50324-1 on 2001-12-01.

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)	2002-12-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2004-12-01

This draft European Standard consists of three parts:

Part 1	Terms and definitions
Part 2	Methods of measurement - Low power
Part 3	Methods of measurement - High power

Contents

Introduction

The principles underlying the piezoelectricity of ceramics are discussed in IEC 60483 “Guide to dynamic measurements of piezoelectric ceramics with high electromechanical coupling”. Piezoelectric ceramics are polycrystalline ferroelectrics mainly based on lead zirconate titanate ($Pb(ZrTi)O_3$), barium titanate ($BaTiO_3$) and lead titanate ($PbTiO_3$). Their piezoelectricity is the result of the preferential orientation of polar regions at remanent polarisation. In ceramics, the remanent polarisation is created by application of a dc electric field to the polycrystalline material. The value of this remanent polarisation results in the high level of piezoelectric activity in piezoceramics.

Both the direct and inverse piezoelectric effects are utilized. In a variety of applications, piezoelectric transducers operate at resonance. Static and quasi-static applications complete a wide range of functions.

1 Scope

This European Standard relates to piezoelectric transducer ceramics for application both as transmitters and receivers in electroacoustics and ultrasonics over a wide frequency range. They are used for generation and transmission of acoustic signals, for achievement of ultrasonic effects, for transmission of signals in communication electronics, for sensors and actuators and for generation of high voltages in ignition devices.

Piezoelectric ceramics can be manufactured in a wide variety of shapes and sizes. Commonly used shapes include discs, rectangular plates, bars, tubes, cylinders and hemispheres as well as bending elements (circular and rectangular), sandwiches and monolithic multilayers.

Relevant sections of IEC 60302 “Standard definitions and methods of measurement for piezoelectric vibrators operating over the frequency range up to 30 MHz” and IEC 60642 “Piezoelectric ceramic resonators and resonator units for frequency control and selection” have been taken into consideration when drafting this standard.

2 Normative references

This European Standard incorporates, by dated or 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 (including amendments).

IEC 60302 Standard definitions and methods of measurement for piezoelectric vibrators operating over the frequency range up to 30 MHz

IEC 60483 Guide to dynamic measurements of piezoelectric ceramics with high electromechanical coupling

IEC 60642 Piezoelectric ceramic resonators and resonator units for frequency control and selection - Chapter I: Standard values and conditions - Chapter II: Measuring and test conditions

3 Definitions

The fundamental parameters of the equivalent electric circuit of a piezoelectric resonator are defined in IEC 60302 and, additionally, IEC 60642 defines terms commonly used to characterize piezoelectrics. The additional terms defined in this standard describe the properties and performance parameters of piezoelectric ceramics.

3.1 Ferroelectricity of ceramics

3.1.1
ferroelectric ceramic
non-linear spontaneously polarised ceramics, generally with a high level of permittivity, exhibit hysteresis in the variation of the dielectric polarization as a function of electric field strength and temperature dependence of the permittivity (see “Curie temperature”). Ferroelectric ceramics become piezoelectric by the induced alignment of dipoles, a process generally referred to as poling

To create the macroscopic piezoelectric effect, the polar axes of dipole regions (domains) in crystallites of ferroelectric ceramics must be aligned. This requires the application of a high dc field at determined conditions of temperature and time. The poled ceramic has a remanent polarization P_r which is necessary for piezoelectric activity.