

Piezoelectric filters —

Part 2: Guide to the use of piezoelectric filters —

Section 2: Piezoelectric ceramic filters

The European Standard EN 60368-2-2:1999 has the status of a British Standard

ICS 31.140; 31.160

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

BSI
Documents

AVA

Document Sharing Hub

National foreword

This British Standard is the English language version of EN 60368-2-2:1999. It is identical with IEC 60368-2-2:1996.

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

- aid enquirers to understand the text;
- present to the responsible 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.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

Attention is drawn to the fact that CEN and CENELEC Standards normally include an annex which lists normative references to international publications with their corresponding European publications. The British Standards which implement these international or European publications may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their 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, pages i and ii, the EN title page, pages 2 to 16, an inside back cover 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 October 1999

© BSI 03-2000

ISBN 0 580 32203 3

Amendments issued since publication

Amd. No.	Date	Comments

Contents

	Page
National foreword	Inside front cover
Foreword	2
Text of EN 60368-2-2	3

English version

Piezoelectric filters
Part 2: Guide to the use of piezoelectric filters
Section 2: Piezoelectric ceramic filters

(IEC 60368-2-2:1996)

Filtres piézoélectriques
Partie 2: Guide d'emploi des
filtres piézoélectriques
Section 2: Filtres à céramique
piézoélectrique
(CEI 60368-2-2:1996)

Piezoelektrische Filter
Teil 2: Leitfaden für die Anwendung
von piezoelektrischen Filtern
Hauptabschnitt 2: Piezoelektrische
Keramikfilter
(IEC 60368-2-2:1996)

This European Standard was approved by CENELEC on 1999-01-01. 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, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, 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

Foreword

The text of the International Standard IEC 60368-2-2:1996, prepared by IEC TC 49, Piezoelectric and dielectric devices for frequency control and selection, was submitted to the formal vote and was approved by CENELEC as EN 60368-2-2 on 1999-01-01 without any modification.

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

Annexes designated “normative” are part of the body of the standard.

In this standard, Annex ZA is normative. Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60368-2-2:1996 was approved by CENELEC as a European Standard without any modification.

Contents

	Page
Foreword	2
Introduction	3
1 Scope	3
2 Normative references	3
3 Terms and definitions	4
3.1 General terms	4
3.2 Electrical properties	4
4 Piezoelectric ceramic resonators for filters	5
4.1 General	5
4.2 Mode of vibration as a function of frequency	6
5 Basic filter characteristics	7
5.1 Types of piezoelectric ceramic filters	7
5.2 Utilization and limitations	12
5.3 Input level	13
6 Practical remarks	15
6.1 Impedance matching	15
6.2 Spurious response suppression	15

7 Measuring techniques	15
8 Marking	15
9 Specification procedure for a piezoelectric ceramic filter	16
Annex ZA (normative) Normative references to international publications with their corresponding European publications	Inside back cover
Figure 1 — Transducer attenuation characteristic of a filter	5
Figure 2 — Mode of vibration and frequency ranges of piezoelectric ceramic resonators	6
Figure 3 — Two types of transducer attenuation characteristics	7
Figure 4 — Example of a three-terminal piezoelectric ceramic resonator using electrodes split into ring and dot	8
Figure 5 — Simplified equivalent circuit of a piezoelectric ceramic resonator using electrodes split into ring and dot	8
Figure 6 — Cascade-connected filters	8
Figure 7 — Examples of transducer amplitudes of ceramic filters	9
Figure 8 — Fundamental connection of a ladder-type filter	9
Figure 9 — Equivalent circuit of Figure 8	10
Figure 10 — Relation of resonance and anti-resonance frequencies of series and parallel connected resonators	10
Figure 11 — Examples of transducer attenuation characteristics of 2-, 3- and 4-section ladder-type filters	11
Figure 12 — Distribution of two kinds of vibrating amplitude	11
Figure 13 — Equivalent circuit of a multicoupling mode piezoelectric ceramic filter	11
Figure 14 — Example of the transducer amplitude of a 10,7 MHz piezoelectric ceramic filter	12
Figure 15 — Frequency ranges of ceramic band-pass filters not requiring critically difficult development work	14
Figure 16 — Example of the transducer attenuation change by impedance matching	15
Table 1 — Typical data on piezoelectric ceramics used for filters	6

Introduction

In accordance with the progress in research and development of stable piezoelectric ceramic materials a new, rather promising field has appeared in designing high quality, miniature and economical filters using piezoelectric ceramic resonators (hereinafter referred to as ceramic resonators).

The availability of ceramic resonators with a high coupling factor, a high quality factor, and a satisfactory stability has permitted a design of a piezoelectric ceramic filter which can be used as an alternative to conventional LC filters, mechanical filters, as well as for new applications.

Piezoelectric ceramic filters (hereafter referred to as ceramic filters) are at present widely used in communication (in IF amplifiers of communication receivers), in equipment for forming a set of reference frequencies, and also in telemetry and measurement application, as well as in the IF amplifiers of broadcast receivers. Although specifications for these filters are very diverse, many of the above needs can be served by a few standard types of ceramic filters.

The standard detail specifications (in the IEC 368 and IEC 1261 series) and national specifications or data sheets issued by manufacturers will define the available combinations of reference frequency, pass bandwidth, ripple, shape factor, terminating impedance, etc. These sheets are compiled to include a wide range of ceramic filters with standardized performances. It cannot be overemphasized that the user should, wherever possible, select his ceramic filters from these specification sheets, when available, even if it may lead to making small modifications to his circuit to enable standard filters to be used. This is especially so in the case of the selection of the reference frequency.

In contrast to conventional LC filters, ceramic filters, as well as quartz crystal filters, offer substantial advantages in design and production costs, when their reference frequencies are limited to a few narrow frequency ranges. Hence, an order which does not specify one of the more commonly used reference frequencies may be uneconomical.

It should be understood that standardization is not a fixed process, but rather a continuing one. As new requirements arise, new detail specifications are prepared to meet these requirements.

It is of prime interest to a user that the filter characteristics should satisfy the requirements of a specification sheet. The selection of internal filter and resonator networks to meet that specification should be an option of the manufacturer.

The amplitude versus frequency characteristics of a filter are usually expressed in terms of transducer attenuation as a function of frequency, as shown in Figure 1. In some applications, such characteristics as transient response or group delay time are more important than transducer attenuation.

Transducer attenuation characteristics are further specified by reference frequency, minimum transducer attenuation, pass-band ripple and shape factor, of which standard values are given in IEC 368-1 and IEC 1261-1. The specification is to be satisfied between the lowest and highest temperature of the specified operating temperature range. This condition should also be satisfied before and after the environmental tests. In some cases, particularly for filters for broadcast receivers, the maximum variation of characteristics over a given temperature range may be specified.

1 Scope

This section of IEC 368-2 describes passive band-pass filters operating over the frequency range of a few kHz to more than 10 MHz which are commercially available as separate and independent units. It is not the aim of this standard to explain theory, nor to attempt to cover all the eventualities which may arise in practical circumstances. This standard draws attention to some of the fundamental questions which should be considered by the user before he places an order for a filter for a new application. Such a procedure will be the user's insurance against unsatisfactory performance.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this section of IEC 368-2. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this section of IEC 368-2 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 368-1:1992, *Piezoelectric filters — Part 1: General information, standard values and test conditions*.

IEC 1261-1:1994, *Piezoelectric ceramic filters for use in electronic equipment — A specification in the IEC quality assessment system for electronic components (IECQ) — Part 1: Generic specification — Qualification approval*.