IEC/TS 61994-2

Edition 2.0 2011-06

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

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

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

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:
Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,…). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:
Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

IEC/TS 61994-2

Edition 2.0 2011-06

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

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

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

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX

R

ICS 31.140; 01.040.31

ISBN 978-2-88912-535-7

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 2: Piezoelectric and dielectric filters

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.

3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.

4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.

6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

– the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or

– the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

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

IEC 61994-2, 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 61994-2 cancels and replaces the first edition published in 2000 This edition constitutes a technical revision.

The main changes with respect to the previous edition are listed below:

– definitions updated,
– terminology given in orderly sequence,
– new terminologies are added,
– drawings inserted for easier understanding.

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

Enquiry draft	Report on voting
49/922/DTS	49/931/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 series 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.

NOTE 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 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

- 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 2: Piezoelectric and dielectric filters

1 Scope

This part of IEC 61994 is a technical specification that gives the terms and definitions for piezoelectric and dielectric filters 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

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

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

IEC 60368-1:2000, *Piezoelectric filters of assessed quality – Part 1: Generic specification*

IEC 60368-2-2:1996, *Piezoelectric filters – Part 2: Guide to the use of piezoelectric filters – Section 2: Piezoelectric ceramic filters*

IEC 60862-1:2003, *Surface acoustic wave (SAW) filters of assessed quality – Part 1: Generic specification*

IEC 60862-2:2002, *Surface acoustic wave (SAW) filters of assessed quality – Part 2: Guidance on use*

IEC 61261-1:1994, *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*

IEC 61337-1:2004, *Filters using waveguide type dielectric resonators – Part 1: Generic specification*

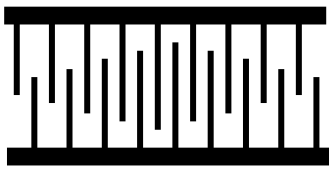
3 Terms and definitions

For the purposes of this document, the following terms and definitions given in IEC 60050-561 as well as the followings apply.

3.1
apodisation (of an interdigital transducer)
IDT
weighting produced by the change of finger overlap over the length of the IDT

NOTE An apodization of IDT is shown in Figure 1.

[IEC 60862-2: 2002, 3.1.18]



IEC 1199/11

Figure 1 – Apodized IDT

3.2
available power
maximum power obtainable from a given source by suitable adjustment of the load impedance

[IEC 60862-1:2003, 2.2.2.35]

3.3
band-pass filter
filter having a single pass band between two specified stop bands

3.4
band-stop filter
filter having a single stop band between two specified pass band

3.5
centre frequency
arithmetic mean of the cut-off frequencies

[IEC 60862-1: 2003, 2.2.2.2]

3.6
comb filter
filter having two or more pass-bands between three or more stop-bands

[IEC 60862-2 :2002, 3.3.5]

3.7
coupling factor for dielectric filters,
k
degree of coupling between two resonators. The coupling between dielectric resonators is mainly made either magnetically or electrically. According to each case, the equivalent circuit of coupling is expressed by inductive or capacitive coupling, respectively.

The coupling factor by inductive or capacitive coupling is defined by the following equations respectively:

$$k = M / \sqrt{L_1 \times L_2} \qquad k = C_m / \sqrt{C_1 \times C_2}$$

where

L_1, C_1 and L_2, C_2 are the resonance circuit elements;

M is the mutual inductance;

C_m is the coupling capacitance;

k is the coupling factor.

In the case of a symmetric circuit of coupling, the coupling factor can be obtained from two resonance frequencies calculated or measured for the coupled resonators:

$$k = (| f_0^2 - f_e^2 |) / (f_0^2 + f_e^2)$$

where

f_e is the resonance frequency in the case of even mode excitation (open-circuited symmetric plane);

f_0 is the resonance frequency in the case of odd mode excitation (short-circuited symmetric plane).

The coupling factor of a band-stop filter is the degree of coupling between the resonator and the transmission line. The coupling factor k is defined as the ratio of the external power loss (P_e) of the resonator system to the internal power loss (P_u) of the resonator and can be expressed by a function of quality factor as follows:

$$k = P_e/P_u = Q_u/Q_e = Q_u/Q_L - 1$$

where

Q_u is the unloaded quality factor of resonator;

Q_e is the external quality factor of resonator;

Q_L is the loaded quality factor of resonator.

[IEC 61337-1: 2004, 2.2.6, modified]

3.8
cut-off frequency
frequency of the pass band at which the relative attenuation of a piezoelectric filter reaches a specified value

NOTE See Figure 4.

3.9
dispersive filter
filter designed so as to have group delay which is a function of frequency, usually by varying the finger periodicity

NOTE An interdigital transducer for a dispersive filter is shown in Figure 2.

[IEC 60862-2: 2002, 3.3.4]

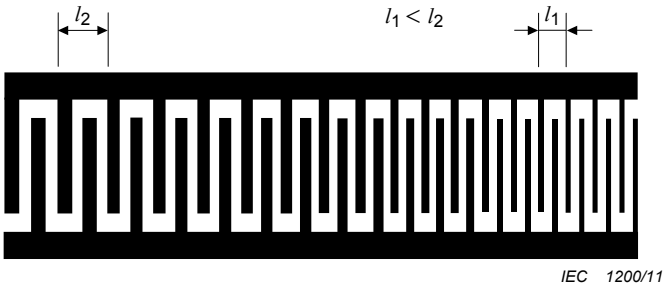


Figure 2 – Configuration of an interdigital transducer for dispersive filter

3.10
distortion of envelope delay time (in an electrical network)
unwanted variation of the envelope delay time of a signal in an electrical network as a function of frequency

3.11
envelope delay time
time of propagation of a certain characteristic of a signal envelope between two points, for a certain frequency

3.12
feedthrough signals (signals of electromagnetic interference)
unwanted signals from the input appearing at the filter output due to stray capacitances and other electromagnetic couplings

[IEC 60862-1: 2003, 2.2.1.29]

3.13
feedthrough signal suppression
relative attenuation which implies the suppression of directly coupled signals by the electromagnetic and electrostatic coupling between the input and output electrodes

[IEC 60862-1: 2003, 2.2.2.27]

3.14
fractional bandwidth (of a band-pass filter)
ratio of the pass bandwidth to the mid-band frequency in the case of band-pass filter

[IEC 61337-1: 2004, 2.2.14, modified]

3.15
fractional bandwidth (of a band-stop filter)

ratio of the stop bandwidth to the mid-band frequency in the case of band-stop filter

[IEC 61337-1: 2004, 2.2.14, modified]

3.16
frequency asymmetrical filter
filter having a specified asymmetrical pass-band or stop-band characteristic in relation to the reference frequency

[IEC 60862-1: 2003, 2.2.3.3]

3.17
frequency symmetrical filter
filter having a symmetrical frequency characteristic in relation to the reference frequency

[IEC 60862-1: 2003, 2.2.3.2]

3.18
group delay
time equal to the first derivative of the phase shift, in radians, between these points with respect to the angular frequency

[IEC 60862-1: 2003, 2.2.2.18]

3.19
group delay distortion
difference between the lowest and highest value of group delay in a specified frequency band

[IEC 60862-1: 2003, 2.2.2.19]

3.20
high-pass filter
filter having a single pass band above a cut-off frequency and a stop band for lower frequencies

3.21
Interdigitated interdigital transducer
IIDT
SAW transducer made of a combination of three or more interdigital transducers. Same as a multi-interdigital transducer

NOTE 1 An interdigitated interdigital transducer (IIDT) is shown in Figure 3.

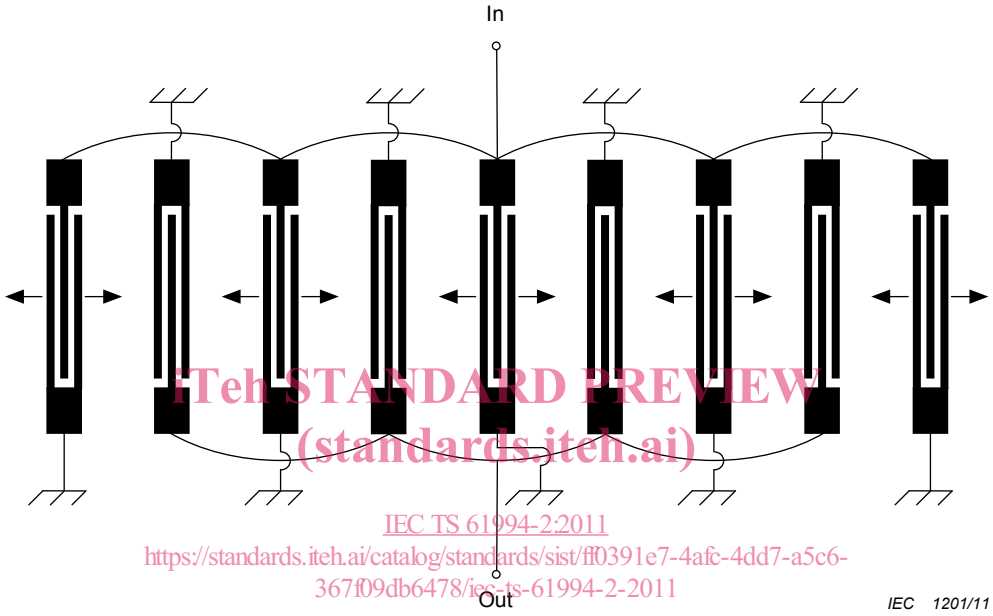


Figure 3 – Interdigited interdigital transducer (IIDT)

NOTE 2 IIDT (or multi-interdigital transducer) resonator filters are referred to as SAW resonator filters composed of a number of interdigital transduces for input and output in a line alternating with grating reflectors confirming the interdigital transducer structure at both ends.

[IEC 60862-2 : 2002, 3.1.13]

3.22
input impedance
impedance presented by a filter to the signal source when terminated by a specified load impedance

3.23
input level
power, voltage or current level applied to the input terminal pair of a filter

[IEC 60862-1: 2003, 2.2.2.29]

3.24
insertion attenuation (of a filter)
ratio, generally expressed in decibels, of the power delivered to the load impedance before insertion of the filter to the power delivered to the load impedance after insertion of the filter

NOTE An example of frequency responses of filter is shown in Figure 4. In this figure, various insertion attenuation levels are shown.

[IEC 60862-2: 2002, 3.2.6]

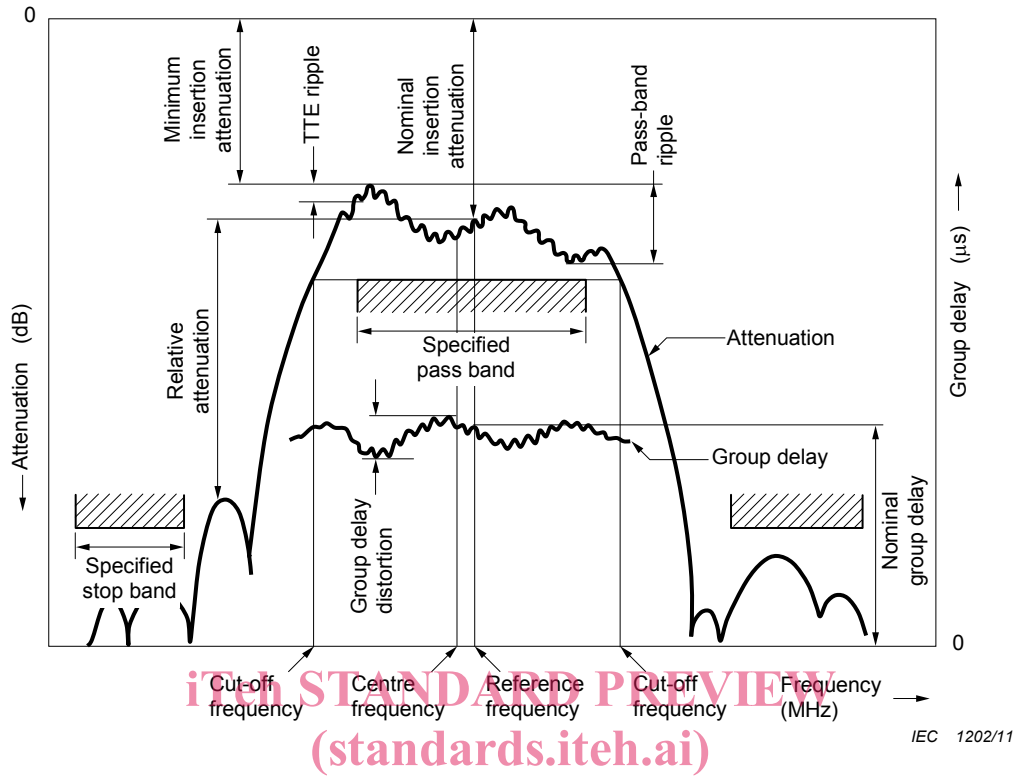


Figure 4 – Frequency response of insertion attenuation of a filter

3.25
intermodulation distortion
distortion resulting from the combination within the filter of two independent input signals

3.26
ladder filter
filter having a cascade or tandem connection of alternating series and shunt SAW resonators

NOTE A typical ladder filter is shown in Figure 5.

[IEC 60862-2: 2002, 3.3.7]

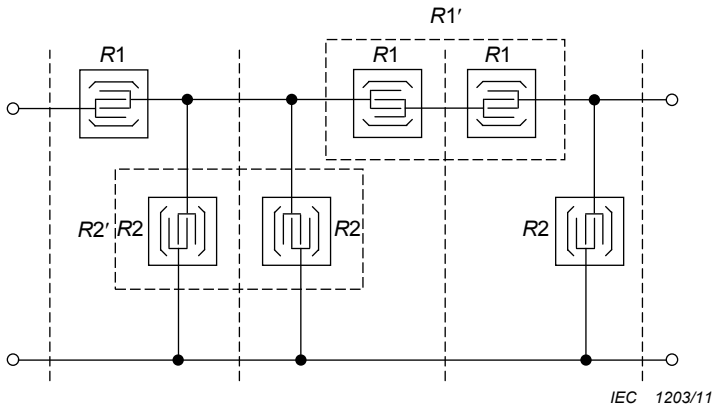


Figure 5 – Configuration of a ladder filter

3.27
lattice filter
filter having at least four SAW resonators connected in series to form a mesh, two nonadjacent junction points are used as input terminals, while the remaining two junction points are used as output terminals (bridge circuit).

NOTE Preferably it can used for balanced circuits. A typical lattice filter is shown in Figure 6.

[IEC 60862-2: 2002, 3.3.8]

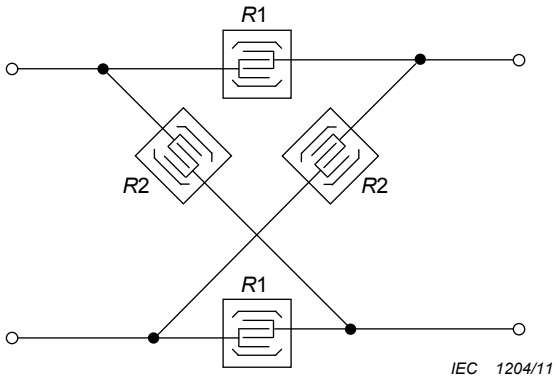


Figure 6 – Configuration of a lattice filter

3.28
low-pass filter
filter having a single pass band below a cut-off frequency and a stop band for higher frequencies

3.29
maximum level
power, voltage or current value above which unacceptable distortion of the signal or irreversible changes may occur in a piezoelectric filter

3.30
mid-band frequency (of a band-pass or band-stop filter)
geometric mean of the cut-off frequencies limiting a single pass band or single stop band

NOTE In practice, the arithmetic mean is often used as a good approximation to the geometric mean for piezoelectric filters with relatively narrow pass bands or stop bands.

3.31
minimum insertion attenuation
minimum value of insertion attenuation in the pass band (see Figure 4).

[IEC 60862-1: 2003, 2.2.2.13]

3.32
multiphase transducer
interdigital transducer having more than two inputs which are driven in different phases. Usually used as a unidirectional transducer

NOTE A example of multiphase transducer is shown in Figure 7.

[IEC 60862-2: 2002, 3.1.11]