

TECHNICAL SPECIFICATION

IEC TS 61994-3

First edition
2004-03

Piezoelectric and dielectric devices for frequency control and selection – Glossary –

Part 3: Piezoelectric and dielectric oscillators



Reference number
IEC/TS 61994-3:2004(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site** (www.iec.ch)

- **Catalogue of IEC publications**

The on-line catalogue on the IEC web site (www.iec.ch/searchpub) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

This summary of recently issued publications (www.iec.ch/online_news/justpub) is also available by email. Please contact the Customer Service Centre (see below) for further information.

- **Customer Service Centre**

If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

Email: custserv@iec.ch
Tel: +41 22 919 02 11
Fax: +41 22 919 03 00

TECHNICAL SPECIFICATION

IEC TS 61994-3

First edition
2004-03

Piezoelectric and dielectric devices for frequency control and selection – Glossary –

Part 3: Piezoelectric and dielectric oscillators

© IEC 2004 — Copyright - all rights reserved

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE

K

For price, see current catalogue

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PIEZOELECTRIC AND DIELECTRIC DEVICES FOR FREQUENCY CONTROL AND SELECTION – GLOSSARY –

Part 3: Piezoelectric and dielectric oscillators

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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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.

IEC 61994-3, which is a technical specification, has been prepared by IEC technical committee 49: Piezoelectric and dielectric devices for frequency control and selection.

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

Enquiry draft	Report on voting
49/573/DTS	49/635/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 61994 consists of the following parts under the general title *Piezoelectric and dielectric devices for frequency control and selection – Glossary*:

- Part 1: Piezoelectric and dielectric resonators;
- Part 2: Piezoelectric and dielectric filters;
- Part 3: Piezoelectric and dielectric oscillators;
- Part 4-1: Piezoelectric and dielectric materials – Synthetic quartz crystal;
- Part 4-2: Piezoelectric and dielectric materials – Piezoelectric ceramics;
- Part 4-4: Piezoelectric and dielectric materials – Materials for SAW devices¹.

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

- transformed into International Standard;
- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

¹ Under consideration.

PIEZOELECTRIC AND DIELECTRIC DEVICES FOR FREQUENCY CONTROL AND SELECTION – GLOSSARY –

Part 3: Piezoelectric and dielectric oscillators

1 Scope

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

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

IEC 60679-1:1997, *Quartz crystal controlled oscillators of assessed quality – Part 1: Generic specification*

3 Terms and definitions

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

3.1

adjustment frequency

the frequency to which an oscillator must be adjusted, under a particular combination of operating conditions, in order to meet the frequency tolerance specification over the specified range of operating conditions, i.e. adjustment frequency = nominal frequency + frequency offset

[IEV 561-04-09]

3.2

Allan variance of fractional frequency fluctuation

an unbiased estimate of the preferred definition in the time domain of the short-term stability characteristic of the oscillator output frequency

[IEC 60679-1, definition 2.2.23]

3.3

amplitude distortion, amplitude modulation distortion, amplitude/frequency distortion

the non-linear distortion in which the relative magnitudes of the spectral components of the modulating signal waveform are modified

[IEC 60679-1, definition 2.2.28]

3.4**crystal cut**

the orientation of the used crystal element with respect to its crystallographic axes

[IEC 60679-1, definition 2.3]

3.5**fall time**

the time interval for the trailing edge of a waveform to change between two defined levels. These levels may be two logic levels V_{OH} and V_{OL} or 90 to 10 % of its maximum amplitude ($V_{HI} - V_{LO}$), or any other ratio as defined in the detail specification

[IEC 60679-1, definition 2.2.34]

3.6**electrostatic discharge****ESD**

a transfer of electrostatic charge between two bodies having different electrostatic potentials

3.7**frequency adjustment range**

the range over which the oscillator frequency may be varied by means of some variable element, for the purpose of:

- a) setting the frequency to a particular value, or
- b) to correct the oscillator frequency to a prescribed value after deviation due to ageing, or other changed conditions

[IEV 561-04-10]

3.8**frequency/load coefficient**

the fractional change in output frequency resulting from an incremental change in electrical load impedance, other parameters remaining unchanged

[IEV 561-04-15]

3.9**frequency offset**

the frequency difference, positive or negative, which should be added to the specified nominal frequency of the oscillator, when adjusting the oscillator frequency under a particular set of operating conditions in order to minimise its deviation from nominal frequency over the specified range of operating conditions

[IEV 561-04-08]

3.10**frequency tolerance**

the maximum permissible deviation of the oscillator frequency from a specified nominal value when operating under specified conditions

[IEV 561-04-07]

3.11**frequency/voltage coefficient**

the fractional change in output frequency resulting from an incremental change in supply voltage, other parameters remaining unchanged

[IEV 561-04-14]

3.12

harmonic distortion

the non-linear distortion characterised by the generation of undesired spectral components harmonically related to the desired signal frequency. Each harmonic component is usually expressed as a power (in decibels) relative to the output power of the desired signal

[IEC 60679-1, definition 2.2.30]

3.13

incidental frequency modulation

the optional measure of the frequency stability in the frequency domain. Incidental frequency modulation is best described in terms of the spectrum of the resultant base-band signal obtained by applying the oscillator signal to an ideal discriminator circuit of specified characteristics. If the detection bandwidth is adequately specified, the incidental frequency modulation may be expressed as a fractional proportion of the output frequency.

(for example 2×10^{-8} r.m.s. in a 10 kHz band)

[IEC 60679-1, definition 2.2.27]

3.14

latch-up

a persistent state in which a low impedance path results from an input, output or supply overvoltage

3.15

non-linearity of frequency deviation (modulation)

measure of the transfer characteristic of a modulation system as compared to its straight line regression function, usually expressed as an allowable non-linearity in per cent of the specified full range deviation. Modulation linearity can also be expressed in terms of the permissible distortion of base-band signals produced by the modulation device. (for example, intermodulation and harmonic distortion products not to exceed –40 dB relative to the total modulating signal power)

3.16

frequency ageing, long-term frequency stability

the change of the frequency of the oscillator over a long periods of time This long-term frequency drift is caused by the secular changes in the crystal unit and/or elements of the oscillator circuit, and should be expressed as fractional change of the mean frequency value per specified time interval

[IEC 60679-1, definition 2.2.21, modified]

3.17

maximum time interval error

MTIE

the largest peak to peak time interval error (TIE) in any observation interval of length τ (in seconds)

3.18

nominal frequency

the frequency used to identify the crystal controlled oscillator

[IEV 561-04-06]

3.19

operable temperature range

the range of temperature over which the oscillator shall continue to provide an output signal, though not necessarily within the specified tolerances of frequency, level, waveform, etc.

[IEV 561-04-12]

3.20

operating temperature range

the range of temperature over which the oscillator will function, maintaining frequency and other output signal characteristics within specified tolerances

[IEV 561-04-11]

3.21

oven controlled crystal oscillator OCXO

a crystal controlled oscillator in which at least the piezoelectric resonator is temperature controlled

[IEV 561-04-05]

3.22

overtone crystal controlled oscillator

an oscillator designed to operate with the controlling piezoelectric resonator in a specified mechanical overtone order of vibration

[IEV 561-04-02, modified]

3.23

phase jitter and wander

the short-term variations of the zero crossings of the oscillator output signal from their ideal position in time. The phase variation $\Delta\phi$ with frequency components greater than or equal to 10 Hz. Slower variations than 10 Hz are defined as wander

3.24

phase noise

the frequency-domain measure of the short-term frequency stability of an oscillator, normally expressed as the power spectral density of the phase fluctuations, $S_\phi(f)$, where the phase fluctuation function is $\phi(t) = 2\pi F t + 2\pi F_0 t$

[IEC 60679-1, definition 2.2.25]

3.25

pulse duration

the duration between pulse start time and pulse stop time

[IEC 60679-1, definition 2.2.32]

3.26

retrace characteristics

the ability of an oscillator to return, after a specified time period, to a previously stabilised frequency, within a given tolerance following a period in the energised condition

[IEC 60679-1, definition 2.2.37, modified]

3.27

rise time

the time interval required for the leading edge of a waveform to change between two defined levels. These levels may be two logic levels V_{OL} and V_{OH} or 10 % to 90 % of its maximum amplitude ($V_{HI} - V_{LO}$), or any other ratio defined in the detail specification

[IEC 60679-1, definition 2.2.33]

3.28

reference point temperature

the temperature measured at a specific reference point relative to the oscillator

[IEC 60679-1, definition 2.2.16]

3.29

reference temperature

the temperature at which certain oscillator performance parameters are measured; normally $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$

[IEC 60679-1, definition 2.2.15]

3.30

r.m.s. fractional frequency fluctuation

a measure in the time domain of the short-term frequency stability of an oscillator, based on the statistical properties of a number of frequency measurements, each representing an average of the frequency over the specified sampling interval τ

[IEC 60679-1, definition 2.2.24]

3.31

short-term frequency stability

the random fluctuations of the frequency of an oscillator over short periods of time

[IEV 561-04-16]

3.32

simple packaged crystal oscillator

SPXO

a crystal controlled oscillator having no means of temperature control or compensation, exhibiting a frequency/temperature characteristic determined substantially by the piezoelectric resonator employed

[IEC 60679-1, definition 2.2.1]

3.33

spectral purity of the output frequency spectrum

measure of the purity of the output frequency spectrum usually represented as power ratio in decibels relative to the output power of desired signal. It includes non-deterministic noise power, harmonic distortion components and spurious frequency interferences

3.34

spurious oscillations

the discrete frequency spectral components, non-harmonically related to the desired output frequency, appearing at the output terminal of an oscillator. These components may appear as symmetrical sidebands or as signal spectral components, depending upon the mode of generation. Spurious components in the output spectrum are usually expressed as a power ratio (in decibels) with respect to the output signal power

[IEC 60679-1, definition 2.2.31]

3.35

stabilization time

warm-up time

the time, measured from the initial application of power, required for a crystal controlled oscillator to stabilize its operation within specified limits. If those limits refer to a maximum power consumption then this time is called "warm-up time" (e.g. in an OCXO)

[IEV 561-04-13]

3.36**storage temperature range**

the minimum and maximum temperatures at which the crystal controlled oscillator may be stored without deterioration or damage to its performance

[IEC 60679-1, definition 2.2.12]

3.37**start-up time**

the time difference t_{SU} between the application of the supply voltage to the oscillator and the time when the r.f. output signal of desired frequency controlled by the quartz resonator fulfils specified conditions

[IEC 60679-1, definition 2.2.38]

3.38**symmetry (mark/space ratio or duty cycle)**

the ratio between the time (t_1), in which the output voltage is above a specified level, and the time (t_2), in which the output voltage is below the specified level, in percent of the duration of the full signal period

[IEC 60679-1, definition 2.2.36]

3.39**temperature compensated crystal oscillator****TCXO**

a crystal controlled oscillator whose frequency deviation due to temperature is reduced by means of a compensation system, incorporated in the device

[IEV 561-04-04]

3.40**transient frequency stability**

the frequency/time response when ambient temperature is changed from one specified temperature to another with a specific rate

[IEC 60679-1, definition 2.2.17, modified]

3.41**time deviation****TDEV**

the r.m.s of filtered time interval error (TIE), where the band-pass filter is centred on a frequency of $0,42/\tau$

3.42**time interval error****TIE**

the time deviation between the signal being measured and the reference clock, typically measured in nanoseconds

3.43**tri-state output**

an output stage which may be enabled or disabled by the application of an input control signal. In the disable mode the output impedance of the gate is set to a high level permitting the application of test signals to following stages

[IEC 60679-1, definition 2.2.35]