SLOVENSKI STANDARD

SIST EN 60758:2005

december 2005

Sintetični kremenčev kristal – Specifikacije in vodilo za uporabo (IEC 60758:2004)

Synthetic quartz crystal – Specifications and guide to the use (IEC 60758:2004)

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ICS 31.140

Referenčna številka
SIST EN 60758:2005(en)

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EUROPEAN STANDARD **EN 60758**

NORME EUROPÉENNE

EUROPÄISCHE NORM February 2005

ICS 31.140

English version

Synthetic quartz crystal – Specifications and guide to the use
(IEC 60758:2004)

Quartz synthétique – Spécifications et guide d'utilisation (CEI 60758:2004)

Synthetischer Quarzkristall - Festlegungen und Leitfaden für die Anwendung (IEC 60758:2004)

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This European Standard was approved by CENELEC on 2005-02-01. 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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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.

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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

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Ref. No. EN 60758:2005 E

Foreword

The text of document 49/696/FDIS, future edition 3 of IEC 60758, prepared by IEC TC 49, Piezoelectric and dielectric devices for frequency control and selection, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60758 on 2005-02-01.

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)	2005-11-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2008-02-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60758:2004 was approved by CENELEC as a European Standard without any modification.

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE Where an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60068-1	1988	Environmental testing Part 1: General and guidance	EN 60068-1 [1)]	1994
IEC 60122-1	2002	Quartz crystal units of assessed quality Part 1: Generic specification	EN 60122-1	2002
IEC 60410	1973	Sampling plans and procedures for inspection by attributes	-	-
IEC 61994	Series	Piezoelectric and dielectric devices for frequency control and selection - Glossary	-	-

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1) EN 60068-1 includes corrigendum October 1988 + A1:1992 to IEC 60068-1.

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INTERNATIONAL STANDARD

IEC 60758

Third edition
2004-12

Synthetic quartz crystal – Specifications and guide to the use

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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
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PRICE CODE X

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SYNTHETIC QUARTZ CRYSTAL – SPECIFICATIONS AND GUIDE TO THE USE

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International Standard IEC 60758 has been prepared by IEC technical committee 49: Piezoelectric and dielectric devices for frequency control and selection.

This third edition cancels and replaces the second edition, published in 1993, and its amendments 1 (1997) and 2 (2001).

This edition includes the following significant technical changes with respect to the previous edition:

a) it combines the information given in the second edition and in the amendments into one single document;

b) it adds the infrared absorbance alpha value compensation method as Annex E.

The text of this standard is based on the following documents:

FDIS	RVD
49/696/FDIS	49/701/RVD

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

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

A bilingual version of this publication may be issued at a later date.

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SYNTHETIC QUARTZ CRYSTAL – SPECIFICATIONS AND GUIDE TO THE USE

1 Scope

This International Standard applies to synthetic quartz single crystals intended for manufacturing piezoelectric elements for frequency control and selection.

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 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60122-1:2002, *Quartz crystal units of assessed quality – Part 1: Generic specification.*

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

IEC 61994 (all parts), *Piezoelectric and dielectric devices for frequency control and selection – Glossary*

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3 Terms and definitions

For the purposes of this document, the following terms and definitions, as well as those given in IEC 61994, apply.

3.1
hydrothermal crystal growth
literally, crystal growth in the presence of water, elevated temperatures and pressures by a crystal growth process believed to proceed geologically within the earth's crust. The industrial synthetic quartz growth processes utilize alkaline water solutions confined within autoclaves at supercritical temperatures (330 °C to 400 °C) and pressures (700 to 2 000 atmospheres). The autoclave is divided into two chambers: the dissolving chamber, containing raw quartz chips at the higher temperature; the growing chamber, containing cut seeds at the lower temperature (see 7.1.2)

3.2
synthetic quartz crystal (also known as cultured quartz crystal**)**
single crystal of α quartz grown by the hydrothermal method. The crystal is of either handedness and in the as-grown condition

3.2.1
as-grown synthetic quartz crystal
single crystal quartz grown hydrothermally. As-grown refers to the state of processing and indicates a state prior to whatever treatment might occur after growth, excluding quality control operations

3.2.2
as-grown Y-bar
crystals which are produced using seed with the largest dimension in the Y-direction

3.2.3
as-grown Z-bar
crystals in which the Z-grown sector is much larger that the X-grown sector. The relative size of the growth sector is controlled by the X-dimension of the seed

3.3
synthetic quartz crystal batch
synthetic quartz crystals grown at the same time in one autoclave

3.4
seed
rectangular parallelepiped quartz plate or bar to be used as a nucleus for crystal growth

3.5
growth zones
regions of a synthetic quartz crystal resulting from growth along different crystallographic directions (see Figure 1)

3.6
orientation of a synthetic quartz crystal
orientation of its seed with respect to the orthogonal axes specified in 3.7

3.7
orthogonal axial system of a quartz crystal

3.7.1
axial system for quartz illustrated in Figure 2

NOTE The Z-cut seed may be oriented at an angle of less than 20° to the Y-axis, in this case the axial system becomes X, Y′, Z′.

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3.7.2
AT-cut plate
rotated Y-cut crystal plate oriented at an angle of about +35° around the X-axis or about -3° from the z (minor rhombohedral)-face as shown in Figure 3

3.7.3
z (minor rhombohedral)-cut plate
crystal plate parallel to the z (minor rhombohedral)-face as shown in Figure 3a

3.7.4
X-cut plate
crystal plate perpendicular to the X-axis as shown in Figure 3b

3.7.5
Y-cut plate
crystal plate perpendicular to the Y-axis as shown in Figure 3b

3.7.6
Z-cut plate
crystal plate perpendicular to the Z-axis as shown in Figure 3b

3.8
dimensions
dimensions pertaining to growth on Z-cut seed rotated less than 20° from the Y-axis

3.8.1
gross dimensions
maximum dimensions along the X-, Y-, or Y′-, and Z- or Z′-axes measured along the X-, Y′- and Z′-axes

3.8.1.1
effective Z-dimension
as-grown effective Z dimension defined as the minimum measure in the Z ($\Theta = 0^{\circ}$) or Z′ direction in usable Y or Y′ area of an as-grown crystal and described by Z_{eff} ,as shown in Figure 1

3.8.1.2
minimum Z-dimension
minimum distance from seed surface to Z-surface described by Z_{min} as shown in Figure 1d

3.8.2
dimensions pertaining to growth on a Z-cut seed rotated more than 20° from the X-axis
(under consideration)

3.9
inclusions
any foreign material within a synthetic quartz crystal, visible by examination of scattered light from a bright source with the crystal immersed in a refractive index-matching liquid. A particularly common inclusion is the mineral acmite (sodium iron silicate)

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3.9.1
seed veil
array of inclusions or voids at the surface of the seed upon which a crystal has been grown

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3.9.2
etch channel
roughly cylindrical void that is present along dislocation line after etching a quartz crystal

3.10
dopant
any additive used in the growth process which may change the crystal habit, chemical composition, physical or electrical properties of the synthetic quartz batch

3.11
pre-dimensioned bar
any bar whose as-grown dimensions have been altered by sawing, grinding, lapping, etc., to meet a particular dimensional requirement

3.12
impurity concentration
concentration of impurities relative to silicon atoms

3.13
dislocations
linear defects in the crystal due to misplaced planes of atoms

3.14
etch channel
roughly cylindrical void present along a dislocation line after etching a test wafer prepared from a quartz crystal

3.15
autoclave
vessel for the high-pressure high-temperature condition required for growth of synthetic quartz crystal

3.16
right-handed quartz or left-handed quartz
handedness of quartz crystal as determined by observing the sense of handedness of the optical rotation in the polarized light. Right-handed quartz is the crystal of dextrorotatory and left-handed quartz is the crystal of levorotary

3.17
twins
twins follow laws of crystallography relating symmetrically to specific faces or axes.

The following types have been identified in synthetic quartz crystals:

a) Electrical twins

Quartz crystal in which regions with the common Z-axis exist showing a polarity reversal of the electrical X-axis.

b) Optical twins

Quartz crystal in which regions with the common Z-axis exhibit handedness reversal of the optical Z-axis

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3.18
infrared absorption coefficient α-value
coefficient (referred to as the α-value) established by determining the relationship between absorption of two wavelengths: one with minimal absorption due to OH impurity, the other with high absorption due to presence of OH impurities in the crystal lattice. The OH impurity creates mechanical loss in resonators and its presence is correlated to the presence of other loss-inducting impurities. The α-value is a measure of OH concentration and is correlated with expected mechanical losses due to material impurities. The infrared absorption coefficient α-value is determined using the following equation:

$$\alpha = \frac{1}{t} \log \frac{T_1}{T_2}$$

where

α is the infrared absorption coefficient;

t is the thickness of Y-cut sample, in centimetres;

T_1 is the per cent transmission at a wave number of 3 800 cm^{-1} or 3 979 cm^{-1};

T_2 is the per cent transmission at a wave number of 3 410 cm^{-1}, 3 500 cm^{-1} or 3 585 cm^{-1} .

3.19
lumbered synthetic quartz crystal
synthetic quartz crystal whose X- and Z- or Z′- surfaces in the as-grown condition have been processed flat and parallel by sawing, grinding, lapping, etc., to meet specified dimensions and orientation

3.19.1
lumbered Y-bar
quartz bars which are lumbered from an as-grown Y-bar

3.19.2
lumbered Z-bar
quartz bars which are lumbered from an as-grown Z-bar