

Surface acoustic wave (SAW) filters of assessed quality —

Part 1: Generic specification

The European Standard EN 60862-1:2003 has the status of a
British Standard

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National foreword

This British Standard is the official English language version of EN 60862-1:2003. It is identical with IEC 60862-1:2003. It supersedes BS EN 166000:1996 which is withdrawn.

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

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

Filtres à ondes acoustiques
de surface (OAS)
sous assurance de la qualité
Partie 1: Spécification générique
(CEI 60862-1:2003)

Oberflächenwellenfilter (OFW-Filter)
mit bewerteter Qualität
Teil 1: Fachgrundspezifikation
(IEC 60862-1:2003)

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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
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Foreword

The text of document 49/587/FDIS, future edition 2 of IEC 60862-1, 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 60862-1 on 2003-07-01.

This European Standard supersedes EN 166000:1995.

The following dates were fixed:

- latest date by which the EN has to be implemented
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- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2006-07-01

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 60862-1:2003 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

- | | | |
|----------------|------|---|
| IEC 60068-2-10 | NOTE | Harmonized as HD 323.2.10 S3:1988 (not modified). |
| IEC 60862-2 | NOTE | Harmonized as EN 60862-2:2002 (not modified). |

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SURFACE ACOUSTIC WAVE (SAW) FILTERS OF ASSESSED QUALITY –

Part 1: Generic specification

1 General

1.1 Scope

This part of IEC 60862 specifies the methods of test and general requirements for SAW filters of assessed quality using either capability approval or qualification approval procedures.

1.2 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 60027 (all parts), *Letter symbols to be used in electrical technology*

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

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

IEC 60068-2-1:1990, *Environmental testing – Part 2: Tests – Tests A: Cold*

IEC 60068-2-2:1974, *Environmental testing – Part 2: Tests – Tests B: Dry heat*

IEC 60068-2-6:1995, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-7:1983, *Environmental testing – Part 2: Tests – Test Ga: Acceleration, steady state*

IEC 60068-2-13:1983, *Environmental testing – Part 2: Tests – Test M: Low air pressure*

IEC 60068-2-14:1984, *Environmental testing – Part 2: Tests – Test N: Change of temperature*

IEC 60068-2-17:1994, *Environmental testing – Part 2: Tests – Test Q: Sealing*

IEC 60068-2-20:1979, *Environmental testing – Part 2: Tests – Test T: Soldering*

IEC 60068-2-21:1999, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27:1987, *Environmental testing – Part 2: Tests – Test Ea and guidance: Shock*

- IEC 60068-2-29:1987, *Environmental testing – Part 2: Tests – Test Eb and guidance: Bump*
- IEC 60068-2-30:1980, *Environmental testing – Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)*
- IEC 60068-2-32:1975, *Environmental testing – Part 2: Tests – Test Ed: Free fall (Procedure 1)*
- IEC 60068-2-45:1980, *Environmental testing – Part 2: Tests – Test XA and guidance: Immersion in cleaning solvents*
- IEC 60068-2-52:1996, *Environmental testing – Part 2: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*
- IEC 60068-2-58:1999, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*
- IEC 60068-2-64:1993, *Environmental testing – Part 2: Tests – Test Fh: Vibration, broad-band random (digital control) and guidance*
- IEC 60068-2-78:2001, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*
- IEC 60122-1:2002, *Quartz crystal units of assessed quality – Part 1: Generic specification*
- IEC 60617, *Graphical symbols for diagrams*
- IEC 60642:1979, *Piezoelectric ceramic resonators and resonator units for frequency control and selection – Chapter I: Standard values and conditions – Chapter II: Measuring and test conditions*
- IEC 60695-2-2:1991, *Fire hazard testing – Part 2: Test methods – Section 2: Needle-flame test*
- IEC 61000-4-2:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 2: Electrostatic discharge immunity test*. Basic EMC Publication
Amendment 1 (1998)
Amendment 2 (2000) ¹
- IEC QC 001001:2000, *IEC Quality Assessment System for Electronic Components (IECQ) – Basic Rules*
- IEC QC 001002-2:1998, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of Procedure – Part 2: Documentation*
- IEC QC 001002-3:1998, *IEC Quality Assessment system for Electronic Components (IECQ) – Rules of Procedure – Part 3: Approval Procedures*

¹ There is a consolidated edition 1.2 (2001) that includes IEC 61000-4-2 (1995) and its amendments 1 (1998) and 2 (2000).

IEC QC 001005:2000, *Register of Firms, Products and Services approved under the IECQ System, including ISO 9000*

ISO 1000:1992, *SI units and recommendations for use of their multiples and of certain other units*

1.3 Order of precedence of documents

Where any discrepancies occur for any reason, documents shall rank in the following order of precedence:

- the detail specification;
- the sectional specification;
- the generic specification;
- any other international documents (for example, of the IEC) to which reference is made.

The same order of precedence shall apply to equivalent national documents.

2 Terms, definitions, units and symbols

2.1 General

Units, graphical symbols, letter symbols and terminology shall, wherever possible, be taken from the following standards:

IEC 60027
IEC 60050(561)
IEC 60617
IEC 60642
IEC 60122-1
ISO 1000

2.2 Definitions

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

2.2.1 General terms

2.2.1.1

surface acoustic wave (SAW)

acoustic wave, propagating along a surface of an elastic substrate, whose amplitude decays exponentially with substrate depth

2.2.1.2

surface acoustic wave filter (SAW filter)

filter characterized by a surface acoustic wave which is usually generated by an interdigital transducer and propagates along a substrate surface to a receiving transducer

2.2.1.3

power flow vector

vector, analogous to a Poynting vector, characterizing energy propagation caused by a surface acoustic wave

2.2.1.4

propagation vector

vector characterizing the phase progression of a wave

2.2.1.5

power flow angle

the angle between the direction of the power flow vector and the direction of the propagation vector

2.2.1.6

SAW beam steering

SAW propagation phenomenon in anisotropic materials described by an angle of power flow which is not zero

2.2.1.7

SAW diffraction

phenomenon (analogous to diffraction of light from a source of finite aperture) which causes SAW beam spreading and wave-front distortion

2.2.1.8

SAW coupling coefficient (k_s^2)

SAW electromechanical coupling coefficient is defined as follows:

$$k_s^2 = 2 \left| \frac{\Delta v_s}{v_s} \right|$$

where

v_s is the SAW propagation velocity on free surface;

Δv_s is the change of SAW velocity due to short-circuiting the surface potential;

$\Delta v_s/v_s$ is the relative velocity change produced by short-circuiting the surface potential from the open-circuit condition

2.2.1.9

interdigital transducer (IDT)

SAW transducer made of two comb-like conductive structures deposited on a piezoelectric substrate transforming electrical energy into acoustic energy or vice versa

2.2.1.10

unidirectional interdigital transducer (UDT)

transducer capable of radiating and receiving surface acoustic waves in or from a single direction

2.2.1.11

multiphase transducer

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

2.2.1.12

finger

element of the IDT comb electrode

2.2.1.13

dummy finger

passive finger which may be included in order to suppress wave-front distortion

2.2.1.14**split finger**

finger formed of more than one element, so as to produce antireflection properties in a surface acoustic wave filter

2.2.1.15**bus bar**

common electrode which connects individual fingers together and also connects the filter to an external circuit

2.2.1.16**weighted-response transducer**

transducer intended to produce a specified impulse response by design of the structure. See 2.2.1.17 to 2.2.1.22

2.2.1.17**finger overlap or source strength**

length of a finger pair between which only electromechanical interaction is generated

2.2.1.18**apodization**

weighting produced by the change of finger overlap over the length of the IDT

2.2.1.19**withdrawal weighting**

weighting by removal of fingers or sources

2.2.1.20**capacitive weighting**

weighting by change of capacitance between electrodes

2.2.1.21**series weighting**

weighting by separation of a finger into individual elements having capacitive coupling between them. The elements may be separated from the bus bar

2.2.1.22**phase weighting**

weighting by change in period of finger arrangement inside the IDT

2.2.1.23**aperture**

normalized beamwidth of the SAW generated at the centre frequency and normalized to the corresponding wavelength

2.2.1.24**multistrip coupler (MSC)**

an array of additional metal strips deposited on a piezoelectric substrate, in a direction transverse to the propagation direction, which transfers acoustic power from one acoustic track to an adjacent track

2.2.1.25**reflector**

SAW reflecting component which normally makes use of the periodic discontinuity provided by a metal strip array or a grooved array

2.2.1.26

spurious reflections

unwanted signals caused by reflection of SAW or bulk waves from substrate edges or electrodes

2.2.1.27

triple transit echo (TTE)

unwanted signals in a SAW filter which have traversed three times the propagation path between input and output IDTs caused by reflections from output and input transducers

2.2.1.28

bulk wave signals

unwanted signals caused by bulk wave excitation and detected at the filter output

2.2.1.29

feedthrough signals (signals of electromagnetic interference)

unwanted signals from the input appearing at the filter output due to stray capacitances and other electromagnetic couplings

2.2.1.30

suppression corrugation

grooves in the non-active side of a substrate for suppressing bulk wave signals

2.2.1.31

acoustic absorber

material with high acoustic loss placed on any part of the substrate for acoustic absorption purposes

2.2.1.32

shielding electrode

electrode intended for the reduction of electromagnetic interference signals

2.2.1.33

interdigitated interdigital transducer (IIDT)

SAW transducer made of a combination of three or more interdigital transducers.

Same as a multi-IDT. In this standard, IIDT (or multi-IDT) resonator filter is used to refer to SAW resonator filters composed of a number of IDTs for input and output in a line alternately with grating reflectors at both ends.

2.2.2 Response characteristics

(See Figure 1)

2.2.2.1

nominal frequency

frequency given by the manufacturer or the specification to identify the filter

2.2.2.2

centre frequency

arithmetic mean of the cut-off frequencies

2.2.2.3

reference frequency

frequency defined by the specification to which other frequencies may be referred

2.2.2.4

cut-off frequency

frequency of the pass band at which the relative attenuation reaches a specified value

2.2.2.5

total power loss

the logarithmic ratio of the available power at the given source to the power that the SAW filter delivers to a load impedance under specified operating conditions

2.2.2.6

insertion attenuation

the logarithmic ratio of the power delivered directly to the load impedance before insertion of the filter to the power delivered to the load impedance after insertion of the filter

2.2.2.7

nominal insertion attenuation

the insertion attenuation at a specified reference frequency

2.2.2.8

relative attenuation

the difference between the attenuation at a given frequency and the attenuation at the reference frequency

2.2.2.9

pass band

band of frequencies in which the relative attenuation is equal to or less than a specified value

2.2.2.10

pass bandwidth

the separation of frequencies between which the relative attenuation is equal to or less than a specified value

2.2.2.11

pass band ripple

the maximum variation in attenuation characteristics within a specified pass band

2.2.2.12

TTE ripple

maximum variation in attenuation characteristics caused by TTE within a specified pass band

2.2.2.13

minimum insertion attenuation

the minimum value of insertion attenuation in the pass band

2.2.2.14

maximum insertion attenuation

the maximum value of insertion attenuation in the pass band

2.2.2.15

stop band

band of frequencies in which the relative attenuation is equal to or greater than a specified value

2.2.2.16

stop bandwidth

separation of frequencies between which the relative attenuation is equal to or greater than a specified value

2.2.2.17

shape factor

ratio of the two bandwidths at specified values of relative attenuation

2.2.2.18

group delay

time equal to the first derivative of the phase shift, in radians, with respect to the angular frequency

2.2.2.19

nominal group delay

group delay at a specified reference frequency

2.2.2.20

group delay distortion

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

2.2.2.21

trap frequency

specified frequency at which the relative attenuation is equal to or greater than a specified value

2.2.2.22

trap attenuation

relative attenuation at a specified trap frequency

2.2.2.23

transition band

band of frequencies between the cut-off frequency and the nearest point of the adjacent stop-band

2.2.2.24

reflection coefficient

dimensionless measure of the degree of mismatch between two impedances Z_a and Z_b given by the expression:

$$\left| \frac{Z_a - Z_b}{Z_a + Z_b} \right|$$

where

Z_a and Z_b represent respectively the input and source impedance or the output and load impedance

2.2.2.25**return attenuation**

absolute value of the reciprocal of the reflection coefficient given by the expression in decibels:

$$20 \log \left| \frac{Z_a + Z_b}{Z_a - Z_b} \right| \text{ dB}$$

2.2.2.26**reflected wave signal suppression**

relative attenuation of unwanted signals caused by reflection of SAW or bulk waves from substrate edges or electrodes within a specified time window

2.2.2.27**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

2.2.2.28**unwanted response**

response other than that associated with the mode of vibration intended for the application

2.2.2.29**input level**

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

2.2.2.30**output level**

power, voltage or current value delivered to the load

2.2.2.31**nominal level**

power, voltage or current value at which the performance measurement is specified

2.2.2.32**input impedance**

impedance presented by the filter to the signal source when the output is terminated by a specified load impedance

2.2.2.33**output impedance**

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

2.2.2.34**terminating impedance**

either of the impedances presented to the filter by the source or by the load

2.2.2.35**available power**

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