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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Surface acoustic wave (SAW) filters of assessed quality – Part 1: Generic specification

Filtres à ondes acoustiques de surface (OAS) sous assurance de la qualité – Partie 1: Spécification générique



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Filtres à ondes acoustiques de surface (OAS) sous assurance de la qualité – Partie 1: Spécification générique

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SURFACE ACOUSTIC WAVE (SAW) FILTERS OF ASSESSED QUALITY –

Part 1: Generic specification

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International Standard IEC 60862-1 has been prepared by IEC technical committee 49: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection.

This third edition cancels and replaces the second edition published in 2003. This edition constitutes a technical revision.

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

- the terms and definitions from IEC 60862-2:2002 are included;
- the measurement method for the balanced type filter is described;
- the electrostatic discharge (ESD) sensitivity test procedure is considered.

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

FDIS	Report on voting
49/1151/FDIS	49/1164/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.

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

A list of all parts in the IEC 60862 series, published under the general title *Surface acoustic wave (SAW) filters of assessed quality*, can be found on the IEC web site.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

The content of the corrigendum 1 (2026-03) has been included in this copy.

SURFACE ACOUSTIC WAVE (SAW) FILTERS OF ASSESSED QUALITY –

Part 1: Generic specification

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.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 (all parts), *International Electrotechnical Vocabulary* (available at www.electropedia.org)

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

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

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

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

IEC 60068-2-7, *Basic environmental testing procedures – Part 2-7: Tests – Test Ga and guidance: Acceleration, steady state*

IEC 60068-2-13, *Basic environmental testing procedures – Part 2-13: Tests – Test M: Low air pressure*

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

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

IEC 60068-2-20, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

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

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

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db and guidance: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-45, *Basic environmental testing procedures – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*

IEC 60068-2-52, *Environmental testing – Part 2-52: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60068-2-58, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderabilitly, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

IEC 60068-2-64, *Environmental testing – Part 2-64: Tests – Test Fh: Vibration, broad-band random and guidance*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

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

IEC 60617, *Graphical symbols for diagrams* (available at http://std.iec.ch/iec60617)

IEC 60642, *Piezoelectric ceramic resonators and resonator units for frequency control and selection – Chapter I: Standard values and conditions – Chapter II: Measuring and test conditions*

IEC 60695-11-5, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60749-28[1] , *Semiconductor devices – Mechanical and climatic test methods – Part 28: Electrostatic discharge (ESD) sensitivity testing direct contact charged device model (DC-CDM)*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61340-3-1, *Electrostatics – Part 3-1: Methods for simulation of electrostatic effects – Human body model (HBM) electrostatic discharge test waveforms*

IEC 61340-3-2, *Electrostatics – Part 3-2: Methods for simulation of electrostatic effects – Machine model (MM) electrostatic discharge test waveforms*

IEC 80000 (all parts), *Quantities and units*

ISO 80000 (all parts), *Quantities and units*

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1 To be published.

3 Terms, definitions, units and symbols

3.1 Terms and definitions

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

3.1.1 General terms

3.1.1.1
surface acoustic wave
SAW
acoustic wave, propagating along a surface of an elastic material, whose amplitude decays exponentially with the depth

3.1.1.2
surface acoustic wave filter
SAW filter
filter characterized by one or more surface acoustic wave transmission line or resonant elements, where the surface acoustic wave is usually generated by an interdigital transducer and propagates along a material surface

3.1.1.3
power flow vector
vector, analogous to a Poynting vector, characterizing energy propagation caused by a surface acoustic wave

3.1.1.4
propagation vector
vector characterizing the phase progression of a wave

3.1.1.5
power flow angle
angle between the direction of the power flow vector and the direction of the propagation vector

3.1.1.6
SAW beam steering
SAW propagation phenomenon in anisotropic materials described by an angle of powerflow which is not zero

3.1.1.7
SAW diffraction
phenomenon, analogous to diffraction of light from a source of finite aperture, which causes SAW beam spreading and wave-front distortion

3.1.1.8
SAW coupling coefficient
k_s^2
electromechanical coupling coefficient defined as follows:

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

where

v_s is the SAW propagation velocity on the 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

3.1.1.9
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

3.1.1.10
unidirectional interdigital transducer
UDT
transducer capable of radiating and receiving surface acoustic waves in or from a single direction

3.1.1.11
multiphase transducer
interdigital transducer having more than two inputs which are driven in different phases

Note 1 to entry: Usually used as a unidirectional transducer.

3.1.1.12
finger
element of the IDT comb electrode

3.1.1.13
solid finger
finger formed of one element with a period of a half wavelength along the propagation direction

3.1.1.14
split finger
finger formed of more than one element, so as to produce antireflection properties in a surface acoustic wave filter

3.1.1.15
dummy finger
passive finger which may be included in order to suppress wave-front distortion

3.1.1.16
bus bar
common electrode which connects individual fingers together and also connects the filter to an external circuit

3.1.1.17
weighted-response transducer
transducer intended to produce a specified impulse response by design of the structure

Note 1 to entry: See 3.1.1.18 to 3.1.1.23.

3.1.1.18
finger overlap or source strength
length of a finger pair between which only electromechanical interaction is generated

3.1.1.19
apodization
weighting produced by the change of finger overlap over the length of the IDT

3.1.1.20
withdrawal weighting
weighting by removal of fingers or sources

3.1.1.21
capacitive weighting
weighting by change of capacitance between electrodes

3.1.1.22
series weighting
weighting by separation of a finger into individual elements having capacitive coupling between them

Note 1 to entry: The elements may be separated from the bus bar.

3.1.1.23
phase weighting
weighting by change in period of finger arrangement inside the IDT

3.1.1.24
aperture
normalized beamwidth of the SAW generated at the centre frequency and normalized to the corresponding wavelength

3.1.1.25
multistrip coupler
MSC
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

3.1.1.26
reflector
SAW reflecting component which normally makes use of the periodic discontinuity provided by a metal strip array or a grooved array

3.1.1.27
spurious reflection
unwanted signal caused by reflection of SAW or bulk waves from substrate edges or electrodes

3.1.1.28
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

3.1.1.29
bulk wave signal
unwanted signal caused by bulk wave excitation and detected at the filter output

3.1.1.30
feed through signal
signal of electromagnetic interference
unwanted signal from the input appearing at the filter output due to stray capacitances and other electromagnetic couplings

3.1.1.31
suppression corrugation
grooves in the non-active side of a substrate for suppressing bulk wave signals

3.1.1.32
acoustic absorber
material with high acoustic loss placed on any part of the substrate for acoustic absorption purposes

3.1.1.33
shielding electrode
electrode intended for the reduction of electromagnetic interference signals

3.1.1.34
interdigitated interdigital transducer
IIDT
SAW transducer made of a combination of three or more interdigital transducers

Note 1 to entry: Same as a muti-IDT in the IEC 60862 series , 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.

3.1.2 Response characteristics related terms

3.1.2.1
nominal frequency
frequency given by the manufacturer or the specification to identify the filter

3.1.2.2
centre frequency
arithmetic mean of the cut-off frequencies

SEE: Figure 1.

3.1.2.3
reference frequency
frequency defined by the specification to which other frequencies may be referred

SEE: Figure 1.

3.1.2.4
cut-off frequency
frequency of the pass band at which the relative attenuation reaches a specified value

SEE: Figure 1.

3.1.2.5
total power loss
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

3.1.2.6
insertion attenuation
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

3.1.2.7
nominal insertion attenuation
insertion attenuation at a specified reference frequency

SEE: Figure 1.

3.1.2.8
relative attenuation
difference between the attenuation at a given frequency and the attenuation at the reference frequency

SEE: Figure 1.

3.1.2.9
pass band
band of frequencies in which the relative attenuation is equal to or less than a specified value

3.1.2.10
pass bandwidth
separation of frequencies between which the relative attenuation is equal to or less than a specified value

3.1.2.11
pass band ripple
maximum variation in attenuation characteristics within a specified pass band

SEE: Figure 1.

3.1.2.12
TTE ripple
maximum variation in attenuation characteristics caused by TTE within a specified pass band

SEE: Figure 1.

3.1.2.13
minimum insertion attenuation
minimum value of insertion attenuation in the pass band

SEE: Figure 1.

3.1.2.14
maximum insertion attenuation
maximum value of insertion attenuation in the pass band

SEE: Figure 1.

3.1.2.15
stop band
band of frequencies in which the relative attenuation is equal to or greater than a specified value

3.1.2.16
stop bandwidth
separation of frequencies between which the relative attenuation is equal to or greater than a specified value

3.1.2.17
stop band rejection
minimum relative attenuation at a specified stop band

3.1.2.18
shape factor
ratio of the two bandwidths at specified values of relative attenuation

3.1.2.19
group delay
time equal to the first derivative of the phase shift, in radians, with respect to the angular frequency

3.1.2.20
nominal group delay
group delay at a specified reference frequency

SEE: Figure 1.

3.1.2.21
group delay distortion
difference between the lowest value and highest value of group delay in a specified frequency band

SEE: Figure 1.

3.1.2.22
trap frequency
specified frequency at which the relative attenuation is equal to or greater than a specified value

3.1.2.23
trap attenuation
relative attenuation at a specified trap frequency

3.1.2.24
transition band
band of frequencies between the cut-off frequency and the nearest point of the adjacent stop band

3.1.2.25
reflectivity
dimensionless measure of the degree of mismatch between two impedances Z_a and Z_b:

$$\frac{Z_a - Z_b}{Z_a + Z_b},$$

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

Note 1 to entry: The absolute value of reflectivity is called the reflection coefficient.

3.1.2.26
return attenuation
value of the reflection coefficient given by the sign changed expression in decibels:

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

3.1.2.27
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

3.1.2.28
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

3.1.2.29
unwanted response
response other than that associated with the mode of vibration intended for the application

3.1.2.30
input level
power, voltage or current value applied to the input terminal of a filter

3.1.2.31
output level
power, voltage or current value delivered to the load circuit

3.1.2.32
nominal level
power, voltage or current value at which the performance measurement is specified

3.1.2.33
input impedance
impedance presented by the filter to the signal source when the output is terminated by a specified load impedance

3.1.2.34
output impedance
impedance presented by the filter to the load when the input is terminated by a specified source impedance

3.1.2.35
terminating impedance
impedance presented to the filter by the source or by the load

3.1.2.36
balanced input/output
filter input/output between two terminals having equal amplitudes and 180 degree different phases

3.1.2.37
available power
maximum power obtainable from a given source by suitable adjustment of the load impedance

3.1.2.38
operating temperature range
range of temperatures, over which the SAW filter will function while maintaining its specified characteristics within specified tolerances

3.1.2.39
operable temperature range
range of temperatures over which the SAW filter continues to provide its specified response characteristics, though not necessarily within the specified tolerances

3.1.2.40
storage temperature range
minimum and maximum temperatures as measured on the enclosure, at which the SAW filter may be stored without deterioration or damage to its performance

3.1.2.41
roll-off rate
index describing the rise-up characteristics for digital communication SAW roll-off filters

Note 1 to entry: It is a ratio of the transition band to the ideal cut-off frequency, which is equal to a half of the sampling frequency in the case of cosine roll-off frequency characteristics.

3.1.2.42
intermodulation distortion
IMD
non-linear distortion of a device response characterized by the appearance of frequencies at the output which is equal to the differences (or sums) of integral multiples of the two or more component frequencies present at the input

Note 1 to entry: This note applies to the French language only.

3.1.3 SAW filter related terms

3.1.3.1
transversal filter
filter consisting of input and output interdigital transducers on a piezoelectric substrate

Note 1 to entry: The impulse response of a transversal filter is given by the convolution of the impulse response of the input IDT and the impulse response of the output IDT. The frequency response is given by the Fourier transform of the impulse response.

3.1.3.2
frequency symmetrical filter
filter having a symmetrical frequency characteristic in relation to the reference frequency

3.1.3.3
frequency asymmetrical filter
filter having a specified asymmetrical pass-band or stop-band characteristic in relation to the reference frequency

3.1.3.4
dispersive filter
filter designed so as to have group delay which is a function of frequency, usually by varying the finger periodicity

3.1.3.5
comb filter
filter having two or more pass bands between three or more stop bands

3.1.3.6
tapered IDT filter
broad-band SAW filter using a fan-shaped IDT called “tapered IDT” or “slanted finger IDT”, in which electrode pitch is varied perpendicular to the propagation direction

3.1.3.7
reflector filter
SAW filter utilizing the frequency characteristics of grating reflectors

Note 1 to entry: Various configurations are in practical use.

3.1.3.8
single-phase unidirectional transducer filter
SPUDT filter
SAW filter composed of single-phase unidirectional transducers (SPUDTs) utilizing internal reflections within the transducer to achieve unidirectional behavior

Note 1 to entry: This note applies to the French language only.

3.1.3.9
resonant SPUDT filter
RSPUDT filter
SAW filter using internal reflection inside SPUDT and multi-reflection between input and output SPUDTs

Note 1 to entry: This note applies to the French language only.

3.1.3.10
resonator filter
filter in which two or more SAW resonators are incorporated

3.1.3.11
coupled resonator filter
band-pass filter achieved by an acoustic coupling between the identical resonators

Note 1 to entry: There are two types of SAW filters called a transversely coupled type and a longitudinally coupled type.

3.1.3.12
ladder filter
filter having a cascade or tandem connection of alternating series and shunt SAW resonators

3.1.3.13
lattice filter
filter having at least four SAW resonators connected in series to form a mesh, two non-adjacent junction points being used as input terminals and the remaining two junction points used as output terminals (bridge circuit)

Note 1 to entry: Preferably, it can be used for balanced circuits.