# IEC 60862-1

Edition 3.0 2015-08

# 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**



IEC 60862-1:2015-08(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 31.140

ISBN 978-2-8322-2863-0

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

# SURFACE ACOUSTIC WAVE (SAW) FILTERS OF ASSESSED QUALITY –

## Part 1: Generic specification

## FOREWORD

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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- withdrawn,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.

# 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*

[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;

$\Delta v_s$ 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