IEC 63041-1

Edition 2.0 2021-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Piezoelectric sensors –
Part 1: Generic specifications

Capteurs piézoélectriques –
Partie 1: Spécifications génériques

IEC 63041-1:2021-09(en-fr)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.140

ISBN 978-2-8322-1023-7

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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PIEZOELECTRIC SENSORS –

Part 1: Generic specifications

FOREWORD

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IEC 63041-1 has been prepared by IEC technical committee 49: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection. It is an International Standard.

This second edition cancels and replaces the first edition published in 2017. This edition constitutes a technical revision.

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

a) the new terms "piezoelectric sensor system" and "wireless SAW sensor system" and their definitions have been added;
b) new types of sensor modules and sensor system have been added;
c) some symbols of sensor elements are added in Clause 4;
d) a new Figure B.3 has been added in Annex B;
e) Annex C has been added.

The text of this International Standard is based on the following documents:

Draft	Report on voting
49/1357/CDV	49/1364/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 63041 series, published under the general title *Piezoelectric sensors*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

PIEZOELECTRIC SENSORS –

Part 1: Generic specifications

1 Scope

This part of IEC 63041 applies to piezoelectric sensors of resonator, delay-line and non-acoustic types, which are used in physical and engineering sciences, chemistry and biochemistry, medical and environmental sciences, etc.

The purpose of this document is to specify the terms and definitions for piezoelectric sensors, and to make sure from a technological perspective that users understand the state-of-art piezoelectric sensors and how to use them correctly.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *International Electrotechnical Vocabulary – Part 561: Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection*

IEC 60122-2-1, *Quartz crystal units for frequency control and selection – Part 2: Guide to the use of quartz crystal units for frequency control and selection – Section One: Quartz crystals for microprocessor clock supply*

IEC 60444-9, *Measurement of quartz crystal unit parameters – Part 9: Measurement of spurious resonances of piezoelectric crystal units*

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

IEC 63041-3:2020, *Piezoelectric sensors – Part 3: Physical sensors*

ISO 2859-1:1999, *Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 80000-1, *Quantities and units – Part 1: General*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60027, IEC 60050-561, IEC 60617, ISO 80000-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

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- ISO Online browsing platform: available at https://www.iso.org/obp

NOTE Piezoelectric sensors covered herein are those used for the detection and measurement of physical quantities, chemical substances or biological molecules.

3.1 Piezoelectric sensors

3.1.1
piezoelectric sensor element
electronic component which is able to detect physical quantities as a change in its frequency, phase, delay, electrical charge, resistance, Q-value, bandwidth, etc.

Note 1 to entry: For chemical and biochemical sensor applications, the piezoelectric sensor element includes a sensitive or receptive layer (target recognition material).

3.1.2
resonator type sensor element
piezoelectric sensor component using acoustic resonances

3.1.3
delay-line type sensor element
piezoelectric sensor component using a delay-line of surface acoustic wave (SAW) transversal filter type

3.1.4
non-acoustic type sensor element
piezoelectric sensor component using the electrical charge induced by a quasi-static force, torque or the like

Note 1 to entry: Here, the term, "non-acoustic", represents "quasi-static piezoelectric". Accordingly, the (piezoelectric) non-acoustic type sensor element means a sensor element using the quasi-static piezoelectric effect.

3.1.5
piezoelectric sensor cell
sensor element equipped with necessary mechanical accessories and attachments to correctly detect the parameters to be measured

3.1.6
piezoelectric sensor module
sensor element or cell equipped with electronic accessories for interfacing to external data acquisitions

3.1.7
piezoelectric sensor system
organized system including detection, amplification of detected value, communication with other equipment and analysis of detected value

Note 1 to entry: Here, these functions cooperate mutually.

3.1.8
piezoelectric sensor
generic term that includes a sensor element, cell, module and system

3.1.9
QCM
quartz crystal microbalance
one of the families of chemical and biochemical sensors using crystal resonators

Note 1 to entry: A thickness shear mode (TSM) sensor is identical with a QCM.

3.2 Types of chemical sensors

3.2.1
piezoelectric chemical sensor element
piezoelectric sensor component including a sensitive layer (target recognition material), which is necessary for the practical measurement of simple non-biological molecules in quantity, and which works and detects chemical substances mainly in the gas phase

Note 1 to entry: A gas sensor element is one of the chemical sensor elements.

3.2.2
piezoelectric biochemical sensor element
piezoelectric sensor component including a receptive layer (target recognition material), which is necessary for the practical measurement of complex biological molecules in quantity, and which works mainly in aqueous media and detects biomolecules therein

3.3 Types of physical sensors

3.3.1
piezoelectric force sensor element
piezoelectric sensor component whose resonance frequency, delay or electrical charge/voltage is used for force measurement

3.3.2
piezoelectric pressure sensor element
piezoelectric sensor component whose resonance frequency, delay or electrical charge/voltage is used for pressure measurement

3.3.3
piezoelectric torque sensor element
piezoelectric sensor component whose resonance frequency, delay or electrical charge/voltage is used for torque measurement

3.3.4
piezoelectric viscosity sensor element
piezoelectric sensor component whose resonance frequency, delay or insertion loss/gain is used for viscosity measurement

3.3.5
piezoelectric temperature sensor element
piezoelectric sensor component whose resonance frequency or delay is used for temperature measurement

3.3.6
piezoelectric film-thickness sensor element
piezoelectric sensor component whose resonance frequency is used for film-thickness measurement

3.4 Types of sensor modules

3.4.1
wireless SAW sensor module
piezoelectric sensor element or cell equipped with an antenna for wirelessly connecting with interrogation unit

Note 1 to entry: Here, the resonator and delay line type elements of the SAW are used for the piezoelectric sensor element or cell.

3.4.2
dual mode sensor module
dual mode sensor element or cell equipped with circuit units for temperature compensation and electronic accessories for interfacing to external data acquisitions

Note 1 to entry: Dual mode sensor is a piezoelectric sensor which is able to detect physical quantities from a change in resonance frequencies of two independent modes on a single piezoelectric plate (see IEC 63041-3:2020, 3.1.5).

3.5 Types of sensor systems

3.5.1
wireless SAW sensor system
generic term that includes wireless SAW sensors and reader unit for sending and receiving RF signals

SEE: Annex C.

3.5.2
dual mode sensor system
generic term that includes dual mode quartz crystal sensor modules, electric device, PC, memory, wired or wireless devices, software, etc.

4 Symbols of sensor elements

4.1 General

Figures 1 to 6 show the conceptual diagrams and defined symbols for sensor elements of bulk acoustic wave (BAW) resonator, SAW resonator and SAW delay-line types. The symbols are essentially the same as those given in IEC 60122-1, IEC 61019-1 and IEC 60862-1.

Figure 7 and Figure 8 show the conceptual diagram and defined symbol for sensor elements of non-acoustic type.

Figures 9 to 12 show the conceptual diagram and defined symbol for sensor elements of wireless SAW resonator and SAW delay-line types. This is shown in Annex C.

NOTE The diagonal line in Figure 2, Figure 4, Figure 6, Figure 8, Figure 10 and Figure 12 shows an emblem expressing changes in objects to be measured.

For letter symbols (see 4.7) showing the types of sensors, these symbols should be defined in the circle at the upper right corner of Figure 2, Figure 4, Figure 6, Figure 8, Figure 10 and Figure 12, and for each sensor application.

4.2 Symbol for sensor elements of BAW resonator type

Figure 1 shows the conceptual diagrams for sensor elements of BAW resonator type from which a mounting portion is omitted. Figure 2 shows the symbol for sensor elements of BAW resonator type.

Figure 1 – Conceptual diagrams for sensor elements of BAW resonator type

NOTE Figure 1 shows examples of disk type and tuning fork type sensor elements.

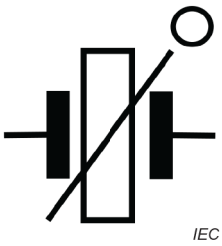

Figure 2 – Symbol for sensor elements of BAW resonator type

4.3 Symbol for sensor elements of SAW resonator type

Figure 3 and Figure 4 show, respectively, the conceptual diagram and symbol for sensor elements of SAW resonator type.

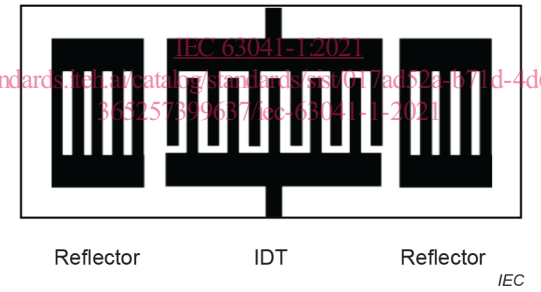

Figure 3 – Conceptual diagram of sensor elements of SAW resonator type

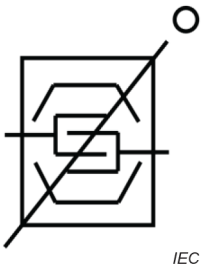

Figure 4 – Symbol for sensor elements of SAW resonator type

4.4 Symbol for sensor elements of SAW delay-line type

Figure 5 and Figure 6 show, respectively, the conceptual diagram and symbol for sensor elements of SAW delay-line type.

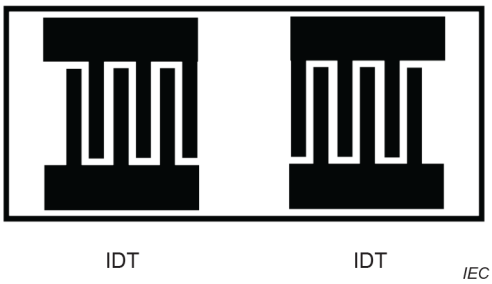

Figure 5 – Conceptual diagram for sensor elements of SAW delay-line type

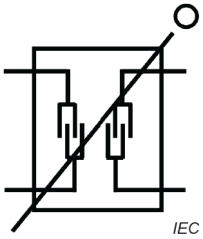

Figure 6 – Symbol for sensor elements of SAW delay-line type

4.5 Symbol for sensor elements of non-acoustic type

Figure 7 shows the conceptual diagrams for sensor elements of non-acoustic type from which a mounting portion is omitted. Figure 8 shows the symbol for sensor elements of non-acoustic type.

Figure 7 – Conceptual diagrams for sensor elements of non-acoustic type

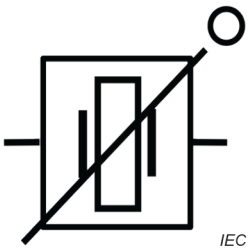

Figure 8 – Symbol for sensor elements of non-acoustic type

4.6 Symbol for wireless SAW sensor element

Figures 9 to 12 show, respectively, the conceptual diagram and symbol for sensor elements of wireless SAW resonator and delay-line type.

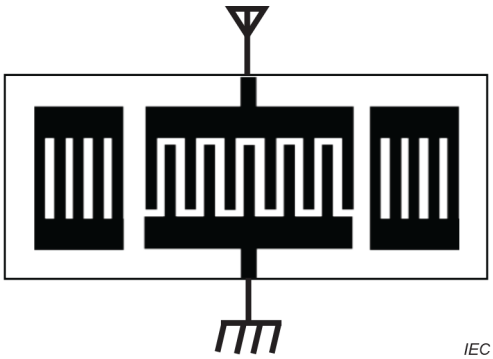

Figure 9 – Conceptual diagram for basic sensor elements of wireless SAW resonator type

Figure 10 – Symbol for basic sensor elements of wireless SAW resonator type

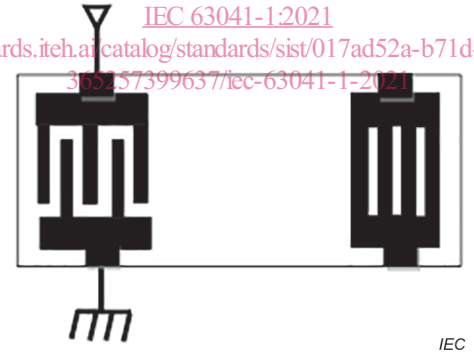

Figure 11 – Conceptual diagram for basic sensor elements of wireless SAW reflective delay-line type

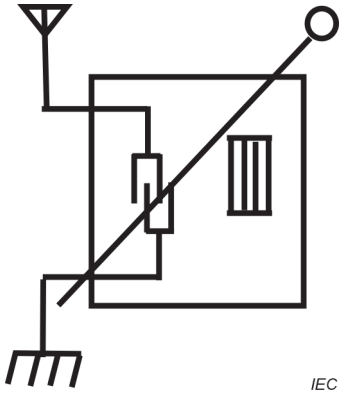

Figure 12 – Symbol for basic sensor elements of wireless SAW reflective delay-line type