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Piezoelectric sensors - Part 3: Physical sensors

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Piezoelectric sensors - Part 3: Physical sensors

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IEC 63041-3 has been prepared by IEC technical committee TC 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 2020. This edition constitutes a technical revision.

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

a) Some terms in Clause 3 have been updated to be consistent with IEC TS 61994-5:2023 [1].

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

Draft	Report on voting
49/1526/FDIS	49/1530/RVD

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 http://www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at http://www.iec.ch/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– withdrawn, or
– revised.

1 Scope

This part of IEC 63041 is applicable to piezoelectric physical sensors mainly used in the field of process control, wireless monitoring, dynamics, thermodynamics, vacuum engineering, and environmental sciences. This document provides users with technical guidelines as well as basic knowledge of common physical sensors.

Piezoelectric sensors covered herein are those applied to the detection and measurement of physical quantities such as force, pressure, torque, viscosity, temperature, film thickness, acceleration, vibration, and tilt angle.

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 60617:2012, *Graphical symbols for diagrams*

IEC 63041-1, *Piezoelectric sensors - Part 1: Generic specifications*

IEC 63041-2, *Piezoelectric sensors - Part 2: Chemical and biochemical sensors*

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

3 Terms, definitions, symbols and units

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60027 (all parts), IEC 60050–561, IEC 60617:2012, IEC 63041-1, IEC 63041-2, and ISO 80000–1 and the following apply.

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

– IEC Electropedia: available at http://www.electropedia.org/
– ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
piezoelectric acceleration sensor element
piezoelectric sensor component whose resonance frequency or delay time is used to measure the change in velocity of an object with time

3.1.2
piezoelectric humidity sensor element
piezoelectric sensor component whose resonance frequency or delay time is used for dew point and moisture detection

3.1.3
piezoelectric tilt angle sensor element
piezoelectric sensor component whose resonance frequency or delay time is used to measure tilt angles, elevation, or depression of an object with respect to gravity's detection

3.1.4
piezoelectric vibration sensor element
piezoelectric sensor component whose resonance frequency or delay time is used for measurement of vibration

3.1.5
dual mode sensor
piezoelectric sensor which is able to detect physical quantities from a change in resonance frequencies of two independent modes on a single piezoelectric plate

Note 1 to entry: In order to achieve improved precision and/or to eliminate undesired influence factors, sensor solutions are employed that utilize two or more modes. By evaluation of combinations of these modes' sensitivities to various ambient conditions, on the one hand, improved detection sensitivity can be achieved, while, on the other hand, undesirable sensitivities can be reduced or eliminated.

3.1.6
differential sensor
piezoelectric sensor which is able to detect physical quantities from a change in resonance frequencies or delay times of two independent and same micro-acoustic structures assembled on the same or different piezoelectric plates

3.1.7
multi-measurand sensor
piezoelectric sensor element that can detect two or more different physical quantities from an analysis of different sensor responses

[SOURCE: IEC TS 61994-5:2023 [1], 3.6]

3.2 Symbols and units

The symbols and units given in IEC 63041-1 apply.

4 Specifications

4.1 General

Key points of the specification are identified in IEC 63041-1, Clause 5.

4.2 Conceptual diagrams of sensor types

4.2.1 General

In addition to the sensors defined in Clause 4 of IEC 63041-1, piezoelectric acceleration sensor element, piezoelectric humidity sensor element, piezoelectric tilt angle sensor element and piezoelectric vibration sensor element are also in practical use as physical sensors.

In addition, dual mode sensor, differential sensor and multi-measurand sensor are used as sensor configuration.

4.2.2 Conceptual diagram for sensor elements of SAW resonator type

Figure 1 and Figure 2 show conceptual diagrams for resonator type SAW sensors. Figure 1 provides one resonance which is sensitive to undesirable influence factors such as frequency pulling. In the case of Figure 2, comprising e.g. a parallel connection of two resonators at