STN	Monokryštalické dosky na súčiastky s povrchovou akustickou vlnou (SAW) Špecifikácia a meracia metóda	STN EN IEC 62276 36 8335

Single crystal wafers for surface acoustic wave (SAW) device applications - Specifications and measuring methods

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 06/25

Obsahuje: EN IEC 62276:2025, IEC 62276:2025

Oznámením tejto normy sa od 30.04.2028 ruší
STN EN 62276 (36 8335) z apríla 2017

140678

Úrad pre normalizáciu, metrológiu a skúšobníctvo Slovenskej republiky, 2025
Slovenská technická norma a technická normalizačná informácia je chránená zákonom č. 60/2018 Z. z. o technickej normalizácii v znení neskorších predpisov.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN IEC 62276

April 2025

ICS 31.140

Supersedes EN 62276:2016

English Version

Single crystal wafers for surface acoustic wave (SAW) device applications - Specifications and measuring methods (IEC 62276:2025)

Tranches monocristallines pour applications utilisant des dispositifs à ondes acoustiques de surface (OAS) - Spécifications et méthodes de mesure
(IEC 62276:2025)

Einkristall-Wafer für Oberflächenwellen-(OFW-)Bauelemente - Festlegungen und Messverfahren
(IEC 62276:2025)

This European Standard was approved by CENELEC on 2025-04-11. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

© 2025 CENELEC All rights of exploitation in any form and by any means reserved worldwide for CENELEC Members.

Ref. No. EN IEC 62276:2025 E

European foreword

The text of document 49/1454/CDV, future edition 4 of IEC 62276, prepared by TC 49 "Piezoelectric, dielectric and electrostatic devices and associated materials for frequency control, selection and detection" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62276:2025.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2026-04-30
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2028-04-30

This document supersedes EN 62276:2016 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 62276:2025 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 standard indicated:

IEC 60862-1	NOTE	Approved as EN 60862-1
IEC 60862-2	NOTE	Approved as EN 60862-2
IEC 60862-3	NOTE	Approved as EN 60862-3
IEC 61019-1	NOTE	Approved as EN 61019-1
IEC 61019-2	NOTE	Approved as EN 61019-2
ISO 21920-2	NOTE	Approved as EN ISO 21920-2

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cencenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60758	2016	Synthetic quartz crystal - Specifications and guidelines for use	EN 60758	2016

IEC 62276

Edition 4.0 2025-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Single crystal wafers for surface acoustic wave (SAW) device applications – Specifications and measuring methods

Tranches monocristallines pour applications utilisant des dispositifs à ondes acoustiques de surface (OAS) – Spécifications et méthodes de mesure

IEC 62276:2025-03(en-fr)

THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2025 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, …). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch
Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, …). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch
Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications, symboles graphiques et le glossaire. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org
Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 500 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 25 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

IEC 62276

Edition 4.0 2025-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Single crystal wafers for surface acoustic wave (SAW) device applications – Specifications and measuring methods

Tranches monocristallines pour applications utilisant des dispositifs à ondes acoustiques de surface (OAS) – Spécifications et méthodes de mesure

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.140 ISBN 978-2-8327-0246-8

Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.

® Registered trademark of the International Electrotechnical Commission
Marque déposée de la Commission Electrotechnique Internationale

CONTENTS

FOREWORD..5
1 Scope..7
2 Normative references..7
3 Terms and definitions..7
  3.1 Flatness..7
  3.2 Appearance defects..11
  3.3 Other terms and definitions..11
  3.4 Terms and definitions related to LN and LT wafers..12
4 Requirements..13
  4.1 General..13
  4.2 Diameters and tolerances..13
  4.3 Thickness and tolerance..14
  4.4 Orientation flat..14
  4.5 Secondary flat..14
  4.6 Front (propagation) surface roughness..14
  4.7 Back surface roughness..14
  4.8 Warp..14
  4.9 TV5 and TTV..14
  4.10 LTV and PLTV..15
  4.11 Front surface defects..16
  4.12 Tolerance of surface orientation..16
  4.13 Inclusions..16
  4.14 Position of seed in synthetic quartz wafer..16
  4.15 Electrical twins in synthetic quartz wafer..16
  4.16 Bevel..16
  4.17 Bulk resistivity (conductivity) for reduced LN and reduced LT..16
  4.18 Transmittance..16
  4.19 Lightness..17
  4.20 Colour difference..17
5 Sampling plan..17
  5.1 General..17
  5.2 Sampling..17
6 Test methods..18
  6.1 Diameter..18
  6.2 Thickness..18
  6.3 Existence and position of OF and SF..18
  6.4 Dimensions of OF and SF..18
  6.5 Orientation of OF and SF..18
  6.6 TV5..18
  6.7 Warp..18
  6.8 TTV, LTV and PLTV..18
  6.9 Front surface defects..18
  6.10 Inclusions..18
  6.11 Position of seed in synthetic quartz wafer..18
  6.12 Electrical twins in synthetic quartz wafer..19
  6.13 Bevel..19

6.14 Front surface and back surface roughness....19
6.15 Orientation....19
6.16 Bulk resistivity....19
6.17 Transmittance....19
6.18 Lightness....19
6.19 Colour difference....19
7 Identification, labelling, packaging, delivery condition....19
7.1 Packaging....19
7.2 Labelling and identification....20
7.3 Delivery condition....20
8 Measurements of orientation by X-ray....20
8.1 Measurement principle....20
8.2 Measurement method....21
8.3 Measuring surface orientation....21
8.4 Measuring OF flat orientation....21
8.5 Typical wafer orientations and reference planes....21
9 Measurement of bulk resistivity....22
9.1 Resistance measurement....22
9.2 Electrode....23
9.3 Bulk resistivity....23
10 Visual inspections – Front surface defects and inclusions inspection method....24
11 Measurement of thickness and thickness variation....25
11.1 Measurement principle....25
11.1.1 Contact measurement....25
11.1.2 Contactless measurement....25
11.2 Sample....25
11.3 Measurement method....25
11.3.1 Contact measurement....25
11.3.2 Contactless measurement....25
12 Measurement of transmittance....26
12.1 Measurement principle....26
12.2 Sample....26
12.3 Measurement method....26
13 Measurement of lightness and colour difference....26
13.1 Measurement principle....26
13.2 Sample....26
13.3 Measurement method....27
Annex A (normative) Expression using Euler angle description for piezoelectric single crystals....29
Annex B (informative) Manufacturing process for SAW wafers....32
B.1 Crystal growth methods....32
B.1.1 Czochralski growth method....32
B.1.2 Vertical Bridgman method....35
B.1.3 Hydrothermal temperature gradient method....36
B.2 Standard mechanical wafer manufacturing....36
B.2.1 Process flow-chart....36
B.2.2 Cutting both ends and cylindrical grinding....37
B.2.3 Marking orientation....37

B.2.4 Slicing 38
B.2.5 Double-sided lapping 38
B.2.6 Bevelling (edge rounding) 38
B.2.7 Polishing....38
Annex C (informative) Measurement principle of lightness and colour difference 39
Bibliography 40

Figure 1 – Wafer sketch and measurement points....8
Figure 2 – Schematic diagram of a TTV....8
Figure 3 – Schematic diagram of a warp....9
Figure 4 – Schematic diagram of a sori 9
Figure 5 – Example of the distribution of sites for measurement of the LTV 10
Figure 6 – LTV defined within each site on the wafer surface 10
Figure 7 – Measurement method by X-ray 20
Figure 8 – Relationship between cut angle and lattice planes....21
Figure 9 – Measuring circuit....22
Figure 10 – Resistance measuring equipment....22
Figure 11 – Shape of electrode 23
Figure 12 – Measurement points for lightness and colour difference determination 27
Figure A.1 – Definition of Euler angles to rotate coordinate system (X, Y, Z) onto (x_1, x_2, x_3) 29
Figure A.2 – SAW wafer coordinate system 30
Figure A.3 – Relationship between the crystal axes, Euler angles, and SAW orientation for some wafer orientations....31
Figure B.1 – Czochralski crystal growth method....33
Figure B.2 – Example of non-uniformity in crystals grown from different starting melt compositions 35
Figure B.3 – Schematic of a Vertical Bridgman furnace and example of temperature distribution....36
Figure B.4 – Process flow-chart 37
Figure C.1 – Sketch for CIE LAB colour space....39

Table 1 – Roughness, warp, TV5 and TTV specification limits....15
Table 2 – LTV and PLTV specification for LN and LT 15
Table 3 – Sampling plan 17
Table 4 – Crystal planes to determine surface and OF orientations 21
Table 5 – Electrode size 23
Table A.1 – Selected SAW substrate orientations and corresponding Euler angles 30

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

SINGLE CRYSTAL WAFERS FOR SURFACE ACOUSTIC WAVE (SAW) DEVICE APPLICATIONS – SPECIFICATIONS AND MEASURING METHODS

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.

3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.

4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.

6) All users should ensure that they have the latest edition of this publication.

7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.

8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 62276 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 fourth edition cancels and replaces the third edition published in 2016. This edition constitutes a technical revision.

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

a) The terms and definitions, the technical requirements, sampling frequency, test methods and measurement of transmittance, lightness, colour difference for LN and LT have been added in order to meet the needs of industry development;

b) The term “inclusion” (mentioned in 4.13 and 6.10) and its definition have been added because there was no definition for it in Clause 3;

c) The specification of LTV and PLTV, and the corresponding description of sampling frequency for LN and LT have been added, because they are the key performance parameters for the wafers;

d) The tolerance of Curie temperature specification for LN and LT have been added in order to meet the development requirements of the industry;

e) Measurement of thickness, TV5, TTV, LTV and PLTV have been completed, including measurement principle and method of thickness, TV5, TTV, LTV and PLTV.

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

Draft	Report on voting
49/1454/CDV	49/1460/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/publications.

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.

SINGLE CRYSTAL WAFERS FOR SURFACE ACOUSTIC WAVE (SAW) DEVICE APPLICATIONS – SPECIFICATIONS AND MEASURING METHODS

1 Scope

This document applies to the manufacture of synthetic quartz, lithium niobate (LN), lithium tantalate (LT), lithium tetraborate (LBO), and lanthanum gallium silicate (LGS) single crystal wafers intended for use as substrates in the manufacture of surface acoustic wave (SAW) filters and resonators.

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 60758:2016, *Synthetic quartz crystal – Specifications and guidelines for use*

koniec náhľadu – text ďalej pokračuje v platenej verzii STN