



DPC: 23 / 30468947 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

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Responsible committee: W/- Miscellaneous Standards # Consumer Products and Services

Interested committees:

Title: BS EN 62276 Single crystal wafers for surface acoustic wave (SAW) device applications - Specifications and measuring methods

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For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



49/1406/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

IEC 62276 ED4

DATE OF CIRCULATION:

2023-01-20

CLOSING DATE FOR COMMENTS:

2023-04-14

SUPERSEDES DOCUMENTS:

49/1401/CD, 49/1403/CC

IEC TC 49 : PIEZOELECTRIC, DIELECTRIC AND ELECTROSTATIC DEVICES AND ASSOCIATED MATERIALS FOR FREQUENCY CONTROL, SELECTION AND DETECTION

SECRETARIAT:

Japan

SECRETARY:

Mr Masanobu Okazaki

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

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☐ ENVIRONMENT

☒ QUALITY ASSURANCE

☐ SAFETY

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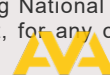
- any relevant patent rights of which they are aware and to provide supporting documentation,
- any local regulations or technical reasons that may exist and should be considered should this proposal proceed, recognizing that failure to address such requirements could result in the need for new or existing "in some countries" clauses. See AC/22/2007.

TITLE:

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

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CONTENTS

1			
2			
3	FOREWORD	6	
4	INTRODUCTION	8	
5	1 Scope	9	
6	2 Normative references	9	
7	3 Terms and definitions	9	
8	3.1 Single crystals for SAW wafer	9	
9	3.2 Terms and definitions related to LN and LT crystals	10	
10	3.3 Terms and definitions related to all crystals	10	
11	3.4 Flatness	11	
12	3.5 Definitions of appearance defects	13	
13	3.6 Other terms and definitions	14	
14	4 Requirements	15	
15	4.1 Material specification	15	
16	4.1.1 Synthetic quartz crystal	15	
17	4.1.2 LN	15	
18	4.1.3 LT	15	
19	4.1.4 LBO, LGS	15	
20	4.2 Wafer specifications	16	
21	4.2.1 General	16	
22	4.2.2 Diameters and tolerances	16	
23	4.2.3 Thickness and tolerance	16	
24	4.2.4 Orientation flat	16	
25	4.2.5 Secondary flat	16	
26	4.2.6 Back surface roughness	17	
27	4.2.7 Warp	17	
28	4.2.8 TV5, TTV	17	
29	4.2.9 LTV, PLTV	18	
30	4.2.10 Front (propagation) surface finish	18	
31	4.2.11 Front surface defects	18	
32	4.2.12 Surface orientation tolerance	18	
33	4.2.13 Inclusions	18	
34	4.2.14 Etch channel number and position of seed for quartz wafer	18	
35	4.2.15 Bevel	19	
36	4.2.16 Curie temperature and tolerance	19	
37	4.2.17 Lattice constant	19	
38	4.2.18 Bulk resistivity (conductivity) for reduced LN and LT	19	
39	4.2.19 Transmittance	19	
40	4.2.20 Lightness	19	
41	4.2.21 Colour difference	19	
42	5 Sampling plan	19	
43	5.1 General	19	
44	5.2 Sampling	20	

45	5.3	Sampling frequency	20
46	5.4	Inspection of whole population	20
47	6	Test methods	20
48	6.1	Diameter	20
49	6.2	Thickness	20
50	6.3	Dimension of OF	20
51	6.4	Orientation of OF	20
52	6.5	TV5	21
53	6.6	Warp	21
54	6.7	TTV, LTV and PLTV	21
55	6.8	Front surface defects	21
56	6.9	Inclusions	21
57	6.10	Back surface roughness	21
58	6.11	Orientation	21
59	6.12	Curie temperature	21
60	6.13	Lattice constant	21
61	6.14	Bulk resistivity	21
62	6.15	Transmittance	21
63	6.16	Lightness	21
64	6.17	Colour difference	21
65	7	Identification, labelling, packaging, delivery condition	21
66	7.1	Packaging	21
67	7.2	Labelling and identification	21
68	7.3	Delivery condition	22
69	8	Measurement of Curie temperature	22
70	8.1	General	22
71	8.2	DTA method	22
72	8.3	Dielectric constant method	22
73	9	Measurement of lattice constant (Bond method)	23
74	10	Measurement of face angle by X-ray	24
75	10.1	Measurement principle	24
76	10.2	Measurement method	25
77	10.3	Measuring surface orientation of wafer	25
78	10.4	Measuring OF flat orientation	25
79	10.5	Typical wafer orientations and reference planes	25
80	11	Measurement of bulk resistivity	26
81	11.1	Resistance measurement of a wafer	26
82	11.2	Electrode	26
83	11.3	Bulk resistivity	27
84	12	Visual inspections – Front surface inspection method	27
85	13	Measurement of thickness and thickness variation	28
86	13.1	Measurement principle	28
87	13.1.1	Contact measurement	28
88	13.1.2	Contactless measurement	28
89	13.2	Sample	28

90	13.3	Measurement method	28
91	13.3.1	Contact measurement	28
92	13.3.2	Contactless measurement	28
93	14	Measurement of transmittance	29
94	14.1	Measurement principle	29
95	14.2	Sample	29
96	14.3	Measurement method	29
97	15	Measurement of lightness and colour difference	29
98	15.1	Measurement principle	29
99	15.2	Sample	29
100	15.3	Measurement method	29
101	Annex A (normative)	Expression using Euler angle description for piezoelectric single crystals	
102			31
103	Annex B (informative)	Manufacturing process for SAW wafers	34
104	B.1	Crystal growth methods	34
105	B.2	Standard mechanical wafer manufacturing	37
106	Annex C (informative)	Measurement principle of lightness and colour difference	40
107	Bibliography		41
108			
109	Figure 1	– Wafer sketch and measurement points for TV5 determination.....	11
110	Figure 2	– Schematic diagram of TTV	12
111	Figure 3	– Schematic diagram of warp	12
112	Figure 4	– Schematic diagram of Sori.....	12
113	Figure 5	– Example of site distribution for LTV measurement	13
114	Figure 6	– LTV value of each site	13
115	Figure 7	– Schematic of a DTA system.....	22
116	Figure 8	– Schematic of a dielectric constant measurement system	23
117	Figure 9	– The Bond method	24
118	Figure 10	– Measurement method by X-ray	24
119	Figure 11	– Relationship between cut angle and lattice planes	25
120	Figure 12	– Measuring circuit	26
121	Figure 13	– Resistance measuring equipment	26
122	Figure 14	– Shape of electrode	27
123	Figure 15	– Measurement points for lightness and colour difference determination	30
124	Figure A.1	– Definition of Euler angles to rotate coordinate system (X, Y, Z) onto (x_1 , x_2 , x_3)	31
125	Figure A.2	– SAW wafer coordinate system.....	32
126	Figure A.3	– Relationship between the crystal axes, Euler angles, and SAW orientation for	
127		some wafer orientations	33
128	Figure B.1	– Czochralski crystal growth method.....	34
129	Figure B.2	– Example of non-uniformity in crystals grown from different starting melt	
130		compositions	36
131	Figure B.3	– Schematic of a Vertical Bridgman furnace and example of temperature	
132		distribution	37

133	Figure B.4 – Process flow-chart	38
134	Figure C.1 – Sketch for CIE LAB colour space	40
135		
136	Table 1 – Description of wafer orientations.....	15
137	Table 2 – Roughness, warp, TV5 and TTV specification limits	17
138	Table 3 – LTV and PLTV specification for LN and LT	18
139	Table 4 – Maximum number of etch channels in seed position	19
140	Table 5 - Tolerance of Curie temperature specification for LN and LT	19
141	Table 6 – Crystal planes to determine surface and OF orientations	25
142	Table 7 – Electrode size	26
143	Table A.1 – Selected SAW substrate orientations and corresponding Euler angles.....	32
144		

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

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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 are added in order to meet the needs of industry development;
- b) The terms and definitions of inclusion mentioned in Clause 5.4 and 6.9 is added because they are for lack of definition in Clause 3;
- c) The specification of LTV and PLTV, and the corresponding description of sampling frequency for LN and LT are added, because they are the key performance parameters for the wafers;
- d) The tolerance of Curie temperature specification for LN and LT are added in order to meet the development requirements of the industry;

- e) Measurement of thickness, TV5, TTV, LTV and PLTV are completed, including measurement principle and method of thickness, TV5, TTV, LTV and PLTV ;
- f) The format of bibliography has been improved in accordance with the latest edition of ISO 690.

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

Draft	Report on voting
XX/XX/FDIS	XX/XX/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 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,
- replaced by a revised edition, or
- amended.

222

INTRODUCTION

223 A variety of piezoelectric materials are used for surface acoustic wave (SAW) filter and
224 resonator applications. Prior to an IEC meeting in 1996 in Rotterdam, wafer specifications were
225 typically negotiated between users and suppliers. During this meeting, a proposal was
226 announced to address wafer standardization. This standard has been prepared in order to
227 provide industry standard technical specifications for manufacturing piezoelectric single crystal
228 wafers to be used in surface acoustic wave devices.

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

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

3 Terms and definitions

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

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

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 Single crystals for SAW wafer

3.1.1

as-grown synthetic quartz crystal

right-handed or left-handed single crystal quartz grown hydrothermally

Note 1 to entry: The term “as-grown” indicates a state prior to mechanical fabrication.

Note 2 to entry: See IEC 60758 for further information concerning crystalline quartz.

3.1.2

lithium niobate

LN

single crystals approximately described by chemical formula LiNbO_3 , grown by Czochralski (crystal pulling from melt) or other growing methods

3.1.3

lithium tantalate

LT

single crystals approximately described by chemical formula LiTaO_3 , grown by Czochralski (crystal pulling from melt) or other growing methods

3.1.4

lithium tetraborate

LBO

single crystals described by the chemical formula $\text{Li}_2\text{B}_4\text{O}_7$, grown by Czochralski (crystal pulling from melt), vertical Bridgman, or other growing methods

3.1.5

lanthanum gallium silicate

LGS

single crystals described by the chemical formula $\text{La}_3\text{Ga}_5\text{SiO}_{14}$, grown by Czochralski (crystal pulling from melt) or other growing methods

3.2 Terms and definitions related to LN and LT crystals

3.2.1

Curie temperature

T_c

phase transition temperature between ferroelectric and paraelectric phases measured by differential thermal analysis (DTA) or dielectric measurement

3.2.2

single domain

ferroelectric crystal with uniform electrical polarization throughout (for LN and LT)

Note 1 to entry: The polarization process is also referred to as "poling".

3.2.3

polarization process

electrical process used to establish a single domain crystal

3.2.4

reduction process

REDOX reaction to increase conductivity to reduce the harmful effects of pyroelectricity

3.2.5

reduced LN

LN treated with a reduction process

Note 1 to entry: Reduced LN is sometimes referred to as "black LN".

3.2.6

reduced LT

LT treated with a reduction process

Note 1 to entry: Reduced LT is sometimes referred to as "black LT".

3.2.7

transmittance

τ

the ratio of transmitted power through the sample to incident power on the sample, expressed in percent

3.2.8

lightness

L^*

the relative light-dark properties of the object surface

Note 1 to entry: In the CIE LAB colour space, L^* is the coordinates representing the lightness of the colour of the object.

3.2.9

colour difference

ΔE_{ab}^*

the difference in colour at different parts of the object surface

Note 1 to entry: In the CIE LAB colour space, ΔE_{ab}^* is the value representing the colour difference of different parts of the object surface.

3.3 Terms and definitions related to all crystals

3.3.1

lattice constant

length of unit cell along a major crystallographic axis measured by X-ray using the Bond method

3.3.2

congruent composition

chemical composition of a single crystal in a thermodynamic equilibrium with a molten solution of the same composition during the growth process

3.3.3

twin

two or more same single crystals which are combined together by the law of symmetrical plane or axis

Note 1 to entry: Twins exhibit symmetry that may be classified as reflection across a mirror plane (twin plane), rotation around an axis (twin axis), or inversion through a point (twin center).

Note 2 to entry: Optical twins (growth twins) and electrical twins (transformation twins) are the most relevant to SAW wafers. Optical twins arise from defects related to growth. Electrical twins may result from extreme conditions (temperature and pressure, for example) during processing.

3.4 Flatness

3.4.1

fixed quality area

FQA

central area of a wafer surface, defined by a nominal edge exclusion, X , over which the specified values of a parameter apply

Note 1 to entry: The boundary of the FQA is at all points (e.g. along wafer flats) the distance X away from the perimeter of the wafer of nominal dimensions as shown in Figure 1.

3.4.2

reference

plane

plane depending on the flatness measurement and which can be any of the following:

- for clamped measurements, the flat chuck surface that contacts the back surface of the wafer;
- for without clamped measurements, three points at specified locations on the front surface within the FQA;
- for without clamped measurements, the least-squares fit to the front surface using all measured points within the FQA.

3.4.3

site

square area on the front surface of the wafer with one side parallel to the OF

Note 1 to entry: Flatness parameters are assessed either globally for the FQA, or for each site individually.

3.4.4

thickness variation for five points

TV5

measure of wafer thickness variation defined as the maximum difference between five thickness measurements, measurement points are shown in Figure 1

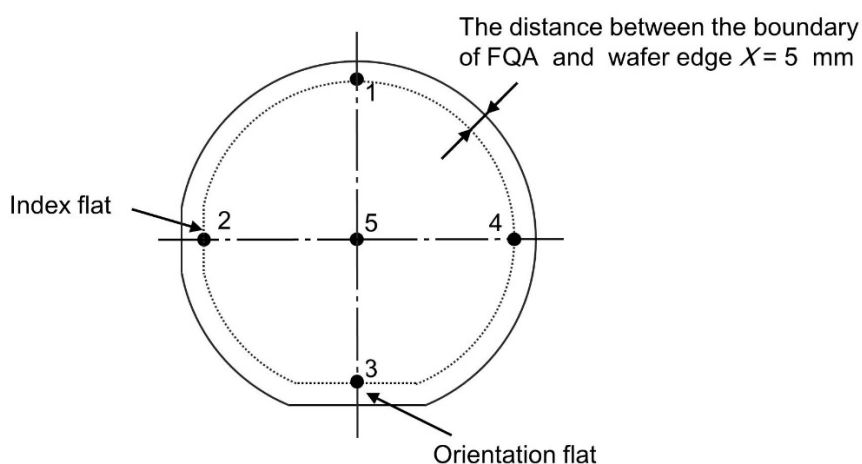


Figure 1 – Wafer sketch and measurement points for TV5 determination

Note 1 to entry: Through contact measurement and contactless point measurement, thickness and TV5 are measured at the centre of the wafer and at four peripheral points.

3.4.5

total thickness variation

TTV

difference between the maximum thickness and the minimum thickness

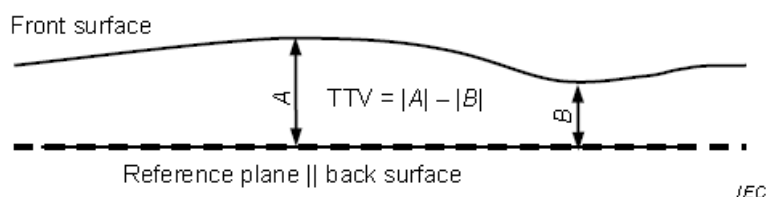


Figure 2 – Schematic diagram of TTV

Note 1 to entry: The maximum thickness is represented by the letter A and the minimum thickness is represented by the letter B in Figure 2.

Note 2 to entry: Measurement of TTV is performed under clamped conditions with the reference plane as defined in 3.4.2 a).

3.4.6

warp

maximum difference between a point on the front surface and a reference plane

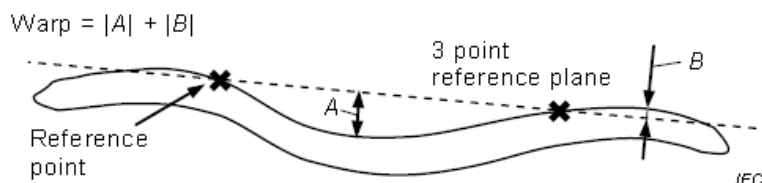


Figure 3 – Schematic diagram of warp

Note 1 to entry: Warp (shown in Figure 3) describes the deformation of an unclamped wafer.

Note 2 to entry: The reference plane is defined by 3-points as described in 3.4.2 b). Warp is a bulk property of a wafer and not of the exposed surface alone.

3.4.7

Sori

maximum difference between a point on the front surface and a reference plane

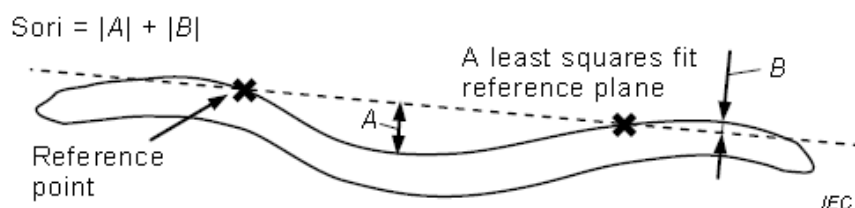


Figure 4 – Schematic diagram of Sori

Note 1 to entry: Sori describes the deformation of an unclamped wafer, as shown in Figure 4.

Note 2 to entry: In contrast to warp, in this case the reference plane is defined by a least-squares fit to the front surface (3.4.2 c)).

3.4.8

local thickness variation

LTV

variation determined by a measurement of a matrix of sites with defined edge dimensions