

---

---

Quartz crystal units of assessed quality - Part 1: Generic specification (IEC 60122-1:2002)

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN 60122-1:2004  
<https://standards.iteh.ai/catalog/standards/sist/a7ba8c9d-9fbb-464d-bde8-41a1b0356fb5/sist-en-60122-1-2004>

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN 60122-1:2004

<https://standards.iteh.ai/catalog/standards/sist/a7ba8c9d-9fbb-464d-bde8-41a1b0356fb5/sist-en-60122-1-2004>

EUROPEAN STANDARD

**EN 60122-1**

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2002

ICS 31.140

Supersedes EN 16800:1993 + A2:1998

English version

**Quartz crystal units of assessed quality**  
**Part 1: Generic specification**  
(IEC 60122-1:2002)

Résonateurs à quartz sous assurance  
de la qualité  
Partie 1: Spécification générique  
(CEI 60122-1:2002)

Schwingquarze mit bewerteter Qualität  
Teil 1: Fachgrundspezifikation  
(IEC 60122-1:2002)

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

This European Standard was approved by CENELEC on 2002-10-01. 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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

**CENELEC**

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

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

### Foreword

The text of document 49/551/FDIS, future edition 3 of IEC 60122-1, prepared by IEC TC 49, Piezoelectric and dielectric devices for frequency control and selection, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60122-1 on 2002-10-01.

This European Standard supersedes EN 168000:1993 + A2:1998.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2003-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2005-10-01

Annexes designated "normative" are part of the body of the standard.

In this standard, annex ZA is normative.

Annex ZA has been added by CENELEC.

---

## iTeh STANDARD PREVIEW Endorsement notice (standards.iteh.ai)

The text of the International Standard IEC 60122-1:2002 was approved by CENELEC as a European Standard without any modification.

[SIST EN 60122-1:2004](https://standards.iteh.ai/catalog/standards/sist/a7ba8c9d-9fbb-464d-bde8-41a1963506b5/sist-en-60122-1-2004)

<https://standards.iteh.ai/catalog/standards/sist/a7ba8c9d-9fbb-464d-bde8-41a1963506b5/sist-en-60122-1-2004>

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

- |                |      |  |
|----------------|------|--|
| IEC 60068-2-58 | NOTE | Harmonized as EN 60068-2-58:1999 (not modified). |
| IEC 60068-2-64 | NOTE | Harmonized as EN 60068-2-64:1994 (not modified). |

---

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60027	Series	Letter symbols to be used in electrical technology	HD 245	Series
IEC 60050-561	1991	International Electrotechnical Vocabulary (IEV) Chapter 561: Piezoelectric devices for frequency control and selection	-	-
IEC 60068-1	1988	Environmental testing Part 1: General and guidance	EN 60068-1 <sup>1)</sup>	1994
IEC 60068-2-1	1990	Part 2: Tests - Tests A: Cold	EN 60068-2-1	1993
IEC 60068-2-2	1974	Part 2: Tests - Test B: Dry heat	EN 60068-2-2 <sup>2)</sup>	1993
IEC 60068-2-3	1969	Part 2: Tests - Test Ca: Damp heat, steady state	HD 323.2.3 S2 <sup>3)</sup>	1987
IEC 60068-2-6 + corr. March	1995 1995	Part 2: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	1995
IEC 60068-2-7	1983	Part 2: Tests - Test Ga and guidance: Acceleration, steady state	EN 60068-2-7 <sup>4)</sup>	1993
IEC 60068-2-13	1983	Part 2: Tests - Test M: Low air pressure	EN 60068-2-13	1999
IEC 60068-2-14	1984	Part 2: Tests - Test N: Change of temperature	EN 60068-2-14 <sup>5)</sup>	1999
IEC 60068-2-17	1994	Part 2: Tests - Test Q: Sealing	EN 60068-2-17	1994

<sup>1)</sup> EN 60068-1 includes corrigendum October 1988 + A1:1992 to IEC 60068-1.

<sup>2)</sup> EN 60068-2-2 includes supplement A:1976 to IEC 60068-2-2.

<sup>3)</sup> HD 323.2.3 S2 includes A1:1984 to IEC 60068-2-3.

<sup>4)</sup> EN 60068-2-7 includes A1:1986 to IEC 60068-2-7.

<sup>5)</sup> EN 60068-2-14 includes A1:1986 to IEC 60068-2-14.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60068-2-20	1979	Part 2: Tests - Test T: Soldering	HD 323.2.20 S3 <sup>6)</sup>	1988
IEC 60068-2-21	1999	Part 2-21: Tests - Test U: Robustness of terminations and integral mounting devices	EN 60068-2-21	1999
IEC 60068-2-27	1987	Part 2: Tests - Test Ea and guidance: Shock	EN 60068-2-27	1993
IEC 60068-2-29 + corr.	1987	Part 2: Tests - Test Eb and guidance: Bump	EN 60068-2-29	1993
IEC 60068-2-30	1980	Part 2: Tests - Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle)	EN 60068-2-30 <sup>7)</sup>	1999
IEC 60068-2-32	1975	Part 2: Tests - Test Ed: Free fall	EN 60068-2-32 <sup>8)</sup>	1993
IEC 60068-2-45	1980	Part 2: Tests - Test Xa and guidance: Immersion in cleaning solvents	EN 60068-2-45	1992
IEC 60122-3	2001	Quartz crystal units of assessed quality Part 3: Standard outlines and lead connections	EN 60122-3	2001
IEC 60444-1	1986	Measurement of quartz crystal unit parameters by zero phase technique in a pi-network Part 1: Basic method for the measurement of resonance frequency and resonance resistance of quartz crystal units by zero phase technique in a pi-network	EN 60444-1	1997
IEC 60444-2	1980	Part 2: Phase offset method for measurement of motional capacitance of quartz crystal units	EN 60444-2	1997
IEC 60444-4	1988	Part 4: Method for the measurement of the load resonance frequency $f_L$ , load resonance resistance $R_L$ and the calculation of other derived values of quartz crystal units, up to 30 MHz	EN 60444-4	1997
IEC 60444-5	1995	Part 5: Methods for the determination of equivalent electrical parameters using automatic network analyzer techniques and error correction	EN 60444-5	1997
IEC 60444-6	1995	Part 6: Measurement of drive level dependence (DLD)	EN 60444-6	1997

<sup>6)</sup> HD 323.2.20 S3 includes A2:1987 to IEC 60068-2-20.

<sup>7)</sup> EN 60068-2-30 includes A1:1985 to IEC 60068-2-30.

<sup>8)</sup> EN 60068-2-32 includes A2:1990 to IEC 60068-2-32.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60617	Series	Graphical symbols for diagrams	EN 60617	Series
IEC 61178-2	1993	Quartz crystal units - A specification in the IEC Quality Assessment System for electronic Components (IECQ) Part 2: Sectional specification - Capability approval	-	-
IEC 61178-3	1993	Part 3: Sectional specification - Qualification approval	-	-
IEC QC 001001	2000	IEC Quality Assessment System for Electronic Components (IECQ)- Basic rules	-	-
IEC QC 001002-2	1998	IEC Quality Assessment System for Electronic Components (IECQ) - Rules of Procedure Part 2: Documentation	-	-
IEC QC 001002-3	1998	Part 3: Approval procedures	-	-
IEC QC 001005	2000	Register of firms, products and services approved under the IECQ system, including ISO 9000	-	-
ISO 1000	1992	SI units and recommendations for the use of their multiples and of certain other units	-	-

iTeH STANDARD PREVIEW  
(standards.iteh.ai)  
SIST EN 60122-1:2004  
<https://standards.iteh.ai/catalog/standards/sist/a7ba8c9d-9fbb-464d-bde8-41a1b0356fb5/sist-en-60122-1-2004>

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

SIST EN 60122-1:2004

<https://standards.iteh.ai/catalog/standards/sist/a7ba8c9d-9fbb-464d-bde8-41a1b0356fb5/sist-en-60122-1-2004>



NORME  
INTERNATIONALE  
INTERNATIONAL  
STANDARD

CEI  
IEC

60122-1

QC 680000

Troisième édition  
Third edition  
2002-08

---

---

Résonateurs à quartz sous assurance  
de la qualité –

Partie 1:  
Spécification générique

iTeh STANDARD PREVIEW

(standards.iteh.ai)  
Quartz crystal units of assessed quality –

Part 1: [SIST EN 60122-1:2004](https://standards.iteh.ai/catalog/standards/sist/a7ba8c9d-9fbb-464d-bde8-41a1b05501b5/sist-cf-60122-1-2004)

<https://standards.iteh.ai/catalog/standards/sist/a7ba8c9d-9fbb-464d-bde8-41a1b05501b5/sist-cf-60122-1-2004>  
Generic specification

© IEC 2002 Droits de reproduction réservés — Copyright - all rights reserved

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'éditeur.

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 the publisher.

International Electrotechnical Commission, 3, rue de Varembe, PO Box 131, CH-1211 Geneva 20, Switzerland  
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: [inmail@iec.ch](mailto:inmail@iec.ch) Web: [www.iec.ch](http://www.iec.ch)



Commission Electrotechnique Internationale  
International Electrotechnical Commission  
Международная Электротехническая Комиссия

CODE PRIX  
PRICE CODE

W

Pour prix, voir catalogue en vigueur  
For price, see current catalogue

## CONTENTS

FOREWORD .....	9
1 General .....	13
1.1 Scope .....	13
1.2 Normative references .....	13
1.3 Order of precedence .....	17
2 Terminology and general requirements .....	17
2.1 General .....	17
2.2 Terms, definitions and classification of phenomena .....	17
2.3 Preferred ratings and characteristics .....	47
2.3.1 Temperature ranges in degrees Celsius (°C) suitable for ambient operation .....	47
2.3.2 Elevated temperature ranges in degrees Celsius (°C) suitable for oven control .....	47
2.3.3 Frequency tolerance ( $1 \times 10^{-6}$ ) .....	47
2.3.4 Circuit conditions .....	47
2.3.5 Levels of drive .....	47
2.3.6 Drive level dependency .....	49
2.3.7 Climatic category .....	49
2.3.8 Bump severity .....	49
2.3.9 Vibration severity .....	51
2.3.10 Shock severity .....	51
2.3.11 Leak rate .....	51
2.4 Marking .....	51
3 Quality assessment procedures .....	53
3.1 Primary stage of manufacture .....	53
3.2 Structurally similar components .....	53
3.3 Subcontracting .....	53
3.4 Manufacturer's approval .....	53
3.5 Approval procedures .....	53
3.5.1 General .....	53
3.5.2 Capability approval .....	53
3.5.3 Qualification approval .....	55
3.6 Procedures for capability approval .....	55
3.6.1 General .....	55
3.6.2 Eligibility for capability approval .....	55
3.6.3 Application for capability approval .....	55
3.6.4 Granting of capability approval .....	55
3.6.5 Capability manual .....	55
3.7 Procedures for qualification approval .....	55
3.7.1 General .....	55
3.7.2 Eligibility for qualification approval .....	55
3.7.3 Application for qualification approval .....	57
3.7.4 Granting of qualification approval .....	57
3.7.5 Quality conformance inspection .....	57
3.8 Test procedures .....	57
3.9 Screening requirements .....	57

3.10	Rework and repair work .....	57
3.10.1	Rework .....	57
3.10.2	Repair work .....	57
3.11	Certified records of released lots .....	57
3.12	Validity of release .....	57
3.13	Release for delivery .....	59
3.14	Unchecked parameters .....	59
4	Test and measurement procedures .....	59
4.1	General .....	59
4.2	Alternative test methods .....	59
4.3	Precision of measurement .....	59
4.4	Standard conditions for testing .....	59
4.5	Visual inspection .....	61
4.5.1	Visual test A .....	61
4.5.2	Visual test B .....	61
4.5.3	Visual test C .....	61
4.6	Dimensioning and gauging procedures .....	61
4.6.1	Dimensions, test A .....	61
4.6.2	Dimensions, test B .....	61
4.7	Electrical test procedures .....	61
4.7.1	Frequency and resonance resistance .....	61
4.7.2	Drive level dependency .....	61
4.7.3	Frequency and resonance resistance as a function of temperature .....	63
4.7.4	Unwanted responses .....	63
4.7.5	Shunt capacitance .....	63
4.7.6	Load resonance frequency and resistance .....	65
4.7.7	Frequency pulling range ( $f_{L1}$ , $f_{L2}$ ) .....	65
4.7.8	Motional parameters .....	65
4.7.9	Insulation resistance .....	65
4.8	Mechanical and environmental test procedures .....	65
4.8.1	Robustness of terminations (destructive) .....	65
4.8.2	Sealing tests (non-destructive) .....	67
4.8.3	Soldering (solderability and resistance to soldering heat) (destructive) .....	71
4.8.4	Rapid change of temperature, two-fluid bath method (non-destructive) .....	71
4.8.5	Rapid change of temperature with prescribed time of transition (non-destructive) .....	71
4.8.6	Bump (destructive) .....	71
4.8.7	Vibration (destructive) .....	73
4.8.8	Shock (destructive) .....	73
4.8.9	Free fall (destructive) .....	73
4.8.10	Acceleration, steady state (non-destructive) .....	73
4.8.11	Dry heat (non-destructive) .....	73
4.8.12	Damp heat, cyclic (destructive) .....	73
4.8.13	Cold (non-destructive) .....	73
4.8.14	Climatic sequence (destructive) .....	75
4.8.15	Damp heat, steady state (destructive) .....	75
4.8.16	Immersion in cleaning solvents (non-destructive) .....	75

4.9	Endurance test procedure.....	75
4.9.1	Ageing (non-destructive).....	75
4.9.2	Extended ageing (non-destructive).....	77
	Bibliography.....	79
	Figure 1 – Symbol and equivalent electrical circuit of a piezoelectric resonator.....	21
	Figure 2 – Impedance $ Z $ , resistance $R_e$ , reactance $X_e$ , series arm reactance $X_1$ of a piezoelectric resonator as a function of frequency.....	27
	Figure 3 – Impedance and admittance diagram of a piezoelectric resonator.....	29
	Figure 4 – Resonance, anti-resonance and load resonance frequencies.....	31
	Figure 5 – Equivalent circuit of a piezoelectric resonator with a series (load) capacitance $C_L$ .....	45
	Figure 6 – Terminal bend test tool.....	69
	Table 1 – List of symbols used for the equivalent electric circuit of a piezoelectric resonator.....	37
	Table 2 – Solutions for the various characteristic frequencies.....	41
	Table 3 – Minimum values for the ratio $Q^2/r$ to be expected for various types of piezoelectric resonators.....	41
	Table 4 – Approximate relations between the characteristic frequencies and the series resonance frequency $f_s$ of a piezoelectric resonator.....	43

(standards.iteh.ai)

SIST EN 60122-1:2004

<https://standards.iteh.ai/catalog/standards/sist/a7ba8c9d-9fbb-464d-bde8-41a1b0356fb5/sist-en-60122-1-2004>

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## QUARTZ CRYSTAL UNITS OF ASSESSED QUALITY –

## Part 1: Generic specification

## FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60122-1 has been prepared by IEC technical committee 49: Piezoelectric and dielectric devices for frequency control and selection.

This third edition of IEC 60122-1 cancels and replaces IEC 61178-1 published in 1993 and IEC 60302 published in 1969 and constitutes their technical revision.

International Standard IEC 60122-1 is the first part of a new edition of the IEC standard series for quartz crystal units of assessed quality.

The text of this standard is based on the following documents:

FDIS	Report on voting
49/551/FDIS	49/558/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 3.