IEC 60122-4

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Quartz crystal units of assessed quality –
Part 4: Crystal units with thermistors

Résonateurs à quartz sous assurance de la qualité –
Partie 4: Résonateurs à quartz équipés de thermistances

IEC 60122-4:2019-01(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

QUARTZ CRYSTAL UNITS OF ASSESSED QUALITY –

Part 4: Crystal units with thermistors

FOREWORD

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

CDV	Report on voting
49/1281/CDV	49/1291/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60122 series, published under the general title *Quartz crystal units of assessed quality*, 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 "http://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- withdrawn,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.

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QUARTZ CRYSTAL UNITS OF ASSESSED QUALITY –

Part 4: Crystal units with thermistors

1 Scope

This part of IEC 60122 is applicable to crystal units with thermistors mainly used in the field of mobile communication that requires high frequency stability such as local reference signal generator for the mobile phone base station or GPS. This document provides users with technical guidelines of crystal units with thermistors as well as basic knowledge of common crystal units with thermistors.

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 60068 (all parts), *Environmental testing*

IEC 60122-1:2002, *Quartz crystal units of assessed quality – Part 1: Generic specification*
IEC 60122-1:2002/AMD1:2017

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 crystal units for microprocessor clock supply*

IEC 60444-1, *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*

IEC 60444-5, *Measurement of quartz crystal unit parameters – Part 5: Methods for the determination of equivalent electrical parameters using automatic network analyzer techniques and error correction*

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

IEC 60539-1:2016, *Directly heated negative temperature coefficient thermistors – Part 1: Generic specification*

IEC 60617 (all parts), *Graphical symbols for diagrams* (available at http://std.iec.ch/iec60617)

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

ISO 80000-1:2009, *Quantities and units – Part 1: General*

3 Terms, definitions, units and symbols

For the purposes of this document, the terms and definitions given in IEC 60027 (all parts), IEC 60050-561, IEC 60617, IEC 63041-1 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 Terms and definitions

3.1.1
FT curve coefficient
coefficient of first, second and third order frequency temperature characteristic curve

3.1.2
residual frequency stability slope
temperature differential of difference between actual FT data and calculated FT value

3.1.3
normal zero-power resistance
normal value at the standard reference temperature of 25 °C, unless otherwise specified

[SOURCE: IEC 60539-1: 2016, 3.19]

3.1.4
B-value
index of the thermal sensitivity

[SOURCE: IEC 60539-1: 2016, 3.22]

3.2 Units and symbols

Crystal units with thermistors covered in this document are those used for the high stability signal generator. For the purposes of this document, units and letter symbols shall, wherever possible, be taken from the following standards: IEC 60027, IEC 60050-561, IEC 60617, IEC 63041-1 and ISO 80000-1:2009.

4 Specifications

4.1 General

Crystal units with thermistors are used for the high stability signal generator. For example, a local reference signal generator is synchronized to the mobile phone base station, or a local reference signal generator for receiving a signal from satellite positioning system represented by Navigation Satellite System.

Characteristics related to crystal units shall follow IEC 60122-2-1, IEC 60444-1, IEC 60444-5, and IEC 60444-9.

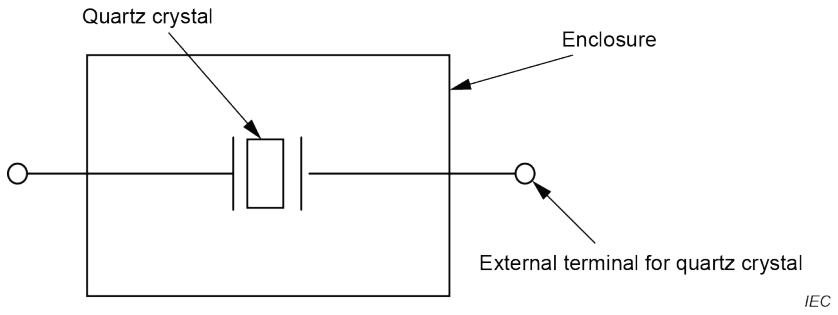
Environmental testing shall meet the requirements of IEC 60068 (all parts).

Concepts and specifications for the crystal units with thermistors are shown in detail in 4.2 to 4.4.

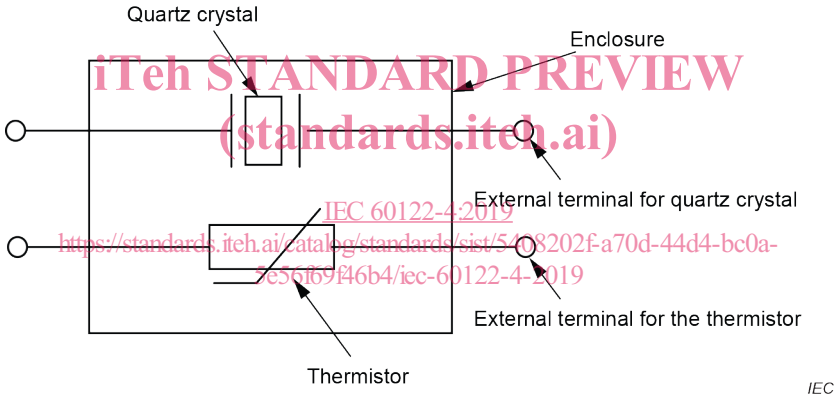
4.2 Structure of crystal units with thermistors

Quartz crystal and thermistor are placed inside or outside enclosures that are different from conventional crystal units.

And equipped with external terminal for quartz crystal and for thermistor (see Figure 1).



a) Conventional quartz crystal resonator units



b) Quartz crystal units with thermistors

Figure 1 – Block diagrams of the quartz crystal units

The effect of frequency stability using crystal units with the thermistors and actual structures are described in Annex A.

4.3 Handling of the thermistor

Thermistor position and fixing method shall be considered as follows:

– Damage for thermistor during handling.
– Fixation method considering solder heating experienced when the product is used.

4.4 Shipping requirements

The requirements listed below shall be specified upon agreement between the supplier and the user:

– First, second and third order FT curve coefficient.
– Residual frequency stability slope.
– Normal zero-power resistance.
– B-value.

5 Delivery conditions

Clause 3 of IEC 60122-1:2002 applies.

6 Quality and reliability

Clauses 4 of IEC 60122-1:2002 and IEC 60122-1/AMD1:2017 apply.

Annex A
(informative)

Effect of frequency stability using crystal units with thermistors

A.1 Object

The object of Annex A is to describe crystal units with thermistors in detail and the effect of frequency stability, and examples.

A.2 Comparison of conventional crystal units with crystal units with thermistors

Figure A.1 shows the conventional TCXO (temperature compensated crystal oscillator) with crystal units and thermistor. In the figure, crystal unit and thermistor on the PCB are described.

The thermistor gives a voltage according to ambient temperature that is converted from analogue to digital data. The digital data will pick up the voltage data from the pre-set memory. The voltage data will convert to analogue voltage and control VCXO to compensate frequency. Accuracy of compensation will be better if the thermistor provides voltage that corresponds as much as possible to the actual crystal temperature.

However, in this structure, temperature difference between the crystal blank and thermistor is large due to the different positions of each part. The temperatures of crystal blank and thermistor are mainly dependent on the position of other parts on the PCB that generate heat. Due to this temperature difference, compensated frequency stability is not small.

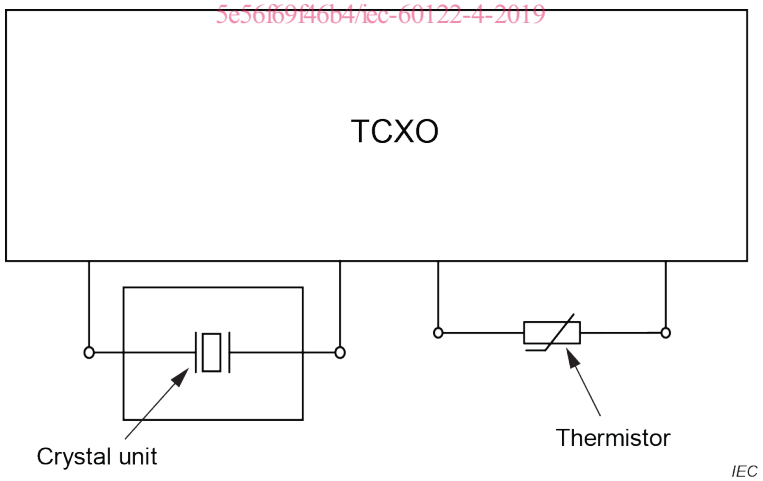


Figure A.1 – Conventional crystal oscillator with thermistor

Figure A.2 shows crystal units with thermistors on PCB.

The frequency compensation system is the same as that shown in Figure 1, but it is distinguished to use crystal units with thermistors.

In this structure, thermistors are placed near the crystal because the temperature difference between crystal blank and thermistor is small. This small difference in temperature between the crystal blank and thermistor leads to small compensated frequency stability.

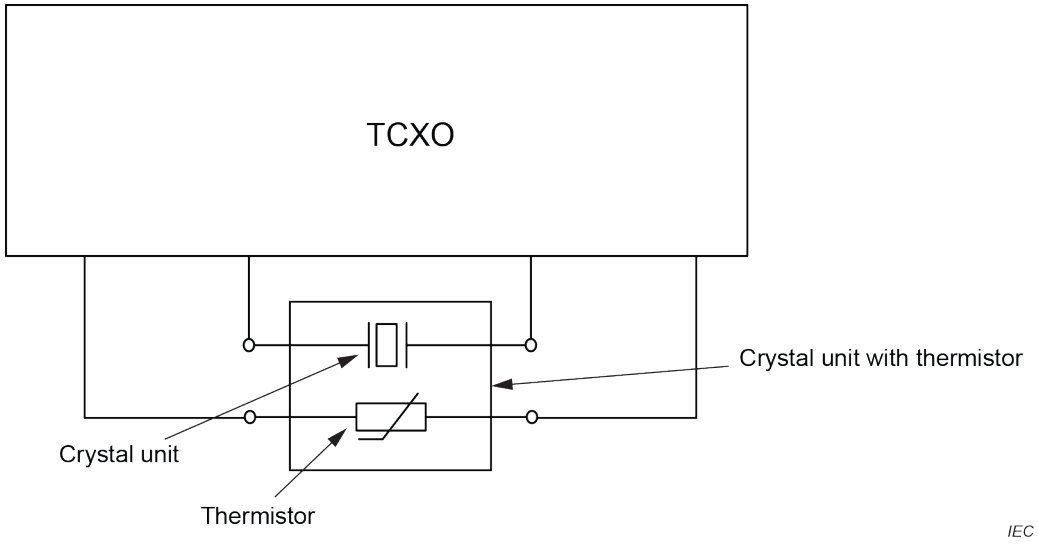


Figure A.2 – Conceptual diagram for crystal units with thermistors

A.3 Verification test of crystal units with thermistors

A.3.1 Test condition

Crystal units with thermistors and a thermistor are mounted on a test PCB. Put the test PCB in oven and measure frequency, thermistor resistance inside crystal, and thermistor resistance on PCB by changing temperature from -30 °C to 90 °C. (Figure A.3).

Temperature ramp-up conditions are given below:

– Test 1: Thermistor resistance is taken from crystal units with thermistors; ramp-up speed is 0,2 °C/min. This ramp-up speed is slow and that will not give temperature difference between crystal and thermistor.
– Test 2: Thermistor resistance is taken from a thermistor mounted on a test PCB; ramp-up speed is 5 °C /min, that is 25 times faster than test 1.
– Test 3: Thermistor resistance is taken from crystal units with thermistors; ramp-up speed is 5 °C /min, that is 25 times faster than test 1.