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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by the Quartz Crystal Industry Association of Japan (QIAJ)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS C 6703:2002** is replaced with this Standard.

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Crystal filters

Introduction

This Japanese Industrial Standard has been prepared based on the fourth edition of **IEC 60368-1** published in 2000 and Amendment 1 published in 2004 with some modifications of the technical contents. The contents of Amendment 1 have been compiled and incorporated into this Standard.

The portions given dotted underlines are the matters in which the contents of the original International Standard have been modified. A list of modifications with the explanations is given in Annex JA.

1 General

1.1 Scope

This Standard is the generic specification of crystal filters and specifies the test methods and general requirements for crystal filters. This Standard is applicable for capacity approval and/or qualification approval procedure(s) based on **IEC** Quality Assessment System for Electronic Components (IECQ).

NOTE 1 This Standard specifies the characteristics of crystal filters; however, specifications concerning characteristics thereof essentially show general specification, therefore it is not intended to perform conformity assessment with this Standard.

NOTE 2 The International Standard corresponding to this Standard is as follows.
IEC 60368-1:2000 Piezoelectric filters of assessed quality—Part 1: Generic specification and Amendment 1:2004 (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

1.2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For the standards with the indication of year, only the edition of the indicated year shall be applied but not any revisions made thereafter (including amendments). For those with no indication of year, the most recent edition (including amendments) shall be applied.

JIS C 0025 *Basic environmental testing procedures Part 2: Tests Test N: Change of temperature*

NOTE : Corresponding International Standard: IEC 60068-2-14:1984 *Environmental testing—Part 2: Tests—Test N: Change of temperature* (MOD)

JIS C 6701:2007 *Generic specification of quartz crystal units*

NOTE : Corresponding International Standard: IEC 60122-1:2000 *Quartz crystal units of assessed quality—Part 1: Generic specification* (IDT)

JIS C 60068-1 *Environmental testing Part 1: General and guidance*

NOTE : Corresponding International Standard: IEC 60068-1 : 1988 *Environmental testing—Part 1: General and guidance* (IDT)

JIS C 60068-2-1 *Environmental testing procedures Part 2: Tests, Tests A: Cold*

NOTE : Corresponding International Standard: IEC 60068-2-1 : 1990 *Environmental testing—Part 2: Tests—Tests A: Cold* (IDT)

JIS C 60068-2-2 *Basic environmental testing procedures Part 2: Tests, Test B: Dry heat*

NOTE : Corresponding International Standard: IEC 60068-2-2 : 1974 *Environmental testing—Part 2: Tests—Tests B: Dry heat* (IDT)

JIS C 60068-2-3 *Basic environmental testing procedures Part 2: Tests, Test Ca: Damp heat, steady state*

NOTE : Corresponding International Standard: IEC 60068-2-3 : 1969 *Environmental testing—Part 2: Tests—Test Ca: Damp heat, steady state* (IDT)

JIS C 60068-2-6 *Environmental testing Part 2: Tests—Test Fc: Vibration (sinusoidal)*

NOTE : Corresponding International Standard: IEC 60068-2-6 : 1995 *Environmental testing—Part 2: Tests—Test Fc: Vibration (sinusoidal)* (IDT)

JIS C 60068-2-7 *Basic environmental testing procedures Part 2: Tests—Test Ga and guidance: Acceleration, steady state*

NOTE : Corresponding International Standard: IEC 60068-2-7 : 1983 *Environmental testing—Part 2: Tests—Test Ga and guidance: Acceleration steady state* (IDT)

JIS C 60068-2-13 *Basic environmental testing procedures Part 2: Tests, Test M: Low air pressure*

NOTE : Corresponding International Standard: IEC 60068-2-13 : 1983 *Environmental testing—Part 2: Tests—Test M: Low air pressure* (IDT)

JIS C 60068-2-17 *Basic environmental testing procedures—Part 2: Tests—Test Q: Sealing*

NOTE : Corresponding International Standard: IEC 60068-2-17 : 1994 *Basic environmental testing procedures—Part 2: Tests—Test Q: Sealing* (IDT)

JIS C 60068-2-20 *Basic environmental testing procedures Part 2: Tests, Test T: Soldering*

NOTE : Corresponding International Standard: IEC 60068-2-20 : 1979 *Environmental testing—Part 2: Tests—Test T: Soldering* (IDT)

JIS C 60068-2-21 *Environmental testing—Part 2-21: Tests—Test U: Robustness of termination and integral mounting devices*

NOTE : Corresponding International Standard: IEC 60068-2-21 : 1999 *Environmental testing—Part 2-21: Tests—Test U: Robustness of terminations and integral mounting devices* (MOD)

JIS C 60068-2-27 *Basic environmental testing procedures Part 2: Tests, Test Ea and guidance: Shock*

- NOTE : Corresponding International Standard: IEC 60068-2-27:1987 *Environmental testing—Part 2: Tests—Test Ea and guidance: Shock* (IDT)
- JIS C 60068-2-29 *Basic environmental testing procedures Part 2: Tests Test Eb and guidance: Bump*
- NOTE : Corresponding International Standard: IEC 60068-2-29:1987 *Environmental testing—Part 2: Tests—Test Eb and guidance: Bump* (IDT)
- JIS C 60068-2-30 *Basic environmental testing procedures Part 2: Tests Test Db: Damp heat, cyclic (12 + 12-Hour cycle)*
- NOTE : Corresponding International Standard: IEC 60068-2-30:1980 *Environmental testing—Part 2: Tests—Test Db and guidance: Damp heat cyclic (12+12-hour cycle)* (IDT)
- JIS C 60068-2-32 *Environmental testing Part 2: Tests. Test Ed: Free fall*
- NOTE : Corresponding International Standard: IEC 60068-2-32:1975 *Environmental testing—Part 2: Tests—Test Ed: Free fall (Procedure 1)* (IDT)
- JIS C 60068-2-45 *Environmental testing procedures of electronic and electrical resistance to solvents (immersion in cleaning solvents)*
- NOTE : Corresponding International Standard: IEC 60068-2-45:1980 *Environmental testing—Part 2: Tests—Test XA and guidance: Immersion in cleaning solvents* (IDT)
- JIS C 60068-2-52 *Environmental testing—Part 2: Tests—Test Kb: Salt mist, cyclic (sodium, chloride solution)*
- NOTE : Corresponding International Standard: IEC 60068-2-52:1996 *Environmental testing—Part 2: Tests—Test Kb: Salt mist, cyclic (sodium chloride solution)* (IDT)
- JIS C 60068-2-58 *Environmental testing—Part 2: Tests—Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*
- NOTE : Corresponding International Standard: IEC 60068-2-58:1999 *Environmental testing—Part 2-58: Tests—Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)* (MOD)
- JIS C 60068-2-64 *Environmental testing Part 2: Test methods—Test Fh: Vibration, broad-band random (digital control) and guidance*
- NOTE : Corresponding International Standard: IEC 60068-2-64:1993 *Environmental testing—Part 2: Test methods—Test Fh: Vibration, broad-band random (digital control) and guidance* (IDT)
- JIS C 61000-4-2 *Electromagnetic compatibility (EMC)—Part 4: Testing and measurement techniques—Section 2: Electrostatic discharge immunity test*
- NOTE : Corresponding International Standard: IEC 61000-4-2:1995 *Electromagnetic compatibility (EMC)—Part 4: Testing and measurement techniques—Section 2: Electrostatic discharge immunity test. Basic EMC Publication, Amendment 1 (1998)* (IDT)

JIS Z 2911 *Methods of test for fungus resistance*

NOTE : Corresponding International Standard: IEC 60068-2-10 : 1988 *Environmental testing—Part 2: Tests—Test J and guidance: Mould growth (MOD)*

JIS Z 8203 *SI units and recommendations for the use of their multiples and of certain other units*

NOTE : Corresponding International Standard: ISO 1000 : 1992 *SI units and recommendations for the use of their multiples and of certain other units (IDT)*

IEC 60027-1 *Letter symbols to be used in electrical technology—Part 1: General*

IEC 60368-4 *Piezoelectric filters of assessed quality—Part 4: Sectional specification—Capability approval*

IEC 60642 : 1979 *Piezoelectric ceramic resonators and resonator units for frequency control and selection—Chapter I: Standard values and conditions—Chapter II: Measuring and test conditions*

IECQ 01 : 2003 *IEC Quality Assessment System for Electronic Components (IECQ)—Basic Rules*

IECQ 001002-2 : 1998 *IEC Quality Assessment System for Electronic Components (IECQ)—Rules of Procedure—Part 2: Documentation*

IECQ 001002-3 : 2005 *IEC Quality Assessment System for Electronic Components (IECQ)—Rules of Procedure—Part 3: Approval Procedures*

1.3 Order of precedence

Where any discrepancies occur for any reason, standards and agreements shall rank in the following order of precedence.

- the agreement between the parties concerned with delivery
- the sectional specification (**IEC 60368-4**)
- the generic specification (this Standard)
- any other referred international standards and the like (for example, **IEC Standards**)

2 Terminology and general requirements

2.1 General

Units, graphical symbols and letter symbols shall be in accordance with the following standards.

- **JIS C 6701**
- **JIS Z 8203**
- **IEC 60027-1**
- **IEC 60642**

2.2 Terms and definitions

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

2.2.1 crystal filter

an electrical filter composed of one or more crystal resonators made from crystals

2.2.2 **band-pass filter**

a filter having a single pass-band between two specified stop-bands

2.2.3 **band-stop filter**

a filter having a single stop-band between two specified pass-bands

2.2.4 **high-pass filter**

a filter having a single pass-band above a cut-off frequency and a stop-band for lower frequencies

2.2.5 **low-pass filter**

a filter having a single pass-band below a cut-off frequency and a stop-band for higher frequencies

2.2.6 **comb filter**

a two terminal pair filter in which there are five or more bands of which two or more are pass-bands and two or more are stop-bands

2.2.7 **monolithic filter**

a filter with at least one monolithic multiple pole resonator (see figure 1)

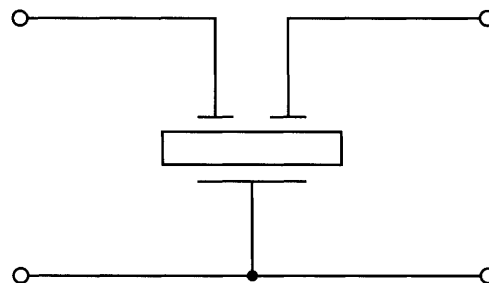


Figure 1 Symbol of monolithic filter

2.2.8 **tandem monolithic filter**

a filter made by electrically connecting at least two monolithic multiple pole resonators (see figure 2)

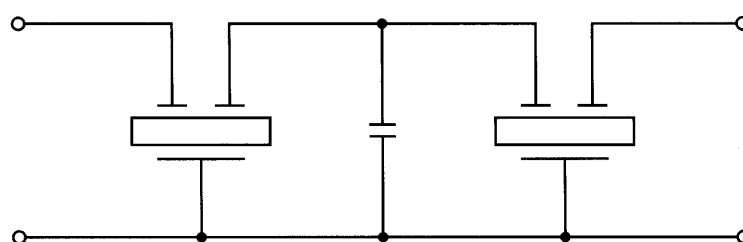


Figure 2 Symbol of tandem monolithic filter

2.2.9 monolithic multiple pole resonator

a crystal resonator with at least two mechanically coupled vibrating regions on a single crystal element (see figure 3)

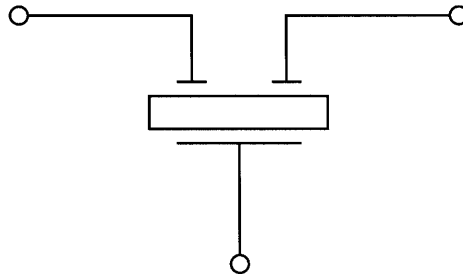


Figure 3 Symbol of monolithic multiple pole resonator

2.2.10 input level

the power, voltage or current value presented to the input terminal pair of a crystal filter

2.2.11 output level

the power, voltage or current value delivered to the load circuit of a crystal filter

2.2.12 rated level

the power, voltage or current value at which the characteristics of a crystal filter are specified

2.2.13 maximum level

the power, voltage or current value above which unacceptable distortion of the signal or irreversible changes may occur in a crystal filter

2.2.14 available power

the maximum power which may be obtained from a given source by suitable adjustment of the load impedance

2.2.15 input impedance

the impedance presented by a crystal filter to the signal source when terminated in the specified load impedance

2.2.16 output impedance

the impedance presented by a crystal filter to the load when its input is connected to the specified source impedance

2.2.17 terminating impedance

the impedance presented to a crystal filter by its load or by its source

2.2.18 cut-off frequency

a frequency of the pass-band at which the relative attenuation of a crystal filter reaches a specified value

2.2.19 mid-band frequency (of a band-pass or band-stop filter)

the geometric mean of the cut-off frequencies limiting a single pass-band or single stop-band

NOTE : In practice, the arithmetic mean is often used as a good approximation to the geometric mean for crystal filters with relatively narrow pass-bands or stop-bands.

2.2.20 nominal frequency (of a crystal filter)

the frequency used to identify a crystal filter

2.2.21 pass-band

a band of frequencies in which the relative attenuation of a crystal filter is equal to or less than a specified value

2.2.22 pass bandwidth

the separation of frequencies between which the attenuation of a crystal filter shall be equal to or less than a specified value

2.2.23 stop band

a band or frequencies in which the relative attenuation of a crystal filter is equal to or greater than specified values

2.2.24 stop bandwidth

the separation of frequencies between which the relative attenuation of a crystal filter shall be equal to a specified value

2.2.25 transition band

a band or frequencies between a cut-off frequency and the nearest point of the adjacent stop-band

2.2.26 envelope delay time

the time of propagation of a certain characteristic of a signal envelope between two points, for a certain frequency

2.2.27 phase delay time

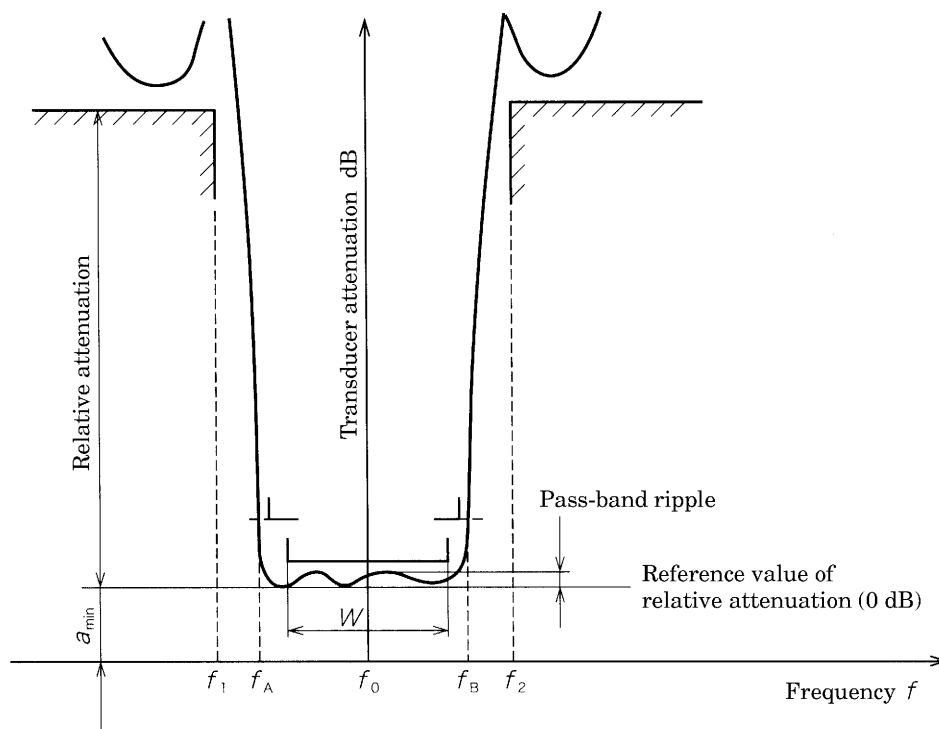
the time of propagation of a sinusoidal oscillation of a certain frequency between two points

2.2.28 group delay

the time equal to the first derivative of the phase shift, in radians, with respect to the angular frequency

2.2.29 transducer attenuation (of a filter)

the ratio, generally expressed in decibels, of the available power of a given source to the power that the filter connected to this source delivers to a load impedance under specified conditions (see figure 4)



$$f_0 = \sqrt{f_A \times f_B}$$

or

$$f_0 = \frac{f_A + f_B}{2}$$

where, f_A, f_B : cut-off frequencies of pass-band
 f_0 : mid-band frequency

W : frequency range for which pass-band attenuation deviation is specified

f_1, f_2 : upper limit frequency and lower limit frequency of stop band

$a_{\min}$: minimum transducer attenuation

Figure 4 Transducer attenuation characteristics of a filter

2.2.30 insertion attenuation (of a filter)

the ratio, generally expressed in decibels, of the power delivered to the load impedance before insertion of the filter to the power delivered to the load impedance after insertion of the filter

2.2.31 insertion phase shift

change in phase caused by the insertion of a filter into a transmission system

2.2.32 transducer phase

the phase difference between the output of a given filter with a specified load impedance and the source connected to its input

2.2.33 modulus of the reflection coefficient

a dimensionless measure of the degree of mismatch between two impedances Z_a and Z_b given by the following formula