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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal of establishing a Japanese Industrial Standard from Reliability Center for Electronic Components of Japan (RCJ)/Japanese Standards Association (JSA), with a draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

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JIS C 60068-2 consists of the following 48 parts;

- JIS C 60068-2-1 *Environmental testing procedures Part 2: Tests, Tests A: Cold*
- JIS C 60068-2-2 *Basic environmental testing procedures Part 2: Tests, Test B: Dry heat*
- JIS C 60068-2-3 *Basic environmental testing procedures Part 2: Tests, Test Ca: Damp heat, steady state*
- JIS C 60068-2-6 *Environmental testing Part 2: Tests—Test Fc: Vibration (sinusoidal)*
- JIS C 60068-2-7 *Basic environmental testing procedures Part 2: Tests—Test Ga and guidance: Acceleration, steady state*
- JIS C 60068-2-11 *Basic environmental testing procedures Part 2: Tests—Test Ka: Salt mist*
- JIS C 60068-2-13 *Basic environmental testing procedures Part 2: Tests, Test M: Low air pressure*
- JIS C 60068-2-17 *Basic environmental testing procedures—Part 2: Tests—Test Q: Sealing*
- JIS C 60068-2-18 *Environmental testing—Part 2-18: Tests—Test R and guidance: Water*
- JIS C 60068-2-20 *Basic environmental testing procedures Part 2: Tests, Test T: Soldering*
- JIS C 60068-2-21 *Environmental testing—Part 2-21: Tests—Test U: Robustness of termination and integral mounting devices*
- JIS C 60068-2-27 *Basic environmental testing procedures Part 2: Tests, Test Ea and guidance: Shock*
- JIS C 60068-2-28 *Environmental testing, Part 2: Tests—Guidance for damp heat tests*
- JIS C 60068-2-29 *Basic environmental testing procedures Part 2: Tests Test Eb and guidance: Bump*
- JIS C 60068-2-30 *Basic environmental testing procedures Part 2: Tests Test Db: Damp heat, cyclic (12 + 12-Hour cycle)*
- JIS C 60068-2-31 *Environmental testing Part 2: Tests, Test Ec: Drop and topple, primarily for equipment-type specimens*
- JIS C 60068-2-32 *Environmental testing Part 2: Tests, Test Ed: Free fall*
- JIS C 60068-2-38 *Basic environmental testing procedures Part 2: Tests Test Z/AD: Composite temperature/humidity cyclic test*
- JIS C 60068-2-39 *Environmental testing—Part 2: Tests, Test Z/AMD: Combined sequential cold, low air pressure, and damp heat test*
- JIS C 60068-2-40 *Environmental testing Part 2: Tests, Test Z/AM: Combined cold/low air pressure tests*
- JIS C 60068-2-41 *Environmental testing Part 2: Tests, Test Z/BM: Combined dry heat/low air pressure tests*
- JIS C 60068-2-42 *Basic environmental testing procedures Part 2: Tests Test Kc: Sulphur dioxide test for contacts and connections*

- JIS C 60068-2-43 *Basic environmental testing procedures Part 2: Tests Test Kd: Hydrogen sulphide test for contacts and connections*
- JIS C 60068-2-45 *Environmental testing procedures of electronic and electrical resistance to solvents (immersion in cleaning solvents)*
- JIS C 60068-2-46 *Basic environmental testing procedures Part 2: Tests Guidance to Test Kd: Hydrogen sulphide test for contacts and connections*
- JIS C 60068-2-47 *Environmental testing—Part 2-47: Test methods—Mounting of components, equipment and other articles for vibration, impact and similar dynamic tests*
- JIS C 60068-2-48 *Environmental testing—Part 2: Tests. Guidance on the application of the tests of JIS environmental testing series to simulate the effects of storage*
- JIS C 60068-2-49 *Basic environmental testing procedures Part 2: Tests Guidance to Test Kc: Sulphur dioxide test for contacts and connections*
- JIS C 60068-2-50 *Basic environmental testing procedures Part 2: Tests Tests Z/AFc: Combined cold/vibration (sinusoidal) tests for both heat-dissipating and non-heat-dissipating specimens*
- JIS C 60068-2-51 *Basic environmental testing procedures Part 2: Tests Tests Z/BFc: Combined dry heat/vibration (sinusoidal) tests for both heat-dissipating and non-heat-dissipating specimens*
- JIS C 60068-2-52 *Environmental testing—Part 2: Tests—Test Kb: Salt mist, cyclic (sodium, chloride solution)*
- JIS C 60068-2-53 *Basic environmental testing procedures Part 2: Tests Guidance to tests Z/AFc and Z/BFc: Combined temperature (cold and dry heat) and vibration (sinusoidal) tests*
- JIS C 60068-2-54 *Environmental testing Part 2: tests. Test Ta: Soldering. Solderability testing by the wetting balance method*
- JIS C 60068-2-56 *Environmental testing Part 2: Tests. Test Cb: Damp heat, steady state, primarily for equipment*
- JIS C 60068-2-57 *Environmental testing—Electrotechnical products—Time-history vibration test method*
- 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)*
- JIS C 60068-2-59 *Environmental testing—Part 2: Test methods Test Fe: Vibration—Sine-beat method*
- JIS C 60068-2-60 *Environmental testing—Part 2: Tests—Test Ke: Flowing mixed gas corrosion test*
- JIS C 60068-2-61 *Environmental testing Part 2: Test methods Test Z/ABDM: Climatic sequence*
- JIS C 60068-2-64 *Environmental testing Part 2: Test methods—Test Fh: Vibration, broad-band random (digital control) and guidance*
- JIS C 60068-2-65 *Environmental testing—Part 2-65: Vibration, acoustically induced*
- JIS C 60068-2-66 *Environmental testing—Part 2: Test methods—Test Cx: Damp heat, steady state (unsaturated pressurized vapour)*
- JIS C 60068-2-67 *Environmental testing—Part 2: Tests—Test Cy: Damp heat, steady state, accelerated test primarily intended for components*
- JIS C 60068-2-68 *Environmental testing—Electrotechnical products—Dust and sand test*
- JIS C 60068-2-75 *Environmental testing—Part 2-75: Tests—Test Eh: Hammer tests*
- JIS C 60068-2-77 *Environmental testing—Part 2-77: Tests—Test 77: Body strength and impact shock*
- JIS C 60068-2-78 *Environmental testing—Part 2-78: Tests—Test Cab: Damp heat, steady state*
- JIS C 60068-2-81 *Environmental testing—Part 2-81: Shock—Shock response spectrum synthesis*

Environmental testing—Part 2-81 : Shock—Shock response spectrum synthesis

Introduction

This Japanese Industrial Standard has been prepared based on the first edition of **IEC 60068-2-81** published in 2003 without modifying the technical contents.

The portions given dotted underlines are the matters not stated in the original International Standard.

This part of **JIS C 60068**, designed for testing with a synthesized shock response spectrum (SRS) is intended for general application for components, equipment and other products, hereinafter referred to as “specimens”, when simulation of transient responses of a complex nature is required. The test method centres on the use of SRS and techniques associated with SRS.

The purpose of the test is to demonstrate the adequacy of the test specimen to resist the specified transient excitation, without unacceptable degradation of its functional and/or structural performance. It is particularly useful for tailoring shock responses where measured data are available from the operational environment. However, the test is applicable to any transient excitation within the limits of the testing apparatus.

The test method is based primarily on the use of an electrodynamic or a servo-hydraulic vibration generator with an associated computer-based control system used as a shock testing system.

Other shock testing machines may be used, provided they fulfil the requirements of this Standard.

It is emphasized that SRS synthesis testing always demands a certain degree of engineering judgement. Both supplier and purchaser should be fully aware of this fact. The writer of the relevant specification is expected to select the testing procedure and the values of severity appropriate to the specimen and its use.

1 Scope

This part of **JIS C 60068** specifies tests using a synthesized shock response spectrum (SRS). It is intended for general application to specimens when simulation of transient excitation of a complex nature is required.

NOTE : The International Standard corresponding to this part of **JIS C 60068** is as follows.

IEC 60068-2-81 : 2003 *Environmental testing—Part 2-81: Tests—Test Ei: Shock—Shock response spectrum synthesis* (IDT)

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**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of **JIS C 60068**. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 0153 *Glossary of terms used in mechanical vibration and shock*

NOTE : Corresponding International Standard: ISO 2041:1990 *Vibration and shock—Vocabulary* (MOD)

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 60068-2-6 *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 60068-2-27 *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 60068-2-47 *Environmental testing—Part 2-47: Test methods—Mounting of components, equipment and other articles for vibration, impact and similar dynamic tests*

NOTE : Corresponding International Standard: IEC 60068-2-47:1999 *Environmental testing—Part 2-47: Test methods—Mounting of components, equipment and other articles for vibration, impact and similar dynamic tests* (IDT)

JIS C 60068-2-57 *Environmental testing—Electrotechnical products—Time-history vibration test method*

NOTE : Corresponding International Standard: IEC 60068-2-57:1999 *Environmental testing—Part 2-57: Tests—Test Ff: Vibration—Time-history method* (IDT)

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)

ISO 266 *Acoustics—Preferred frequencies*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in **JIS B 0153**, **JIS C 60068-1**, **JIS C 60068-2-6**, **JIS C 60068-2-27**, **JIS C 60068-2-57** and **JIS C 60068-2-64**, together with the following definitions, apply.

3.1 -3 dB bandwidth

frequency bandwidth between two points in a frequency response function which is 0.707 of the maximum response when associated with a single resonance peak

3.2 critical damping

minimum viscous damping that will allow a displaced system to return to its initial position without oscillation in the shortest time possible

3.3 critical frequency

frequencies at which

- malfunctioning and/or deterioration of performance of the specimen which are dependent on vibration are exhibited, and/or
- mechanical resonances and/or other response effects occur, for example chatter

3.4 damping

generic term ascribed to the numerous energy dissipation mechanisms in a system

In practice, damping depends on many parameters, such as the structural system, mode of vibration, strain, applied forces, velocity, materials, joint slippage, etc.

3.5 damping ratio

ratio of actual damping to critical damping in a system with viscous damping

3.6 decibel, dB

relation between magnitudes written in a logarithmic form:

$$L = 20 \log_{10} \left(\frac{X}{X_0} \right) \text{ (dB)}$$

where

L : the logarithmic value (dB);

X/X_0 : the relation between magnitudes X and X_0

NOTE : See **1.58** and **1.59** of **JIS B 0153** for a more detailed definition.

3.7 fixing point

part of the specimen in contact with the fixture or vibration table at a point where the specimen is normally fastened in service

NOTE : If a part of the real mounting structure is used as the fixture, the fixing points are taken as those of the mounting structure and not of the specimen.

3.8 g_n

standard acceleration due to the earth's gravity, which itself varies with altitude and geographical latitude

NOTE 1 For the purposes of this Standard, the value of g_n is rounded up to the nearest whole number, that is, 10 m/s².

NOTE 2 Here g_n is described as is translated, although g_n is not used in Japan where SI unit system is adopted.

3.9 Hanning window

weighting function for time-histories that forces the start and the end of the time-history to a zero value in the selected time window

It has the shape of a cosine bell.

NOTE : See **ISO 18431-2** for a more detailed definition.

3.10 high-frequency asymptote, HFA

high-frequency asymptotic value of the SRS curve (see figure 3)

NOTE 1 The SRS high-frequency asymptote is of practical significance as it represents the largest peak value of the excitation time-history. This is not to be confused with the peak value in the SRS.

NOTE 2 Another name of the SRS high-frequency asymptote is zero-period acceleration (ZPA).

3.11 measuring points

specific points at which data are gathered when conducting the test

These points are of three types, as defined below.

3.11.1 check point

point located on the fixture, on the vibration table or on the specimen as close as possible to, or combined with, one of its fixing points, and in any case rigidly connected to it

NOTE 1 A number of check points are used as a means of ensuring that the test requirements are satisfied.

NOTE 2 If four or fewer fixing points exist, each is used as a check point. If more than four fixing points exist, four representative fixing points will be defined in the relevant specification to be used as check points.

NOTE 3 In special cases, for example, for large or complex specimens, the check points will be prescribed by the relevant specification if not close to the fixing points.

NOTE 4 Where a large number of small specimens are mounted on one fixture, or in the case of a small specimen where there are a number of fixing points, a single check point (that is the reference point) may be selected for the derivation of the control signal. This signal is then related to the fixture rather than to the fixing points of the specimen(s). This procedure is only valid when the lowest resonance frequency of the loaded fixture is well above the upper frequency of the test.

3.11.2 reference point

point, chosen from the check points, whose signal is used to control the test

3.11.3 response point

point on the specimen used for measurement of the response during vibration response investigation or during testing

This point is not a check or a reference point.

NOTE : More than one response point can be used.

3.12 natural frequency

frequency of damped or undamped free vibration of a structure depending only on its own physical characteristics (mass, stiffness and damping)

3.13 number of high peaks of the response time-history

measured number of peaks at the response point or number of peaks of the calculated response time-history of one single-degree-of-freedom system (oscillator), excited by a time-history, exceeding a specified threshold value (see figure 1)

NOTE 1 In practice, reference is made to high peaks of the response time-history since it is difficult to identify complete response cycles due to a transient excitation.

NOTE 2 The peak is a positive or a negative maximum deviation from the zero-line between two consecutive zero-crossing points (see figure 2).

NOTE 3 Calculated peaks instead of measured peaks are preferred in this Standard, as it is not always possible to obtain measured peaks of response time-histories.

3.14 oscillator

single-degree-of-freedom system intended to produce, or be capable of maintaining, mechanical oscillations

3.15 pause

interval between two consecutive time-histories

NOTE : A pause should be such as to result in no significant superposition of the response motion of the specimen and can be obtained from

$$T > \frac{1}{f} \times \frac{100}{d}$$

where

T : the duration (s);

f : the lowest undamped natural frequency (Hz);

d : the damping ratio at the lowest natural frequency (%).

3.16 preferred testing axes

three orthogonal axes which correspond to the most vulnerable axes of the specimen

3.17 Q-factor

quantity, which is a measure of the sharpness of resonance, or frequency selectivity of a resonant oscillatory mechanical system having a single degree of freedom

The Q -factor is one-half the reciprocal of the damping ratio.

3.18 required SRS

SRS specified in the relevant specification (see figure 3)

NOTE : The relevant specification can contain more than one SRS with different Q -factors for a certain test case.

3.19 shock response spectrum, SRS

plot of the maximum response (displacement, velocity or acceleration) of a base-excited series of single-degree-of-freedom systems to a defined input motion as a function of their undamped natural frequencies and at a specified Q -factor

NOTE 1 For calculation purposes, linear fixed-base single-degree-of-freedom systems and viscous damping are assumed, if not otherwise defined.

NOTE 2 The relevant specification can contain several SRS with different Q -factors for a given test case, from which the required SRS shall be selected depending on the Q -factor of the test specimen.

3.20 sampling frequency

number of discrete magnitude values taken per second to record or represent a time-history in digital form

3.21 signal tolerance

signal tolerance S_t (%) is defined as

$$S_t = \left(\frac{NF}{F} - 1 \right) \times 100 \text{ (per cent)}$$

where

NF : the r.m.s. value of the unfiltered signal;

F : the r.m.s. value of the filtered signal

NOTE 1 This parameter applies to whichever signal, i.e. acceleration, velocity or displacement, is being used to control the test.

NOTE 2 This parameter applies only to excitation with sinusoidal vibration.

3.22 strong part of the time-history

part of the time-history from the time when the plot first reaches 25 % of the maximum value to the time when it falls for the last time to the 25 % level (see figure 4)

3.23 synthesized time-history

artificially generated time-history such that its SRS envelops the required SRS

3.24 test frequency range

frequency range chosen for testing depending on the synthesizing of the required SRS and on the capabilities of the test apparatus with the test specimen attached

It has a lower (f_1) and an upper (f_2) frequency limit, corresponding to the lowest and highest wavelet frequency that may be used.