BRITISH STANDARD

BS EN
61337-1:2004

Filters using waveguide type dielectric resonators —

Part 1: Generic specification

The European Standard EN 61337-1:2004 has the status of a British Standard

ICS 31.140

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 61337-1:2004. It is identical with IEC 61337-1:2004. It supersedes BS EN 171000:2001 which will be withdrawn on 2007-10-01.

The UK participation in its preparation was entrusted to Technical Committee EPL/49, Piezo-electric devices for frequency control and selection, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 25 and a back cover.

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Amendments issued since publication

Amd. No.	Date	Comments

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 10 March 2005

ISBN 0 580 45576 9

EUROPEAN STANDARD **EN 61337-1**

NORME EUROPÉENNE

EUROPÄISCHE NORM December 2004

ICS 31.140 Supersedes EN 171000:2001

English version

Filters using waveguide type dielectric resonators
Part 1: Generic specification
(IEC 61337-1:2004)

Filtres utilisant des résonateurs diélectriques à modes guidés
Partie 1: Informations générales
(CEI 61337-1:2004)

Filter mit dielektrischen Resonatoren vom Wellenleitertyp
Teil 1: Fachgrundspezifikation
(IEC 61337-1:2004)

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

Ref. No. EN 61337-1:2004 E

Foreword

The text of document 49/685/FDIS, future edition 1 of IEC 61337-1, 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 61337-1 on 2004-10-01.

This European Standard supersedes EN 171000:2001.

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)	2005-08-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2007-10-01

Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 61337-1:2004 was approved by CENELEC as a European Standard without any modification.

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CONTENTS

FILTERS USING WAVEGUIDE TYPE DIELECTRIC RESONATORS –

Part 1: Generic specification

1 General

1.1 Scope

This part of IEC 61337 applies to filters using waveguide type dielectric resonators of assessed quality using either capability approval or qualification approval procedures. It also lists the test and measurement procedures which may be selected for use in detail specifications for such filters.

1.2 Normative references

The following referenced documents are indispensable for the application 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):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*

IEC 60068-2-1:1990, *Environmental testing – Part 2: Tests – Test A: Cold*

IEC 60068-2-2:1974, *Environmental testing – Part 2: Tests – Test B: Dry Heat*

IEC 60068-2-6:1995, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-7:1983, *Environmental testing – Part 2: Tests – Test Ga: Acceleration, steady state*

IEC 60068-2-13:1983, *Environmental testing – Part 2: Tests – Test M: Low air pressure*

IEC 60068-2-14:1984, *Environmental testing – Part 2: Tests – Test N: Change of temperature*

IEC 60068-2-20:1979, *Environmental testing – Part 2: Tests – Test T: Soldering*

IEC 60068-2-21:1999, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27:1987, *Environmental testing – Part 2: Tests – Test Ea and guidance: Shock*

IEC 60068-2-29:1987, *Environmental testing – Part 2: Tests – Test Eb and guidance: Bump*

IEC 60068-2-30:1980, *Environmental testing – Part 2: Tests – Test Db and guidance: Damp heat, cyclic (12 + 12 hour cycle)*

IEC 60068-2-58:1999, *Environmental testing – Part 2-58: Tests – Tests Td: Test methods for solderability, resistance to dissolution of metalization and to soldering heat of surface mounting devices (SMD)*

IEC 60068-2-78:2001, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60617 (all parts) [DB][1], *Graphical symbols for diagrams*

QC 001001:2000, *IEC Quality Assessment System for Electronic Components (IECQ) – Basic Rules*

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

QC 001002-3:1998, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of Procedure – Part 3: Approval Procedures*

QC 001005:2000, *Register of Firms, Products and Services approved under the IECQ System, including ISO 9000*

ISO 1000:1992, *SI units and recommendation for the use of their multiples and of certain other units*

1.3 Order of precedence

Where any discrepancies occur for any reason, documents shall rank in the following order of authority:

– detail specification;
– sectional specification;
– generic specification;
– any other international documents (for example, of the IEC) to which reference is made.

The same order of precedence shall apply to equivalent national documents.

2 Terminology and general requirements

2.1 General

Units, graphical symbols, letter symbols and terminology shall whenever possible, be taken from IEC 60617, IEC 60027, IEC 60050(561) and ISO 1000.

Any other units, symbols and terminology peculiar to one of the components covered by the Generic Specification, shall be taken from the relevant IEC or ISO documents listed under 1.2.

2.2 Terms and definitions

For the purposes of this part of IEC 61337, the following terms and definitions apply.

Further detailed information may be provided in IEC 61994-1 for some of the following terms.

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1 "DB" refers to the IEC on-line database.

2.2.1
dielectric filter
filter in which one or more dielectric resonators are incorporated

2.2.2
dielectric mono-block filter
filter consisting of a metallized rectangular ceramic block with cylindrical holes, which functions as a TEM (Transverse-ElectroMagnetic) mode filter with two or more stages

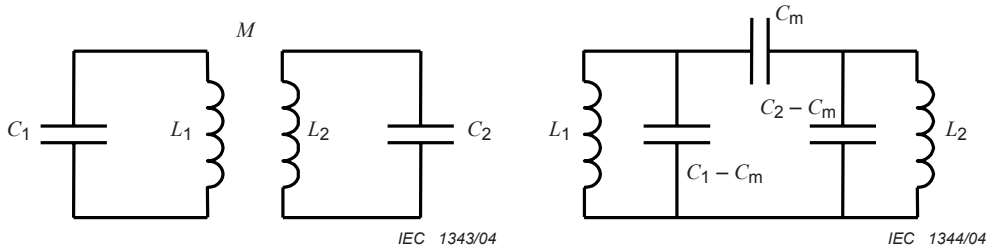
2.2.3
stripline filter
filter consisting of stripline resonators, which functions as a TEM mode filter with two or more stages

2.2.4
microstripline filter
filter consisting of microstripline resonators, which functions as a TEM mode filter with two or more stages

2.2.5
coplanar filter
filter consisting of coplanar line resonators, which functions as a TEM mode filter with two or more stages

2.2.6
coupling factor
k
coupling factor of a band-pass filter is the degree of coupling between two resonators.

NOTE The coupling between dielectric resonators is mainly done either magnetically or electrically. According to each case, the equivalent circuit of coupling is expressed by inductive or capacitive coupling, respectively, see Figure 1.



(a) Inductive coupling (b) Capacitive coupling

Figure 1 – Equivalent circuit

The coupling factor by inductive or capacitive coupling is defined by the following respective equations:

$$k = \frac{M}{\sqrt{L_1 \times L_2}} \qquad k = \frac{C_m}{\sqrt{C_1 \times C_2}}$$

where

L_1, C_1 and L_2, C_2 are the resonance circuit elements;

M is the mutual inductance;

C_m is the coupling capacitance;

k is the coupling factor.

In the case of a symmetrical circuit of coupling, the coupling factor can be obtained from two resonance frequencies calculated or measured for the coupled resonators:

$$k = \frac{\left| f_o^2 - f_e^2 \right|}{f_o^2 + f_e^2}$$

where

f_e is the resonance frequency in the case of even mode excitation (open-circuited symmetric plane);

f_o is the resonance frequency in the case of odd mode excitation (short-circuited symmetric plane).

The coupling factor of a band-stop filter is the degree of coupling between the resonator and the transmission line. The coupling factor k is defined as the ratio of the external power loss (P_e) of the resonator system to the internal power loss (P_u) of the resonator and can be expressed by a function of quality factor as follows:

$$k = \frac{P_e}{P_u} = \frac{Q_u}{Q_e} = \frac{Q_u}{Q_L} - 1$$

where

Q_u is the unloaded quality factor of resonator;

Q_e is the external quality factor of resonator;

Q_L is the loaded quality factor of resonator.

2.2.7
mid-band frequency
arithmetic mean of the cut-off frequencies (see Figures 2 and 3)

2.2.8
cut-off frequency
frequency of the pass band at which the relative attenuation reaches a specified value (see Figures 2 and 3)

2.2.9
trap frequency
frequency of the trap at which the attenuation reaches a large peak value (see Figure 2)

2.2.10
pass-band
band of frequencies in which the relative attenuation is equal to or less than a specified value (see Figures 2 and 3)

2.2.11
pass bandwidth
separation of the frequencies between which the attenuation is equal to or less than a specified value (see Figure 2)

2.2.12
stop band
band of frequencies in which the relative attenuation is equal to or greater than a specified value (see Figures 2 and 3)

2.2.13
stop bandwidth
separation of frequencies between which the attenuation is equal to or greater than a specified value (see Figures 2 and 3)

2.2.14
fractional bandwidth
a) ratio of the pass bandwidth to the mid-band frequency in the case of band-pass filter
b) ratio of the stop bandwidth to the mid-band frequency in the case of band-stop filter

2.2.15
insertion attenuation
logarithmic ratio of the power delivered directly to the load impedance before insertion of the filter to the power delivered to the load impedance after the insertion of the filter

The value is defined by

$$10\log_{10}\frac{P_o}{P_t}(dB)$$

where

P_o is the power delivered to the load impedance before insertion of the filter;

P_t is the power delivered to the load impedance after insertion of the filter.

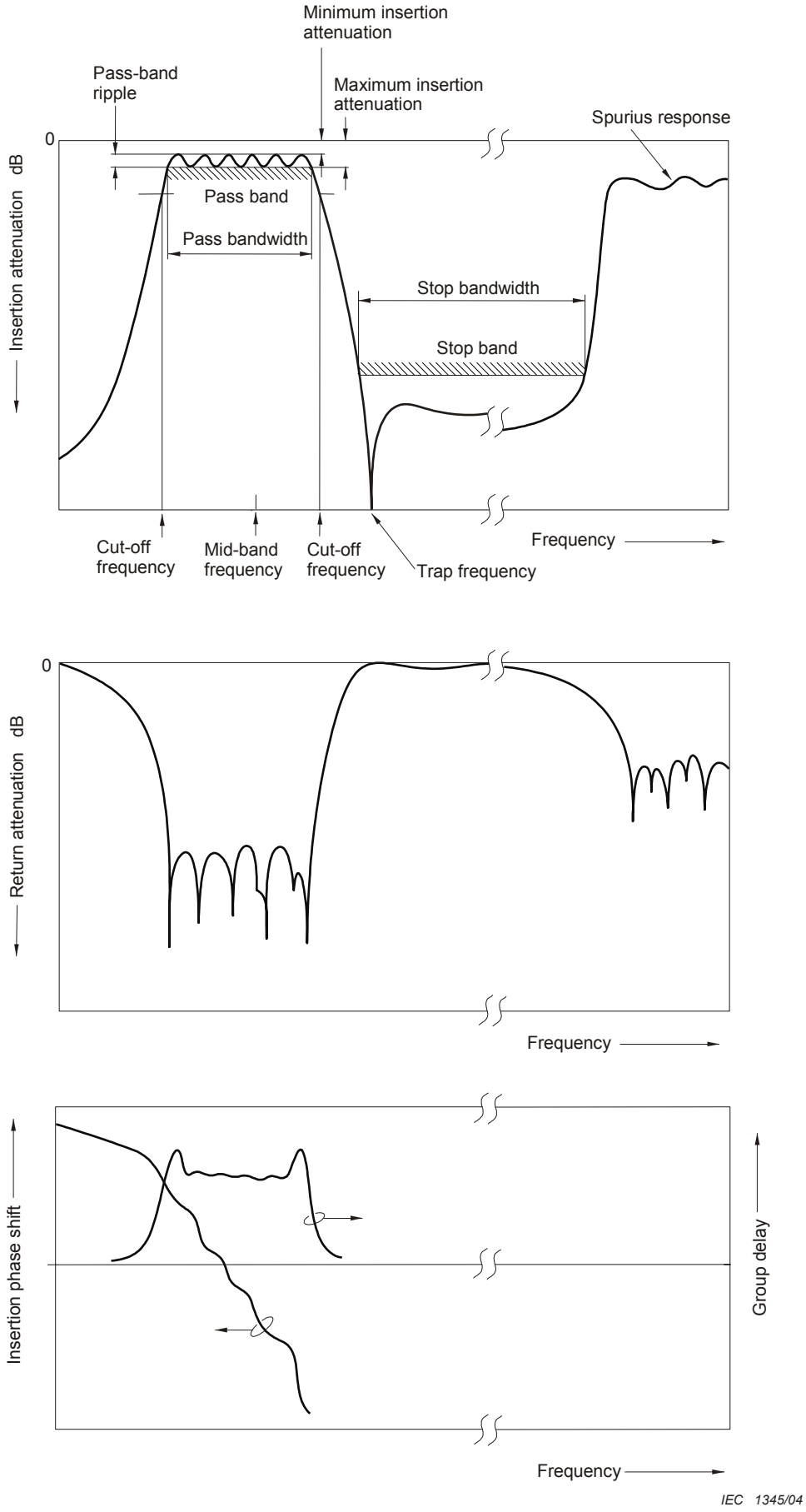


Figure 2 – Typical frequency characteristics of a band-pass filter

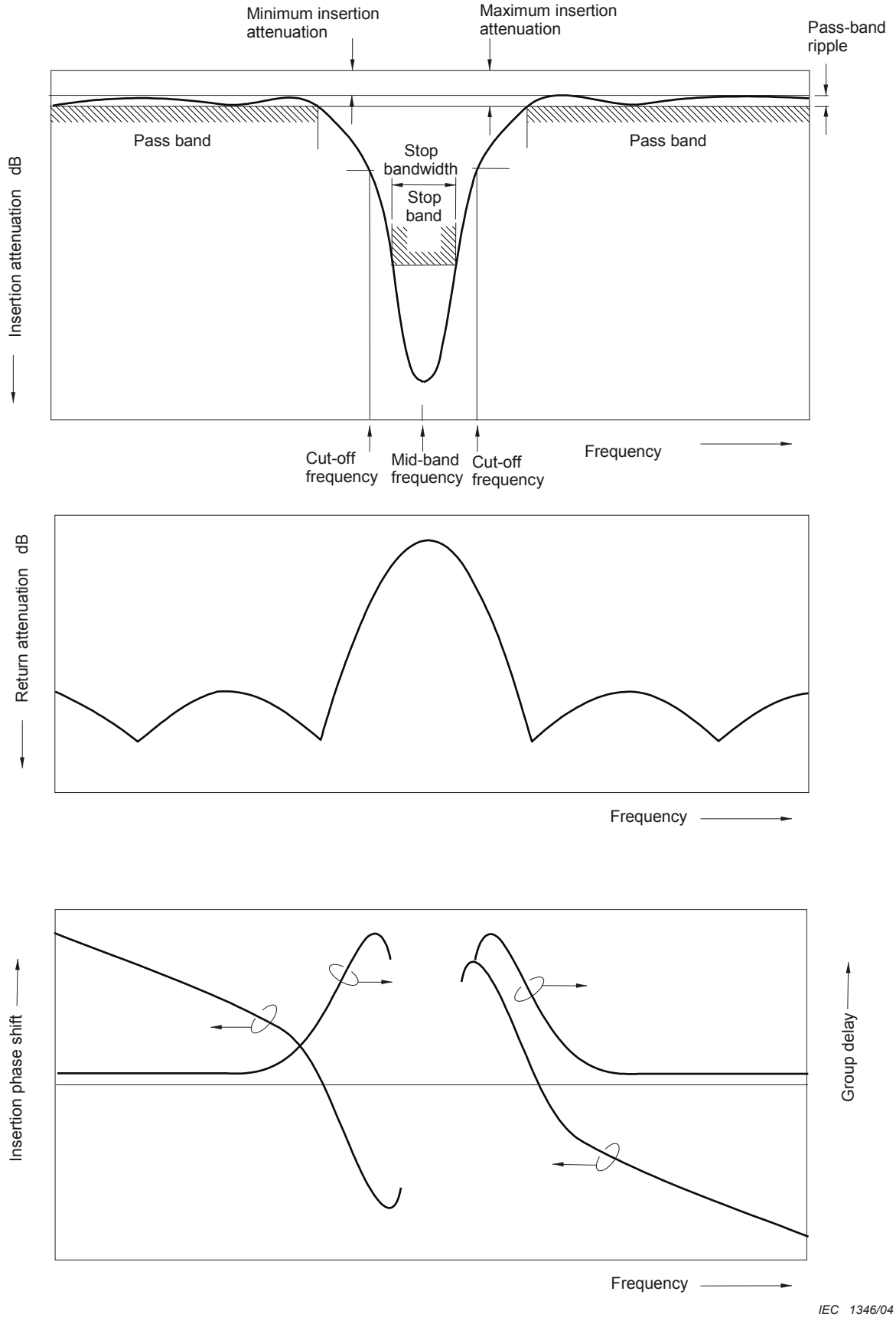


Figure 3 – Typical frequency characteristics of a band-stop filter

2.2.16
relative attenuation
difference between the attenuation at a given frequency and the attenuation at the reference frequency

2.2.17
minimum insertion attenuation
the minimum value of insertion attenuation in the pass band

2.2.18
maximum insertion attenuation
the maximum value of insertion attenuation in the pass band

2.2.19
pass-band ripple
maximum variation of attenuation within a defined portion of a pass band (see Figures 2 and 3)

2.2.20
spurious response
the response of a filter other than that associated with the working frequency (see Figure 2)

2.2.21
spurious response rejection
difference between the maximum level of spurious response and the minimum insertion attenuation

2.2.22
return attenuation
logarithmic ratio of the power P_o to the power P_r

The value is defined by

$$10\log_{10}\frac{P_o}{P_r}(dB)$$

where

P_o is the power available from the oscillator;

P_r is the power reflected from the filter after insertion of the filter with the load impedance.

NOTE Alternative expression by $VSWR$ (Voltage Standing Wave Ratio) is:

$$VSWR = \frac{1+|\Gamma|}{1-|\Gamma|}$$

where

$|\Gamma| = \sqrt{\frac{P_r}{P_o}}$ is the modulus of the reflection coefficient.

2.2.23
insertion phase shift
change in phase caused by the insertion of the filter into a transmission system

2.2.24
group delay
time equal to the first derivative of the phase shift in radians with respect to the angular frequency

2.2.25
group delay distortion
difference between the lowest and highest value of group delay in a specified frequency band

2.2.26
maximum power level
power level above which intolerable signal distortion or irreversible changes in a structure may take place

2.2.27
reference frequency
frequency defined by the specification to which other frequencies may be referred

2.2.28
Band-Pass Filter
BPF
filter having a signal pass band between two specified stop bands

2.2.29
Band-Stop Filter
BSF
filter having a signal stop band between two specified pass bands

2.3 Preferred ratings and characteristics

Values should preferably be chosen from the following Subclauses.

2.3.1 Temperature ranges in degrees Celsius (°C) for ambient operation

–20 to +75 –30 to +60 –35 to +85 0 to +55

NOTE Other temperature ranges may be used, but the lowest temperature should not be lower than –60 °C and the highest temperature should not exceed 125 °C.

2.3.2 Climatic category

40/085/56

For requirements where the operating temperature range of the filter is greater than –40 °C to +85 °C, a climatic category consistent with the operating temperature range shall be specified.

2.3.3 Bump severity

4 000 ± 10 bumps at 40 g_n peak acceleration in each direction along three mutually perpendicular axis. Pulse duration 6 ms.

2.3.4 Vibration severity

Frequency	Vibration severity
10 to 500 Hz	0,75 mm amplitude or 10 g_n acceleration;
10 to 2 000 Hz	0,75 mm amplitude or 10 g_n acceleration;
10 to 2 000 Hz	1,5 mm amplitude or 20 g_n acceleration.

2.3.5 Shock severity

6 ms duration, 100 g_n acceleration.

2.4 Marking

Each filter shall be clearly and durably marked with the following minimum information:

– type designation as defined in the detail specification;
– nominal frequency in MHz;
– year and week of manufacture;
– manufacturer's name or trade mark.

Each package of filters shall be marked with the following information:

– quantity (if applicable);
– type designation;
– number of the detail specification;
– manufacturer's factory identification code;
– date code;
– additional marking as required by the detail specification.

3 Quality assessment procedures

3.1 Primary stage of manufacture

The primary stage of manufacture for a filter using waveguide type dielectric resonators, in accordance with Clauses 3 and 4 of QC 001002-3, is the assembly of the filter.

3.2 Structurally similar components

The grouping of structurally similar filters for the purpose of qualification approval, capability approval and quality conformance inspection shall be prescribed in the relevant sectional specification.

3.3 Sub-contracting

These procedures shall be in accordance with Clause 3 of QC 001002-3.

3.4 Incorporated components

Where the final component contains components of a type covered by a generic specification in the IEC series, these shall be produced using the normal IEC release procedures.

3.5 Manufacturer's approval

To obtain manufacturer's approval, the manufacturer shall meet the requirements of Clause 2 of QC 001002-3.

3.6 Approval procedures

3.6.1 General

To qualify a filter, either capability approval or qualification approval procedures may be used. These procedures conform to those stated in QC 001001 and QC 001002-3.

3.6.2 Capability approval

Capability approval is appropriate when structurally similar filters based on common design rules are fabricated by a group of common processes.

Under capability approval, detail specifications fall into the following three categories.

3.6.2.1 Capability Qualifying Components (CQCs)

A detail specification shall be prepared in accordance with the National Supervising Inspectorate (NSI). It shall identify the purpose of the CQC and include all relevant stress levels and test limits.

3.6.2.2 Standard catalogue items

When a component covered by the capability approval procedure is intended to be offered as a standard catalogue item, a detail specification complying with the blank detail specification shall be written. Such specifications shall be registered by the IECQ and the component may be listed in QC 001005.

3.6.2.3 Custom built filters

The content of the detail specification shall be by agreement between the manufacturer and the customer in accordance with Clause 4 of QC 001002-3.

Further information on detail specifications is contained in the sectional specification.

The product and capability qualifying components (CQCs) are tested in combination and approval given to a manufacturing facility on the basis of validated design rules, processes and quality control procedures. Further information is given in 3.7 and in the sectional specification.

3.6.3 Qualification approval

Qualification approval is appropriate for components manufactured to a standard design and established production process and conforming to a published detail specification.

The programme of tests defined in the detail specification for the appropriate assessment and severity level applies directly to the filter to be qualified, as prescribed in 3.8 and the sectional specification.

3.7 Procedures for capability approval

3.7.1 General

The procedures for capability approval shall be in accordance with QC 001002-3.

3.7.2 Eligibility for capability approval

The manufacturer shall comply with the requirements of Clause 4 of QC 001002-3 and the primary stage of manufacture as defined in 3.1 of this generic specification.

3.7.3 Application for capability approval

In order to obtain capability approval, the manufacturer shall apply the rules of procedure given in Clause 4 of QC 001002-3.

3.7.4 Granting of capability approval

Capability approval shall be granted when the procedures in accordance with Clause 4 of QC 001002-3 have been successfully completed.

3.7.5 Description of capability

The contents of the description of capability shall be in accordance with the requirements of the sectional specification.

The NIS shall treat the description of capability as a confidential document. The manufacturer may, if he so wishes, disclose part or all of it to a third party.

3.8 Procedures for qualification approval

3.8.1 General

The procedures for qualification approval shall be in accordance with Clause 3 of QC 001002-3.

3.8.2 Eligibility for qualification approval

The manufacturer shall comply with the requirements of Clause 3 of QC 001002-3 and the primary stage of manufacture as defined in 3.1 of this generic specification.

3.8.3 Application for qualification approval

In order to obtain qualification approval, the manufacturer shall apply the rules of procedure given in Clause 3 of QC 001002-3.

3.8.4 Granting of qualification approval

Qualification approval shall be granted when the procedures in accordance with Clause 3 of QC 001002-3 have been successfully completed.

3.8.5 Quality conformance inspection

The blank detail specification associated with the sectional specification shall prescribe the test schedule for quality conformance inspection.

3.9 Test procedures

The test procedures to be used shall be selected from this generic specification. If any required test is not included it shall then be defined in the detail specification.

3.10 Screening requirements

Where screening is required by the customer for filters, this shall be specified in the detail specification.

3.11 Rework and repair work

3.11.1 Rework

Rework is the rectification of processing errors and shall not be carried out.

3.11.2 Repair work

Repair work is the correction of defects in a component after release to the customer.

3.12 Certified records of released lots

The requirements of clause 1 of QC 001002-2 shall apply. When certified records of released lots (CRRL) are prescribed in the sectional specification for qualification approval and are requested by the customer, the results of the specified tests shall be summarized.

3.13 Validity of release

Filters held for a period exceeding two years following acceptance inspection shall be re-inspected for the electrical tests detailed in 4.5.2 with a sample tested as described in 4.6.4.2 prior to release.

3.14 Release for delivery

Filters shall be released in accordance with Clauses 3 and 4 of QC 001002-3.

3.15 Unchecked parameters

Only those parameters of a component which have been specified in a detail specification and which were subject to testing can be assumed to be within the specified limits. It should not be assumed that any parameter not specified will remain unchanged from one component to another. Should it be necessary for further parameters to be controlled, then a new, more extensive, detail specification should be used. The additional test method(s) shall be fully described and appropriate limits, quality and inspection levels specified.

4 Test and measurement procedures

4.1 General

The test and measurement procedures shall be carried out in accordance with the relevant detail specification.

4.2 Test and measurement conditions

4.2.1 Standard conditions for testing

Unless otherwise specified all tests shall be carried out under standard atmospheric conditions for testing as specified in 5.3 of IEC 60068-1.

Temperature	15 °C to 35 °C
Relative humidity	25 % to 75 %
Air pressure	86 kPa to 106 kPa

In case of dispute, the reference conditions are:

Temperature	(23 ± 1) °C
Relative humidity	48 % to 52 %
Air pressure	86 kPa to 106 kPa

Before measurements are made, the filter shall be stored at the measuring temperature for a time sufficient to allow the filter to reach thermal equilibrium. Controlled recovery conditions and standard conditions for assisted drying are given in 5.4 and 5.5 of IEC 60068-1.

When measurements are made at a temperature other then the standard temperature, the results shall, where necessary, be corrected to the specified temperature.

The ambient temperature during measurements shall be recorded and stated in the test report.

4.2.2 Precision of measurement

The limits given in detail specifications are true values. Measurement inaccuracies shall be taken into account when evaluating the results. Precautions shall be taken to reduce measurement errors to a minimum.

4.2.3 Alternative test methods

Measurements shall preferably be carried out using the methods specified. Any other method giving equivalent results may be used except in case of dispute.

NOTE By “equivalent” is meant that the value of the characteristic established by a such other method falls within the specified limits when measured by the specified method.

4.3 Visual inspection

Unless otherwise specified, the visual examination shall be performed under normal factory lighting and visual conditions.

The filter shall be visually examined to ensure that the condition, workmanship and finish are satisfactory. The marking shall be legible. Filters with metal enclosures shall have earthing facilities unless otherwise specified.

4.4 Dimensions and gauging procedures

The dimensions shall be measured and shall comply with the specified values.

4.5 Electrical test procedures

4.5.1 General

The following test procedures are described using network analyzers which usually have system impedance of 50 Ω, it is therefore necessary to take into consideration the termination condition between the filters and the equipment when making measurements.

4.5.2 Insertion attenuation

4.5.2.1 Principle of measurement

The insertion attenuation is obtained as a ratio of the signal level measured when the test port cables are connected through the reference transmission line having the same characteristics as the line of the test fixture to the signal level measured when the filter is inserted in the test fixture (see Figure 4).

In the case of filters with input/output connectors such as SMA connectors, the reference level can be given by the direct connection of the test port cables.

4.5.2.2 Measuring circuit

The measurement set-up is shown in Figure 4. All connections shall be made with rf cables whose nominal impedance should be exactly equal to the system impedance.

4.5.2.3 Filter test fixture

If the filter under test has no coaxial connector interface, an appropriate test fixture shall be used whose output shall be well shielded from the input and minimizing the insertion attenuation.

4.5.2.4 Measurement method

Connect port 1 and 2 test cables directly together or through a straight line in order to make the reference level calibration of the network analyzer.

Disconnect the test port cables and insert the filter under test and record the measurement.

The ratio of the two measurements is the insertion attenuation which shall be within the limits stated in the detail specification.

4.5.3 Insertion attenuation as a function of temperature

The filter shall be inserted into the test circuit as shown in Figure 4 and as described in 4.5.2. The insertion attenuation measurements shall be made as described in 4.5.2 except that they shall be measured over the specified temperature range and at the nominal level of drive.

The insertion attenuation shall be within the limits specified in the detail specification.

4.5.4 Group delay

4.5.4.1 Principle of measurement

Group delay t_g is calculated from the following formula.

$$t_g = \frac{\partial \varphi}{\partial \omega}$$

where

t_g is the group delay;

φ is the phase (lag) of the filter in radian;

ω is the angular frequency.

In practice, measurement t_g is determined by measuring the phase shift $\Delta\varphi$ between two frequencies which are expressed as $\omega \pm \Delta\omega/2$ where $\omega = 2\pi f$

Then $$t_g = \frac{\Delta \varphi}{\Delta \omega}$$

4.5.4.2 Measuring circuit

The measuring circuit is as shown in Figure 4 and the filter test equipment set to the group delay indication mode.

4.5.4.3 Filter test fixture

The test fixture used shall be as described in 4.5.2.3.

4.5.4.4 Measurement method

The filter test equipment shall be set to the group delay indication mode and the filter under test inserted. The group delay shall be measured and shall be within the limits stated in the detail specification.

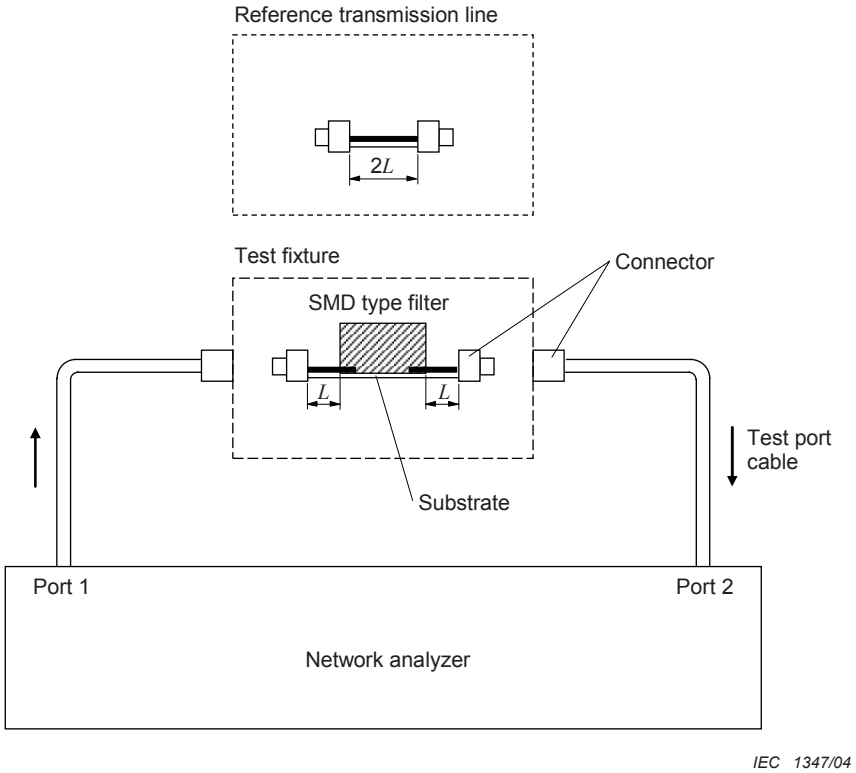


Figure 4 – Insertion attenuation and group delay measurement

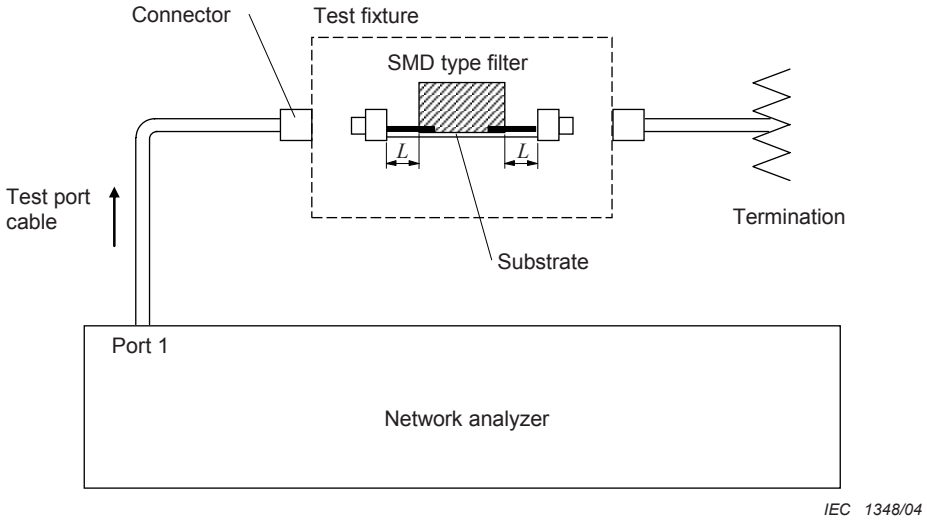


Figure 5 – Return attenuation measurement

4.5.5 Group delay as a function of temperature

The filter shall be inserted into the test circuit as shown in Figure 4 and as described in 4.5.4.

The group delay measurements shall be made as described in 4.5.4 except that they shall be measured over the specified temperature range and at the nominal level of drive.

The group delay shall be within the limits as specified in the detail specification.

4.5.6 Return attenuation

4.5.6.1 Principle of measurement

The return attenuation is obtained as a ratio of the signal level measured when the test port cable is open- or short-circuited when the filter is connected to the test port cables (see Figure 5).

4.5.6.2 Measuring circuit

The measuring circuit shall be as shown in Figure 5.

NOTE The distance between the test port and the filter under test should be as short as possible to ensure accurate measurements.

4.5.6.3 Filter test fixture

If the filter under test has no coaxial connector interface, an appropriate test fixture, which minimizes both insertion attenuation and impedance discontinuity, shall be used.

4.5.6.4 Measurement method

The filter under test shall be inserted into the test circuit as shown in Figure 5 and measurements taken.

The return attenuation shall be within the limits as specified in the detail specification.

4.5.7 Insulation resistance

The insulation resistance shall be measured by means of direct voltage as specified in the detail specification. The voltage shall be applied between:

– the terminations;
– the terminations connected together and the metal case.

The insulation resistance shall be not less than the value specified in the detail specification.

4.5.8 Voltage proof

An alternating voltage of a value specified in the detail specification shall be applied for a period of 5 s between:

– the terminations;
– the terminations connected together and the metal case.

There shall be no evidence of arcing, flashover, insulation breakdown or damage.

4.5.9 Power capability

A power level as specified in the detail specification shall be applied to the filter for a period of 1 h.

There shall be no evidence of damage.

4.6 Mechanical and environmental test procedures

4.6.1 Storage (non-destructive)

Unless otherwise specified in the detail specification, the filter shall be stored for 2 000 h without operation at either the minimum or maximum temperature, as specified, of the rated operating temperature range ±3 K.

After the test period, the filter shall be kept at standard atmospheric conditions for testing until thermal equilibrium has been reached.

The specified test shall be carried out and the final measurements shall be within the limits specified in the detail specification.

4.6.2 High temperature ageing (non-destructive)

The filter shall be maintained at (85 ± 3) °C for a continuous period of 30 days unless otherwise specified in the detail specification.

After the test, the filter shall be kept at standard atmospheric conditions for testing until thermal equilibrium has been reached.

The specified test shall be carried out and the final measurements shall be within the limits specified in the detail specification.

4.6.3 Robustness of terminations (destructive)

4.6.3.1 Tensile and thrust test

The test shall be performed in accordance with Test Ua_1: Tensile, and Test Ua_2: Thrust, of IEC 60068-2-21.

4.6.3.2 Bend test

The test shall be performed in accordance with Test Ub: Bending, of IEC 60068-2-21.

4.6.3.3 Torque test

The test shall be performed in accordance with Test Ud: Torque, of IEC 60068-2-21.

4.6.4 Soldering (destructive)

4.6.4.1 Resistance to soldering heat and to dissolution of metallization

Under consideration.

The test method of resistance to soldering heat and to dissolution of metallization of SMDs using a solder bath is given in IEC 60068-2-58, but this test may not be applicable to the large size devices with large heat capacity. The test methods such as the reflow soldering method and the hot plate method are proposed for SMDs which shall be assessed, for reflow processes only. These methods will be applied for the test of resistance to soldering heat and to dissolution of metallization.

4.6.4.2 Solderability of terminations

Test A: Solder bath method.

The test shall be performed in accordance with Method 1 of Test Ta of IEC 60068-2-20. The solder bath shall be heated to (235 ± 5) °C, unless otherwise specified.

Test B: Soldering iron method

This method shall be used when Test A is impracticable. The test shall be performed in accordance with Method 2 of Test Ta of IEC 60068-2-20.

4.6.5 Rapid change of temperature (non-destructive)

The test shall be performed in accordance with Test Na of IEC 60068-2-14.

The low and high test chamber temperatures are the extreme temperatures of the operating range stated in the relevant detail specification, the filters shall be maintained for 30 min at each temperature extreme. The filter shall be subjected to five complete thermal cycles and then exposed to standard atmospheric conditions for recovery for not less than 2 h.

4.6.6 Bump (destructive)

This test shall be performed in accordance with Test Eb: Bump, of IEC 60068-2-29. The filter shall be suitably mounted with clamps on the body. The bumps shall be applied in three mutually perpendicular axes, one of which is parallel to the terminations.

The relevant detail specification shall specify the degree of the severity in accordance with Test Eb of IEC 60068-2-29.

4.6.7 Vibration (destructive)

The test shall be performed in accordance with Test Fc, of IEC 60068-2-6. The filters shall be suitably mounted as required by the detail specification. The vibration shall be applied in three mutually perpendicular axes, one of which is parallel to the terminations.

The relevant detail specification shall specify the degree of severity in accordance with Test Fc of IEC 60068-2-6.

4.6.8 Shock (destructive)

The test shall be performed in accordance with Test Ea: Shock, of IEC 60068-2-27. The filter shall be suitably mounted as required by the detail specification. The shock shall be applied in three mutually perpendicular axes, one of which is parallel to the terminations.

The relevant detail specification shall specify the degree of severity in accordance with Test Ea of IEC 60068-2-27.

4.6.9 Acceleration, steady state (non-destructive)

The test shall be performed in accordance with Test Ga of IEC 60068-2-7. The filter shall be mounted as required by the detail specification. The procedure and severity shall be stated in the relevant detail specification.

4.6.10 Climatic test (destructive)

The tests described in 4.6.11 to 4.6.13 can be performed as a climatic sequence test according to Clause 7 of IEC 60068-1. Where applicable, each test can be performed as an individual test.

4.6.11 Dry heat (non-destructive)

The tests shall be performed in accordance with Test Ba: Dry heat for non-heat dissipating specimens with sudden change of temperature, of IEC 60068-2-2, at (85 ± 2) °C for 16 h, unless otherwise stated in the relevant detail specification.

4.6.12 Damp heat, cyclic (destructive)

The test shall be performed in accordance with Test Db, variant 1 of IEC 60068-2-30: Damp heat, cyclic (12 + 12-hour cycle), for one cycle of 24 h, unless otherwise stated in the relevant detail specification.

4.6.13 Cold

The test shall be performed in accordance with Test Aa of IEC 60068-2-1, for non-heat dissipating specimen with sudden change of temperature, at (–40 ± 3) °C for 2 h, unless otherwise stated in the relevant detail specification.

4.6.14 Damp heat, steady state

The test shall be performed in accordance with Test Ca of IEC 60068-2-78, using a degree of severity corresponding to the climatic category of the filter under test.

4.6.15 Low air pressure (non-destructive)

The test shall be performed in accordance with Test M of IEC 60068-2-13. The pressure in the chamber shall be reduced to 30 kPa for a duration of 2 h, unless otherwise stated in the relevant detail specification.

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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.

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

Publication	Year	Title	EN/HD	Year
IEC 60027	Series	Letter symbols to be used in electrical technology	HD 245 HD 60027	Series 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 [1)]	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 - Tests B: Dry heat	EN 60068-2-2 [2)]	1993
IEC 60068-2-6	1995	Part 2: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	1995
IEC 60068-2-7	1983	Part 2: Tests - Test Ga: Acceleration, steady state	EN 60068-2-7 [3)]	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 [4)]	1999
IEC 60068-2-20	1979	Part 2: Tests - Test T: Soldering	HD 323.2.20 S3 [5)]	1988
IEC 60068-2-21	1999	Part 2-21: Tests - Test U: Robustness of terminations and integral mounting devices	EN 60068-2-21	1999

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

2) EN 60068-2-2 includes supplement A:1976 to IEC 60068-2-2:1974.

3) EN 60068-2-7 includes A1:1986 to IEC 60068-2-7:1983.

4) EN 60068-2-14 includes A1:1986 to IEC 60068-2-14:1984.

5) HD 323.2.20 S3 includes A2:1987 to IEC 60068-2-20:1979.

Publication	Year	Title	EN/HD	Year
IEC 60068-2-27	1987	Part 2: Tests - Test Ea and guidance: Shock	EN 60068-2-27	1993
IEC 60068-2-29	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 [6)]	1999
IEC 60068-2-58	1999	Part 2-58: Tests - Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)	EN 60068-2-58 [7)]	1999
IEC 60068-2-78	2001	Part 2-78: Tests - Test Cab: Damp heat, steady state	EN 60068-2-78	2001
IEC 60617	database	Graphical symbols for diagrams	-	-
IEC QC 001002-2	1998	IEC Quality Assessment System for Electronic Components (IECQ) - Rules of Procedure Part 2: Documentation	-	-
IEC QC 001001	2000	IEC Quality Assessment System for Electronic Components (IECQ) - Basic rules	-	-
IEC QC 001002-3	1998	IEC Quality Assessment System for Electronic Components (IECQ) - Rules of Procedure 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	-	-

6) EN 60068-2-30 includes A1:1985 to IEC 60060-2-30:1980.

7) EN 60068-2-58 is superseded by EN 60068-2-58:2004, which is based on IEC 60068-2-58:2004.

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