IEC 61337-1

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Filters using waveguide type dielectric resonators –
Part 1: Generic specification

Filtres utilisant des résonateurs diélectriques à modes guidés –
Partie 1: Spécification générique

IEC 61337-1:2004

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Part 1: Generic specification

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of 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, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61337-1 has been prepared by IEC technical committee 49: Piezoelectric and dielectric devices for frequency control and selection.

This part of IEC 61337 cancels and replaces IEC 61337-1-1:1995 and IEC 61337-1-2:1999.

This bilingual version (2013-08) corresponds to the monolingual English version, published in 2004-11.

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

FDIS	Report on voting
49/685/FDIS	49/695/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.

The French version of this standard has not been voted upon.

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

IEC 61337 consists of the following parts, under the general title *Filters using waveguide type dielectric resonators*:

Part 1: Generic specification

Part 2: Guidance for use

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

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: Piezo-electric 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

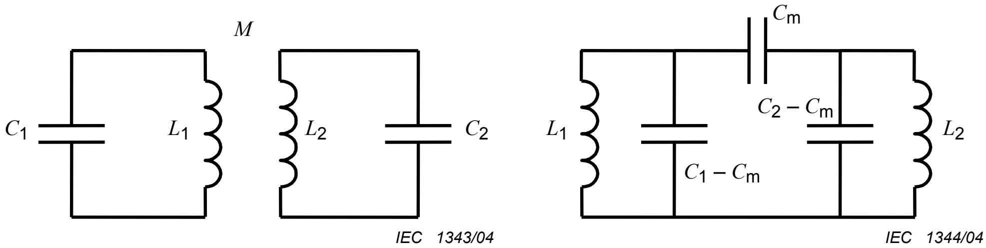
2.2.3
stripline filter
filter consisting of stripline resonators, which functions as a TEM mode filter with two or more stages

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.

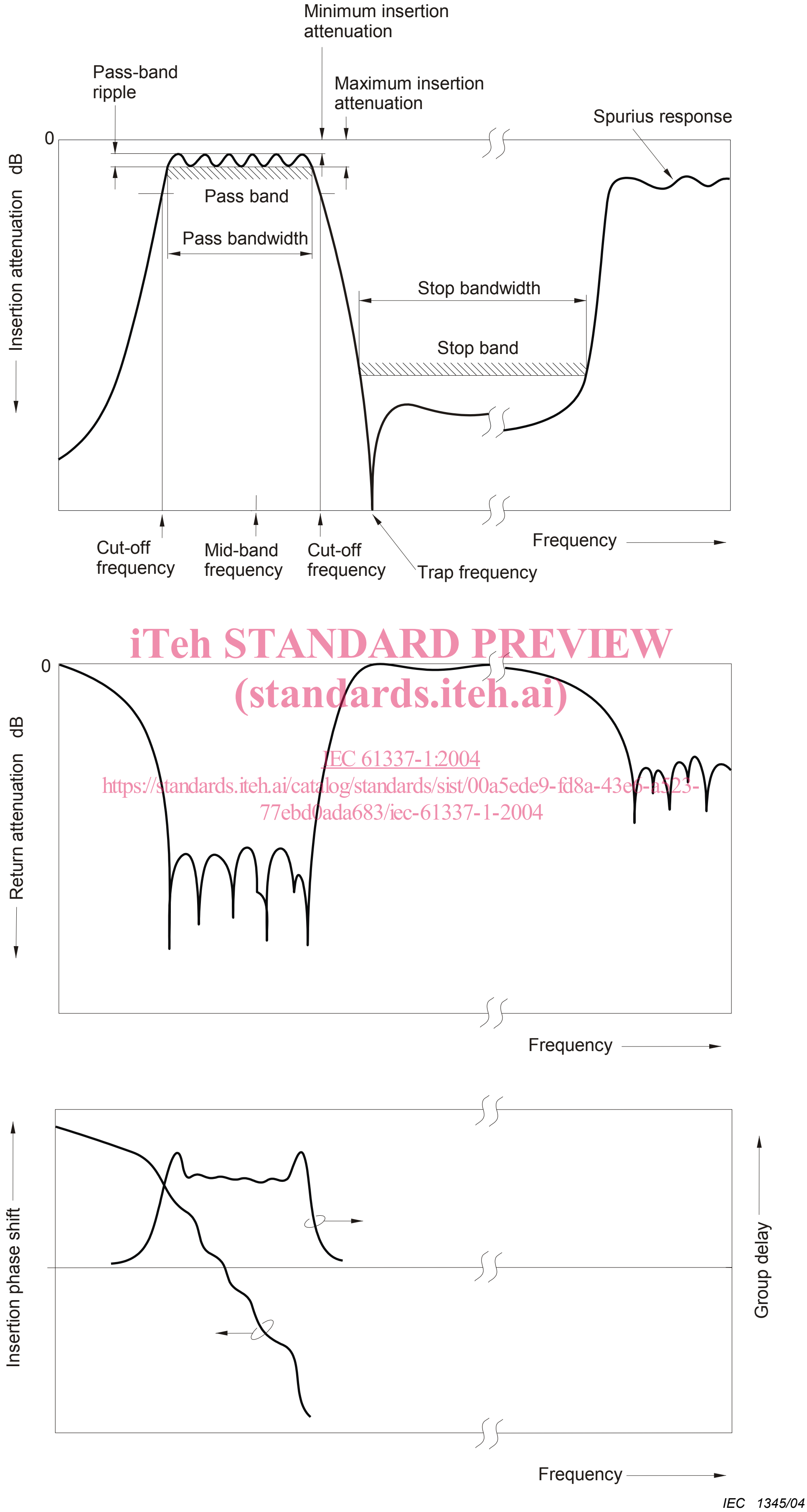


Figure 2 – Typical frequency characteristics of a band-pass filter

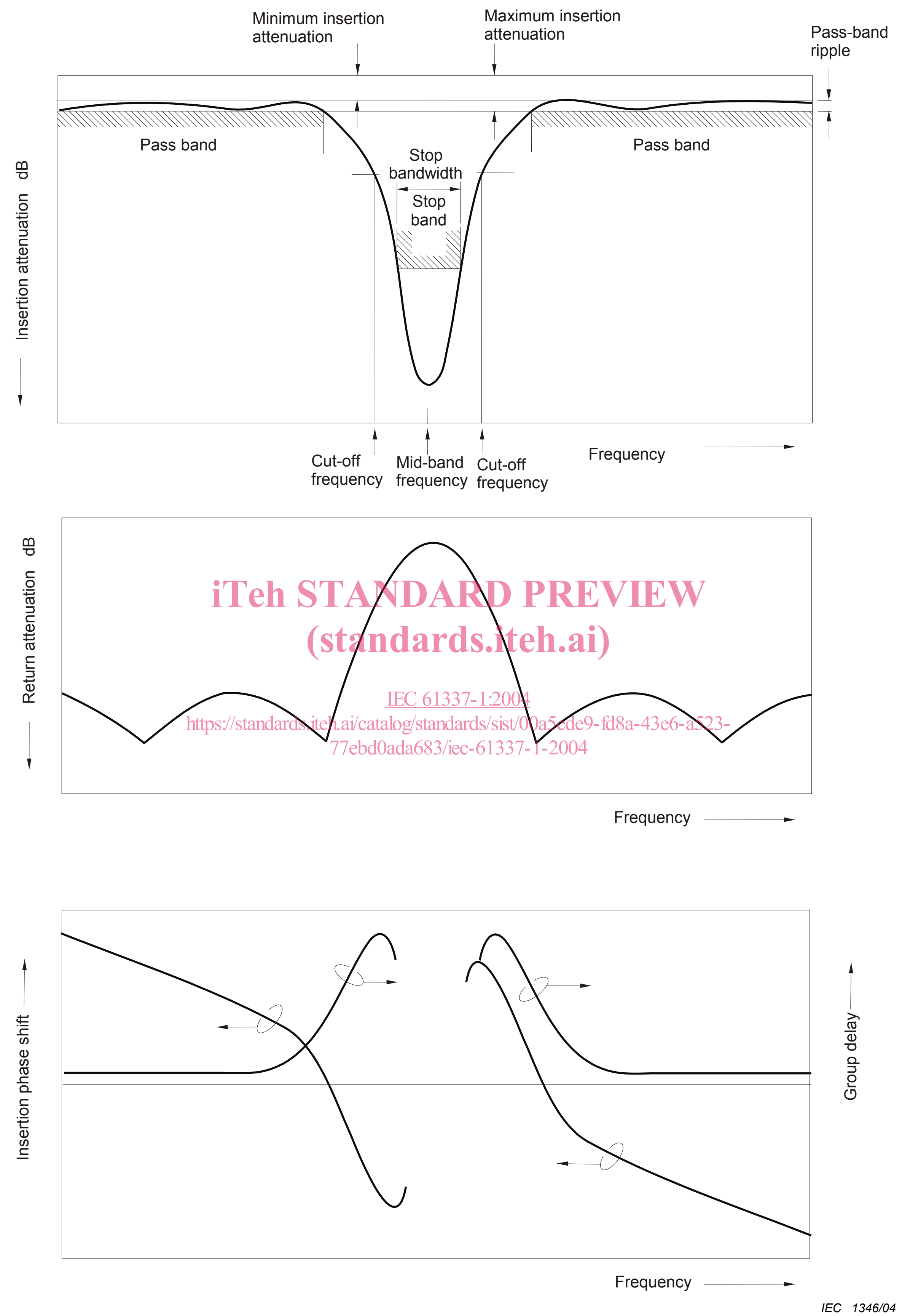


Figure 3 – Typical frequency characteristics of a band-stop filter

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.