

Specification for

Piezoelectric crystal filters of assessed quality: generic data and methods of test

UDC 621.372.54.082.73

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW



Document Sharing Hub

Committees responsible for this British Standard

This British Standard was published under the direction of the Electronic Components Standards Committee ECL/-. Its preparation was entrusted to Technical Committee ECL/11 upon which the following bodies were represented:

- Electronic Components Industry Federation
- Electronic Engineering Association
- Institution of Electronic and Radio Engineers
- Ministry of Defence
- Society of British Aerospace Companies Limited
- Telecommunication Engineering and Manufacturing Association (TEMA)
- Coopted member

This British Standard, having been prepared under the direction of the Electronic Components Standards Committee, was published under the authority of the Board of BSI and comes into effect on 30 June 1983

© BSI 02-2000

First published January 1977
First revision June 1983

The following BSI references relate to the work on this standard:
Committee reference ECL/11
Draft for comment 82/20627 DC

ISBN 0 580 11982 3

Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

	Page
Committees responsible	Inside front cover
Foreword	iii
Section 1. Principles and mandatory procedures	
1.1 General matters	1
1.1.1 Scope	1
1.1.2 Related documents	1
1.1.3 Terminology	1
1.1.4 Letter symbols, signs and abbreviations	4
1.1.5 Graphical symbols	4
1.1.6 Marking of the component and package	4
1.1.7 Eligibility for qualification approval	4
1.1.8 Structurally similar components	5
1.1.9 Delayed delivery	5
1.1.10 Supplementary procedures for qualification approval	5
1.1.11 Certified test records	6
1.1.12 Standard ratings and characteristics	6
1.1.12.1 Operating temperature range (°C)	6
1.1.12.2 Climatic category	6
1.1.12.3 Torque test	6
1.1.12.4 Bump severity	6
1.1.12.5 Vibration severity	6
1.1.12.6 Shock severity	7
1.1.12.7 Leak rate	7
1.1.13 Unchecked parameters	7
1.1.14 Procedure to be followed in the event of failures at group C or D inspection	7
1.1.15 Ordering information	7
1.1.16 Release prior to completion of group B tests	7
1.2 Test procedures	7
1.2.1 Test and measurement conditions	7
1.2.2 Visual inspection	7
1.2.2.1 Visual test A	7
1.2.2.2 Visual test B	7
1.2.2.3 Visual test C	7
1.2.3 Dimensioning and gauging procedures	7
1.2.3.1 Dimensions test A	7
1.2.3.2 Dimensions test B	7
1.2.4 Electrical test procedures	7
1.2.4.1 Transducer attenuation at standard atmospheric conditions	7
1.2.4.2 Amplitude response at standard atmospheric conditions	8
1.2.4.3 Phase response at standard atmospheric conditions	8
1.2.4.4 Group delay response at standard atmospheric conditions	8
1.2.4.5 Time domain characteristics at standard atmospheric conditions	8
1.2.4.6 Return attenuation	8
1.2.4.7 Electrical tests as a function of temperature	8
1.2.4.8 Intermodulation distortion	8
1.2.4.9 Insulation resistance	9
1.2.4.10 Amplitude response after application of maximum power	9
1.2.5 Mechanical test procedures	9

	Page
1.2.6 Mechanical and environmental test procedures	9
1.2.6.1 Robustness of terminations	9
1.2.6.2 Sealing tests	9
1.2.6.3 Solderability	9
1.2.6.4 Rapid change of temperature, thermal shock in air	10
1.2.6.5 Bump	10
1.2.6.6 Vibration	10
1.2.6.7 Shock	10
1.2.6.8 Acceleration (steady state)	10
1.2.6.9 Climatic sequence	10
1.2.6.10 Damp heat (steady state)	10
1.2.6.11 Salt mist	10
1.2.6.12 Mould growth	10
1.2.7 Endurance test procedure	10
1.2.7.1 Ageing	10
1.2.7.2 Shelf life	10
Section 2. Procedures for the preparation of detail specifications	
2.1 Basic information	11
2.1.1 Originator of the specification	11
2.1.2 Number of the specification	11
2.1.3 Description of the component and assessment level	11
2.1.4 Outline drawing	11
2.1.5 Ratings	11
2.1.6 Characteristics	11
2.1.7 Related documents	12
2.1.8 Additional information	12
2.1.9 Instructions for ordering components	12
2.2 Inspection requirements	12
2.3 Certified test records	13
2.3.1 General information	13
2.3.2 Measurement information	13
2.3.3 Explanatory information	13
Appendix A Test circuits for the measurement of transducer attenuation and amplitude frequency response	14
Appendix B Phase characteristics and group delay measurement test circuit	18
Appendix C Time domain measurement test circuit	20
Appendix D Return attenuation measurement test circuit	22
Appendix E Intermodulation distortion test circuit	24
Appendix F Example of a certified test record	Inside back cover
Figure 1 — Test circuit A.1	14
Figure 2 — Test circuit A.2	15
Figure 3 — Test circuit A.3	16
Figure 4 — Test circuit B.1	18
Figure 5 — Test circuit B.2	19
Figure 6 — Test circuit C.1	21
Figure 7 — Diagram of pulse characteristics	22
Figure 8 — Test circuit D.1	23
Figure 9 — Test circuit E.1	24

Foreword

This British Standard, which has been prepared under the direction of the Electronic Components Standards Committee, is the generic specification for piezoelectric filters in the BS 9000 series of standards for electronic components of assessed quality, and is a revision of BS 9600:1977 which is withdrawn.

Account has been taken of experience gained in the use of the previous edition and this revision incorporates the following major changes:

- a) improvements to the procedures for the inspection of structurally similar components, and a revision of the structural similarity clause;
- b) inclusion of supplementary procedures for qualification approval.

This standard calls for the use of substances and/or test procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and in no way absolves either the supplier or the user from legal obligations relating to health, safety and fire hazard at any stage of manufacture or use.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 24, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. Principles and mandatory procedures

1.1 General matters

1.1.1 Scope

This British Standard gives details of the essential test requirements and other general information relating to piezoelectric filters intended for use in radio communications and similar applications. The range of frequency coverage is from a few kilohertz to approximately 200 MHz. It is intended to be used in conjunction with the standards of the BS 9000 series and with the relevant detail specifications in which requirements for individual types of filter are given. The general procedures necessary for the preparation of these detail specifications are given in section 2 of this standard.

1.1.2 Related documents

BS 1991 (IEC 27)	<i>Letter symbols, signs and abbreviations</i>
BS 2011 (IEC 68)	<i>Basic environmental testing procedures</i>
(IEC 68-1)	Part 1.1 <i>General</i>
(IEC 68-2-3)	Part 2.1Ca <i>Test Ca. Damp heat, steady state</i>
(IEC 68-2-27)	Part 2.1Ea <i>Test Ea. Shock</i>
(IEC 68-2-29)	Part 2.1Eb <i>Test Eb. Bump</i>
(IEC 68-2-6)	Part 2.1Fc <i>Test Fc. Vibration (sinusoidal)</i>
(IEC 68-2-7)	Part 2.1Ga <i>Test Ga. Acceleration, steady state</i>
(IEC 68-2-10)	Part 2.1J <i>Test J. Mould growth</i>
	Part 2.1Kb <i>Test Kb. Salt mist</i>
(IEC 68-2-14)	Part 2.1N <i>Test N. Change of temperature</i>
(IEC 68-2-17)	Part 2.1Q <i>Test Q. Sealing</i>
(IEC 68-2-20)	Part 2.1T <i>Test T. Soldering</i>
	Part 2.1Z/ABDM <i>Climatic sequence, primarily intended for components</i>
BS 3939 (IEC 117)	<i>Graphical symbols for electrical power, telecommunications and electronics diagrams</i>
BS 4727 (IEC 50)	<i>Glossary of electrotechnical, power, telecommunications, electronics, lighting and colour terms</i>
BS 5069 (IEC 122-3 and 368-3)	<i>Dimensions of piezoelectric devices</i>
BS 6001	<i>Sampling procedures and tables for inspection by attributes</i>
BS 9000	<i>General requirements for electronic parts of assessed quality.</i>

NOTE When reference to an IEC Publication is given in parentheses, the British Standard is identical in technical content with the IEC Publication except where deviation(s) are indicated in the British Standard.

1.1.3 Terminology

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

1.1.3.1 Filter types

1.1.3.1.1

filter

a network, the primary function of which is to separate wanted from unwanted frequency bands

1.1.3.1.2

band-pass filter

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

1.1.3.1.3

band-stop filter

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

1.1.3.1.4

high-pass filter

a filter having a single pass band above a specified frequency and a stop band for lower frequencies

1.1.3.1.5

low-pass filter

a filter having a single pass band below a specified frequency and a stop band for higher frequencies

1.1.3.2 Filter parameters

1.1.3.2.1

group delay

for a specified frequency, the time equal to the first derivative with respect to the angular frequency of the phase shift in radians between the source and the output

1.1.3.2.2

insertion attenuation

for a specified frequency, the attenuation resulting from the insertion of a filter into a transmission system, i.e. the logarithmic ratio of the power delivered to the load before insertion of the filter to the power delivered to the load after insertion of the filter

NOTE Pass band insertion attenuation is often specified at the frequency of minimum attenuation.

1.1.3.2.3

insertion phase

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

1.1.3.2.4

intermodulation distortion

a constituent of non-linearity distortion consisting of the occurrence, in the response to coexistent sinusoidal excitations, of sinusoidal components (intermodulation products) the frequencies of which are sums and differences of the excitation frequencies or of integral multiples of these frequencies

1.1.3.2.5

maximum level

the maximum power, voltage or current level that may be applied to a filter without intolerable signal distortion or irreversible changes taking place

1.1.3.2.6

overshoot

the peak value of the output response above its final value following the application of a step voltage input usually expressed as a percentage of the final value

1.1.3.2.7

pass band

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

1.1.3.2.8

pass band ripple

the greatest difference within the pass band between the minimum attenuation and the attenuation at points where the slope of the attenuation/frequency characteristic is zero

1.1.3.2.9

pass bandwidth

the separation of frequencies between which the relative attenuation is equal to or less than a specified value

1.1.3.2.10

phase delay

for a specified frequency, the time equal to the phase shift in radians between the source and the output divided by that angular frequency

1.1.3.2.11**preshoot**

a negative response occurring immediately before the main response in the output, following the application of a step voltage input, usually expressed as a percentage of the final value

1.1.3.2.12**pulse delay time**

the elapsed time between the 50 % point on the leading edge of the input and the 50 % point on the leading edge of the output pulse

1.1.3.2.13**pulse width**

the elapsed time on the pulse between the 50 % point on the leading edge and the 50 % point on the trailing edge

1.1.3.2.14**rated level**

the power, voltage or current level at which the performance is specified

1.1.3.2.15**reference frequency**

a frequency defined by specification to which other frequencies may be referred

1.1.3.2.16**reflection coefficient**

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

$$\frac{Z_a - Z_b}{Z_a + Z_b}$$

where

Z_a is either the input or output impedance

Z_b is either the source or load impedance.

1.1.3.2.17**relative attenuation**

the difference between the attenuation at a given frequency and either the minimum attenuation in the pass band or the attenuation at the reference frequency

1.1.3.2.18**return attenuation**

the value of the reciprocal of the modulus of the reflection coefficient, expressed in decibels. Quantitatively it is equal to

$$20 \log_{10} \left(\frac{Z_a + Z_b}{Z_a - Z_b} \right)$$

where Z_a and Z_b are as given in **1.1.3.2.16**

1.1.3.2.19**ringing**

oscillations (caused by a filter) that occur in the output pulse following the application of a step voltage input

1.1.3.2.20**rise time**

the elapsed time between the 10 % and the 90 % points on the leading edge of the pulse

1.1.3.2.21

stop band

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

1.1.3.2.22

stop bandwidth

the separation of frequencies between which the relative attenuation is equal to or greater than a specified value

1.1.3.2.23

terminating impedances

the impedances presented to the filter by the source and by the load

1.1.3.2.24

transducer attenuation

for a specified frequency, the logarithmic ratio of the available power of the given source to the power that the filter delivers to a load impedance under specified operating conditions

NOTE Pass band transducer attenuation is often specified at the frequency of minimum attenuation

1.1.3.2.25

transducer phase

for a specified frequency, the relative angle of the phase between the output of the filter and the source

1.1.3.2.26

transition band

a frequency band between a stop band and an adjacent pass band

1.1.3.2.27

undershoot

the difference between the final output and the first negative peak after the output has first reached the final value following the application of a step voltage input, usually expressed as a percentage of the final value

1.1.3.2.28

unwanted output

an output from the filter in the stop band(s) or the transition band(s) that exceeds the specified value(s)

1.1.4 Letter symbols, signs and abbreviations

The letter symbols, signs and abbreviations that are employed in all documents applicable to electronic components covered by this standard shall be in accordance with BS 1991 or shall be derived in accordance with the principles of that standard.

1.1.5 Graphical symbols

The graphical symbols that are employed in all documents applicable to electronic components covered by this standard shall be in accordance with BS 3939 or shall be derived in accordance with the principles of that standard.

1.1.6 Marking of the component and package

The component and its package shall be marked with the following information:

- a) the number of the detail specification and any other coding as given in the detail specification to identify the particular item;
- b) the reference frequency;
- c) the date code (see clause 22 of BS 9000-1:1981);
- d) the manufacturer's code.

1.1.7 Eligibility for qualification approval

1.1.7.1 The first stage of processing for the crystal filter in accordance with clause 14 of BS 9000-1:1981 shall be the assembly of the filter.