

**Harmonized system of quality
assessment for electronic components**

Sectional specification: Flex-rigid multilayer printed boards with through connections

The European Standard EN 123600:1996 has the status of a
British Standard

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Committees responsible for this British Standard

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- British Telecommunications plc
- Federation of the Electronics Industry
- GAMBICA BEAMA Ltd.
- National Supervising Inspectorate (BSI-PC)
- Printed Circuit Interconnection Federation
- Surface Mount and Related Technologies (SMART Group) Ltd.

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National foreword

This British Standard has been prepared by Technical Committee EPL/52, and is the English language version of EN 123600:1996 *Sectional specification: Flex-rigid multilayer printed boards with through connections*, published by the European Committee for Electrotechnical Standardization (CENELEC). It supersedes BS 9766:1983, which is obsolescent; BS 9766:1983 remains valid for existing approvals, but may not be used for any new approvals.

Cross-references

Publication referred to	Corresponding British Standard
EN 123000:1991	BS EN 123000:1992 <i>Harmonized system of quality assessment for electronic components. Generic specification: Printed boards</i> BS 2011 <i>Environmental testing</i>
IEC 68-2-3:1969	Part 2.1Ca:1977 <i>Test Ca. Damp heat, steady state</i>
IEC 68-2-20:1979	Part 2.1T:1981 <i>Test T. Soldering</i>
IEC 68-2-38:1974	Part 2.1Z/AD:1977 <i>Tests Z/AD. Composite temperature/humidity cyclic test</i>
IEC 194:1988	BS 4727 <i>Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms</i> Part 1 <i>Terms common to power, telecommunications and electronics</i> Group 11:1991 <i>Printed circuits</i> BS 6221 <i>Printed wiring boards</i>
IEC 326-2:1990	Part 2:1991 <i>Methods of test</i>
IEC 326-3:1991	Part 3:1991 <i>Guide for the design and use of printed wiring boards</i>

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 44, 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.

Descriptors: Multilayer printed boards, with through connections, capability test, quality conformance inspection, test patterns

English version

Sectional specification:
Flex-rigid multilayer printed boards with through
connections

Spécification intermédiaire:
Cartes imprimées multicouches flexorigides
avec connexions transversales

Rahmenspezifikation:
Biegesteife Mehrlagen-Leiterplatten mit
Durchverbindungen

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

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Foreword

This European Standard was prepared by CLC/TC CECC/SC 52, Printed boards (former WG 23).

It is based, wherever possible, on the Publications of the International Electrotechnical Commission, and in particular on IEC 326-11, Printed boards, Part 11: Specification for flex-rigid multilayer printed boards with through connections.

The text of the draft based on document CECC(Secretariat)2823 was submitted to the formal vote; together with the voting report, circulated as document CECC(Secretariat)3022, it was approved as EN 123600 on 1992-02-14.

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) 1997-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2003-05-01

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1 Introduction

IEC 326-11 is the IEC Standard for flex-rigid multilayer printed boards with through connections. The following document comprises this IEC Standard and in accordance with the Generic Specification EN 123000, the information additionally necessary for printed boards intended to be handled within the CENELEC system for electronic components of assessed quality.

1.1 Scope and object

This document is a Sectional Specification (SS) relating to flex-rigid multilayer printed boards with through connections irrespective of their method of manufacture, when they are ready for the mounting of the components. It defines the characteristics to be assessed and the test methods to be used for capability approval testing and for quality conformance inspection (lot-by-lot and periodic inspection).

1.2 Related documents

IEC 68, *Basic environmental testing procedures*.

IEC 97, *Grid system for printed circuits*.

IEC 194, *Terms and definitions for printed circuits*.

IEC 249, *Metal-clad base materials for printed circuits*.

IEC 326-1, *Printed boards, instructions for the specification writer*.

IEC 326-2, *Test methods for printed boards*.

IEC 326-3, *Recommendations for the design and the use of printed boards*.

IEC 326-11, *Specification for the design and use of flex-rigid multilayer printed boards with through-connections*.

2 General

This Sectional Specification (SS) applies to flex-rigid printed boards with through-connections and is intended as a basis for the preparation of a

- Capability Detail Specification (CapDS) applying to specific materials e.g. according to IEC 249-2, and to be used for Capability Approval Procedures. It may be necessary to have a CapDS for each type of material. A CapDS may be prepared by an international or national body or by a manufacturer (see also CECC 00111/IV).
- Customer Detail Specification (CDS) for the custom built printed boards, according to clause 5 of EN 123000. The CDS will normally be written by the customer and allocated a number within his own system. Further details are also given in EN 123000 and CECC 00114/III.

Table I contains the basic characteristics that will normally be important for flex-rigid multilayer printed boards with through-connections and makes reference to the appropriate tests to verify these characteristics.

Table II contains the additional characteristics that may be important for certain flex-rigid multilayer printed boards with through connections and/or certain applications and makes reference to the appropriate tests to verify these characteristics. Where necessary, the relevant specification may quote characteristics and tests from this Table II.

Where additional details for a test have to be specified in the relevant specification, this shall be indicated by “*” in the relevant column. These details shall then be specified in accordance with CECC 00010 (IEC 326-2).

Table III contains the capability test programme. A specified composite test pattern (CTP) is used as a capability qualifying component.

Table IV contains the information for the quality conformance inspection.

The tables are not intended to prescribe a test sequence. The tests may be carried out in any sequence, unless otherwise specified.

3 Test specimen

A test specimen, which may be specifically designed for this purpose (composite test pattern), or taken from production (production board), which is used for verifying capability in accordance with the relevant Generic Specification. A suitable composite test pattern is shown in Figure 3a, Figure 3b, Figure 3c, Figure 3e, Figure 3f, Figure 3d, Figure 3g, Figure 3h, Figure 4a, and Figure 4b.

3.1 Capability Approval

3.1.1 *Basic capability*

The test shall be carried out on the composite test pattern given in clause 8.

3.1.2 *Additional capability*

Clause 3.5.3 of EN 123000 shall apply. For multiple arrangements; see also clause 8.

3.1.3 *Maintenance of Capability Approval*

Clause 3.8 of EN 123000 shall apply.

3.2 Quality conformance inspection

Unless otherwise specified, production boards and/or specially designed test patterns may be used for carrying out tests for the lot-by-lot and the periodic inspection.

Where specifically designed test patterns shall be used they may be included in the panel. They may be based on the appropriate pattern of the composite test pattern; see clause 8. Consultation between manufacturer and customer will usually be necessary.

4 Relevant specification

The term “relevant specification” means a product specification for an actual printed board., i.e. a CDS as well as a CapDS applied to a specific material and technique, as applicable.

The relevant specification shall contain all information necessary to define the printed board clearly and completely. The recommendations given in IEC 326-3 shall preferably be followed.

Care should be taken to avoid unnecessary prescription. Permissible deviations should be stated where necessary, nominal values without tolerances or simple maxima or minima shall be given where sufficient. Where tolerances are necessary for certain areas or parts of the printed board only, they shall be applied and restricted to those areas or parts.

If there are several possibilities of presentation of tolerance classes etc., the selections given in IEC 326-3 shall preferably be applied.

In cases of discrepancy between the CDS and other pertinent specifications (e.g. BS, CS, or SS), the CDS shall prevail.

5 Characteristics of the printed board

Basic characteristics, see Table I

Additional Characteristics, see Table II

Table I — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC 326-2	Additional Tests	Specimen of Composite Test Pattern	Requirements	Remarks
<u>General Examination</u>					
<u>Visual Examination</u>					
Conformity and Identification	1	^a	Complete printed board or composite test pattern	Pattern, marking, identification, material and finishes shall comply with the relevant specification. There shall be no apparent defects.	
Appearance and Workmanship	1a		Complete printed board or composite test pattern	The boards shall appear to have been processed in a careful and workmanlike manner, in accordance with good current practice.	
Plated-through holes			Complete printed board or composite test pattern	Plated-through holes shall be clean and free from inclusions of any sort that could affect component insertion and solderability. Total area of the voids shall not exceed 10 % of the total wall area. The largest dimension shall not exceed 25 % of the hole circumference in the horizontal plane and 25 % of the thickness of the board in the vertical plane. Plated-through holes shall have no plating voids at the interface of the hole wall and the conductive pattern or internal layer ring. The interface shall be considered to extend into the hole below the surface of the board a distance of 1,5 times the total copper thickness on the surface or to be two times the inner layer thickness at the level of contact ring. Resin smear at the edge of the clad copper and the continuous plated copper is permitted provided the smear does not interrupt electrical continuity.	
	1c				
^a see clause 2					

Table I — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC 326-2	Additional Tests	Specimen of Composite Test Pattern	Requirements	Remarks
Board Edges	1a		Complete printed board or composite test pattern	There shall be no circumferential cracks of the copper, or circumferential separation of the copper from the wall of the plated-through holes Holes with plating voids shall not exceed 5 % of the total number of plated-through holes The edges of the board and internal cutouts shall be clean cut without tears or nicks	
Eyelets			Complete printed board or composite test pattern	Eyelets shall be firmly secured. Plated eyelets shall not have exposed bare metal. Eyelets shall not have cracked flanges. There shall be no damage to conductors or substrate around the eyelet.	
Bonding Conductor to Substrate	1a		Complete printed board or composite test pattern	There shall be no separation of the conductors from the substrate by apparent blisters or wrinkles other than those permitted in the material specification.	
Bonding Coverlayer to substrate and pattern	1		Complete printed board	The bonding shall appear to be complete and uniform, Minor delaminations are permitted in the following positions:	
	1a			a) At random locations away from the conductors. Such delaminations shall have an area not exceeding 0,5 mm ² from the edges, and each shall be more than 0,5 mm from the edges. b) Along conductor edges. Such delaminations shall not infringe upon the design spacing between the conductors by more than 20 % of the design width by visual estimation. (see Figure 5)	

Table I — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC 326-2	Additional Tests	Specimen of Composite Test Pattern	Requirements	Remarks
Conductor defects	1b		Complete printed board or composite test pattern	There shall be a minimum continuous bonding width of 0,5 mm between adjacent conductors. There shall be no delamination with conductor spacings less than 0,5 mm. There shall be no cracks or breaks. Imperfections such as voids or edge defects are permissible, provided that the conductor width or leakage path between conductors is not reduced by more than that specified in the relevant specification, e.g. 20 % or 35 %. (see Figure 1)	Where necessary, this shall be verified by dimensional examination using test 2a.
Particles between conductors	1b or 1c		Complete printed board or composite test pattern	Residual metallic particles are permissible provided that the leakage path is not reduced by more than 20 % or to less than the distance required for circuit voltage.	Where necessary, this shall be verified by dimensional examination using test 2a.
<u>Dimensional Examination</u>					
Board Dimensions	2		Complete printed board or composite test pattern	Dimensions and tolerances shall comply with the relevant specification. The nominal board thickness shall comply with the relevant specification.	
Board Thickness in the zone of edge board contacts	2		K	The total board thickness shall comply with the relevant specification.	Total board thickness and tolerances shall be specified in accordance with IEC 321
Holes	2		Complete printed board or composite test pattern	Nominal diameters and tolerances of mounting holes and of component holes shall comply with the relevant specification.	A recommended range of holes and tolerances is given in IEC 326-3.

Table I — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC 326-2	Additional Tests	Specimen of Composite Test Pattern	Requirements	Remarks
Access holes	2		Complete printed board or composite test pattern	The nominal diameter of plated-through holes used for through connections only shall comply with the relevant specifications. Registration of an access hole including the influence of any adhesive flow in the coverlayer with relation to the relevant land on the base material shall be such that any overlapping will not reduce the effective land dimensions to less than the minimum stated in the relevant specification. (see Figure 6)	Accurate measurement is not necessary since deviations are not important. Recommended min. effective land at any point around the hole: Plain hole: 0,15 mm Plated-through hole: 0,10 mm
Slots, notches	2		Complete printed board or composite test pattern	The dimensions shall comply with the relevant specification.	
Conductor width	2		Complete printed board or composite test pattern	The width shall comply with any specific dimensions given in the relevant specification.	If no tolerances are stated, the coarse deviation given in IEC 326-3 shall apply.
	2a			Imperfections such as voids or edge defects are permissible, provided the conductor width is not reduced by more than specified in the relevant specification, e.g. 20 % or 35 %. The length L of a defect shall not be greater than the conductor width S or 5 mm, whichever is the smaller (see Figure 1)	
Spacing between conductors	2		Complete printed board or composite test pattern	The spacing between conductors shall comply with any specific dimensions given in the relevant specification.	
Misalignment of hole and land	1a 2a		Complete printed board or composite test pattern	There shall be no interruption of the land. There shall be no breakout at the junction of the land and the conductor.	

Table I — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC 326-2	Additional Tests	Specimen of Composite Test Pattern	Requirements	Remarks
Positional tolerance of hole centres	1a		Complete printed board or composite test pattern	The hole centres shall be within any deviation specified in the relevant specification.	
Bonding flexible parts to rigid parts			Complete printed board or composite test pattern	The bonding between the flexible parts and the rigid parts shall appear complete and uniform. The following conditions are permitted at the junction between flexible and rigid parts. Resin flow onto the flexible part must not exceed 2 mm beyond the junction. A non-bonded zone may also extend onto the rigid part up to 2 mm from the junction.	
<u>Electrical Tests</u>					
Resistance	3c of IEC 326-2a		D	The requirements of the relevant specification shall be met.	Not applicable to polyester materials.
Change in resistance of plated-through holes, thermal cycling					
Eyelets	4a	a	Complete printed board or composite test pattern	Under consideration.	
Short circuit					
<u>Insulation Resistance</u>	6	a		The insulation resistance shall comply with the relevant specification.	Insulation resistance shall be measured before and after environmental conditioning and at elevated temperature
Preconditioning	18a	a			
Measurement at standard atmospheric conditions	6	a			
Conditioning IEC 68-2-3 Test Ca damp heat steady state, or IEC 68-2-38, Test Z/AD, composite temperature/humidity cyclic test		a			
a see clause 2					

Table I — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC 326-2	Additional Tests	Specimen of Composite Test Pattern	Requirements	Remarks
Measurement at elevated temperature	6	^a			Not applicable to polyester materials.
Surface Layers	6a		E or J		
Internal Layers	6b		E or J		
Between layers	6c		M		
<u>Mechanical Tests</u>					
Peel Strength					
Conductor to base material			G	The peel strength shall comply with the relevant specification.	
Measurement at standard atmospheric conditions	10a	^a			
Measurement at elevated temperature	10b	^a			Not applicable to polyester materials.
Pull-off strength					
Pull-off strength, lands with plain holes	11a	^a	C	The land shall not become detached during the soldering operation. The pull-off strength shall not be less than the value specified in the relevant specification.	A flexible specimen needs to be supported by a rigid board.
Pull-out strength					
Landless plated-through holes	11b		B	The pull-out strength shall not be less than the value specified in the relevant spec.	
<u>Miscellaneous Tests</u>					
Plating Finishes					
Adhesion of plating, tape method	13a		K	There shall be no evidence of plating adhering to the tape after removal from the conductor, other than resulting from overhang.	
Thickness of plating, contact areas	13f		K or printed board	The thickness shall comply with the relevant specification.	
^a see clause 2					

Table I — Basic characteristics (mandatory assessments)

Characteristics	Test No. IEC 326-2	Additional Tests	Specimen of Composite Test Pattern	Requirements	Remarks
Solderability	14a	^a	H, A	The conductors shall be covered with a smooth and bright solder coating with not more than traces (approx. 5 %) of scattered imperfections such as pinholes, unwetted or dewetted areas. The imperfections shall not be concentrated on one area.	Not applicable to polyester materials. For polyimide materials, appropriate drying protecting the soldering may be necessary. Testing shall be carried out in the as received condition or after accelerated ageing, as agreed upon between purchaser and vendor.
A) When the use of a non-activated flux is agreed between purchaser and Vendor					Non-activated flux is specified in IEC 68-2-20, Sub-clause 6.6.1
As received condition				Wetting: The specimen shall wet within 3 s. When temporary protective coating intended to preserve the wettability is used, the specimen shall wet within 4 s.	
After accelerated ageing				Dewetting: The specimen shall remain in contact with the molten solder for between 5 s and 6 s, and shall not have dewetted	
				Wetting: The specimen shall wet within 4 s.	
				Dewetting: The specimen shall remain in contact with the molten solder for between 5 s and 6 s, and shall not have dewetted	
^a see clause 2					