

Printed wiring boards —

Part 21: Guide to the rework of unassembled boards

ICS 31.180

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW



Document Sharing Hub

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee EPL/501, Electronic assembly technology, upon which the following bodies were represented:

- Association of Contract Electronics Manufacturers
- Federation of the Electronics Industry
- GAMBICA
- Ministry of Defence
- National Supervising Inspectorate
- Printed Circuit Interconnection Federation
- Surface Mounting and Related Technologies (Smart Group) Ltd.

This British Standard, having been prepared under the direction of the Electrotechnical Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 February 2001

© BSI 02-2001

First published April 1984
Second edition February 2001

The following BSI references relate to the work on this standard:
Committee reference EPL/501
Draft for comment 99/202817 DC

ISBN 0 580 33256 X

Amendments issued since publication

Amd. No.	Date	Comments

Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Classification of defects	2
5 General	3
6 Health and safety	3
7 Removal and restoration of protective coatings	3
8 Defective conductors	3
9 Lifted conductors	7
10 Lifted and defective lands associated with plain holes	7
11 Eyelet and tubular pin defects	10
12 Defective plated-through holes (double-sided boards)	10
13 Base laminate material defects (single- and double-sided boards)	13
14 Inclusions	14
15 Rework of inner layers of multilayer printed boards after lamination	14
16 Rework of printed edge contacts	15
Bibliography	16
Figure 1 — Defective conductors	4
Figure 2 — Tinned copper wire connections	5
Figure 3 — Insulated wire connections	6
Figure 4 — Straight conductor rework using parallel gap welding	6
Figure 5 — Lifted conductors	7
Figure 6 — Rework of damaged land using overlaid land	8
Figure 7 — Replacement bonded land	8
Figure 8 — Lifted land and conductor	9
Figure 9 — Eyelet and tubular pin defects	10
Figure 10 — Rework of defective plated-through hole by the wire link method	11
Figure 11 — Rework of defective plated-through hole by the eyelet method	11
Figure 12 — Rework of defective plated-through holes (vias) by parallel gap welding: method 1	12
Figure 13 — Rework of defective plated-through holes (vias) by parallel gap welding: method 2	12
Figure 14 — Damaged base laminate materials	13
Table 1 — Type 1 defects	2
Table 2 — Type 2 defects	2
Table 3 — Applicability of methods for the rework of defective conductors	5

Foreword

This British Standard has been prepared by Technical Committee EPL/501. It supersedes BS 6221-21:1984, which is withdrawn.

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 and ii, pages 1 to 16, an inside back cover and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

1 Scope

This part of BS 6221 provides guidance on the rework of printed boards that has to be carried out in the normal course of fabrication and test before release to the user. Some of the techniques described are suitable for use after acceptance by the user, though their application may invalidate any formal unassembled board release documentation.

The standard covers the following types of rework:

- a) corrective touch-up carried out as part of the normal production and inspection procedures, and used where minor defects occur;
- b) corrective action on more serious defects that in themselves would be cause for rejection;
- c) modifications requested by the customer.

All the methods described are applicable to rigid printed boards and may be applicable to flexible printed boards.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of BS 6221. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 4727-1:Group 11:1991, *Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms — Part 1: Terms common to power, telecommunications and electronics — Group 11: Printed circuits*.

BS EN 61249 (all parts), *Materials for interconnection structures*.

3 Terms and definitions

For the purposes of this part of BS 6221, the definitions given in BS 4727-1:Group 11:1991 apply, together with the following.

3.1

rework

rectification of manufacturing errors on a printed board prior to its release

NOTE 1 Rework is carried out either by means not differing from the current manufacturing process (reprocessing) or by the rework processes as permitted by the relevant CECC or IECQ process approval document(s)/process assessment schedule(s), or by using a combination of both, and using methods that do not unacceptably degrade the reliability of the printed board.

NOTE 2 Rework is carried out by the board manufacturer before delivering the printed boards to the user.

3.2

modification

change to a printed board, including deletion and addition of conductors

3.3

lifted conductor

conductor that has become detached from the base laminate but not broken

3.4

inclusion

any foreign body contained within the base copper-clad material or prepreg, or introduced between the base materials during processing

4 Classification of defects

4.1 Defects on printed boards are classified as follows:

- a) *Type 1*: defects that may be reworked without customer notification (see 4.2);
- b) *Type 2*: defects that require customer notification and approval before reworking (see 4.3).

4.2 The defects given in Table 1, classified as “Type 1 defects”, may be reworked. They need not be the subject of a formal verification exercise, nor limited in number.

4.3 The defects given in Table 2, classified as “Type 2 defects”, should be reworked only subject to a formal verification exercise. The number of reworked defects per batch is sometimes limited by agreement with the customer.

Table 1 — Type 1 defects

Defect	Description	Comments
Reduction in conductor spacing	Excess metal that reduces the design spacing to less than the specified minimum	
External short circuit	Conductive material bridging two or more conductors	Includes inner layers prior to lamination
External open circuit	Conductor break	
Plating defects (tin–lead only)	Local deficiency in thickness	Plated-through hole and edge contact defects are classified as Type 2 (see Table 2)
Defective marking and identification	Notation missing or illegible	
Scratches	Scratches in the surface over-plating or solder resist	Scratches penetrating to an under-plating or to the copper cladding are classified as Type 2 (see Table 2)

Table 2 — Type 2 defects

Defect	Description	Comments
Conductor width violation	Complete breaks, cracks, deep scratches, nicks or pinholes which reduce the conductor width to less than the specified minimum	
Inner layer short circuit	Conductive material bridging two or more conductors	Detected after lamination. It is not necessary to determine the location of the defect
Inner layer open circuit	Conductor break	
External layer open circuit	Conductor break	
Plated-through hole defect	Voids of excess size and/or quantity. Total absence of plating	The rework method should not impede mounting of components. Rework of plating that connects to inner layers should be limited to replating
Inclusions	Any foreign particle within the base material that reduces the design spacing to less than the specified minima	All inclusions should be regarded as detrimental unless proven otherwise
Edge contact defects	Deep scratches. Pitting. Part or whole of contact missing. Plating thickness deficiency. Excess porosity	Stripping and replating of complete edge connectors is considered as reprocessing

5 General

- 5.1** The methods described in this standard may be used subject to the requirements of customer detail specifications and relevant board specifications.
- 5.2** Rework should be carried out by trained and competent operators who have been nominated to do the work and who are equipped with all the appropriate facilities.
- 5.3** The limitations of the operator and method should be defined in terms of conductor width and spacing.
- 5.4** Rework should be performed only when the cause of failure is understood, as a fault can indicate latent weakness elsewhere in the board(s), or in the production method.
- 5.5** All reworked printed boards should be clearly identified with a distinctive indelible marking. The marking should be non-conductive.
- 5.6** Where an original surface coating is removed, either completely or locally during rework, it should be restored on completion of the work. If the original coating is unobtainable, or its use is impracticable, a substitute acceptable to the customer should be employed.
- 5.7** On completion of the work, the printed board(s) should be visually inspected at a suitable magnification. Other tests required in order to meet the customer's specification should also be performed.
- 5.8** For more detailed information on the handling of electrostatic-sensitive devices, see BS EN 100015-1:1992.

6 Health and safety

Attention is drawn to health and safety precautions.

7 Removal and restoration of protective coatings

7.1 Removal

Any surface coating should be removed from the local rework area by either of the following methods:

a) *Use of a suitable solvent.*

When using solvents, care should be taken to ensure that boards, components and the operator are adequately protected from the hazards associated with the use of these materials.

b) *Abrasive removal.*

This may be performed either manually or using miniature rotary powered methods. Stiff nylon bristle or glass-fibre brushes are commonly used, but impregnated rubber tools may prove suitable alternatives. All debris should be removed before rework commences.

After completion of the rework, the surface coating should be restored (see **7.2**).

7.2 Restoration

After rework, the coating should be restored to maintain the protective or insulating function for which it was originally specified.

A wide range of coatings is available, and care should be taken to ensure that any touch-up coating is compatible with the original.

Areas not to be coated should be masked using materials which are not affected by coating solvents. Peelable masks are useful for contact areas, or non-transferable adhesive tape may be used.

Coating compatibility should be checked before touch-up, and components should be checked to ensure that they are not damaged by the coating solvents.

8 Defective conductors

8.1 General

8.1.1 Defective conductors are conductors that show evidence of:

- a) a complete break, i.e. no electrical continuity [see Figure 1a)];
- b) scratches, nicks or pinholes, which reduce the effective cross-sectional area of the conductor by more than the specified tolerance [see Figure 1b)].