

Harmonized system of quality assessment for electronic components Sectional specification: Capability approval of manufacturers of printed board assemblies of assessed quality

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ICS 31.180

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National foreword

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- 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.

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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 37 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.

Amendments issued since publication

Amd. No.	Date	Comments

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 February 1998

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ISBN 0 580 29214 2

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English version

Sectional Specification: Capability approval of manufacturers of printed board assemblies of assessed quality

Rahmenspezifikation:
Befähigungsanerkennung für Hersteller
von bestückten Leiterplatten mit
bewerteter Qualität

This European Standard was approved by CENELEC on 1996-12-09. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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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

Foreword

This European Standard was prepared by the British ONH under the CECC Single Originator Procedure.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 160100 on 1996-12-09.

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) 1998-03-01

- latest date by which the national standards conflicting with the EN have to be withdrawn

(dow) 1998-03-01

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1 General

1.1 Scope

This document is a sectional specification relating to printed board assemblies (as defined in 1.3.2 below) of assessed quality which meet the criteria for a modular electronic unit as defined in the generic specification EN 160000. It applies to both custom built products and to standard catalogue items and defines the characteristics to be assessed and the test methods to be used for capability approval, for quality conformance inspection (lot-by-lot) and maintenance of approval. Acceptance criteria for specific printed board assemblies will be given in the relevant detail specifications in accordance with blank detail specification EN 160101.

This sectional specification is to be read in conjunction with EN 160000. It invokes all of the requirements of CECC 00 114-III in addition to meeting the requirements of Annex A of EN 160000.

1.2 Related documents

IEC publication 68, *Basic environmental testing procedures*.

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

IEC publication 321-2, *Auxiliary printed board information — Part 2: Rework, repair, modifications*.

IEC publication 410, *Sampling procedures*.

IEC publication 589, *Methods of test for determination of ionic impurities in electrical insulating materials by extraction with liquids*.

CECC 00 400-IV, *Preparation of capability approval generic, sectional and blank detail specifications*.

EN 100 114-1, *Quality assessment procedures — Approval of manufacturers and other organisations*.

CECC 00 114-III, *Capability approval of an electronic component manufacturing activity*.

CECC00200, *Register of firms products and services approved under the CECC system*.

CECC 00 802, *CECC standard method for the specification of surface mounting components (SMDs) of assessed quality*.

CECC 00 803, *Guidance document: Visual inspection of soldered surface mounted assemblies*.

EN 123000, *Generic specification: printed boards*.

EN 100015, *Basic specification: Protection of electrostatic sensitive devices*.

EN 160000, *Generic specification: modular electronic units*.

EN 160101, *Blank detail specification: Printed board assembly modular electronic units of assessed quality (capability approval)*.

NOTE The above references apply to the current editions except for parts of IEC 68 where the referenced edition applies.

1.3 Units, symbols and terminology

Units, graphical symbols, letter symbols and terminology shall, whenever possible, be taken from the following documents:

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units*.

IEC 27, *Letter symbols to be used in electrical technology*.

IEC 50, *International electrotechnical vocabulary*.

IEC 617, *Graphical symbols for diagrams*.

All other units, symbols and terminology peculiar to printed board assemblies, shall be taken from the relevant IEC or ISO documents, listed under “Related documents”.

When none in the standard are suitable, appropriate ones shall be devised and shall be listed in the detail specification for the printed board assembly. General dimensioning and tolerancing procedures used for production of drawings shall be in accordance with the relevant ISO standards.

Other terms are in accordance with EN 100114-1 and EN 160000. For the purpose of this sectional specification the following additional definitions apply:

1.3.1 printed circuit (IEC 194)

this term is in common use with at least three meanings:

- A generic term to describe a certain technique;
- Circuit obtained by printing and comprising printed components, printed wiring, or a combination thereof, all formed in a predetermined design in, or attached to, a surface or surfaces of a common base;
- Circuit obtained by printing and comprising printed wiring and conventional components, all arranged in a predetermined design in, or attached to a surface or surfaces of a common base.

1.3.2 printed board (IEC 194)

base material cut to size containing all holes and bearing at least one conductive pattern
printed boards are typically subdivided according to:

- their structure (e.g. single and double sided, multilayers);

— the nature of the base material (e.g. rigid, flexible).

1.3.3

printed board assembly (IEC 194)

printed board with electrical and mechanical components and/or other printed boards attached to it with all manufacturing processes, soldering, coating, etc. completed. The completed assembly may be supplied with or without an individual housing relevant to the structure and performance of the unit and must meet the criteria for a Modular Electronic Unit set down in CECC 60 000

1.3.4

pin-in-hole assembly (PIH)

components have wire or tape leads which are inserted into holes in the mounting substrate and soldered to connect the lead mechanically and electrically to the conductors on the substrate

1.3.5

surface mounting assembly (SMA) or surface mounting technology (SMT)

components which may or may not have wire or tape terminations are mounted on the surface of the substrate. They may be held initially by adhesive or by a solder paste but are finally soldered to the pads on the substrate surface to provide electrical and mechanical connections to the circuit

1.3.6

rework (RP14-III:subsection 1.4)

rework is the rectification, of processing errors prior to release of the printed board assembly by means not differing from those used in the current process or the rework process described by the approved manufacturer in his quality manual or referenced therein.

1.3.7

repair (RP14-III:subsection 1.5)

repair is the making good of an approved printed board assembly which has been damaged or has become defective after release. In accordance with RP 14-III:subsection 7.2, printed board assemblies which have been repaired shall not be released under the CECC system

1.4 Marking of the printed board assembly and package

Marking materials used shall be resistant to discoloration, abrasion and to common solvents employed for fluxes and cleaning of electronic assemblies. The following information shall be marked as appropriate on the assembly and/or package:

a) function and/or type number;

b) identification of termination and their polarity where applicable;

c) date code;

d) manufacturer's factory identification code;

e) climatic category in accordance with IEC 68, if applicable;

f) any special markings, e.g. relating to hazard or special operating conditions;

g) the number of the detail specification to which the printed board assembly conforms and any other designations prescribed by that specification shall be marked on the package.

2 Quality assessment procedures

2.1 General

2.1.1 Eligibility for capability approval (subsection 2.1:RP 14-III)

Prior to making application for capability approval a manufacturer shall first obtain manufacturer's inspection approval in accordance with CECC 00 114-1.

The manufacturer is eligible for capability approval in accordance with the system if he can demonstrate that supervision by the approved person(s) of one or more approved manufacturers is applied to the manufacturing process, either in its entirety or commencing at the primary stage of manufacture.

2.1.2 Primary stage of manufacture

The primary stage of manufacture is the stage at which the electronic components and substrate are selected, procured and brought together to create a kit of parts for issue to the assembly shop floor.

NOTE It is the responsibility of the procuring authority to demonstrate, by test or otherwise, that the solderability of all soldering terminations is adequate for the method of soldering to be employed.

2.1.3 Structural similarity

Structural similarity is applicable to capability approval of PBAs in terms of similar substrates, similar mounting (PIH or SMT or mixed, see 3.5) and jointing technology and similar tests and inspections.

2.1.4 Subcontracting

Procedures used shall be as set down in CECC 00 114-III, 2.2

1) Subcontracting to an unapproved manufacturer

Subcontracting of any operations corresponding to the primary stage or any subsequent stage to an unapproved manufacturer shall be controlled as set down in CECC 00 114-III.

2) Subcontracting of specialized processes

Specialized processes such as the following may be subcontracted to a specialist processor provided that the approved manufacturer's approved person is able to verify that the process has been performed in a satisfactory manner, CECC 00 114-III, **2.2.2**:

- deposition of specific metallic coatings;
- application of specific paint finishes;
- polyparaxylylene;
- encapsulation;
- component pre-conditioning;
- burn-in.

All specialist processes subcontracted shall be listed and described in the approved manufacturer's capability manual and shall be demonstrated by an appropriate CQC.

2.1.5 Incorporated components (subsection 2.3: RP 14-III)

Incorporated components include the printed board substrate (which may be a printed board with discrete wired layers) and all electronic components be to assembled thereon. They do not include piece parts without a distinctive electronic function.

In addition to the correct specification of electronic/electrical performance and outline dimensions, see **2.1.5 2)** and **3)**, the process suitability of all surface mounting components shall be specified in accordance with guidance document CECC 00 802.

No changes may be made to any component incorporated in the approval build without reference to the design authority for the printed board assembly. This includes the purchase of an approved component from an alternative supplier not specifically listed by the design authority as an alternative source.

1) Printed board substrate materials

Printed board substrate materials shall normally be selected from those covered by IEC Publication 249 base materials for printed circuits. Other materials such as fluoropolymers, cyanate esters and alumina ceramics may be used provided that the quality is verified as outlined below for unapproved components.

2) Approved components

Wherever possible, incorporated components, including printed boards, shall be approved to a relevant CECC detail specification and shall be procured using normal CECC release procedures.

3) Unapproved components

Components which cannot be obtained with release to a relevant CECC specification shall be treated as unapproved components. The approved manufacturer's approved person shall verify their quality before their incorporation and shall:

- be satisfied that the quality and performance of an unapproved component is adequate for its purpose;
- ensure that a specification exists for the unapproved component covering all those aspects necessary to ensure its satisfactory performance as part of the final product;
- establish a quality programme to verify continuing supply of the component in accordance with the specification requirements;
- ensure that goods inward inspection procedures are adequate for determining the level of quality of the product(s) being received.

2.1.6 Validity of release

1) General

The validity of release is maintained provided that the requirements both for maintenance of capability approval (**2.3.1**) and release for delivery (**2.4**) are met and that continuous production [**2.3.1 3)**] subsists.

2) Delayed delivery

Following successful completion of final testing, printed board assemblies held by the manufacturer for more than twelve months shall be reinspected visually for cleanliness and freedom from corrosion and other visible defects, **3.4.8**. The solderability of any items required to be soldered by the customer, e.g. terminations, shall be shown to be satisfactory prior to delivery. When appropriate, the printed board assembly shall be electrically retested before release.

Unless otherwise prescribed by the detail specification, PBAs shall be stored at a temperature in the range + 10 °C to + 25 °C. Conditions shall be clean and free from condensation. The assembly shall be supported in such a way as to minimise distortion and packed in a clean container to prevent contamination and mechanical damage. Care must be taken to meet any requirement for protection from static electricity.

3) Repair

In accordance with CECC 00 114-III, **7.2**, printed board assemblies which have been repaired shall not be released under the CECC system.

4) Modifications

Modifications, for example to customise standard catalogue items, shall be permitted only as agreed with the customer and stated in the customer detail specification (customer detail specification), or by an agreed written customer amendment. The procedures and controls for carrying out modifications shall be set down or referenced in the description of capability.

e) Rework (subsection 7.1: RP 14-III)

Whenever possible, rework methods shall be based on those shown in IEC 321-2. Rework is restricted in accordance with the following requirements:

- the approved manufacturer must have written procedures available for all rework methods used, covering the equipment required, the process to be used and the workmanship standards set these procedures shall be included in the approved manufacturer's quality manual or shall be in a separate document referenced by the quality manual;
- provided that there is no visible sign of damage to the printed board, laminate, lands or conductors, or to the component, a component may be removed and replaced three times maximum;
- the customer detail specification may place restrictions on rework permitted on a particular contract.

2.2 Procedures for capability approval

2.2.1 Application for capability approval (subsection 2.4: RP 14-III)

A manufacturer seeking capability approval to this specification shall apply in writing to the body designated in the national rules referring to this sectional specification and stating in his application the scope of the proposed approval, preferably in the form of a first draft of the capability abstract, see 2.2.7. The types and sizes of substrate and the mounting and jointing technologies shall be clearly defined.

In his application the manufacturer shall demonstrate that he is in a position to apply all the processes, tests and measurements required from the primary stage onwards or that certain, stated, processes will be sub-constacted. The primary stage of manufacture is defined in 2.1.2 of this specification.

Capability approval programme

The manufacturer shall prepare a programme for the assessment and demonstration of the declared capability to the satisfaction of the ONS. The programme shall be so designed that all declared limits of capability are related to the range of CQCs that verifies them.

The programme shall contain the following:

- a) a bar chart or other means of showing the proposed timetables for the approval exercise;
- b) details of all the capability qualifying components to be used with references to their detail specifications;
- c) a chart showing the features to be demonstrated by capability qualifying components.

2.2.2 Granting of capability approval

Capability approval shall be granted when the manufacturer has:

- prepared to the satisfaction of the national supervising inspectorate (ONS) a description of the capability for which approval is sought;
- agreed with the ONS the range of CQCs, as defined in CECC 00 114-III: 1.2, which will be used for the assessment of the capability;
- successfully demonstrated his ability to produce PBAs which satisfy the requirements of this sectional specification within the limits of his capability;
- prepared a capability approval test report to the satisfaction of the ONS;
- met the requirements of this specification.

2.2.3 Description of capability (subsection 2.5: RP 14-III)

The description of capability (which may be in the form of a capability manual) shall be compiled in accordance with Annex B of CECC 00 114-III.

The manual shall be approved by the ONS who shall ensure that it is a true and complete record of procedures carried out by the manufacturer during the production, testing, inspection and release of PBAs.

As a minimum, the manual shall include the following:

- the scope of capability approval;
- the limits of capability — a declaration of the processes and boundaries for which approval has been sought these declarations may be combined with the list of CQCs;

- a description of the technologies and materials involved in the manufacture of PBAs and listings of materials used with references to corresponding purchasing specifications and goods inwards inspections;

- brief descriptions of the range of facilities and control procedures used in the production of PBAs including flow charts covering the total process capability showing quality control points, permitted rework loops and references to all inspection, process and quality control procedures;

- a statement on whether or not any stages of manufacture are subcontracted and identification of any which are;

- a description of the manufacture to customer interface, including provision of design rules where appropriate and assistance to customers in the formulation of their requirements;

- a detailed description of design rules to be used such as, e.g. spacings around components to be allowed to permit automatic mounting/insertion, inclusion of test pads;

- a list of capability qualifying components (CQCs) used to assess the capability, with a general description of each supported by a detailed table showing where the declared limits of capability are demonstrated by a particular CQC design;

- a detail specification for each CQC produced to the satisfaction of the ONS;

- the procedure to be adopted in the event of CQC or product failures;

- guidance on the application of structural similarity in sampling for quality conformance testing.

2.2.4 Capability qualifying components (CQCs)

1) General

Annex A shows a generalised manufacturing diagram, in flow chart form, which covers the basic technologies employed in the production of PBAs. The basic methods of construction used include pin-in-hole assembly (1.3.4) and surface mount technology (1.3.5).

These methods may be intermixed ("mixed" technology) and are not exclusive. If other methods of construction and/or joining are employed, appropriate CQCs shall be agreed with the ONS.

The manufacturer shall agree with the ONS the range of capability qualifying components selected in accordance with his general plan, specified in his capability manual. The CQCs shall comply with the following requirements:

- i) The range of CQCs used shall collectively cover all the processes and limits of the declared capability including, when appropriate, additional capability.

- ii) The CQCs shall be one of the following:

- a test specimen designed for the assessment of a process or range of processes;

- printed board assemblies in production;

- a combination of these, provided the requirements of i) are met.

- iii) All CQCs shall be positively identified and specify those test requirements that they are designed to demonstrate.

When CQCs are designed and produced solely for capability approval, the manufacturer shall satisfy the ONS that the same design rules, materials and manufacturing processes will be applied to released products.

2) Limits of capability

As this capability approval is essentially dependent upon process capability it is not practicable to divorce the limits of capability from process limitations. CQCs shall demonstrate a set of limits of capabilities (boundaries) which shall include the following:

- assembly technologies available, e.g. manual placement and/or automatic placement for pin-in-hole (PIH) and/or surface mounting (SMT) and/or combination of PIH and SMT (mixed technology);

- maximum size of assembly — to include maximum panel size and maximum assembly area;

- joining processes employed, e.g. hand soldering, wave or drag soldering and/or reflow soldering;

- electrical test capability, e.g. none or limited (hand probe testing), in-circuit testing and/or functional testing;

- mechanical test capability, e.g. none, pull/peel testing, full capability;

and when relevant:

- environmental test capability, e.g. none, temperature cycling with or without humidity control and/or vibration, shock and acceleration capability;